7.2 Water Resources

7.2.1 Overview

This section discusses water resources in the vicinity of Nevada Irrigation District's (NID or Licensee) Yuba-Bear Hydroelectric Project (Project). This section is divided into nine major subsections, including this overview (Section 7.2.1).

Section 7.2.2 provides drainage area information at major Project facilities.

Section 7.2.3 discusses regulated and unimpaired hydrology in the Project-affected river reaches. For the purpose of this Pre-Application Document (PAD), "regulated" is used to refer to hydrologic conditions during operation of the Project. For the most part, regulated hydrology is measured flow or reservoir elevation, and is reported by USGS in annual reports (data primarily measured by the United States Geological Survey, or USGS, or Licensee). Section 7.2.3 also provides a summary of hydrology data at Project powerhouse intakes and points of diversion and other points of interest (i.e., nodes) in Project-affected river reaches. Appendix H at the end of the PAD provides on a data digital versatile disc (DVD) all available historical regulated and unimpaired hydrology data from for the Period of Record for the Project, Water Year 1976 through Water Year 2004, including monthly flow duration curves. Appendix H also presents the methods used to develop the unimpaired data for the Period of Record.

Section 7.2.4 provides a brief description of a Water and Power Model (Model) of the Drum-Spaulding Project and Yuba-Bear Hydroelectric Project using as a platform the United States Army Corps of Engineer's (USACE) Hydrologic Engineering Center's (HEC) Reservoir Simulation (ResSim) software (Version 2). An executable copy of the Model, including a Model Validation Report, is included on CD as Appendix G.

Section 7.2.5 describes existing instream flow uses related to the Yuba-Bear Hydroelectric Project.

Section 7.2.6 describes existing water rights related to the Yuba-Bear Hydroelectric Project.

Section 7.2.7 provides for each Project reservoir the following: 1) surface area; 2) volume; 3) estimated maximum depth; 4) estimated mean depth; 5) estimated shoreline length; normal flushing rate; and 6) substrate composition where it is known. Section 7.2.7 also provides the results of Licensee's 2007 reservoir bathymetry surveys.

Section, 7.2.8, provides information regarding physical characteristics of Project-affected river reaches.

Section 7.2.9 provides water quality standards applicable to the Project.

Section 7.2.10 describes existing, relevant and reasonably available water quality information found by Licensee in waters affected by the Project. This information includes water

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temperature and dissolved oxygen data and physical and chemical water quality data in Project-affected river reaches. Water quality information collected by Licensee in 2007 is also provided.

Section 7.2.11 describes available information about mercury in the Bear River and Yuba River areas.

The last section, 7.2.12, presents a list and description of the attachments for the Water Resources section of the PAD, which provide relevant data, reports, and other sources of information referred to by the text of this sub-section.

A description of the basins and sub-basins affected by the Project, including a list of river reaches that Licensee believes are affected, or potentially affected, by continued Project operation and maintenance (O&M) is included in Section 3.0 of this PAD. Section 6.0 provides a description of the Project including flow and reservoir stage requirements in the existing Federal Energy Regulatory Commission (FERC) license for the Project.

7.2.2 Drainage Area

There are four primary sub-basins that are directly or indirectly affected by operation of the Yuba-Bear system in Nevada, Placer, and Sierra counties. Table 7.2.2-1, below, summarizes the the length of reaches directly and indirectly affected by the project within the Project-affected sub-basins. Refer to Section 3.1 for a full discussion and description of the Project-affected sub-basins.

- Middle Yuba River Sub-Basin – About 34 miles of the Middle Yuba River from Jackson Meadows Reservoir to the Yuba County Water Agency's Our House Diversion Dam, and about 0.3 miles of Wilson Creek, a tributary to the Middle Yuba River.
- Canyon Creek Sub-Basin – About 11.4 miles of stream, including Canyon Creek from French Lake to the Texas Creek confluence, Jackson Creek and Texas Creeks, which are tributaries to Canyon Creek and on which Project facilities are located.
- Fall Creek Sub-Basin – About 0.9 miles of Clear Creek from the Clear Creek Diversion Dam to the confluence with Fall Creek; and about 1.2 miles of Trap Creek from the Trap Creek Diversion Dam to the confluence with Fall Creek.
- Bear River Sub-Basin - About 6.9 miles of Bear River from Dutch Flat Afterbay to the normal maximum water surface elevation of Rollins Reservoir.

Table 7.2.2-1. Drainage Areas and Reaches Directly/Indirectly Affected by the Project in the Project-Affected Sub-Basins.

Project-Affected Sub-Basin	Number of Affected Reaches	Total Length of Affected Reaches (miles)	Approximate Drainage Total Area (acres)
Middle Yuba River	3	33.9	92,100
Canyon Creek	5	11.4	31,800
Fall Creek	2	2.1	7,000
Bear River	2	6.9	79,200

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The Project includes a total of 11 reservoirs, including 9 on-stream and 2 off-stream impoundment facilities. The diversion dams associated with the project generally have less than 1 acre-foot of storage associated with them, and are not considered impoundment facilities.

Table 7.2.2-2 shows the drainage areas of the on-stream Project reservoirs within the Project-affected sub-basins.

Table 7.2.2-2. Drainage Areas of On-Stream Project Reservoirs.

Project-affected Stream	Reservoir	Drainage Area (sq m)
Middle Yuba River	Jackson Meadows	37.40
	Milton Diversion Impoundment	39.8
Canyon Creek	Jackson Lake	0.65
	French Lake	4.60
	Faucherie Lake	8.97
	Sawmill Lake	16.40
	Bowman Lake and Bowman-Spaulding Impoundment	27.10
Texas Creek	No Project reservoirs or impoundments	
Clear Creek	No Project reservoirs or impoundments	
Trap Creek	No Project reservoirs or impoundments	
Bear River	Dutch Flat Afterbay	21.50
	Rollins Reservoir	104.00

7.2.3 Streamflow, Gage Data and Flow Statistics

7.2.3.1 Streamflow and Other Gages in the Project Vicinity

Flow data for the Project comes from various USGS gage locations and NID/PG&E gage locations within the basins. Table 7.2.3-1 identifies the main gages within the Project-affected sub-basins. Some of theses gages provide flow data; others provide data on reservoir levels.

Table 7.2.3-1. Streamflow gages in Yuba-Bear Hydroelectric Project vicinity including Project-affected stream reaches (direct/indirect and cumulative), Project diversions, tunnels and powerhouses, and lake level gages at Project reservoirs.

NID Gage ID	USGS Identifier	Gage Name
MIDDLE YUBA RIVER SUB-BASIN		
YB-300 [a]	11407800	Jackson Meadows Reservoir near Sierra City
YB-301	11407900	Middle Yuba River below Jackson Meadows Dam near Sierra City (1965-1987)
	11407815	Middle Yuba River controlled release from Jackson Meadows Dam near Sierra City (1994-2004)
YB-302 [a]	N/A	Milton Reservoir
YB-304	11408550	Middle Yuba River below Milton Dam
CANYON CREEK SUB-BASIN		
YB-303	11408000	Milton-Bowman Tunnel Outlet near Graniteville
YB-305 [a]	11414400	French Lake near Cisco
YB-306	11414410	Canyon Creek below French Lake
YB-307 [a]	11414440	Faucherie Lake
YB-308	11414450	Canyon Creek below Faucherie Lake
YB-309 [a]	11414465	Sawmill Lake near Graniteville
CANYON CREEK SUB-BASIN		
YB-310	11414470	Canyon Creek below Sawmill Lake
YB-311 [a]	11414690	Jackson Lake near Sierra City
YB-312	11414700	Jackson Creek below Jackson Lake
YB-313 [a]	11415500	Bowman Lake near Graniteville
YB-314	11416000	Bowman-Spaulding Canal intake near Graniteville
YB-315	11416500	Canyon Creek below Bowman Lake

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Table 7.2.3-1 (continued)

NID Gage ID	USGS Identifier	Gage Name
FALL CREEK SUB-BASIN		
No gages below Bowman-Spaulding Conduit		
RUCKER CREEK SUB-BASIN		
No gages below Bowman-Spaulding Conduit		
SOUTH YUBA RIVER SUB-BASIN		
YB-14	11416100	Bowman-Spaulding Conduit below Fuller Lake
YB-29	11414250	South Yuba River at Lang's Crossing
none	11417500	South Yuba River at Jones Bar
BEAR RIVER SUB-BASIN		
YB-43 [a]	None	Drum Afterbay
YB-44	11421770	Bear River below Drum Afterbay
YB-194	11421750	Dutch Flat Number 1 Powerhouse near Dutch Flat
YB-195 [a]	11421800	Rollins Reservoir near Colfax
YB-196	11422500	Bear River below Rollins Dam near Colfax
YB-197	11421790	Bear River below Dutch Flat Afterbay Near Dutch Flat
YB-238 [a]	N/A	Dutch Flat Forebay
YB-239	11421760	Dutch Flat Number 2 Flume near Blue Canyon
YB-245	11421780	Chicago Park Flume near Dutch Flat
YB-258	N/A	Chicago Park Powerhouse
YB-279	11421900	Rollins Powerhouse near Colfax

[a] Indicates a lake-level/storage gage.

7.2.3.2 Regulated Hydrology Data for Directly/Indirectly-Affected Reaches

Available regulated flow data are summarized in Section 7.2.3.2. These summaries include data available for reaches directly/indirectly affected by the Project, immediately downstream of the facilities, Project powerhouses, Project canals and points of diversion, and other points of interest such as USGS gage locations. Licensee synthesized unimpaired flow data for these points of interest are included with the complete hydrology data for both regulated and unimpaired flows in Appendix H.

The flow data summarized here is grouped into the Project-affected sub-basins. In some cases, facilities lie off-channel between two watersheds – these facilities are generally addressed with the watershed where their flow originates.

<u>Regulated Hydrology in the Middle Yuba River Sub-basin</u>

<u>Jackson Meadows Reservoir and Jackson Meadows Dam Reach</u>

Jackson Meadows Reservoir has a gross storage of 69,205 ac-ft, and a useable storage of 65,519 ac-ft. The Licensee maintains a storage gage on Jackson Meadows Reservoir, Gage YB-300 (USGS 11407800.)

Jackson Meadows Dam Reach is a 1.6-mile-long reach of the Middle Yuba River between Jackson Meadows and Milton reservoirs. Jackson Meadows Dam conveys a mean of 107 cfs into Milton Reservoir via the Jackson Meadows Dam Reach of the Middle Yuba River. A minimum flow of 5 cfs is released continuously to the Middle Yuba River downstream of Jackson Meadows Dam. The 10%, 50%, and 90% monthly exceedance flows as reported by gage YB-301 (USGS 11407900) on the Middle Yuba River for the period 1976 to 2004 are

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summarized in Table 7.2.3-2. See Appendix H for estimated unimpaired flows at the head of this reach.

(NOTE: this gage does not currently record spill, and therefore provides an incomplete record of flows at this location.)

Table 7.2.3-2. Monthly 10%, 50% and 90% Exceedance flows in the Middle Yuba River below Jackson Meadows Reservoir (Gage YB-301.)

Month	10% Exceedance Flow (cfs)	50% Exceedance Flow (cfs)	90% Exceedance Flow (cfs)
October	305	154	6.1
November	284	13	7.0
December	162	9.2	4.0
January	128	9.4	4.5
February	191	10	4.7
March	220	85	6.1
April	275	82	7.7
May	400	88	7.7
June	379	94	5.5
July	189	100	5.0
August	149	91	5.0
September	286	145	5.4

Source: YB-301 gage (USGS 11407900) Middle Yuba river near below Jackson Meadows Dam, 1976 to 2004 (NOTE: this gage does not currently record spill, and therefore provides an incomplete record of flows at this location).

Milton Reservoir and the Milton-Bowman Diversion Conduit

Milton Reservoir has a gross storage of 295 ac-ft and a useable storage of 275 ac-ft. The Licensee maintains a storage gage on Milton Reservoir, Gage YB-302 (no USGS designation.)

Milton Dam and Wilson Creek combined divert an average of 81 cfs into Bowman Lake via the Milton –Bowman Diversion Conduit; the majority of this flow originates at Milton Reservoir. The 10%, 50%, and 90% monthly exceedance diversion flows as reported by YB-303 Gage located at the outlet of the Milton–Bowman Diversion Conduit (USGS 11408000) for the period 1976 to 2004 are summarized in Table 7.2.3-3.

Table 7.2.3-3 Monthly 10%, 50% and 90% Exceedance Flows diverted from Milton Reservoir into Milton-Bowman Diversion Conduit (Gage YB-303.)

	10% Exceedance Flow (cfs)	50% Exceedance Flow (cfs)	90% Exceedance Flow (cfs)
October	298	128	6.4
November	294	22	6.7
December	176	12	5.1
January	45	17	6.5
February	140	17	6.6
March	180	33	10
April	170	41	13
May	257	50	13
June	199	32	7.0
July	154	88	5.5
August	182	94	3.7
September	256	130	4.7

Source: YB-303 gage (USGS 11408000) Milton-Bowman Diversion Conduit, 1976 to 2004.

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Milton Diversion Dam Reach

Milton Diversion Dam Reach is a 32-mile-long reach of the Middle Yuba River from the Milton Diversion Dam to the Yuba County Water Agency's (YCWA) Our House Diversion Dam. The 10%, 50%, and 90% monthly exceedance flows in the Middle Yuba River below Milton Reservoir as recorded by the YB-304 gage (USGS 11408550) are summarized in Table 7.2.3-4; this location is missing data for some months in the 1980 through 1984 period. Statistics presented below provide approximate flow conditions – see Appendix H for a full treatment of the data at this location.

Further downstream, these flows are augmented by several tributaries; downstream of the YCWA Our House Dam, the Middle Yuba River eventually joins the North Yuba River to become the Yuba River. The Licensee has a minimum instream flow requirement of 3 cfs below Milton Diversion Dam, but provides an average instream flow of 19 cfs. See Appendix H for estimated unimpaired flows at the head of this reach.

Table 7.2.3-4. Monthly 10%, 50% and 90% Exceedance Flows in Middle Yuba River below Milton Dam (Gage YB-304.)

Month	10% Exceedance Flow (cfs)	50% Exceedance Flow (cfs)	90% Exceedance Flow (cfs)
October	4.4	3.7	3.2
November	4.2*	3.7*	3.1*
December	4.2*	3.5*	3.1*
January	4.6*	3.5*	3.0*
February	6.0*	3.7*	2.8*
March	5.0*	3.8*	2.5*
April	4.9*	3.8*	2.0*
May	137*	3.8*	2.0*
June	287*	3.8*	3.2*
July	5.8*	3.7*	3.1*
August	4.6	3.7	3.1
September	4.5*	3.8*	3.4*

Source: YB-304 gage (USGS 11408550) Middle Yuba River below Milton Dam, 1976 to 2004.
* - Denotes missing data within the given period

Wilson Creek Diversion Reach

The Wilson Creek Diversion Reach is a 0.3-mile-long reach of Wilson Creek, from the Milton-Bowman Diversion Conduit to the confluence with the Middle Yuba River. The Licensee diverts up to approximately 17.5 cfs from Wilson Creek to Bowman Lake via the Milton-Bowman Diversion Conduit. There is less than 1 ac-ft of storage associated with the diversion structure and diversion flows are not gaged. The current FERC license does not require a minimum release into the Wilson Creek Reach and flows are not measured. See Appendix H for estimated unimpaired flows at the head of this reach.

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Regulated Hydrology in the Canyon Creek Sub-Basin

Jackson Lake and Jackson Lake Dam Reach

Jackson Lake has a gross storage capacity of 1,330 ac-ft, useable storage capacity of 970 ac-ft. Licensee maintains a storage gage on Jackson Lake, YB-311 (USGS gage 11414690.)

The Licensee conveys water from Jackson Lake to Bowman Lake via the Jackson Lake Dam Reach of Jackson Creek. A minimum flow of 0.75 cfs is released continuously to Jackson Creek downstream of Jackson Dam as a part of its current FERC license requirements (Article 32). There are no flow statistics for this stream reach as NID maintains a partial flow gage (YB-312/USGS 11414700) calibrated for low-flow stages to ensure compliance with its minimum instream flow requirements. See Appendix H for the partial flow record available at this location, and for estimated unimpaired flows at the head of the Jackson Lake Dam Reach.

French Lake and French Lake Dam Reach

French Lake has a gross storage capacity of 13,940 ac-ft, and useable storage capacity of 13,940. Licensee maintains a storage gage on French Lake, YB-305 (USGS gage 11414400.)

The Licensee conveys water from French Lake to Faucherie Lake via the French Lake Dam Reach of Canyon Creek. A flow of at least 2.5 cfs is released continuously to Canyon Creek downstream of French Lake Dam as a part of its current FERC license requirements (Article 32). There are no flow statistics for this stream reach as NID maintains a partial flow gage (YB-306/USGS 11414410) calibrated for low flow stages to ensure compliance with its minimum instream flow requirements. See Appendix H for the partial flow record available at this location, and for estimated unimpaired flows at the head of this reach.

Faucherie Lake and Faucherie Lake Dam Reach

Faucherie Lake has a gross storage capacity of 3,980 ac-ft, a useable storage capacity of 3,740 ac-ft. Licensee maintains a storage gage on Faucherie Lake, YB-307 (USGS gage 11414440.)

The Licensee conveys water from Faucherie Lake to Sawmill Lake via the Faucherie Lake Dam Reach of Canyon Creek. A flow of at least 2.5 cfs is released continuously to Canyon Creek downstream of Faucherie Lake Dam as a part of its current FERC license requirements (Article 32). There are no flow statistics for this stream reach as NID maintains a partial flow gage (YB-308/USGS 11414450) calibrated for low flow stages to ensure compliance with its minimum instream flow requirements. See Appendix H for the partial flow record available at this location, and for estimated unimpaired flows at the head of this reach.

Sawmill Lake and Sawmill Lake Dam Reach

Sawmill Lake has a gross and useable storage capacity of 3,030 ac-ft. Licensee maintains a storage gage on Sawmill Lake, YB-309 (USGS gage 11414465.)

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The Licensee conveys water from Sawmill Lake to Bowman Lake via the Sawmill Lake Dam Reach of Canyon Creek. A flow of at least 2.5 cfs is released continuously to Canyon Creek downstream of Sawmill Lake Dam as a part of its current FERC license requirements (Article 32). There are no flow statistics for this stream reach as NID maintains a partial flow gage (YB-310/USGS 11414470) calibrated for low flow stages to ensure compliance with its minimum instream flow requirements. See Appendix H for the partial flow record available at this location, and for estimated unimpaired flows at the head of this reach.

Bowman-Spaulding Diversion Impoundment

Bowman-Spaulding Diversion Dam diverts an average of 170 cfs through Fuller Lake to Lake Spaulding via the Bowman-Spaulding Conduit. The 10%, 50%, and 90% monthly exceedance diversion flows as reported by YB-314 Gage located at the head of Bowman-Spaulding Conduit (USGS 11416000) for the period 1976 to 2004 are summarized in Table 7.2.3-5. Appendix H contains the monthly flow duration curves for the diversion of flows from the Bowman-Spaulding Diversion Impoundment to Fuller Lake.

Table 7.2.3-5. Monthly 10%, 50% and 90% Exceedance Flows in the Bowman-Spaulding Conduit (Gage YB-314.)

Month	10% Exceedance Flow (cfs)	50% Exceedance Flow (cfs)	90% Exceedance Flow (cfs)
October	296	221	69
November	294	182	52
December	281	176	53
January	248	161	58
February	247	159	42
March	250	157	15
April	238	128	5.2
May	234	139	33
June	289	197	48
July	294	240	0.1
August	306	286	98
September	305	271	151

Sources: YB-314 gage (USGS 11416000) Bowman-Spaulding Conduit, 1976 to 2004.

Bowman Lake and Bowman-Spaulding Diversion Dam Reach

Bowman Lake inflows come from Canyon Creek, Jackson Creek, and the Milton-Bowman Diversion Conduit. Bowman Lake has a gross storage capacity of 68,510 ac-ft, a useable storage capacity of 68,010 ac-ft. Licensee maintains a storage gage on Bowman Lake, Gage YB-313 (USGS gage 11415500.)

The Licensee releases water into the Bowman-Spaulding Diversion Impoundment, immediately downstream of the Bowman Dam, then into the Bowman-Spaulding Diversion Dam Reach of Canyon Creek. The Bowman-Spaulding Diversion Dam Reach is a 4.4-mile-long reach of Canyon Creek from the Bowman-Spaulding Diversion Dam to the confluence of Canyon and Texas creeks. A flow of at least 3 cfs from April 1 to October 31, and 2 cfs from November 1 to March 31 is released into to Canyon Creek downstream of Bowman Dam as a part of its current FERC license requirements (Article 32.) The 10%, 50%, and 90% monthly exceedance flows as reported by YB-315 Gage located on Canyon Creek (USGS 11416500) for the period 1976 to

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2004 are summarized in Table 7.2.3-6. See Appendix H for estimated unimpaired flows at the head of this reach, and the monthly flow duration curves for the controlled release of flows from Bowman Lake to the Bowman-Spaulding Diversion Impoundment.

Table 7.2.3-6. Monthly 10%, 50% and 90% Exceedance Flows in Canyon Creek below Bowman-Spaulding Diversion Dam (Gage YB-315.)

Month	10% Exceedance Flow (cfs)	50% Exceedance Flow (cfs)	90% Exceedance Flow (cfs)
October	6.5	4.3	2.5
November	7.7	3.9	2.1
December	10	4.2	2.1
January	16	4.6	2.3
February	43	4.9	2.4
March	106	6.0	2.9
April	144	5.2	3.2
May	231	4.7	2.9
June	219	4.7	3.1
July	10	4.5	2.4
August	6.6	4.3	2.5
September	6.3	4.2	2.5

Sources: YB-315 gage (USGS 11416500) Canyon Creek below Bowman-Spaulding Diversion Dam, 1976 to 2004.

Regulated Hydrology in the Fall Creek Sub-Basin

Clear Creek Diversion Dam Reach

Clear Creek Diversion Dam Reach is a 0.9-mile-long reach of Clear Creek, from the Bowman-Spaulding Conduit to the confluence of Clear and Fall creeks. NID diverts Clear Creek into the Bowman-Spaulding Conduit. There is less than 1 ac-ft of storage associated with the diversion structure, and diversion flows are not gaged. The current FERC license does not require a minimum release into the Clear Creek Diversion Dam Reach and flows are not measured. Bypass flows from this 0.9-mile stream reach eventually join Fall Creek below the Bowman-Spaulding Conduit Diversion Dam.

Trap Creek Diversion Dam Reach

Trap Creek Diversion Dam Reach is a 1.2-mile-long reach of Trap Creek from the Bowman-Spaulding Conduit to the confluence of Trap and Fall creeks. NID diverts Trap Creek into the Bowman-Spaulding Conduit. There is less than 1 ac-ft of storage associated with the diversion structure, and diversion flows are not gaged. The current FERC license does not require a minimum release into the Trap Creek Diversion Dam Reach and flows are not measured. Bypass flows from this 1.2-mile stream reach eventually join Fall Creek.

Regulated Hydrology in the Bear River Sub-Basin

Dutch Flat No. 2 Flume – from Drum Afterbay (PG&E)

Licensee diverts an average of 292 cfs from Drum Afterbay into Dutch Flat Forebay via the Dutch Flat No. 2 Flume. The 10%, 50%, and 90% monthly exceedance diversion flows as reported by YB-239 Gage located on the Dutch Flat No. 2 Flume (USGS 11421760) for the

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period 1976 to 2004 are summarized in Table 7.2.3-7. Appendix H contains the monthly flow duration curves for the diversion of flows from Drum Afterbay to Dutch Flat Forebay.

Table 7.2.3-7. Monthly 10%, 50% and 90% Exceedance diversion flows from Drum Afterbay into the Dutch Flat No. 2 Flume (YB-239.)

Month	10% Exceedance Flow (cfs)	50% Exceedance Flow (cfs)	90% Exceedance Flow (cfs)
October	457	119	0.5
November	473	214	2.3
December	538	232	3.2
January	557	281	2.5
February	572	356	2.5
March	583	439	2.2
April	588	479	1.0
May	595	489	1.1
June	571	432	6.7
July	557	386	10
August	541	344	8.0
September	494	42	0.5

Sources: YB-239 gage (USGS 11421760) Dutch Flat No. 2 Flume, 1976 to 2004.

Dutch Flat No. 2 Forebay

Dutch Flat No. 2 Forebay is an off-stream forebay that receives inflow from PG&E's Drum Afterbay via the Dutch Flat No. 2 Conduit and has a storage capacity of 185 ac-ft. Inflow to the forebay is gaged on the Dutch Flat No. 2 Flume; see Table 7.2.3-7 for hydrology data from the flume. Outflows from the forebay flow to Dutch Flat Powerhouse No. 2, and then into Dutch Flat Afterbay.

Dutch Flat Afterbay and the Chicago Park Flume/Chicago Park Forebay

Dutch Flat Afterbay receives inflow from the Dutch Flat No. 2 Forebay penstock, PG&E's Dutch Flat No. 1 penstock, and PG&E's Drum Afterbay reach on the Bear River, and Little Bear River. Dutch Flat Afterbay has a storage capacity of 2,037 ac-ft, diverts an average of 549 cfs into the Chicago Park Conduit, through the Chicago Park Forebay, to the Chicago Park Powerhouse. The 10%, 50%, and 90% monthly exceedance diversion flows as reported by YB-245 Gage located on the Chicago Park Flume (USGS 11421780) for the period 1976 to 2004 are summarized in Table 7.2.3-8. Appendix H contains the monthly flow duration curves for the diversion of flows from Dutch Flat No. 2 Forebay to the Bear River below Dutch Flat No. 2 Forebay.

Table 7.2.3-8. Monthly 10%, 50% and 90% Exceedance diversion flows from Dutch Flat Afterbay into the Chicago Park Conduit (YB-245.)

Month	10% Exceedance Flow (cfs)	50% Exceedance Flow (cfs)	90% Exceedance Flow (cfs)
October	799	301	0.0
November	866	429	16
December	1030	495	116
January	1060	550	30
February	1060	584	20
March	1070	708	92
April	1070	864	20
May	1070	879	216
June	983	756	265

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Table 7.2.3-8. (continued)

Month	10% Exceedance Flow (cfs)	50% Exceedance Flow (cfs)	90% Exceedance Flow (cfs)
July	880	694	304
August	816	595	230
September	765	355	0.0

Sources: YB-245 gage (USGS 11421780) Chicago Park Conduit, 1976 to 2004.

Dutch Flat Afterbay Dam Reach

An average flow of 27 cfs is released to Bear River downstream of Dutch Flat Afterbay Dam. This reach of the Bear River has a seasonally-variable minimum flow requirement of 10 cfs from May 1 to October 31, and 5 cfs from November 1 to April 30. The 10%, 50%, and 90% monthly exceedance flows as reported by the YB-197 Gage located on the Bear River (USGS 11421790) for the period 1976 to 2004 are summarized in Table 7.2.3-9. Appendix H contains the monthly flow duration curves for the diversion of flows from Dutch Flat Afterbay.

Table 7.2.3-9. Monthly 10%, 50% and 90% Exceedance Flows in the Bear River below Dutch Flat Afterbay (YB-197.)

Month	10% Exceedance Flow (cfs)	50% Exceedance Flow (cfs)	90% Exceedance Flow (cfs)
October	13	11	9.4
November	12	6.7	5.2
December	13	6.7	5.0
January	14	6.5	5.3
February	14	6.4	5.3
March	79	6.9	5.3
April	76	7.1	5.5
May	12	11	6.3
June	12	11	6.3
July	55	11	6.3
August	51	11	9.9
September	45	11	10

Sources: YB-197 gage (USGS 11421790) Bear River Below Dutch Flat Afterbay, 1976 to 2004.

Chicago Park Powerhouse and Chicago Park Powerhouse Reach

The Chicago Park Powerhouse Reach is a 1.5-mile-long reach of the Bear River, from the Chicago Park Powerhouse outflow to Rollins Reservoir. An average flow of 573 cfs is released to the Bear River at Chicago Park Powerhouse; there is no minimum streamflow release from the powerhouse into this reach. The Chicago Park Powerhouse is used for generating power at peak-load times. The 10%, 50%, and 90% monthly exceedance flows as reported by YB-258 Gage located at Chicago Park Powerhouse for the period 1976 to 2000 are summarized in Table 7.2.3-10. No data were collected after water year 2000.

Table 7.2.3-10. Monthly 10%, 50% and 90% Exceedance Flows at Chicago Park Powerhouse (YB-258.)

Month	10% Exceedance Flow (cfs)	50% Exceedance Flow (cfs)	90% Exceedance Flow (cfs)
October	765*	293*	0.0*
November	838*	433*	0.0*
December	1,006*	540*	161*
January	1,040*	548*	38*
February	1,053*	612*	127*
March	1,040*	749*	168*
April	1,050*	864*	130*

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Table 7.2.3-10. (continued)

Month	10% Exceedance Flow (cfs)	50% Exceedance Flow (cfs)	90% Exceedance Flow (cfs)
May	1,016*	862*	321*
June	948*	742*	314*
July	868*	673*	357*
August	792*	592*	305*
September	761*	370*	0.0*

Sources: YB-258 gage at Chicago Park Powerhouse, 1976 to 2000.

Rollins Reservoir and Rollins Powerhouse

Rollins Reservoir inflow is from upstream releases and local runoff into the Bear River, the Chicago Park Powerhouse and Greenhorn Creek reach of the Bear River. Rollins Reservoir has a gross storage capacity of 65,988 ac-ft, and a useable storage capacity of 61,804 ac-ft. Reservoir water is diverted to Rollins Powerhouse at an average rate of 610 cfs. The 10%, 50%, and 90% monthly exceedance flows as reported by YB-279 Gage located at Rollins Powerhouse near Colfax (USGS 11421900) for the period 1976 to 2004 are summarized in Table 7.2.3-11.

Table 7.2.3.-11. Monthly 10%, 50% and 90% Exceedance Flows at Rollins Powerhouse below Rollins Dam (YB-279.)

Month	10% Exceedance Flow (cfs)	50% Exceedance Flow (cfs)	90% Exceedance Flow (cfs)
October	817*	560*	351*
November	757*	477*	0.0*
December	817*	226*	0.0*
January	875*	505*	190*
February	991*	528*	168*
March	1,040*	782*	109*
April	1,010*	817*	207*
May	1,040*	802*	236*
June	1,010*	817*	385*
July	1,010*	817*	448*
August	957*	718*	494*
September	825*	607*	490*

Sources: YB-279 gage (USGS 11421900) Rollins Powerhouse near Colfax, 1976 to 2004.

7.2.3.3 Regulated Hydrology Data for Cumulatively-Affected Reaches

Available regulated flow data for cumulatively-affected reaches are summarized in Section 7.2.3.3. These summaries include data available for reaches affected by the Project and by other entities, including PG&E by way of its Drum-Spaulding Project. The complete hydrology data for both regulated and unimpaired flows are available in Appendix H.

Regulated Hydrology in the Canyon Creek Sub-basin

Texas Creek Diversion Dam Reach

Texas Creek Diversion Dam Reach is a 0.6-mile-long reach of Texas Creek, from the Project's Bowman-Spaulding Conduit to the confluence with the South Yuba River. The current Yuba-Bear Hydroelectric Project FERC license does not have a minimum streamflow requirement in this reach downstream of NID's diversion dam. NID diverts Texas Creek into the Bowman-Spaulding Conduit. There is less than 1 ac-ft of storage associated with the diversion structure,

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and diversion flows are not gaged. Upstream of the Bowman-Spaulding Conduit, the operation of the following Drum-Spaulding Project reservoirs may affect flows in this reach: Culbertson Lake, Upper and Lower Rock lakes, and Upper, Middle and Lower Lindsey lakes. Flows in this reach of Texas Creek are not gaged, nor are NID's diversions into the Bowman-Spaulding Conduit. Flows that bypass the Bowman-Spaulding diversion dam in this 0.6-mile reach of Texas Creek flow into Canyon Creek, between the head of the Bowman-Spaulding Conduit and the confluence of Canyon Creek and the South Yuba River.

Canyon Creek below Texas Creek Confluence Reach

The Canyon Creek below Texas Creek Confluence Reach is a 6.1-mile-long reach of Canyon Creek, from the confluence of Texas Creek and Canyon Creek to the confluence of Canyon Creek with the South Yuba River. NID's Yuba-Bear Hydroelectric Project FERC license requires a minimum flow in Canyon Creek above this reach – 3 cfs April through October and 2 cfs from November through March. There is no minimum streamflow requirement for Texas Creek. Flows in Canyon Creek upstream of this reach are affected by NID's Yuba-Bear Hydroelectric Project Bowman Reservoir and Bowman-Spaulding Conduit; flows in Texas Creek upstream of the head of this reach are affected by NID's diversion into the Bowman-Spaulding Conduit, and in certain times of year may be affected by the Drum-Spaulding Project's reservoirs upstream on the Texas Creek system, including Culbertson Lake, Upper and Lower Rock lakes, and Upper, Middle and Lower Lindsey lakes. Flows in this reach are not gaged, and estimated unimpaired flows are not available for this reach.

Regulated Hydrology in the Fall Creek Sub-basin

Fall Creek Diversion Dam Reach

Fall Creek Diversion Dam Reach is a 2.0-mile-long reach of Fall Creek from NID's Yuba-Bear Hydroelectric Project Bowman-Spaulding Conduit to the confluence of Fall Creek with the South Yuba River. The current Yuba-Bear Hydroelectric Project FERC license does not have a minimum streamflow requirement in this reach downstream of NID's diversion dam. NID diverts Fall Creek into the Bowman-Spaulding Conduit. There is less than 1 ac-ft of storage associated with the diversion structure, and diversion flows are not gaged. Upstream of the Bowman-Spaulding Conduit, the PG&E's Drum-Spaulding Project reservoirs of Feeley and Carr lakes may affect flows in this reach. Clear Creek and Trap Creek both flow into this reach of Fall Creek, downstream of NID's Clear and Trap creeks diversions into the Bowman-Spaulding Conduit.

Flows on Fall Creek downstream of the Bowman-Spaulding Conduit are not gaged. See Appendix H for estimated unimpaired flows at the head of this reach.

Regulated Hydrology in the Rucker Creek Sub-basin

Rucker Creek Diversion Dam Reach

Rucker Creek Diversion Dam Reach is a 1.2-mile-long reach of Rucker Creek, from NID's

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Yuba-Bear Hydroelectric Project Bowman-Spaulding Conduit to the confluence of Rucker Creek with the South Yuba River. The current Yuba-Bear Hydroelectric Project FERC license does not have a minimum streamflow requirement in this reach downstream of NID's diversion dam. NID diverts Rucker Creek into the Bowman-Spaulding Conduit. There is less than 1 ac-ft of storage associated with the diversion structure, and diversion flows are not gaged. Upstream of the Bowman-Spaulding Conduit, the PG&E's Drum-Spaulding Project reservoirs of Blue and Rucker lakes may affect flows in this reach. Flows in Rucker Creek that are not diverted into the Bowman-Spaulding Conduit join the South Yuba River downstream of PG&E's Drum-Spaulding Project Lake Spaulding reservoir.

Flows on Rucker Creek downstream of the Bowman-Spaulding Conduit are not gaged. See Appendix H for estimated unimpaired flows at the head of this reach.

Regulated Hydrology in the South Yuba River Sub-Basin

Fuller Lake Dam Reach

Fuller Lake Dam Reach is a 1.0-mile–long reach of an unnamed stream, and extends from the base of PG&E's Drum-Spaulding Project Fuller Lake Dam to the confluence of the unnamed stream with Jordan Creek. There is no existing minimum streamflow requirement in this reach. The reach generally receives flow from natural accretion, releases from Fuller Lake Dam, and a small amount of flow year-round from Fuller Lake Dam leakage. Flows in this reach are affected by operation of the Drum-Spaulding Project through Fuller Lake, and the Yuba-Bear Hydroelectric Project through the operation of the Bowman-Spaulding Conduit, which is Fuller Lake's primary source of inflow and outflow.

Flows downstream of Fuller Lake Dam are not gaged; therefore, the full range of regulated flows and flow statistics are not available at this location. See Appendix H for estimated unimpaired flows at the head of this reach.

Jordan Creek Diversion Reach

Jordan Creek Diversion Reach is a 1.7-mile-long reach of Jordan Creek from the PG&E Drum-Spaulding Project's Jordan Canal Diversion, which diverts water to Lake Spaulding via the Jordan Canal, to the confluence of Jordan Creek and the South Yuba River. There is no required minimum streamflow in Jordan Creek at any point. Jordan Creek is affected both by the Drum-Spaulding Project and Yuba-Bear Hydroelectric Project. PG&E diverts flow at the head of this reach from Jordan Creek to Lake Spaulding via the Jordan Canal; 0.4 miles downstream of the Jordan Creek Diversion, PG&E spills water from Lake Spaulding via Spaulding Dam No. 3; 0.6 miles downstream of the Jordan Creek Diversion, PG&E spills water from Lake Spaulding to Jordan Creek via Spaulding Dam No. 2, the main spillway for Lake Spaulding and in this same location, Jordan Creek receives flow from the unnamed stream below Fuller Lake Dam. NID affects flows in this reach through its ability to spill water from the Bowman-Spaulding conduit into Jordan Creek, and further downstream by its effects on flows in the Fuller Lake Dam Reach.

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Diversions into the Jordan Canal at the head of this reach are not gaged, nor are spills into Jordan Creek gaged at any point; therefore the full range of regulated flows and flow statistics are not available for Jordan Creek. See Appendix H for estimated unimpaired flows at the head of this reach.

South Yuba Reach #1 (Jordan Creek Confluence Reach, including South Yuba at Lang's Crossing USGS gage)

South Yuba Reach #1 is a 3.2-mile-long reach of the South Yuba River from the confluence of Jordan Creek and the South Yuba River to the confluence of Rucker Creek with the South Yuba River. PG&E's Drum-Spaulding Project FERC license requires a year-round minimum streamflow requirement of 5 cfs at Lang's Crossing, 0.2 miles downstream of the confluence of Jordan Creek and the South Yuba River. PG&E generally maintains flows between 5 and 15 cfs in this reach from July through December. From January through June, the flows in this reach vary widely depending on the water year type. In dry years when Lake Spaulding does not spill, flows may remain low, between 5 and 20 cfs, throughout the year. In years when Lake Spaulding spills, which usually occurs from April through June or July in wetter years, mean daily flows in the reach may be in excess of 10,000 cfs when the reservoir is spilling.

The primary flows in this reach include flows released by PG&E from the low-flow outlet at Spaulding Dam, discharge from the PG&E South Yuba Canal at Spaulding No. 2 Powerhouse, and any spills from PG&E's Drum-Spaulding Project Lake Spaulding conveyed by Jordan Creek. NID's Yuba-Bear Hydroelectric Project can also affect this reach, through its effects on the Fuller Lake Dam Reach and on Jordan Creek from the operation of the Bowman-Spaulding Conduit. Gage YB-29 (USGS gage 11414250) at Lang's Crossing, records flows in this reach. For the period of record, from 1976 to 2004, the annual 90% exceedance flow was 5.4 cfs, 50% exceedance flow was 7.6 cfs, and the 10% exceedance flow was 99.0 cfs. The period of record has a complete data set at this location, and unimpaired flows at Lang's Crossing are also available for the full period of record.

The 90% exceedance, 50% exceedance, and 10% exceedance monthly diversion flows as reported by the YB-29 gage (USGS 11414250) for the period 1976 to 2004 are summarized in Table 7.2.3-12.

Table 7.2.3-12. Monthly 10%, 20% and 50% Exceedance Flows in the South Yuba River at Lang's Crossing (Gage YB-29.)

Month	90% Exceedance Flow (cfs) Regulated	50% Exceedance Flow (cfs) Regulated	10% Exceedance Flow (cfs) Regulated
October	5.2	6.2	8.6
November	5.3	6.9	19
December	5.6	7.6	39
January	5.5	11	52
February	5.9	15	75
March	7.0	17	84
April	5.7	14	233
May	5.7	23	1122
June	5.5	9.1	1242
July	5.2	6.3	30
August	5.1	6.1	7.8

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Table 7.2.3-12 (continued)

Month	90% Exceedance Flow (cfs) Regulated	50% Exceedance Flow (cfs) Regulated	10% Exceedance Flow (cfs) Regulated
September	5.3	6.5	9.0

Sources: YB-29 gage (USGS ID 11414250) South Yuba River at Lang's Crossing, 1976 to 2004.

South Yuba Reach #2

South Yuba Reach #2 is a 1.4-mile-long reach of the South Yuba River from the confluence with Rucker Creek to the confluence with Fall Creek. This reach conveys spills and outflow from Lake Spaulding, and any additional inflow from Rucker Creek. Flows in this reach are affected by operations of the Drum-Spaulding Project at Lake Spaulding; Jordan Creek; Fuller Lake; and Blue and Rucker lakes on Rucker Creek. Flows are also affected by NID's Yuba-Bear Hydroelectric Project operation of the Bowman-Spaulding Conduit and diversions at the Rucker Creek Diversion Dam. See Appendix H for estimated unimpaired flows at the head of this reach.

South Yuba Reach #3

South Yuba Reach #3 is a 3.2-mile-long reach of the South Yuba River from the confluence with Fall Creek to the confluence with Canyon Creek. This reach conveys spills and outflow from Lake Spaulding, and any additional inflow from Rucker Creek and Fall Creek. Flows in this reach are affected by operations of the Drum-Spaulding Project at Lake Spaulding; Jordan Creek; Fuller Lake; Blue and Rucker lakes on Rucker Creek; and Feeley and Carr lakes on Fall Creek. Flows are also affected by NID's Yuba-Bear Hydroelectric Project operation of the Bowman-Spaulding Conduit and the Rucker, Trap, Fall and Clear creeks diversions into the Bowman-Spaulding Conduit. See Appendix H for estimated unimpaired flows at the head of this reach.

South Yuba Reach #4

South Yuba Reach #4 is a 4.4-mile-long reach of the South Yuba River from the confluence with Canyon Creek to the confluence with Poorman Creek. This reach conveys spills and outflow from Lake Spaulding, and any additional inflow from Rucker Creek, Fall Creek, Canyon Creek, and a number of smaller tributaries to the South Yuba River. Flows in this reach are affected by operations of the Drum-Spaulding Project at Lake Spaulding; Jordan Creek; Fuller Lake; Blue and Rucker lakes on Rucker Creek; Feeley and Carr lakes on Fall Creek; and several reservoirs on Texas Creek and its tributaries. Flows in this reach are also affected by NID's Yuba-Bear Hydroelectric Project operation of the Bowman-Spaulding Conduit; the Rucker, Trap, Fall, Clear and Texas creeks diversions into the Bowman-Spaulding Conduit; and by the NID operation of the Yuba-Bear Hydroelectric Project reservoirs in the upper Canyon Creek system, including Bowman Lake. See Appendix H for estimated unimpaired flows at the head of this reach.

South Yuba Reach #5

South Yuba Reach #5 is an 8.5-mile-long reach of the South Yuba River extends from the confluence with Poorman Creek to the confluence with Humbug Creek. This reach conveys

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spills and outflow from Lake Spaulding, and any additional inflow from Rucker Creek, Fall Creek, Canyon Creek, Poorman Creek, and a number of smaller tributaries to the South Yuba River. Poorman Creek is an unregulated tributary, but both the PG&E Drum-Spaulding Project and the NID Yuba-Bear Hydroelectric Project affect flows in this reach. See Appendix H for estimated unimpaired flows at the head of this reach.

South Yuba Reach #6

South Yuba Reach #6 is a 19.5-mile-long reach of the South Yuba River from the confluence with Humbug Creek to the normal high-water level of Englebright Reservoir (USACE reservoir, non-Project). This reach conveys spills and outflow from Lake Spaulding, and any additional inflow from Rucker Creek, Fall Creek, Canyon Creek, Poorman Creek, Humbug Creek, and a number of smaller tributaries to the South Yuba River. Poorman Creek and Humbug Creek are unregulated tributaries, but both the PG&E Drum-Spaulding Project and the NID Yuba-Bear Hydroelectric Project affect flows in this reach. See Appendix H for estimated unimpaired flows at the head of this reach.

Flows on the South Yuba River in this reach are recorded at Jones Bar by USGS gage 114175000 (Yuba County Water Agency's NY-29 gage.) The period of record has a complete data set at this location. The 90% exceedance, 50% exceedance, and 10% exceedance monthly diversion flows as reported by this gage for the period 1976 to 2004 are summarized in Table 7.2.3-13.

Table 7.2.3-13. Monthly 10%, 20%, 50% Exceedance Flows in the South Yuba River at Jones Bar (USGS Gage 114175000.)

Month	90% Exceedance Flow (cfs) Regulated	50% Exceedance Flow (cfs) Regulated	10% Exceedance Flow (cfs) Regulated
October	30	46	84
November	39	67	327
December	55	120	806
January	66	260	1,450
February	104	387	1,741
March	175	546	1,644
April	139	435	1,171
May	77	368	1,814
June	46	116	1,801
July	34	61	145
August	26	44	68
September	28	43	65

Sources: NY-29 gage (USGS ID 11417500) South Yuba River at Jones Bar, 1976 to 2004.

Regulated Hydrology in the Bear River Sub-basin

Drum Afterbay Dam Reach

Drum Afterbay Dam Reach is a 4.7-mile-long reach of the Bear River from the PG&E Drum-Spaulding Project's Drum Afterbay Dam to NID's Dutch Flat Afterbay. The Drum-Spaulding Project FERC license has minimum streamflow requirements in this reach of 10 cfs from March 1 through September 30 of a normal water year, and 5 cfs for this same period during a dry year;

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the winter streamflow requirement from October 1 through the end of February is 5 cfs, regardless of water year type. This reach is affected by PG&E's Drum-Spaulding Project operation of the Drum Afterbay, and by diversion of water around this reach, which is routed through either the Drum-Spaulding Project Dutch Flat No. 1 Powerhouse or NID's Yuba-Bear Hydroelectric Project Dutch Flat No. 2 Powerhouse.

Flows in the Drum Afterbay Dam Reach are measured by the YB-44 gage (USGS gage 11421770.) For the period of record, from 1976 to 2004, the annual 90% exceedance flow was 5.2 cfs, the 50% exceedance flow was 6.5 cfs, and the 10% exceedance flow was 14.3 cfs. The period of record has a complete data set at this location.

The 90% exceedance, 50% exceedance, and 10% exceedance monthly diversion flows as reported by YB-44 Gage located on the Bear River (USGS 11421770) for the period 1976 to 2004 are summarized in Table 7.2.3-14.

Table 7.2.3-14. Monthly 10%, 20%, 50% Exceedance Flows at Bear River below Drum Afterbay (Gage YB-44.)

Month	90% Exceedance Flow (cfs) Regulated	50% Exceedance Flow (cfs) Regulated	10% Exceedance Flow (cfs) Regulated
October	5.1	5.9	10
November	5.1	5.8	7.6
December	5.1	5.8	6.9
January	5.1	5.9	6.9
February	5.2	6.1	90
March	5.5	10	158
April	5.4	10	249
May	5.4	10	206
June	5.4	10	13
July	5.3	10	13
August	5.3	10	13
September	5.3	10	13

Sources: YB-44 gage (USGS ID 11421770) Bear River below Drum Afterbay Dam, 1976 to 2004.

Bear River Canal Diversion Dam Reach

The Bear River Canal Diversion Dam Reach of the Bear River is 10.4 miles long, and spans from the PG&E Drum-Spaulding Project's Bear River Canal Diversion Dam, to the normal high-water elevation of NID's Combie Reservoir (non-Project). Minimum streamflows requirements in this reach range from 15 cfs to 75 cfs, depending on the season and year-type, and are required under Article 33 of the NID Yuba-Bear Hydroelectric Project FERC license. PG&E's Bear River Diversion Dam facility is immediately downstream of NID's Yuba-Bear Hydroelectric Project Rollins Reservoir. Operation of NID's Rollins Reservoir and PG&E's Bear River Canal Diversion Dam are coordinated, and PG&E diverts a portion of the flows released at Rollins Reservoir Dam by NID. This reach also receives spill from NID's Rollins Reservoir in most years; NID's Rollins Reservoir spilled in 21 out of 29 years within the period of record, for periods ranging from 3 to 6 months.

Bear River Canal Diversion Dam has historically bypassed an average of 391.0 cfs into the Bear River; flows in this reach (Bear River Canal Diversion Dam Reach) are measured by USGS gage

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11421900 (YB-196.) For the period of record, from 1976 to 2004, the annual 90% exceedance flow was 22.0 cfs, the 50% exceedance flow was 135.0 cfs, and the 10% exceedance flow was 938.8 cfs. The period of record has a complete data set at this location. Flows in the Bear River in the Bear River Canal Diversion Dam Reach are composed partly of water imported from other watersheds via the Drum Canal, and therefore under regulated conditions the annual volume of water that flows through this reach may be greater than it would be under unimpaired conditions.

The 90% exceedance, 50% exceedance, and 10% exceedance monthly diversion flows as reported by YB-196 Gage located on the Bear River for the period 1976 to 2004 are summarized in Table 7.2.3-15.

Table 7.2.3-15. Monthly 10%, 20%, 50% Exceedance Flows at Bear River below the Bear River Diversion Dam (Gage YB-196.)

Month	90% Exceedance Flow (cfs) Regulated	50% Exceedance Flow (cfs) Regulated	10% Exceedance Flow (cfs) Regulated
October	55	82	297
November	19	26	572
December	20	27	759
January	18	100	1260
February	18	405	1790
March	21	606	1650
April	23	589	1310
May	77	507	984
June	80	407	650
July	79	155	464
August	79	142	365
September	74	96	354

Sources: YB-196 gage Bear River below Bear River Diversion Dam, 1976 to 2004.

7.2.4 Water and Power Model

The Licensee, in conjunction with PG&E, prepared a Water and Power Model (Model) for the Yuba-Bear Hydroelectric Project and Drum-Spaulding Project relicensings. Because these two projects are physically and operationally intertwined, development of a single Model was deemed the most efficient way for both licensees and Relicensing Participants to evaluate physical and operational scenarios that may affect one or both projects.

The Licensee and PG&E used the United States Army Corps of Engineer's (USACE) Hydrologic Information Center's (HEC) Reservoir Simulation (ResSim) software (Version 2) as the platform for the Model. The current Model is provided on CD in Appendix G of the PAD. The Licensee and PG&E are in the process of upgrading the existing Model from ResSim Version 2 to ResSim Version 3 and will be made available to Relicensing Participants upon finalization. ResSim is a publicly available reservoir simulation tool which provides third-party objectivity in terms of the underlying modeling mechanics, but which is open-source in terms of project-specific logic, including reservoir guide curves and operating rules, powerhouse operation and water delivery diversion rules. The modeling effort consisted of three phases:

1. development of unimpaired hydrology
2. construction of Model topology and operational logic

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3. Model calibration and validation

Unimpaired hydrology is the basic input to the Model, as dictates how much water is available as runoff into each reservoir and inflow node on a daily basis which subsequently drives operating decisions along with regulated hydrology and power generation accuracy. A discussion of the unimpaired hydrology development and a database of daily unimpaired hydrology at each Model inflow node are included in Appendix H.

Construction of the Model began with GIS data, used as the underlying map of the region which ultimately provides the interface to all components of the Drum-Spaulding Project and Yuba-Bear Hydroelectric Project. The project's physical layout and infrastructure were added to this interface, which would include: (1) linking the unimpaired hydrology and any observed data to the Model topology; (2) all of the reservoirs and dams and their attributes, such as the dam crest elevation and length, low level outlet elevation and capacities, spillway elevations and capacities, reservoir area-capacity curves; (3) the powerhouses and their attributes such as installed capacity and the turbine efficiency curves; (4) the diversions and their attributes such as inflow and outflow reaches; and finally (5) the interconnecting reaches, such as river segments, canals, flumes, and tunnels. The final part of the Model's development actually occurred in concert with Model calibration. Each of the man-made structures was given operating rules, such as: (1) pool segmentation, guide curves, and operating rule sets for the reservoirs, which serve to govern releases via low level outlets and/or the spillways as appropriate; (2) powerhouse operating rules, which (in general) are also governed by the reservoir guide curves; (3) diversion operating rules by season, flow rate, or other Model parameter; and (4) look-back data required for the simulation's initial conditions.

Finally, the Model was validated by comparing model outcomes with known data for three representative water years (dry, normal and wet). Each of these phases is discussed in greater detail in the draft Model Validation Report, provided in Appendix G with the Model executable file (the Model Validation Report included in Appendix G is based on the Version 2 Model and will be updated with the release of the Version 3 Model).

7.2.5 Existing Instream Flow Uses

Project waters are used for power production as well as recreation, aquatic habitat, wildlife habitat, irrigation, domestic, municipal and industrial water supply.

<u>Hydroelectric Uses</u>

The four Project powerhouses use the storage capacities of upstream reservoirs and the diversion capacities of their water conveyance system, and are operated generally as a mix of base-loaded (Bowman, Rollins) and intermediate-loaded (Dutch Flat No. 2, Chicago Park) hydroelectric systems, with daily schedules based primarily on water supply demands in the lower Project Vicinity.

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Recreation Uses

The recreational use of Project waters occurs at Project reservoirs of various sizes. Primary uses of these waters are for boating, fishing and camping. Refer to Section 7.8 for a more detailed discussion of Project recreation.

Aquatic and Wildlife Habitats

A wide variety of aquatic and terrestrial species inhabits the Project Area. Refer to Sections 7.3 and 7.4 for a more detailed discussion of aquatic and wildlife habitats, and associated species.

Irrigation, Municipal, Steam Electric, and Industrial Uses

Project waters are used by Licensee for irrigation, domestic, municipal and industrial uses in Nevada, Placer and Yuba counties. Project waters are not used for steam electric purposes.

Existing Instream Flow Uses

There are minimum streamflow requirements in the Middle Yuba River below Jackson Meadows Reservoir and Milton Diversion Dam, in Jackson Creek below Jackson Lake, in Canyon Creek below French Lake to Bowman Lake, and below the Bowman-Spaulding Diversion Dam, and in the Bear River below the Dutch Flat Afterbay and below Rollins Reservoir. These minimum streamflow requirements are for protecting the aquatic resources of the Project-affected streams.

7.2.6 Existing Water Rights

7.2.6.1 Licensee's Water Rights for Power Generation

Licensee's water rights related to the Yuba-Bear Hydroelectric Project for power generation are listed in Table 7.2.6-1 and Table 7.2.6-2.

Table 7.2.6-1. Summary of Pre-1914 non-consumptive water rights held by the Nevada Irrigation District for the purpose of power generation at the Yuba-Bear Hydroelectric Project (FERC Project No. 2266).

Priority Date	*Application*	*License*	*Source*	*Place of Storage or Diversion*
1873	S4716	Pre-1914 Right	Canyon Creek	Sawmill Lake
1859	S4717	Pre-1914 Right	Canyon Creek	French Lake
1854	S13330	Pre-1914 Right	Middle Yuba River	Milton
1872	S13800	Pre-1914 Right	Canyon Creek	Bowman
1872	S13801	Pre-1914 Right	Canyon Creek	Faucherie Lake
1874	S13927	Pre-1914 Right	South Yuba River	South Yuba Canal
1874	S13928	Pre-1914 Right	South Yuba River	Drum Canal
1853	S14354	Pre-1914 Right	Bear River	Rollins
1853	S14355	Pre-1914 Right	Bear River	Bear River Canal
1872	S14356	Pre-1914 Right	Canyon Creek	Bowman

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Table 7.2.6-2. Summary of non-consumptive water rights held by the Nevada Irrigation District for the purpose of power generation at the Yuba-Bear Hydroelectric Project (FERC Project No. 2266), with Priority Dates after 1914.

Priority Date	*SWRCB Designation*			*Source*	*Amount*		*Place of Storage or Diversion*	*Season of*		*Beneficial Use – Powerhouse (PG&E in Parentheses)*
	Application	*Permit*	*License*		*cfs*	*ac-ft*		*Diversion*	*Storage*	
3/25/21	2275	2084	12796 (Issued 7/10/91)	Middle Yuba River		60,000	Jackson Meadows Bowman		1/1-12/31	(Spaulding No. 3)
6/3/21	2372	2087	12798 (Issued 7/10/91)	Jackson Creek Canyon Creek Canyon Creek Canyon Creek Canyon Creek Texas Creek Fall Creek Trap Creek	 152 30 15 5	970 2,993 3,030 47,530	Jackson Lake Faucherie Lake Sawmill Lake Bowman Bowman-Spaulding Conduit Bowman-Spaulding Conduit Bowman-Spaulding Conduit Bowman-Spaulding Conduit	 1/1-12/31 1/1-12/31 1/1-12/31 1/1-12/31	12/1-7/15 12/1-7/15 12/1-7/15 12/1-7/15	(Spaulding No. 3)
11/7/34	4309	2935	4544 (2/11/57)	Middle Yuba River Canyon Creek & Others Not Listed	135		Drum Canal	1/1-12/31		(Spaulding No. 1, Drum, Dutch Flat)
11/7/24	4310	2936	1707 (12/15/36)	Middle Yuba River Canyon Creek & Others Not Listed	126		South Yuba Canal	1/1-12/31		(Spaulding No. 2, Deer Creek)
6/16/30	6701	5806	12799 (7/10/91)	Clear Creek Fall Creek Trap Creek	5 10 5		Bowman-Spaulding Conduit Bowman-Spaulding Conduit Bowman-Spaulding Conduit	10/1-9/30 12/1-7/31 1/1-7/31		Dutch Flat No. 2, Chicago Park (Spaulding No. 1, Spaulding No. 2, Spaulding No. 3, Deer Creek, Drum, Dutch Flat No. 1)
11/27/34	8178	5813	12802 (7/10/91)	Texas Creek Clear Creek Fall Creek Trap Creek Rucker Creek	68 13.6 75.7 8.6 25		Bowman-Spaulding Conduit Bowman-Spaulding Conduit Bowman-Spaulding Conduit Bowman-Spaulding Conduit Bowman-Spaulding Conduit	1/1-6/30 1/1-7/31 12/1-7/31 4/15-6/30 1/1-12/31		Dutch Flat No. 2, Chicago Park (Spaulding No. 1, Spaulding No. 2, Spaulding No. 3, Deer Creek, Drum, Dutch Flat No. 1, Halsey, Wise)
11/27/34	8179	5814	12803 (7/10/91)	Wilson Creek	3.5	680	Milton-Bowman Conduit Bowman	1/1-12/31	11/1-6/30	Dutch Flat No. 2, Chicago Park (Spaulding No. 1, Spaulding No. 2, Spaulding No. 3, Deer Creek, Drum, Dutch Flat No. 1, Halsey, Wise)
9/3/53	15525	13771	10016 (3/5/73)	South Yuba River	200		Spaulding Lake	9/1-6/30		Dutch Flat No. 2, Chicago Park (Spaulding No. 1, Halsey, Wise)
4/6/61	20072	13773	In Progress	Middle Yuba River		50,000	Jackson Meadows Bowman		10/1-6/30	Dutch Flat No. 2, Chicago Park (Spaulding No. 1, Spaulding No. 2, Spaulding No. 3, Deer Creek, Drum, Halsey, Wise)
2/5/63	21151	14799	9903 (4/19/72)	Bear River	1,056		Chicago Park Flume	1/1-12/31		Chicago Park
2/5/63	21152	14800	9902	Bear River	550		Dutch Flat Flume	1/1-12/31		Dutch Flat No. 2
			(4/19/72)							
1/9/76	24983	16953	In Progress	Bear River	700	62,080	Rollins Reservoir	1/1-12/31	11/30-6/1	Rollins
10/22/82	27559	19158	In Progress	Canyon Creek	322	65,000	Bowman	1/1-12/31	1/1-7/31	Bowman

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7.2.6.2 Pending Applications for Non-Consumptive Water Rights

Licensee has three power generation water right applications that are in the progress of being licensed; please refer to Table 7.2.6-1.

7.2.7 Morphometric Data for Existing Reservoirs

Table 7.2.7-1 summarizes relevant data related to existing Project reservoirs including elevation, gross storage, usable storage, surface area, volume, estimated maximum depths, and shoreline length.

Reservoir bathymetry data are currently available for Dutch Flat Afterbay, Jackson Meadows, and Rollins Reservoir.

Table 7.2.7-1. Relevant information regarding Project reservoirs

Project Reservoir	NMWSE[1]	Gross Storage[2]	Usable Storage[2]	Surface Area[2]	Max. Depth[2]	Shoreline Length[2]
	(feet)	(acre-feet)	(acre-feet)	(acres)	(feet)	(miles)
Jackson Meadows Reservoir	6,036.0	69,205	66,000	1,054	147	9.9
Milton Diversion Dam Impoundment	5,690.0	295	275	103	unknown	1.3
Jackson Lake	6,594.0	1,330	940	58	54	1.1
French Lake	6,660.0	13,940	13,691	356	60	5.3
Faucherie Lake	6,123.0	3,980	3,750	155	42	2.4
Sawmill Lake	5,860.0	3,030	3,030.	79.4	55	2.6
Bowman Lake	5,562.0	68,510	65,000	828	163	7.6
Dutch Flat Forebay	3,330.0	179	75	8	61	0.5
Dutch Flat Afterbay	2,741.0	2,037	397	140	unknown	1.9
Chicago Park Forebay	2,716.0	117	78	7	unknown	0.7
Rollins Reservoir	2,171.0	65,988	60,988	828	206	19.0

[1] Normal Maximum Water Surface Elevation
[2] At Normal Maximum Water Surface Elevation

7.2.8 Gradient of Downstream Reaches

There are 65 stream reaches affected by the Drum-Spaulding Project and Yuba-Bear Hydroelectric Project that were evaluated in 2007 for overall morphometric and habitat characteristics. Reaches were separated into sub-reaches if there were major differences in gradient and geologic parent material. Licensee also included data from a study completed in 2003 (SWS 2006) that used an aerial video to characterize the mainstems of Middle and South Yuba rivers. A summary of the geomorphic and habitat characteristics, including the gradient of each Project-affected reach, are included in the Preliminary River Reaches Matrix, a large summary table included as Attachment 7.3A to Section 7.3 of this PAD. Complete data regarding geomorphic and habitat characteristics are are available in the habitat mapping report included as Attachment 7.3B to Section 7.3 of this PAD.

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7.2.9 Applicable Water Quality Standards

Refer to Section 4.1.10, and in particular Table 4.1.10-1, for a description of federally-approved water quality standards that apply to Project waters.

7.2.10 Existing Water Quality Information

The NID (Licensee) reviewed historical water quality data to support the relicensing of the Yuba-Bear Hydroelectric Project. The Yuba-Bear Hydroelectric Project includes nine reservoirs and sixteen river reaches that could be affected by operations of the Project facilities. Relevant water quality data were located for six of the Project reservoirs (Jackson Meadows, Milton, Jackson Lake, Bowman Lake, French Lake, and Rollins) and several of the reaches both directly/indirectly and cumulatively affected by the Project. The investigation of existing water quality data were conducted in conformance to guidelines established by FERC as a part of its ILP.

Water quality data used to inform this discussion are provided as Attachments 7.2B though 7.2F. Alkalinity, hardness, and turbidity values remain low as water flows downstream through the watershed, suggesting that water quality is essentially maintained. However, stream reaches in the lower watersheds tend to be of low to medium gradients and hence, more sediment transport and deposition is observed there. Water treatment plant raw water data (2001-2005) suggests that water between Lake Spaulding and Rollins Reservoir stays below 10 NTUs[1] year-round, while Rollins Reservoir's turbidity increases after rain events, affecting downstream turbidities throughout winter and spring (Starr and Palencia, 2007).

Temperature profile data were collected by the Upper Yuba River Studies Program (UYRSP) and California Department of Fish and Game (CDFG) at various times between 1970 and 2004. Jackson Meadows, French Lake, and Rollins Reservoirs thermally stratify during the summer, while Milton and Bowman reservoirs have slightly decreasing temperatures at depth but do not stratify or weakly stratify. In general, these Project reservoirs have cool water with warm season surface temperatures of approximately 20 °C and bottom temperatures of about 6 °C in the stratified reservoirs. Thermal descriptions were not found for the other Project reservoirs. Stream reach temperature data are available for four of the fourteen stream reaches; temperatures in these reaches were found to be consistently below 20 °C.

In addition, a water temperature model was completed in 2006 in the Middle and South Yuba rivers as part of the UYRSP. The model, developed with Hydrologic Simulation Program – FORTRAN (HSPF) (a module of USEPA's BASINS software) was intended to be a preliminary screening tool to evaluate the effect of incremental flow increases on water temperature at various locations in the Middle and South Yuba rivers during summer baseflow conditions. The HSPF platform was selected in order to take advantage of previous work performed by USGS, which used HSPF for the purposes of sediment transport and flow routing in the Middle and South Yuba rivers. A copy of the water temperature modeling report and supporting data is included in Appendix H of this PAD.

[1] Nephelometric turbidity units (NTU).

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Bacteria sampling on the Middle and South Yuba River have been collected primarily by the South Yuba River Citizens League (SYRCL) while bacteria sampling on the Bear River has primarily been conducted in support of drinking water treatment plant operations. Data collected to date show little to no bacteria in most of the watershed, most of the year, for all Project facilities but Rollins Reservoir. Although still lower than the regulatory action level, Auburn Water Treatment Plant raw water data indicate that there is a predominantly summer-time upstream source of bacteria to this facility; Rollins Reservoir is upstream of Auburn Water Treatment Plant.

Details of historical chemical data used to inform this description are provided in the following sections.

7.2.10.1 Existing Water Quality Data

As part of its acquisition of existing, relevant and reasonably available information for inclusion in this document, Licensee found a considerable amount of water quality information, the most relevant of which was collected from the 1950's to the present. The Licensee consulted with and reviewed the following sources of information to prepare the description of water quality contained in this report

- USEPA Storage and Retrieval (STORET) Reports
- Licensee's past Submittals to FERC
- SWRCB Reports
- USGS National Water Information System (NWIS) Reports
- CDFG Fisheries Studies
- California Department of Water Resources (CDWR) and UYRSP Technical Reports
- Water Quality Data from Non-government Organizations, such as the South Yuba River Citizen's League (SYRCL), and Friends of Deer River (FODC).
- Nevada Irrigation District (NID) and Placer County Water Agency (PCWA) Water Treatment Plant Sanitation Surveys
- Sacramento River Watershed Program (SRWP) regional monitoring data
- California's Office of Environmental Health Hazard Assessment (OEHHA) fish ingestion advisories

Information from the above sources is summarized briefly below and is then presented in detail for each Project reservoir (Section 7.2.10.2) and affected stream reach (7.2.10.3). Water treatment plant intake data, which are more general to the watershed, are summarized in Section 7.2.10.4. Raw data and selected references are provided as attachments.

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7.2.10.2 Water Quality of the Project Reservoirs

Connected through a number of canals, flumes, and natural waterways, Yuba-Bear Hydroelectric Project Reservoirs are located within the Middle Yuba River Sub-basin, the Canyon Creek Sub-basin, and the Bear River Sub-basin.

NID Reservoirs in the Middle Yuba River Sub-Basin
There are two Yuba-Bear reservoirs in the Middle Yuba River Sub-basin.

Table 7.2.10-1 Historical Water Quality Data for Yuba-Bear Reservoirs in the Middle Yuba River Sub-basin

Reservoir [A]	Date	Temp. [B] (°C)		PH	Turbidity		Conduct-ivity (µmhos/cm)	Dissolved Oxygen (MG/L)	Notes
					NTU	Secchi Depth (FT)			
Jackson Meadows Reservoir	Aug 2007; Oct 2007	Top	Aug. 21.5 Oct. 10.5					7.29 – 7.52	
	July –Oct 2004	bottom	<6.0						
	1975-1976								TDS 38 mg/L Alkalinity 15-20 mg/L $CaCO_3$
Milton Reservoir	1987			6.0-7.5		14-18			Alkalinity 2.0 mg/L $CaCO_3$

[a] Only reservoirs with historical data are listed herein. A blank square means no data were found for that parameter.
[b] Samples were assumed to be surface samples unless report indicated otherwise (see narratives, below).

Jackson Meadows Reservoir

The UYRSP (2006) produced a technical report addressing fish habitat conditions in the upper Yuba watershed UYRSP (2006) is provided as Attachment 7B to this document. As a part of this report, a comprehensive temperature-monitoring program included temperature profiles of the Jackson Meadows Reservoir from July to October of 2004. Graphical displays of these profile data can be found in Figure 6, page 16 within Attachment 7B. The UYRSP profile data from Jackson Meadows Reservoir indicates summer stratification with temperatures of less than 6 °C near the bottom or the reservoir. Although no data were provided, the UYRSP findings confirm a CDFG observation that "…during September of 1968… [Jackson Meadows Reservoir] was thermally stratified and dissolved oxygen deficiencies were noted in deeper water" (CDFG, 1975).

In 2007, Licensee conducted reservoir profiles at three locations within Jackson Meadows Reservoir: near the dam, at mid reservoir and upstream near the Middle Yuba River inflow. (DTA, *unpublished data*). Profiles were collected at two dates, August 1 and October 26, 2007. For the August sampling effort, there was a thermocline present 30 feet below the water surface at all three locations. August surface temperatures approached 21ºC while temperatures below the thermocline were 6ºC at Site-1 and Site-2. During the October sampling, the thermocline at Site-1 persisted at a depth of 70 below the water surface, while reservoir temperatures remained relatively stable throughout the water column (~10ºC) at Site-2 and Site 3. (Figure 7.2.10-1 – Figure 7.2.10-3).

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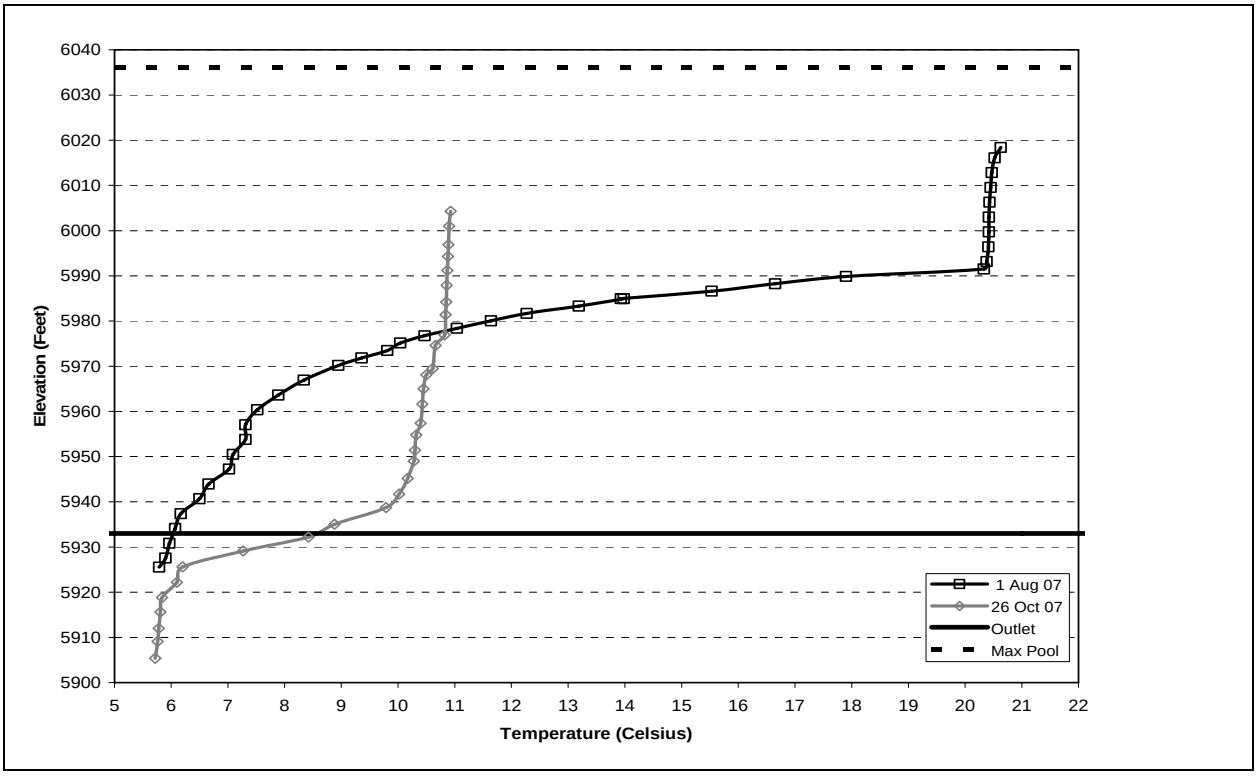

Figure 7.2.10-1. Jackson Meadows Reservoir water temperature profile, Site 1 – near dam (DTA, *unpublished data*)

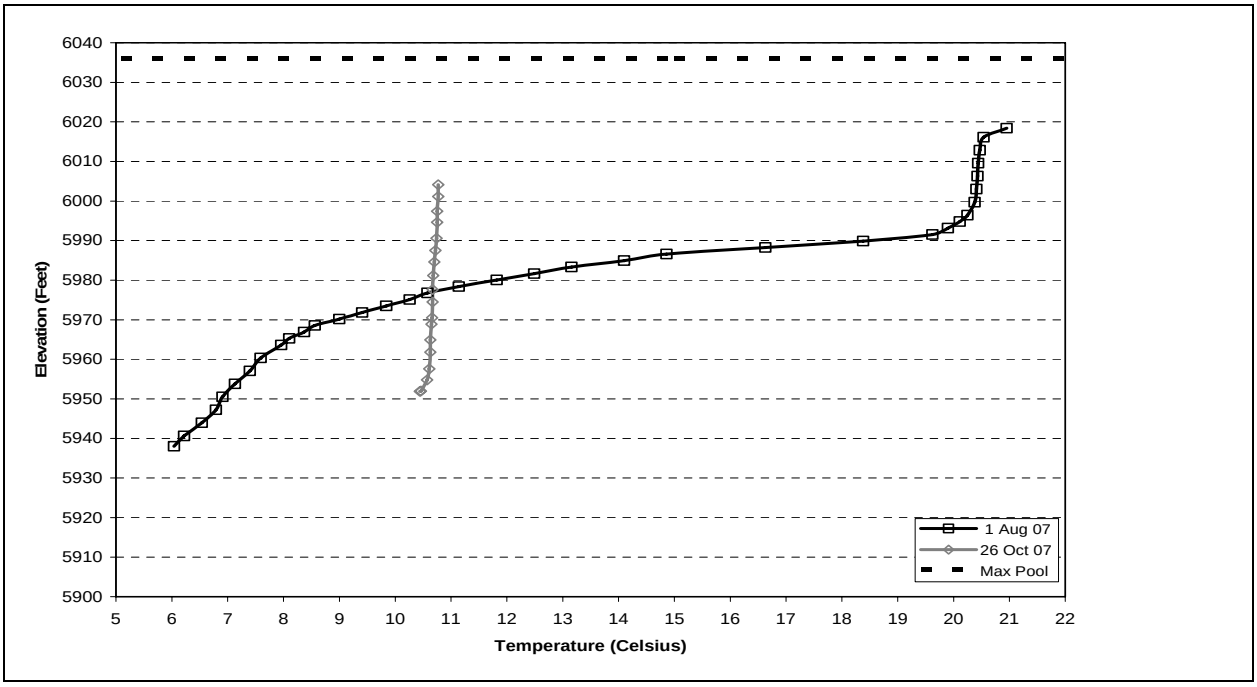

Figure 7.2.10-2. Jackson Meadows Reservoir water temperature profile, Site 2 – mid reservoir (DTA, *unpublished data)*

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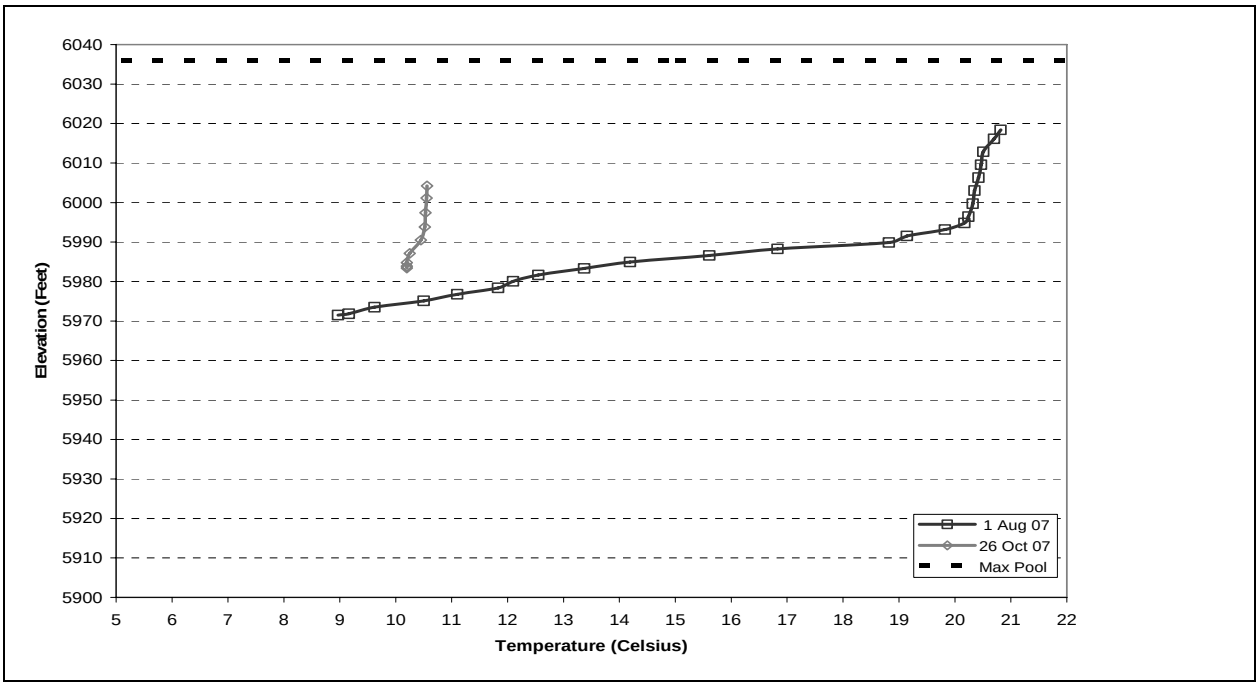

Figure 7.2.10-3. Jackson Meadows Reservoir water temperature profile, Site 3 – near Middle Yuba inflow (DTA, unpublished data)

There is limited water quality data available from the CDFG (1975, 1976); however, these memos cite Nicola and Cordone (1973) who characterize the reservoir as being oligotrophic with very low primary productivity. CDFG (1975, 1976) also includes some quantitative data for the reservoir with total dissolved solids (TDS) and alkalinity values of 38 mg/L and 15-20 mg/L $CaCO_3$, respectively.

The Licensee also collected dissolved oxygen (DO) information from three sites at Jackson Meadows Reservoir in 2007. These data are summarized in the table below.

Table 7.2.10-2 Dissolved oxygen data collected at Jackson Meadows Reservoir in 2007.

	Site 1		Site 2		Site 3	
Date	Depth (m)	DO (mg/L)	Depth (m)	DO (mg/L)	Depth (m)	DO (mg/L)
8/1/07	0.3	7.52	0.3	7.47	0.3	7.47
	14	10.08	12	10.41	7.5	7.43
	28	6.68	24	6.4	14.5	7.43
10/26/07	0	7.47	0.1	7.35	0	7.29
	14.3	6.88	8.1	7.11	3.2	7.22
	29	0.35	15.9	6.5	6.2	4.51

Milton Reservoir

The Licensee was able to locate limnological data from CDFG that were collected during gill net surveys in the fall of 1980, 1983, 1985, 1987, and 1992 (CDFG, 1980; 1985; 1986a; 1986b; 1987; and 1992). CDFG data from 1987 indicates that water temperatures in Milton Reservoir decreases with depth, but the reservoir does not thermally stratify. Temperature differences

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reported between the surface and at depth varied from only 3 to 6 degrees, while DO concentrations decreased by 3.0 mg/L at a depth of 18 feet. Water clarity, as measured by Secchi disc ranged from 14-18 feet while pH values were 6.0 to 7.5. A surface measurement of alkalinity was taken only during the 1987 gill net survey and registered 2.0 mg/L $CaCO_3$.

NID Reservoirs in the Canyon Creek Sub-Basin

There are five Yuba-Bear reservoirs in the Canyon Creek Sub-basin.

Table 7.2.10-3 Historical Water Quality Data for Yuba-Bear Reservoirs in the Canyon Creek Sub-basin.

Reservoir [A]	Date	Temp. [B] (°C)		PH	Turbidity		Conduct-ivity (µmhos/cm)	Dissolved Oxygen (MG/L)	Notes
					NTU	Secchi Depth (FT)			
Jackson Lake	October 1985			6.5			15		Alkalinity 4.0 mg/L $CaCO_3$ Hardness 4.0 mg/L $CaCO_3$
French Lake	July 1970	surface	19						
		bottom	5						
	October 1985			6.73	0.3	20.5	7.6		
Bowman Lake	August 2007; October 2007	Top	Aug. 20.3 Oct. 11.2					7.46 – 7.86	
	July-October 2004	surface	13-19						
		bottom	6-15						
	August 1968							9.5-10.0	Transparency 50 ft Alkalinity 9.5 mg/L $CaCO_3$ TDS 32 mg/L
	October 1985			7.39	0.2	30	7.6		Alkalinity 0.3 mg/L $CaCO_3$

[a] Only reservoirs with historical data are listed herein. A blank square means no data were found for that parameter.
[b] Samples were assumed to be surface samples unless report indicated otherwise (see narratives, below).

Jackson Lake

The Licensee was able to locate limnological data on Jackson Lake from the USEPA STORET data archive (USEPA, 2006; provided as Attachment 7C to this document). The data is from one sampling event in October of 1985. The SWRCB tested for a variety of water quality parameters, but their sampling was limited to surface values only. Basic water quality parameters, conductivity (15 µmhos/cm), alkalinity (4.0 mg/L $CaCO_3$), and hardness (4.0 mg/L $CaCO_3$), were low and pH was slightly acidic at 6.5. With the exception of calcium (1.6 mg/L), sulfate (1.0 mg/L), and silica (5.2 mg/L), major inorganic ions (sodium, potassium. chloride, fluoride, and magnesium) and the trace element boron were in low concentrations. A low nitrate level (0.2 mg/L) was also detected and is considered indicative of an oligotrophic waterbody.

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French Lake

There are two sources of available data for French Lake. CDFG has temperature profile data from July 1970 (CDFG, 1970) and the USEPA STORET program has data from a sampling effort in October of 1985 (USEPA, 2006; provided as Attachment 7C to this document). The CDFG data indicates that French Lake is thermally stratified with a thermocline depth of 24 feet. Water temperatures were 19 °C at the lake surface and measured 5 °C near the bottom of the lake, a depth of 63 feet.

The USEPA STORET data provides a more detailed assessment of various water quality parameters, but their sampling appears to be limited to surface values only. Conductivity (7.6 μmhos/cm) is very low and pH is slightly acidic (6.73). The USEPA also sampled trace elements (iron, aluminum, manganese, and fluoride), inorganic nutrients (nitrate and phosphorus) as well as the major inorganic ions (sulfate, carbon, calcium, sodium, potassium, chloride, and silica,). With the exception of Silica (2.9 mg/L) and Total Phosphorus (1.1 mg/L), all concentrations of these water quality parameters were very low and indicate an oligotrophic waterbody. The USEPA lake sampling also indicates a relatively clear body of water with low turbidity values (0.3 NTU) and a Secchi Depth of 20.5 feet.

Faucherie Lake

After a review of the data resources listed above, the Licensee is unaware of existing water quality data for Faucherie Lake.

Sawmill Lake

After a review of the data resources listed above, the Licensee is unaware of existing water quality data for Sawmill Lake.

Bowman Lake

There are four sources of available data for Bowman Lake:

- Reservoir profiles were conducted by UYRSP from July to October of 2004 (UYRSP, 2006). Graphical displays of UYRSP (2006) Bowman Lake profile data indicate weak thermal stratification with surface temperatures ranging from 13°C to 19°C and bottom temperatures from 6 °C to 15 °C for the 2004 sampling season (See Appendix F, Figure 7 of their report in Attachment 7B).
- CDFG has limited data collected during August 1968 (CDFG, 1974). The CDFG data summarizes Bowman Lake as having high transparency (50 feet) and DO (9.5-10.0 mg/L) while alkalinity (9.5 mg/L) and TDS (32 mg/L) are low. CDFG did not summarize their profile data from August 1968, but they describe the lake as being stratified with thermocline at a depth of 23 feet and DO levels that remain constant above and below the thermocline (CDFG, 1974).

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- Data collected by Nicola and Cordone (1973) from July to September 1968 are similar to the UYRSPST and CDFG data. They characterize the reservoir as having a moderate degree of thermal stratification, being oligotrophic, and having very low primary productivity. Nicola and Cordone (1973) detected low concentrations of inorganic nutrients (nitrate and phosphorus) as well as the major ions (sulfate, calcium, magnesium, sodium, potassium, chloride, and TDS). Phytoplankton productivity was calculated to be low at 136 milligrams carbon per meter-squared (mg C/m^2) and 3.1 mg C/m^3.

- The USEPA STORET program has data for a sampling effort conducted in October 1985 and is provided in Attachment 7C. (USEPA, 2006). Conductivity (7.6 µmhos/cm) and alkalinity levels (0.3 mg/L $CaCO_3$) are low and Ph is slightly basic (7.39). USEPA data also include various water quality parameters, but their sampling appears to be limited to surface samples only (USEPA, 2006). USEPA analyzed for trace elements (iron, aluminum, manganese, and fluoride), inorganic nutrients (nitrate and phosphorus) as well as the major ions (sulfate, carbon, calcium, sodium, potassium, chloride, and silica). Except for sulfate, total phosphorus (3.8 mg/L), sodium (1.2 mg/L), and silica (9.3 mg/L), all levels were very low and indicative of an oligotrophic waterbody. The water clarity of Bowman Lake is excellent with a Secchi Depth of 30 feet and a turbidity value of 0.2 NTU.

In 2007, the Licensee collected water temperature profiles at three locations in Bowman Lake – near the dam, at mid reservoir, and at the upstream end (DTA, *unpublished data*). Data were collected on two dates, August 2 and October 23, 2007. Site 1, near the dam, had a defined thermocline present 30 feet below the surface in August but none in October (Figure 7.2.10-4). Site 2, at mid reservoir, had a slight thermocline present in August but none in October (Figure 7.2.10-5). Site 3, at the upstream end of the reservoir, had a slight thermocline present during both the August and October sampling (Figure 7.2.10-6).

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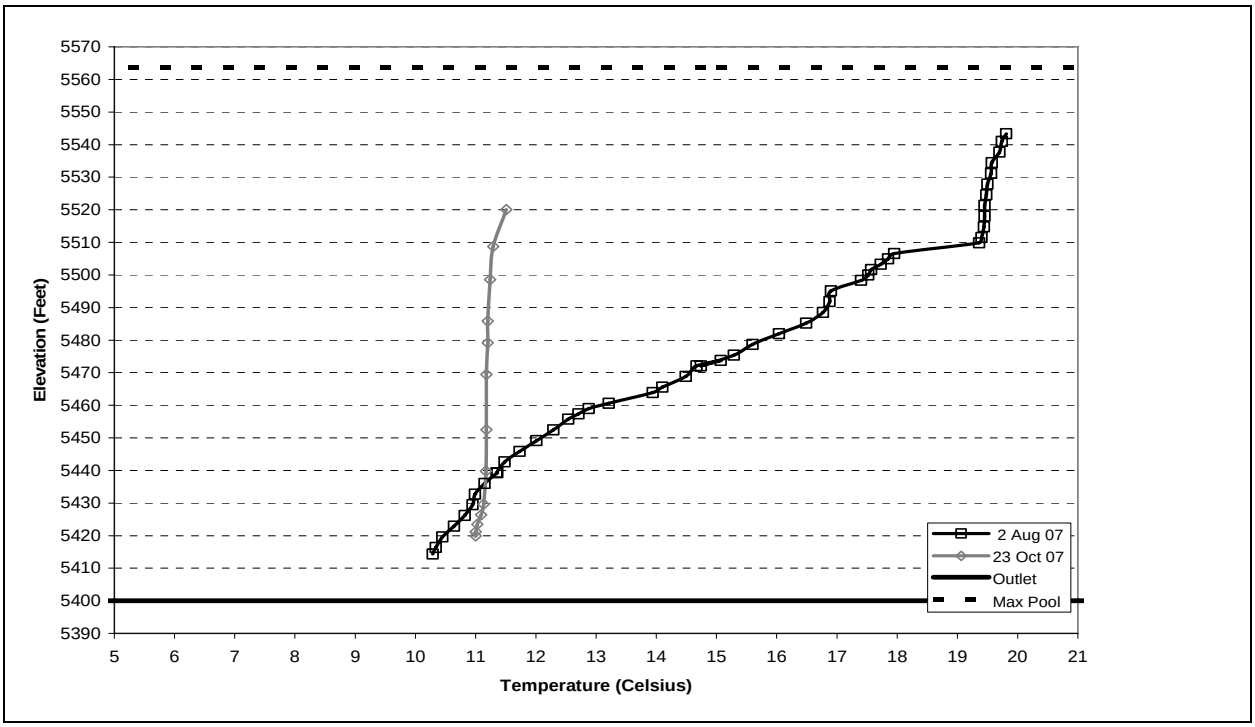

Figure 7.2.10-4. Bowman Lake water temperature profile, Site 1 – near dam (DTA, *unpublished data*)

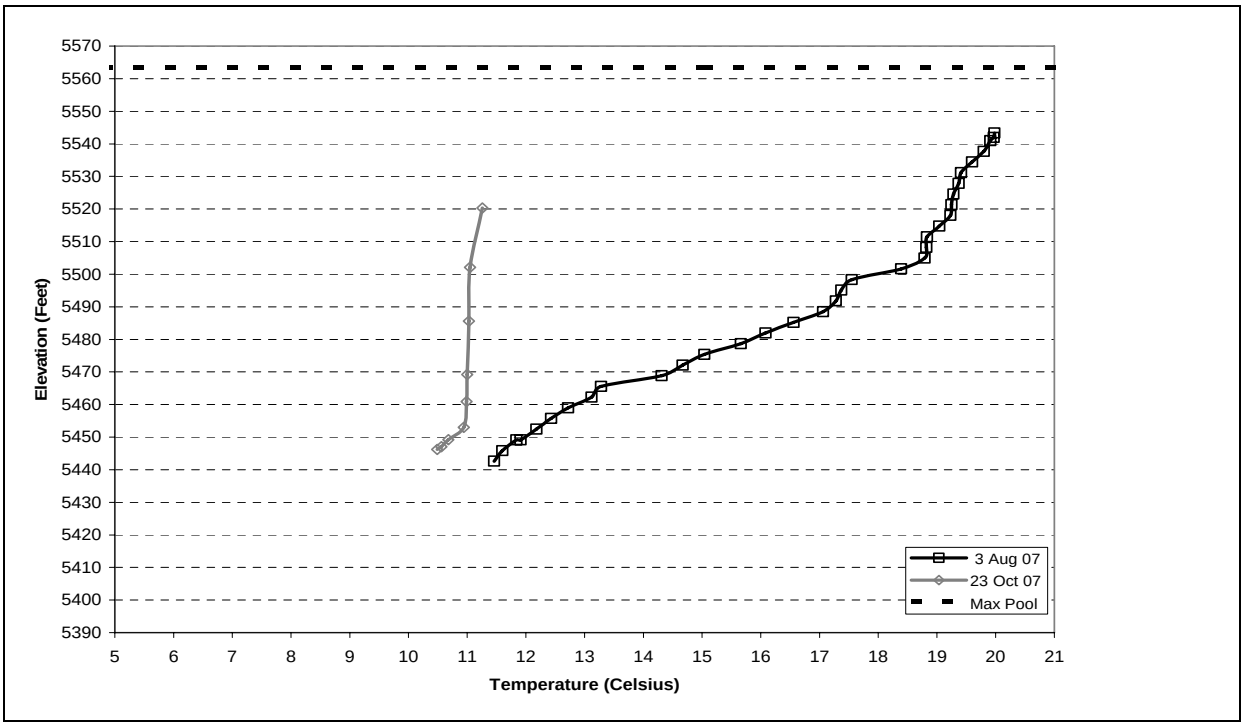

Figure 7.2.10-5. Bowman Lake water temperature profile, Site 2 – mid reservoir (DTA, *unpublished data*)

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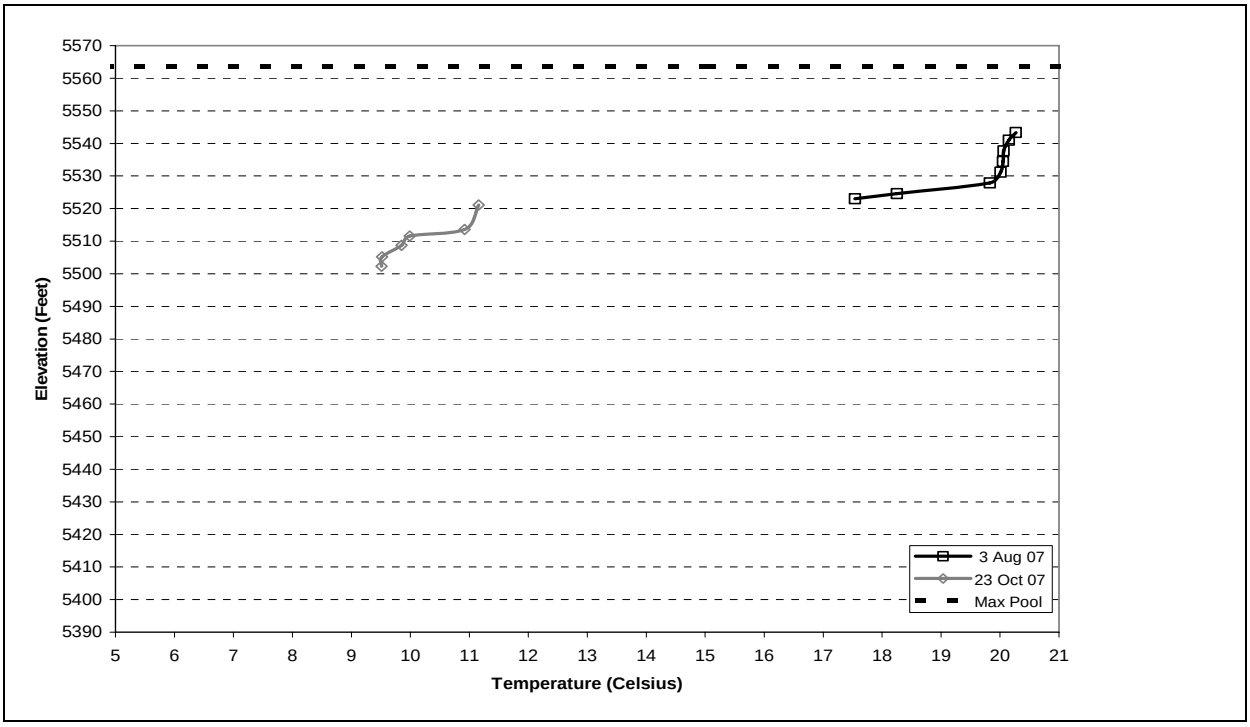

Figure 7.2.10-6. Bowman Lake water temperature profile, Site 3 – upstream end of reservoir (DTA, *unpublished data*)

The Licensee also collected DO information from three sites at Bowman Lake in 2007 (DTA, *unpublished data*). These data are summarized in the table below.

Table 7.2.10-4 Dissolved oxygen data collected at Bowman Lake in 2007.

Date	Site 1		Site 2		Site 3	
	Depth (m)	DO (mg/L)	Depth (m)	DO (mg/L)	Depth (m)	DO (mg/L)
8/3/07	0.3	7.86	0.3	7.85	0.3	7.73
	19	8.11	15	8.04	3	7.8
	39	6.9	30	7.59	6	8.07
10/23/07	3	7.87	5	7.46	1.5	7.6
	14.9	7.5	10	7.37	2.1	8.15
	30	7.3	22	7.41	4	8.07

Little Bowman Basin. CDFG also conducted a temperature and DO profile of Little Bowman Basin in September of 1981 (CDFG, 1981). Little Bowman Basin is a natural impoundment that retains the residual water of Bowman Lake during the fall drawdown period and provides some insight into water quality of Bowman Lake during the low water period. CDFG found that Little Bowman Basin has a depth of 22 feet and does have a thermocline at about 5 feet of depth. Surface temperatures are about 5 degrees warmer than at depth (19 °C and 14 °C) and DO readings were 10 mg/L near the surface and decreased to 2 mg/L near the bottom of the basin. Water from Little Bowman Basin seeps from its outlet at about 1-2 cfs before joining with the lotic waters of Canyon Creek that flow through the Bowman Lake Basin during the fall drawdown period.

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NID Reservoirs in the Bear River Sub-Basin

There are two Yuba-Bear reservoirs in the Bear River Sub-basin.

Table 7.2.10-5 Historical Water Quality Data for Yuba-Bear Reservoirs in the Bear River Sub-Basin

Reservoir [A]	Date	Temp. [B] (°C)		PH	Turbidity		Conductvity (mmhos/cm)	Dissolved Oxygen (MG/L)	Notes
					NTU	Secchi Depth (FT)			
Rollins Reservoir	April 1966	surface	16			2			
		bottom	7						
	November 1975	surface	10.7	7.2			30	9.1	Total Hardness 9.0 mg/L $CaCO_3$
	July 2007 October 2007	Surface	July 24.5 Oct. 16.1					8.21-10.63	

[a] Only reservoirs with historical data are listed herein. A blank square means no data were found for that parameter.
[b] Samples were assumed to be surface samples unless report indicated otherwise (see narratives, below).

Dutch Flat Afterbay

Upon review of the data resources listed above, the Licensee is only aware of mercury fish tissue data for Dutch Flat Afterbay. With respect to mercury, five rainbow trout (*Salmo gairdneri*) were collected from a quarter-mile of Dutch Flat Afterbay in August of 1998 (Hunerlach et. al., 1999). Total mercury concentrations in fillets ranged 0.03 to 0.05 ppm[2] body weight on a wet-weight[3] basis. These values are much less than the California Office of Environmental Health Hazard Assessment (OEHHA) screening value of 0.30 ppm wet-weight total mercury as a potential human health concern (OHHEA, 1999). The United States Food and Drug Administration (FDA) action level for regulating mercury in commercial fish is 1 ppm wet-weight in fish tissue (FDA, 2001).

For the sake of comparison, in a later study, trout collected in the two local reference sites (stream reaches relatively unaffected by gold mining activities) had mercury concentrations equal to or less than 0.10 ppm wet-weight. (May et. al., 2000) Reference sites were on the South Yuba near Emigrant Gap and Bear River at Highway 20[4].

Rollins Reservoir

A CDFG memorandum (1966) that addresses a creel survey also includes some water quality data. A thermocline was detected in Rollins Reservoir as temperature measurements in April 1966 indicate a surface and bottom temperature of 16 °C and 7 °C, respectively. Descriptive data of the reservoir states that transparency was poor (about 2 feet) with high turbidity levels

[2] Data provided in Hunerlach et. al. 1999 are actually given in µg/g, not "ppm." The units were changed herein to simplify comparisons between sites and with the OHHEA screening value of 0.30 ppm.
[3] Wet-weight concentrations of mercury *in fillets* best reflect concentrations potentially ingested by humans.
[4] These reaches have been called "Upper Yuba Reach #2"and "Bear River Reach #2,' respectively, in other project–related documents. They are not Project-affected reaches.

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detected near the reservoir outlet. Another CDFG memorandum (1974) also indicates that there are sub-impoundments within the reservoir with improved water clarity.

The Licensee provided water quality data for Rollins Reservoir from two Exhibit E filings for the Christian Valley and Fiddler Green Powerhouses (PG&E, 1982a). Reservoir data were collected by the CDWR in November 1975 (PG&E, 1982a; see Table 2.3.1, pages CVE-10 and FGE-11, of the Exhibit E). Data is assumed to be from surface samples as no depth information was provided. Surface water temperature, conductivity, and total hardness values were low (10.7 °C, 30 µmhos/cm, and 9.0 mg/L $CaCO_3$, respectively). DO concentrations were near saturation at 88 percent (9.1 mg/L) and Ph levels were within USEPA and CVRWQCB criteria at 7.2. Sodium and sulfate concentrations were also very low at concentrations of 1.9 mg/L and 0.8 mg/L, respectively.

A mercury bioaccumulation study was conducted on fish species collected from the Greenhorn Creek and Bear River arms of the Rollins Reservoir in Fall of 1999 (May et. al., 2000). Data from this study are summarized in Figure 6 and Table 5 of the report. Overall, 15 of the 28 fish samples had mercury concentrations in excess of 0.30 ppm wet-weight, with channel catfish having the highest average concentrations (geometric mean of 0.35 ppm wet-weight). Data collected for the May et. al. (2000) study, included fish tissue samples from two local reference sites (South Yuba near Emigrant Gap and Bear River at Highway 20) that are relatively unaffected by gold mining activities. Each reference site had mercury concentrations equal to or less than 0.10 ppm wet-weight. (May et. al., 2000).

Rollins Reservoir is the source water to PCWA's Auburn Water Treatment Plant, via the Bear River Canal. Although still lower than the regulatory action level, Auburn Water Treatment Plant raw water data indicate that there is an upstream source of bacteria to this facility with concentrations ranging from 20-130 MPN/100mg/L (Starr and Palencia, 2007). Auburn Water Treatment Plant also shows a strong seasonal variation in turbidity, with elevated levels during the winter and spring (Starr and Palencia, 2007). The turbidity increases at the Auburn Water Treatment Plant are directly correlated to turbid waters entering Rollins Reservoir after substantial rain events during the winter and spring (Starr and Palencia, 2007).

In 2007, Licensee collected water temperature profiles at four locations in Rollins Reservoir. Sampling was conducted on two dates, July 31 and October 17 2007 (DTA, *unpublished data*). At Site 1, near the dam, a distinct thermocline was present 20 feet below the surface in July but not in October (Figure 7.2.10-7). Site 2, at mid reservoir, had defined thermoclines during both the July and October surveys but at different depths (Figure 7.2.10-8). Site 3, in the Greenhorn Creek arm, had a slight thermocline during July but none in October (Figure 7.2.10-9). At Site 4, in the Bear River arm, there was a slight thermocline during July but none in October (Figure 7.2.10-10).

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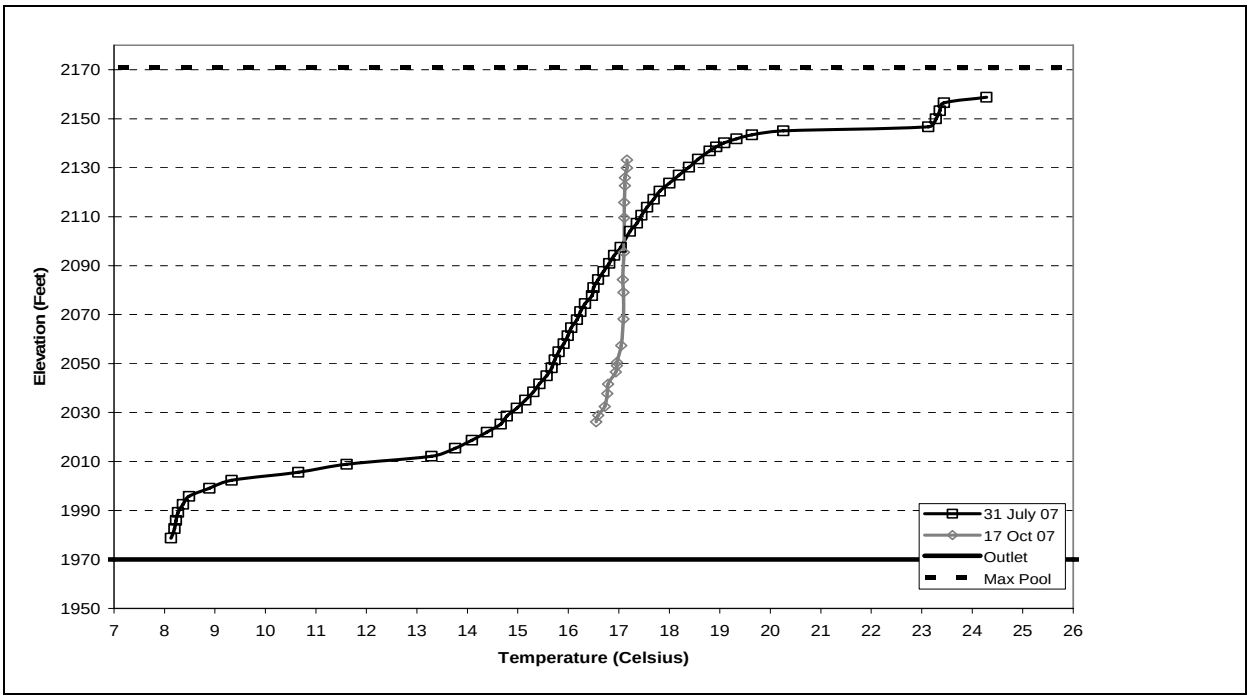

Figure 7.2.10-7. Rollins Reservoir water temperature profiles, Site 1 – near dam (DTA, *unpublished data*)

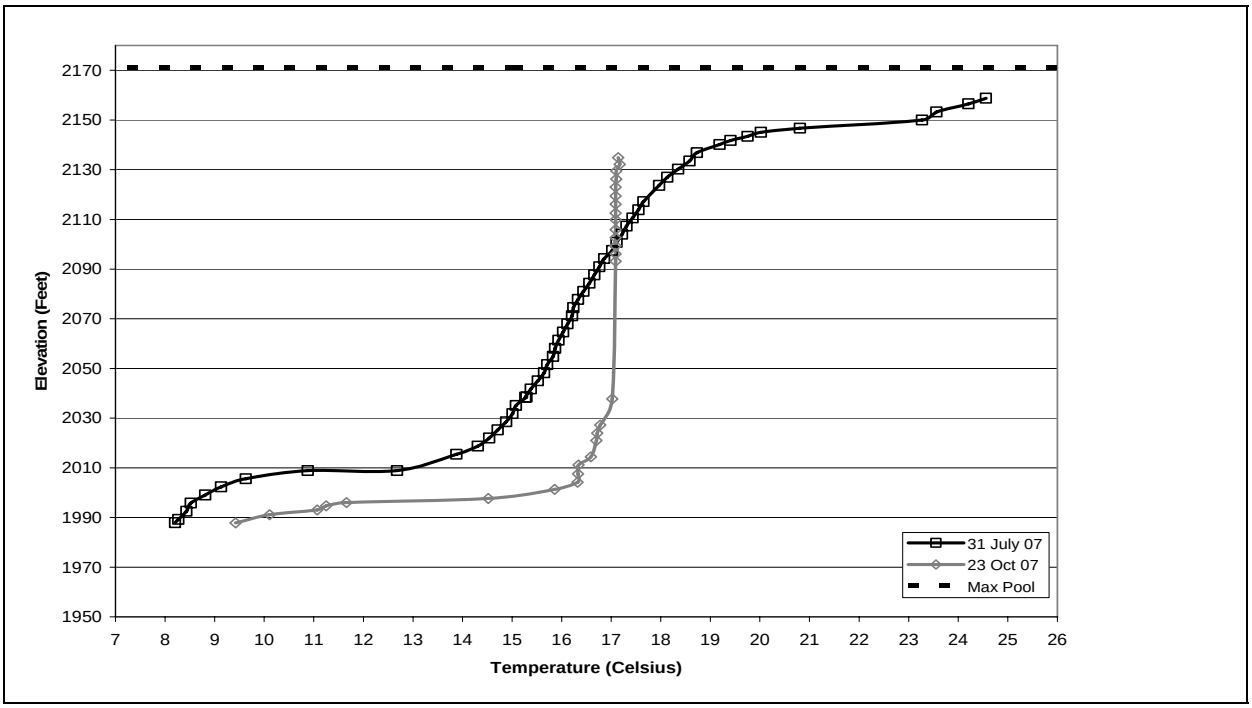

Figure 7.2.10-8. Rollins Reservoir water temperature profiles, Site 2 – mid reservoir (DTA, *unpublished data*)

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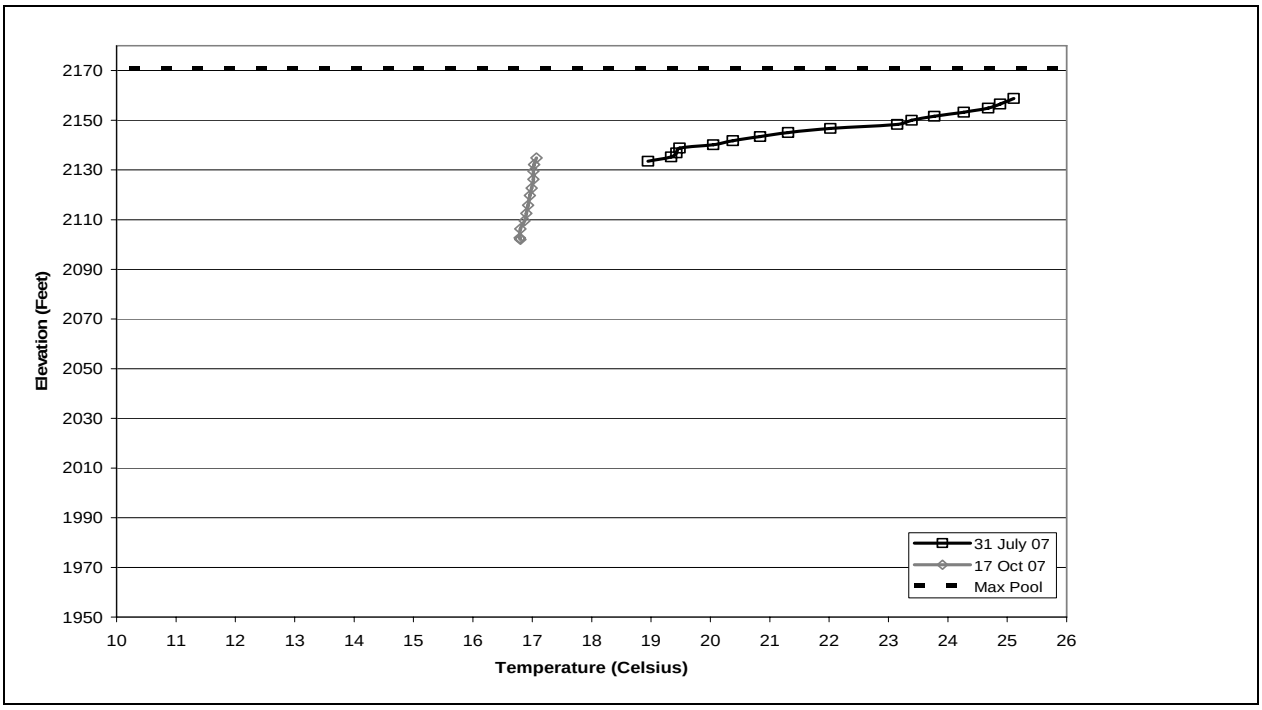

Figure 7.2.10-9. Rollins Reservoir water temperature profiles, Site 3 – Greenhorn Creek arm (DTA, *unpublished data*)

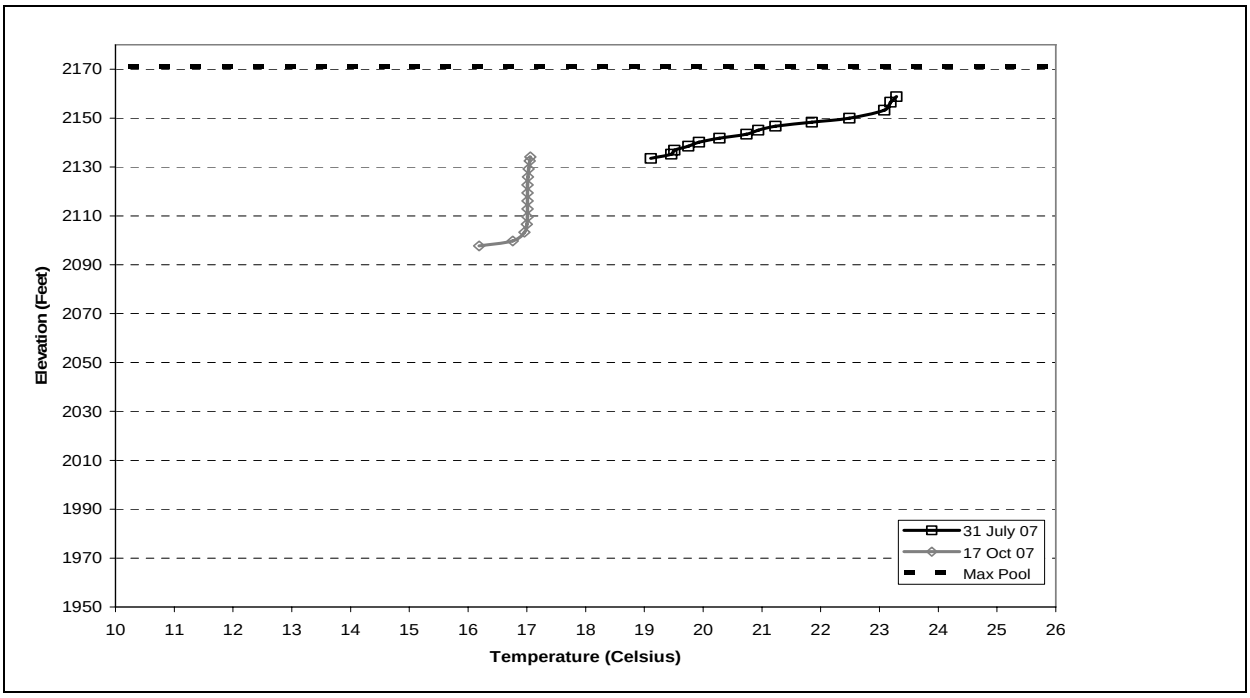

Figure 7.2.10-10. Rollins Reservoir water temperature profiles, Site 4 – Bear River arm (DTA, *unpublished data*)

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The Licensee also collected DO information from four sites at Rollins Reservoir in 2007 (DTA, *unpublished data*). These data are summarized in the table below.

Table 7.2.10-6 Dissolved oxygen data collected at Rollins Reservoir in 2007.

Date	Site 1		Site 2		Site 3		Site 4	
	Depth (m)	DO (mg/L)	Depth (m)	DO (mg/L)	Depth (m)	DO (mg/L)	Depth (m)	DO (mg/L)
7/31/07	0.3	8.14	0.3	8.21	0.3	8.13	0.3	8.17
	27	7.62	26	8.04	3.5	7.95	3.5	8.26
	54	4.96	52	5.25	7.5	6.01	7.5	8.54
10/17/07	0.8	9.75	0.3	10.63	0.3	7.95	0.5	9.93
	15.7	6.83	13	6.75	4.9	6.92	6	6.98
	32.6	6.2	44.1	1.86	10.1	6.7	11	6.78

7.2.10.3 Existing Water Quality Data in Project-Affected Stream Reaches

Yuba-Bear Hydroelectric Project-affected river reaches are located within the Middle Yuba River Sub-basin, the Canyon Creek Sub-basin, the Fall Creek Sub-basin, the Rucker Creek Sub-basin and the Bear River Sub-basin. Data general to the watershed are summarized here, followed by reach-by-reach descriptions. SYRCL collected E. coli samples at various locations in the South Yuba and Middle Yuba River systems. In the upper reaches of these river systems, including the Jackson Meadows Dam Reach, E. coli concentrations were extremely low (0 MPN/100ml to 1 MPN/100ml). In the lower reaches of the South Yuba River, *E. coli* were more abundant, but still relatively low (0 MPN/100ml to 40 MPN/100ml). Bacteria data specific to the Bear River reaches were not found.

USGS conducted a mercury bioaccumulation study on fish collected in various Project-affected reaches of the Yuba and Bear Rivers (May et. al., 2000). Overall, average mercury concentrations for brown trout and rainbow trout were less than 0.30 ppm wet-weight at 11 of the 13 sampling sites. All of the reaches sampled above Rollins Reservoir had mercury concentrations of less than the OHHEA (1999) guideline of 0.30 ppm, while the average mercury concentration for fish tissue samples collected in the Bear River downstream of Rollins Reservoir was 0.40 ppm, with values ranging from 0.38 to 0.43 ppm. In contrast, trout collected in the two reference sites (stream reaches relatively unaffected by gold mining activities) had mercury concentrations equal to or less than 0.10 ppm (May et. al., 2000). Reference sites were on the South Yuba near Emigrant Gap and Bear River at Highway 20.

7.2.10.3.1 Existing Water Quality Data in Stream Reaches Directly/Indirectly affected by the Project

<u>Project-Affected Stream Reaches in the Middle Yuba River Sub-Basin</u>

There are three river reaches in the Middle Yuba River Sub-basin directly or indirectly affected by the Yuba-Bear Hydroelectric Project. Historical water quality data were available for two of the reaches.

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Table 7.2.10-7. Historical Water Quality Data for Stream Reaches Affected by the Yuba-Bear Hydroelectric Project in the Middle Yuba River Sub-Basin

Stream Reach [A]	Date	Temp. [B] (°C)		PH	Turbidity		Conductivity (µmhos/cm)	Dissolved Oxygen (MG/L)	Notes
					NTU	Secchi Depth (FT)			
Jackson Meadows Dam Reach	2000-2001		<10	7.0 - 8.2			<30	8.5	TSS <10 mg/L
Milton Diversion Dam Reach	1967		10	7.0			56	9.9	Alkalinity 21 mg/L $CaCO_3$ Hardness 23 mg/L $CaCO_3$
	2001-2007	1.8	22.7	5.6 - 8.5	0.29		102.9	9.9	TSS 2.36 mg/L *E. coli* 0.097 MPN Arsenic 15.84 ppb

[a] Only stream reaches with historical data are listed herein. A blank square means no data were found for that parameter.
[b] Samples were assumed to be surface samples unless report indicated otherwise (see narratives, below).

Jackson Meadows Dam Reach

Reservoir profile data for the Jackson Meadows Reservoir indicates that cold water of approximately 6 °C is released to the upper end of this reach (UYRSP, 2006). The nearest water quality station is located downstream in the Milton Dam Reach (described below), which should have a similar water quality composition.

In 2007, Licensee collected water temperature data from the Middle Yuba River below Jackson Meadows dam (DTA, *unpublished data*). Site MYR-2 is located approximately 0.5 miles downstream of the dam. During the two months of monitoring, the average daily temperature never exceeded 10 ºC (Figure 7.2.10-11).

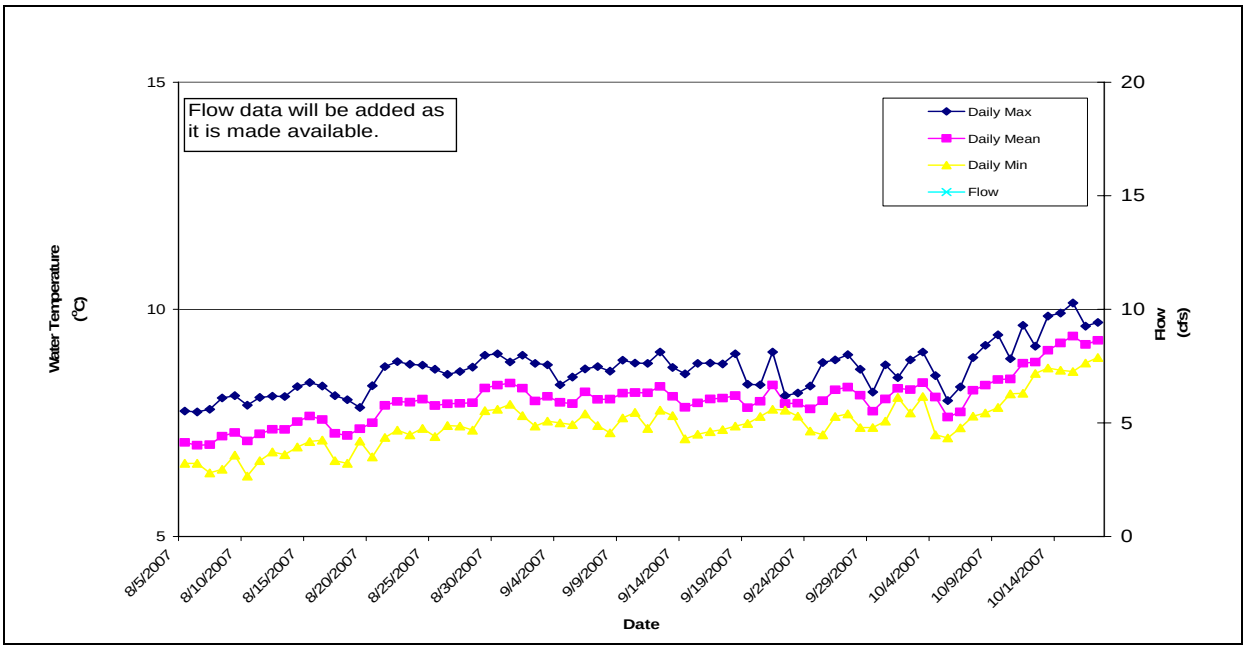

Figure 7.2.10-11. Stream water temperature data collected at Site MYR-2, Jackson Meadows Dam reach.

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The Licensee also reviewed a data report from the SYRCL who had one sampling station within this stream reach (Shilling, 2001; provided as Attachment 7.2D of this document). The SYRCL sampling site is located just downstream of the Jackson Meadows Reservoir; details of the 2000 - 2001 data reports are summarized in various bar graphs from the Shilling (2000) report. Overall, the waters from this reach are cool (less than 10 °C) and have low conductivity (less than 30 µmhos/cm). DO levels were 8.5 mg/L and Ph levels ranged from 7.0 to 8.2. Total Suspended Solid (TSS) values were less than 10 mg/L for most of the sampling dates with the exception of May 2001 where TSS values increased to 45 mg/L. Data summaries for arsenic and *E. Coli* from the October 2000 to June 2001 sampling period are provided in tables from the Shilling (2001) report. All of the arsenic samples were below detection limits and *E. Coli* was not present with counts of "0.0 MPN/100 ml[5]" reported for all of the sampling events.

Middle Yuba River Upstream of Jackson Meadows Reservoir. Water temperature data was also recorded in the Middle Yuba River upstream of Jackson Meadows Reservoir (DTA, *unpublished data*). Only one month of data was collected at this location (MYR-1) and while the average daily temperature did not exceed 20ºC, there were differences between the daily maximum and minimum temperatures (Figure 7.2.10-12).

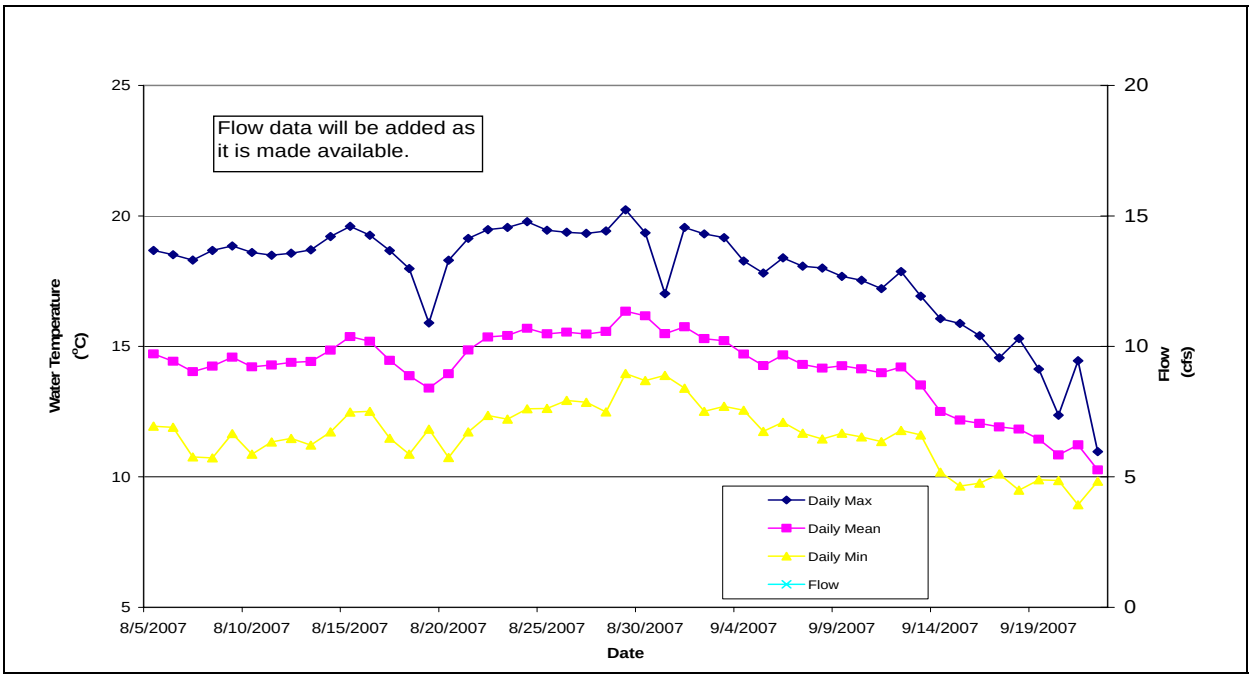

Figure 7.2.10-12. Stream water temperature data collected at Site MYR-2, Yuba River Upstream of Jackson Meadows Reservoir (DTA, *unpublished data*).

Milton Diversion Dam Reach

Three temperature-monitoring sites were located in the Milton Diversion Dam reach to provide a comprehensive assessment of temperature trends. The UYRSP studied this section of the Middle

[5] When a report provided "0.0" in lieu of "non-detect," the value "0.0" was transcribed "as is" into this document.

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Yuba River from June 2003 to November 2005. A graphical summary of their results is provided in Attachment 7.2B (UYRSP, 2006; see Figures 4A, 4B, and 4C). Daily average temperatures increase in a downstream direction and peak in late July and early August. Inter-site temperature trends were very consistent during the three sampling years, with the upstream site (below Milton Dam) having an annual maximum temperature near 10 °C and the downstream site (above Wolf Creek) reaching an annual maximum temperature of approximately 20 °C.

In 2007, Licensee collected water temperature data at the Milton-Bowman Tunnel outlet (DTA, *unpublished data*). Site MBT1 is approximately 0.1 miles downstream from Bowman Lake at the outlet of the tunnel. During the monitoring period, average daily temperatures did not exceed 20 ºC (Figure 7.2.10-13)

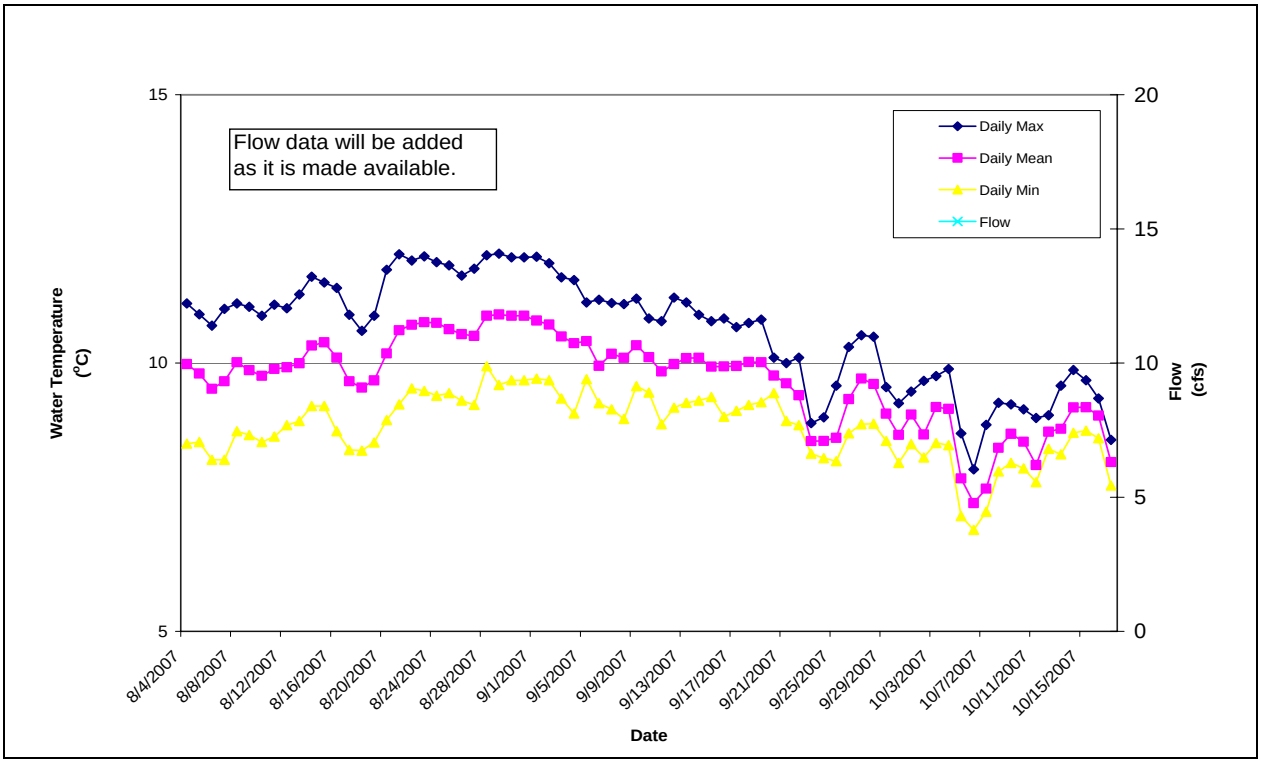

Figure 7.2.10-13. Stream water temperature data collected at Site MBT1, Milton-Bowman Tunnel outlet (DTA, *unpublished data*).

The Licensee was also able to locate water quality data collected in 1967 by the SWRCB in the STORET database (USEPA, 2006; see Attachment 7.2.C). The sampling site is located just downstream of Milton Dam. Overall, the waters from this reach are cool (10 °C) with low conductivity (56 µmhos/cm). DO levels were supersaturated to nearly 108 percent (9.9 mg/L) and Ph levels were neutral (7.0) Alkalinity and Hardness values were low (21 mg/L $CaCO_3$ and 23 mg/L $CaCO_3$ respectively) as were concentrations of inorganic ions.

SYRCL provided water quality data between 2001 and 2007 from five sites along this reach: Sites 7 (Below Jackson Meadows Reservoir), 8 (Plumbago Crossing above Kanaka Creek), 27

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(Kanaka Creek), 37 (Milton Reservoir, Middle Fork downstream of Jackson Meadows), and 46 (Our House Dam Pike). The overall minimum and maximum conductivity values were 10 µmhos/cm and 430 µmhos/cm, respectively. The average conductivity was 102.9 µmhos/cm. The overall minimum and maximum DO values were 2.2 mg/L and 14.5 mg/L, respectively. The average DO value was 9.9 mg/L. The overall minimum and maximum water temperature values were 1.8°C and 22.7°C, respectively. The overall average water temperature value was 10.7°C. The overall minimum and maximum turbidity values were 0 NTU and 6.89 NTU, respectively. The average turbidity value was 0.29 NTU. The overall minimum and maximum pH values were 5.6 and 8.5, respectively. The average pH value was 7.2.

SYRCL monitored total suspended solids (TSS), and bacterial levels at five sites (#7, 8, 27, 37 and 46) along the Milton Diversion Dam Reach. SYRCL collected data from these location from 2001-2007. For these years, TSS averaged 2.36 mg/L with a high of 9.4 mg/L. The levels of *E. coli* averaged 9.74 MPN/100mL with a high of 101.7 MPN/100ml. Arsenic levels averaged 15.84 ppb with a high of 47.2 ppb over the measurement period.

All of the average levels of bacteria and metals fall within EPA drinking water standards except for arsenic. The EPA standard for arsenic is 10 ppb, while the average measured arsenic level in the reach is 15.84 ppb. Kanaka Creek, which feeds into the Middle Yuba River at measuring site 27 is listed under Section 303(d) of the Clean Water Act as "impaired" due to arsenic levels and contributes to the measured high levels of arsenic (SYRCL 2006). This site accounted for the highest measured level of arsenic (47.2 ppb in August 2002).

Wilson Creek Diversion Reach

After a review of the data resources listed above, the Licensee is unaware of existing water quality data for Wilson Creek reach.

Project-Affected Stream Reaches in the Canyon Creek Sub-Basin

There are five river reaches directly or indirectly affected by the Yuba-Bear Hydroelectric Project-affected in the Canyon Creek Sub-basin. Historical water quality data are available for two of these reaches.

Table 7.2.10-8. Historical Water Quality Data for Yuba-Bear Stream Reaches in the Canyon Creek Sub-Basin

Stream Reach [A]	Date	Temp. [B] (°C)		PH	Turbidity		Conduct-ivity (µmhos/cm)	Dissolved Oxygen (MG/L)	Notes
					NTU	Secchi Depth (Ft)			
Jackson Lake Dam Reach	1960			6.5			15		Alkalinity 4 mg/L $CaCO_3$ Hardness 4 mg/L $CaCO_3$
Bowman-Spaulding Diversion Dam Reach	1967-1968		10.7-11.7	7.1 - 7.4			34-65		Alkalinity 15-22 mg/L $CaCO_3$ Hardness 15-22 mg/L $CaCO_3$

[a] Only stream reaches with historical data are listed herein. A blank square means no data were found for that parameter.
[b] Samples were assumed to be surface samples unless report indicated otherwise (see narratives, below).

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Jackson Lake Dam Reach

The Licensee was able to locate SWRCB water quality data from 1960 in the USEPA STORET database (USEPA, 2006; provided as Attachment 7.2C). The sampling site is located at the upstream end of the reach, just below the Jackson Dam Outlet. Overall, the waters from this reach have low conductivity (15 µmhos/cm), alkalinity (4 mg/L $CaCO_3$) and hardness (4 mg/L $CaCO_3$). Concentrations of inorganic ions were also extremely low with nitrate and boron concentrations of 0.2 mg/L and 0.0 mg/L respectively. Measurements of Ph (6.5) were at the low end of the CVRWQCB scale.

French Lake Dam Reach

After a review of the data resources listed above, the Licensee is unaware of existing water quality data for French Lake Dam reach.

Faucherie Lake Dam Reach

After a review of the data resources listed above, the Licensee is unaware of existing water quality data for Faucherie Lake Dam reach.

Sawmill Lake Dam Reach

After a review of the data resources listed above, the Licensee is unaware of existing water quality data for Sawmill Lake Dam reach.

Bowman-Spaulding Diversion Dam Reach

The UYRSP study monitored temperature at one site in the downstream section of this reach as well as monitoring temperatures in the Bowman-Spaulding Conduit just downstream of Bowman Lake (UYRSP, 2006; provided as Attachment 7.2B). A graphical summary of these monitoring results are only available for the Bowman-Spaulding Conduit site below Bowman Lake (UYRSP, 2006; see Figure 11 of Attachment 7.2B). Annual maximum temperatures in the conduit occur in September with a maximum temperature of approximately 16 °C in September of 2004.

In 2007, Licensee collected water temperature data in the Bowman-Spaulding Diversion Dam Reach (DTA, *unpublished data*). Site CC1 is approximately 0.75 miles downstream of the diversion dam on Canyon Creek. During the two-month monitoring period, daily average water temperature never exceeded 20 ºC (Figure 7.2.10-14).

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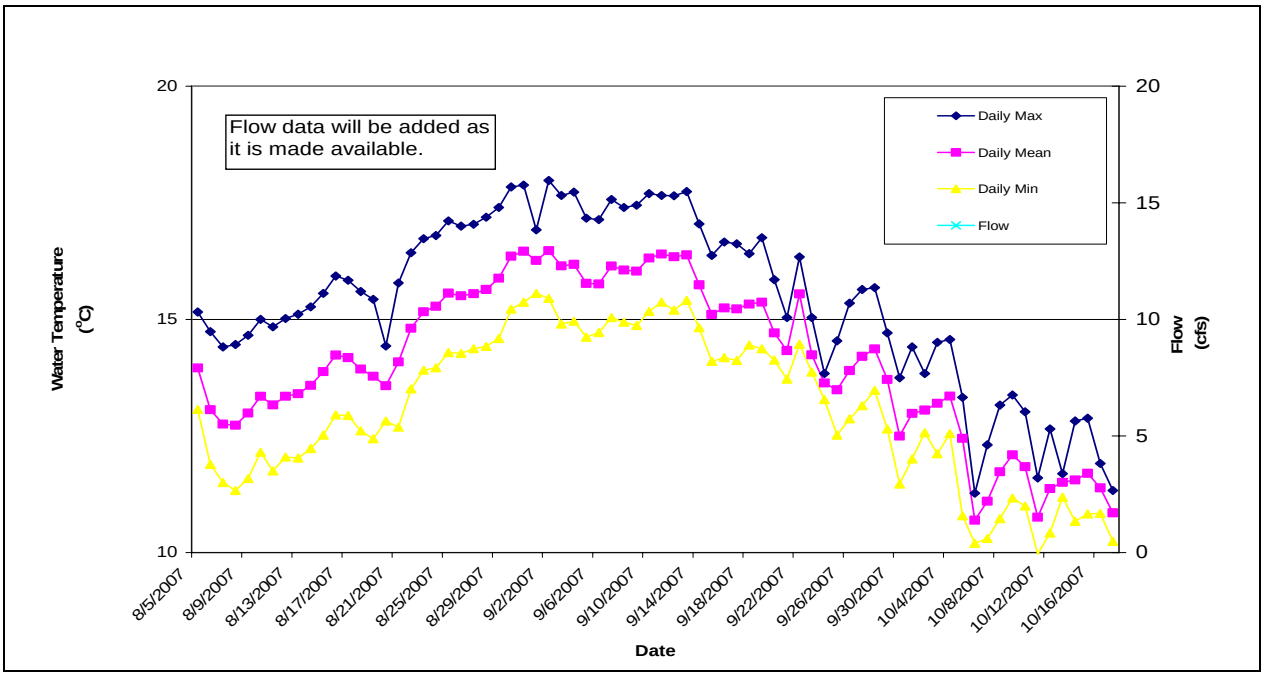

Figure 7.2.10-14. Stream water temperature data collected at Site CC1, Bowman-Spaulding Diversion Dam Reach (DTA, *unpublished data*).

Licensee also collected water temperature data at two locations along the Bowman-Spaulding canal (DTA, *unpublished data).* Site BSC1 is located near gage YB-314, downstream from the Bowman-Spaulding diversion dam and daily average water temperatures did not exceed 20 ºC for the duration of the two-month monitoring period (Figure 7.2.10-15). Site BSC2 is located near the Rucker Creek diversion and daily average water temperatures did not exceed 20 ºC for the duration of the two-month monitoring period (Figure 7.2.10-16).

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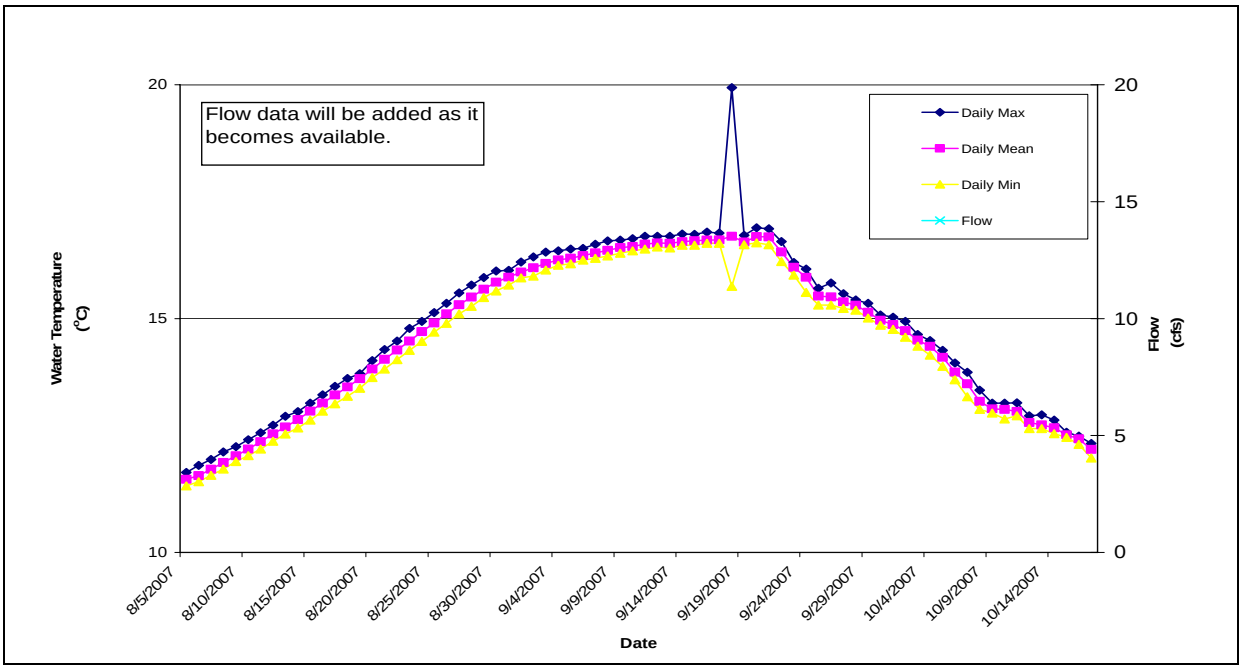

Figure 7.2.10-15. Stream water temperature data collected at Site BSC1, Bowman-Spaulding Canal near gage YB-314 (DTA, unpublished data). Note canal outage on 9/18/2007.

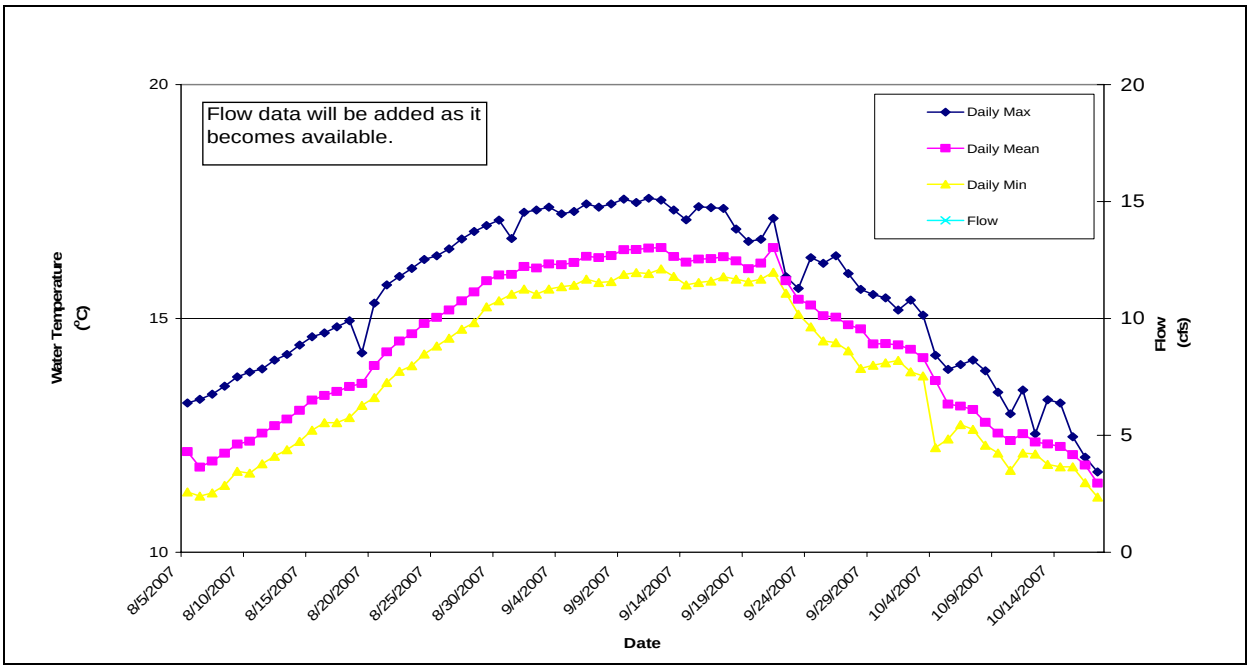

Figure 7.2.10-16. Stream water temperature data collected at Site BSC2, Bowman-Spaulding Canal at Rucker Creek Diversion (DTA, *unpublished data*)

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The Licensee was also able to locate water quality data collected by the SWQCB in 1967-68 from the USEPA STORET database (USEPA, 2006). One of the sampling sites is located at the upstream end of the stream reach ("below Bowman Lake"); while the other monitoring site is in a downstream reach of Canyon Creek ("near Washington"). Overall, the waters from this reach have cool temperatures (10.7 °C to 11.7 °C) and low conductivity (34-65 µmhos/cm). DO levels were only measured at the downstream site and were super saturated at 104 percent in October of 1967 and 110 percent in April of 1968. Measurements of Ph were relatively constant (7.1-7.4) between sites, as were values for alkalinity (15-22 mg/L $CaCO_3$) and hardness (15-22 mg/L $CaCO_3$). Concentrations of inorganic ions were extremely low and reported as "0.0 mg/L" (non-detect) for some of the sampling dates.

Project-Affected Stream Reaches in the Fall Creek Sub-Basin

There are two stream reaches directly or indirectly affected by the Yuba-Bear Hydroelectric Project in the Fall Creek Sub-basin.

Clear Creek Diversion Dam Reach

After a review of the data resources listed above, the Licensee is unaware of existing water quality data for Clear Creek Dam reach.

Trap Creek Diversion Dam Reach

After a review of the data resources listed above, the Licensee is unaware of existing water quality data for the Trap Creek Dam reach.

Project-Affected Stream Reaches in the Bear River Sub-Basin

There are wo river reaches directly or indirectly affected by the Yuba-Bear Hydroelectric Project in the Bear River Sub-basin.

Table 7.2.10-9 Historical Water Quality Data for Yuba-Bear Stream Reaches in the Bear River Sub-Basin

Stream Reach [A]	Date	Temp. [B] (°C)		PH	Turbidity		Conductivity (µmhos/cm)	Dissolved Oxygen (MG/L)	Notes
					NTU	Secchi Depth (FT)			
Dutch Flat Afterbay Dam Reach	September-October 1999		16.2-16.3	7.0 - 7.2			56-59		Alkalinity 25 mg/L $CaCO_3$

[a] Only stream reaches with historical data are listed herein. A blank square means no data were found for that parameter.
[b] Samples were assumed to be surface samples unless report indicated otherwise (see narratives, below).

Dutch Flat Afterbay Dam Reach

The Licensee was also able to locate historical water quality data for the Dutch Flat Afterbay Dam Reach in the USGS NWIS database (USGS, 2007; provided as Attachment 7.2E to this

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document). The sampling site (USGS 11421790) is located in the upstream section of the stream reach, just below the Dutch Flat Afterbay Dam, and includes data from September through October 1999. Waters from this reach have cool temperatures (16.2-16.3 °C), low conductivity readings (56-59 µmhos/cm) and Ph levels within CVRWQCB criteria (7.0 to 7.2). Alkalinity was relatively low at 25 mg/L $CaCO_3$. Nutrient concentrations were also very low with ammonia concentrations of 0.04 to 0.07 mg/L, total phosphorus ranging from 0.011 to 0.059 mg/L, and orthophosphate values less than 0.01 mg/L.

A mercury bioaccumulation study included samples of fish fillets collected from the Dutch Flat Afterbay Dam Reach (May et. al., 2000). Data from this study are summarized in Figure 9 and Table 8 of the May et. al. (2000) report. Four trout samples were collected in the Dutch Flat Afterbay Dam Reach for this study. Mercury concentrations ranging from 0.07 to 0.28 ppm wet-weight were observed. These concentrations were less than the OEHHA (1999) guideline of 0.30 ppm.

Chicago Park Powerhouse Reach

After a review of the data resources listed above, the Licensee is unaware of any historical water quality data for the Chicago Park Powerhouse Reach. However, in 2007, Licensee collected water temperature data in the Chicago Park Powerhouse Reach (DTA, *unpublished data*). Site BR1 is located approximately .25 miles downstream of Chicago Park Powerhouse. During the monitoring period, daily average temperatures did not exceed 20 ºC (Figure 7.2.10-17).

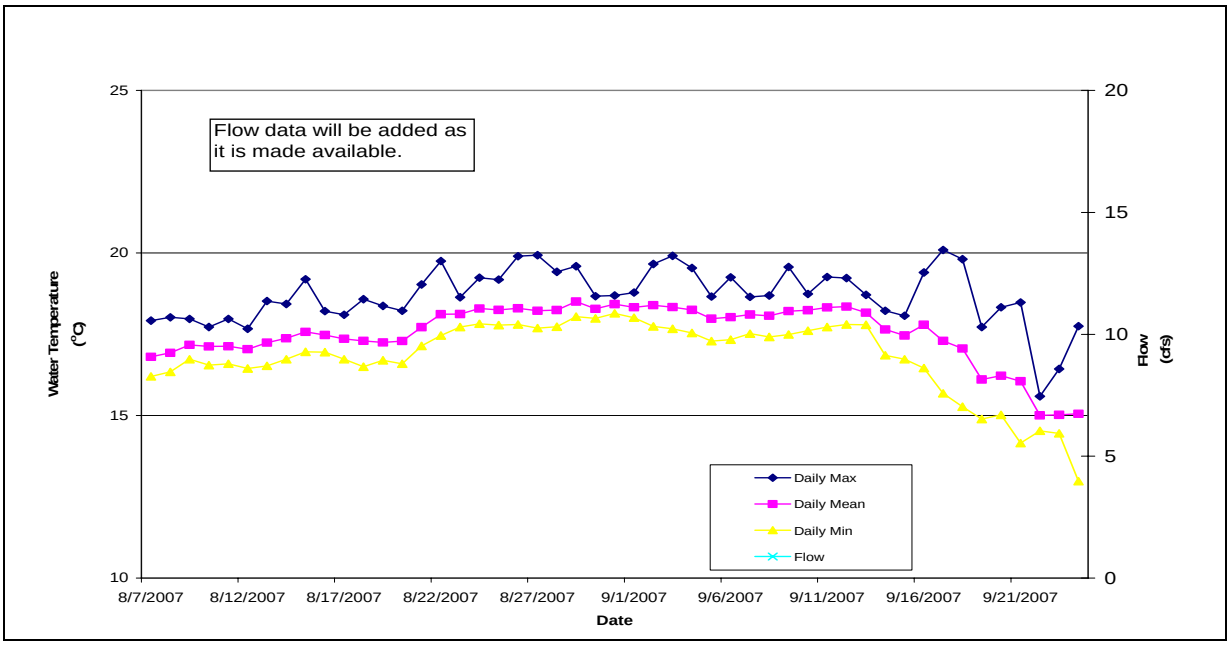

Figure 7.2.10-17. Stream water temperature data collected at Site BR1, Chicago Park Powerhouse reach (DTA, *unpublished data*).

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Greenhorn Creek, Upstream of Rollins Reservoir. Water temperature was also recorded for Site GHC1, within Greenhorn Creek above Rollins Reservoir. Within the monitoring period, daily average water temperature exceeded 20 ºC on 18 of the study days (Figure 7.2.10-19).

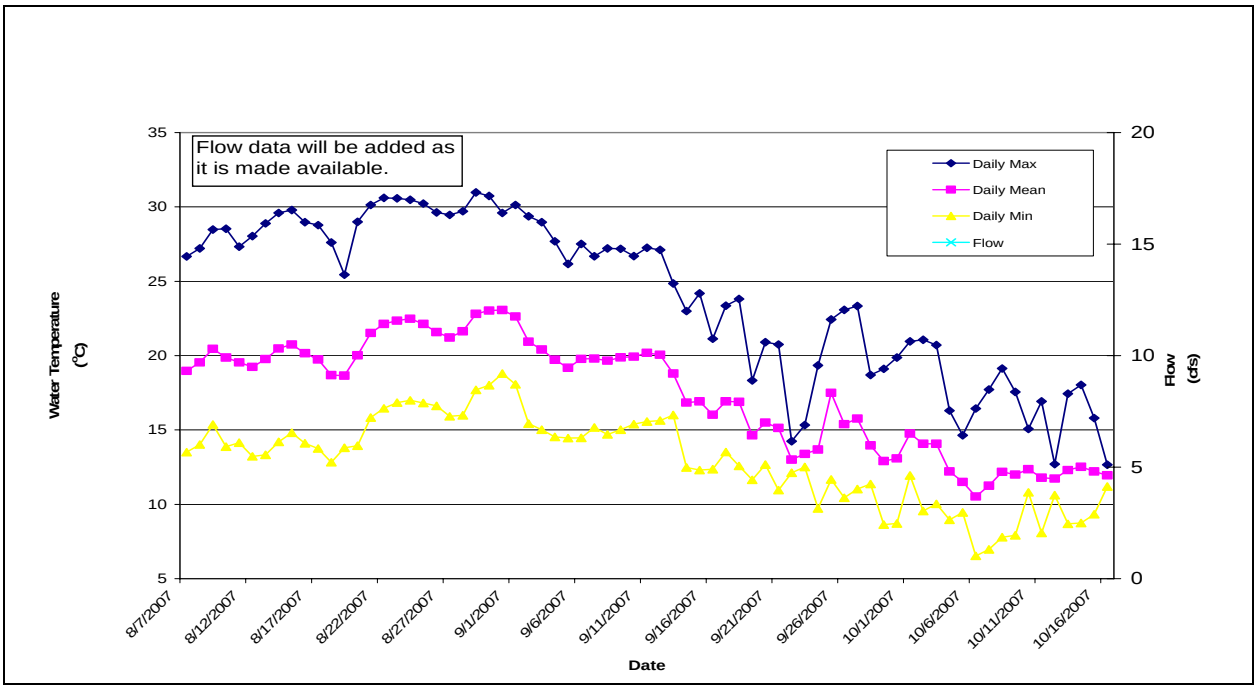

Figure 7.2.10-19. Stream water temperature data collected at Site GHC1, Greenhorn Creek upstream of Rollins Reservoir (DTA, *unpublished data*)

7.2.10.4 Water Quality Data – Cumulative-effects reaches

Water Quality Data in the Canyon Creek Sub-basin

There are two stream reaches potentially cumulatively affected by the Yuba-Bear Hydroelectric Project and other entities in the Canyon Creek Sub-basin.

Texas Creek Diversion Dam Reach

After a review of the data resources listed above, the Licensee is unaware of existing water quality data for the Texas Creek Diversion Dam reach.

Canyon Creek below Texas Creek Confluence Reach

The UYRSP study monitored temperature at one site in the downstream section of this reach, but data were not available in the UYRSP 2006 report. The Licensee was also able to locate water quality data collected by the SWQCB in 1967-68 from the USEPA STORET database (USEPA, 2006). One of the sampling sites is located on Canyon Creek above the head of the upstream end of this reach ("below Bowman Lake"); while the other monitoring site is in a downstream

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section of this reach ("near Washington"). Overall, the waters in Canyon Creek have cool temperatures (10.7 °C to 11.7 °C) and low conductivity (34-65 µmhos/cm). DO levels were only measured at the downstream site and were super saturated at 104 percent in October of 1967 and 110 percent in April of 1968. Measurements of pH were relatively constant (7.1-7.4) for the two sites, as were values for alkalinity (15-22 mg/L $CaCO_3$) and hardness (15-22 mg/L $CaCO_3$). Concentrations of inorganic ions were extremely low and reported as "0.0 mg/L" (non-detect) for some of the sampling dates.

Water Quality Data in the Fall Creek Sub-basin

There is one stream reach potentially cumulatively affected by the Yuba-Bear Hydroelectric Project and other entities in the Fall Creek Sub-basin.

Fall Creek Diversion Dam Reach

After a review of the data resources listed above, the Licensee is unaware of existing water quality data for Fall Creek Diversion Dam Reach.

Water Quality Data in the Rucker Creek Sub-basin

There is one stream reach potentially cumulatively affected by the Yuba-Bear Hydroelectric Project and other entities in the Rucker Creek Sub-basin.

Rucker Creek Diversion Dam Reach

After a review of the data resources listed above, the Licensee is unaware of existing water quality data for Rucker Creek Diversion Dam Reach.

Project-Affected Stream Reaches in the South Yuba River Sub-Basin

There are eight stream reaches potentially cumulatively affected by the Yuba-Bear Hydroelectric Project and other entities in the South Yuba River Sub-basin. Available measured water quality data are summarized in Table 7.2.10-10. Each reach is discussed below.

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Table 7.2.10-10. Historical Water Quality Data for Yuba-Bear Stream Reaches in the South Yuba River Sub-Basin.

Stream	Reach[a]	Date	Temp (°C)		PH	Conduct-Ivity (µmhos/cm)	Total Hard-Ness (mg/L $CaC0_3$)	Alkalinity (mg/L $CaC0_3$)	Fecal Coliform (MPN)	DO (MG/L)	Notes
South Yuba River	South Yuba Reach #1	June 2003 – September 2004	Daily average maximum	<17							
		October 1952; October 1967; April 1968			7.3-7.7	65-81	25-34	21-34		9.2-11.4	Low concentrations of nutrients and other elements. Boron 50 µg/L Nitrate 0.2 mg/L
		June 2001							1		TSS < 5 mg/L
		2001-2007		1.4-18.5	5.8-8.2	3-90			7.82	5-18	*E. coli* 3.64 MPN TSS 1.32 mg/L Turbidity 0-1.73
	South Yuba Reach #3	July 2003 – September 2005	Daily average maximum	~26							
	South Yuba Reach #4	June 2003 – July2004	Daily average maximum	~26							
		April 1958; May 1971			6.7 – 7.8	19-102	7-39	7-39		7.1-11.4	Boron ND-200 µg/L Nitrate ND-0.8 mg/L Iron ND-20 µg/L
		2001-2007		3.9-20	5.4-8	10-70			10.71	3.1-13.3	*E. coli* 127.31 MPN TSS 9.22 mg/L Turbidity 0-238
	South Yuba Reach #5	2001-2007		0.7-24.1	3.9-8.6	0-90			7.94	5.3-17.6	*E. coli* 35.42 MPN TSS 1.86 mg/L Copper 14.67 ppb Zinc 10.73 ppb Chromium 17.92 Iron 292.92 ppb Turbidity 0-1100

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Table 7.2.10-10 (continued)

Stream	Reach[a]	Date	Temp (°C)		PH	Conduct-Ivity (µmhos/cm)	Total Hard-Ness (mg/L $CaC0_3$)	Alkalinity (mg/L $CaC0_3$)	Fecal Coliform (MPN)	DO (MG/L)	Notes
South Yuba River (continued)	South Yuba Reach #6	2000-2007		1.7-27.3	5.1-11.5	0-340			9.84	2.4-18	*E. coli* 42.58 MPN TSS 1.57 mg/L Turbidity 0-202

[a] Only river reaches with historical data are listed herein.

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Fuller Lake Dam Reach

After a review of the data resources listed above, the Licensee is unaware of water quality data for the Fuller Lake Dam Reach.

Jordan Creek Diversion Reach

After a review of the data resources listed above, the Licensee is unaware of water quality data for the Jordan Creek Diversion Reach.

South Yuba Reach #1

The UYRSP monitored temperature at one site within this stream reach from June 2003 to September 2004. A graphical summary of these monitoring results is shown in Attachment 7.2C (UYRSP, 2006; see Figures 5A and 5B in Attachment 7.2C located on the CD at the end of Section 7.2 of this PAD). Maximum daily average temperatures in this stream reach occur in the month of August with a maximal daily average temperature of less than 17ºC for the 2003 and 2004 sampling periods.

The Licensee was also able to locate historical CVRWQCB water quality data from the USEPA STORET database for this reach (USEPA, 2007; provided as Attachment 7.2B of this document located on the CD at the end of Section 7.2 of this PAD). The sampling site, Lang Crossing, below Lake Spaulding is located at the same position as the UYRSP temperature site and includes data from October 1952, October 1967, and April 1968 (Table 7.2.10-8). Overall, the waters from this reach have low conductivity (65-81 µmhos/cm) and concentrations of nutrients and other elements. Boron and nitrate were the only detectable ions at levels of 50 µg/L and 0.2 mg/L respectively. Measurements of pH were stable over time, ranging from 7.3-7.7, as were values for alkalinity (21-34 mg/L $CaCO_3$) and hardness (25-34 mg/L $CaCO_3$). DO concentrations varied from 9.2 mg/L to 11.4 mg/L over the sampling period, but when adjusted for percent saturation, DO levels were very consistent at 102% to 104%.

The Licensee also reviewed a data report from the South Yuba River Citizens League (SYRCL) who also established a sampling station at Lang's Crossing (Shilling 2001; provided as Attachment 7.2D of this document). From October 2000 through April 2001, SYRCL citizen monitors sampled or observed DO, pH, DSS, TSS, bacteria, oil and grease, metals, and temperature. Data collected by SYRCL are consistent with and/or confirm both the STORET data and the UYRSP data for all parameters except bacteria and TSS, which were not analyzed for elsewhere. Data summaries for E. coli and TSS from the October 2000 to June 2001 sampling period are provided in various tables and graphs from the Shilling (2001) report (Table 7.2.10-8). E. coli presence was only detected in June 2001 at a concentration of 1 MPN/100ml. TSS values were also extremely low for the sampling period with concentrations less than 5 mg/L.

SYRCL monitored TSS, metal and bacterial levels at Lang's Crossing (site #11) from 2001-2006. They measured an average TSS level of 1.32 mg/L with a high of 5 mg/L. *E. coli* levels

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averaged 3.64 MPN/100ml with a high of 41.6 MPN/100ml. All measured levels were well below EPA water quality standards.

SYRCL provided water quality data between 2001 and 2007 from one site along this reach: Site 11 (Langs Crossing). The overall minimum and maximum conductivity values were 3 µmhos/cm and 90 µmhos/cm, respectively. The average conductivity value was 50 µmhos/cm. The overall minimum and maximum DO values were 5 mg/L and 18 mg/L, respectively. The average DO value was 9.3 mg/L. The overall minimum and maximum water temperature values were 1.4°C and 18.5°C, respectively. The overall average water temperature value was 9.2°C. The overall minimum and maximum turbidity values were 0 NTU and 1.73 NTU, respectively. The average turbidity value was 0.28 NTU. The overall minimum and maximum pH values were 5.8 and 8.2, respectively. The average pH value was 6.9.

South Yuba Reach #2

After a review of the data resources listed above, the Licensee is unaware of water quality data specific to South Yuba River Reach #2.

South Yuba Reach #3

The UYRSP monitored temperature at one site within this stream reach from July 2003 to September 2005. A graphical summary of these monitoring results is provided in Attachment 7.2C of this report (UYRSP, 2006; see Attachment 7.2C located on a CD at the end of Section 7.2 of this PAD). Maximum daily average temperatures in this stream reach occur in late July and early August with a maximal daily average temperature of ~26ºC for the 2003 to 2005 sampling periods.

South Yuba Reach #4

The UYRSP monitored temperature at one site within this stream reach from June 2003 to July 2004. A graphical summary of these monitoring results is shown in Attachment 7.2C (UYRSP, 2006; see Attachment 7.2C located on the CD at the end of this section) Maximum daily average temperatures in this stream reach occur in late July and early August with a maximum daily average temperature of ~26ºC for the 2003 to 2004 sampling periods.

The Licensee was also able to locate historical CVRWQCB water quality data from the USEPA STORET database (USEPA, 2007; see Attachment 7.2C located on the CD at the end of Section 7.2 of this PAD) . The two sampling sites are located near the town of Washington (see Figure 6-1) and include data from April 1958 through May 1971. Waters from this reach have variable conductivity readings (19-102 µmhos/cm) with the elevated values occurring from samples in the fall/early winter (September to December). DO concentrations stayed above 7 mg/L and ranged from 7.1 mg/L to 11.4 mg/L, while pH levels were within CVRWQCB criteria over the sampling period (6.7 to 7.8). Alkalinity and hardness values were relatively low with both components ranging from 7-39 mg/L $CaCO_3$. Elevated Alkalinity and hardness values tend to occur during summer and fall sampling periods. Boron, nitrate and iron were the only sampled ions that had concentrations above detection limits. Boron was detected at both sites and had variable

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concentrations ranging from non-detect to 200 µg/L. Nitrate concentrations also ranged from non-detect to 0.8 mg/L. Iron samples were taken during May and October 1958, with a concentration of 20 µg/L and 0.0 µg/L (not detected) reported in these months, respectively. The elevated boron and nitrate concentrations do not appear to be associated with any particular sampling season.

SYRCL monitored TSS and bacterial levels at one station (#49 below Washington) from 2001-2007. They measured an average TSS of 9.22 mg/L with a high of 31 mg/L and an average *E. coli* of 127.32 MPN/mL with a high of 1732.9 MPN/100mL. Although the high for *E. coli* slightly exceeded EPA standards, the average for all TSS and bacterial levels fell within EPA standards for water quality.

SYRCL provided water quality data between 2001 and 2007 from three sites along this reach: Sites 25 (Scotchman Creek near Washington), 42 (Canyon Creek near Bowman Lake Road), and 49 (South Yuba River below Washington Relief Hill Road). The overall minimum and maximum conductivity values were 10 µmhos/cm and 70 µmhos/cm, respectively. The average conductivity value was 43.3 µmhos/cm. The overall minimum and maximum DO values were 3.4 mg/L and 13.3 mg/L, respectively. The average DO value was 9.4 mg/L. The overall minimum and maximum water temperature values were 3.9°C and 20°C, respectively. The overall average water temperature value was 10.1°C. The overall minimum and maximum turbidity values were 0 NTU and 238 NTU, respectively. The average turbidity value was 10.7 NTU. The overall minimum and maximum pH values were 5.4 and 8, respectively. The average pH value was 6.6.

South Yuba Reach #5

The Licensee reviewed a data report for South Yuba Reach #5 from SYRCL, who monitored TSS, metals and bacterial levels at six sites (#12, 13, 23, 29, 51, 53) from 2001-2006. They recorded an average TSS of 1.86 mg/L with a high of 6.9. The average level of *E. coli* was measured at 35.42 MPN/100mL with a high of 1,413.6 MPN/mL. Copper levels averaged 14.66 ppb (with a high of 141 ppb), while zinc averaged 10.73 ppb (with a high of 130 ppb). Only iron approached EPA drinking water standards (300 ppb), averaging 292.92 ppb (with a high of 742 ppb taken at site 29- Keleher).

SYRCL provided water quality data between 2000 and 2007 from six sites along this reach: Sites 12 (Upper Humbug Creek), 13 (South Yuba River above Humbug Creek), 23 (Poorman Creek past Washington), 29 (Keleher past Washington), 51 (Hiller Tunnel), and 53 (Humbug Relief Hill). The overall minimum and maximum conductivity values were 0 µmhos/cm and 90 µmhos/cm, respectively. The average conductivity value was 75 µmhos/cm. The overall minimum and maximum DO values were 5.3 mg/L and 17.6 mg/L, respectively. The average DO value was 10.2 mg/L. The overall minimum and maximum water temperature values were 0.7°C and 24.1°C, respectively. The overall average water temperature value was 10.1°C. The overall minimum and maximum turbidity values were 0 NTU and 1100 NTU, respectively. The average turbidity value was 16.6 NTU. The overall minimum and maximum pH values were 3.9 and 8.6, respectively. The average pH value was 7.0.

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South Yuba Reach #6

SYRCL monitored TSS, metal and bacterial levels along the South Yuba Reach #6 at eighteen stations (#9, 14, 15, 19, 21, 22, 26, 30, 31, 33, 34, 35, 36, 45, 47, 50, 52, 56) from 2000-2007. TSS levels averaged 1.57 mg/L over that period with a high of 5.8 mg/L. Levels of *E. coli* averaged 42.59 MPN/100mL with a high of 2419.2 MPN/100mL. Arsenic averaged 4.27 ppb with a high of 13.2 ppb, while copper averaged 14.01 ppb with a high of 174 ppb. Zinc averaged 10.29 with a high of 107 ppb, while nitrate averaged 0.01 ppb with a high of 0.04 ppb. All of these measured levels of metals, bacteria and TSS fell within EPA standards.

However, both iron and chromium average levels exceeded EPA standards (300 ppb and 0.1 ppb respectively). Iron levels averaged 1877.01 ppb with six readings over 10,000 ppb. Chromium levels averaged 15.01 ppb with a high of 74 ppb.

SYRCL provided water quality data between 2000 and 2007 from 17 sites along this reach: Sites 9 (Foote's Crossing at South Fork Yuba), 14 (South Yuba River below Humbug Creek), 15 (Purdon Crossing at bridge), 19 (Jones Bar), 21 (Spring Creek, downstream from Edwards Crossing), 22 (Lower Rock Creek at confluence with South Yuba River), 26 (Shady Creek), 30 (Edwards Crossing), 31 (Highway 49 Bridge), 33 (Brodgeport), 34 (Rock Creek above Lake Vera), 35 (Lower Rush Creek at Jones Bar), 36 (Upper Rush Creek/Highway 49 at Rush Creek Road), 45 (Kentucky Ravine Creek at Bitney Springs Road), 47 (Rock Creek below Lake Vera Dam), 50 (Above Purdon Crossing), and 52 (Upstream of Humbug confluence). The overall minimum and maximum conductivity values were 0 µmhos/cm and 340 µmhos/cm, respectively. The average conductivity value was 88.9 µmhos/cm. The overall minimum and maximum DO values were 2.4 mg/L and 18 mg/L, respectively. The average DO value was 10 mg/L. The overall minimum and maximum water temperature values were 1.7°C and 27.3°C, respectively. The overall average water temperature value was 12.1°C. The overall minimum and maximum turbidity values were 0 NTU and 202 NTU, respectively. The average turbidity value was 3.5 NTU. The overall minimum and maximum pH values were 5.1 and 11.5, respectively. The average pH value was 7.2.

Water Quality Data in the Bear River Sub-basin

There are two stream reaches potentially cumulatively affected by the Yuba-Bear Hydroelectric Project and other entities in the Bear River Sub-basin.

Table 7.2.10-11 Historical Water Quality Data for Stream Reaches in the Bear River Watershed

Stream Reach [A]	Date	Temp. [B] (°C)		PH	Turbidity		Conductivity (µmhos/cm)	Dissolved Oxygen (MG/L)	Notes
					NTU	Secchi Depth (FT)			
Drum Afterbay Dam Reach	1999								Mercury in Fish Tissue 0.06 – 0.20 ppm wet-weight
Bear River Canal Diversion Dam Reach	March 2003		6.0-18.5	6.4-7.9			28-51		Alkalinity 8.2 to 16.5 mg/L $CaCO_3$

[a] Only stream reaches with historical data are listed herein. A blank square means no data were found for that parameter.
[b] Samples were assumed to be surface samples unless report indicated otherwise (see narratives, below).

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Drum Afterbay Dam Reach

A mercury bioaccumulation study was conducted by USGS on fish species collected 1998 from the Drum Afterbay Dam Reach (May et al. 2000). Data from this study are summarized in Figure 9 and Table 8 of the May et al. (2000) report. The four trout samples collected in the Drum Afterbay Dam Reach had mercury concentrations ranging from 0.06 to 0.20 ppm wet-weight. These concentrations were less than the OEHHA (1999) guideline of 0.30 ppm.

Bear River Canal Diversion Dam Reach

The Licensee was also able to locate historical water quality data from the USGS NWIS database for the Bear River Canal Diversion Dam Reach (USGS, 2007; provided as Attachment E of this report). The USGS monitored water quality parameters in the upstream section of this stream reach, just below Rollins Reservoir (USGS 11422500). In addition, water samples were collected in March 2003 from the Bear River Canal below the diversion dam structure (USGS 11422000). In general, water quality data from the Bear River Canal sampling effort is similar to the data collected from the riverine reach. Waters from this reach of the Bear River have cool water temperatures (6.0-18.5 ºC), low conductivity readings (28-51 µmhos/cm) with variable Ph levels (6.4-7.9). The Ph value of 6.4 exceeds the minimum Ph criteria of 6.5 established by the CVRWQCB. Alkalinity was relatively low with values ranging from 8.2 to 16.5 mg/L $CaCO_3$. All nutrient concentrations were below detection limits with the exception of a total phosphorus sample from February 2003 at 0.005 mg/L. Elemental mercury was also sampled at this station, with dissolved concentrations from 0.87 to 2.09 nanograms per liter.

In 2007, Licensee collected water temperature data in the Bear River Canal Diversion Dam Reach (DTA, *unpublished data*). Site BR2 is located approximately .25 miles downstream of the Bear River Canal diversion dam. During the monitoring period, daily average temperatures did not exceed 20 ºC (Figure 7.2.10-18).

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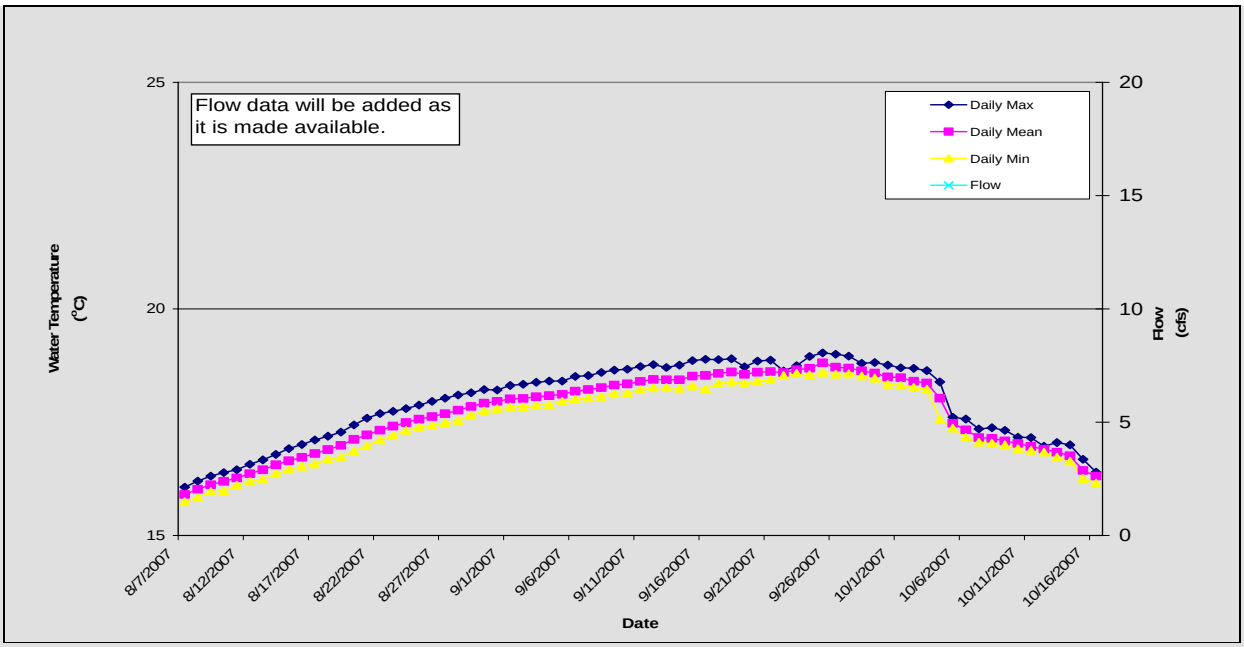

Figure 7.2.10-18. Stream water temperature data collected at Site BR2, Bear River Canal Diversion Reach (DTA, *unpublished data*).

A mercury bioaccumulation study was conducted by the USGS on fish species collected from the Bear River Canal Diversion Dam Reach (May et. al., 2000). Data from this study are summarized in Figure 9 and Table 8 of the May et. al. (2000) report. Overall, average mercury concentrations for brown trout and rainbow trout were less than the OEHHA (1999) guideline of 0.30 mg/L at 11 of the 13 sampling sites. In addition, trout collected in the two reference sites (stream reaches relatively unaffected by gold mining activities) had concentrations less than 0.10 mg/L. The three trout samples collected in the Bear River Canal Diversion Dam Reach represent the highest mercury concentrations of fish collected in stream habitats for this study. The average concentration was 0.40 mg/L, with values varying from 0.38 to 0.43 mg/L. These concentrations exceed the OEHHA (1999) guideline of 0.30 ppm.

7.2.10.5 Water Treatment Plant Raw Water Quality Data

Together, NID and PCWA operate fifteen water treatment plants that treat water from the Yuba and the Bear Rivers for drinking water. Two NID water treatment plants and three PCWA water treatment plants have intake structures on or close to Project facilities or affected river reaches:

- **Cascade Shores Water Treatment Plant:** This NID water treatment plant's intake structure is closest to Lake Spaulding (South Yuba River). The bulk of its water comes from Lake Spaulding, but some water from Deer Creek is also included.
- **North Auburn Water Treatment Plant:** This NID water treatment plant's intake structure is in Rock Creek Reservoir downstream from Rollins Reservoir. The bulk of its water originates in Lake Spaulding; however, some water from the North Fork of the North Fork American River is also included.

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- **Alta Water Treatment Plant:** This PCWA water treatment plant's intake is closest to Lake Spaulding and Lake Valley Reservoir. Alta Water Treatment Plant also treats Canyon Creek water.
- **Monte Vista Water Treatment Plant:** This PCWA water treatment plant sometimes receives water from YB-184 on the Little Bear River, downstream of the Alta Powerhouse.
- **Bowman Water Treatment Plant:** This PCWA water treatment plant usually receives water from YB-87 on the Bear River Canal, downstream of Rollins, but upstream of NID's North Auburn Water Treatment Plant intake.

In support of water treatment plant operation and compliance, treated water is sampled for all required Title 22 compliance constituents, while raw water is regularly sampled for turbidity, bacteria, radioactivity (early 1990's), total organic carbon, and alkalinity. Available raw surface water data are summarized below.

Table 7.2.10-12 Raw water data summary for water treatment plants in the vicinity of the Project[d]

Water Treatment Plant	Dates Of Collection	Monthly Average Turbidity (NTU)	Median Total Coliform (MPN/100 ml)	Gross Alpha Activity (pci/l)	Average Total Organic Carbon (mg/l)	Alkalinity (mg/L)
Cascade Shores (NID)	1991-1995a	1.3-7.9 Usually ≤2.5 Spikes in January	<3 – 2400 Usually <150 spikes in July-October	0.10 (one measure-ment in 1989)	--	--
	1996-2000b	Usually < 5; spikes associated with storm events	Total Coliform spikes occur year-round	--	--	--
	2001-2006c	1.3 Usually < 10	Coliform standards were met in the period of study	--	1.2	--
Alta (PCWA)	1991-1995a	0.4-95	<2 – >1600 Total Coliform spikes occur year-round	--	--	--
	1996-2000b	Usually < 10	Total Coliform spikes occur year-round	--	1.8	--
	2001-2006c	4.5 Usually < 10	Coliform standards were met in the period of study	--	1.4	21
Monte Vista (PCWA)	1991-1995a	0.7-41	11-1600 Total Coliform spikes occur year-round	--	--	--
	1996-2000b	Usually < 10	Total Coliform spikes occur year-round	--	1.7	--
	2001-2006c	6.7 Usually <10	Coliform standards were met in the period of study	--	1.3	40
Bowman (PCWA)	1991-1995a	1.0-120	4-900 Usually <150 spikes in November, December	--	--	--
	1996-2000b	<50	Total Coliform spikes occur year-round	--	1.2	--
	2001-2006c	5.3 Usually <10	Positive Coliform samples in the distribution in 2005 only	--	1.3	22

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Table 7.2.10-12 (continued)

Water Treatment Plant	Dates Of Collection	Monthly Average Turbidity (NTU)	Median Total Coliform (MPN/100 ml)	Gross Alpha Activity (pci/l)	Average Total Organic Carbon (mg/l)	Alkalinity (mg/L)
North Auburn (NID)		1.1-18.1 Higher December through April; <3 May - November	150-12000 Usually <1000 spikes in November, December	0.15 - <2	--	--
	Black & Veatch 2002	Usually < 30	Total Coliform spikes occur year-round	--	--	--
		3.7 Usually <10	Coliform standards were met in the period of study	--	1.5	--

a NID & PCWA 1996
b Black & Veatch 2002
c Starr and Palencia 2007
d The above table is not shaded due to formatting issues associated with the printing of shaded tables. The content of the table is consistent with the corresponding table in PG&E's Drum-Spaulding Project PAD.

Available sanitary survey appendices consisting of raw water quality data are provided as Attachment 7.2F. Black & Veatch (2002) observed that all water treatment plants receive water that is low in alkalinity and hardness. Other observations that can be made include (Table 7.2.10-10):

- Median raw water turbidity increases from upstream to downstream;
- Generally raw water turbidity in the Project area is less than 10 NTU.
- The 1996 survey observed that highest total coliform excursions occur July – October (NID & PCWA, 1996). The 2002 and 2007 surveys observed spikes throughout the year, but that standards were still met (Black & Veatch, 2002; Starr and Palencia, 2007).
- Average TOC levels for all water treatment plants are < 2 mg/L
- TOC levels do not increase downstream
- TOC levels are seasonally variable with the peak levels during the wet season (late fall to early spring).

Overall, the Yuba and Bear Rivers provides excellent water quality to the water treatment plants in the Project Area. Alkalinity received is generally greater than 20 mg/L. All raw water can be treated to meet drinking water standards using conventional treatment processes (Starr & Palencia 2007).

7.2.11 Mercury in the Bear and Yuba Watersheds

Mercury contamination in sport fish is found to be widespread in waterbodies throughout northern California due to both (1) historical mercury mining in the Coast Ranges, and (2) the use of the mercury in the gold extraction processes of the Sierra-Nevada gold mines (DWR 2007; Davis et. al. 2002). In the Sierra-Nevada, a large fraction of the mercury used in hydraulic mining of placer ores in the late 1800's was lost during processing and persists in the environment. Mercury associated with gold mining has been measured in the sediment, water, and biota from the Sierra Nevada's gold mining regions, the Central Valley, the Sacramento-San

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Joaquin Delta, and San Francisco Bay (DWR 2007; Davis. et. al. 2002). Mercury is of concern because it is a potent neurotoxin that bioaccumulates in muscle tissue.

Since the early 1990's, the South Yuba River and Bear Rivers have been studied by UC Davis and USGS (Alpers et al 2005; Hunderlach et al 1999; May et al 2000; and Slotton et al 1995 *IN* May et al 2000). Findings from these studies indicate that

- A significant amount of Gold Rush era mercury still exists in sediment in the upper Yuba watershed. This sediment is being transported downstream into reservoirs on the Yuba River, where it is largely trapped (Hunerach 1999; Alpers 2005). Data suggest this same process occurs on other rivers affected by hydraulic mining, such as the Bear River.
- Mercury in its bioavailable form, and attributable to historic hydraulic mining, has been found in fish tissue downstream of Spaulding Reservoir on the Yuba River and downstream and within Rollins Reservoir on the Bear River, at concentrations above California's OEHHA 1999 guideline of 0.30 ppm wet-weight (May et al, 2000; OEHHA 2003).
- South Yuba River Reach #2[6] and Bear River Reach #2[7] are thought to be above the gold mining influence, and hence were chosen by USGS as suitable reference sites (May et. al. 2000; Alpers et. al. 2005). Fish tissue, water, and sediment samples taken from the reference locations were non-zero but below regulatory benchmarks, as ambient sources of mercury also exist. Ambient sources include aerial deposition from industrial sources and forest fires that release mercury sequestered biomass.

Consequently, in the Project Area and its immediate vicinity, the Bear River from and including Rollins Reservoir to Lake Combie (Calwater Watersheds 51633010 and 51634033, respectively) are listed for mercury impairment (Medium TMDL Priority)[8]. Further, human-health based fish consumption advisories are also in place in these reservoirs and sections of the Bear River, as well the South Yuba River downstream of Lake Spaulding (OHHEA 2003).

Mercury data in fish tissue collected in the vicinity of the Project are summarized in Table 7.2.11-1 by basin:

Table 7.2.11-1 Fish Tissue Data from the Yuba and Bear River Watersheds in the Project Vicinity[1,2, 12]

Sample Location		Date	Species	Number of fish in Sample	Concentration Range (ppm)	Reference
Yuba River Basin						
South Yuba River Reach #2	South Yuba River Near Emigrant Gap	10/99	Brown trout	6	0.04-0.06	May et al 2000
South Yuba River Reach #4	South Yuba River near Edwards Crossing	9/99	Rainbow trout	2	0.09-0.15	May et al 2000

[6] Named "South Yuba River near Emigrant Gap" in May et. al. 2000.
[7] Named "Bear River at Highway 20" in May et. al. 2000.
[8] based on a review of the 2006 California 303(d) List and Total Maximum Daily Loads (TMDL) Priority Schedule, as shown on the SWRCB's website: http://www.swrcb.ca.gov/tmdl/303d_lists2006approved.html.
[12] The above table is not shaded due to formatting issues associated with the printing of shaded tables. The contact of the table is consistent with the corresponding table in PG&E's Drum-Spaulding PAD.

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Table 7.2.11-1 (continued)

Sample Location		Date	Species	Number of fish in Sample	Concentration Range (ppm)	Reference
Yuba River Basin (continued)						
South Yuba watershed, includes Deer Creek samples		1999	Rainbow trout	7	0.15-0.22 0.17 (avg)	May et al 2000 IN OEHHA 2003
Bear River Basin						
Bear River Reach #2	Bear River at Highway 20	8/99	Brown trout	composite	0.05-0.1	May et al 2000
Drum Afterbay Reach	Bear River above Dutch Flat	10/99	Brown trout, rainbow trout	composite	0.06-0.2	
Dutch Flat Afterbay Reach	Bear River Below Dutch Flat	10/99	Brown trout, rainbow trout	composite	0.07-0.23	
Dutch Flat Afterbay		1988	Rainbow trout	6	0.1-0.2	Hunderlach et al 1999
		1988	Rainbow trout	composite	0.03-0.05	
Rollins Reservoir		8/99-10/99	Black crappie, bluegill, brown trout, channel catfish, & largemouth bass	28	0.02-0.48	May et al 2000
		1995	Largemouth bass	1	0.56	California TSMP3 in May et al 2000
		1995	Smallmouth bass	1	0.14	
		1984	Channel catfish	1	0.25	
		1985	Channel catfish	1	0.35	

[1] Additional fish tissue data is available for areas downstream of the project.
[2] All results are in wet-weight or assumed to be in wet-weight.
[3] State of California Toxic Substances Monitoring Program (TSMP).

Reservoir operation may affect methylmercury concentrations within the Bear and Yuba watersheds. Within reservoirs, mercury loads, and hence methyl mercury loads, are influenced by their primary source of origin and physical form (solid, suspected, liquid or airborne), as well as seasonal changes and the resultant water chemistry changes due to thermal stratification (Austin 2006; Slotton et al 1995 *IN* Jones & Slotton 1996). Studies indicate that the wet-season is largely a time of transport of inorganic particulate mercury, whereas the more problematic methylation and bioaccumulation largely occur in the dry season (Olof et al 1997; Austin 2006). Research at Davis Creek Reservoir in the Berryessa/Clear Lake historic mercury mining district found that the seasonally anoxic bottom waters for the reservoir provided an annual pulse of methyl mercury to the reservoir food chain (Slotton et al 1995 *IN* Jones & Slotton 1996)

The deeper areas of a reservoir tend to stay cooler, and therefore denser, than the water above, and may become isolated during periods of warm weather. The oxygen in these deep regions is rapidly depleted, and the anoxic zone becomes available to the anaerobic bacteria that produce methylmercury. Withdrawals from this hypolimnetic zone may release methylmercury to the river below the dam.

Because the methylation of mercury is primarily a biological process, the degree of bacterial activity can, within a broad range, be more important than the total mercury concentration in the generation of elevated fish tissue mercury levels.[9] Anything that promotes the growth of

[9] Named "South Yuba River near Emigrant Gap" in May et. al. 2000.
[9] Named "Bear River at Highway 20" in May et. al. 2000.
[9] based on a review of the 2006 California 303(d) List and Total Maximum Daily Loads (TMDL) Priority Schedule, as shown on the SWRCB's website: http://www.swrcb.ca.gov/tmdl/303d_lists2006approved.html.
[9] http://www.wildlife.state.nm.us/recreation/fishing/documents/MercuryAdvisoryReport1.htm

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bacteria will tend to increase the production of methylmercury within the reservoir. While the micro-organisms involved generally use sulfate rather than oxygen as an electron receptor, their basic nutrient is still carbon. Reservoirs with a vegetative fringe show a pulse of methyl mercury production following inundation and desiccation of the shoreline vegetation. Factors contributing to mercury methylation and organism uptake are many, varied, and complex, however. In addition to organic carbon, redox potential, temperature, alkalinity buffering capacity, suspended sediment load, and geomorphology have also been identified as affecting methylation and organism exposure rates (OEHHA 2003)

7.2.12 List of Attachments

The following attachments are provided in the accompanying CD:

- Attachment 7.2A – Contains Yuba-Bear Draft Bathymetric Study Report. (Adobe PDF file)
- Attachment 7.2B – Contains raw data stored in the USEPA's STORET database (USEPA, 2006). Water quality data from non-Project-affected reaches are also included herein. (Adobe PDF, Microsoft Excel and Read me files)
- Attachment 7.2C – Contains raw data and publications of the SYRCL (SYRCL, 2001). (Microsoft Excel files)
- Attachment 7.2D - Contains data collected in support of NID and PCWA's Sanitary Surveys. (Adobe PDF files)
- Attachment 7.2E – Contains raw data stored in USGS' NWIS database (USGS, 2007). The sole sampling site is USGS 11421790, within Dutch Flat Afterbay Dam reach. Also consists of water quality data that were found to be from locations within the Yuba and Bear River watersheds, but outside the Project boundaries. (Adobe PDF, Microsoft Excel and Read me files)
- Attachment 7.2F - Contains temperature data collected in support of the Upper Yuba River Studies Program in 2004 (Appendix F of UYRSP, 2006). (Adobe PDF file)

Complete citations for these and other references are provided in the Reference section.

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