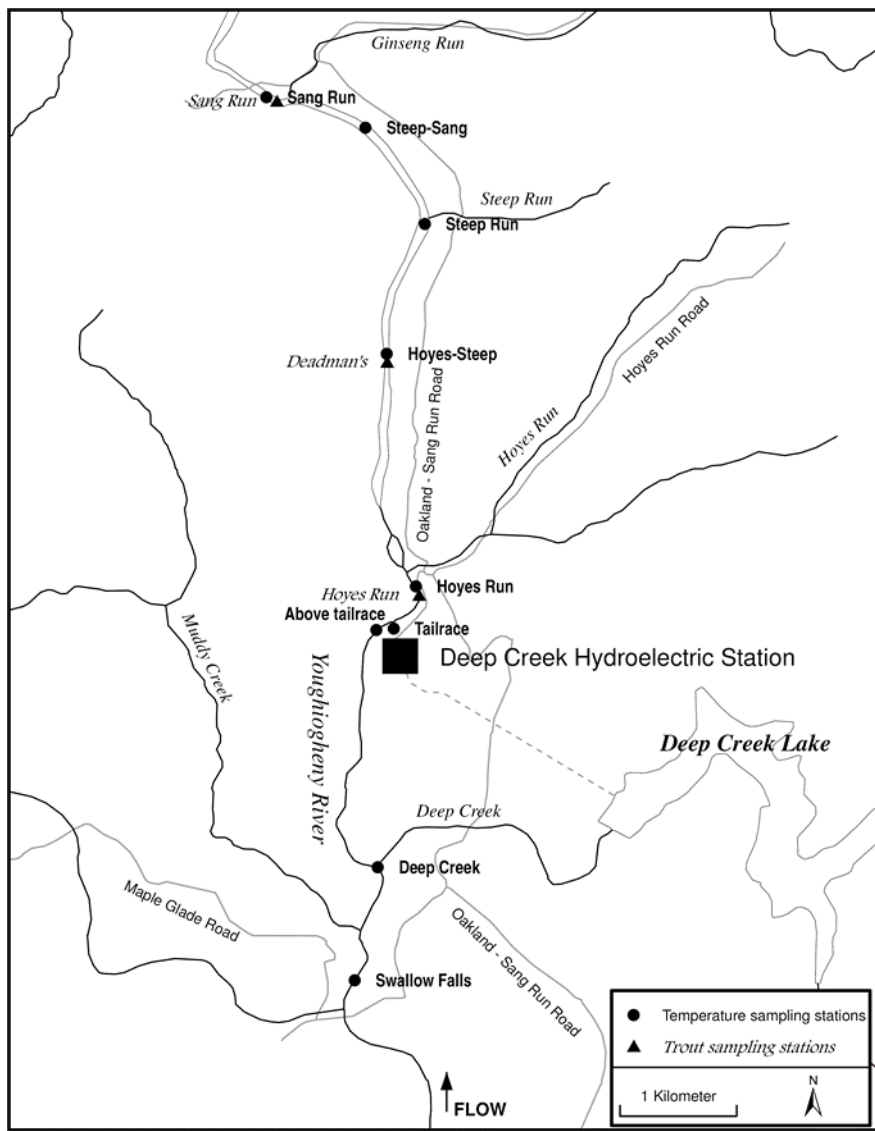
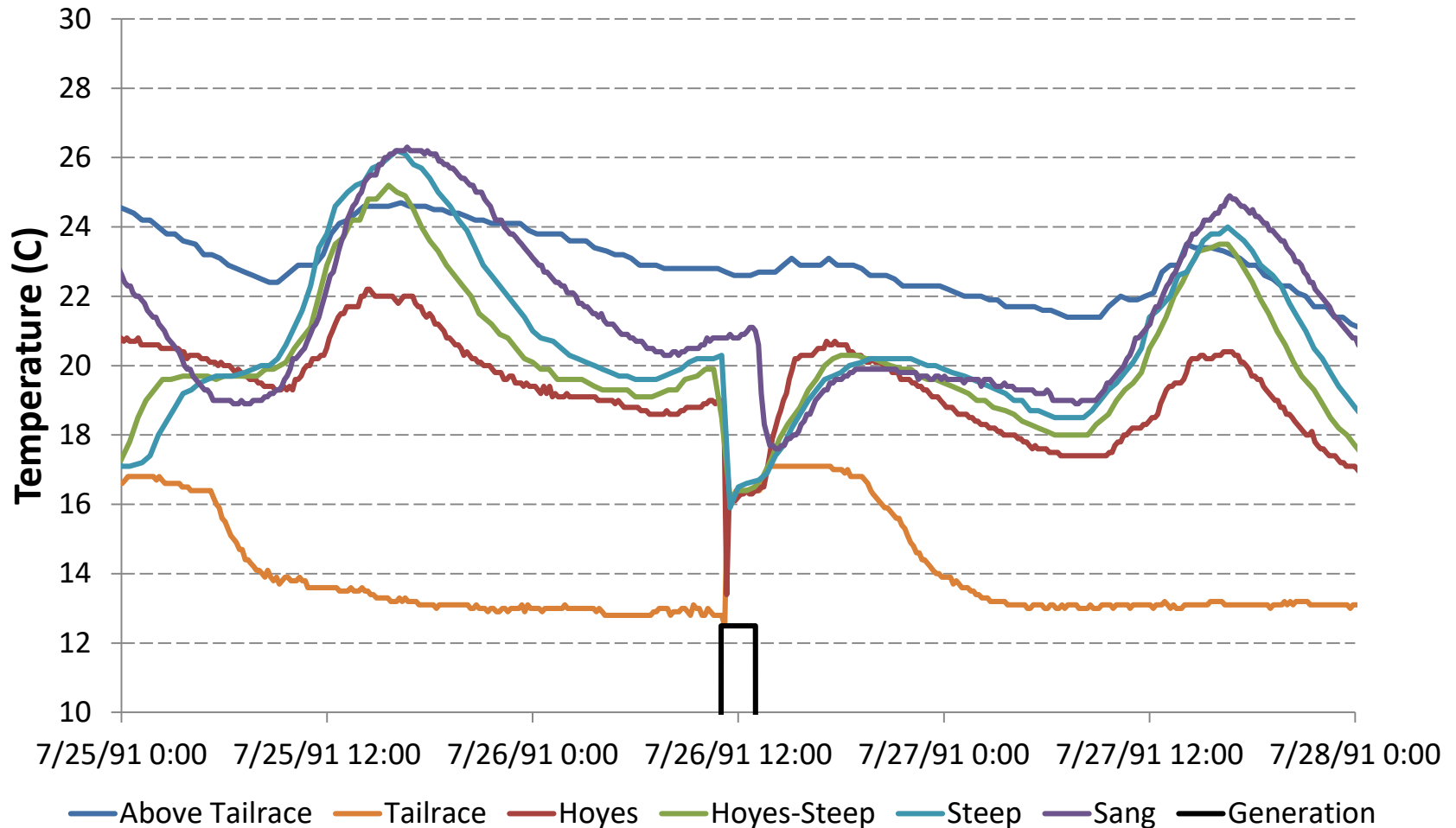


Youghiogheny River Temperature Protocol for Operating Deep Creek Hydro Station: Overview and Potential Changes

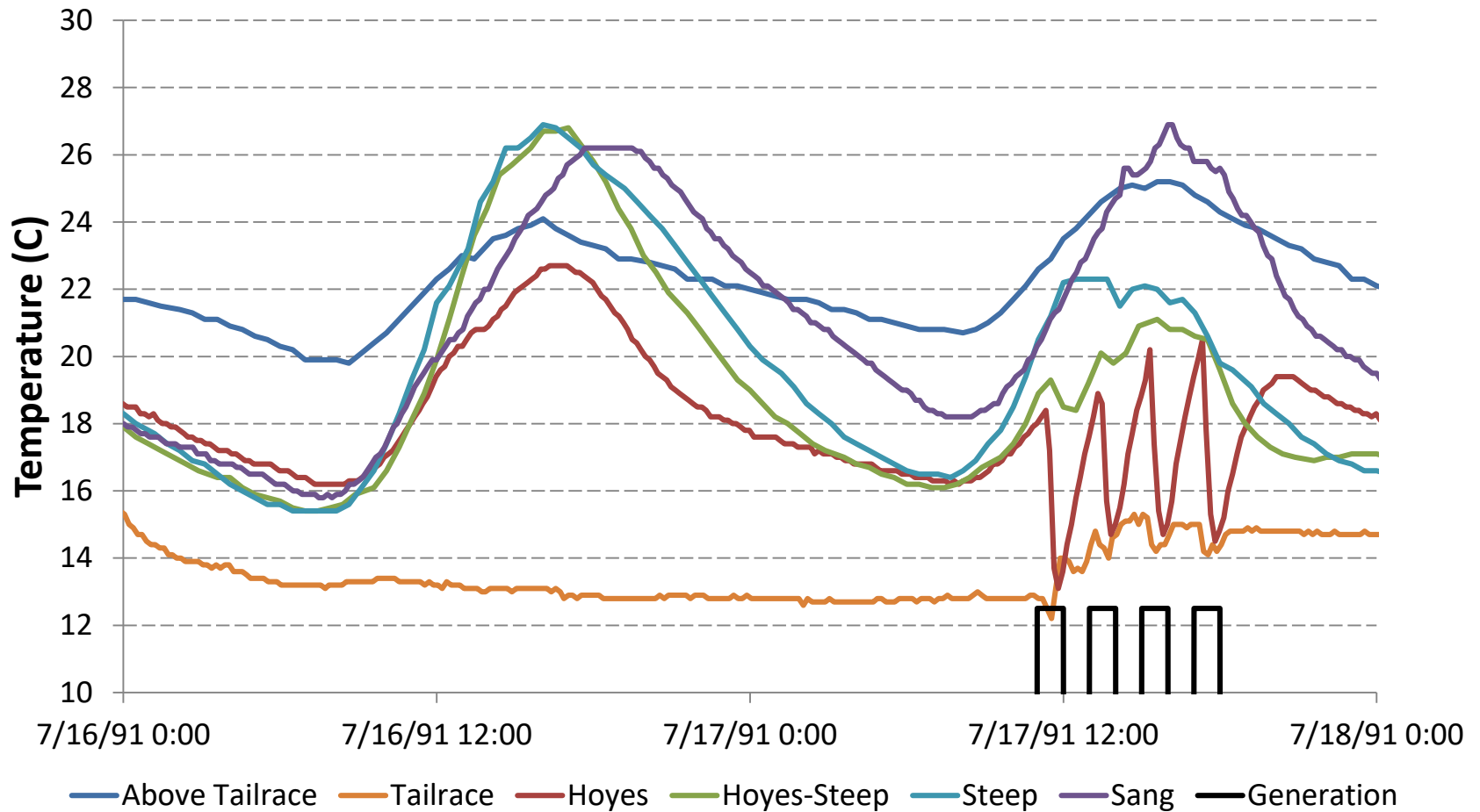
August 1, 2019 TER Workgroup Meeting



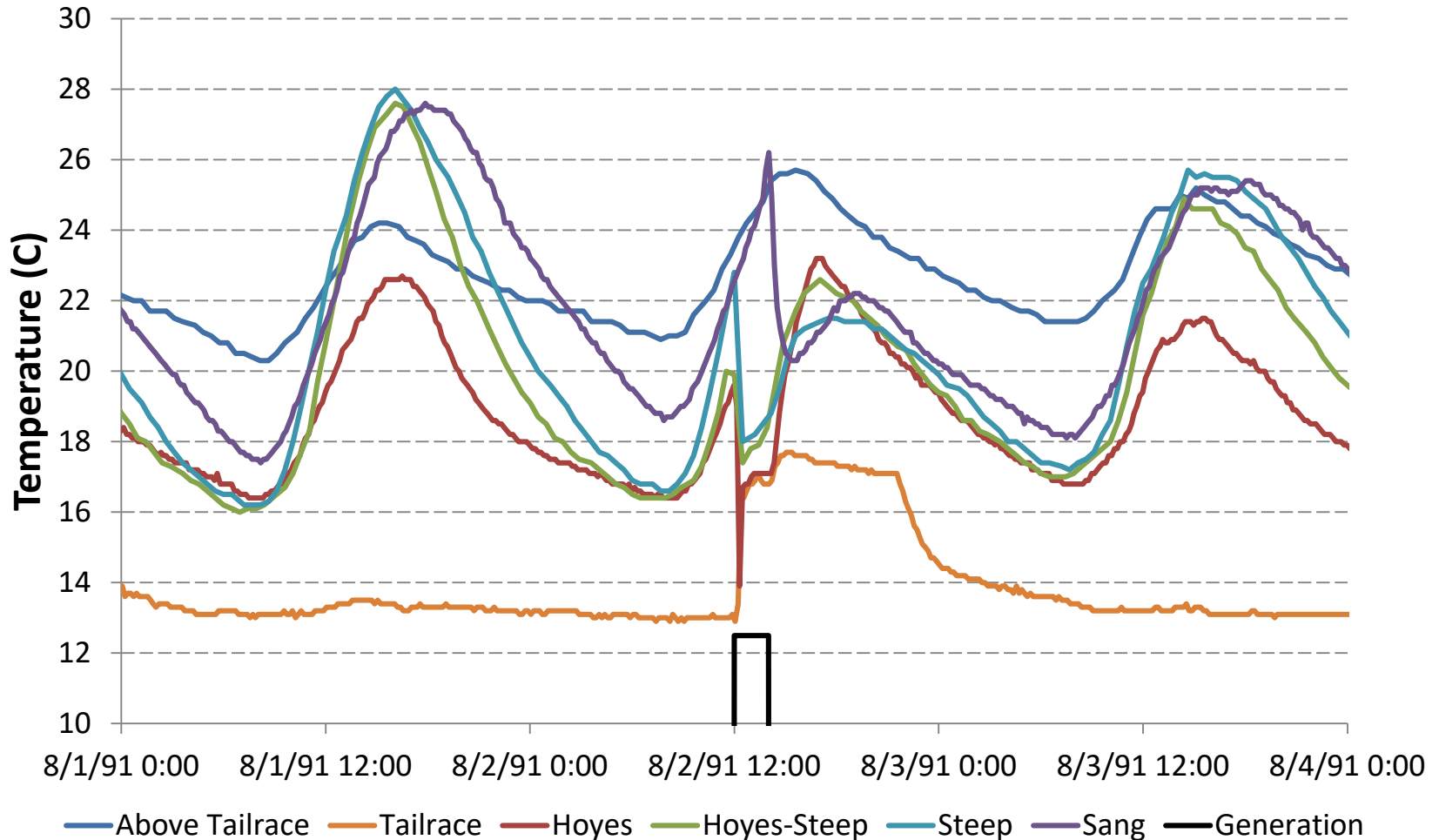
Test release – 2 turbines@full gate at 1100 for 2 hours



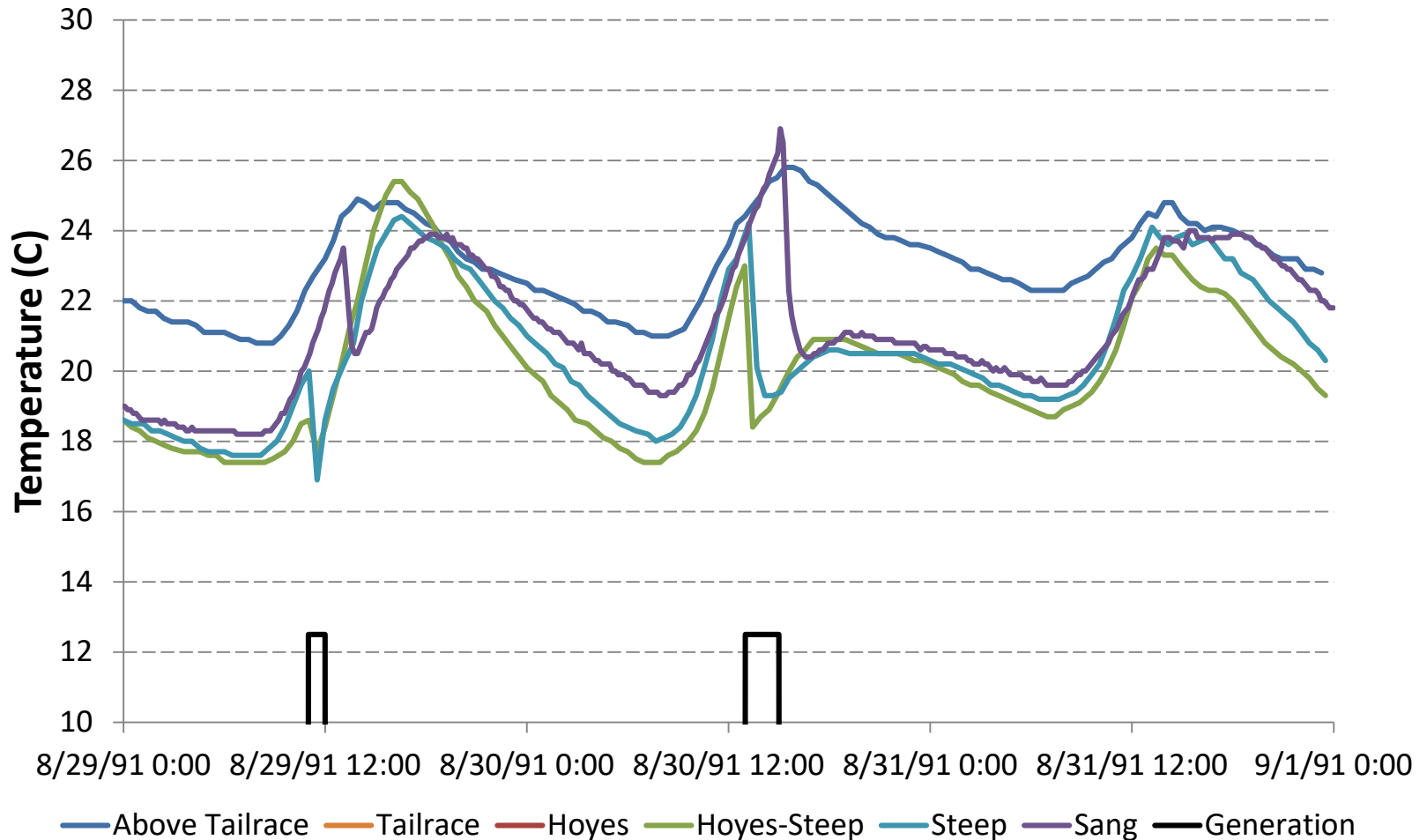
Test release – 1 turbine@315 cfs at 1100, 1300, 1500, 1700 for 1 hour



Test release – 2 turbines@full gate at 1200 for 3 hours



Test release – 2 turbines@full gate at 1100 for 1 hour (8/29) and 2 hours at 1300 (8/30)



Temperature Enhancement Release (TER) Protocol Goals

- Use a 2-hour generation release on the warmest days
- Use a 1-hour generation release on moderate days
- Provide a river temperature prediction mechanism for releases so several hour's notice of the 2-hour releases could be provided for boaters

Temperature Release Protocol

- Uses regression-based equations of river temperatures, river flow, and maximum air temperature with cloud cover predictions
- Run protocol June 1 – August 31 based on data from 1987-1993
- Predictions made at 7, 9, and 11 am for 2-hour release for warmest days
- Predictions made at 12, 2, and 3 pm for 1-hour release on moderate days

Temperature Release Results 1995-2018

- Average of 17 releases per year
- Exceedances at Sang Run occur on average 11/yr (vs. 26 days $> 25^{\circ}\text{C}$ at Swallow Falls)
- 64% of exceedances $< 26^{\circ}\text{C}$
- 92% reduction of time $> 25^{\circ}\text{C}$ vs. Swallow Falls
- 1.4 'Unnecessary' releases occur per year, on average, < 3 hours per year ($<$ than 1/2 inch of lake level)

Youghiogheny River temperature enhancement release (TER) protocol – summary table

Sensor Read Time	0700	0900	1100	1200	1400	1500
Release time	1100	1100	1230	1200	1400	1500
Time Release Reaches Sang Run	1300	1300	1430	1400	1600	1700
Release duration (hours)	2	2	2	1	1	1
Trigger temperature (°C)	26.4	25.9	25.4	25.3	25.2	25.1
Input variables	Flow Maxair Cloud Temp7	Flow Maxair Cloud Temp7 Temp9	Maxair Cloud Temp9 Temp11	Maxair Cloud Temp9 Temp12	Maxair Temp12 Temp14	Maxair Temp12 Temp15




Continue TERs into September

How many exceedances have occurred after August 31?

- 11 exceedances have occurred in September 2008-2018 (0-3/year)
- 1 in 2008, 2 in 2010, 1 in 2011, 3 in 2015, 1 in 2016, 3 in 2018, averaging 1/year
- 1/3 inch of lake level on average
- 1 inch of lake level for 3 additional releases

Monitor May Temperatures

- Request Brookfield to monitor river temperature at Sang Run bridge May 15-31 to assess needs for running TER protocol earlier
- Data collection only at this time



Increase flow trigger from 150 cfs to some higher number

How many exceedances have occurred with a baseflow > 150 cfs

- Since 2010, 5 exceedances have occurred with baseflow > 150 cfs and < 200 cfs
- 2010:1; 2013:2; 2017:1; 2018:1
- 1 additional two-hour release = 1/3 inch of lake level
- 2 additional two-hour releases = ~ 2/3 inch of lake level

Summary: Lake Level Changes

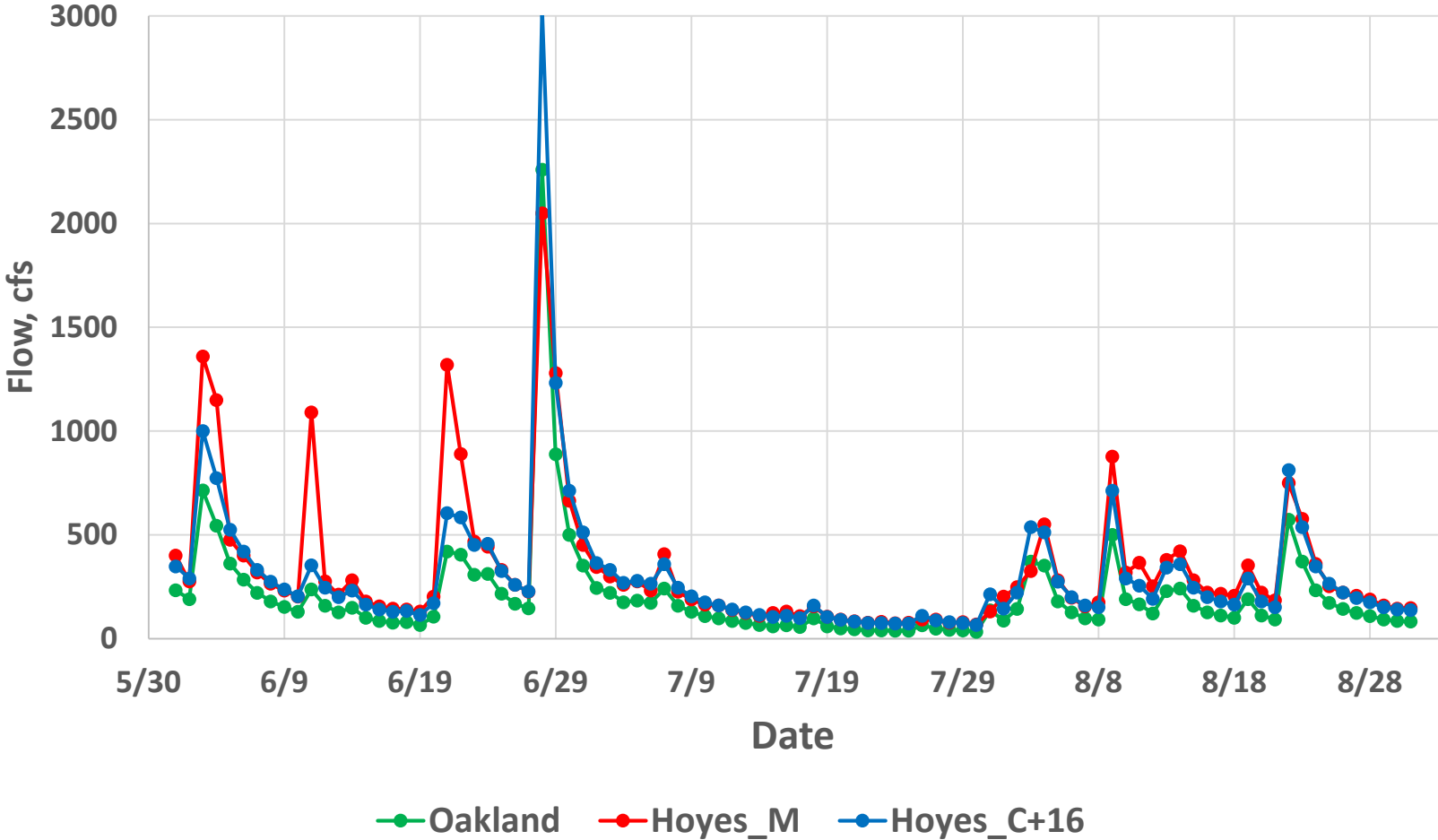
(assuming no inflow)

<u>Protocol Change</u>	<u>Average</u>	<u>Worst-Case</u>
1. September TERs	0.3 in.	1 in.
2. 200 cfs trigger	0.3 in.	0.7 in.
TOTAL	0.6 in.	1.7 in.

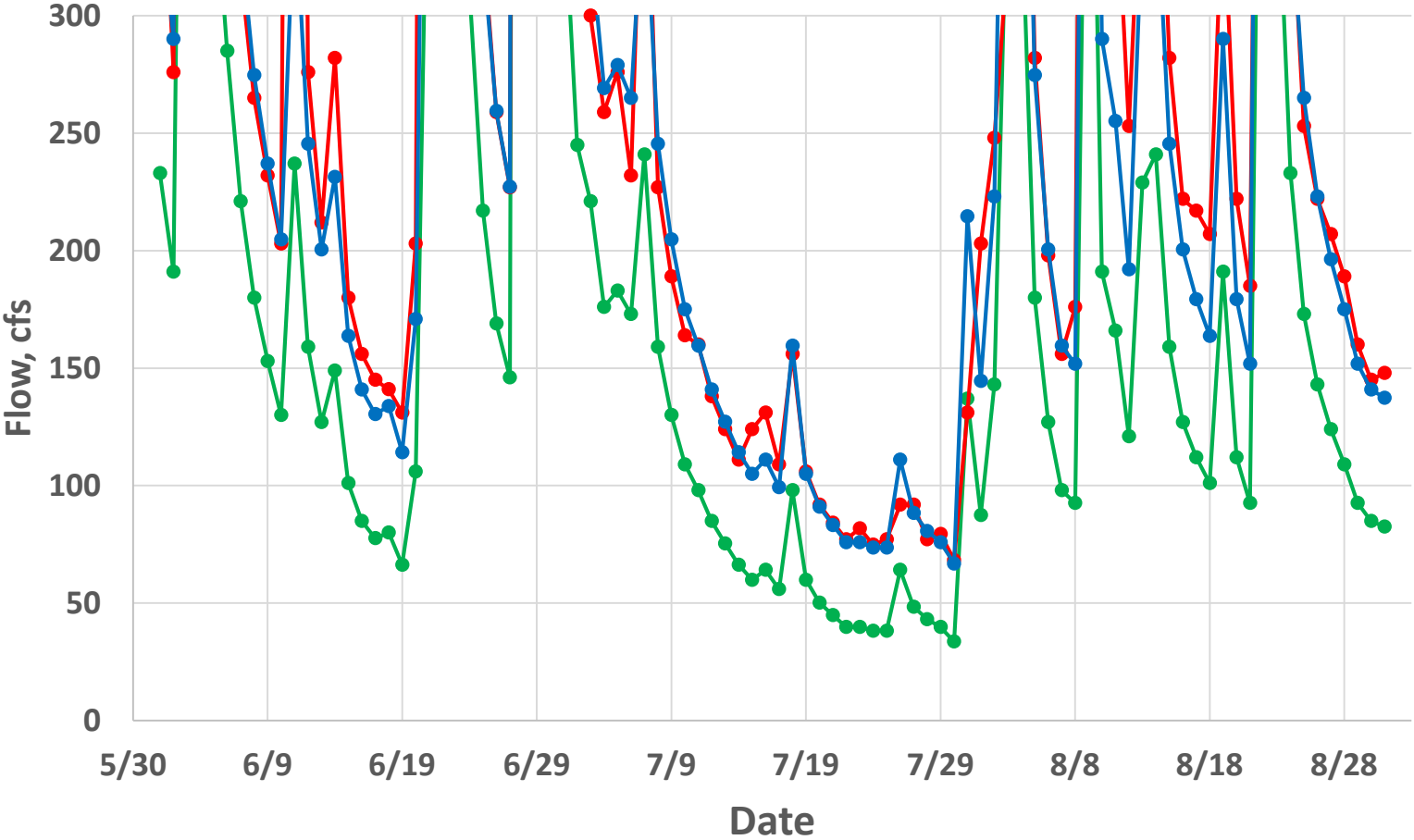
Additional Discussion

- Use of Hoyes gage instead of Oakland

Youghiogheny River flow 2018



Youghiogheny River flow 2018



—●— Oakland —●— Hoyes_M —●— Hoyes_C+16

Additional Discussion

- Evaluate TER flow release of lower flow or shorter duration
- Timing of protocol modification