6.4 Water Resources

6.4 Water Resources

This section describes the surface water resources in the vicinity of the Upper North Fork Feather River Hydroelectric Project (UNFFR Project) and analyzes the impacts on hydrology of the operation of the UNFFR Project under a new Federal Energy Regulatory Commission (FERC) license. The following topics are not discussed in this section for the reasons noted:

- **Groundwater Recharge:** Neither the Proposed UNFFR Project nor either alternative would modify groundwater recharge in the area.

6.4.1 Environmental Setting

North Fork Feather River Watershed

The North Fork Feather River watershed encompasses approximately 3,500 square miles in the northern Sierra Nevada (Ecosystems Sciences Foundation 2005). The elevation range of the watershed is from 2,250 feet above mean sea level above Lake Oroville to more than 10,000 feet at Mount Lassen. Precipitation is the primary source of water in the watershed, with groundwater contributing a small percentage of flow through springs. Annual precipitation levels range from more than 90 inches at higher elevations in the Sierra Nevada and Cascade Range to less than 11 inches at lower elevations in the Sierra Valley. Flow from the North Fork Feather River watershed is captured in Lake Oroville, which is part of the State Water Project and is managed by the California Department of Water Resources under FERC Project No. 2100.

The watershed contains 24 subwatersheds and four main river branches—North Fork, South Fork, Middle Fork, and West Branch of the Feather River (Ecosystems Sciences Foundation 2005). The North Fork Feather River is divided into 17 subwatersheds, which encompass an area of 1.38 million acres or almost 60 percent of the entire watershed (Figure 6.4-1). The North Fork Feather River subwatersheds contribute approximately 60 percent, or 3,228 cubic feet per second (cfs, average daily flow), of the inflow to Lake Oroville. The other subwatersheds contribute approximately 2,110 cfs (average daily flow). The combined total average daily inflow to Lake Oroville is estimated at 5,338 cfs.

A series of hydroelectric projects heavily regulate flows along the North Fork Feather River above Oroville dam. One of the upstream-most projects is the UNFFR Project, which consists of Lake Almanor, Butt Valley reservoir, Belden forebay, the Upper North Fork Feather River, Butt Creek, and associated hydroelectric facilities (Figure 3-1). As part of the UNFFR Project, constant instream flow releases are made at Canyon dam and Belden forebay dam, and operational releases flow through the dams, reservoirs, outlets, and powerhouses. The water bodies associated with the UNFFR Project are described below.

UNFFR Project Reservoirs

Lake Almanor

Lake Almanor is a man-made reservoir created in 1914 by Great Western Power Company (now Pacific Gas and Electric Company [PG&E]) as a key element of the UNFFR Project. The reservoir receives natural flow from the North Fork Feather River and other tributaries, diverted water from Mountain Meadows reservoir, and springflow from submerged springs (Earthworks Restoration, Inc., and CH2M Hill 2007). The lake receives flow from an area of approximately 200,000 acres, encompassing Mount Lassen and the western slopes of the Sierra Nevada. The North Fork Feather River contributes approximately half of the annual surface inflow to Lake

Almanor, and the Hamilton Branch diversion from Mountain Meadows reservoir contributes approximately one quarter of the inflow. Lake Almanor provides some flood control benefit during periods of high inflow (wet years or flood events) because of its large surface area.

Lake Almanor has a usable storage capacity of 1.134 million acre-feet (AF) at its normal maximum water level of 4,494 feet (PG&E datum) (Pacific Gas and Electric Company 2002). The reservoir is managed to store water during the winter and spring and release it to generate hydropower during the summer and fall.

PG&E regulates Lake Almanor water levels at or below the maximum water level through releases into the North Fork Feather River through Canyon dam and diversions to Butt Valley reservoir via the Prattville intake. Lake levels are closely regulated to prevent flooding and overtopping of Canyon dam. Releases through the Canyon dam low-level outlet to maintain water levels below the maximum level are rare and typically occur only during wet years.

Up to 2,100 cfs of water from Lake Almanor is diverted through the Prattville intake to Butt Valley powerhouse and Butt Valley reservoir for power generation and storage. Water is released into the North Fork Feather River at Canyon dam to maintain flows in the Seneca Reach. Releases through Canyon dam into the North Fork Feather River are discussed below in the section titled “Seneca Reach of the North Fork Feather River.”

Butt Valley Reservoir

Butt Valley reservoir was created by damming a segment of Butt Creek in 1912 to store 64 AF of water for hydropower generation (Zemke 2006). It was expanded in 1921 by a larger dam, which was enlarged again in 1924 and modified in 1997 to its current configuration. The reservoir receives natural flow from Butt Creek and diverted flow from Lake Almanor via the Butt Valley powerhouse. Butt Creek contributes approximately 95 cfs mean annual flow to the reservoir, and flow from Lake Almanor varies substantially depending on the water year and demand (Federal Energy Regulatory Commission 2005). PG&E diverts Butt Valley reservoir inflow to Caribou Nos. 1 and 2 powerhouses. Flow is not released into lower Butt Creek downstream of the reservoir.

Butt Valley reservoir has a usable storage capacity of 49,897 AF at its maximum normal water surface elevation of 4,132.1 feet (PG&E datum) (Pacific Gas and Electric Company 2002). PG&E diverts water from Butt Valley reservoir through the Caribou Nos. 1 and 2 powerhouses into Belden forebay. Approximately 280 and 650 cfs, respectively, are diverted on average through each powerhouse, with the Caribou No. 2 powerhouse being operated more frequently for power production. The releases from Butt Valley reservoir are heavily regulated by PG&E to operate the powerhouses; therefore, inflow to the powerhouses varies daily, with higher flows during peak demand periods. For example, during peak operations, each powerhouse may experience a change in flow of more than 1,000 cfs within a few minutes. Butt Valley reservoir has a very low potential to overtop because of the regulated nature of the inflow to the reservoir and PG&E’s ability to regulate outflow through the Caribou intakes.

Belden Forebay

Belden forebay was created in the late 1950s as the last and smallest impoundment in the UNFFR Project (Pacific Gas and Electric Company 2002). It receives inflow from two discrete intakes at the downstream end of Butt Valley reservoir via the Caribou Nos. 1 and 2 powerhouses, lower Butt Creek, and the Seneca reach of the North Fork Feather River. Inflow is heavily regulated by releases from Lake Almanor via Canyon dam and the Caribou

powerhouses. The forebay's surface water elevation typically fluctuates by 5 to 10 feet on a daily basis. The forebay has a usable storage capacity of 2,421 AF at its normal maximum water elevation of 2,975 feet (PG&E datum). Water is diverted from the forebay via tunnels and penstocks through the Belden powerhouse, or it is released into the Belden reach of the North Fork Feather River via the Oak Flat powerhouse. Similar to Butt Valley reservoir, the highly regulated inflow to the forebay reduces the likelihood of flooding, and spills over the Belden dam are rare.

North Fork Feather River Upstream of Belden Powerhouse

Upper North Fork Feather River (above Lake Almanor)

The upper North Fork Feather River has its headwaters on the slopes of Mt. Lassen and Mt. Conrad. It flows south-southeast through alluvial valleys and empties into Lake Almanor in the reach that historically flowed through Big Meadows. Average daily flow in the North Fork Feather River upstream of Lake Almanor ranges from approximately 200 cfs to less than 700 cfs throughout the year, with higher flows between January and July, the peak snowmelt period (Federal Energy Regulatory Commission 2005).

Hamilton Branch

The Hamilton Branch of the North Fork Feather River was impounded by Indian Ole dam to form Mountain Meadows reservoir in 1927 as part of a project to provide water and power to logging camps in the area. PG&E acquired this project in 1945 and continues to operate it under a FERC exemption. Water is diverted from the reservoir to Lake Almanor via the Hamilton Branch powerhouse. The channel of Hamilton Branch also conveys flow from the reservoir to Lake Almanor. Average daily flow through the powerhouse ranges from approximately 60 to 130 cfs, with slightly lower flows on the order of 50 to 120 cfs in the bypass reach of the Hamilton Branch (Federal Energy Regulatory Commission 2005). Flow fluctuates throughout the year with peaks between March and May.

Seneca Reach of North Fork Feather River

The Seneca reach of the North Fork Feather River begins below Canyon dam at Lake Almanor and flows into Belden forebay. The Seneca reach flows through a steep canyon with a well-defined river channel. Per PG&E's current license, a minimum flow of 35 cfs is released from Lake Almanor via Canyon dam into the Seneca reach (Federal Energy Regulatory Commission 2005). The Seneca reach also receives inflow from various small tributaries. The Seneca reach conveys flow to Belden forebay, contributing a mean annual flow of approximately 125 cfs, where it converges with lower Butt Creek. Pulse flows and additional recreational flows are not currently released into the Seneca reach.

Butt Creek

The headwaters of Butt Creek originate in the Cascade Range north of Butt Valley reservoir, and the creek flows east into Butt Valley reservoir. Inflow to the reservoir from the creek is estimated at 95 cfs mean annual flow (Federal Energy Regulatory Commission 2005). Lower Butt Creek flows for a short distance downstream of Butt Valley reservoir and converges with the Seneca reach of the North Fork Feather River before emptying into Belden forebay. Between 1970 and 1984, mean annual flow in lower Butt Creek near Caribou was estimated to be 29 cfs (Federal Energy Regulatory Commission 2005). Flow in lower Butt Creek below Butt Valley reservoir emerges from springs along the waterway.

Belden Reach of North Fork Feather River

The Belden reach of the North Fork Feather River begins at Belden dam and continues downstream to Belden powerhouse at the downstream end of the UNFFR Project. Downstream of Belden forebay, the North Fork Feather River flows through a steep canyon and receives flow from the forebay, Mosquito Creek, and the East Branch of the North Fork Feather River. Under the current license, PG&E operates Belden dam to maintain a minimum of 140 cfs in the Belden Reach during the fishing season (last Saturday in April through Labor Day) and 60 cfs the rest of the year (Federal Energy Regulatory Commission 2005). Mosquito Creek contributes between 2 and 10 cfs, with an average of 5 to 6 cfs during the summer. The East Branch is a major tributary of the North Fork Feather River and has median monthly flows greater than 1,500 cfs during March and April, with substantially lower flows between July and November (100 to 200 cfs). Pulse flows and additional recreational flows are not currently released into the Belden reach from Belden forebay.

North Fork Feather River Downstream of Belden Powerhouse

The North Fork Feather River continues downstream of Belden powerhouse to Lake Oroville. PG&E operates two other hydroelectric projects along the river (the Rock Creek–Cresta Hydroelectric Project [FERC Project No. 1962] and the Poe project [FERC Project No. 2107]) and one on a tributary (the Bucks Creek project [FERC Project No. 619]). These projects divert substantial flow for power generation and influence the quantity of flow in the North Fork Feather River. Downstream of the confluence of the North Fork Feather River with the East Branch of the North Fork Feather River, water enters Rock Creek reservoir and is diverted through a tunnel to the Rock Creek powerhouse. The diverted flow enters Cresta reservoir with flow from the North Fork Feather River and several tributaries downstream of Rock Creek reservoir. From Cresta reservoir, flow is diverted to the Cresta powerhouse or released into the North Fork Feather River to flow into Poe reservoir with flow from Grizzly Creek. From Poe dam, water is diverted to the Poe powerhouse or released into the North Fork Feather River to flow into Lake Oroville.

Water Rights and Use

PG&E holds water rights to divert, store, and use water from the North Fork Feather River and its tributaries primarily for its hydroelectric projects, although some of PG&E's water rights authorize the use of water for consumptive purposes (Federal Energy Regulatory Commission 2005). PG&E holds licensed rights to divert water from French Creek for domestic use, industrial use, and fire protection at Caribou camp and from Oak Creek for domestic use and fire protection at Howells patrol station. PG&E also stores water in Lake Almanor and Butt Valley reservoir and releases the water for irrigation in the Sacramento Valley under claimed pre-1914 appropriative rights. The Western Canal Water District uses water under these consumptive water rights pursuant to a 1986 contract, which provides that PG&E must release 145,000 AF from storage in its reservoirs between March 1 and October 31 of each year for irrigation downstream of Lake Oroville (California Department of Water Resources 1986, as cited in Federal Energy Regulatory Commission 2005).

The primary use of water diverted from the North Fork Feather River is power generation, although other agencies, companies, and the public also use the river for fire protection and domestic, industrial, and irrigation supply. The water bodies associated with the UNFFR Project contribute to the water supply provided by Lake Oroville for the State Water Project.

6.4.2 Environmental Impacts and Mitigation Measures

Methodology

The water resources impact analysis is based on the description of the surface water hydrology of the North Fork Feather River in the Environmental Setting section and includes a qualitative discussion of changes in flow and UNFFR Project operations associated with the Proposed UNFFR Project and both alternatives. Information for the environmental setting section is based on a watershed assessment (Earthworks Restoration, Inc., and CH2M Hill 2007), management plan (Ecosystems Sciences Foundation 2005), modeling of the Feather River, and information from PG&E's relicensing application (Pacific Gas and Electric Company 2002). The impact analysis addresses the effects of the Proposed UNFFR Project and each alternative on hydrology, flood potential or hazards, and downstream water supply.

Thresholds of Significance

Impacts on water resources would be significant if the Proposed UNFFR Project or an alternative would:

- substantially alter the existing drainage pattern of the site or area or substantially increase the rate or amount of surface runoff in a manner that would result in flooding on or off site;
- expose people or structures to a significant risk of loss, injury, or death involving flooding; or
- reduce water supplies in a manner that would substantially affect existing users.

Impacts and Mitigation Measures

This section discusses the anticipated impacts of the Proposed UNFFR Project and each alternative on water resources and identifies mitigation measures for significant impacts. Table 6.4-1 compares the final level of significance for each impact (with incorporation of mitigation measures if appropriate).

Table 6.4-1. Summary of Water Resources (WR) Impacts

IMPACT	PROPOSED UNFFR PROJECT	ALTERNATIVE 1	ALTERNATIVE 2
Impact WR-1: Construction activities associated with the UNFFR Project could require use of water from Lake Almanor or Butt Valley reservoir that is not approved under existing water rights.	Less than significant	Less than significant	Less than significant
Impact WR-2: Implementation of the UNFFR Project could increase the potential for flooding along the Seneca and Belden reaches as a result of modified flows in the North Fork Feather River.	Less than significant	Less than significant	Less than significant
Impact WR-3: Implementation of the UNFFR Project could modify water deliveries from Lake Almanor, affecting existing water uses downstream.	No impact	No impact	No impact

Impact WR-1: Construction activities associated with the UNFFR Project could require use of water from Lake Almanor or Butt Valley reservoir that is not authorized under existing water rights.

Proposed UNFFR Project and Alternatives 1 and 2

Construction activities could require a temporary water supply for dust suppression (watering the construction area) or other construction uses. PG&E's permitted water rights authorize the use of water stored in Lake Almanor and Butt Valley reservoir for power production; the water rights do not authorize industrial use. PG&E could change the purpose of use under its claimed pre-1914 consumptive-use water rights to allow for water use during construction activities, provided that no third-party water right holders would be injured by the change and the amount of water would not exceed that of the claimed pre-1914 consumptive use amount. Alternatively, PG&E could apply for a temporary water right permit, or identify an alternative water supply, such as from the local communities. If the water supply from the local communities is used, PG&E would need to coordinate with the utility company to ensure that an adequate supply is available and identify a method for withdrawing water from the supply. The temporary water supply to support construction is unlikely to require construction of a new water supply system or establishment of permanent, new water rights because of the temporary nature of the use. All water used to support construction will come from a valid water right. Adverse environmental effects are not anticipated as a result of the need for a water supply during construction; therefore, impacts would be **less than significant**.

Impact WR-2: Implementation of the UNFFR Project could increase the potential for flooding along the Seneca and Belden reaches as a result of modified flows in the North Fork Feather River.

Implementation of the UNFFR Project would entail modifications to flows released from Canyon dam and Belden dam. The effects of these changes on flood potential and related hazards along the North Fork Feather River are described in this section. The effects of flow modifications on water quality and aquatic habitat in the North Fork Feather River are described in Section 6.5, Water Quality, and Section 6.6, Fisheries, respectively.

Proposed UNFFR Project

The Proposed UNFFR Project would involve the implementation of the minimum instream flows outlined in the 2004 Settlement Agreement. The North Fork Feather River would experience an initial increase in flows but these flows would become fairly steady, with increases or decreases as required by the 2004 Settlement Agreement.

The Seneca reach would experience an increase in minimum flows from 35 cfs to between 60 and 150 cfs under the 2004 Settlement Agreement, depending on the water year type and month. The North Fork Feather River would experience an initial increase in flows as the minimum flow through Canyon dam is increased, but the flow would become fairly steady, with monthly increases or decreases as required. The short-term changes could result in flooding along the canyon in areas that have not been frequently inundated and could expose recreationists using this reach to flood hazards. PG&E would follow safety protocols and properly inform the public of the increased releases prior to making any changes in the releases. The longer term flood potential along this reach would be similar to current conditions and would be minimal as a result of the highly regulated nature of the inflow from Lake Almanor.

The Belden reach would experience an increase in minimum flows from 60 cfs to between 110 and 210 cfs between Labor Day (September) and March, depending on the water year type and month. During the fishing season (April to Labor Day), minimum flows would increase from 140 cfs to a high of 235 cfs during April and May in wet years. These changes in flows would result in effects similar to those described above for the Seneca reach and could result in localized flooding during the initial increase in releases. The fluctuating releases through Belden dam would be similar to current releases, with peak flows during the fishing season and lower flows during the rest of the year. Recreationists along the Belden reach would be exposed to flood hazards from fluctuating water levels similar to those under current conditions.

The 2004 Settlement Agreement can require pulse flow releases from both Canyon dam and Belden forebay in each of January, February, and March if the forecasted water year type for that month indicates that the water year is anticipated to be normal or wet. The peak streamflow is variable and depends on month and water year type. The pulse flow events are limited to a total of 1,800 AF per event and must follow the protocol outlined in the 2004 Settlement Agreement. The short-term changes could expose recreationists using this reach to flood hazards; however, PG&E would follow safety protocols and properly inform the public of the increased releases prior to making any changes in the releases.

In summary, the Seneca and Belden reaches would experience changes in their flow regimes, but the potential for flooding would be minimal and similar to current conditions. With the minimal seasonal flow changes, impacts on other resources along the North Fork Feather River, such as riparian vegetation, wildlife, soils, and river morphology, would also be minimal. Hydrologic impacts associated with the changes in flow under the Proposed UNFFR Project would be **less than significant**.

Alternative 1

Operation of the thermal curtains in Lake Almanor and Butt Valley reservoir would not modify releases into the North Fork Feather River or increase the potential for flooding. However, under Alternative 1, modifications to the Canyon dam outlet[1] structure would increase flows up to 250 cfs in the Seneca reach from June 15 through September 15 to increase the amount of cool water.

During other months, the Seneca reach would experience an increase in minimum flows from 35 cfs to between 60 and 150 cfs under the 2004 Settlement Agreement, as modified by the State Water Board (see Chapter 4, Project Alternatives), depending on the water year type and month (Table 6.4-2).

The effects of the increased minimum flows in the Seneca reach would be similar to those outlined above for the Proposed UNFFR Project. The maximum release of 250 cfs could periodically increase the water surface elevation in the river channel between Canyon dam and Belden forebay and pose a hazard to recreationists along this reach. PG&E would follow safety protocols and properly inform the public of the increased releases prior to making any changes in the releases through Canyon dam. The longer term flood potential along this reach would be similar to current conditions and would be minimal as a result of the highly regulated nature of the inflow from Lake Almanor. Flooding below Belden forebay is not expected because of the regulated nature of the flows.

[1] Canyon dam “intake” and Canyon dam “outlet” are synonymous.

Table 6.4-2. Alternative Minimum Streamflow Releases from Canyon Dam

WATER YEAR TYPE	JAN	FEB	MAR	APR	MAY	JUN*	JUL*	AUG*	SEP*	OCT	NOV	DEC
Critically Dry	70	70	80	80	85	85	85	80	60	60	60	70
Dry	90	90	100	100	100	100	100	100	60	60	60	75
Normal	90	100	110	110	120	120	110	100	60	60	60	75
Wet	90	100	110	130	150	150	110	100	60	60	60	75

* Under Alternative 1, instream flows from June 15 through September 15 would be increased by up to 250 cfs to increase the volume of cool water in the North Fork Feather River.

The Belden reach would experience an increase in minimum flows from 60 cfs to between 110 and 210 cfs between Labor Day (September) and March under the 2004 Settlement Agreement, as modified by the State Water Board (see Chapter 4, Project Alternatives), depending on the water year type and month (Table 6.4-3). During the fishing season (April to Labor Day), minimum flows would increase from 140 cfs to a high of 235 cfs during April and May in wet years. These changes in flows would result in effects similar to those described above for the Seneca reach and could result in localized increases in water surface elevation during the release periods. The fluctuating releases through Belden dam would be similar to current releases, with peak flows during the fishing season and lower flows during the rest of the year. Recreationists along the Belden reach would be exposed to hazards from fluctuating water levels similar to those under current conditions.

Table 6.4-3. Alternative Minimum Streamflow Releases from Belden Dam

WATER YEAR TYPE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Critically Dry	110	130	170	180	185	140	140	140	140	110	110	110
Dry	135	140	175	195	195	160	140	140	140	120	120	120
Normal	140	140	205	225	225	225	175	140	140	140	140	140
Wet	140	140	210	235	235	225	175	140	140	140	140	140

Alternative 1 would not require any pulse flow events, as was discussed in Chapter 4 of this document.

In summary, under Alternative 1, the Seneca and Belden reaches would experience changes in their flow regimes, but the potential for flooding would be minimal and similar to current conditions. With the minimal seasonal flow changes, impacts on other resources along the North Fork Feather River, such as riparian vegetation, wildlife, soils, and river morphology, would also be minimal. Hydrologic impacts associated with the changes in flow under Alternative 1 would be **less than significant**.

Alternative 2

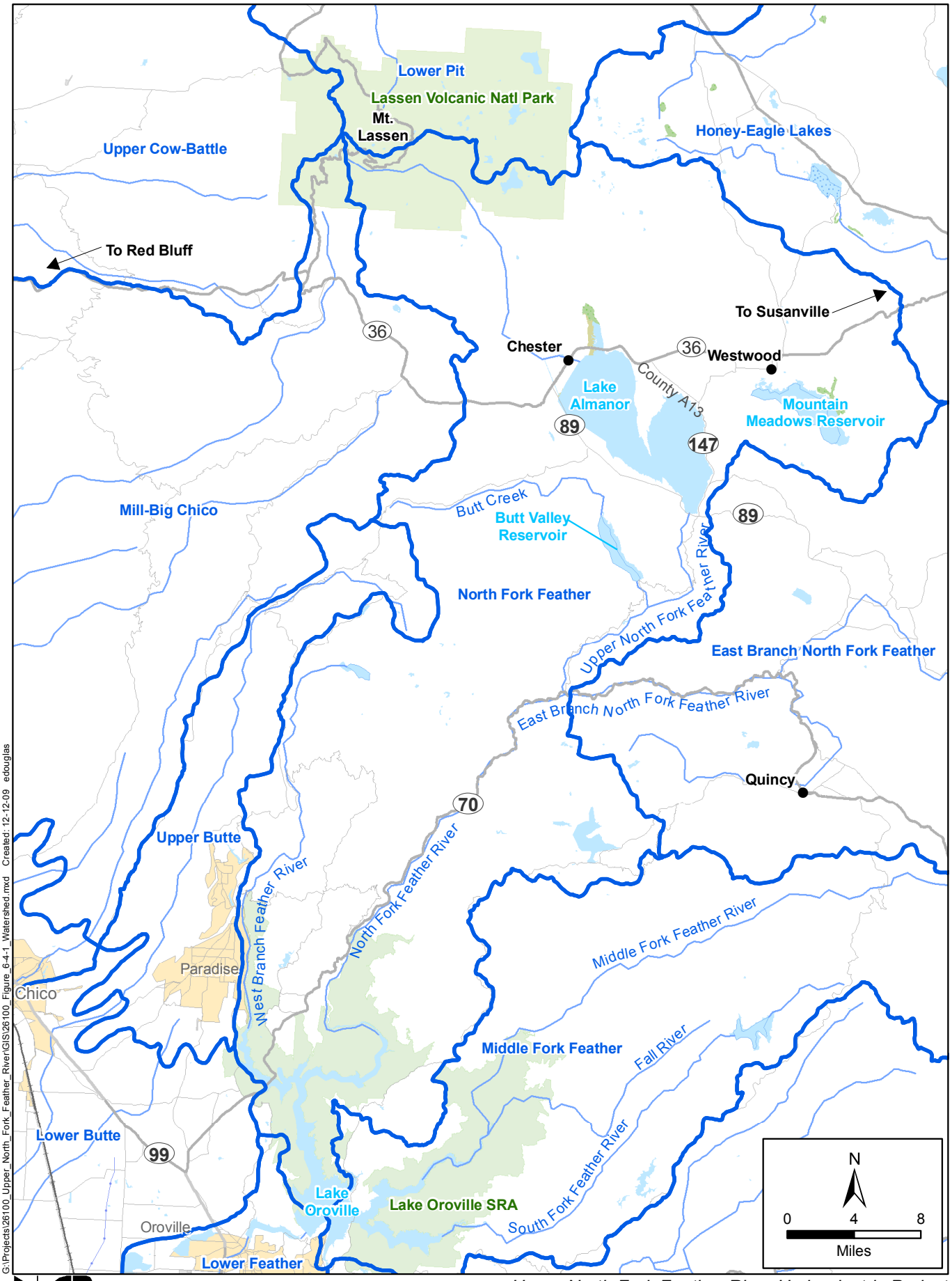
Under Alternative 2, implementation of the thermal curtains at Prattville intake and Caribou intakes would not increase the potential for flooding in the North Fork Feather River because the volume of discharges through the intakes would not be modified as a result of curtain installation. Water levels on Lake Almanor and Butt Valley reservoir would also not be affected by the thermal curtains, and flood hazards would not be increased at the reservoirs. Changes in minimum flows in the Seneca and Belden reaches (Tables 6.4-2 and 6.4-3, respectively) would result in the same impacts described under Alternative 1 with the exception of the additional

Canyon dam releases. Under Alternative 2, Canyon dam releases would not be increased up to 250 cfs from June 15 through September 15. Hydrologic impacts would be **less than significant**.

Impact WR-3: Implementation of the UNFFR Project could modify water deliveries from Lake Almanor, affecting existing water rights and uses downstream.

Proposed UNFFR Project and Alternatives 1 and 2

Although the Proposed UNFFR Project and both alternatives will result in a change in flows in the North Fork Feather River due to modifications in releases through Canyon dam, PG&E would still be capable of meeting its water delivery obligations to downstream users. Flow releases would be maintained or increased to improve aquatic habitat. Existing water rights would still apply. The Proposed UNFFR Project and both alternatives would not affect downstream users. **No impacts** would occur.



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North State Resources, Inc.

Upper North Fork Feather River Hydroelectric Project

Figure 6.4-1
North Fork Feather River Watershed