Hampton Roads Regional Water Quality Monitoring Network

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The problem...

- Data describing urban stormwater sediment and nutrient loading rates within the Coastal Plain are lacking
- This lack of locally relevant loading rates limits the calibration of the Chesapeake Bay watershed model in these areas

The Objective

- Collect high quality nutrient and sediment data representative of the Coastal Plain

- Compute loads that can be compared to those developed for the Chesapeake Bay TMDL

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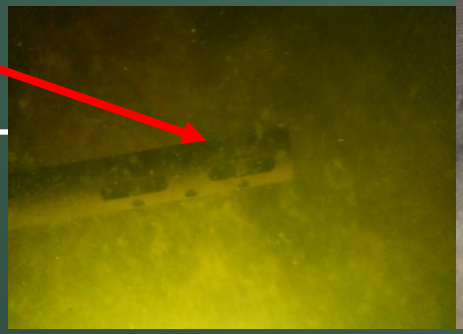
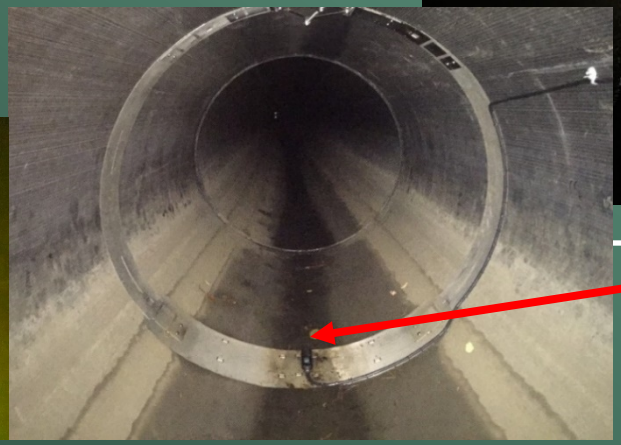
Approach: Intensive Monitoring

- Operate 12 intensive monitoring stations
- Continuous data collection (5 minute
  - Flow (level, velocity)
  - Turbidity
  - Specific Conductivity
  - Water temperature
- Nutrient and sediment sampling over r
  - Storm event sampling via autosample
    - 40-60 per site per year
  - Baseflow sampling via grab sample
    - Quarterly

Water Quality Sonde





Area-Velocity Meter

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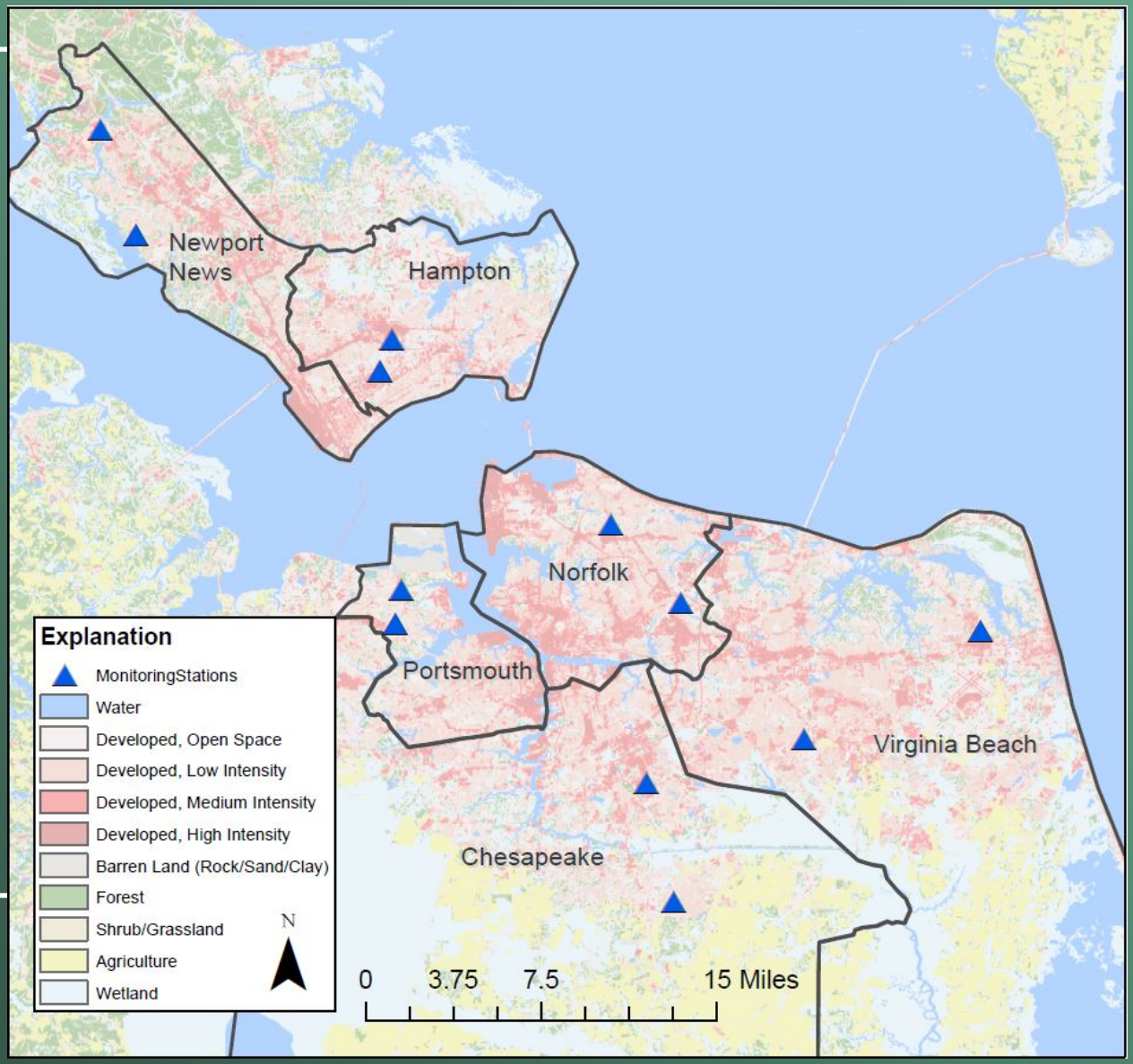
Monitoring Network

Sites represent 3 primary land use types

- **Single-family residential**
- **High-density residential**
- **Commercial & light industrial**



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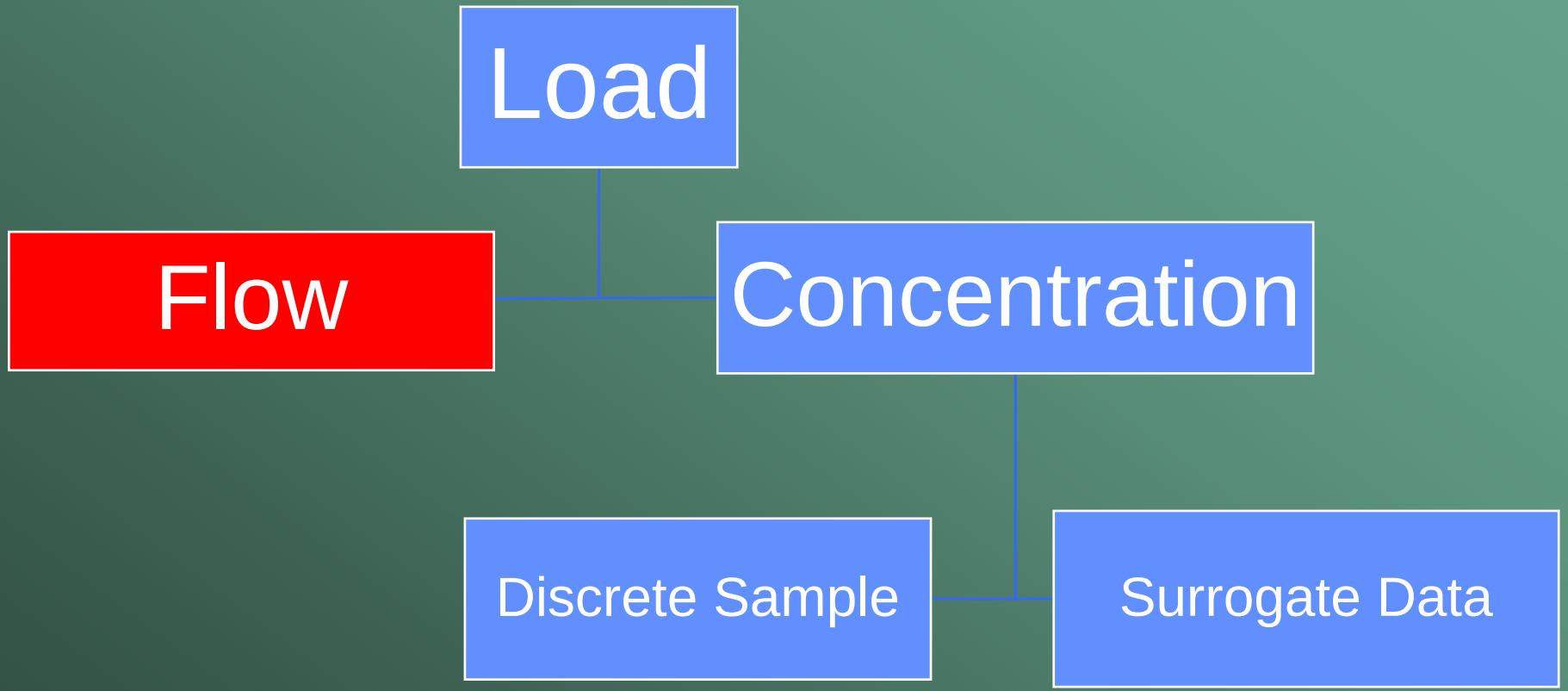
Load = Flow *x* Concentration

(Total Mass) *(Volume)* *(Mass per unit volume)*



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Load = Flow x Concentration

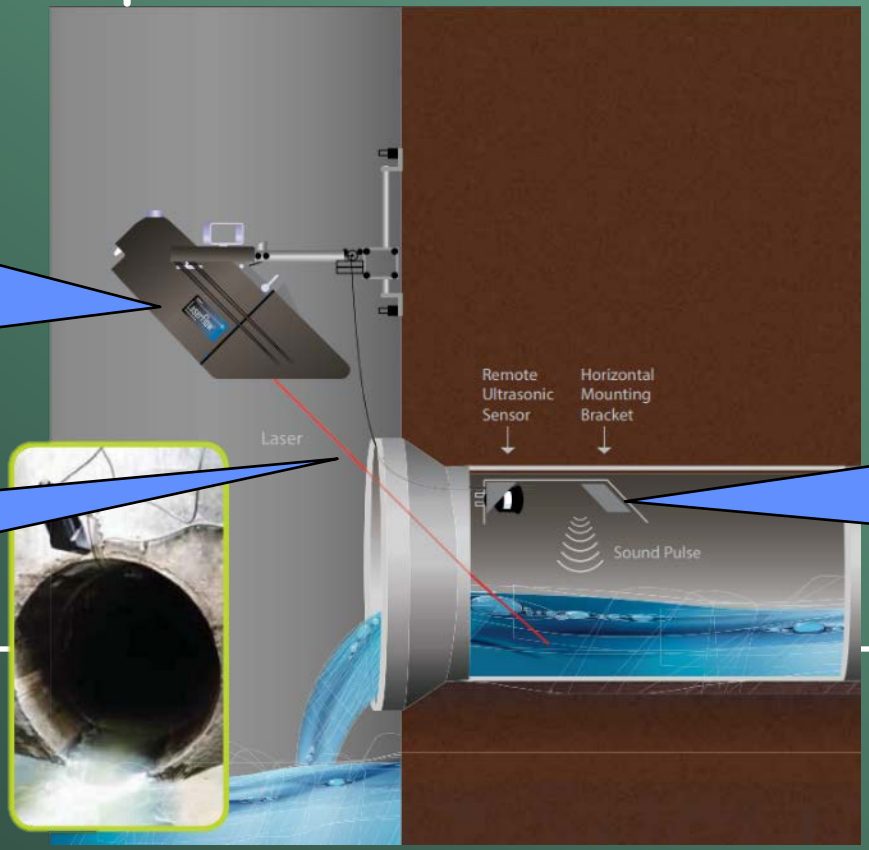
(Total Mass) *(Volume)* *(Mass per unit volume)*

In-pipe Flow Measurement

- Continuous water level, velocity, & flow
- Channels are presumed static

Computed area
(from pipe dimensions & water level)
X
Velocity

Flow



Continuous measurement of velocity

Continuous measurement of water level (stage)

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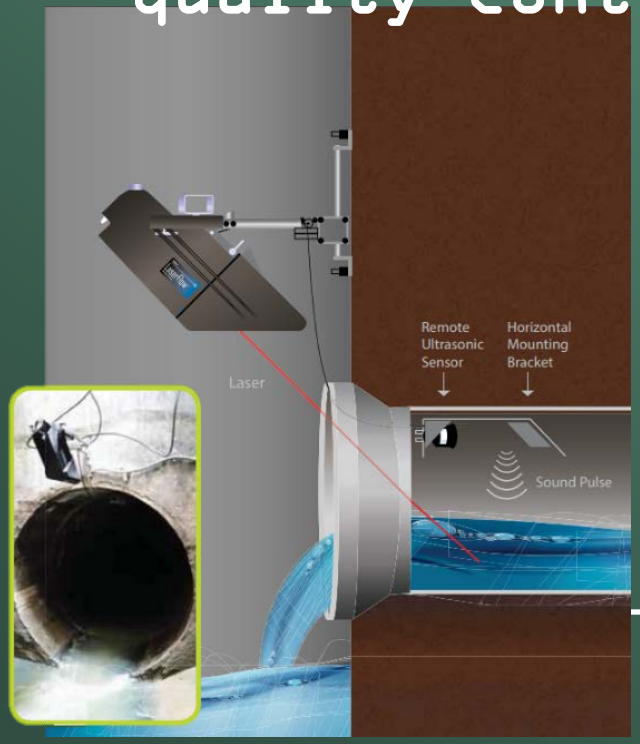
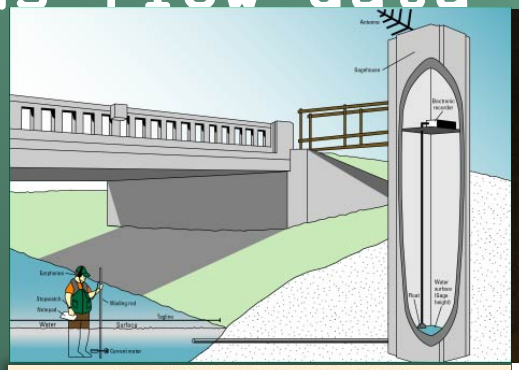
Load = Flow x Concentration

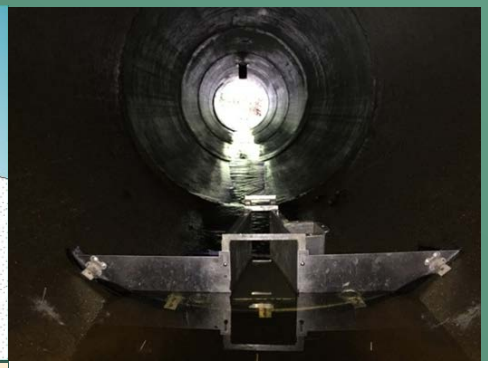
(Total Mass) *(Volume)* *(Mass per unit volume)*

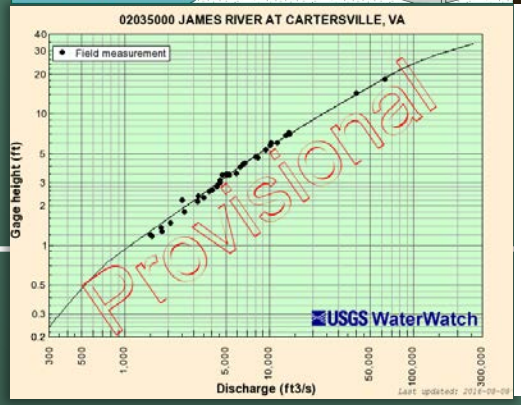
Hampton Roads Network

- Combining in-pipe measurement with streamgaging methods to generate high-quality continuous flow data







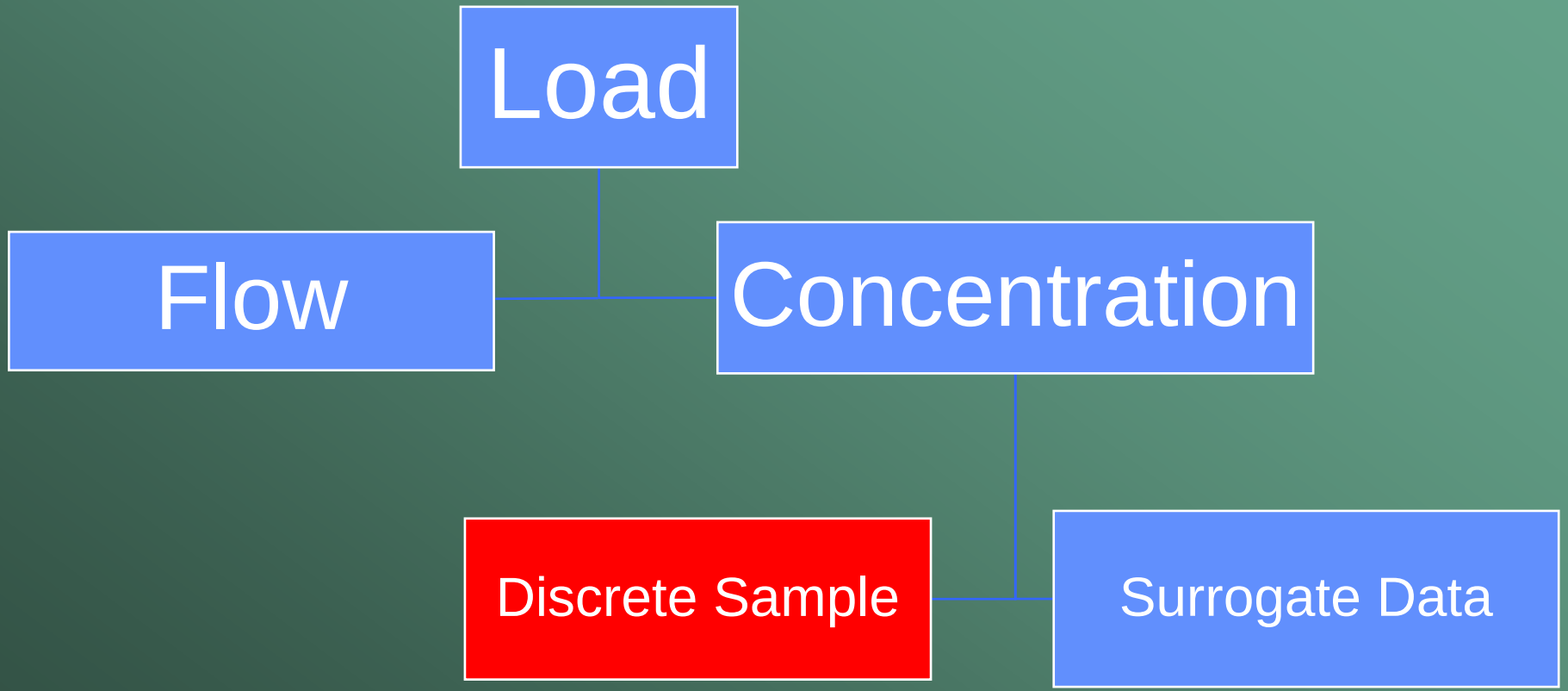


Manning's Equation

$$V = \frac{1.49}{n} R_h^{2/3} S^{1/2}$$

Load = Flow *x* Concentration

(Total Mass) *(Volume)* *(Mass per unit volume)*



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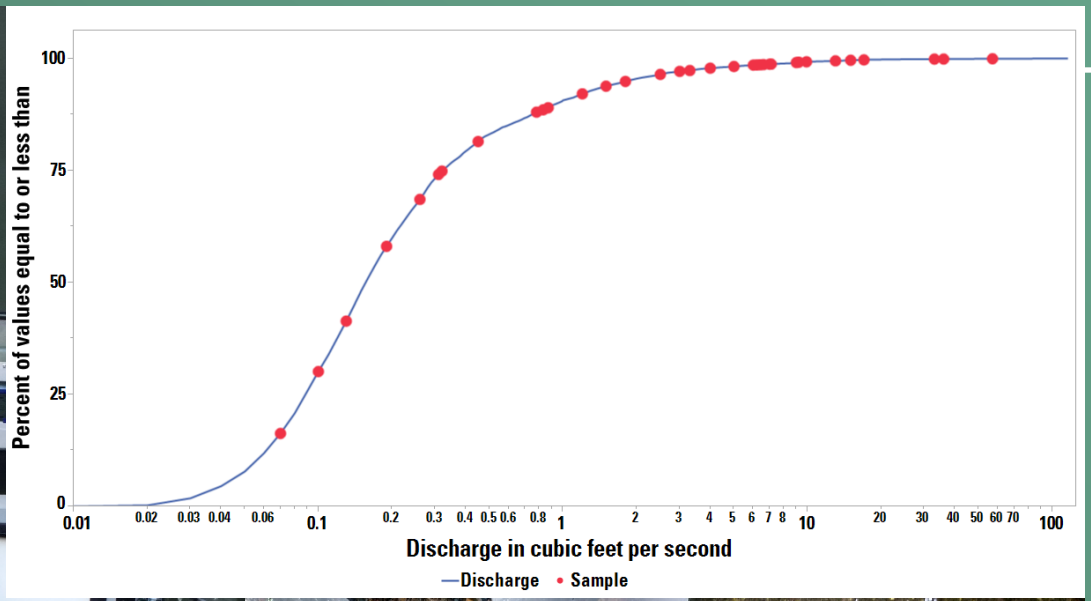
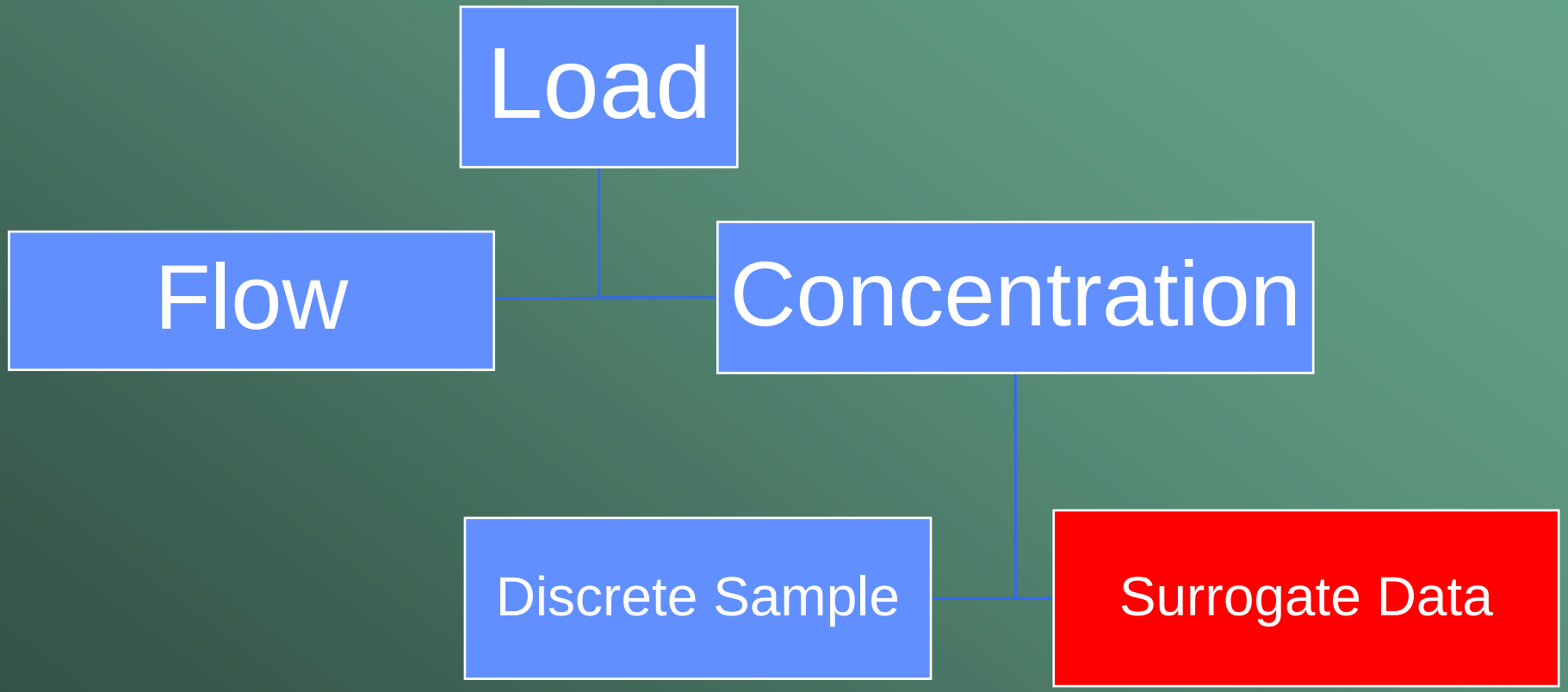
Automated Sampler



Samples analyzed for nutrients and sediment

Load = Flow *x* Concentration

(Total Mass) *(Volume)* *(Mass per unit volume)*



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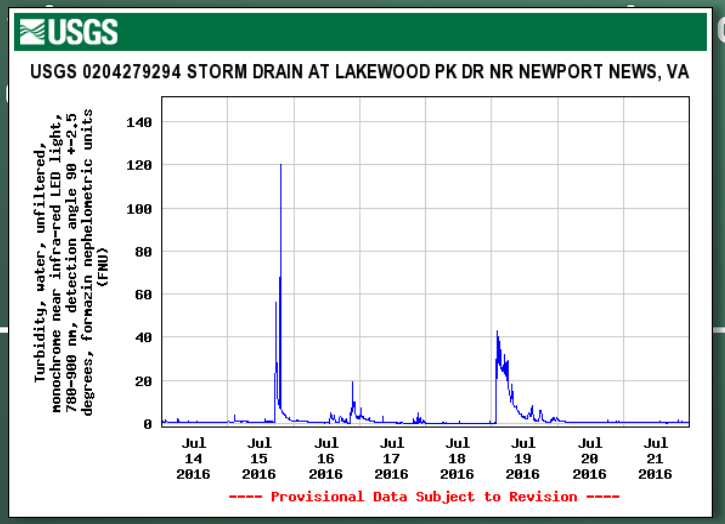
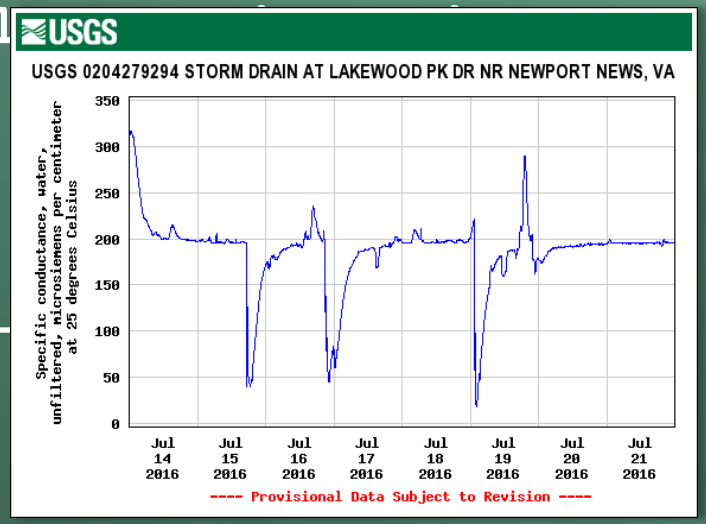
Load = Flow *x* Concentration

(Total Mass) *(Volume)* *(Mass per unit volume)*

Compute continuous concentrations

- Need continuous trace of concentration to pair with continuous flow
- Start with water quality parameters we can measure *in-situ* continuously
  - Turbidity - particulate material - i.e. Sediment
  - Speci… ol…
    Nutri…





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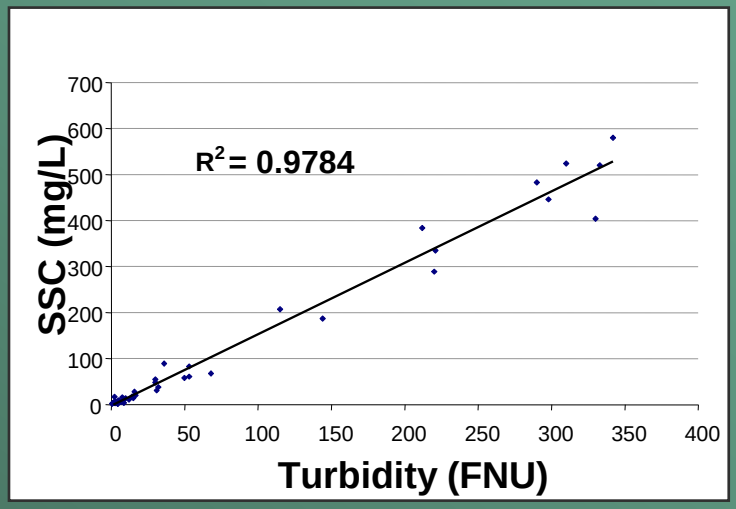
Load = Flow *x* Concentration

(Total Mass) (Volume) (Mass per unit volume)

Surrogate Approaches

for continuous concentration and load estimation

- Multivariate Regression
  - Best Subsets Regression to determine the best explanatory variables



$$SSC^{*} = f^{-1}[\hat{\beta}_0 + \hat{\beta}_1 f(turbidity) + \hat{\beta}_j f(x_j) \ldots \hat{\beta}_k f(x_k) + \varepsilon]$$

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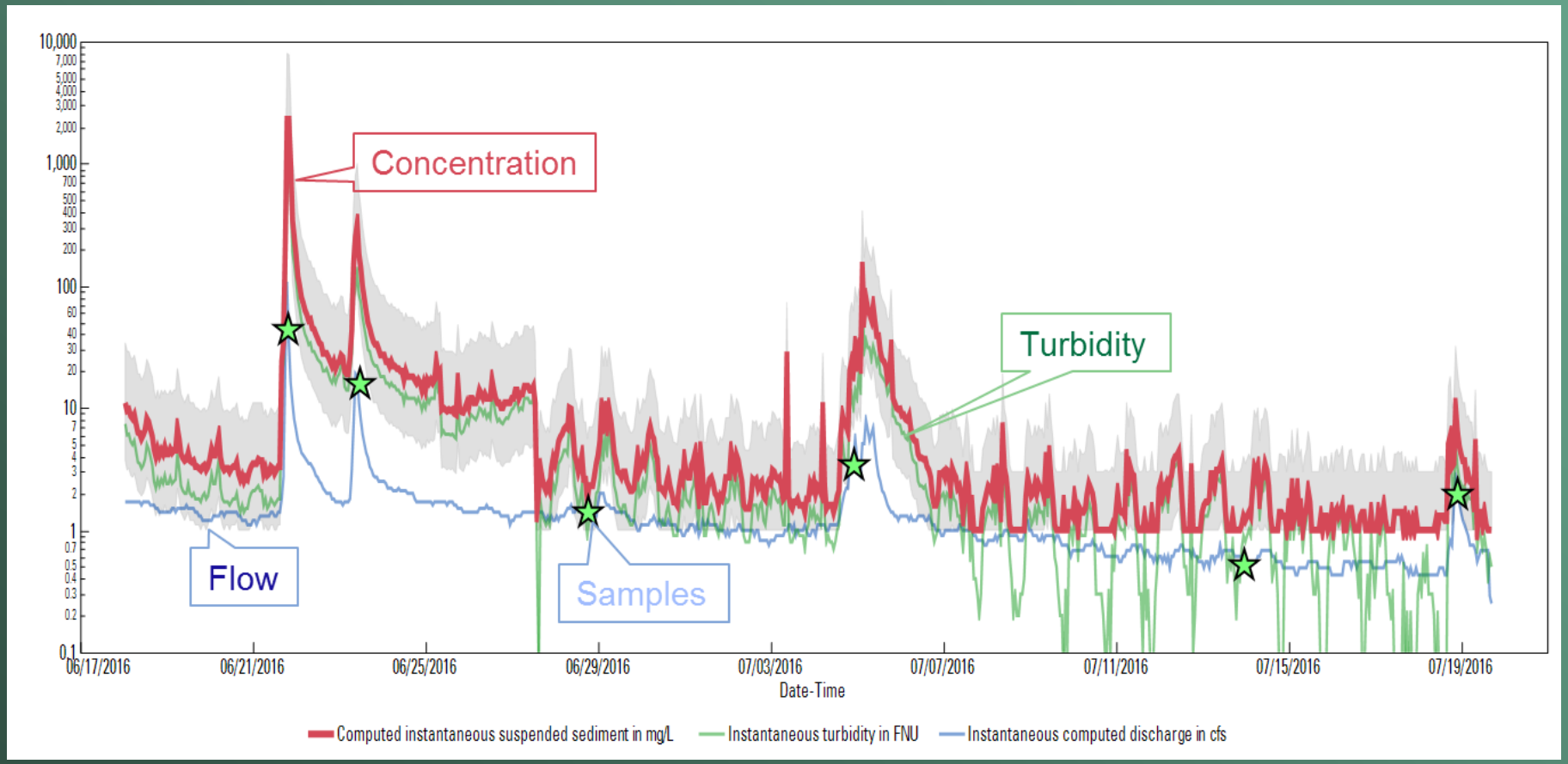
* Applies for sediment, nutrients, and other constituents of interest

Load = Flow x Concentration

(Total Mass) *(Volume)* *(Mass per unit volume)*



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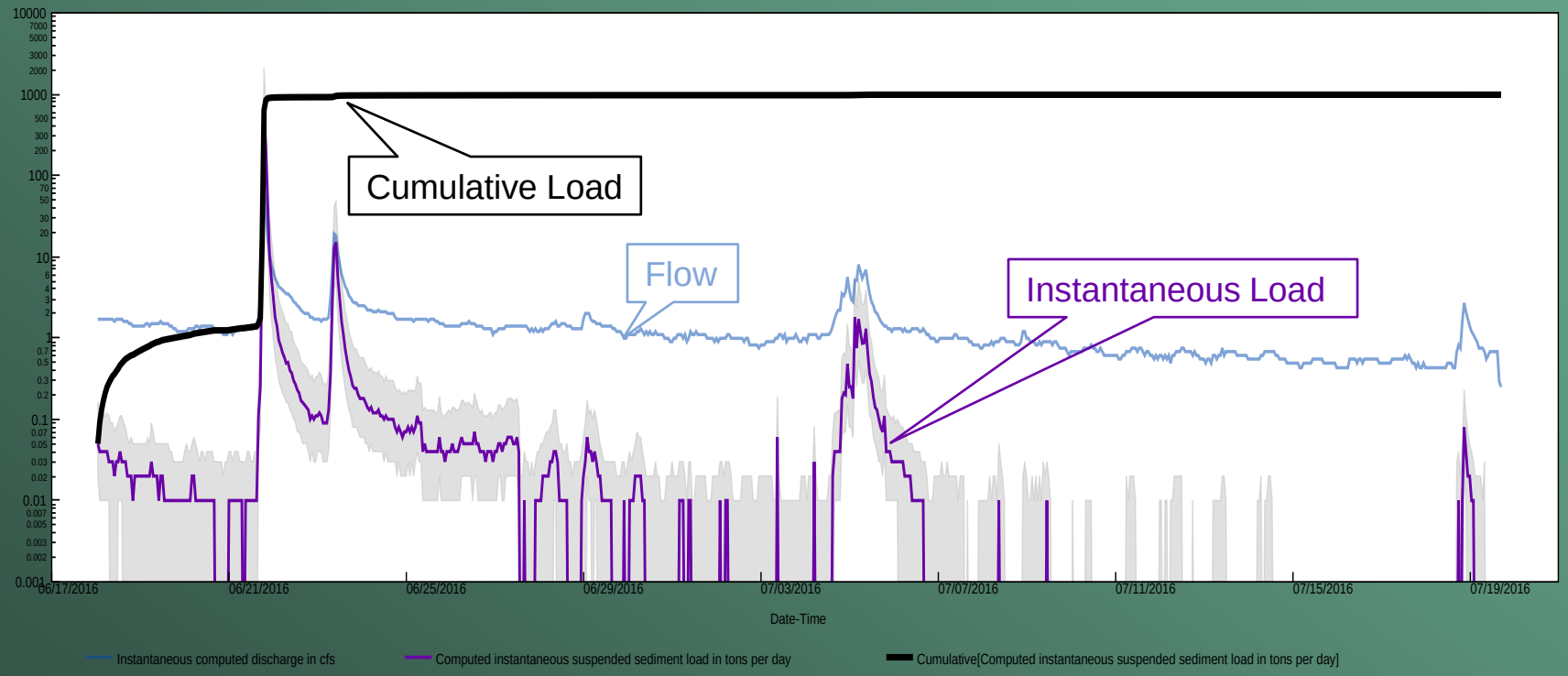
Compute Loads and Yields



Daily, Monthly, or Annual Loads

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★ Data Rich Approach

Why we compute loads?

- Quantify load/yield variability between land use types (density of development)
- Compare to loads generated for the Chesapeake Bay TMDL
- Assess the effectiveness of BMPs
- Help our cooperators make informed and effective stormwater management decisions

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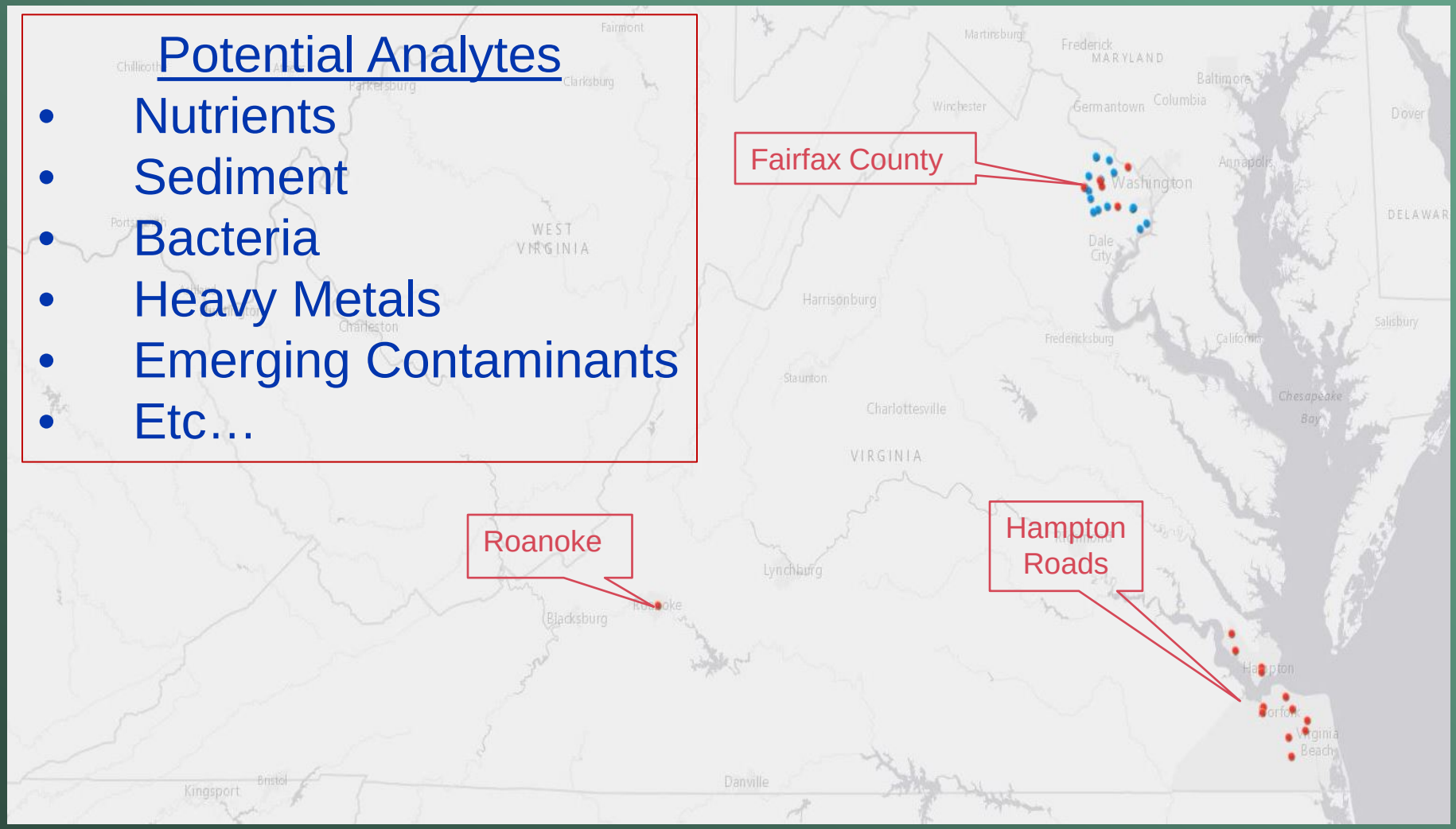
Statewide: Urban Stormwater Monitoring Network



Questions???

USGS science for a changing world

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