Monitoring and assessing freshwater salinity in Fairfax County streams

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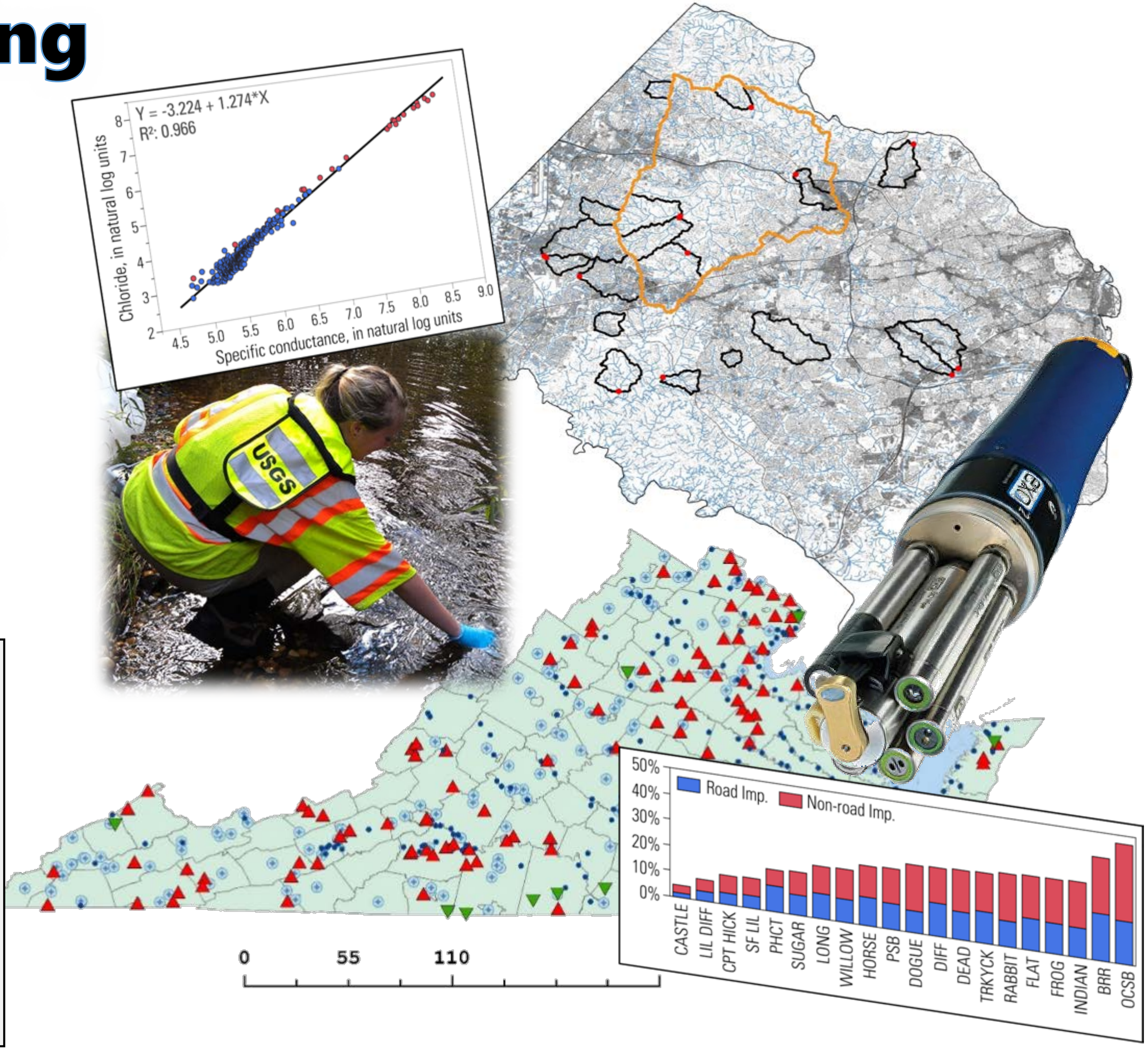


Objectives:

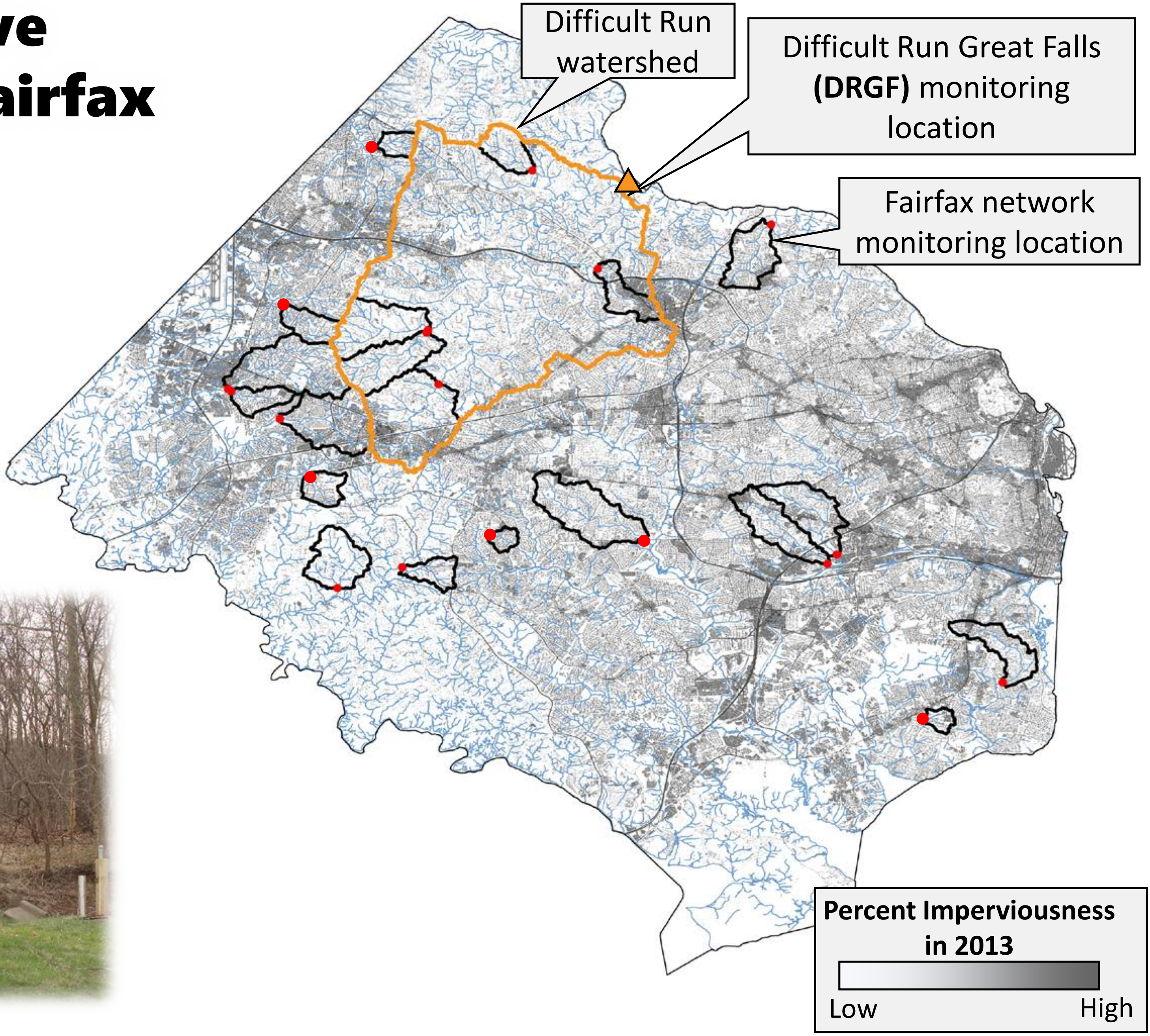
1. To describe annual chloride loads at a Fairfax County monitoring location.
2. To describe spatial and temporal specific conductance and chloride variability throughout Fairfax County streams.
3. To provide an overview of state, regional, and national monitoring networks that assess salinity.

Specific conductance data have been measured throughout Fairfax County streams since 2008

Specific conductance has been measured at 20 stream locations as part of monthly water-quality sampling.

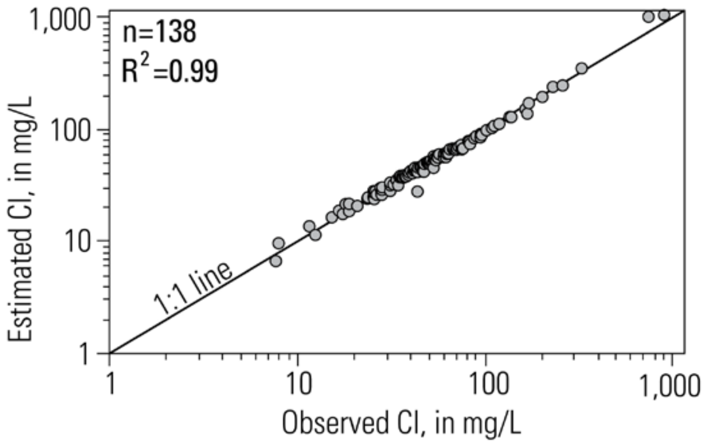
Specific conductance has been measured every 15-minutes at 7 stations with continuous water-quality and streamflow monitoring. Data are reported online in near real-time.

Chloride data have been measured extensively throughout the Difficult Run watershed and an annual chloride load has been computed at the Difficult Run Great Falls **(DRGF)** monitoring location.

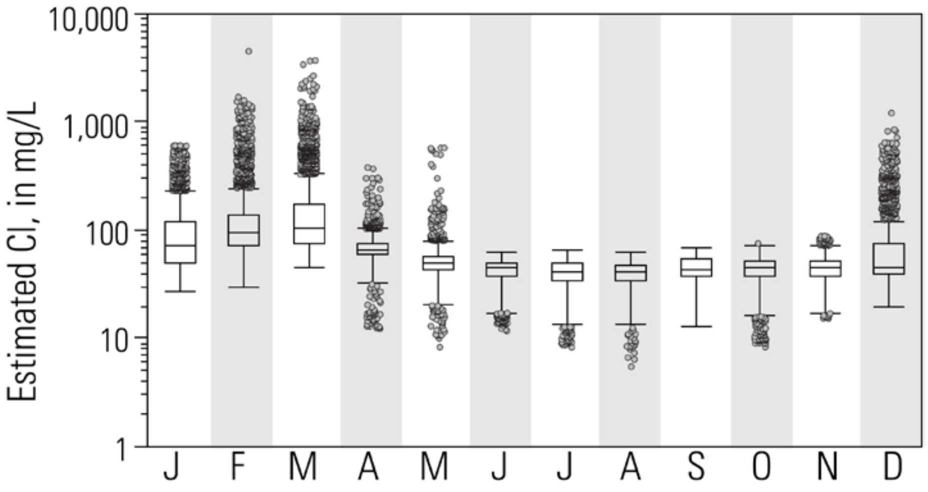


A chloride load has been estimated at DRGF using a surrogate regression model

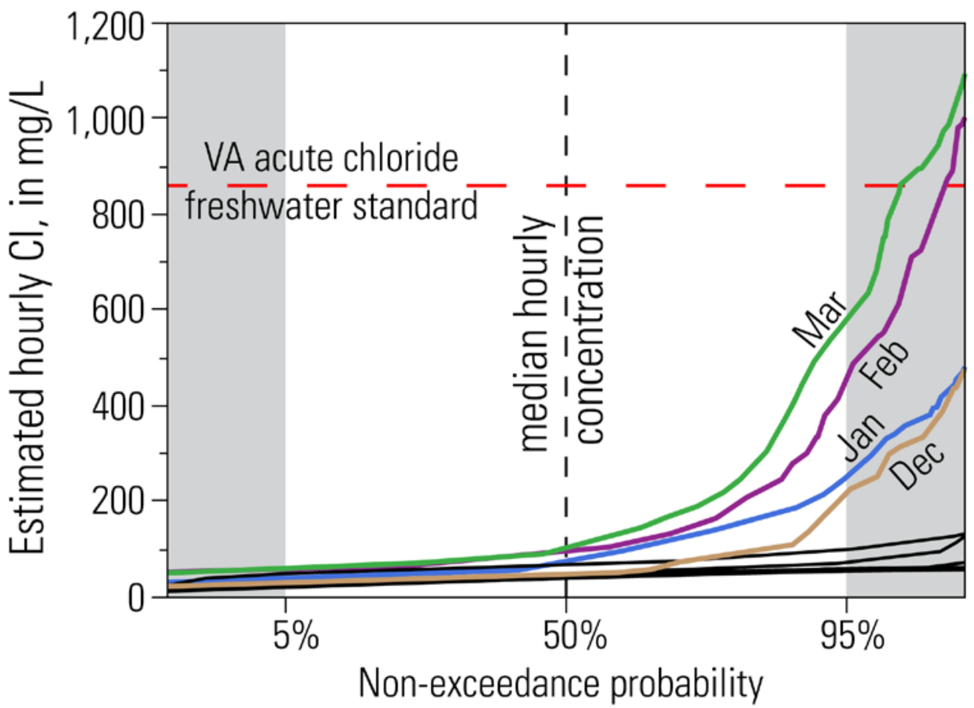
Chloride concentrations are estimated at **DRGF** using a streamflow + specific conductance regression model



As streamflow and specific conductance are measured every 15-minutes, this regression model is used to estimate chloride concentrations for every hour between water year 2012 – 2018.



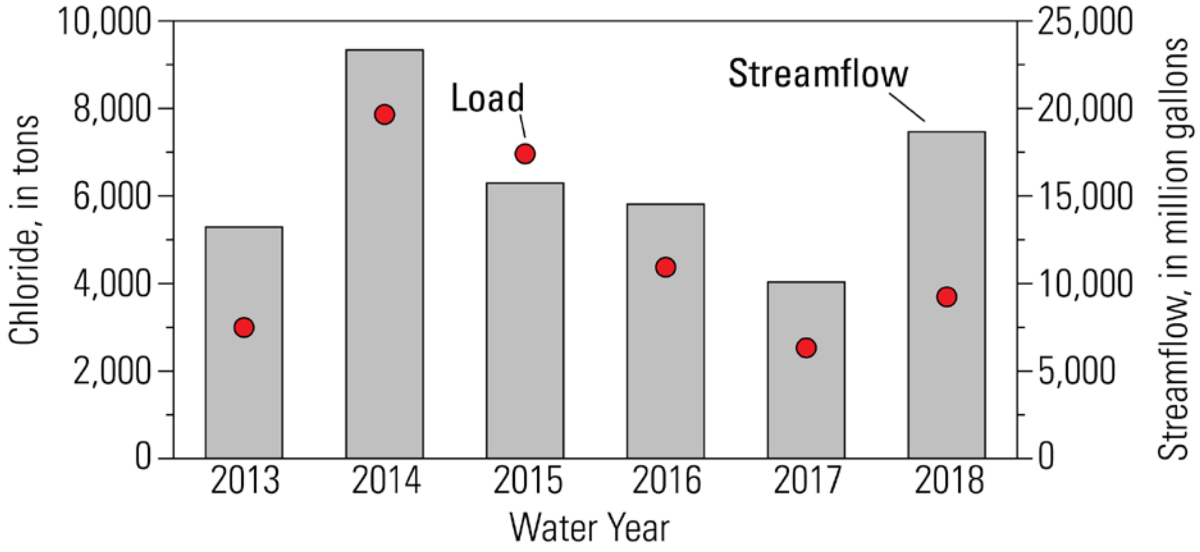
Monthly median chloride concentrations are typically below 100 mg/L, but are highest in December, January, February, and March.



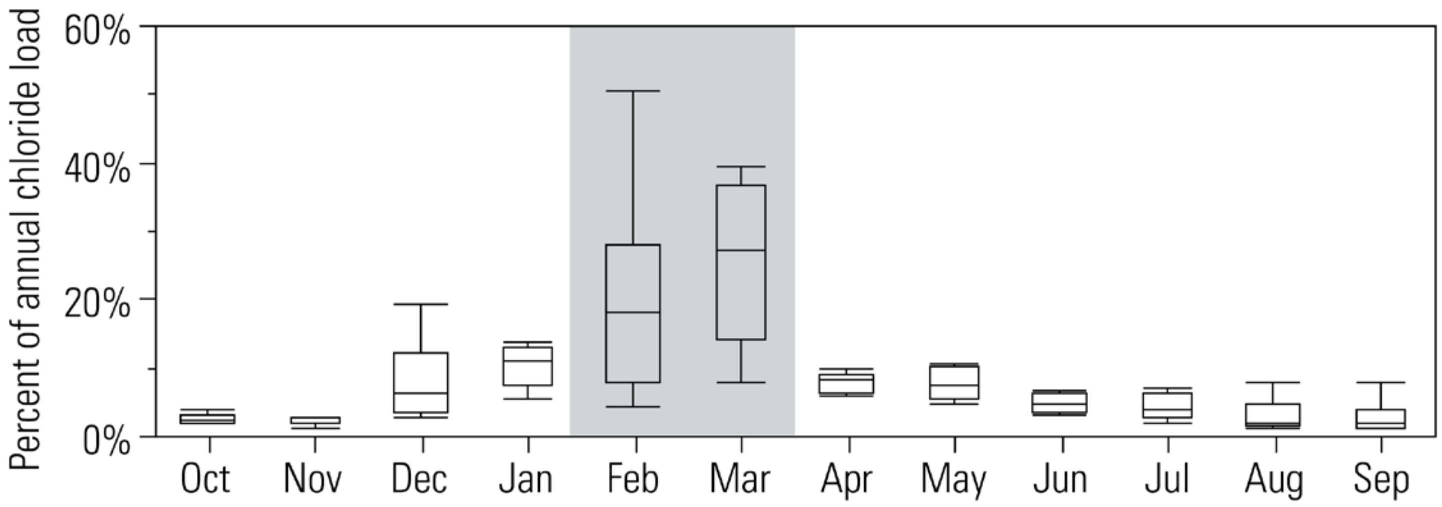
Hourly chloride concentration estimates at **DRGF** exceed the acute Virginia freshwater chloride standard of 860 mg/L less than 5% of the time in February and March.

Chloride loads at DRGF varied by year, but were consistently highest in February and March

Annual chloride loads varied from about 2,500 – 8,000 tons/yr, or 45 – 140 tons/mi^2.

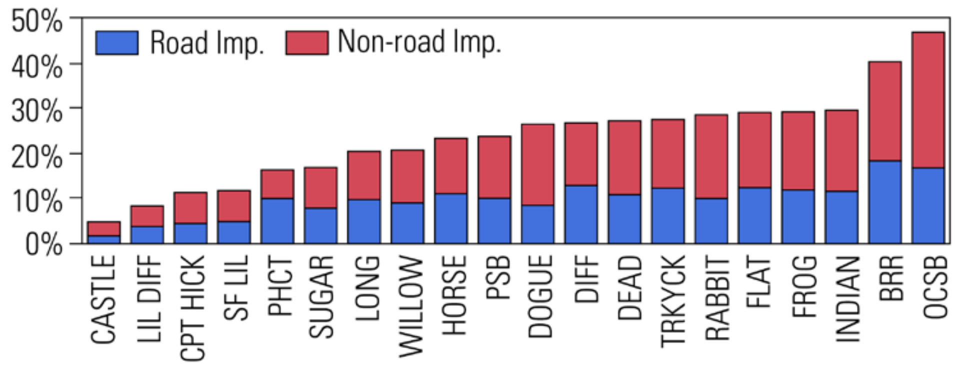


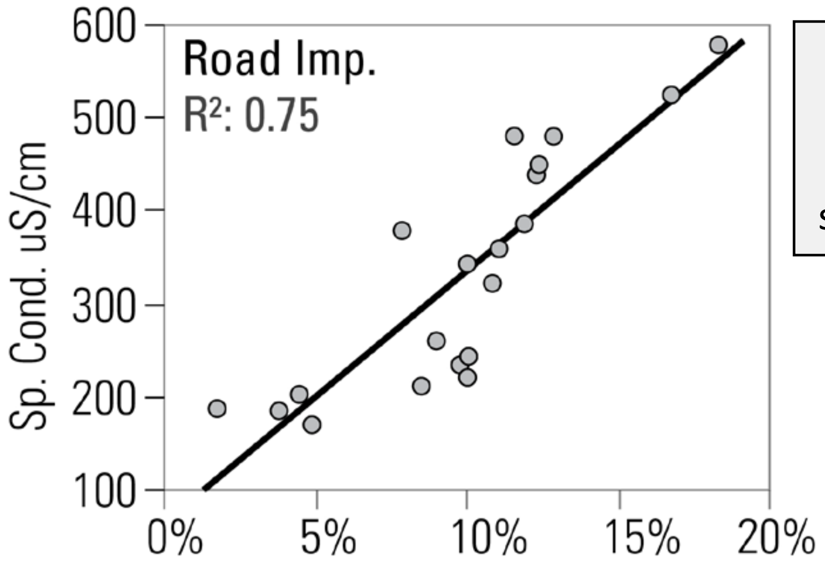
The largest chloride loads occurred in February and March, months that typically accounted for more than 50% of the annual load.



Specific conductance is highest in the most impervious watersheds

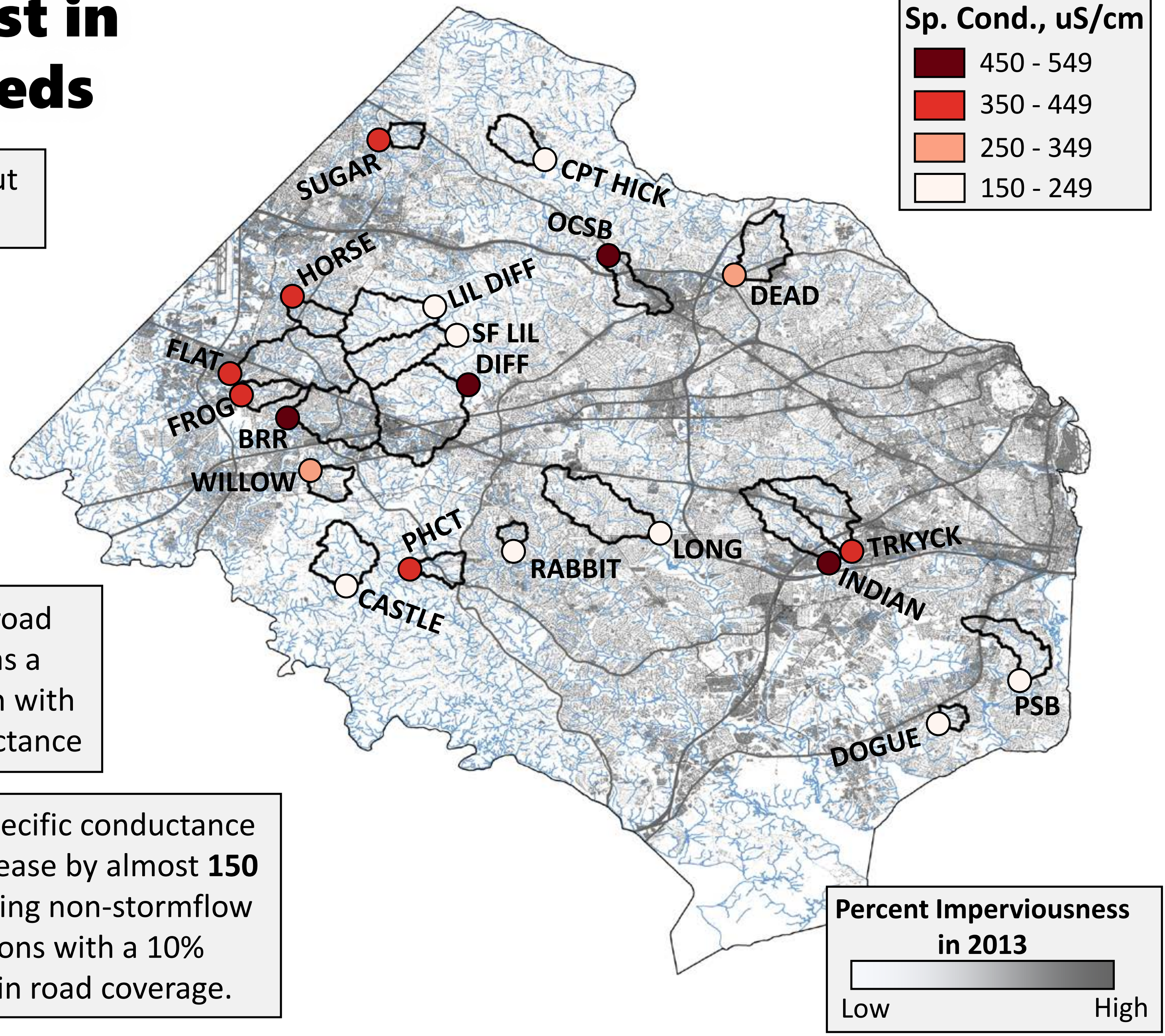
Road and non-road impervious land cover ranges from about **5% to 50%** of watershed area in the monitoring network.





Impervious road coverage has a strong relation with specific conductance

Average specific conductance values increase by almost **150 uS/cm** during non-stormflow conditions with a 10% increase in road coverage.



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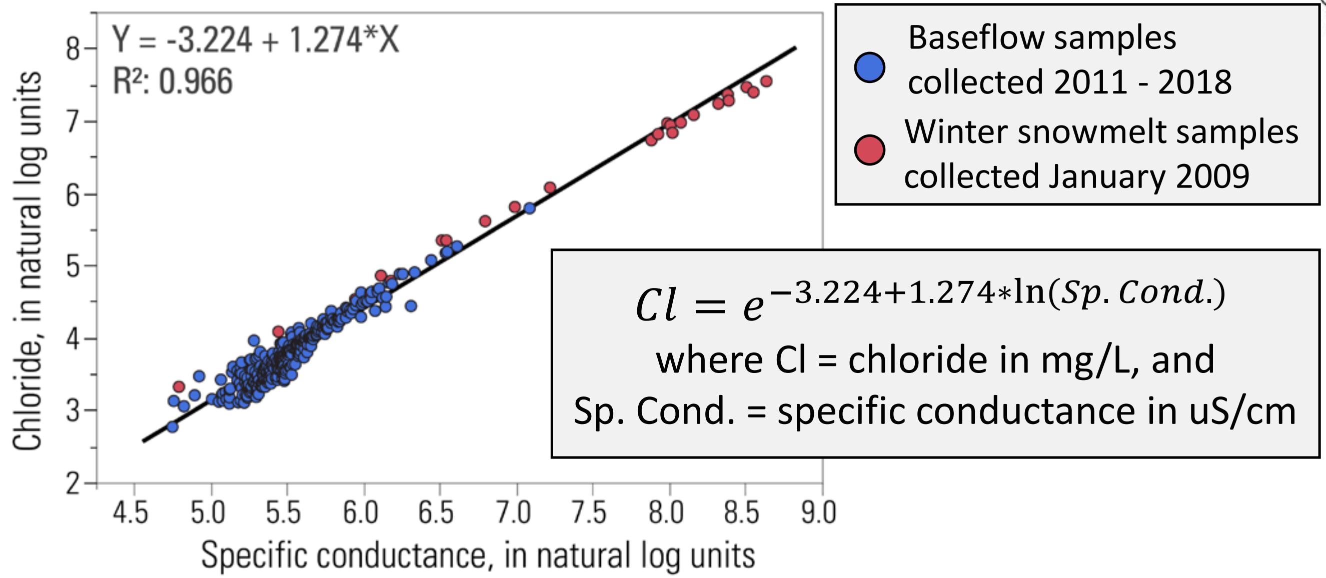
Preliminary Information-Subject to Revision. Not for Citation or Distribution

Chloride concentrations were estimated for Fairfax County streams using water-quality samples collected throughout the Difficult Run watershed

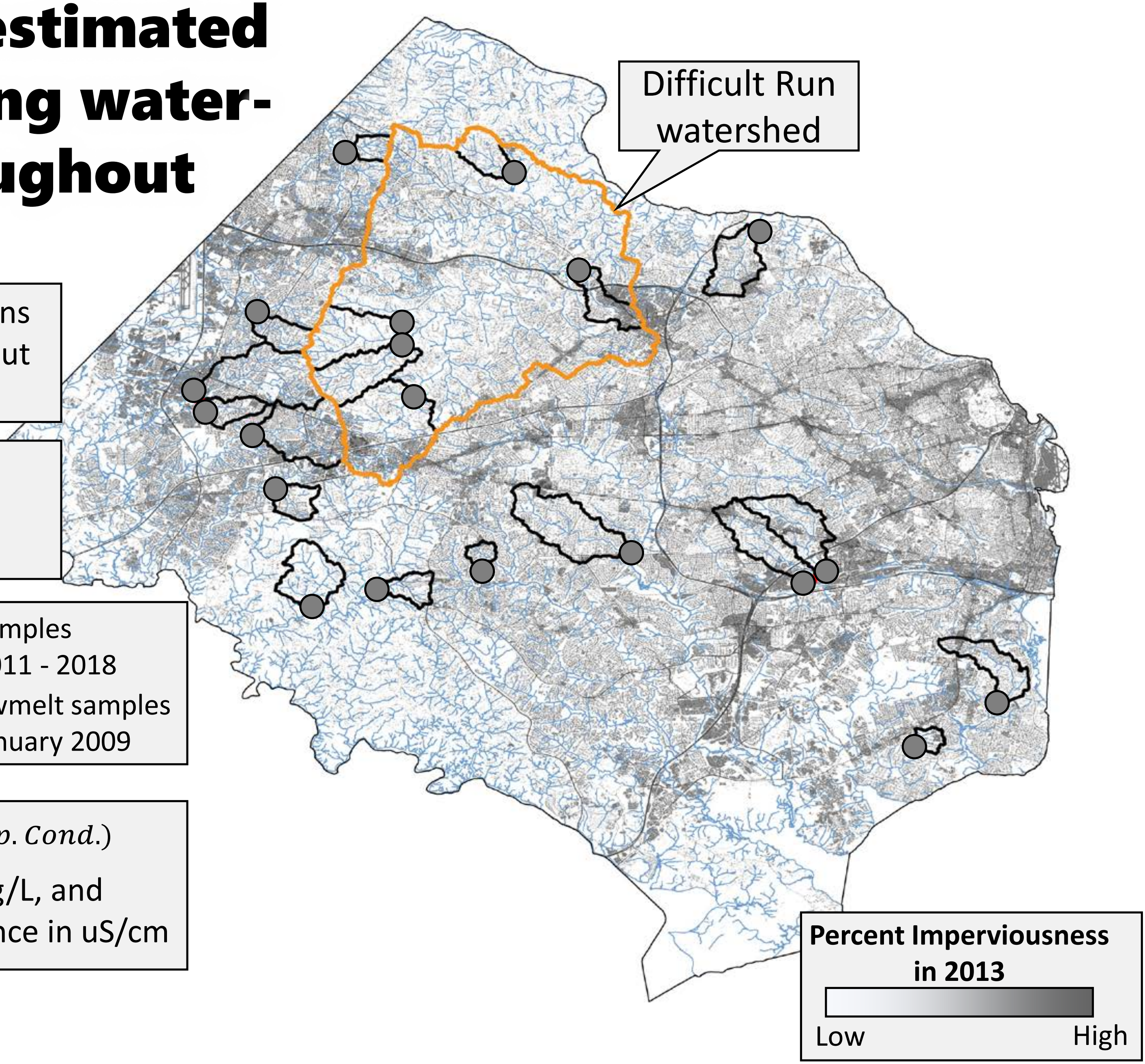
Specific conductance and lab-measured chloride concentrations have been collected from approximately 35 streams throughout the Difficult Run watershed over the past ten years.

The relation between specific conductance and chloride in Difficult Run streams was used to estimate chloride concentrations throughout Fairfax County streams.



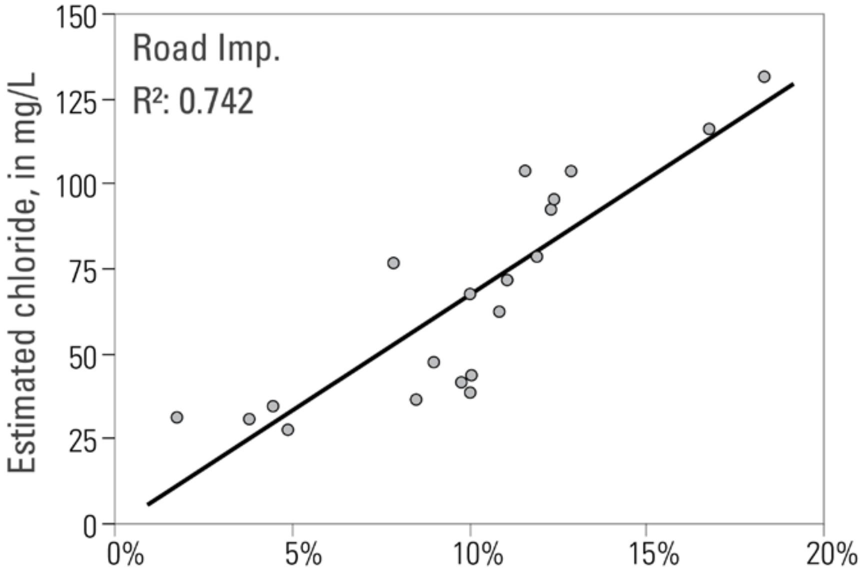
$$Cl = e^{-3.224+1.274*\ln(Sp.\,Cond.)}$$

where Cl = chloride in mg/L, and
Sp. Cond. = specific conductance in uS/cm

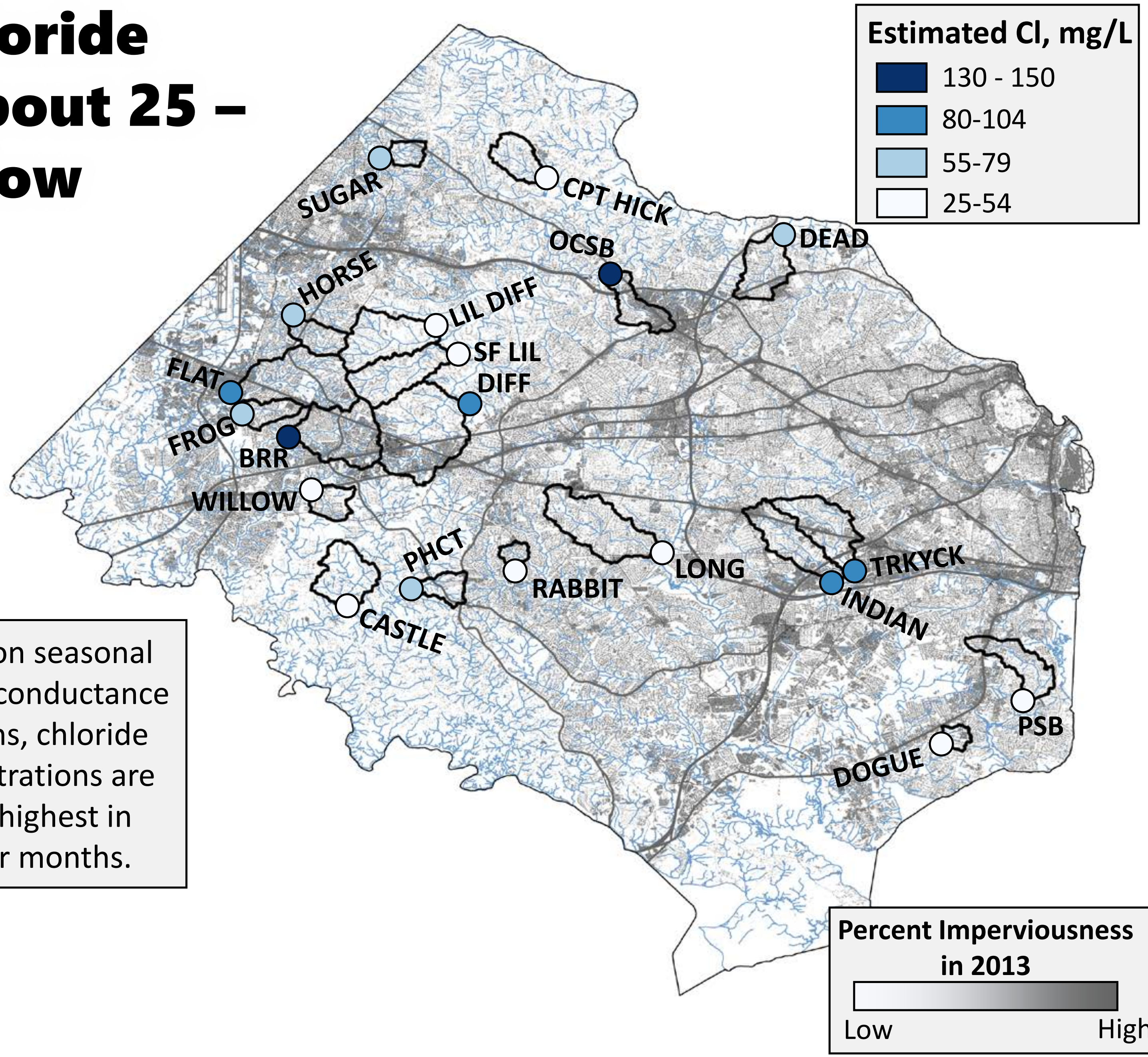


Estimated annual average chloride concentrations range from about 25 – 130 mg/L during non-stormflow conditions

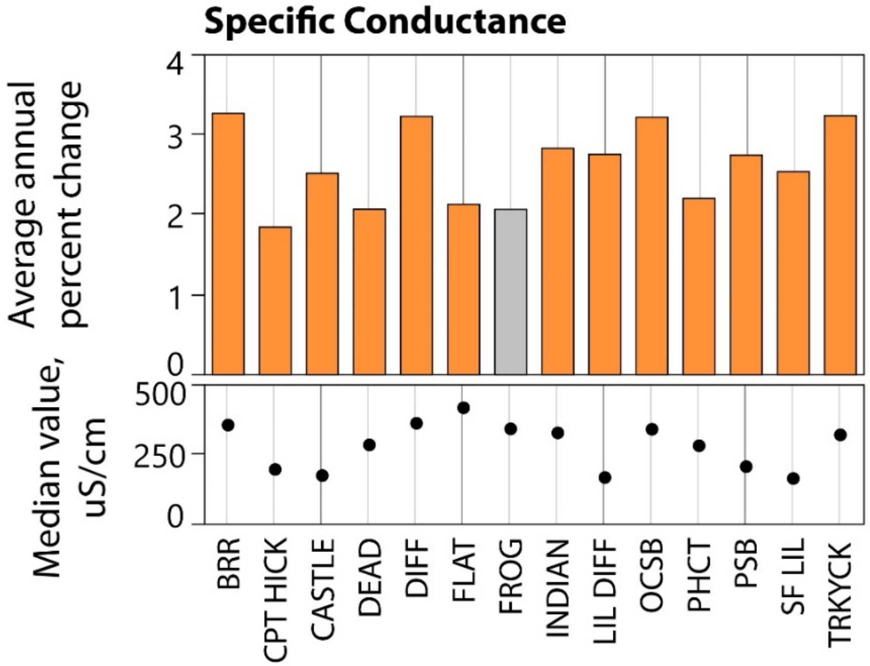
Estimated annual average chloride concentrations increase by almost **70 mg/L** during non-stormflow conditions with a **10% increase in road coverage**.

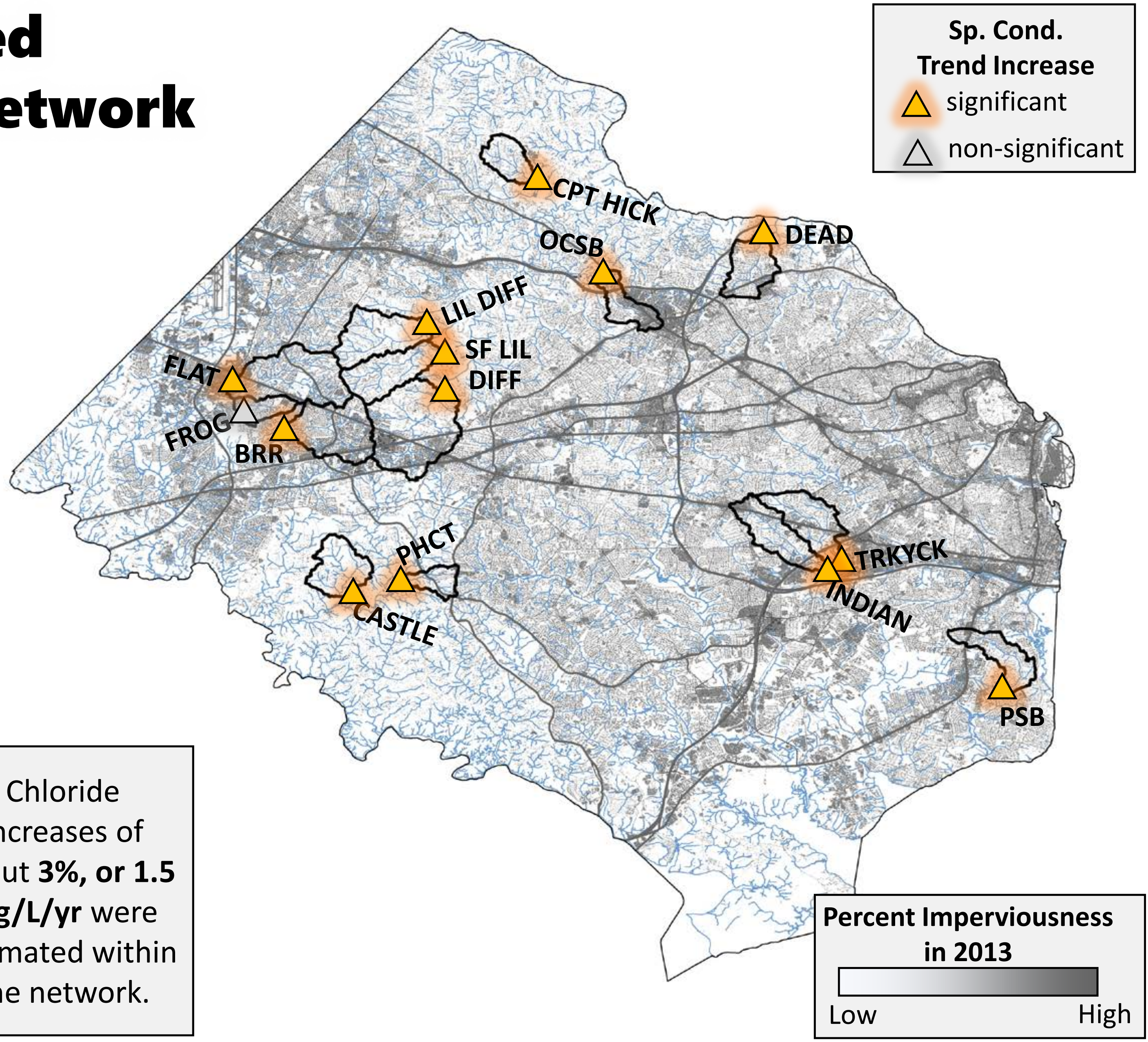


Based on seasonal specific conductance patterns, chloride concentrations are likely highest in winter months.



Specific conductance increased throughout the monitoring network between 2008- 2018





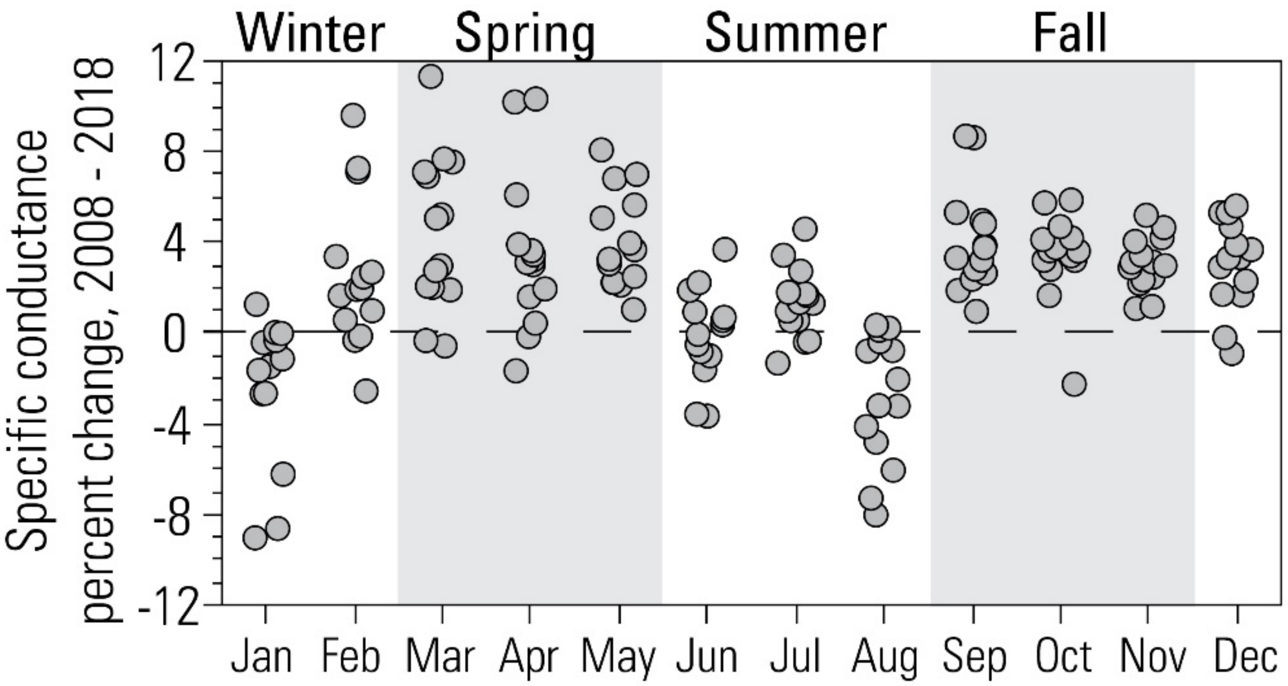
Specific conductance increases of about **2.5%, or 7.5 uS/cm/yr** were observed throughout the network.

Previous work by Fairfax County staff identified (1) county-wide increases in specific conductance between 2004 – 2017 that (2) were largest in the most impervious watersheds.

Chloride increases of about **3%, or 1.5 mg/L/yr** were estimated within the network.

Specific conductance increases occurred in both winter and non-winter months

Specific conductance increased in winter, spring, and fall months in most sites. Such non-winter trends can occur when chloride, which is highly soluble, reaches the groundwater and is discharged to streams year-round

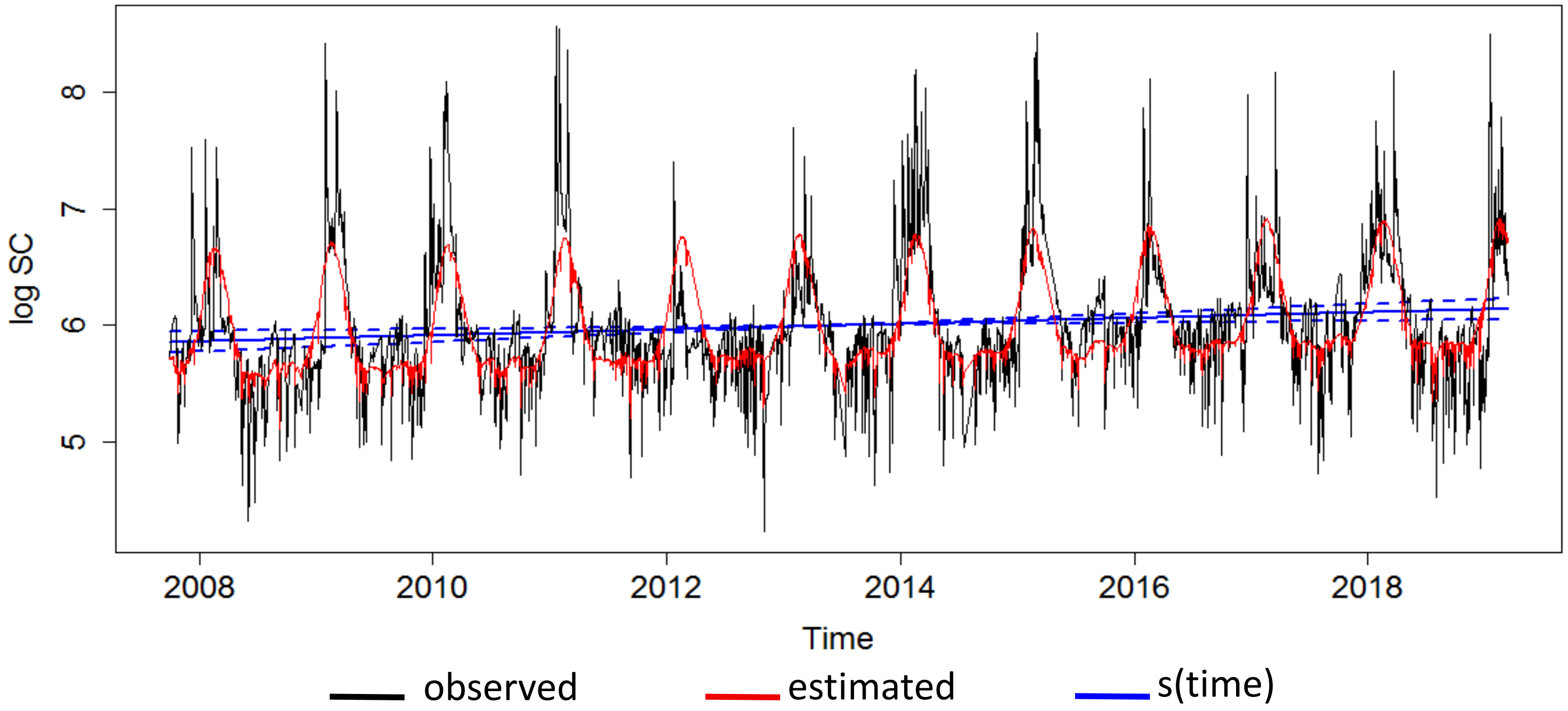


Increasing specific conductance trends were quantified at DIFF using a novel method to estimate trends in continuous water-quality data

Gavin Yang (Virginia and West Virginia USGS Water Science Center) is developing a method to quantify trends in continuous water-quality data using a General Additive Model (GAM) framework, which will be published in a forthcoming journal article.

The approach was applied at **DIFF** and identified a significant increase in specific conductance between 2008 – 2018.

DIFF, specific conductance



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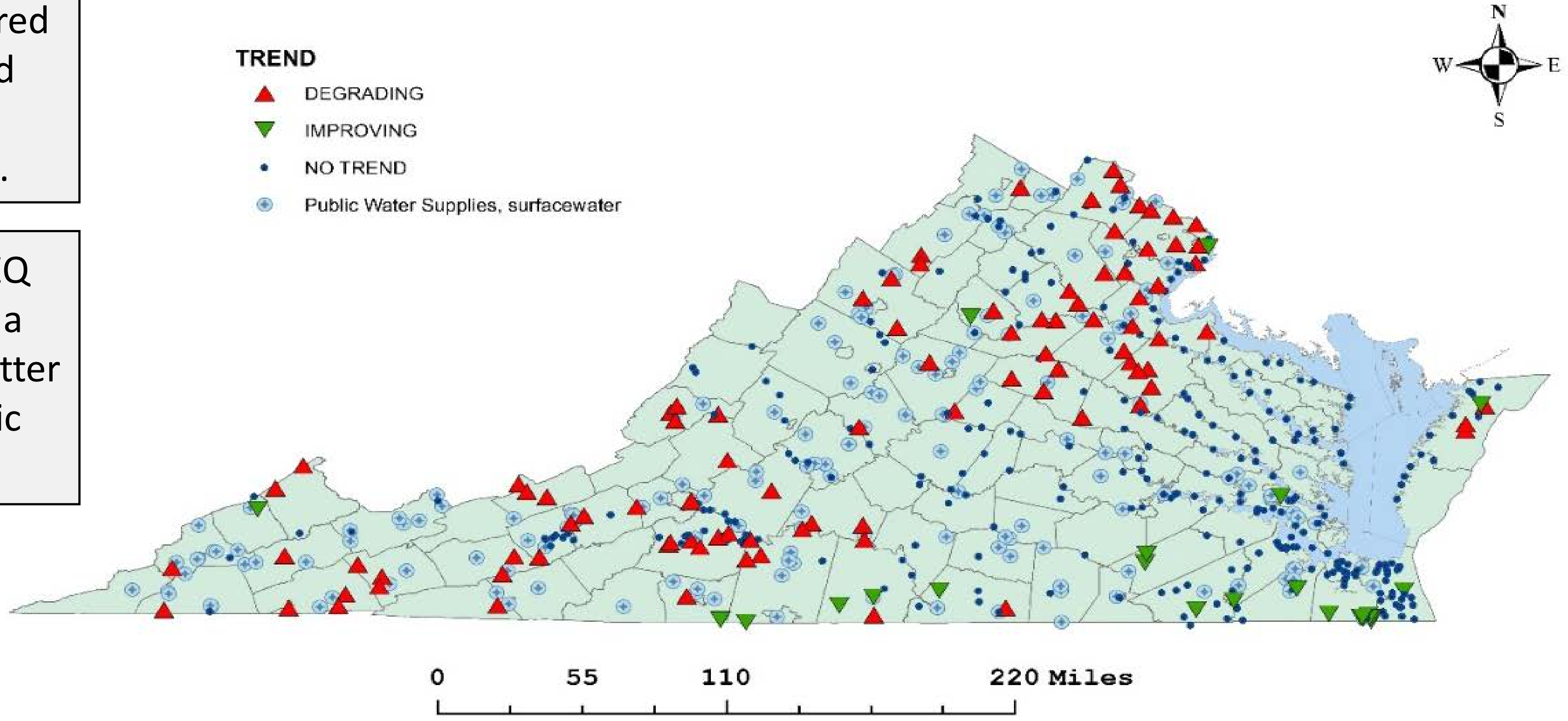
Specific conductance increases occurred at 94 (36%) of 259 VA DEQ trend monitoring stations between 1997 - 2016

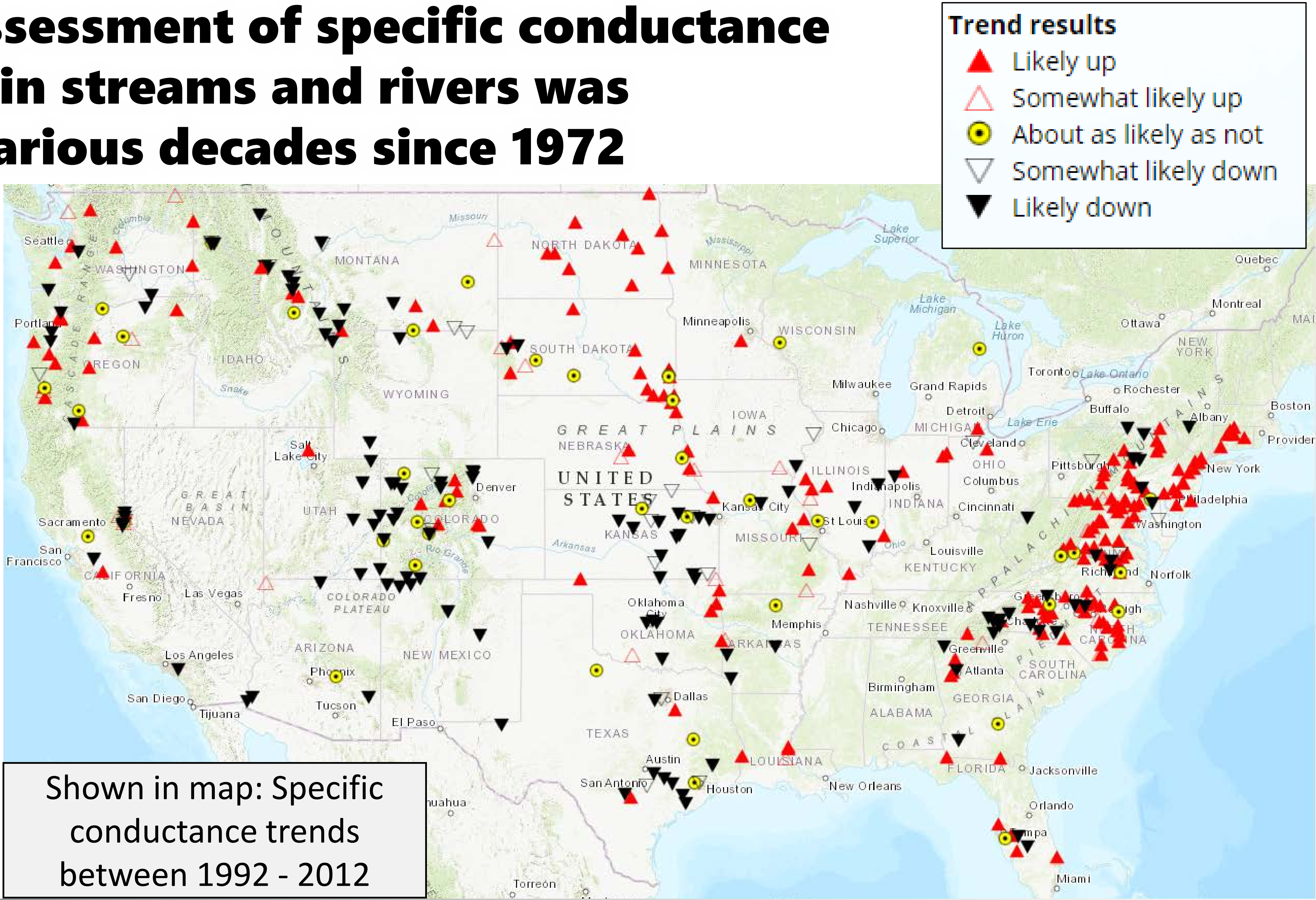
Specific conductance is measured throughout the VA DEQ trend monitoring network , which consists of over 300 stations.

Based on these results, VA DEQ added major ion sampling to a subset of stations in 2018 to better understand the changing ionic composition of VA streams.



A nationwide assessment of specific conductance and TDS trends in streams and rivers was computed for various decades since 1972

Results available online: https://nawqatrends.wim.usgs.gov/swtrends/



Shown in map: Specific conductance trends between 1992 - 2012

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The addition of **major ion sampling** to existing networks will help assess road salt impacts and the effects of mitigation efforts.

Fixed-frequency chloride sampling at many sites would be helpful to assess trends, **baseflow and stormflow chloride sampling** at select sites would be helpful to determine loads and freshwater criteria attainment.