Evaluation of the variability of sediment and nutrient loading into San Antonio Bay

September 27, 2016

U.S. Geological Survey
Texas Water Science Center
Gulf Coast Program Office

Texas Water Development Board

USGS

Project Tasks

1. Collection of periodic water-quality samples in the Guadalupe River (USGS station 08188810).

2. Develop regression model to estimate suspended-sediment concentrations using backscatter signal from ADVM at streamgaging station.

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Project Tasks

3. Develop a continuous record of suspended-sediment concentrations for period of gage operation and evaluate nutrient relations with in situ parameters.

4. Evaluate historic flow data for the Guadalupe and San Antonio River below Victoria, Texas.

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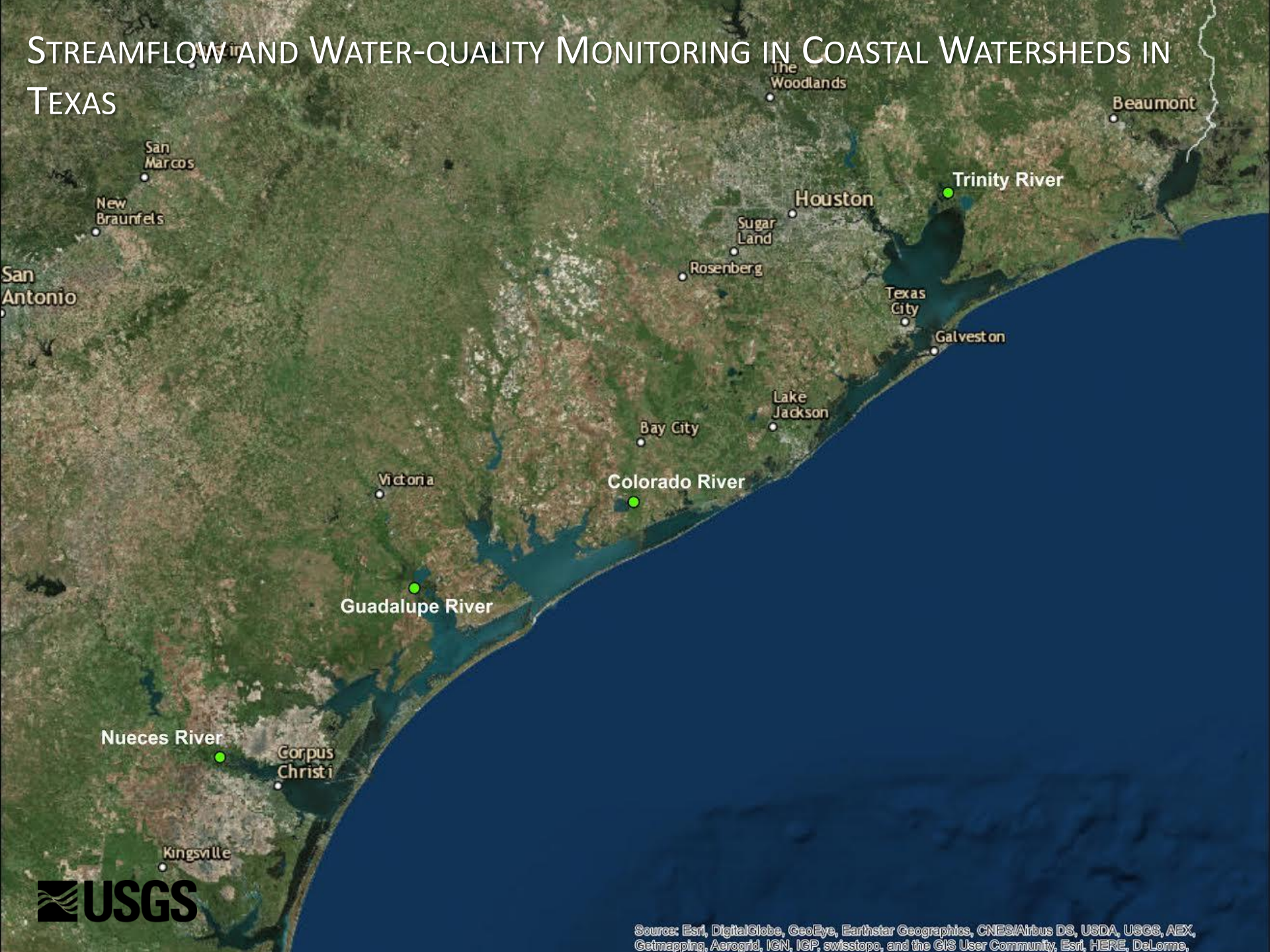
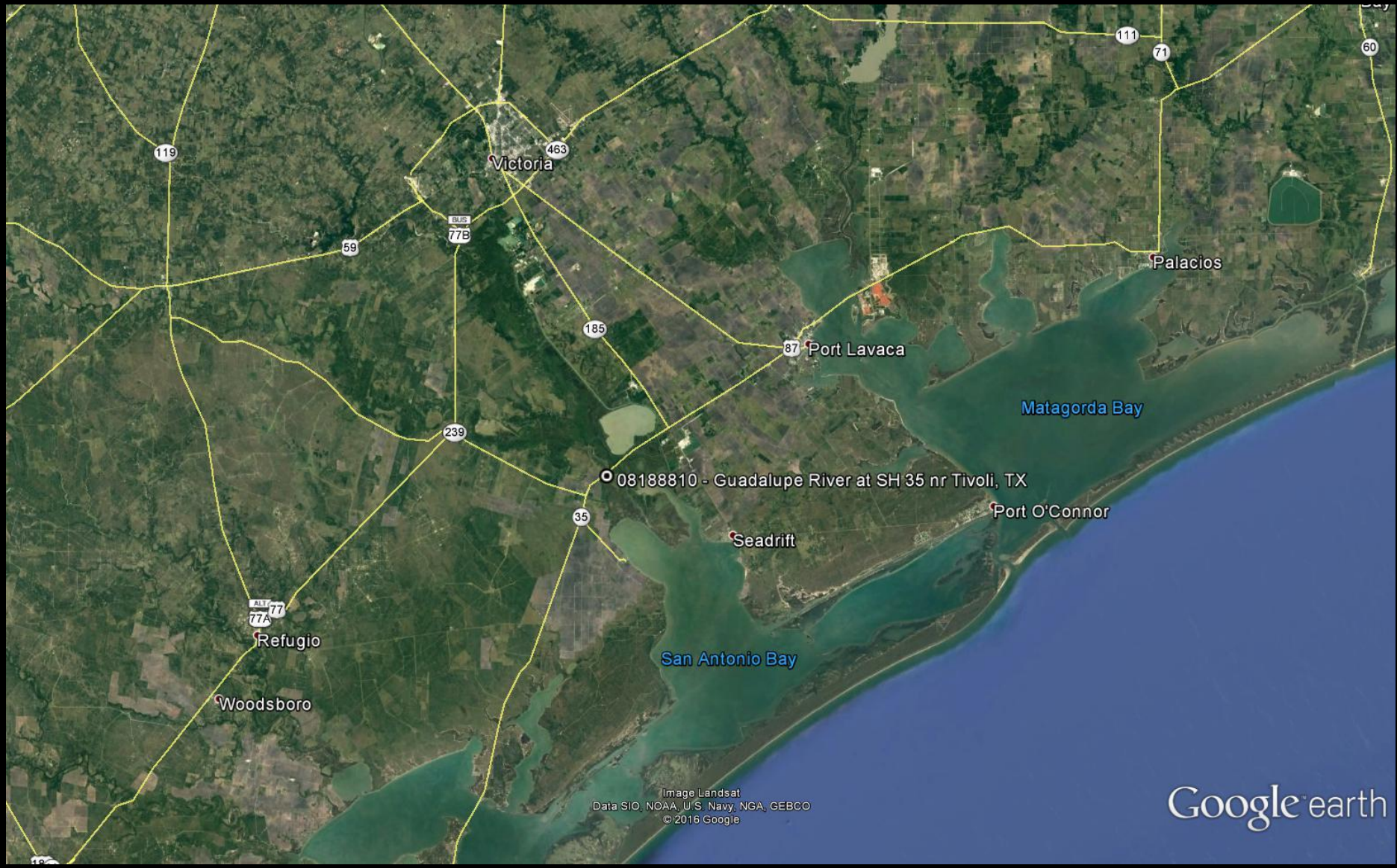
Streamflow and Water-quality Monitoring in Coastal Watersheds in Texas




Victoria
Palacios
Port Lavaca
Matagorda Bay
08188810 - Guadalupe River at SH 35 nr Tivoli, TX
Port O'Connor
Seadrift
Refugio
San Antonio Bay
Woodsboro
Image Landsat
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
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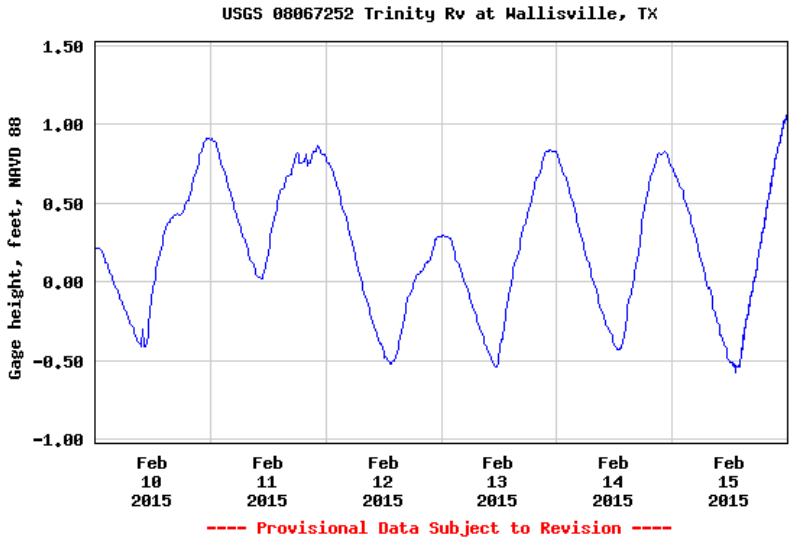
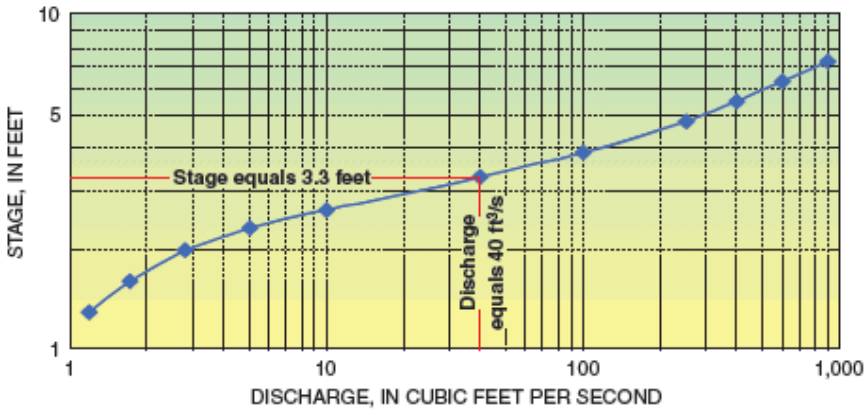
Google earth

INDEX-VELOCITY GAGE





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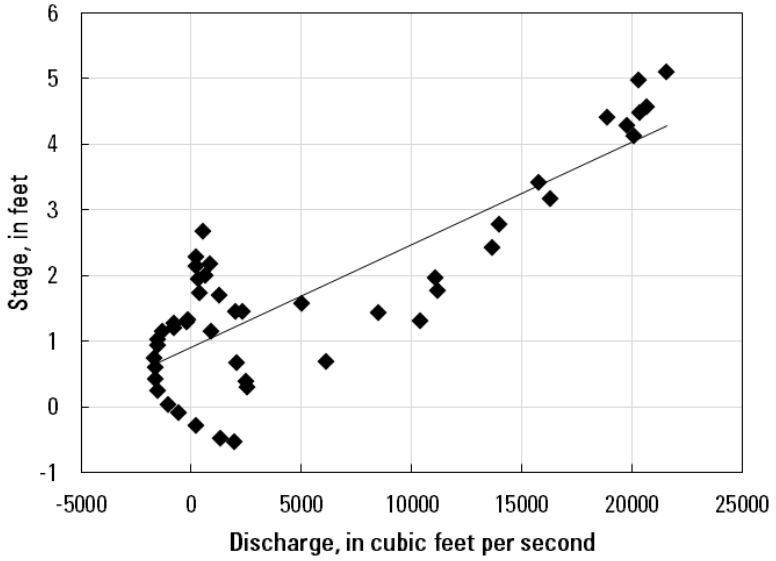
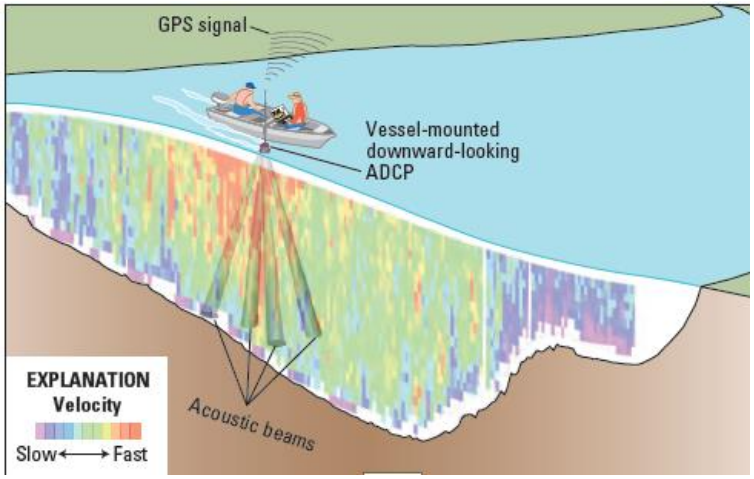


INDEX-VELOCITY GAGE

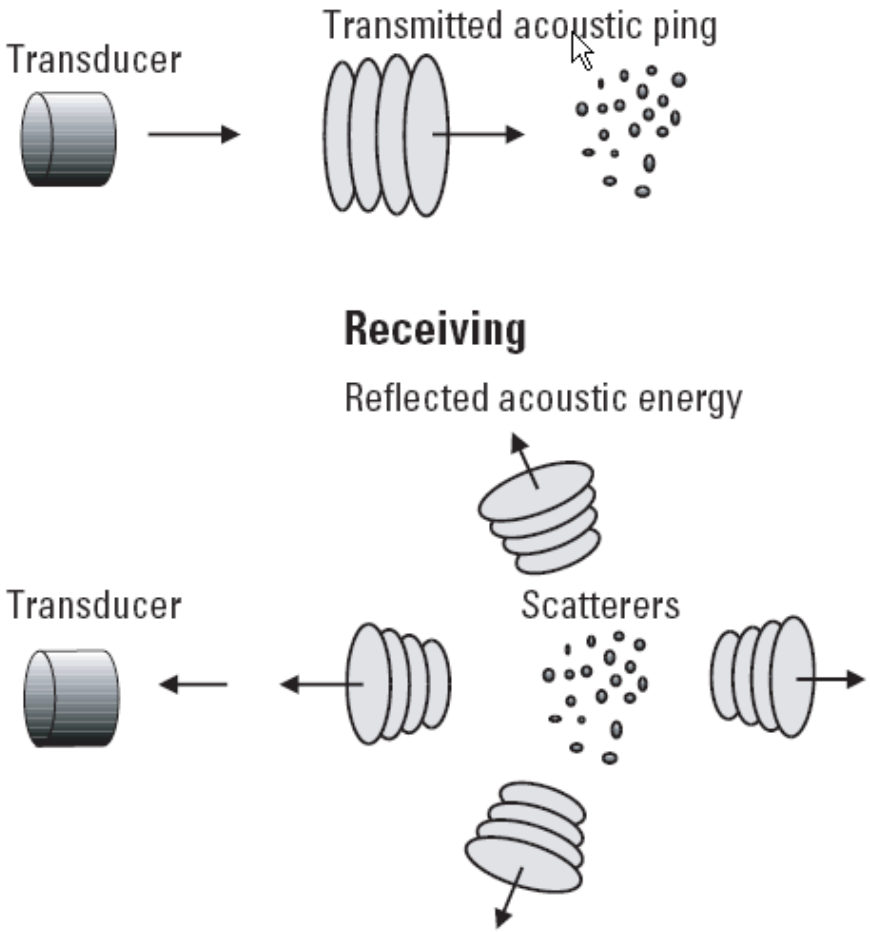


Discharge = Velocity x Area

Acoustic Backscatter

- The ADVM transmits acoustic energy at a known frequency and measures the change in frequency of the acoustic energy reflected back (backscattered) from particles in the water column.

- Acoustic waves passing through a water-sediment mixture will scatter and attenuate as a function of fluid, sediment, and acoustic instrument characteristics.



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Advantages of Acoustic Backscatter

- High Temporal Resolution & Real Time
- Greater Accuracy
- Concurrent Velocity and Streamflow Data
- Reduced Cost and Maintenance
- Large Sample Volume

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Data Collection

- Water-quality samples
  - Suspended-sediment
  - Nutrients (N, P & C)
  - Physical water properties
- Concurrent and continuous acoustic backscatter data from ADVM

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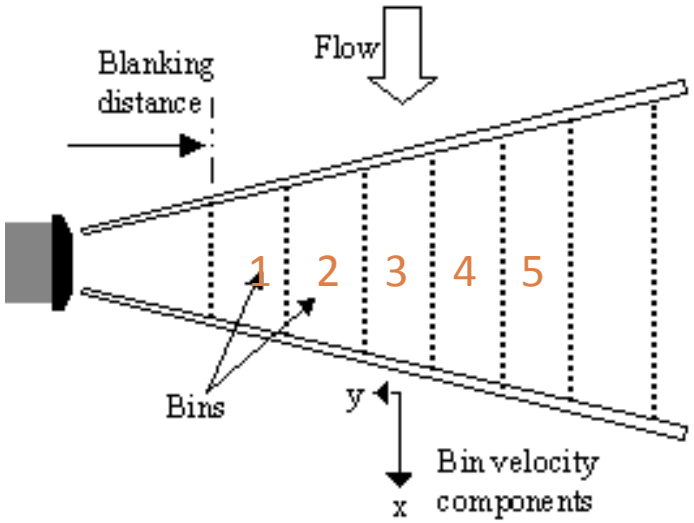
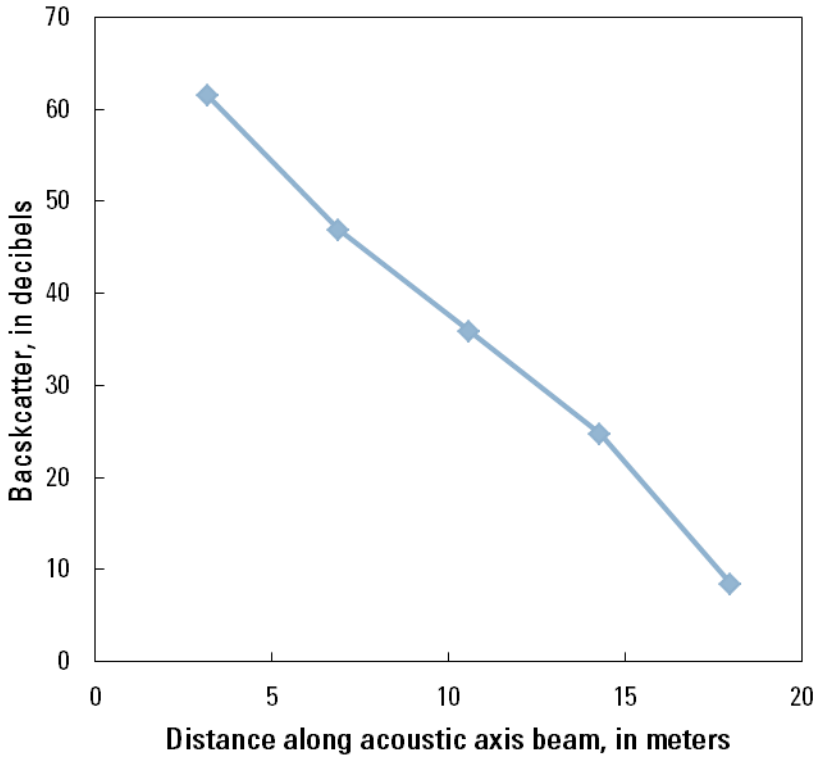
Data Management



(A) Horizontally-oriented profiler



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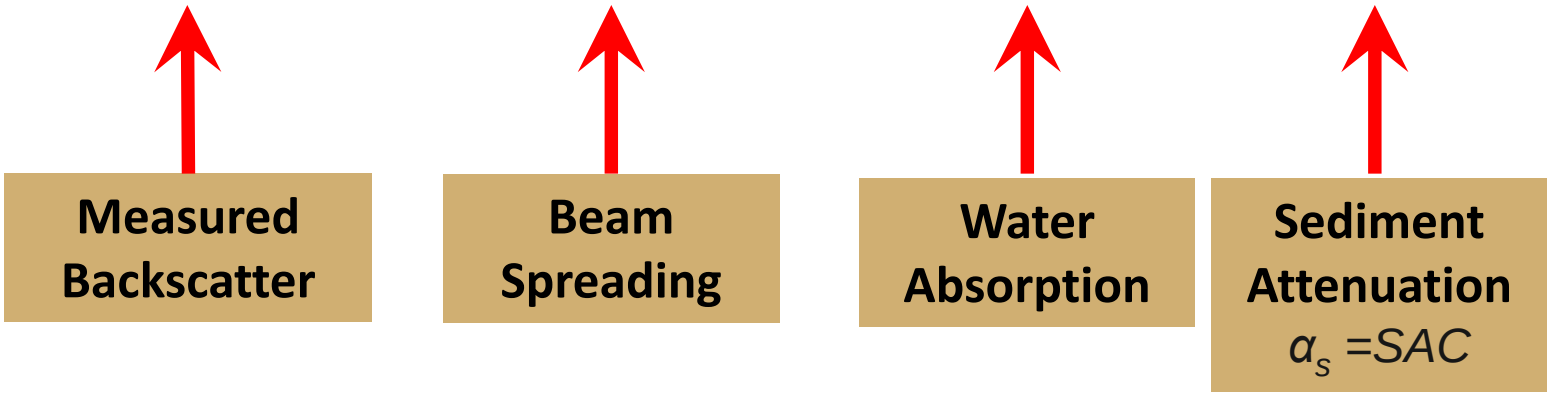
Data Management

$$SCB = MB + 20log_{10}(\psi r) + 2r(\alpha_w) + 2r\alpha_s$$



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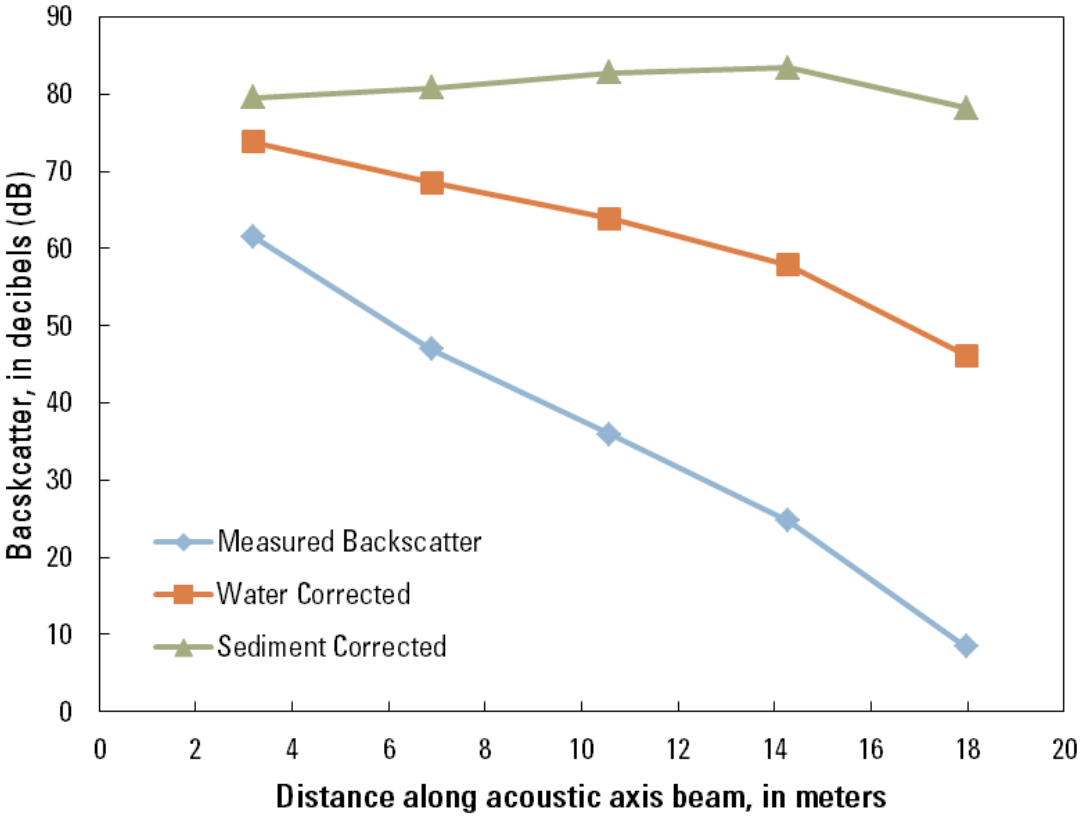
Data Management



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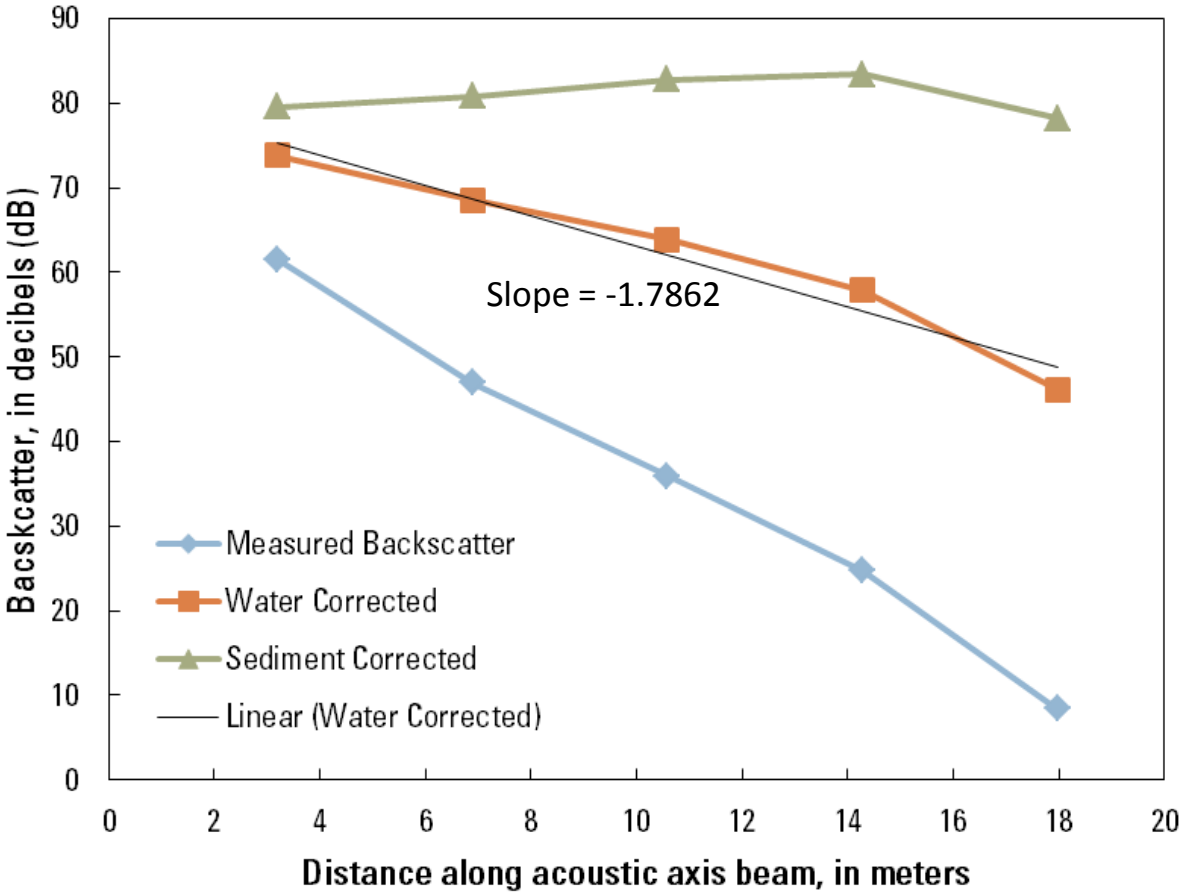
Data Management



Sediment attenuation coefficient: 0.893

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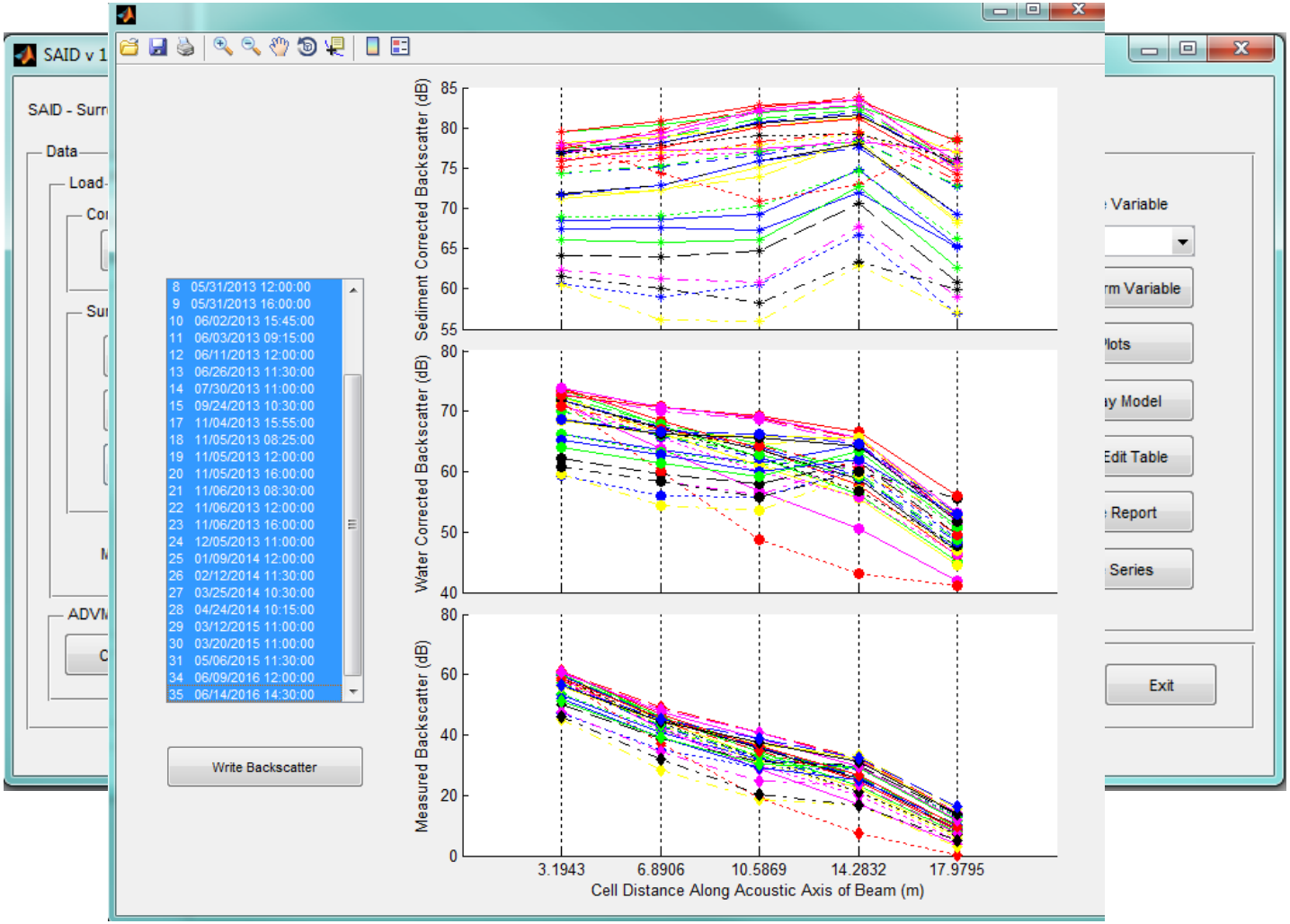
SEDIMENT ACOUSTIC INDEX DEVELOPER TOOL



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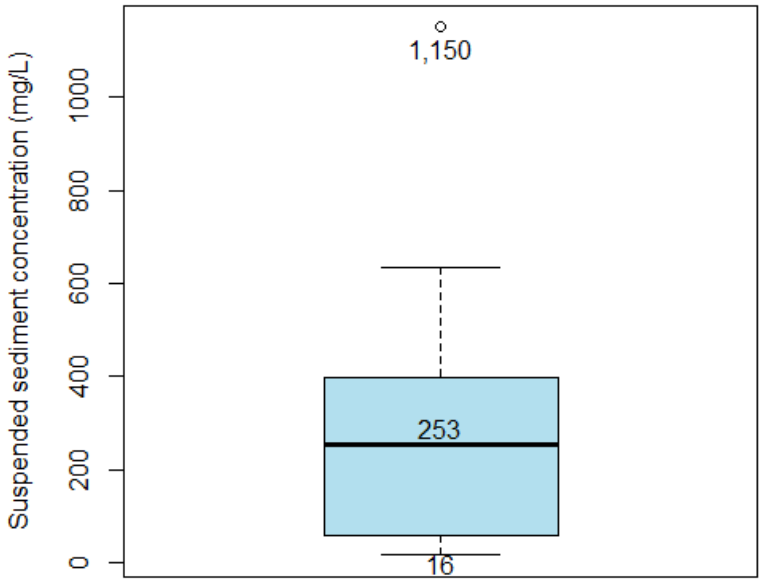
Guadalupe River Preliminary Model

- Calibration date range: **4/29/2013 – 6/14/2016**



- Predictive variables considered:
  - Sediment corrected backscatter
  - Sediment attenuation coefficient
  - Discharge

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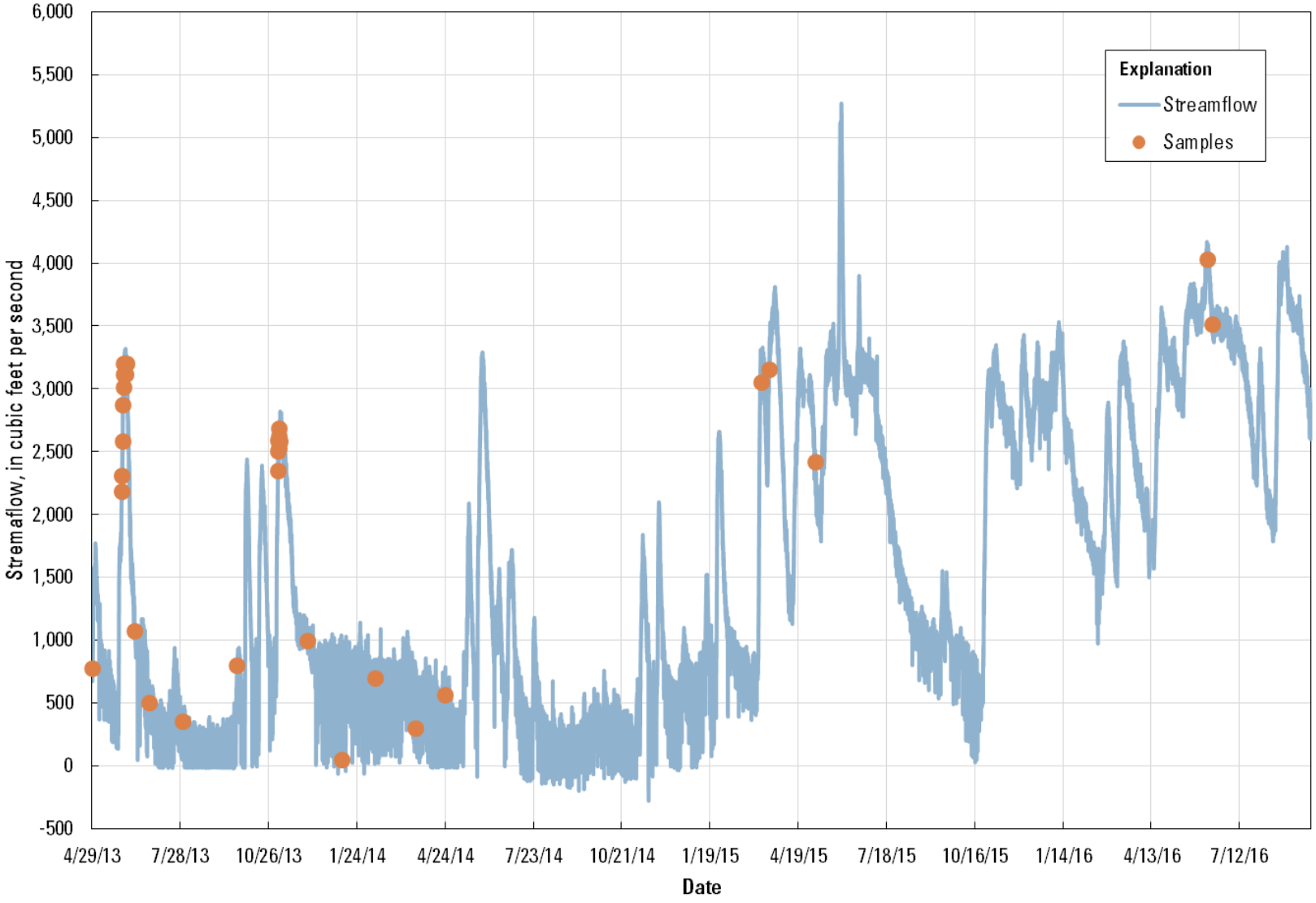
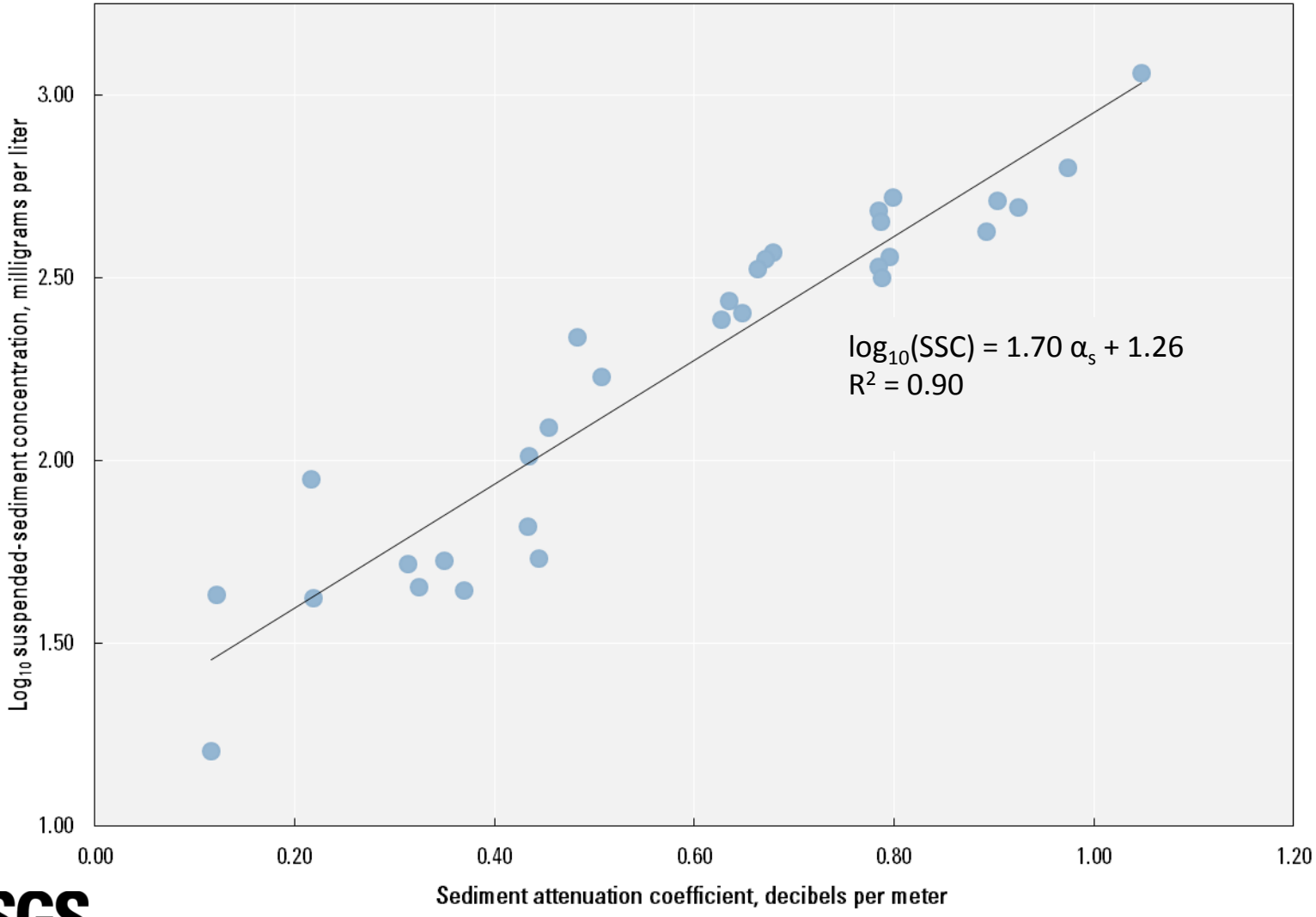

Explanation
Streamflow
Samples
Streamflow, in cubic feet per second
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
-500
4/29/13
7/28/13
10/26/13
1/24/14
4/24/14
7/23/14
10/21/14
1/19/15
4/19/15
7/18/15
10/16/15
1/14/16
4/13/16
7/12/16
Date

Guadalupe River Preliminary Model



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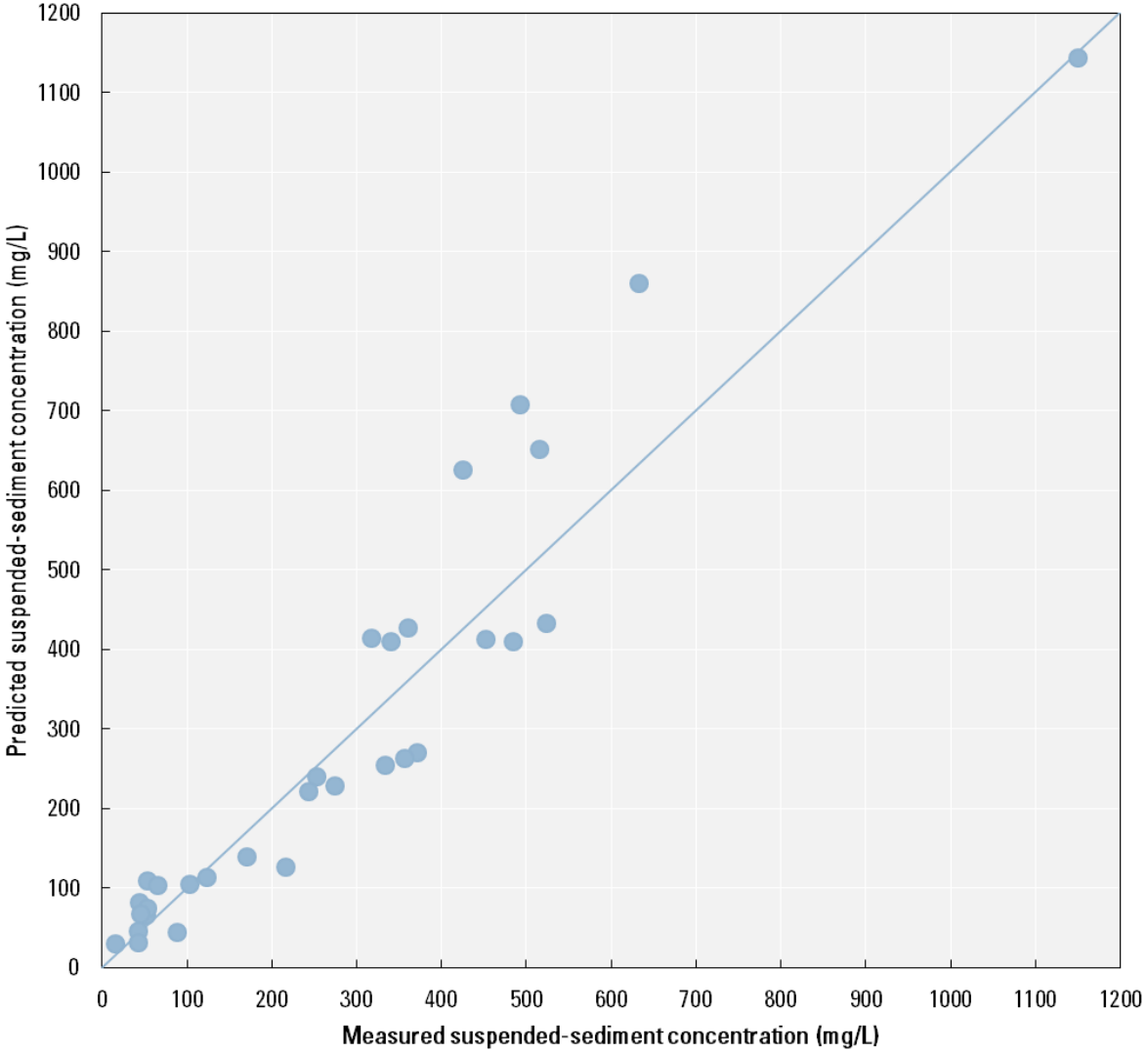
Guadalupe River Preliminary Model



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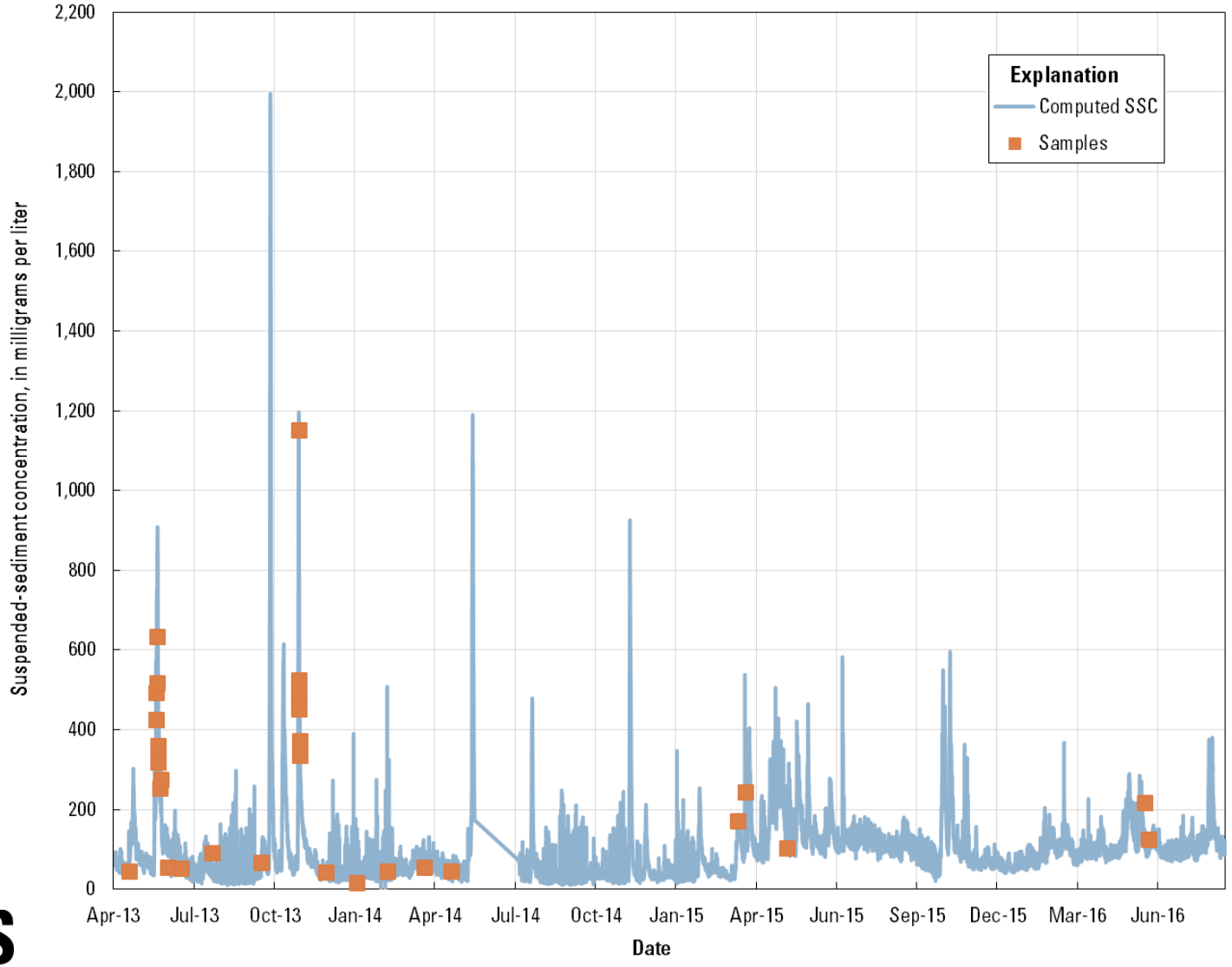
Continuous Suspended-Sediment Data



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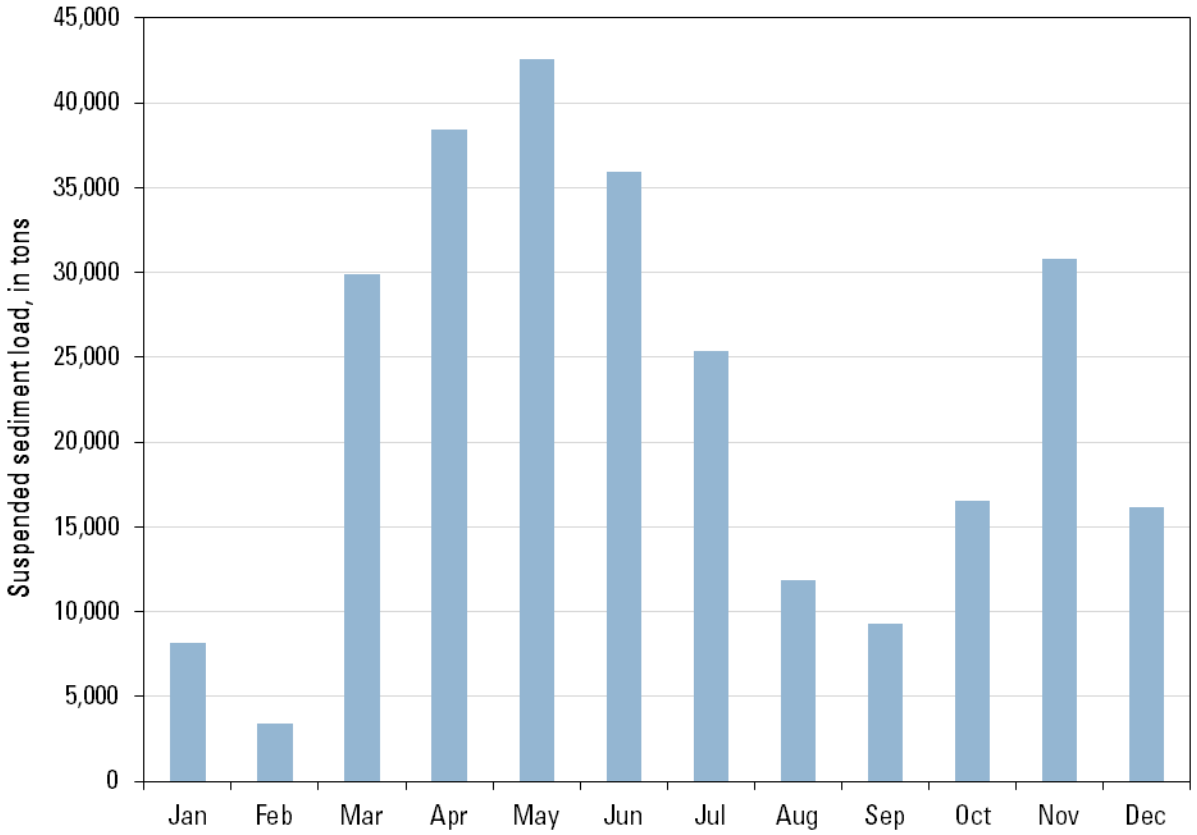
--Preliminary data, subject to revision-

Suspended-Sediment Loading in 2015



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--Preliminary data, subject to revision-

Water-Quality Data

- 3 samples collected in 2016
- 34 since 2013

	Concentration (mg/L)		
	Min.	Median	Max.
Nitrate	0.44	1.14	4.89
Total Nitrogen	1.25	2.09	5.81
Total Phosphorus	0.269	0.537	1.25

--Preliminary data, subject to revision-

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FINDINGS

- Sediment attenuation coefficient, an acoustic backscatter variable, appears to be highly correlated to suspended-sediment concentrations at USGS station 08188810.
- Additional samples are needed to include high suspended-sediment concentrations in calibration and for model verification.

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What's Next?

- Collection of more samples to expand and maintain surrogate model
- Publish real-time suspended-sediment concentration data on the web
- Evaluate potential surrogates for nutrient parameters
- Evaluate historic flow data in in the lower watershed to assess magnitude of unaccounted flow

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