

**ASSESSMENT OF
HIGH INSTREAM FLOW RELEASES
THROUGH THE
CANYON DAM LOW-LEVEL OUTLET
DURING JULY AND AUGUST
ON
THE INFLOW TEMPERATURE FOR THE
BELDEN REACH**

March 28, 2005

OBJECTIVE

Analyze alternative operating procedures for flow releases from Canyon Dam and the Butt Valley and Caribou Powerhouses to evaluate changes in inflow temperatures for the Belden Reach

PRESENTATION OUTLINE

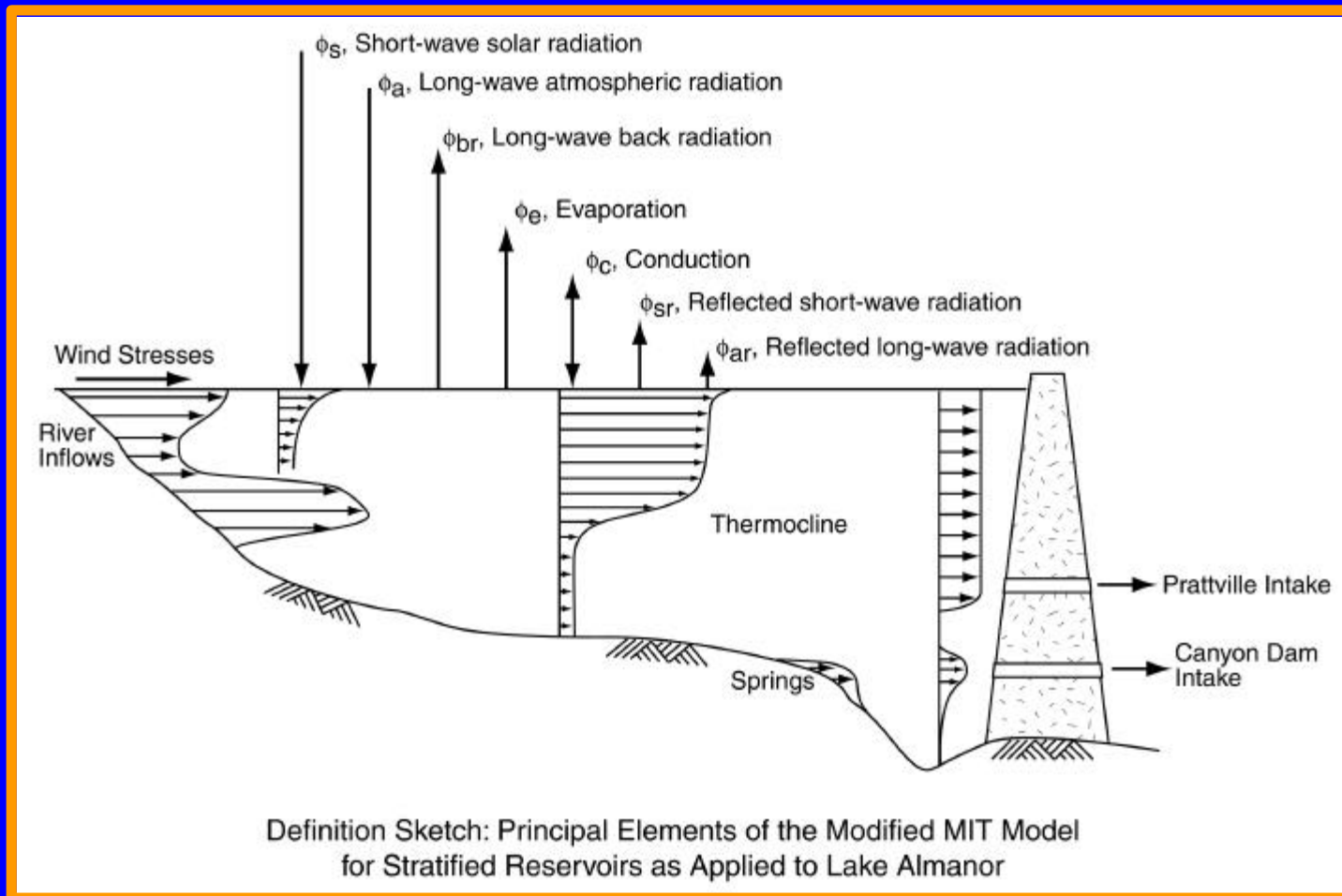
- **SETTLEMENT AGREEMENT FLOWS (existing conditions with blending of Canyon Dam releases)**
- **HIGH INSTREAM FLOW RELEASES (Canyon Dam low-level outlet and Seneca Reach)**
- **METHODOLOGY AND ANALYSES**
- **RESULTS AND DISCUSSION**
- **CONCLUSIONS**

SETTLEMENT AGREEMENT CASE

Settlement Agreement case is for existing reservoir conditions in Lake Almanor and Butt Valley Reservoirs

Input to the Settlement Agreement case includes calibrated model parameters, 33-years of meteorological, inflow, and Lake Almanor operation data based on the Settlement Agreement (with blending of Canyon Dam releases)

Schematic Profile - Lake Almanor Model



HIGH INSTREAM FLOW RELEASES FOR LAKE ALMANOR AND CANYON DAM

Flow releases through the Canyon Dam low-level outlet were increased from 60 to 400 cfs during July & August

During July and August, no flow releases were made through the Canyon Dam mid-level outlet (i.e. no blending of flows)

Flow releases from the Prattville Intake were reduced during July and August to compensate for the increased releases at Canyon Dam

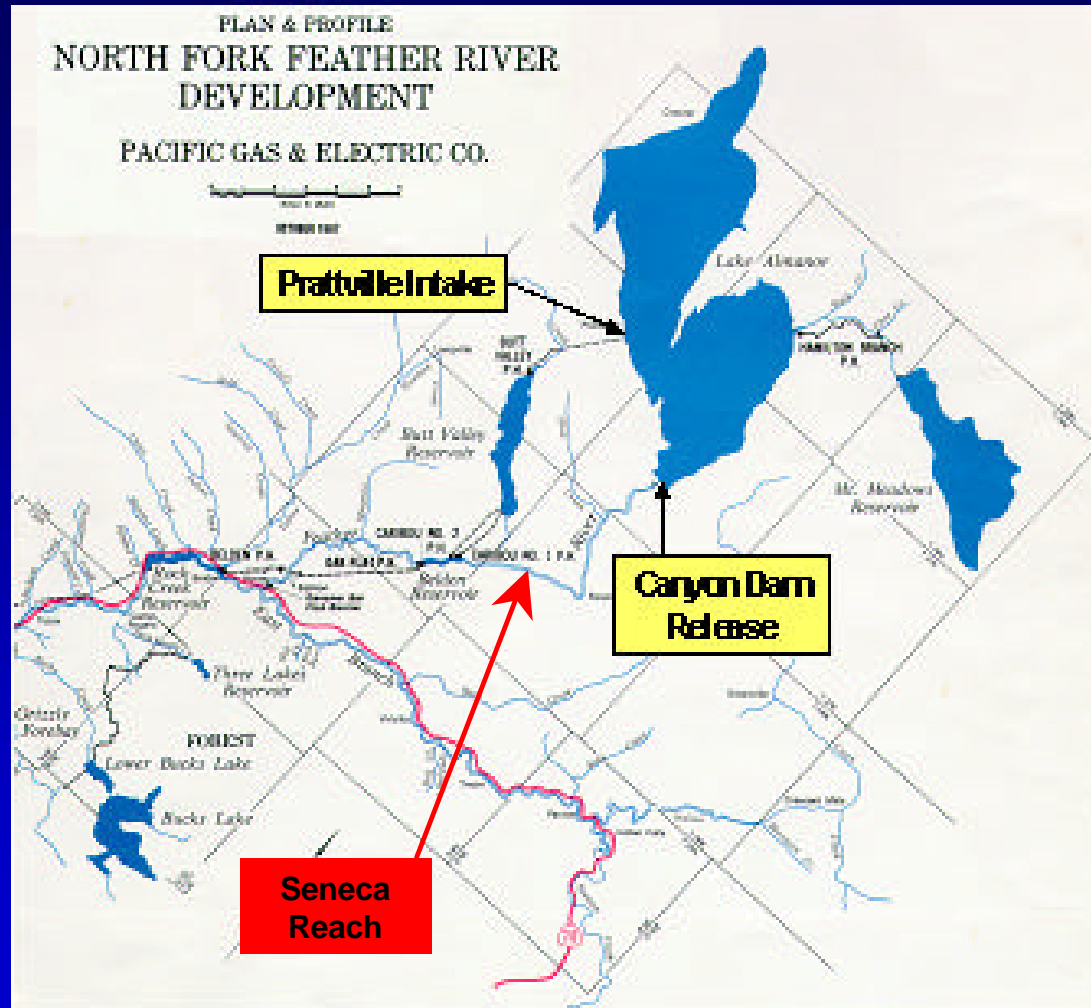
HIGH INSTREAM FLOW RELEASE MODEL FOR BUTT VALLEY RESERVOIR

**Inflows from Prattville Intake during July
and August were reduced by the amount
released through Canyon Dam**

**Prattville Inflow temperatures to Butt Valley
were estimated from the Lake Almanor
Model**

**Releases through Caribou 2 were given
priority over Caribou 1 during July and
August**

Upper North Fork Feather River



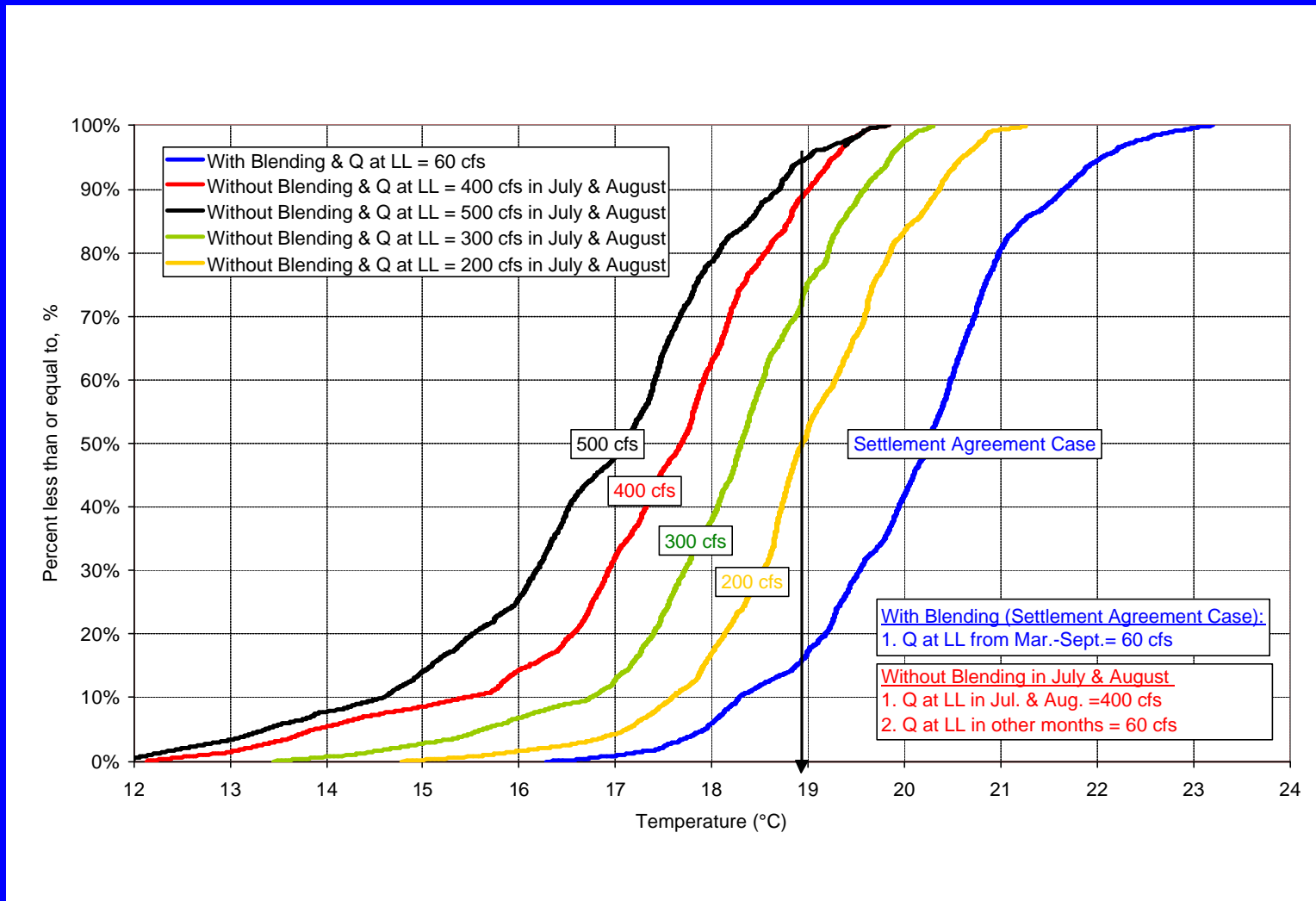
METHODOLOGY AND ANALYSES

Run temperature models for Lake Almanor and Butt Valley Reservoir for both “settlement agreement case” and “high instream release of 400 cfs” to obtain outflow temperatures

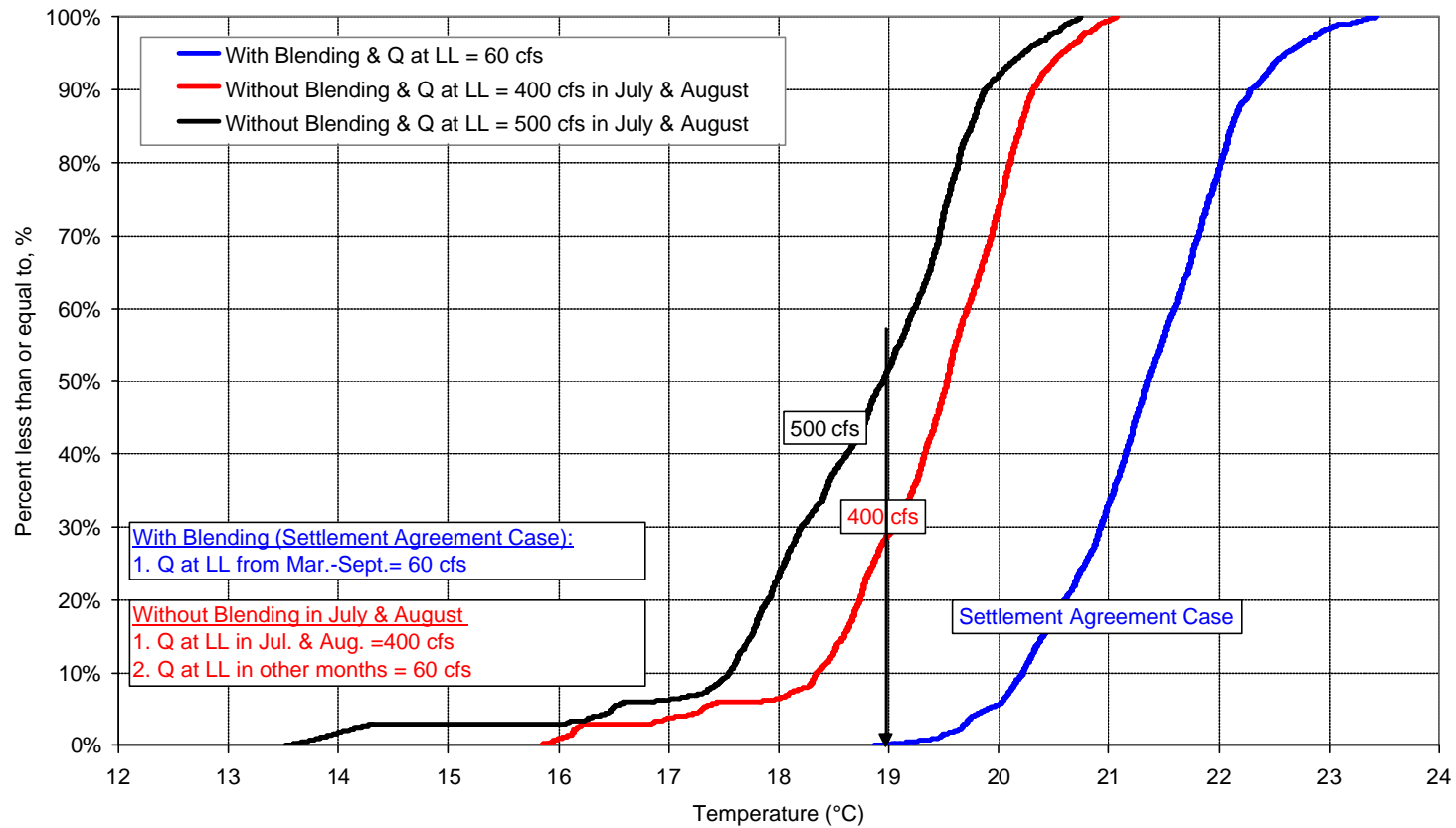
Instream flow temperatures at the downstream end of the Seneca Reach (at Belden Dam) were estimated by adding 1.5 °C to the simulated outflow temperatures at Canyon Dam

Inflow temperatures for the Belden Reach were calculated based on the simulated outflows and outflow temperatures at Caribou 1 & 2 and the instream flow and instream temperatures at the downstream end of the Seneca Reach. A mixed inflow temperature was calculated

Mixed Instream Flow Temperatures for the Belden Reach in July

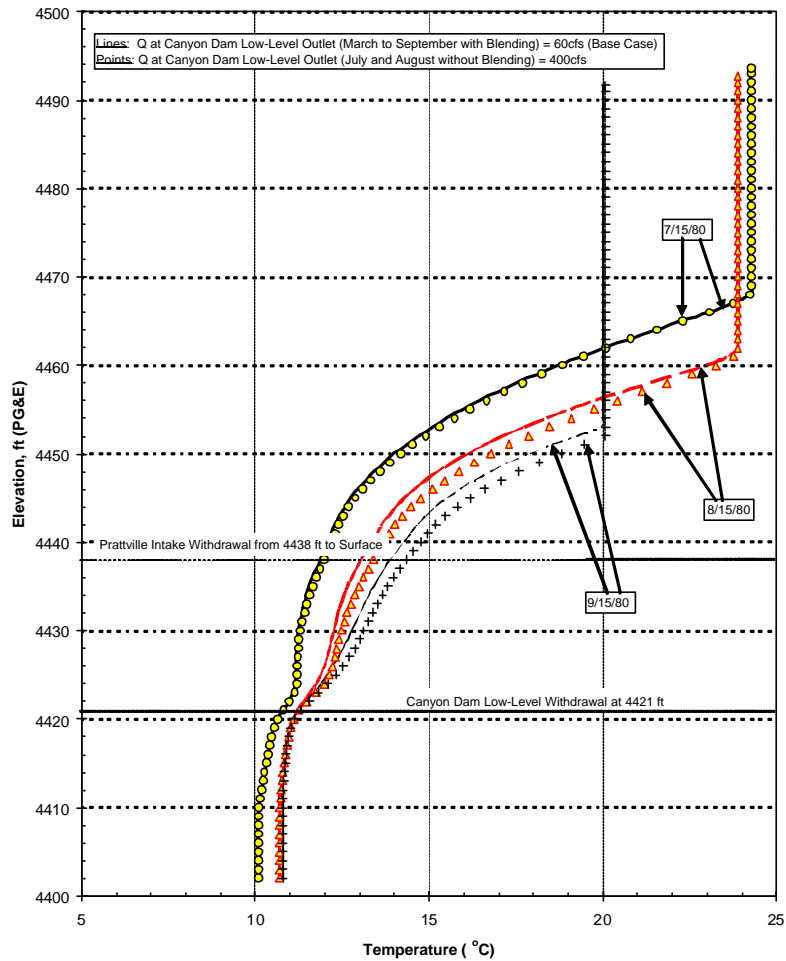


Mixed Instream Flow Temperatures for the Belden Reach in August

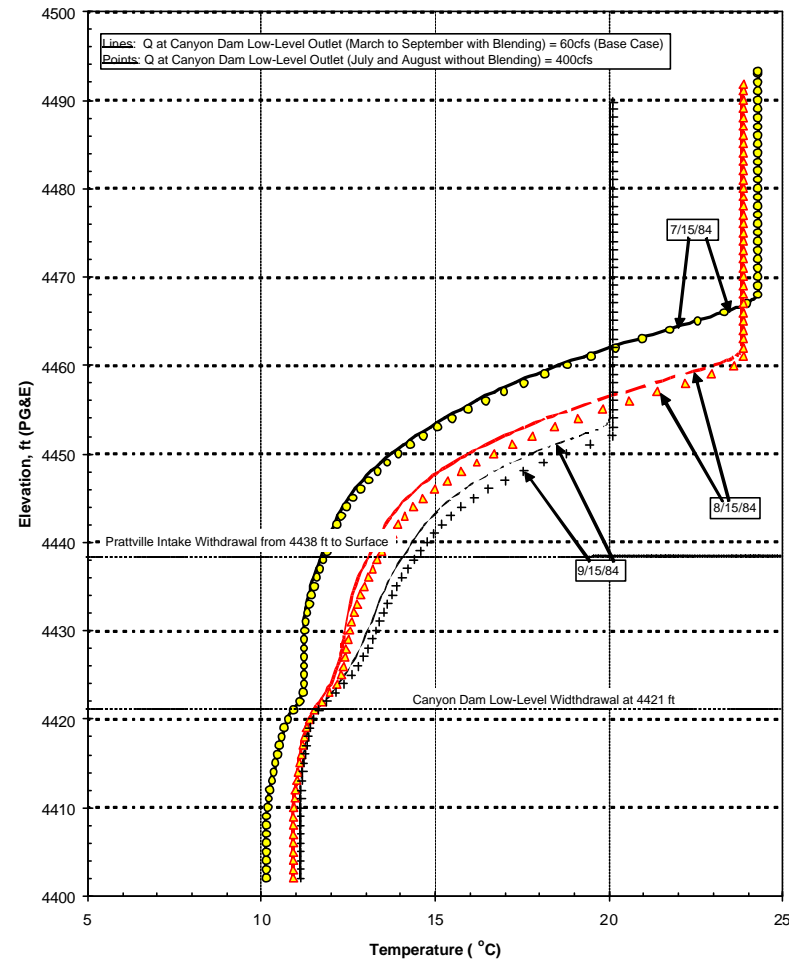


Lake Almanor - Temperature Profiles

Lake Almanor - Temperature Profiles
for Average Operation in a Normal Year (1980)

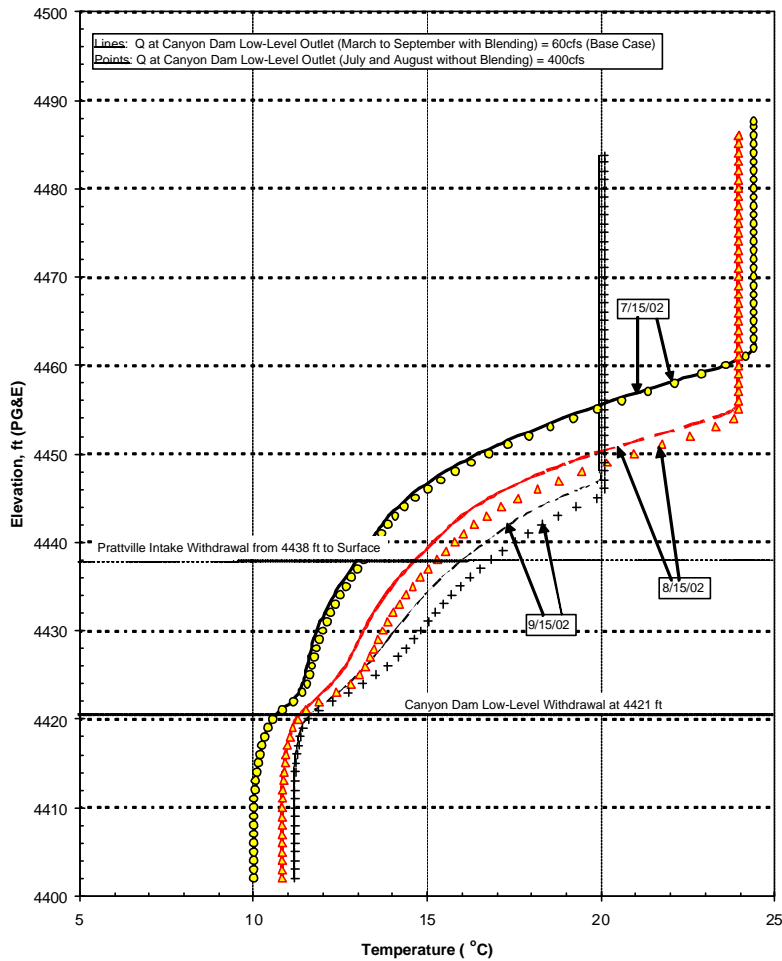


Lake Almanor - Temperature Profiles
for Average Operation in a Wet Year (1984)

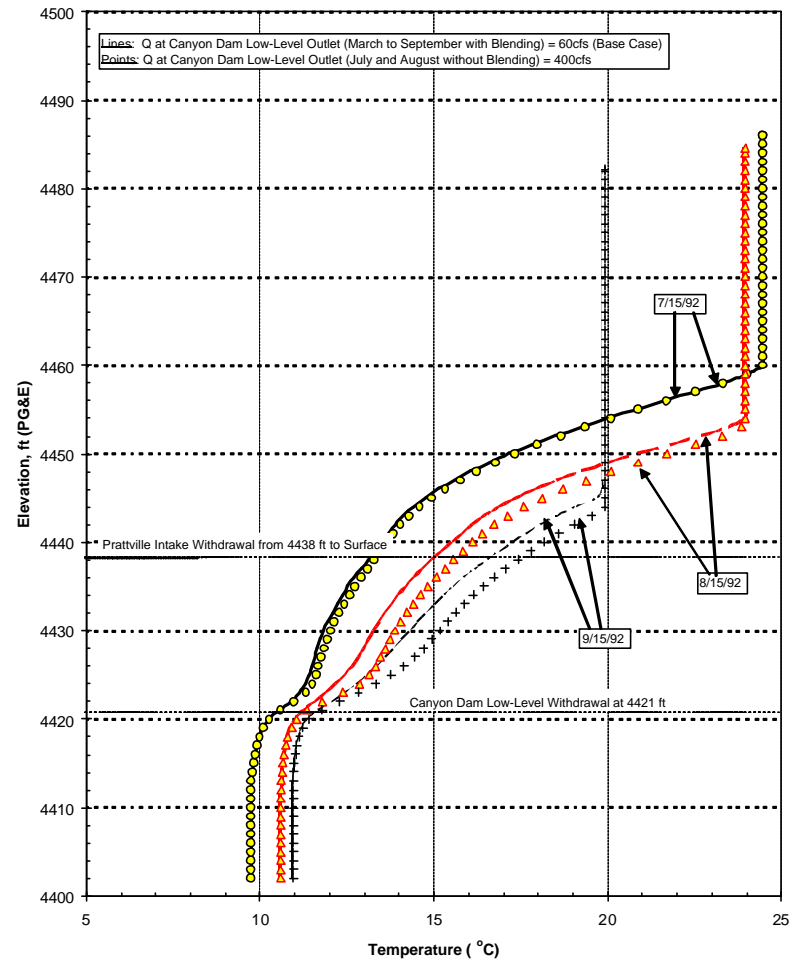


Lake Almanor - Temperature Profiles

Lake Almanor - Temperature Profiles
for Average Operation in a Dry Year (2002)

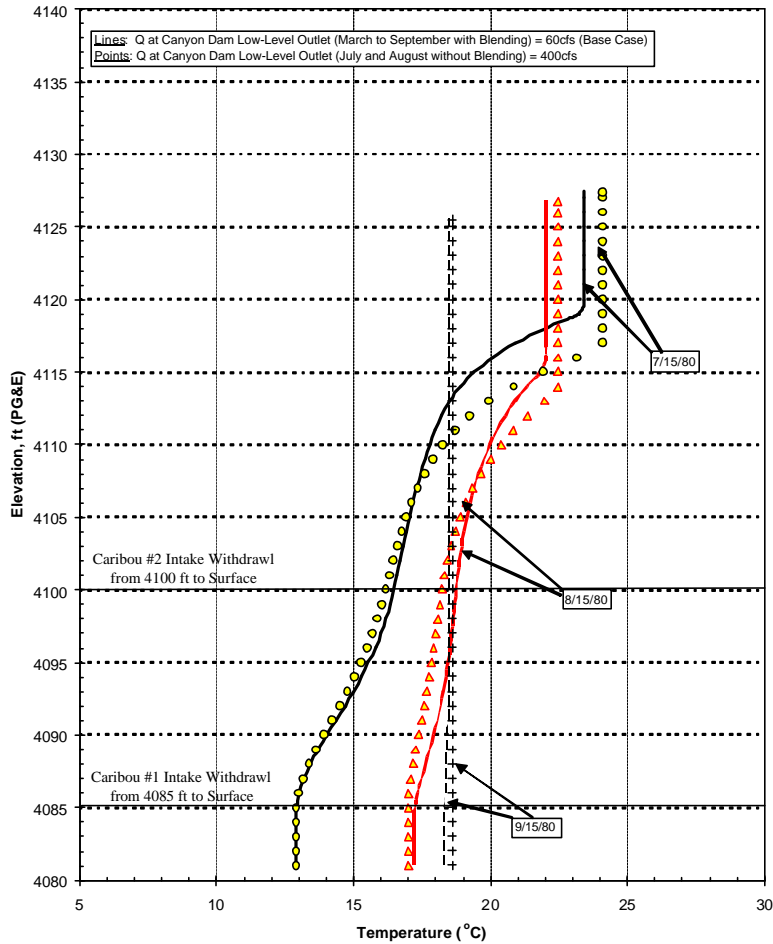


Lake Almanor - Temperature Profiles
for Average Operation in a Critical Dry Year (1992)

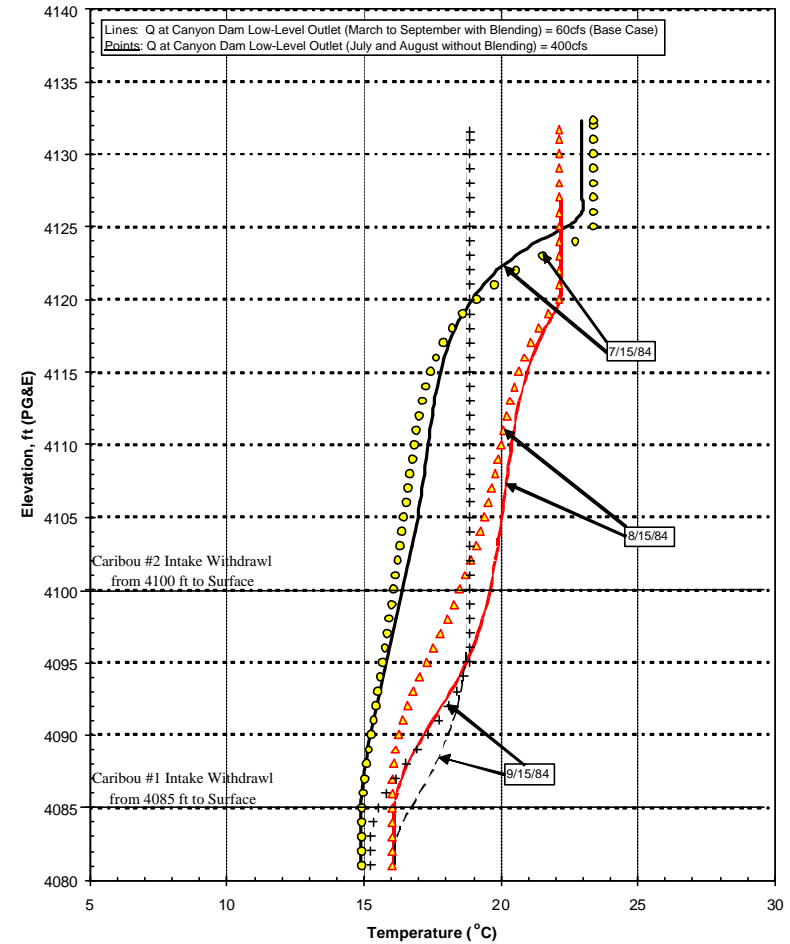


Butt Valley Reservoir - Temperature Profiles

Butt Valley Reservoir - Temperature Profiles
for Average Operation in a Normal Year (1980)

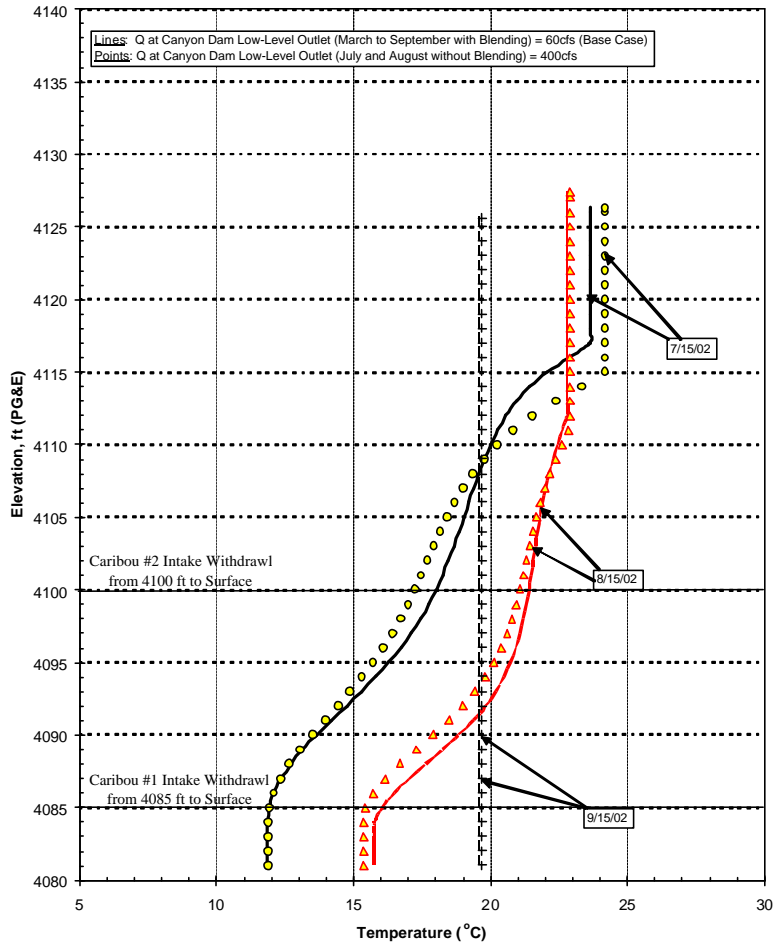


Butt Valley Reservoir - Temperature Profiles
for Average Operation in a Wet Year (1984)

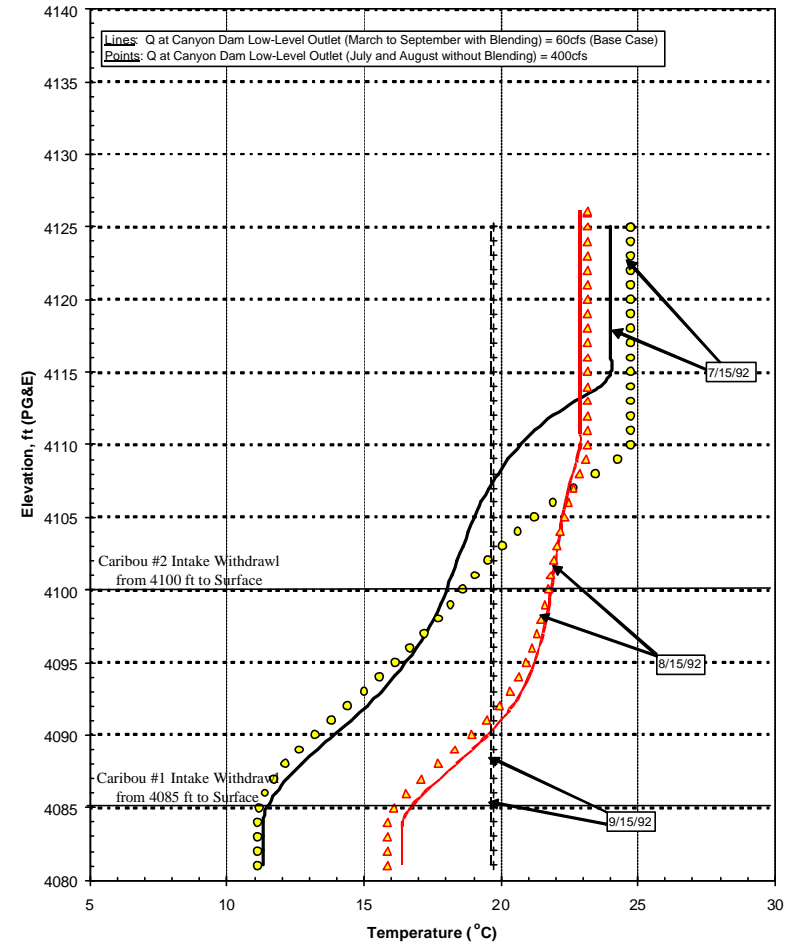


Butt Valley Reservoir - Temperature Profiles

Butt Valley Reservoir - Temperature Profiles
for Average Operation in a Dry Year (2002)



Butt Valley Reservoir - Temperature Profiles
for Average Operation in a Critical Dry Year (1992)



Contrast, Lake Almanor vs. Butt Valley Reservoir

LAKE ALMANOR

- ✓ Temperature profiles not overly sensitive to inflows and outflows
- ✓ Temperature structure dominated by solar radiation

BUTT VALLEY

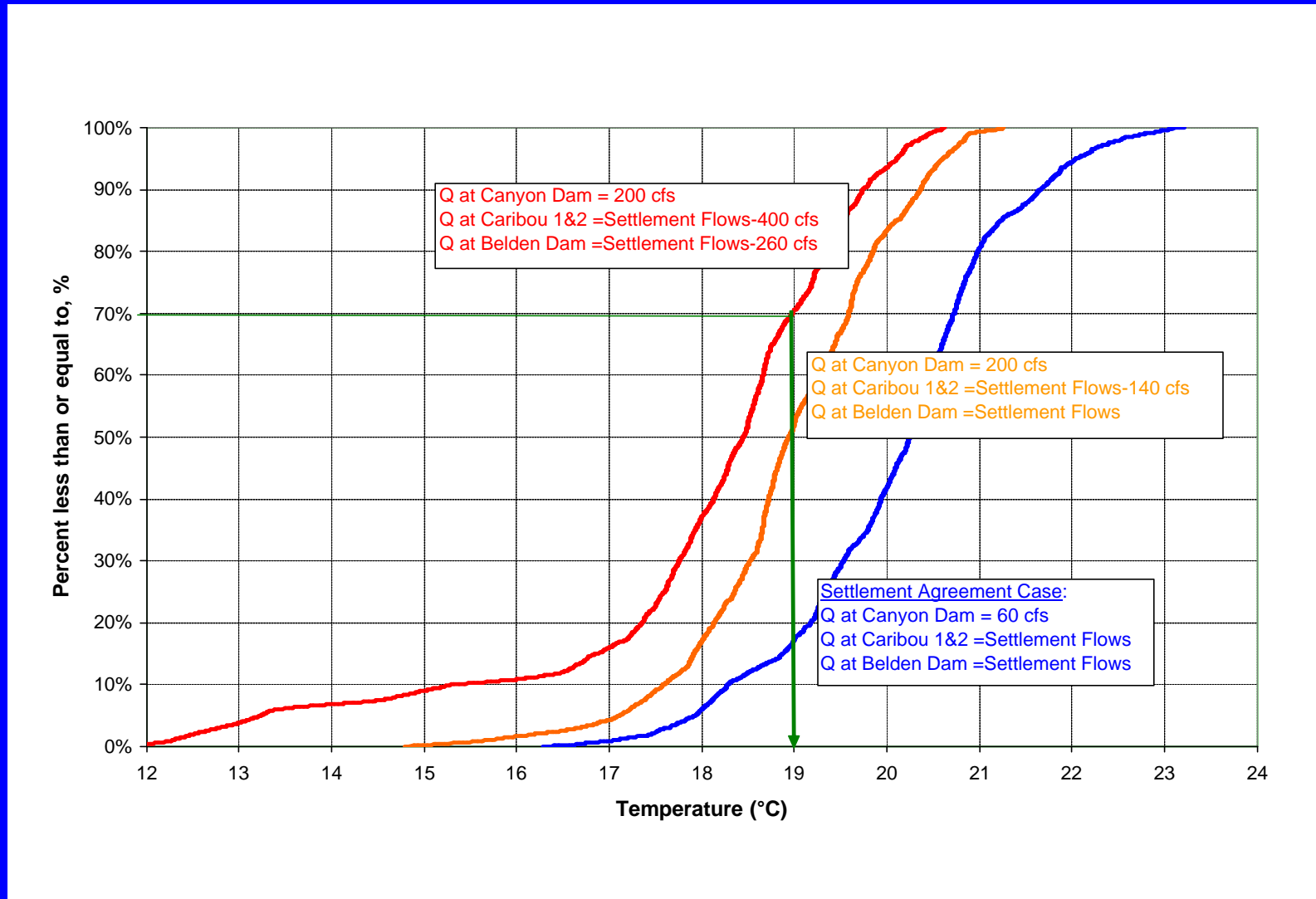
- ✓ Temperature profiles sensitive to inflows and outflows

Analysis for 70% Exceedance at 19°C

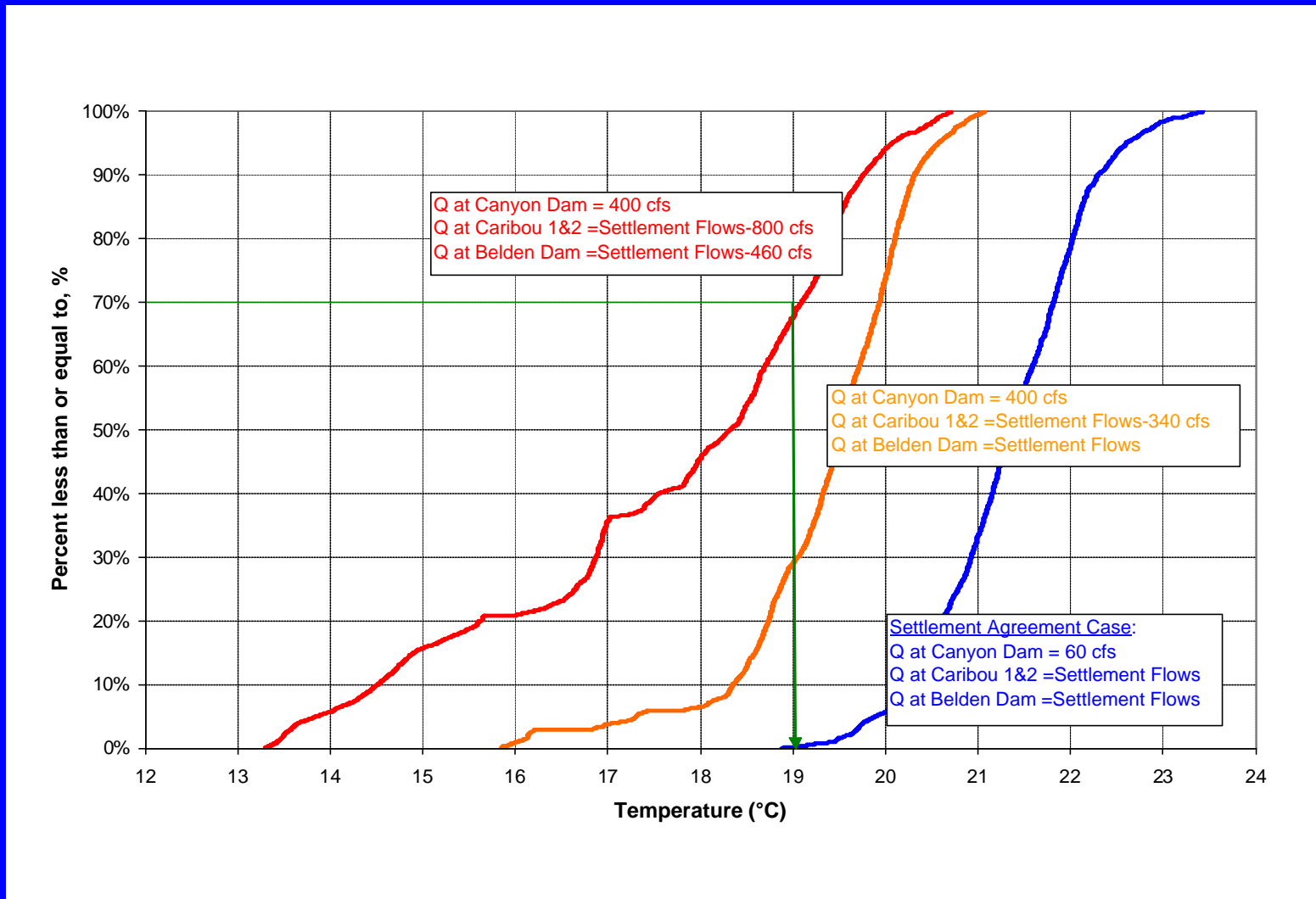
Start with 200 cfs in July, 400 cfs in August and Settlement Flows at Belden Reach (trade flows at Canyon Dam with those at Prattville Intake)

Reduce flows at Caribou 1 and 2 until 70% at 19° is met. This means that the flows through Prattville are also reduced accordingly.

Instream Flow Temperatures at Belden Dam - July (Canyon Dam Low-Level Release = 200 cfs)



Instream Flow Temperatures at Belden Dam - August (Canyon Dam Low-Level Release = 400 cfs)



Summary of Results for 70% Exceedance at 19° C

Flows at Caribou 1 & 2 and Belden Dam for 70 % Temperature Exceedance - July

Flows at Canyon Dam	Flows at Caribou 1& 2 Powerhouses	Flows at Belden Dam	% Temperature Exceedance at 19 °C
60 cfs	Settlement Flows	Settlement Flows	18%
200 cfs	Settlement Flows - 140 cfs	Settlement Flows	50%
200 cfs	Settlement Flows - 400 cfs	Settlement Flows - 260 cfs	70%

Flows at Caribou 1 & 2 and Belden Dam for 70 % Temperature Exceedance - August

Flows at Canyon Dam	Flows at Caribou 1& 2 Powerhouses	Flows at Belden Dam	% Temperature Exceedance at 19 °C
60 cfs	Settlement Flows	Settlement Flows	0%
400 cfs	Settlement Flows - 340 cfs	Settlement Flows	30%
400 cfs	Settlement Flows - 800 cfs	Settlement Flows - 460 cfs	70%

CONCLUSIONS (1)

1. The instream flow temperatures for the Belden Reach in July are less than 19 °C 50 % of the time, if the releases through the Canyon Dam low-level outlet are 200 cfs or greater and settlement flows are maintained at the Belden Reach
2. To achieve the same level of instream flow temperatures conditions (i.e. 50% at 19 °C) for the month of August, flow releases through the Canyon Dam low-level outlet must be at least 500 cfs, due to the warmer temperatures in the reservoirs and higher Caribou powerhouse flows in August compared to conditions in July.

CONCLUSIONS (2) Cont'd

4. **Temperature profiles in Lake Almanor are not affected significantly for a 400 cfs release through the low level outlet at Canyon Dam as compared to existing conditions.**
5. **There are more significant effects in Butt Valley Reservoir, including:**
 - a. **Higher temperatures in the epilimnion (surface layers)**
 - b. **A lower thermocline**
 - c. **Colder water below the thermocline**

CONCLUSIONS (3) Cont'd

6. To achieve 70% exceedance at 19° C in July with 200 cfs released through Canyon Dam, we have to reduce the flows through Caribou 1 and 2 by an additional 260 cfs. The flows in to the Belden Reach are then the settlement flows minus 260 cfs.
7. To achieve 70% exceedance in August at 19° C with 400 cfs released through Canyon Dam, we have to reduce the flows through Caribou 1 and 2 by an additional 460 cfs. The flows in the Belden Reach are then the settlement flows minus 460 cfs.