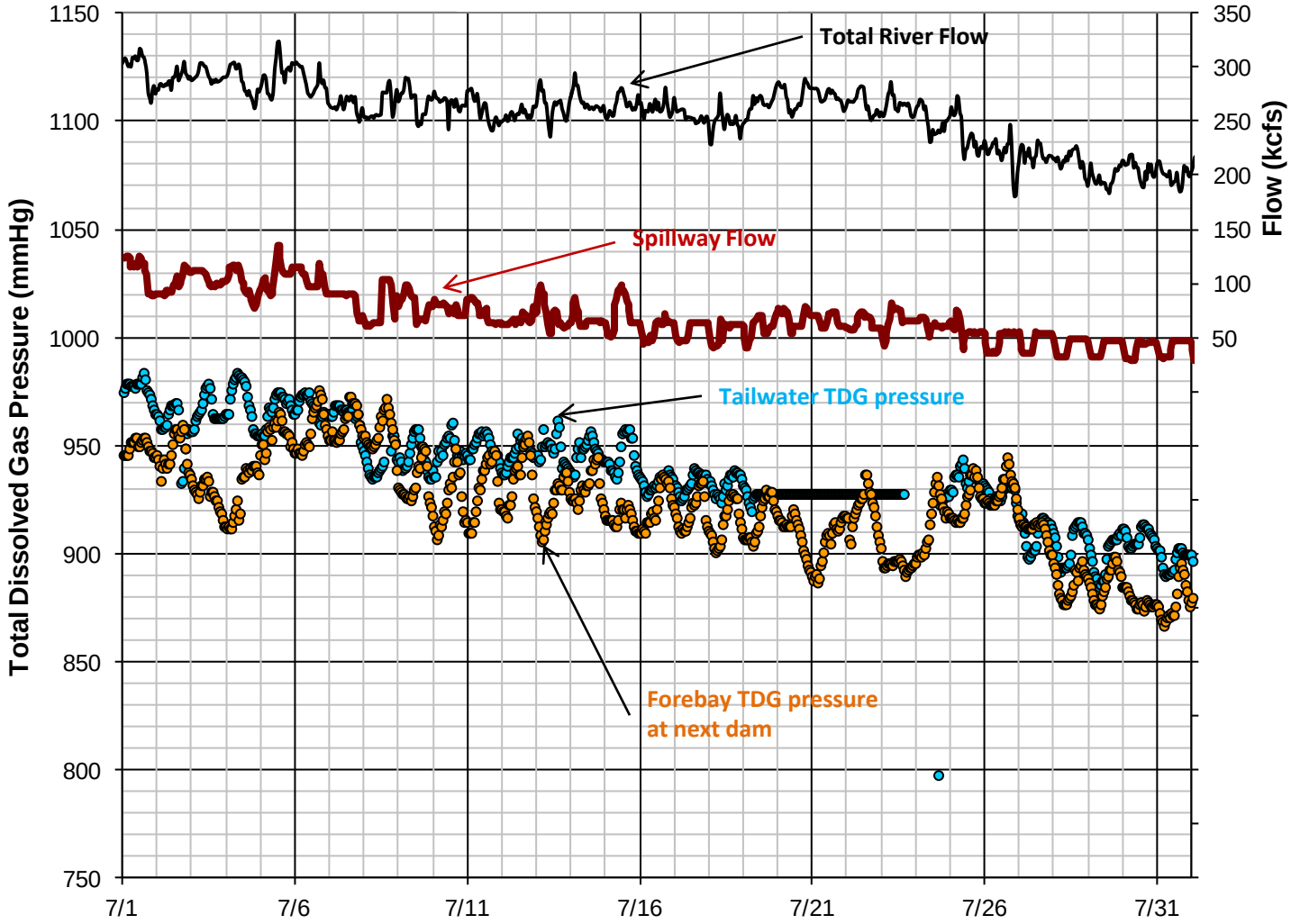
Detection of sampling or measurement anomalies

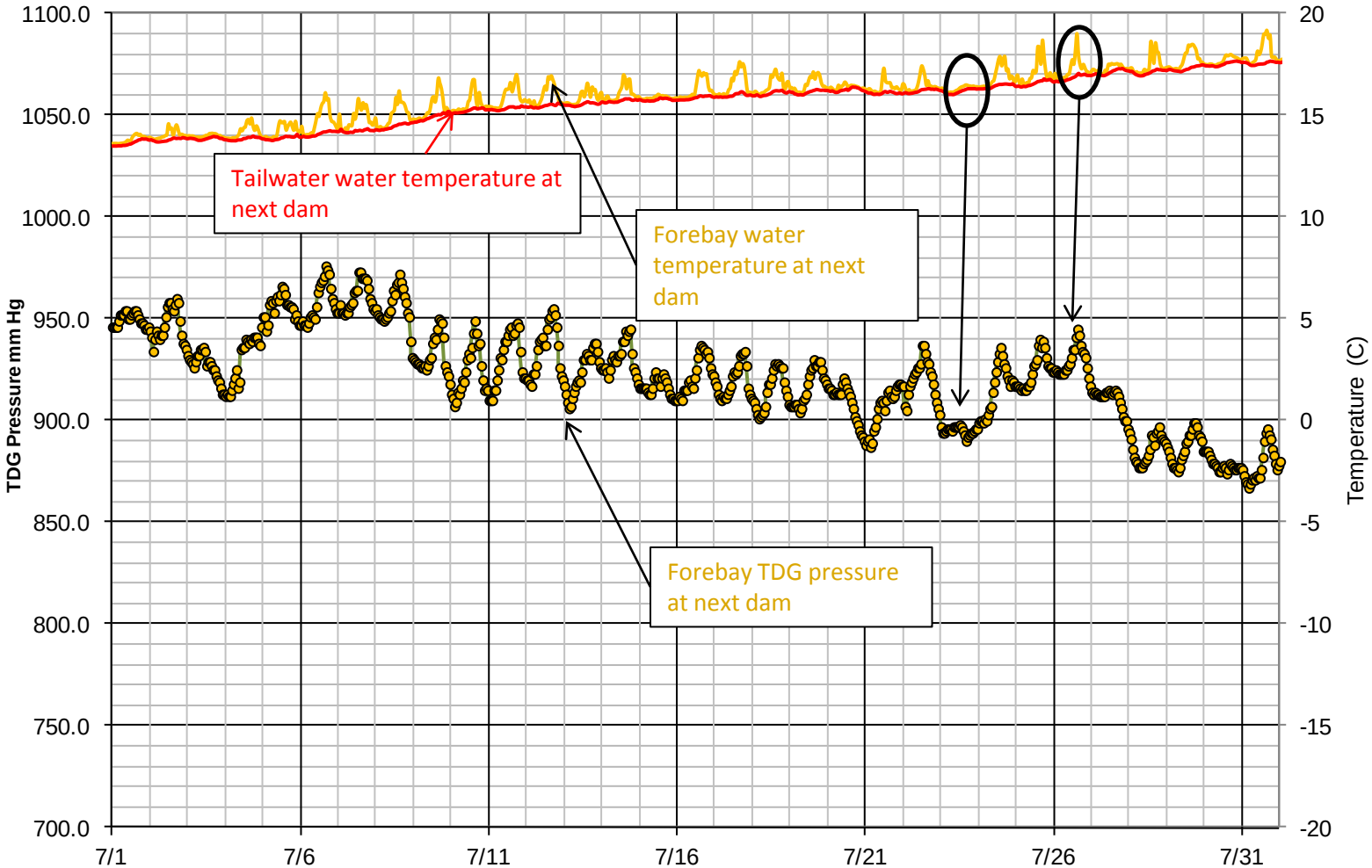
An end users perspective on fixed monitoring station water quality data in the Columbia River basin.

Detection of sampling or measurement anomalies

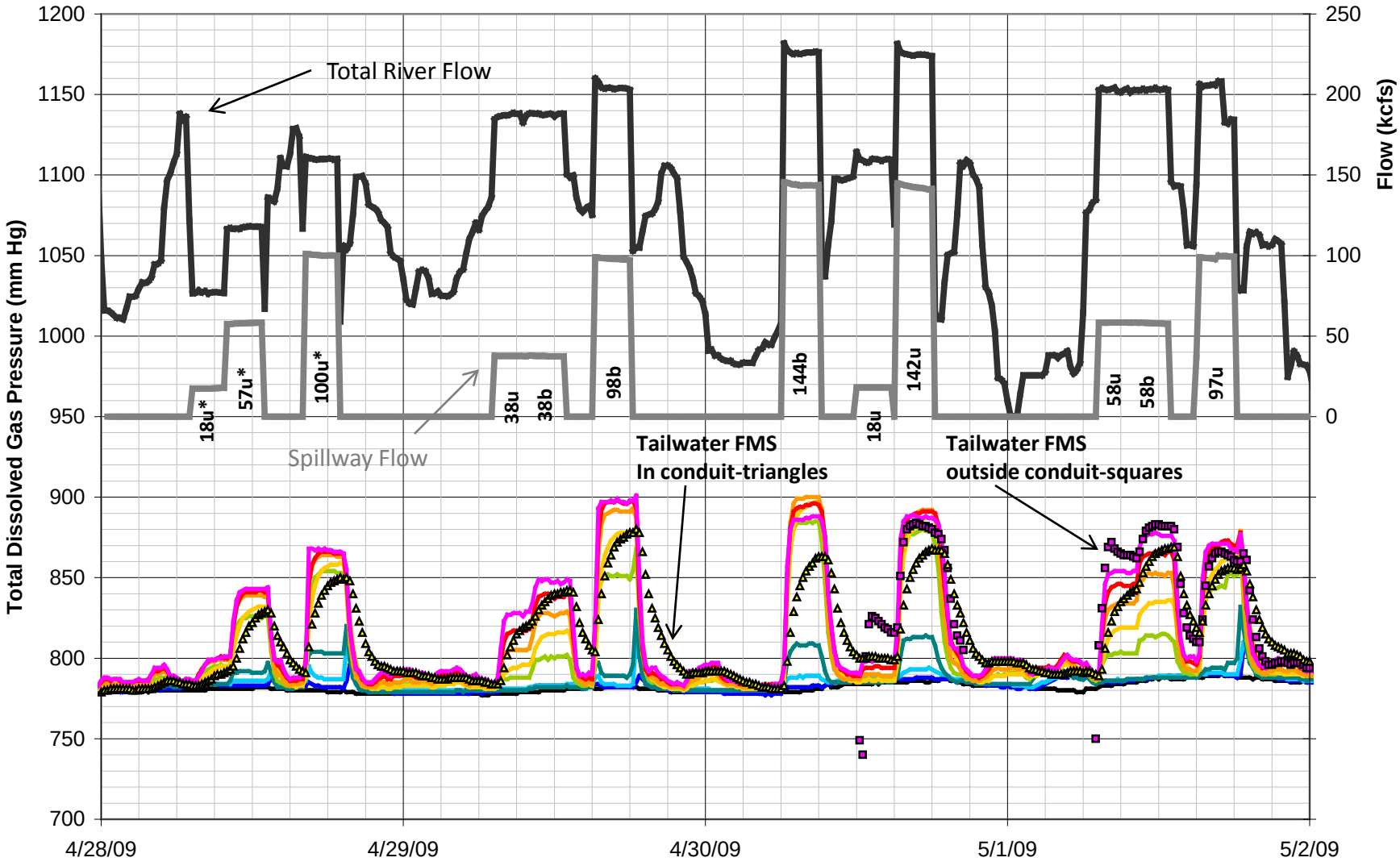
- Data quality interpretation through understanding of process
  - Consistent response to causal factors
    - Tailwater Stations
      - TDG content in spillway flows or aggregate project release
      - Spill magnitude and pattern
      - Spillway to powerhouse flow ratio
      - FMS location relative to mixing zone
    - Forebay Stations
      - Residual TDG loading from upstream source
      - Rearation-net degassing
      - Thermal impacts-gas laws relating temp-pressure-mass concentration
      - Dilution from tribs-reduction in TDG pressures
      - Biological processes
    - Temporal and Spatial consistency



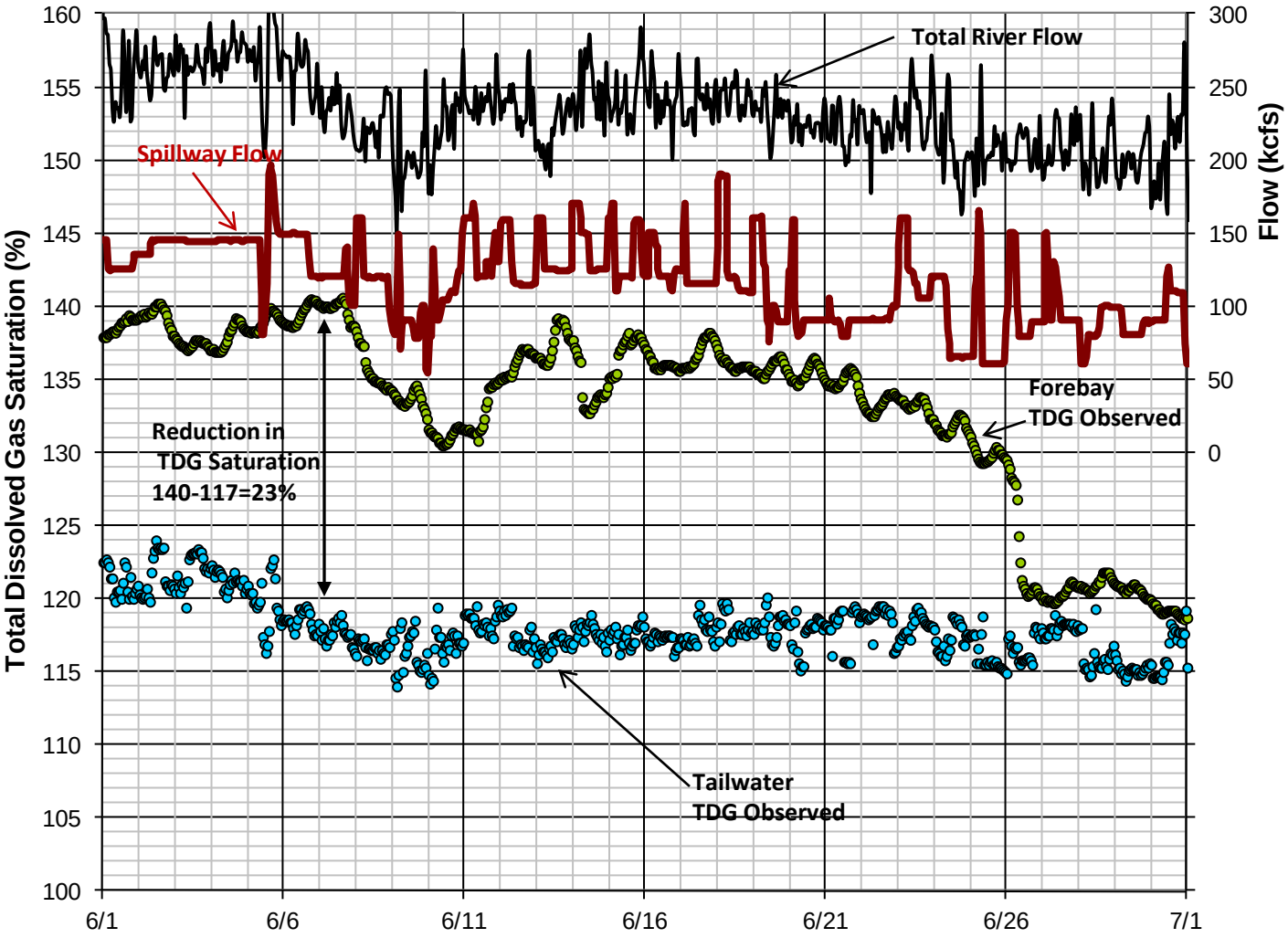
Daily Peaking operations at a project results in a daily cycling of TDG loading. The fate of these operations at the next downstream project are prominent daily cycling of TDG pressures.



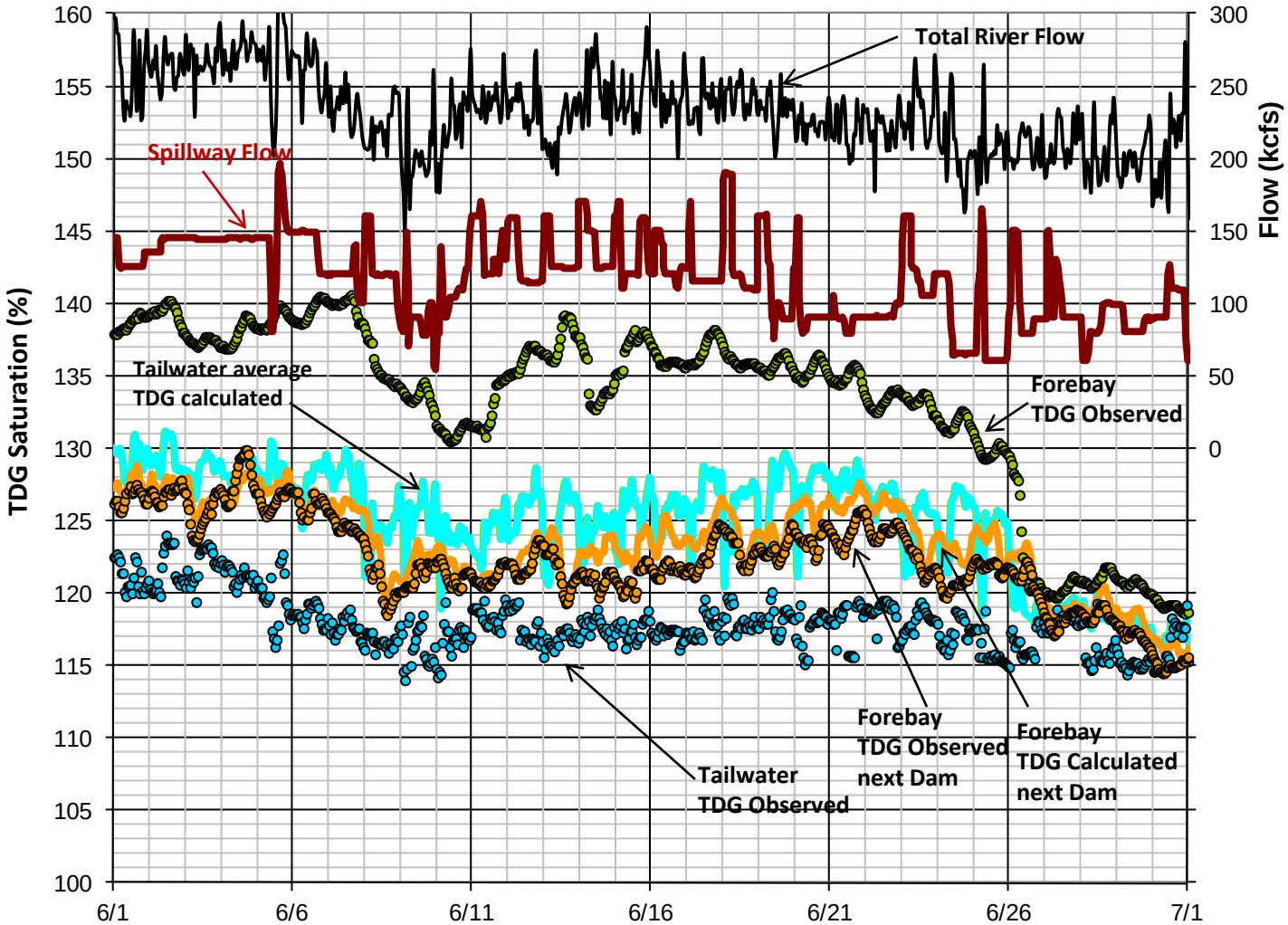
While it is true that daily peaking operations at a project can result in cycling of TDG loading at the next downstream project, there are also surface heat exchange processes that result in thermally induced pressure cycling. (rule of thumb: 1 degree Celsius change in temperature can result in a 2-3 percent change in TDG saturation for a constant mass of atmospheric gasses in solution)



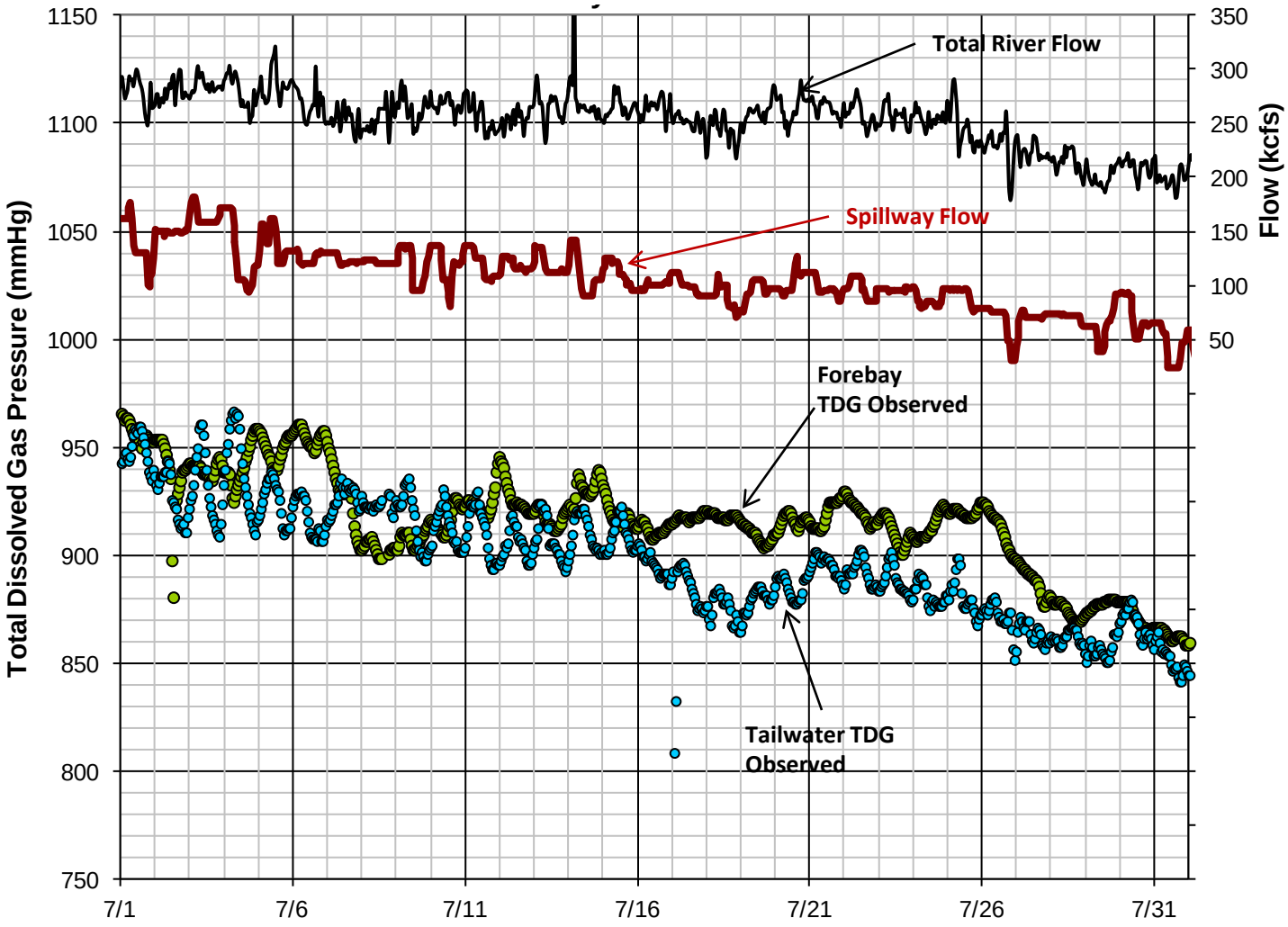
Time history of project operations and Total Dissolved Gas Pressures in the Columbia River on Transect T4 and selected monitoring stations, April 28-May 1, 2009 (note: spill event label discharge+spill pattern uniform or bulk with * indicating low tailwater conditions). Lagged and attenuated response of tailwater FMS TDG pressure in conduit Is consistent with restricted water exchange between the conduit and free flowing river.



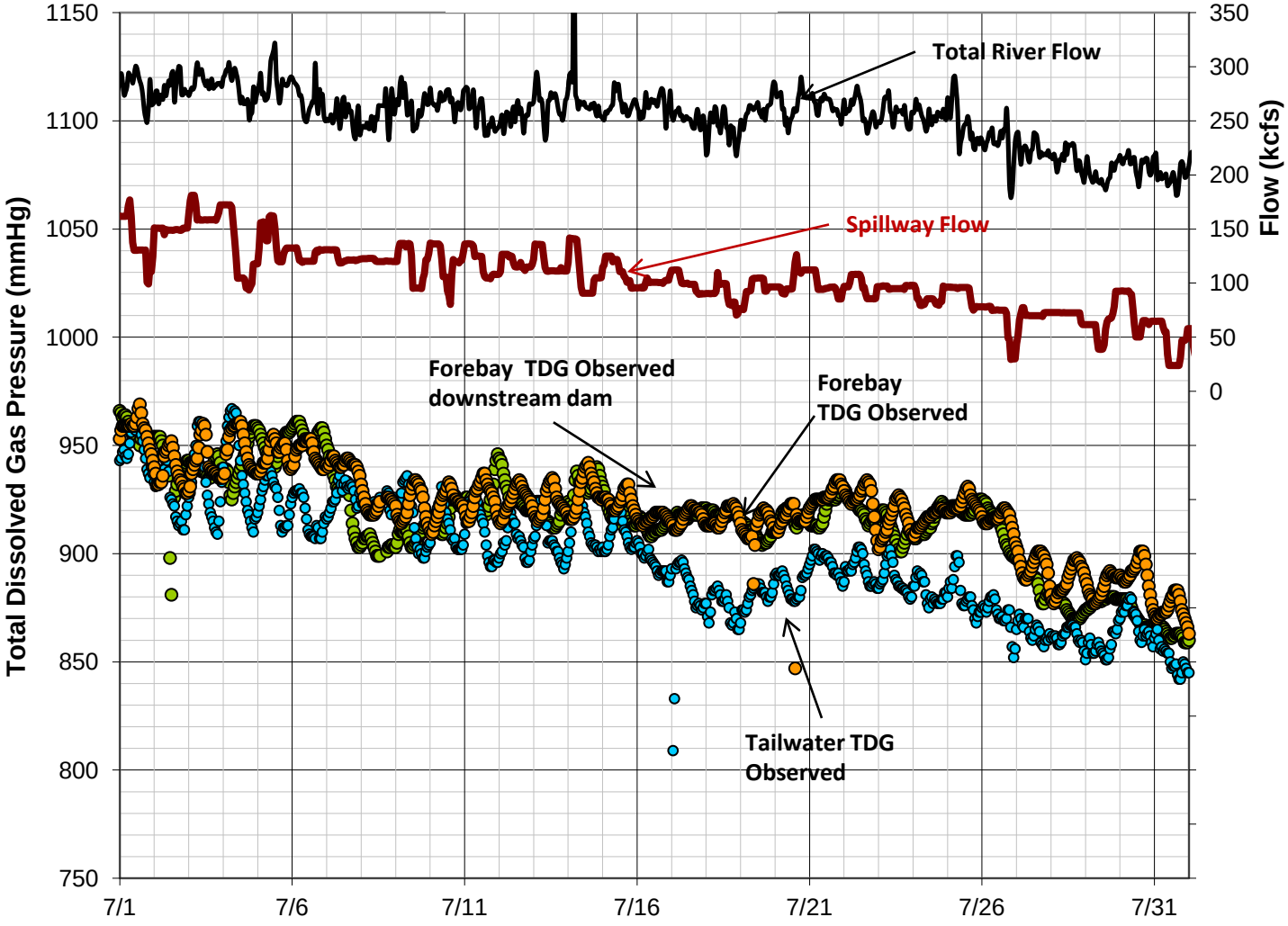
A sizable reduction in TDG loading during spillway operations is not plausible because spilling water generates TDG supersaturation.



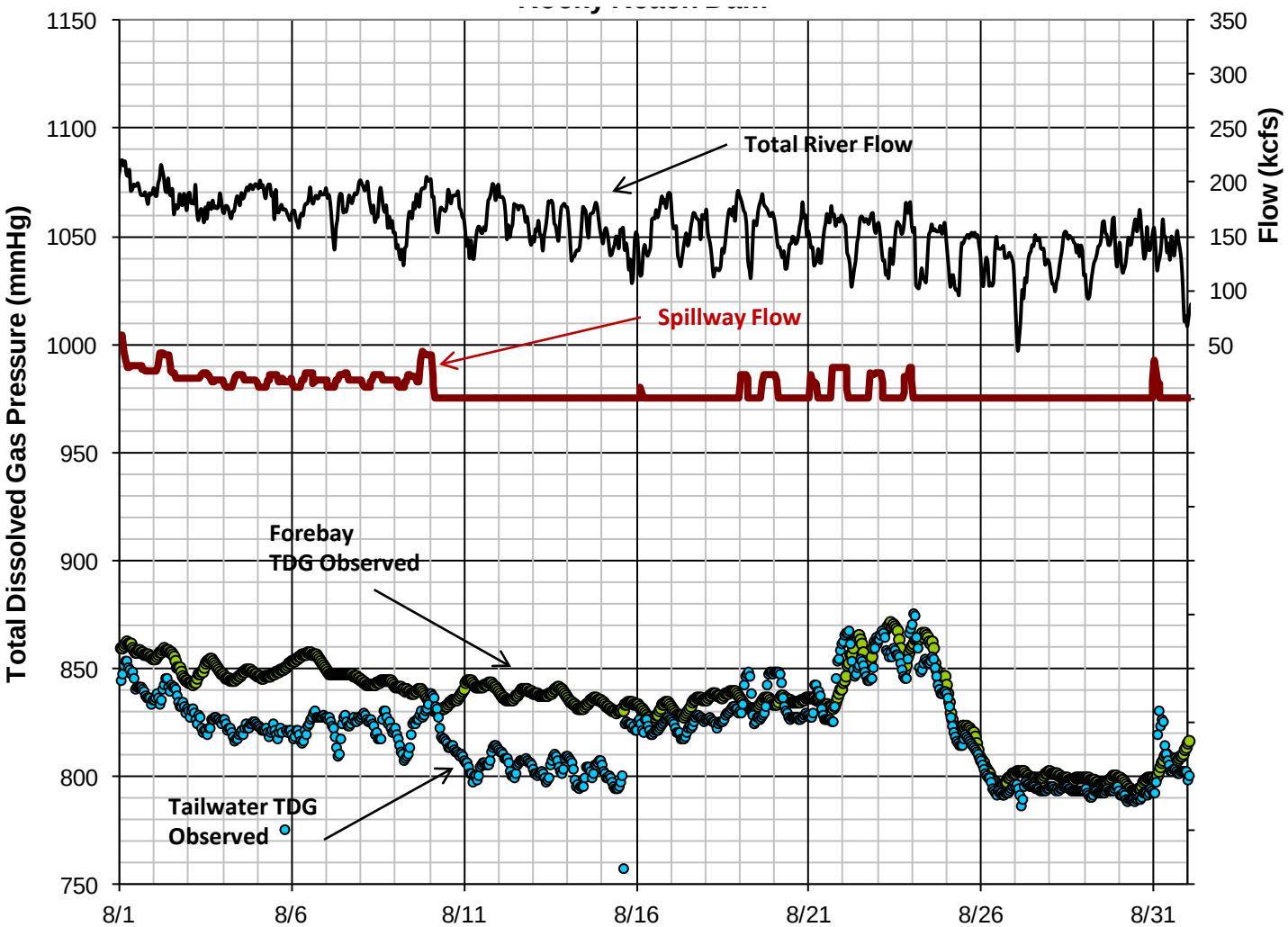
A sizable reduction in TDG loading during spillway operations can take place and will depend upon the background TDG levels and TDG exchange properties of a given spillway.
Flow weighting powerhouse and spillway flows (light blue) with added tributary dilution,
And modest levels of reaeration in route provides reasonable estimates (gold line) of TDG saturation at next project downstream. (note: TDG exchange in highly aerated flow is an equilibrium process not an additive process)



This is another example of spillway operations resulting in a net reduction in TDG loading during spillway operations.

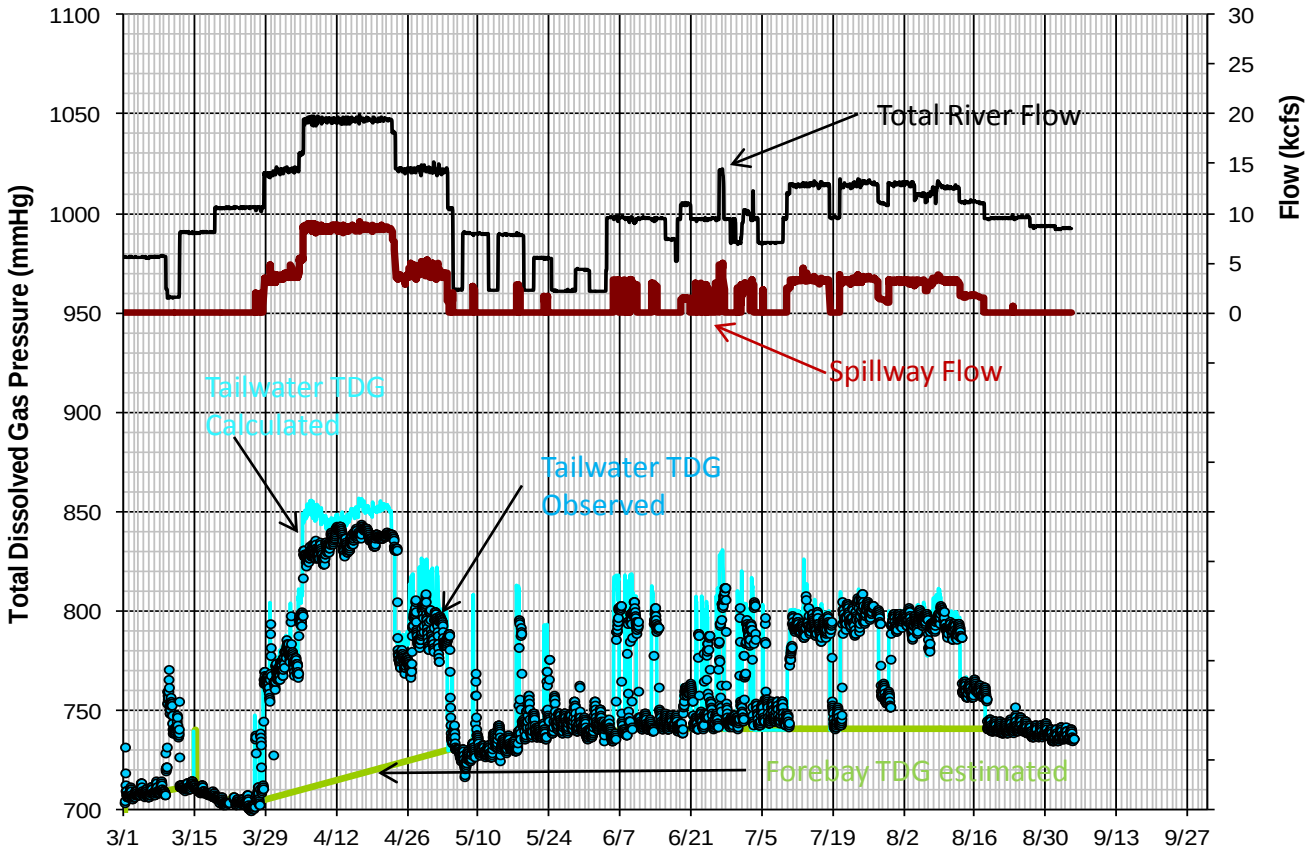


Is this another example of spillway operations resulting in a net reduction in TDG loading during spillway operations? However, there is little evidence of a reduction In the TDG load observed at the next project downstream (TDG loading arriving to reference Project is equal to TDG loading arriving at the next project downstream).

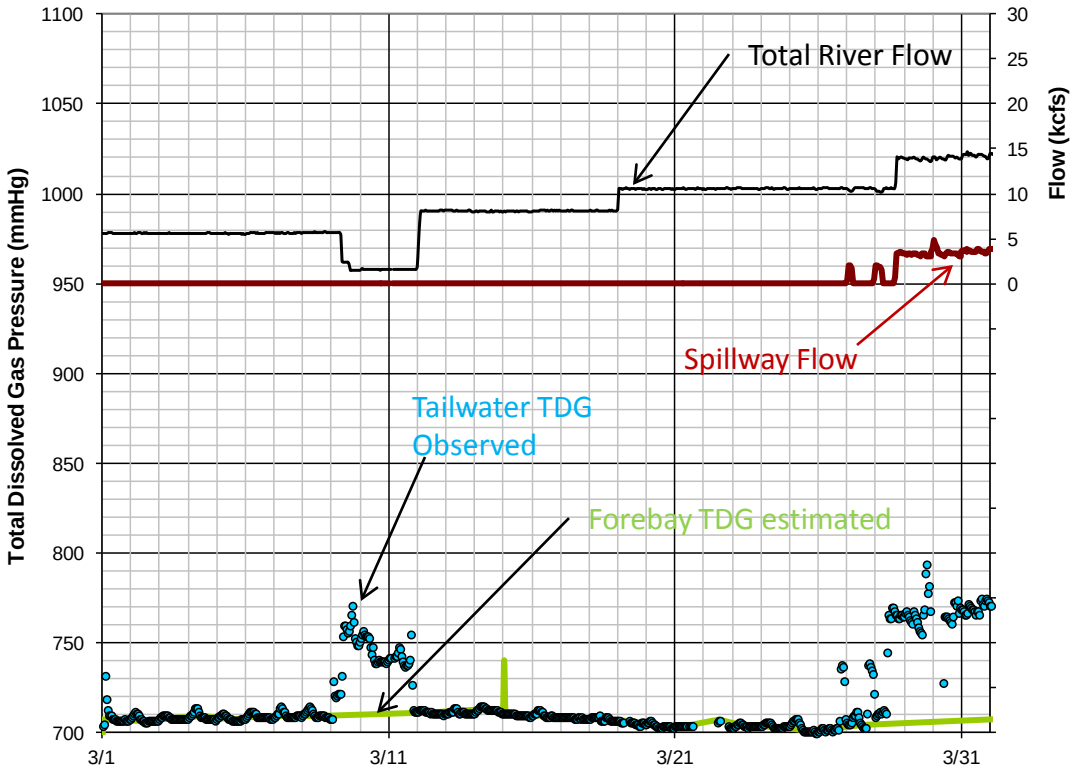


Additional evidence was provided in August when spillway operations were terminated all together on the morning of August 10 and the equipment servicing occurred on August 15.
(Note: spillway operations leading to a net reduction in TDG loadings are unusual events and commonly associated with high background TDG conditions).

Elevated TDG pressures are only associated with aerated flows caused by spillway or regulating outlet releases.

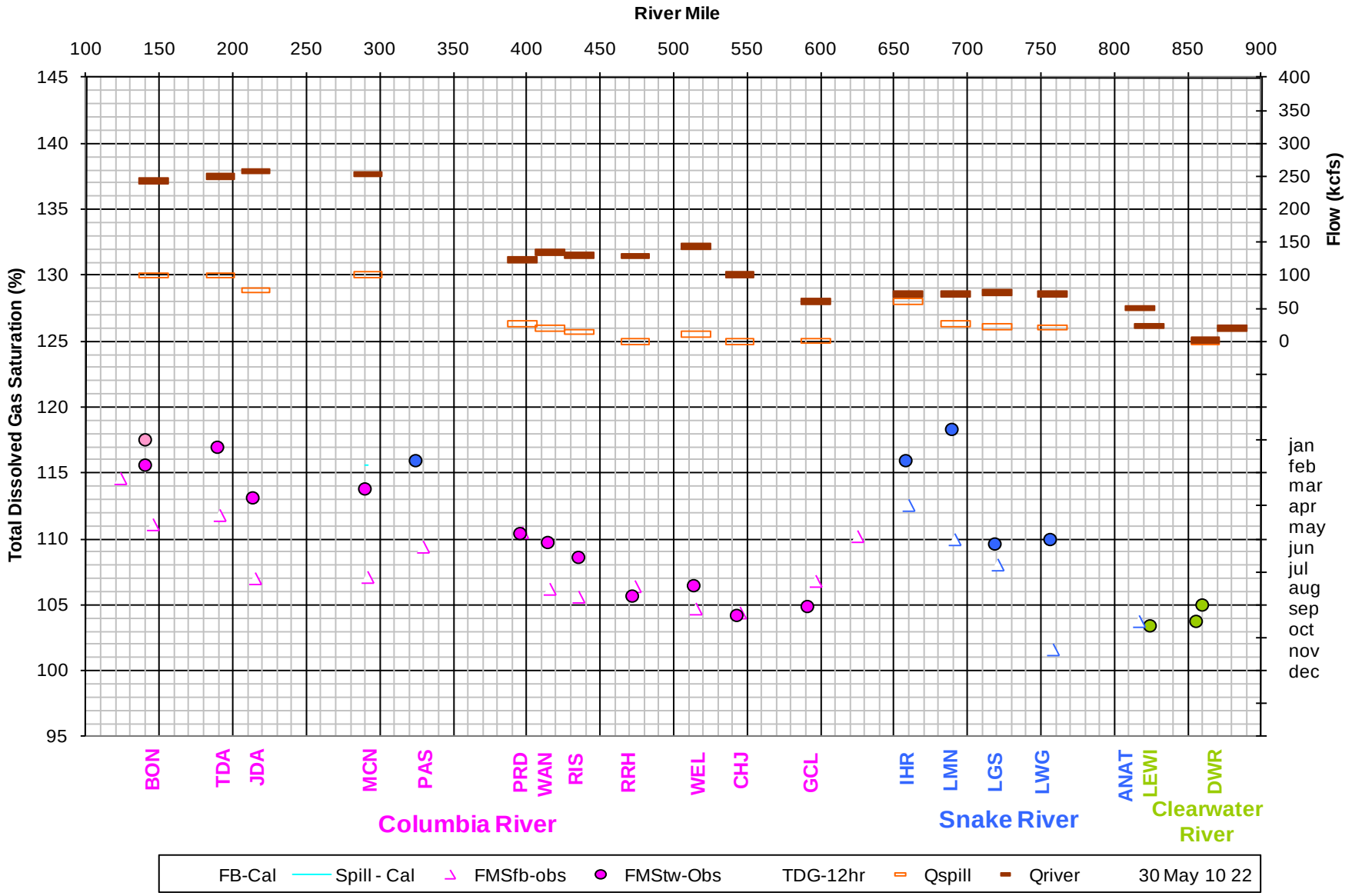


Elevated TDG pressures are only associated with aerated flows caused by spillway or regulating outlet releases. False. This figure shows the elevation of TDG pressures during minimum turbine releases resulting in air being aspirated into this discharge causing an uptake in TDG pressures



Detection of sampling or measurement anomalies

- Conclusion
  - Consistent TDG response to causal factors
    - Temporal
    - Spatial
  - Sampling anomalies
    - FMS location
    - Water sampled not representative of river conditions
  - Measurement anomalies
    - Equipment failure


River Mile
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800
850
900
Total Dissolved Gas Saturation (%)
145
140
135
130
125
120
115
110
105
100
95
Flow (kcfs)
400
350
300
250
200
150
100
50
0
jan
feb
mar
apr
may
jun
jul
aug
sep
oct
nov
dec
BON
TDA
JDA
MCN
PAS
PRD
WAN
RIS
RRH
WEL
CHJ
GCL
IHR
LMN
LGS
LWG
ANAT
LEWI
DWR
Columbia River
Snake River
Clearwater River
FB-Cal
Spill - Cal
FMSfb-obs
FMStw-Obs
TDG-12hr
Qspill
Qriver
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