

RMP SPLWG Meeting

May 15, 2026

“Bay SPL since 1998”



Item 1: Introductions and Meeting Goals



Zoom Stuff

1. This meeting is being recorded and AI transcribed
2. Update your name and add your affiliation
3. Raise your hand if you have a comment or question
4. Unmute yourself and turn on video when you are speaking
5. Use the chat function if you have a **secondary** comment, question, or technical issue



In-Person Attendees

1. Mute your microphone and the volume on your laptop
2. Turn off your camera
3. Silence cell phone
4. Keep side conversations to a minimum, new SFEI mic system is very sensitive
5. We assume consent to photograph the event and attendees and use the photos for our website and newsletter unless you inform us otherwise

Guidelines for Inclusive Conversations

1. Try it on
2. Practice self focus
3. Understand the difference between intent and impact
4. Practice both / and
5. Refrain from blaming or shaming self and others
6. **Move up / move back**
7. Practice mindful listening
8. Right to pass
9. Avoid jargon
10. It's okay to disagree

Workgroup Guidelines

- Advisors first
- Hear from all/many participants
- Be mindful of the clock

We acknowledge that the San Francisco Bay Area is the ancestral homeland of many indigenous people, including the Ohlone, Patwin, Coast Miwok, and Bay Miwok



Regional Monitoring Program for Water Quality in San Francisco Bay

Collect data and communicate information about water quality in San Francisco Bay in support of management decisions

~ 68 participants in the Program

- Municipal wastewater
- Industrial wastewater
- Municipal stormwater
- Dredgers



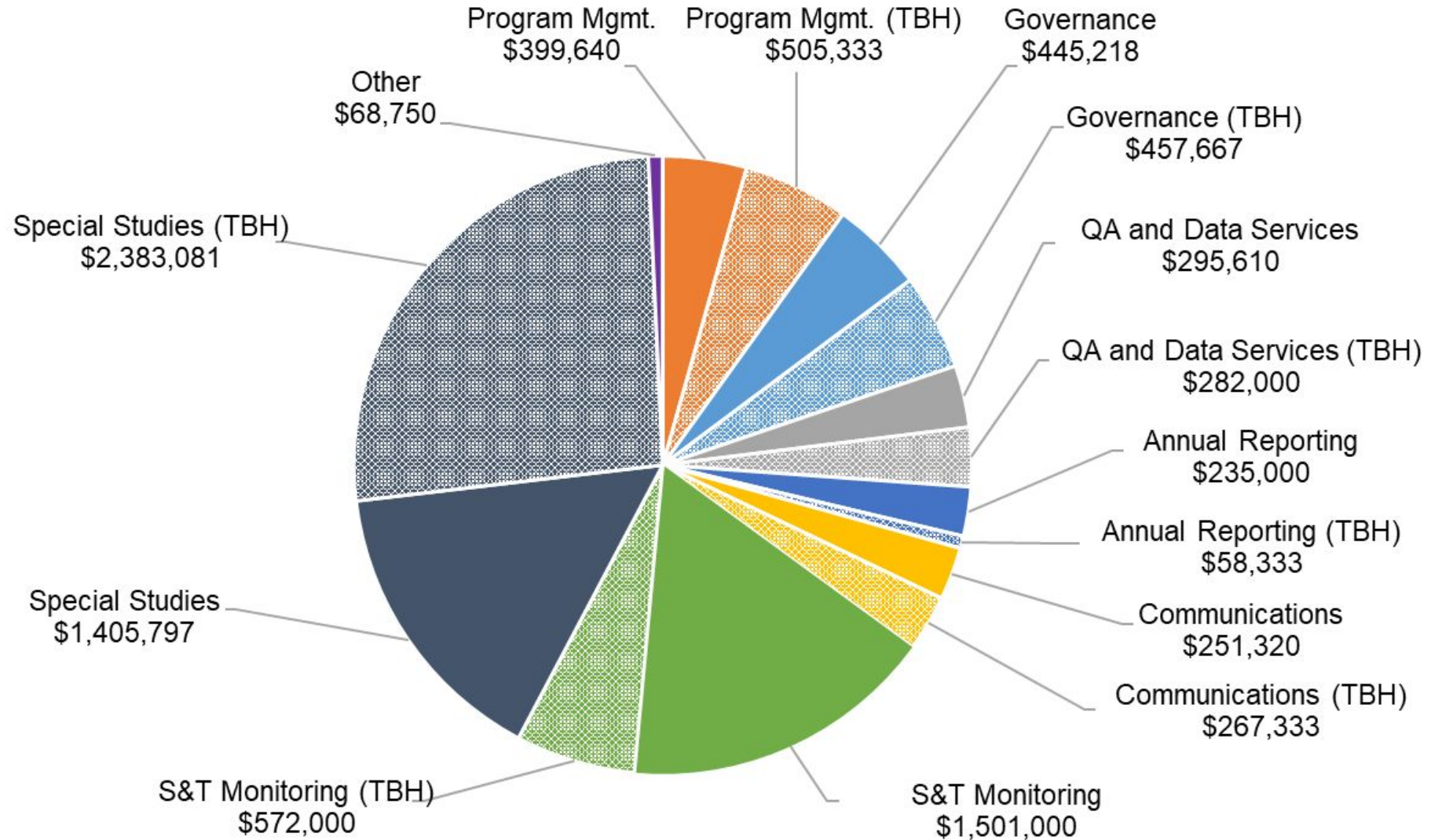
2026 Budget:
\$9.2M

\$3.8M for Special
Studies

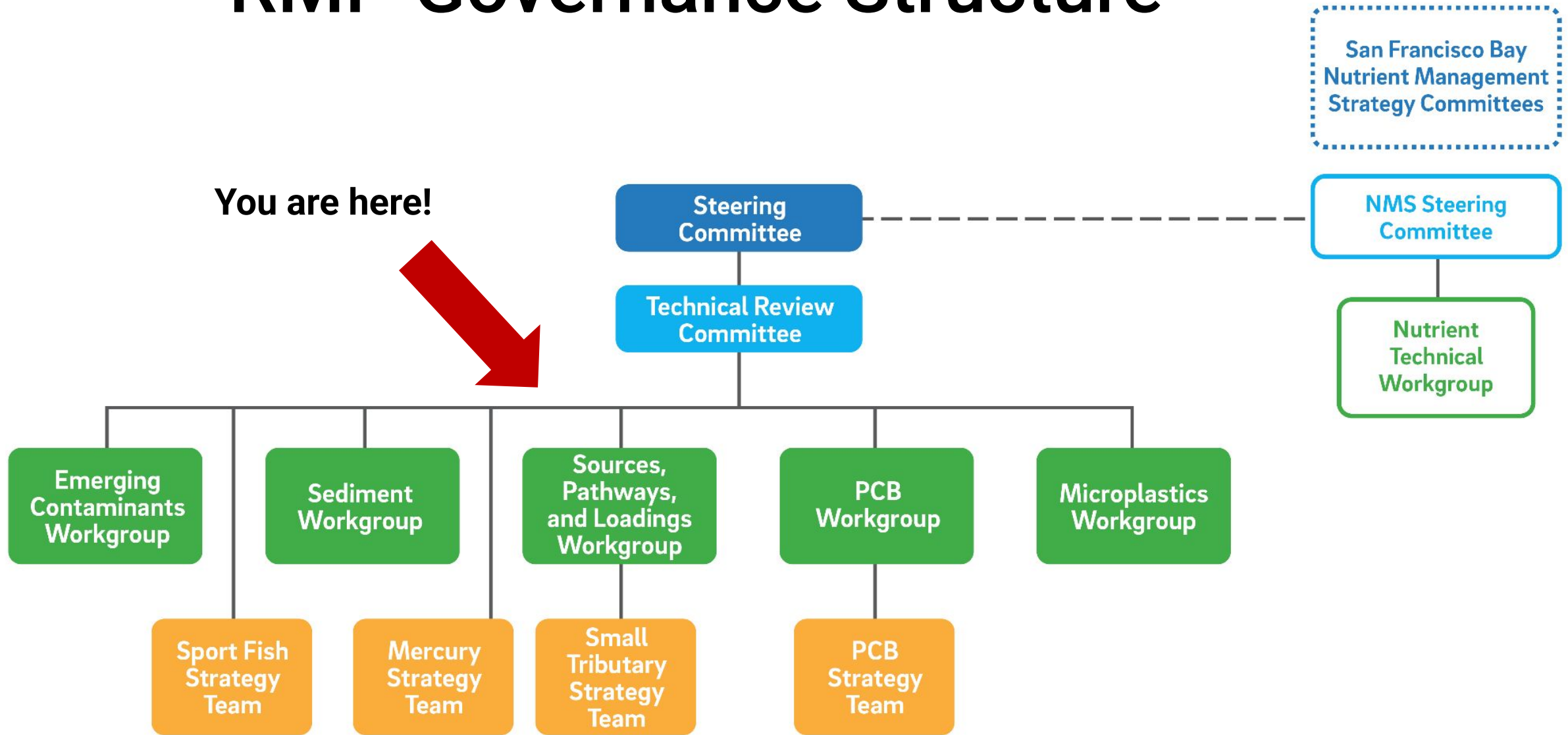
\$519K for SPL
Special Studies

Additional \$\$\$ for
watershed
modeling and
fixed-station
monitoring

RMP Budget



RMP Governance Structure



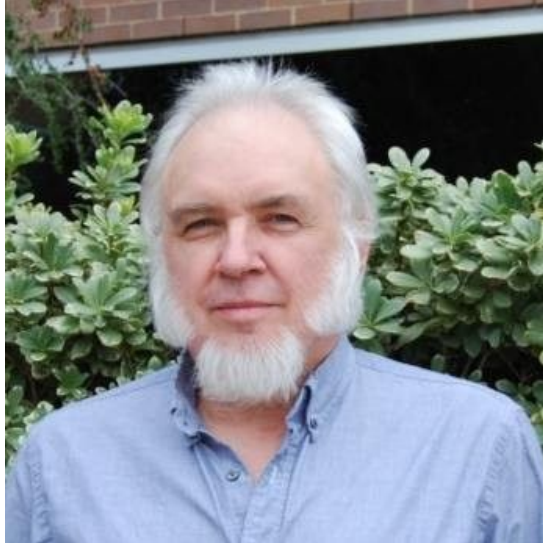
SPLWG Science Advisors

Tom Jobes
Independent



Dr. James Limbrunner
Tufts University

Dr. Jon Butcher
Tetra Tech



Dr. Robert Budd
CA Department of
Pesticide Regulation



Goals/Agenda

DAY 1: May 14, 2026

1.	Introductions and Meeting Goals The goals for the next two days are to: • Provide updates on recent and ongoing SPLWG activities from the perspectives of Water Board, BAMSC, and SFEI (Day 1) • Obtain workgroup input on RMP watershed modeling and Fixed Monitoring Station Network plans (Day 1) • Inform group of project proposals in other workgroups that relate to SPLWG (Day 2) • Receive review and advice on SPLWG proposals for 2027 (Day 2) • Prioritize special study proposals for funding (Day 2) Meeting materials: SPLWG Meeting Notes from April 2025 meeting, pages 8-23.	9:00 - 9:20 Jay Davis
2.	Information: SPLWG Stakeholder Perspectives • Water Board briefing on its schedule, plans, and data needs for the upcoming TMDL reviews for PCBs and Mercury. • Water Board and Municipalities briefing on the SPLWG science needed to support management and policy decision-making. Desired Outcome: Informed Workgroup	9:20 - 10:00 Water Board and BAMSC representatives
3.	Information: SPLWG Programmatic Context, Activities, and Accomplishments SFEI's SPLWG co-leads will present an overview of the current Multi-Year Plan, including its alignment with management needs. They will also provide an update on workgroup-related RMP activities and summarize work products completed or underway since the April 2025 SPLWG meeting. In addition, anticipated short-term funding levels for 2027 and projected funding through 2030 will be discussed. This overview is intended to provide context for proposed 2027 and multi-year special studies. Meeting materials: RMP project spotlight report, Multi-Year Plan Table (pages 25 - 26) Desired Outcome: Informed Workgroup	10:00 - 10:30 Alicia Gilbreath, Matt Heberger

Goals/Agenda

	Break	10:30 - 10:45
4.	Project Update and Discussion: Watershed Dynamic Model Update The RMP plans to use the Watershed Dynamic Model (WDM) to estimate pollutant loads, simulate management scenarios, and coupled with hydrodynamic models, evaluate the Bay's recovery from legacy pollution. Recently, SFEI made important updates to the model's input data, hydrology, and sediment, with simulation of pollutants mercury and PCBs underway. We will present the latest findings from the model, discuss its continued development and enhancement, and plans for future modeling applications. - Modeling update - hydrology and sediment 10:45 - 11:30 - Mercury and PCBs 11: 30 - 12:00 (more watershed modeling discussion after lunch) Meeting materials: - Virtual meeting handout: https://mghydro.com/pages/wdm - Mercury modeling memo dated April 28, 2026 Desired outcome: - Informed workgroup - Feedback on watershed modeling	10:45 - 12:00 Matt Heberger
	LUNCH	12:00 - 12:30
5.	Project Update and Discussion: Watershed Dynamic Model Update (cont.) Modeling applications 12:30 - 1:15	12:30 - 1:15 Matt Heberger
6.	Project Update and Discussion: WY 2026 Stormwater Monitoring Update SFEI scientists conducted 40 monitoring efforts during 5 storms in Water Year 2026. Most of these samples were collected for other RMP workgroups and two studies were outside of the RMP. We will provide a high-level overview of the stormwater season and briefly discuss each project. Desired outcome: Informed workgroup	1:15 - 1:45 Alicia Gilbreath

Goals/Agenda

7.	Discussion: Fixed Monitoring Station Network - Visioning the Broader Network The RMP plans to expand the FMSN beyond the first pilot station, with up to three new stations by Water Year (WY) 2028 or 2029. In this item, we will begin broader discussions on the design of the full network of fixed monitoring stations. Planning for the three new stations and the broader network is expected to begin this summer. Topics for discussion include: • Network Design Approach: How should we prioritize and integrate important design aspects? Should we have stations that integrate or that are less diverse? Should we have a background station? Should we have a monitoring station at the head of the Estuary (Central Valley Watershed)? • Regional Representation: How many stations are needed to broadly reflect the urbanized Bay Area? The first 4 stations will focus on old industrial land use (PCBs). How do we capture diversity via infrastructure age, construction, & demographics? • Collaborations: Are there unidentified opportunities for collaboration? • General Advice: What other general advice do you have for fixed station design? Are there any other network examples to learn from? Desired outcomes: • Informed workgroup • Input on science questions about the design of the network • Input of the station selection criteria	1:45 - 2:50 Lester McKee
	Break	2:50 - 3:05
8.	Discussion: Fixed Monitoring Station Network: Pilot Station Selection In this item, we will summarize progress to date on the planning process for the first pilot station in the FMSN. To date, SFEI, BAMSC, and the Water Board have worked collaboratively to refine and narrow potential locations for the first pilot station. This process has resulted in two remaining high-priority sites under consideration. We will present an overview of these candidate sites and their associated watersheds, and request that the group discuss the pros and cons of a preferred location to move forward for pilot implementation. Additional specific questions for discussion include: • Which criteria or characteristics do you feel are important to inform pilot station selection? • What additional ideas do you have for consideration of the pilot station? Desired outcomes: • Informed workgroup • Input on the pros and cons of the pilot station	3:05 - 3:35 Alicia Gilbreath

Goals/Agenda

9.	Information: 2026 Hg Synthesis Document – Central Valley and Guadalupe River Load Updates In support of the forthcoming TMDL update, SFEI is preparing a Mercury Synthesis Report to provide a "state of the science" updates in the following key areas: • Biological & Physical Trends: Biota status/trends, Surface sediment status/trends, and active sediment layer reviews. • External Inputs: from atmospheric deposition, Central Valley rivers, wastewater, local watersheds, and the Guadalupe River. • System Dynamics: Bed erosion/deposition, loss due to dredging and sand mining, and Bay recovery trajectories. • Restoration Impacts: Wetland restoration and food-web mercury. These sections will inform a synthesis summary featuring sub-embayment-scale Hg budgets and recovery trajectories. Lester will overview the Central Valley and Guadalupe River load sections, representing two decades of SPLWG oversight. Workgroup members will be invited to review the draft report in June 2026. Desired outcomes: • Informed workgroup	3:35 - 3:45 Lester McKee
10.	Recap of Day 1, Report on Action Items, Comments from Science Advisors	3:45 - 4:00
	Adjourn	4:00

Happy Hour: 5 Tacos and Beer, 1175 Solano Ave, Albany, CA 94706



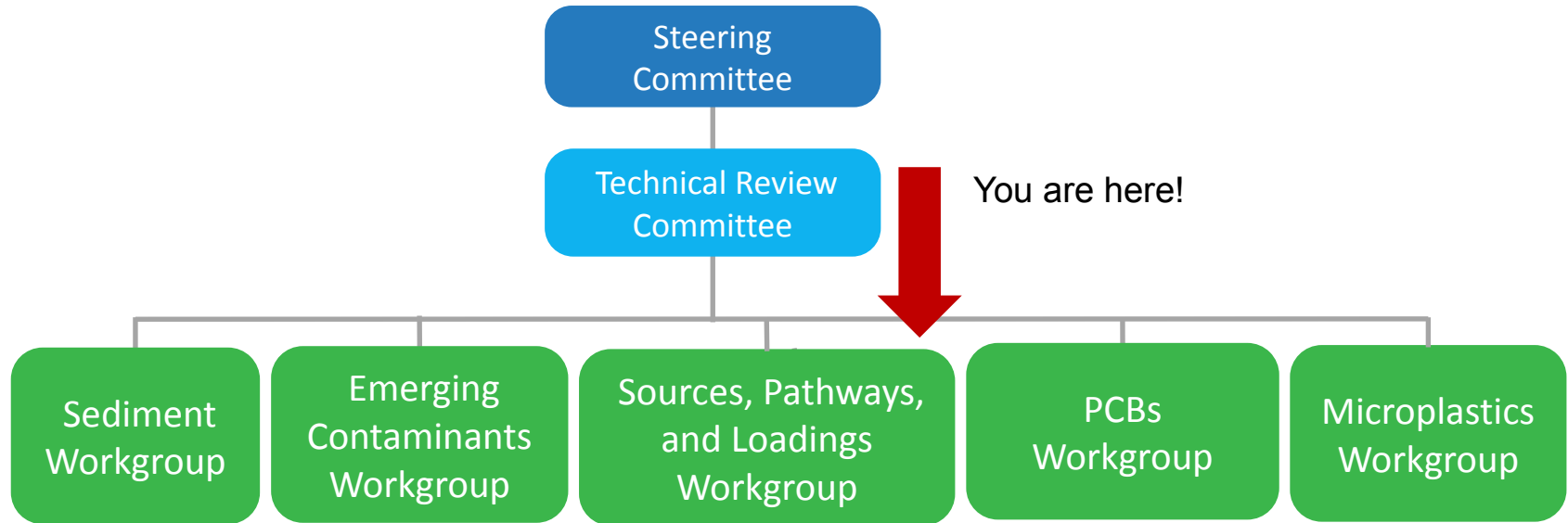


SPLWG Programmatic Context, Activities, and Accomplishments

Alicia Gilbreath | Matt Heberger

SPLWG 2026

RMP Structure



SPLWG Management Questions



MQ1:

What are the sources, pathways, and loadings of pollutants and sediment to the Bay?

MQ2:

Which are the priority sources and pathways of pollutants that adversely impact or potentially adversely impact the Bay's environmental quality?

MQ3:

What are the management actions that could be implemented in the region to address pollutant pathways and sources, and where would they have the greatest benefit?

MQ4:

Are levels of individual pollutants or pollutant classes changing over time in the sources, pathways, and loadings? What factors or management interventions have contributed to the change?

SPLWG Program Funds



\$519k
RMP Special Studies
2027

\$2.5 Million
Modeling

\$1.15 Million
Fixed Monitoring Station
Network



Activities & Accomplishments

Stormwater Monitoring Activities



11

Stormwater
Studies

3*

Workgroups

3

Funders

RMP

EPA

USC Sea Grant

5

Storm
Sampling Tools

ISCO, Aquamatic
Small Automated

Bailer

Rain Buckets!

640

Hours in the Rain

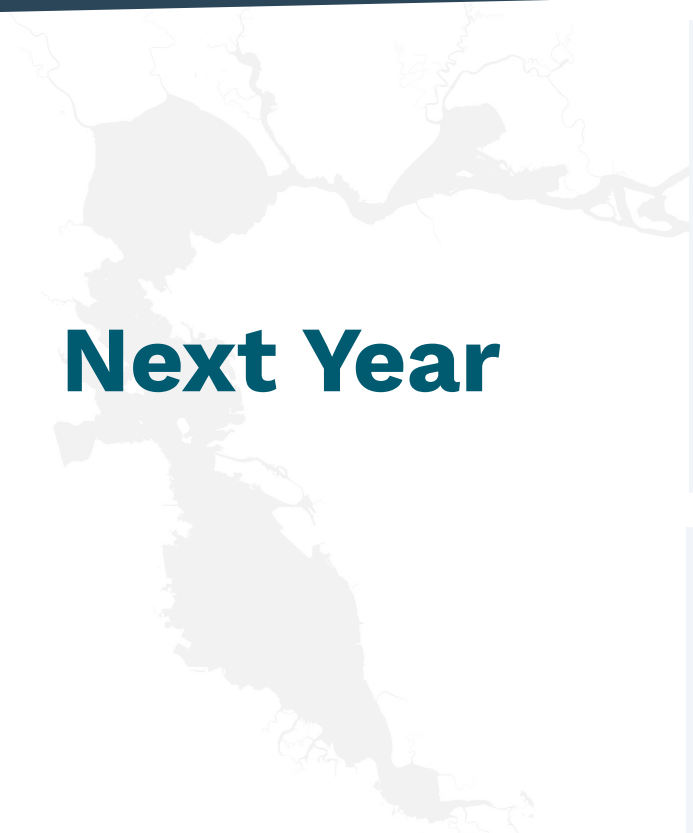
86

Burritos
Consumed

1931

High Fives

Stormwater Monitoring Activities



Next Year

**Studies from 3 other workgroups
supported**

**Emerging Contaminants WG
Microplastics WG
PCBs WG**

**Fixed Monitoring Station Network
(FMSN)**

****SPLWG****

Watershed Modeling Activities



Modeling Strategy

Published the Integrated Watershed-Bay Modeling Strategy in early 2026.

4

Key Meetings

Engaged stakeholders, science advisors, and modeling experts.

19

Use Cases

Specific modeling applications identified for the Bay.

74

Pages of Detail

Comprehensive documentation of use cases, draft multi-year workplan.

Strategic Roadmap

Outlined a plan for continuous enhancements and applications of a suite of models.

Objective: Inform management of water quality in the Bay.

Watershed Modeling Activities



Modeling Accomplishments

- (a) Updated meteorological forcing data
- (b) Update river reach hydraulics
- (c) Recalibrated hydrology (flow simulation)
- (d) Recalibrated sediment (erosion, transport)
- (e) Calibration of mercury underway
- (f) Created model web portal v0.1

Petaluma R. Basin: Ran flow and sediment scenarios under future climate and management actions (Sediment Solutions project).

In-Bay Support: Provided critical boundary conditions to the in-Bay modeling team.

Urban Creeks: Forecasted discharge and stage using SWMM to assist in programming remote samplers.



SPLWG Working Multi-Year Plan

MYP - Modeling Studies



Element	Study	Funder	Collaboration with other Workgroups	2026	2027	2028	2029	2030
Strategy	SPLWG strategy (formerly STLS coordination)	RMP		72	80	88	97	105
Modeling	Modeling to support regional loads and trends (PCB/Hg)	USEPA RMP		222				
	Watershed Dynamic Model development and applications	USEPA RMP	PCBWG	240	580	600	641	679
	Guadalupe PCB Pollutant load trends	RMP	PCBWG			80	80	
	Improving Watershed Delineation to Support Modeling and Site Selection	USEPA RMP	All		75	50	50	

MYP - Stormwater Studies



Element	Study	Funder	Collaboration with other Workgroups	2026	2027	2028	2029	2030
Monitoring	Remote sampler improvements	RMP	ECWG		60	30	30	40
	Improved stormwater systems management	RMP	All	30	60	50	50	50
	Dry weather monitoring for CECs	RMP	ECWG			50	75	75
	Fixed Monitoring Station network implementation	USEPA RMP	All	250	400	400	100	
	Fixed station monitoring	RMP	All		144	155	160	185
	Discharge rating curve development/flow monitoring	USEPA RMP			100	65	75	
Monitoring funded by other workgroups	Stormwater CECs Monitoring and Modeling	RMP USEPA	ECWG	375* (53)*	325*	325*	325*	325*
	Stormwater PCBs	RMP	PCBWG		200*			
	Stormwater (microplastics)	RMP	MPWG		160*	110*	160*	50*
SPLWG Program Totals				814	1,599	1,608	1,383	1,159



SF Bay Watershed Dynamic Model Update

For the Sources, Pathways, and Loadings Workgroup
of the Regional Monitoring Program

May 14, 2026

Matthew Heberger & Pedro Avellaneda

Presentation Outline

- Status of WDM Development and Calibration
- Updated forcing data (precipitation and evaporation)
- Updated hydrology calibration
- Updated sediment calibration
- Mercury model development and parameterization
- Future watershed modeling development and applications

Virtual Meeting Handout:

<https://mghydro.com/pages/wdm/>

Watershed Modeling Purposes

- Support TMDL and Permit Requirements
- Estimate Regional Loads
- Assess Management Actions
 - Identify High-Leverage Sources
- Simulate Sediment Dynamics
- Create an Integrated Watershed-Bay Modeling Platform

Watershed Modeling Purposes

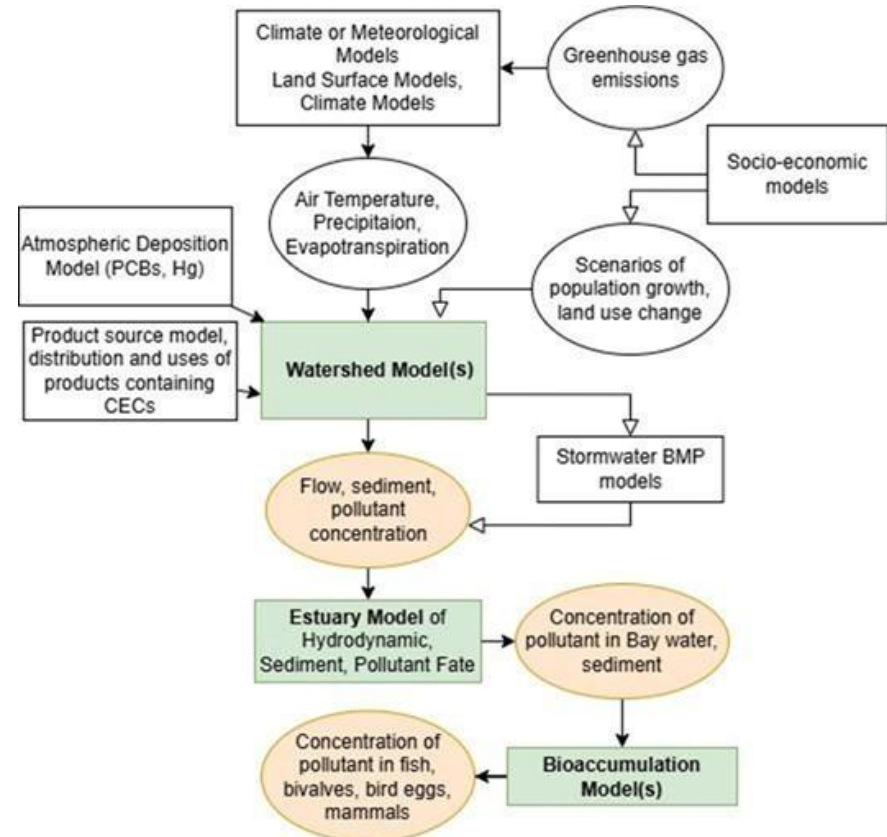
- Support TMDL and permit requirements
- Estimate regional loads
- Assess management actions
- Identify High-Leverage Sources
- Simulate sediment erosion and transport to the Bay
- Provide input to the Bay Hydrodynamic Model, as part of an Integrated Watershed-Bay Modeling system

Background and Motivation

- SFEI has been developing the Watershed Dynamic Model (WDM) since 2020.
- Currently, the WDM simulates discharge (flow), sediment concentration for 255 river reaches draining to the Bay.
- Calibration of PCBs and **mercury** pollutant models is underway, but delayed to make important fixes to hydrology and sediment.
- EPA Tracking Bay Health grant funds (\$2.5 million over the next 4 years) have been earmarked for modeling.
- We propose to continuously improve the WDM and extend it to a range of new applications that will provide valuable information to water quality managers.

Roadmap for WDM Development

- Support for entire program using the RMP's 2 models (WDM, RWSM) for a range of constituents: PCBs, Hg, sediment, CECs, nutrients
- Water Board's information needs to support revision of the TMDLs for mercury (2028) and PCBs (2030)
- Vision outlined in two key reports:
 - *Integrated Watershed Monitoring and Modeling Strategy* (2025)
 - *Integrated Watershed-Bay Modeling Strategy* (2026)



Detour: the need to fix the sediment model

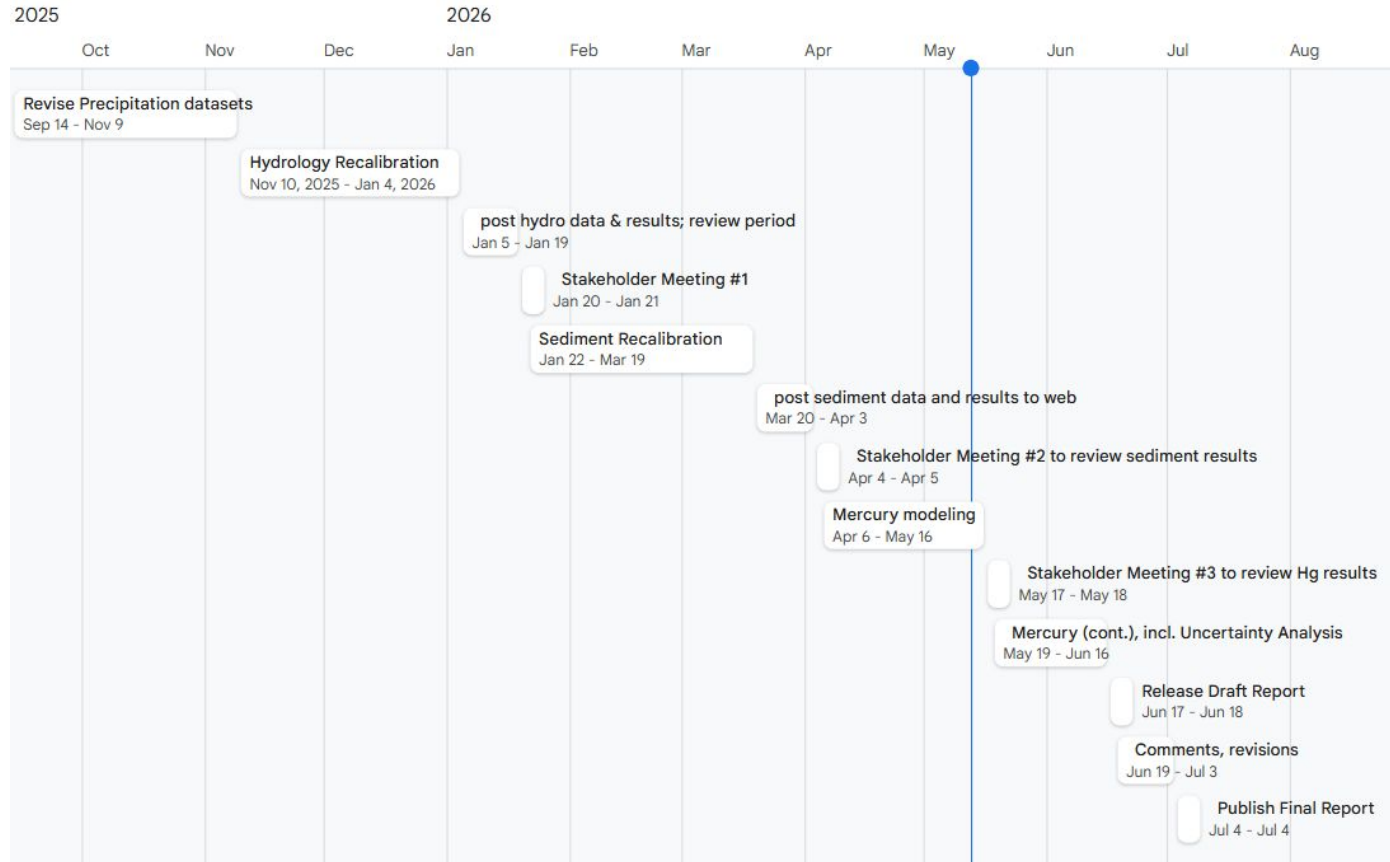
- In the spring of 2025, we determined that the physics of erosion and sediment transport at the hydrologic response unit (HRU) scale are unrealistic.
- This prevents us from creating a credible pollutant loading model that is suitable for making management decisions.
- See Matt's April 10, 2025 memo for full details...

(The fit between observed and simulated sediment concentration is good; however the model physics are suspect.)

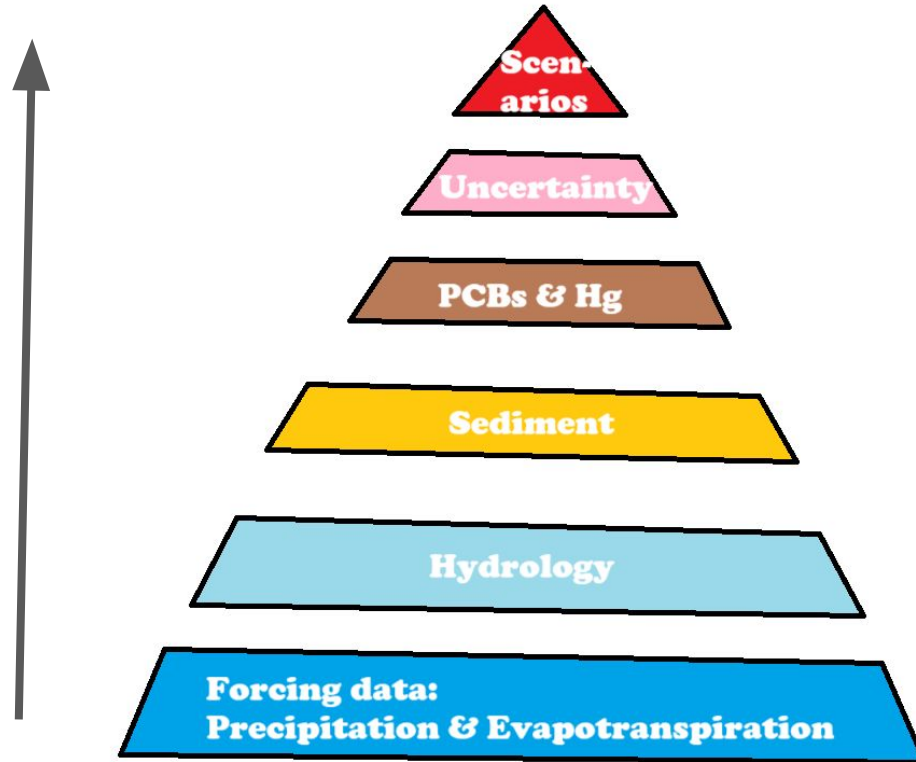
Additional Challenges Uncovered

- **Hydrology** - model fits to daily observed flows were relatively poor
- **Precipitation** - errors in data processing -- overall precip. totals were correct, but the way they were disaggregated was poor, making the hourly time series wrong.
- **Evapotranspiration** - input data was coarse resolution, included “coastal contamination”
- **Reservoirs** - there was a mistake in how reservoirs were being handled in the model, with the downstream overflow or release and the water supply withdrawals **reversed** for several reservoirs.
- **River hydraulics** - Unrealistically high velocities in many reaches caused excess bed scour and sediment transport.

Roadmap



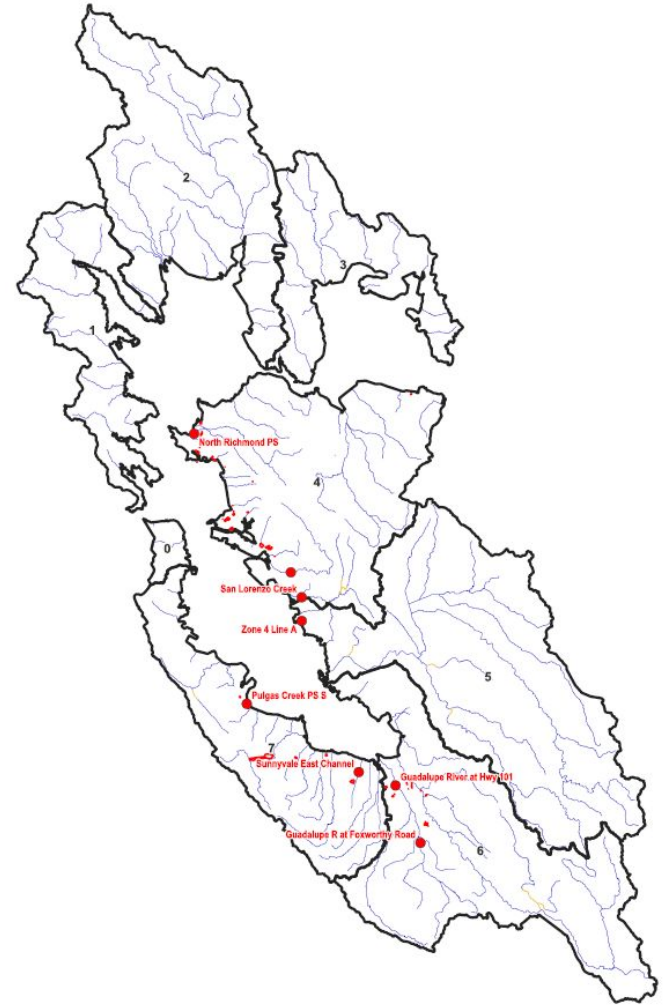
Each stage of model development builds upon the previous one...



Modeling Projects in 2026

Model structural improvements:

- ✓ (a) Update meteorological forcing data: evapotranspiration and precipitation
- (b) Update subbasin boundaries with more accurate watershed areas
- ✓ (c) Simplify and streamline model parameters
- 2/3 (d) Recalibrate the model (for flow, sediment, and pollutants)



Applying "FAIR" Principles to Watershed Modeling

Commitment to Open Science: Providing model code and data to stakeholders and the public.

F

Findable

Metadata and data should be easy to find for both humans and computers.

A

Accessible

Once the user finds the required data, they need to know how it can be accessed.

I

Interoperable

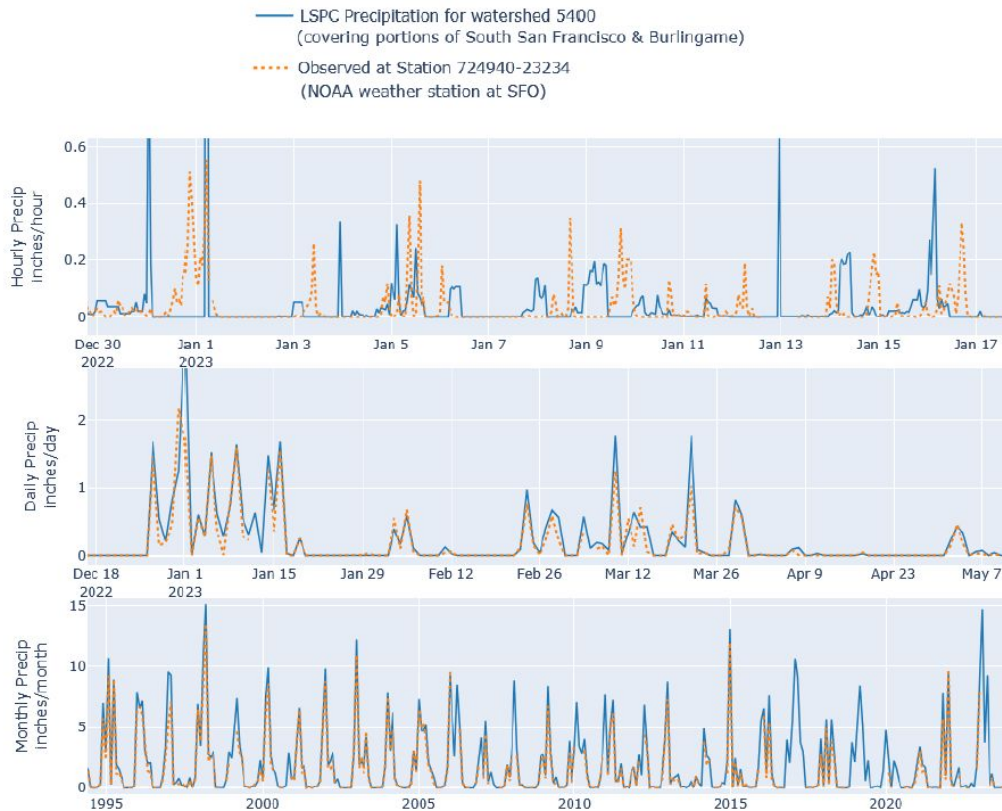
The data usually needs to be integrated with other data and workflows.

R

Reusable

Data and metadata should be well-described so that they can be replicated or combined.

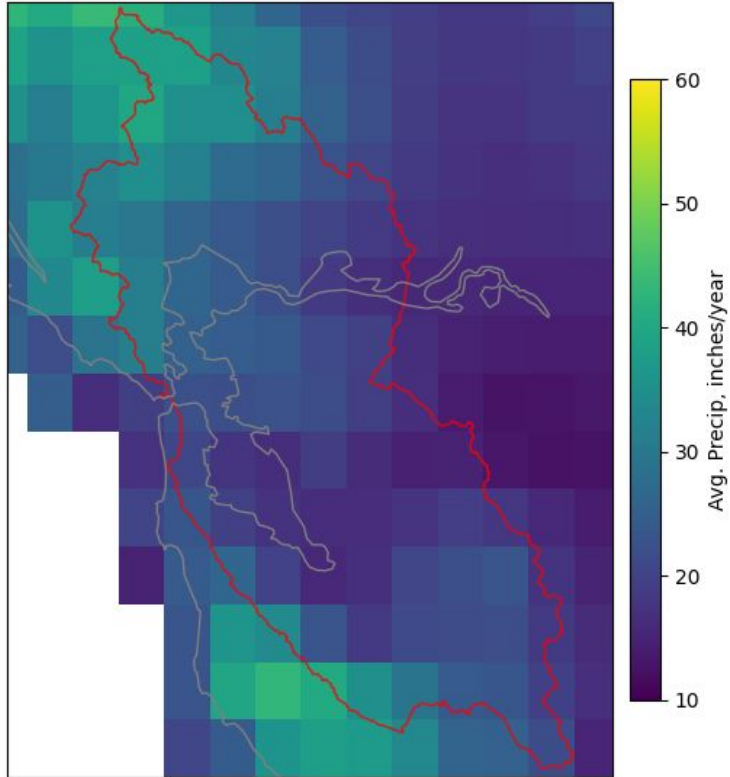
Daily discharge predictions were relatively poor because of a problem with precipitation data



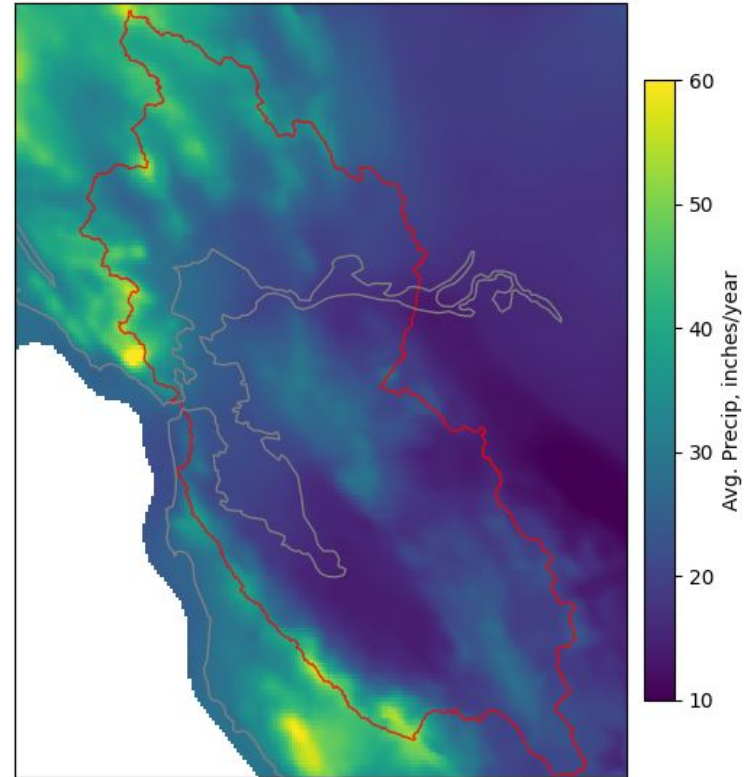
The hourly precipitation was off, because of a bug in the code used to disaggregate daily data from the PRISM dataset.

Why data fusion?

NLDAS Annual Avg. Precip.



PRISM Annual Avg. Precip.



Validating the Precipitation Forcing Data

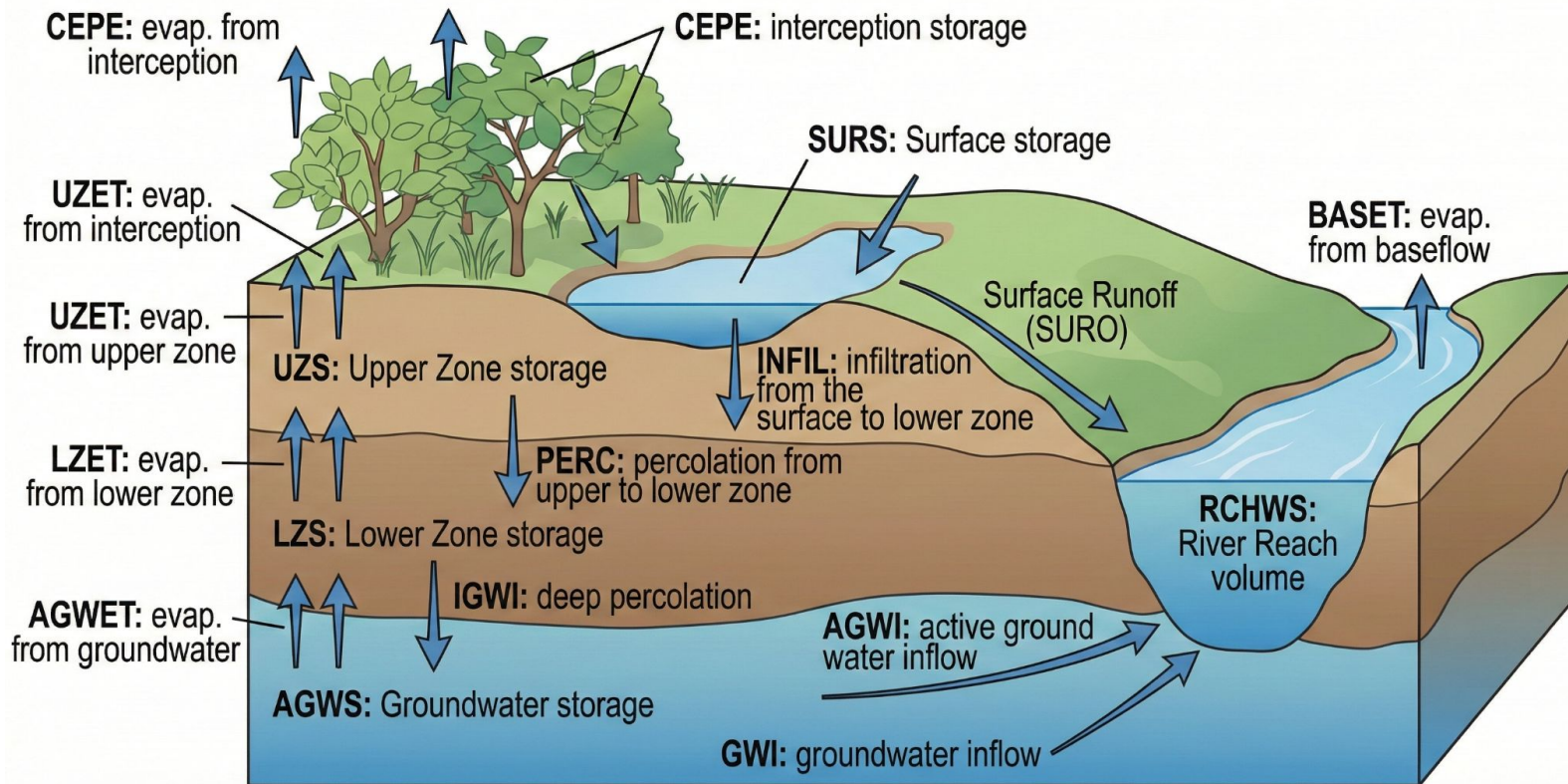
- Compare dataset to station observations.
- Since NOAA stations are mostly at airports at sea level: also downloaded observed precipitation at CDEC stations. This catalog contains station data collected by local agencies such as water suppliers and flood control districts.
- Time series plots: <https://mghydro.com/pages/wdm/precip/>
- Scatterplots:
https://mghydro.com/pages/wdm/precip/_scatterplots.html

The Challenge

- The model fit to observed daily discharge got an immediate bump when we updated the precipitation data, but still not up to our expectations.
- Calibrating a watershed model at a single gage is straightforward; simultaneously optimizing the fit at 17 gages is a bigger challenge.
- We've developed several Python scripts to visualize model output and compute fit statistics (see model web page)

LSPC Hydrology Conceptual Model

HSPF PRLND MODULE: HYDROLOGIC POOLS AND FLUXES DIAGRAM



The Reservoir Problem

- The fit at gages downstream of major reservoirs was especially poor, prompting us to look more closely at how we are simulating reservoirs.
- An error was introduced in the input files at some point circa 2023 (?) that swapped the reservoir outflow and withdrawals.
- Some diagnostic plots:
 - F-Table Data: Plots of the volume-discharge relationships:
<https://mghydro.com/pages/wdm/reservoirs/>
 - Time series plots of reservoir inflow, outflow, and volume:
<https://mghydro.com/pages/wdm/reservoirs/plots.html>

Hydrology Recalibration

- Never going to be a perfect match between simulations and observations. “Good enough” for now, with an eye to constant improvement in the future.
- Our aim is to communicate honestly about the strengths **and** weaknesses of the model.
- We’ve worked to incorporate feedback from our advisors and stakeholders.

Sediment recalibration: Overview



Goals



Calibration
approach



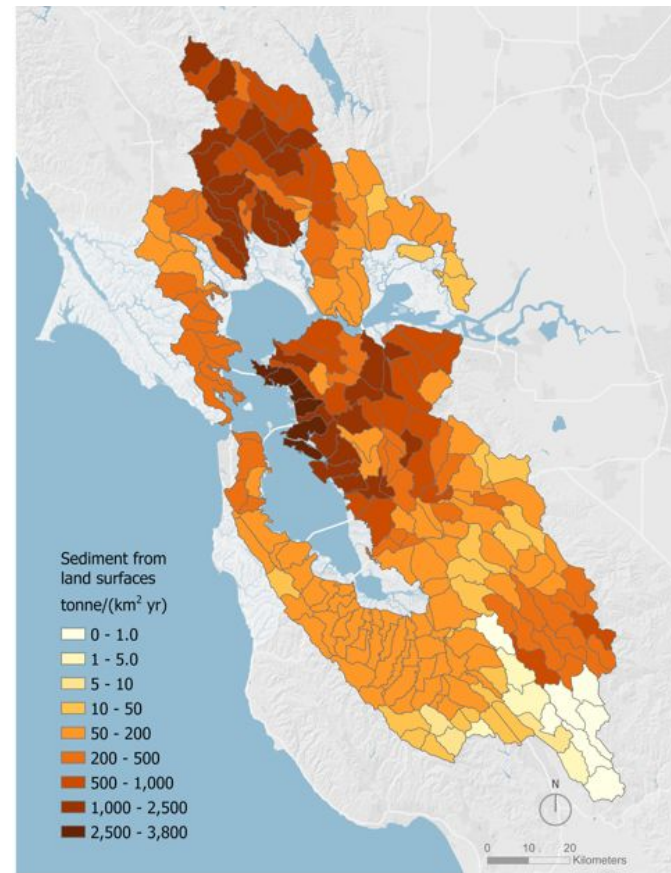
Data sources



Output
visualization

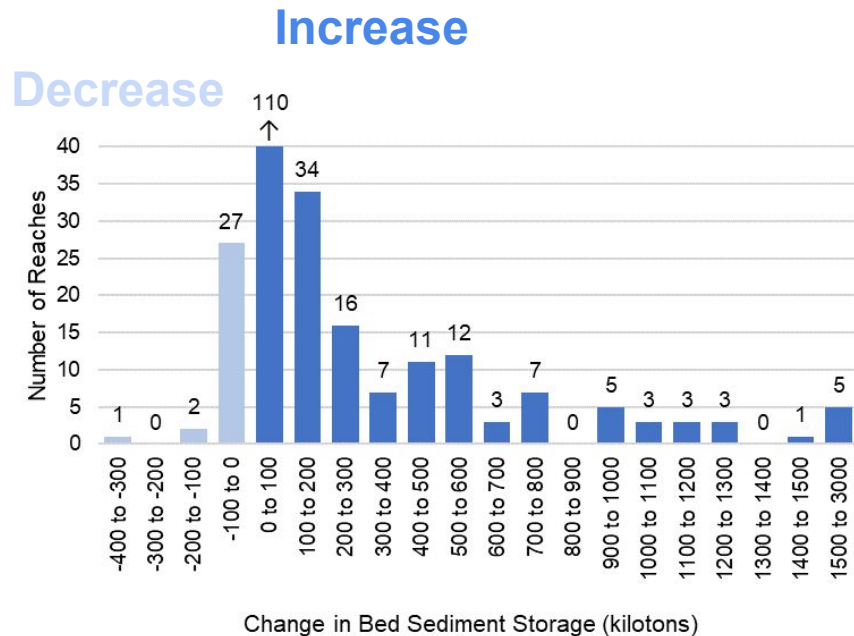
Sediment Watershed Modeling Goals

- Create a reasonable and accurate model of sediment production and transport within the constraints of the LSPC platform
- Sediment production from the landscape is realistic
- Regional patterns of erosion and sediment yield reflect our conceptual understanding



Modeling goals

- Reasonable amounts of sediment scour and deposition in channels that are in equilibrium over the long term
- Reasonable shear stress in channels



Modeling goals

- Model parameters are consistent with acceptable ranges from modeling guidance and the literature
- Model parameters vary in ways that are logical and consistent with geology, soil type, slope, and land cover/land use

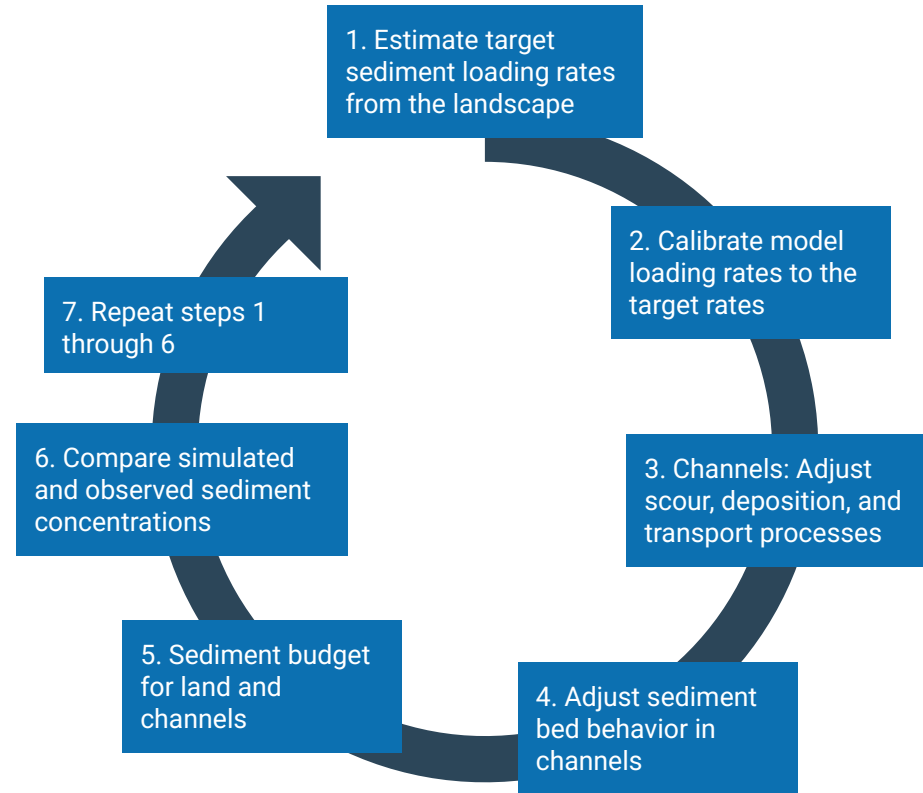
Land use: Agriculture, Slope: Low,
Soil type: D, Geology: Franciscan

Region	SMPF	KRER	JRER	AFFIX
1	1	0.90	2.5	0.0
2	1	0.56	2.0	0.2
3	1	0.56	2.0	0.2
4	1	0.90	3.3	0.0
5	1	0.90	1.5	0.0
6	1	0.50	2.5	0.0
7	1	0.50	2.5	0.0

* Parameters of soil detachment equation

Calibration approach

- Follow procedures from BASINS Technical Note 8: Sediment parameter and calibration guidance for HSPF (USEPA, 2006)
- Use an iterative process, starting with processes in the land and then down in the channels

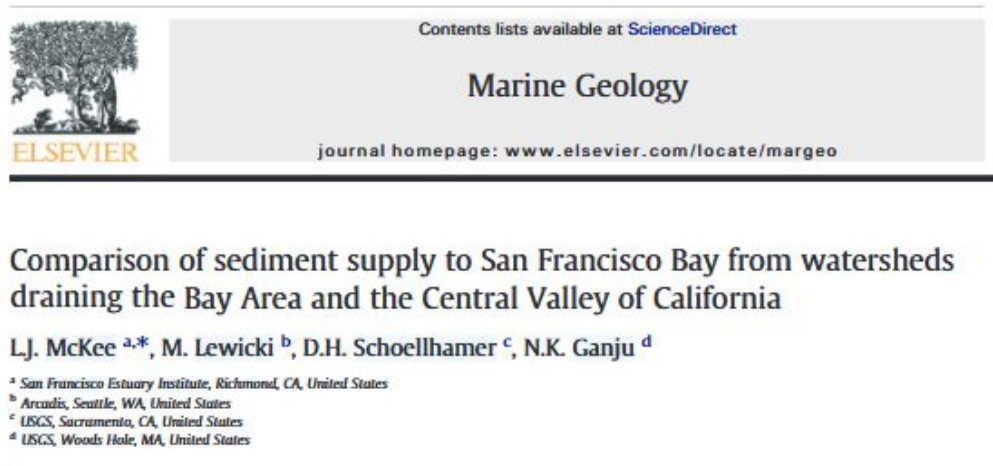
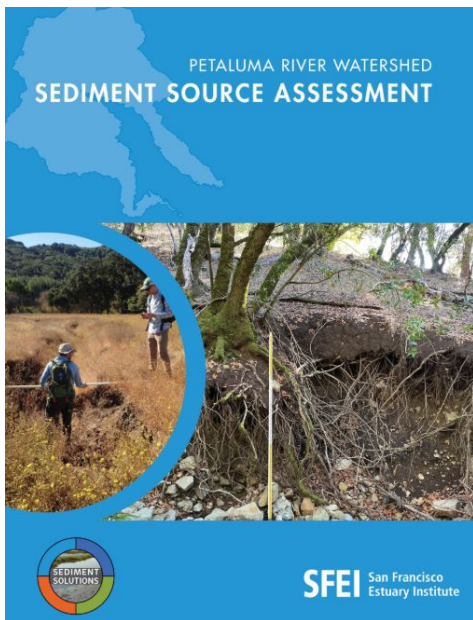


Calibration approach

- Use a nested approach, starting with upper watershed gages draining a small area, then move downstream to gages draining a larger area
- Focus on the calibration on sites with observed data and review the simulations on all parts of the model

Data sources

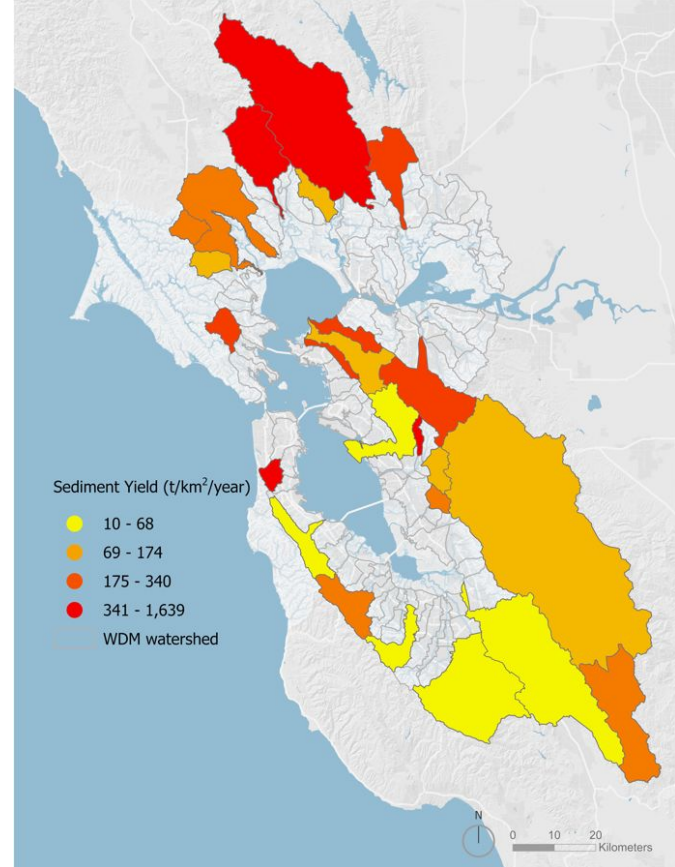
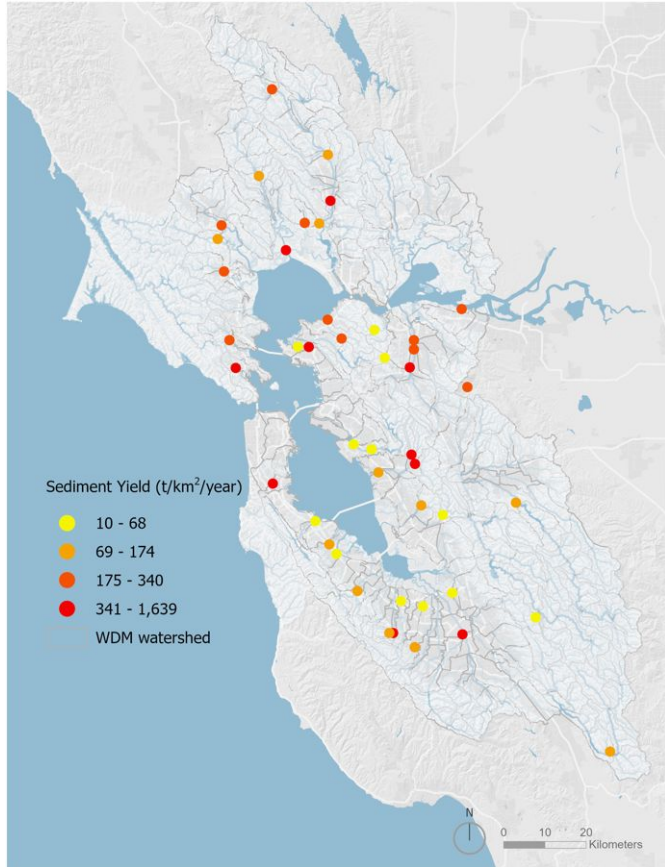
- General literature
- Local sediment source assessments (RMP reports and journal articles)



Data sources

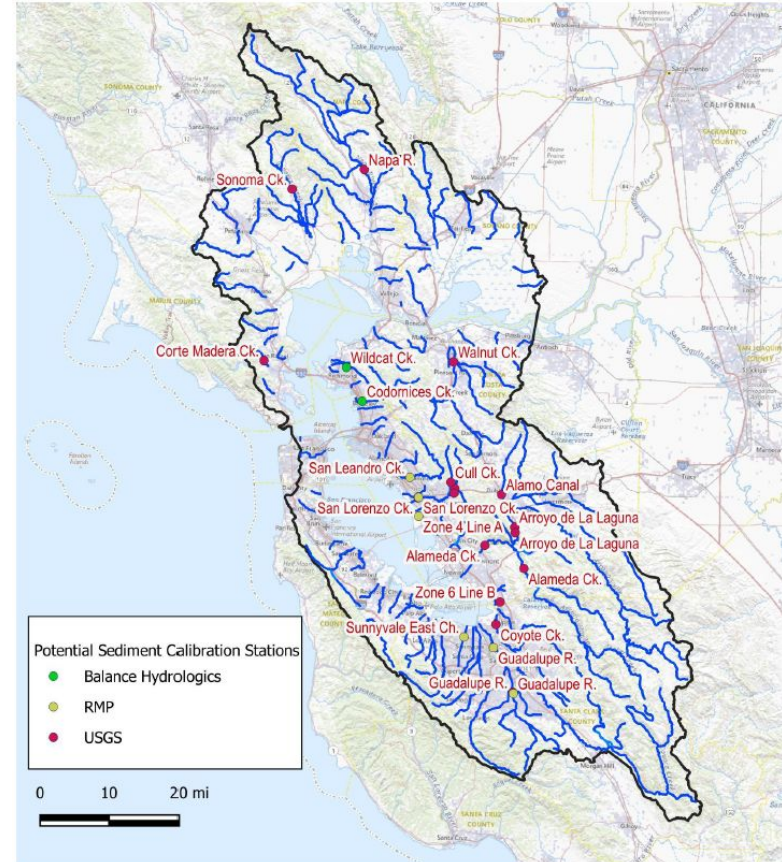
Source publication	Watershed name	Watershed area (km ²)	Watershed outlet location (source or whether it was estimated)	Latitude	Longitude	Yield estimate (metric t/km ² /yr)
Comparison of sediment supply to San Francisco Bay from watersheds draining the Bay Area and the Central Valley of California (McKee et al, 2013)	Stevens Creek	79	USGS 11166550	37.40	-122.07	33
Comparison of sediment supply to San Francisco Bay from watersheds draining the Bay Area and the Central Valley of California (McKee et al, 2013)	Calabazas Creek	53	USGS 11169616	37.30	-122.03	91
Comparison of sediment supply to San Francisco Bay from watersheds draining the Bay Area and the Central Valley of California (McKee et al, 2013)	Permanente Creek	45	USGS 11166575	37.33	-122.09	89
Comparison of sediment supply to San Francisco Bay from watersheds draining the Bay Area and the Central Valley of California (McKee et al, 2013)	Colma Creek	41	USGS 11162720	37.65	-122.43	476
Suspended Sediment Loads Analysis of Four Creeks in the San Francisco Bay Area (Gilbreath et al. 2023)	Arroyo Corte Madera del Presidio	12	RMP	37.90	-122.54	188
Suspended Sediment Loads Analysis of Four Creeks in the San Francisco Bay Area (Gilbreath et al. 2023)	Novato Creek	26	RMP	38.11	-122.58	180
Suspended Sediment Loads Analysis of Four Creeks in the San Francisco Bay Area (Gilbreath et al. 2023)	Belmont Creek	8	RMP	37.52	-122.27	90
Suspended Sediment Loads Analysis of Four Creeks in the San Francisco Bay Area (Gilbreath et al. 2023)	Walnut Creek	232	RMP	37.97	-122.05	250
Petaluma River Watershed Sediment Source Assessment (Peterson et al. 2025).	Petaluma River	321	Estimated based on watershed area	38.21	-122.59	184

Data sources



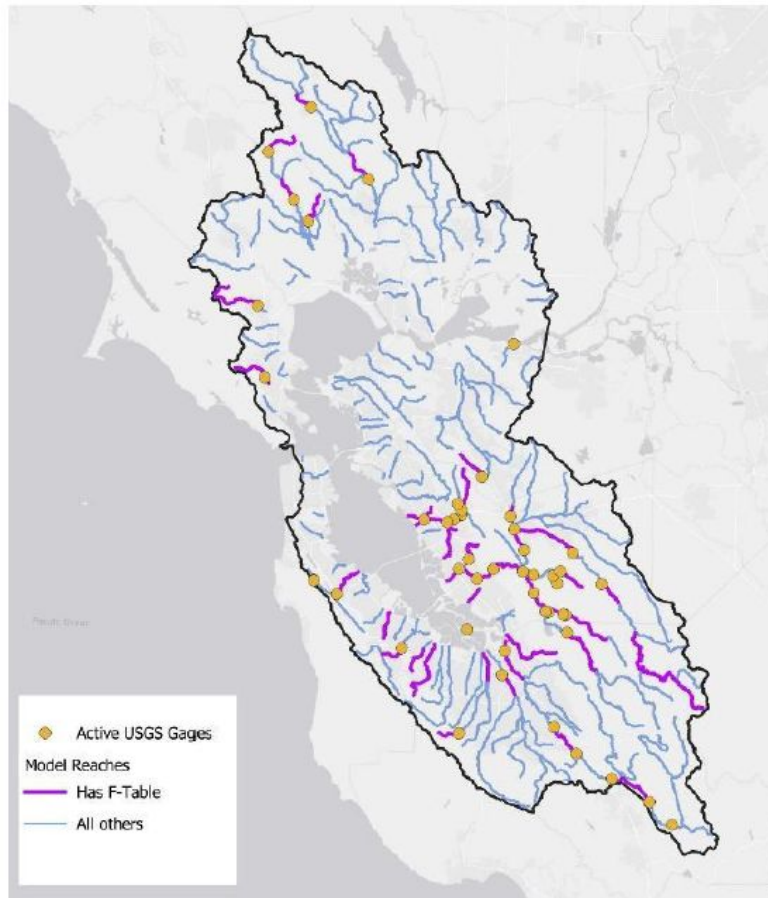
Data sources: suspended sediment concentrations

- 27 potential sediment concentrations stations for calibration: USGS (17), Balance hydrologics (2), RMP (8) (primary, 5; secondary, 3)
- This represents a larger set of stations for sediment calibration (in the Phase 2 report, only 5 stations were used)



Data sources: channel cross data

- The model has custom F-tables for 45 out of the 255 river reaches. LSPC calculates the F-Table for the other 210 river reaches, based on an idealized cross-section.
- We received “Hydromodification Studies” reports from the Water Board and permittees.



Data sources: model parameters

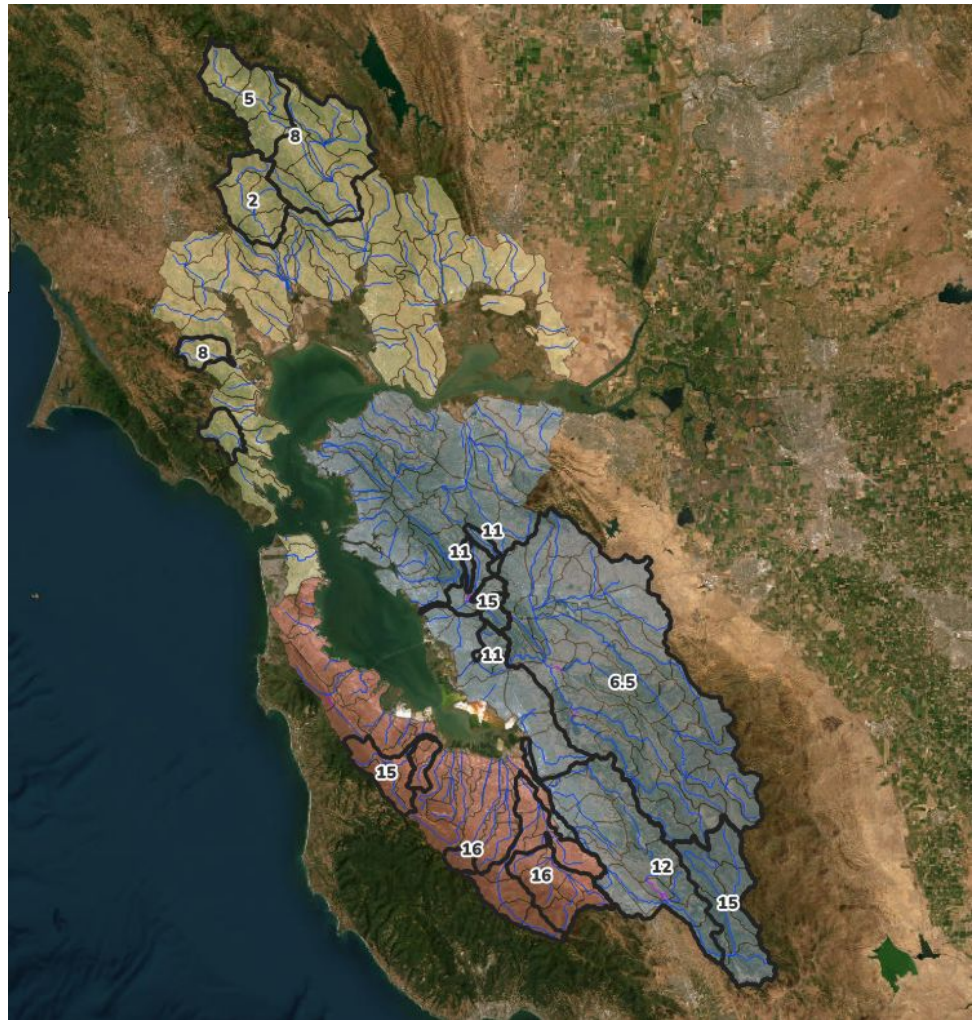
- USGS HSPF models
- RAA modeling: LSPC models for the San Mateo and Santa Clara counties
- BAHM: HSPF model by Aquaterra that simulates sediment and copper

Output visualization

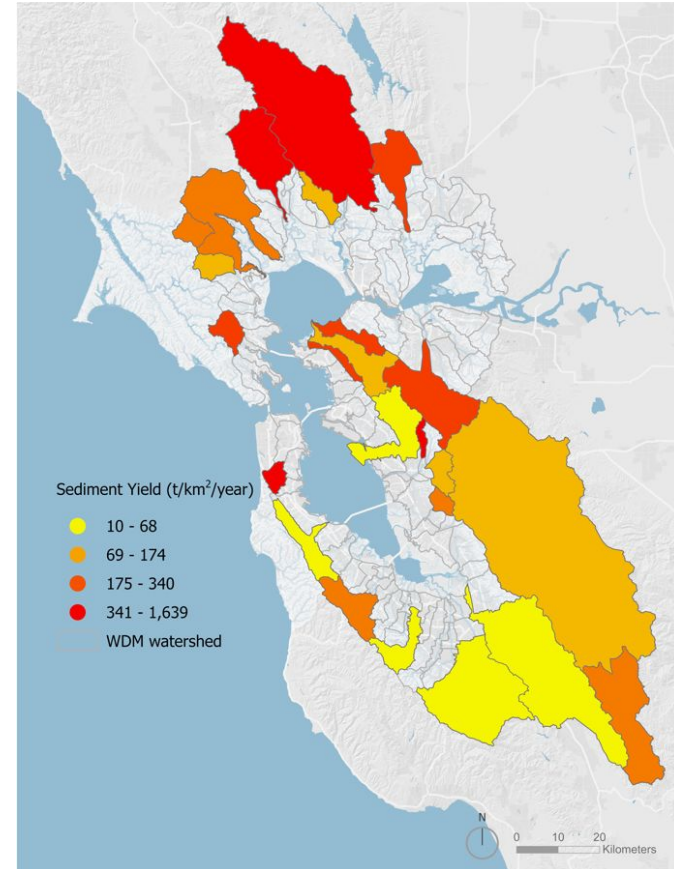
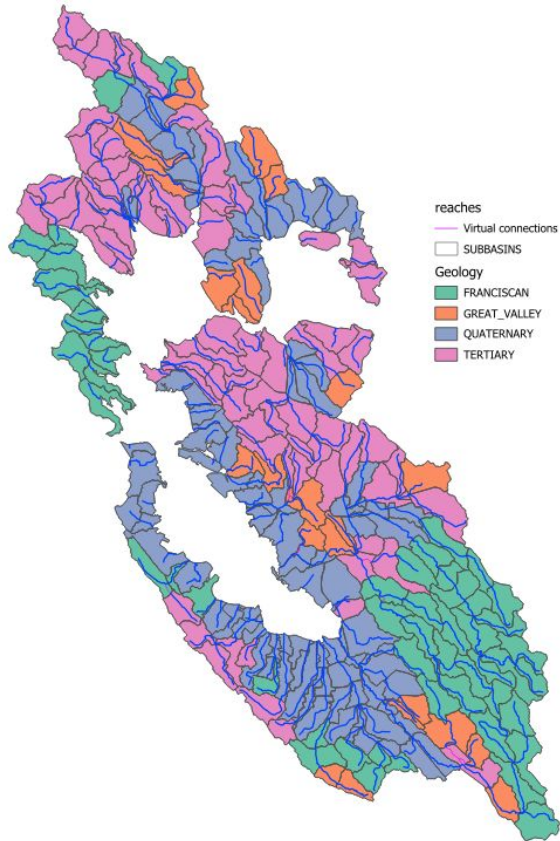
- Annual sediment load to the Bay (also by river reach and fraction)
- Simulated vs. observed suspended sediment concentrations (R^2 , percent bias, RMSE, NSE)
- Tabular or graphical summaries of sediment yield (e.g., soil, slope, land use)
- Maps of sediment delivery ratio

Defined 3 regions based on rainfall-runoff response

Map shows optimum value of the
parameter LZSN (nominal lower
zone soil moisture, in inches) from
dozens of runs



Model was simplified by removing the geology overlay



Sediment recalibration: Results



Goals



Calibration
approach



Data sources

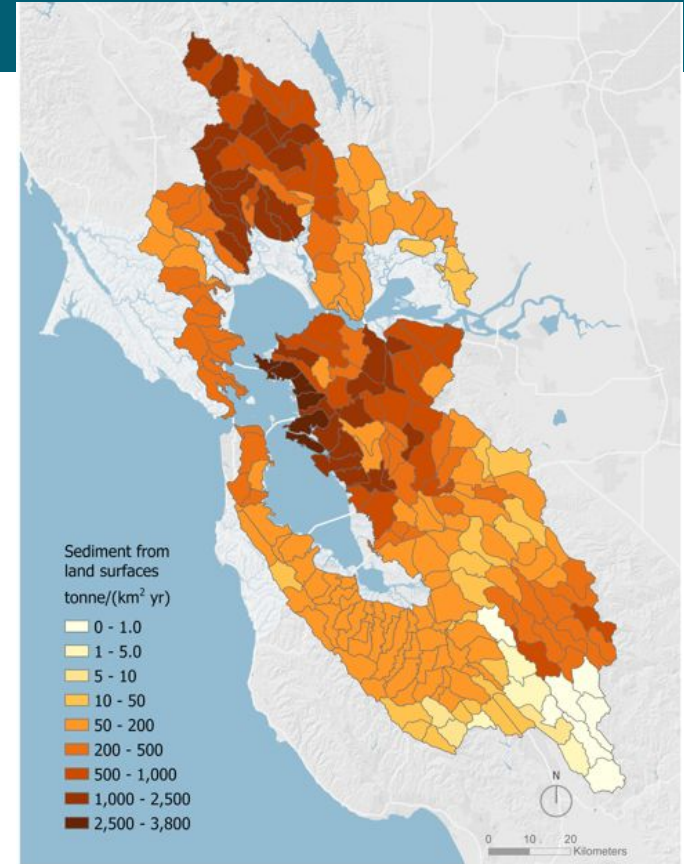


Output
visualization

Three main recommendations:

1

Fix erosion and sediment washoff from land surfaces, which show unusual patterns that are inconsistent with our understanding of watershed processes.



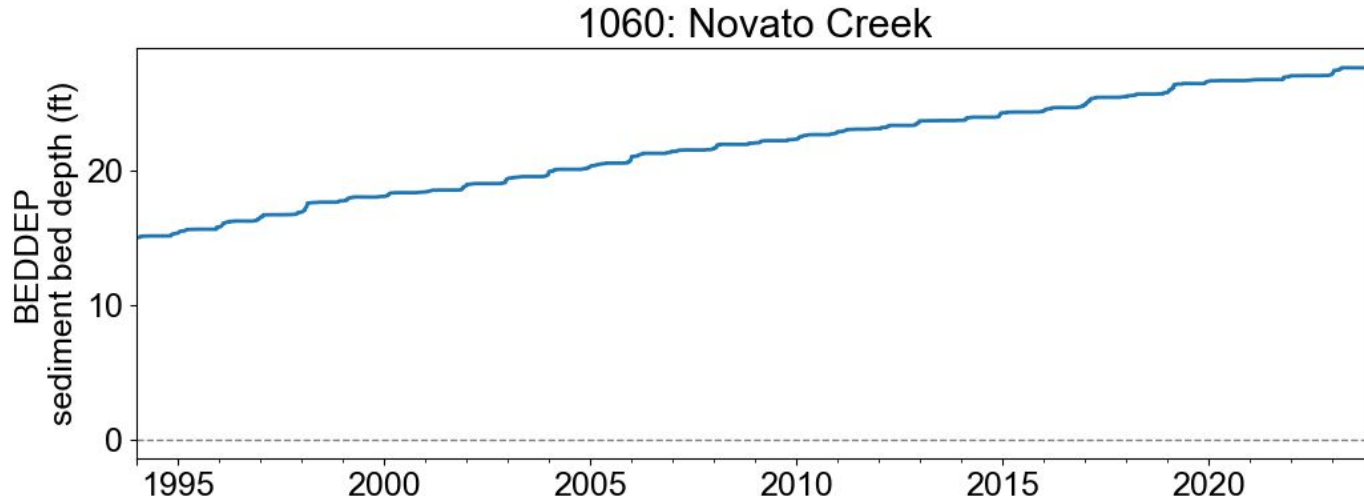
What did we change?

- Reviewed and changed key sediment parameters (land and in-stream) based on Basins Technical Note 8
- Parameters remained consistent across the region
- Targeted typical sediment yields for land uses (based on literature, local reports, and journal articles)

Three main recommendations:

2

Balance sediment scour and deposition in channels, which is out of balance in over 80% of reaches.



What did we change?

- Defined new critical bed shear stresses for silt and clay
- Reviewed and changed reach slope across the domain
- Removed several F-tables that were causing unusual flow velocities (>20 ft/s) in several model reaches
- Defined sediment fractions as follows: 12% sand, 38% silt, 50% clay (USGS data).

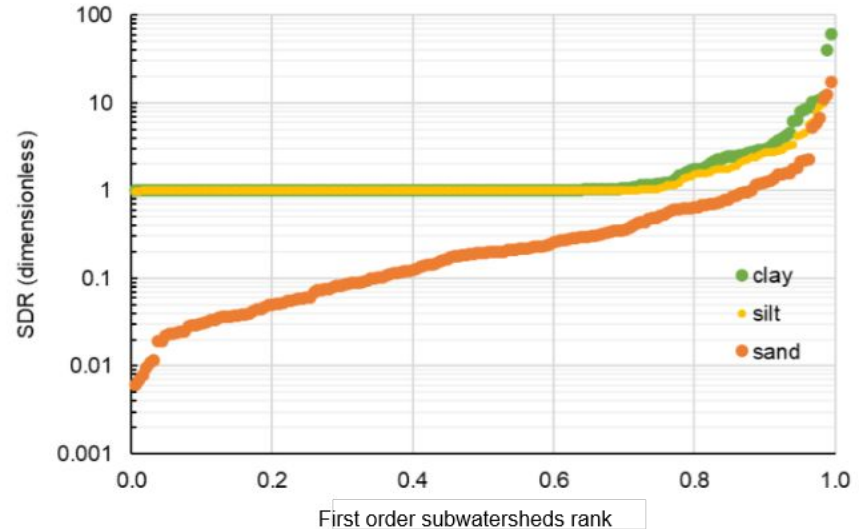
Three main recommendations:

3

Verify sediment delivery ratios (SDR) for all 3 classes (sand, silt, clay)

Average SDR > 1 not possible.

Implication: majority of the sediment in flow is coming from the reservoir of channel bed sediment and NOT the land surfaces in the watershed



$$SDR = \frac{\text{sediment leaving an outlet}}{\text{sediment from watershed land}}$$

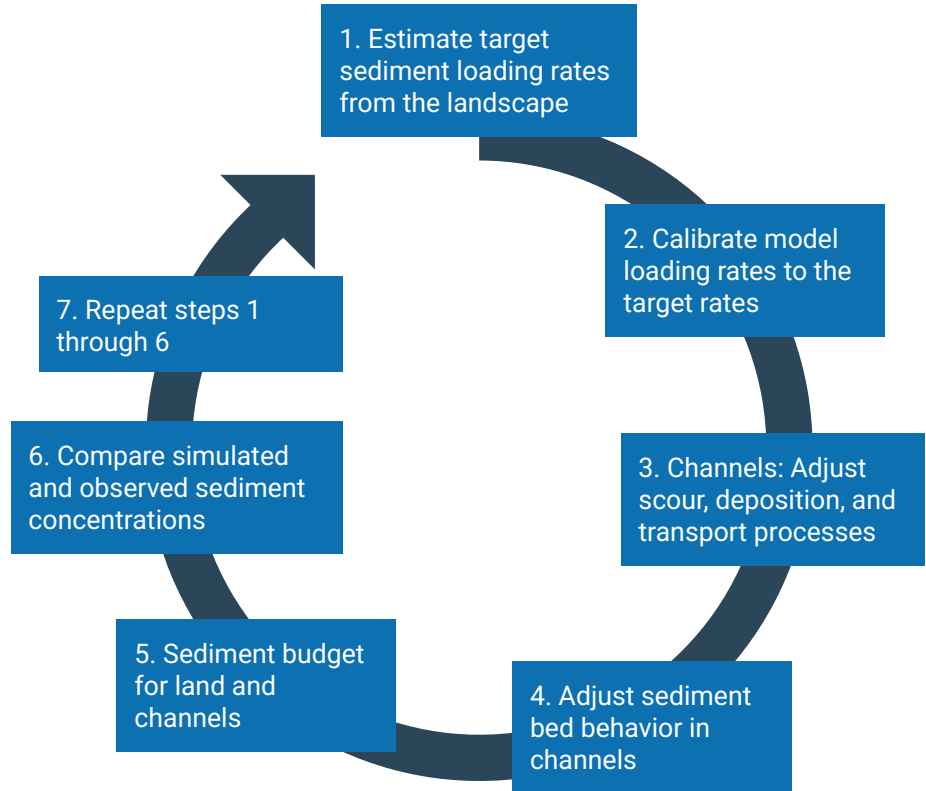
What did we change?

- All of the changes above affected sediment delivery ratios
- Checked sediment deposition in reservoirs

Use an iterative process, starting with processes in the land and then down in the channels

Follow procedures from BASINS Technical Note 8: Sediment parameter and calibration guidance for HSPF (USEPA, 2006)

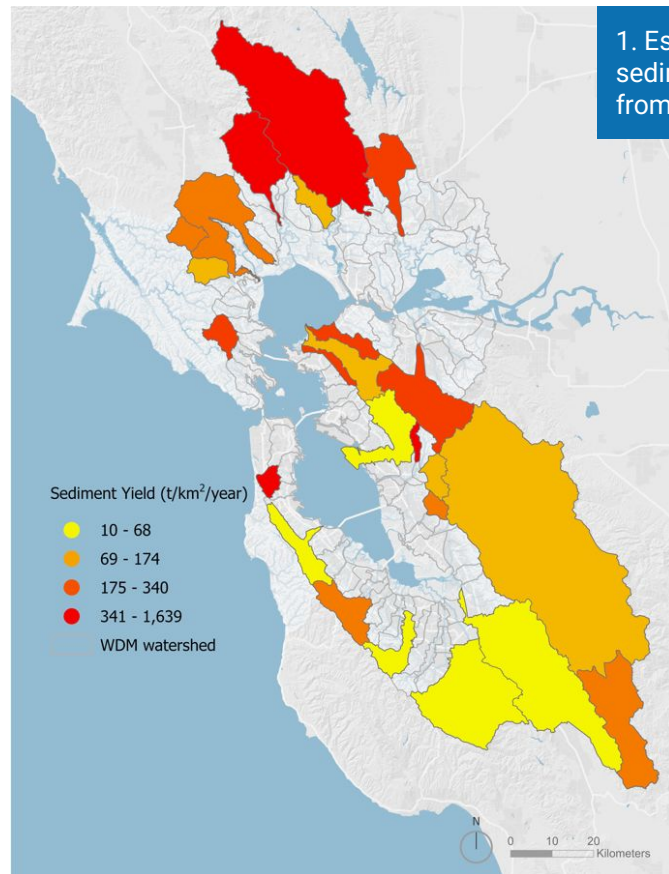
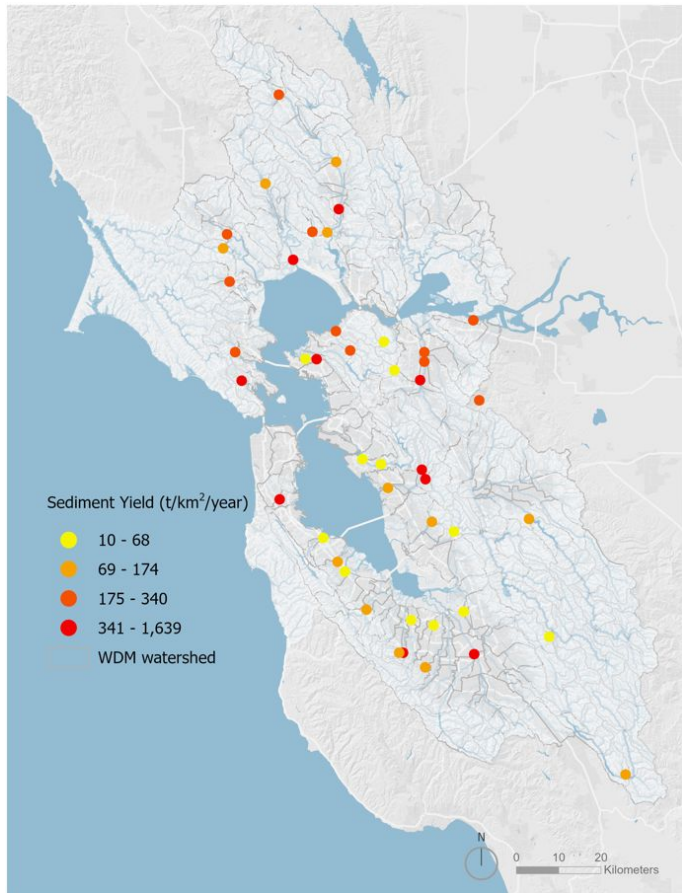
<https://www.epa.gov/hydrowq/basins-technical-notes>

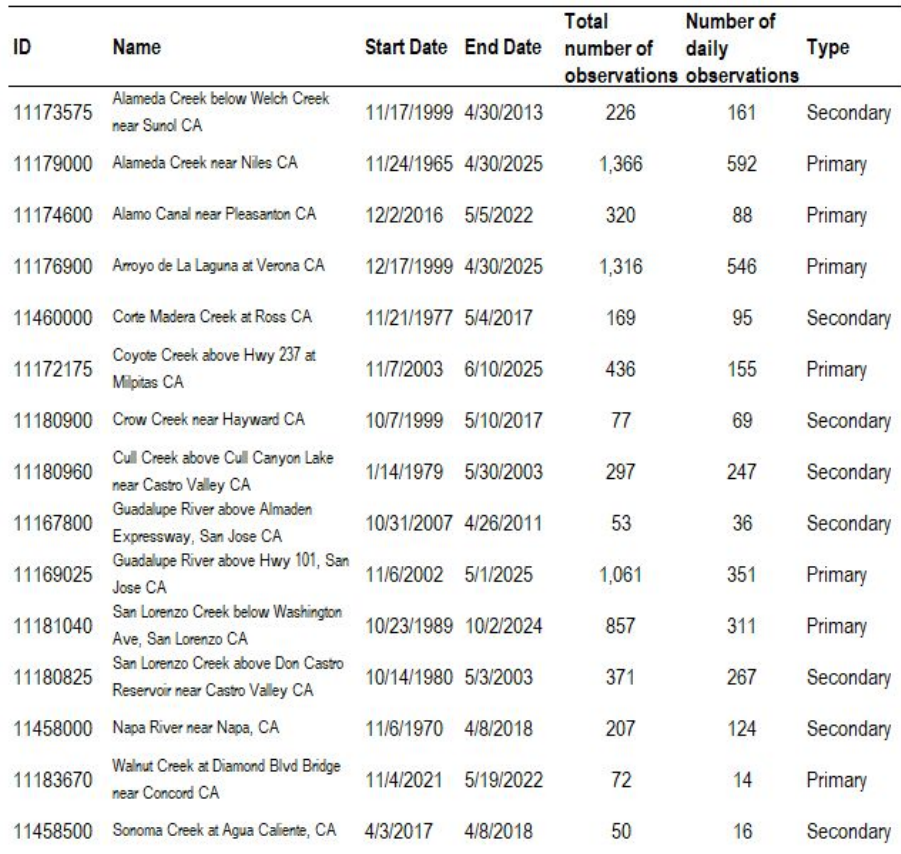


Calibration data is the heartbeat of the WDM

Source publication	Watershed name	Watershed area (km ²)	Watershed outlet location (source or whether it was estimated)	Latitude	Longitude	Yield estimate (metric t/km ² /yr)
Comparison of sediment supply to San Francisco Bay from watersheds draining the Bay Area and the Central Valley of California (McKee et al, 2013)	Stevens Creek	79	USGS 11166550	37.40	-122.07	33
Comparison of sediment supply to San Francisco Bay from watersheds draining the Bay Area and the Central Valley of California (McKee et al, 2013)	Calabazas Creek	53	USGS 11169616	37.30	-122.03	91
Comparison of sediment supply to San Francisco Bay from watersheds draining the Bay Area and the Central Valley of California (McKee et al, 2013)	Permanente Creek	45	USGS 11166575	37.33	-122.09	89
Comparison of sediment supply to San Francisco Bay from watersheds draining the Bay Area and the Central Valley of California (McKee et al, 2013)	Colma Creek	41	USGS 11162720	37.65	-122.43	476
Suspended Sediment Loads Analysis of Four Creeks in the San Francisco Bay Area (Gilbreath et al. 2023)	Arroyo Corte Madera del Presidio	12	RMP	37.90	-122.54	188
Suspended Sediment Loads Analysis of Four Creeks in the San Francisco Bay Area (Gilbreath et al. 2023)	Novato Creek	26	RMP	38.11	-122.58	180
Suspended Sediment Loads Analysis of Four Creeks in the San Francisco Bay Area (Gilbreath et al. 2023)	Belmont Creek	8	RMP	37.52	-122.27	90
Suspended Sediment Loads Analysis of Four Creeks in the San Francisco Bay Area (Gilbreath et al. 2023)	Walnut Creek	232	RMP	37.97	-122.05	250
Petaluma River Watershed Sediment Source Assessment (Peterson et al. 2025).	Petaluma River	321	Estimated based on watershed area	38.21	-122.59	184

Information on sediment yields across the region

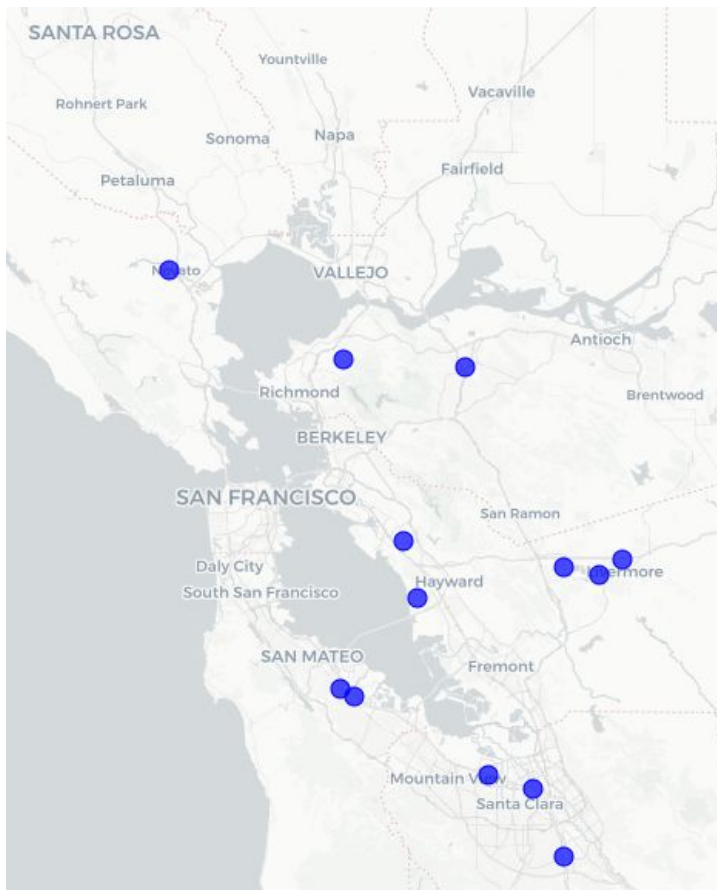




In-stream suspended sediment concentration (SSC)

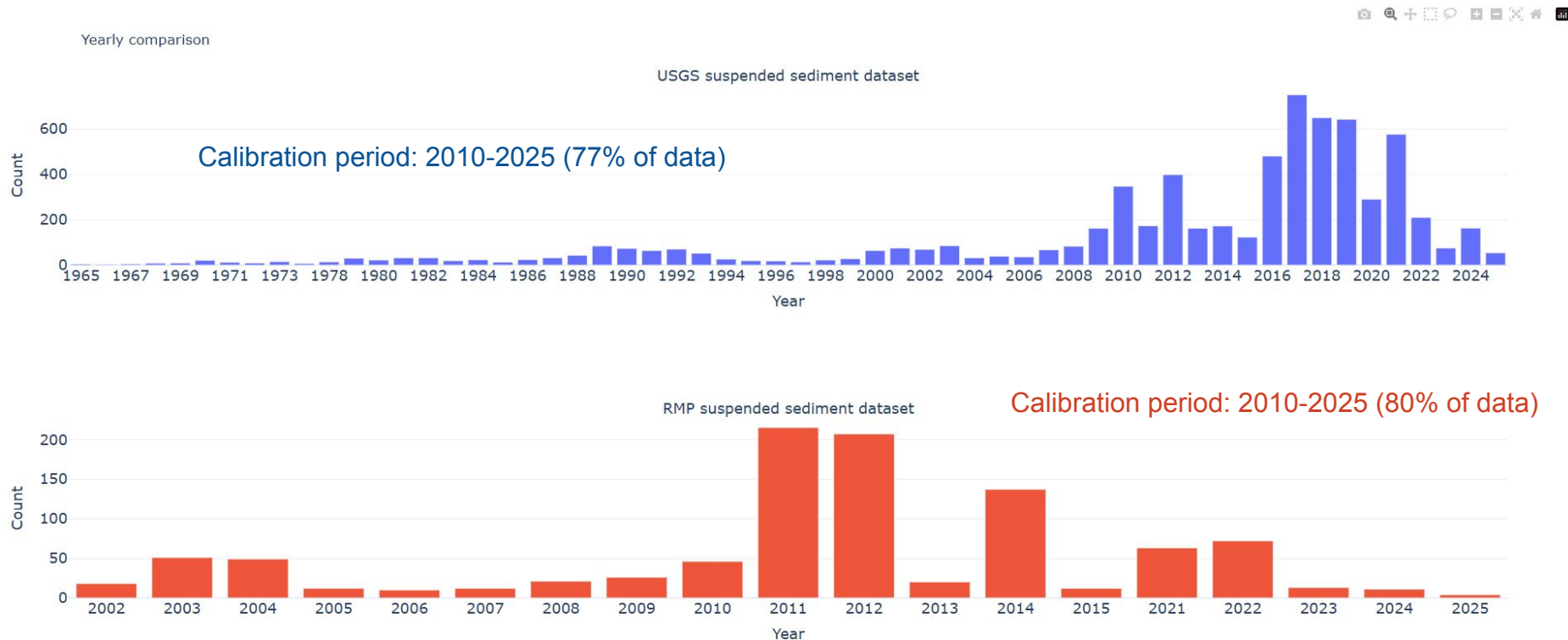
- **Two types of SSC observations:**
 - ***Discrete*** (grab samples, USGS & RMP)
 - ***Continuous*** turbidity-surrogate SSC (USGS)
- We estimated a *flow weighted mean* concentration when more than one SSC was collected during a day, to match the way LSPC outputs “daily mean SSC concentration”
- A monitoring site is labeled as “Primary” if it aligns relatively well with a WDM watershed outlet
- A monitoring site is labeled as “Secondary” if it does not align well with a WDM watershed outlet

In-stream suspended sediment concentrations: RMP



ID	Name	Begin	End	Total number of observations	Number of daily observations	Type
201	Guadalupe R at Foxworthy Road	2009	2010	17	8	Secondary
202	Guadalupe River at Hwy 101	2002	2024	143	67	Primary
203	San Leandro Creek	2012	2014	44	15	Secondary
205	Sunnyvale East Channel	2012	2025	54	16	Primary
206	Zone 4 Line A	2006	2024	67	34	Primary
208	Pulgas Creek PS S	2011	2014	33	9	Secondary
210	Belmont Creek	2021	2023	52	14	Primary
211	Walnut Creek	2023	2024	49	17	Primary
212	Pinole Creek	2003	2004	67	12	Secondary
213	Novato Creek	2022	2023	30	6	Primary
214	Arroyo Mocho at Hageman	2010	2014	146	39	Secondary
215	Arroyo Mocho at Pleasanton	2010	2015	165	48	Secondary
216	Arroyo Las Positas at Livermore	2011	2015	130	34	Secondary

In-stream suspended sediment concentrations



Inventory of in-stream *discrete* SSC observations

[illegible]

Inventory of *continuous* (turbidity-surrogate) SSC observations

Gage	Name	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	
11167800	Guadalupe R Ab Almaden Expressway															•	•	•	•														
11169025	Guadalupe R Abv Hwy 101										•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
11172175	Coyote C Ab Hwy 237											•	•	•	•		•	•	•	•	•									•	•	•	
11173575	Alameda C Bl Welch C Nr Sunol							•	•	•	•				•	•	•	•	•	•	•												
11174600	Alamo Cn Nr Pleasanton																								•	•	•	•	•	•			
11176900	Arroyo de La Laguna A Verona														•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
11179000	Alameda C Nr Niles							•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
11180825	San Lorenzo C Ab Donstro Res	•				•	•	•	•	•	•																						
11180900	Crow C Nr Hayward							•	•	•	•																						
11180960	Cull C Ab Cull C Res Nr Castro Valley	•	•	•	•	•	•	•	•	•	•																						
11181040	San Lorenzo C A San Lorenzo																•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
11183670	Walnut C A Diamond Blvd Bridge																													•			
11460000	Corte Madera C A Ross																	•	•	•	•												
	Count	2	1	1	1	2	2	5	5	5	6	3	3	3	5	5	7	8	8	7	7	4	4	4	5	5	5	5	5	7	5	5	

Number of stations available varies by year; no water year is complete.
Some of the data is 20+ years old

Sediment erosion calibration: basic representation of land processes

Impervious land

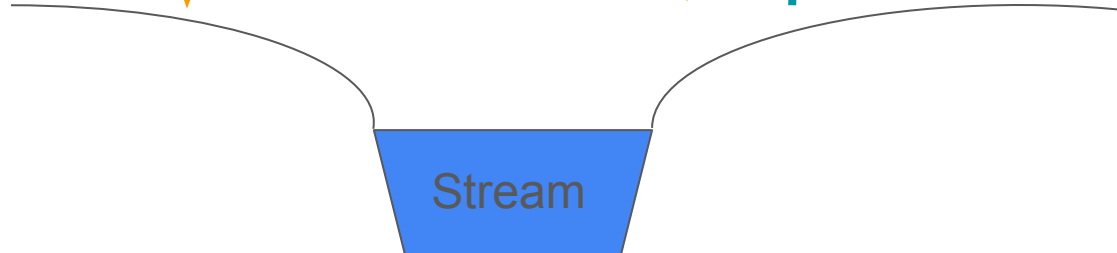


Sediment washoff
(KSER, JSER)

Pervious land



Soil detachment
(KRER, JRER)



Sediment erosion calibration

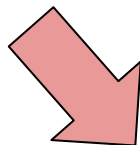
Basins Technical Note 8



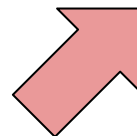
Parameter	Description	Minimum	Maximum	Unit
KRER	Coefficient of soil-detachment equation (pervious land)	0.05	0.75	complex*
JRER	Exponent of soil-detachment equation (pervious land)	1.00	3.00	none
KSER	Coefficient of detached sediment washoff equation (pervious and impervious)	0.10	10.00	complex*
JSER	Exponent of detached sediment washoff equation (pervious and impervious)	1.00	3.00	none

* ton/acre/day if exponent is equal to 1

Land use	Minimum Sediment Yield (tons/(ac*yr))	Maximum Sediment Yield (tons/(ac*yr))
Forest	0.05	0.4
Pasture	0.3	1.5
Conventional Tillage	1	7
Conservation Tillage	0.5	4
Hay	0.3	1.8
Urban	0.2	1
Highly erodible land	15	-



Land use	KRER	JRER	KSER	JSER
Agriculture	0.4	1.6	10	2
Forest	0.3	2	1	2
Grassland	0.3	2	2	2
Shrub	0.3	2	2.5	2
Urban	0.3	2	0.3	2



Sediment erosion calibration

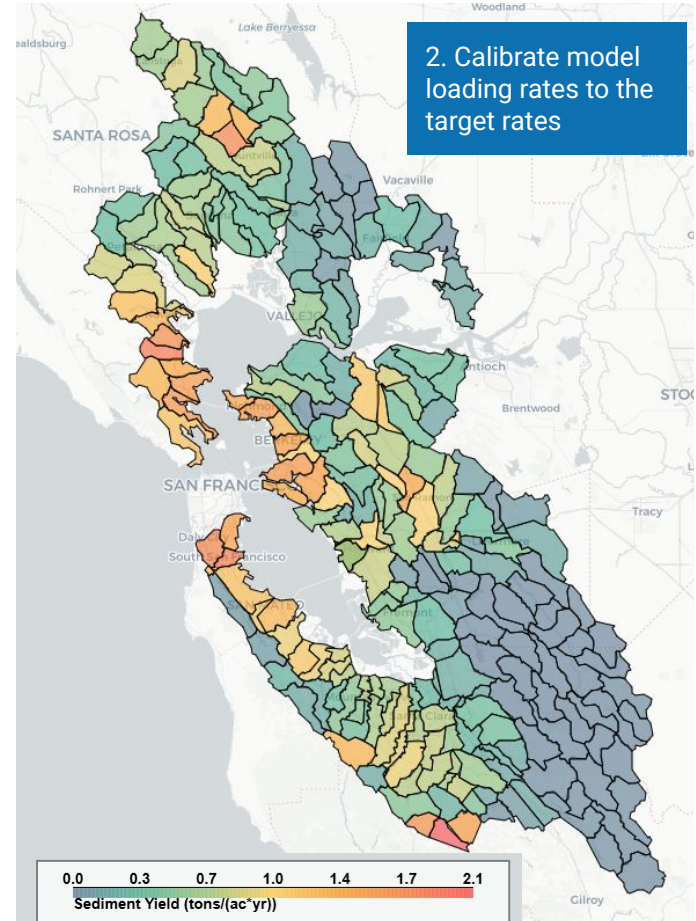
Map of sediment yield for agricultural land use

Map of sediment yield for industrial land use

Boxplot of sediment yields

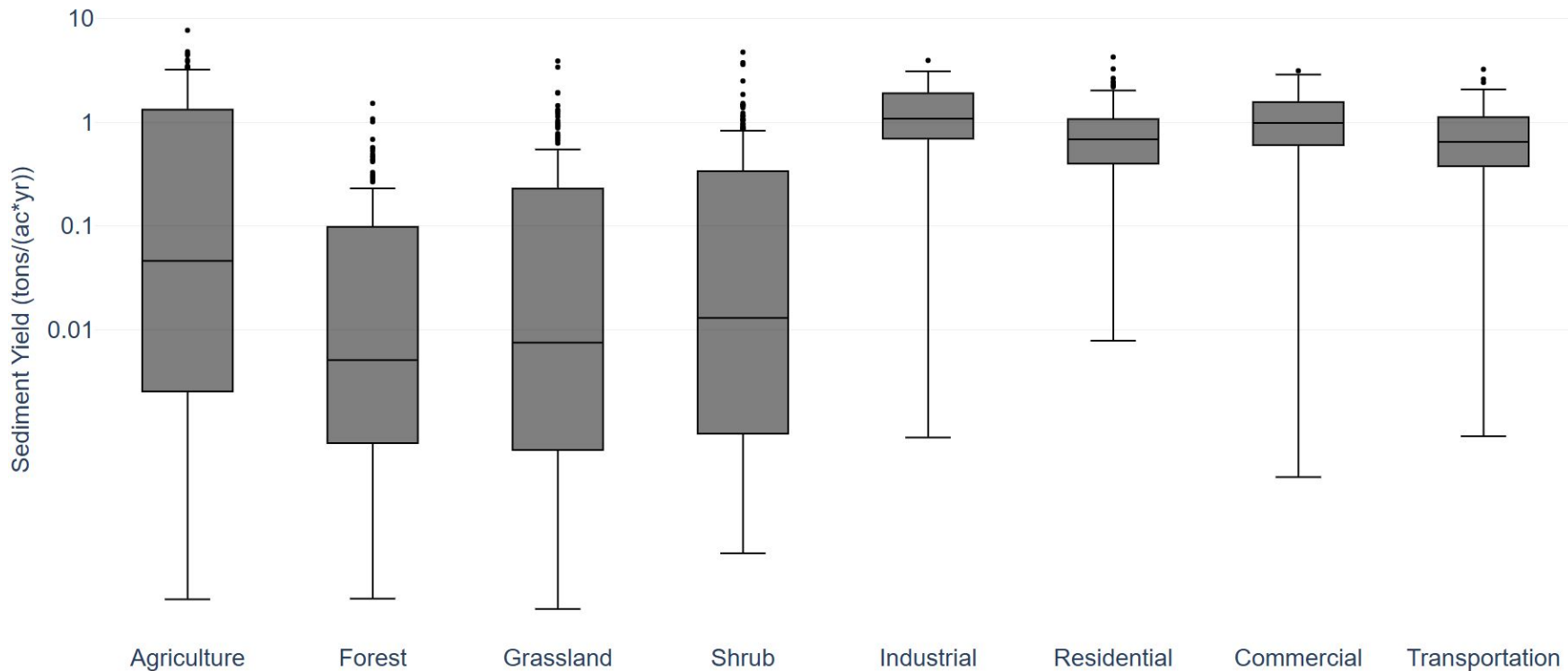
Sediment yield from land surface

Sediment loads



Erosion and sediment washoff from land surfaces

Sediment Yield by Land Use



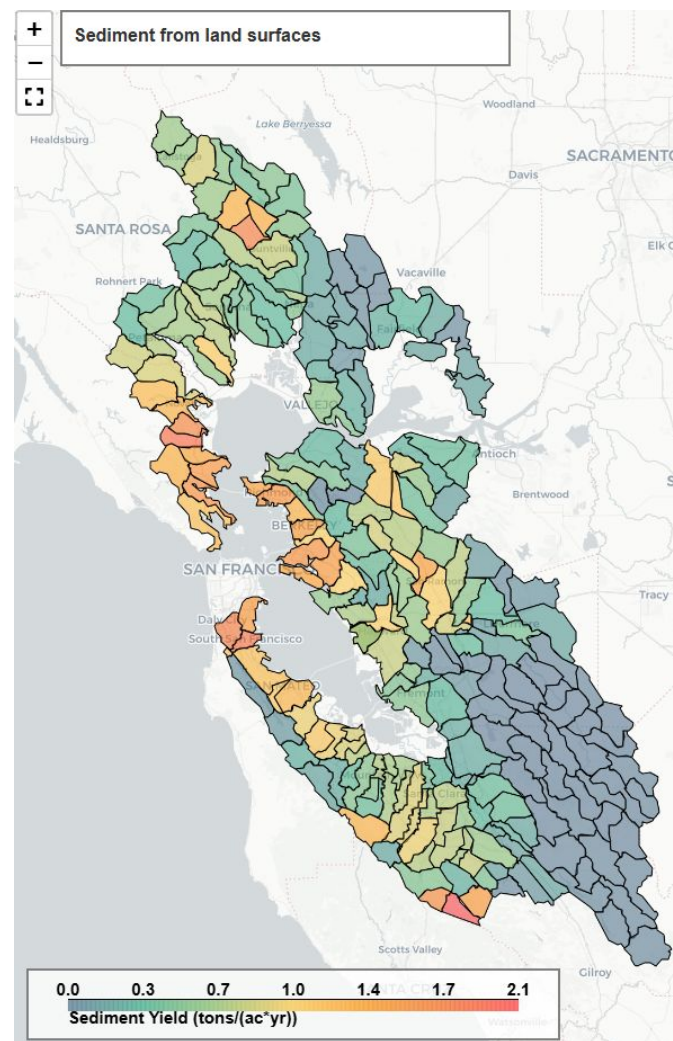
Ag: 0.5 - 7 tons/ac/yr

Grass: 0.3 - 1.5 tons/ac/yr

Urban: 0.2 - 1.0 tons/ac/yr

1

- Lower sediment yields in urban areas, consistent with values from the literature
- Sediment erosion on the Peninsula and East Bay are within the same order of magnitude



2 In-stream sediment transport



[Dashboard: Discrete SSC data](#)

[Dashboard: Continuous SSC data](#)

[Dashboard: Cumulative distribution function](#)

[Dashboard: Sediment rating curve](#)

[Sediment delivery ratios](#)

[Dashboard: Sand, silt, clay](#)

[Dashboard: Reservoirs](#)

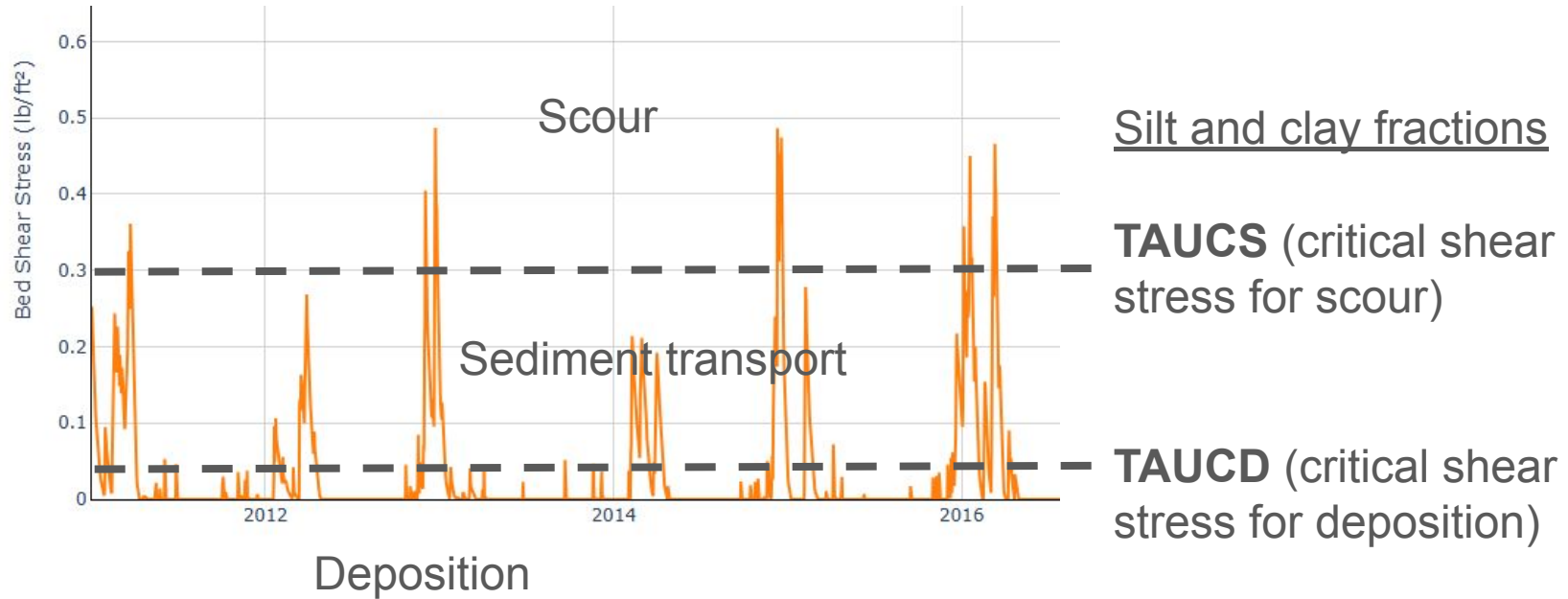
[Dashboard: Sediment load at reach outlet](#)

[Sand fraction map](#)

[Silt fraction map](#)

[Clay fraction map](#)

In-stream sediment transport



2 In-stream sediment transport

We redefined critical bed shear stress (TAUCS, TAUCD) silt and clay

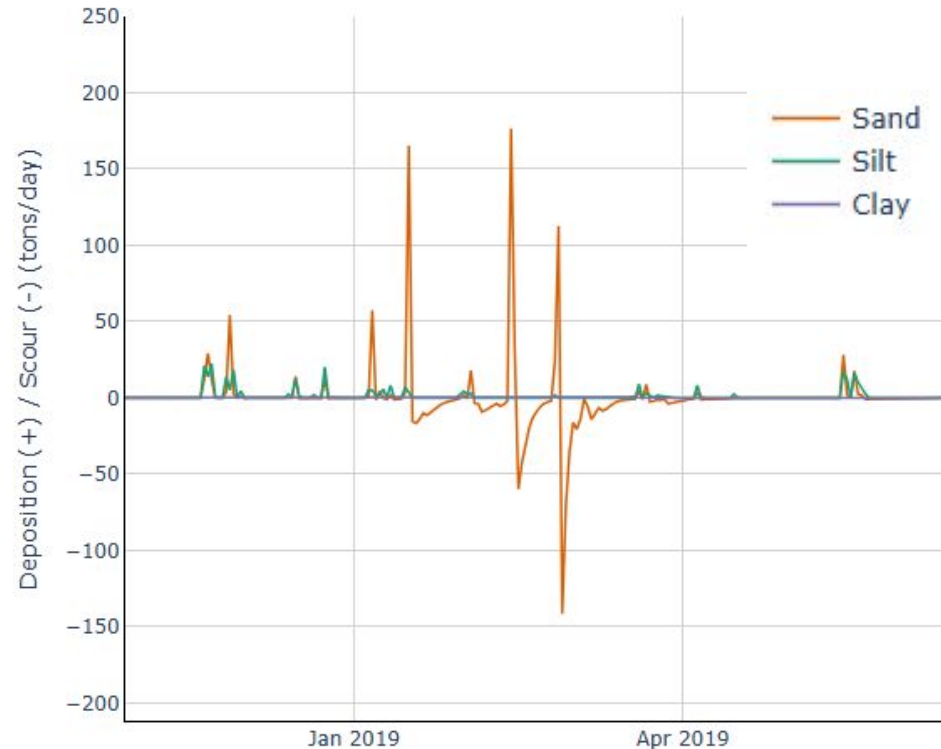
Silt

- **TAUCS:** 90th percentile
- **TAUCD:** 50th percentile

Clay

- **TAUCS:** 85th percentile
- **TAUCD:** 35th percentile

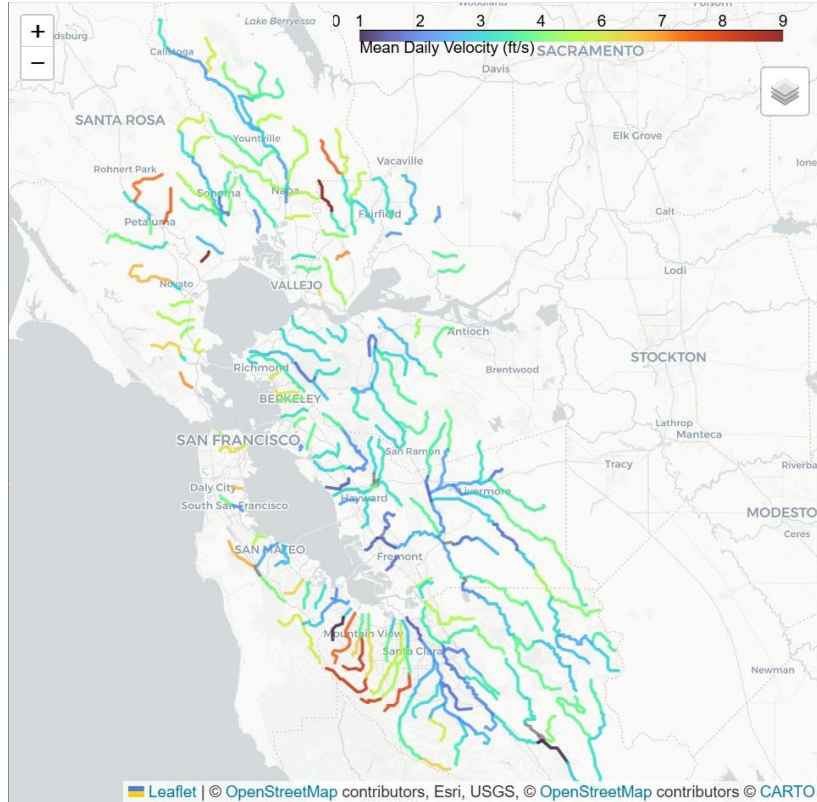
1060: Novato Creek - Sediment Fractions



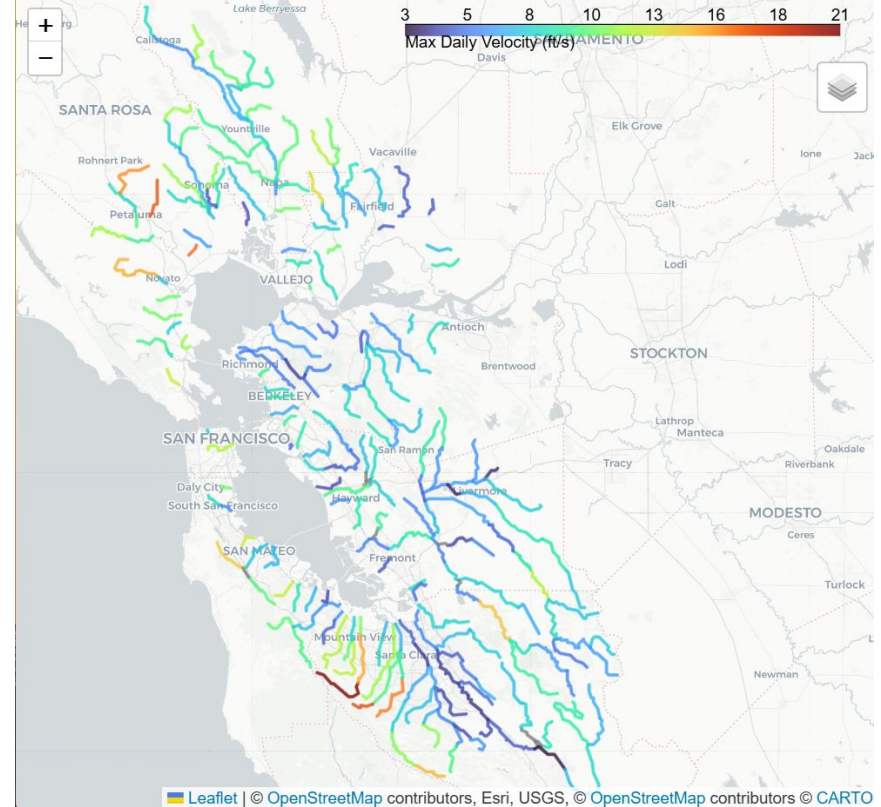
Update to Reach Geometries and Flow Routing

- Existing calibration showed unrealistically high channel scour, which we traced to high flow **velocities**.
- Many, but not all, problem reaches had **user-defined F-Tables**.
- We recalculated the channel **slopes** and increased channel **lengths** and **widths**.
- Impact on hydrology (fit to observed flows) was very small.
- Now, the velocities much more **realistic**, however we don't know if they're **right**
- Velocity has never been one of our calibration targets. (But it probably should be in the future!)

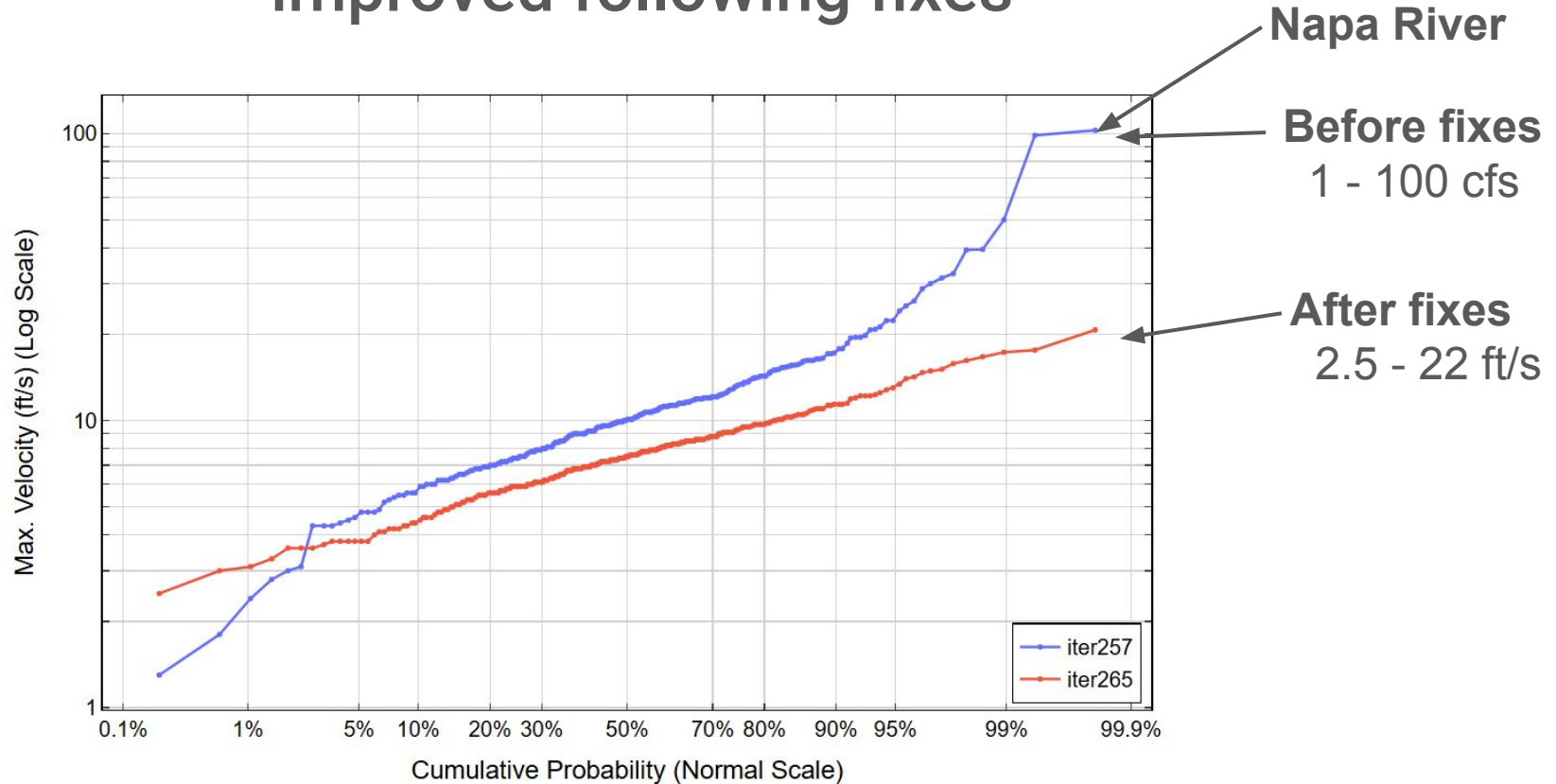
Mean velocity (when flow > 1 cfs)



Maximum velocity

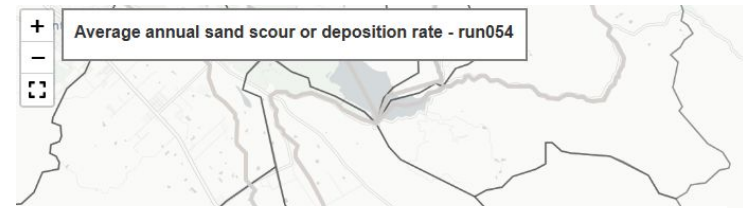


Distribution of maximum velocities much improved following fixes

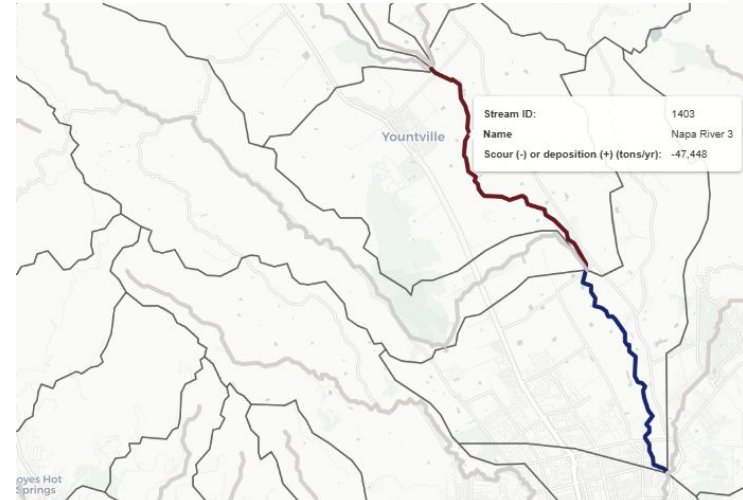


2 In-stream sediment transport

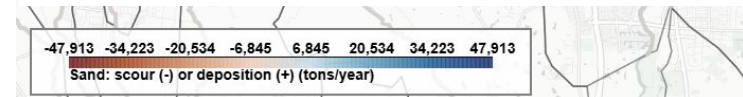
We identified unrealistic scour and deposition patterns in several reaches



Scour (sand): -47,448 tons/year

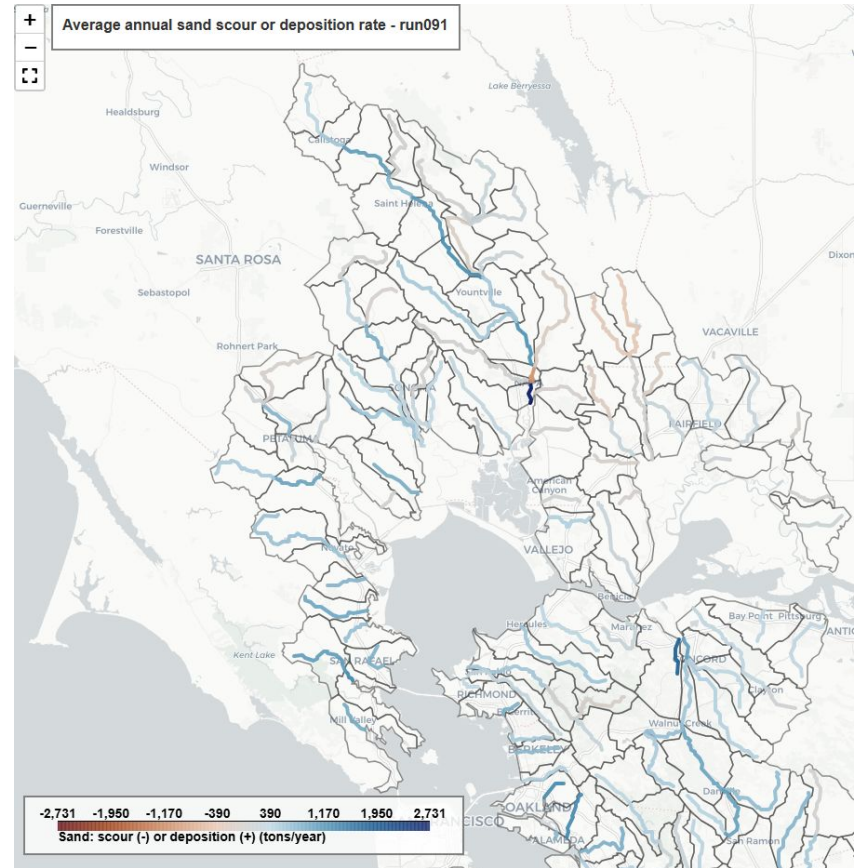


Deposition (sand): 47,913 tons/year



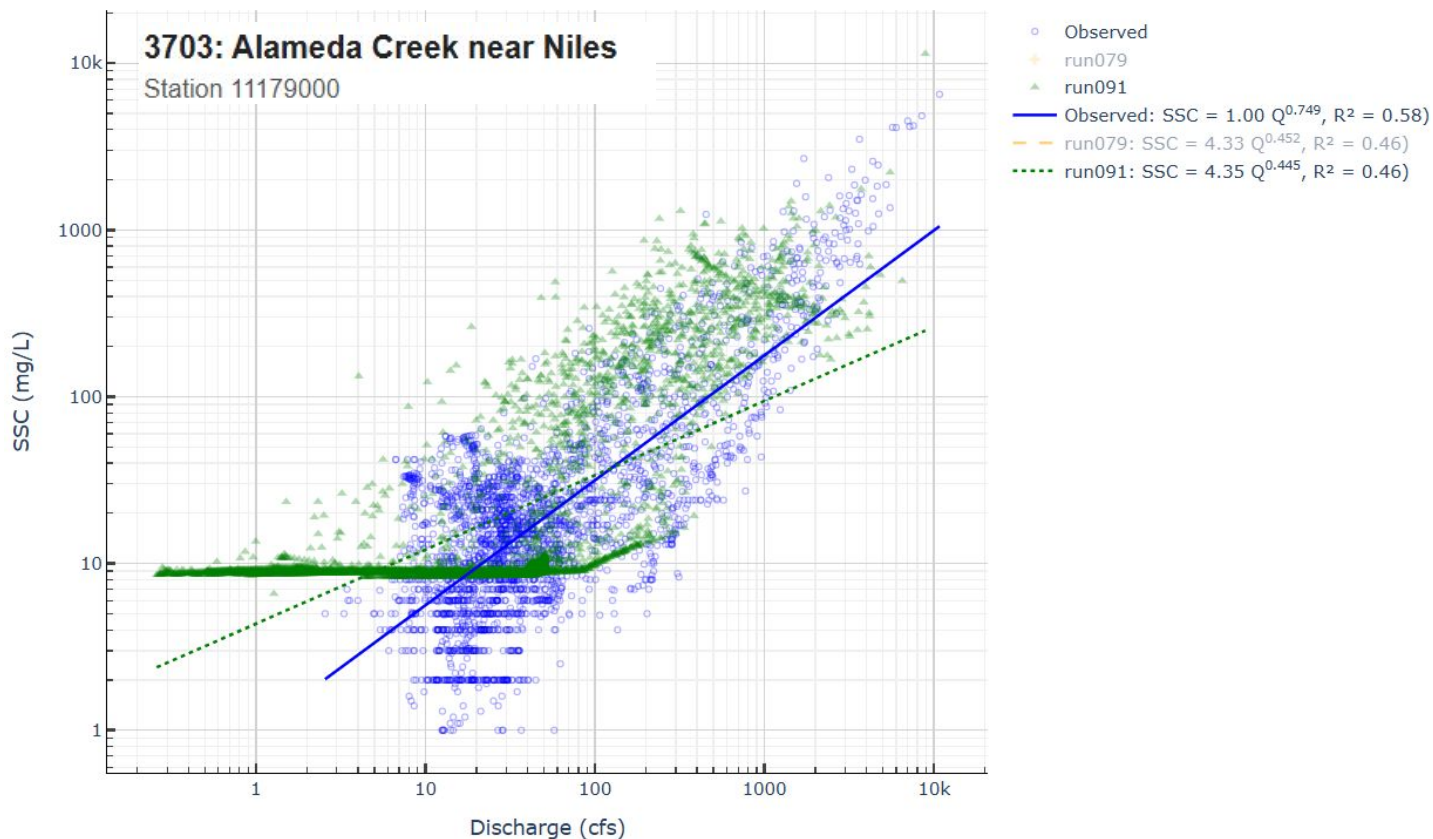
2 In-stream sediment transport

- We recalculated scour and deposition
- We expect more scour in reaches with a steeper slope and deposition in lower-sloped reaches near the Bay



2 In-stream sediment transport

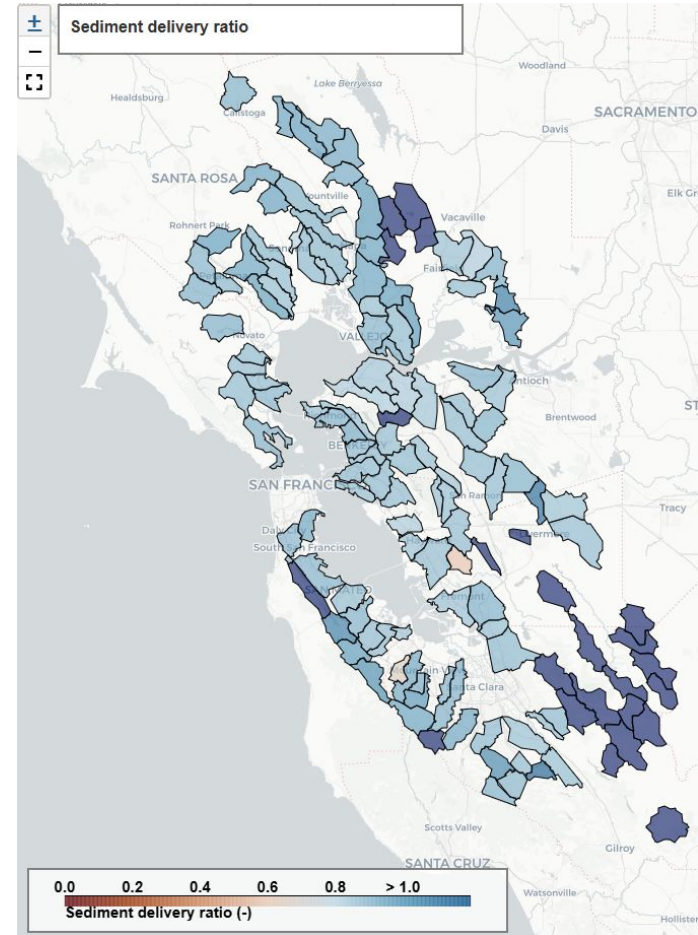
Overview of simulated SSC



Verify sediment delivery ratios (SDR) for all 3 classes (sand, silt, clay)

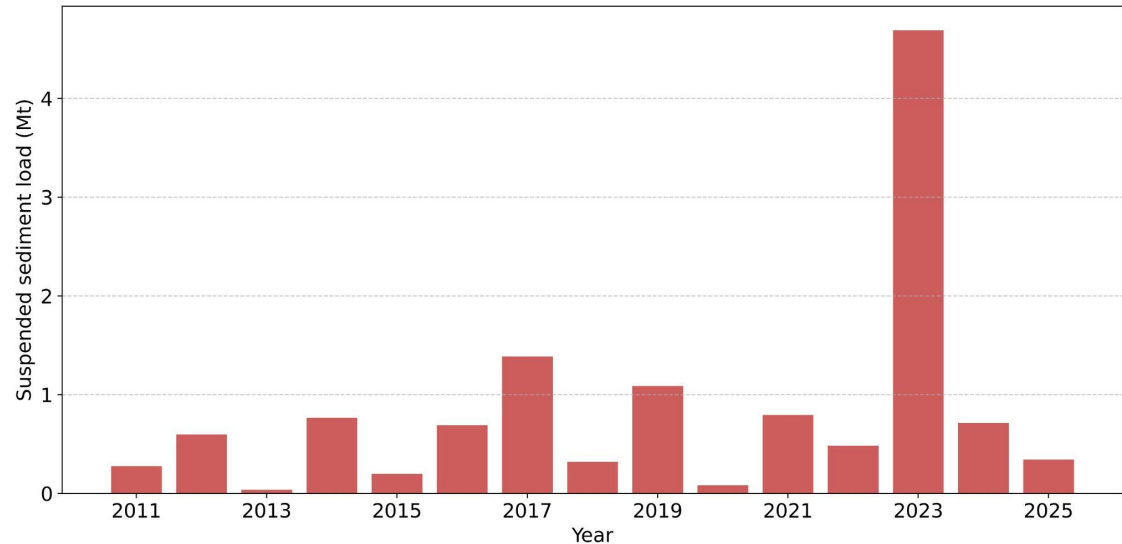
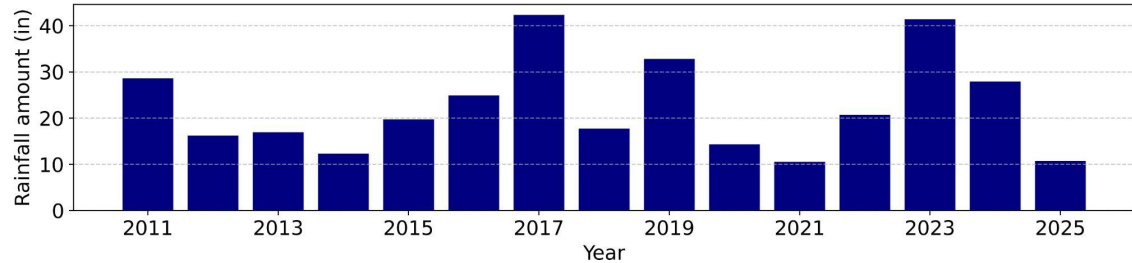
- SDR in first-order subbasins varied from 0.57 to 7.30.

SDR > 1 in upstream subbasins, where sediment loads are relatively low



Suspended sediment load entering the Bay (under review)

- We estimated an average 0.76 Mt annual sediment load to the Bay (2011-2025)
- McKee et al. (2013) estimated an annual average sediment load of 1.39 Mt (1995-2010)
- 2023 was the second wettest year between 1994 and 2025: 41.6 in



Discussion and next steps

- Review by SFEI staff, stakeholders, and science advisors
- Model validation using data from 1995 - 2010
- Continuous improvements detailed in “Proposed Watershed Modeling Workplan for 2027”
- Production of interactive maps and figures for Watershed Dynamic Model website: selection of colors, information, and units (SI)

Mercury model



Goals



Calibration
approach



Data sources

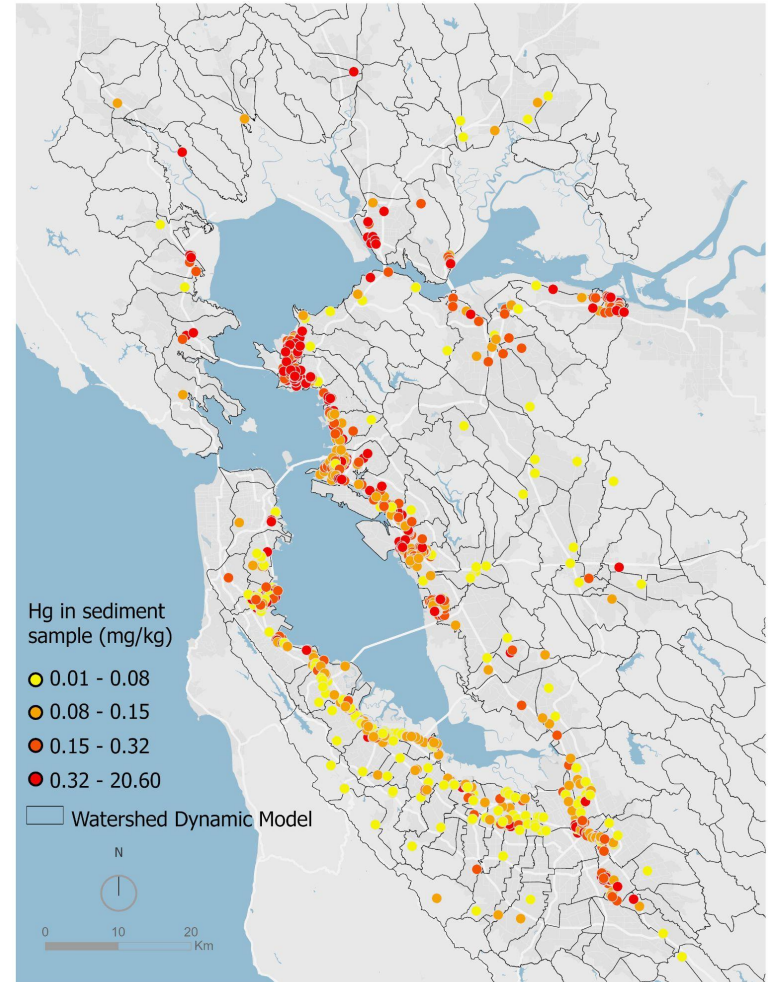


Output
visualization

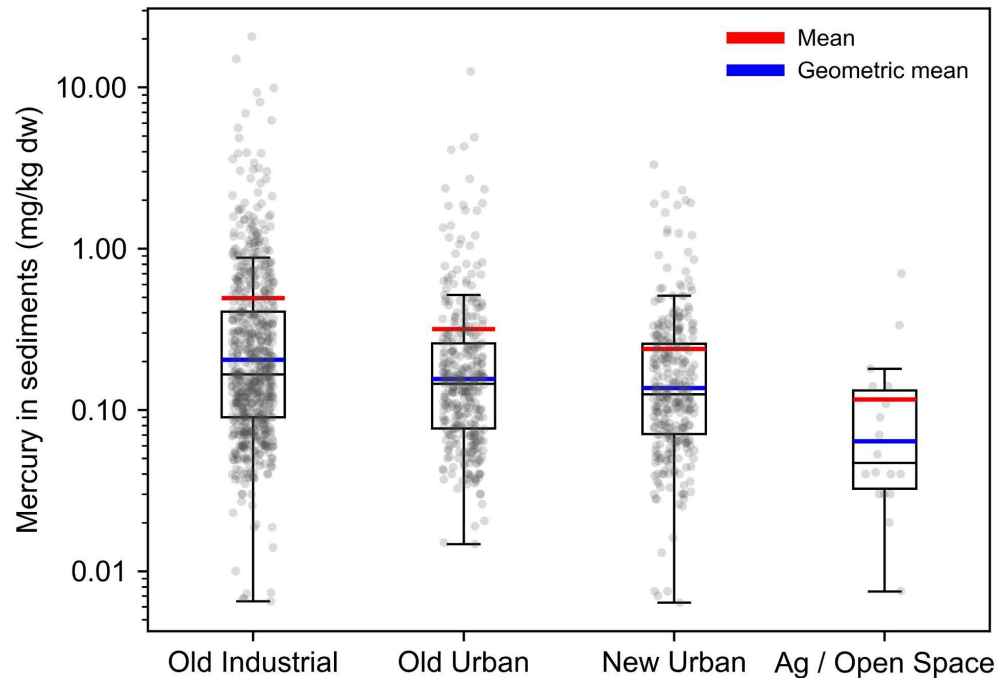
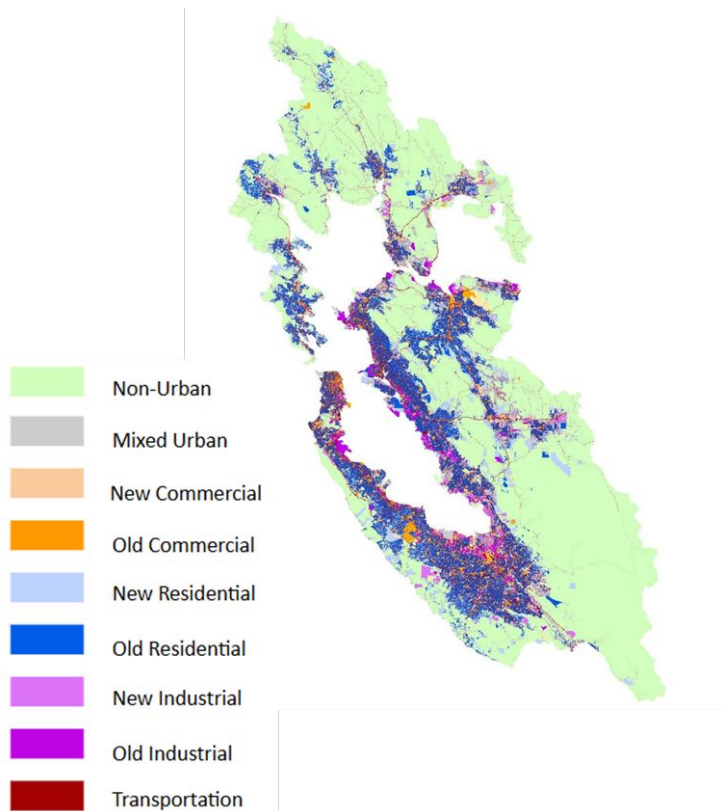
Various data sources contributed to a unique dataset to develop potency factors

- 1,367 soil samples tested for Hg
- The majority of data collected by different county stormwater agencies

These data sources are described in our Apr 28 memo ([link on web portal](#))



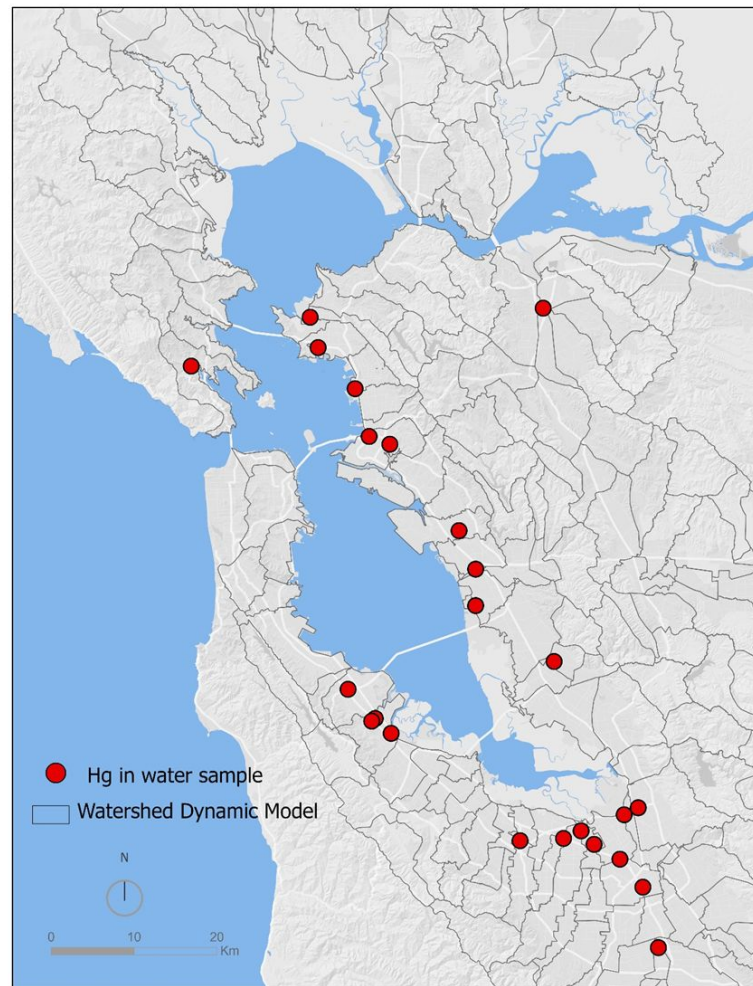
Dataset to develop Hg potency factors



We assembled an extensive calibration dataset for in-stream Hg calibration

Stations	Number of in-stream Hg samples
Arroyo Corte Madera del Presidio	15
Guadalupe River at Foxworthy Road	46
Guadalupe River at Hwy 101	269
North Richmond PS	51
Pulgas Creek PS	35
San Leandro Creek	51
Sunnyvale East Channel	43
Walnut Creek	18
Zone 4 Line A	118

dozens of other stations with few observations



Dry and wet mercury atmospheric deposition

Atmospheric mercury fluxes in the Bay Area were last estimated approximately 25 years ago (Tsai, 2001; Steding and Flegal, 2002).

Deposition Type	Mean Rate ($\mu\text{g}/\text{m}^2/\text{y}$)	Range / Specific Locations ($\mu\text{g}/\text{m}^2/\text{y}$)
Dry Deposition	19	18 – 21 (Across 3 Bay sites)
Wet Deposition	4.2	3.5 (South Bay) to 4.5 (Central Bay)

Background concentration of dissolved mercury



- Hg is predominantly associated with sediment, yet there is a small amount of dissolved Hg present in baseflow.
- Can be established through calibration, however we have samples collected during low-flow conditions.
- The lowest concentration SFEI measured in Zone 4 Line A, a well-sampled urban watershed, was 1.4 ng/L.
- Researchers from UC Santa Cruz and Stanford measured submarine groundwater discharge of total mercury and methylmercury at Stinson Beach and Elkhorn Slough (Black et al., 2009)

Water Source	Original Range (pM)	Converted Range (ng/L)
Filtered Groundwater	1.2 to 28.3	0.24 to 5.68
Filtered Surface Waters	0.8 to 11.6	0.16 to 2.33
Unfiltered Surface Waters	2.5 to 12.9	0.50 to 2.59



Share your thoughts!

matth@sfei.org

pedroa@sfei.org



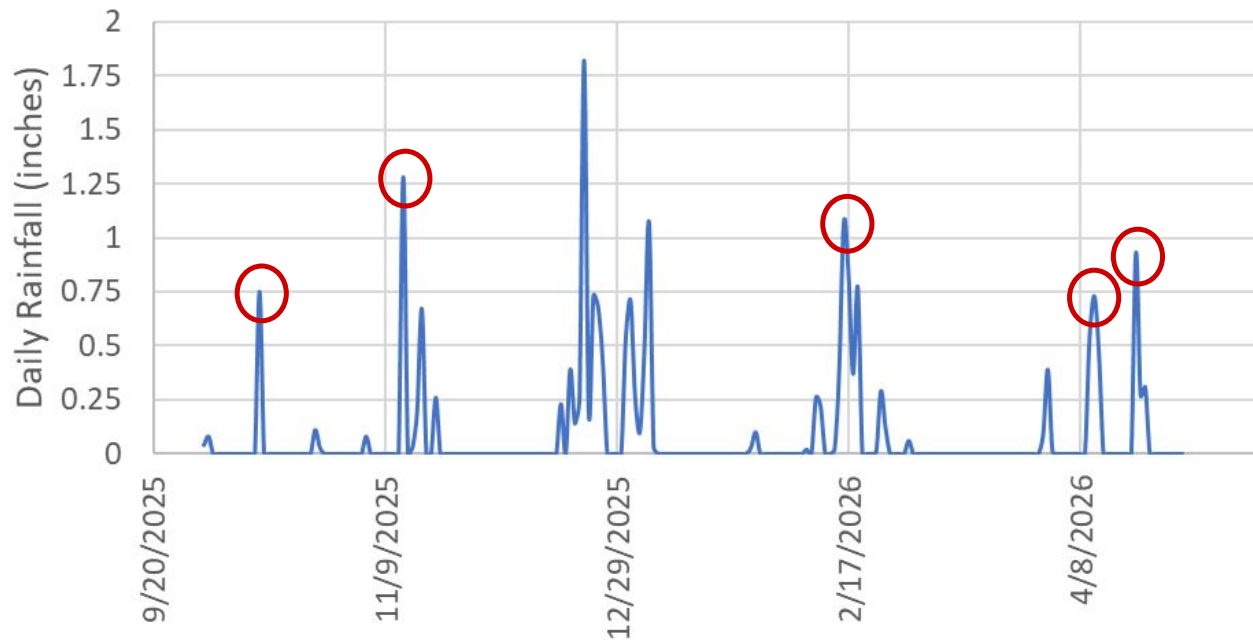
WY 2026 Stormwater Monitoring Update



WY 2026 Rainfall Season



Downtown San Francisco



Season Overview

- Across the region, Water Year 2026 rainfall was approximately the annual average.
- 7 significant precipitation events; we sampled 5 missing 2 events during holidays.
- **Red circles** denote sampled storms.

WY 2026 Stormwater Monitoring Scorecard

Project	Pollutant Focus	Sites/Storms	Progress
SW CECs Small Remotes	PFAS ¹	Up to 22 sites, 1 storm ea	
SW CECs Manual	PFAS and other CECs ²	6 sites, 1 storm ea	
SW CECs Large Remotes	PFAS and other CECs ³	3 sites, 1 storm ea	
S&T Wet Season Near Field	PFAS and other CECs ⁴	5 sites, 2 storms ea	
EPA - Bioretention Study	Traditional pollutants and Microplastics	2 sites, 3 storms ea	
Sea Grant: MPs in Trash Capture Devices	Microplastics	3 sites, 3 storms ea	

¹ Includes PFAS in rainwater at some sites

² Includes add-on studies: QACs, Tire-derived Contaminants, Carbendazim/biocides, NTA, PFAS NMR, PFAS in rainwater

³ Includes same as SW CECs Manual sampling add-ons except no NTA

⁴ Includes: PFAS, SSC, Tire-derived Contaminants (add on), NTA, QACS (add on)

Successful

Unsuccessful; sites to be resampled

Storm

Site

Highlights of WY 2026



Season by the Numbers

- **20+** remote sampler deployments, 17 successful
- **22** manual team sampling events in 5 storms
- **2** S&T post-storm sampling events



Program Growth

- Expansion this year and expected next year
- Significant systems improvements



New Samplers

- Small automated samplers
- Introduced new large automated sampler - Aquamatic
- PFAS in rainfall study



Stormwater CECs

ISCOs and Aquamatics and Small Automated Samplers, Oh My! (and don't forget the buckets and bailers)

Pre-Season Overview

- Desktop and physical recon
- Review with counties
- 30-35 sites selected for monitoring
- Permitting and contracting
- Sampling and Analysis Plans, Standard Operating Procedure development

Season Overview

- Remote Sampling: Collected 17 samples using the small automated sampler (PFAS Target and TOP)
- On-Location Sampling:
 - Sampled 6 sites manually including a reference site on SFPUC land in San Mateo County
 - Sampled using the Aquamatic during 2 events
 - 16 analytes, 26 bottles not including QA, multiple sampling tools and techniques analyte-dependent

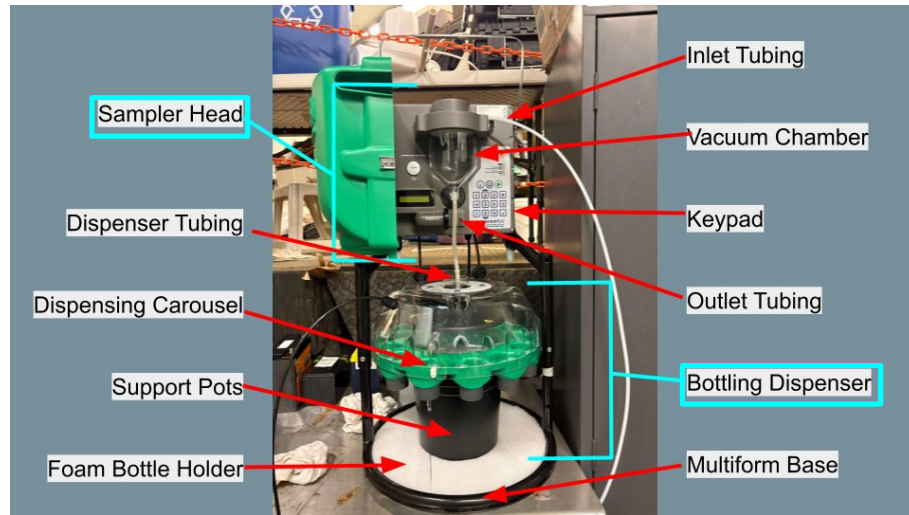
Stormwater CECs

Continued Improvements on Small Automated Samplers



Stormwater CECs

Aquamatic Piloting



Microplastics in Trash Capture Devices



USC Sea Grant Project: Clean Streets for Clean Seas

- Sampling MPs before and after trash capture devices to assess effectiveness at MP removal
- 3 sites in Hayward
- 1 connected pipe screen site;
2 sites with CDS
hydrodynamic separators
- 3 storms each

Recent Findings

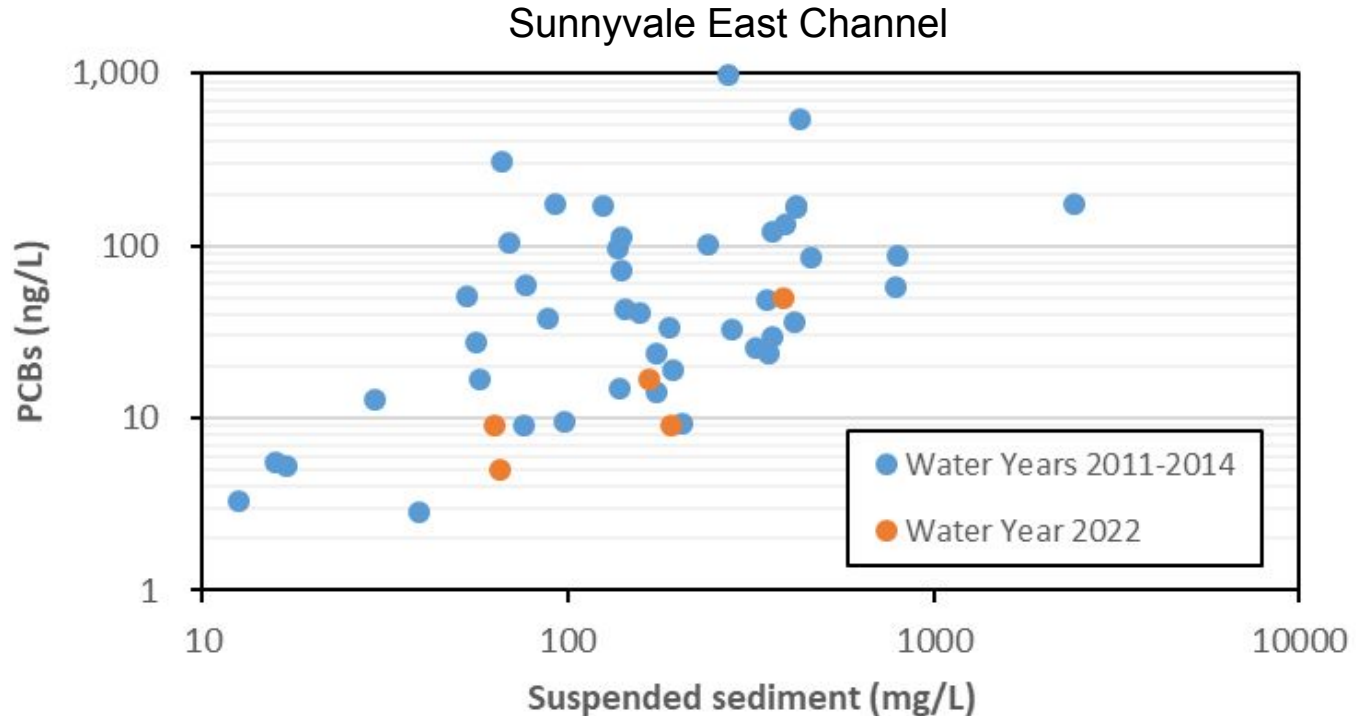
WYs 2021-2022 POC Report

Watershed	Open Space	Residential	Commercial	Industrial	Transportation
Kerner Pump Station	2%	22%	33%	18%	26%

Watershed	County	Water Year sampled	Total area (km2)	Impervious cover (%)	Polychlorinated biphenyls (PCBs)		Total mercury (HgT)		Suspended sediment concentration (SSC)
					(ng/g)	(ng/L)	(ng/g)	(ng/L)	(mg/L)
Canal Pump Station	Marin	2022	1.39	67	55	1.7	-	-	31
Kerner Pump Station	Marin	2022	0.51	81	76	3.6	1,192	57.2	48
Meeker Slough at Regatta Blvd.	Contra Costa	2022	7.01	65	94	4.4	863	39.7	46
Santa Fe Channel Stormdrain at South 8th St.	Contra Costa	2022	2.15	70	233	12	612	31.8	52
Sunnyvale East Channel at Ahwanee Ave. (averaged)	Santa Clara	2022	12.02	60	102	18	200	34.9	175
End of Eden Park Place	Alameda	2021	5.65	60	85	-	-	-	-
Zone 9 Line C at Juniper St.	Alameda	2021	3.32	69	265	-	-	-	-

Recent Findings

WYs 2021-2022 POC Report





Item#7 FMSN 4.0 - Part 1: Visioning & Planning

SPLWG, May 14, 2026



Outline (65 minutes)

Provide background information

- Provide the management context
- Remind you that the FMSN is part of a broader monitoring strategy
- Give a brief history of past FMSNs
- Discuss the FMSN vision, need, collaboration, funding, and timeline
- Give an overview of Bay Area geography
- Discuss station selection ideas

Get input on

- Station selection criteria
- Science questions about the design of the network

Core Management Questions

Core management question common to many parts of the RMP program



Sources

Where are the pollutants coming from? (Spatial trends)



Loads

How much is entering the Bay?



Trends

Are conditions improving or worsening over time? (Temporal trends)

Continued Mobile/Agile Sampling Methods (Spatially and temporally flexible)



Manual sampling

Versatile collection at any location



Small automated sampler fleet

Flexible, event-driven deployments



Passive suspended sediment samplers

Long-term integrated spatial data

Primary Goal

**Reconnaissance
characterisation**

Complementary Monitoring Methods

Fixed Station Monitoring

Strength: Temporal Coverage

Understanding how concentrations and loads change across events, seasons, and years.

Mobile Monitoring Methods

Strength: Spatial Flexibility

Applicable to new or repeated sites, covering a wider population of watersheds. Easy to relocate, but more effort for long-term repeated monitoring (setup/takedown every event).

Together, these methods provide the **robust dataset** required for our statistical and numerical modeling tools to answer ALL **THREE** of our **core management questions**.

FMSN 4.0: The Vision

To collaboratively build a network of monitoring stations that together generally represent the region's local watersheds, to produce robust, quality-assured, publicly available long-term data on stormwater flow and pollutant concentrations to address evolving management questions.

Each station will include:



Facilities for automated and manual collection of creek water samples



Gauges and sensors for ancillary data (flow, rainfall, turbidity, conductivity)



Potential instrumentation for capturing rainfall and air samples



Hardware for data storage and communications for remote access.

Fixed Monitoring Station Network: Past Objectives

FMSN	Era	Focus	Primary Goal
1.0	Late 80s – Early 90s	Management & Permits	Establishing baseline conditions for early MS4 permits.
2.0	WYs 2002–2010	TMDL Development	Loads estimation (PCBs and Hg), conceptual model, impairment assessment reports (Dioxins/Furans, OC Pesticides, PBDE, PAHs).
3.0	WYs 2012–2014	Model Parameterization, Calibration and Verification	Load verification, data to support Reasonable Assurance Analysis (RAA) and watershed modeling.

A Past Example: Sunnyvale East



Why Have a Fixed Station Network



Long-Term Trends

Establish contaminant concentration and loading trends from local watersheds to the Bay.



Continuous Datasets for Sediment and Other Contaminants

Capture multi-contaminant samples and real-time flow, turbidity, and rainfall data.



Regional Representation

Ensure monitoring efforts will provide a representative view of the region's diverse watersheds.



Modeling Support

Provide high-quality data for robust watershed model calibration and predictive analysis.



Support Data Interpretation

Inform storm-driven variability analysis and examine relationships with landscape features.



Resource Efficiency

Provide a framework for representative sampling of any contaminant with optional use of large automated samplers

FMSN 4.0: What Does Permanent Stations Mean?

Permanent fixed stations
to monitor watershed
inputs to San Francisco
Bay

- Earlier fixed monitoring stations were in place for 2-5 years
- We envision this one to last for decades

FMSN 4.0: Making it Happen

Management Team

Collaborating on station siting and capabilities:

- Bay Area Stormwater Management Coalition (BAMSC)
- Water Board
- RMP Scientists and Workgroup Leads

Funding & Responsibility

RMP and BAMSC share responsibilities. BAMSC building first four stations with:

- County construction funding
- USEPA grant funding for planning/design

BAMSC Grant Requirements

- First four stations must be suitable for PCBs trends. *This is a requirement of the USEPA BAMSC grant.*

Co-location Strategy

- RMP and BAMSC will likely have parallel equipment co-located at each station. *Note: Not anticipating shared equipment at these stations.*

Building out the network

- We will likely need more than four permanent stations to broadly represent Bay Area characteristics for contaminants beyond PCBs.
- This will take further funding.



FMSN 4.0: Possible Contaminants

Core Contaminants

- PCBs
- Hg (selected stations)
- Suspended sediments
- Cu (Total)

In Discussion

- Cu (dissolved), other legacy metals
- Sediment bedload

Emerging Contaminants and Microplastics

- PFAS, including PFOS
- Microplastics, including tire wear particles, fibers
- Other contaminants TBD

Nutrients (unlikely)

Unknown future contaminants, as needed to address RMP management questions

FMSN Schedule

TRACK 1: PILOT STATION DEPLOYMENT (2025 - 2026)

OCT 2025

Project Kickoff

Conduct monthly management meetings.

LATE 2025 - EARLY 2026

Station Selection

Conduct monitoring location reconnaissance and mapping.

MAY 2026

Final Selection

Finalize pilot station selection with input from Science Advisors and Stakeholders.

SUMMER 2026

Final Decision

Confirm station equipment requirements.

SUMMER 2026

Design & Prep

Complete pilot design and secure necessary equipment for pilot operation.

OCT 2026

Go Live

Pilot station is operational.

TRACK 2: REST OF NETWORK PLANNING & CONSTRUCTION

NOV 2026

SPLWG Mtg #2

Perform technical review of the expanded network design.

WINTER 2026 - SPRING 2027

Station Selection

Validate final station locations based on technical reviews.

APRIL 2027

SPLWG Mtg #3

Confirm network design and finalize equipment requirements.

FALL 2027 - 2029

Full Launch

Complete construction and go live with monitoring for all stations.

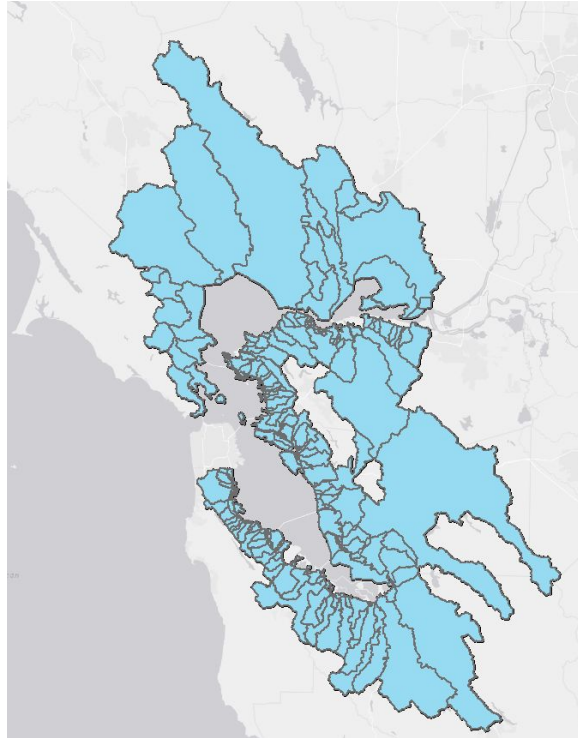


FMSN 4.0 : Geography & Characteristics

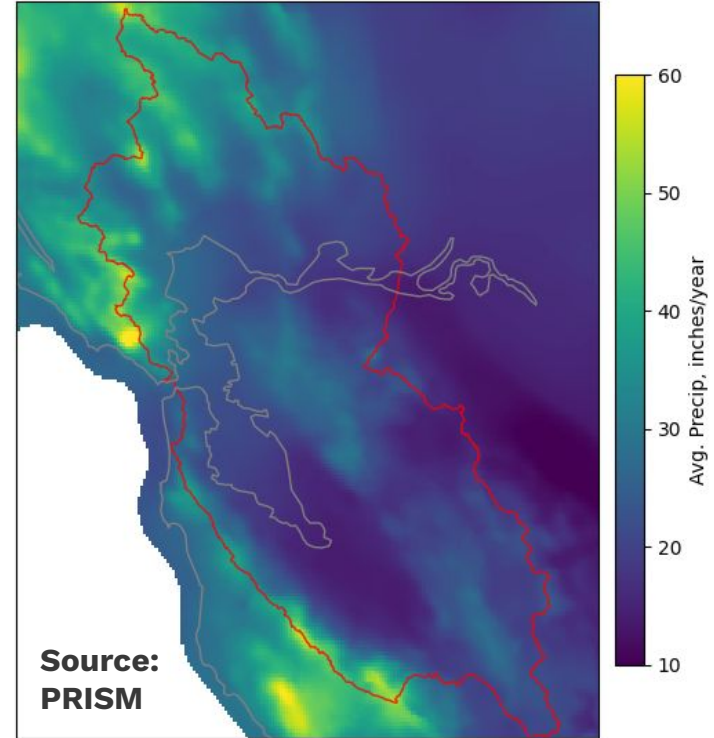
Watersheds of diverse land use



Over 350 discrete watersheds

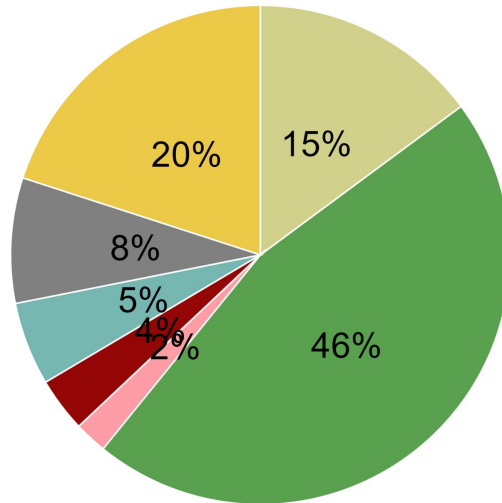


Average rainfall that varies 4-fold

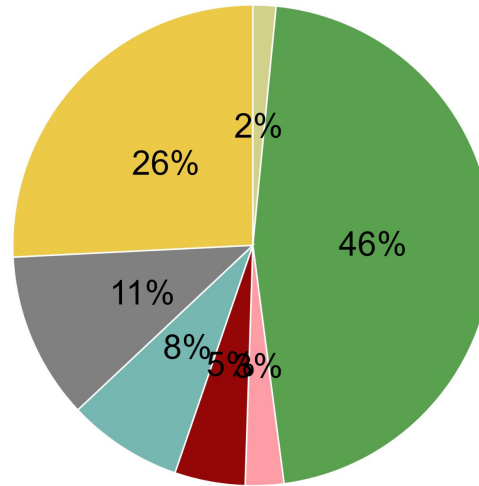


FMSN 4.0 : A Early Focus on Urban Landuse

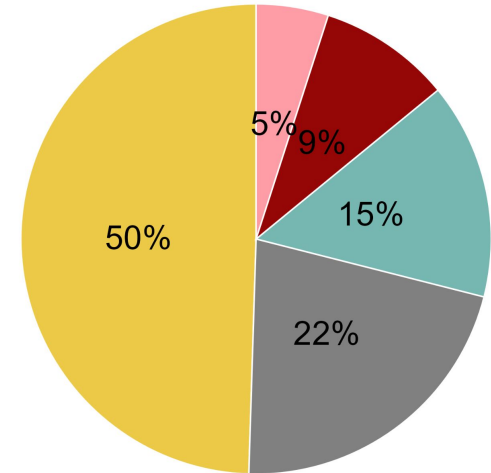
Entire Region



Alameda, Contra Costa, San Mateo, Santa Clara



Alameda, Contra Costa, San Mateo, Santa Clara - Urban



FMSN 4.0: Draft Station Selection Criteria



Technical Feasibility

- Feasible and safe for automated and manual sampling
- Suitable for wet/dry deposition (no overhead obstructions)

Watershed Dynamics

- Hydrologic representativeness
- Watershed size considerations
- No unique point sources of pollution

Station Reliability

- Power & Internet access (wired vs solar/cell)
- Physical stability (stream stability, trash, debris)

Network Distribution

- Good geographic coverage
- Represents a range of land uses, urban design, and age

Strategic Partnerships & Linkages

- BAMSC First 4 stations: Prioritize stations with PCB trend data
- Leverage SWAMP Stream Pollution Trends & DPR collaborations
- Coordinate with Bay RMP (Priority Margin Units, near-field monitoring)

Prior Monitoring Data

- Consider new vs. previously sampled locations
- Target locations with high/prior detects for contaminants of interest
- For new stations with no prior sampling, do characterisation sampling before committing



FMSN 4.0: Draft Station Selection Criteria

The next four slides contain some draft ideas. The are not meant to be fully formulated but rather were prepared to help generate discussion.

FMSN 4.0: Straw Structure Considerations

What Should the Network Distribution Capture?

The network could be "stratified" to ensure we capture the specific signals of interest.

Land Use/Urban Design

Mix of **Old Industrial** (PCB), **Mining** (Hg), **Residential**, **Commercial**, **Transportation** and **other land uses**, and **various building ages**

Watershed Size & Geometry

"Flashy" small watersheds (local sources) and **large "Integrator" watersheds** (regional averages).

Geography

Distribution across **sub-embayments** (North Central, South, Lower South) to account for differing Bay recovery trajectories.

Infrastructure Age

Year Built of the urban fabric as predictor of some pollutants rather than simple land-use categories.

FMSN 4.0: Straw Structure Considerations

Is there a Minimum Number of Stations to represent the region?

To broadly reflect the Bay Area, we need to figure out a "sweet spot" for network design.



The Core

Initially four but a growing number of Permanent Stations

The backbone of the network

Key Purpose:

- Provide critical multi-decadal data
- Sufficient to support current and evolving management questions



Candidate Stations

May shift to permanent stations

The future of the network

Key Purpose:

- Do some monitoring at these stations before committing

FMSN 4.0: Straw Structure Considerations



Standardized Methods

Standardized Protocols: All stations must use standardized flow gauging and automated turbidity or stage-triggered sampling.

Ensures data from all the stations is directly comparable.



Station Differences

Spatial Variance: Stations should have intentionally different watershed characteristics to help to tease apart spatial variability and causes/sources of different contaminants.

FMSN 4.0: Straw Structure Considerations



Collaboration & Integration



Head of Estuary

Do we include a station at Mallard Island?

It represents the single largest input of water, sediment, and pollutants. Without it, the Bay "budget" cannot be closed.



Agency Synergy

Leveraging **SWAMP SPoT** or **CDPR** locations may be a high-yield opportunity.

Coordination with other Bay RMP monitoring like **PCB PMUs** and **S&T near-field** sampling.



Background Station

Do we need at least one regional station?

To understand the "non-urban" baseline for MPs and CECs.

May have little or no permanent equipment.



FMSN 4.0: Draft Science Questions



Network Design Approach

How should we prioritise and integrate important design aspects?

- Stations that integrate or that are less diverse?
- A background station?
- A monitoring station at the head of the Estuary (Central Valley Watershed)?



Regional Representation

How many stations are needed to broadly reflect the urbanized Bay Area?

- First 4 stations focus on old industrial land use (PCBs).
- Capture diversity via infrastructure age, construction, & demographics.



Collaborations

Are there unidentified opportunities for collaboration?



General Advice

What other general advice do you have for fixed station design?

Are there any other network examples to learn from?



Item#7 FMSN 4.0 - Part 2: Pilot Station Selection

SPLWG, May 14, 2026



Outline (30 minutes)

Provide background information (15 min)

- Update group on pilot station selection process
- Provide basic information on two candidate stations
- Describe initial list of pros and cons for siting the station at each location

Discussion (15 min)

- Continued discussion of pros and cons for each candidate location
- Criteria of characteristics that are important to inform pilot station selection
- Any other ideas for consideration of the pilot station

FMSN 4.0: Pilot Station Selection Process

- Group agreed to locate pilot station in Alameda County
- Began with a broad list of candidate stations previously sampled, collaboratively reviewed to narrow the list
- Reconned 9 stations (-> 6 kept)
- Evaluated information on station feasibility, e.g., past PCB and PFAS contamination & data, likely future management actions, monitoring accessibility

Feasible and Safe

- For automated and manual sampling

Reliability

- Power (wired versus solar)
- Internet (wired versus telecom)
- Stream stability, trash, debris

FMSN 4.0: Ettie St. Pump Station - feasible

- Safe - behind locked gate
- Suitable space for samplers
- Head height = 16 ft
- Ground level access to incoming pipe
- Safe and feasible to collect grab samples
- Flow measurement system (needs verification)
- Open sky for placement of rain gage and solar panel



FMSN 4.0: Zone 4 Line A - feasible

Recon observations:

- Safe - behind locked gate
- Head height ~6ft
- Flow measurement possible (+ existing rating curve)
- Open for placement of rain gage and solar panel
- Grab collection possible
- Space for samplers



FMSN 4.0: Ettie St Pump Station

Legend

- ★ Candidate Monitoring Location
- ▭ Candidate Watershed

■ GSI Treatment Project

Old Industrial Baseline

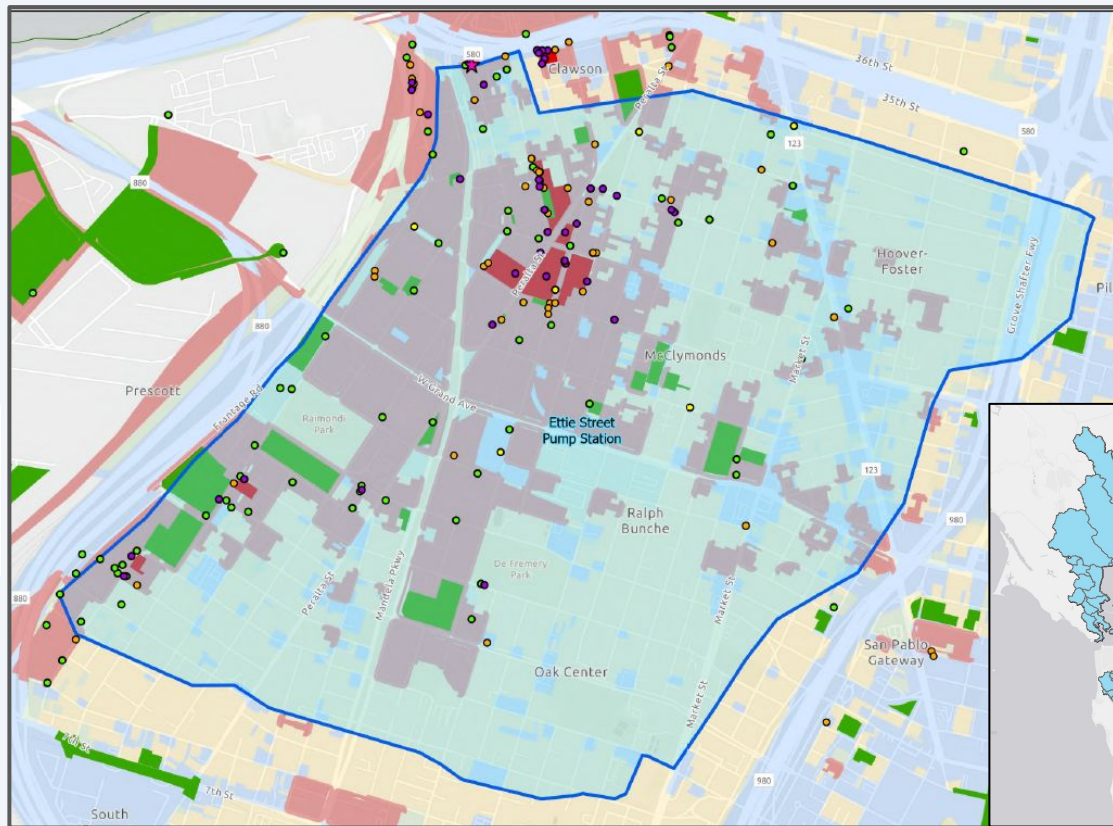
- Old Industrial Baseline
- Source Properties

Other Baseline Category

- Old Commercial & Old Transportation
- Old Residential
- New Urban & Open Space

Sediment Samples (through WY 2025)

- <0.2 mg/kg PCBs & <0.3 mg/kg Hg
- <0.2 mg/kg PCBs & >0.3 mg/kg Hg
- 0.2 - 1.0 mg/kg PCBs
- >1.0 mg/kg PCBs



FMSN 4.0: Zone 4 Line A

Legend

★ Candidate Monitoring Location

▭ Candidate Watershed

— Flow Lines

▭ GSI Treatment Project

Old Industrial Baseline

▭ Old Industrial Baseline

▭ Source Properties

Other Baseline Category

▭ Old Commercial & Old Transportation

▭ Old Residential

▭ New Urban & Open Space

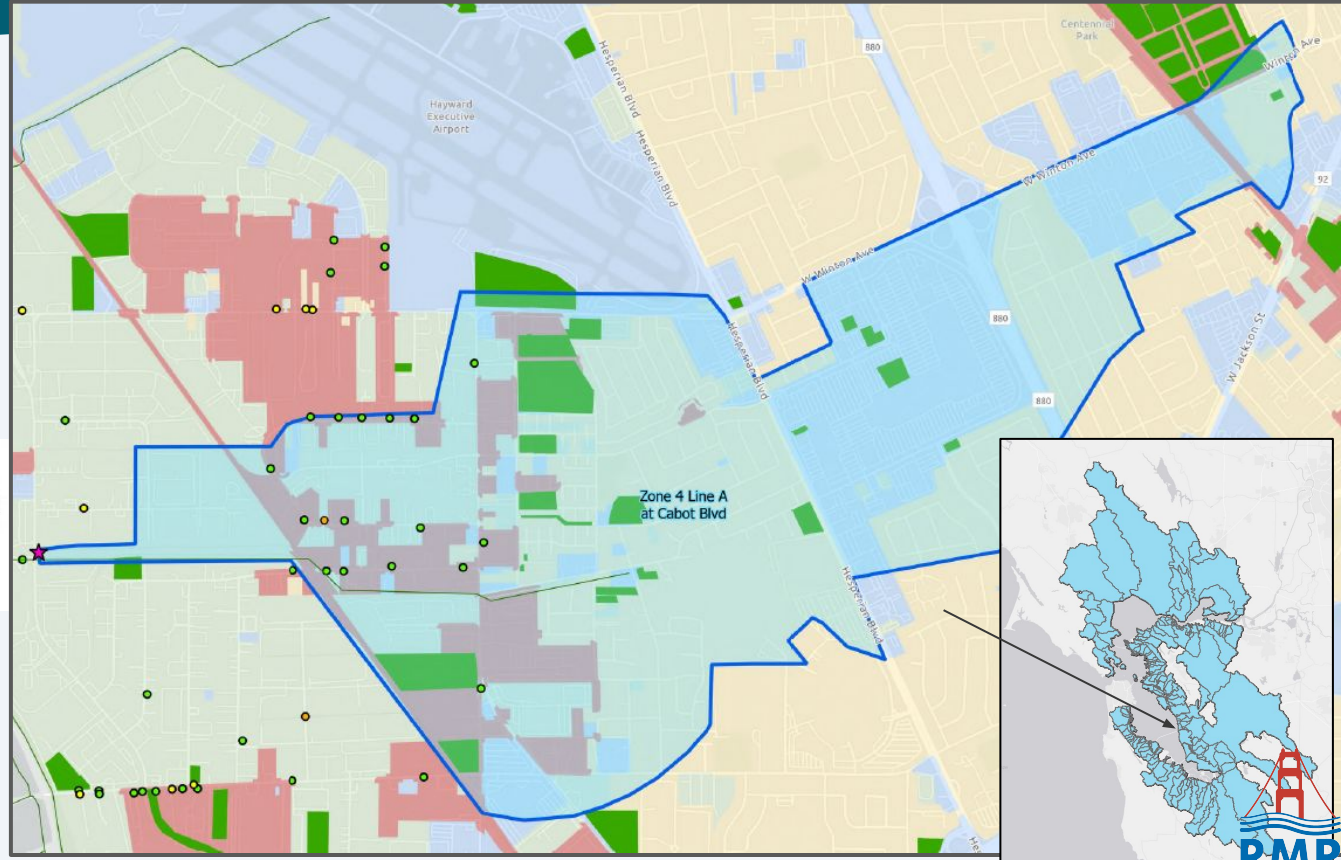
Sediment Samples (through WY 2025)

● <0.2 mg/kg PCBs & <0.3 mg/kg Hg

● <0.2 mg/kg PCBs & >0.3 mg/kg Hg

● 0.2 - 1.0 mg/kg PCBs

● >1.0 mg/kg PCBs

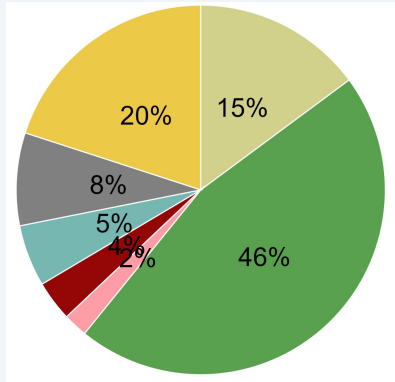


FMSN 4.0: Other Station Selection Criteria

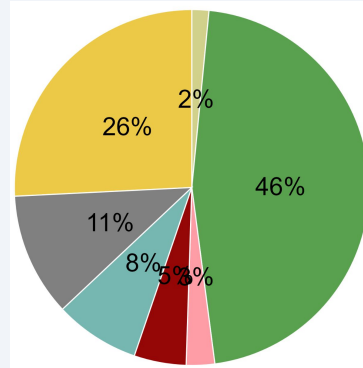
	Ettie St. Pump Station, Oakland	Zone 4 Line A, Hayward
Hydrologic representativeness	Representative sampling may be trickier	Simple channel geometry
Stream stability, trash, debris	Drainage stable, minimal large debris	Drainage stable, some trash and debris but no significant problems with previous sampling
Free of overhead obstructions	Clearance fine for rain but may be problematic for air deposition sampling	Yes
No unique pollution source	Freeway next to station	None identified
Wired Power/Internet	Yes	Unlikely
Watershed size	4.2 sq km	4.9 sq km
Other	Unique design relative to other stations	PFAS source area (Hayward Airport) adjacent but outside boundary

FMSN 4.0: Pilot Stations characteristics in context

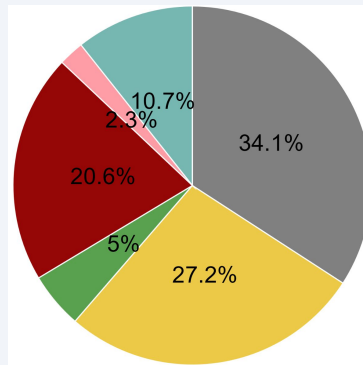
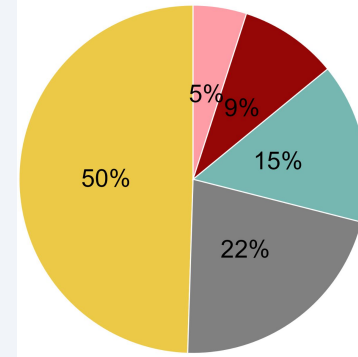
Entire Region



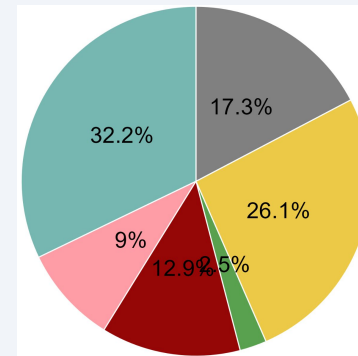
4 Counties



4 Counties - Urban Only



Ettie St. Pump Station



Zone 4 Line A

Land Use Type



FMSN 4.0: Candidate Pilot Stations

	Ettie St. Pump Station, Oakland	Zone 4 Line A, Hayward
Pros	* Need to install optical proximity sensor to track pumps RPM * Higher PCB particle ratio * High level of management actions to be implemented for PCBs (redevelopment, targeted O&M) * Sampled moderately-intensively	* Prior rating curve (but needs verification) * Sampled intensively * Going through normal redevelopment - more representative so possibly good for overall network
Cons	* Unique design relative to typical creeks * Representative sampling may be tricky * Elevated freeway so maybe/likely unsuitable for wet/dry deposition, rain probably okay	* May not be having a quickly reducing PCB concentration signal * Wired power/internet unlikely

Pilot Stations - Discussion

- Which criteria or characteristics do you feel are important to inform pilot station selection?
- What additional ideas do you have for consideration of the pilot station?



Hg synthesis: Central Valley and Guadalupe River Load Update

Hg Strategy Team



Meeting History

Six meetings conducted since February 2025 to align on strategic objectives.

Core Objective

Plan, oversee, and review data collection, modeling, and information synthesis to support the Hg TMDL revision.

DEADLINE

July 2026

Final Information Due

Implementation Agreements (2nd Meeting)

- Synthesis work plan
- Bay modeling work plan
- Minimal analysis of archived samples to support data gaps

*** No new field data collection!**

- [illegible]

- Central Valley
- Guadalupe

2.1	Biota status and trends
2.2	Surface sediment status and trends
2.3	Active sediment layer information review
2.4	Atmospheric deposition lit review
2.5	Central Valley load
2.6	Wastewater inputs
2.7	Watershed inputs
2.8	Guadalupe River inputs
2.9	Buried sediment / Review of bed erosion/ deposition information
2.9.1	Loss due to dredging and sand mining
2.9.2	Hg budget table and synthesis (subembayment and total Bay summary)
2.10	Recovery trajectories (In-Bay Model Results)
2.11	Wetland Restoration & Food-Web Mercury

Section Outlines



Methodology & Results (Aspects common to both sections)

Introductions: Brief history of Hg mining, previous loading studies, and objectives.

Methods: Data sources, compilation process, and interpretive techniques.

Results: Summaries of measured wet season concentrations, particle ratios, and loads.

Discussion:

- Daily estimated concentrations, particle ratios, and loads to support in-Bay model boundary conditions
- Measured and modeled annual load variability
- Evidence-based trajectories or theoretical basis for trends or a lack thereof.

Central Valley (Unique aspects)

Introduction

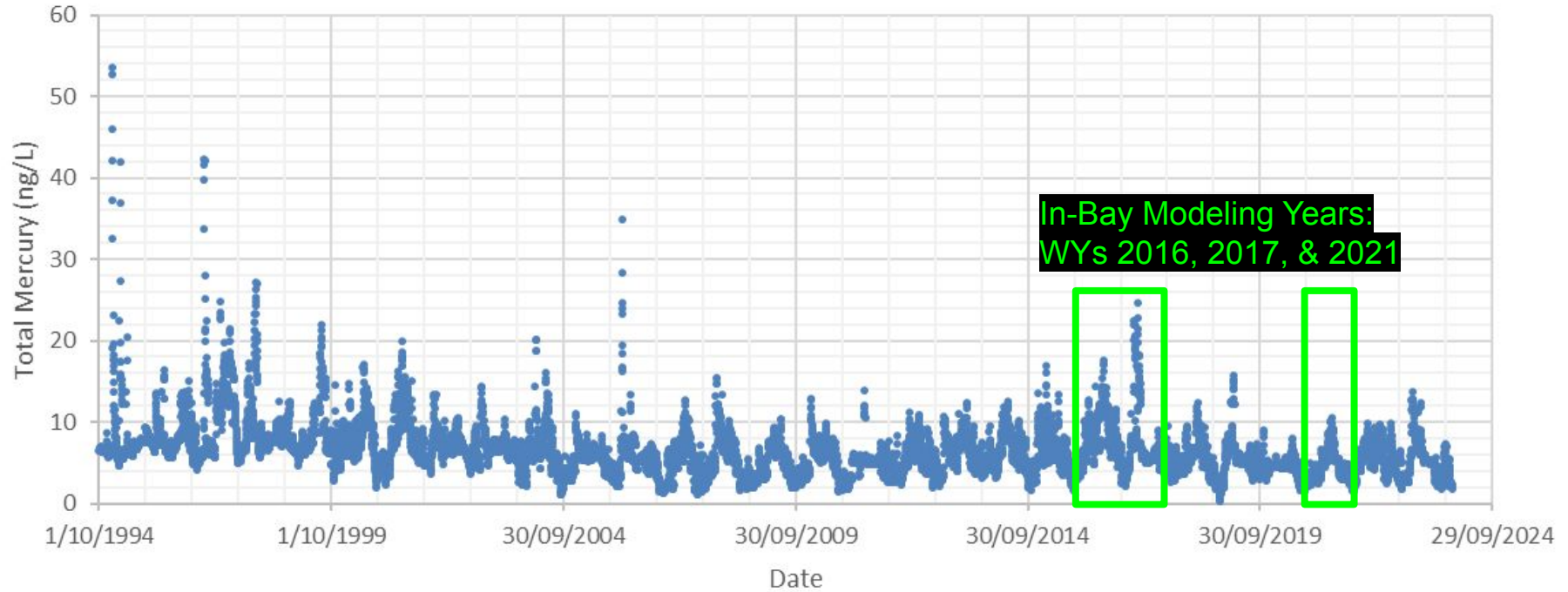
- Includes a brief history of Hg use in gold extraction.

Guadalupe River (Unique aspects)

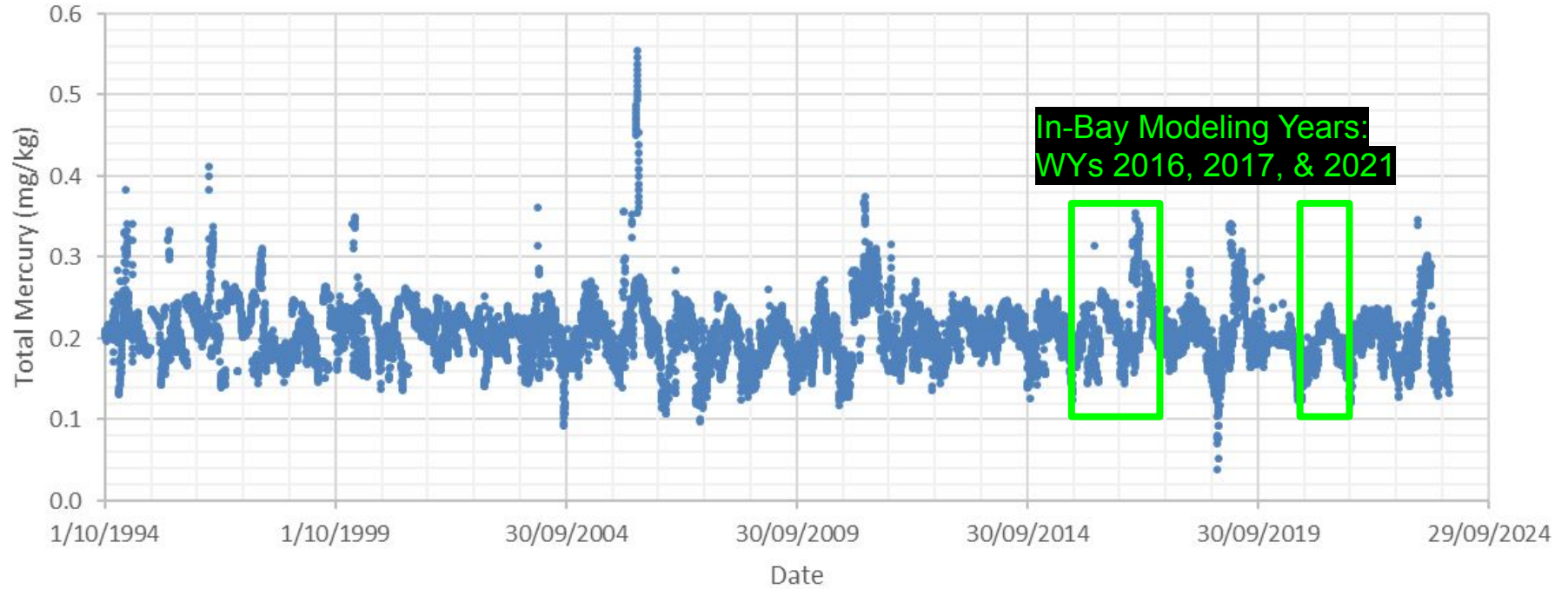
Discussion

- Rolling 5-year average measured concentrations and particle ratios.
- Rolling 5-year measured and modeled loads (Water method & Sediment method).

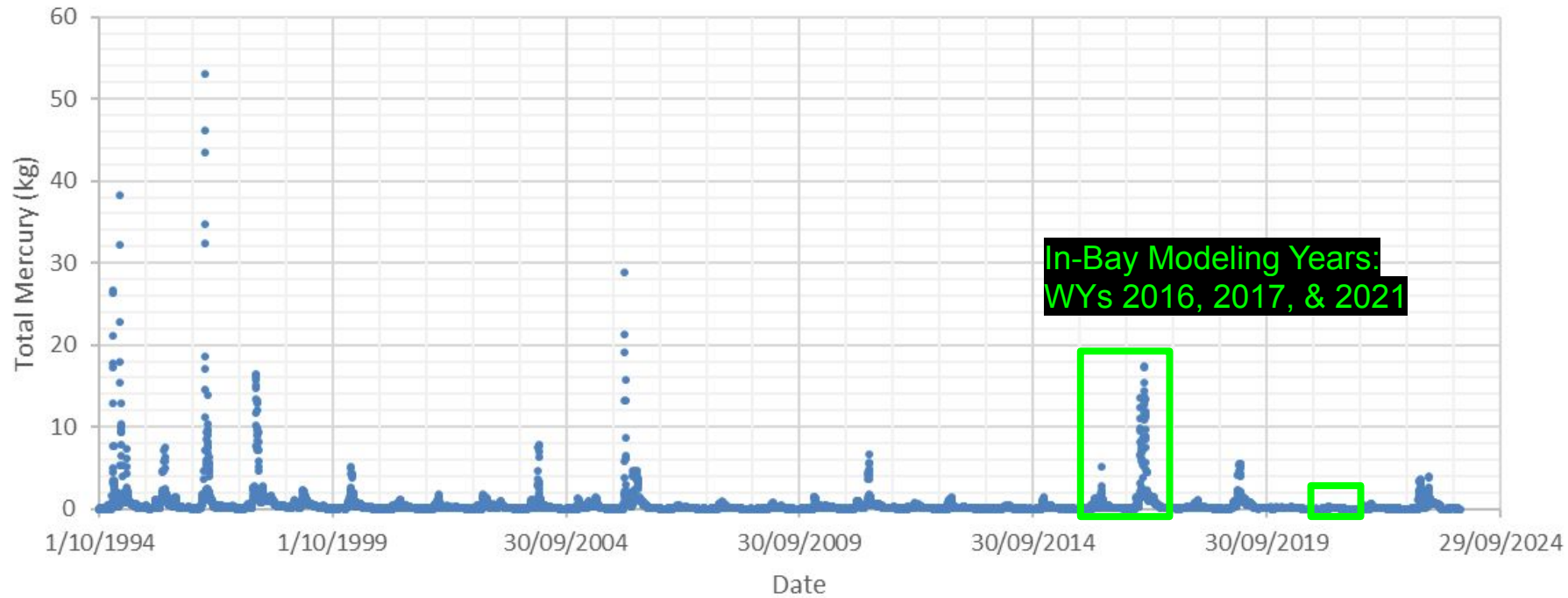
Sacramento River at Mallard Island: Modeled Concentrations



Sacramento River at Mallard Island: Modeled Particle Ratios

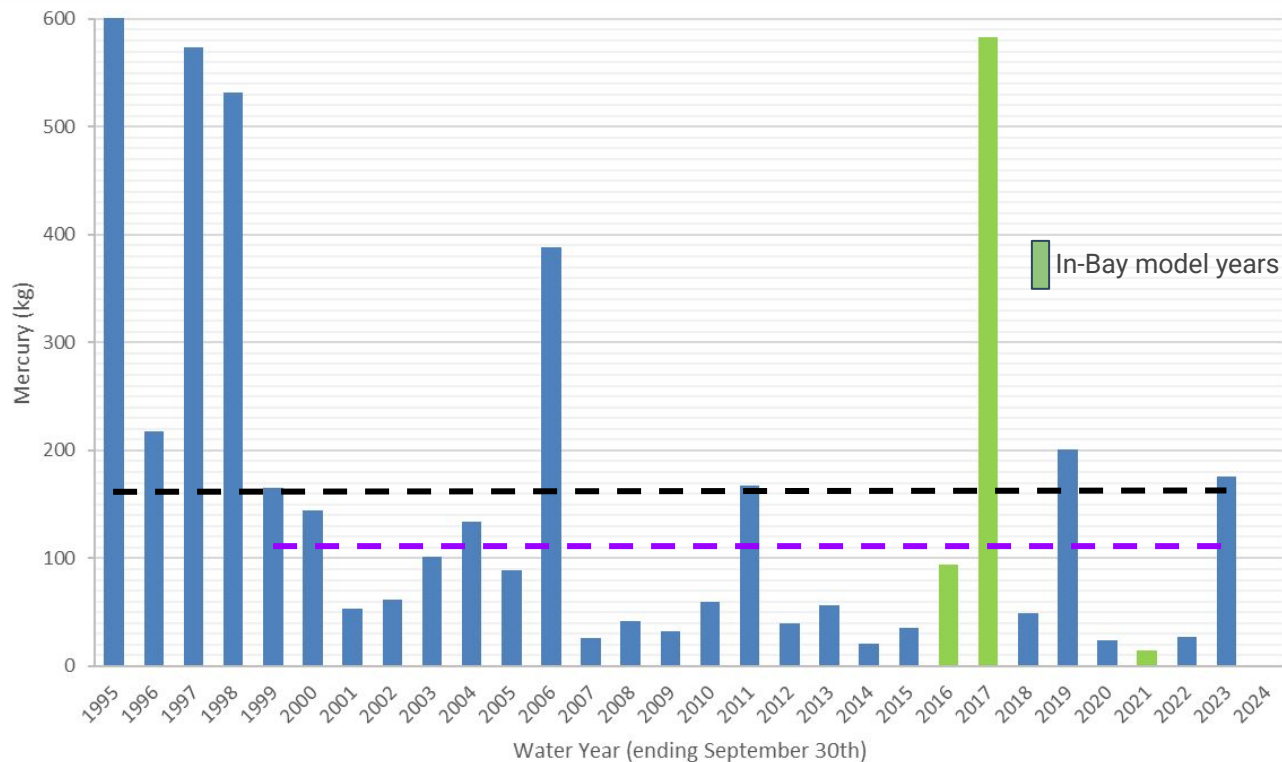


Sacramento River at Mallard Island: Modeled Daily Loads



Sacramento River at Mallard Island

Modeled Annual Mercury Loads



TMDL Benchmarks

Estimate: **440 kg**

Allocation: **330 kg**

Summary Metrics

27-Yr Arithmetic Average

163 kg

Post-1999 Average

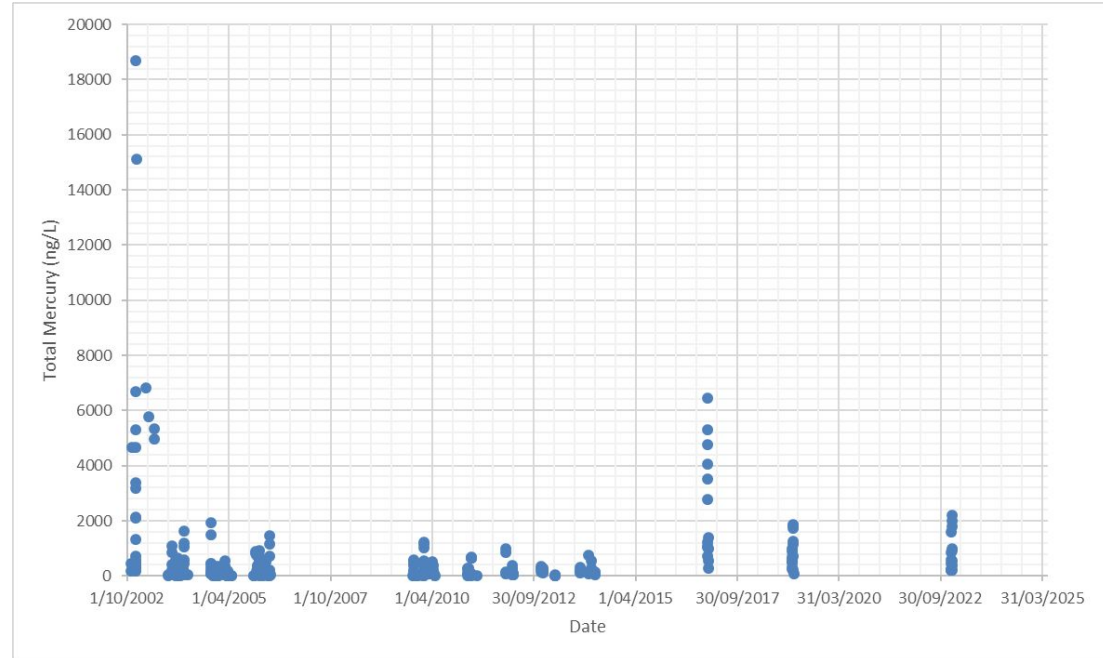
112 kg

Guadalupe River:

Measured Concentrations



Water Year	HgT (FWM)	Information Source
2003		McKee et al. (2017a)
2004		McKee et al. (2017a)
2005		McKee et al. (2017a)
2006		McKee et al. (2017a)
2010		McKee et al. (2017a)
2011		Balance Hydrologics (2011)
2012		McKee et al. (2017a)
2013		McKee et al. (2017a)
2014		McKee et al. (2017a)
2015		AECOM (2015)
2017		McKee et al. (2017b)
2019		TetraTech (2024) Table 3-17.
2020		TetraTech (2024) Table 3-17.
2021		TetraTech (2024) Table 3-17.
2022		TetraTech (2024) Table 3-17.
2023		TetraTech (2024) Table 3-17.

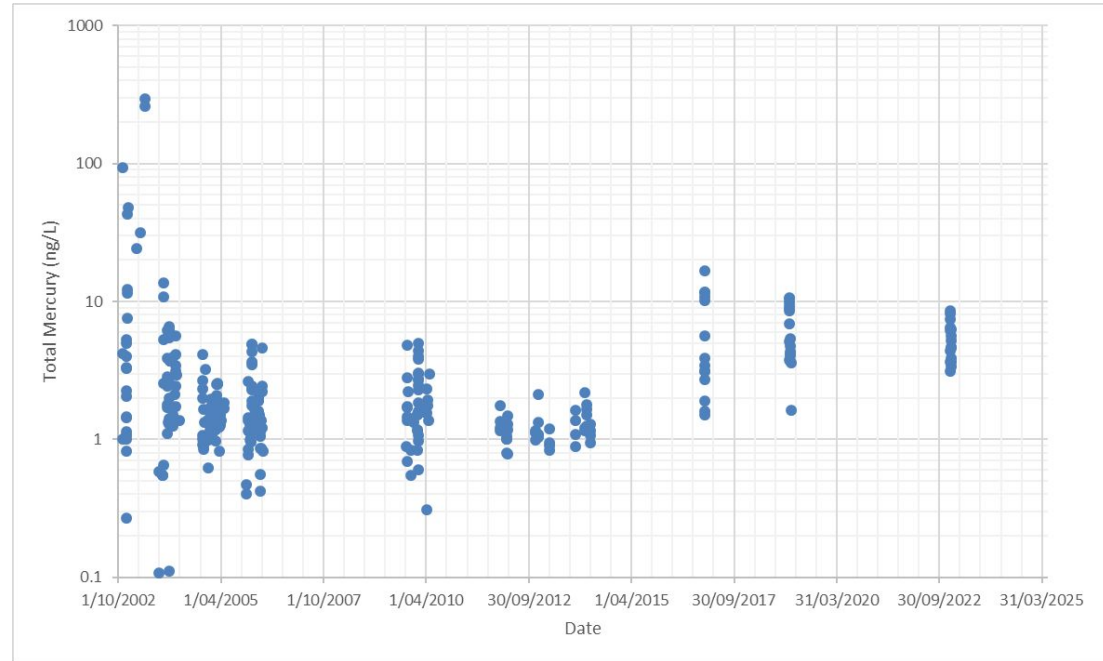


Guadalupe River:

Measured Particle Ratios

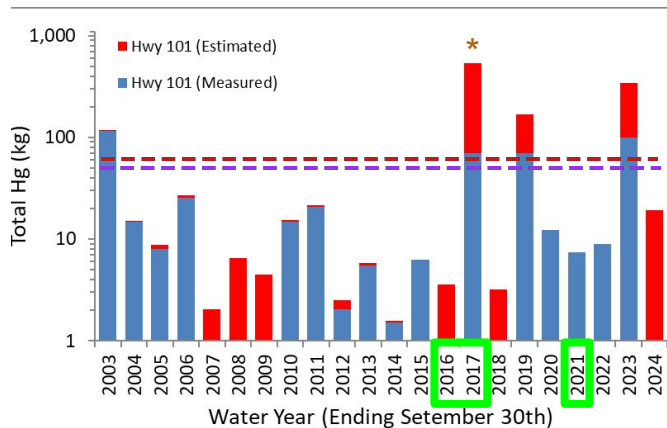
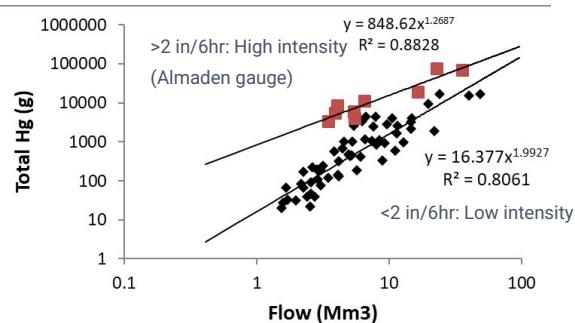


Water Year	HgT (FWM)	Information Source
2003		McKee et al. (2017a)
2004		McKee et al. (2017a)
2005		McKee et al. (2017a)
2006		McKee et al. (2017a)
2010		McKee et al. (2017a)
2011		Balance Hydrologics (2011)
2012		McKee et al. (2017a)
2013		McKee et al. (2017a)
2014		McKee et al. (2017a)
2015		AECOM (2015)
2017		McKee et al. (2017b)
2019		TetraTech (2024) Table 3-17.
2020		TetraTech (2024) Table 3-17.
2021		TetraTech (2024) Table 3-17.
2022		TetraTech (2024) Table 3-17.
2023		TetraTech (2024) Table 3-17.



Guadalupe River: Wet Season Loads

Based on flow-based method (McKee et al., 2004, 2005, 2010, 2017)



* Technical Note

This value is approximately half of the 2019 Pulse report (1,072 kg). Methodological evolution with new data points significantly influences regression results, particularly given the small dataset size.

Modeling Context
IN-BAY MODEL YEARS

TMDL Benchmarks

Load Estimate: **92 kg**

Allocation: **2 kg**

Calculated Averages

Arithmetic Average

61 kg

Climate-Weighted Average

52 kg

Progress and Next Steps

Planned Process

MAY 26

**Draft report sections
sent out for review**

JUNE 2 (9 AM - 1 PM)

Hg Strategy Team Meeting

✓ Presentation of draft final results for discussion

JUNE 16

Comments due from the committees

Hg Strategy Team; SPLWG, TRC

JULY 7



**Synthesis report
published**



Proposed Watershed Modeling Workplan for 2027

For the Sources, Pathways, and Loadings Workgroup
of the Regional Monitoring Program

May 15, 2026

Matthew Heberger & Pedro Avellaneda

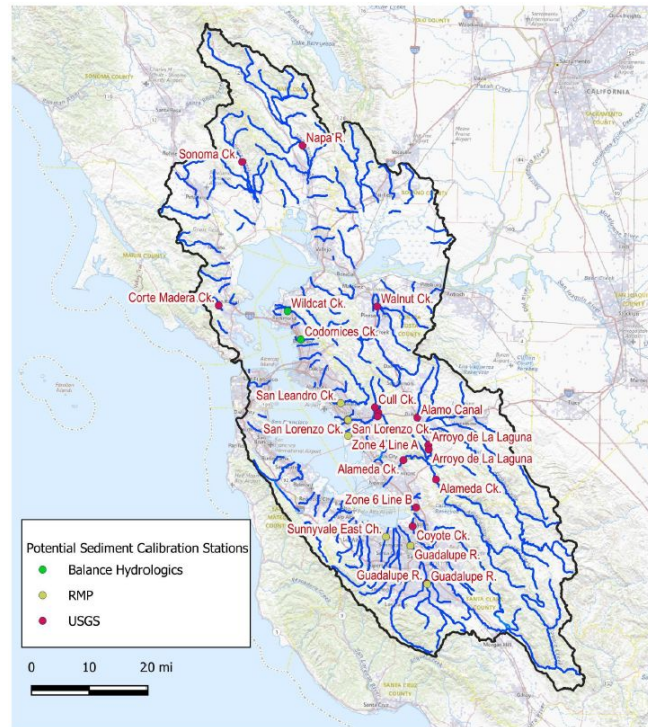
Project Context

Watershed modeling for 2026 - 2030 is funded by the **Tracking Bay Health (TBH)** grant from the USEPA.

We are proposing an “**agile**” project management style for timely completion high-priority tasks while maintaining flexibility.

This workgroup will play an important role in **planning and oversight** for watershed modeling.

Additionally, consultation with and oversight by Sediment, Mercury, PCB, Emerging Contaminants, Microplastics Workgroups.



Main Goals for 2027



Pollutant Load Estimates

Provide updated estimates for critical pollutant loading across the region.



PMU Management

Support the modeling and management of Priority Margin Units (PMUs).



Model Refinement

Continue to update and refine the model, focusing on sediment transport.

Primary Regulatory Drivers

Mercury (Hg) TMDL

Scheduled update for **2028**.

Requires refined regional-scale pollutant load estimates and boundary data.

PCBs TMDL

Scheduled update for **2030**.

Focus on Priority Margin Units (PMUs) to explore load reduction feasibility.

Modeling provides the necessary "what-if" scenarios for recovery trajectories.

Planned expenses

Table 2. Planned expenditures for watershed modeling, by category for 2027 to 2030, the duration of the EPA Tracking Bay Health grant.

All values in \$1000s

Category	2027	2028	2029	2030	Total
SFEI Labor	450	479	510	543	1,982
Subcontracts	115	120	130	135	500
Comp. Hardware & Software	15	1	1	1	18
Total	580	600	641	679	2,500

Proposed projects in 2027

Task		Budget (x \$1000)	
1. Model configuration and calibration			
	A. Update meteorological forcing datasets	50	
	B. Update channel geometry river reach F-tables	25	
	C. WDM/RWSM: Update and improve land use input data	60	
	D. Enhancements to sediment modeling	65	
			200

Proposed projects in 2027 (#2)

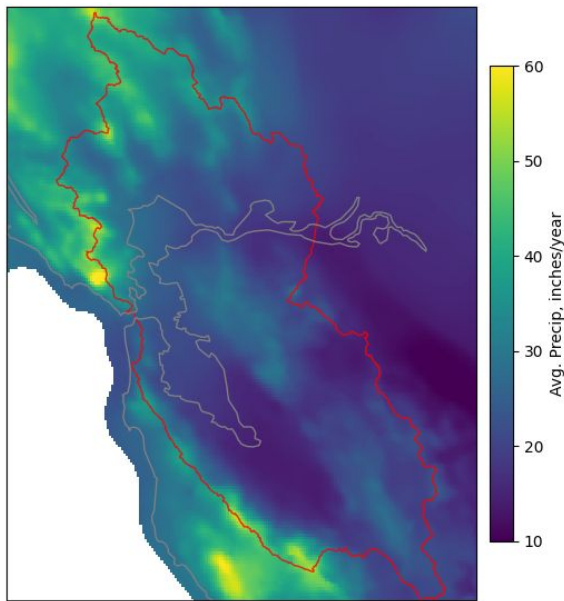
2. Watershed modeling applications			
	A. RWSM: Align HRUs with WDM and recalibrate RWSM	40	
	B. PCB TMDL Bay recovery: PMUs: Explore control measure feasibility through varied simulations by control measure type, scale, and pacing	100	
	C. Microplastics: Annual average discharge and load at the HRU scale	50	
	D. Provide boundary condition for in-Bay model: Daily flows by near-field subwatershed, three sediment size classes	50	
			240

Proposed projects in 2027 (#3)

3. Reporting and management			
	A. Reporting	85	
	B. Administration, stakeholder engagement, and project management	55	
			140
Total			580

Task 1.A. Update Meteorological Forcing

PRISM Annual Avg. Precip.



Partnering with University of Nebraska-Lincoln (Dr. Tirthankar Roy) to create state-of-the-art datasets.



- Addresses extreme spatial heterogeneity of rainfall in the Bay Area

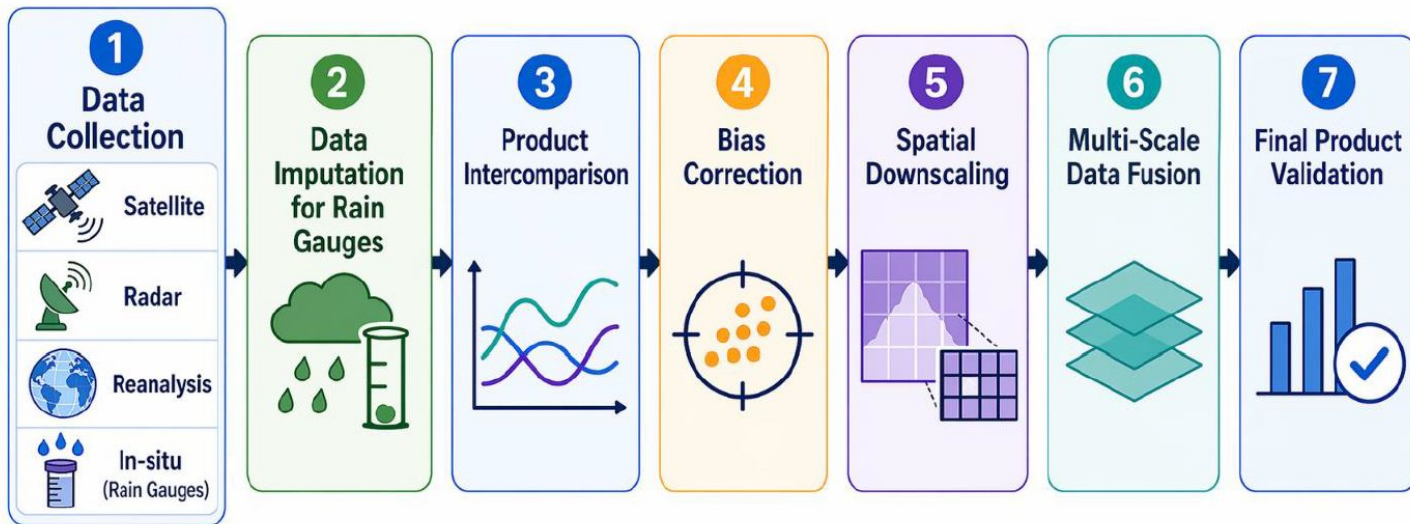


- Novel imputation methods for missing data



- Deliverable: Gridded hourly precipitation dataset

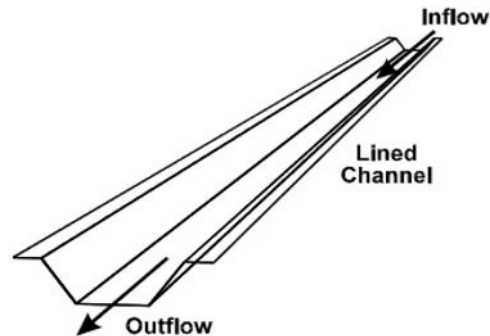
Task 1.A. Update Meteorological Forcing



Bottom line: Precipitation is fundamental to watershed modeling; improvements in forcing datasets will increase our model's skill for predicting discharge, sediment, and pollutant concentrations

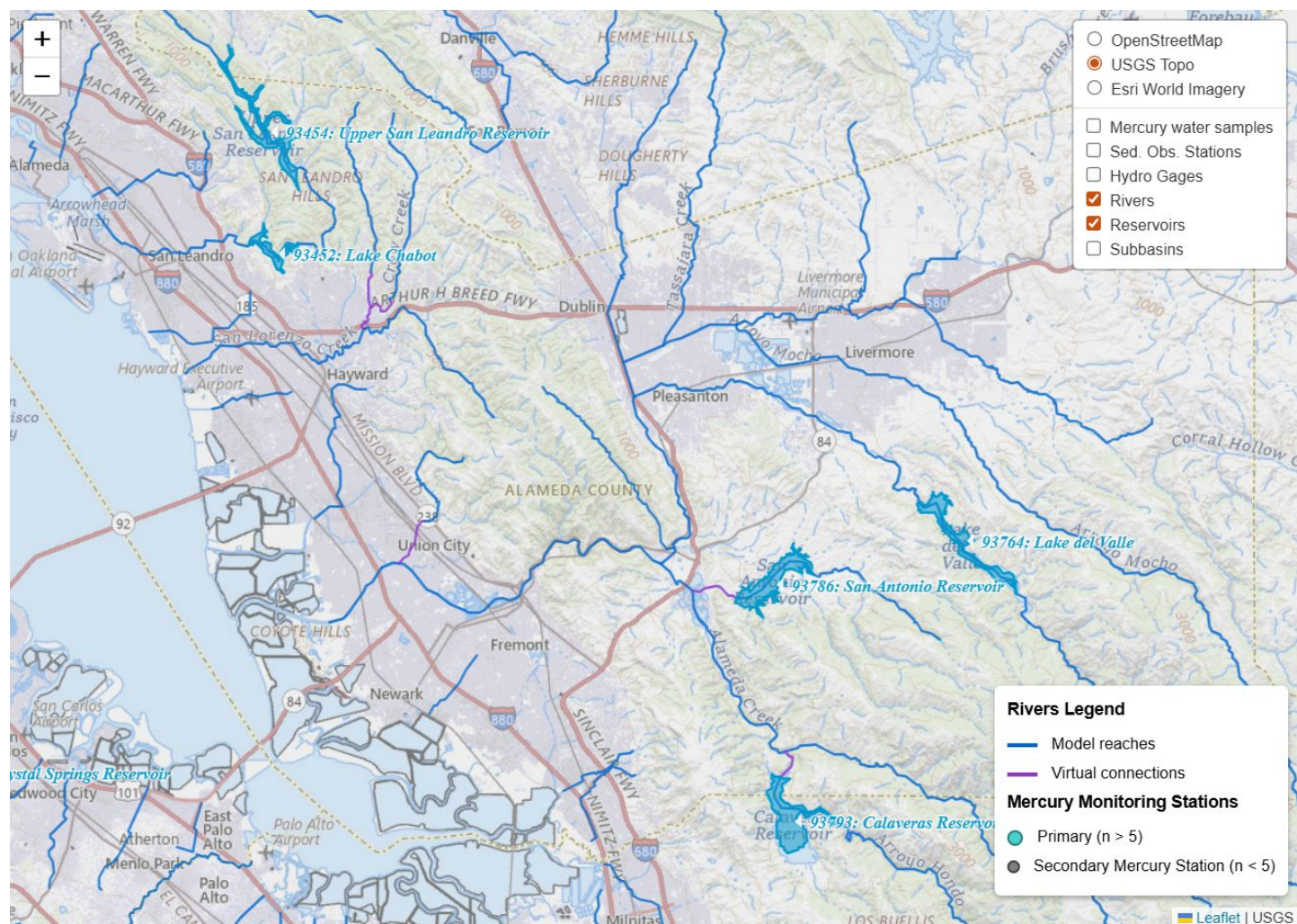
Task 1.B. Update Channel Geometry

- Continuation of work begun in 2026.
- Replacing idealized volume-outflow relationships with real-world measurements of channel geometry
- In 2027, focus on improved representations of **reservoirs**, to improve the model simulation in critical watersheds like Alameda and Coyote Creeks.



Col	1	2	3	4	5	6	7
Row #	Depth	Surface area	Volume	F1 (vol)	F2 (vol)	F3 (vol)	F4 (vol)
1	0	0	0	0	0	0	0
2	1.5	1	8	12	6	10	0
3	10	15	80	12	18	10	0
4	50	100	2500	12	36	20	20

RCHTAB

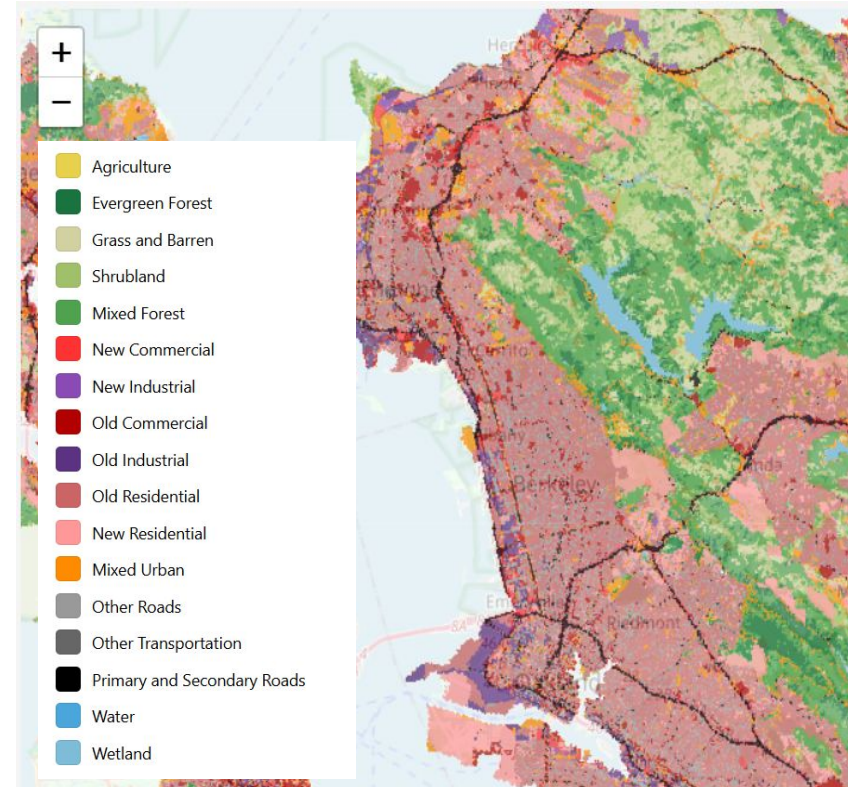


4000: Coyote Creek above Hwy 237 at Milpitas CA — Daily



Task 1.C. Improve land use data

- Data Quality Assessment on the MTC 2020 land use dataset to ensure accurate spatial representation of human activities.
- Refinement of Pervious vs. Impervious areas
- Update to Directly Connected Impervious Area (DCIA)
- Impacts runoff algorithms and pollutant partitions



Task 1.D. Enhancements to sediment modeling

- Incorporate more local data for calibration and validation, from local watershed reports and USGS data
- Use more RMP continuous turbidity-surrogate SSC observations
- Validate channel water velocity simulation
- Increase focus on the 3 sed. size classes

Why this matters:

- The physics of sediment transport vary between cohesive and non-cohesive sediments.
- PCBs and Mercury bind differently to different grain sizes.





2. Watershed Modeling *Applications*

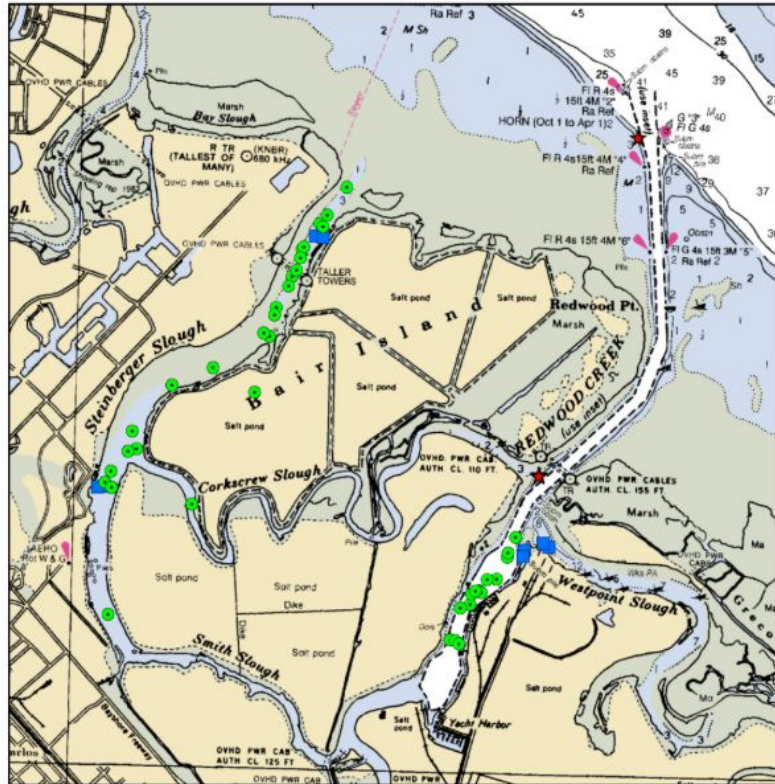
Transforming model skill into management decisions

Task 2.A. Update and recalibrate the RWSM

- The RMP has two main models: The RWSM (simple) and WDM (complex) that were developed separately.
- Simple models remain useful, especially when data are scarce, the case for CECs, microplastics, etc.
- Aligning the watershed boundaries and Hydrologic Response Units (HRUs) in the RWSM will make the models more readily intercomparable.
- HRUs are land areas where combination of land use, soil, slope, geology, etc. give it a unique hydrologic fingerprint.



Task 2.B. PCB Recovery & Control Measure Feasibility



Focus on Priority Margin Units (PMUs)

Evaluating recovery trajectories for sites like San Leandro Bay and Redwood Creek.

Scenario Modeling:

- What happens if we increase street sweeping?
- How long until bed sediment concentrations drop (and fish tissue concentrations) if we implement large-scale GSI?

Goal: Quantify the "pacing" of recovery for water quality management.

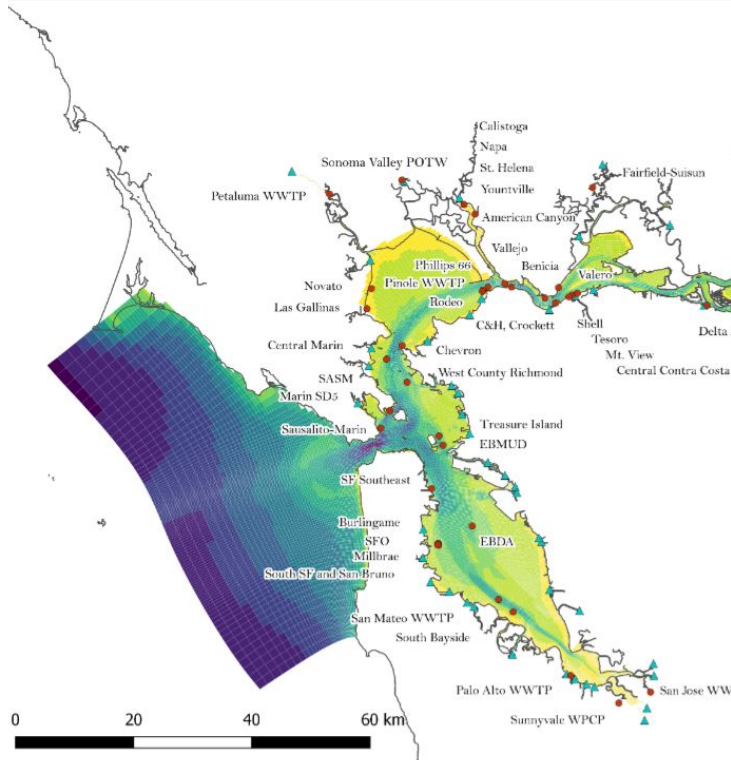
Task 2.C. Microplastics Modeling

Quantifying an emerging threat

- **Objective:** Generate robust, regional-scale microplastic (MP) loading estimates.
- **Method:** Applying MP concentration data to modeled HRU (Hydrologic Response Unit) discharge.
- **Outcome:** Identifying "hotspot" watersheds to prioritize for future monitoring and trash capture.



Task 2.D: Integration with Bay Modeling



- **Boundary conditions:** The WDM provides the essential input data for Bay hydrodynamic models.
- **Coupled Systems:** Simulating the full lifecycle of a pollutant—from its source in the atmosphere or land surface to its accumulation in Bay fish.
- **Scale:** Moving from broad regional averages to site-specific subwatershed precision.

A Community Modeling Approach



Open Access

Creation of a permanent watershed modeling web portal on SFEI.org to share all files and documentation.



Transparency

Quarterly model update meetings for stakeholders and science advisors.

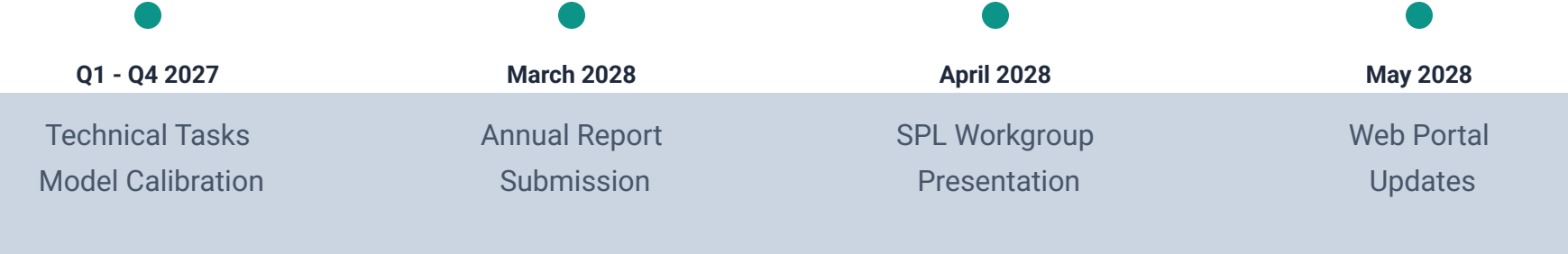


Engagement

Collaborative feedback loops ensure results are scientifically defensible.



2027 Deliverables & Timeline



Task Group	2027 Budget	Key Deliverable
1. Configuration & Calibration	\$200,000	Precipitation Dataset & F-Tables
2. Modeling Applications	\$240,000	PCB Feasibility & MP Estimates
3. Reporting & Management	\$140,000	Web Dashboard & Final Report



Questions & Discussion

Desired outcome:

Feedback on watershed modeling plans and priorities

matth@sfei.org

pedroa@sfei.org

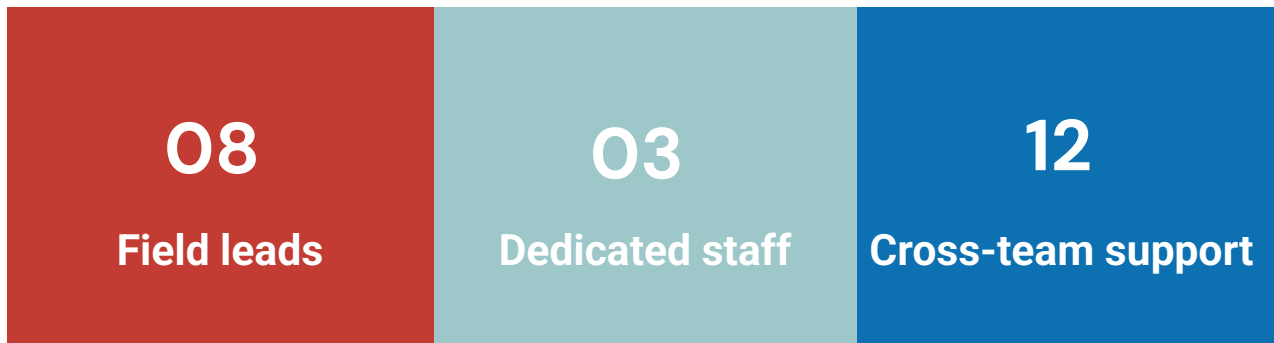


Stormwater Systems Improvements

Jennifer Dougherty | Alicia Gilbreath

SPLWG 2026 | May 15

Stormwater Team



Our program leverages a diverse talent pool from SFEI and the Water Board WSPs



Stormwater Systems Improvements since SPLWG 2025



Field Proficiency & Specialized Training



- Sampling techniques
 - ISCO use & microplastics
- Aquamatic training
 - Field leads
- Operations
 - Field sheet for leads & COC training

Stormwater Operational Resources



Stormwater Website

Coordination hub for field operations



QR Deployment Workflows

Pre/post deployment workflows



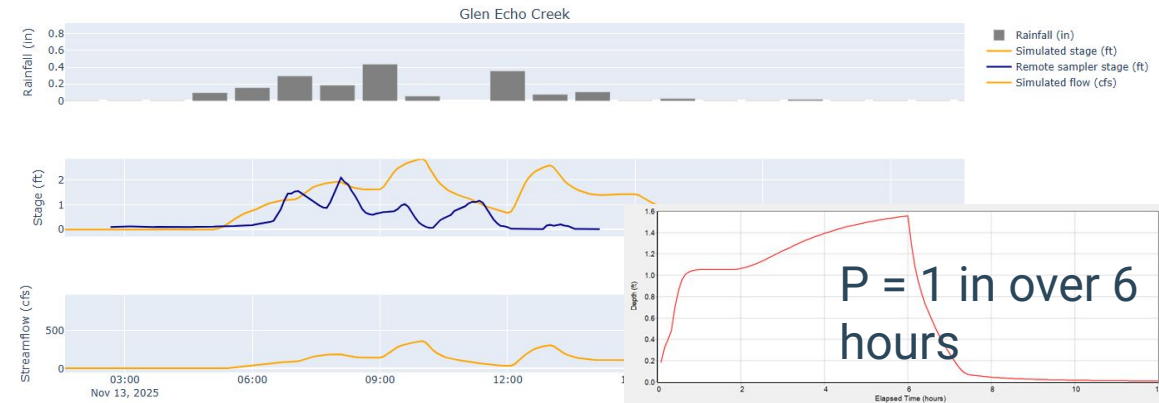
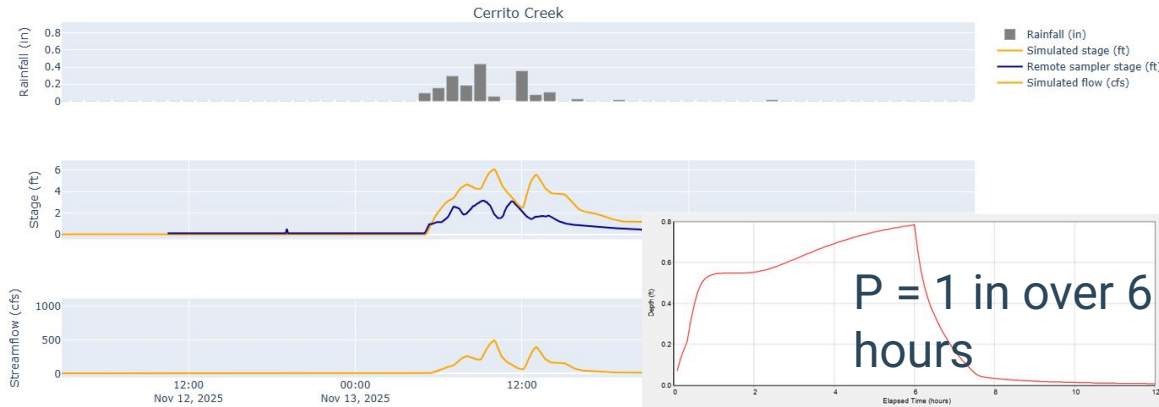
Site Information Database

Site database (*final QA in progress*)

Rainfall-stage analysis method using SWMM modeling

Feasible to predict stage from predicted rainfall

uncertainty in rainfall
prediction → model
uncertainty



Building Operational Infrastructure



Data Organization

Organized 20+ years of spatial data (*in process*) and standardized historical site names and records



Standardized Methods

Developed SAPs and SOPs for large automated sampler



Team Coordination

Improved coordination through recurring meetings and dedicated communication channels



Proposed Stormwater Systems Improvements



Enhancing Program Coordination



Weekly Meetings



QA/QC Tool



Sample Coordinator

Field Deployment & Site Information Systems



Field Checklists & Integrated Mapping

- Mobile-accessible deployment checklists
- Integrated site maps and setup guides
- Supports loading, unloading, and debriefing
- Enables deployment regardless of site familiarity

Centralized Site Database

- Transitioning site reconnaissance to ArcGIS Survey123
- Centralized photos & site characteristics
- Improved information sharing and accessibility
- Supports scalable field operations

Budget & Deliverables



Expense	Est. Hours	Cost
Labor		
Task 1. QA/QC Planning & Forms	12	\$2,000
Task 2. Internal Coordination	220	\$33,000
Task 3. Checklists & Integrated Maps	7	\$1,000
Task 4. Site Information Database	40	\$7,000
Task 5. Formalized Sample & Equipment Management	40	\$7,000
Task 6. Critical Additional Tasks as Needed	70	\$10,000
Annual Total (through 2030)		\$60,000

Deliverable	Due Date
Annual Summary of Plan for the Upcoming Year	May 2027
Task 1. QA/QC Planning Form	July 2027
Task 2. Sites Information Database	August 2027



**THANK YOU FOR
YOUR TIME**

stormwater@sfei.org





Small Automated Sampler Improvements

Jennifer Dougherty | Alicia Gilbreath | Don Yee | Kayli Paterson | Lorenzo Flores | Kelly Moran

SPLWG 2026 | May 15



Small Automated Sampler Improvements since SPLWG 2025



Objectives...from SPLWG 2025



Sierra Garcia

- Improve the remote reconfiguration and logging/collection programming
- Continue to refine hardware and deployment procedures

Software & User Interface Improvements



Remote Restart

Added ability to remotely restart via web interface



Logic Updates

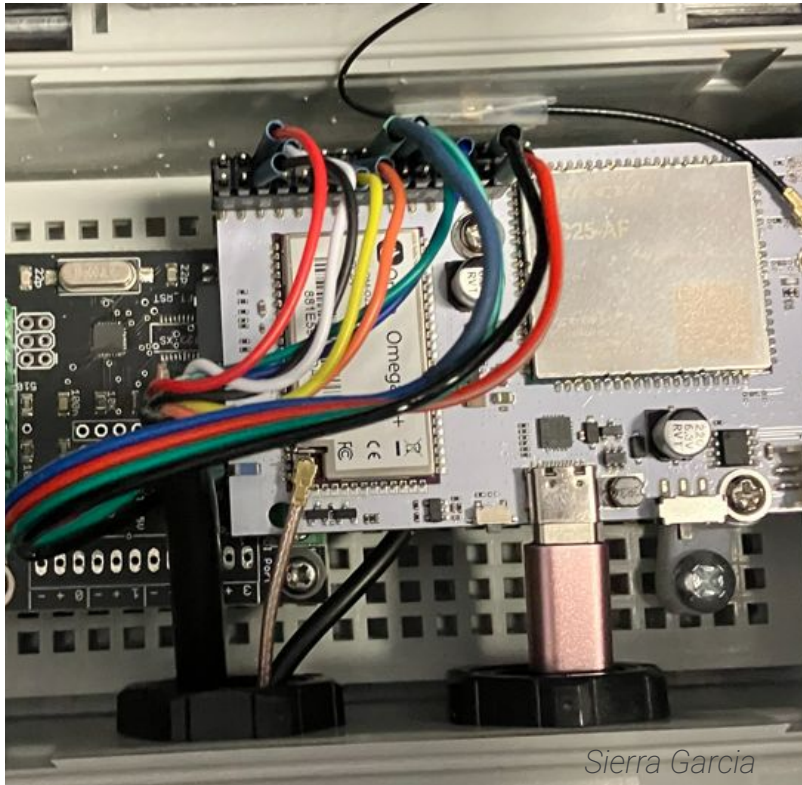
Tracks cumulative instead of remaining volume. Logic tied to logging intervals



Configuration

Added config files download and upload for quick config adjustments

User Interface & Data Integrity



Error Handling

Blocked invalid entries



Redundancy

Data recording to cloud, internal memory and SD cards



Connectivity

Increased cloud comm frequency for better monitoring/updating.



Bug / Logic Fixes

Code corrections for sensor response, setting baseflow, collection triggers

Hardware Improvements

10

New units

Built from beginning
to end

05

Retrofits

Older units upgraded
with design
improvements

70

Pump ready

Wired 70 pumps for
more samples/site

Training & Deployment



Sierra Garcia

- Standardized field ops
 - Updated checklists & field sheets
- Staff capacity
 - New training for less specialized teams
- Documentation
 - Completed set-up and construction manual
- Maintenance
 - Implemented maintenance & tracking manual and checklist



Proposed Small Automated Sampler Improvements



Background & Motivation



Sierra Garcia

- Field & logistical challenges of stormwater sampling
- Automated samplers can help
- Collection failures & inconsistent performance remain limitations
- Improving reliability & repeatability is critical for scalable deployment

Planned Improvements

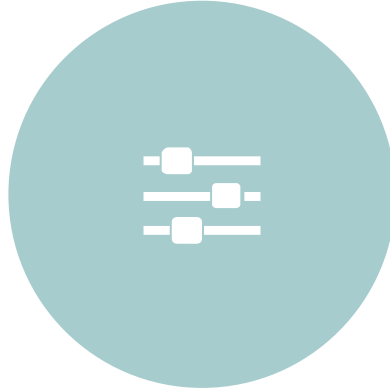


Hardware

Power/electrical

Line clogging

Component durability



Software

Configuration

Sampling control logic

User interface



Operations

QA/QC procedures

Standardize workflows

Budget & Deliverables



Expense	Est. Hours	2027 Cost	2028	2029	2030
Labor					
Hardware Improvements	16	\$4,500	tbd	tbd	tbd
Software & UI Improvements	130	\$28,400	tbd	tbd	tbd
Operational Improvements	68	\$15,100	tbd	tbd	tbd
Project Management		\$9,000	tbd	tbd	tbd
Direct Costs					
Equipment		\$3,000	tbd	tbd	tbd
Annual Total		\$60,000	\$30k	\$30k	\$40k

Deliverable	Due Date
Setup and Construction Manual, to be posted on GitHub	May 2027
Operation Manual, to be posted on GitHub	May 2027



**THANK YOU FOR
YOUR TIME**

sw_remotesquad@sfei.org

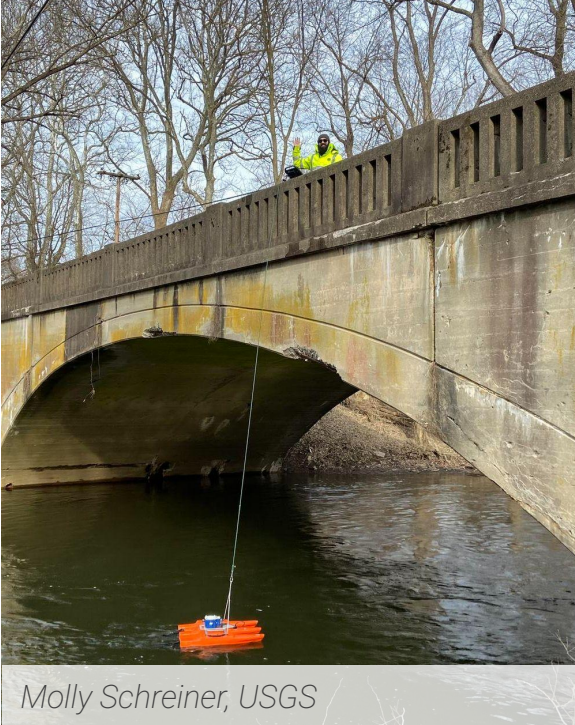




Developing Discharge Rating Curves



Project Goal and Motivation



Molly Schreiner, USGS

- Goal: Develop discharge rating curves at locations of existing, stage-only gages
- Motivation: Expand streamflow datasets to calibrate the San Francisco Bay Watershed Dynamic Model (WDM)

Rating Curves

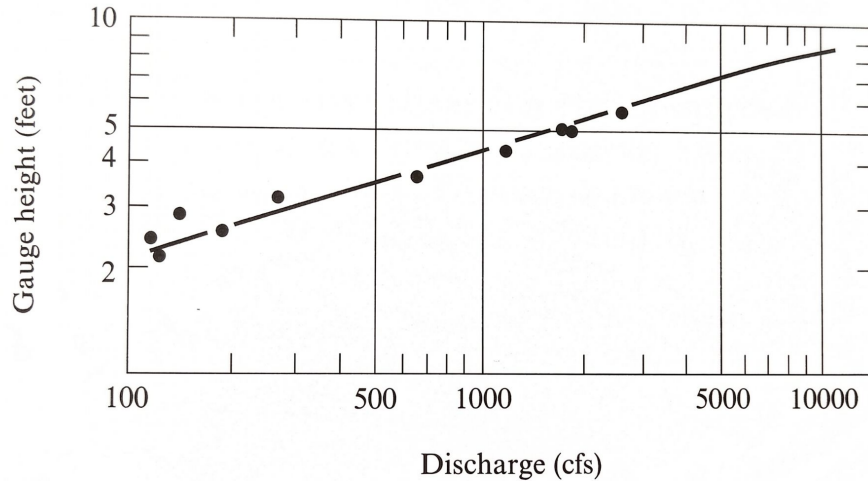


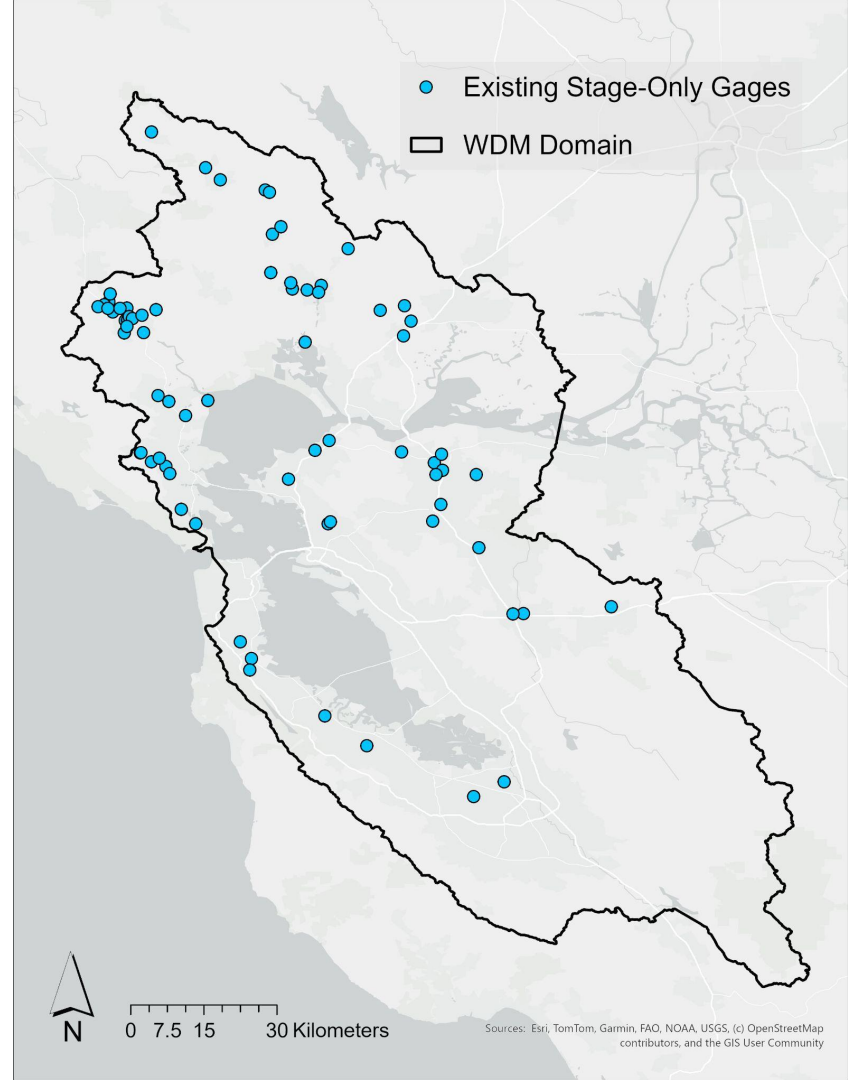
Figure 16-4 Rating curve for the New Fork River at Boulder, Wyoming.

Dunne, T., & Leopold, L. B. (1978).

- Defines a correlation between a river's stage and discharge
- Requires discharge measurements are collected at a variety of stage levels, especially high flows

Background

- ~75 stage-only gages with publicly accessible data throughout the Bay Area
- Existing infrastructure can be leveraged to develop cost-effective datasets



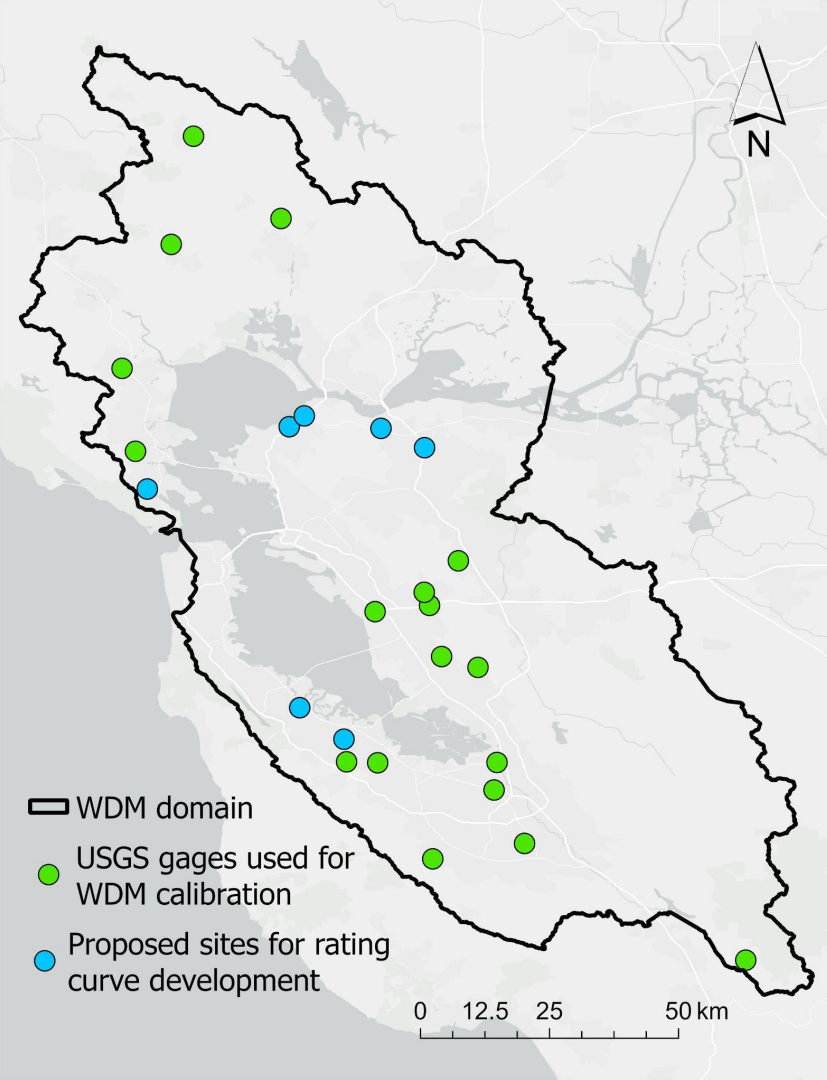
Work to Date

- Site selection

- Gathered all stage-only gages in the Bay Area
- Identified sites of interest, using geographic flow data gaps as the primary selection criterion
- Performed site recon to assess feasibility

- Outreach to gage managers

- Shared historical data
- Provided insight into each potential location



Monitoring Approach

1. Develop rating curves over 3 water years
2. Measure flow through the duration of two large storms at each site
 - Ideal to only sample during 1-in-2 year storms
 - Some sites of interest have existing rating curves and could require only a single storm event to complete or validate their rating curves.
3. Measure discharge using Acoustic Doppler Current Profiler (ADCP)
 - Becoming industry standard for collecting discharge data in non-wadeable streams
 - Quicker measurements while collecting full channel profiles
 - Having two ADCP units will enable staff to monitor two sites simultaneously

Multi-year Tasks and Budget

	Budget per Water Year (in thousands)		
	WY 2027	WY 2028	WY 2029
Labor Costs			
<i>Task 1. Equipment learning, SOP development and training</i>	\$10		
<i>Task 2. Season Preparation</i>	\$7	\$6	\$6
<i>Task 3. Storm Monitoring</i>	\$34	\$51	\$17
<i>Task 4. Project Management</i>	\$7	\$7	\$7.75
<i>Task 5. Data Management and Analysis</i>			\$24
<i>Task 6. Report</i>			\$20
Direct Costs			
<i>Equipment</i>	\$40		
<i>Travel</i>	\$0.50	\$1	\$0.25
<i>Permits</i>	\$2		
Total per year	\$100	\$65	\$75
Total for project			\$240

Timeline and Deliverables

2027

- Equipment Learning and Training
- Four Monitoring Events
- Deliverable:
 - Standard Operating Procedure for ADCP discharge monitoring (May 2027)

2028 and 2029

- Six monitoring events in 2028
- Two monitoring events in 2029
- Deliverables:
 - Draft Report (Feb 2030)
 - Final Report (April 2030)
 - Electronic data package (Apr 2030)

Sites of Interest for Supporting Model Calibration	Gage Owner	Existing Rating Curve Notes	Other RMP interests
Alhambra Ck @ D St	Contra Costa County Flood Control District	No existing discharge rating curves	
Pinole Ck @ San Pablo Ave Bridge	Contra Costa County Flood Control District	SFEI developed a rating curve in the Pinole Creek watershed in 2004. Monitoring at this site can help determine the validity of the existing rating curve.	SedWG - high sediment yields
Rodeo Ck @ Hawthorne Dr	Contra Costa County Flood Control District	No existing discharge rating curves.	
Walnut Ck @ Diamond Blvd Bridge	Contra Costa County Flood Control District	USGS developed a rating curve in 2021 that lacks measurements at high flows. Collecting measurements during high flows will increase model confidence during peak flows.	SedWG - high sediment yields; PCB and Hg data collected during one storm in WY 2011
Arroyo Corte Madera @ La Goma St	County of Marin	The County of Marin provided SFEI with two differing rating curves. Monitoring once at this site would be valuable to determine which of the two is correct.	
Belmont Creek @ Old County Road	San Mateo County	SFEI developed a rating curve in 2023 containing some small data gaps. Monitoring once at these sites could fill those data gaps.	PCB and Hg data collected during one storm in WY 2011
Atherton Channel @ CalTrain	San Mateo County	No existing discharge rating curves.	

Table 2. Proposed sites for discharge rating curve development where existing flow gages are present, and current status of rating curves at each site.



SPLWG 2027 Special Study Proposal: Improved Watershed Delineation

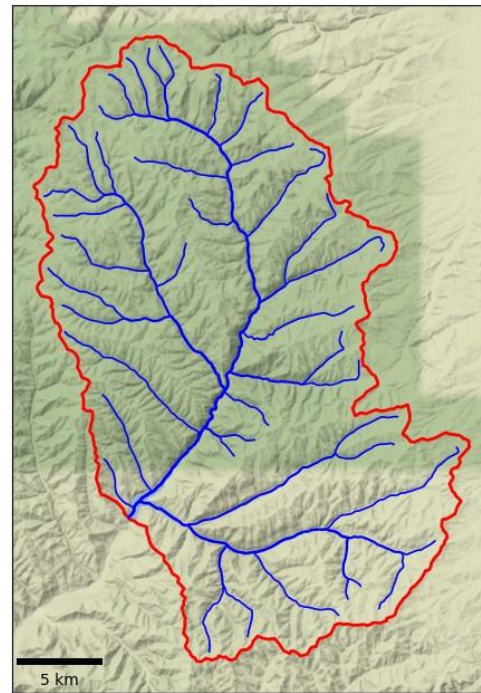
Supporting Modeling, Data Interpretation, and Site Selection

Study Objectives & Management Questions

Study Objective	SPLWG Management Question (MQ)
Improve delineations for better monitoring data interpretation and model parameterization.	MQ1: What are the sources, pathways, and loadings of pollutants and sediment to the Bay?
Accurately identify potential contaminant sources in each specific urban watershed.	MQ2: Which are priority sources and pathways adversely impacting the Bay's quality?
Enhance long-term tools for ongoing RMP watershed modeling efforts.	Long-term: Support for emerging contaminants (PFAS) and legacy PCBs/Mercury.

Traditional Watershed GIS Analysis

- Input: Digital Elevation Model (DEM) and a sample point
 - Contributing area based off of flow direction and flow accumulation
- Generally works well for:
 - Large watersheds
 - Areas of high slope
 - When topography drives water movement
 - Rural areas
- Can use lower resolution DEMs.
- Doesn't work well in flat urban areas



Challenges of Urban Watersheds

- Low slope areas
- Obstructed Channels
 - Culverts & overpasses
- Storm water flows into stormwater inlets and open waterway channels
- Water is conveyed underground through a stormwater network

Ways to address these challenges:

- High resolution lidar based DEM
- Hydroconditioning - channel under culverts & overpasses
- Stormwater inlet locations
- Stormwater network

Improved Watershed Delineation

Proposal:

- Budget of \$75,000
- Address the Urban Gap:
 - Current manual delineation methods are slow, subjective, and prone to inconsistency and error.
- Develop a Robust Geospatial Tool:
 - We propose a geospatial tool that integrates lidar elevation with municipal stormwater network data to accurately automate the delineation of urban watersheds for Bay Area monitoring.

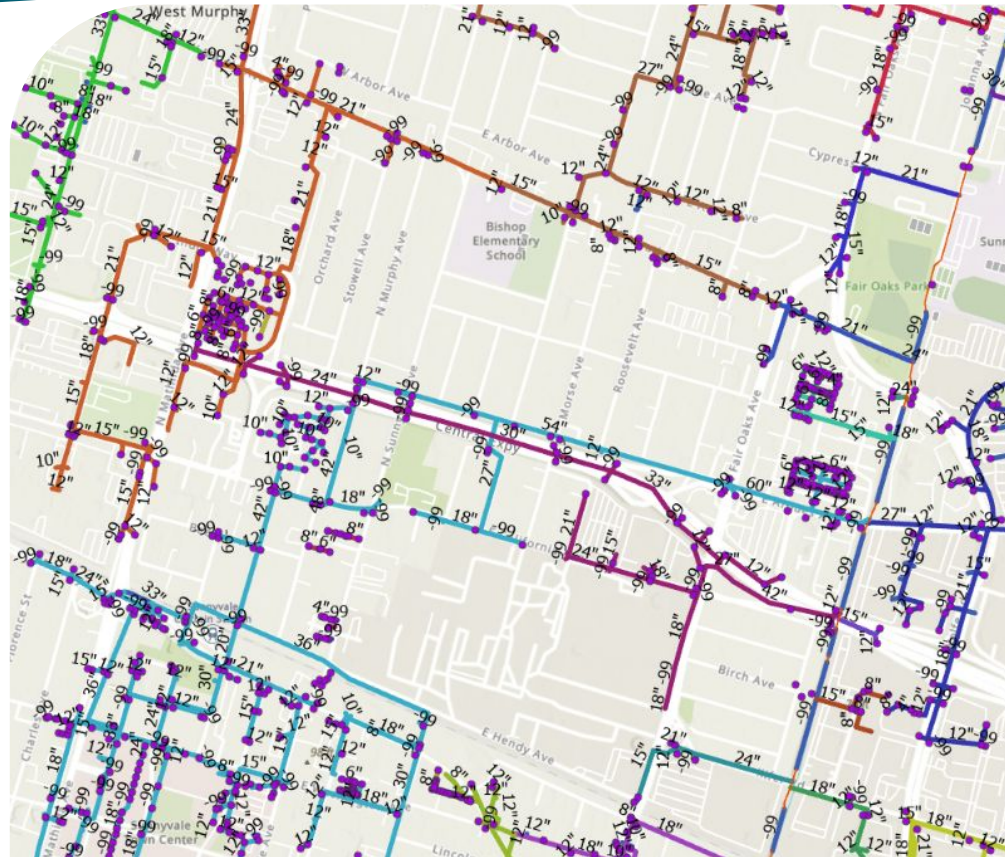
Project Schedule (2027-2028)

- **Task 1: Research** Q1 2027
 - Literature review of urban watershed tools (e.g. Scalgo, USGS Missouri StreamStats)
- **Task 2: Tool Development** Q2-Q4 2027
 - Development of an ArcGIS toolbox
- **Task 3: Municipal Data Collection** Q3 2027- Q1 2028
 - Work with BAMSC partners to obtain
- **Task 4: Watershed Delineation** Q1 2028
 - Delineation of 30-40 priority watershed and stakeholder review
- **Task 5: Tool Publication** June 2028
 - Final tool package published on SFEI website and GitHub



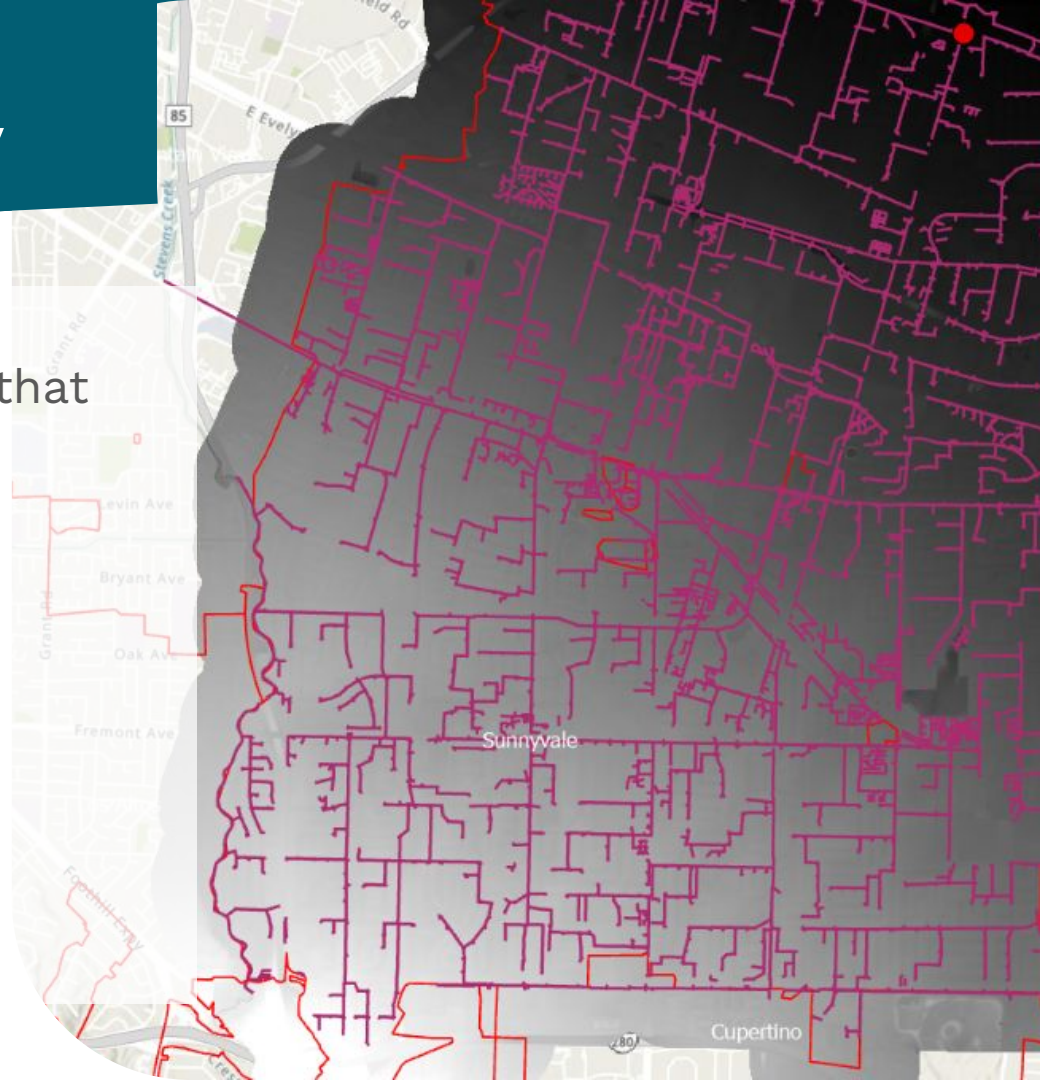
Municipal Stormwater Network Data

- Variation in municipal data formats and completeness
- Variation in documentation flow directions
- Circular and non dendritic stormwater networks



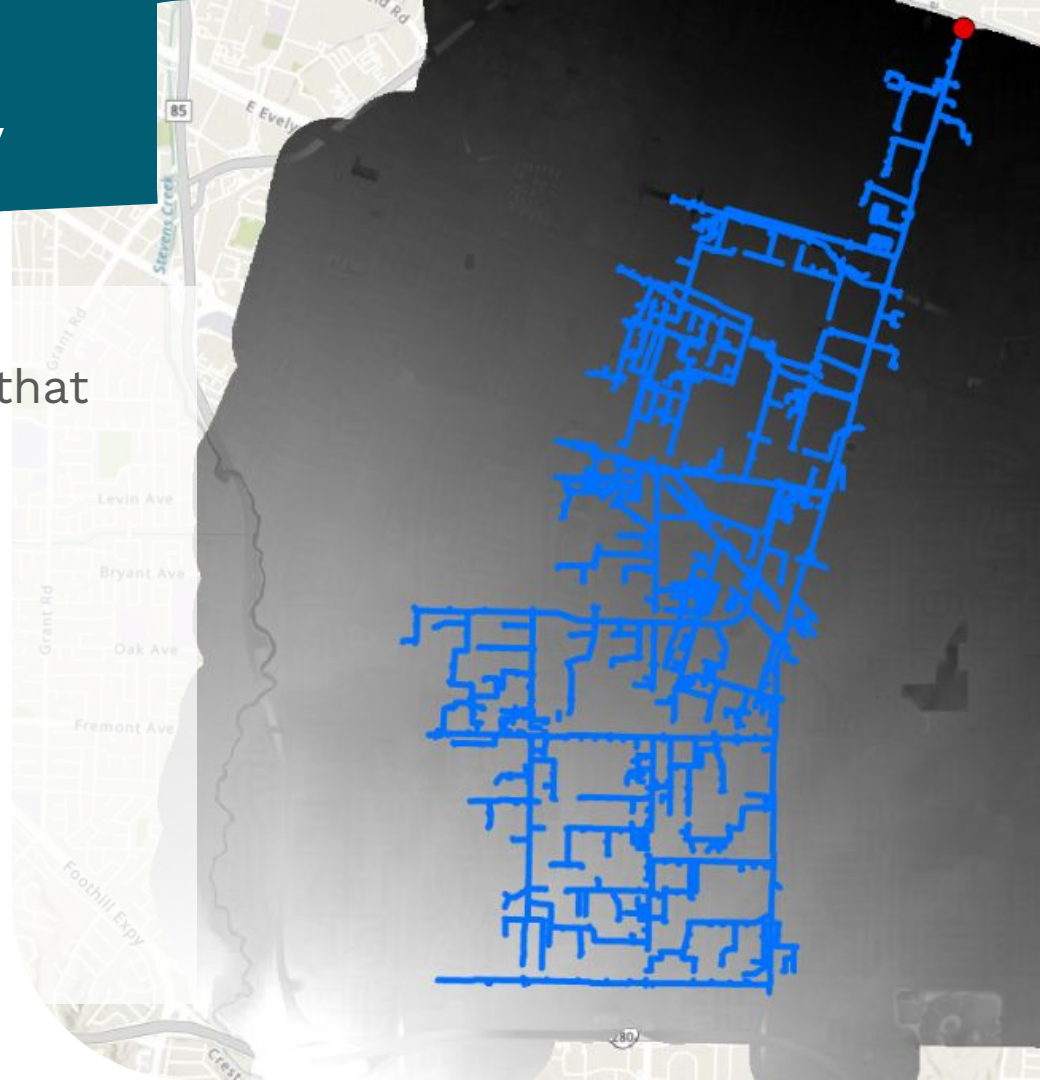
Proposed Workflow / Sunnyvale Initial Study

- Manual
 - Select stormwater network that flows to sample point



Proposed Workflow / Sunnyvale Initial Study

- Manual
 - Select stormwater network that flows to sample point



Proposed Workflow / Sunnyvale Initial Study

- Manual
 - Select stormwater network that flows to sample point
- Automated Tool
 - Burn in stormwater network into DEM



Proposed Workflow / Sunnyvale Initial Study

- Manual
 - Select stormwater network that flows to sample point
- Automated Tool
 - Burn in stormwater network into DEM



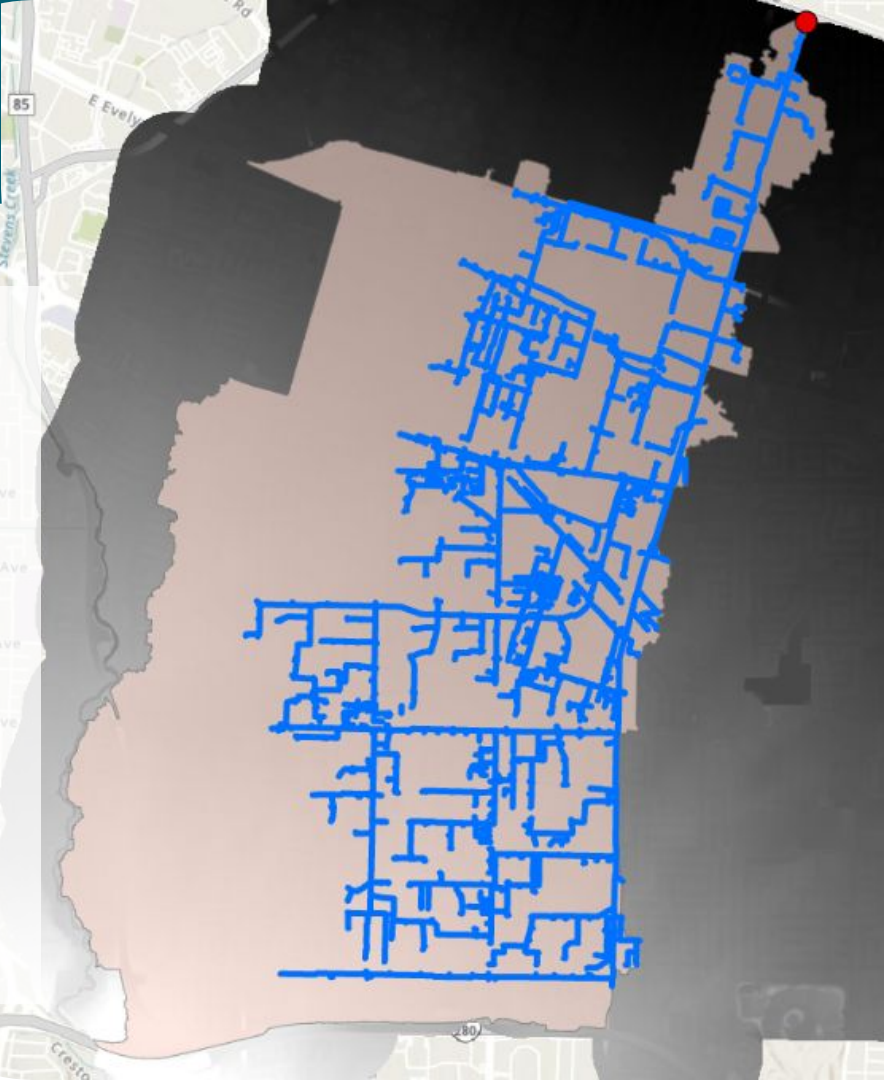
Proposed Workflow / Sunnyvale Initial Study

- Manual
 - Select stormwater network that flows to sample point
- Automated Tool
 - Burn in stormwater network into DEM
 - Fill
 - Flow Direction
 - Flow Accumulation



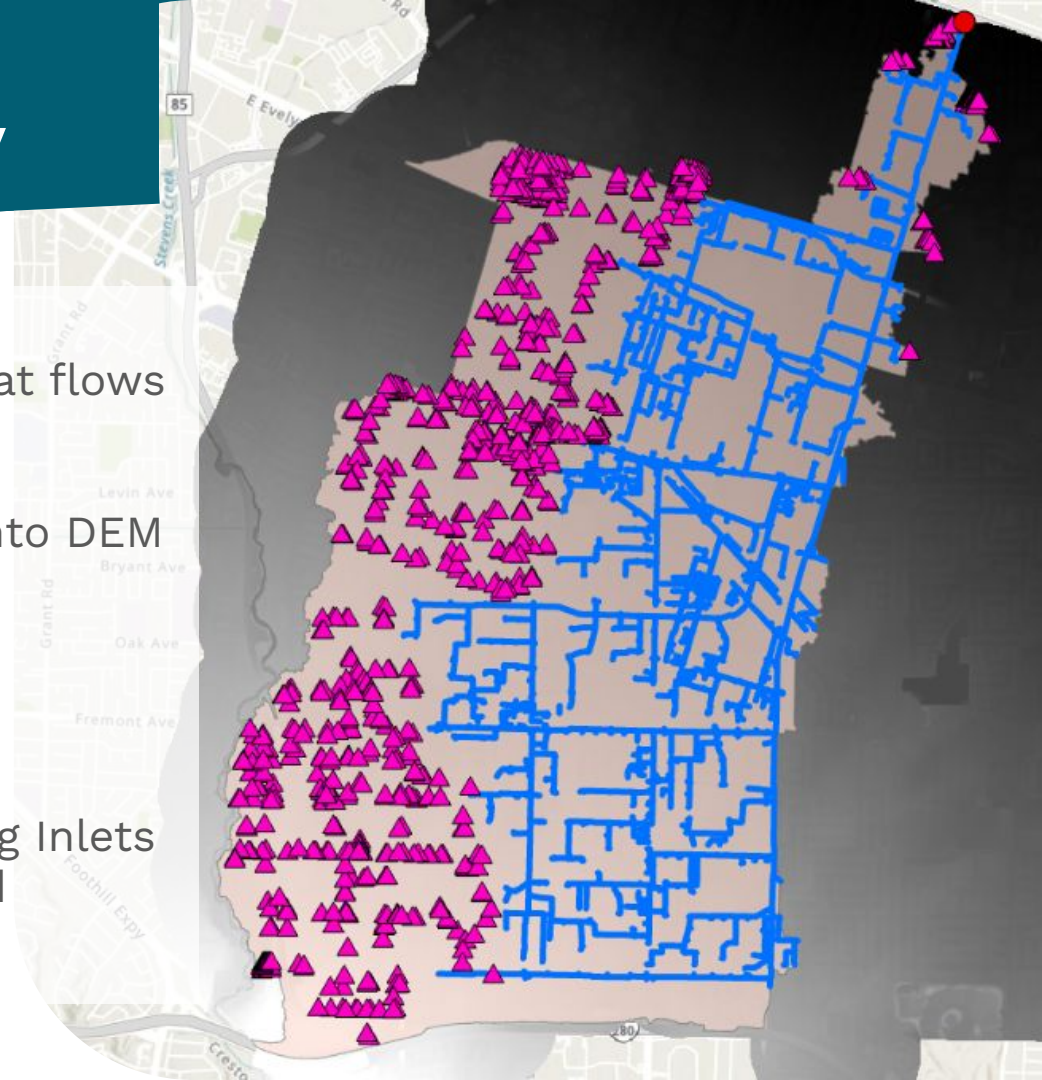
Proposed Workflow / Sunnyvale Initial Study

- Manual
 - Select stormwater network that flows to sample point
- Automated Tool
 - Burn in stormwater network into DEM
 - Fill
 - Flow Direction
 - Flow Accumulation
 - Watershed tool



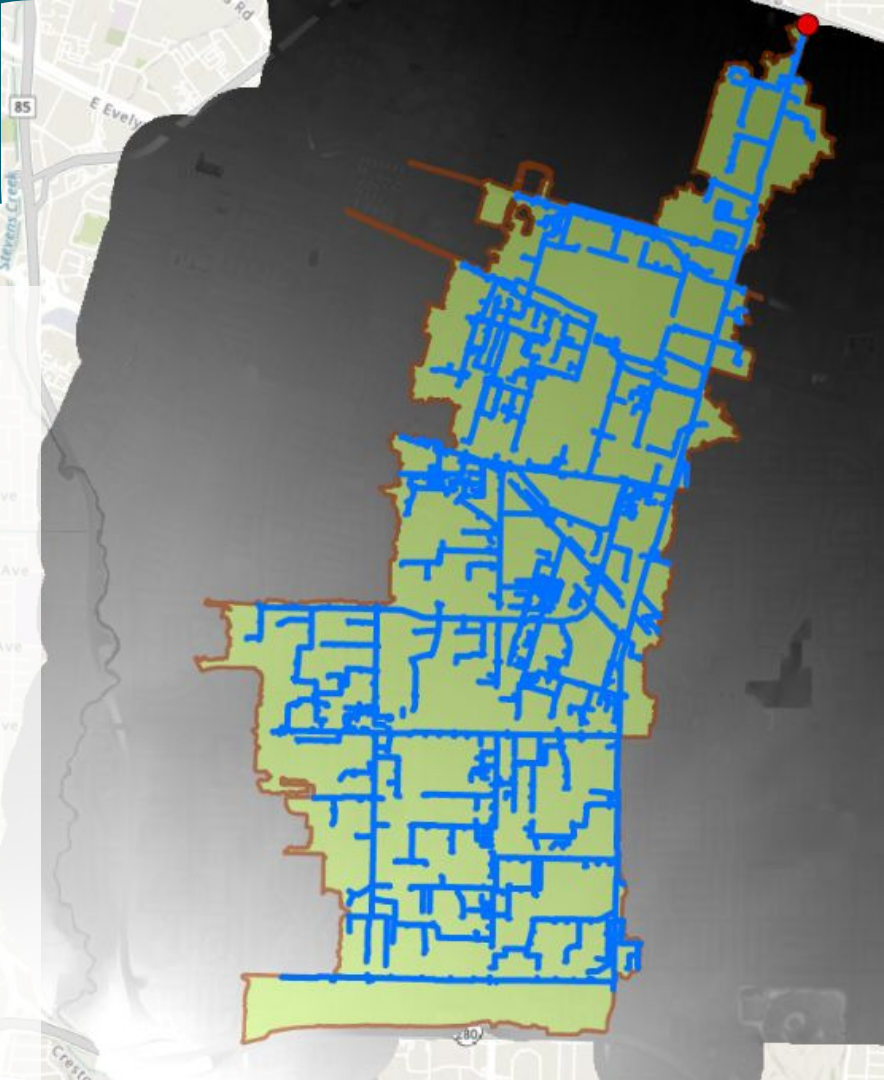
Proposed Workflow / Sunnyvale Initial Study

- Manual
 - Select stormwater network that flows to sample point
- Automated Tool
 - Burn in stormwater network into DEM
 - Fill
 - Flow Direction
 - Flow Accumulation
 - Snap sample point
 - Watershed tool
- Add in drainage area to surrounding Inlets
 - Remove drainage areas around network of interest



Proposed Workflow / Sunnyvale Initial Study

- Manual
 - Select stormwater network that flows to sample point
- Automated Tool
 - Burn in stormwater network into DEM
 - Fill
 - Flow Direction
 - Flow Accumulation
 - Snap sample point
 - Watershed tool
- Add in drainage area to surrounding Inlets
 - Remove drainage areas around network of interest
 - Could try using other network portions instead



Expected Project Advancements

- Big step forward from current methods
 - Current manual estimation - inconsistent, error prone
- Use of updated municipal stormwater data
 - Account for recent development and redevelopment
 - Oakland museum data dates back to 1993 in areas
- Public tool providing a consistent repeatable workflow
 - Larger advancement than just the 30-40 watersheds for this specific project
 - Improves ability to identify contributing areas and potential pollutant sources relevant for water sample and testing locations in urban settings

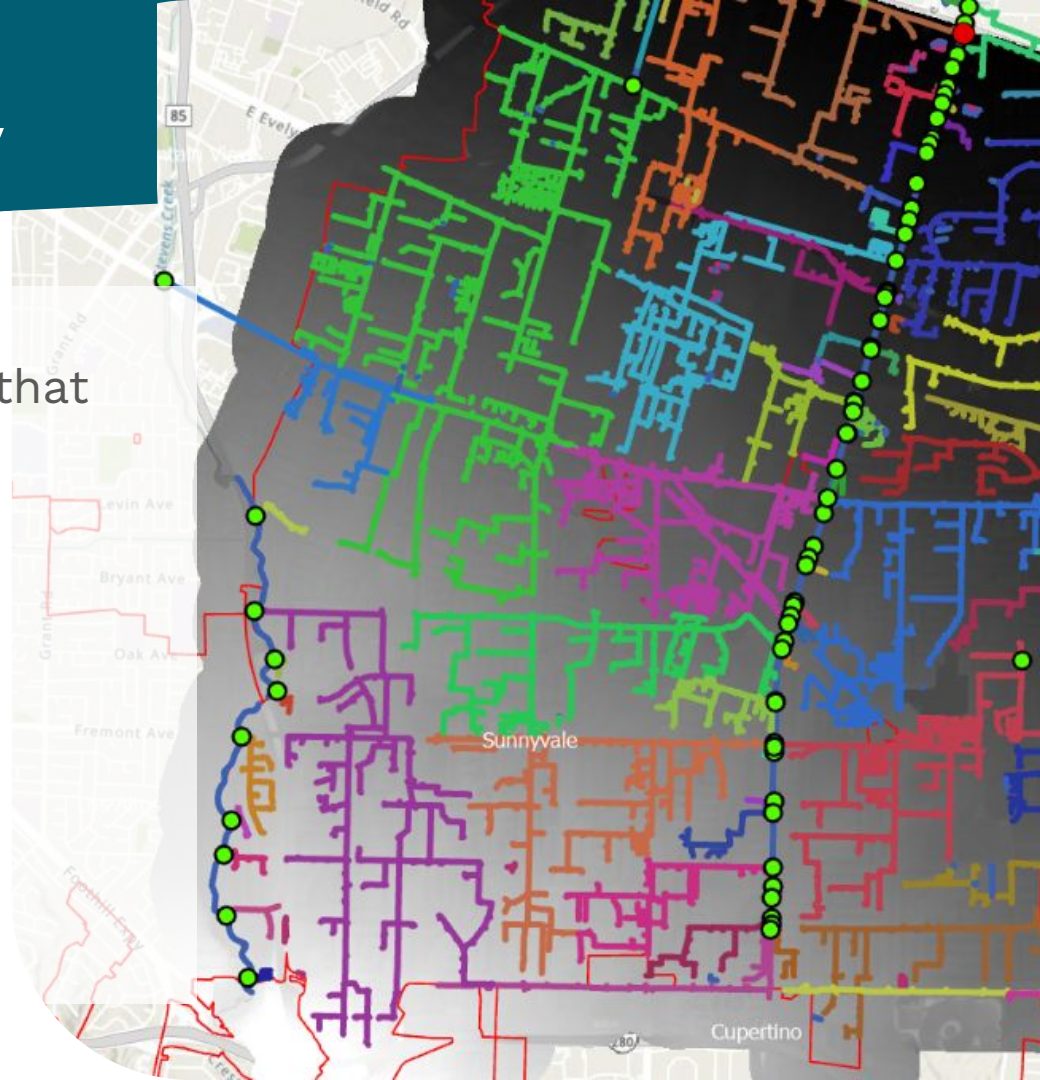
Questions?

Improving Watershed Delineation to Support Modeling and Site Selection

Pete Kauhanen | Alicia Gilbreath | Matt Heberger
San Francisco Estuary Institute (SFEI)

Proposed Workflow / Sunnyvale Initial Study

- Manual
 - Select stormwater network that flows to sample point





WY 2027 Fixed Station Monitoring

Proposal to the SPLWG, May 2026

FMSN Vision

To collaboratively build a network of monitoring stations that together generally represent the region's local watersheds, to produce robust, quality-assured, publicly available long-term data on stormwater flow and pollutant concentrations to address evolving management questions.



Long-Term Trends

Establish contaminant concentration and loading trends from local watersheds to the Bay.



Continuous Datasets for Sediment and Other Contaminants

Capture multi-contaminant samples and real-time flow, turbidity, and rainfall data.



Support Data Interpretation

Inform storm-driven variability analysis and examine relationships with landscape features.



Modeling Support

Provide high-quality data for robust watershed model calibration and predictive analysis.

Study Approach

Storm Monitoring (WY 2027)

Collect 4-5 discrete samples during 4 storm monitoring efforts

Rating Curve Development or Verification

Proposed Analytes

SSC, PCBs, Total Hg, Total Metals, Total Organic Carbon

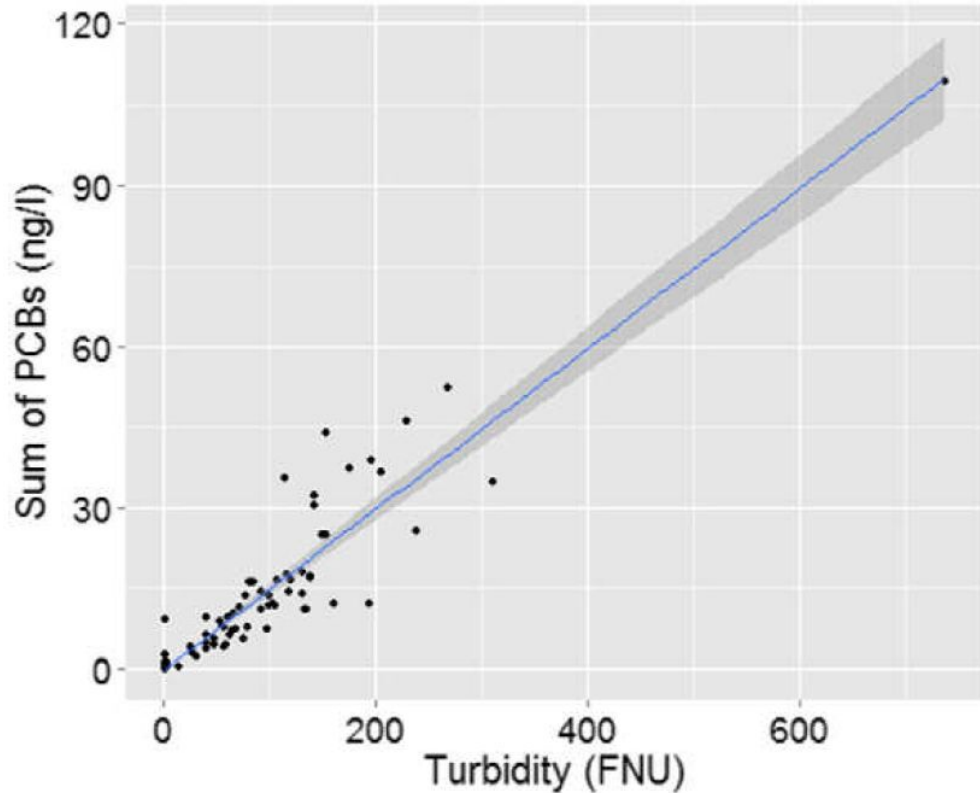
Monitoring Methods

4 storms

- *First (of season) Flush*
- *One of the three largest storm events of the year*
- *2 additional storms distributed across season*

Desired Collection Approach

- *Each storm, 4-5 discrete samples across range of turbidity using turbidity-surrogate regression*
- *Typically, early rising limb, late rising limb, peak flow, and the falling limb*



Multi-Year Study Approach



Total Budget Request for all 4 stations monitored - \$644k

Water Years 2027-2029 monitor each of 4 stations one year*

Technical report for each station plus synthesis

Year 1 Tasks and Budget

Expense	Est. Hours	Cost
Labor		
Task 1. Season, site, and sampling prep	72	\$12K
Task 2. Stormwater Sampling	220	\$37k
Task 3. Data QA	150	\$25k
Task 4. Data Report	105	\$18k
Task 5. Project Management	75	\$13k
Subcontracts		
<i>Lab Analysis - contractors TBD</i>		\$36k
Direct Costs		
Supplies	-	\$0.5k
Travel	-	\$0.5k
Shipping	-	\$2k
Total		\$144k

Timeline and Deliverables



Aug/Sep 2026

Contracting & Permitting

Oct 2026 - Apr 2027

Stormwater Monitoring

Summer 2027

Laboratory Analysis

Fall 2027

Quality Assurance

Spring 2028

Report and Workgroup Presentation; Data uploaded to CEDEN