National Water Quality Monitoring Council

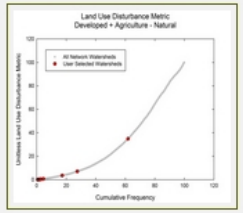
Working together for clean water

The National Network of Reference Watersheds

About NNRW | Core Watersheds | Watershed Search | User Guide | Cooperators

The National Network of Reference Watersheds is a collaborative and multipurpose network of minimally disturbed watersheds and monitoring sites. The purpose of this website is to allow users to search the NNRW database of reference watersheds, to identify watersheds of interest, and download watershed information and water quality data. The current scope of the network is limited to freshwater streams. Membership in the network is voluntary and open to individuals, agencies, and institutions interested in participating in monitoring and (or) research in minimally disturbed and pristine watersheds.

What is a Reference Watershed?



The NNRW defines reference watersheds as those minimally disturbed by human activity preferably in an area protected from human-induced changes. References watersheds can be used to measure changes in soil chemistry, vegetation, water quality, and biology through time as well as to compare to disturbed watersheds.

The network is currently composed mainly of U.S. Geological Survey and U.S. Environmental Protection Agency watersheds however, as the network expands watersheds will be added from other Federal, State, tribal, interstate, academic, local and private sector organizations that choose to participate.

The "Watershed Search" section of the website allows users to search the entire network database. The database includes many types of reference watersheds; some are considered reference based on low hydrologic disturbance, others based on land use disturbance, and others based on water quality, stream biology, or some combination of criteria. Results of users searches can placed into context with all watersheds in the database on cumulative frequency diagrams like the one to the right.

The "Core Watersheds" section of the website allows users to search a subset of the NNRW database that contains only the most pristine watersheds based on specific land use criteria Core watersheds also have stream discharge data available.

Select the "Core Watersheds" tab to explore the most pristine watersheds in the network or select the "Watershed Search" tab to search the entire NNRW database of reference watersheds and access data available for those sites.

Today's Featured Watershed

Cache Creek

The Cache Creek Basin is located in western Wyoming. Cache Creek drains about 27 km² of steep mountain and canyon terrain in the Gros Ventre Mountains...

Watersheds Where I Live

Find a Core Reference Watershed near your location

Input either a 5 digit zipcode or latitude and longitude (in decimal degrees).

Zipcode: Latitude:

Longitude:

Submit

If you would like to submit a watershed or a group of watersheds to be included in the network please contact Mike McHale

https://my.usgs.gov/nnrw/

tices

Purpose of the Network

- Provide access to documented quality data and information from minimally or least disturbed watersheds to be used in assisting with establishing “background” conditions for select hydrologic variables and water-quality.
- Increase the efficiency of monitoring with improved coordination and collaboration and increased opportunities to leverage existing reference sites, networks, and financial resources
- The network links Reference Watersheds to their water quality data in the Water Quality Portal
- NNRW watersheds are also linked to the closest National Atmospheric Deposition Program collector to make atmospheric deposition data available for each watershed.

National Network of Reference Watersheds

Mike McHale, Chair, USGS New York Water Science Center

- Current status
  - Available on Council website
  - Over 2500 watersheds with more than 10 years of flow data
  - Ability to use pre-defined or customize criteria for reference watersheds
  - Download Water Quality data for up to 50 watersheds at a time
- Focus in 2018
  - Continue to expand users and data (e.g., include Forest Service Priority watersheds and EPA lake watersheds)
  - Develop a revised Hydrologic Disturbance Metric
  - Incorporate National Atmospheric Deposition Program Total Deposition data into the website
  - Continue to develop R analytical tools to compile and assess water quality data in reference watersheds
  - Revise the Core Watersheds webpage to include a more definitive set of National Core Reference Watersheds based on the work by Miller et al., 2016
  - Increase the visibility/use of the website

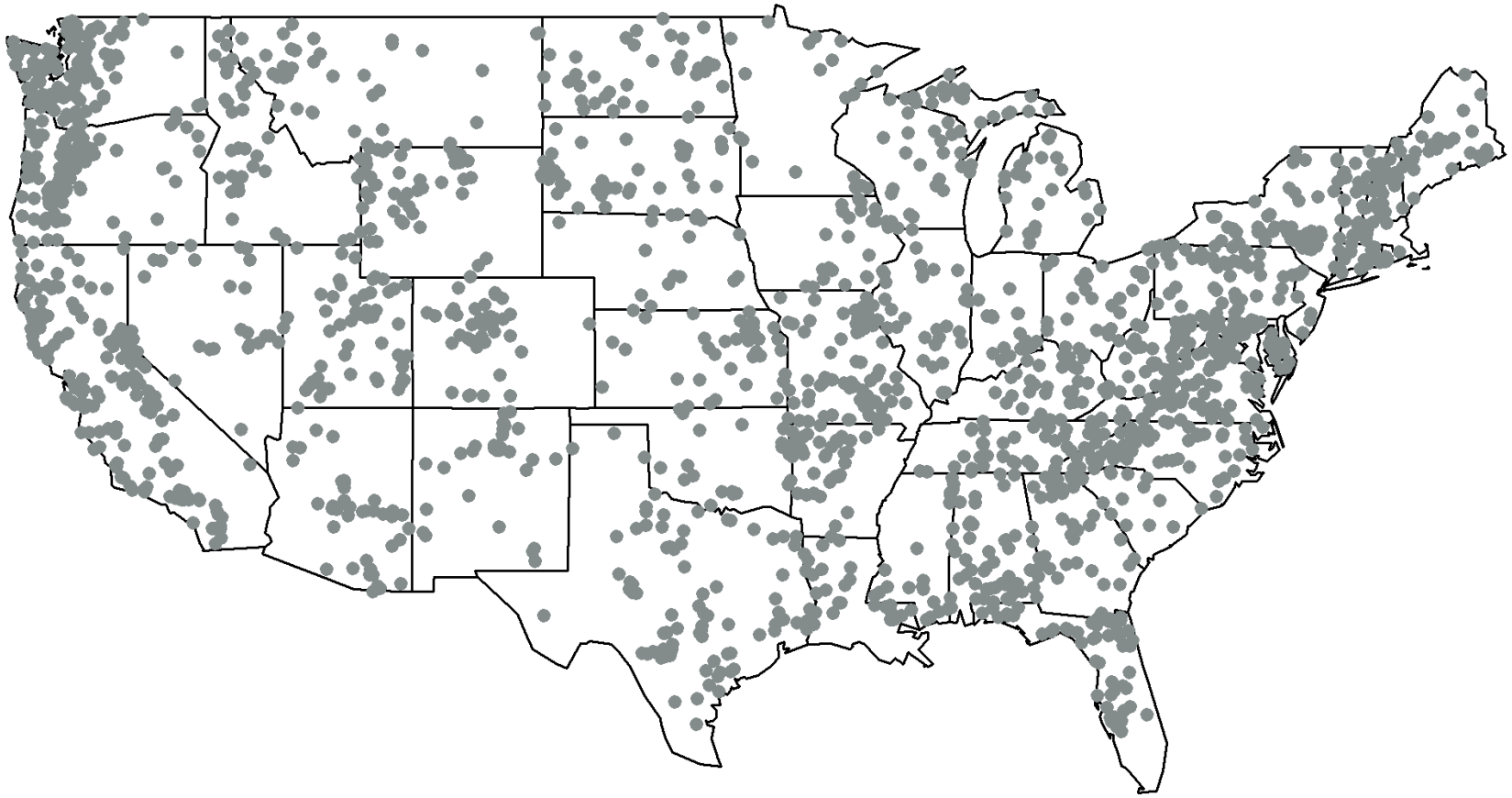
ACWI

NWQMC

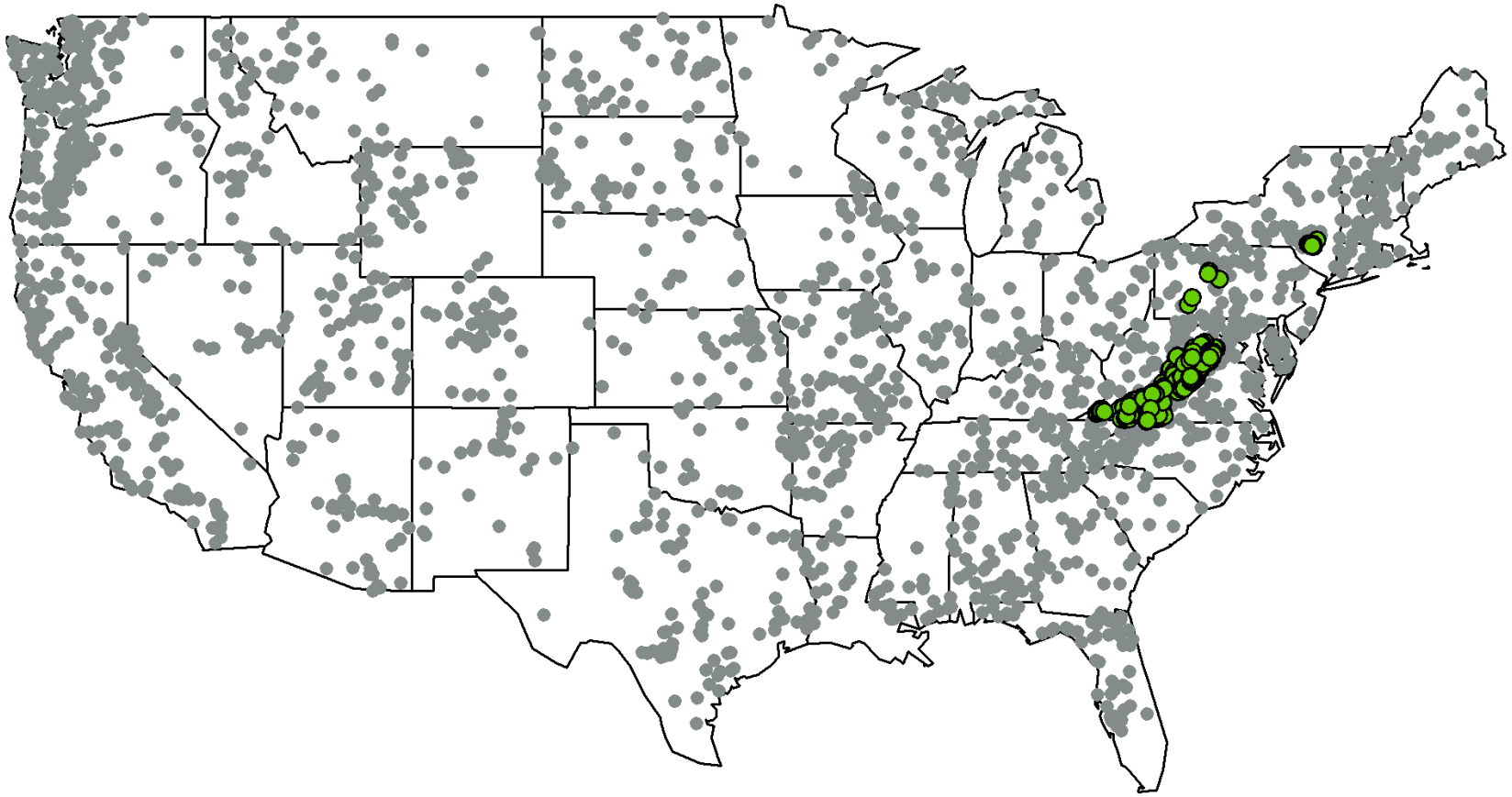
NNRW FY18 Communication Plan

- Interface with the C & O Working Group as a starting point
- Talk to Jim Kreft and others about how they have promoted the WQP
- Create an NNRW Project on Research Gate

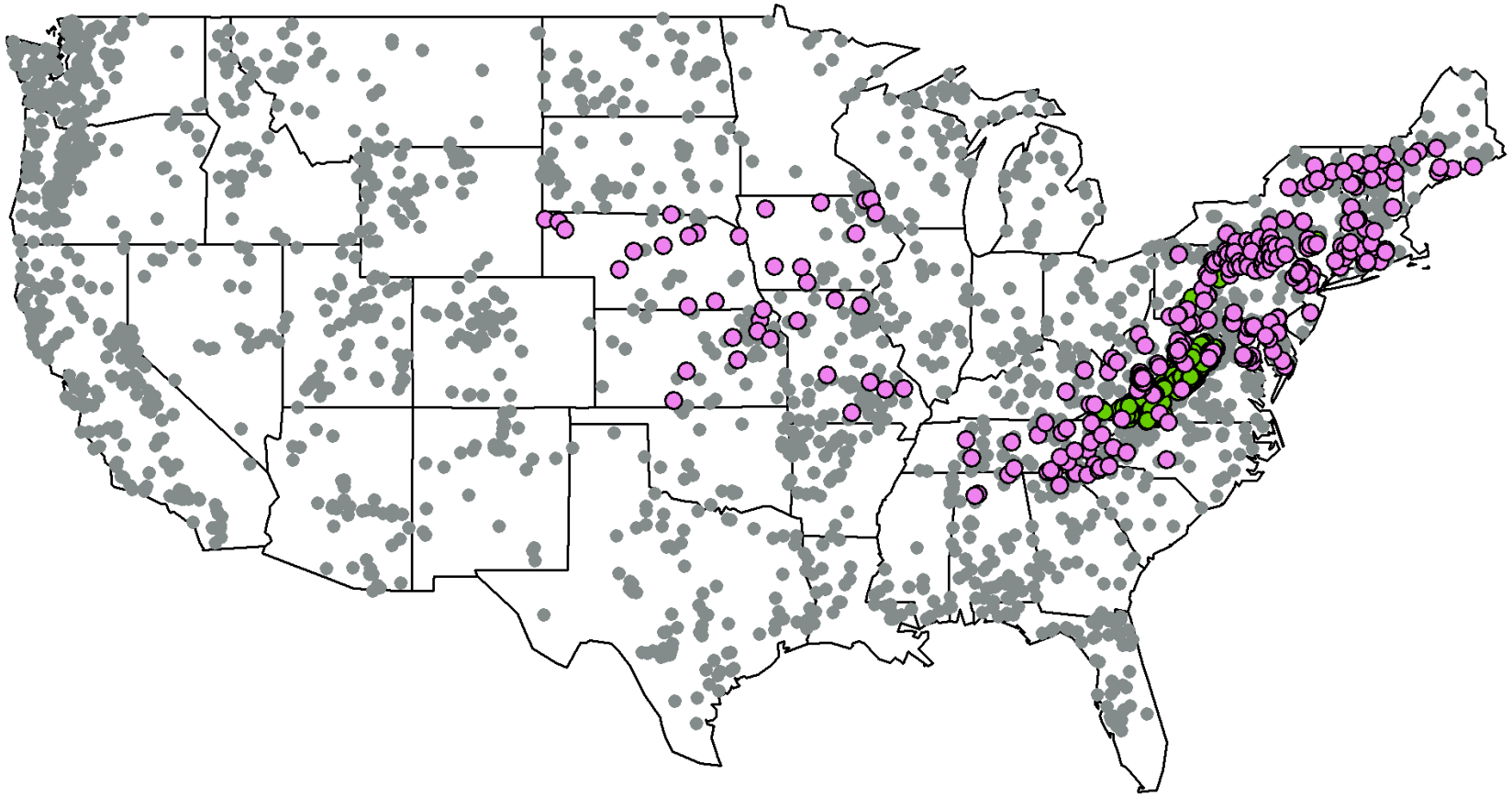
Original NNRW Watersheds
(GAGESII Reference Watersheds defined by Falcone and others 2010)



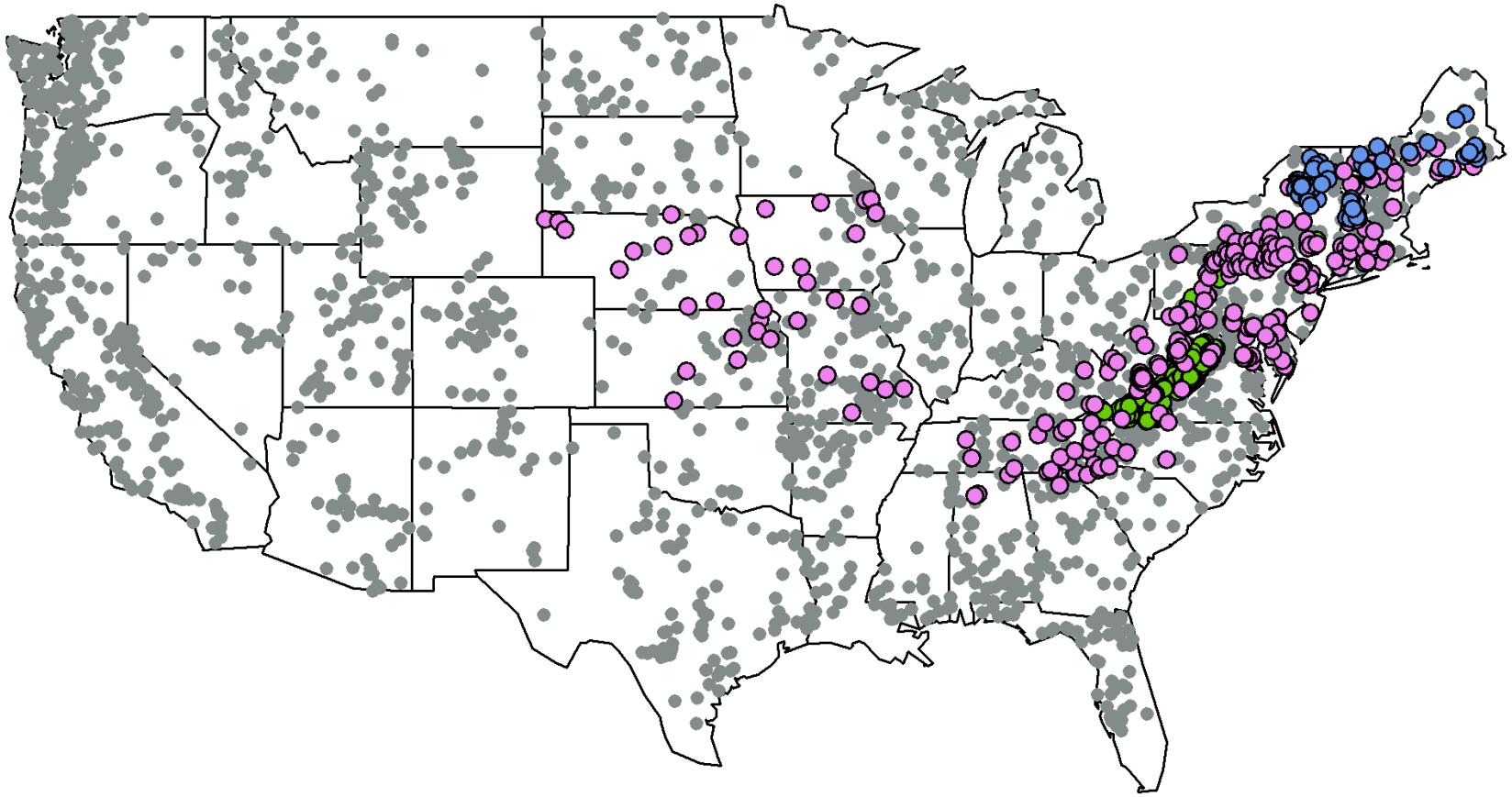
EPA Long-Term Monitoring Watersheds



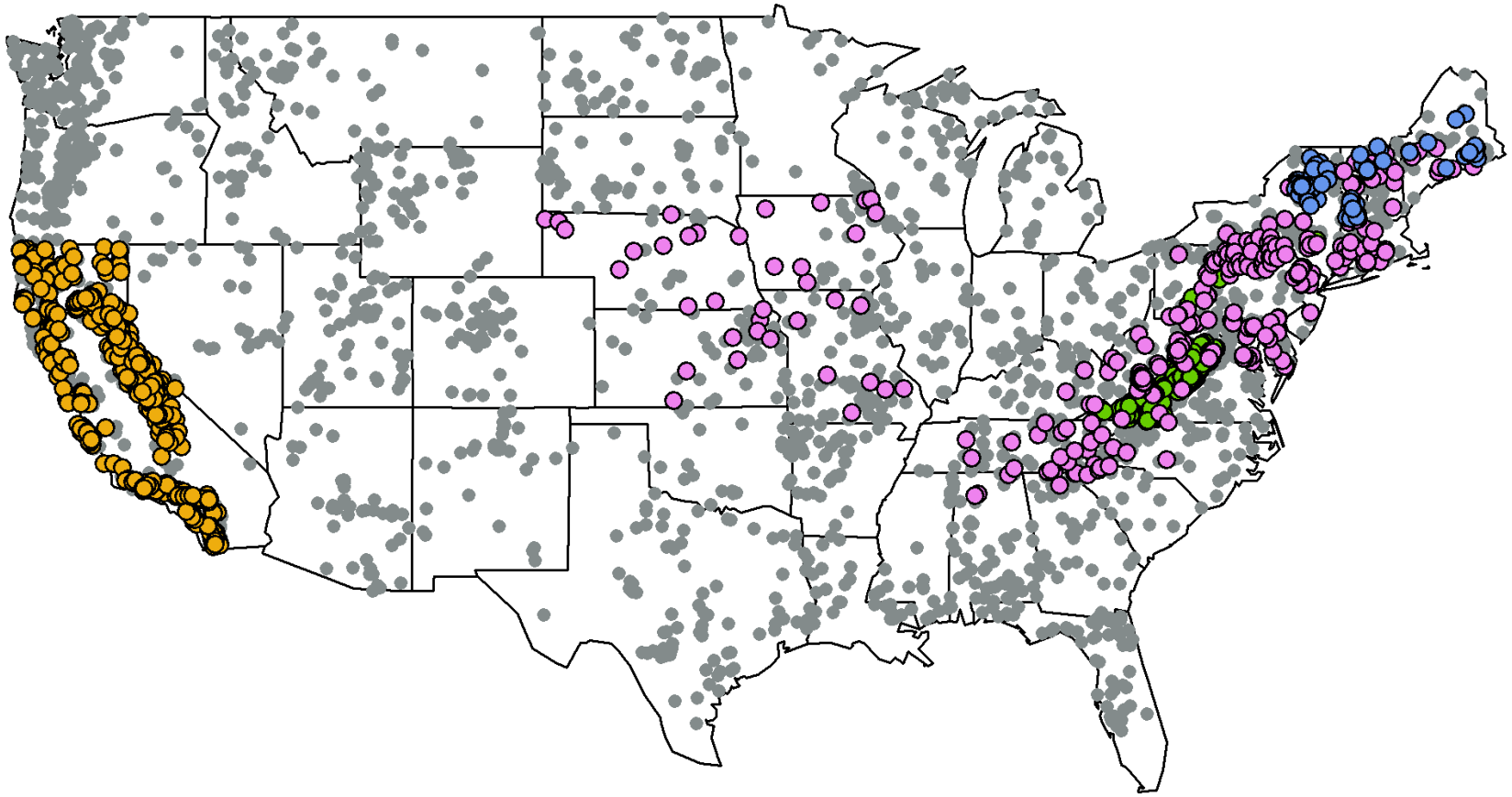
EPA Regional Monitoring Watersheds (State Sites – still actively being added)



EPA Long-term Monitoring Lake Watersheds (Planned for addition in 2018)

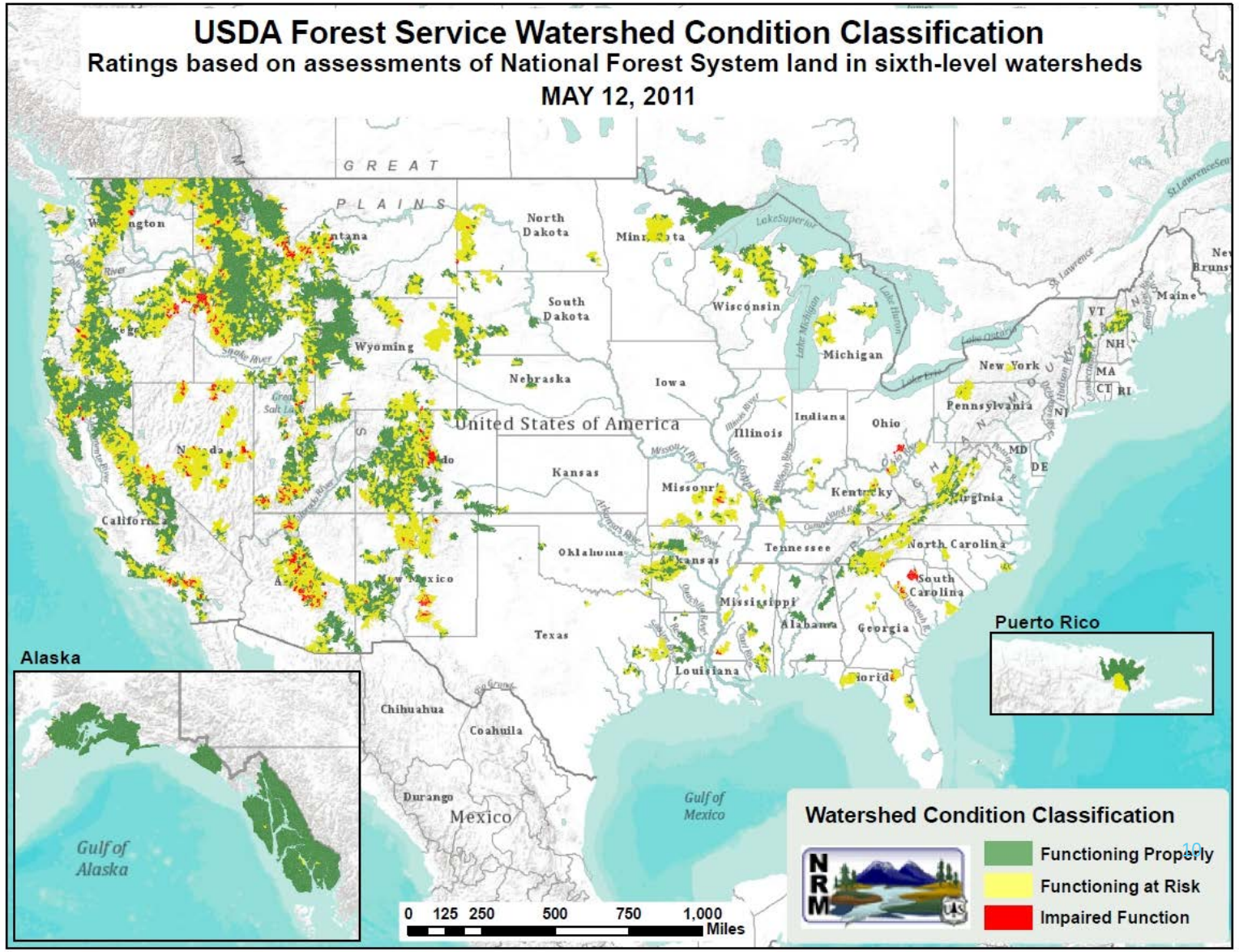


California Reference Watersheds
(Actively evaluating for inclusion in the NNRW)



Forest Service Priority Watersheds

Dave Levinson (USFS)



NNRW Core Watersheds (“Pristine”)

- 0% Row Crops
- < 5% Pasture
- 0% High Impact Development
- 0% Medium Impact Development
- < 10% Low Impact Development
- Low hydrologic disturbance (no Major Dams, low storage)
- Based on the 2006 National Land Cover Dataset.
- There are currently 504 NNRW Core watersheds

NNRW Core Watersheds Definition Open Questions

- Data Availability
  - Flow Data
  - Water Quality Data (and which parameters)
  - Biological Data – types?
  - Other data?
- Period of Record available for those data
- Data comparability – Remember Lori Sprague's Presentation
- Should we create a tiered framework for the watersheds based on data availability?
- Should the criteria be regionally sensitive?

https://nawqatrends.wim.usgs.gov/swtrends/

Water-Quality Changes in t...

USGS Water-Quality Changes in the Nation's Streams and Rivers

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BASEMAPS

MAP LAYERS

CONSTITUENT SELECT

Constituent group:

Nutrients

Constituent:

Nitrate

For more information, see User Guide

Trend type

- Concentration
- Load

Trend period

- 1972-2012
- 1982-2012
- 1992-2012
- 2002-2012

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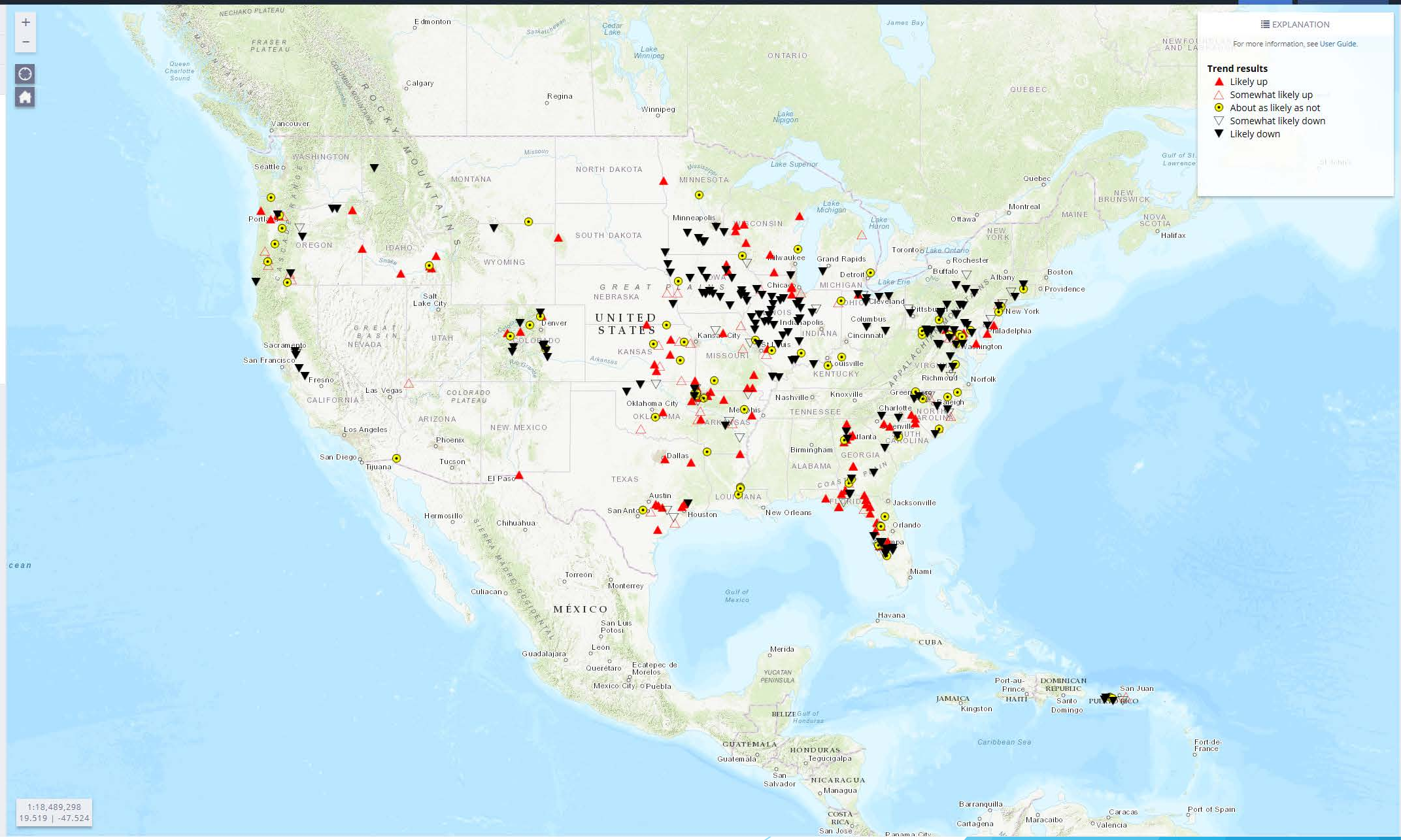

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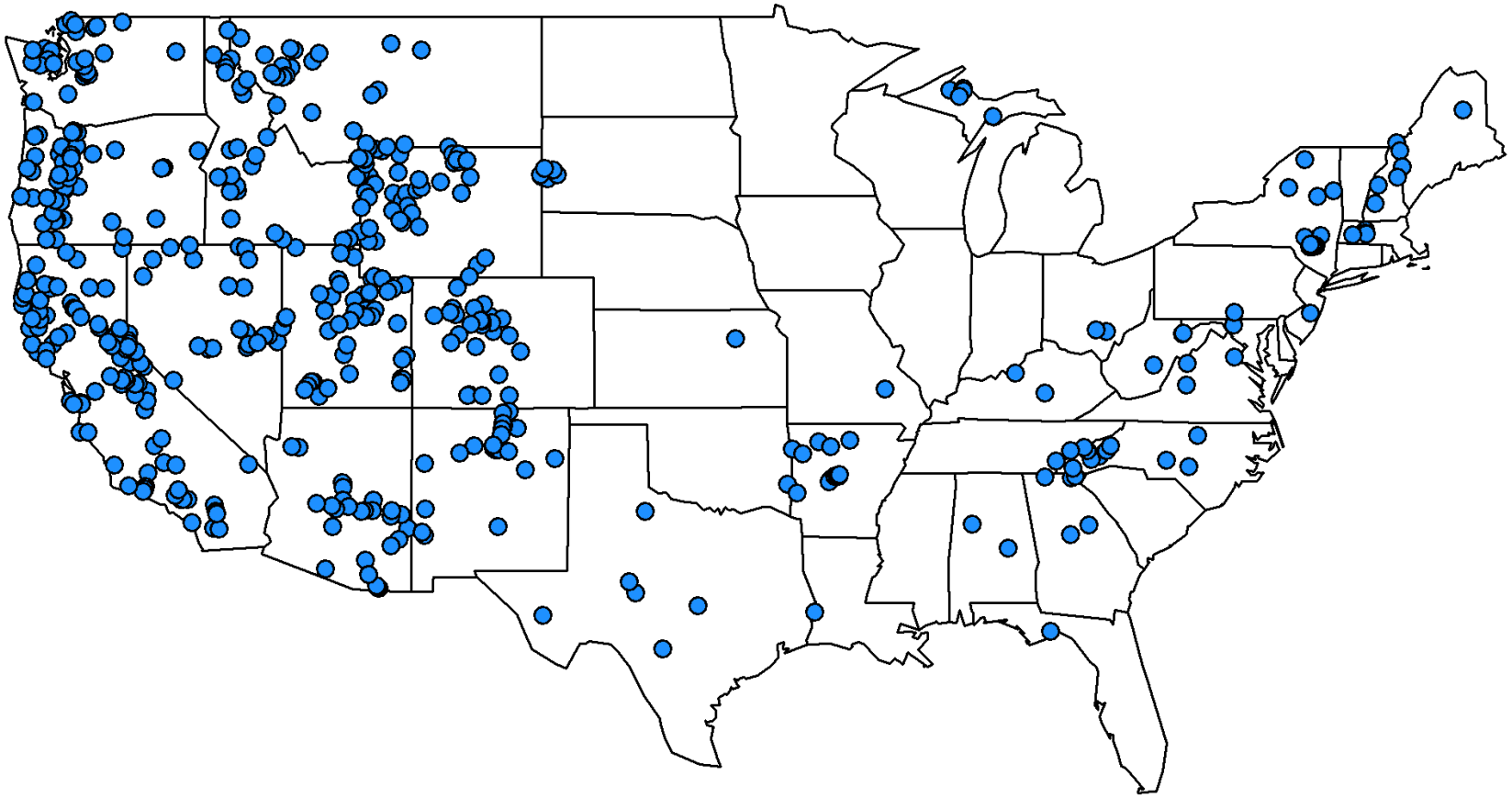


Reference from a biological perspective

Stoddard et al. 2006

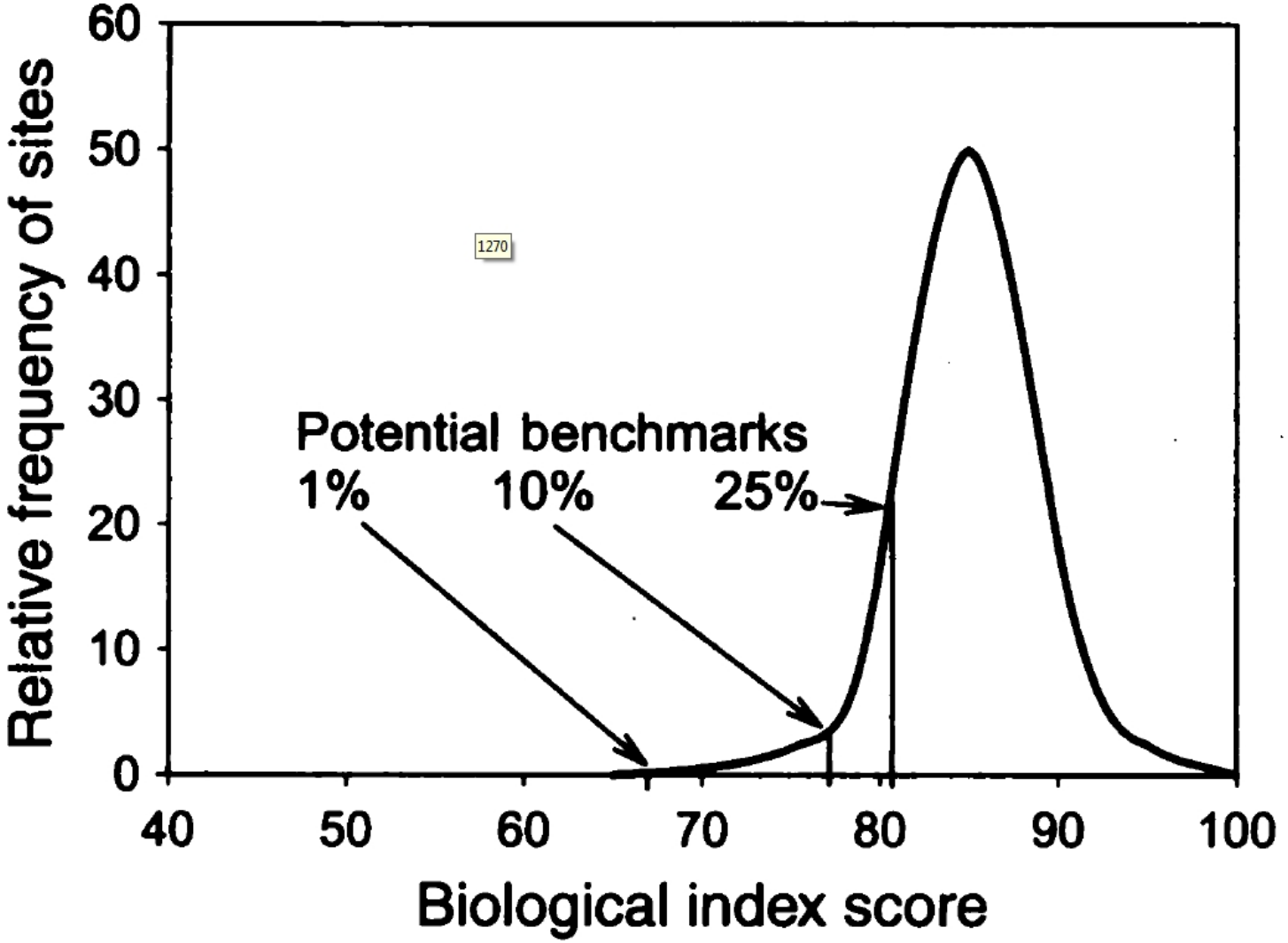
1. Reference Condition for biological integrity
2. Minimally Disturbed Condition
3. Historical Condition
4. Least Disturbed Condition
5. Best Attainable Condition

Methods to Define Reference

Stoddard et al. 2006

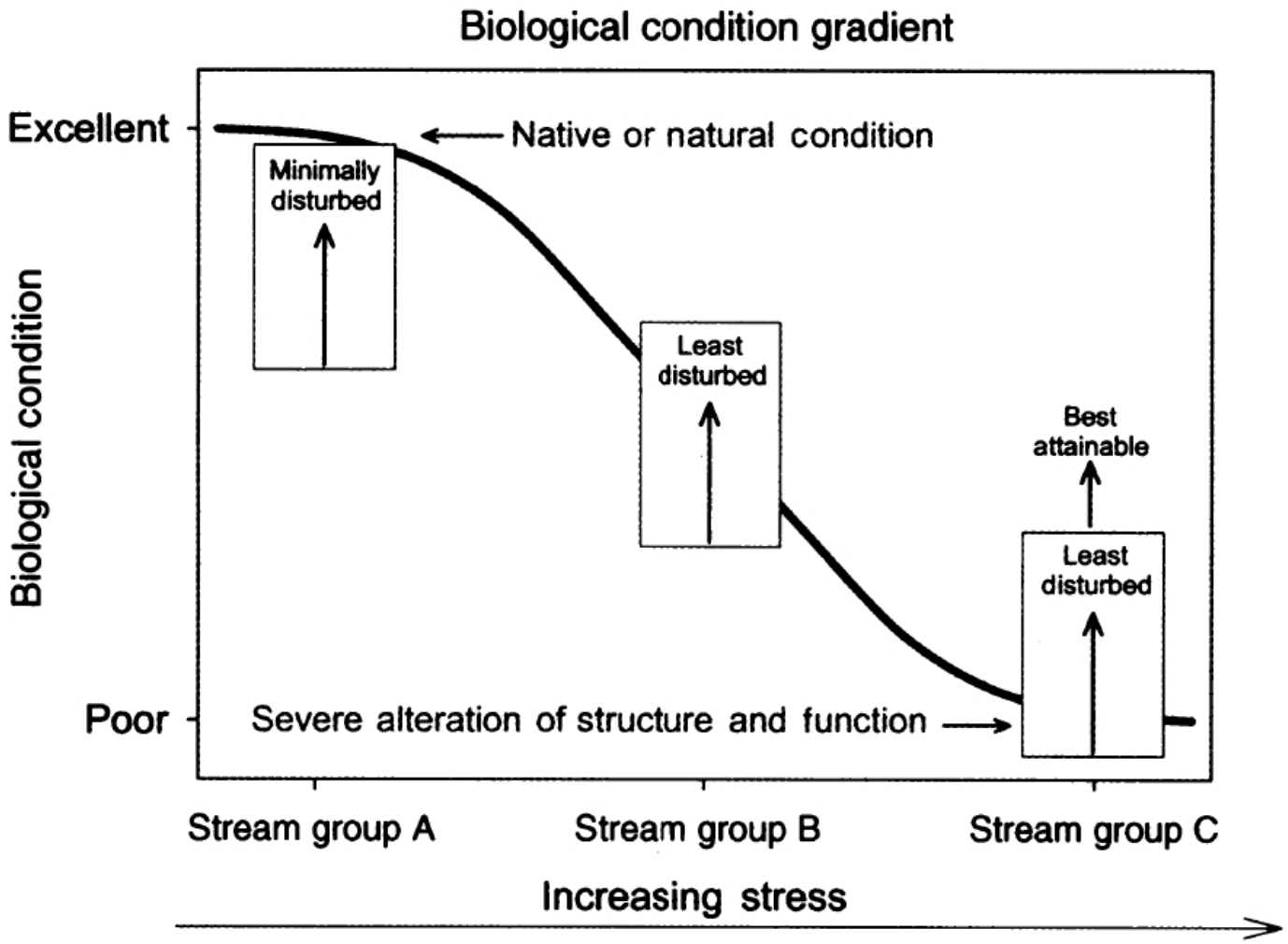
1. Reference Site Approach (condition at minimally or least disturbed sites)
2. Best Professional Judgement
3. Interpretation of Historical Condition
4. Extrapolation of Empirical Models
5. Evaluation of Ambient Distributions

Defining Benchmarks



Stoddard et al. 2006

Disturbance Metrics



Stoddard et al. 2006

A Large-Scale, Multiagency Approach to Defining a Reference Network for Pacific Northwest Streams

Stephanie Miller ● Peter Eldred ● Ariel Muldoon ● Kara Anlauf-Dunn ●Charlie Stein ● Shannon Hubler ● Lesley Merrick ● Nick Haxton ● Chad Larson ● Andrew Rehn ● Peter Ode ● Jake Vander Laan

Environmental Management (2016) 58:1091–1104 DOI 10.1007/s00267-016-0739-6

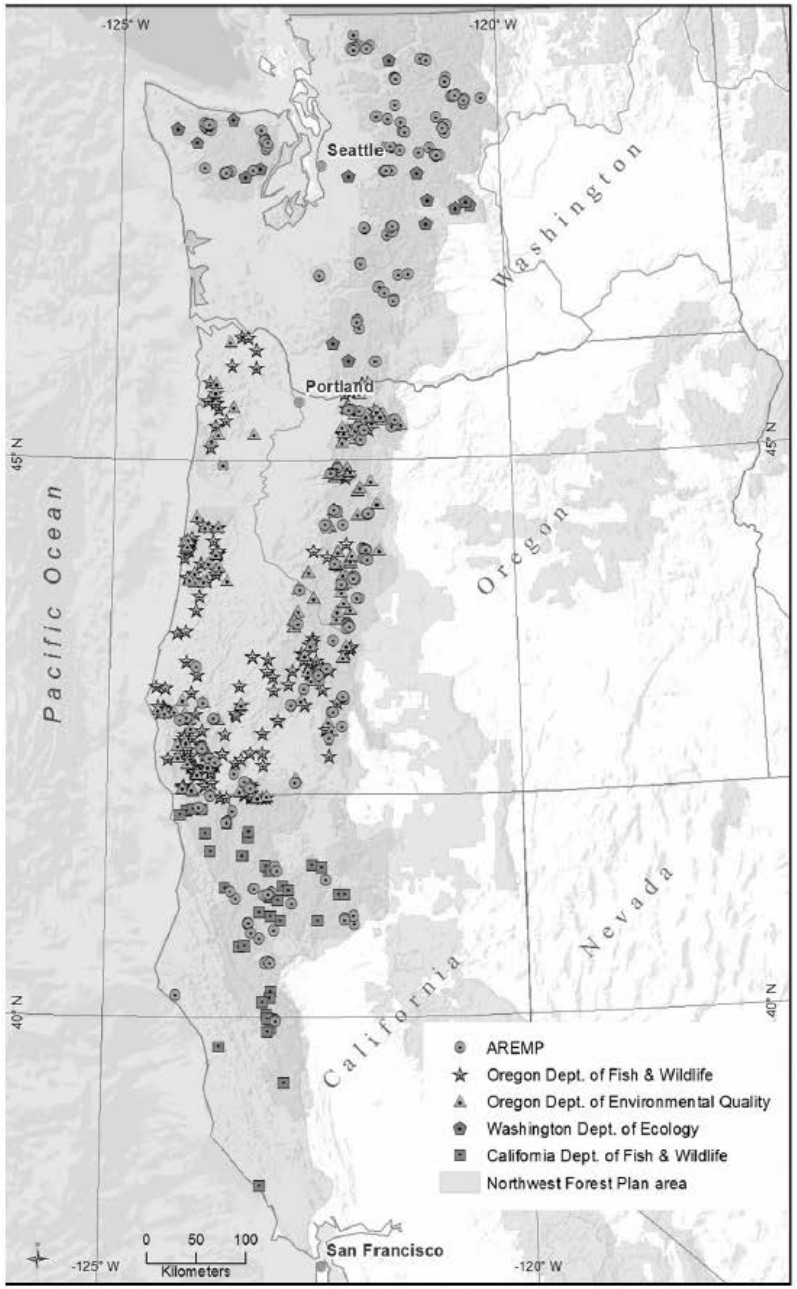


Fig. 1 Spatial distribution of reference sites across the study area by agency

Reference Criteria

Miller et al. 2016

Table 1 Stressor metric percentiles used to discriminate between impaired and reference sites

		Percentile	
		Reference	Most human disturbed
Metric	Unit	25th	90th
Road density[a]	km/km^2	1.347	3.87
Stream crossing[a]	count/km^2	0.241	1.013
Agriculture[b]	%	0.047	2.735
Developed open space[b]	%	1.996	7.821
Mines[c]	%	0.209	26.640
Gravel mines[c]	mines/km^2	0.005	0.059
Canals[d]	%	1.703	29.273
		75th	10th
Distance to dam*[d]	km	20.559	3.555

Our goal was to produce a reference network that adequately represented as much of the landscape as possible. To verify our success, we compared the ranges of various natural gradient metrics (e.g., climate, elevation, gradient, etc.) in both the reference and non-reference populations.

Miller et al. 2016

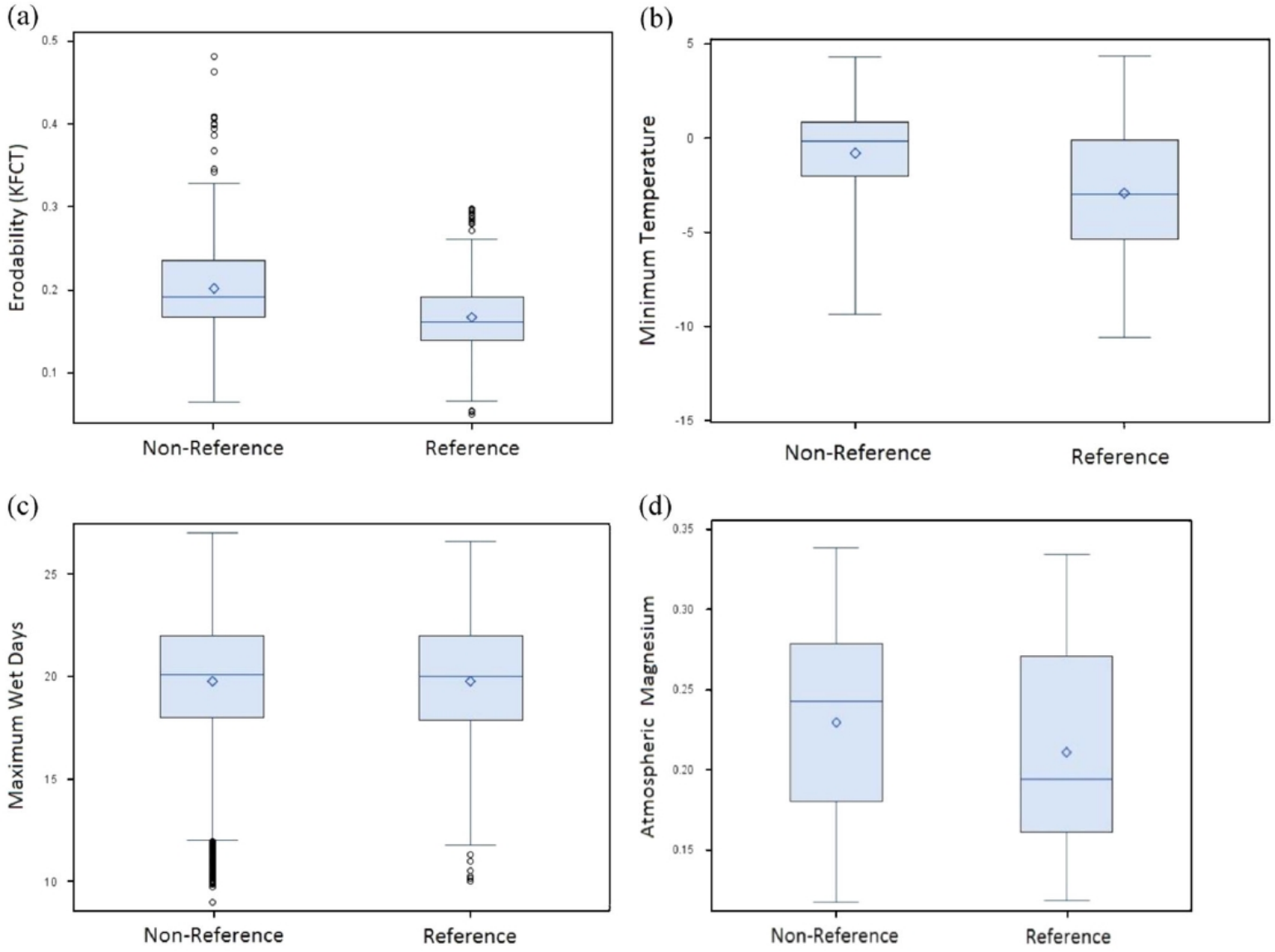


Fig. 3 Boxplots for a subset of variables that describe distribution in reference areas versus non-reference: **a** bulk density (erodibility), **b** minimum temperature, **c** maximum wet days, and **d** atmospheric magnesium

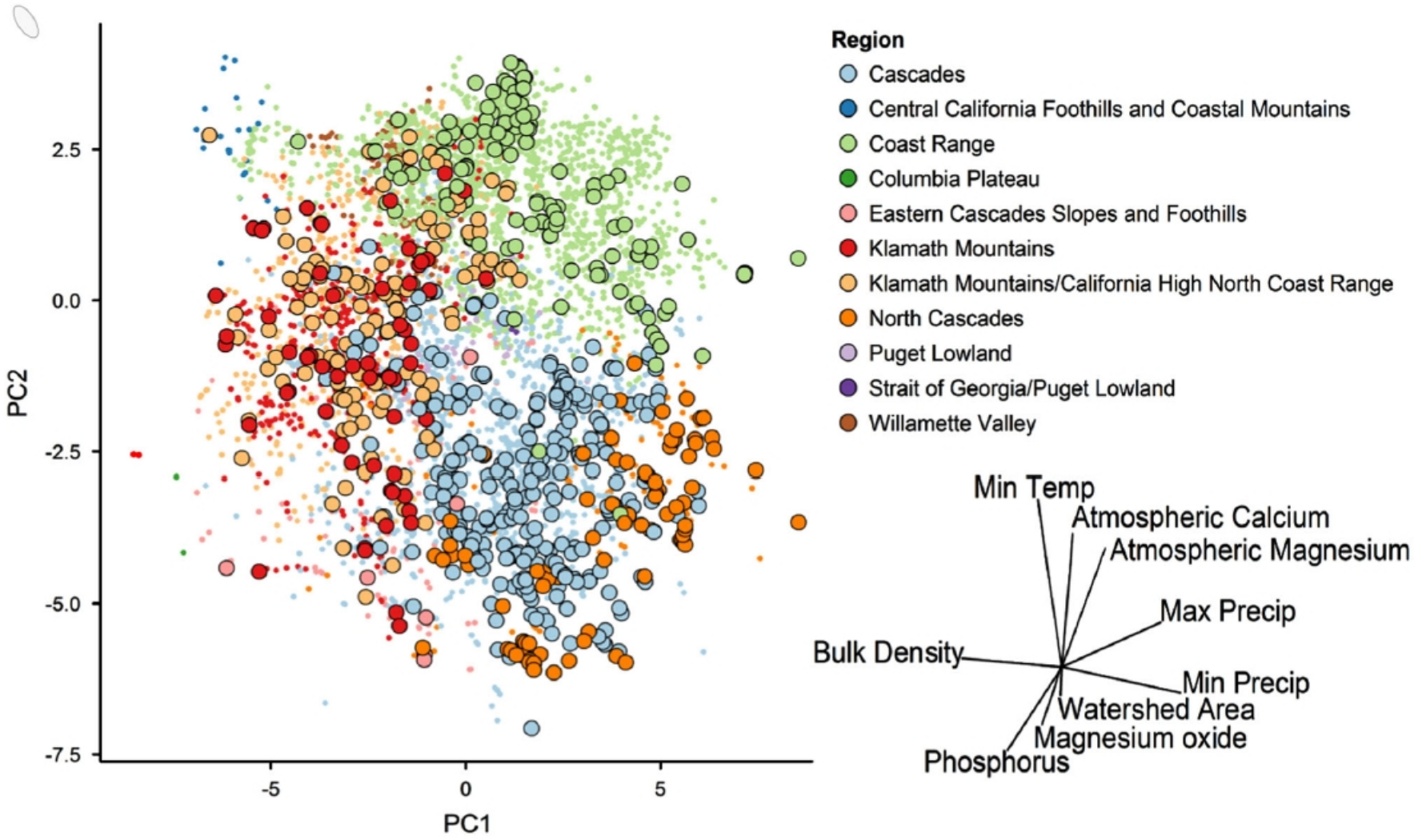
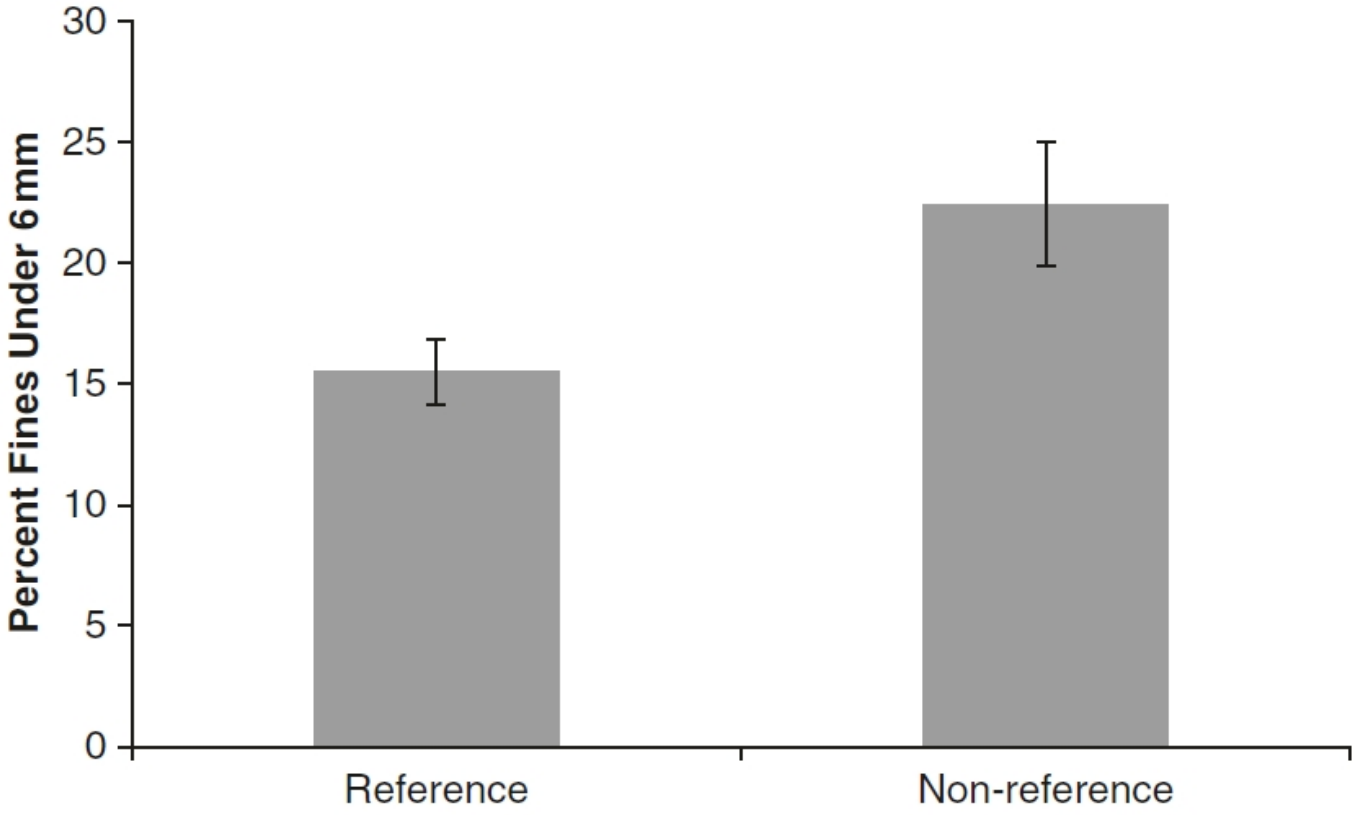


Fig. 4 Principal component analysis using standardized natural gradient metrics (Table 1). Reference sites are denoted by *larger circles* and *colors* consistent with region. Note that the Central California Foothills and Coastal Mountains, Columbia Plateau, Puget Lowland, Strait of Georgia/Puget Lowland, and the Willamette Valley region had no reference sites based on our criteria. A subset of standardized natural gradient vectors based on the first two principal components is included to the *right* of the graph, below the region legend. *Vectors* represent variables that may represent areas with less optimal coverage of reference site representation based on visual inspection of the PCA plot

Miller et al. 2016

Comparison of Reference and Non-Reference fine sediment

Fig. 5 Means with *upper* and *lower* 95 % confidence intervals for percent fines under 6 mm within reference versus non-reference sites. Mean values and confidence intervals were back-transformed to original scale. AREMP data from the first rotation (2002–2009) were used in this analysis



Miller et al. 2016

Reference Watershed Working Group

- USGS/NADP
- EPA
- USFS
- BLM
- Volunteer Monitoring
- State perspective

What do we need?

- Feedback and opinions regarding the “Open Questions” I described earlier
- Quarterly Conference calls
- Email Feedback