Long-term Water Quality (Tony Stahl's Talk) and Phytoplankton Characteristics (Ed Carney's Talk) of the Kansas River

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Division of Environment
Bureau of Water, Watershed Planning
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Photo credit: Steve Cringan

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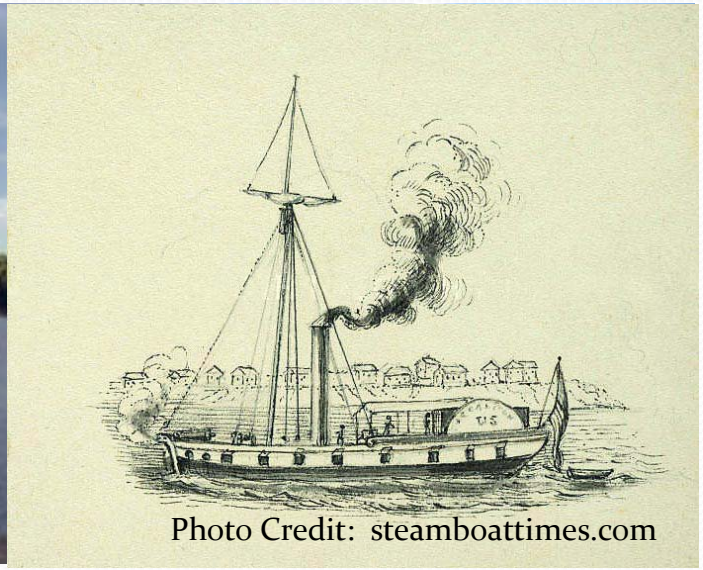
Background: KDHE Stream Chemistry Monitoring Program

Photo Credit: kansasmemory.org

Kansas State Board of Health
Dr. Samuel Crumbine's Legacy

Photo Credit: Craig Thompson



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Stream Chemistry Monitoring Network

- 1885 Kansas State Board of Health (KSBH) formed – the predecessor agency to the Kansas Department of Health and Environment (KDHE).
- 1886 The first biological and chemical analyses were performed at KSBH.
- 1906 A joint agreement between KSBH and United States Geological Survey (USGS) in conjunction with the University of Kansas Chemistry Department assessed the quality of Kansas surface waters.
- 1907 KSBH established environmental laboratory analyses of waters and wastewaters.

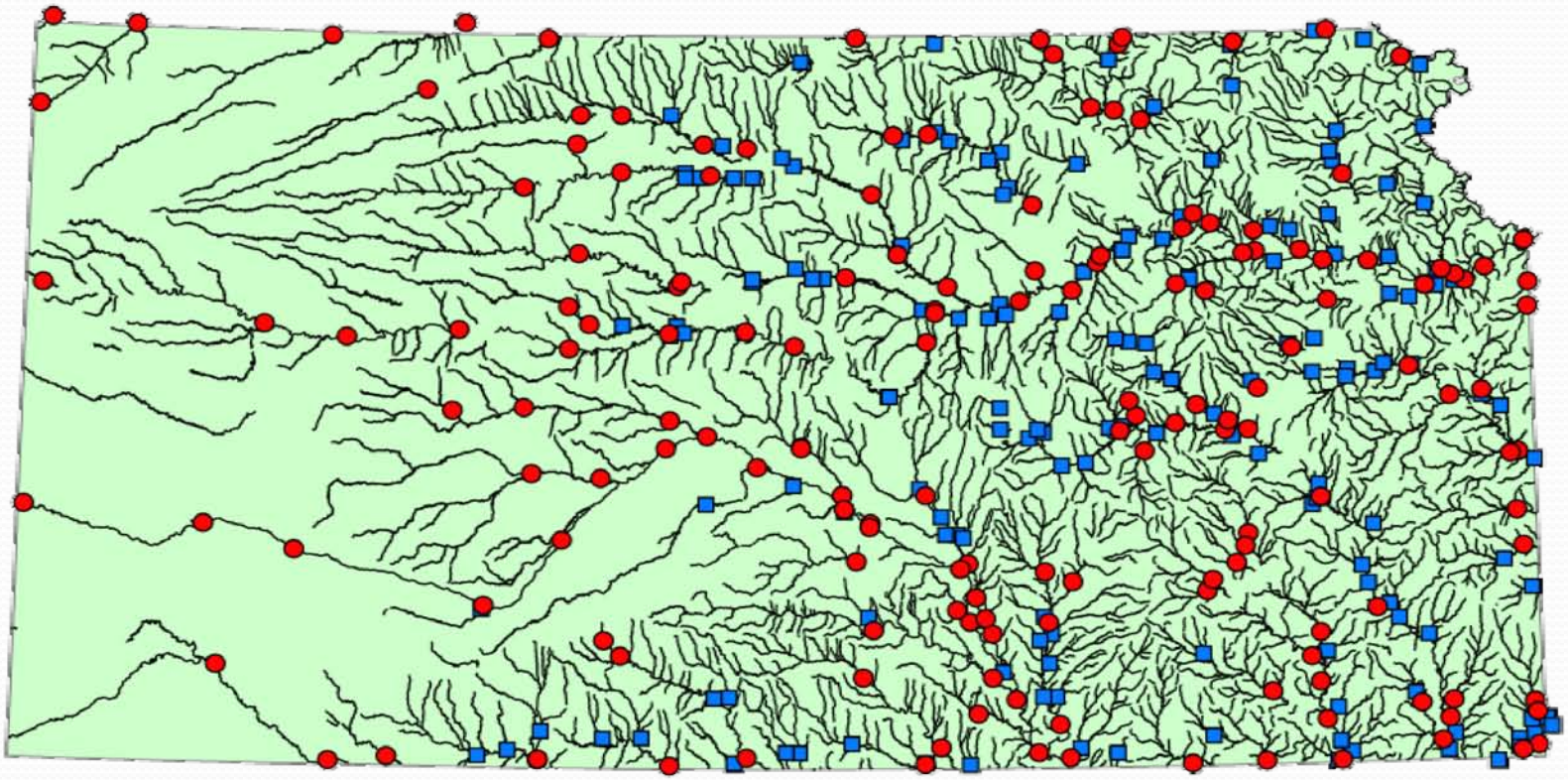
Stream Chemistry Monitoring Network

- Mid 1890s - early 1920s Early monitoring efforts focused primarily on the sanitary condition of waterbodies serving as public water supplies.
- 1922 - 1978 Intensive river basin surveys were performed on an episodic basis
- 1956 - 1961 KSBH collected water samples on a monthly basis from a network of 39 monitoring stations.
- 1961 - 1975 A cooperative agreement between KSBH and USGS created a joint state/federal network consisting of 140 stations.
- 1974 -1975 KDHE replaces KSBH and terminates the cooperative agreement with USGS

Stream Chemistry Monitoring Network

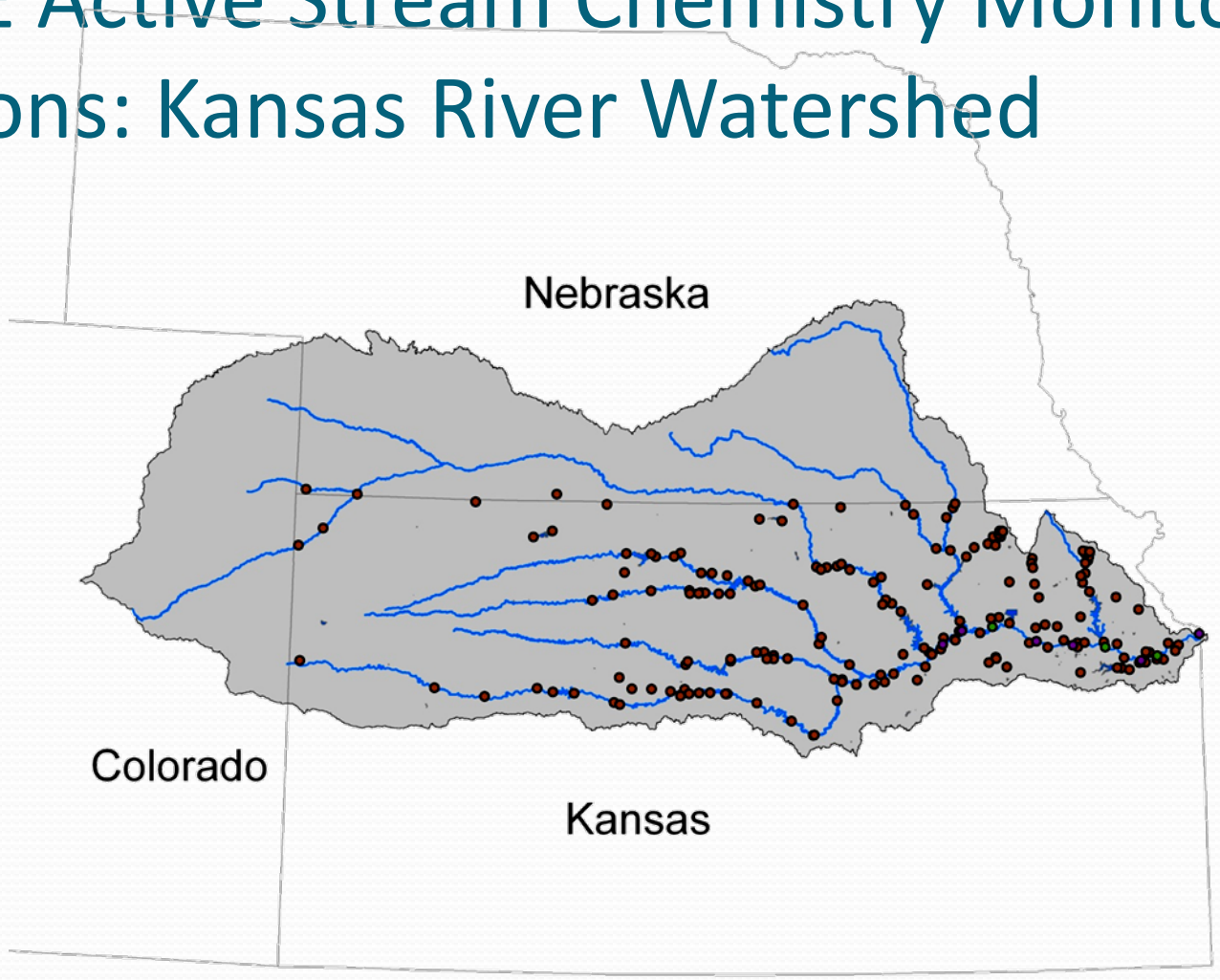
- 1975 - 1990 KDHE reduced the network to approximately 115 stations – the collection of transition metal and pesticide samples was implemented at all stations.
- 1990 – 2000 KDHE revamped the network, added core and rotational monitoring stations to obtain greater geographical perspective on water quality conditions.
- 2000 – 2009 Focus was largely on quality assurance/quality control and data management and reference stream (the study of minimally altered ecological systems) identification.
- 2010 Due to budgetary constraints (laboratory and bureau), KDHE reduced the frequency of collection from bimonthly (6 times a year) to quarterly (4 times a year).

Statewide Monitoring Program

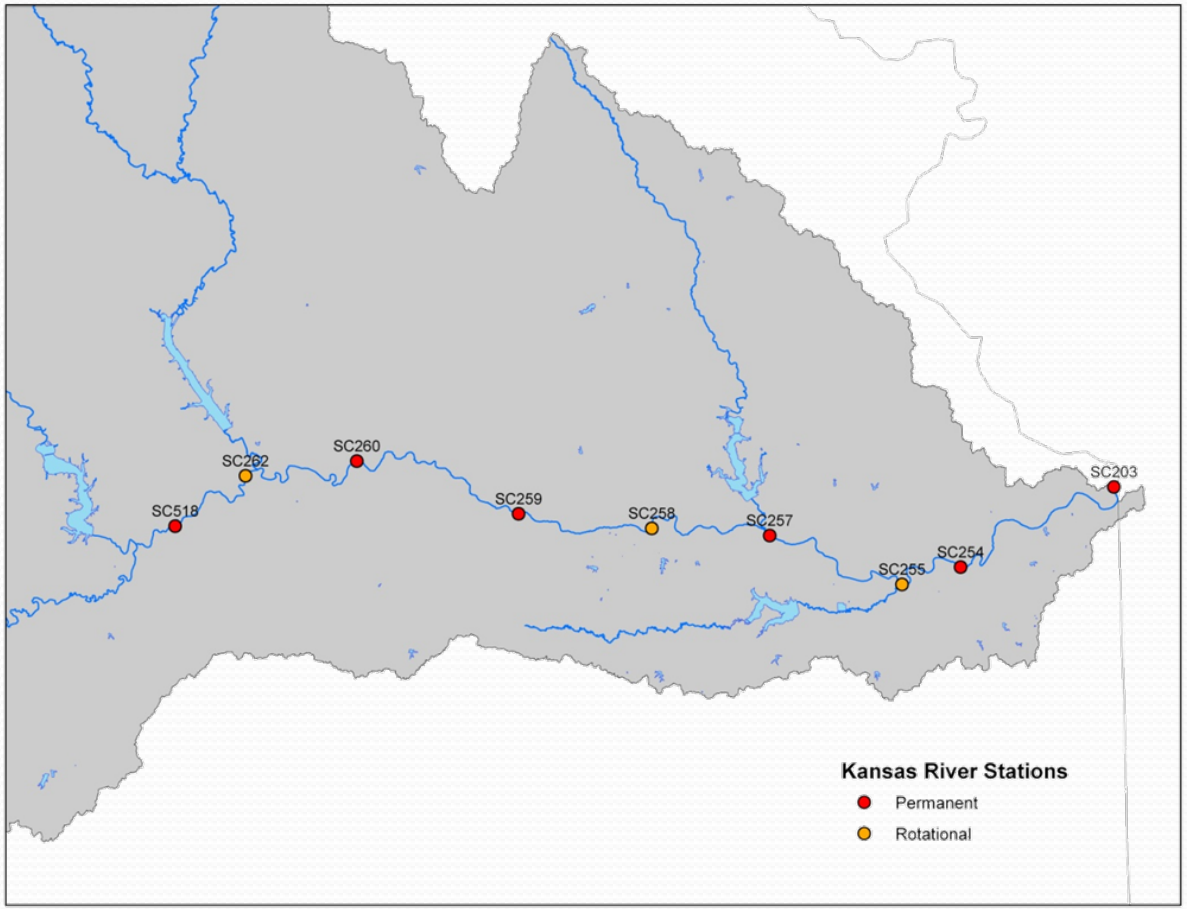


Red circles: Core stations
Blue squares: Rotational stations

KDHE Active Stream Chemistry Monitoring Stations: Kansas River Watershed



KDHE Active Stream Chemistry Monitoring Stations: Kansas River



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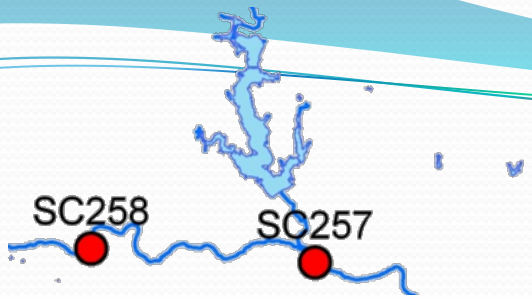
SC260
Kansas River at Wamego

upstream

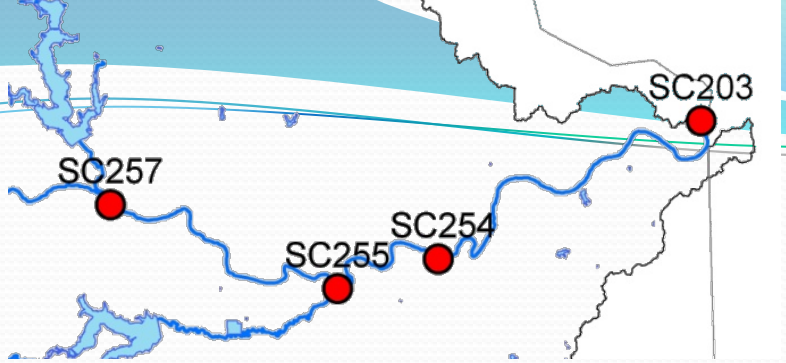
downstream



SC257
Kansas River at Lecompton

upstream

downstream



SC254
Kansas River at De Soto

upstream

downstream

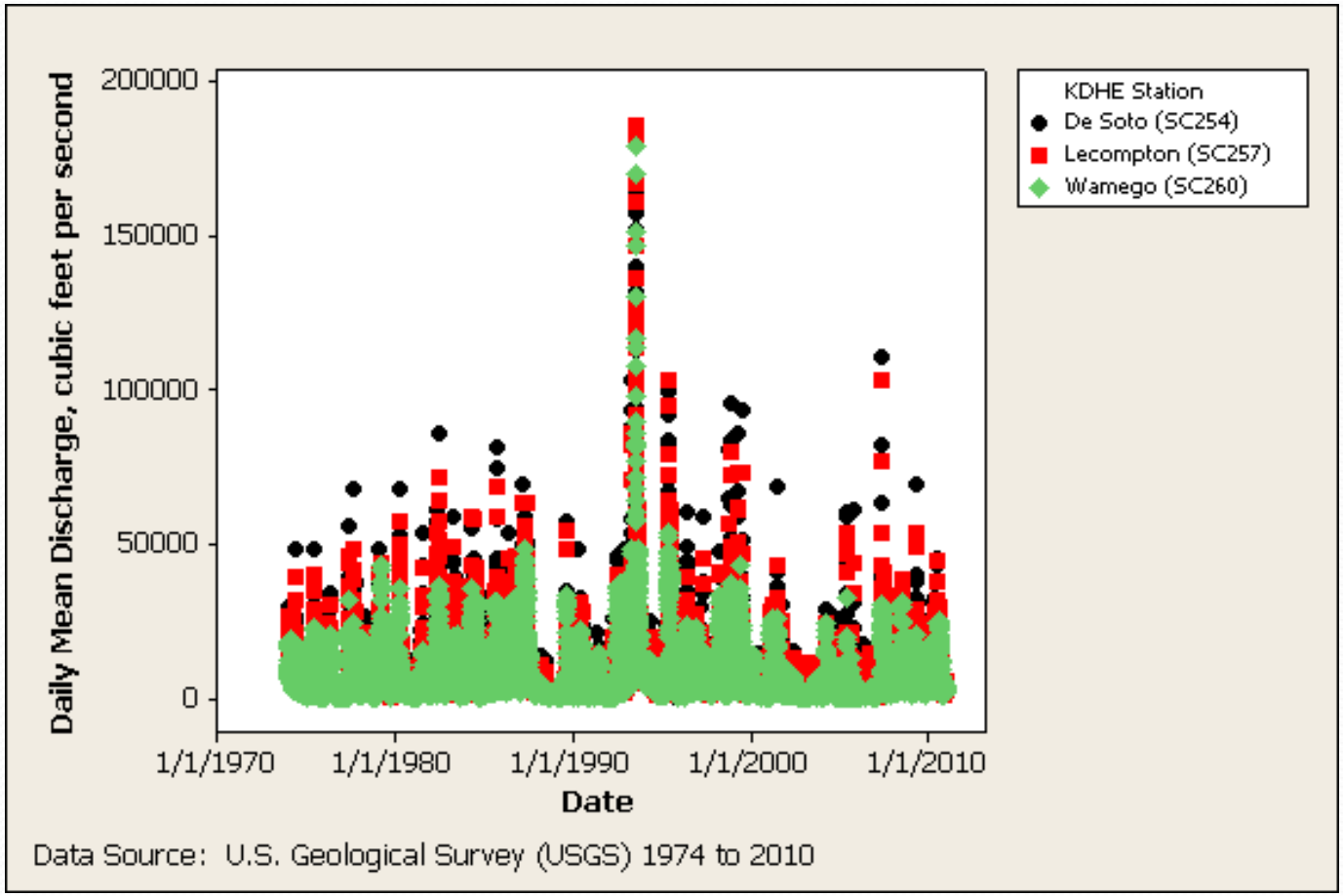
Long-term Water Quality Characteristics for Monitoring Years 1974 – 2010 (37 Years)

- Characterize the general hydrology during this period.
- Characterize the water quality at 3 KDHE monitoring sites (co-located with USGS gage stations) in the Kansas River with the effects of exogenous variables (stream flow and seasonal variation).
  - 1986 – 2010 pH field (220 observations)
  - 1974 – 2010 chloride (1002 observations)
  - 1977 – 2010 atrazine (427 observations)
  - 1974 – 2010 total suspended solids (963 observations)

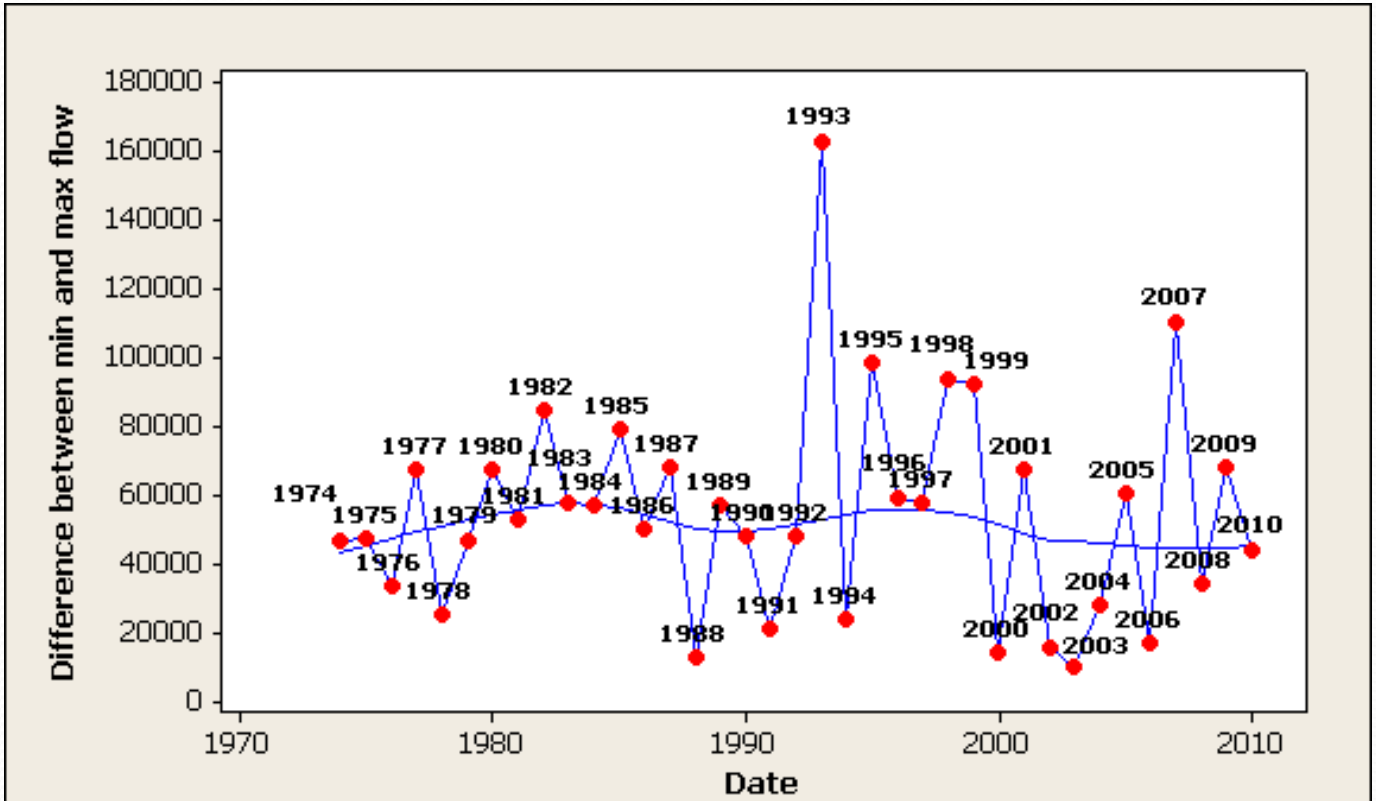
Kansas River Hydrologic Conditions U.S. Geological Survey (USGS) 1974 to 2010

KDHE Monitoring Station	Number	Mean m3/s	Minimum	25th Percentile (LOW)	50th Percentile (AVERAGE)	75th Percentile (HIGH)	Maximum
Wamego (SC260)	13514	5320	427 (11/7/2006)	1250	2670	5903	179000 (7/26/1993)
Lecompton (SC257)	13514	7239	436 (2/25/2003)	1840	3610	8090	186000 (7/26/1993)
De Soto (SC254)	13514	8038	323 (1/16/2007)	2000	4050	9270	167000 (7/27/1993)

Mean Daily Discharge 1974 - 2010



Kansas River Stream Flow Variability



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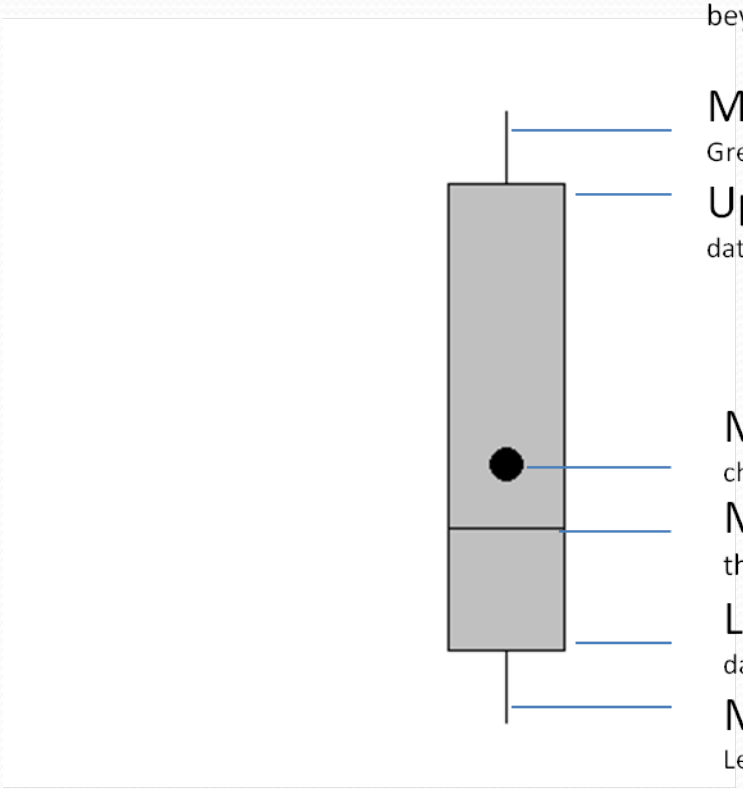
Hydrogen-ion Activity (pH)

- The pH of a solution is critical since it changes a number of parameters (i.e., solubility or reactivity) as pH changes (e.g., toxicity of ammonia for fish increases as the pH increases).
- Algal respiration and photosynthesis can have an effect on pH, particularly in areas where water flow is negligible.

Boxplot (box-and-whisker plots)



Outlier An unusually large or small observation. Values beyond the whisker.

Maximum
Greatest value, excluding outliers

Upper Quartile 25% of data greater than this value

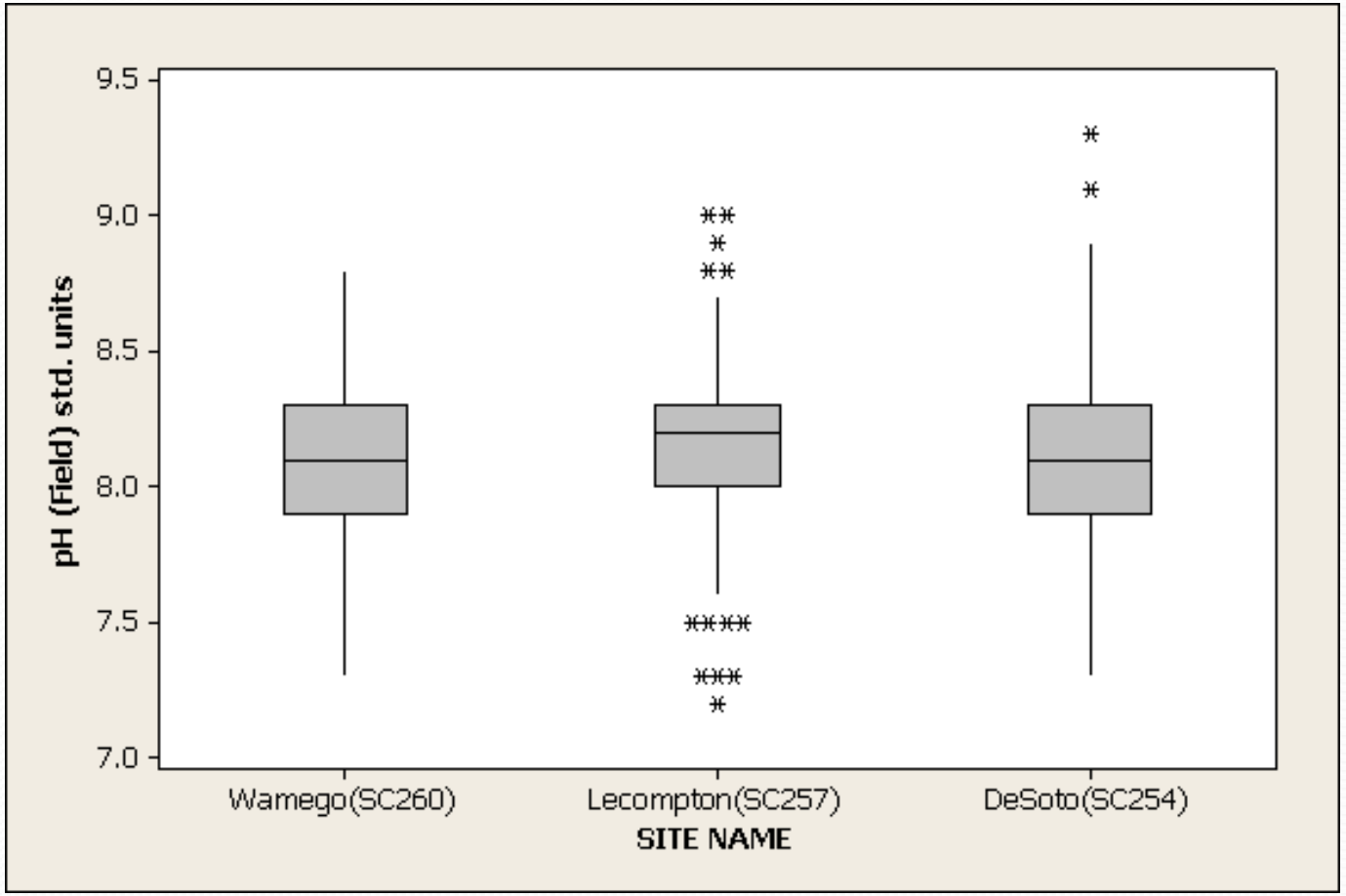
Mean Average concentration of chemical parameter

Median 50% of data is greater than this value; middle of dataset

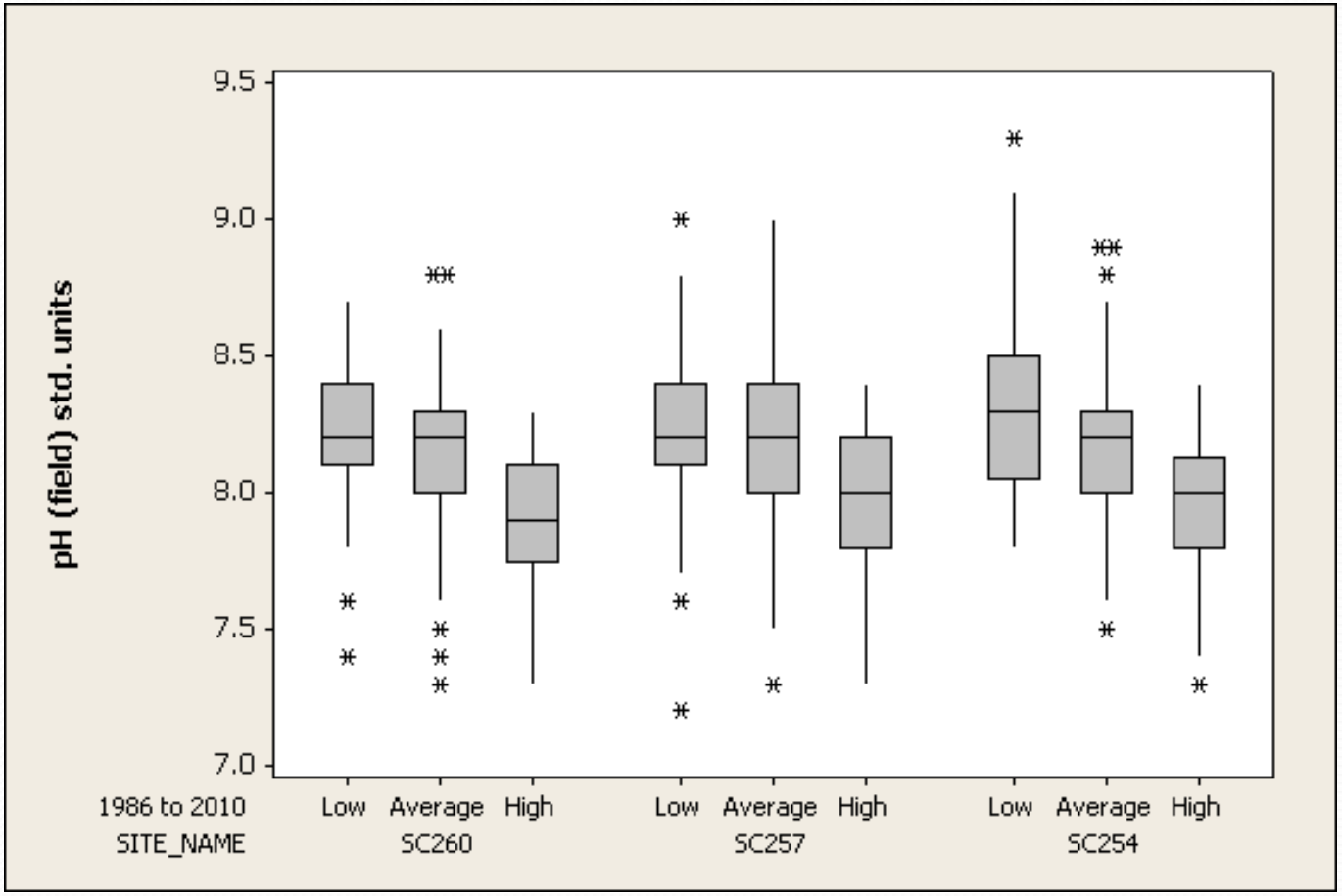
Lower Quartile 25% of data less than this value

Minimum
Least value, excluding outliers

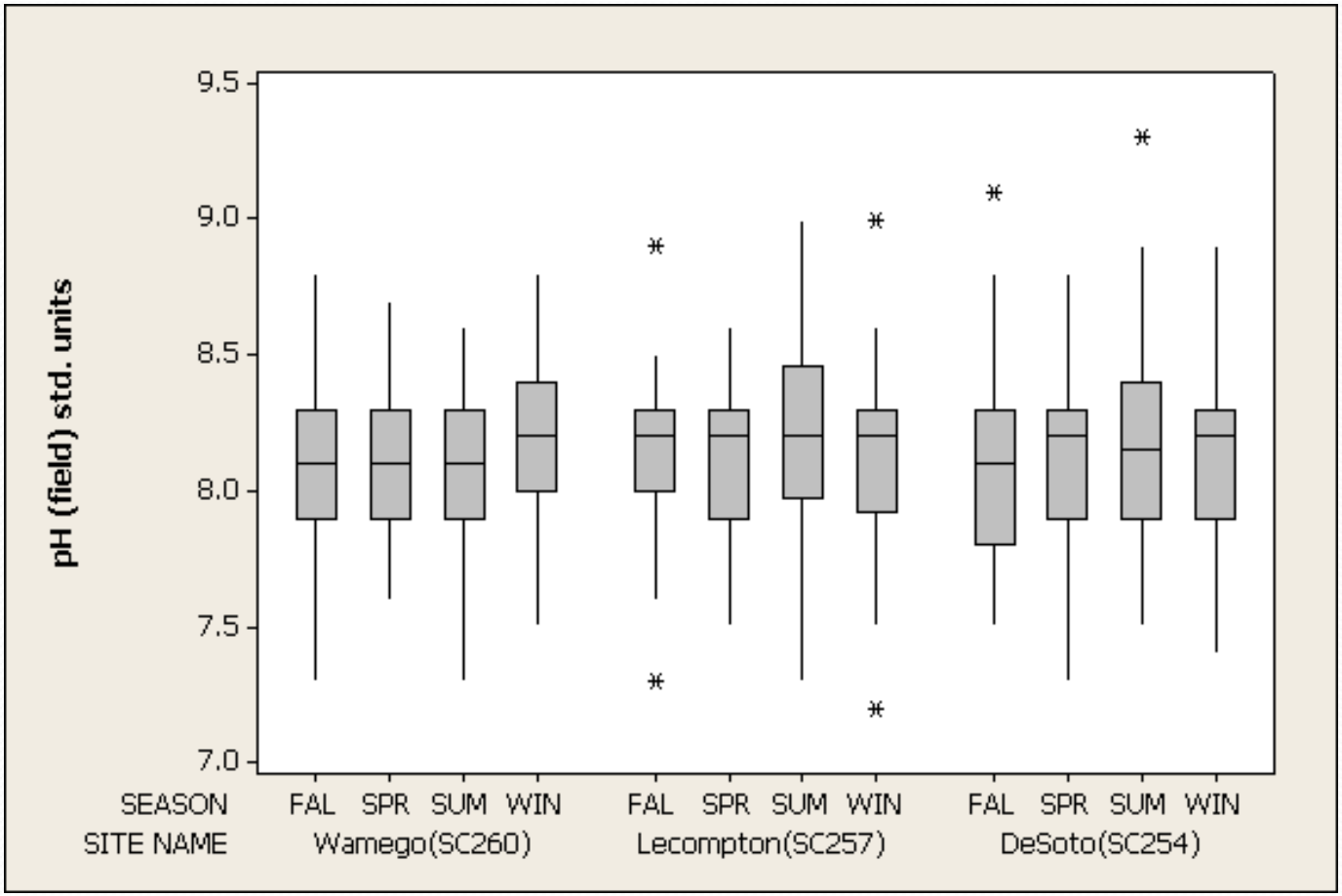
Location Variability and pH



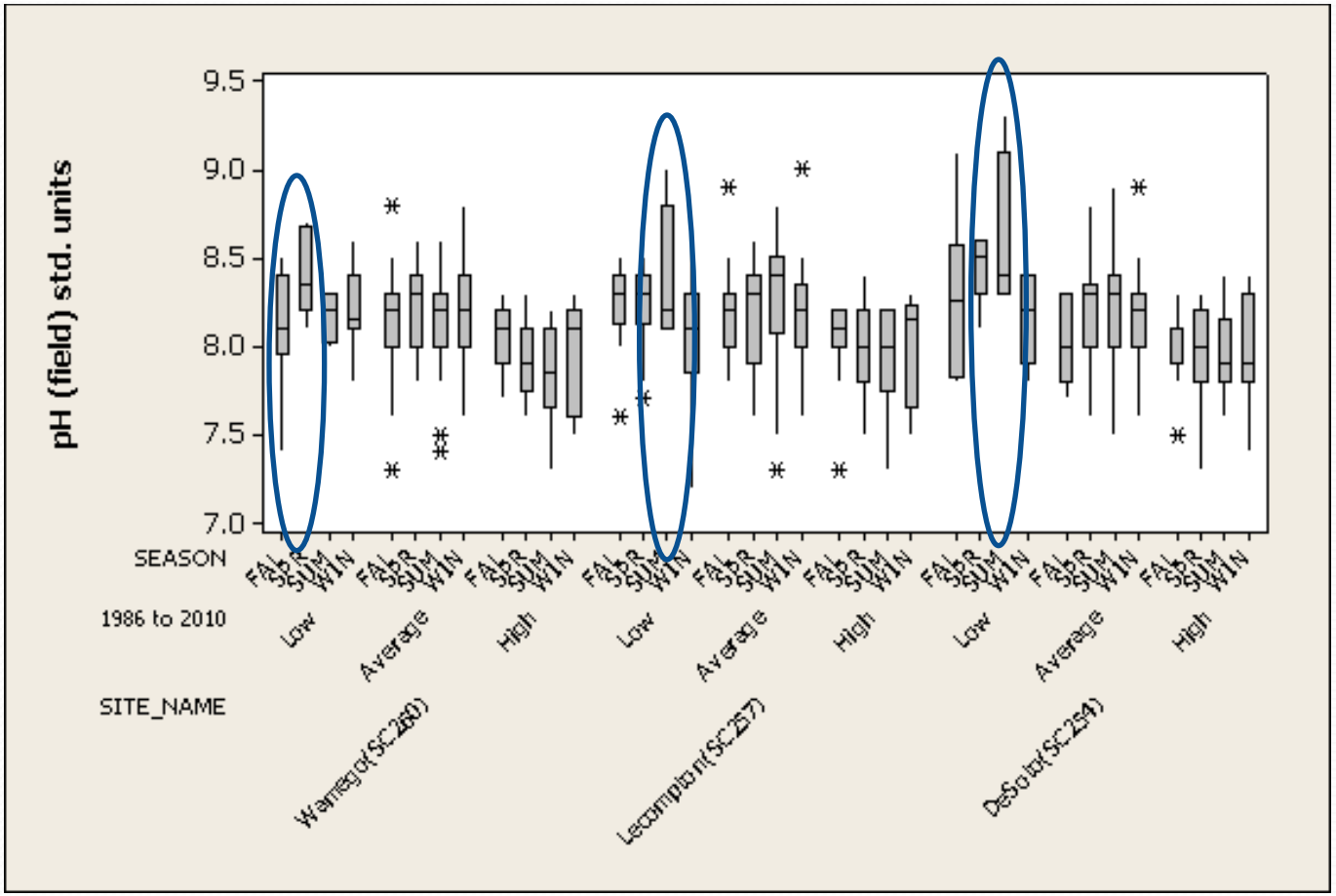
Stream Flow Variability and pH



Season Variability and pH



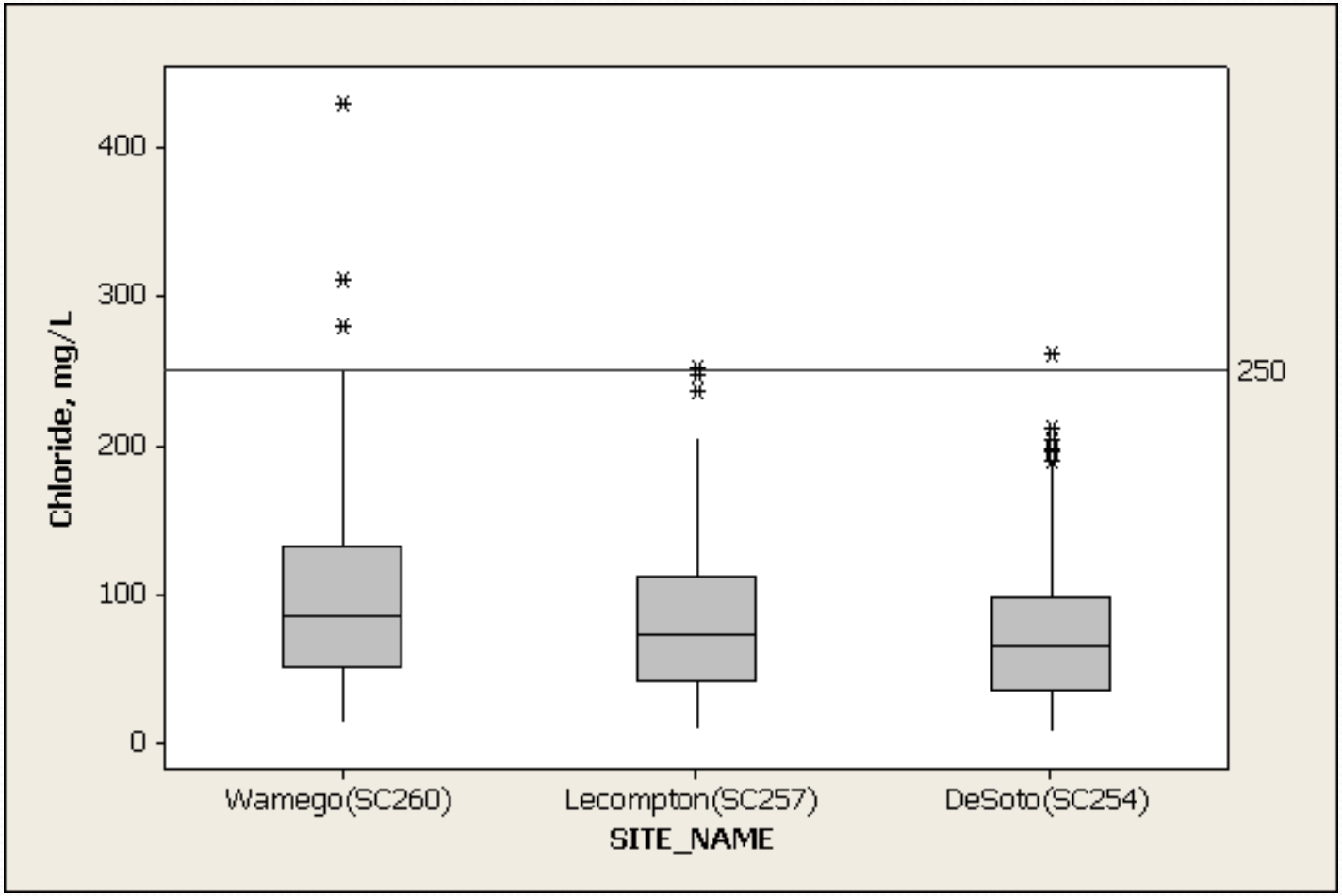
Combined: Stream Flow, Season, and pH



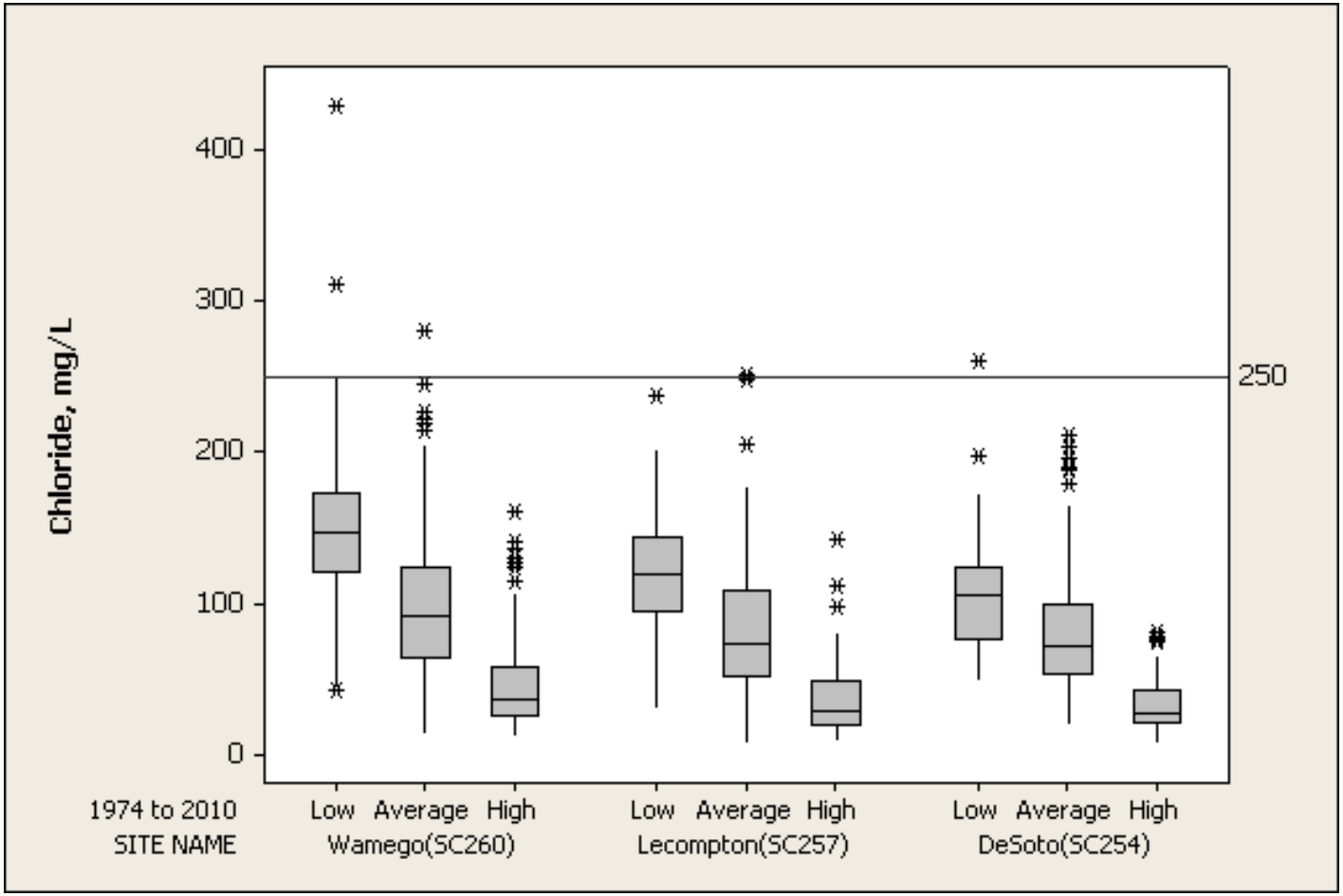
Chloride

- Chloride is considered an conservative element (i.e., its chemical behavior in water is very tame and subdued compared to the other major ions).
- Kansas Geological Survey (KGS) research suggests some of the chloride concentrations in the Kansas River are derived primarily (though not exclusively) from a salt-water intrusion problem between Salina and Solomon, in the Smoky Hill River Valley.
- KDHE has documented elevated chloride concentrations during snowmelt or during times of significant winter runoff conditions attributed to road salt applications (mainly urban or near-by urban streams).

Location Variability and Chloride



Stream Flow Variability and Chloride



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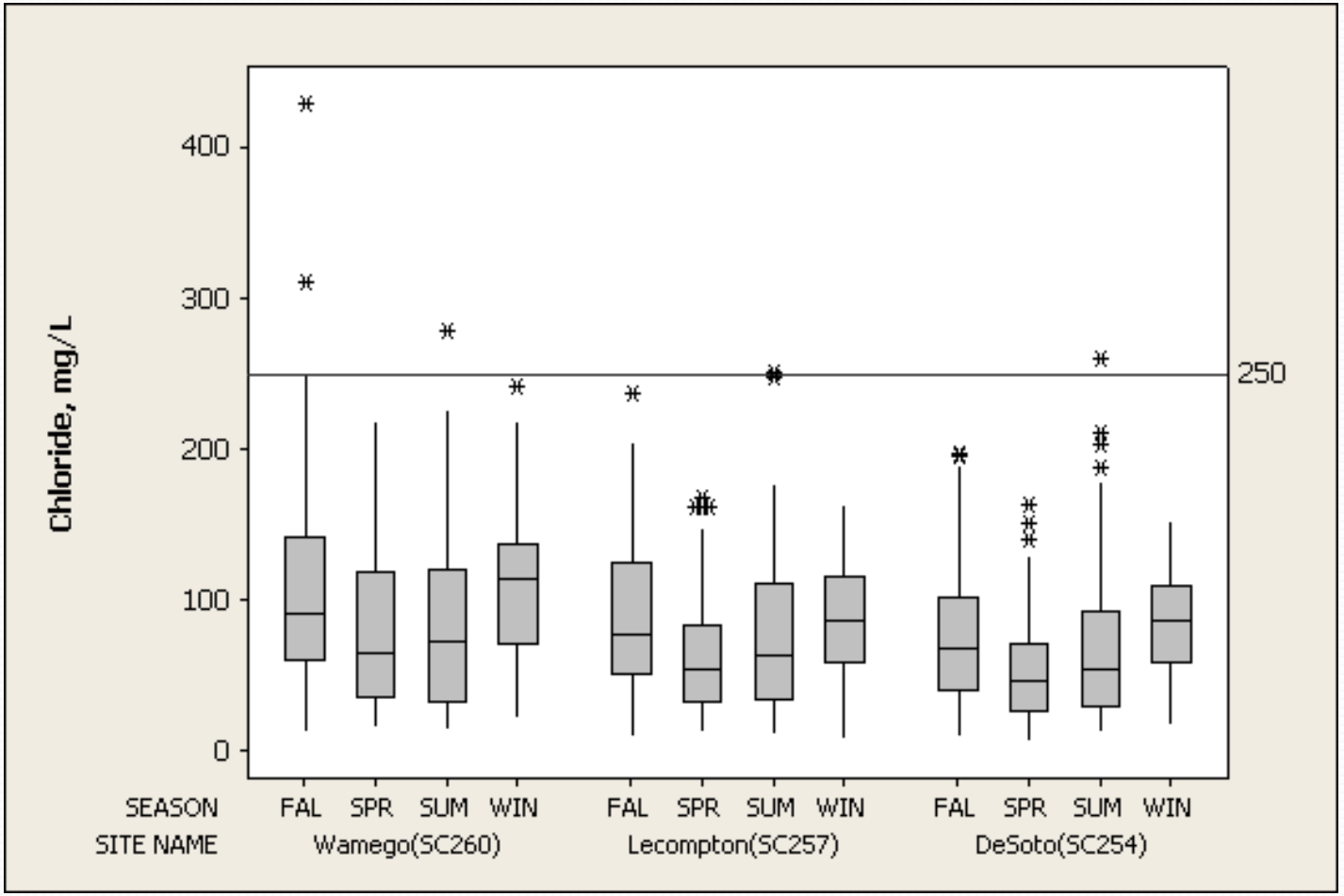
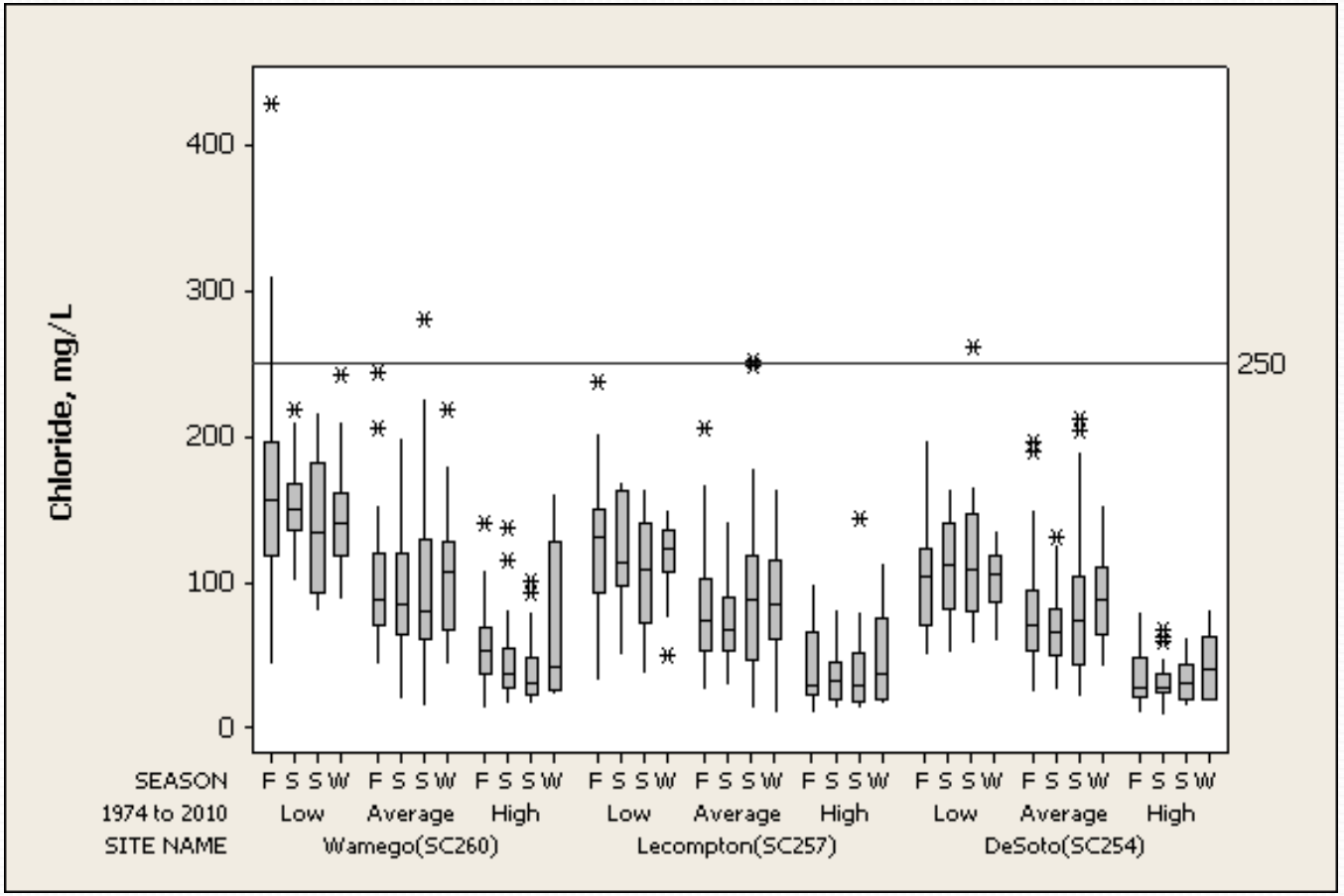
Season Variability and Chloride



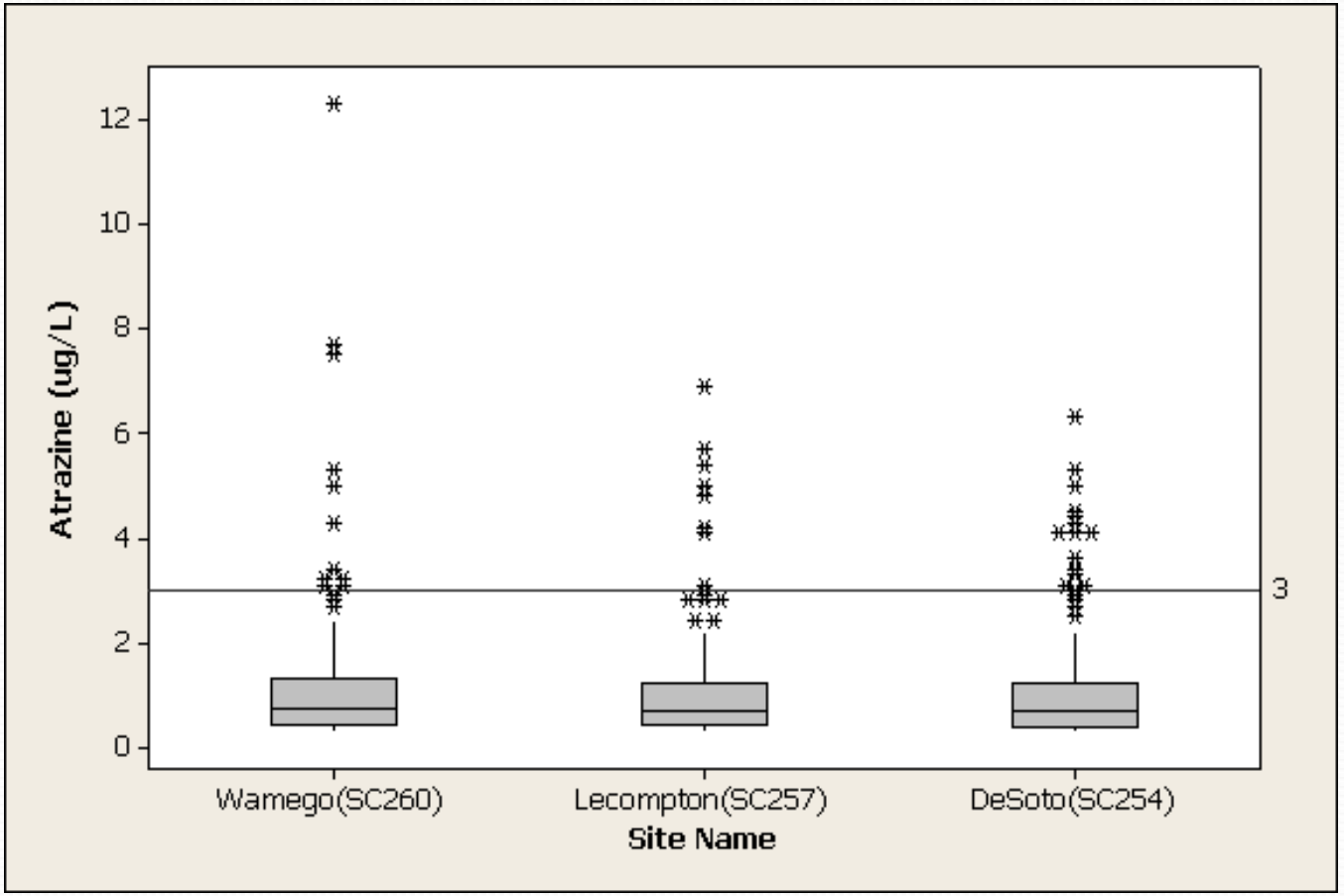
Combined: Stream Flow, Season, and Chloride



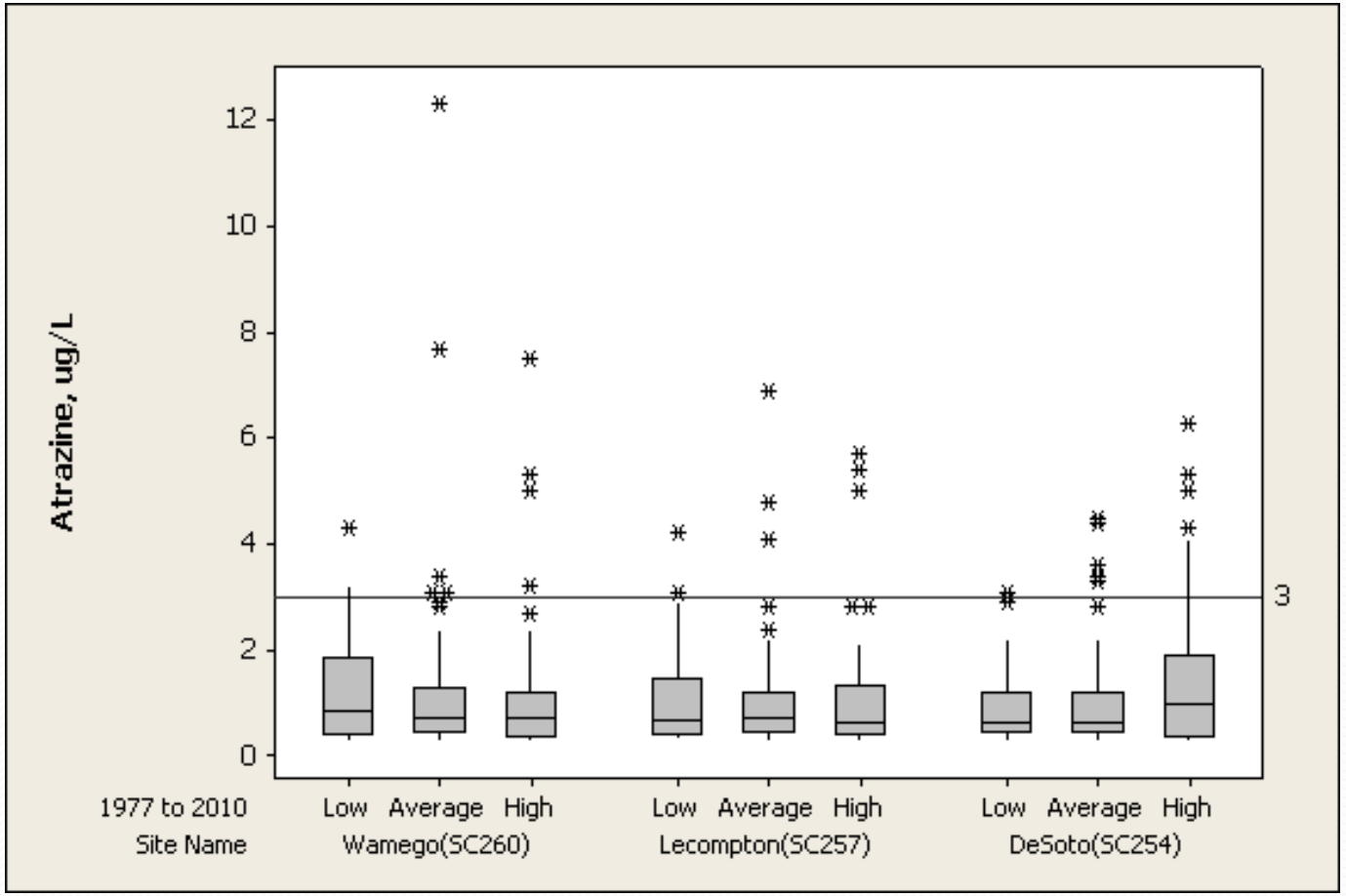
Atrazine

- Atrazine and other biocides are derived primarily from agricultural applications and secondarily from urban/residential applications and usage on railroad and highway right-of-ways.
- Atrazine is a widely used herbicide for control of broadleaf and grass weeds and is not effectively removed from drinking water supplies with conventional water treatment.

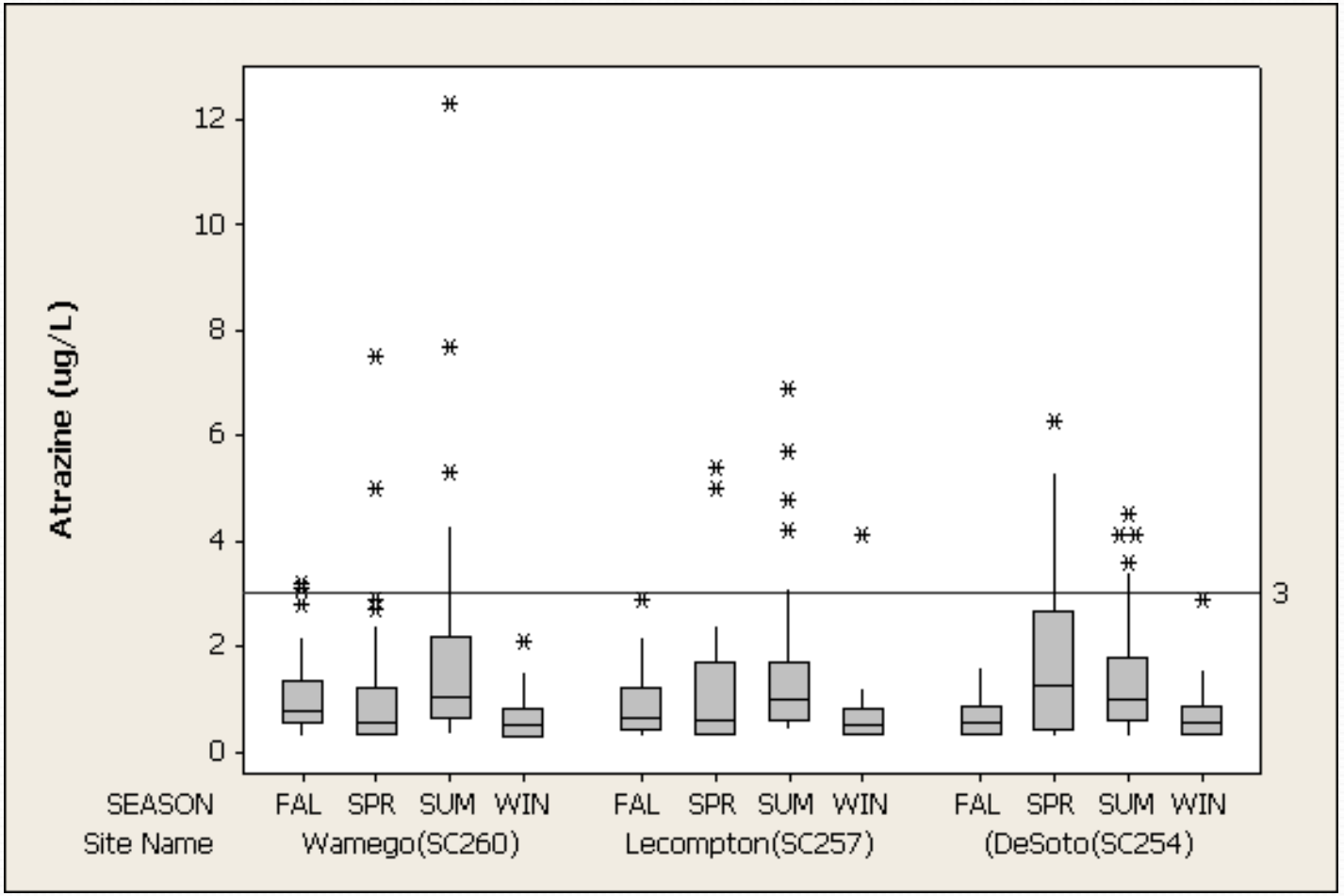
Location Variability and Atrazine



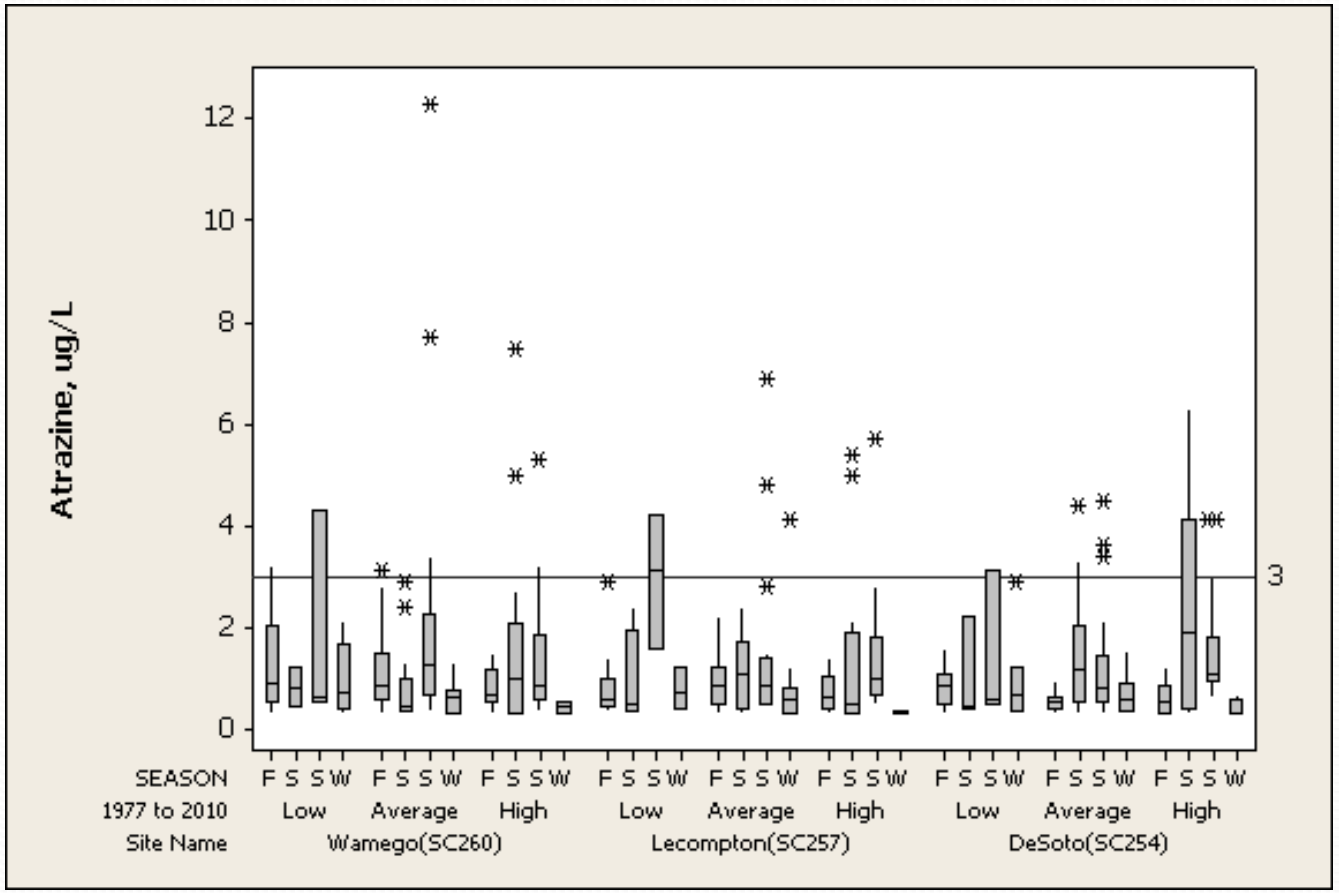
Stream Flow Variability and Atrazine



Season Variability and Atrazine



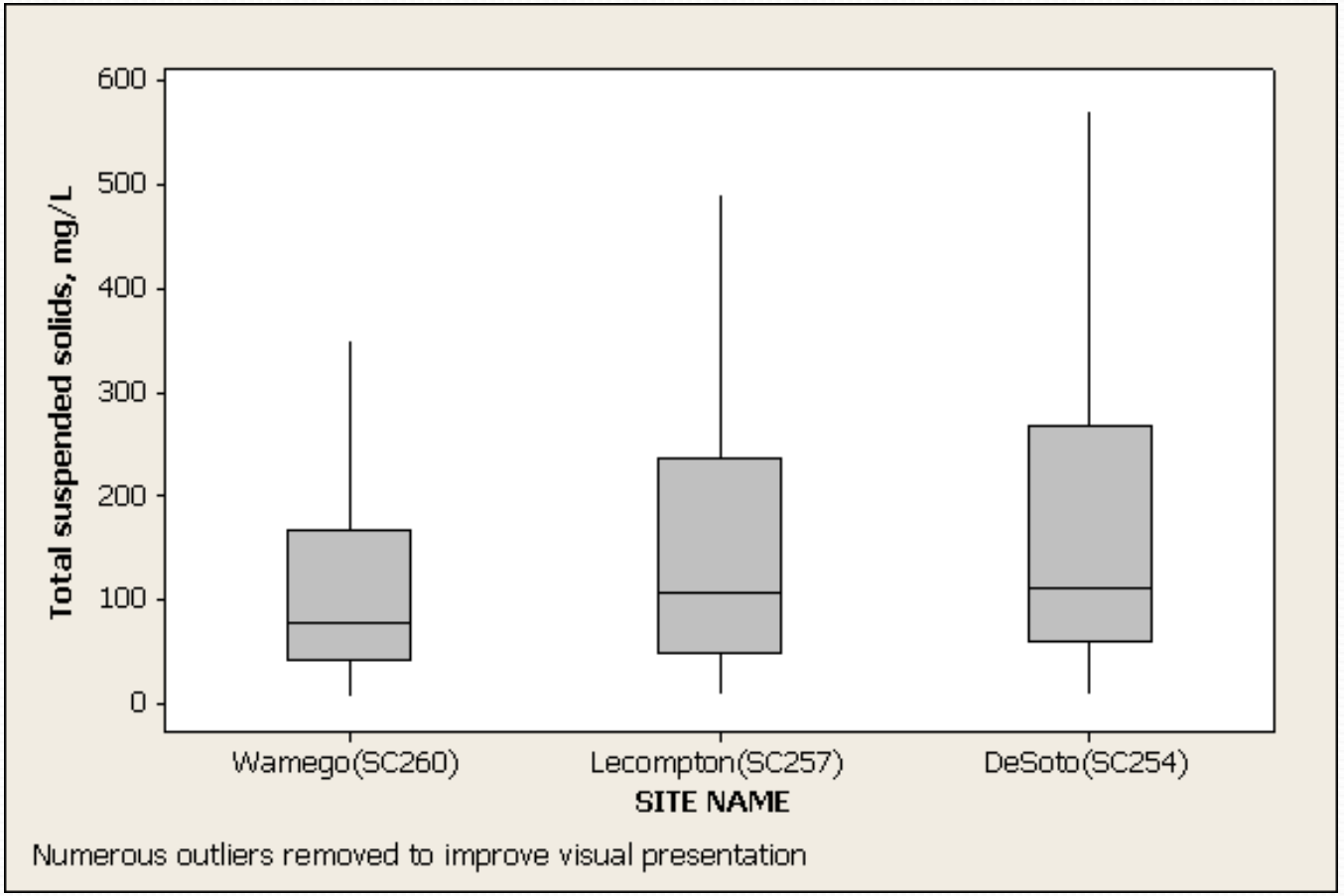
Combined: Stream Flow, Season, and Atrazine



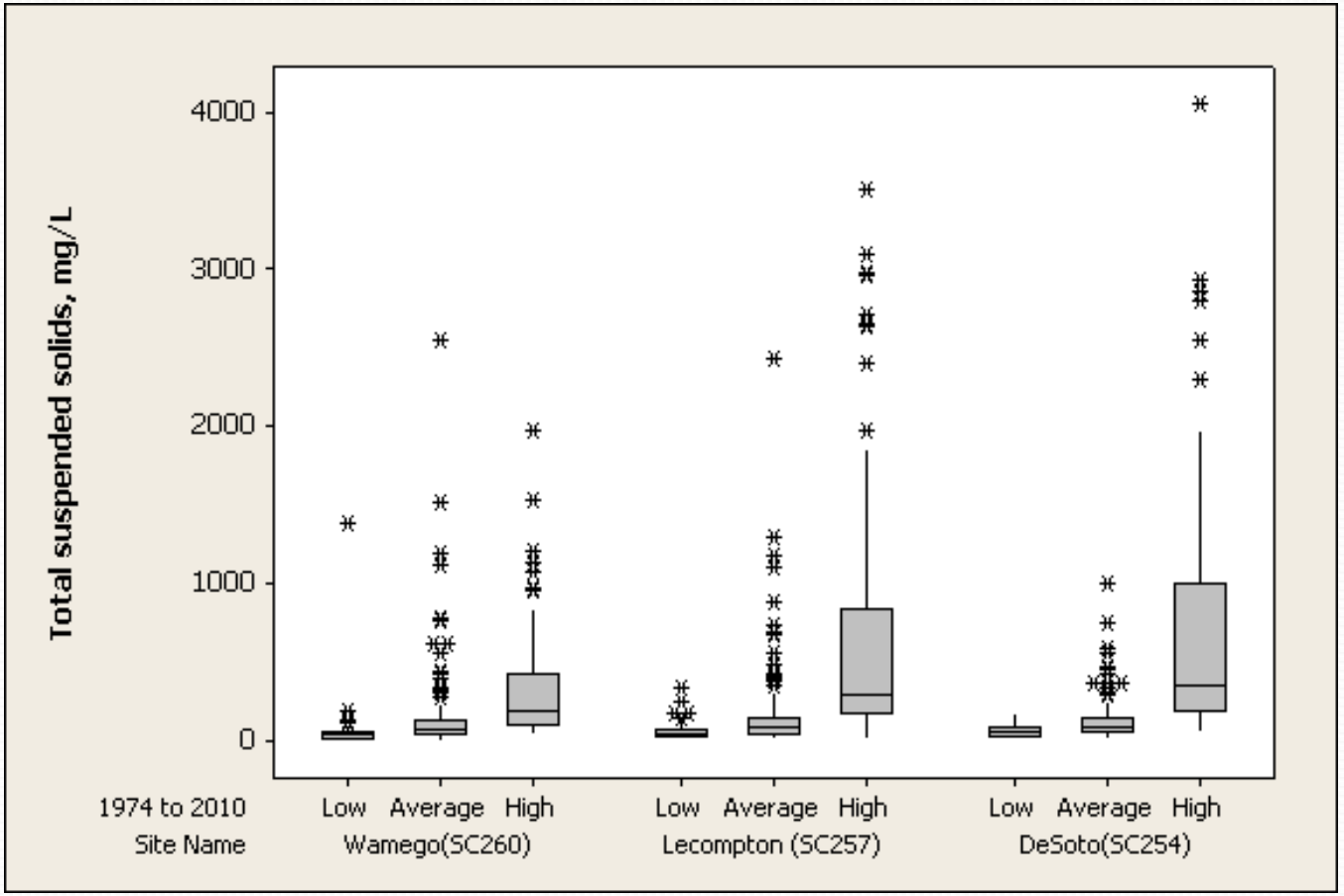
Total Suspended Solids

- Total suspended solids (TSS) are materials suspended in water such as silt, plankton, and industrial wastes.
- TSS can result from erosion from urban runoff and agricultural land, bank erosion, bottom feeders (such as carp), algae growth or wastewater discharges.

Location Variability and TSS



Stream Flow Variability and TSS



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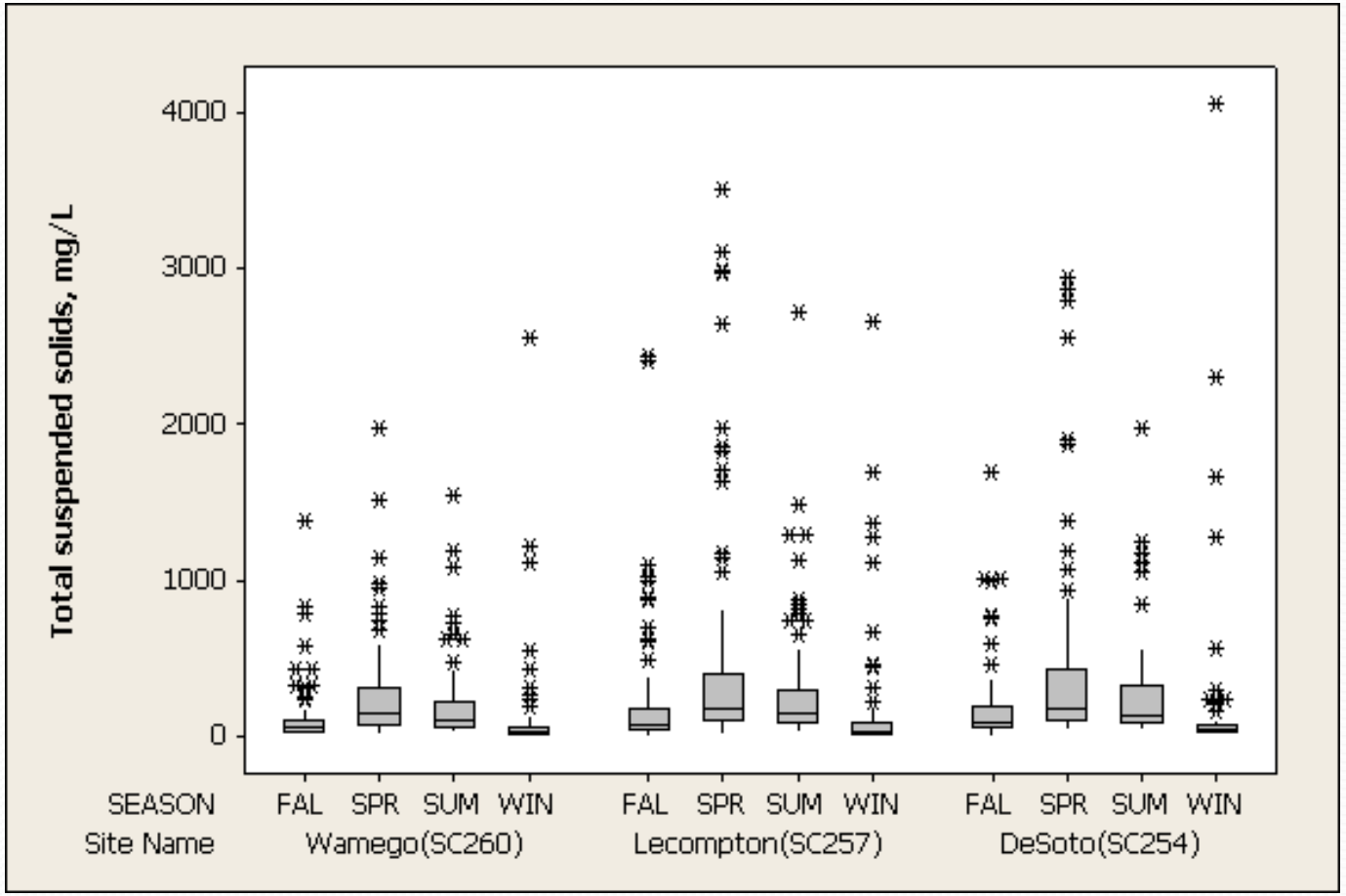
Season Variability and TSS



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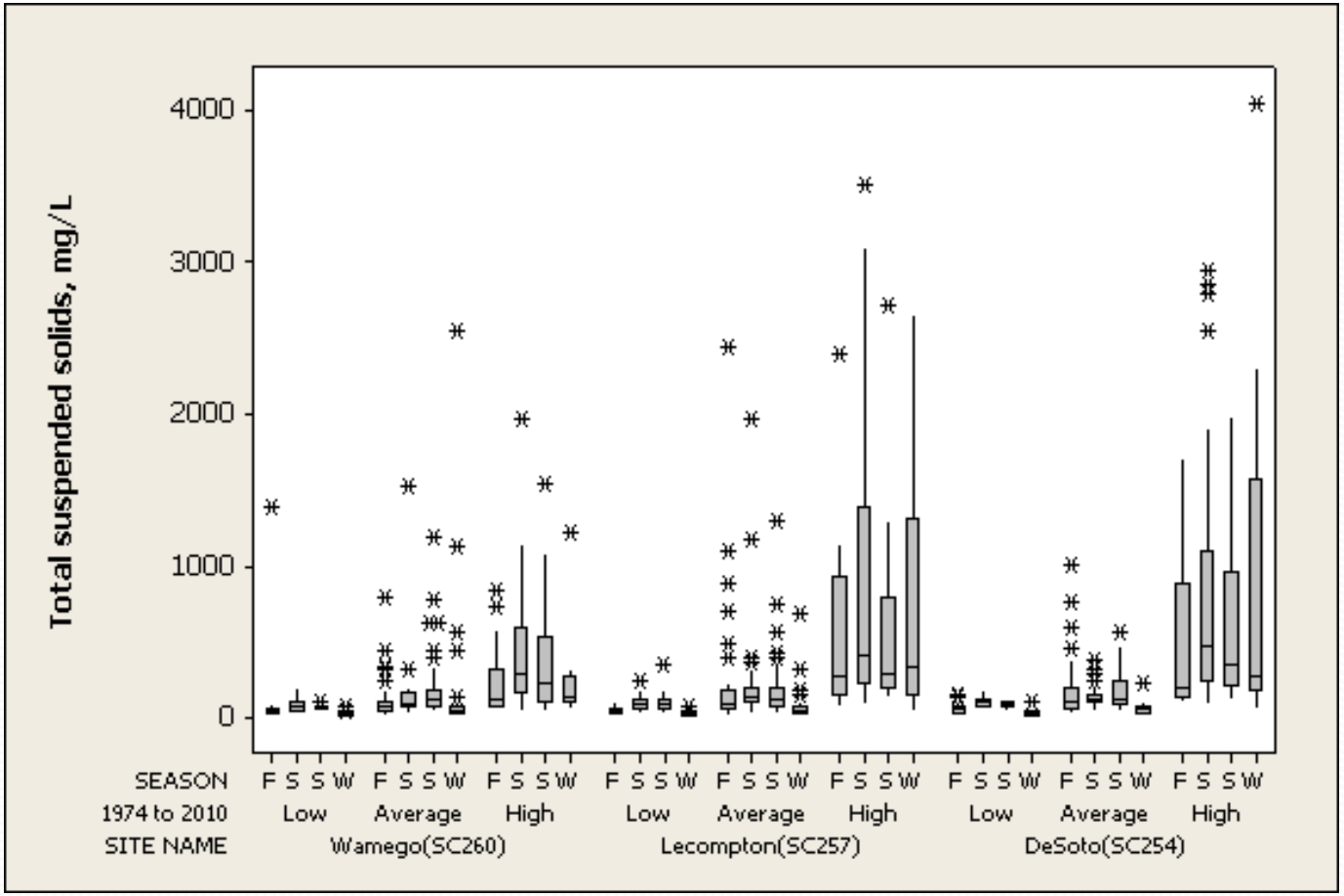
Combined: Stream Flow, Season, and TSS



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Zebra Mussel (*Dreissena polymorpha)*

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