PACIFIC GAS AND ELECTRIC COMPANY

Rock Creek-Cresta Hydroelectric Project
FERC Project No. 1962

Water Temperature Monitoring
5-year Summary Report – 2002-2007

June 2008

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WATER TEMPERATURE MONITORING 5-YEAR SUMMARY REPORT 2002-2007

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SECTION 1.0

Introduction

1.1 Background

This report will summarize the results of six years of water temperature monitoring conducted by PGE as part of compliance with the Rock Creek-Cresta (RCC) Hydroelectric Project Federal Energy Regulatory Commission (FERC) License requirements. The monitoring program involved collecting data from facilities associated with the Licensee's Upper NFFR Project (FERC 2105) and RCC Project (FERC 1962). Both Projects are part of a series of major hydroelectric generation projects that utilize the water resources of the NFFR and its tributaries for hydroelectric power generation. Downstream of these Projects is the Poe Project (FERC 2107) operated by the Licensee, and the Oroville Project (FERC 2100) owned by the State of California Department of Water Resources (DWR). Delivering water to the NFFR upstream of Licensee's Rock Creek Powerhouse is the Licensee's Bucks Creek Project (FERC 619).

North Fork Feather River (NFFR) water temperatures in the RCC reaches reflect a combination of sources from three distinct watersheds. These sources in order of decreasing volume are; the Upper NFFR Project (Federal Energy Regulatory Commission [FERC] 2105), flows from the unregulated East Branch of NFFR (EBNFFR) and its tributaries, and the Bucks Creek Project (FERC 619). Diversions and tributary inflows within the two reaches also influence water temperatures in the Rock Creek-Cresta Project (Project).

The temperature of water arriving from FERC 2105 exerts significant influence on conditions in the RCC reaches. Water temperatures in FERC 2105 are primarily determined by conditions at the non-selective Prattville Intake in Lake Almanor. Pursuant to FERC Condition 4C of the Project License (issued October 24, 2001), temperature monitoring is required during the summer months to determine if and to what extent the 20°C temperature level can be met with reasonable control measures.

This report will focus on summarizing the results of water temperature monitoring conducted during the 2002 through 2007 monitoring periods. The 2007 monitoring effort was effectively the 6th year compliance monitoring (or the first year defined in the 2nd 5-year flow period) after the issuance of FERC 1962 License (issued October 24, 2001).

1.2 Regulatory History

1.2.1 FERC License

The original license for Rock Creek-Cresta was issued in 1947, and expired in 1982. PG&E filed a Relicensing application in 1979; between 1979 and 1993 PG&E amended its application a number of times. Following the expiration of the existing license in 1982, annual licenses were issued and Project operations continued pursuant to those annual licenses pending the disposition of PG&E's application for the new license.

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A draft Environmental Assessment for Rock Creek-Cresta was issued on November I, 1996. Subsequently, PG&E, and nine of the eleven interveners negotiated and signed a settlement agreement (Settlement) which resolves various issues in the proceeding. On September 29, 2000, PG&E, on behalf of the signatories, filed the Settlement with FERC, requesting that the measures for protection, mitigation, and enhancement (PM&E) of fish and wildlife resources set forth in the Agreement's Appendix A be incorporated, as articles in the new Rock Creek-Cresta license (FERC 2001).

A final EA evaluating the Relicensing proposal as modified by the Agreement and the Forest Service's preliminary Federal Powers Act Section 4(e) conditions and 10(a) (l) recommendations, was prepared jointly by FERC and the Forest Service and was issued on May 30, 2001. The Final License Application was issued by FERC on October 24, 2001.

1.2.2 Settlement Agreement

In July 1998, Pacific Gas and Electric Company (Licensee or PG&E), the USDA Forest Service (FS), the USDT Fish and Wildlife Service (FWS), the California Department of Fish and Game (CDFG), the California State Water Resources Control Board (SWRCB), American Whitewater (AW), Friends of the River (FOR), Chico Paddleheads (CP), Shasta Paddlers (SP), California Trout (CT), California Outdoors (CO), California Sportfishing Protection Alliance (CSPA), Plumas County (PC), and Natural Heritage Institute (NHI) agreed to engage in a public, collaborative process with the goal of executing a Settlement Agreement (Settlement). After a broad review of potential issues, it was decided that the efforts of the Collaborative should focus primarily on river flow and related issues (PG&E 2000a).

The Settlement was developed and executed with an Effective Date of September 29, 2000. As of that date, all of the Parties listed above with the exception of CSPA became signatories to the Settlement. Appendix A of the Settlement specifies Protection, Mitigation, and Enhancement (PM&E) measures recommended for inclusion in the new Project license, Section 4(e) Conditions, and other mandatory license conditions. Appendix B of the Settlement specifies additional measures agreed to among the Parties but not to be included in a new Project license, Section 4(e) Conditions, and other mandatory license conditions (PG&E 2000a).

The Agreement's Appendix A, which contains the signatories' proposed license conditions, provides for PG&E, among other conditions, to maintain a mean daily water temperature of 20 degrees Celsius or less in the Rock Creek and Cresta bypassed reaches, to the extent that the licensee can reasonably control such temperatures; and establish an Ecological Resources Committee (ERC), to be comprised of the representatives of the original parties to the Settlement (with the exception of the Forest Service, who will designate a liaison), for the purpose of assisting the licensee in the design of monitoring plans, review, and evaluation of data for implementation of the Settlement. While Appendix A requires establishment of the ERC, Appendix B, which the signatories did not propose to be included in the license, set out the purpose, composition, procedures, and function of the ERC.

In addition to the Settlement document, a Rationale Report providing the supporting documentation and rationale used by the Rock Creek - Cresta Relicensing Collaborative (Collaborative) in developing the PM&E measures and other measures included in the

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Settlement was compiled and released on November 29, 2000. The Rationale Report includes descriptions of the relationship between the available scientific information and the resulting measures outlined in the Settlement (PG&E 2000b). The Rationale Report addresses all of the PM&E measures recommended in Appendix A of the Settlement for inclusion in the new license and also other recommendations in

1.2.3 Other Documents and Related Regulatory Process

1.2.3.1. Informational Report on Water Temperature Monitoring

PG&E identified and evaluated twenty-four potential water temperature control alternatives for achieving colder water for the NFFR. Twenty of the twenty-four alternatives have potential application to the Rock Creek and Cresta reaches. Two others (Alternatives 12 and 24) are targeted at reducing water temperatures in the downstream Poe Reach and the other two (Alternatives 9 and 18) are targeted at the upstream Belden Reach. A detailed description of each of the potential water temperature control alternatives and PG&E's evaluation of each alternative's potential to achieve a mean daily water temperature of 20°C or less year-round in the subject reaches is provided a report titled: *Study Data and Informational Report on Water Temperature Monitoring and Additional Reasonable Water Temperature Control Measures* (PG&E 2005b).

1.2.3.2. Water Temperature Monitoring Plan

The Rock Creek-Cresta Hydroelectric Project License No.1962 (issued October 24, 2001) required the Licensee to file with FERC a water temperature monitoring plan which provided for the implementation of a water temperature monitoring program described in Condition No. 4C of the new Project License. The water temperature monitoring plan was to be filed with FERC within one year of issuance of the new Project License.

A draft Water Temperature Monitoring Plan was distributed to participants on the ERC by letter dated February 20, 2002. At the April 10, 2002 meeting the ERC concurred with the changes to the plan and referred the plan for approval by the SWRCB as specified in Appendix A, Section I.3 of the Settlement Agreement. The approved monitoring plan was issued on October 22, 2002. PG&E implemented the monitoring program on June 1, 2002 ahead of the one year grace period granted by the License conditions.

The general conditions outlined in the monitoring program were based on the Settlement Agreement and FERC License. These conditions included:

(1) Temperature and flow will be monitored from June 1 through September 30 for 15 years following issuance of the New Project License. The program shall meet the following minimum conditions: (a) no less than five years after installation of the Prattville Intake Modification provided for in the Settlement Agreement's Appendix A, Section I.2, or (b) five years after a determination pursuant to the Settlement Agreement's Section I.2, that the Prattville Intake Modification will be ineffective and therefore should not be constructed. During the term of the project license, the monitoring and reporting requirements may be reduced or terminated after it is demonstrated to the satisfaction of the FS and ERC that

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mean daily temperatures of 20°C (Temperature Objective) or less have been and will be achieved, or that a given requirement is not necessary to determine whether this Temperature Objective will be met. Additionally, once a predictive temperature model has been determined by the ERC and FS to be reasonably accurate for determining downstream temperatures, the number of non-telemetered sites or the frequency of reporting may be reduced.

(2) Temperatures at NF57 (the gaging station below Rock Creek Dam) and at NF56 (the gaging station below Cresta Dam) are to be monitored and telemetered, from June 1 through October 31, for the term of the project license. If the temperatures from the telemetered stations demonstrate that mean daily water temperatures regularly exceed 20°C in October, five selected monitoring stations in Rock Creek-Cresta reach will be expanded to include October.

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1.2.3.3. California Environmental Quality Act (CEQA) for FERC 2105

PG&E submitted an application to the FERC for relicensing of the Upper NFFR Project (FERC 2105). Prior to issuance of a new federal license, PG&E must obtain Clean Water Act (CWA) section 401 water quality certification by SWRCB. 401 certification of the FERC 2105 is subject to the California Environmental Quality Act (CEQA), and an Environmental Impact Report (EIR) with CEQA alternatives that include water temperature reduction proposals will be prepared to meet this requirement. SWRCB has endorsed a three-phased approach in order to base its findings on alternatives and project approval on “substantial evidence”. Level 1 casts a “wide net” that captures most all of the possible water temperature reduction alternatives and follows through a set of coarse screening criteria. Level 2 screens-out (eliminates) those water temperature reduction alternatives passing Level 1 screening that, after closer examination, are ineffective, infeasible, or are clearly inferior to other alternatives. The Level 1 and 2 was completed in 2007 and the report was issued on November 14, 2007. The Level 3 analysis will verify the effectiveness, sustainability and long-term reliability of the water temperature reduction measures. Currently, SWRCB is in the process of conducting Level 3 analysis and final screening of water temperature alternatives suitable for analysis in the EIR for the CEQA process. The result of the CEQA process will affect the water temperature regime in Rock Creek-Cresta.

1.2.3.4. Additional Reasonable Control Measures in Condition 4D

In pursuant to Condition 4D in FERC 1962 License, within five years of the date when FERC approves the water temperature monitoring plan, the licensee shall prepare a report that evaluates whether mean daily temperatures of 20 degrees Celsius or less have been and will be achieved in the Rock Creek and Cresta reaches, and if not, whether additional reasonable control measures are available. Due to the on-going CEQA process in the Upper NFFR (FERC 2105) described in Section 1.2.3.3, which will potentially affect water temperature regime in Rock Creek-Cresta reaches, ERC, in May 21, 2008, has collectively agreed to postpone the preparation of Condition 4D report and will recommend a submittal date after the completion of Level 3 analysis in the 2105 CEQA process.

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SECTION 2.0

Water Resource Monitoring

2.1 Condition 4C Compliance Monitoring

The RCC Hydroelectric Project FERC License No. 1962 required PG&E file a water temperature monitoring plan with FERC, which described the implementation (including a schedule for implementation) of the water temperature monitoring program described in Condition No. 4C of the Project License. The RCC water temperature monitoring plan was prepared in consultation with the RCC ERC and the FS and was implemented in June 2002.

The objective of the water temperature monitoring program is to:

1. *Document summer water temperatures and flows in the Rock Creek and Cresta reaches as well as in upstream drainages tributary to the Project.*
2. *Determine if mean daily water temperatures of 20°C or less can be met in the Rock Creek and Cresta reaches to the extent that Licensee can reasonably control such temperatures, particularly if a modified Prattville Intake is implemented.*
3. *Develop and verify a temperature model that predicts, with reasonable accuracy, the temperature profile of the river based on data from two telemetered temperature stations.*
4. *Install and monitor continuous temperature recorders at two telemetry stations installed at flow gaging stations in the Rock Creek and Cresta reaches.*

2.1.1 Water Temperature

In accordance with the Condition 4C in FERC 1962 License (issued October 2001), PG&E has been conducting water temperature monitoring program since 2002. This program covers temperature monitoring from Project 2105 upstream, from the unregulated East Branch of NFFR and other tributaries, from Bucks Creek Project FERC 619), and the Rock Creek and Cresta Project reaches. A complete discussion of each year's monitoring activities is presented in the respective annual reports ((PG&E 2003, 2004a, 2005a, 2006, 2007, 2008)). This section discusses in a generalized manner the monitoring program as implemented by PG&E.

Thirty-nine continuous water temperature stations are currently instrumented in an effort to define temperature characteristics at locations throughout the greater NFFR study area. Table 2-1 lists the station locations, and Figure 1 displays the spatial location of each station within the study area. Additionally, a continuous temperature recorder was located at Milsap Bar in the Middle Fork Feather River as a reference station.

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Table 2-1. Monitoring stations and descriptions.

Station ID	Alternate Station Identification	Station Location	Monitoring Activity [1]
NF1T	----	NFFR above Chester, CA.	F, TR
HB1T	----	Hamilton Branch of NFFR at HWY bridge	TR, F
NF-83	----	Hamilton Branch Powerhouse	F
HB2T	----	Hamilton Branch Powerhouse – canal head-works	TR
LA1T-S	----	Lake Almanor near Canyon Dam - Epilimnion	TR - buoy
LA1T-B	----	Lake Almanor near Canyon Dam - Hypolimnion	TR - buoy
LA – P1	----	Lake Almanor near Canyon Dam – near intake	IS-P
LA – P2	----	Lake Almanor - Offshore of Prattville Intake (LA2)	IS-P
LA – P3	----	Lake Almanor – middle of Eastern lobe (LA8)	IS-P
LA – P4	----	Lake Almanor – middle of Western lobe (LA6)	IS-P
LA-MET	----	Meteorological station on Prattville Intake	M
NF-1	11-399000	Lake Almanor near Prattville	Lake storage
NF2T	----	NFFR below Canyon Dam	TR,
NF-2	11-399500	NFFR below Canyon Dam	F
NF3T	----	NFFR at Seneca	TR
NF4T	NF-47 (PG&E)	NFFR above Caribou No.1 Powerhouse	TR F
BV1T		Butt Valley Powerhouse Tailrace	TR
NF-71	11-400600	Butt Valley Powerhouse	F
BV2T_S	----	BVR near Caribou No.1 Intake - Epilimnion	TR - buoy
BV2T_B	----	BVR near Caribou No.1 Intake - Hypolimnion	TR - buoy
BV-P1	----	BVR at Caribou No. 1 Intake	IS-P
BV-P2	----	BVR near Cool Springs Campground	IS-P
BV-P3	----	BVR near boat ramp	IS-P
BV-P4A	----	BVR near Caribou No.2 intake channel	IS-P (special)
BV-P4B	----	BVR at mouth of Caribou No.2 intake channel	IS-P (special)
NF-8	11-401050	Butt Valley Reservoir near Caribou (at dam)	Lake storage
CARB1T	----	Caribou No. 1 Powerhouse (internal)	TR
NF-63	11-401110	Caribou No. 1 Powerhouse	F
CARB2T	----	Caribou No. 2 Powerhouse tailrace (internal)	TR
CARB2BT	----	Caribou No. 2 Intake channel bottom at structure	TR
NF-263	11-401109	Caribou No. 2 Powerhouse	F
BC1T	----	Butt Creek upstream of Butt Valley Reservoir	TR
NF-4	11-400500	Butt Creek below ABC tunnel, near BVR	F
BC2T	----	Butt Creek downstream of Butt Valley Reservoir	TR
BC3T	----	Butt Creek near confluence with NFFR	TR, F
BD1T	----	Belden Reservoir at powerhouse intake	TR
NF-67	11-403050	Belden Reservoir	Lake storage
NF-103	----	Oak Flat Powerhouse	F

F = Flow
TR = Temperature Recorder, TR-buoy = Temp Recorders attached to buoy
TM= Telemetered Temperature RTU unit
IS-P = *In Situ* Profile
S = Staff gage
M = Meteorological station data

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Table 2-1 Continued

Station ID	Alternate Station Identification	Station Location	Monitoring Activity [1]
NF5T	---	NFFR below Belden Dam	TR
NF-70	11-401112	NFFR below Belden Dam	F
MC1T	----	Mosquito Creek near mouth	TR, F
NF6T	----	NFFR near Queen Lily Campground	TR
NF7T	----	NFFR near Gansner Bar	TR
EB1T	----	East Branch of NFFR above confluence	TR
NF-51	11403000	East Branch of NFFR above confluence	F
NF8T	----	NFFR at Belden Town Bridge	TR
BD2T	----	Belden Powerhouse (internal)	TR
NF-74	11-403050	Belden Powerhouse	F
YC1T	----	Yellow Creek near mouth	TR, F
RCK-MET	----	Meteorological station on Rock Creek Dam	M
CHIPT	----	Chips Creek near mouth	TR, S
NF9T	----	NFFR below Rock Creek Dam	TR
NF10T	----	NFFR below Rock Creek Dam at NF-57	TR
NF-57	11-403200	NFFR downstream of Rock Creek Dam	F
NF-57(water Temp)		Telemetered water temperature station at Gaging NF-57	TM
MR1T	----	Milk Ranch Creek near mouth	TR, F
CHAMT	----	Chambers Creek near mouth	TR, S
NF11T	----	NFFR below Granite Creek	TR
JC1T	----	Jackass Creek near mouth	TR
NF12T	----	NFFR above confluence with Bucks Creek	TR
BUCK1T	11-403700	Bucks Creek near mouth	TR, F
NF-20	----	Bucks Creek Powerhouse	F
BUCK2T	----	Bucks Creek Powerhouse tailrace	TR
NF13T	----	NFFR above Rock Creek Powerhouse	TR
RC1T	11-403800	Rock Creek Powerhouse (internal)	TR
NF-64	----	Rock Creek Powerhouse	F
RC2T	----	Rock Creek near mouth	TR, S
NF14T	----	NFFR below Cresta Dam	TR
GR1T	----	Grizzly Creek near mouth	TR, F
NF15T	----	NFFR downstream of Grizzly Creek	TR
NF-56	11-404330	NFFR downstream of Grizzly Creek	F
NF-56(Water Temp)		Telemetered water temperature station at Gaging NF-56	TM
NF16T	----	NFFR upstream of Cresta Powerhouse	TR
CR1T	----	Cresta Powerhouse (internal)	TR
NF-62	11-404360	Cresta Powerhouse	F
MB1T	----	Middle Fork Feather River at Milsap Bar	TR

F = Flow
TR = Temperature Recorder, TR-buoy = Temp Recorders attached to buoy
TM= Telemetered Temperature RTU unit
IS-P = *In Situ* Profile
S = Staff gage
M = Meteorological station data

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Temperature profiles in Lake Almanor and Butt Valley Reservoir were collected on a monthly basis. Water temperature profiles were collected at four locations in Lake Almanor; near the Canyon Dam Intake tower, near the Prattville Intake, in the middle of eastern lobe, and in the middle of western lobe. Three profiles are collected in Butt Valley Reservoir; one near the dam face in front of Caribou No. 1 Intake, and at points one-third and two-thirds of the reservoir length. A thermistor array, deployed from a buoy is installed in each reservoir to record continuous temperatures in the epilimnion and hypolimnion layers. Each buoy is located near the main dam in each reservoir.

2.1.2 Stream Flow

Twenty-seven flow monitoring stations are selected to capture the hydrological characteristics in the study area, including U. S. Geological Survey (USGS) gaging stations maintained by the Licensee, powerhouse flow data, and several temporary continuous flow stations or staff gauge stations at major tributaries.

Stream flow at un-gaged key locations will be measured at twelve stations in the study area (see Table 2-1). This monitoring is conducted independent of the Licensee's operation of the official USGS flow stations. During each site visit (May, June, July and September), stream stage will be recorded and flow measurements made to define the stage-flow relationship. Of the twelve flow monitoring stations, seven will be installed with a continuous stage recorder because their historic flow data were about 10% of the flow in the main stem, and the remaining five will be manually recorded for the stream stage. The streamflow measurements will be made using USGS approved streamflow measurement techniques. All measurements will be made using a Price AA-type flow meter and 5-foot top-setting wading rod. Measurement accuracy is within 10-15% due to the large substrate in the channel control.

2.1.3 Meteorology

Two meteorological stations, one at the Prattville Intake and the other at Rock Creek Dam, will monitor climatic conditions (see Figure 2-1). A full suite of meteorological data will be collected and stored on an hourly basis. This data includes air temperature, wind speed, wind direction, relative humidity and solar radiation. These stations are operated independent of any other meteorological stations located in the regional area.

2.1.4 Telemetry Stations

The NF57 and NF56 stations located at two USGS gaging stations will provide real-time telemetry of temperature data (see Figure 2-1). The telemetry stations, designated as "NF57 (water temp)" and "NF56 (water Temp)", are close to temperature stations NF10T (NF10 in Figure 2-1) and NF15T (NF15 in Figure 2-1) in Table 2-1, respectively. The data will be recorded, transmitted and alert status flagged to the Rock Creek and Caribou powerhouses, respectively. Temperature data at 30-minute intervals are to be stored locally in a data logger and transmitted through SCADA to powerhouses. At a designated time of the day, all transmitted data (a total of 48 points) are averaged to determine the mean daily temperatures of the preceding 24 hour period and an alert status of NF57 can be displayed at Caribou Powerhouse and that of NF56 can be displayed at Rock Creek Powerhouse. The superintendent

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at Rock Creek Powerhouse will review the status of both stations if the daily value exceeds 20°C. If mean daily temperatures exceed 20°C on two consecutive days, the Licensee will notify the ERC and FS. The data logger at each station will be serviced on a monthly basis or sooner in the event the radio transmission interruptions occur due to weather or other unforeseen conditions. The telemetered sensors, probe, and wiring system will be maintained and serviced annually to ensure its accuracy within 0.1°C.

2.1.5 Annual and Weekly Reporting

Comprehensive data reports have been provided on an annual basis, and submitted to the ERC and FS following each year's water temperature monitoring effort. The report include all monitoring results for the prior year and analyze the effectiveness of the control measures in achieving mean daily temperatures of 20°C or less in the Rock Creek and Cresta Reaches ((PG&E 2003, 2004a, 2005a, 2006, 2007, 2008)).

A second data product required by the Settlement Agreement is the provision of monitoring results on a short-term frequency basis during select periods of long-term monitoring. Specifically, data will be provided to the ERC weekly in dry or critical dry water years and bi-weekly in normal and wet water years, for the following 7 monitoring sites (see Table 2-1): NF9T, NF57 (Water Temp) (equivalent to NF10T), NF12T, NF13T, NF14T, NF56 (Water Temp) (equivalent to NF15T) and NF16T. The increased reporting effort shall occur 9 years of the first 15 years after issuance of project license. The ERC and FS shall determine, by May 1 of each year, if such provision is to take place under the current year. The mean daily temperatures will be provided via email sent mid-week by the Licensee.

The increased reporting effort was conducted in 2007 as a result of critically dry year conditions and will be repeated in 2008 (also a critical dry year condition). All data was provided to the ERC via email as prescribed for the period June 1 through September 30.

2.2 Special Investigations

2.2.1 Caribou Selective Use Testing

In addition to the routine compliance monitoring, a series of special tests were conducted in response to specific requests by the ERC. These special tests were conducted by the Licensee and the implementation and monitoring methods were improved over the years (PG&E 2003, 2004a, 2005a, 2006, 2007, and 2008). This section will discuss tests conducted to determine the effect of various controllable mitigation options that may have the potential to reduce water temperatures below the 20°C level. As part of the Condition 4C requirements, the Licensee was to determine the effect controllable factors (flow releases, intake configuration, release locations) would have on temperature control in the project area, as well as the effect of non-controllable factors (e.g. solar radiation, lack of shading, tributary inflow, powerhouse return flow).

To define and quantify the effect that preferential use of Caribou No. 1 has on temperatures in the lower NFFR, the Licensee conducted a special short duration operational test in July 2002. This test was conducted from July 3 through July 7, 2002 (PG&E 2003). During this period Caribou No. 1 was operated preferentially over Caribou No. 2. This test was again repeated

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July 18 through July 25, 2003 (PG&E 2004). The selective use test was not conducted in 2004 due to an extended outage at Butt Valley Powerhouse (PG&E 2005a). The selective use test was again conducted during the period July 9 through July 15, 2005 (PG&E 2006). During the 2006 monitoring effort and expanded testing regime was conducted as part of State Water Quality Control Board's CEQA Investigation under FERC 2105 Re-licensing. The result of this expanded monitoring effort as well as a focused discussion of results is presented in the report: *CEQA Special Testing Program Report* (Stetson/PG&E, 2007). During the period July 7 through July 13, 2007, the Licensee initiated temperature-based operational changes at the Caribou Powerhouse Complex in order to mitigate temperatures downstream (PG&E 2008).

2.2.2 CEQA Investigation Under FERC 2105

PG&E has investigated opportunities to minimize adverse water temperature effects to the NFFR through operational changes or physical modifications to existing facilities. A broad range of potential measures for reducing water temperature along all or segments of the NFFR has been described by PG&E (Source: North Fork Feather River Study Data and Informational Report on Water Temperature Monitoring and Additional Reasonable Water Temperature Control Measures, PG&E, Amended September 2005) and more recently, supplemented with measures developed by Stetson Engineers Inc. (Stetson) under supervision from SWRCB.

Preliminary assessment of the NFFR water temperature reduction measures available for consideration revealed a need for additional water temperature data collection, special field testing, and improved modeling to develop a set of feasible and effective alternatives suitable for California Environmental Quality Act (CEQA) analysis. Special tests and monitoring were proposed by Stetson, to collect the needed data and evaluate the effectiveness of promising measures to reduce NFFR water temperature. The testes included the following categories: (1) increased Canyon Dam release; (2) extended off-peaking hours at the Caribou Powerhouses; (3) reduced Butt Valley Powerhouse discharge for coldwater selective withdrawal; (4) conceptual development of Yellow Creek flow bifurcation from Belden Powerhouse discharge; and (5) increased Grizzly Creek release. These special tests are described in the following sections. A complete presentation of the results of these tests in provided in the report titled, 2006 North Fork Feather River Special Testing Data Report (Stetson /PG&E 2007).

The result of these tests helps develop and solidify assumptions that are being used in the development of a three-phased approach endorsed by SWRCB for the EIR analysis. Finding of the first two phases are being documented in the report: Level 1 and Level 2 Report, Development and Screening of Potentially Effective and Feasible Alternatives to Achieve the Basin Plan Objective for Water Temperature and Protect Cold Freshwater Habitat Beneficial Use Along the North Fork Feather River (Stetson, October 2007). The Level 3 study is currently under investigation and is expected to be completed by early 2009.

2.2.2.1. Cold-water Plume Plunge Tests

A total of six special tests were conducted (Table 3-1 in Stetson/PG&E 2007 report). Special Tests 1, 2 and 4 - Increased Canyon Dam Release Tests with Restricted Peaking Operations at Caribou #2 Powerhouse (which produces warm discharge). The purpose of these special tests was to better understand the effects of increased release of cold water from the Canyon Dam low

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level outlets on the thermal structure at Belden Reservoir while avoiding disturbance and mixing of warm powerhouse discharge from Caribou #2. Special Test 1 considered a cold water release rate of 90 cfs. Special Test 2 considered a 250 cfs release rate, and Special Test 4 considered a 600 cfs release rate. Additionally, the special testing program was designed to evaluate Belden Reservoir thermocline development and sustainability as the density current travels through the reservoir, monitor the water temperature of Belden Dam releases to the Belden Reach, and characterize thermal responses in the downstream reaches (e.g., Rock Creek, Cresta, and Poe reaches).

Special Test 3 - Extended Off-Peaking Hours Test for Caribou #2 Powerhouse concurrent with a combined increase of Canyon Dam/Caribou #1 release at 250 cfs. The purpose of the special test was to better understand the effects of the duration of peaking operations at the Caribou #2 Powerhouse on the thermal structure at Belden Reservoir and the water temperature of Belden Dam releases. This special test was designed to assess whether extending off-peaking hours (3 additional hours off compared to Test 2) for the Caribou #2 Powerhouse would allow more volume of cold water from the Canyon Dam low level outlet release to plunge into the bottom of Belden Reservoir thereby strengthening the thermocline and increasing the available cold water pool.

Special Test 5 - Caribou Special Test with Reduced Butt Valley Powerhouse Flows. Data collected by PG&E during testing conducted August 1-5. 1994, suggests that decreasing the rate of Butt Valley Powerhouse discharge to below 800 cfs by reducing approach velocities at the Prattville Intake would selectively increase the withdrawal from the Lake Almanor hypolimnion and lower the discharge water temperature (Source: Figure 7 in North Fork Feather River Study Data and Informational Report on Water Temperature Monitoring and Additional Reasonable Water Temperature Control Measures, PG&E, Amended September 2005). The purpose of Special Test 5 was to better understand the relationship between the discharge rate and discharge water temperature (and the associated dissolved oxygen level) at the Butt Valley Powerhouse. This special test was also intended to provide data to evaluate whether the colder water release from the Butt Valley Powerhouse (through a reduction in discharge rate) would plunge and travel 5-miles through Butt Valley Reservoir to become available for withdrawal at the Caribou No. 1 Intake. This special test was designed to include the collection of physical water quality data (temperature, dissolved oxygen and velocity) to better characterize the hydraulic behavior within the reservoir with changes in water delivery temperature.

2.2.2.2. Increased Grizzly Releases

Grizzly Creek Release Test comprised Special Test 6. The purpose of Special Test 6 was to better understand the effect of increased Grizzly Creek releases on warming rates associated with travel time along the creek to its confluence with the NFFR, and potential temperature reduction benefits available to the NFFR within the Cresta reach. It was expected that increased releases from Grizzly Forebay would shorten travel time and effectively reduce warming along the creek. Two special Grizzly releases were conducted, 20-cfs and 50-cfs. The special tests confirmed the reduction of the warming in Grizzly Creek by 2°C at the confluence with NFFR. Nevertheless, the colder water contributions from Grizzly Creek to the NFFR reduced water temperature only slightly in the Cresta Reach (Stetson/PG&E, 2007). .

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2.2.3 SNTMP Model

Several water temperature modeling studies have been developed and validated for PG&E on various reaches of the North Fork Feather River, from Seneca Reach to Poe Reach. Stream Network Temperature (SNTEMP) model developed by the U.S. Fish and Wildlife Service (Theurer et al 1984; Bartholow and Waddle 1986; Bartholow 1989) is used. Each reach has developed its own SNTEMP model with the stream geometry, shading effect and elevations specifically for its segment. Most of these models were initially developed in 1986 (WCC 1986), and since then have been fine-tuned and validated with multiple years of data (TRPA 2002, 2003; PG&E 2003; Bechtel Corporation and TRPA 2006).

In an effort to test the validity of, expand the scope of, and strengthen the output of existing models, data from Condition 4C are being added to enhance the creditability of the existing models. The primary purpose of this analysis is to validate and if necessary recalibrate the SNTEMP models for five different individual reaches of the NFFR (i.e. Seneca, Belden, Rock Creek, Cresta, and Poe) to allow for reliable prediction of the mean daily stream water temperature over a wide and broader range of hydrologic and meteorological conditions. A secondary purpose is to calibrate and test the capacity of each model to simulate daily maximum stream water temperature. The final calibrated reach models are to be used as a tool for the evaluation of daily mean and maximum temperatures under alternative project management scenarios in comparison to those under the existing conditions, The modeling simulation result will provide a basis for evaluating the reasonableness of water temperature control measures outlined in project Relicensing settlement agreements (PG&E 2000a; 2004b).

2.3 Water Temperature Mitigation

2.3.1. Facility Modifications

There has been no physical modification to any of the upstream project facilities to date that were part of any plan to modify water temperatures coming from the upper NFFR Project (FERC 2105). Licensee has evaluated the possible temperature effect from 24 alternative measures (North Fork Feather River Study Data and Informational Report on Water Temperature Monitoring and Additional Reasonable Water Temperature Control Measures, PG&E, Amended September 2005). SWRCB is currently conducting independent investigation in the EIR analysis for FERC 2105 re-licensing project. The finding of that study will potentially affect temperature regime in Rock Creek Cresta. In viewing the on-going studies, in their May 21, 2008 meeting, ERC has collectively determined to postpone any discussion on this matter until the completion of Level 3 study in the 2105 CEQA process. The completion is to be expected in early 2009.

2.3.2. Operational Modifications

The most significant change in operation resulting from the new license is the initiation of increased instream flow release in the Rock Creek and Cresta reaches. Table 2-2 summarizes the change in minimum flow regimes at each facility in the RCC reach. In accordance with the license condition, Licensee has initiated the second 5-year stream flow release schedule starting 2007.

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At present PG&E has found limited effect in using modified operations as a method of temperature control in the various reaches of the RCC Project. All operational based mitigation efforts have their nexus in the telemetered water temperature monitoring system installed in the permanent gages NF57 (Rock Creek Reach) and NF56 (Cresta Reach). As discussed previously, if mean daily temperatures at either location exceed 20 °C on two consecutive days, the Licensee will notify the ERC and FS. PG&E in consultation with the ERC and FS will then determine the appropriate course of action in an attempt to maintain daily average water temperature at 20°C or less.

In response to temperatures exceeding the two day 20°C threshold, PG&E will typically first use a modified operational regime at the Caribou Powerhouse Complex. As discussed in Section 2.2.1, the selective use of Caribou No. 1 over Caribou No. 2 can produce short-term temperature reductions in the downstream reaches of the RCC Project. Typically, this action produces best results when used in the early part of the season (early July). PG&E utilized this option during the period July 2005.

In addition to utilizing a modified operational regime, PG&E is required to increase base flow releases in the affected reach. For instance, in critically dry years, such as 2007, the instream flow increase from 150 cfs (for Rock Creek) or 140 cfs (for Cresta) to 200 cfs, or to any flow between 150/140 cfs and 200 cfs (with exceptional terms and conditions specified in Footnote 7 of Table A.1 in the FERC 1962 license, issued October 24, 2001) is considered an action plan when the reach temperature exceeds 20 °C on two consecutive days. PG&E utilized this option during the summer period of 2007.

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Table 2-2. Summary of minimum flow requirements.

Reach	Station	Water Year Condition	Pre-2002 Minimum Instream Release (cfs)											
			Mar	April	May	June	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb
Rock Creek	NF57	Wet-Normal	50	50	100	100	100	100	100	100	50	50	50	50
		Dry	50	50	50	50	50	50	50	50	50	50	50	50
		Critical Dry	50	50	50	50	50	50	50	50	50	50	50	50
Cresta	NF56	Wet-Normal	50	50	50	50	50	50	50	50	50	50	50	50
		Dry	50	50	50	50	50	50	50	50	50	50	50	50
		Critical Dry	50	50	50	50	50	50	50	50	50	50	50	50

Reach	Station	Water Year Condition	1st 5-yr Period (2002-2006) Minimum Instream Release (cfs)											
			Mar	April	May	June	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb
Rock Creek	NF57	Wet-Normal	250	250	250	220	180	180	180	180	180	200	225	225
		Dry	200	200	200	175	150	150	150	150	150	160	180	180
		Critical Dry	110	110	150	150	150	150	150	150	110	110	110	110
Cresta	NF56	Wet-Normal	250	250	250	240	220	220	220	220	220	240	240	240
		Dry	200	200	200	190	175	175	175	175	175	190	190	190
		Critical Dry	100	100	140	140	140	140	140	140	100	100	100	100

Reach	Station	Water Year Condition	2nd 5-yr Period (2007-2011) Minimum Instream Release (cfs)											
			Mar	April	May	June	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb
Rock Creek	NF57	Wet-Normal	350	350	350	260	260	260	260	2680	2680	350	350	350
		Dry	280	280	280	210	210	210	210	210	210	280	280	280
		Critical Dry	110	110	150	150	150	150	150	150	110	110	110	110
Cresta	NF56	Wet-Normal	350	350	350	325	325	325	325	325	325	350	350	350
		Dry	280	280	280	260	260	260	260	260	260	280	280	280
		Critical Dry	100	100	140	140	140	140	140	140	100	100	100	100

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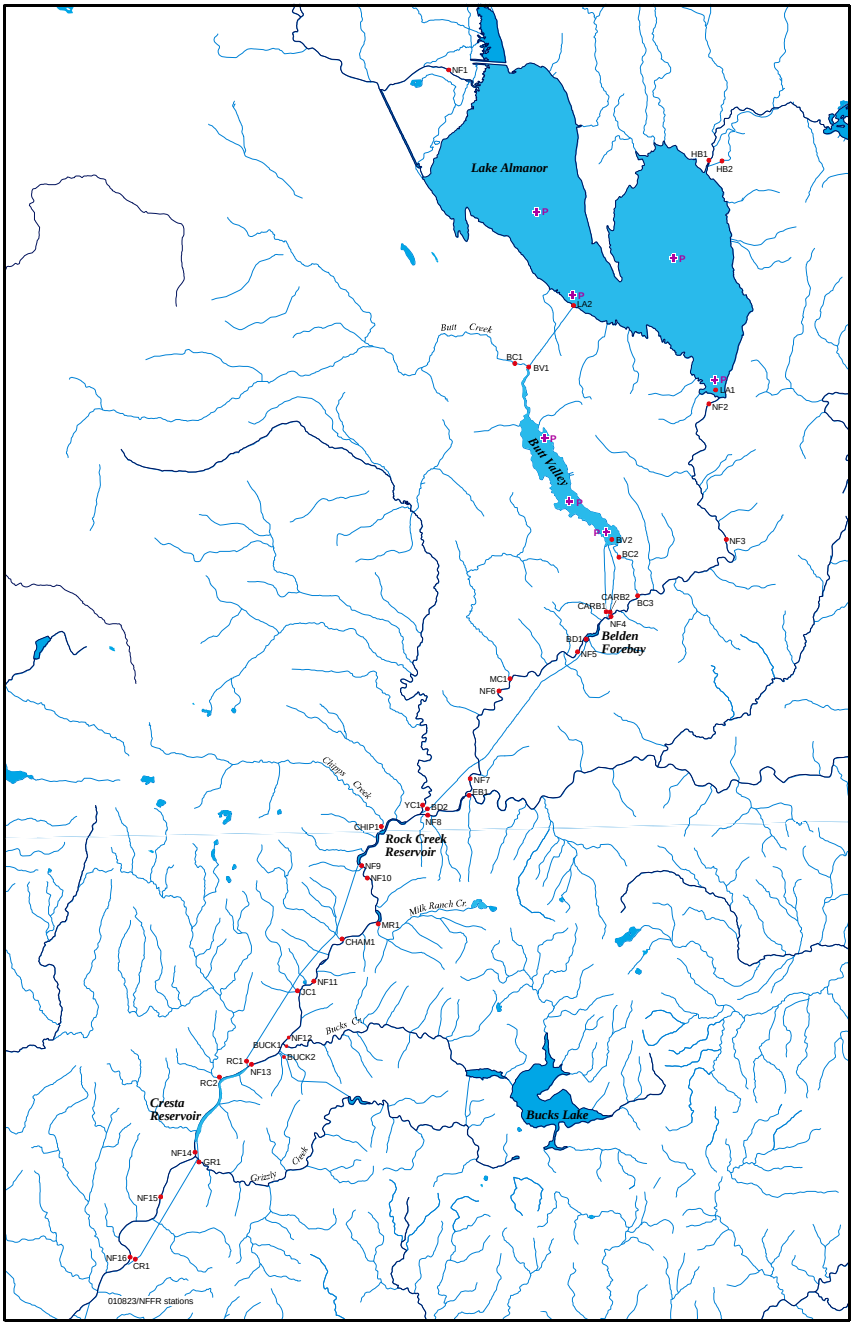

Figure 2-1. Regional map locating monitoring stations.

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SECTION 3.0

Discussion

3.1 Summary of Monitoring Results

3.1.1 Environmental Setting Characterization

3.1.1.1. Meteorology

Data from the two temporary meteorological stations is not presented in this document; rather this information is presented and discussed in each of the annual reports ((PG&E 2003, 2004a, 2005a, 2006, 2007, 2008). Data from these locations is collected primarily in support of the water temperature modeling efforts conducted as part of the Relicensing. Average monthly air temperature conditions reported from the Canyon Dam monitoring station are summarized for the period of record in Table 3-1. The data from the Canyon Dam station is presented in order to place the 2002-2007 monitoring periods in context with the historical record.

3.1.1.2. Hydrology

Data from the 12 stations where synoptic stream flow was measured are not presented in this document; rather this information is presented and discussed in each of the annual reports ((PG&E 2003, 2004a, 2005a, 2006, 2007, 2008). Data from these locations is collected primarily in support of the water temperature modeling efforts conducted as part of the Relicensing. Stream flow data from the permanent monitoring stations in the Rock Creek and Cresta reaches are summarized for the period of record in Table 3-2. The data from these permanent stations is presented in order to place the 2002-2007 monitoring periods in context with the historical record.

3.1.1.3. Official Classification

The water year types for the 2002-2007 periods are presented in Table 3-3, the water year types are defined in the Rock Creek-Cresta Relicensing Settlement Agreement (PG&E 2000a). Water years are defined as; *wet,* if the annual inflow to Oroville is greater than or equal to 5,679 thousand acre-feet (TAF); *normal,* if the annual inflow to Oroville is less than 5,679 TAF. but greater than or equal to 3,228 TAF; *dry,* if the annual inflow to Oroville is less than 3,228 TAF, but greater than or equal to2,505 TAF; and *critically dry,* if the annual inflow to Oroville Is less than 2,505 TAF. Table 3-3 also characterizes the average July and August air temperatures at the Prattville Climate Station for the six-year period in comparison to the long-term 32-year mean for the summer months.

As indicated by this data, the 2003, 2004, 2005 monitoring years were classified as having normal runoff conditions. The 2006 monitoring year was considered wet, while 2002 was considered dry. The 2007 monitoring effort was conducted under critically dry conditions.

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Table 3-1. Summary of regional air temperature data

	Monthly Average Air Temperature [1]										Annual
	May		June		July		August		September		Average
Year	(°F)	Key[2]	(°F)	Key	(°F)	Key	(°F)	Key	(°F)	Key	(°F)
1948	--	z	--	z	63.7		61.7		56.7		49.3
1949	51.3		60.8		65.8		61.7		59.4		45.4
1950	52.9		58.3		68.4		66.4		59.3		47.6
1951	52.3		62.6		66.5		64.9		62.2		47.6
1952	52.8		55.6		69.1		64.9		61.1	a	45.8
1953	45.8		54.2		66.4		62.1		62.5		46.7
1954	56.0		57.3		66.3		61.1		56.1	a	47.2
1955	51.3	b	59.3		62.8	a	65.7		58.1	a	45.2
1956	51.7		59.3		66.8		63.4		58.5		46.0
1957	49.9	a	61.6		64.1	a	61.5		60.0	b	46.2
1958	55.0	c	58.0	a	65.4	a	68.1		59.1	a	48.3
1959	48.9	d	59.5	g	66.4	f	62.7	b	54.8	a	44.5
1960	48.3	a	64.1		69.4	c	63.6	b	59.1	a	47.2
1961	47.6	d	61.7	c	65.2	c	64.0	a	52.8	f	44.7
1962	45.8	a	55.5		62.1	a	62.1		60.5		45.0
1963	53.1		57.1		61.3	b	63.6		60.6	d	47.0
1964	48.3		55.3		64.3		64.7		55.8	a	45.8
1965	49.1	a	57.6	a	64.9	a	61.7	b	53.6		45.6
1966	55.9	b	57.7	b	63.0	a	66.7	b	60.5		46.9
1967	48.6	d	57.8	e	66.6	b	69.4	g	60.7	g	42.7
1968	49.6	b	60.7		66.9		61.5	b	58.6	c	46.6
1969	55.2	b	59.1		66.1	b	65.3		60.5	c	46.1
1970	52.1	a	59.6	a	67.4	b	66.1		57.3		47.2
1971	48.5		56.5	a	68.0	b	67.9	a	56.5	a	45.2
1972	52.5		61.0		68.2	a	66.1		55.3	c	46.4
1973	56.2		61.8		67.9	a	65.2		58.3	b	48.3
1974	52.6		63.1	a	65.7		65.7		63.3	a	48.0
1975	52.4		60.1		65.6		63.5		63.1		46.3
1976	55.3	a	58.2		66.9		60.1		59.9	b	47.8
1977	44.6	b	65.0	a	67.2	a	69.3	b	57.1		48.2
1978	51.7		58.4		65.7		64.7		54.8		48.4
1979	54.0		59.5		66.1	c	63.6	c	61.4	b	47.7
1980	50.7		54.9		65.7		63.5	b	58.6		47.6
1981	53.1		62.9	a	65.4	a	67.8	b	61.5		49.3
1982	53.6		58.2		63.7		64.0		55.9		45.8
1983	51.9		57.9		60.9		64.4		59.2		46.9
1984	54.7		58.1		69.2		65.0		59.6		47.4
1985	51.8		--	z	68.5		63.5		53.7		45.4
1986	52.3		61.8		64.0		66.9		52.9		48.9
1987	55.4		62.5		63.2		67.8		61.7		51.3
1988	49.7		60.6	a	71.6		68.0		61.2		49.3
1989	51.2		58.8		60.6		58.4		54.2		44.9
1990	46.4		54.0		63.1		60.6		56.2		43.8

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	Monthly Average Air Temperature [1]										Annual
	May		June		July		August		September		Average
Year	(°F)	Key[2]	(°F)	Key	(°F)	Key	(°F)	Key	(°F)	Key	(°F)
1991	48.4		56.8		67.7		64.5		63.2		48.1
1992	59.1		61.1		64.7		67.9		60.5		49.4
1993	52.2		56.8		62.3		63.2		59.1		45.7
1994	53.2		59.2		69.9		64.9		60.2		47.5
1995	49.5		57.0		63.7		63.8		61.6		48.0
1996	51.2		61.6		69.9		67.4		58.0		49.1
1997	56.3		59.2		66.1		65.1		59.2		48.6
1998	-----	z	57.5		67.9		67.3		61.5		47.0
1999	51.6		59.1		64.9		63.8		61.4		48.1
2000	52.8		63.3		64.2		65.8		58.3		48.4
2001	59.6		61.4		67.0		67.6		62.4	a	49.4
2002	51.9		62.5		70.9		66.5		61.3		49.0
2003	52.5		64.1		70.1		65.4		62.7		49.4
2004	52.4		62.5		67.7		66.4		59.3		48.6
2005	52.3		--	z	70.3		66.9		56.5		47.5
2006	54.3		63.3		69.3		65.1		60.5		48.1
2007	53.9		60.4		68.2		66.3		57.7		49.8
Period of Record Statistics											
MEAN	51.9		59.5		66.2		64.7		59.0		47.3
S.D.	3.1		2.7		2.6		2.3		2.7		1.4
SKEW	-0.1		0.0		-0.1		-0.4		-0.5		-0.4
MAX	59.6		65.0		71.6		69.3		63.3		49.4
MIN	44.6		54.0		60.6		58.4		52.9		43.8
NO YRS	58		56		59		59		58		47

1: Data source: California Climate Data Archive, Western Region Climate Center website.

2: Key, Alphabetical value represents the number of missing data days in the month. For example a = 1 missing day, while z = 26 missing days, no period with more than 25 missing days was included in the statistics.

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Table 3-2. Summary of monthly stream flow data from NF56 and NF57 monitoring stations.

Gage NF57 - Rock Creek Reach - below Rock Creek Dam												
YEAR	Monthly mean in cfs (Calculation Period: 1986-10-01 through 2007-09-30)[1] Period-of-record for statistical calculation restricted by user											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1986	--	--	--	--	--	--	--	--	--	175	64	62
1987	61	177	222	62	55	56	55	53	53	53	53	60
1988	58	53	54	57	112	111	108	109	106	109	171	54
1989	55	54	2225	139	104	116	123	107	107	109	58	54
1990	53	56	53	54	110	108	106	106	106	106	56	53
1991	54	53	361	90	108	108	108	107	107	107	55	53
1992	52	69	61	60	108	109	110	109	109	107	71	55
1993	337	207	3262	1283	561	132	111	111	110	116	57	54
1994	53	53	53	54	112	111	113	113	112	110	54	52
1995	2362	774	8612	5384	7371	2684	163	125	121	111	158	272
1996	115	3378	1699	3014	1963	172	113	119	112	113	76	3012
1997	12700	2257	375	187	186	168	134	178	314	151	115	81
1998	652	1271	2128	783	1255	2105	164	146	143	151	226	586
1999	396	2299	751	671	256	200	131	145	199	211	75	70
2000	283	1328	402	152	122	146	169	120	179	116	60	60
2001	59	135	130	57	110	111	113	113	115	111	76	118
2002	403	121	352	359	316	267	217	209	228	218	225	747
2003	373	240	594	374	421	295	230	215	221	224	212	265
2004	353	1612	505	318	306	313	275	270	259	272	221	272
2005	361	367	587	279	1323	483	265	264	290	243	247	2845
2006	2855	1605	3041	5979	4314	643	276	288	299	297	341	609
2007	550	666	422	248	185	180	216	280	277			

1: Data Source: USGS web site

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Table 3-2. Continued

Gage NF56 - Cresta Reach - below Grizzly Creek

YEAR	Monthly mean in cfs (Calculation Period: 1986-10-01 through 2007-09-30)[1] Calculation period restricted by USGS staff due to special conditions at/near site											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1985	--	--	--	--	--	--	--	--	--	182	169	183
1986	605	--	--	--	--	--	--	--	--	129	59	60
1987	77	357	482	106	75	66	59	59	59	59	61	215
1988	140	80	86	78	69	56	55	56	57	59	256	78
1989	62	72	4115	458	97	63	63	62	66	99	73	59
1990	114	79	132	95	107	106	60	60	59	60	60	60
1991	56	62	669	208	117	62	56	56	56	57	59	61
1992	62	256	140	164	68	58	58	57	59	65	58	148
1993	837	493	5375	2270	1320	219	62	62	64	64	64	82
1994	68	105	113	92	76	60	60	59	60	61	60	83
1995	4995	1364	10220	6777	9322	3842	221	120	87	89	92	468
1996	258	4344	2026	3420	3492	203	82	62	60	59	198	5071
1997	16310	6576	2774	459	113	95	196	205	89	94	130	151
1998	1435	2153	2666	1384	2160	3465	205	78	68	108	589	925
1999	589	2582	1031	840	318	107	72	99	235	303	136	75
2000	243	1934	748	468	168	92	123	62	58	62	62	66
2001	68	103	182	143	111	63	54	55	72	59	108	196
2002	439	196	451	393	343	321	265	261	262	260	320	1457
2003	904	389	778	543	875	335	307	292	276	296	292	475
2004	500	2151	821	448	361	279	273	273	282	283	247	347
2005	472	498	796	321	2188	374	297	305	305	282	299	4320
2006	3852	2104	3740	7446	5937	964	285	293	292	285	636	1382
2007	647	1065	516	318	190	183	224	260	262			

1: Data Source: USGS web site

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Table 3-3. Summary of water year classifications – 1977 to 2007.

			Air Temperature			
Water	**Oroville Inflow**	**Water Year**	**Average July**		**Average August**	
Year	**Acre/ft**	**Classification**	**°F**	**Classified**	**°F**	**Classified**
1977	994460	Critical Dry	67.2	Norm	69.3	Hot
1978	5685200	Wet	65.7	Norm	64.7	Norm
1979	3022670	Dry	66.1	Norm	63.6	Norm
1980	5532910	Normal	65.7	Norm	63.5	Below norm
1981	2477630	Critical Dry	65.4	Norm	67.8	Above norm
1982	8997970	Wet	63.7	Below norm	64.0	Norm
1983	9417900	Wet	60.9	Cold	64.4	Norm
1984	5766850	Wet	69.2	Above norm	65.0	Norm
1985	2641570	Dry	68.5	Above norm	63.5	Below norm
1986	6760096	Wet	64.0	Below norm	66.9	Above norm
1987	2227099	Critical Dry	63.2	Below norm	67.8	Hot
1988	2048746	Critical Dry	71.6	Hot	68.0	Hot
1989	3687208	Normal	60.6	Cold	58.4	Cold
1990	2171008	Critical Dry	63.1	Below norm	60.6	Cold
1991	2056564	Critical Dry	67.7	Norm	64.5	Norm
1992	1897540	Critical Dry	64.7	Below norm	67.9	Hot
1993	5713493	Wet	62.3	Cold	63.2	Below norm
1994	1891318	Critical Dry	69.9	Hot	64.9	Norm
1995	9279510	Wet	63.7	Below norm	63.8	Norm
1996	5782870	Wet	69.9	Hot	67.4	Above norm
1997	6754364	Wet	66.1	Norm	65.1	Norm
1998	7199112	Wet	67.9	Above norm	67.3	Above norm
1999	5277732	Normal	64.9	Norm	63.8	Norm
2000	4244967	Normal	64.2	Below norm	65.8	Norm
2001	2040604	Critical Dry	67.0	Norm	67.6	Above norm
2002	3084333	Dry	70.9	Hot	66.5	Above norm
2003	4692588	Normal	70.1	Hot	65.4	Norm
2004	3800133	Normal	67.7	Above norm	66.4	Above norm
2005	4266478	Normal	70.3	Hot	66.9	Above norm
2006	8212277	Wet	69.3	Above norm	65.1	Norm
2007	2481814	Critical Dry	68.2	Above norm	66.3	Above norm

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3.1.2 Compliance with License

The objective of the water temperature monitoring program is to:

1. *Document summer water temperatures and flows in the Rock Creek and Cresta reaches as well as in upstream drainages tributary to the Project.*
2. *Determine if mean daily water temperatures of 20°C or less can be met in the Rock Creek and Cresta reaches to the extent that Licensee can reasonably control such temperatures, particularly if a modified Prattville Intake is implemented.*

The discussion of each monitoring years results will not be duplicated in this document, rather this information is presented and discussed in each of the annual reports (PG&E 2003, 2004a, 2005a, 2006, 2007, and 2008). A summary of average water temperature, stream flow, and reservoir elevations for the July-August period measured during the six compliance monitoring years (2002-2007) are summarized in Table 3-4. Also included in Table 3-4 is an evaluation of water temperature exceedance of the 20°C daily average criteria prescribed in the Agreement. The exceedance value is expressed as the percent of days during the July-August period when daily average temperatures exceeded 20°C. The data presented in Table 3-4 includes all stations monitored as part of the water temperature monitoring effort and illustrate in a broad manner the areas of the watershed that experience water temperatures exceeding the 20°C criteria.

Mean daily water temperature data collected from key locations over the 2002-2007 monitoring period were evaluated with regard to distribution of water temperatures. The resulting water temperature distribution is presented using a range of exceedance values. These values are expressed as categories representing 10, 25, 50, 75, 90 percent exceedance. The results of this analysis is presented in Table 3-5, and discussed by stream reach in the following sections. Unless specified otherwise, the discussion is limited to daily average water temperatures.

3.1.2.1. Seneca Reach

The Seneca Reach of the NFFR extends from Canyon Dam to its terminus upstream of Belden Forebay and the Caribou Powerhouse complex. Three stations are monitored in the main stem of the NFFR in this reach (NF2T, NF3T, and NF4T). Butt Creek is the only large tributary in the reach, entering the NFFR downstream of Station NF3T (Figure 2-1). The results of the water temperature distribution analysis from Station NF2T (initial conditions) for all data from the period June through September 2002-2007 is presented in Figure 3-1. Daily average water temperatures at Station NF2T exceeded 20°C, 17 % of the monitoring days in July, and 16 % of the monitoring days in August. Water temperatures over 20°C were the result of operational conditions occurring in 2004 when the upper gate of the Canyon Dam intake tower was used exclusively to make the minimum release. This was necessary to facilitate required repairs to the lower release gate. The results of the water temperature distribution analysis from the NF4T station (terminal conditions) for all data from the period June through September 2002-2007 is presented in Figure 3-2. As indicated, water temperatures at this station are

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Table 3-4. Percent of time daily average water temperature exceeding 20° C, 2002-2007 monitoring data

		Period - July 1 through August 31			
Station	**Year**	**Average Water Temperature For period (° C)**	**Daily Average Exceedance (%of days exceeding 20°C)**	**Maximum Hourly Water Temperature (° C)**	**Average Flow for period (cfs)**
River Stations					
NF1T	2002	14.9	0%	20.1	148
	2003	13.9	0%	19.9	225
	2004	14.3	0%	19.1	160
	2005	14.1	0%	19.3	200
	2006	12.8	0%	18.1	283
	2007	14.5	0%	20.4	95
HB1T	2002	11.9	0%	17.1	75
	2003	11.5	0%	14.9	89
	2004	11.9	0%	15.5	29
	2005	11.5	0%	14.7	84
	2006	11.6	0%	15.6	125
	2007	11.6	0%	15.6	80
BC1T	2002	13.9	0%	18.9	44
	2003	13.7	0%	19.0	65
	2004	13.4	0%	18.1	50
	2005	13.9	0%	18.4	58
	2006	15.7	0%	17.6	70
	2007	13.2	0%	18.1	75
NF2T	2002	12.9	0%	14.0	36
	2003	11.9	0%	12.8	36
	2004	21.1	98%	23.0	36
	2005	13.6	2%	21.5	37
	2006	9.2	0%	16.7	57
	2007	12.3	0%	14.3	40

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Table 3-4

(Continued)

		Period - July 1 through August 31			
Station	**Year**	**Average Water Temperature For period (^{o}C)**	**Daily Average Exceedance (%of days exceeding 20°C)**	**Maximum Hourly Water Temperature (^{o}C)**	**Average Flow for period (cfs)**
River Stations					
NF3T	2002	14.7	0%	17.4	----
	2003	13.9	0%	17.2	----
	2004	18.4	0%	21.4	----
	2005	14.9	0%	20.6	----
	2006	11.7	0%	18.3	----
	2007	14.0	0%	16.7	----
NF4T	2002	15.4	0%	18.4	75
	2003	14.8	0%	18.8	70
	2004	16.8	0%	20.1	64
	2005	15.1	0%	19.0	71
	2006	13.2	0%	18.6	101
	2007	14.6	0%	17.7	64
BD1T	2002	21.7	95%	23.0	----
	2003	20.0	65%	22.0	----
	2004	21.2	90%	22.4	----
	2005	20.6	79%	22.2	----
	2006	18.1	0%	19.8	----
	2007	20.5	85%	21.7	----
NF5T	2002	20.1	61%	21.5	143
	2003	19.1	23%	21.0	143
	2004	20.8	79%	22.1	145
	2005	19.8	55%	21.9	147
	2006	17.2	0%	19.6	143
	2007	19.9	66%	21.5	146

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Table 3-4

(Continued)

		Period - July 1 through August 31			
Station	**Year**	**Average Water Temperature For period (^{o}C)**	**Daily Average Exceedance (%of days exceeding 20°C)**	**Maximum Hourly Water Temperature (^{o}C)**	**Average Flow for period (cfs)**
NF6T	2002	19.9	48%	22.9	----
	2003	18.9	8%	22.4	----
	2004	20.4	77%	23.2	----
	2005	19.4	45%	22.9	----
	2006	17.2	0%	20.4	----
	2007	19.7	48%	22.7	----
NF7T	2002	19.9	50%	24.0	----
	2003	19.1	10%	23.6	----
	2004	20.3	76%	23.9	----
	2005	19.5	40%	23.3	----
	2006	17.5	0%	21.3	----
	2007	19.6	35%	23.5	----
NF8T	2002	21.1	87%	25.2	----
	2003	20.7	73%	25.4	----
	2004	21.3	100%	25.5	----
	2005	21.1	97%	25.3	----
	2006	19.9	37%	24.1	----
	2007	20.7	87%	24.8	----
EB1T	2002	22.8	97%	26.5	66
	2003	22.3	100%	27.4	128
	2004	22.3	100%	26.6	76
	2005	22.4	97%	26.6	147
	2006	21.4	82%	26.5	197
	2007	22.4	100%	26.0	72

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Table 3-4

(Continued)

		Period - July 1 through August 31			
Station	**Year**	**Average Water Temperature For period (^{o}C)**	**Daily Average Exceedance (%of days exceeding 20°C)**	**Maximum Hourly Water Temperature (^{o}C)**	**Average Flow for period (cfs)**
NF9T	2002	----	----	----	----
	2003	20.0	58%	22.2	----
	2004	21.1	92%	22.2	----
	2005	20.7	81%	22.0	----
	2006	18.7	0%	20.3	----
	2007	20.5	85%	21.6	----
NF10T	2002	21.3	97%	23.4	213
	2003	20.1	65%	22.8	214
	2004	21.1	92%	22.5	272
	2005	20.7	81%	22.6	265
	2006	18.7	3%	20.8	282
	2007	20.5	85%	22.4	248
NF11T	2002	21.3	93%	24.0	----
	2003	20.3	68%	24.3	----
	2004	21.1	95%	23.9	----
	2005	20.7	82%	24.1	----
	2006	19.2	15%	22.9	----
	2007	20.8	92%	23.7	----
NF12T	2002	21.3	95%	24.0	----
	2003	20.3	66%	23.9	----
	2004	21.2	97%	23.6	----
	2005	20.8	84%	23.9	----
	2006	19.4	23%	22.7	----
	2007	20.8	94%	23.4	----

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Table 3-4

(Continued)

		Period - July 1 through August 31			
Station	**Year**	**Average Water Temperature For period (^{o} C)**	**Daily Average Exceedance (%of days exceeding 20°C)**	**Maximum Hourly Water Temperature (^{o} C)**	**Average Flow for period (cfs)**
River Stations					
NF13T	2002	20.0	58%	24.1	----
	2003	18.5	18%	24.2	----
	2004	18.8	10%	22.8	----
	2005	17.9	0%	22.7	----
	2006	16.6	0%	21.2	----
	2007	19.6	35%	23.6	----
NF14T	2002	20.9	94%	22.8	----
	2003	19.8	34%	22.9	----
	2004	20.7	87%	22.2	----
	2005	20.7	73%	22.1	----
	2006	18.4	3%	20.9	----
	2007	20.3	71%	22.5	----
NF15T	2002	20.9	92%	23.5	263
	2003	19.9	42%	23.9	291
	2004	20.7	85%	23.3	273
	2005	20.2	66%	23.3	301
	2006	18.5	6%	22.2	289
	2007	20.4	71%	23.6	242
NF16T	2002	21.3	95%	23.9	----
	2003	20.1	50%	23.9	----
	2004	21.0	95%	23.4	----
	2005	20.5	77%	23.4	----
	2006	18.8	8%	22.2	----
	2007	20.8	87%	23.6	----

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Table 3-4

(Continued)

		Period - July 1 through August 31			
Station	**Year**	**Average Water Temperature For period (^{o}C)**	**Daily Average Exceedance (%of days exceeding 20°C)**	**Maximum Hourly Water Temperature (^{o}C)**	**Average Flow for period (cfs)**
Tributary Stations					
BC2T	2002	10.7	0%	11.2	----
	2003	10.8	0%	11.9	----
	2004	10.7	0%	11.2	----
	2005	10.8	0%	11.4	----
	2006	10.9	0%	11.7	----
	2007		Not Deployed in 2007		
BC3T	2002	12.4	0%	14.0	14.0
	2003	12.3	0%	14.3	15.1
	2004	12.6	0%	14.5	15.1
	2005	12.4	0%	14.3	14.4
	2006	12.1	0%	14.2	14.8
	2007	12.1	0%	13.9	12.9
MC1T	2002	14.3	0%	16.7	4.3
	2003	13.5	0%	NA	6.4
	2004	14.0	0%	16.2	5.6
	2005	14.0	0%	16.4	6.7
	2006	13.5	0%	16.3	9.4
	2007	13.7	0%	15.8	4.7
YC1T	2002	16.4	0%	20.1	55
	2003	15.7	0%	20.1	81
	2004	15.7	0%	18.1	64
	2005	15.8	0%	19.1	105
	2006	15.0	0%	19.2	99
	2007	15.9	0%	20.3	55

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Table 3-4

(Continued)

		Period - July 1 through August 31			
Station	**Year**	**Average Water Temperature For period (^{o}C)**	**Daily Average Exceedance (%of days exceeding 20°C)**	**Maximum Hourly Water Temperature (^{o}C)**	**Average Flow for period (cfs)**
Tributary Stations					
CHIPT	2002	16.3	0%	21.0	21
	2003	15.4	0%	20.7	30
	2004	15.6	0%	19.5	21
	2005	15.1	0%	19.1	43
	2006	14.9	0%	19.7	33
	2007	16.1	0%	20.0	18
MR1T	2002	15.7	0%	20.4	4.3
	2003	15.4	0%	21.1	11.7
	2004	15.5	0%	20.2	6.1
	2005	15.5	0%	19.8	9.2
	2006	14.9	0%	19.9	8.3
	2007	15.5	0%	19.2	3.4
CHAMT	2002	16.3	0%	21.4	5.3
	2003	15.7	0%	22.2	10.1
	2004	16.0	0%	20.9	4.4
	2005	15.9	0%	21.4	11.9
	2006	15.2	0%	21.1	7.6
	2007	15.9	0%	20.4	2.8
JC1T	2002	16.5	0%	21.2	----
	2003	16.4	2%	22.8	----
	2004	16.5	0%	21.4	----
	2005	16.6	0%	21.9	----
	2006	16.1	0%	21.9	----
	2007	16.5	0%	20.2	----

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Table 3-4

(Continued)

		Period - July 1 through August 31			
Station	**Year**	**Average Water Temperature For period (^{o}C)**	**Daily Average Exceedance (%of days exceeding 20°C)**	**Maximum Hourly Water Temperature (^{o}C)**	**Average Flow for period (cfs)**
Tributary Stations					
BUCK1T	2002	17.7	3%	23.5	14
	2003	17.0	8%	23.5	25
	2004	17.3	0%	23.2	15
	2005	17.0	0%	22.7	20
	2006	16.4	0%	22.6	21
	2007	16.8	0%	22.5	13
RC2T	2002	17.6	0%	20.7	4.0
	2003	17.9	19%	22.7	5.5
	2004	17.4	0%	20.5	3.9
	2005	17.3	0%	20.9	16.3
	2006	16.8	3%	21.3	6.9
	2007	17.3	0%	20.3	3.5
GR1T	2002	18.7	19%	22.7	21
	2003	17.8	13%	22.7	27
	2004	18.4	3%	22.3	20
	2005	18.0	3%	22.3	30
	2006	17.5	8%	22.5	29
	2007	18.4	11%	22.1	16
MB1T	2002	21.1	76%	25.3	----
	2003	20.5	42%	24.6	----
	2004	20.7	76%	24.1	----
	2005	20.6	70%	23.4	----
	2006	19.9	39%	24.5	----
	2007	21.0	73%	24.8	----

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Table 3-4

(Continued)

		Period - July 1 through August 31			
Station	**Year**	**Average Water Temperature For period (^{o}C)**	**Daily Average Exceedance (%of days exceeding 20°C)**	**Maximum Hourly Water Temperature (^{o}C)**	**Average Flow for period (cfs)**
Powerhouse Stations					
HB2T	2002	15.4	0%	21.6	51
	2003	15.6	0%	21.2	89
	2004	14.7	0%	19.4	23
	2005	15.2	0%	19.8	18
	2006	15.4	0%	20.3	36
	2007	16.5	0%	20.9	21
BV1T	2002	20.7	85%	22.6	865
	2003	18.6	15%	20.8	1,281
	2004	20.4	69%	22.1	1,445
	2005	19.6	56%	21.6	1,547
	2006	15.7	0%	19.2	1,354
	2007	19.9	54%	21.5	1,126
CARB1T	2002	20.4	68%	22.2	401
	2003	18.8	0%	20.3	406
	2004	20.6	74%	22.1	542
	2005	19.2	50%	21.7	496
	2006	16.2	0%	18.8	398
	2007	19.3	45%	21.4	289
CARB2T	2002	22.9	100%	24.7	408
	2003	20.9	80%	24.1	873
	2004	22.0	100%	23.4	841
	2005	21.8	88%	23.9	996
	2006	19.2	6%	20.9	971
	2007	21.5	100%	22.9	842

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Table 3-4

(Continued)

		Period - July 1 through August 31			
Station	**Year**	**Average Water Temperature For period (^{o}C)**	**Daily Average Exceedance (%of days exceeding 20°C)**	**Maximum Hourly Water Temperature (^{o}C)**	**Average Flow for period (cfs)**
Powerhouse Stations					
BD2T	2002	21.5	93%	22.8	759
	2003	20.0	65%	21.8	1,195
	2004	21.3	92%	22.3	1,283
	2005	20.7	79%	22.2	1,435
	2006	18.4	0%	19.7	1,321
	2007	20.7	89%	21.8	1,082
BUCK2T	2002	15.5	0%	20.0	98
	2003	13.4	0%	20.1	125
	2004	13.6	0%	15.9	164
	2005	12.5	0%	18.6	190
	2006	11.8	0%	18.5	209
	2007	15.1	0%	21.2	106
RC1T	2002	21.5	97%	22.8	925
	2003	20.5	77%	22.7	1,478
	2004	21.6	97%	22.7	1,455
	2005	21.0	81%	22.5	1,687
	2006	18.5	0%	20.0	1,634
	2007				1,191
CR1T	2002	21.2	100%	22.8	977
	2003	19.9	47%	22.7	1,581
	2004	20.7	89%	21.9	1,627
	2005	20.2	73%	21.6	1,852
	2006	18.5	2%	20.4	1,909
	2007				1,290

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Table 3-4

(Continued)

			Period - July 1 through August 31 Average Water Temperature		
Station	**Year**	**Elevation (ft PGE datum)**	**Epilimnion (° C)**		**Hypolimnion (° C)**
Lake	2002	4483.7	23.3		10.4
Almanor	2003	4487.6	23.0	Partial	10.1
	2004	4485.8	22.7		12.2
	2005	4486.8	23.3		10.8
	2006	4490.7	23.0		7.4
	2007	4494.0	22.0	Partial	10.3
Butt	2002	4128.1	23.0		17.5
Valley	2003	4130.2	21.6		16.0
Reservoir	2004	4129.9	22.5		20.2
	2005	4130.2	22.3		16.9
	2006	4127.9	20.5		16.4
	2007	4135.1	22.0		17.3

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Table 3-5. Summary of daily average water temperature statistical distribution for all monitoring stations (2002 through 2007).

Month	Exceedance Level	Stations									
		NF1T	HB1T	HB2T	LA1T-S	LA1T-B	BV1T	BC1T	BV2T_S	BV2T-B	NF2T
June	90%	10.2	10.8	11.6	17.6	6.6	12.5	11.1	16.7	9.9	10.5
	75%	10.7	11.2	12.4	18.1	8.6	13.1	12.4	18.4	10.7	10.8
	50%	11.9	11.6	13.2	19.4	9.1	15.1	13.3	19.3	11.9	11.7
	25%	13.3	11.9	14.2	20.7	10.7	16.3	13.8	20.7	13.1	15.8
	10%	14.2	12.3	17.0	21.8	13.8	17.4	14.4	21.4	13.8	17.8
July	90%	12.8	11.3	12.9	21.6	7.2	14.6	13.1	19.8	12.7	8.9
	75%	13.8	11.6	13.1	22.2	9.5	16.6	13.6	21.5	13.6	11.6
	50%	14.8	12.0	13.5	23.0	10.0	18.6	14.3	22.4	15.0	12.2
	25%	15.4	12.3	14.4	24.1	11.1	19.9	14.7	23.0	17.3	12.9
	10%	16.0	12.7	16.9	25.0	14.4	20.6	15.2	23.7	19.2	20.6
Aug	90%	12.5	10.7	16.4	21.6	8.1	17.8	12.0	20.6	17.7	9.6
	75%	13.0	11.0	16.7	22.0	10.1	19.7	12.3	21.4	18.4	12.2
	50%	13.5	11.3	17.4	22.5	10.6	20.7	12.8	22.0	19.3	13.0
	25%	14.2	11.7	18.2	23.1	11.0	21.1	13.3	22.5	20.3	13.3
	10%	14.8	12.0	18.6	23.7	11.1	21.3	13.8	22.8	21.0	21.3
Sept	90%	9.2	9.2	13.4	17.7	8.4	16.7	9.5	17.7	17.3	11.4
	75%	10.2	9.7	14.3	18.8	9.9	17.8	10.0	18.8	17.9	12.8
	50%	11.2	10.2	14.9	19.7	10.8	18.5	10.8	19.6	18.6	13.4
	25%	11.9	10.6	16.3	20.8	11.4	19.5	11.4	20.6	19.5	14.0
	10%	12.6	10.9	16.9	21.6	11.8	20.0	11.8	21.1	20.1	18.1

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Table 3-5. Continued

Month	Exceedance Level	Stations								
		NF3T	NF4T	BC2T	BC3T	CARB1T	CARB2T	BD1T	BD2T	NF5T
June	90%	12.4	12.7	10.3	10.9	11.3	16.0	15.2	15.3	14.3
	75%	13.0	13.5	10.5	11.3	11.7	17.5	16.4	16.4	15.5
	50%	13.6	14.1	10.6	11.5	12.3	18.3	17.9	17.9	16.8
	25%	14.8	14.8	10.7	11.8	13.0	19.4	19.0	18.9	17.6
	10%	16.2	15.6	10.8	12.1	14.6	20.6	19.7	19.6	18.4
July	90%	11.4	13.2	10.7	11.9	14.9	18.7	17.3	17.7	16.3
	75%	13.7	14.5	10.7	12.1	16.5	19.7	18.1	18.6	17.4
	50%	14.7	15.4	10.8	12.3	18.6	21.8	20.3	20.3	19.1
	25%	15.5	16.1	10.9	12.6	19.7	22.4	21.3	21.3	20.1
	10%	18.4	17.0	11.0	12.7	20.5	23.2	21.7	21.6	20.8
Aug	90%	12.0	13.2	10.6	11.9	17.3	19.7	18.9	19.0	18.5
	75%	13.5	14.0	10.7	12.1	19.5	21.3	20.6	20.7	19.7
	50%	14.0	14.5	10.7	12.3	20.5	21.7	21.2	21.3	20.7
	25%	14.7	15.3	10.8	12.5	21.3	22.3	21.6	21.6	21.1
	10%	17.9	16.3	10.8	12.7	21.5	22.6	21.9	21.9	21.4
Sept	90%	11.3	11.2	10.4	11.2	16.9	17.6	17.4	17.5	17.0
	75%	12.2	12.3	10.5	11.6	17.9	18.5	18.2	18.4	17.7
	50%	12.9	13.0	10.5	12.0	18.8	19.5	19.2	19.2	18.9
	25%	13.7	13.7	10.6	12.1	19.9	20.5	20.0	20.1	19.5
	10%	14.8	14.6	10.6	12.4	20.4	21.1	20.8	20.8	20.4

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Table 3-5. Continued

Month	Exceedance Level	Stations								
		NF6T	MC1T	NF7T	EB1T	NF8T	YC1T	CHIP1T	NF9T	NF10T
June	90%	14.3	11.1	14.6	15.7	15.6	12.1	9.0	14.1	14.3
	75%	15.3	11.7	15.6	17.6	17.1	13.2	10.5	15.7	15.8
	50%	16.6	12.5	16.9	19.4	18.6	14.5	12.2	17.3	17.5
	25%	17.4	13.2	17.7	21.1	19.8	15.4	14.2	18.8	19.0
	10%	18.2	13.6	18.4	21.9	20.3	15.8	15.0	19.6	19.7
July	90%	16.6	13.3	17.1	21.2	19.6	15.0	14.2	18.3	18.5
	75%	17.6	13.7	17.9	22.1	20.4	15.6	14.9	19.1	19.5
	50%	18.9	14.3	19.1	23.1	21.2	16.5	16.0	20.0	20.3
	25%	19.9	14.7	20.0	23.9	21.8	17.1	16.7	21.0	21.2
	10%	20.5	15.1	20.6	24.7	22.2	17.8	17.4	21.4	21.7
Aug	90%	18.2	12.8	18.1	20.1	19.4	13.9	14.3	18.8	18.9
	75%	19.3	13.2	19.1	20.7	20.0	14.5	14.8	20.0	20.2
	50%	20.1	13.6	19.9	21.3	20.5	15.1	15.3	20.6	20.7
	25%	20.5	14.0	20.4	22.3	21.2	15.8	15.7	21.1	21.2
	10%	20.8	14.3	20.7	22.8	21.6	16.3	16.4	21.4	21.5
Sept	90%	15.7	10.5	15.2	14.9	15.2	10.4	11.3	16.3	16.8
	75%	16.5	11.0	16.2	16.1	16.2	11.2	11.8	17.2	17.6
	50%	17.6	11.9	17.3	17.8	17.7	12.5	13.3	18.4	18.7
	25%	18.4	12.5	18.2	19.2	19.0	13.4	14.0	19.4	19.4
	10%	19.4	13.1	19.0	20.0	19.6	14.1	14.9	20.0	20.0

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Table 3-5. Continued

Month	Exceedance Level	Stations								
		MR1T	CHAM1T	NF11T	JC1T	NF12T	BUCK1T	BUCK2T	NF13T	RC1T
June	90%	10.6	9.4	14.3	10.9	14.4	12.4	9.6	13.4	15.1
	75%	11.8	10.8	16.0	12.5	16.2	13.6	11.1	14.5	16.5
	50%	13.3	12.8	17.6	13.8	17.7	15.1	12.3	16.1	17.9
	25%	14.5	14.5	19.1	15.0	19.2	16.3	13.5	18.3	19.1
	10%	15.4	15.6	19.9	16.1	20.0	17.1	15.9	19.6	19.9
July	90%	14.4	14.5	19.0	15.0	19.1	16.0	11.9	16.2	18.7
	75%	15.0	15.3	19.9	15.8	20.0	16.7	12.7	17.8	19.6
	50%	15.9	16.2	20.7	16.7	20.9	17.7	13.6	19.0	20.7
	25%	16.8	17.3	21.5	17.8	21.6	18.6	15.0	20.2	21.5
	10%	17.5	18.2	22.0	18.5	22.1	19.7	16.9	21.0	21.9
Aug	90%	13.7	14.1	19.2	14.8	19.4	15.0	11.6	16.4	18.7
	75%	14.3	14.6	20.0	15.4	20.0	15.6	12.3	17.4	20.8
	50%	14.9	15.2	20.6	16.0	20.6	16.3	12.9	18.1	21.4
	25%	15.6	15.9	21.1	16.7	21.2	17.1	14.0	18.8	21.8
	10%	16.1	16.7	21.5	17.2	21.6	17.8	14.3	20.1	22.1
Sept	90%	10.8	11.4	16.2	12.3	16.2	11.3	11.4	15.0	16.8
	75%	11.4	12.3	17.2	13.1	17.2	12.2	11.9	15.4	18.5
	50%	12.6	13.4	18.4	14.4	18.4	13.6	12.7	16.2	19.0
	25%	13.5	14.3	19.2	15.4	19.2	14.6	13.3	17.7	20.3
	10%	14.4	15.2	19.9	16.1	19.9	15.5	13.7	18.2	20.9

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Table 3-5. Continued

Month	Exceedance Level	Stations								
		RC2T	NF14T	GR1T	NF15T	NF16T	CR1T	MB1T	NF17T	NF18T
June	90%	9.5	14.1	12.3	14.3	13.9	13.9	15.1	14.1	17.1
	75%	11.4	15.3	13.9	15.4	15.5	15.2	16.2	15.9	18.5
	50%	13.4	17.3	15.3	17.2	17.4	17.2	18.2	17.6	20.0
	25%	15.7	18.6	16.8	18.7	19.0	18.6	19.5	19.3	21.2
	10%	16.6	19.6	17.6	19.5	20.0	19.8	20.1	20.0	21.8
July	90%	16.1	18.1	17.1	18.2	18.5	18.1	19.6	18.9	20.9
	75%	16.7	19.3	17.7	19.4	19.8	19.3	20.1	19.7	21.9
	50%	17.7	20.3	18.7	20.4	20.8	20.4	21.4	20.7	22.8
	25%	18.6	21.0	19.6	21.1	21.5	21.1	22.1	21.4	23.6
	10%	19.4	21.4	20.3	21.5	22.0	21.5	22.8	21.9	23.9
Aug	90%	15.8	18.5	16.4	18.5	18.7	18.8	18.8	18.6	20.4
	75%	16.4	19.6	16.9	19.6	19.8	20.0	19.3	20.0	21.2
	50%	17.0	20.3	17.5	20.2	20.4	20.5	20.0	20.6	21.7
	25%	17.6	20.7	18.3	20.7	20.9	20.8	20.8	21.0	22.4
	10%	18.4	21.0	18.9	21.0	21.3	21.1	21.3	21.3	22.8
Sept	90%	12.7	16.3	12.5	16.3	16.0	16.5	14.0	16.3	16.8
	75%	13.3	17.2	13.2	17.0	17.1	17.4	15.0	17.3	17.6
	50%	14.7	18.2	14.8	18.0	18.3	18.4	16.8	18.5	19.1
	25%	15.6	19.1	16.0	18.9	19.1	19.3	18.2	19.3	20.0
	10%	16.4	19.7	16.8	19.4	19.8	19.9	19.2	19.9	20.6

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typically less than 18°C, with no periods where daily average water temperatures exceeded 20°C (Tables 3-4 and 3-5).

In order to establish the relationship between stations, a longitudinal comparison was developed comparing each station in the Seneca Reach. Figure 3-3 compares the results of the distribution analysis from each station in the Seneca Reach for the July period. The same comparison for August is presented in Figure 3-4. In general, water temperatures increase as they move downstream through the reach. The exception being the previously discussed period in 2004, when release temperatures were elevated related to repair operations. In this case water temperatures decreased as they moved through the reach.

3.1.2.2. Butt Valley-Caribou Complex

As discussed previously, Lake Almanor is the primary source of stream flow to Projects on the lower NFFR during non-runoff periods. There are two pathways by which these flows can reach the lower NFFR. The first is through releases made from Canyon Dam to the Seneca Reach of the NFFR, flows in this reach pass into Belden Forebay (Figure 2-1), however, prior to entering the forebay the Seneca flow mixes with flows from the Caribou Powerhouse Complex when Caribou powerhouses are in operation. The second pathway flows from Lake Almanor reach the lower NFFR is through diversion to Butt Valley Reservoir. Lake Almanor diversion flows are initially passed through Butt Valley Powerhouse, after which they are stored in Butt Valley Reservoir for release through Caribou No.1 and Caribou No. 2 Powerhouses (Figure 2-1). Based on this configuration, water temperatures at Butt Valley Powerhouse represent conditions leaving Lake Almanor; while those at Caribou No.1 and No. 2 combined represent conditions leaving Butt Valley Reservoir.

Three stations are monitored as part of the Butt Valley – Caribou Powerhouse complex (BV1T, CARB1T, and CARB2T). A thermistor array is also deployed in Butt Valley Reservoir near the dam at the Caribou No.1 intake (Figure 2-1). These data are summarized in Table 3-4, with a complete discussion contained in the annual monitoring reports ((PG&E 2003, 2004a, 2005a, 2006, 2007, and 2008)). However, data from this array will not be discussed as part of this evaluation.

The results of the water temperature distribution analysis from the Station BV1T (initial conditions) for all data from the period June through September 2002-2007 is presented in Figure 3-5. As indicated, water temperatures at this station exceed the 20 °C threshold more frequently in August than July, reflecting the continued warming of source waters released from Lake Almanor. This progressive warming trend observed in Lake Almanor is a function of seasonal heating and reservoir drawdown. The drawdown causes the Butt Valley Powerhouse intake in Lake Almanor (Prattville Intake) to withdraw progressively more water from upper warm layers of the lake as the season progresses. Daily average water temperatures at Station BV1T exceeded 20°C, 23 % of the monitoring days in July, and 69 % of the monitoring days in August.

The results of the water temperature exceedance analysis from the CARB1T station (part of the terminal condition) for all data from the period June through September 2002-2007 is presented in Figure 3-6. As indicated, water temperatures at this station also exceed the 20°C threshold

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more frequently in August than July, however, the magnitude of the exceedance is slightly less than that observed at BV1T, this is related to the fact that the Caribou No.1 intake is located in the deeper depths of Butt Valley and as a result access the cooler thermally isolated waters of the hypolimnion of the reservoir. As continued withdrawal occurs through the summer, this pool of cooler water is utilized resulting in near isothermal conditions by August. Daily average water temperatures at Station CARB1T exceeded 20°C, 17 % of the monitoring days in July, and 64 % of the monitoring days in August.

The results of the water temperature exceedance analysis from the CARB2T station (part of the terminal condition) for all data from the period June through September 2002-2007 is presented in Figure 3-7. As indicated, water temperatures at this station exceeded 20 °C nearly all summer periods (June through September). This is directly related to the Caribou No.2 intake being located in the shallower depths of Butt Valley Reservoir and as a result withdrawing water from the warmer upper layers of the reservoir. In addition, Caribou No.2 Powerhouse is used preferentially to Caribou No.1 Powerhouse due to its greater efficiency. As a result, flows from Caribou No. 2 Powerhouse constitute are larger percentage of the flow weighted temperature regime entering Belden Forebay. Daily average water temperatures at Station CARB2T exceeded 20°C, 71 % of the monitoring days in July, and 84 % of the monitoring days in August.

The results of the water temperature exceedance analysis from Belden Powerhouse (Station BD2T) for all data from the period June through September 2002-2007 is presented in Figure 3-8. This station represents conditions leaving Belden Forebay as is being withdrawn by the Belden Intake structure after commingling of all sources entering this facility. Note that the temperatures at this station represent discharge conditions that enter Yellow Creek about 9 miles downstream from Belden Dam. It also constitutes the pathway of the largest volume of flow leaving this facility. As indicated, water temperatures at this station exceeded 20 °C primarily during the period July through September. Daily average water temperatures at Station BD2T exceeded 20°C, 55 % of the monitoring days in July, and 83 % of the monitoring days in August.

Figure 3-9 compares the results of the distribution analysis from each station in the Butt Valley-Caribou Powerhouse complex for the July period. The same comparison for August is presented in Figure 3-10. As indicated by these figures, water temperatures from Caribou No.1 Powerhouse and Butt Valley Powerhouse exhibit similar patterns of temperature distribution. Whereas, Caribou No.2 exhibits a decidedly warmer distribution and Belden Powerhouse (BD2T) exhibits a pattern that is obviously weighted toward Caribou No.2 due the preferential use of that facility.

3.1.2.3. Belden Reach

The Belden Reach of the NFFR extends from Belden Dam to its terminus upstream of Belden Powerhouse. A total of four stations are monitored in the main stem of the NFFR in this reach (NF5T, NF6T, NF7T, and NF8T). The East Branch Feather River (EBFR) enters the NFFR immediately downstream of Station NF7T, greatly influencing temperatures at NF8T (Figure 2-1). The results of the water temperature exceedance analysis from the NF5T station (initial condition for Belden Reach) for all data from the period June through September 2002-2007 is presented in Figure 3-11. As indicated, water temperatures at this station typically exceed 20°C

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only during the months of July and August. The results of the water temperature distribution analysis from the NF7T station (terminal conditions upstream of the EBFR) for all data from the period June through September 2002-2007 is presented in Figure 3-12. Water temperature distribution analysis from the NF8T station (terminal conditions downstream of the EBFR) is presented in Figure 3-13.

Figure 3-14 compares the results of the distribution analysis from each station in the Belden Reach for the July period. In general, water temperatures in the Belden Reach upstream of the East Branch confluence are relatively stable and remain below 20°C. Daily average water temperatures in the reach upstream of the confluence with the East Branch (NF7T) exceeded 20°C, 25 % of the monitoring days in July. Figure 3-14 illustrates that flows from the East Branch significantly increase temperatures measured at NF8T. Daily average water temperatures in the reach downstream of the confluence with the East Branch (NF8T) exceeded 20°C, 83 % of the monitoring days in July.

The same longitudinal comparison in Belden Reach for August is presented in Figure 3-15. This figure illustrates the influence of warmer late season water arriving from Butt Valley through the Caribou Powerhouse complex. As indicated, August temperatures at NF5T are generally higher than those measured at NF7T, and in fact are very similar in distribution to those observed at Station NF8. Daily average water temperatures in the reach upstream of the confluence with the East Branch (NF7T) exceeded 20°C, 43 % of the monitoring days in August. Figure 3-15 illustrates that flows from the East Branch significantly increase temperatures measured at NF8T. Daily average water temperatures in the reach downstream of the confluence with the East Branch (NF8T) exceeded 20°C, 77 % of the monitoring days in August.

3.1.2.4. Rock Creek Reach

The Rock Creek Reach of the NFFR extends from Rock Creek Dam to its terminus upstream of Rock Creek Powerhouse. A total of five stations are monitored in the main stem of the NFFR in this reach (NF9T, NF10T, NF11T, NF12T, and NF13T). Flow from Bucks Creek Project (FERC 619) enters the NFFR immediately downstream of Station NF13T, and as a result greatly influences temperatures at NF13T (Figure 2-1). In effect when Bucks Creek Project is not in operation, Station NF12T represents the location of maximum water temperatures in the Rock Creek reach. The results of the water temperature distribution analysis from the NF10T station (initial conditions, co-located with NF57) for all data from the period June through September 2002-2007 is presented in Figure 3-16. As indicated, water temperatures at this station typically exceed 20°C only during the months of July and August. The results of the water temperature distribution analysis from the NF12T station (terminal conditions upstream of the Bucks Creek Powerhouse) for all data from the period June through September 2002-2007 is presented in Figure 3-17. Water temperature distribution analysis from the NF13T station (terminal conditions downstream of the Bucks Creek Powerhouse) is presented in Figure 3-18.

Figure 3-19 compares the results of the distribution analysis from each station in the Rock Creek Reach for the July period. Daily average water temperatures in the reach upstream of Bucks Creek Powerhouse (NF12T) typically exceeded 20°C, 75 % of the monitoring days in July. Figure 3-19 also indicates that flows from Bucks Creek Powerhouse significantly decrease

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temperatures measured at NF13T. The same longitudinal comparison for August is presented in Figure 3-20. As indicated, daily average water temperatures at NF12T exceeded 20°C, 75 % of the monitoring days in August.

3.1.2.5. Cresta Reach

The Cresta Reach of the NFFR extends from Cresta Dam to its terminus upstream of Cresta Powerhouse. A total of three stations are monitored in the main stem of the NFFR in this reach (NF14T, NF15T, and NF16T). Flow from Grizzly Creek enters the NFFR downstream of Station NF14T (Figure 2-1). Station NF16T represents the location of maximum water temperatures in the Cresta Reach. The results of the water temperature distribution analysis from the NF14T station (initial conditions) for all data from the period June through September 2002-2007 is presented in Figure 3-21. As indicated, water temperatures at this station typically exceed 20°C only during the months of July and August. The results of the water temperature distribution analysis from the NF16T station (terminal conditions upstream of the Cresta Powerhouse) for all data from the period June through September 2002-2007 is presented in Figure 3-22.

Figure 3-19 compares results of the distribution analysis from each station in the Cresta Reach for the July period. Daily average water temperatures in the NFFR upstream of Cresta Powerhouse (NF16T) exceeded 20°C, 69 % of the monitoring days in July. The same longitudinal comparison for August is presented in Figure 3-20. As indicated, daily average water temperatures at NF16T exceeded 20°C, 66 % of the monitoring days in August.

3.1.2.6. Poe Reach

The Poe Reach of the NFFR extends from Poe Dam to its terminus upstream of Poe Powerhouse. The Poe data are not required as part of the on-going monitoring effort specified in Condition 4C under FERC 1962 License. PG&E has volunteered this monitoring in order to address the watershed temperature issue. A total of two stations are monitored in the main stem of the NFFR in this reach (NF17T and NF18T). The Poe Reach is the lowest in the NFFR watershed, as well as having the longest distance between the diversion and the powerhouse (not shown in Figure 2-1). Station NF18T represents the location of maximum water temperatures in the Poe Reach. The results of the water temperature distribution analysis from the NF17T station (initial conditions) for all data from the period June through September 2002-2007 is presented in Figure 3-23. As indicated, water temperatures at this station typically exceed 20°C only during the months of July and August. The results of the water temperature distribution analysis from the NF18T station (terminal conditions upstream of the Poe Powerhouse) for all data from the period June through September 2002-2007 is presented in Figure 3-24. This data indicates that water temperature exceed 20°C June through September in the period 2002-2007.

Figure 3-19 compares results of the distribution analysis from each station in the Poe Reach for the July period. Daily average water temperatures in the NFFR upstream of Poe Powerhouse (NF18T) exceeded 20°C, 98 % of the monitoring days in July. The same longitudinal comparison for August is presented in Figure 3-20. As indicated, daily average water temperatures at NF18T exceeded 20°C, 95 % of the monitoring days in August.

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3.1.3 Comparison with Unregulated Stream Reaches

Water temperature data for the 2002-2007 monitoring periods from the terminal stations in the three lower bypass reaches (Rock Creek, Cresta, Poe) of the NFFR was compared with data from two regional stations that represent unregulated conditions (East Branch NFFR [EB1T] and Middle Fork Feather River at Merrimac [MB1T]). The results of this comparison are presented in Figures 3-25 and 3-26. As indicated by this comparison, the July and August water temperature regime of the Rock Creek and Cresta reaches is typically similar to or cooler than those exhibited in either the East Branch and Middle Fork of the Feather River. The July and August water temperature regime of the Poe Reaches is typically similar to that exhibited in the East Branch, but warmer than those measured in the Middle Fork.

3.1.4 Comparison of 2002-2007 Data with Historic Information

As discussed in Section 2.2, following implementation of conditions included in the settlement agreement, PG&E conducted a number of selective use tests using the Caribou Powerhouse complex in an attempt to mitigate water temperatures in the Rock Creek Cresta Reach. These tests are discussed specifically in their respective reports (PG&E 2002, 2003, 2005a, Stetson/PG&E 2007). In addition to the active mitigation efforts, the increase in minimum flow releases to the Rock Creek and Cresta reaches was initiated in 2002. As such, some comparison to historic data was under taken to determine the magnitude of influence these changes have had on water temperatures in the affected reaches (Rock Creek, Cresta, and Poe).

The availability of data from periods prior to any formal attempts at water temperature mitigation is limited; some information was obtained from past monitoring efforts by PGE as well as the CDFG. This information is summarized in Table 3-6. This table also presents any supporting stream flow, reservoir elevation and meteorological information relevant to defining conductions during the monitoring effort. Daily maximum and minimum data from the Rock Creek and Cresta reaches for the July-August period 1977 and 1978 were obtained and a daily mean estimated using the average of the maximum and minimum. The actual data from the CDFG study conducted in 1981-1985 was not available, however, the report included a summary of distribution values and this information was utilized to generate information included in Table 3-6. Mean daily data from data collected by PG&E in 1985 and 1986, as well as the complete sets of data generated in 2002-2007 were utilized in the development of this analysis. Data from all months was discarded from the analysis if there were less than 25 data days in the data set. Months when data existed but was limited to periods less than 25 days is noted as being partial in Table 3-6.

The historic information is not complete enough with regard to consistency of stationing and annual data coverage to allow for the detection of any trends regarding the influence of the increased minimum releases or other mitigative measures on water temperatures in the various stream reaches. Under the same water year type, the water temperature differences, if any, induced by the increased minimum releases since 2002, is likely within the range of natural variations.

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Table 3-6. Comparison of historic information from select stations in the Project affected reaches with data from current monitoring program.

Rock Creek Reach Stations										
July Conditions							July Water Temperature Statistics			
				Lake Almanor		Stream	NF9T/NF10T		NF12T	
Water Year	Water Year Classification	Air Temp Classification[1]		Elevation (ft) Start	Elevation (ft) End	Flow @ NF57	Average (°C)	Exceedance (%)	Average (°C)	Exceedance (%)
1977	Critical Dry	AN	34%	4475.1	4474.4	6	20.3	68%	21.8	100%
1981	Critical Dry	BN	64%	4482.1	4480.7	101	---	P[2]	---	--
2001	Critical Dry	AN	36%	4479.1	4477.2	113	---	--	---	--
2007	Critical Dry	AN	20%	4485.9	4483.9	216	20.4	74%	20.9	94%
1985	Dry	AN	17%	4478.3	4475.2	210	20.2	55%	20.8	p
2002	Dry	EH	2%	4485.0	4483.8	217	21.3	94%	21.6	100%
2000	Normal	BN	75%	4490.8	4488.0	169	---	35%	---	
2003	Normal	EH	5%	4489.5	4487.6	230	19.8	42%	20.3	65%
2004	Normal	AN	29%	4488.2	4486.0	275	20.9	84%	21.2	94%
2005	Normal	EH	3%	4489.1	4487.1	265	20.3	61%	20.8	74%
1978	Wet	N	56%	4488.8	4489.7	128	17.6	0%	19.2	32%
1982	Wet	BN	81%	4493.5	4491.5	160	---	p	---	--
1983	Wet	N	62%	4491.8	4491.6	114	---	--	---	--
1984	Wet	AN	14%	4491.7	4489.6	212	---	40%	---	--
1986	Wet	BN	78%	4490.9	4488.5	220	19.1	10%	19.7	39%
2006	Wet	AN	12%	4492.0	4490.9	276	18.6	6%	19.5	32%

1: BN = Below normal, N=normal, AN=above normal, EH=Extreme heat

2: P = Partial data period, not evaluated

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Table 3-6. Continued.

Cresta Reach Stations										
July Conditions							July Water Temperature Statistics			
				Lake Almanor		Stream	NF14T		NF16T	
Water	Water Year	Air Temp		Elevation (ft)		Flow @	Average	Exceedance	Average	Exceedance
Year	Classification	Classification[1]		Start	End	NF56	(°C)	(%)	(°C)	(%)
1977	Critical Dry	AN	34%	4475.1	4474.4	0	19.8	23%	23.2	100%
1981	Critical Dry	BN	64%	4482.1	4480.7	52	---	--	---	P[2]
2001	Critical Dry	AN	36%	4479.1	4477.2	54	---	--	---	--
2007	Critical Dry	AN	20%	4485.9	4483.9	224	20.5	77%	21.1	97%
1985	Dry	AN	17%	4478.3	4475.2	161	20.3	58%	20.7	p
2002	Dry	EH	2%	4485.0	4483.8	265	21.2	100%	21.7	100%
2000	Normal	BN	75%	4490.8	4488.0	123	---		---	
2003	Normal	EH	5%	4489.5	4487.6	307	19.6	32%	20.1	55%
2004	Normal	AN	29%	4488.2	4486.0	273	20.7	77%	21.1	90%
2005	Normal	EH	3%	4489.1	4487.1	297	19.9	52%	20.4	68%
1978	Wet	N	56%	4488.8	4489.7	34	19.6	42%	p	p
1982	Wet	BN	81%	4493.5	4491.5	54	---	p	---	19%
1983	Wet	N	62%	4491.8	4491.6	52	---	--	---	60%
1984	Wet	AN	14%	4491.7	4489.6	152	---	--	---	87%
1986	Wet	BN	78%	4490.9	4488.5	159	18.5	0%	19.6	32%
2006	Wet	AN	12%	4492.0	4490.9	285	18.4	6%	18.9	16%

1: BN = Below normal, N=normal, AN=above normal, EH=Extreme heat

2: P = Partial data period, not evaluated

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Table 3-6. Continued.

Poe Reach Stations										
July Conditions							July Water Temperature Statistics			
				Lake Almanor		Stream	NF17T		NF18T	
Water Year	Water Year Classification	Air Temp Classification[1]		Elevation (ft) Start	Elevation (ft) End	Flow @ Pulga	Average (°C)	Exceedance (%)	Average (°C)	Exceedance (%)
1977	Critical Dry	AN	34%	4475.1	4474.4	33	---	--	---	--
1981	Critical Dry	BN	64%	4482.1	4480.7	55	---	--	---	--
2001	Critical Dry	AN	36%	4479.1	4477.2	114	21.5	100%	22.5	100%
2007	Critical Dry	AN	20%	4485.9	4483.9	132	21.0	100%	22.6	100%
1985	Dry	AN	17%	4478.3	4475.2	62	---	--	---	--
2002	Dry	EH	2%	4485.0	4483.8	119	21.6	100%	23.7	100%
2000	Normal	BN	75%	4490.8	4488.0	107	19.2	6%	21.4	100%
2003	Normal	EH	5%	4489.5	4487.6	133	19.9	48%	22.1	90%
2004	Normal	AN	29%	4488.2	4486.0	115	21.0	94%	22.9	100%
2005	Normal	EH	3%	4489.1	4487.1	147	20.1	55%	23.0	100%
1978	Wet	N	56%	4488.8	4489.7	47	---	--	---	--
1982	Wet	BN	81%	4493.5	4491.5	58	---	--	---	--
1983	Wet	N	62%	4491.8	4491.6	69	---	--	---	--
1984	Wet	AN	14%	4491.7	4489.6	58	---	--	---	--
1986	Wet	BN	78%	4490.9	4488.5	63	---	--	---	--
2006	Wet	AN	12%	4492.0	4490.9	140	19.0	9%	21.3	97%

1: BN = Below normal, N=normal, AN=above normal, EH=Extreme heat

2: P = Partial data period, not evaluated

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Table 3-6. Continued.

Rock Creek Reach Stations										
August Conditions							August Water Temperature Statistics			
				Lake Almanor		Stream	NF9T/NF10T		NF12T	
Water	Water Year	Air Temp		Elevation (ft)		Flow @	Average	Exceedance	Average	Exceedance
Year	Classification	Classification[1]		Start	End	NF57	(°C)	(%)	(°C)	(%)
1977	Critical Dry	EH	0%	4474.2	4471.8	6	20.8	87%	21.2	84%
1981	Critical Dry	EH	10%	4480.7	4479.1	101	---	100%	---	--
2001	Critical Dry	AN	12%	4477.1	4475.3	113	---	--	---	--
2007	Critical Dry	AN	27%	4483.8	4481.7	280	20.6	77%	20.7	97%
1985	Dry	BN	75%	4475.1	4474.0	212	19.6	26%	19.8	45%
2002	Dry	AN	22%	4483.8	4482.0	209	21.2	94%	21.0	100%
2000	Normal	AN	32%	4487.9	4484.9	120	---	39%	---	
2003	Normal	N	37%	4487.6	4485.5	215	20.3	45%	20.3	68%
2004	Normal	AN	24%	4485.9	4482.8	270	21.3	87%	21.3	94%
2005	Normal	AN	19%	4486.9	4483.4	264	21.0	65%	20.9	77%
1978	Wet	N	54%	4489.6	4486.9	124	P[2]	p	20.1	39%
1982	Wet	N	61%	4491.4	4488.2	151	---	30%	---	--
1983	Wet	N	58%	4491.6	4489.2	105	---	13%	---	--
1984	Wet	N	46%	4489.5	4487.6	209	---	p	---	--
1986	Wet	AN	17%	4488.5	4485.6	211	20.1	68%	20.3	71%
2006	Wet	N	42%	4490.9	4488.5	288	18.8	6%	19.3	32%

1: C = Critical dry, D = Dry, N = Normal, W=Wet

2: BN = Below normal, N=normal, AN=above normal, EH=Extreme heat

3: P = Partial data period, not evaluated

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Table 3-6. Continued.

Creata Reach Stations										
August Conditions							August Water Temperature Statistics			
				Lake Almanor		Stream	NF14T		NF16T	
Water	Water Year	Air Temp		Elevation (ft)		Flow @	Average	Exceedance	Average	Exceedance
Year	Classification	Classification1		Start	End	NF56	(°C)	(%)	(°C)	(%)
1977	Critical Dry	EH	0%	4474.2	4471.8	0	20.4	84%	22.7	100%
1981	Critical Dry	EH	10%	4480.7	4479.1	51	---	--	---	100%
2001	Critical Dry	AN	12%	4477.1	4475.3	55	---	--	---	--
2007	Critical Dry	AN	27%	4483.8	4481.7	260	20.1	71%	20.5	97%
1985	Dry	BN	75%	4475.1	4474.0	160	19.6	29%	19.7	32%
2002	Dry	AN	22%	4483.8	4482.0	261	20.7	100%	20.9	100%
2000	Normal	AN	32%	4487.9	4484.9	62	---		---	
2003	Normal	N	37%	4487.6	4485.5	292	20.0	35%	20.2	58%
2004	Normal	AN	24%	4485.9	4482.8	273	20.6	81%	20.9	90%
2005	Normal	AN	19%	4486.9	4483.4	305	20.5	55%	20.6	71%
1978	Wet	N	54%	4489.6	4486.9	31	20.5	52%	p	p
1982	Wet	N	61%	4491.4	4488.2	64	---	19%	---	19%
1983	Wet	N	58%	4491.6	4489.2	115	---	--	---	74%
1984	Wet	N	46%	4489.5	4487.6	151	---	--	---	p
1986	Wet	AN	17%	4488.5	4485.6	171	19.4	0%	20.1	61%
2006	Wet	N	42%	4490.9	4488.5	293	18.4	6%	18.7	16%

1: BN = Below normal, N=normal, AN=above normal, EH=Extreme heat

2: P = Partial data period, not evaluated

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Table 3-6. Continued.

Poe Reach Stations										
August Conditions							August Water Temperature Statistics			
				Lake Almanor		Stream	NF17T		NF18T	
Water	Water Year	Air Temp		Elevation (ft)		Flow @	Average	Exceedance	Average	Exceedance
Year	Classification	Classification[1]		Start	End	Pulga	(°C)	(%)	(°C)	(%)
1977	Critical Dry	EH	0%	4474.2	4471.8	13	---	--	---	--
1981	Critical Dry	EH	10%	4480.7	4479.1	53	---	--	---	--
2001	Critical Dry	AN	12%	4477.1	4475.3	108	21.5	100%	22.1	100%
2007	Critical Dry	AN	27%	4483.8	4481.7	128	20.7	100%	21.8	100%
1985	Dry	BN	75%	4475.1	4474.0	62	---	--	---	--
2002	Dry	AN	22%	4483.8	4482.0	119	21.0	100%	22.2	100%
2000	Normal	AN	32%	4487.9	4484.9	104	19.9	10%	21.2	100%
2003	Normal	N	37%	4487.6	4485.5	126	20.3	52%	21.5	90%
2004	Normal	AN	24%	4485.9	4482.8	115	20.9	94%	22.1	100%
2005	Normal	AN	19%	4486.9	4483.4	142	20.6	58%	22.1	100%
1978	Wet	N	54%	4489.6	4486.9	47	---	--	---	--
1982	Wet	N	61%	4491.4	4488.2	52	---	--	---	--
1983	Wet	N	58%	4491.6	4489.2	63	---	--	---	--
1984	Wet	N	46%	4489.5	4487.6	59	---	--	---	--
1986	Wet	AN	17%	4488.5	4485.6	64	---	--	---	--
2006	Wet	N	42%	4490.9	4488.5	139	18.6	9%	20.4	97%

1: BN = Below normal, N=normal, AN=above normal, EH=Extreme heat

2: P = Partial data period, not evaluated

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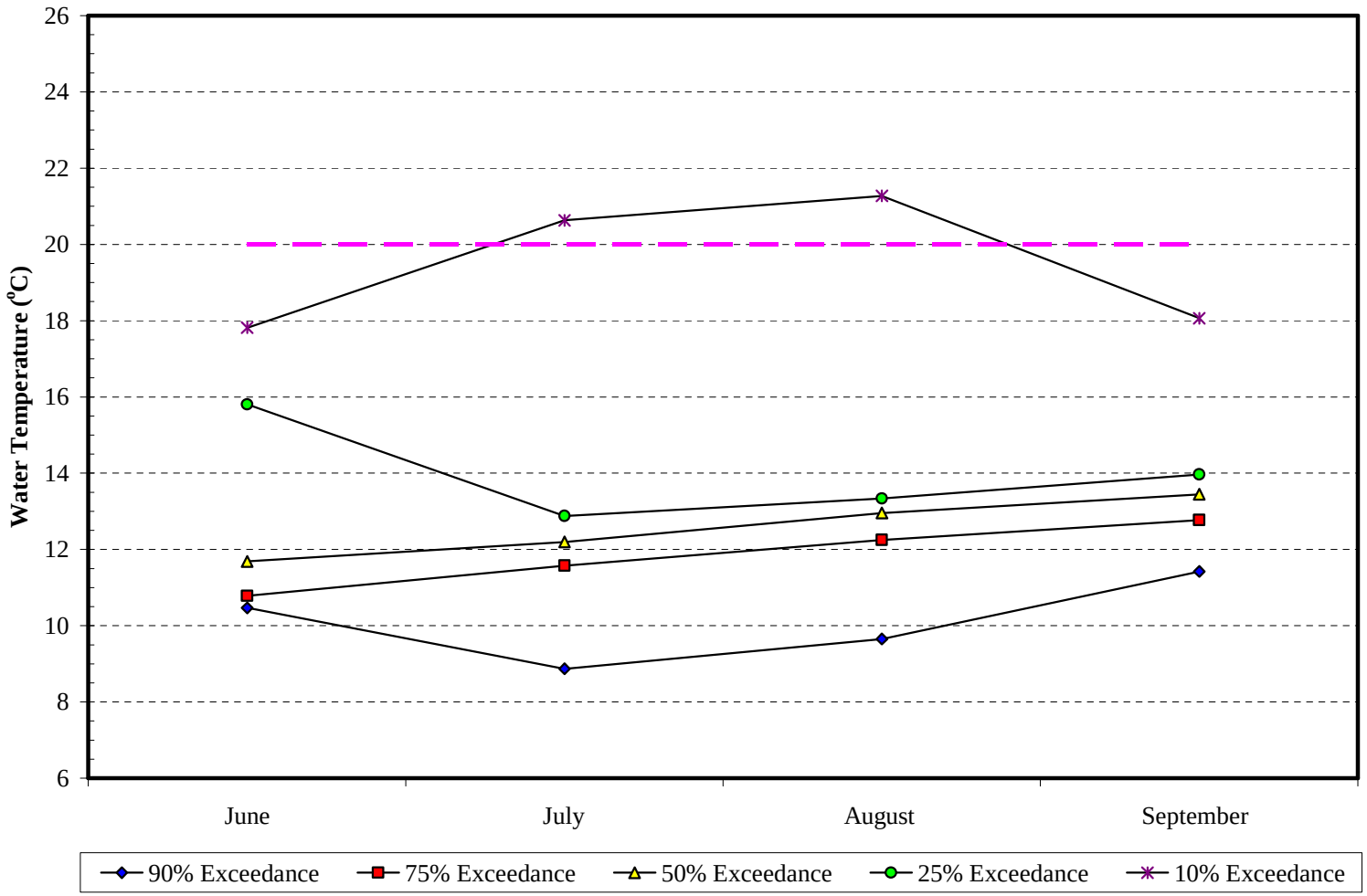

Figure 3-1. Comparison of monthly water temperature distribution at Station NF2T (2002-2007 Mean daily data).

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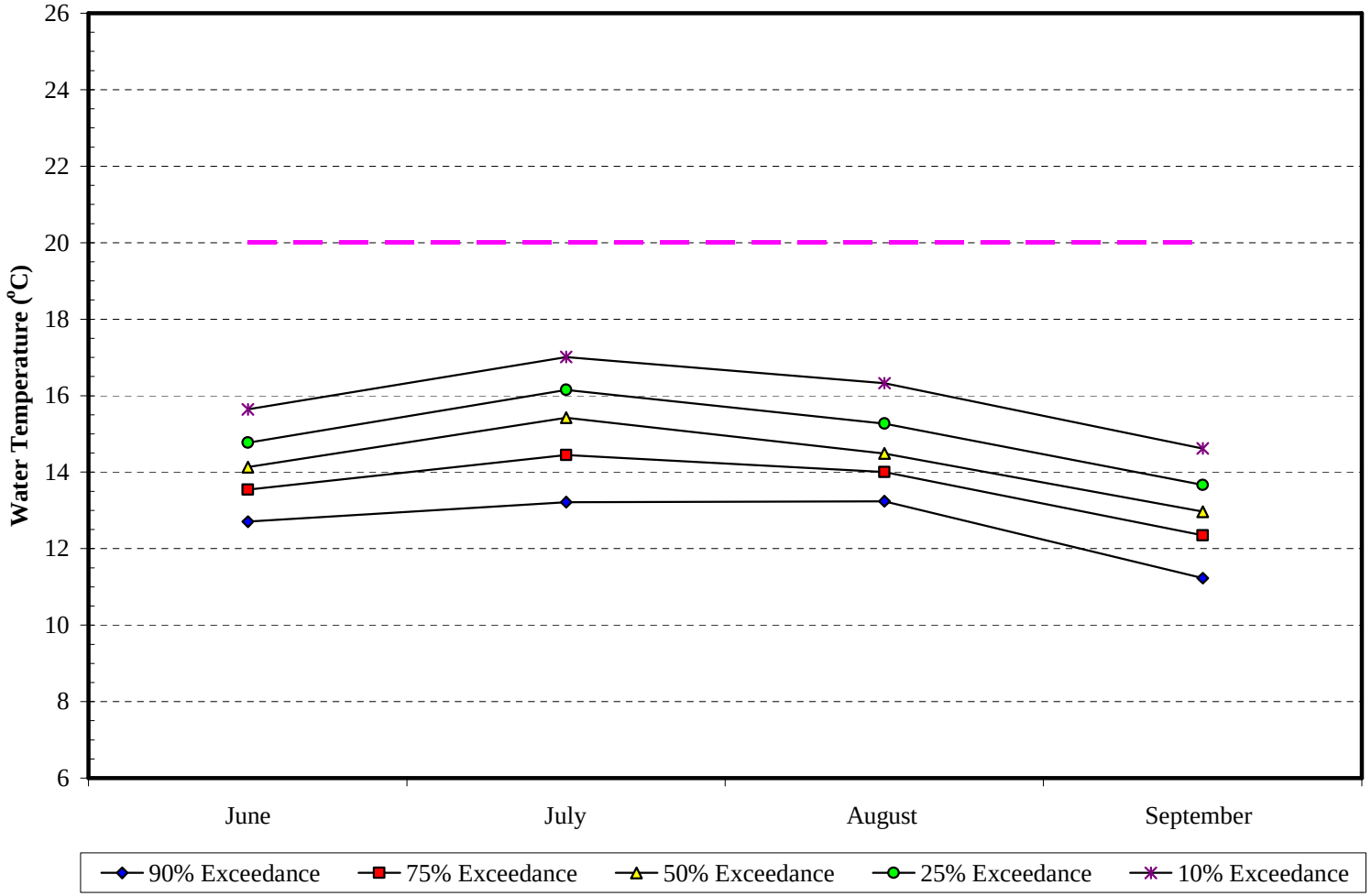

Figure 3-2. Comparison of monthly water temperature distribution at Station NF4T (Based on 2002-2007 daily average data).

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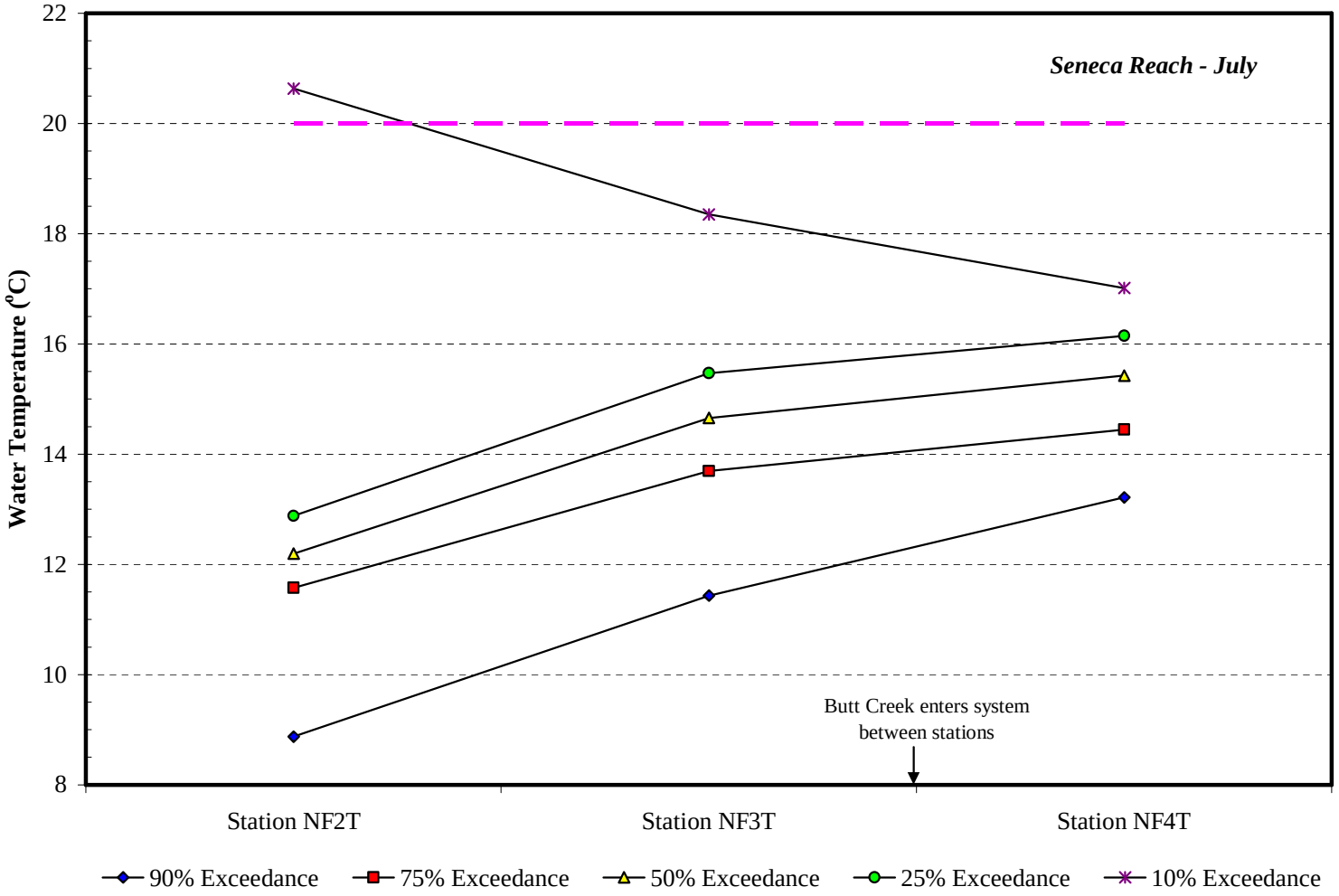

Figure 3-3. Longitudinal comparison of July water temperature distribution at three stations in the Seneca Reach (Based on 2002-2007 daily average data).

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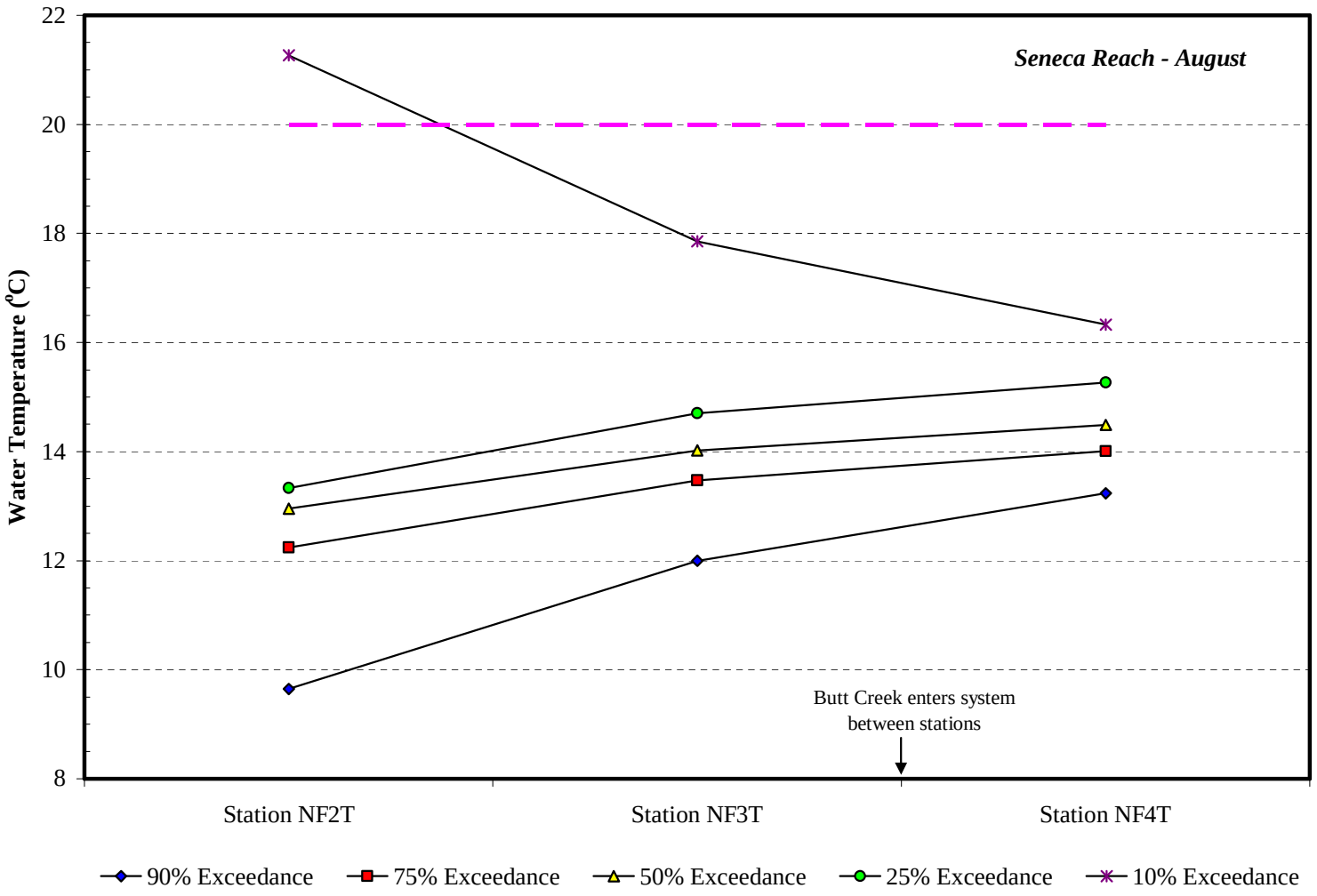

Figure 3-4. Longitudinal comparison of August water temperature distribution at three stations in the Seneca Reach (Based on 2002-2007 daily average data).

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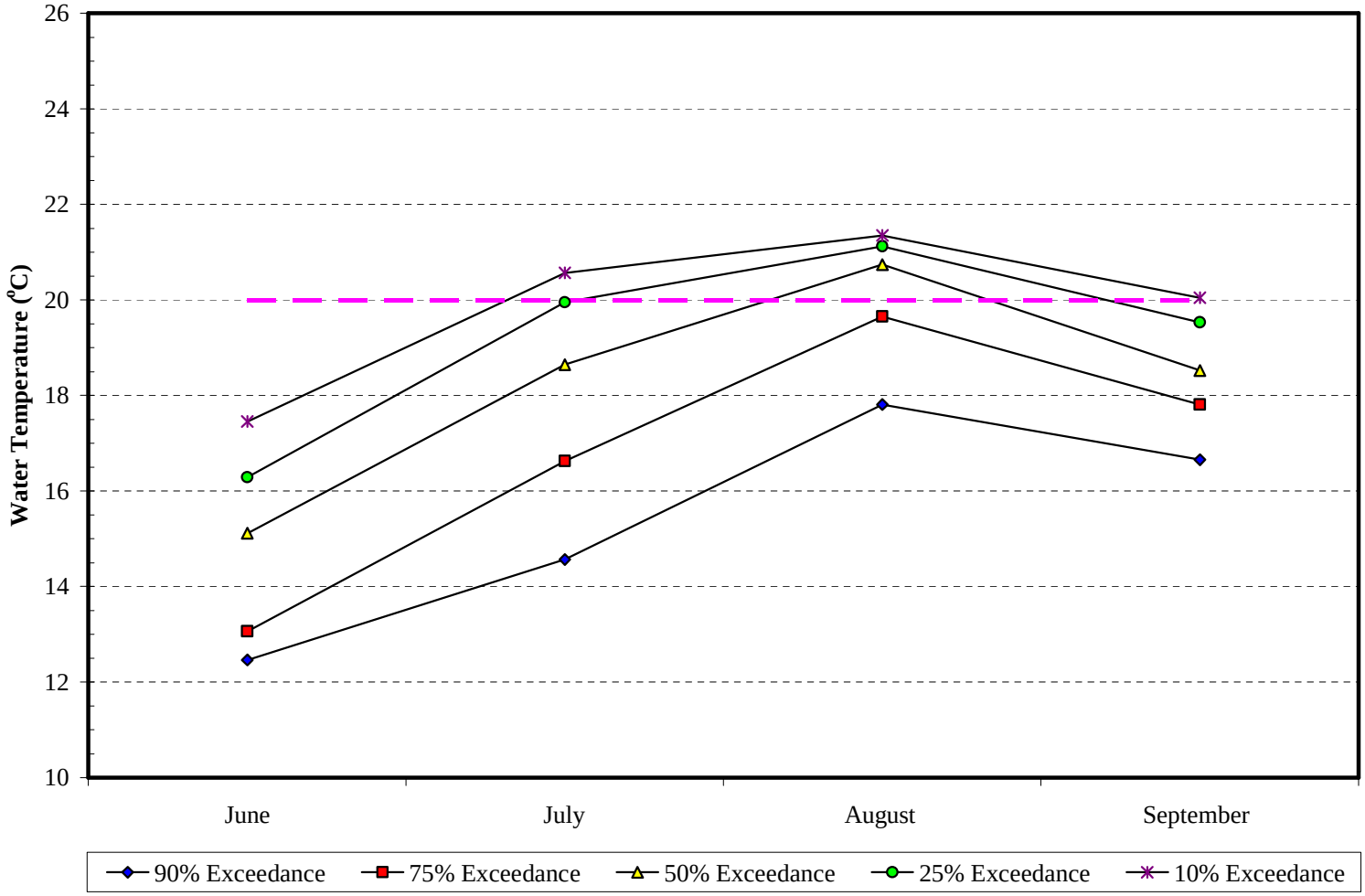

Figure 3-5. Comparison of monthly water temperature distribution at Station BV1T (Based on 2002-2007 daily average data).

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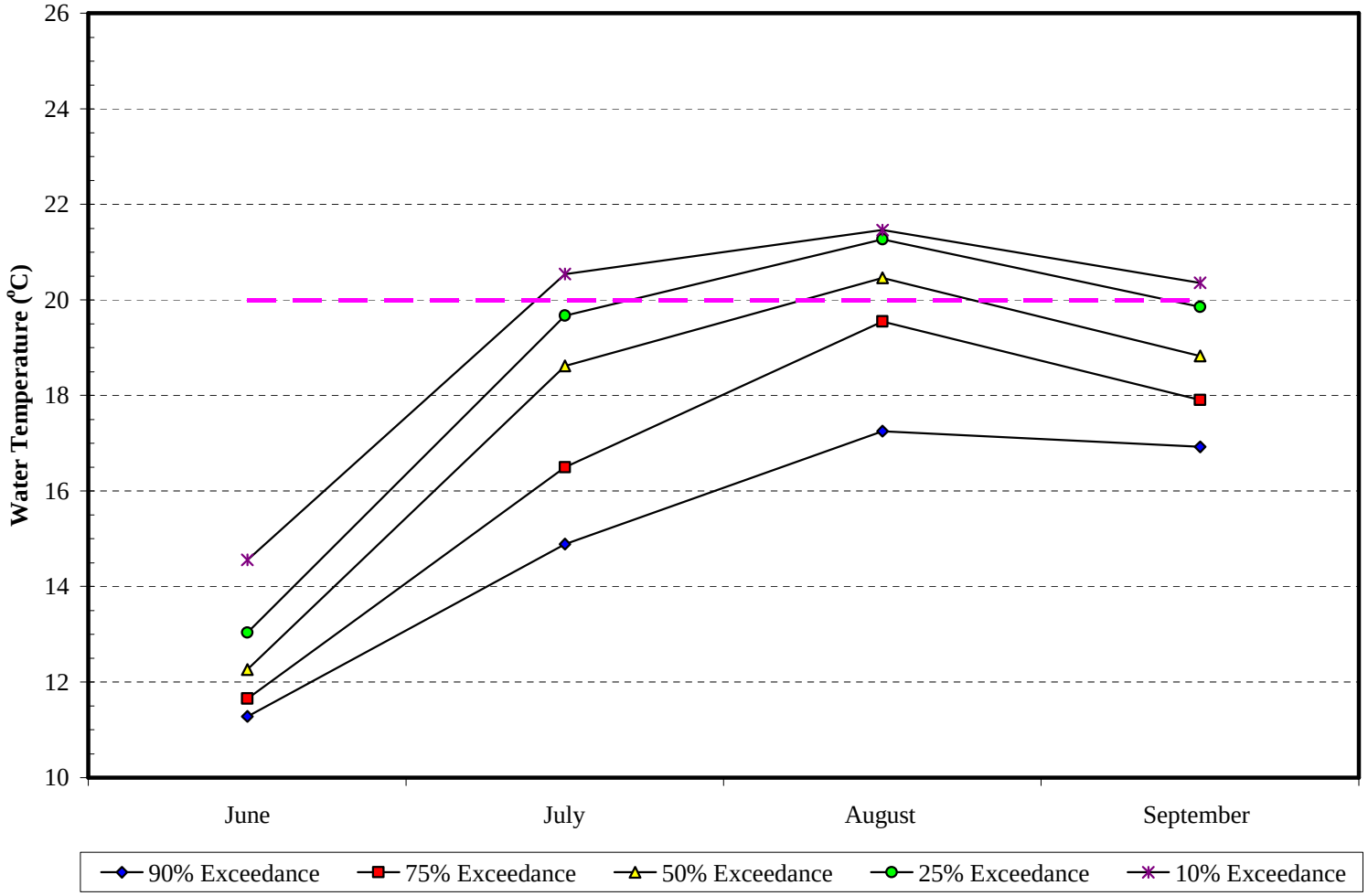

Figure 3-6. Comparison of monthly water temperature distribution at Station CARB1T (Based on 2002-2007 daily average data).

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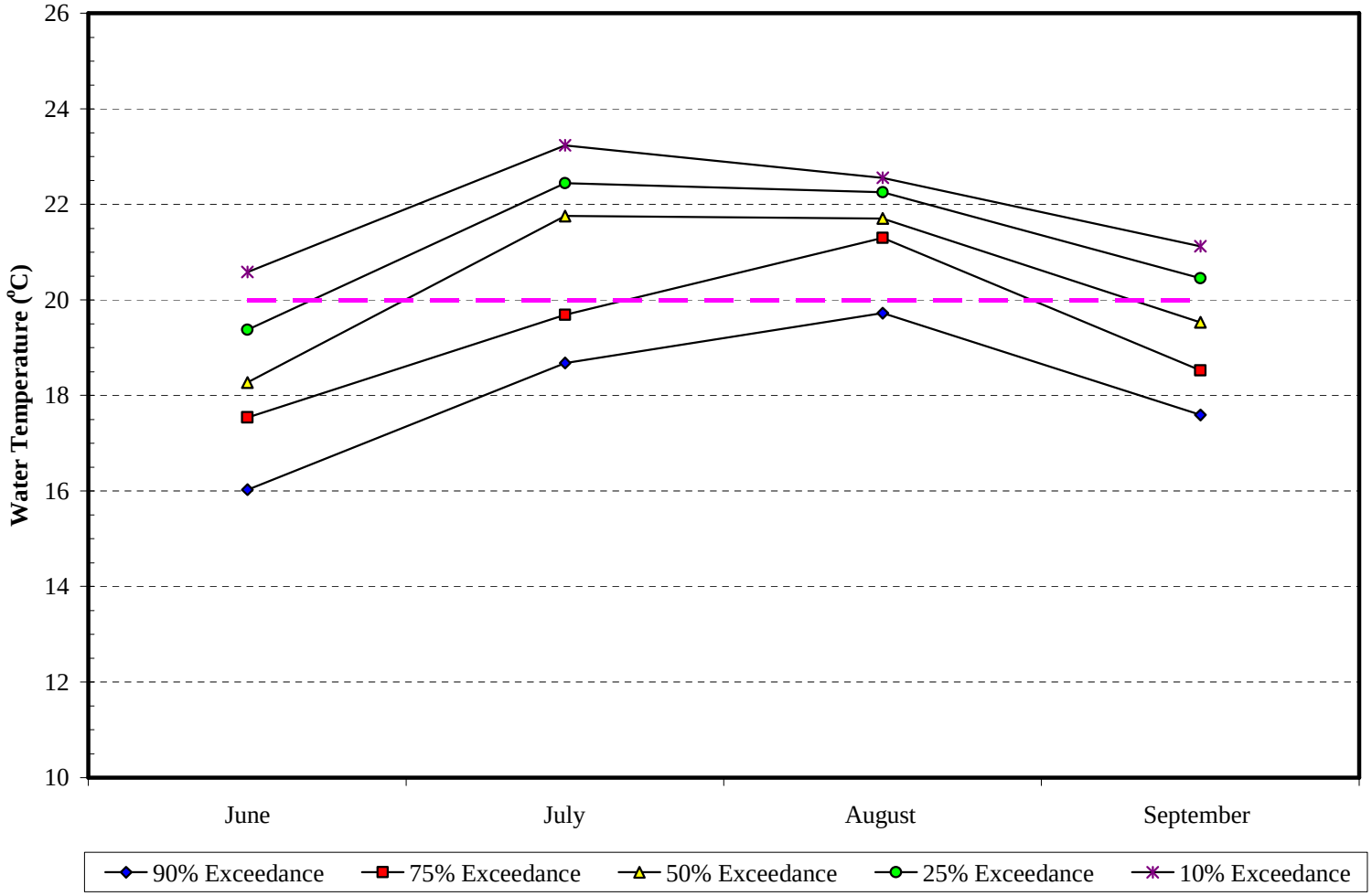

Figure 3-7. Comparison of monthly water temperature distribution at Station CARB2T (Based on 2002-2007 daily average data).

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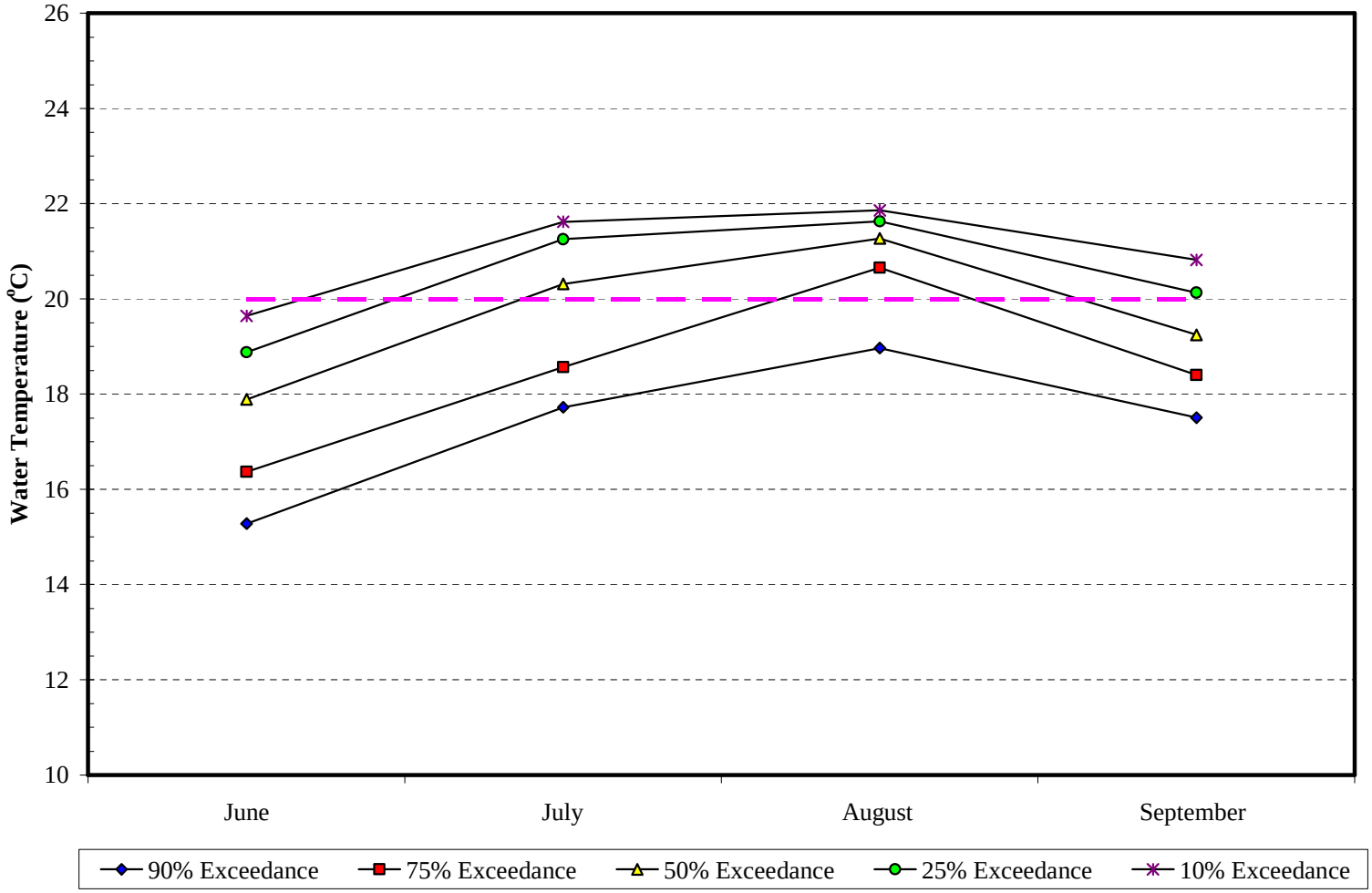

Figure 3-8. Comparison of monthly water temperature distribution at Station BD2T (Based on 2002-2007 daily average data).

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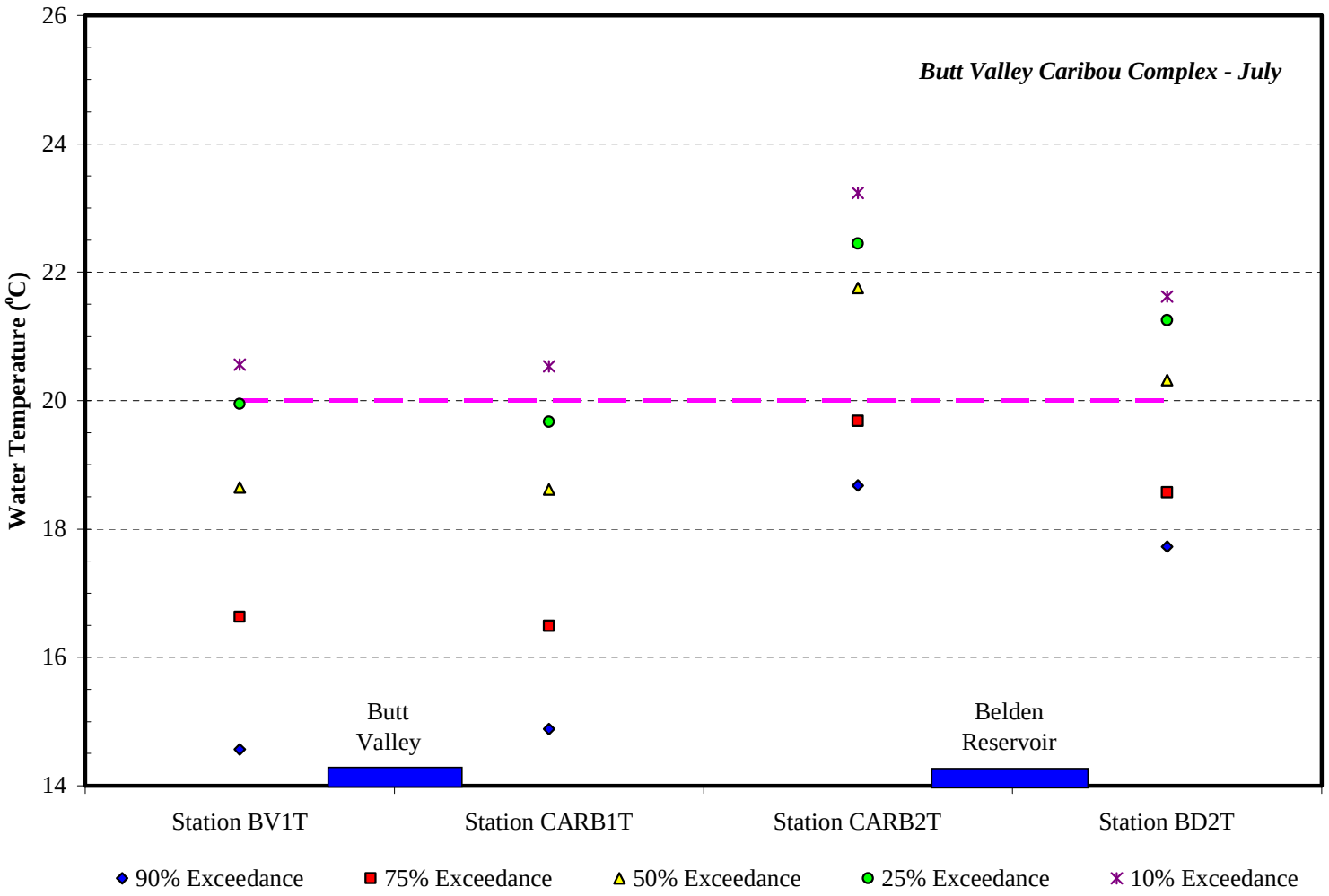

Figure 3-9. Longitudinal comparison of July water temperature distribution at four stations in the Butt Valley/Caribou Powerhouse complex (Based on 2002-2007 daily average data).

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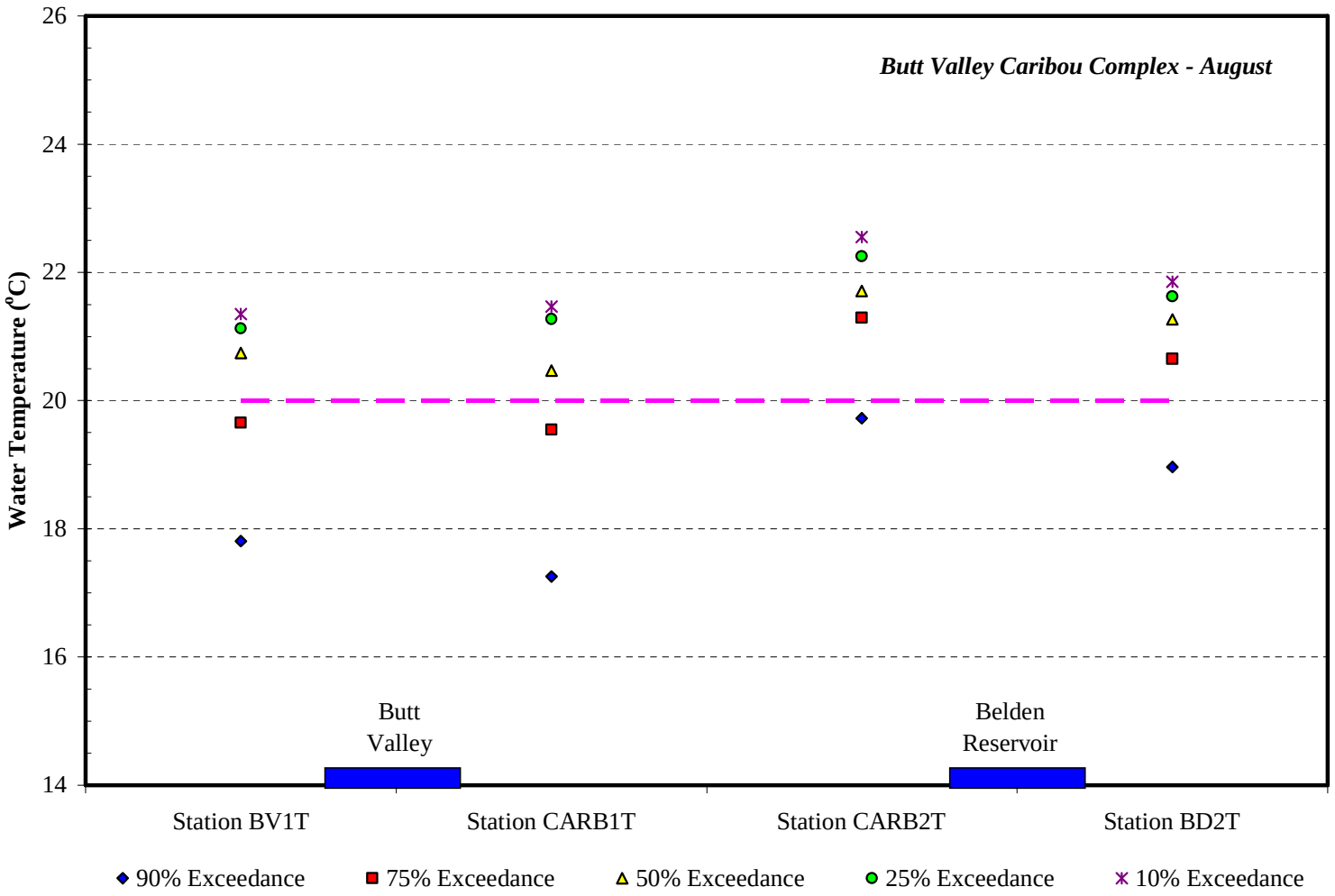

Figure 3-10. Longitudinal comparison of August water temperature distribution at four stations in the Butt Valley/Caribou Powerhouse complex (Based on 2002-2007 daily average data).

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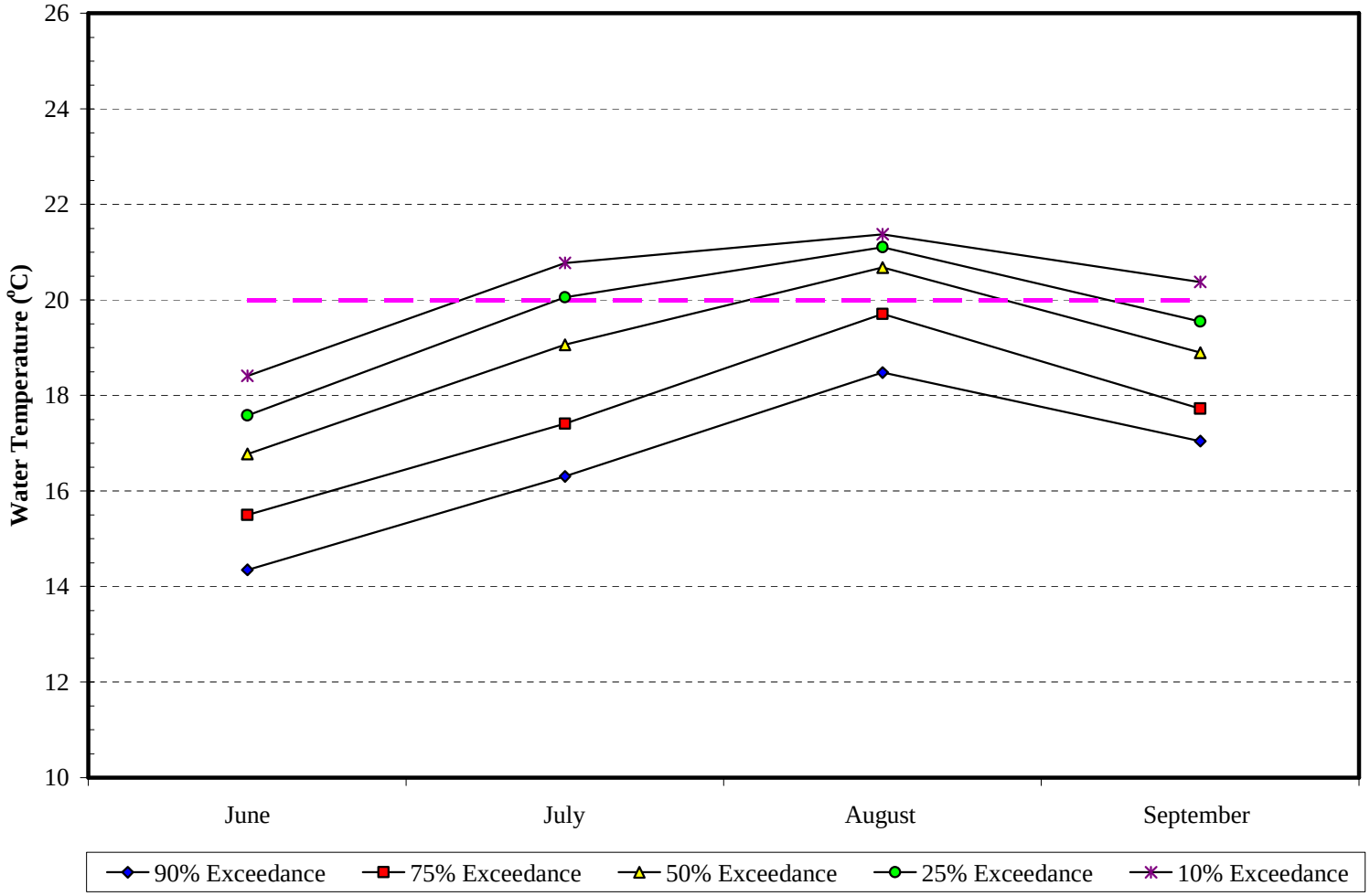

Figure 3-11. Comparison of monthly water temperature distribution at Station NF5T (Based on 2002-2007 daily average data).

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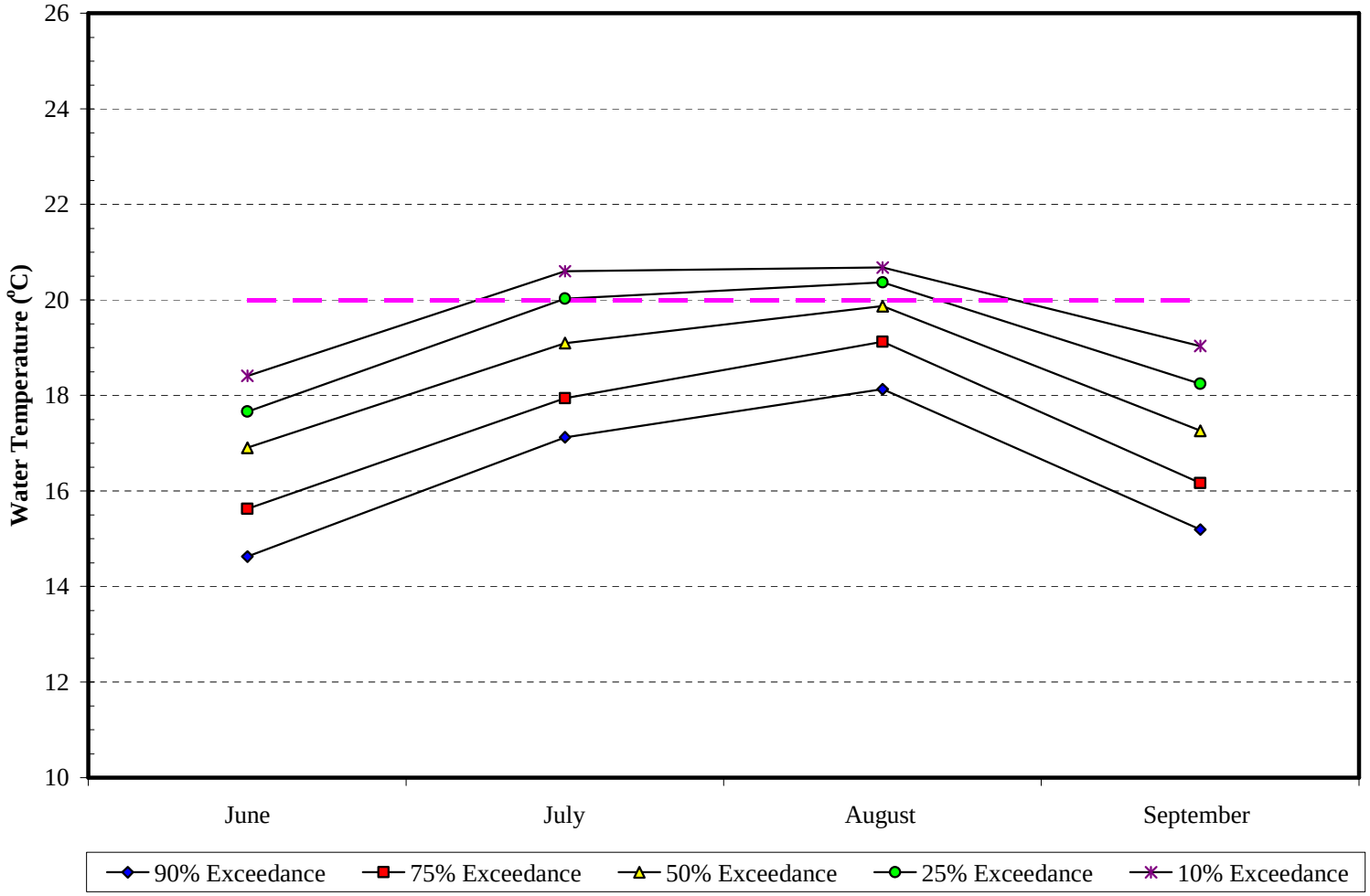

Figure 3-12. Comparison of monthly water temperature distribution at Station NF7T (Based on 2002-2007 daily average data).

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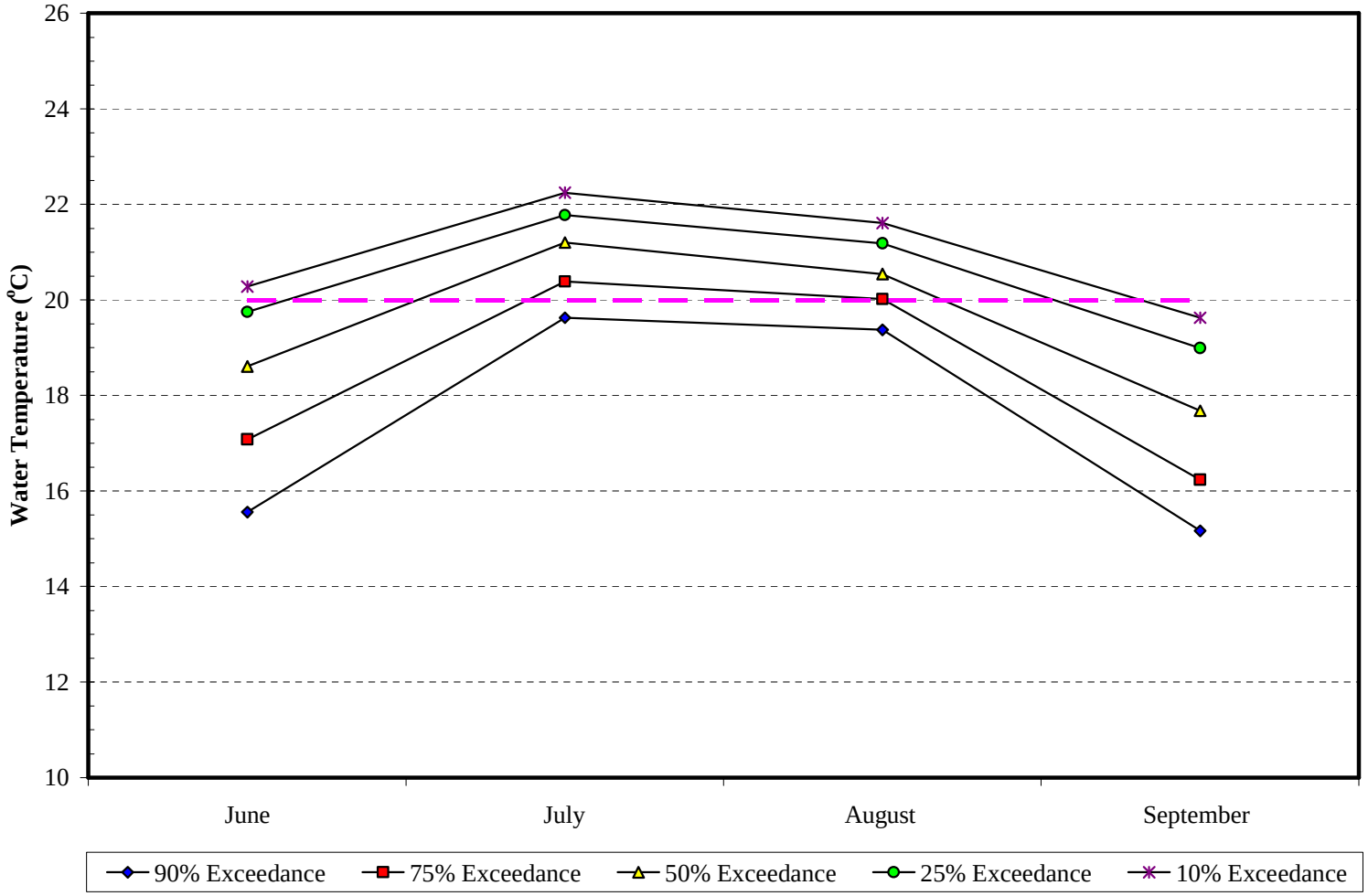

Figure 3-13. Comparison of monthly water temperature distribution at Station NF8T (Based on 2002-2007 daily average data).

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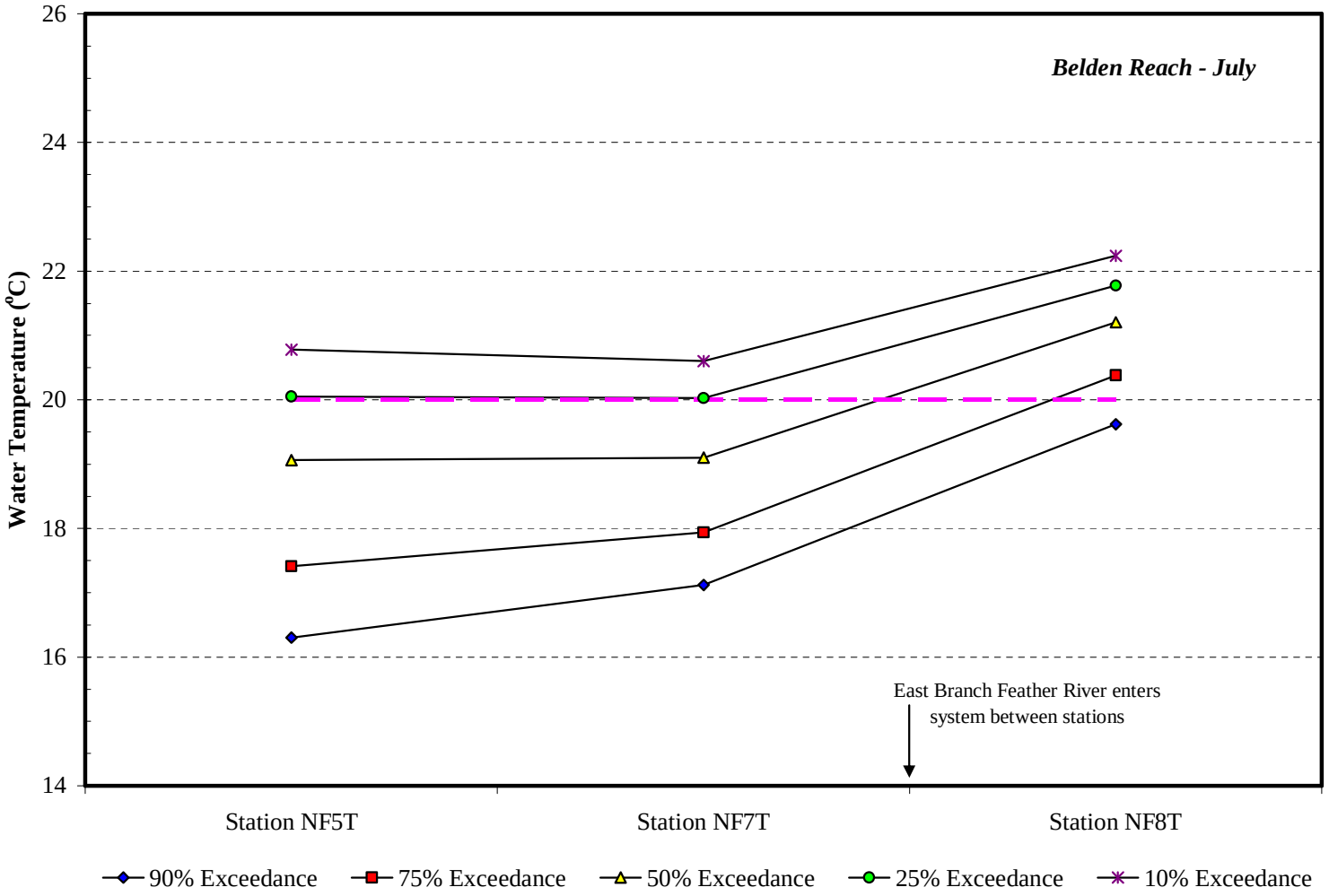

Figure 3-14. Longitudinal comparison of July water temperature distribution at three stations in the Belden Reach (Based on 2002-2007 daily average data).

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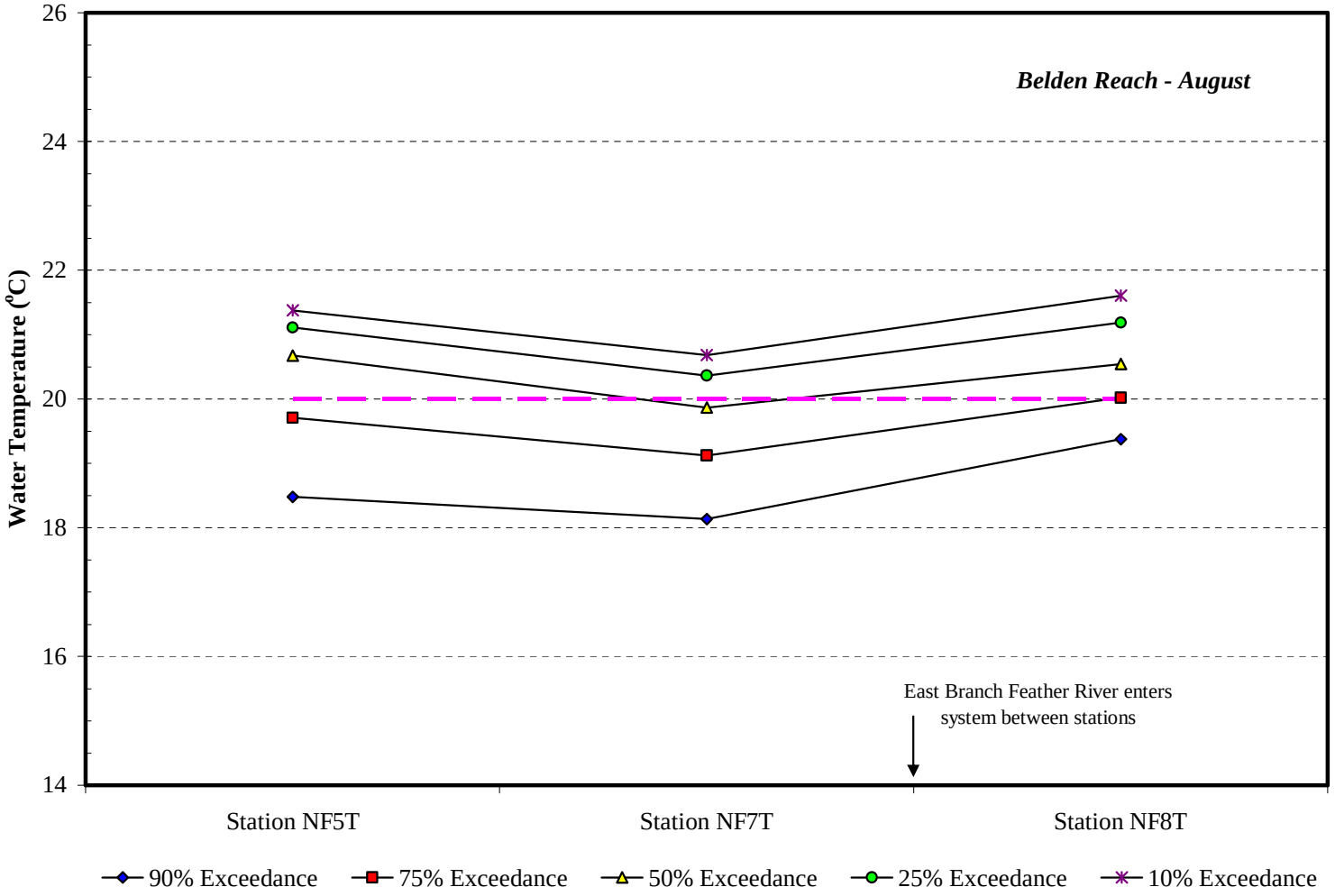

Figure 3-15. Longitudinal comparison of August water temperature distribution at three stations in the Belden Reach (Based on 2002-2007 daily average data).

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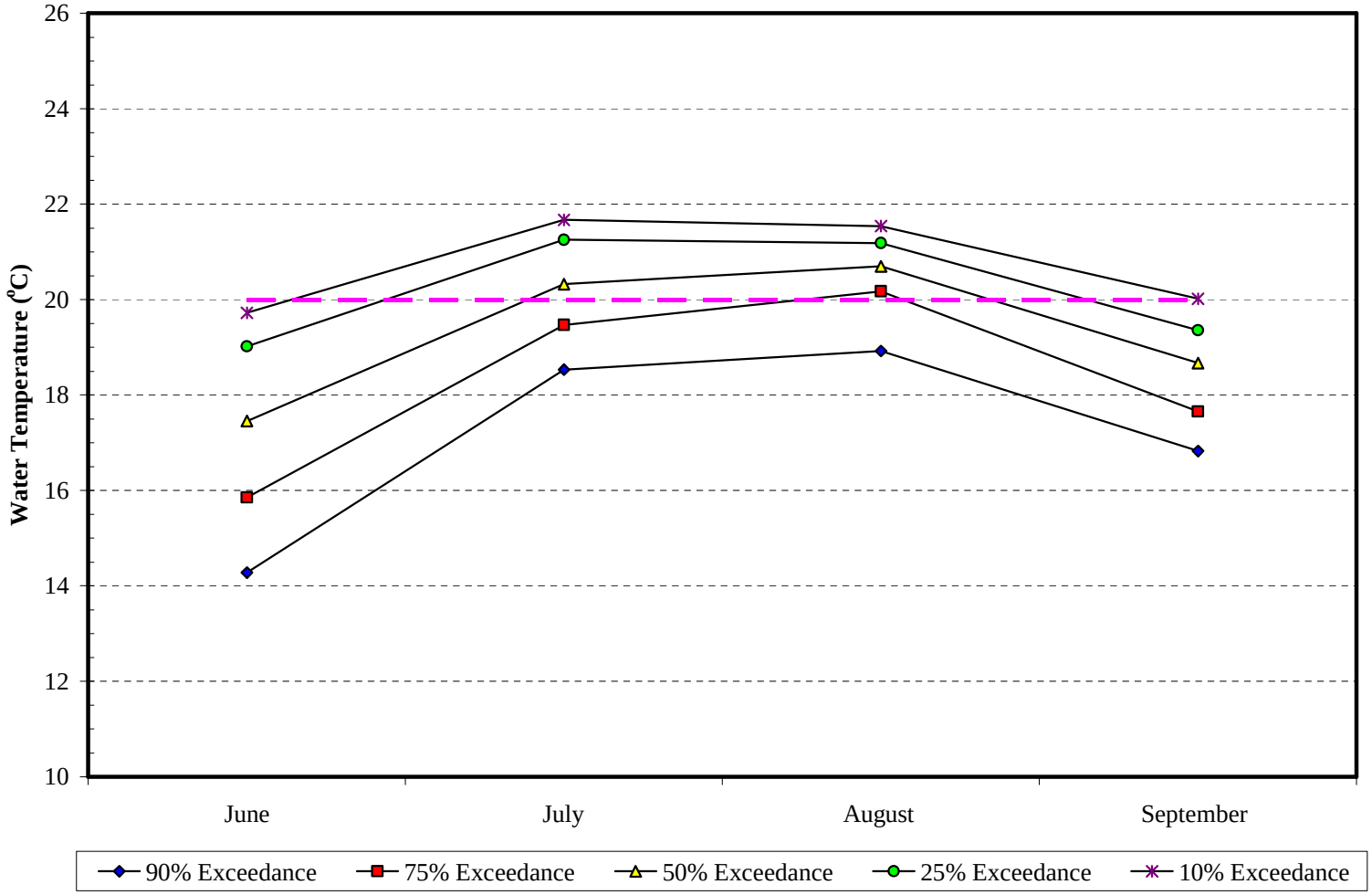

Figure 3-16. Comparison of monthly water temperature distribution at Station NF10T (Based on 2002-2007 daily average data).

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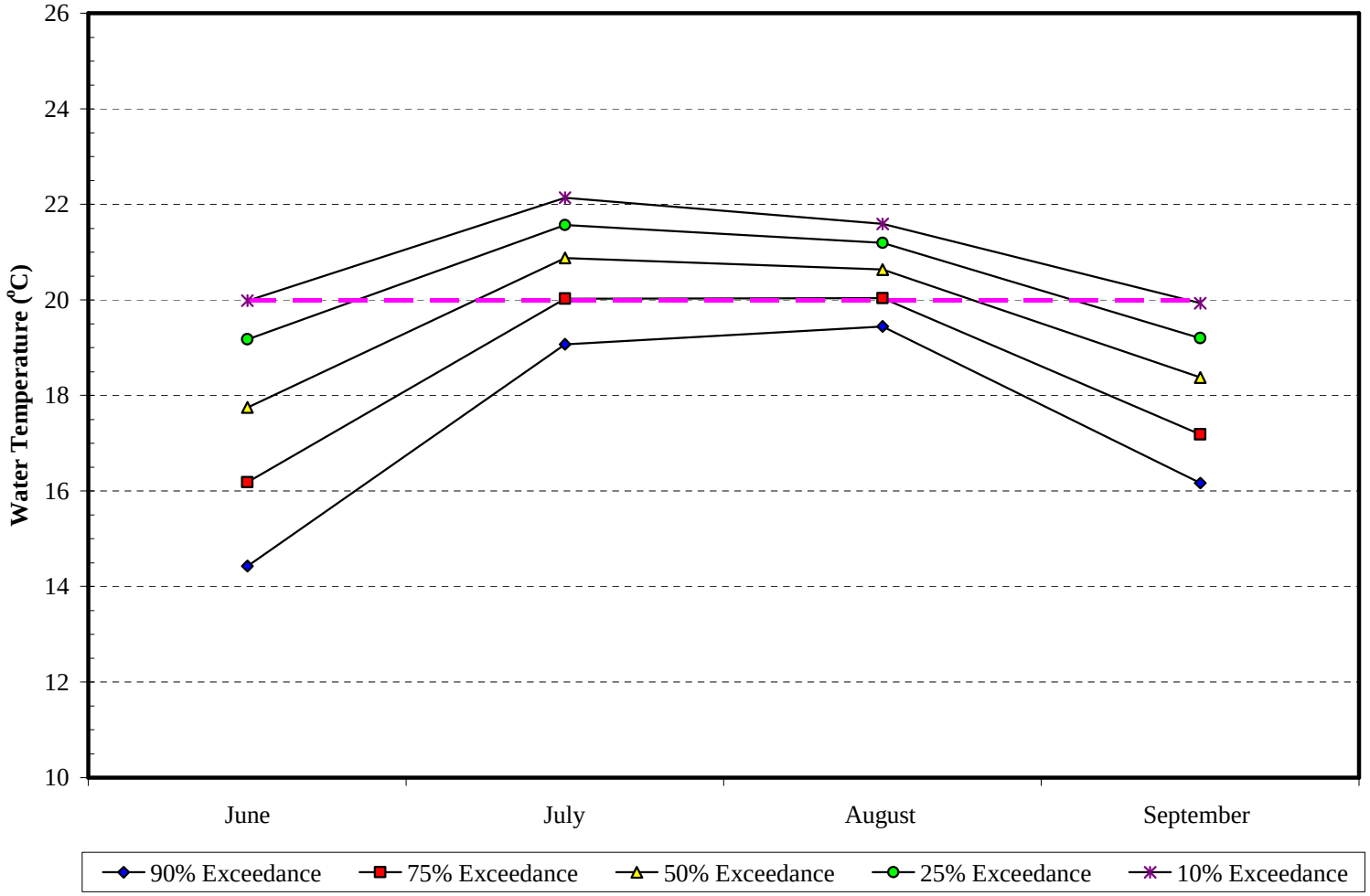

Figure 3-17. Comparison of monthly water temperature distribution at Station NF12T (Based on 2002-2007 daily average data).

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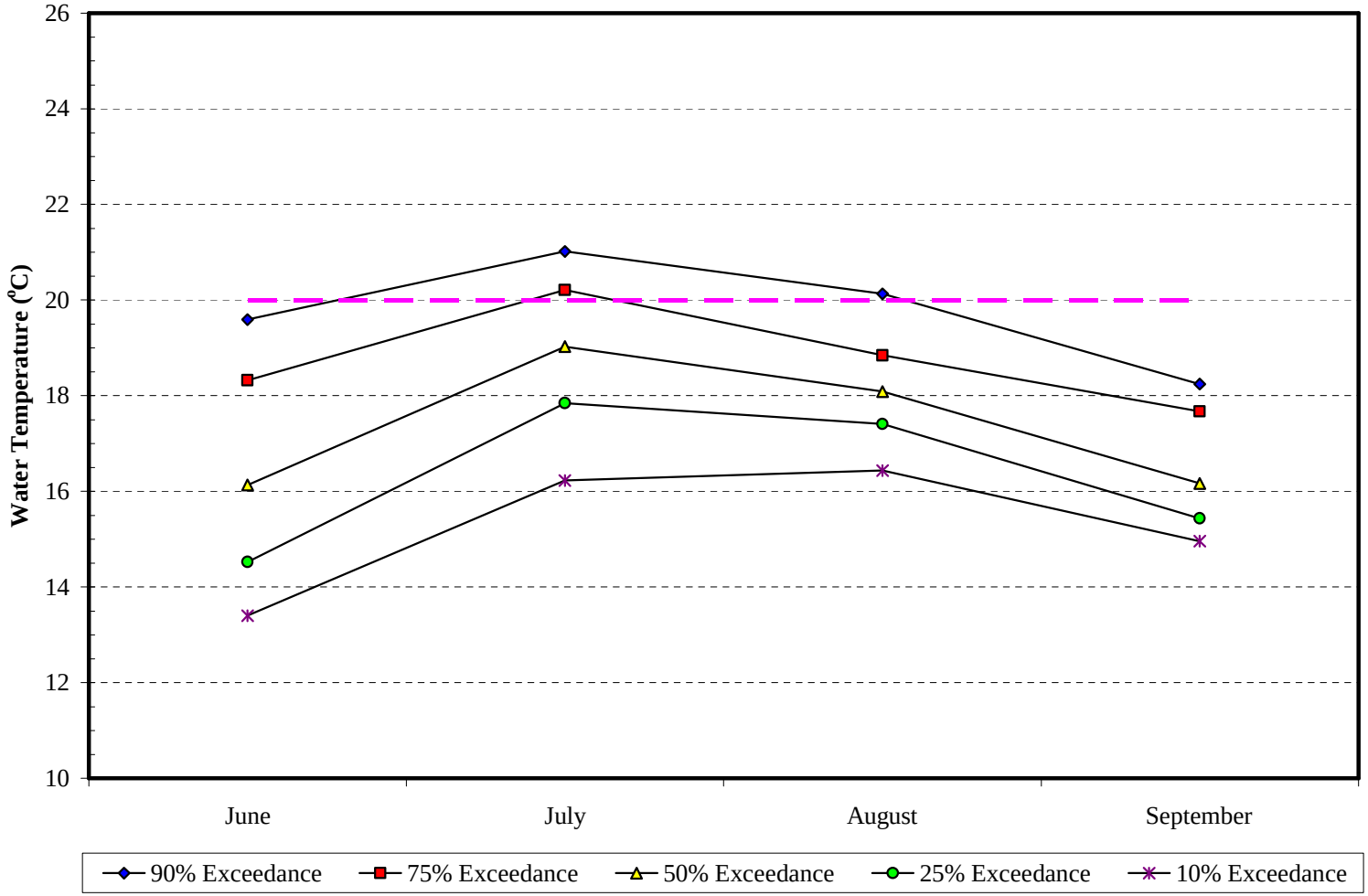

Figure 3-18. Comparison of monthly water temperature distribution at Station NF13T (Based on 2002-2007 daily average data).

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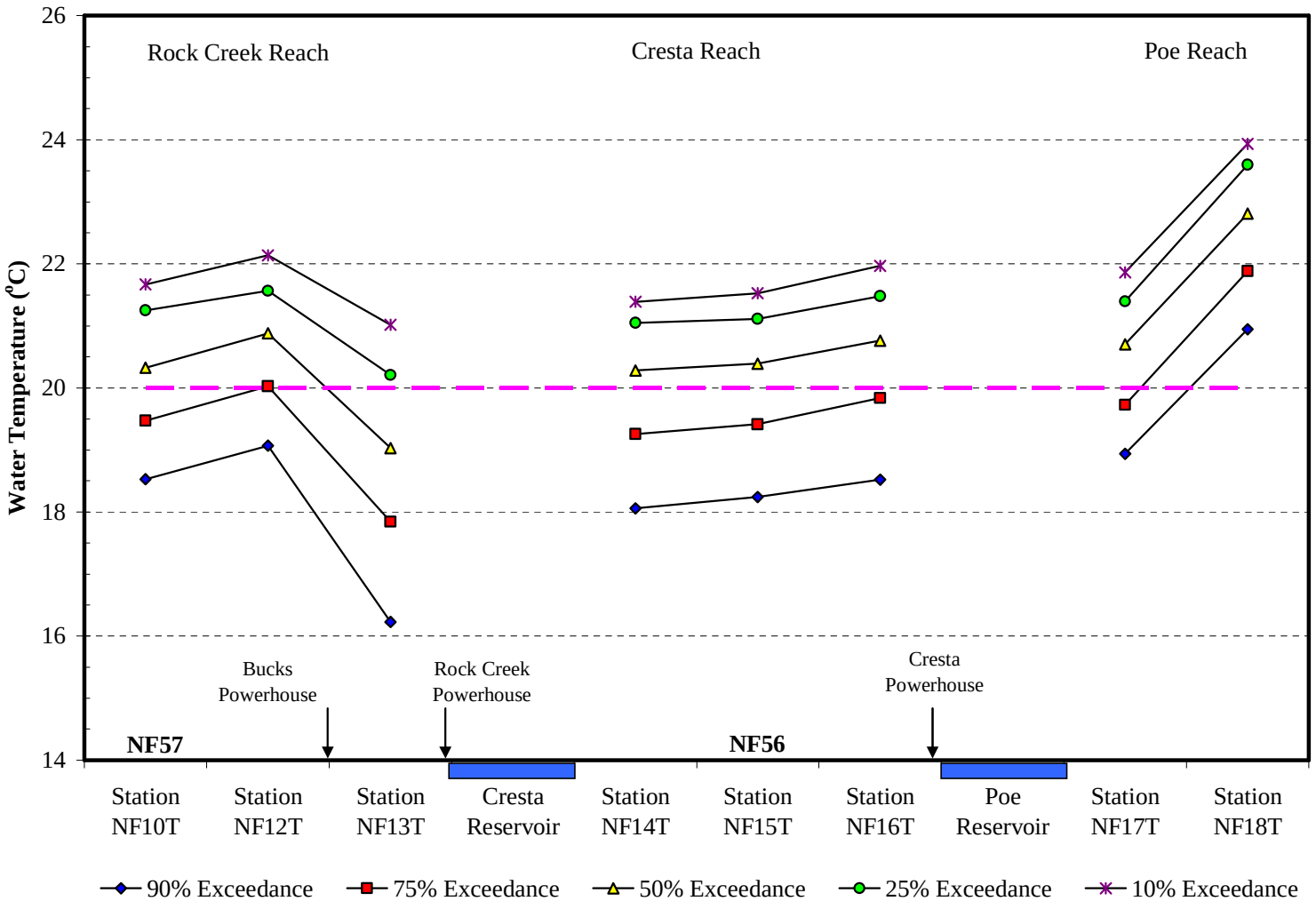

Figure 3-19. Longitudinal comparison of July water temperature distribution from eight stations in the Rock Creek-Cresta, and Poe reaches (Based on 2002-2007 daily average data).

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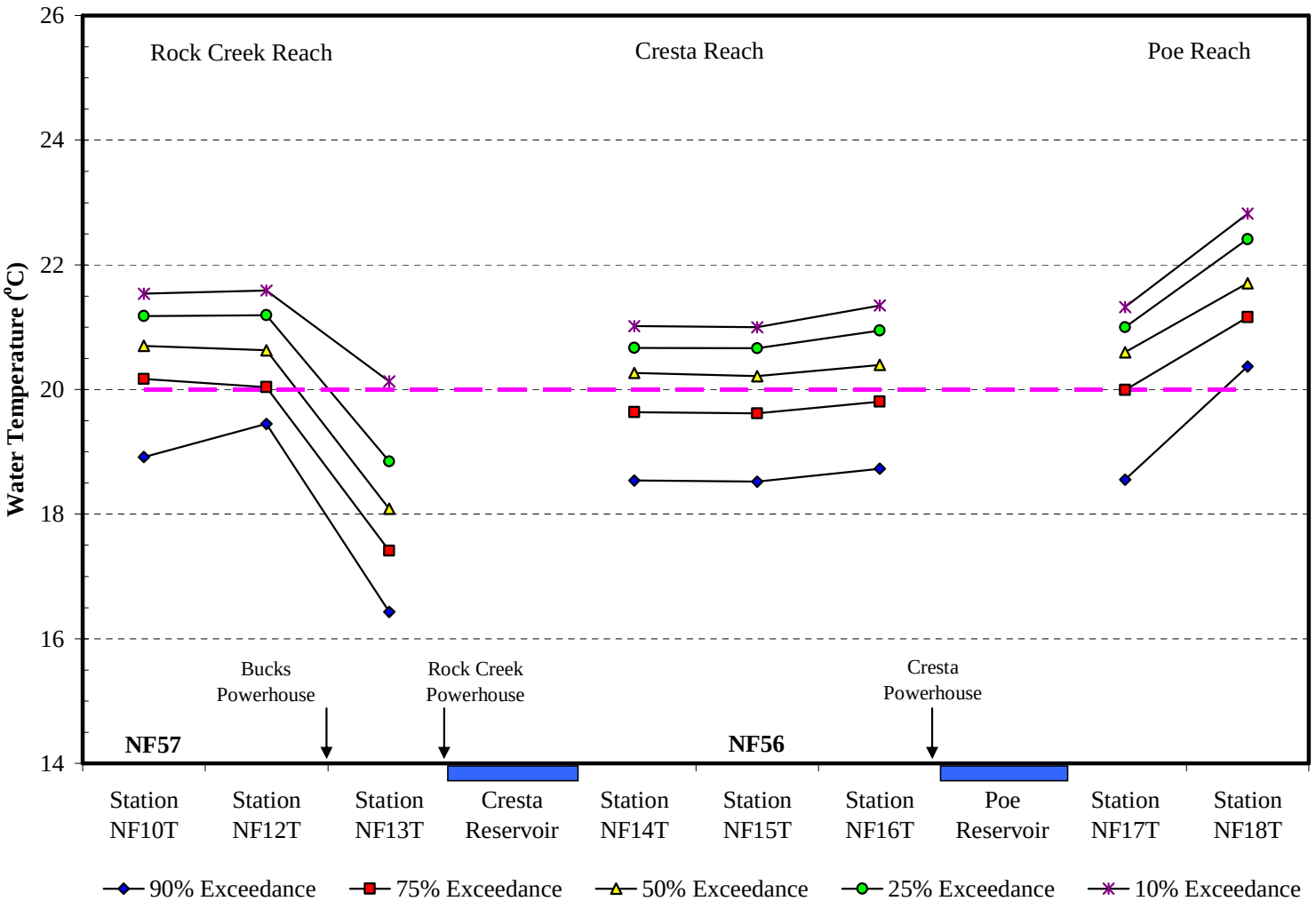

Figure 3-20. Longitudinal comparison of August water temperature distribution from eight stations in the Rock Creek-Cresta, and Poe reaches (Based on 2002-2007 daily average data).

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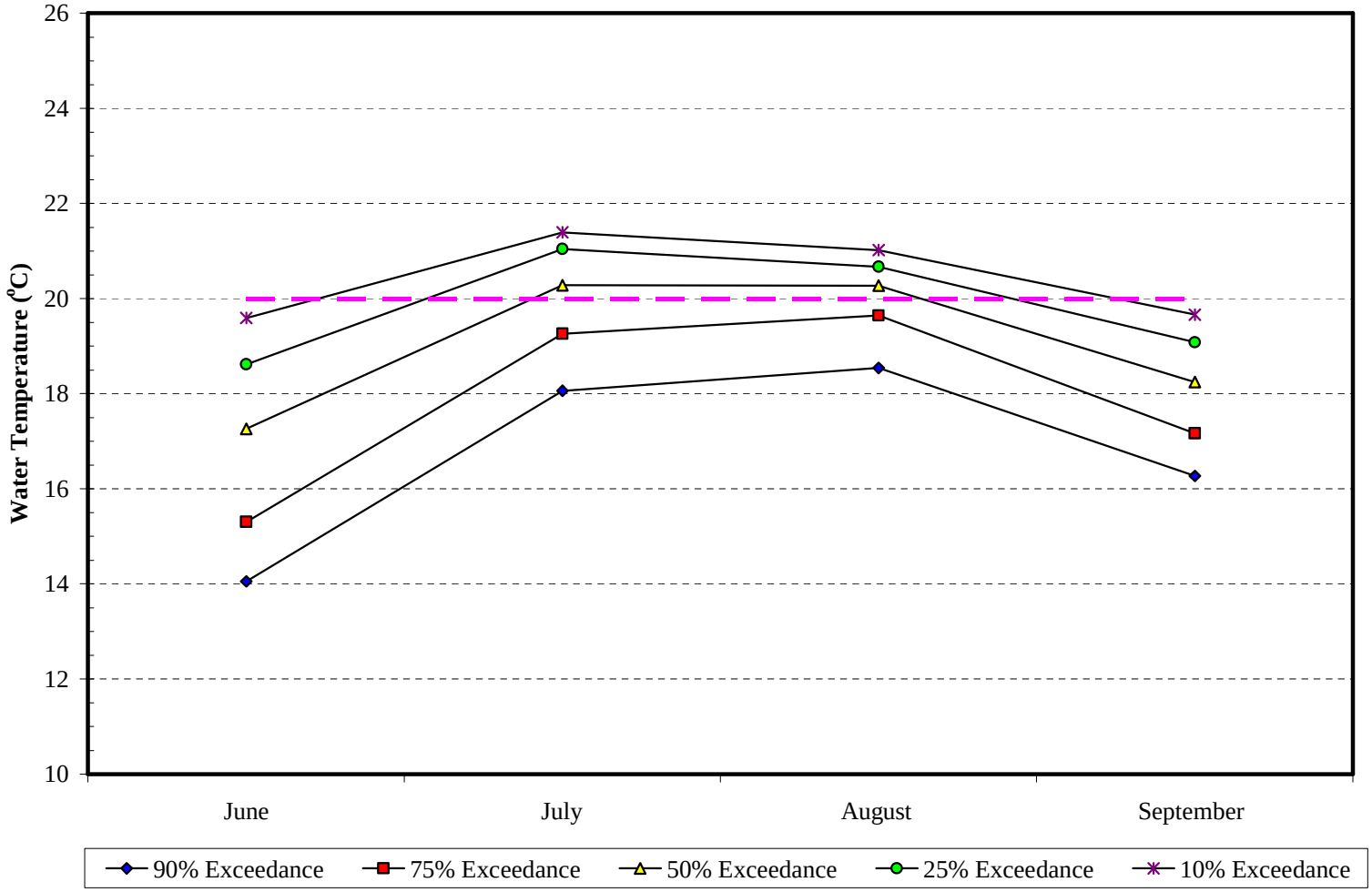

Figure 3-21. Comparison of monthly water temperature distribution at Station NF14T (Based on 2002-2007 daily average data).

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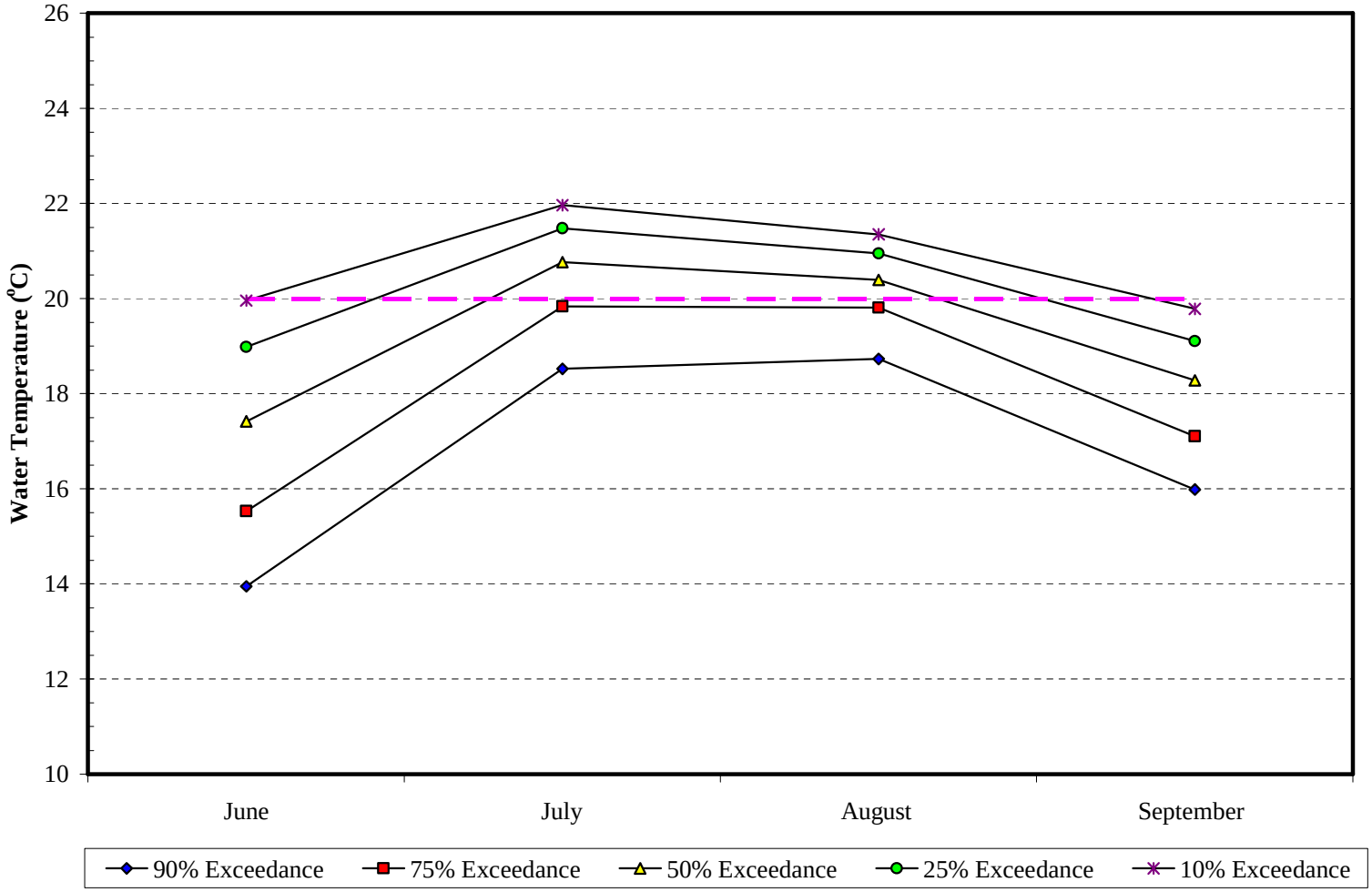

Figure 3-22. Comparison of monthly water temperature distribution at Station NF16T (Based on 2002-2007 daily average data).

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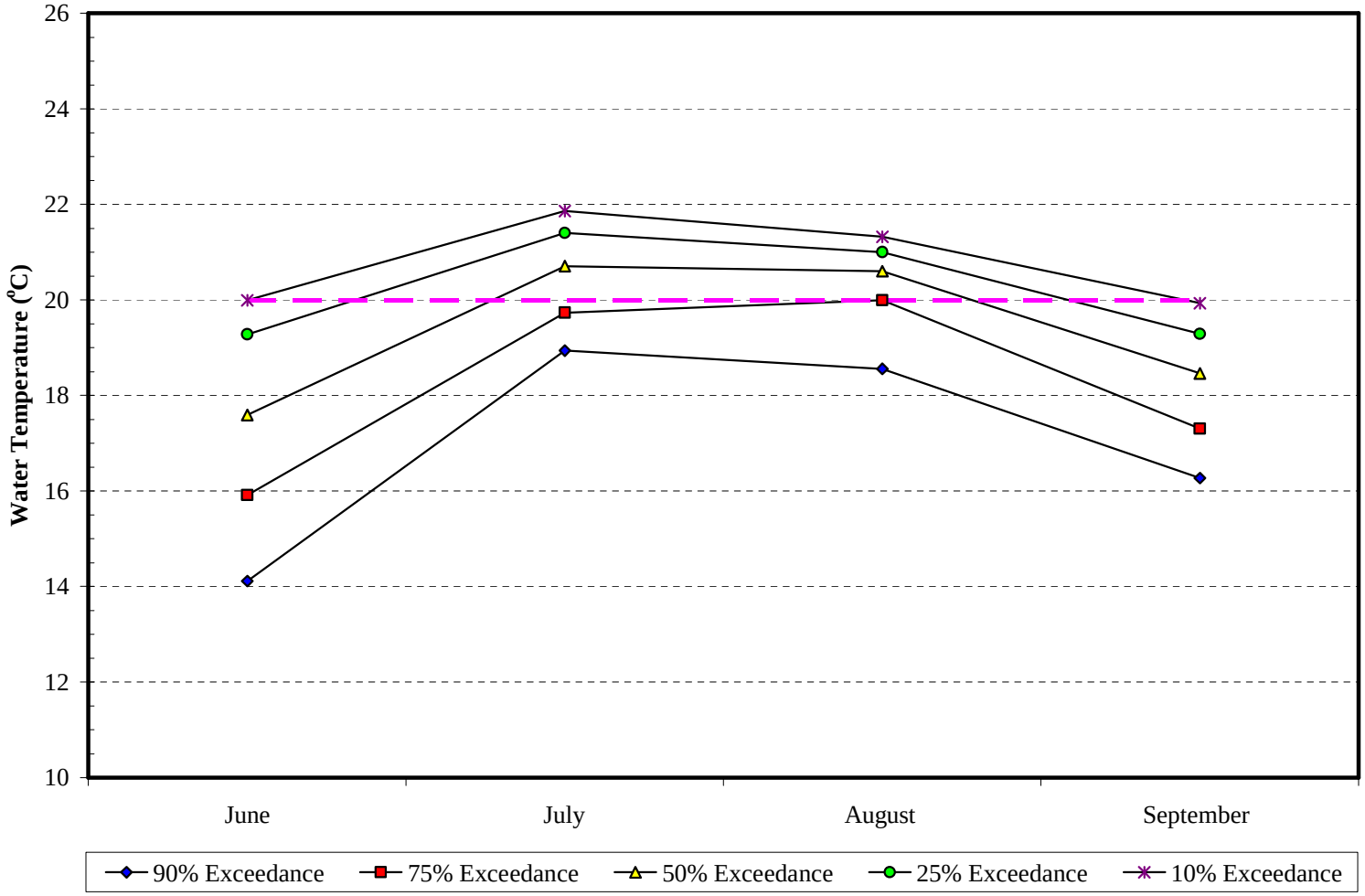

Figure 3-23. Comparison of monthly water temperature distribution at Station NF17T (Based on 2002-2007 daily average data).

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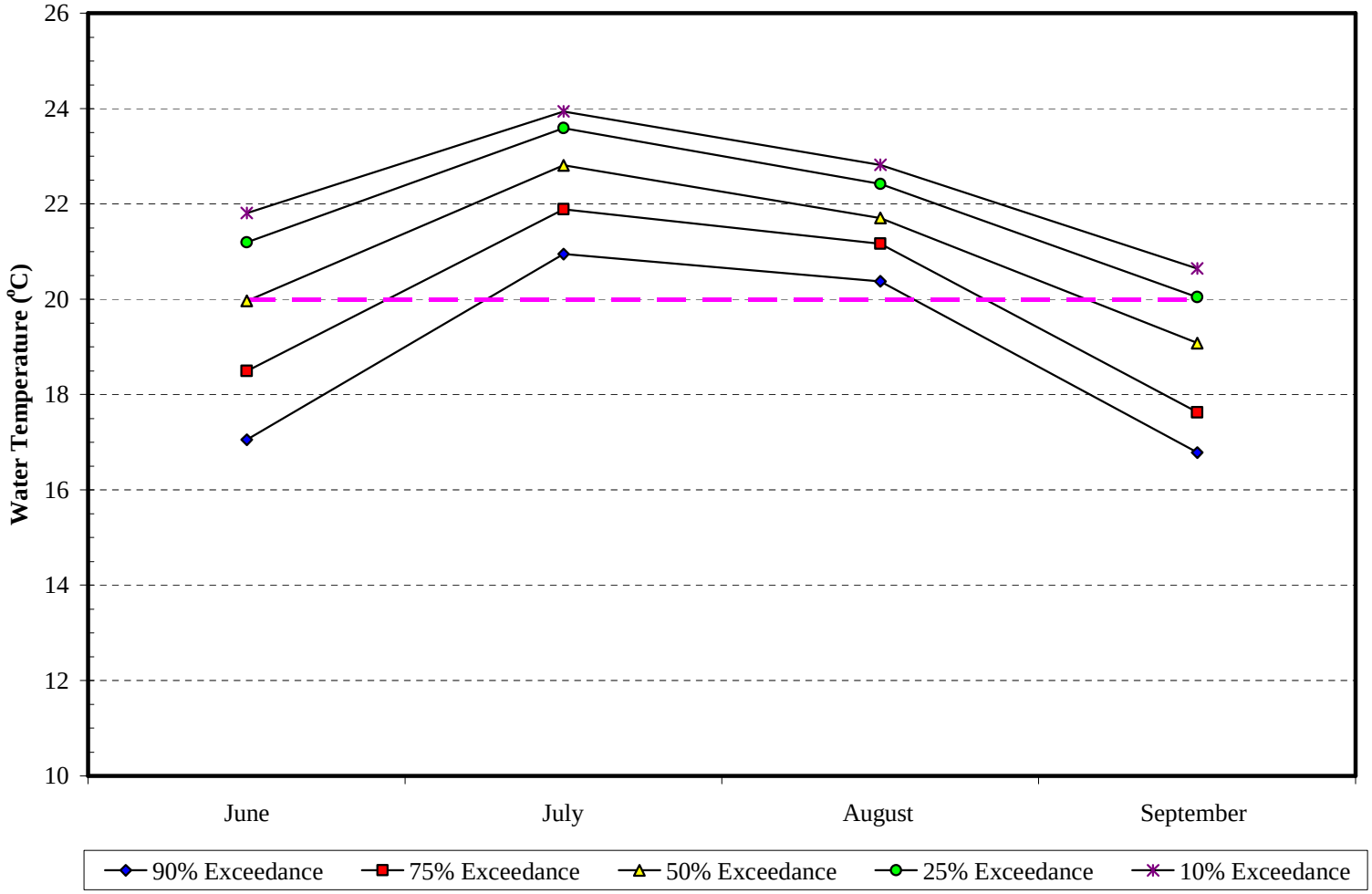

Figure 3-24. Comparison of monthly water temperature distribution at Station NF18T (Based on 2002-2007 daily average data).

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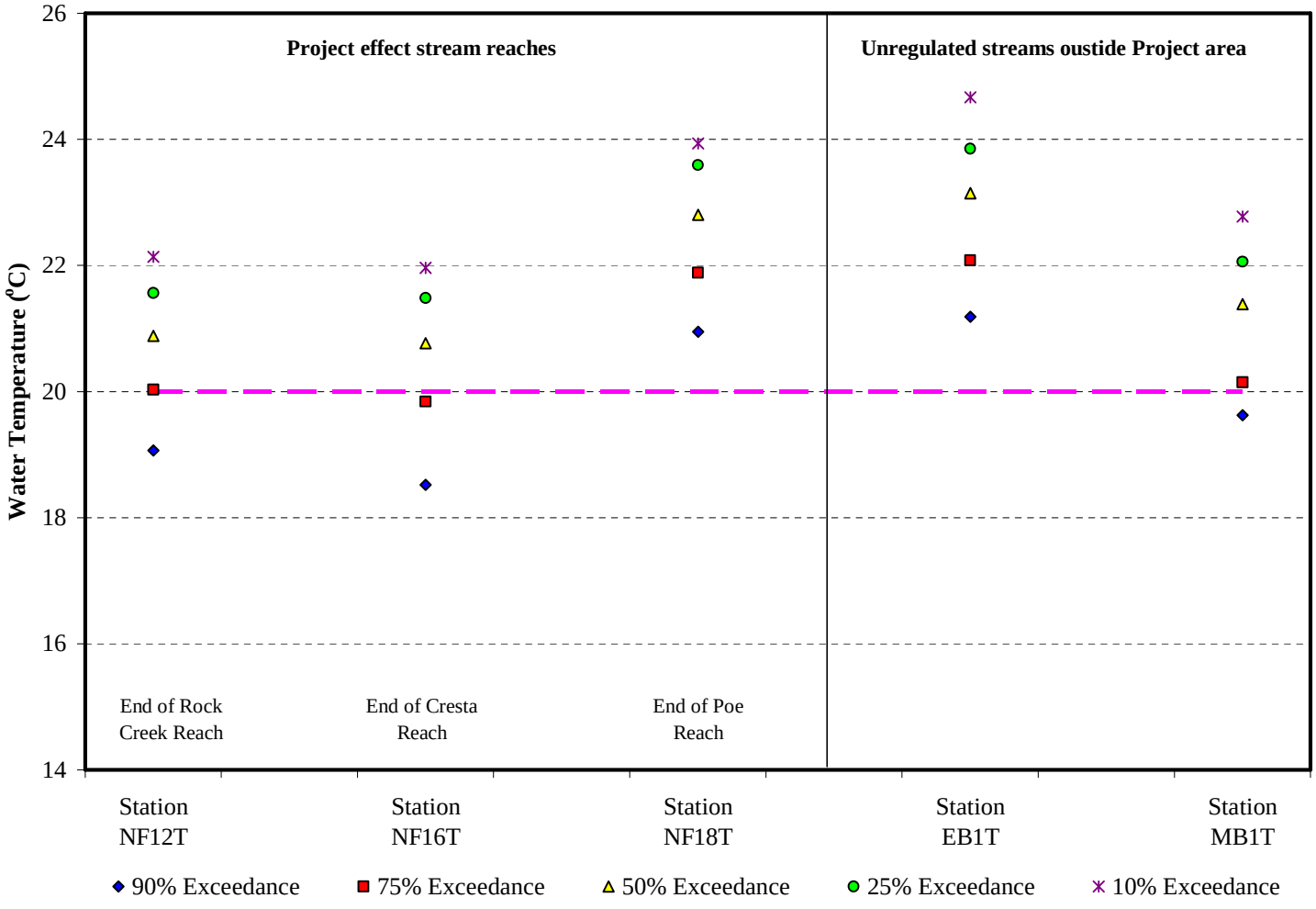

Figure 3-25. Comparison of July water temperature distribution from terminal stations in three Project effected reaches with two stations from un-regulated streams (Based on 2002-2007 daily average data).

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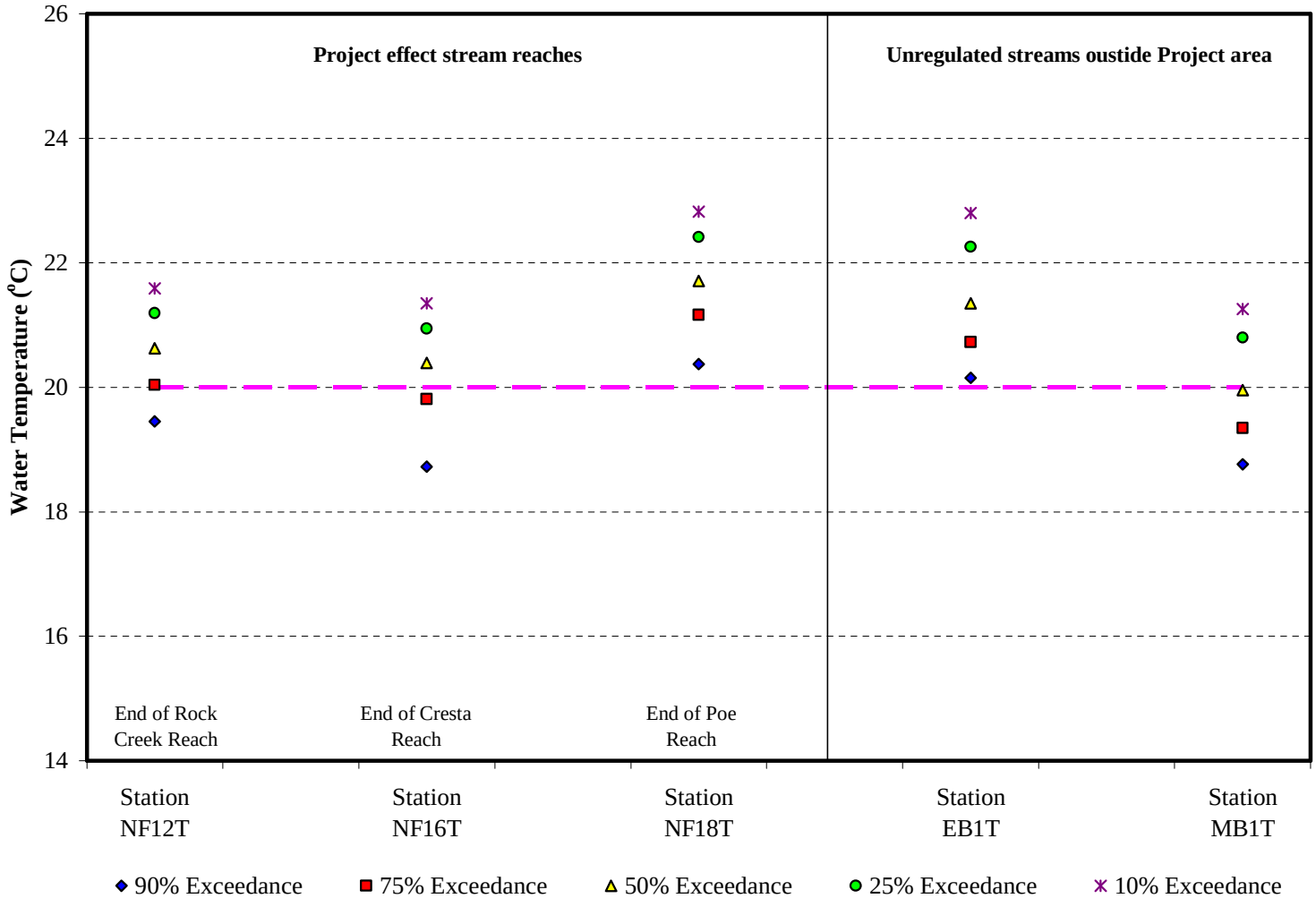

Figure 3-26. Comparison of August water temperature distribution from terminal stations in three Project effected reaches with two stations from un-regulated streams (Based on 2002-2007 daily average data).

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SECTION 4.0

References

Bartholow, J.M. 1989. Stream temperature investigations: field and analytic methods. Instream Flow Information Paper No. 13. U.S. Fish Wildl. Serv. Biol. Rep. S9(i7). 139pp.

Bartholow, LM., and T.I Waddle. 1986. Introduction to stream network habitat analysis. Instream Flow Information Paper 22. U.S. Fish and Wildlife Service Biological Report. 86(8). 242pp.

Bechtel Corporation and Thomas R. Payne & Associates (TRPA), 2006. Pacific Gas and Electric Company North Fork Feather River instream temperature studies: 33 years of synthesized reservoir operations, evaluation of installation of curtains and modifications in Lake Almanor and Butt Valley reservoirs, and high instream flow releases from Canyon Dam. December 2006 Report No. 026.11.06.23 prepared for Pacific Gas and Electric Company.

Federal Energy Regulatory Commission (FERC). 2001. *Order Approving Settlement and Issuing New License* (Issued October 24, 2001) Projects Nos. 1962-000 and 028..

Pacific Ga_5 & Electric Company (PG&E). 2000a. Rock Creek-Cresta Project, FERC Project No. 1962. Rock Creek-Cresta Relicensing Settlement Agreement.

___. 2000b. Rock Creek-Cresta Project, FERC Project No. 1962. Rationale Report for the Rock Creek-Cresta Settlement Agreement. November 29, 2000.

___. 2003. Water temperature monitoring of 2002, Rock Creek-Cresta Project, FERC Project No. 1962, Final Report.

___. 2004a. Water temperature monitoring of 2003, Rock Creek-Cresta Project, FERC Project No. 1962, Final Report.

___. 2004b. Upper North Fork Feather River Project, FERC Project No. 2105, Relicensing Settlement Agreement.

___. 2005a. Water temperature monitoring of 2004, Rock Creek-Cresta Project, FERC Project No. 1962, Final Report.

___. 2005b. Study Data and Informational Report on Water Temperature Monitoring and Additional Reasonable Water Temperature Control Measures. Issued September 2005.

___. 2006. Water temperature monitoring of 2005, Rock Creek-Cresta Project, FERC Project No. 1962, Final Report.

___. 2007. Water temperature monitoring of 2006, Rock Creek-Cresta Project, FERC Project No. 1962, Final Report.

©2008, Pacific Gas and Electric Company

___. 2008. Water temperature monitoring of 2007, Rock Creek-Cresta Project, FERC Project No. 1962, Final Report.

Stetson Engineers Inc. and Pacific Gas and Electric Company (Stetson /PG&E). 2007. 2006 North Fork Feather River Special Testing Data Report. Jointly prepared by Stetson Engineers Inc. and Pacific Gas and Electric Company.

Theurer, F.D., K.A. Voos. and W.L Miller, 1984. Instream water temperature model Instream Flow information Paper 16. United States Fish and Wildlife Service, FWS/QBS-S4/I5. 250pp.

Thomas R. Payne & Associates (TRPA). 2002. *North Fork Feather River and Butt Creek Instream Flow Study, North Fork Feather River Hydroelectric Project, FERC Project No. 2105*. Prepared for Pacific Gas and Electric Company. Arcata, CA.

___. 2003. *Revised Water Temperature Modeling for the Rock Creek-Cresta Hydroelectric Project – FERC Project No. 1962*. Presented as an appendix to the 2002 Water Temperature Monitoring Report for Rock Creek-Cresta. Arcata, CA.

___. 2007. North Fork Feather River Stream Network Temperature Models - Daily Mean and Daily Maximum Water Temperature Model*. Report prepared for Pacific Gas & Electric Company Technical and Ecological Services, San Ramon, CA.

Woodward-Clyde Consultants (WCC), 1986. Rock Creek-Cresta Project, cold water feasibility study, volume L May 1986 report prepared for Pacific Gas & Electric Company.

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