US Army Corps of Engineers ®
Sacramento District

Funding provided in part by
NATIONAL SYSTEM OF PUBLIC LANDS
SOUTHERN NEVADA PUBLIC LAND MANAGEMENT ACT
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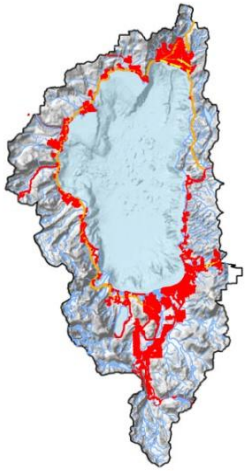
CALIFORNIA TAHOE CONSERVANCY

ndep NEVADA DIVISION OF ENVIRONMENTAL PROTECTION
protecting the future for generations

Developing Road RAM

TAHOE SCIENCE CONFERENCE



May 24, 2012

nhc

Environmental Incentives

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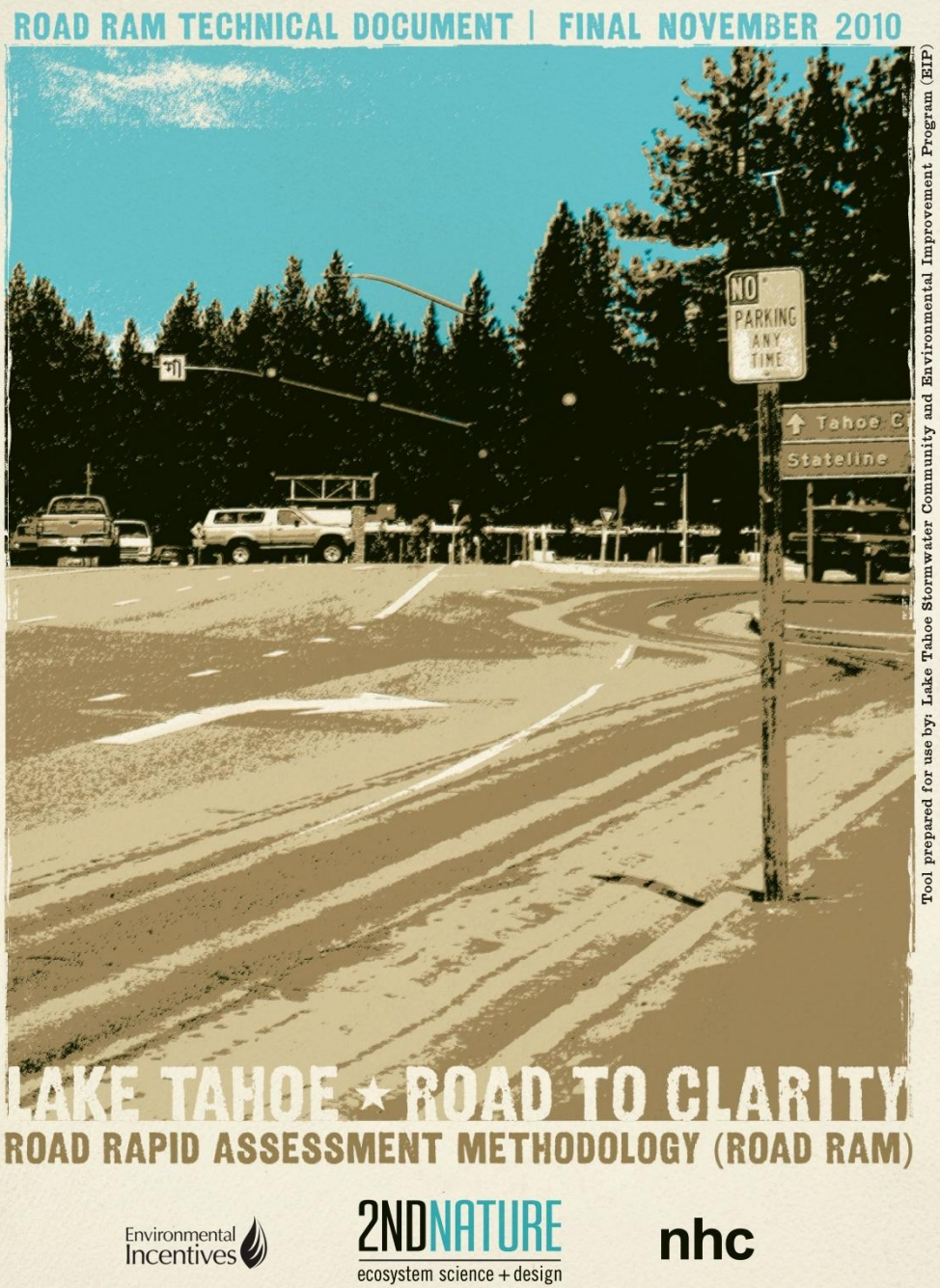
What makes an effective RAM?

- Objective and well structured protocols
- Focused data collection
- Standardized
- Theory-tested with empirical data

Road RAM

Track **relative FSP risk** to downslope water quality from **impervious** road surfaces.



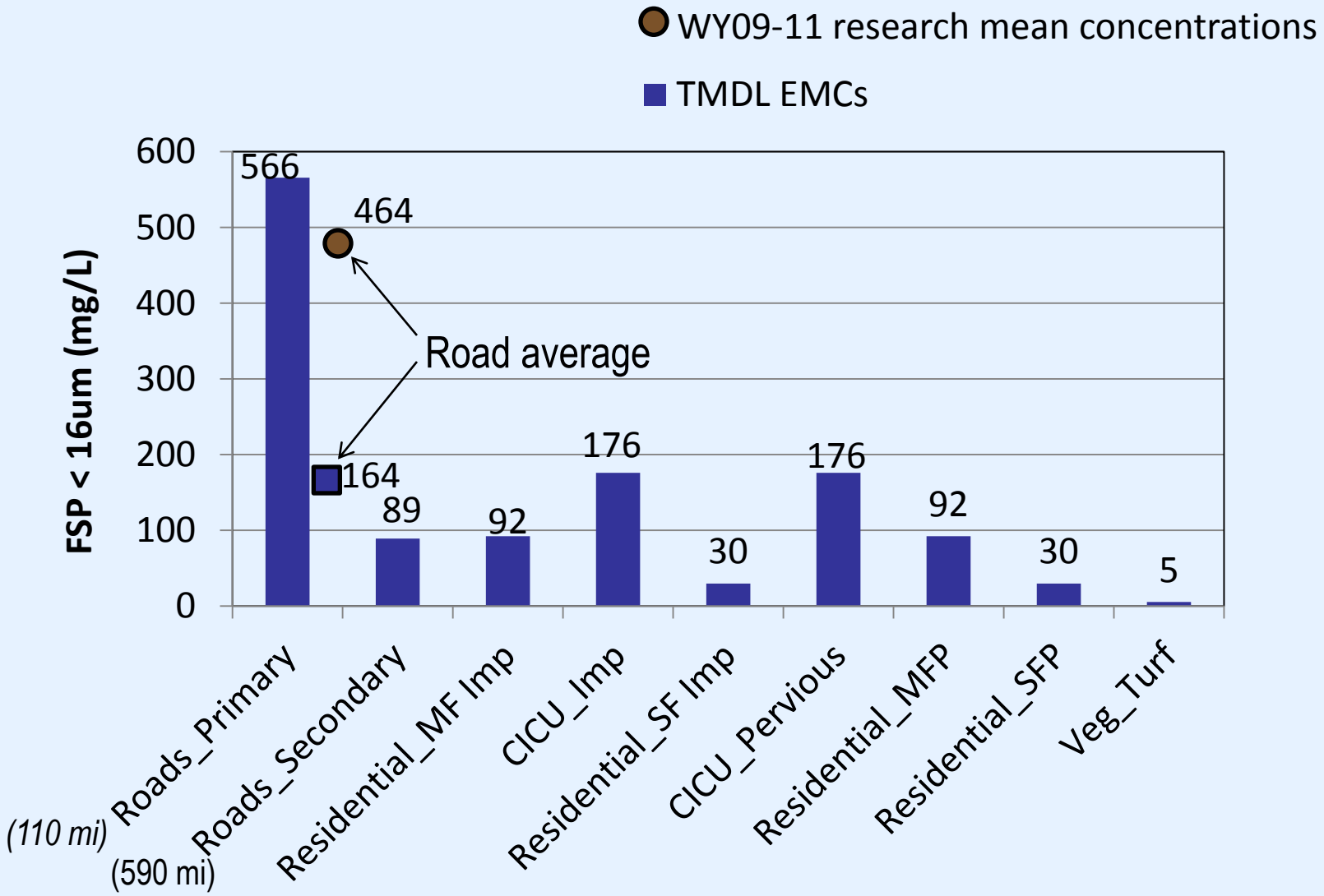
Underlying Road RAM hypotheses

1. There is an opportunity to reduce FSP concentrations on roads in the Tahoe Basin.

2. The relative condition of a road at any given time can be measured objectively.

3. Visual observations can serve as proxies to determine road condition and the FSP risk to downslope water quality.

Hypothesis #1: Opportunity to reduce FSP concentrations on roads



LRWQCB and NDEP (2008); 2N and NHC (2012)

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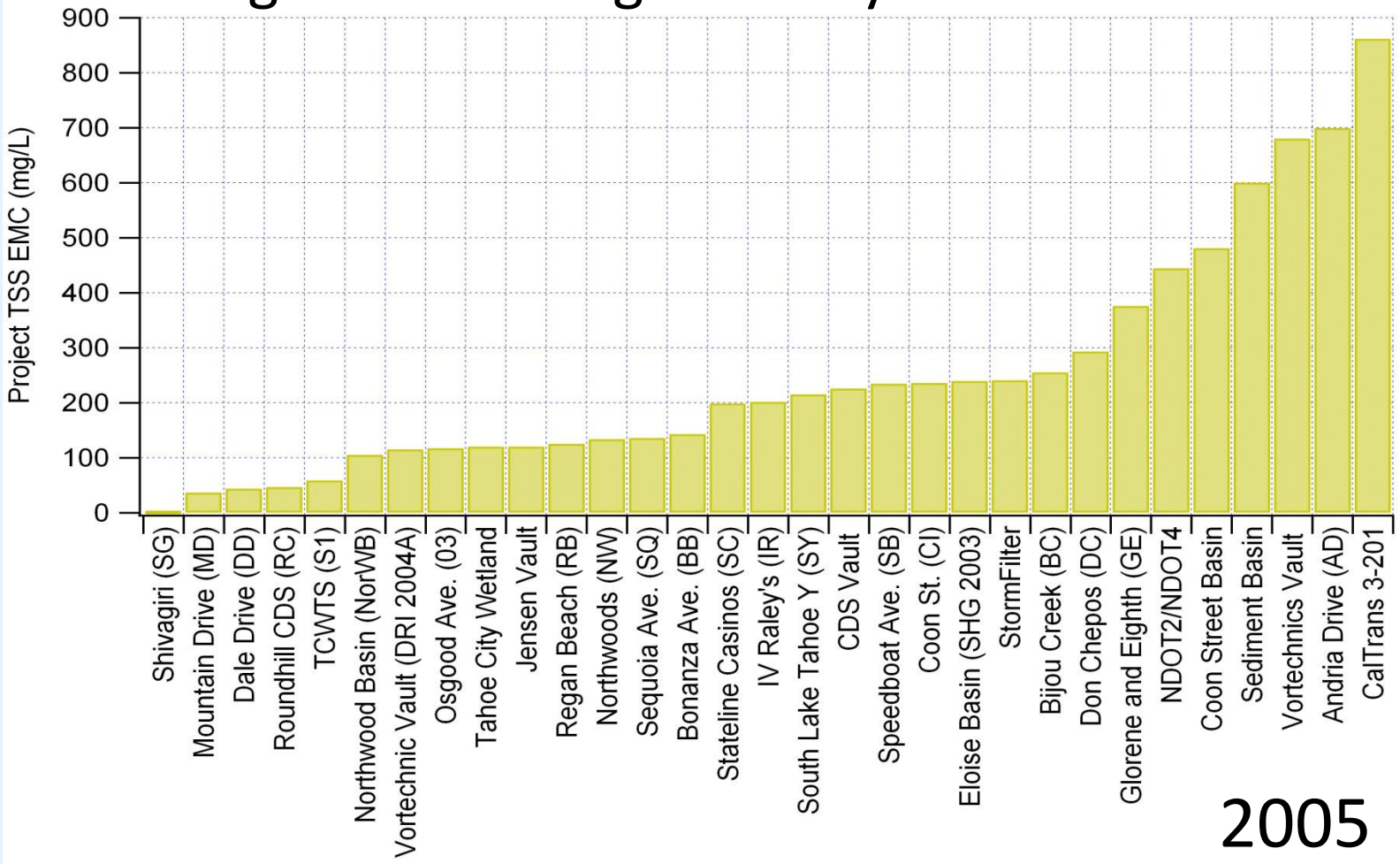
Why do seemingly similar urban water quality monitoring sites have significantly different TSS EMCs?



NHC, Geosyntec, and 2NDNATURE (2009)

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Hypothesis #2: Relative road condition can be measured.

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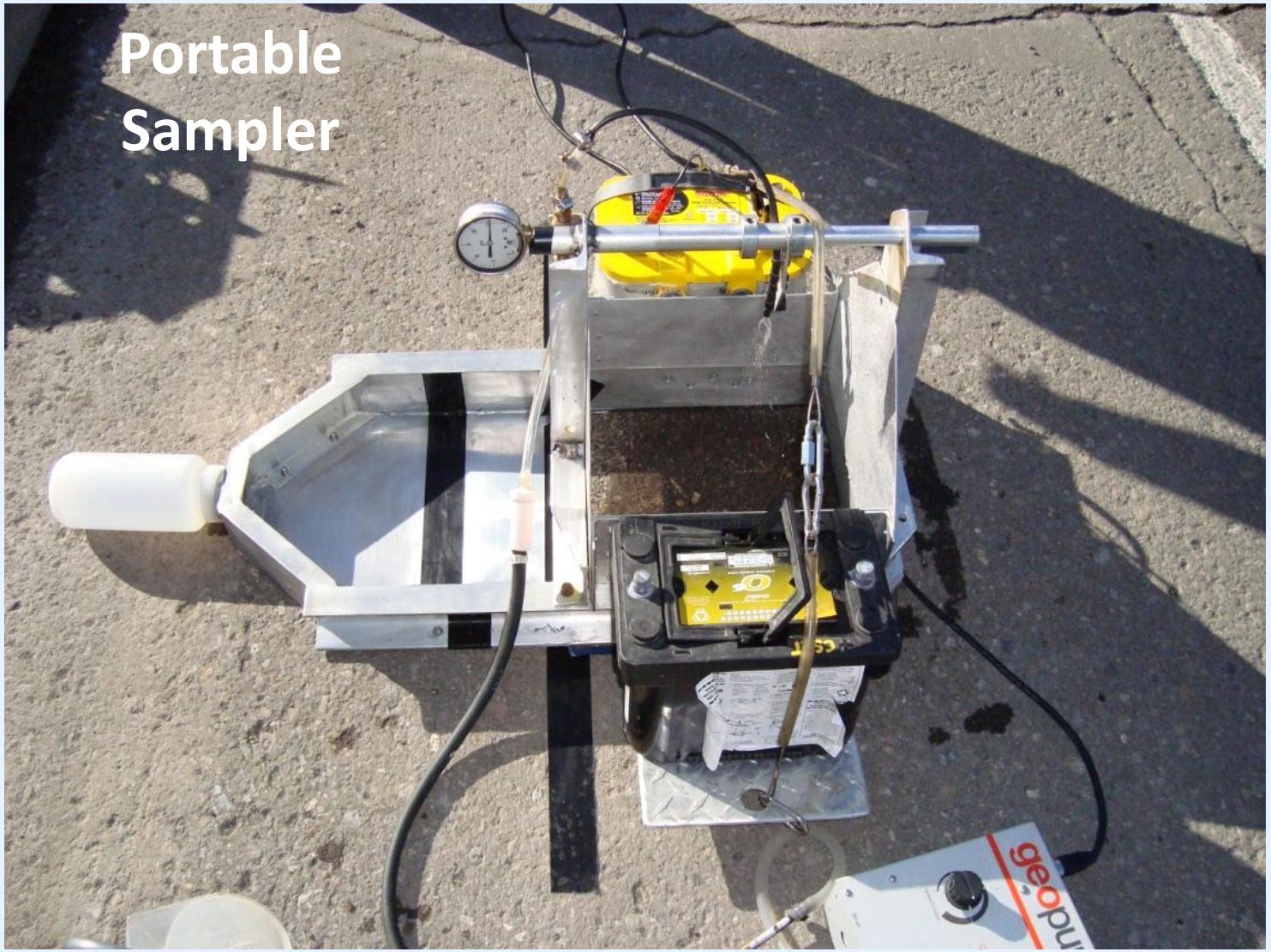

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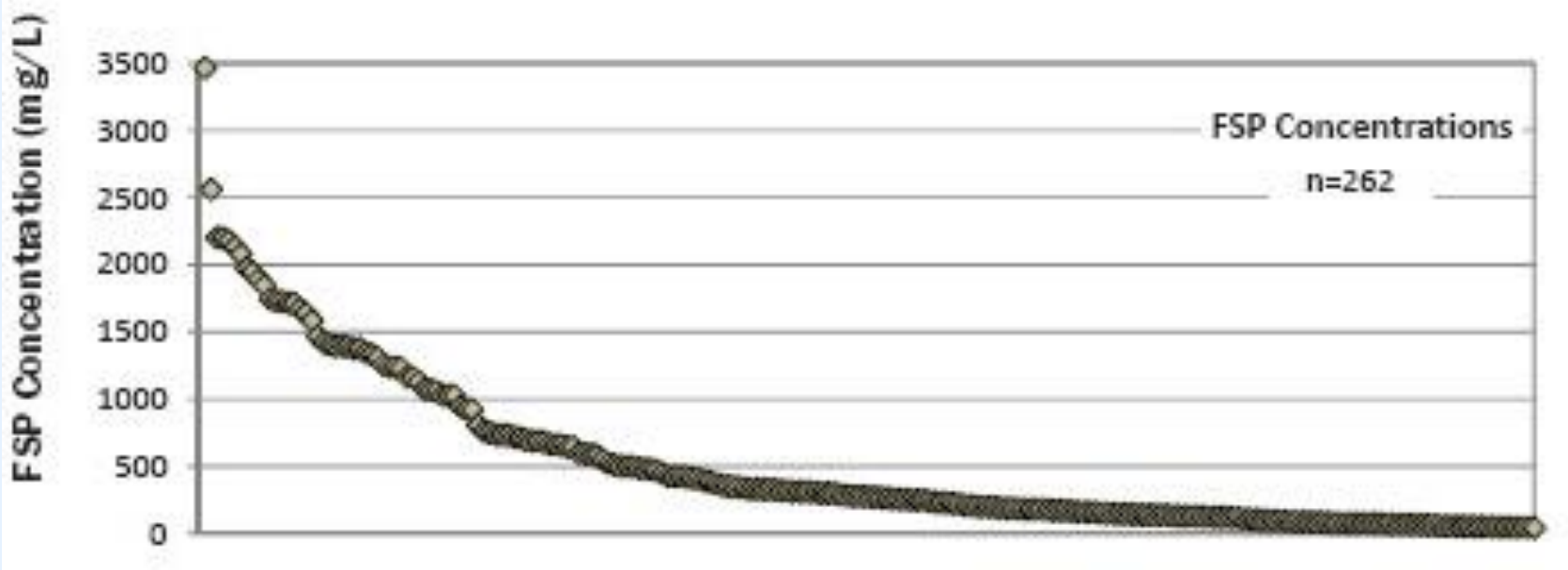
Observations at 34 road segments over all seasons (WY09-WY11)



2NDNATURE and NHC (2012)

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Hypothesis #2: Relative road condition can be measured.

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Hypothesis #2: Relative road condition can be measured.

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Hypothesis #3: Visual proxies of downslope water quality risk.

In adjacent 1’x1’ square, performed numerous visual observations to predict the measured FSP concentration.

Criteria:

- Relatively consistent results
- Repeatable across users (more quantitative than qualitative)
- Rapid

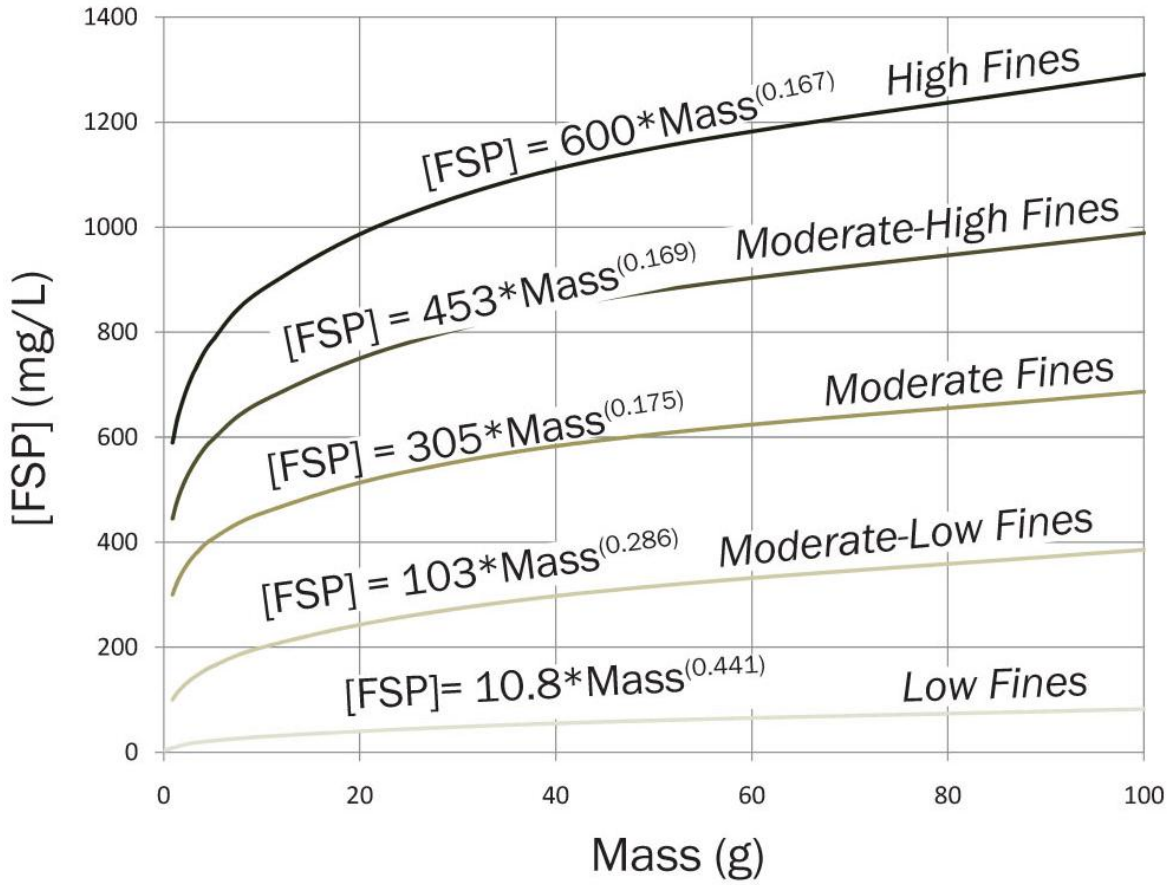
Multivariate Analysis

Predictive capability of visual proxies to predict FSP concentration measured on 1 ft^2 by portable sampler

Predictor Variable	F	P-value
Dry Mass	277.34	<0.001
Degree of Fines	25.79	<0.001

These 2 factors explain 76.4% of the variance measured.

Hypothesis #3: Visual proxies of downslope water quality risk.



*Mass + Degree of Fines = FSP Concentration [**FSP**] (mg/L)*

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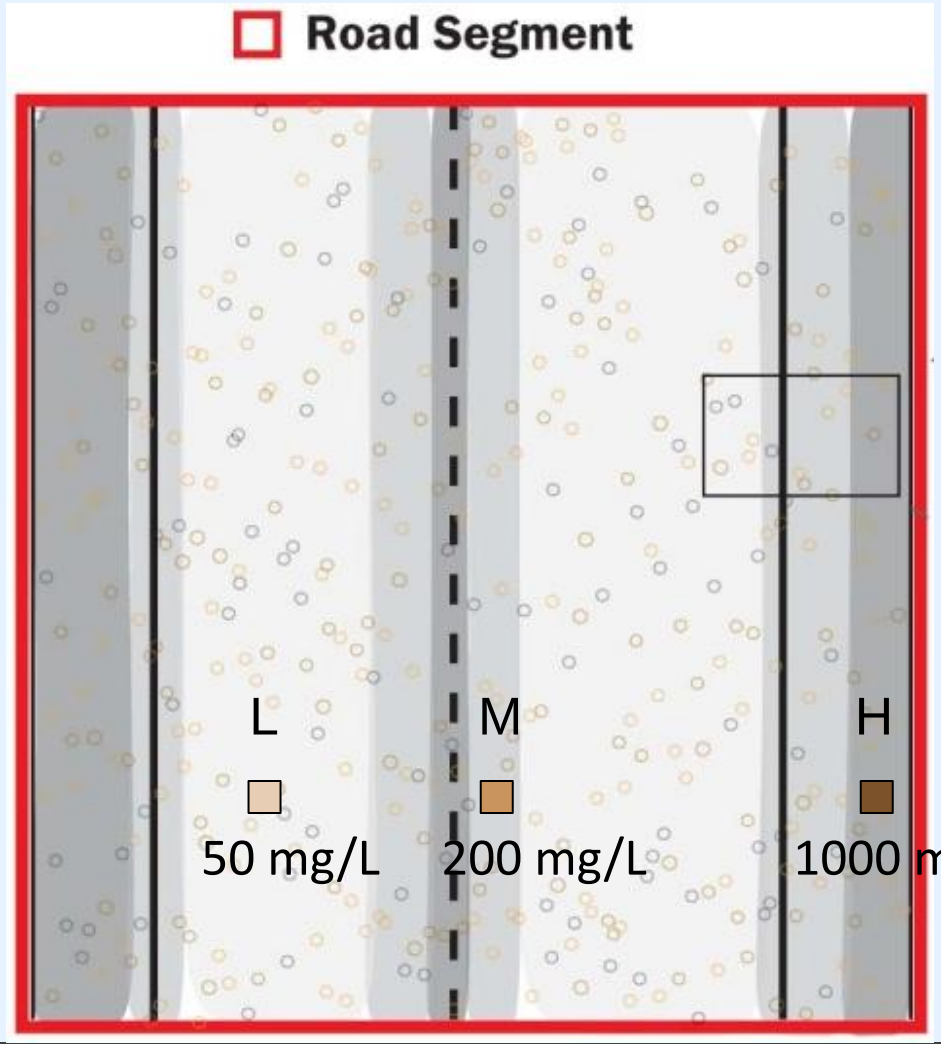
Hypothesis #3: Visual proxies of downslope water quality risk.

Road Segment FSP Concentration



60% Low
25% Mod
15% High
=
230 mg/L

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Road RAM Scores

FSP Concentration (mg/L) range	Road RAM Score	Condition
1,592 – 680	0 – 1.0	Poor
679 – 291	>1.0 – ≤ 2.0	Degraded
290 – 124	> 2.0 - ≤ 3.0	Fair
123 – 53	> 3.0 - ≤ 4.0	Acceptable
52 – 23	> 4.0 - 5.0	Desired

Hypothesis #3: Visual proxies of downslope water quality risk.

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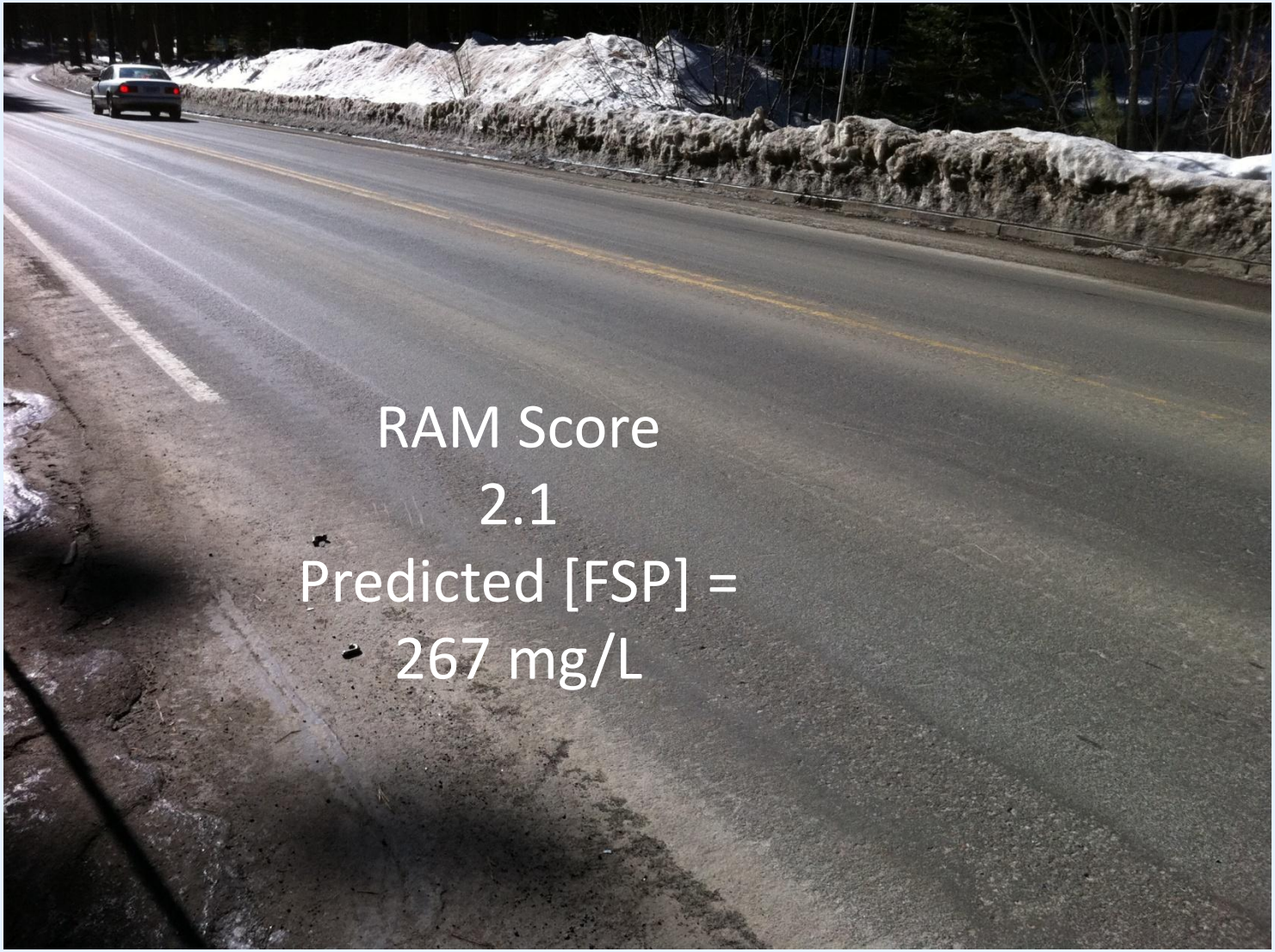
Hypothesis #3: Visual proxies of downslope water quality risk.



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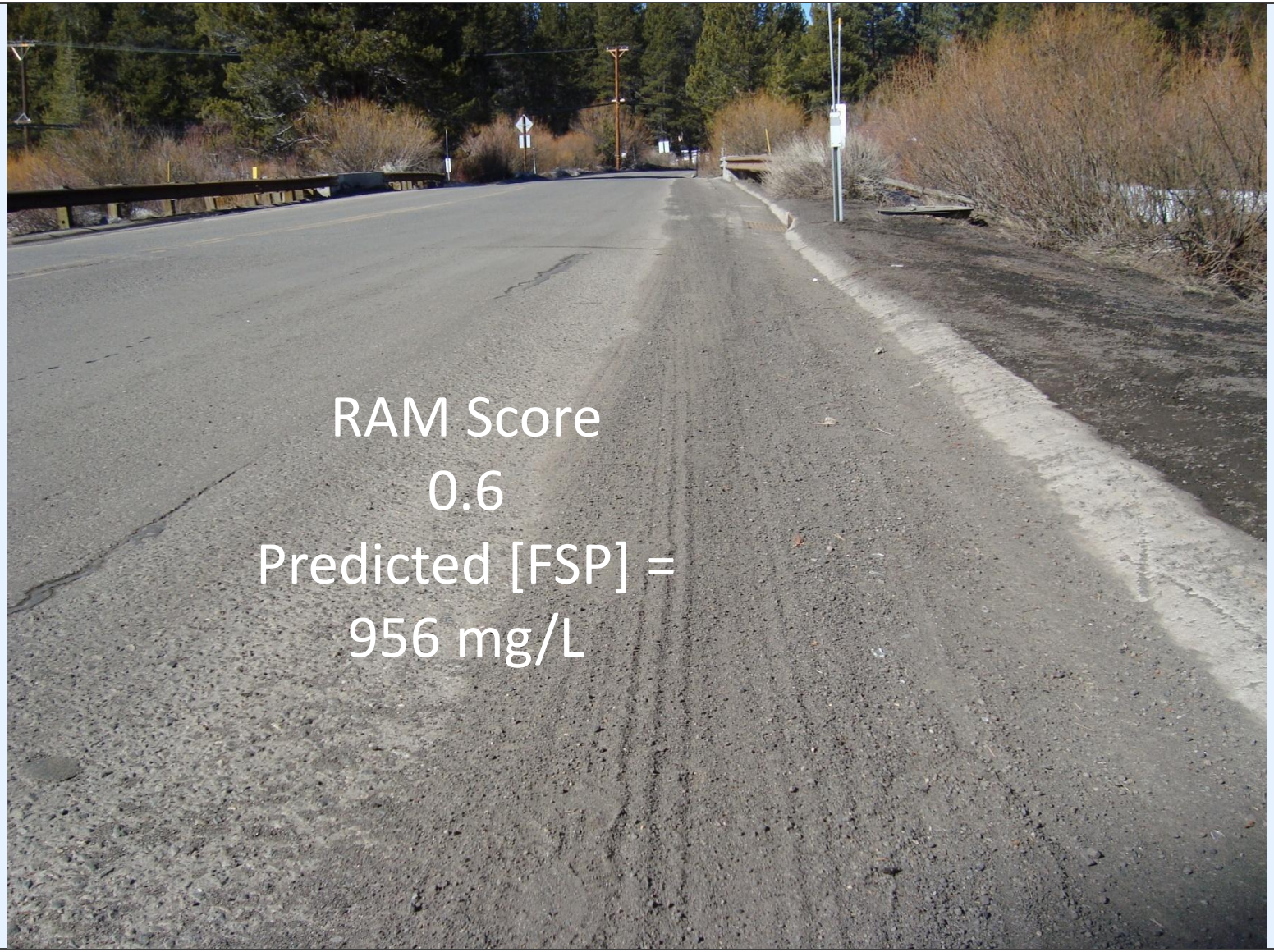
Hypothesis #3: Visual proxies of downslope water quality risk.



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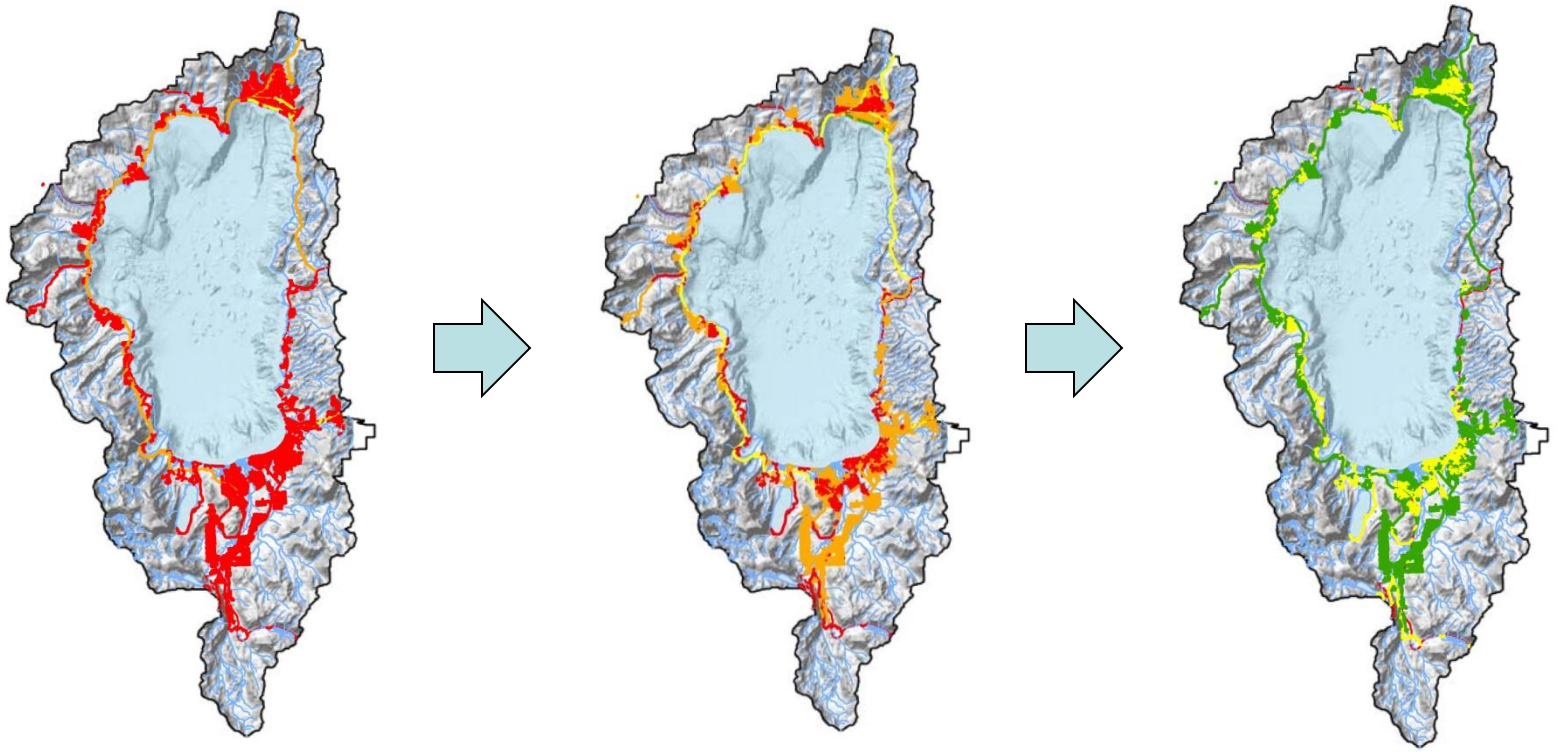
Why Road RAM

Track relative FSP risk to downslope water quality from impervious road surfaces.



2004 2012 2020

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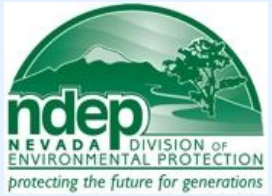
Thank You

Road RAM funders



2NDNATURE, NHC, and EI (2010)

Supporting Research funders

2NDNATURE and NHC (2010, 2012)

Technical Advisory Committee

Scott Cecchi (CTC)
Jason Kuchnicki (NDEP)
Nova Lance-Seghi (Placer County)
Robert Larsen (LRWQCB)
Dick Minto (Washoe County)
John Reuter (UC Davis)
Leslie Waters (Caltrans)
Russ Wigart (El Dorado County)

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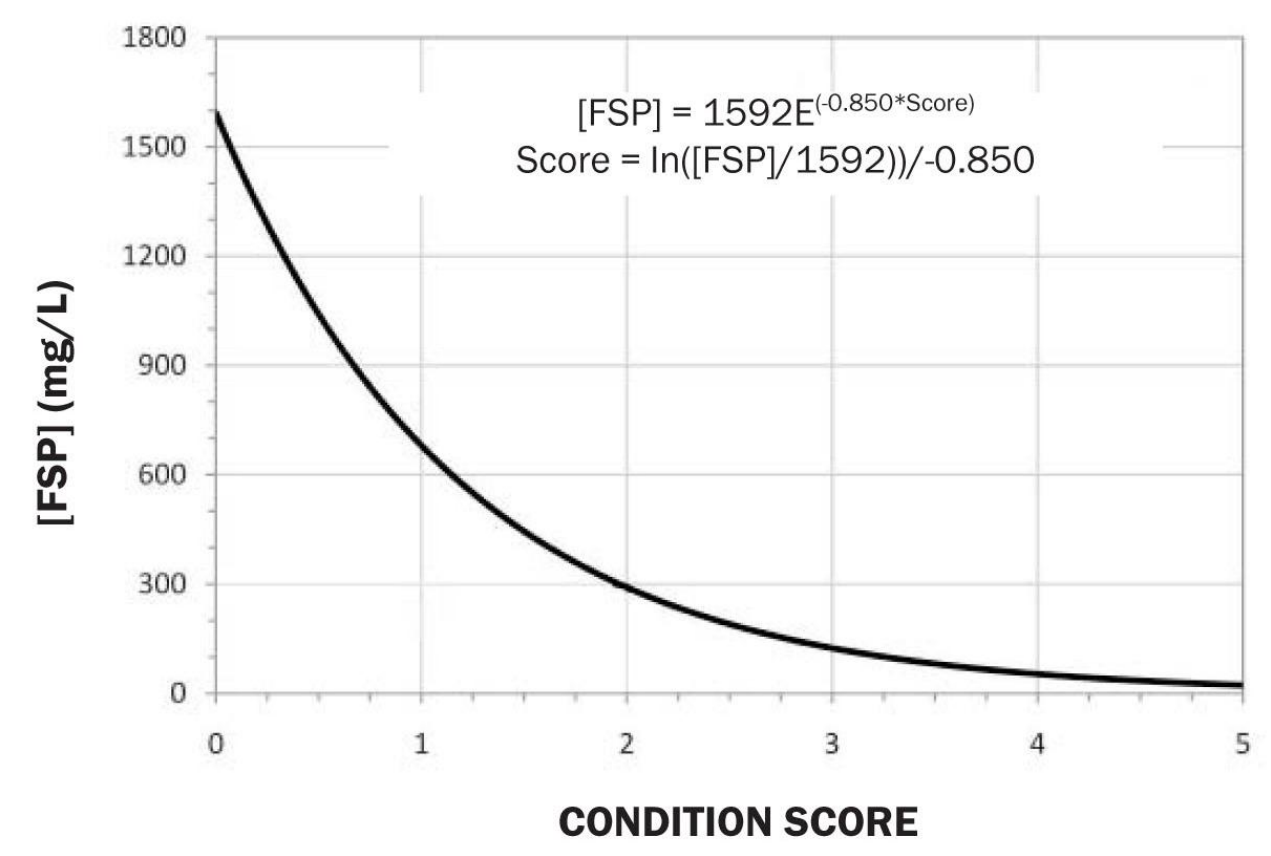
ADDITIONAL SLIDES

Road RAM Scores



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Comparison of RAM score differences vs FSP concentration % differences

RAM Score	FSP Concentration (mg/L)	Absolute FSP Difference	Average FSP Difference	% Difference
0.9	741	60.4		
1.0	680		57.9	9%
1.1	625	55.4		
3.9	58	4.7		
4.0	53		4.5	9%
4.1	49	4.3		

2NDNATURE Field Precision Testing

METRIC	DIFFERENCE
Number	54
Average	0.3
Maximum	1.0 (n=1)
Minimum	0.0 (n=9)
Score Differences > 0.5	n=4

Hypothesis #3: Visual proxies of downslope water quality risk.

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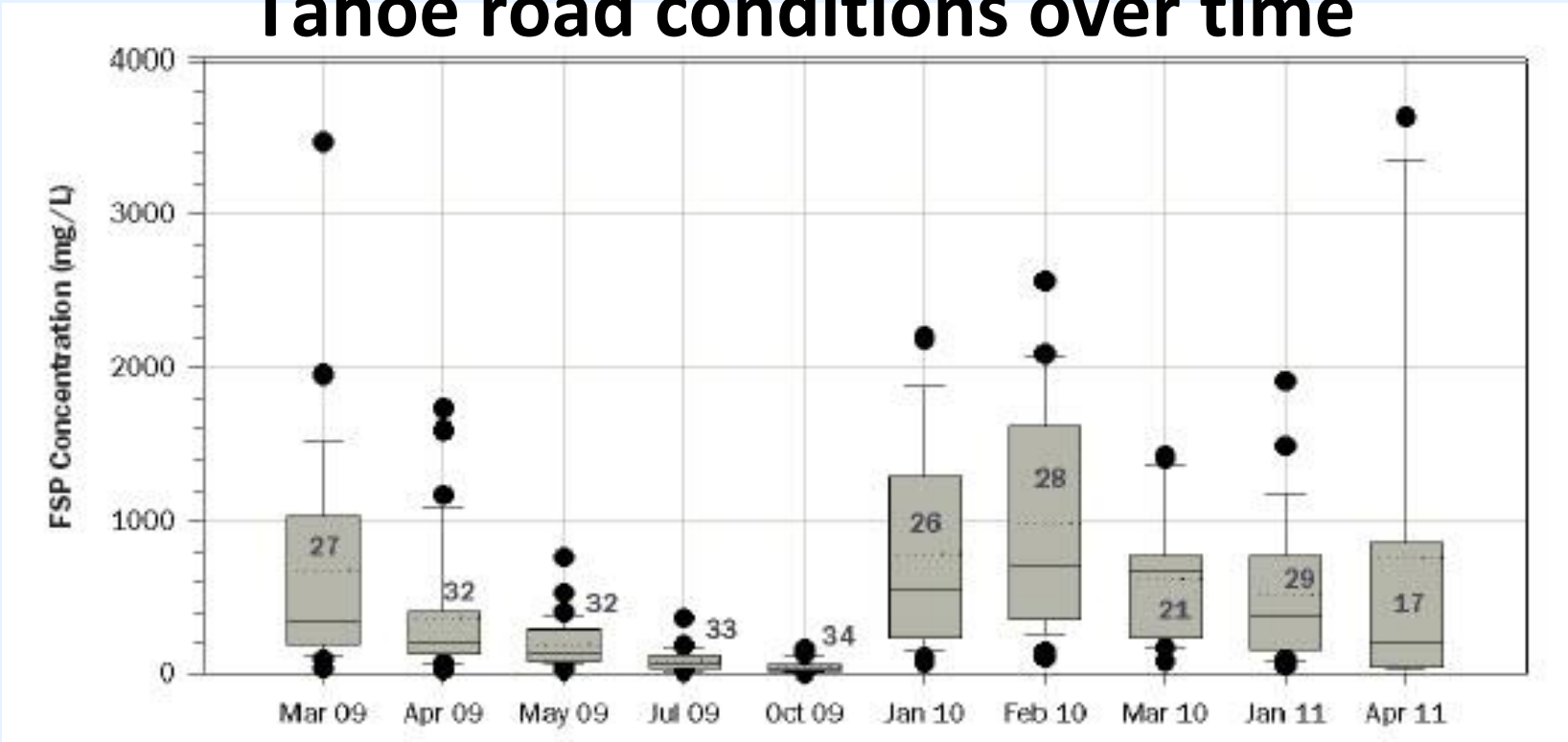
Tahoe road conditions over time



WY09-WY11 all road samples
34 sites across jurisdictions and road types

n = 279

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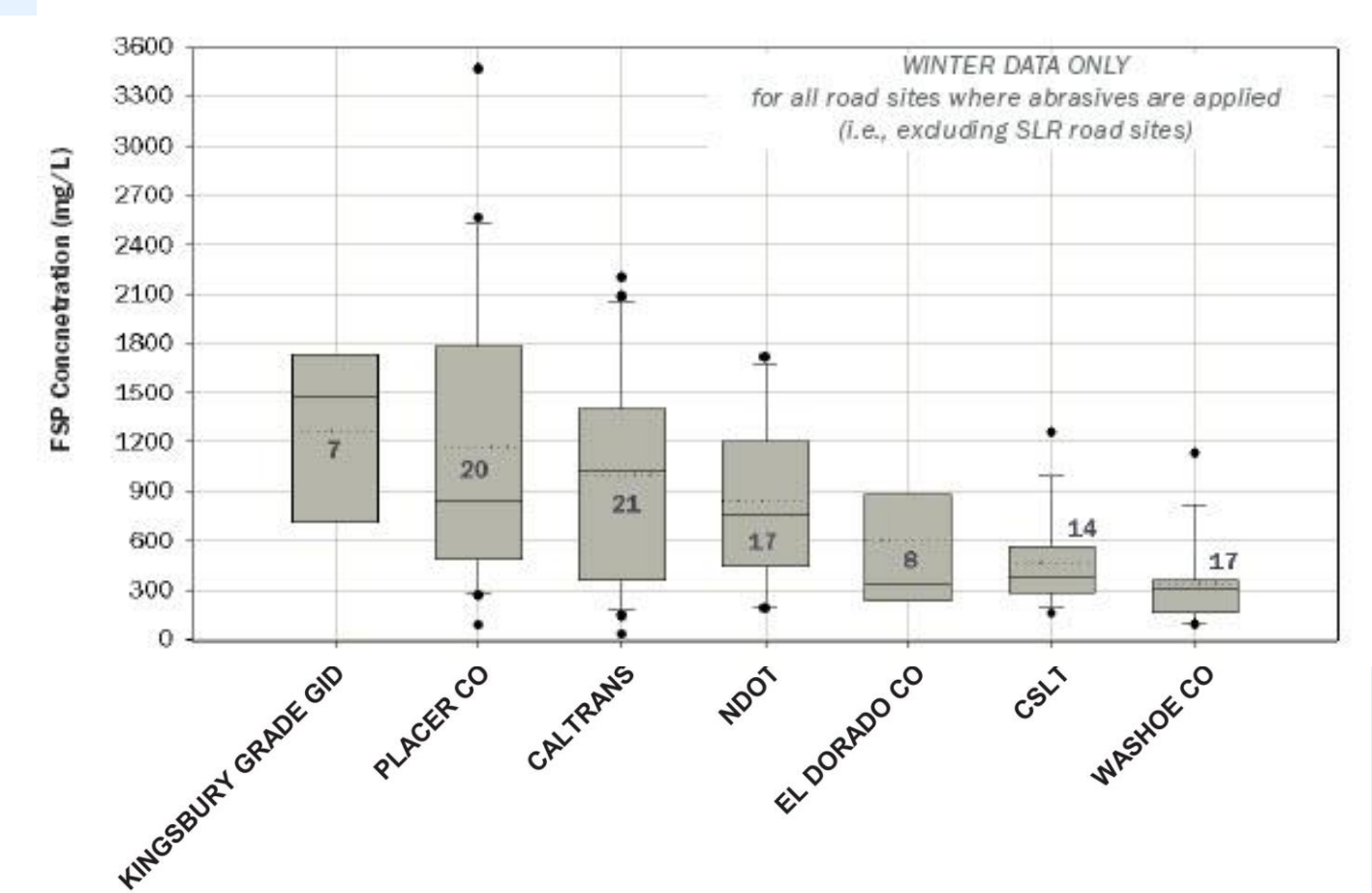
Hypothesis #2: Relative road condition can be measured.



Winter samples only (Dec-March)
No roads where abrasives are not applied

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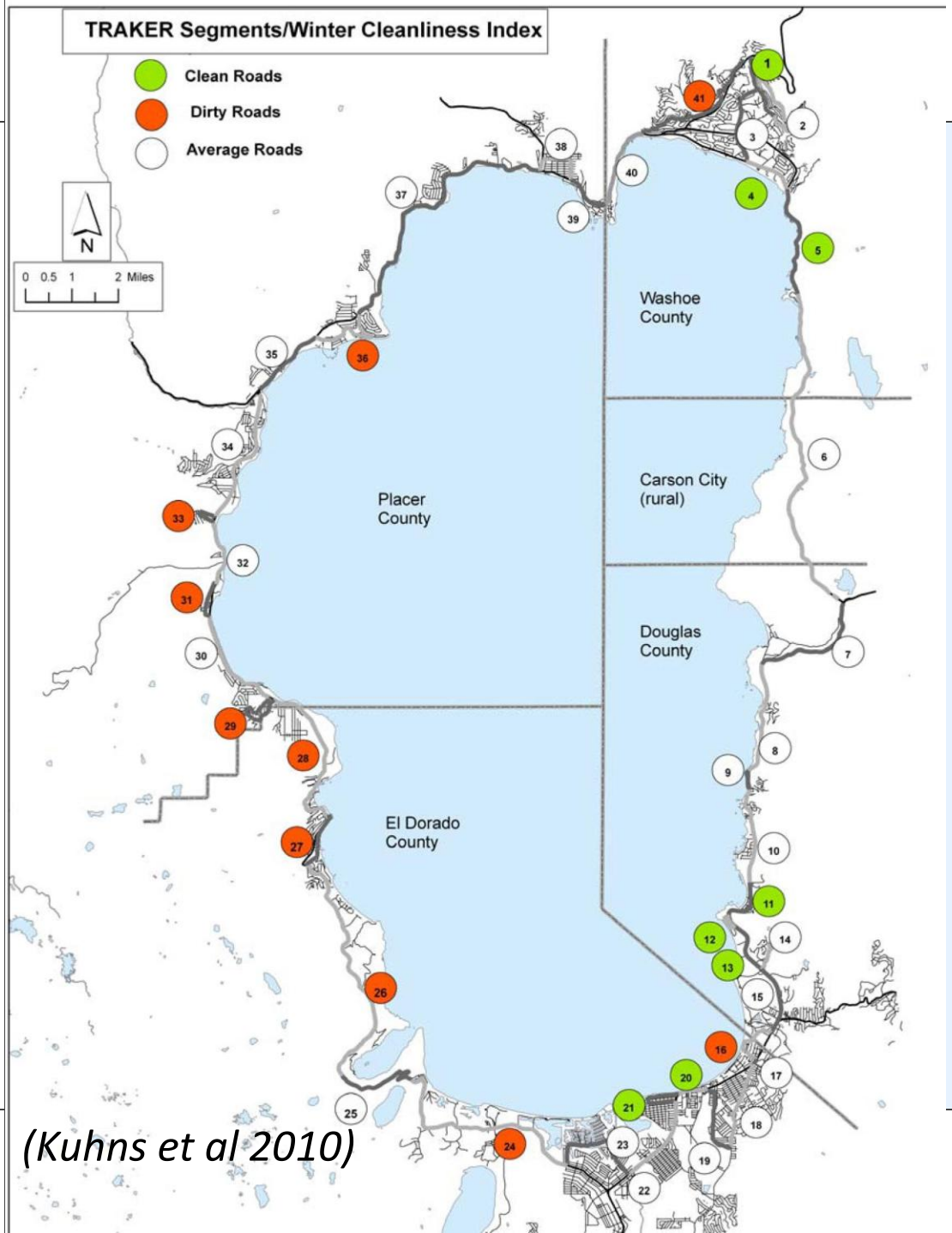

(Kuhns et al 2010)

Is Road RAM score sensitive to road maintenance practices?

Jurisdictional Variation winter

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Tahoe ROAD RAM STEPs

Timeframes

STEP 1: Define area of interest

STEP 2: Create Inventory (GIS)

STEP 3: CLASSIFY Roads

Years

STEP 4: Field Observations

STEP 5: Obtain RAM Scores

STEP 6: Analyze Results

Months or seasons

MAKE DECISIONS