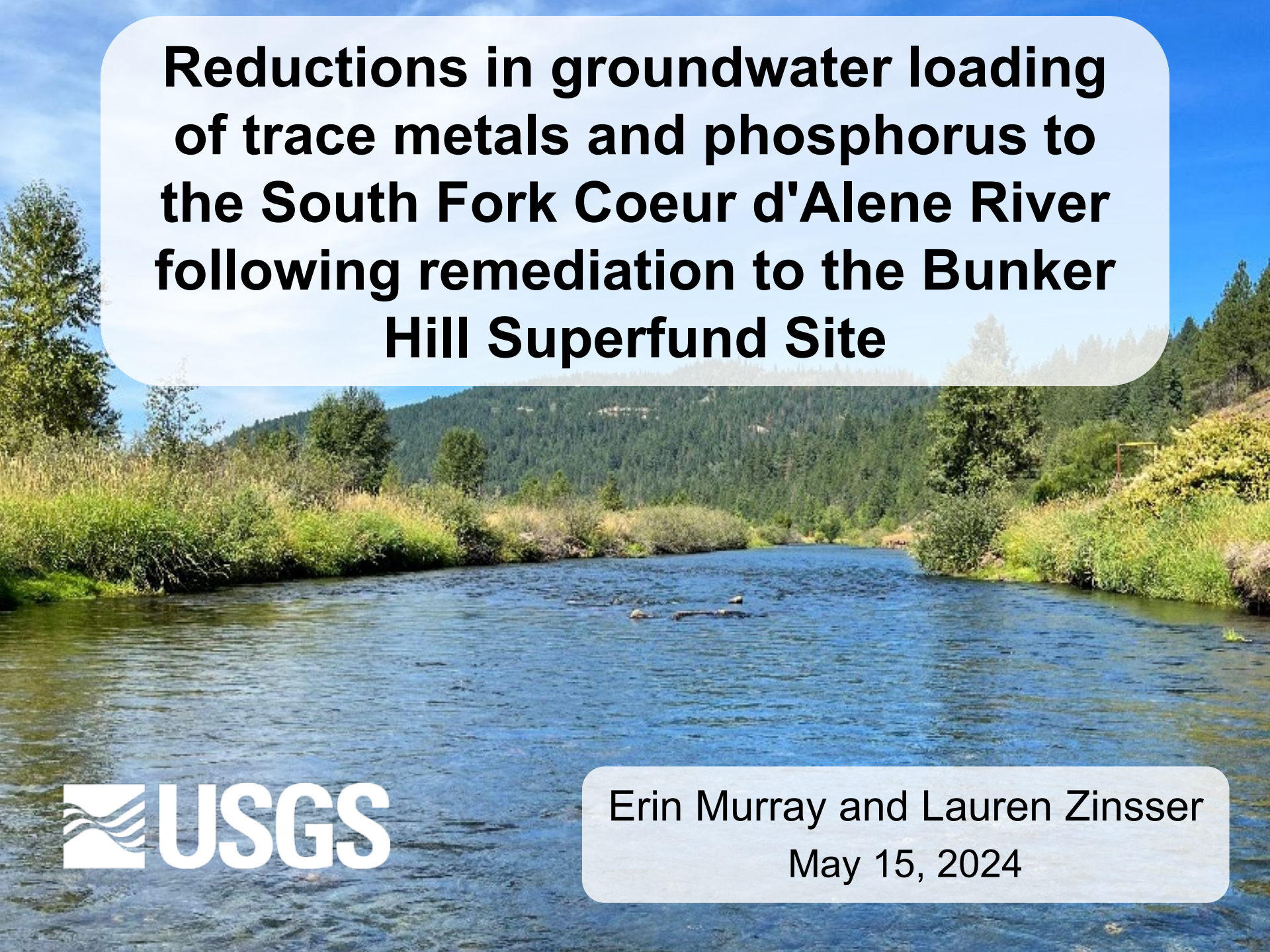
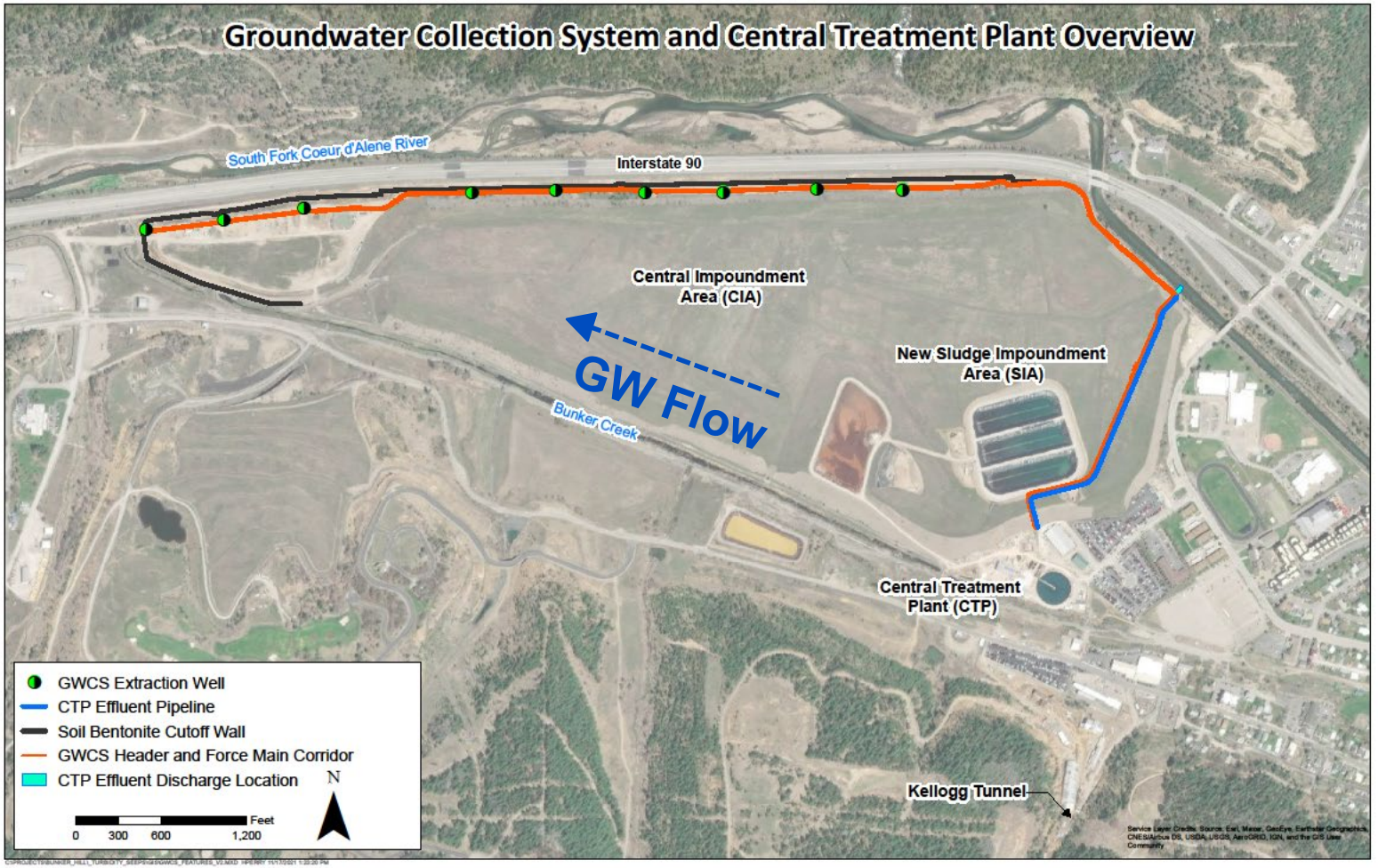
Reductions in groundwater loading of trace metals and phosphorus to the South Fork Coeur d'Alene River following remediation to the Bunker Hill Superfund Site



Erin Murray and Lauren Zinsser

May 15, 2024

Groundwater Remediation 2017-2022



USGS

River Flow

(Base Map from EPA)

Our Goals

- **Measure the groundwater specific input to the South Fork Coeur d'Alene River: flow, concentrations, and loads**
- **Compare to pre-remediation**

2017

(Zinsser, 2019)

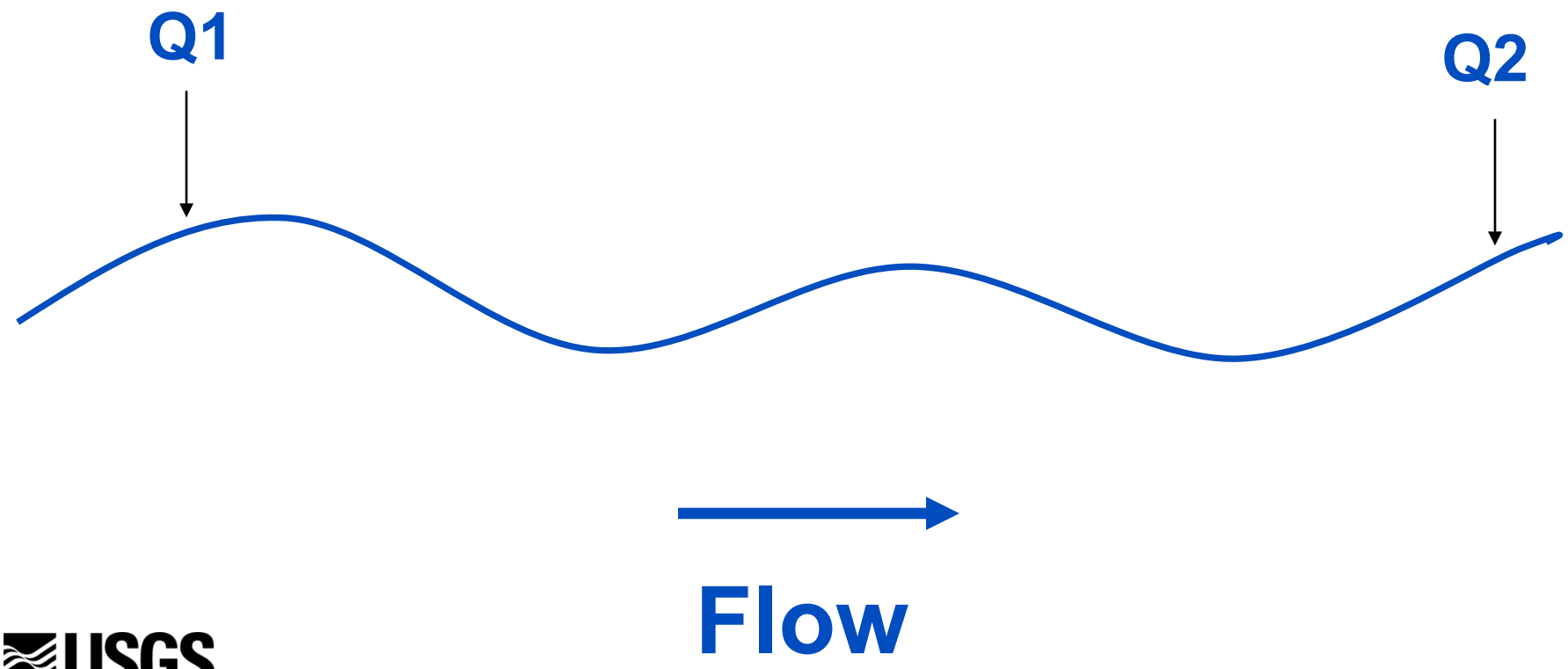
2022

(Murray and Zinsser, 2023)

USGS

What is a seepage study?

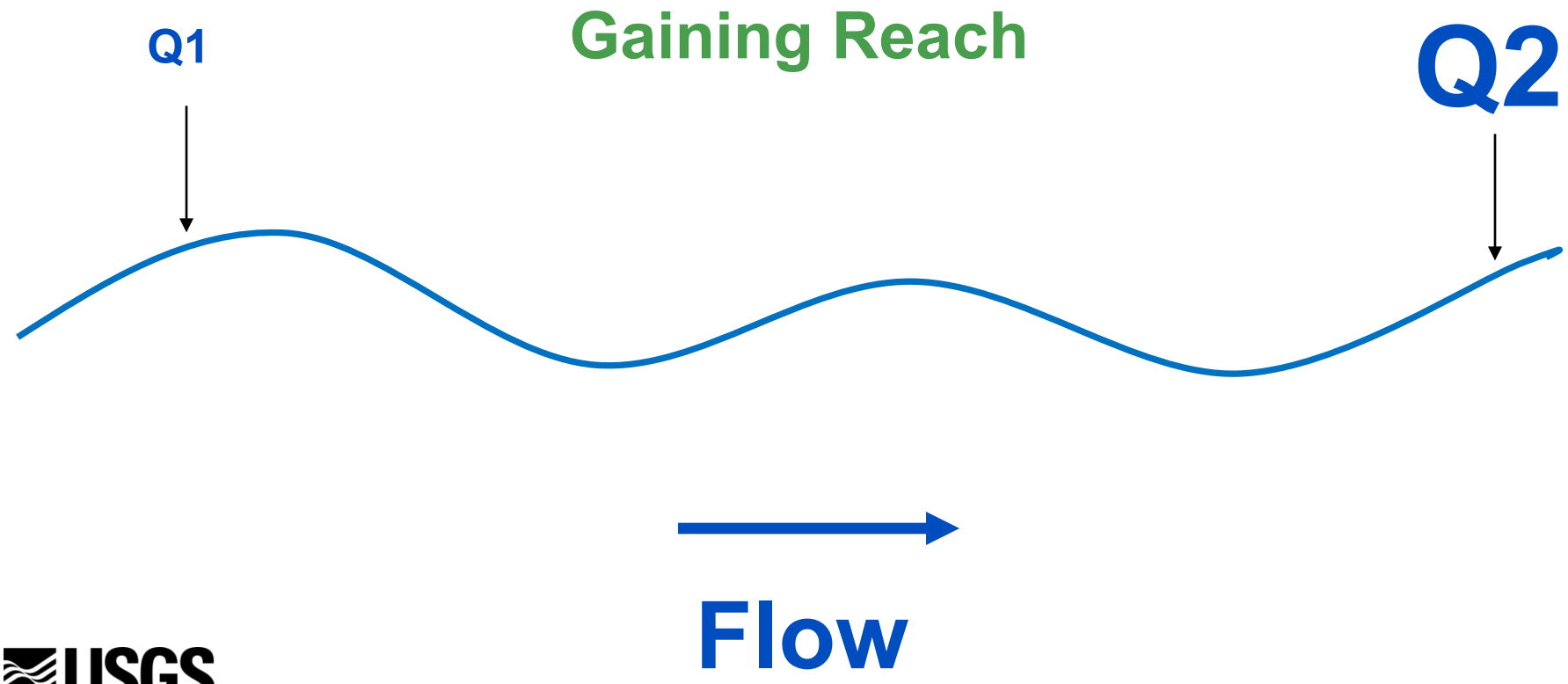
Groundwater = Q2-Q1



USGS

What is a seepage study?

Groundwater = Q2-Q1

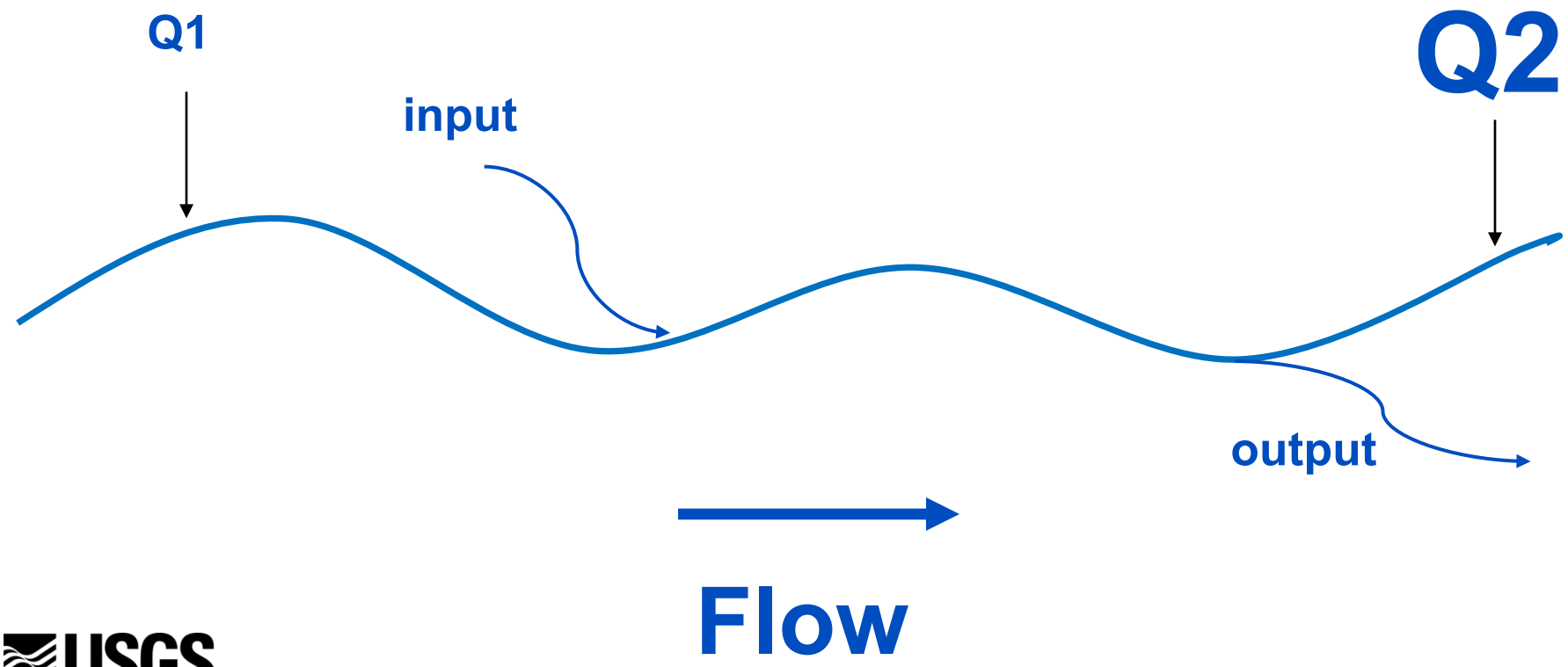


USGS

What is a seepage study?

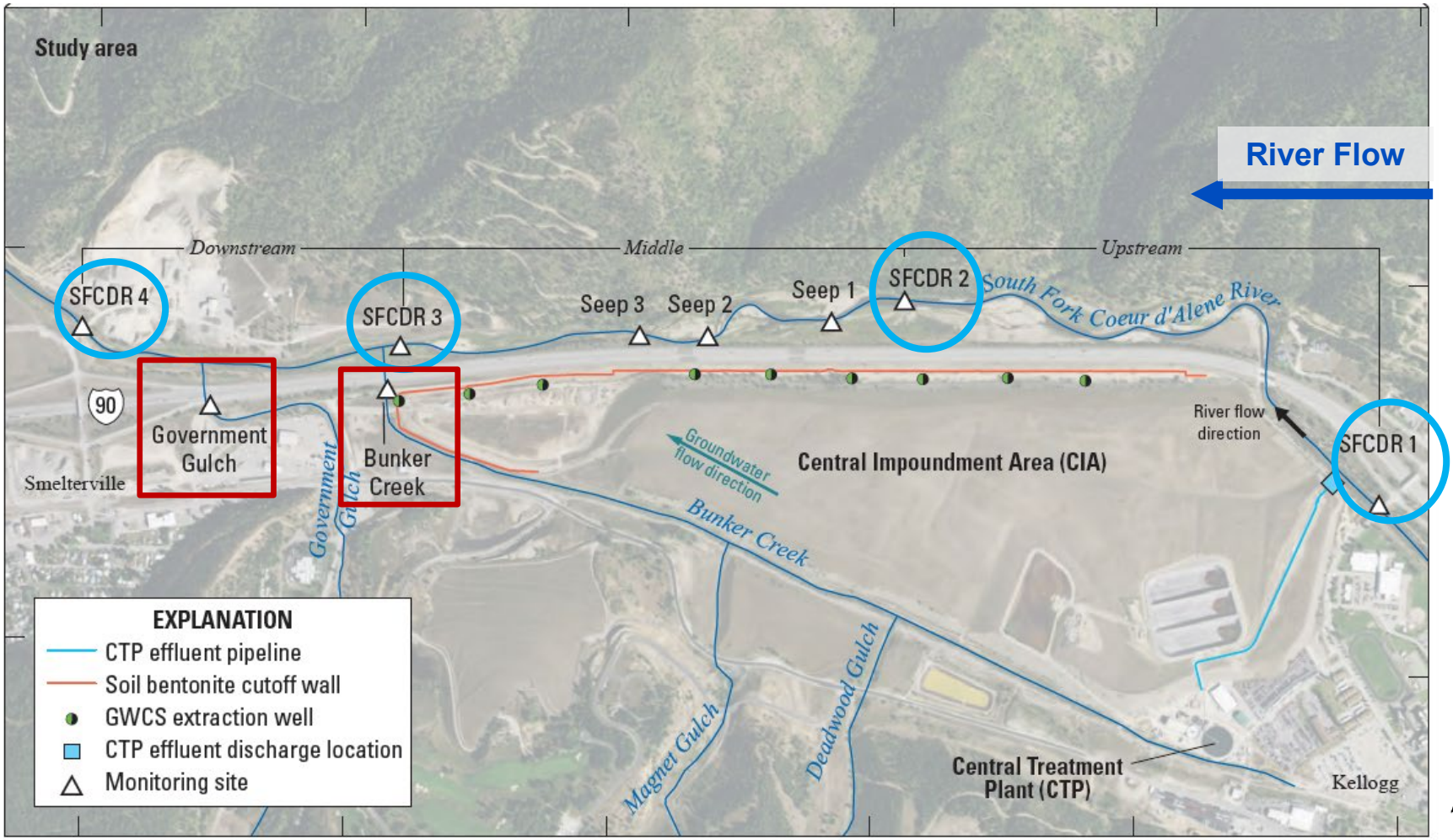
Groundwater* = Q2-Q1-inputs+outputs

*Discharge, Loads



USGS

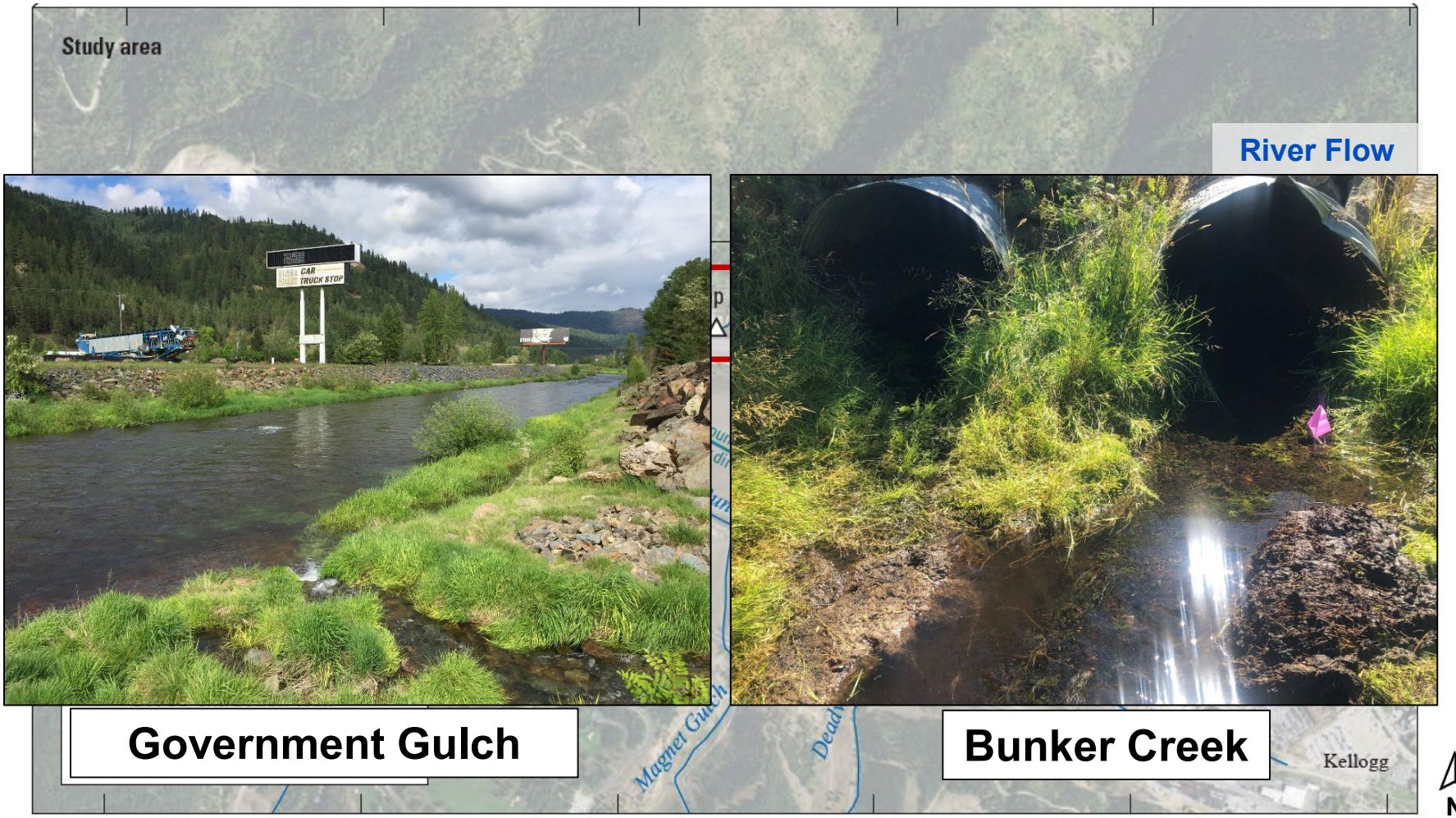
Study Area: 2017 and 2022



Base from U.S. Department of Agriculture National Agricultural Imagery Program, 2019; Idaho Transverse Mercator coordinate system; North American Datum of 1983

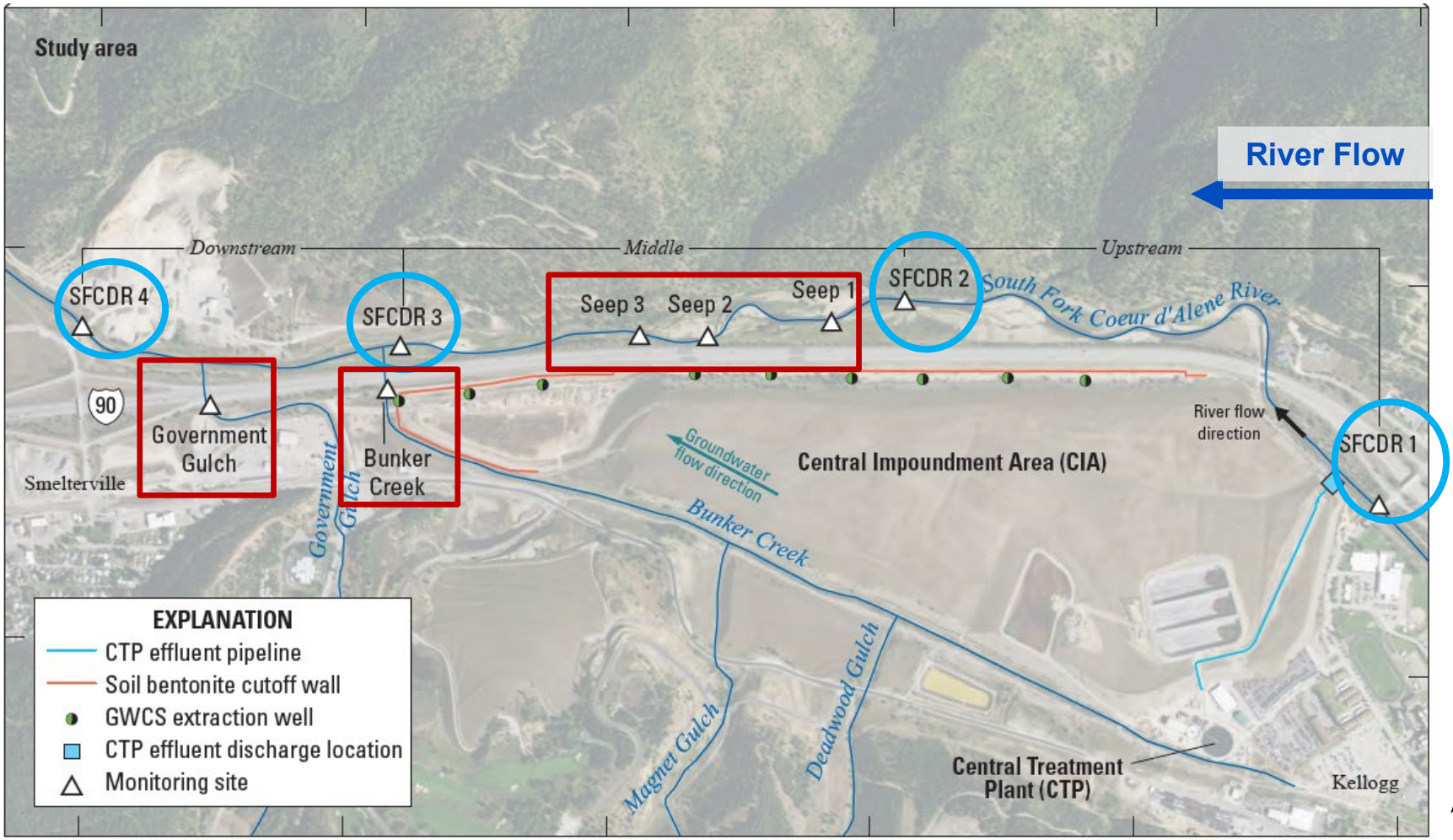
USGS

Study Area: 2017 and 2022



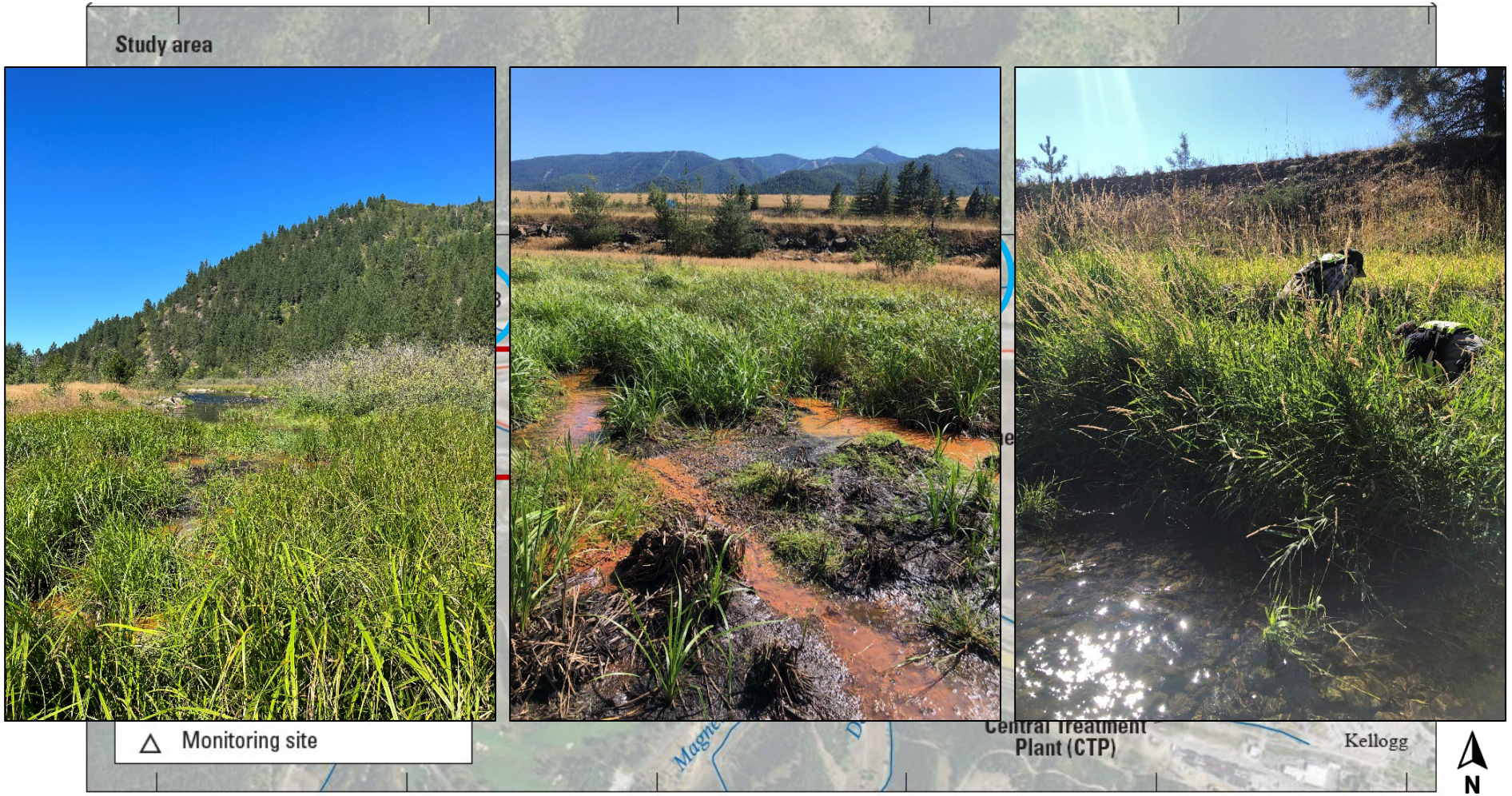
USGS

Study Area: 2017 and 2022



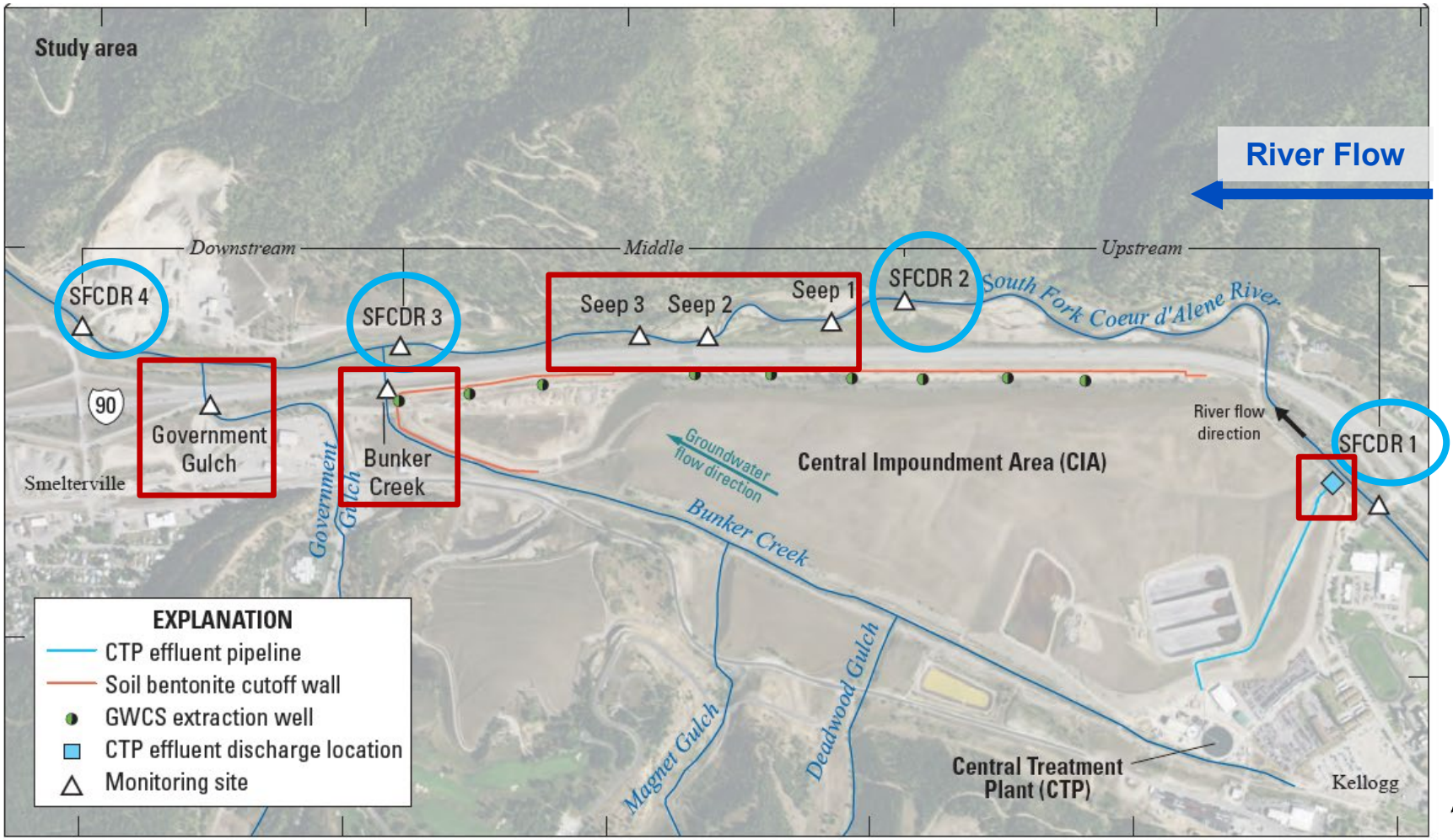
USGS

Study Area: 2017 and 2022



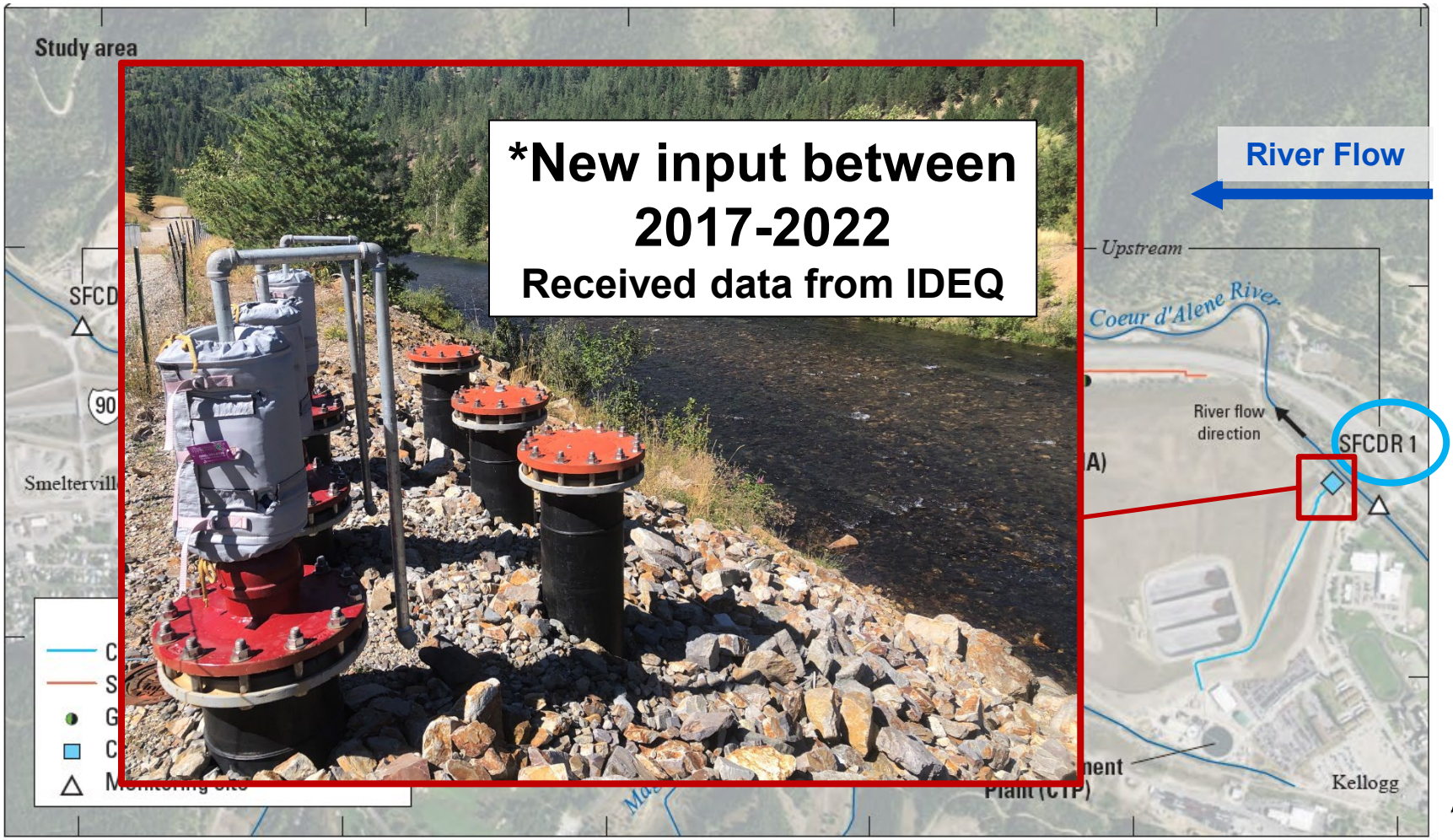
USGS

Methods



USGS

Methods



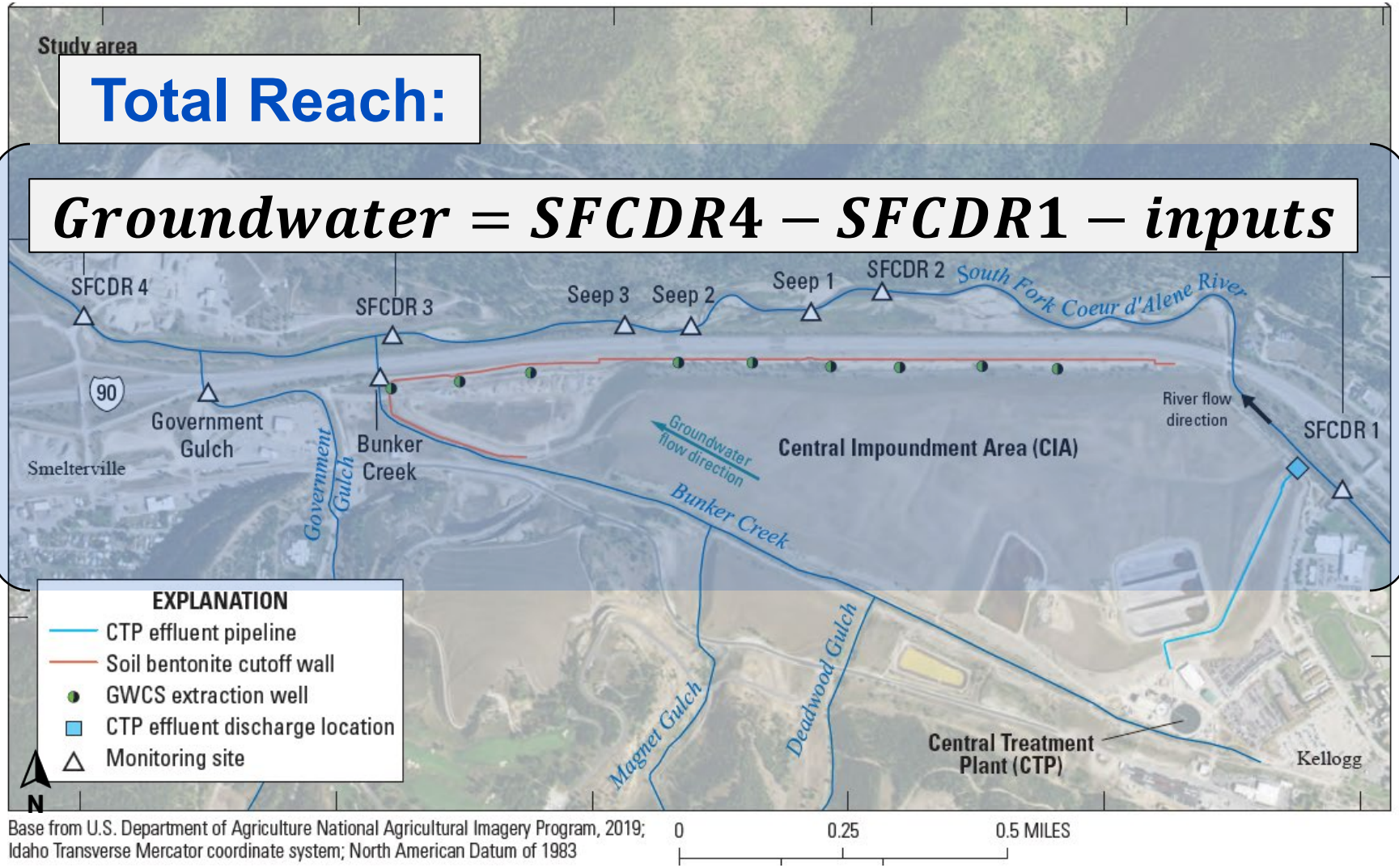
USGS

Methods

- **Baseflow (Aug 30-31, 2022)**
- **Measured**
  - Flow (Q)
  - Concentrations (C)
    - Zinc, Cadmium, Phosphorus
- **Calculated**
  - Loads (Q x C)
  - Groundwater gains/losses

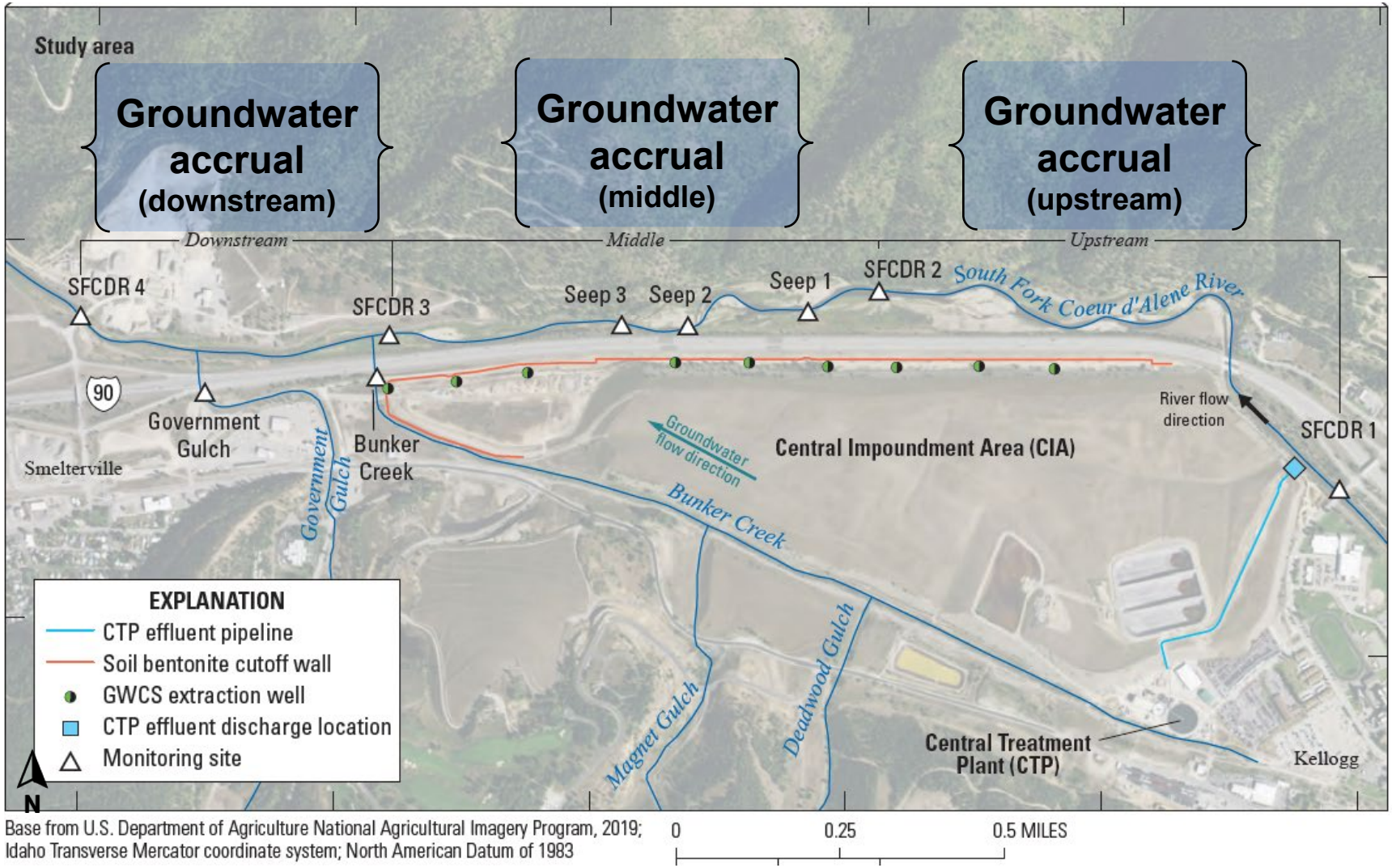
USGS

Methods



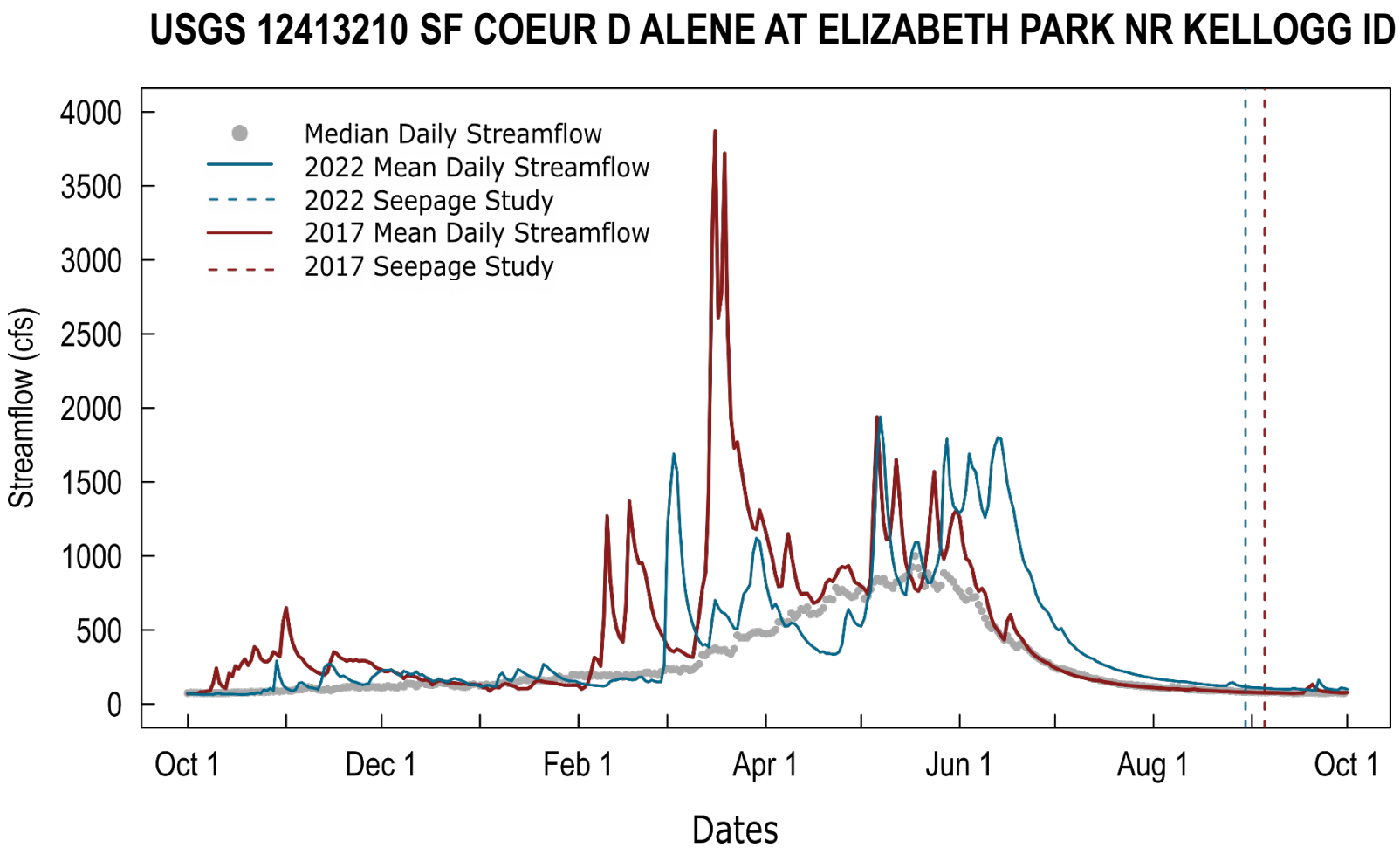
USGS

Methods



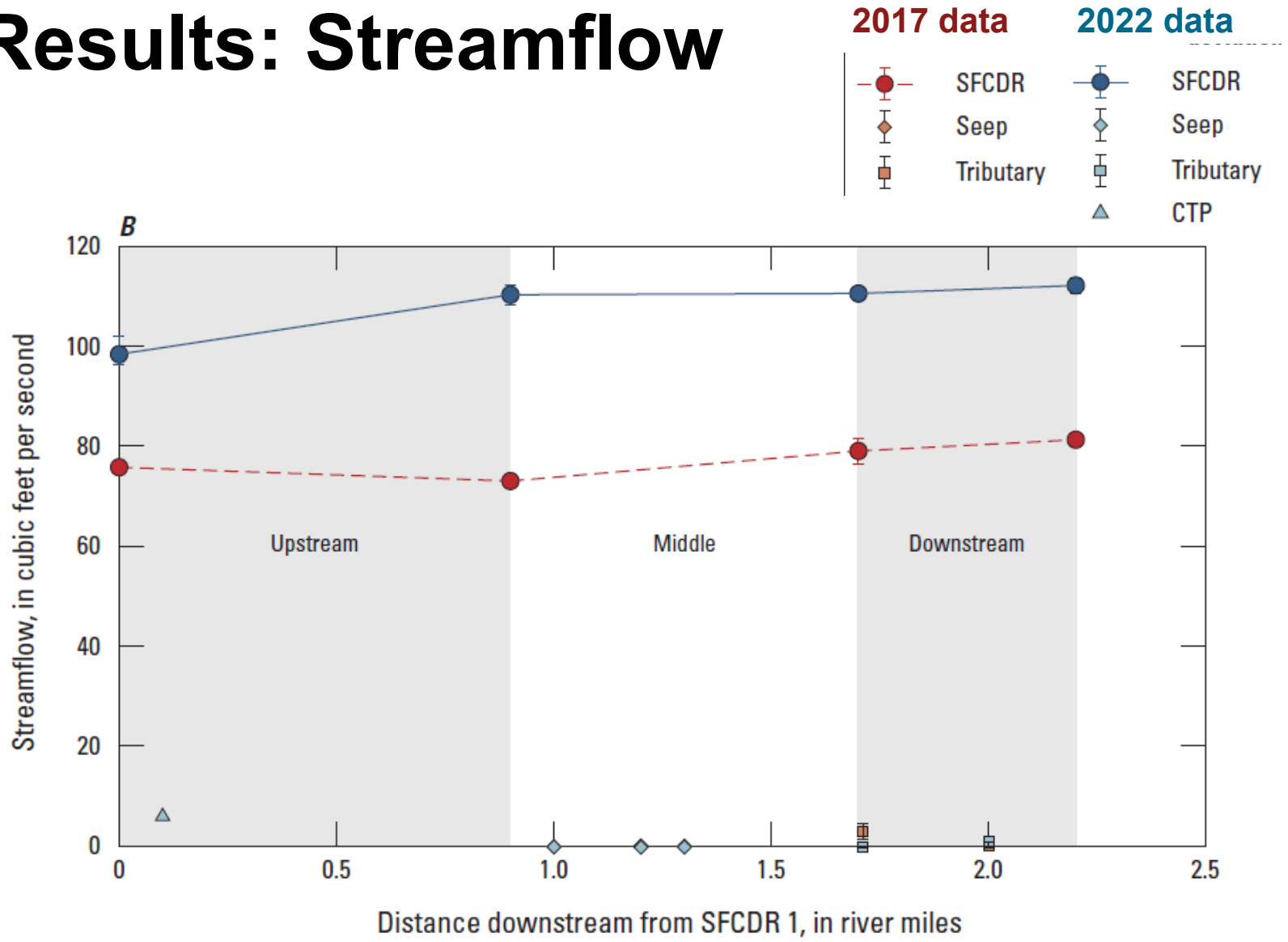
USGS

Water Year Summary



USGS

Results: Streamflow

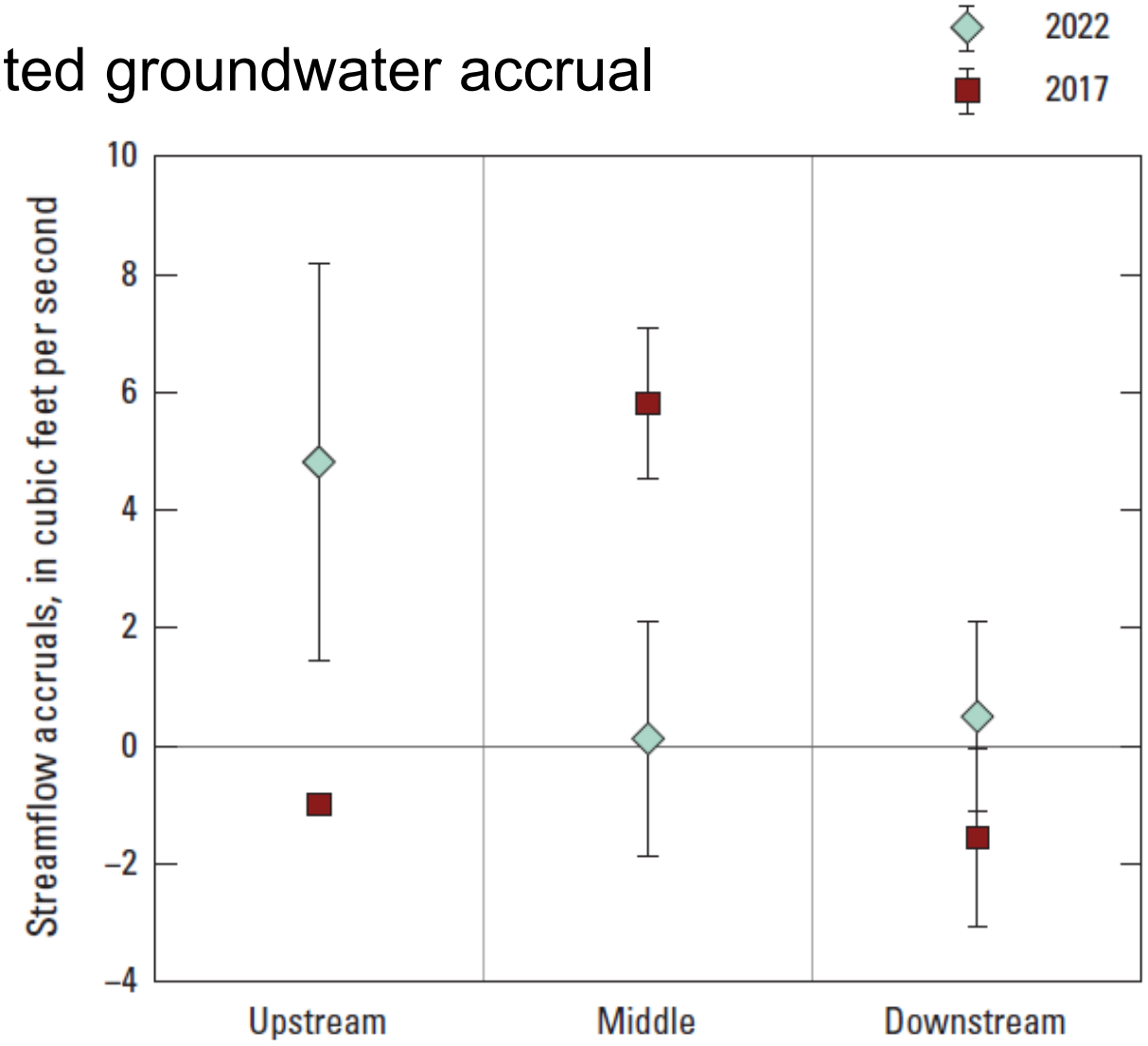


USGS

(Murray and Zinsser, 2023)

Results: Streamflow

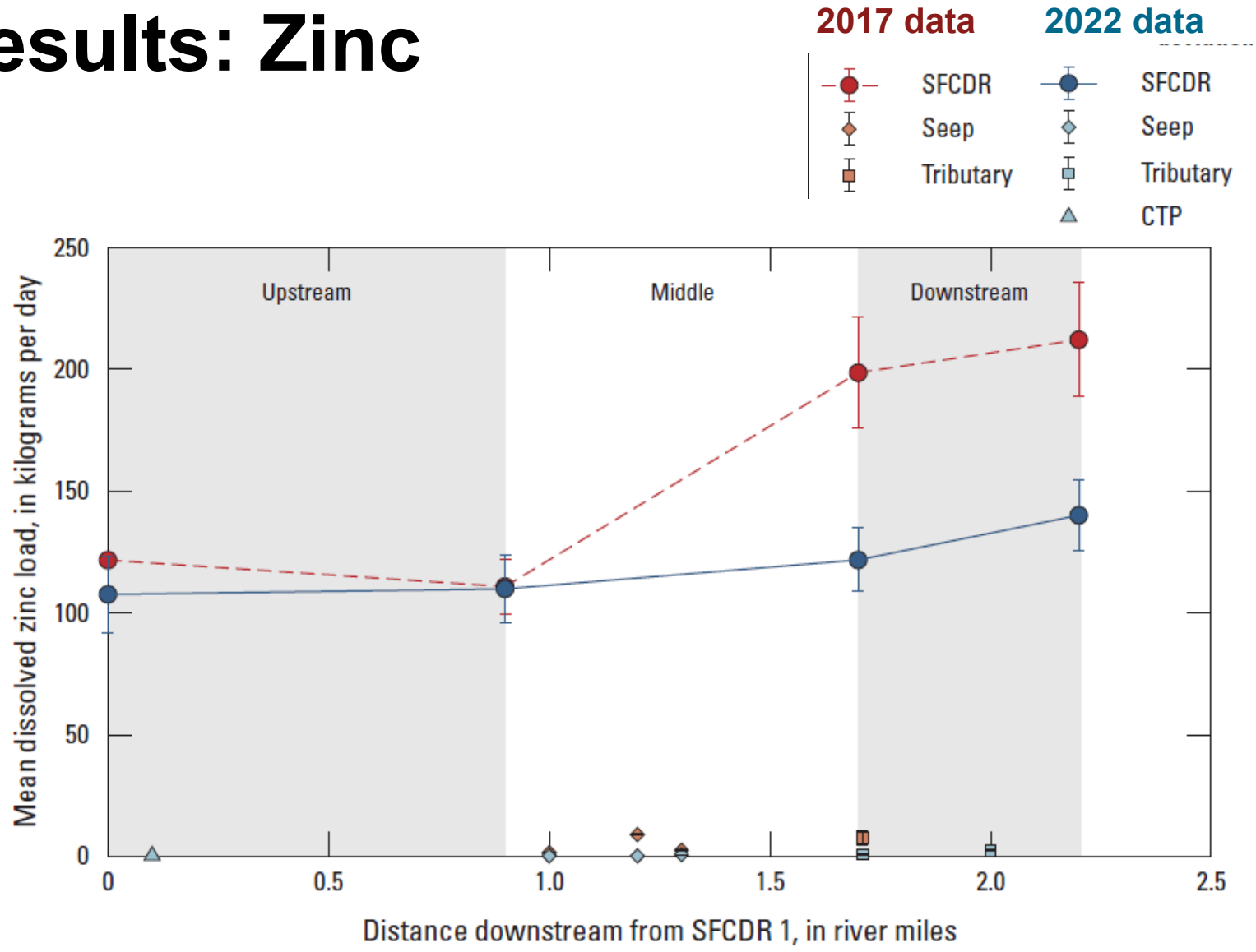
Calculated groundwater accrual



USGS

(Murray and Zinsser, 2023)

Results: Zinc

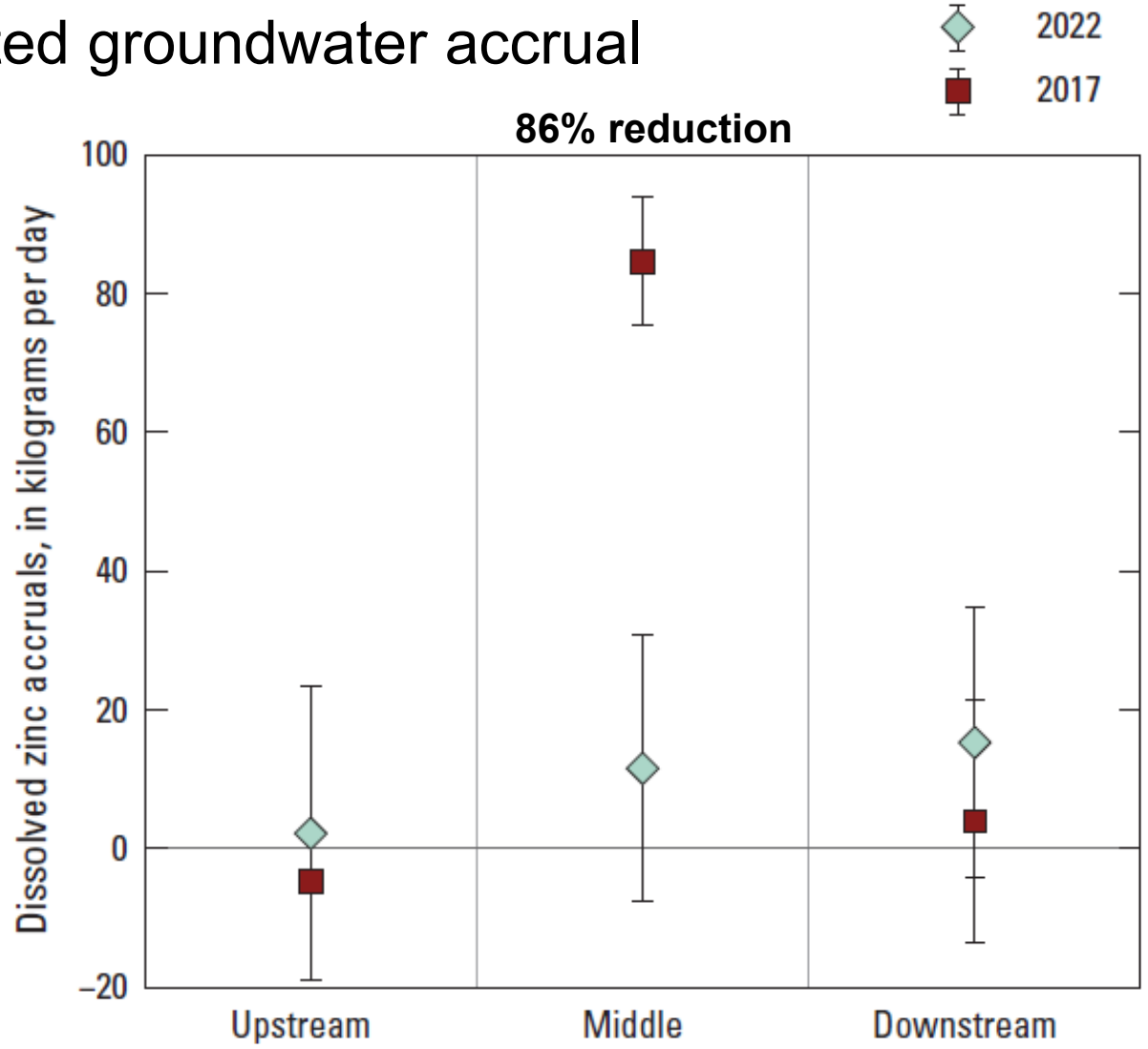


USGS

(Murray and Zinsser, 2023)

Results: Zinc

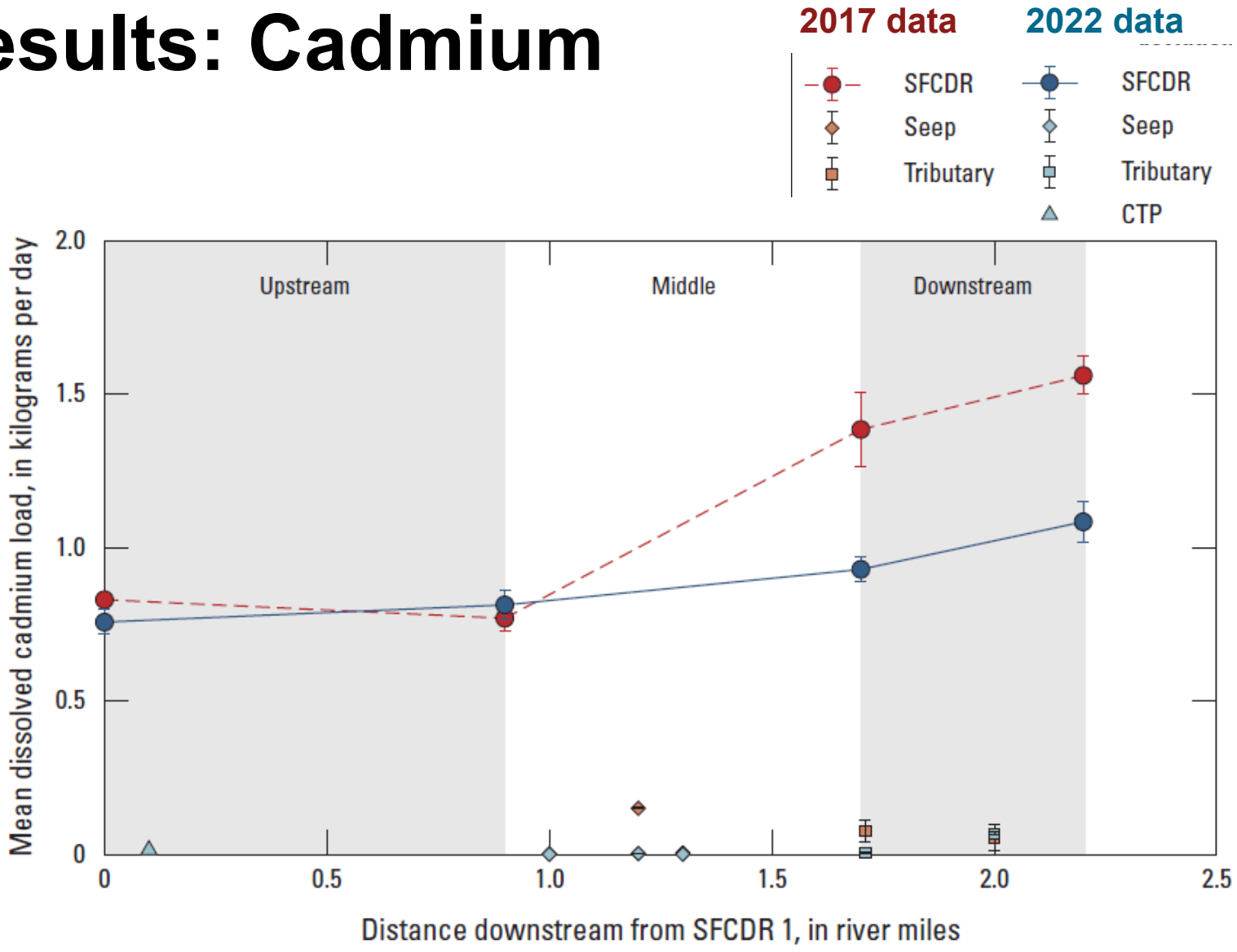
Calculated groundwater accrual



USGS

(Murray and Zinsser, 2023)

Results: Cadmium

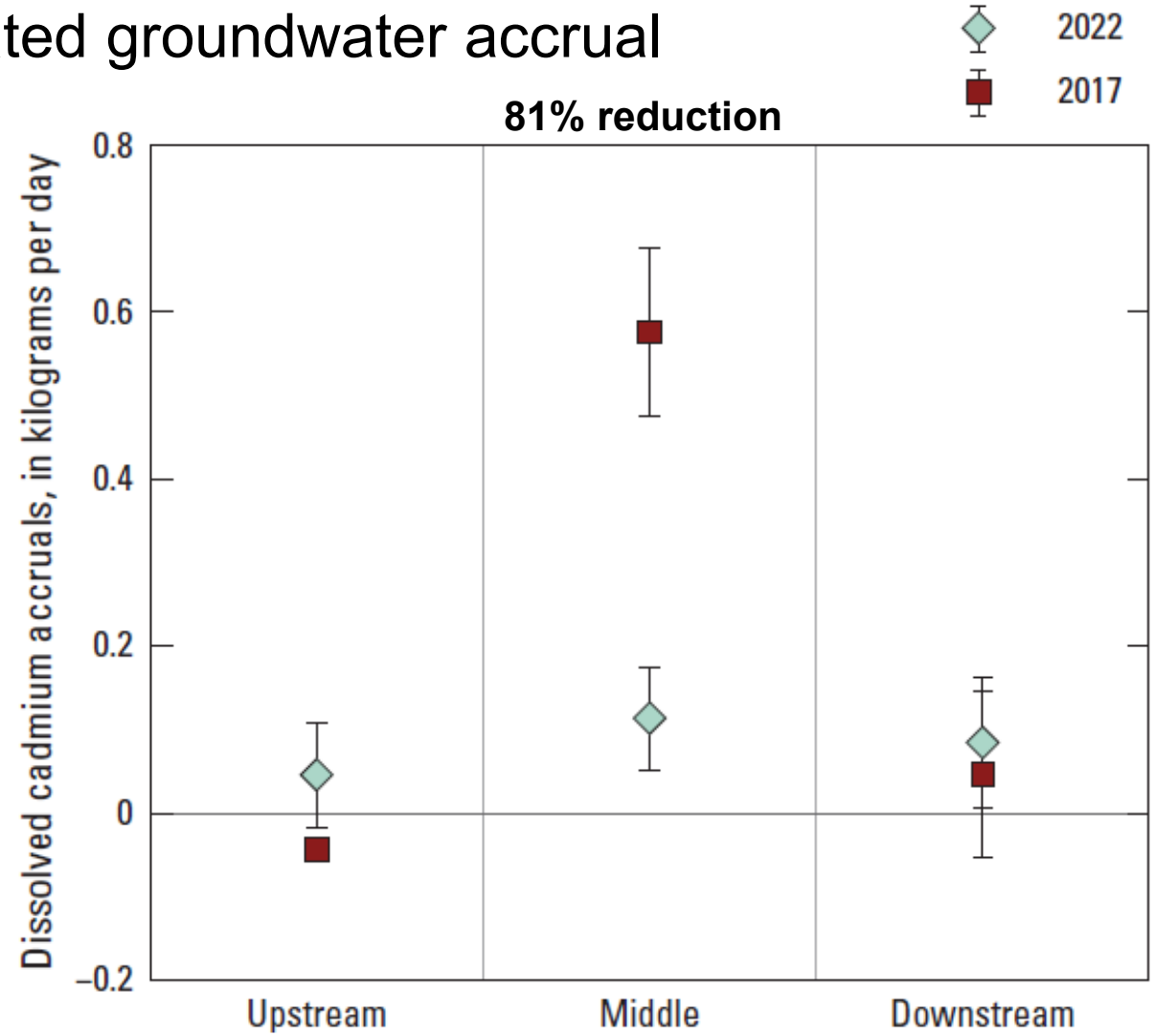


USGS

(Murray and Zinsser, 2023)

Results: Cadmium

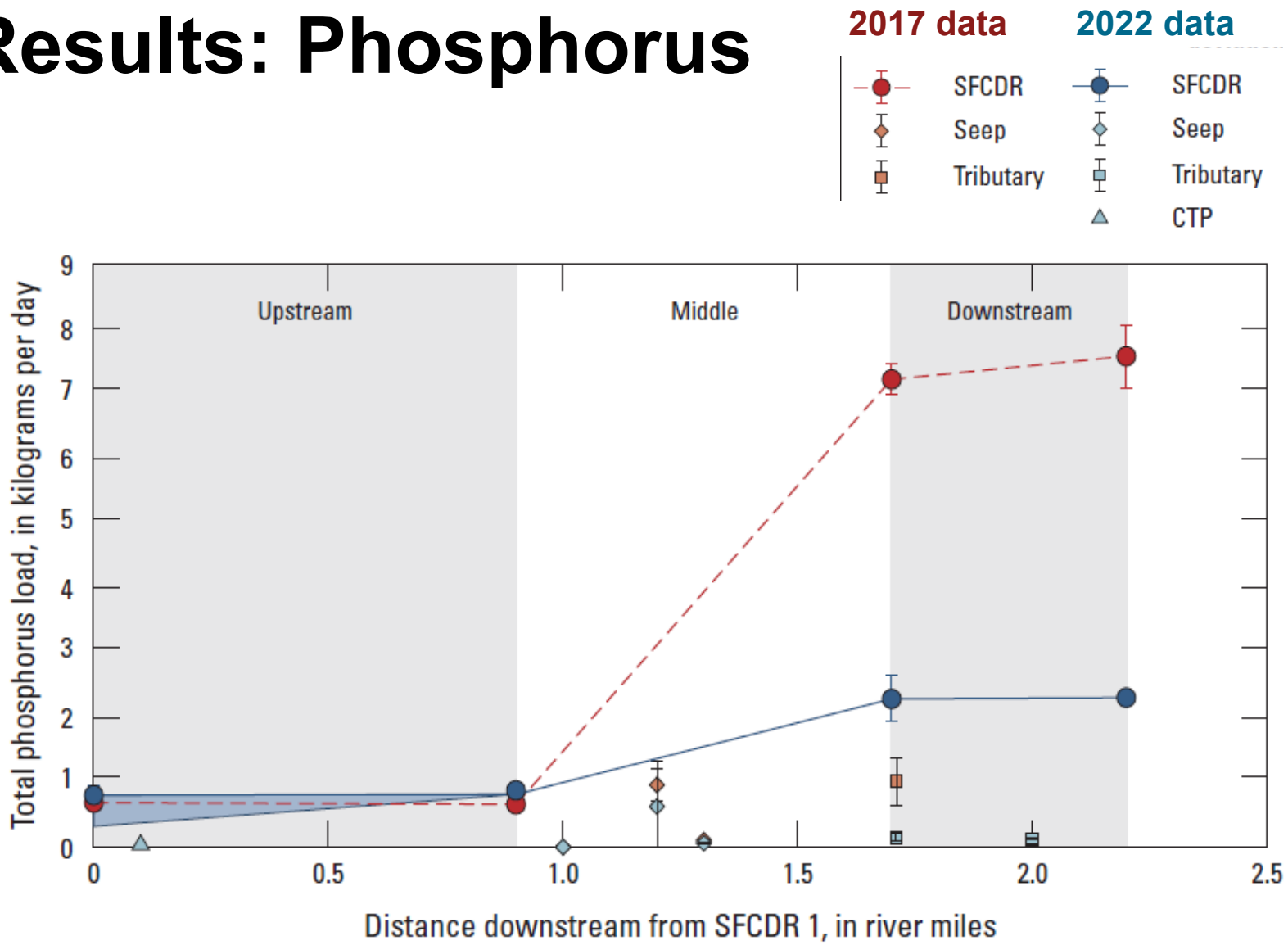
Calculated groundwater accrual



USGS

(Murray and Zinsser, 2023)

Results: Phosphorus

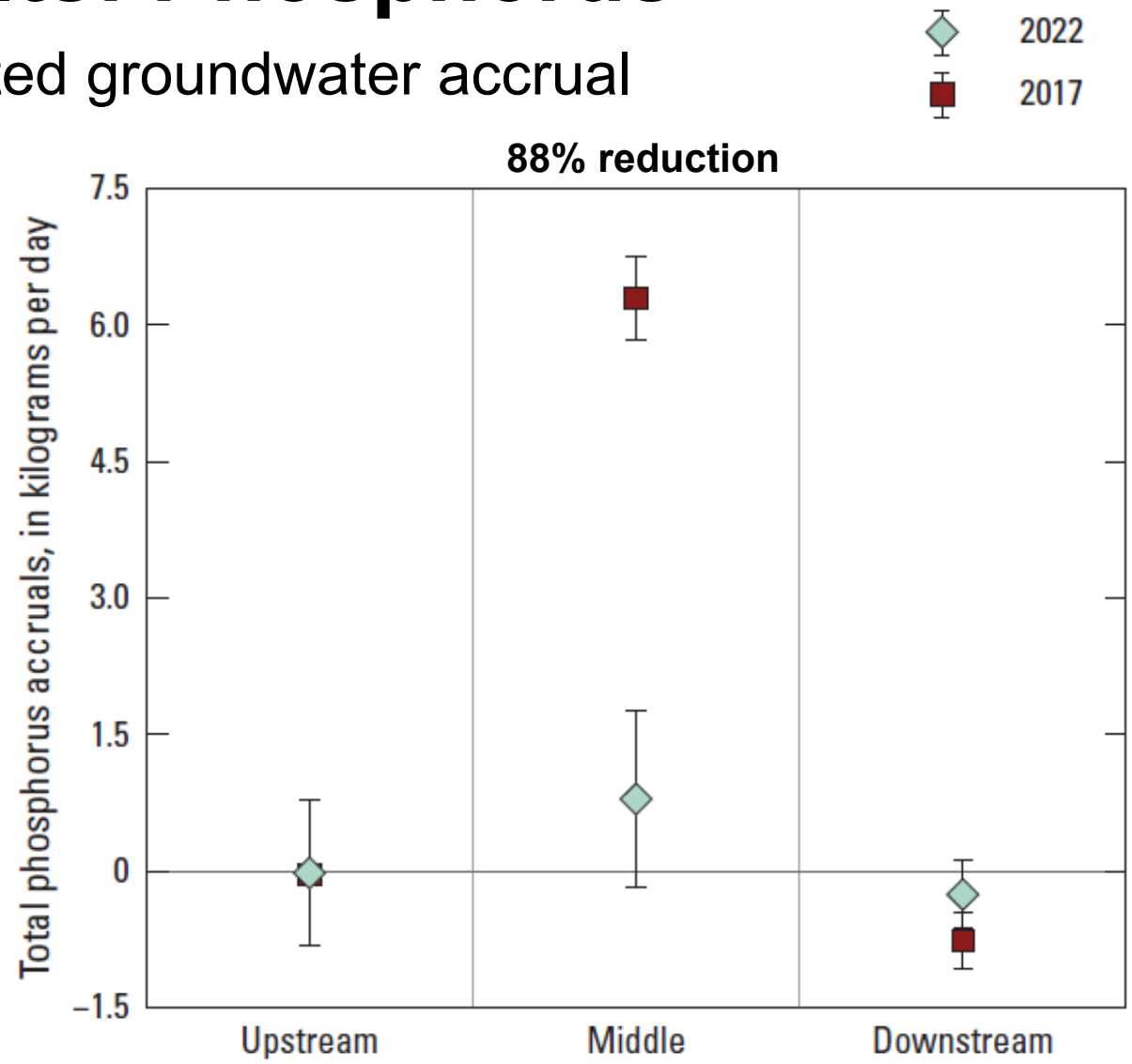


USGS

(Murray and Zinsser, 2023)

Results: Phosphorus

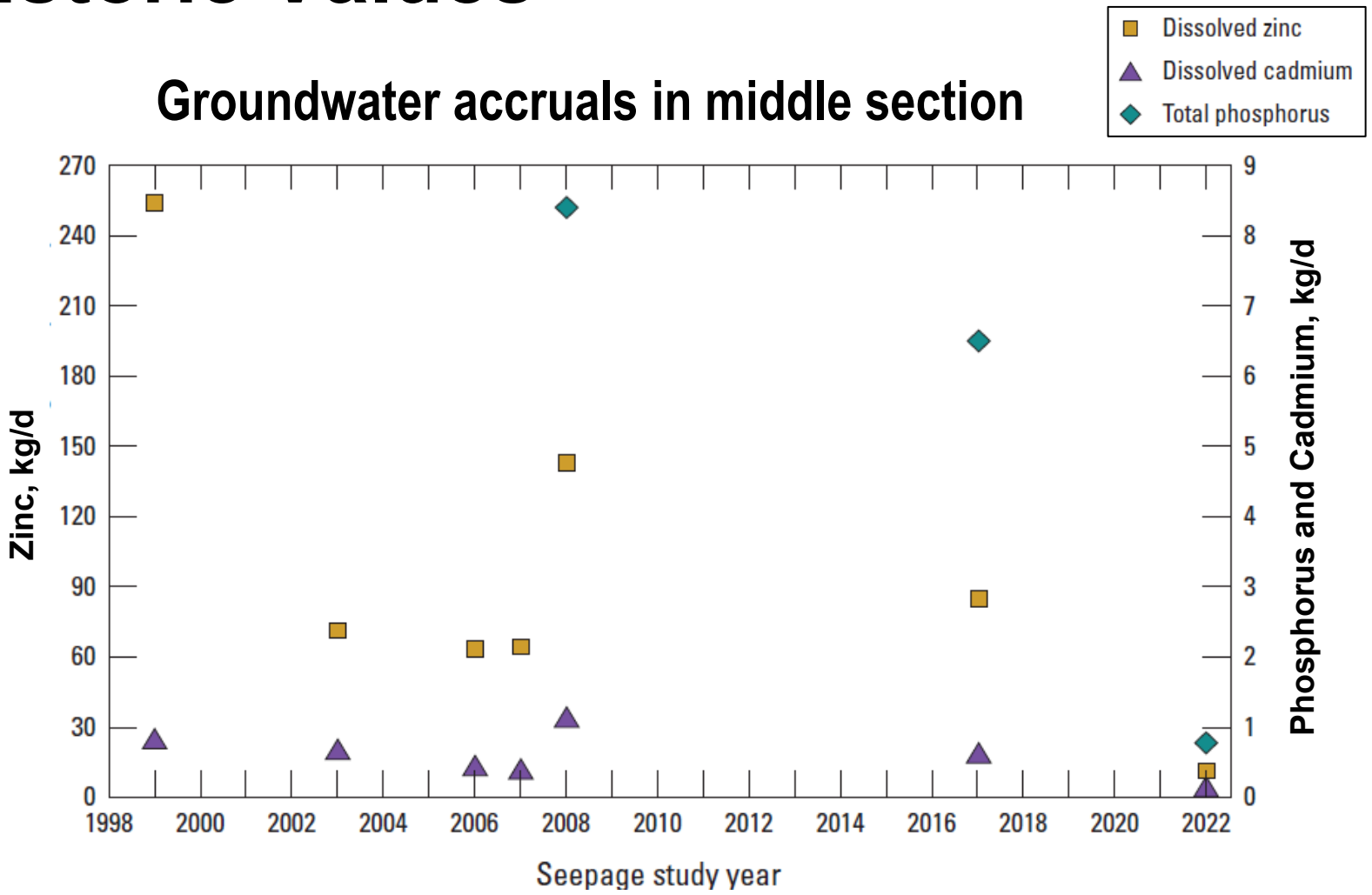
Calculated groundwater accrual



USGS

(Murray and Zinsser, 2023)

Historic Values



USGS: 1999, 2017, 2022
CH2M: 2003, 2006, 2007, 2008

(Murray and Zinsser, 2023)

Field Observations

USGS

Field Observations

USGS

Conclusions

- Success Story!
- Groundwater input of Zinc, Cadmium, and Phosphorus decreased 2017-2022
- Final load value at farthest downstream site decreased 2017-2022; lower trace metal and nutrient load to Coeur d'Alene River & Lake

USGS

Acknowledgements

- **USGS Upper Columbia Field Office:**

  Kevin Kirlin, Nick Korzen, Niko Parish, Keith Hein, Derek Kondratowicz, and Mike Michelotti
- **Coauthor Lauren Zinsser, USGS**
- **Funding from EPA**

USGS


USGS
Questions?

Reductions in middle section

- **Dissolved zinc from 85 ± 9.3 kilograms per day (kg/d) in 2017 to 11.6 ± 19.2 kg/d in 2022 (86-percent reduction),**
- **dissolved cadmium decreased from 0.59 ± 0.10 kg/d in 2017 to 0.11 ± 0.06 kg/d in 2022 (81-percent reduction), and**
- **total phosphorus decreased from 6.5 ± 0.45 kg/d in 2017 to 0.79 ± 0.97 kg/d in 2022 (88-percent reduction).**

USGS