USGS
science for a changing world

US Army Corps of Engineers

Suspended-Sediment and Dissolved Oxygen Monitoring during Operational Drawdowns of Fall Creek Lake, 2012-2017

U.S. Department of the Interior
U.S. Geological Survey

Liam Schenk (lschenk@usgs.gov)
Heather Bragg (hmbragg@usgs.gov)

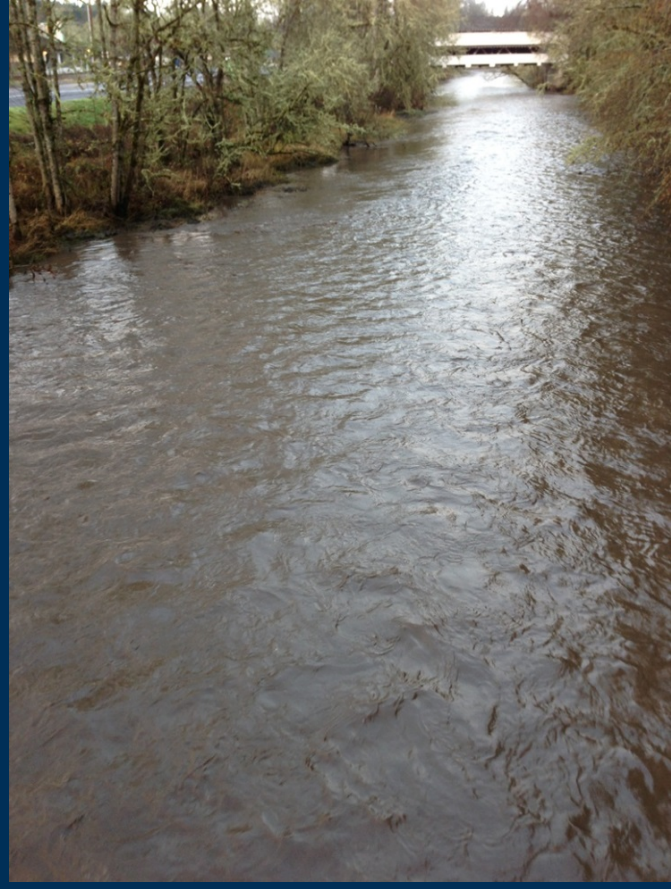
Acknowledgments

- **USGS**
  - Heather Bragg, Mackenzie Keith, Rose Wallick, Brandon Overstreet, James White
- **USACE**
  - Greg Taylor, Mary-Karen Scullion, John Pielli, Lookout Point Control Room

USGS

Presentation Outline

- Methods
- Suspended-sediment loads 2012-2016 drawdowns
- Changes in grain size during and after drawdowns
- 2015-2016 Dissolved Oxygen



USGS

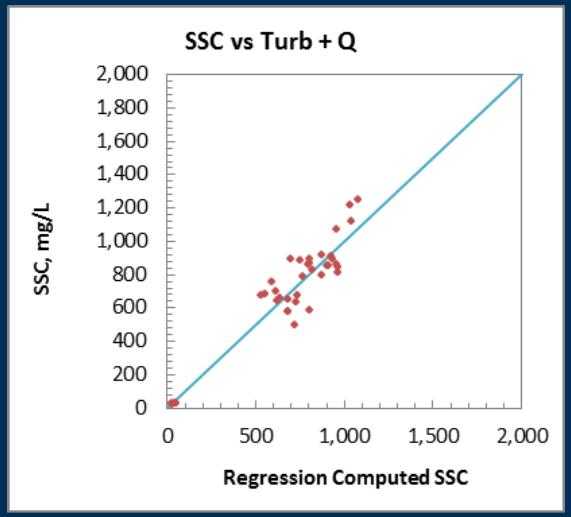
Methods

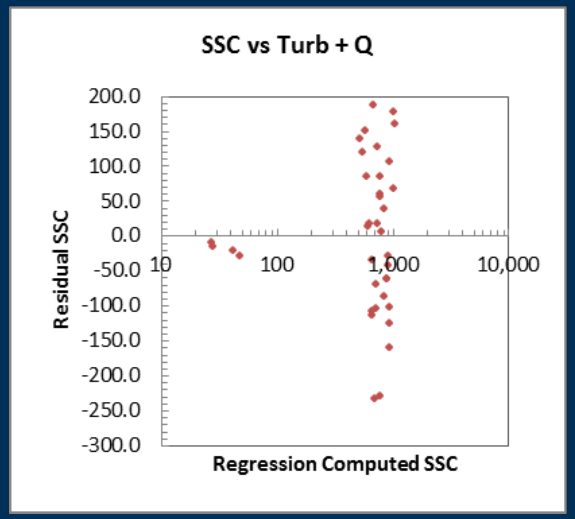
- Monitor turbidity and collect suspended sediment concentration (SSC) samples below Fall Creek Dam and Middle Fork at Jasper
  - Hydrolab SC turbidity sensors on DS 4a and 5x
  - Campbell OBS-500 sensor; WY 2014-2016
  - EWI sampling protocols for SSC + Pump Samples
- Continuous dissolved oxygen at Jasper and Fall Creek Outflow WY 2013, 2015, 2016

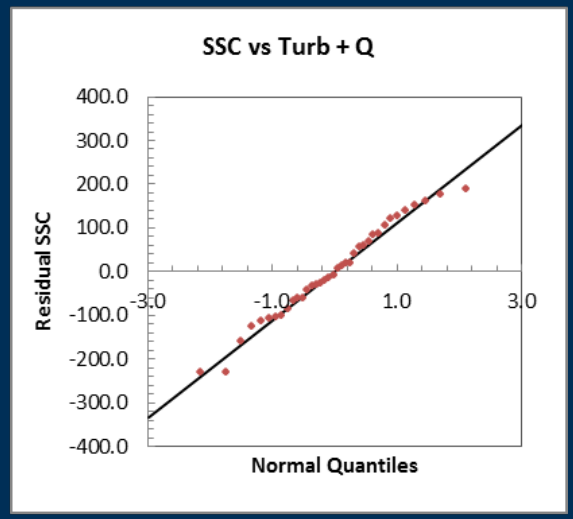
USGS

Regression Model Development Methods

- Turbidity/streamflow as explanatory variables
- Log-transformed vs non-transformed models
  - Probability plot correlation coefficient (PPCC)
  - Duan BCF used for transformed data
- SLR vs MLR
  - Multi-collinearity

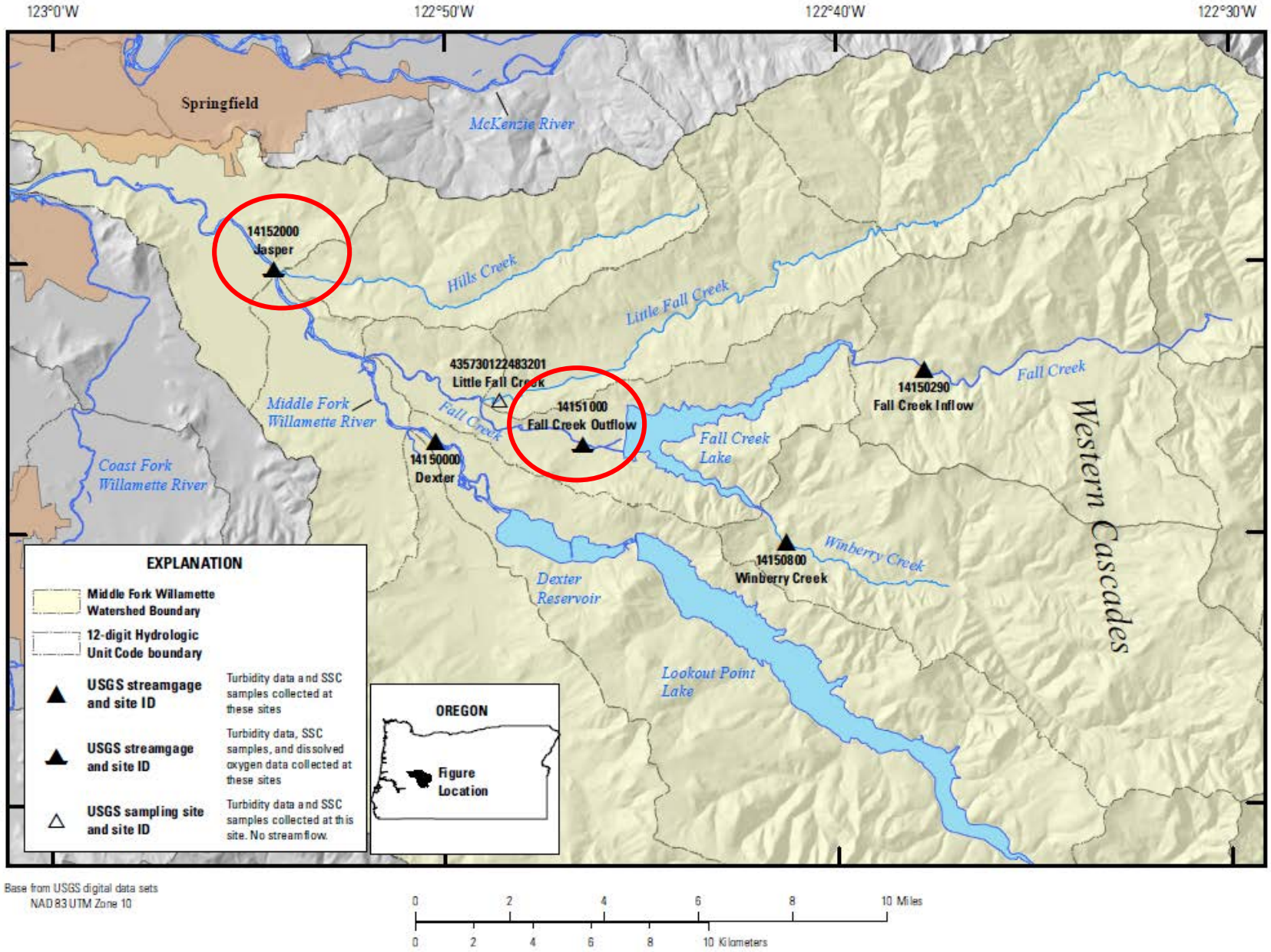




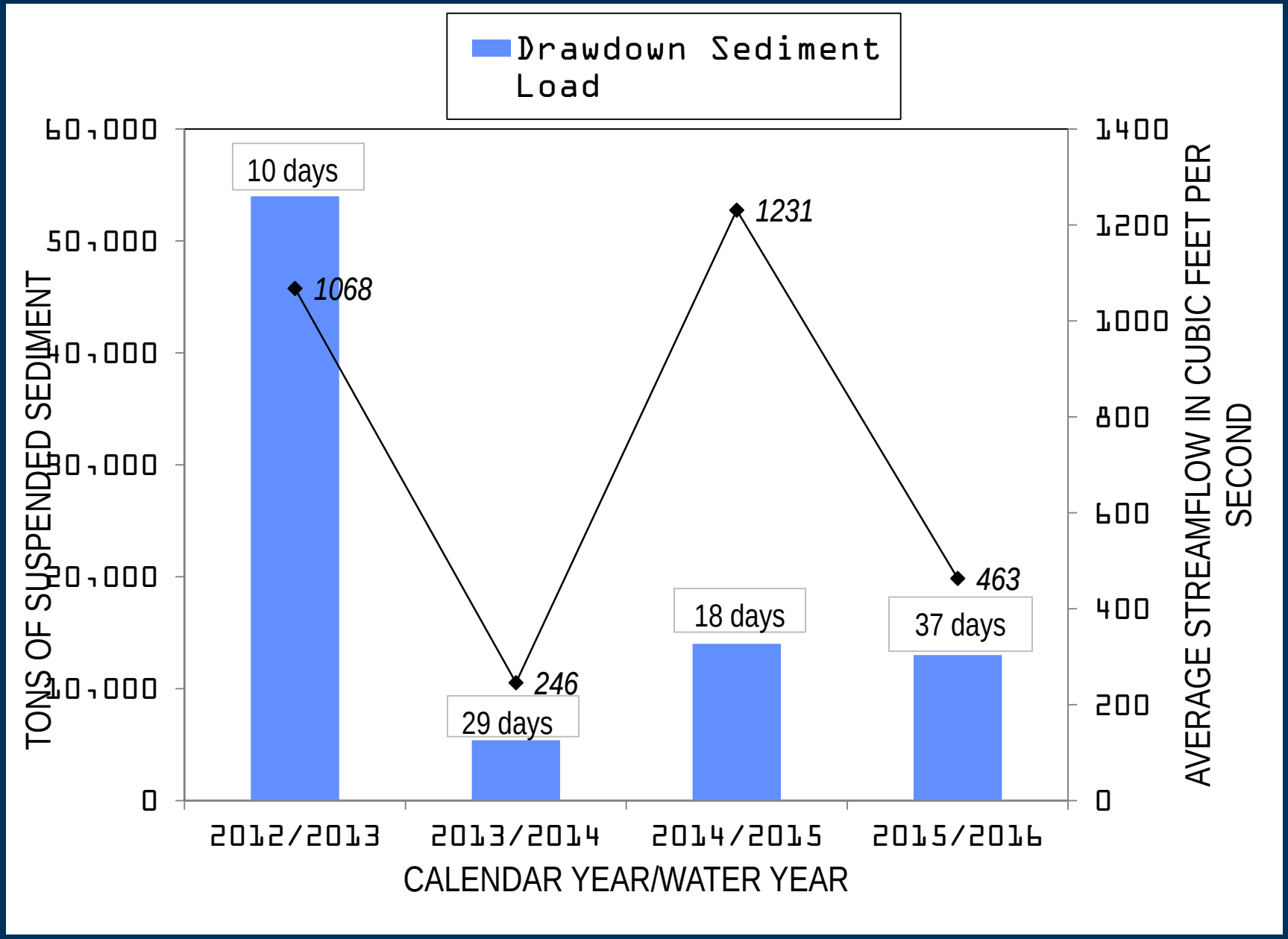


USGS

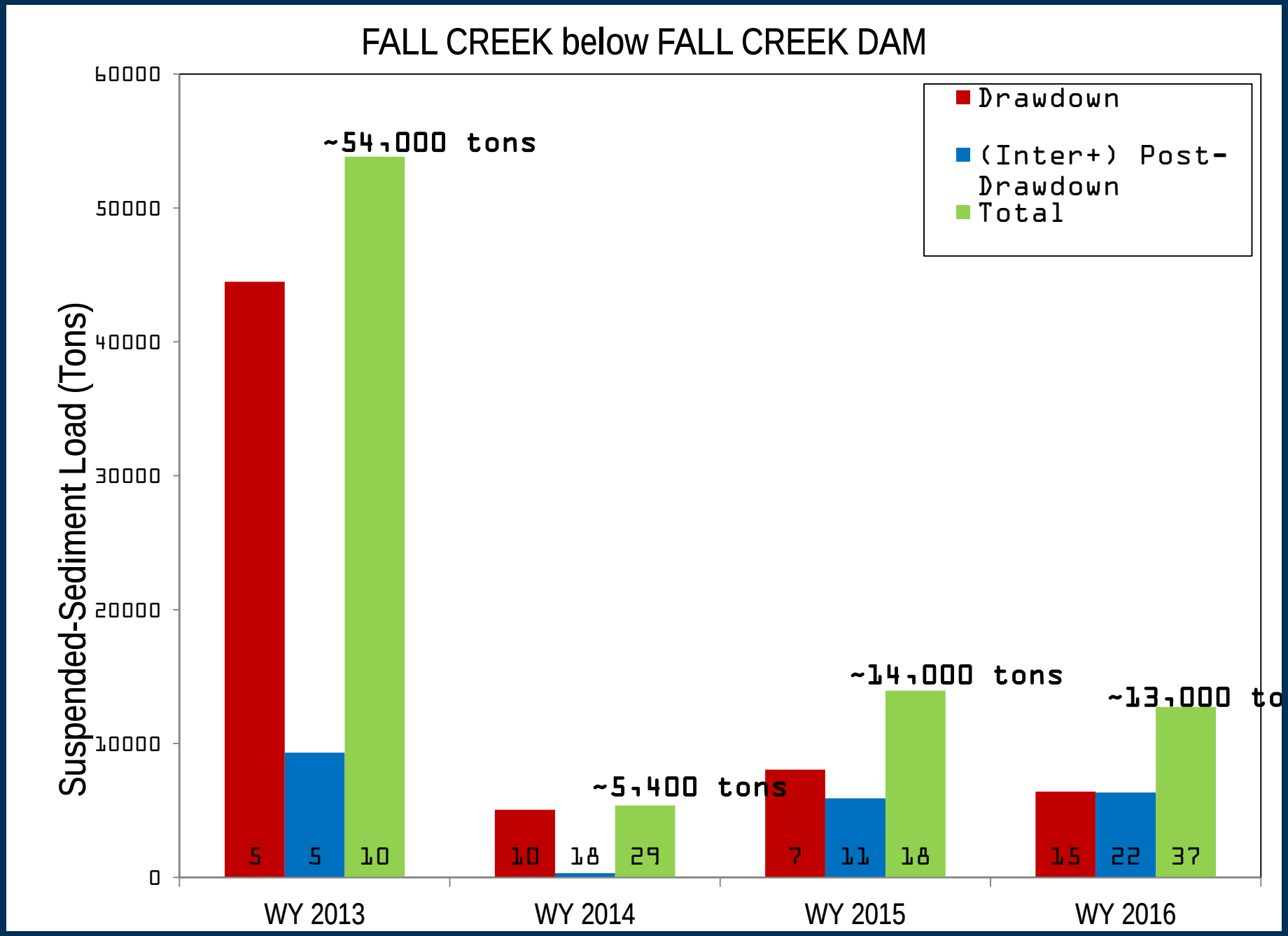
Project Sites: 2012-2017



Sediment Loads During and after Periods of Drawdown

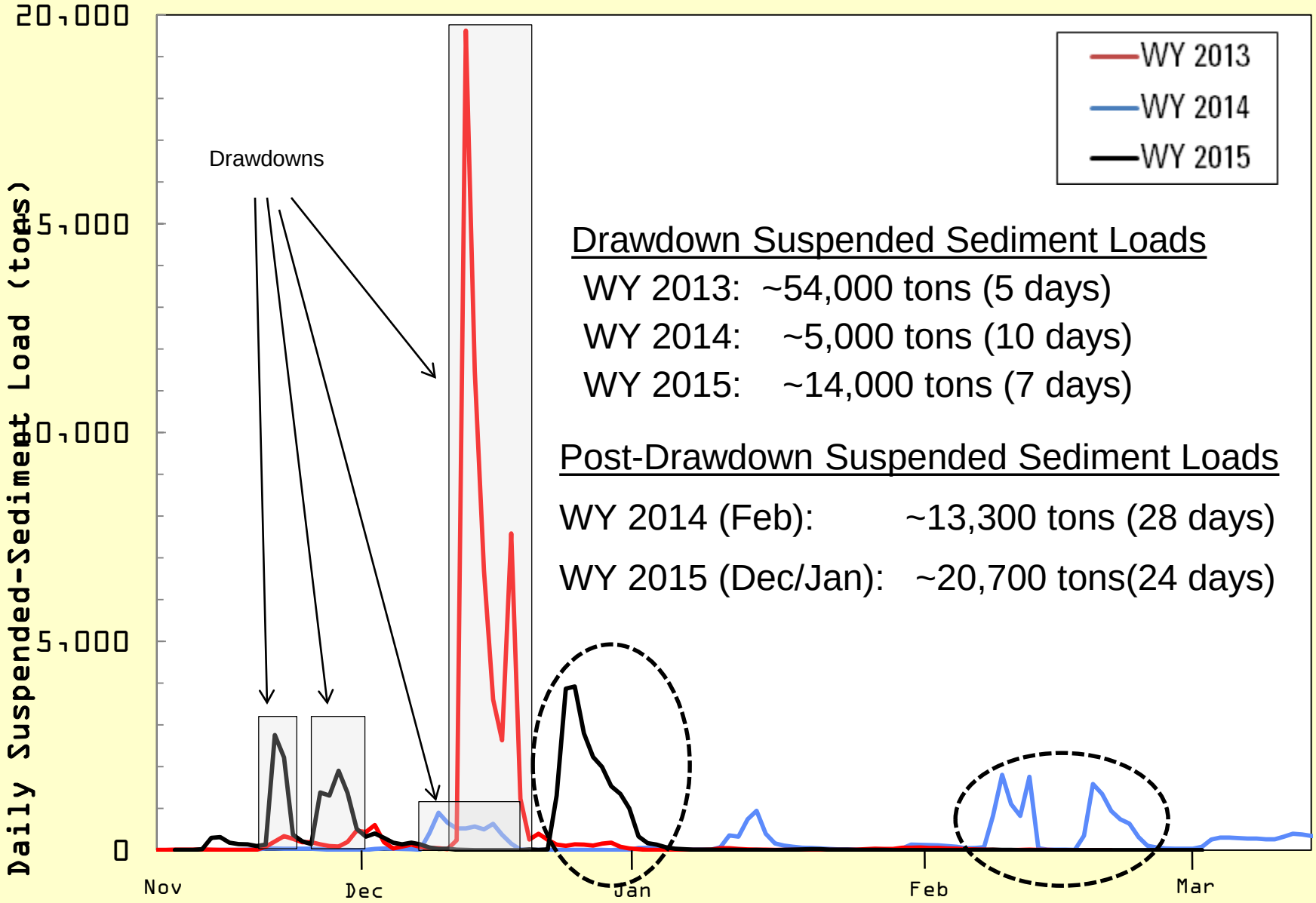


WY 2016 Data are provisional and subject to revision



WY 2016 Data are provisional and subject to revision

Fall Creek Outflow Daily Suspended Sediment Loads



Drawdown Suspended Sediment Loads

WY 2013: ~54,000 tons (5 days)

WY 2014: ~5,000 tons (10 days)

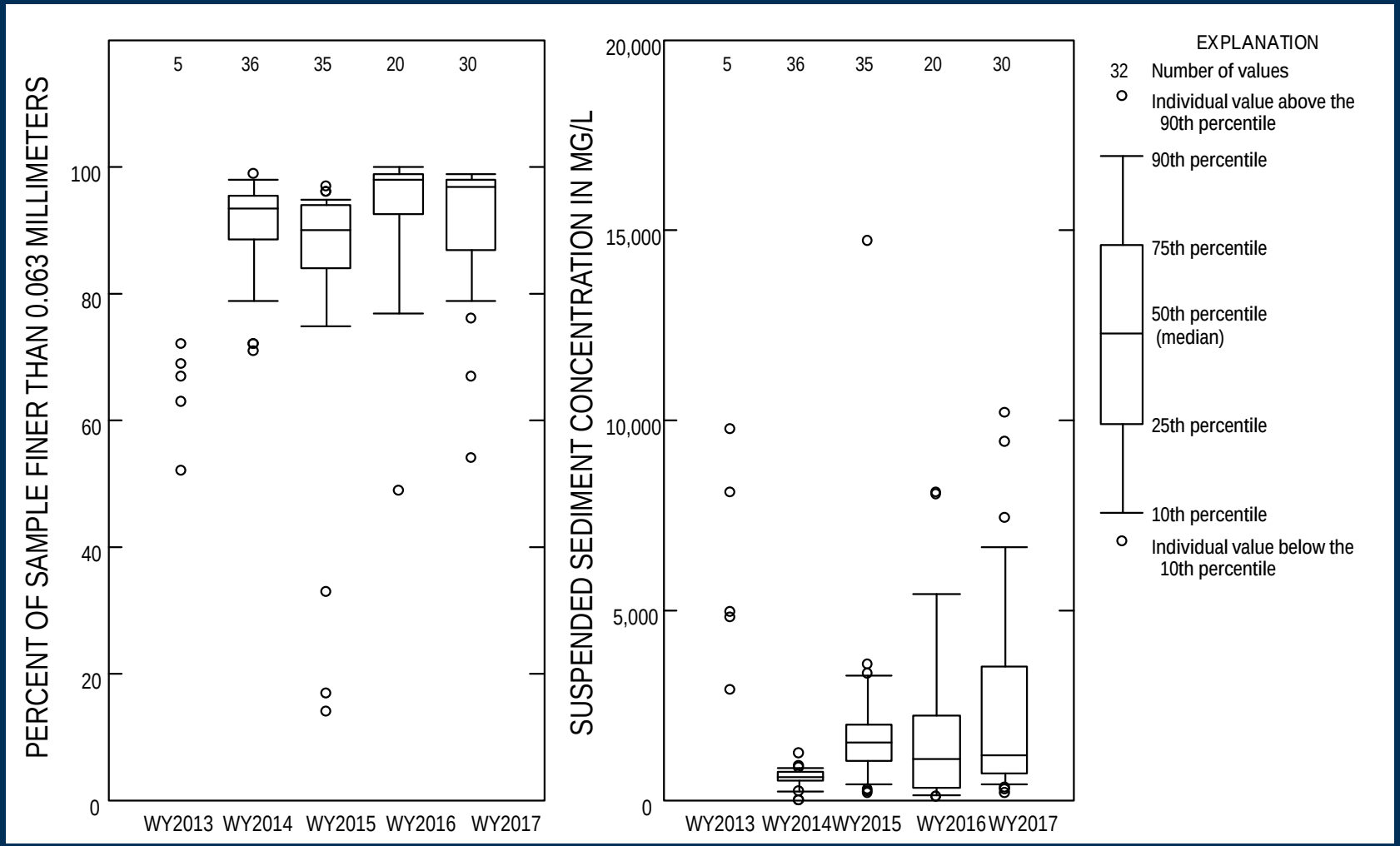
WY 2015: ~14,000 tons (7 days)

Post-Drawdown Suspended Sediment Loads

WY 2014 (Feb): ~13,300 tons (28 days)

WY 2015 (Dec/Jan): ~20,700 tons(24 days)

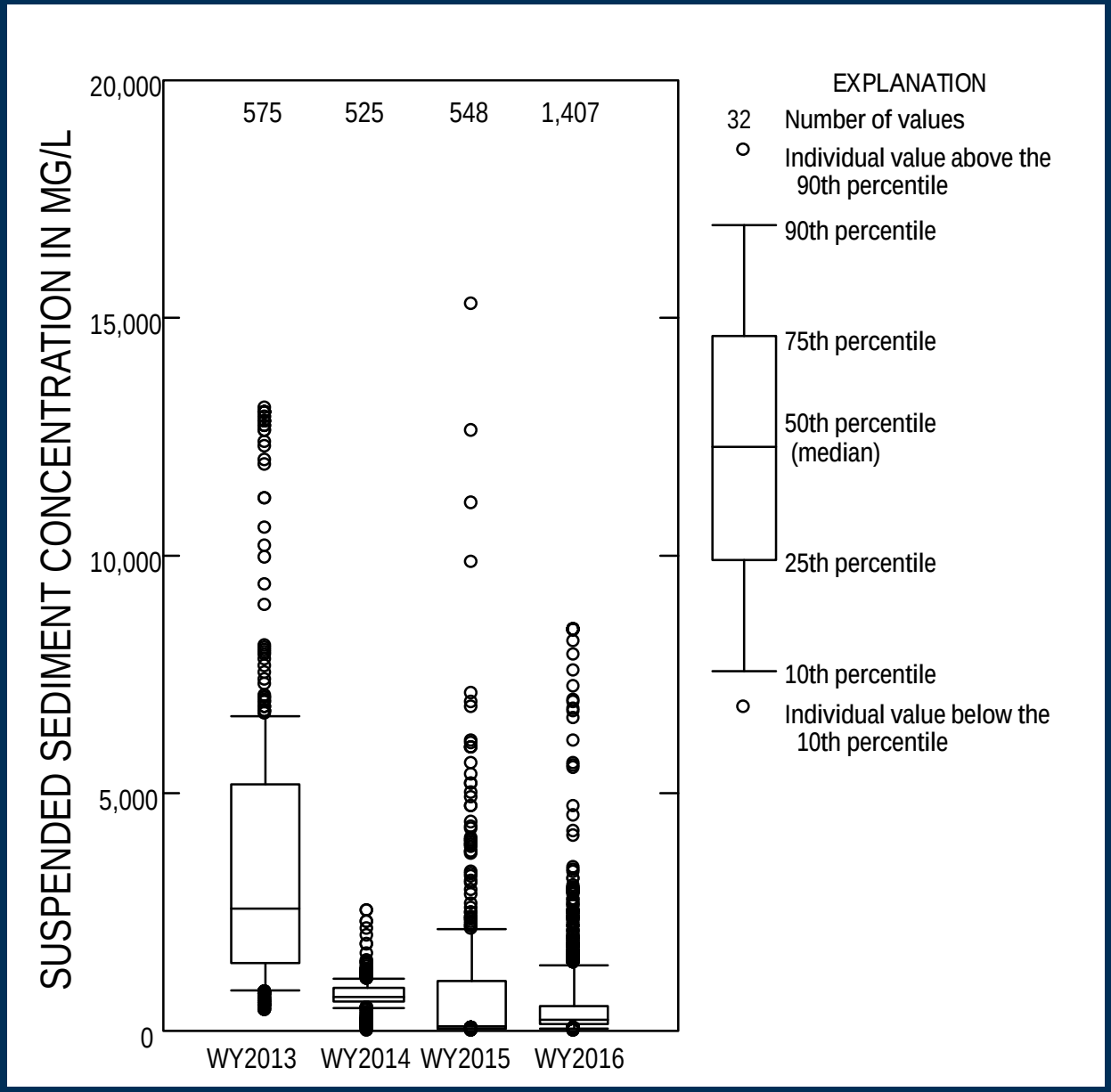
SSC concentrations and % Fines Drawdown Samples



2015 and 2016 data provisional and subject to change

USGS

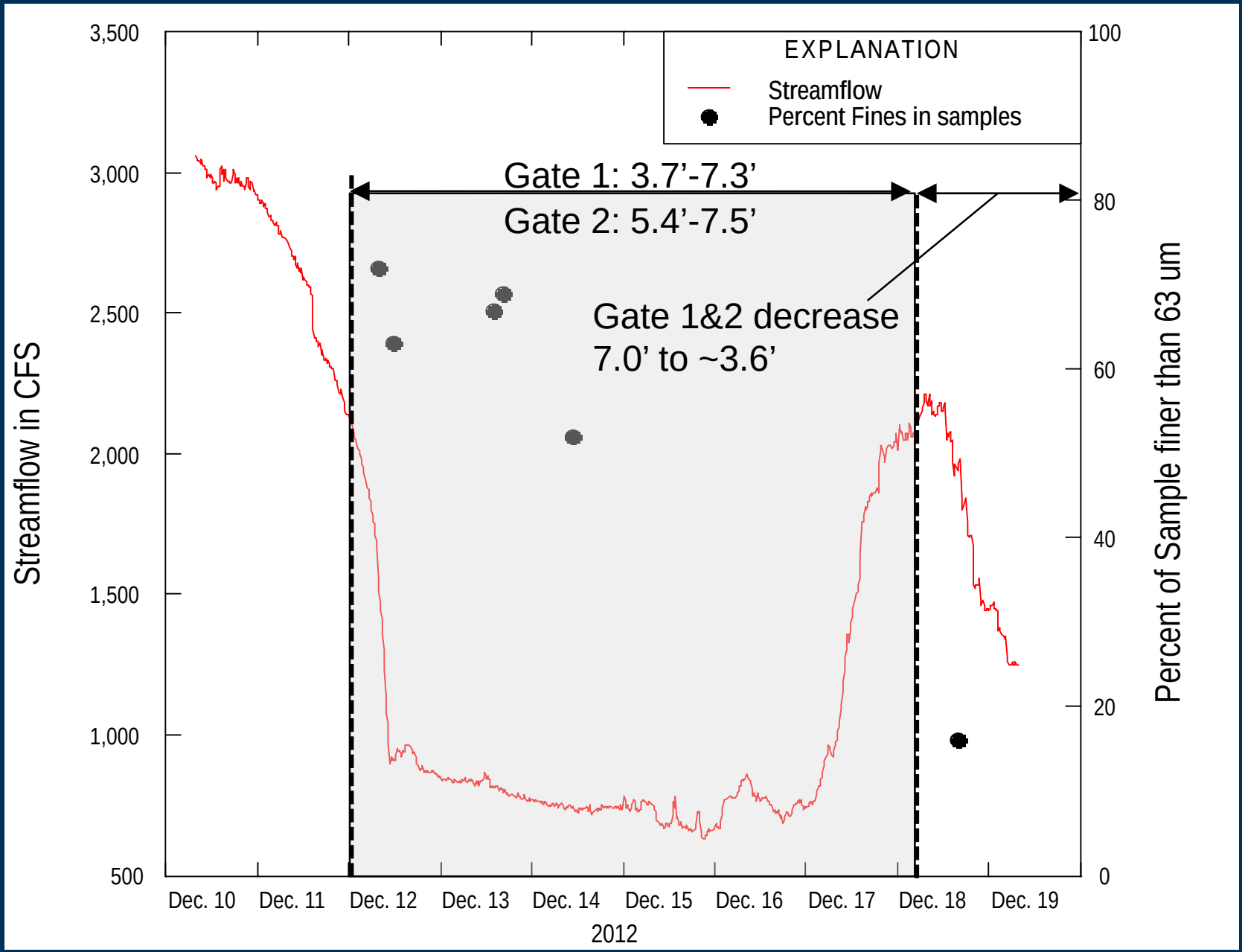
Computed SSC unit values during drawdowns



USGS

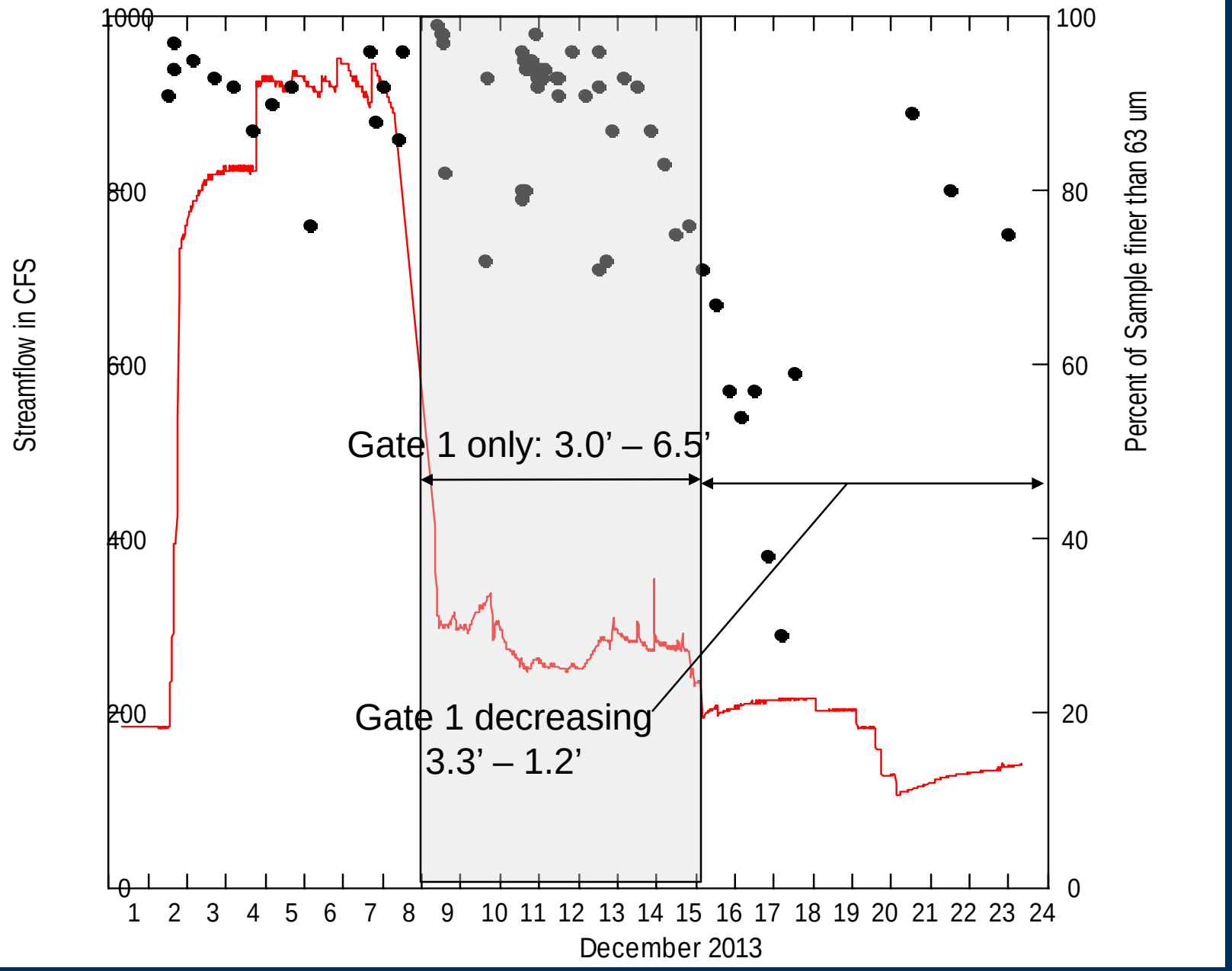
WY2016 data provisional and subject to change

Percent Fines related to gate position and flow



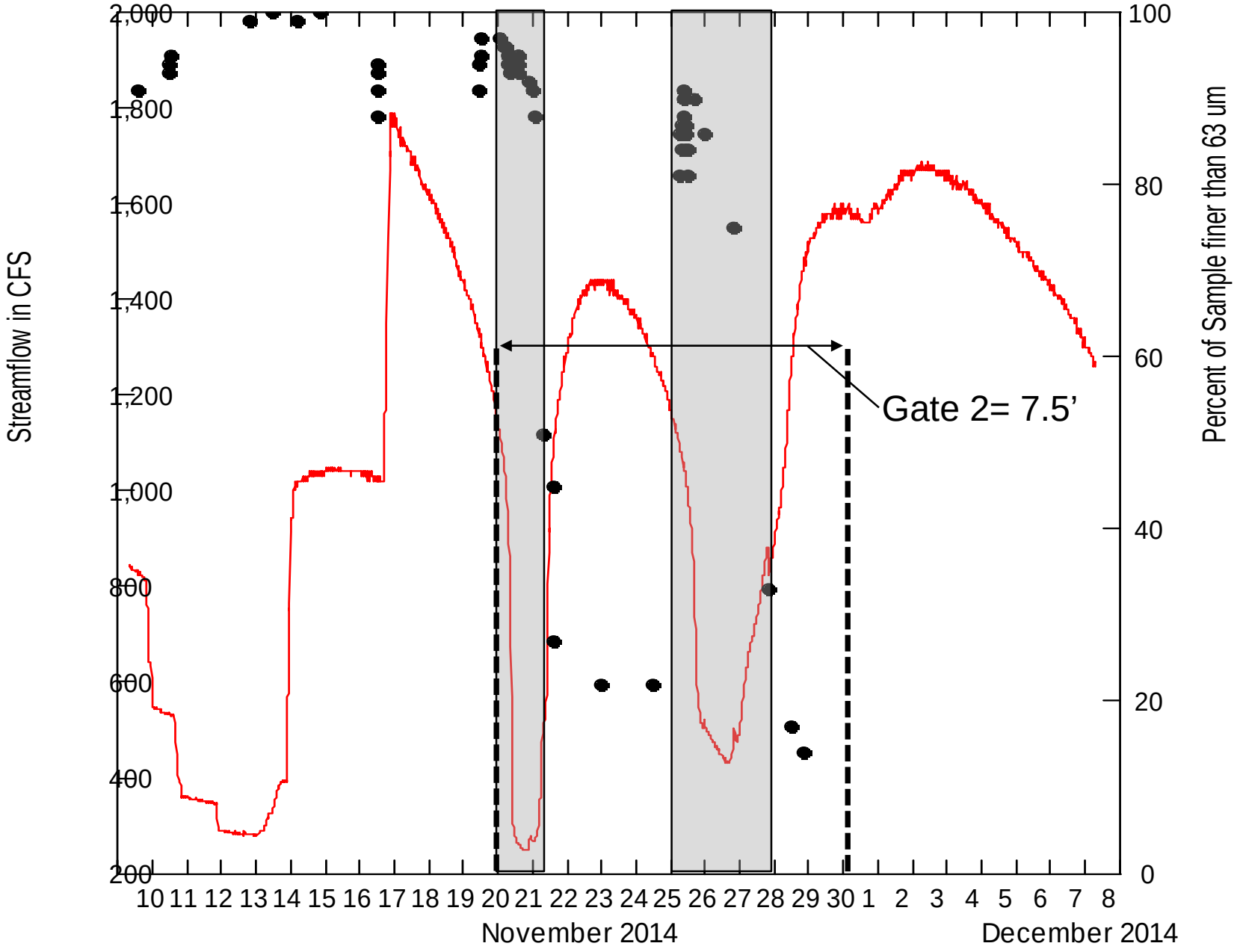
U.S. Geological Survey, 2013

Percent Fines related to gate position and flow



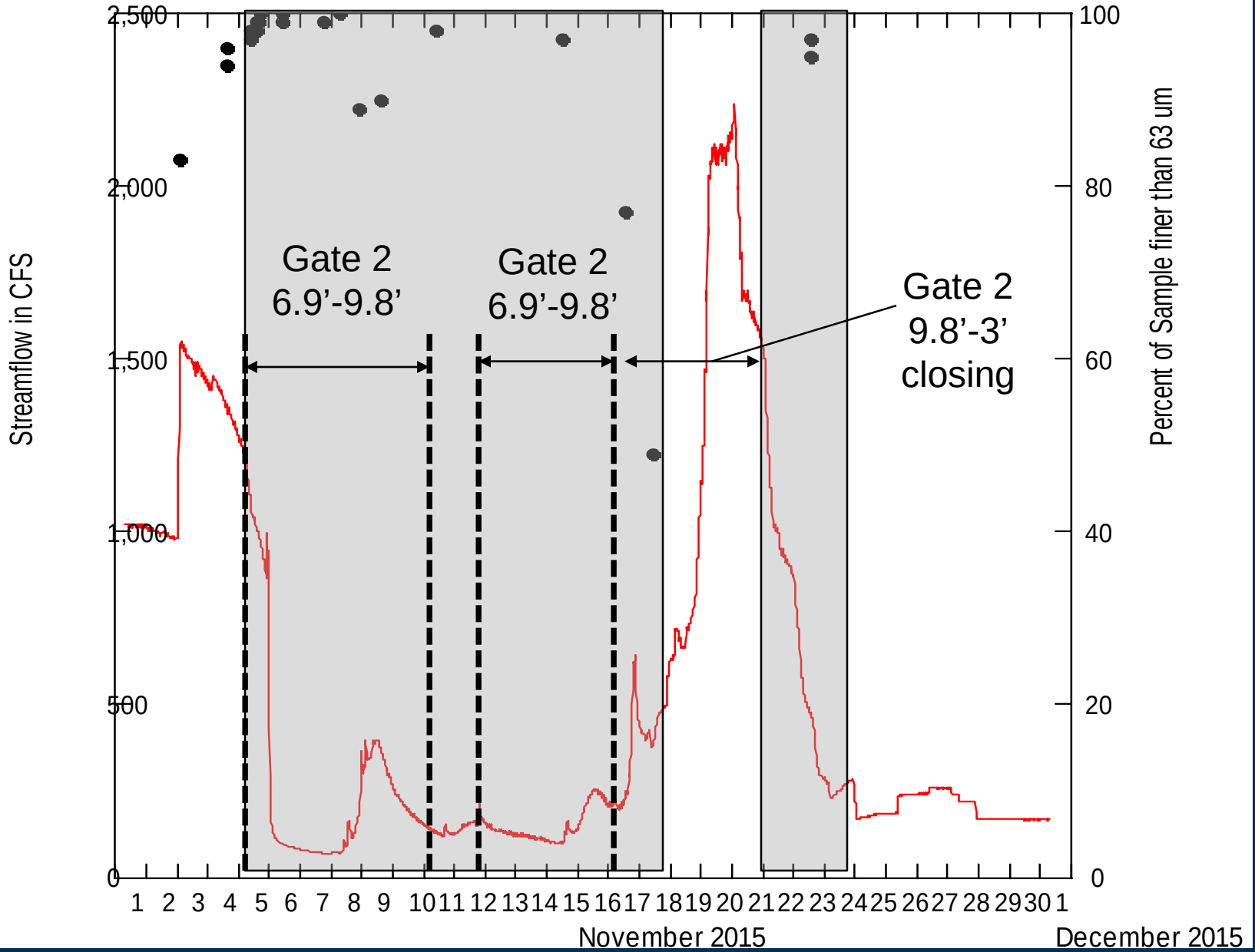
U.S. Geological Survey, 2014

Percent Fines related to gate position and flow



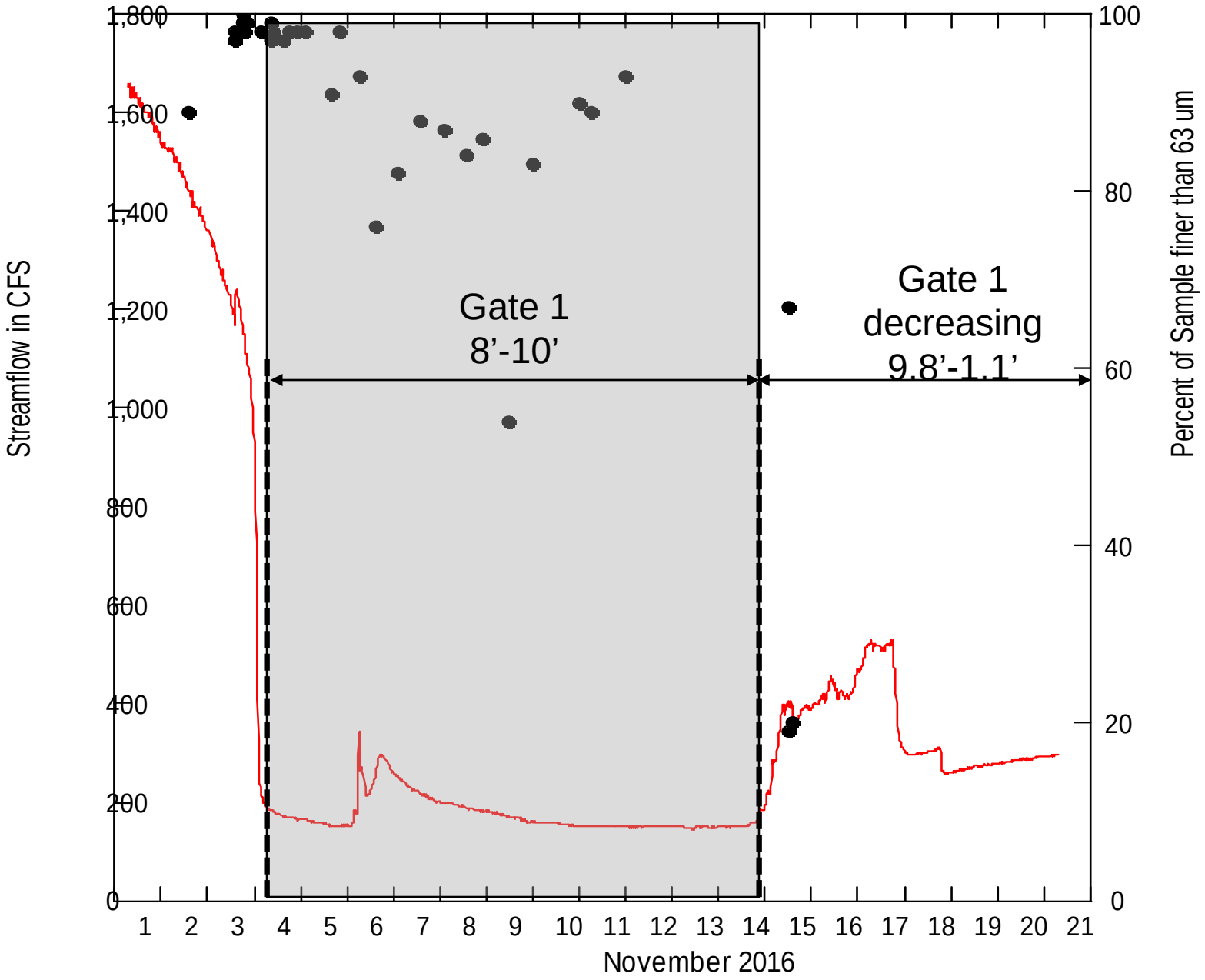
U.S. Geological Survey, 2015

Percent Fines related to gate position and flow



Data are provisional and subject to change

Percent Fines related to gate position and flow



Data are provisional and subject to change

Grain Size changes during drawdowns

- In most years, percent fines decrease toward the end of the drawdown
- Potential controlling factors
  - Stream energy
  - Sediment supply in the reservoir at streambed
  - Sediment carrying capacity

$$Qs = k * w^{-0.4} * Q^{1.4} * S^{1.4}$$ (Young et. al., 2001)

Qs=Total sediment transport capacity

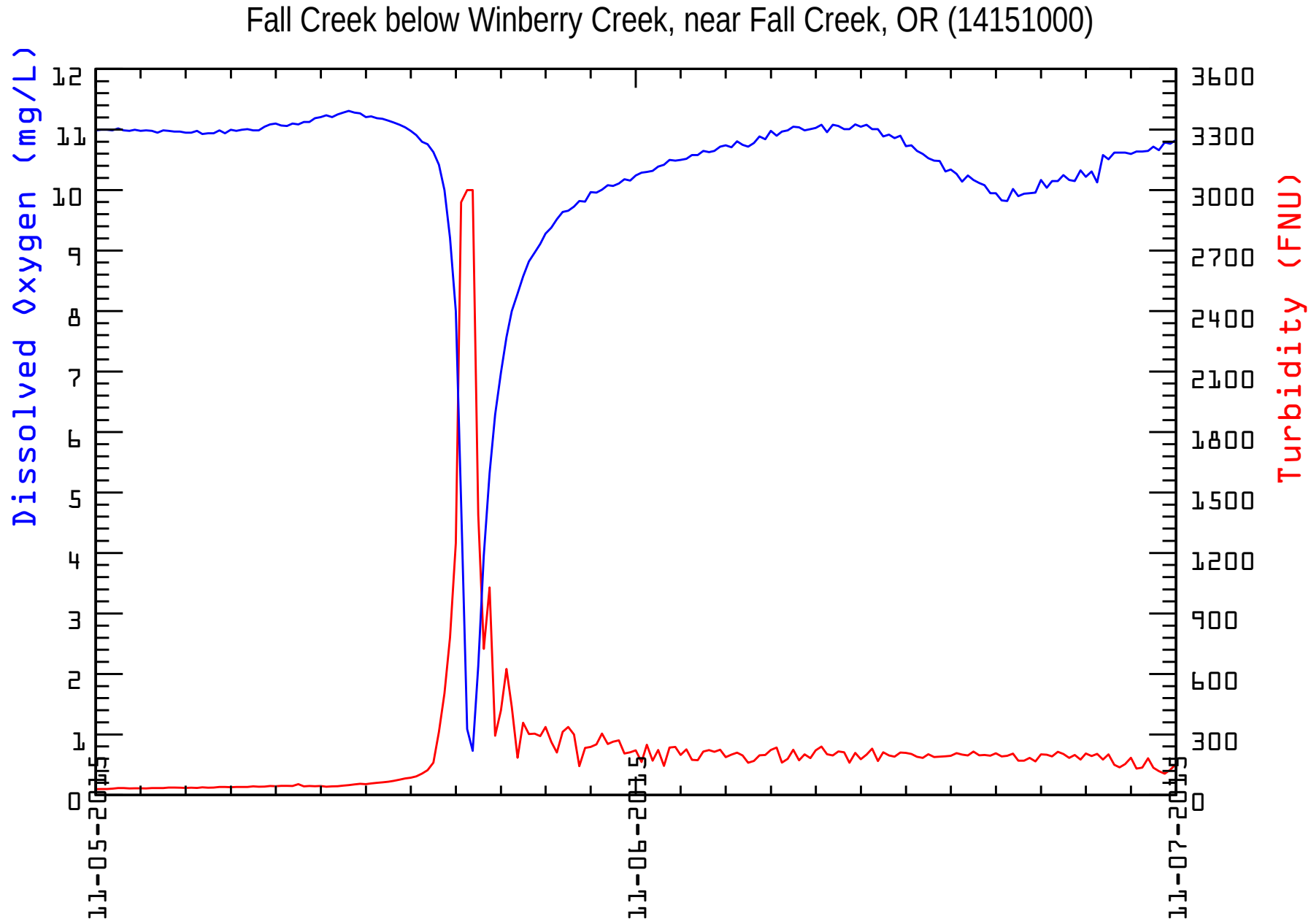
k=hydraulic roughness

Q=discharge

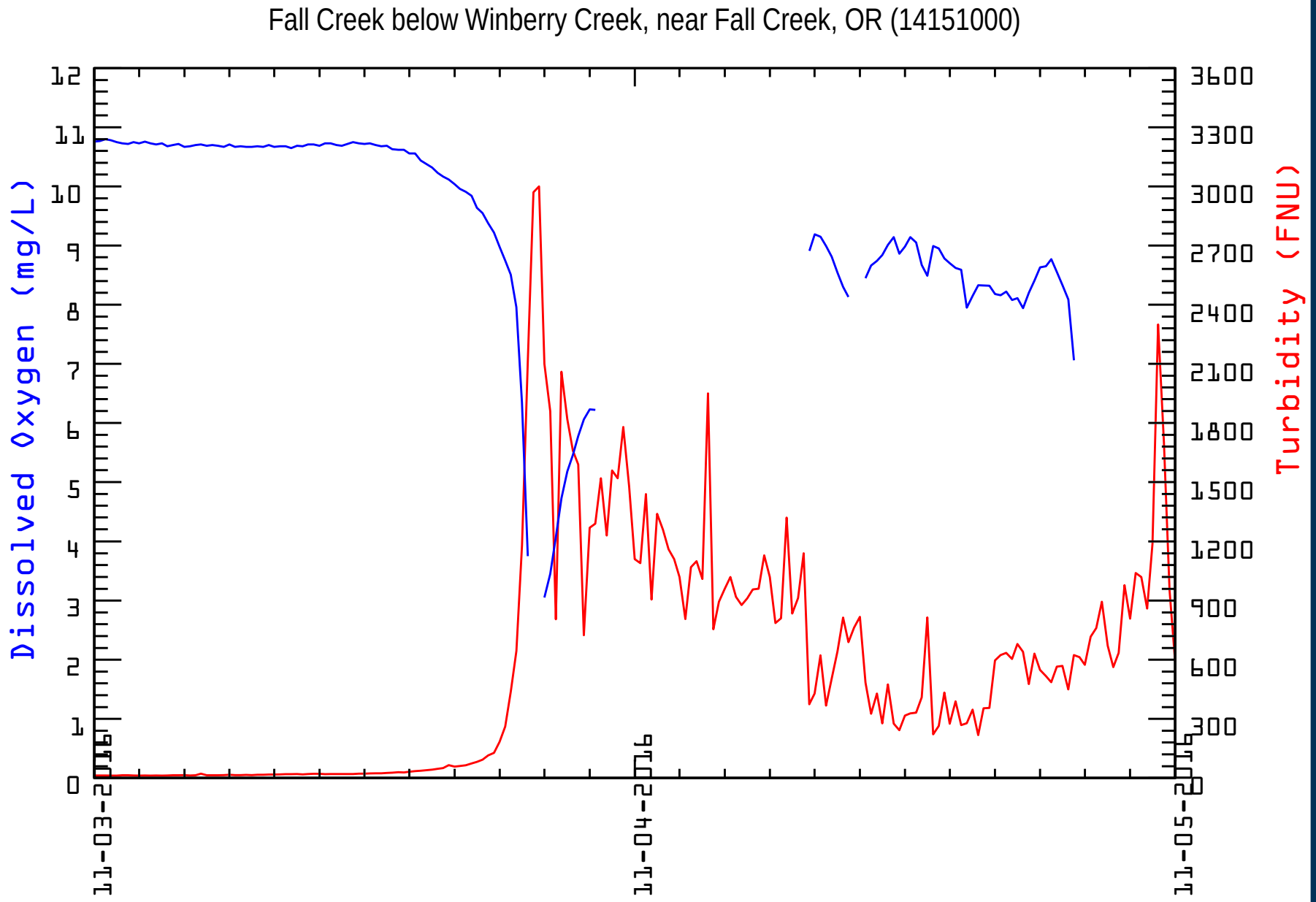
S=slope

USGS

Dissolved Oxygen and Turbidity, November 2015



Dissolved Oxygen and Turbidity, November 2016



Data are provisional and subject to change

Summary

- Suspended-sediment loads highest in Dec 2012, variable but lower for WY 2014-2016.
  - Affected by hydrologic, meteorological conditions, and sediment supply
- Coarse sediment (> 0.063mm) transport
  - Sediment supply, stream energy, and transport capacity possible controlling factors in coarse sediment transport (>0.063mm)
  - Sand transport may be limited by timing drawdowns with low inflows, and avoiding drastic changes in streamflow
- Periods of hypoxia occurring at the onset of the sediment release 1 mile below the dam evident in WY 2016 and 2017

USGS

Questions?

References

Schenk, L.N., and Bragg, H.M., 2014, Assessment of suspended-sediment transport, bedload, and dissolved oxygen during a short-term drawdown of Fall Creek Lake, Oregon, winter 2012–13: U.S. Geological Survey Open-File Report 2014–1114, 80 p., http://dx.doi.org/10.3133/ofr20141114.

Schenk, L.N., and Bragg, H.M., 2015, Suspended-Sediment Concentrations and Loads During an Operational Drawdown of Fall Creek Lake, Oregon, Winter 2013-2014: U.S. Geological Survey Data Release, http://or.water.usgs.gov/proj/Fall_Creek/Fall_Crk_data_release_2014.pdf

U.S. Geological Survey, 2015-2016, USGS water data for Oregon: http://waterdata.usgs.gov/or/nwis/nwis/

Young, W. J., et al. (2001). "Relative changes in sediment supply and sediment transport capacity in a bedrock-controlled river." Water Resources Research 37(12): 3307-3320.

USGS