Where do ammonia and other nutrients in the Delaware Estuary originate, and how do we know?

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Manager, Water Quality Assessment

and

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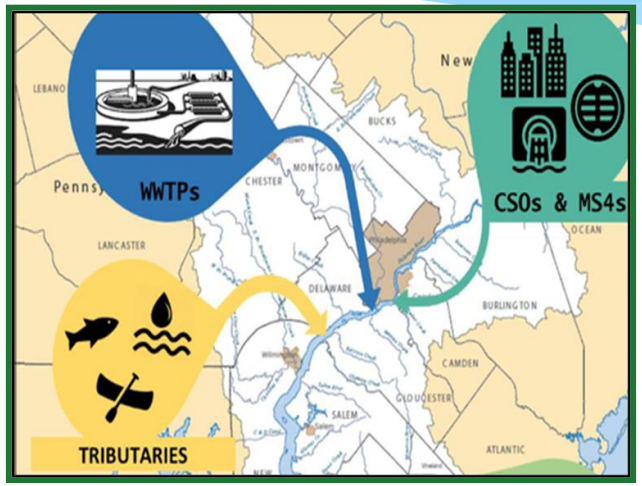
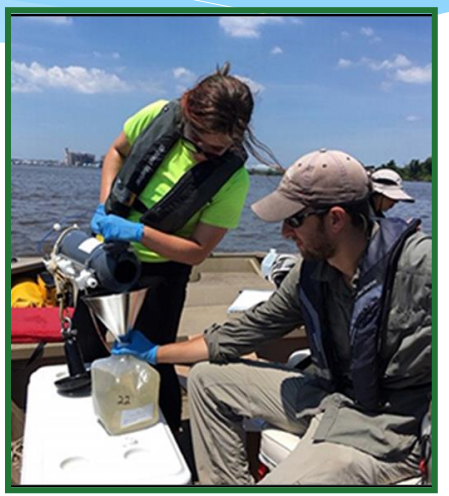
Water Resource Scientist

Delaware River Basin Commission





Partnership for the Delaware Estuary Science and Environmental Summit

January 30, 2023

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Monitoring in Support of Aquatic Life Uses

- Point discharge nutrient monitoring (1st round) (2011 – 2015)
- Ferry Monitoring Flux Study (2013)
- Primary productivity studies (2014 & 2018, 2019)
- Winter Ammonia Study (2016)
- Expanded tributary nutrient monitoring (2016-2020)
- Expanded ambient nutrient monitoring (2017-2020)
- Addition of salinity monitors to tidal boundaries (Lewes, DE and C&D Canal) (2017-Present)
- Continuous real-time nitrate spectral analyzers (2017-Present)
- Ichthyoplankton Survey Augmentation (2018)
- Light attenuation & CDOM studies (2018-2019)
- Point discharge nutrient monitoring (model calibration period) (2018-2019)
- Algal speciation studies (2018-2019)

Focus on Ammonia

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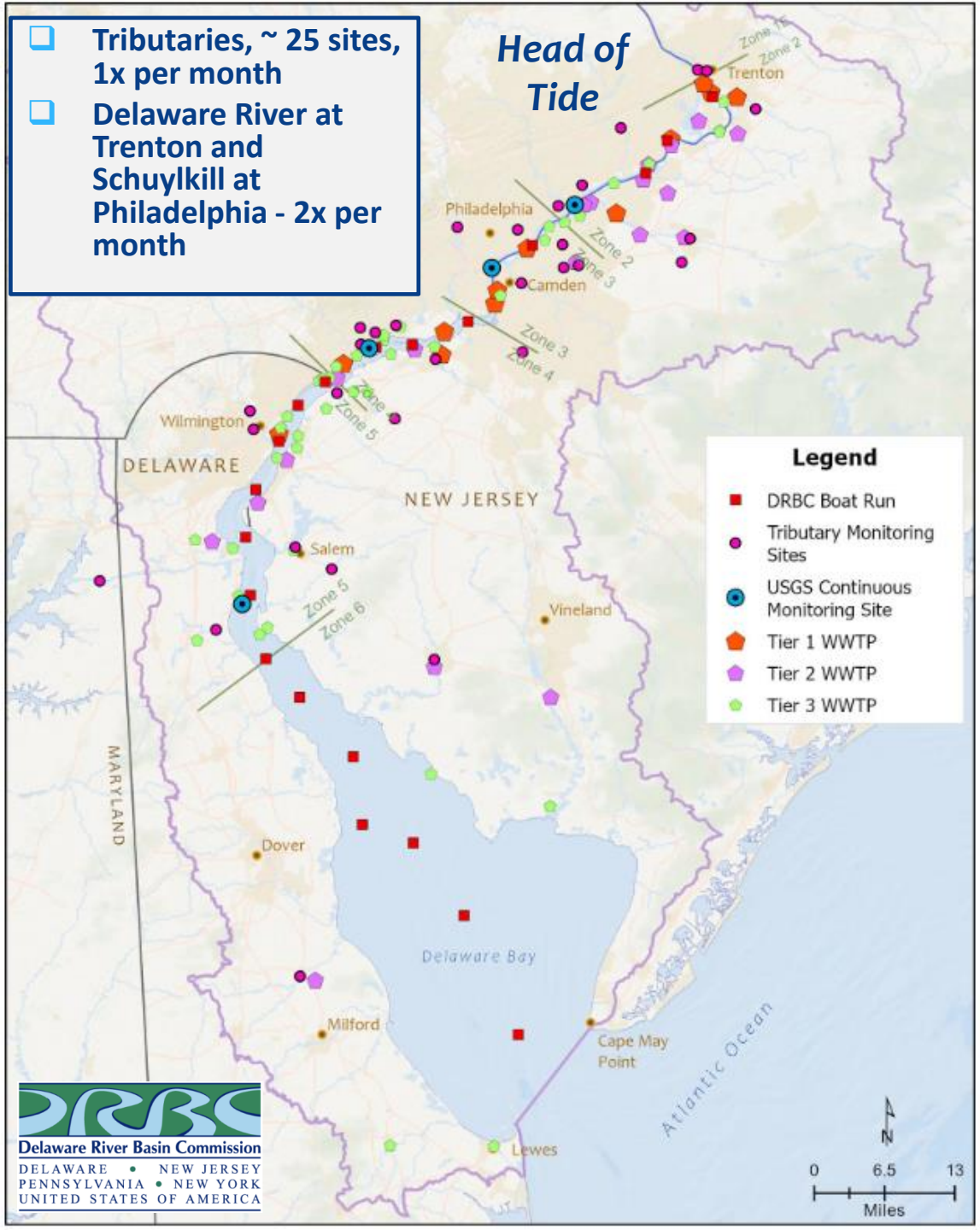
- Tributaries, ~ 25 sites, 1x per month
- Delaware River at Trenton and Schuylkill at Philadelphia - 2x per month



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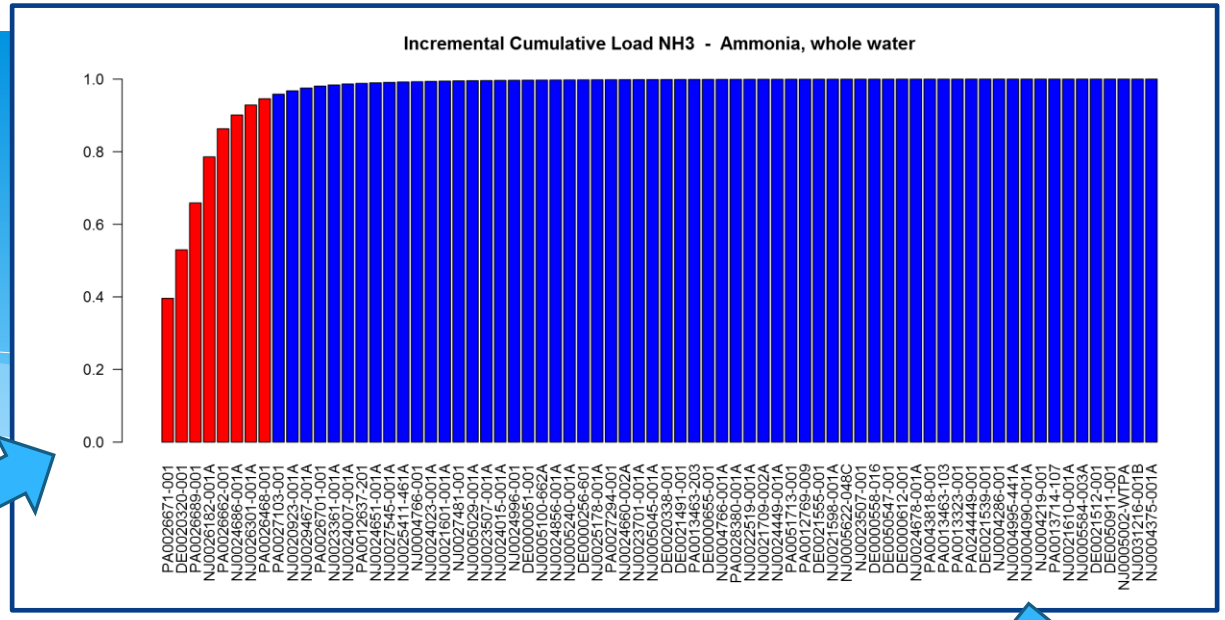
DRBC initiated extensive monitoring during the 2018-2019 eutrophication model calibration period

Analytical Parameter	Units	Filtration	Sample Type
Total Phosphorus (TP)	mg/L as P	Unfiltered	24-hour composite
Total Kjeldahl Nitrogen (TKN)	mg/L as N	Unfiltered	24-hour composite
Nitrate Nitrogen (NO3-N)	mg/L as N	Unfiltered	24-hour composite
Nitrite Nitrogen (NO2-N)	mg/L as N	Unfiltered	24-hour composite
20-day Biochemical Oxygen Demand (BOD_{20})	mg/L	Unfiltered	24-hour composite
5-day Carbonaceous Biochemical Oxygen Demand ($CBOD_5$)*	mg/L	Unfiltered	24-hour composite
Chemical Oxygen Demand (COD)	mg/L	Unfiltered	24-hour composite
Total Organic Carbon (TOC)	mg/L	Unfiltered	24-hour composite
Dissolved Organic Carbon (DOC)*	mg/L	0.45 µm filter	24-hour composite
Total Suspended Solids (TSS)	mg/L	Unfiltered	24-hour composite
Soluble Reactive Phosphorus (SRP)	mg/L as P	0.45 µm filter	24-hour composite
Ammonia Nitrogen (NH3-N)	mg/L as N	0.45 µm filter	24-hour composite
Discharge Flow	MGD	N/A	daily average
Water Temperature	°C	N/A	24-hour mean
Dissolved Oxygen	mg/L	N/A	24-hour mean
pH	1-14 S.U.	N/A	24-hour mean
Specific Conductance or TDS	µS/cm or mg/L	N/A	24-hour mean

Two Rounds of Point Discharge Nutrient Monitoring

First Round (2011-2015)

- Facilities < 1 MGD: quarterly for 2 years (28 facilities)
- Facilities > 1 MGD: monthly for 2 years (55 facilities) for:
  - BOD5, CBOD5, BOD20
  - Ammonia, Nitrite, Nitrate, TKN, SKN
  - TP, SRP
  - Discharge flow (Q), temperature, DO, Conductivity, pH
  - Ultimate BOD (UBOD) by the 21 discharges with largest BOD loads twice (1 summer, 1 winter)



Model Calibration Period

- Weekly for Tier 1 (Top 12)
- Monthly for Tier 2 (Next 20)
  - COD, TOC, DOC, CBOD5
  - Ammonia, Nitrite, Nitrate, TKN, SKN
  - TP, SRP
  - TSS, TDS or conductivity
  - In-situ DO, pH, and temperature
- Daily discharge

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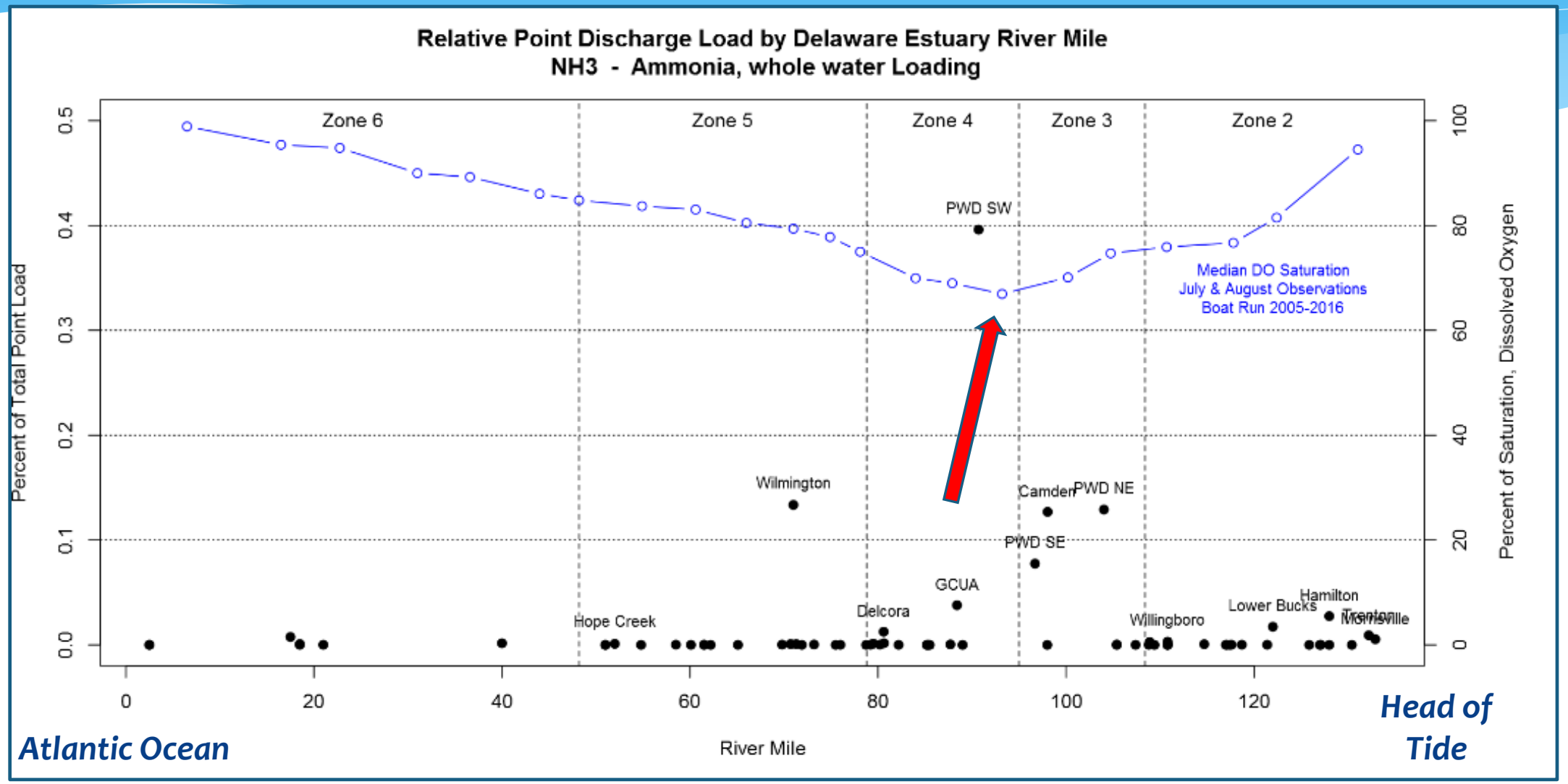
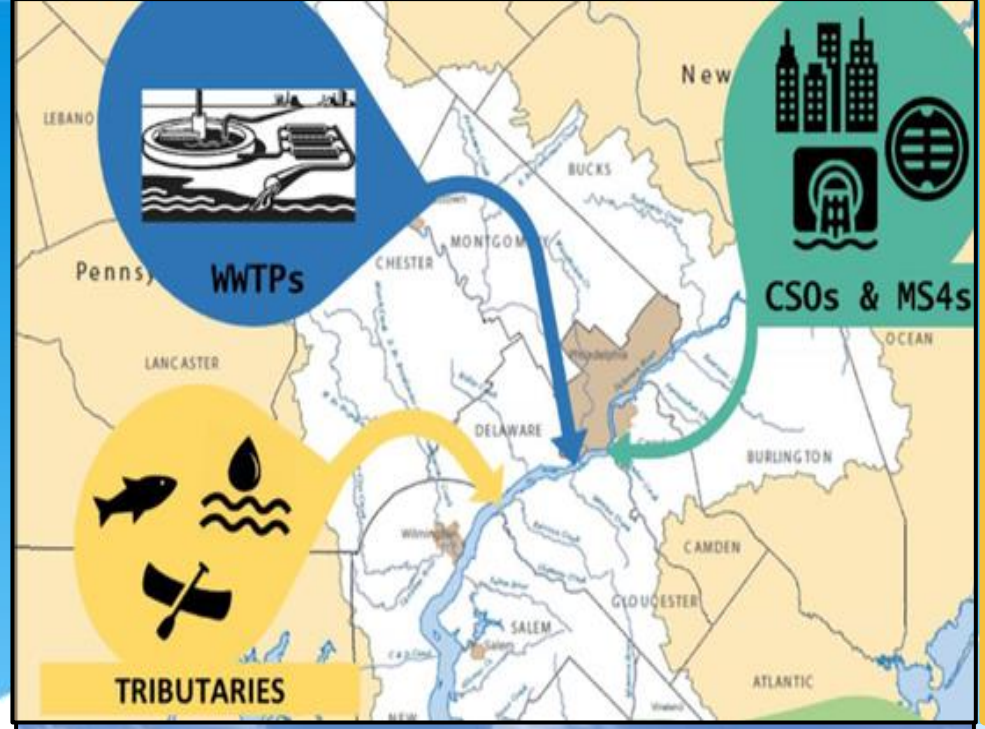
DO Sag Co-Located with Highest Ammonia Point Discharge Loads





Where do ammonia and other nutrients originate in the Delaware Estuary?

How do we know?

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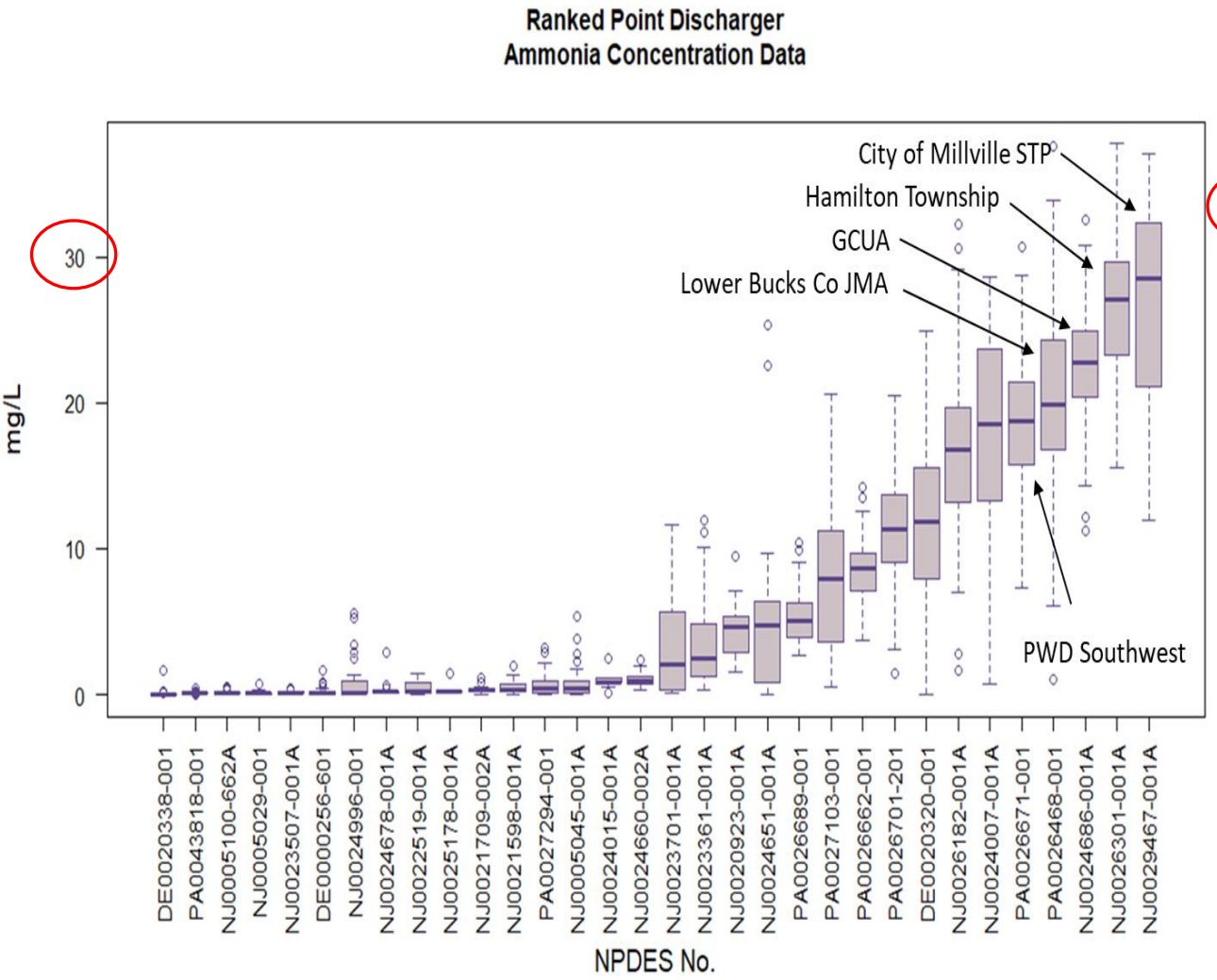
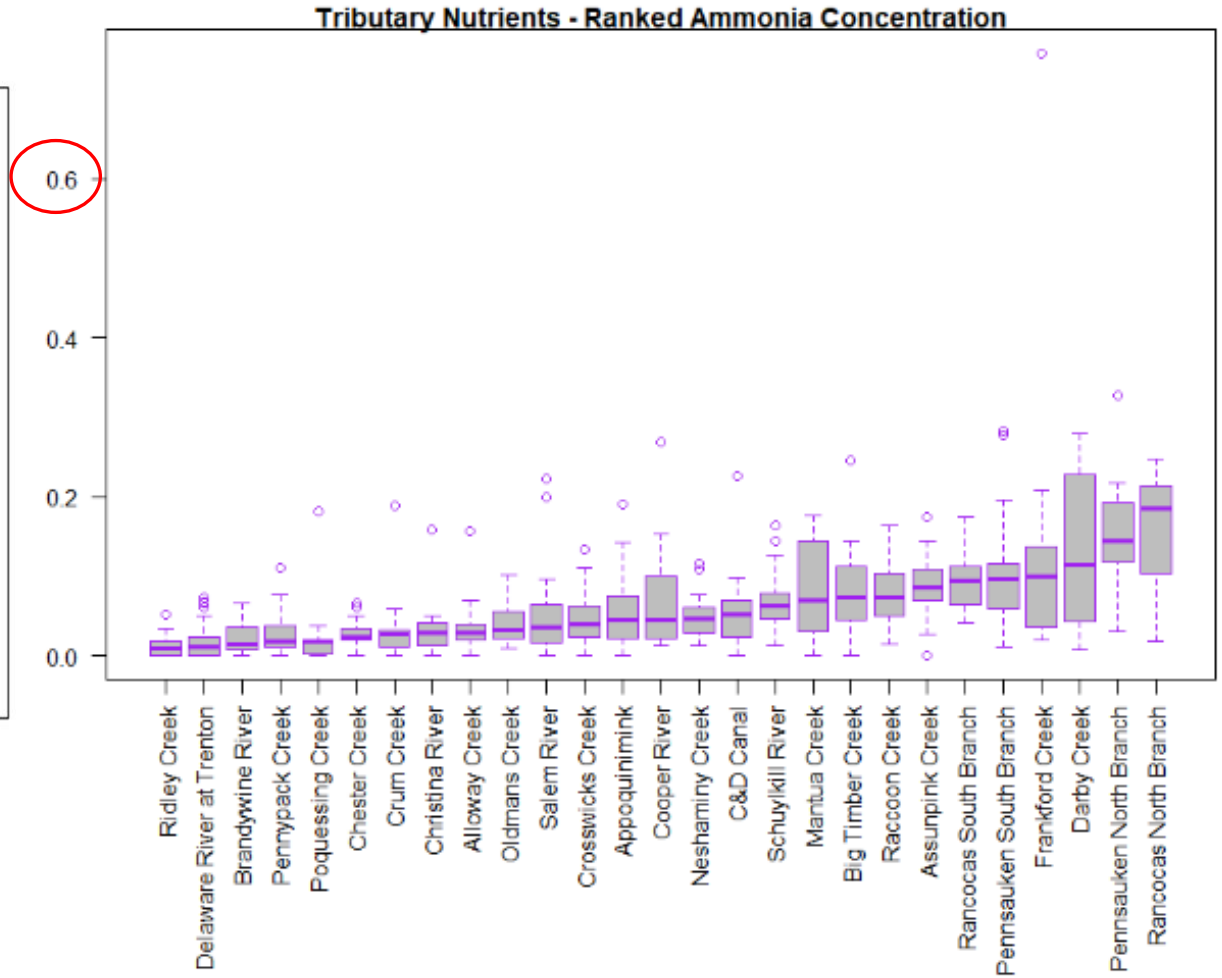
Ammonia concentrations: point-discharges and tributaries





Loading of ammonia from point-discharges compared to the largest freshwater inflows of the Delaware Estuary

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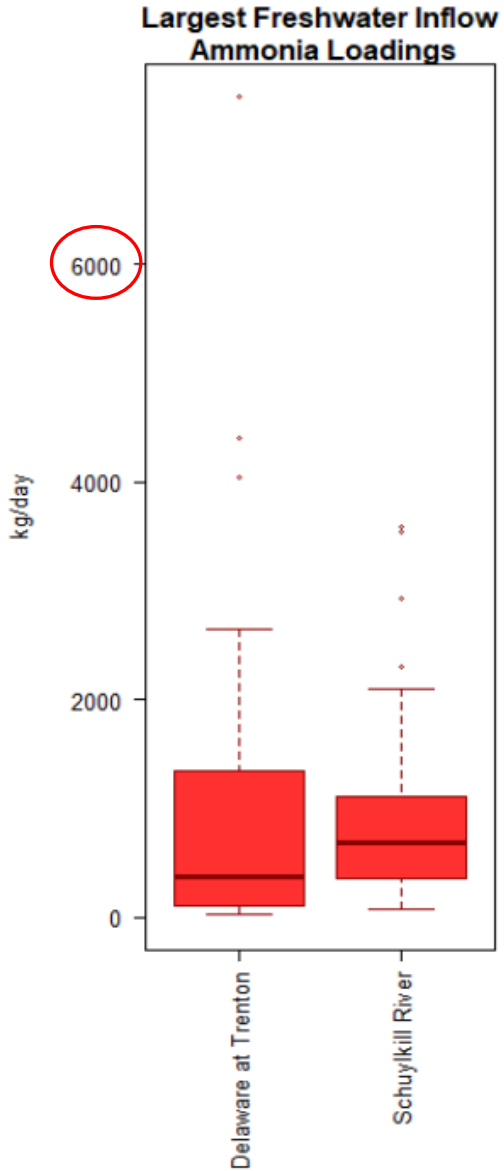
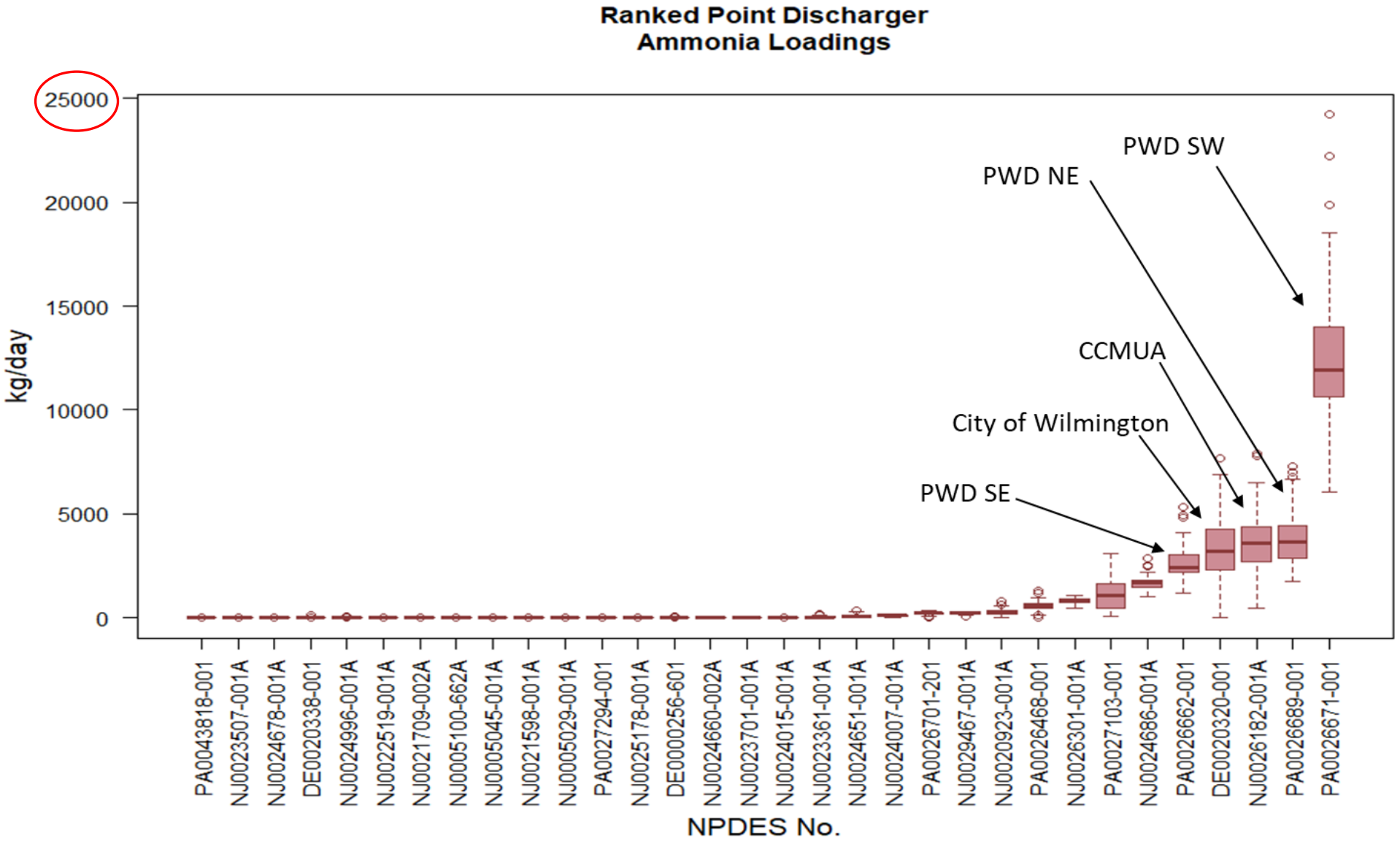
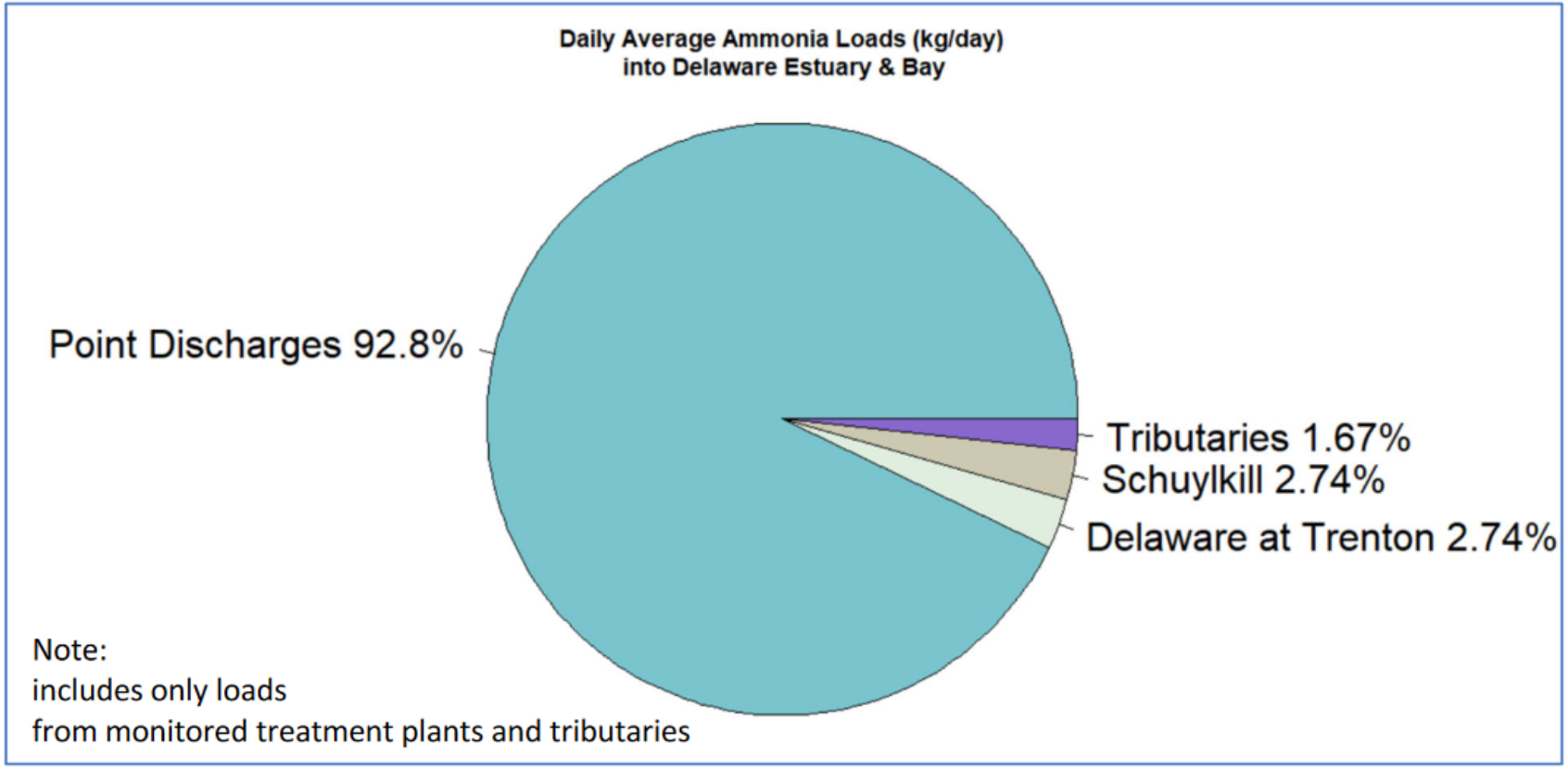
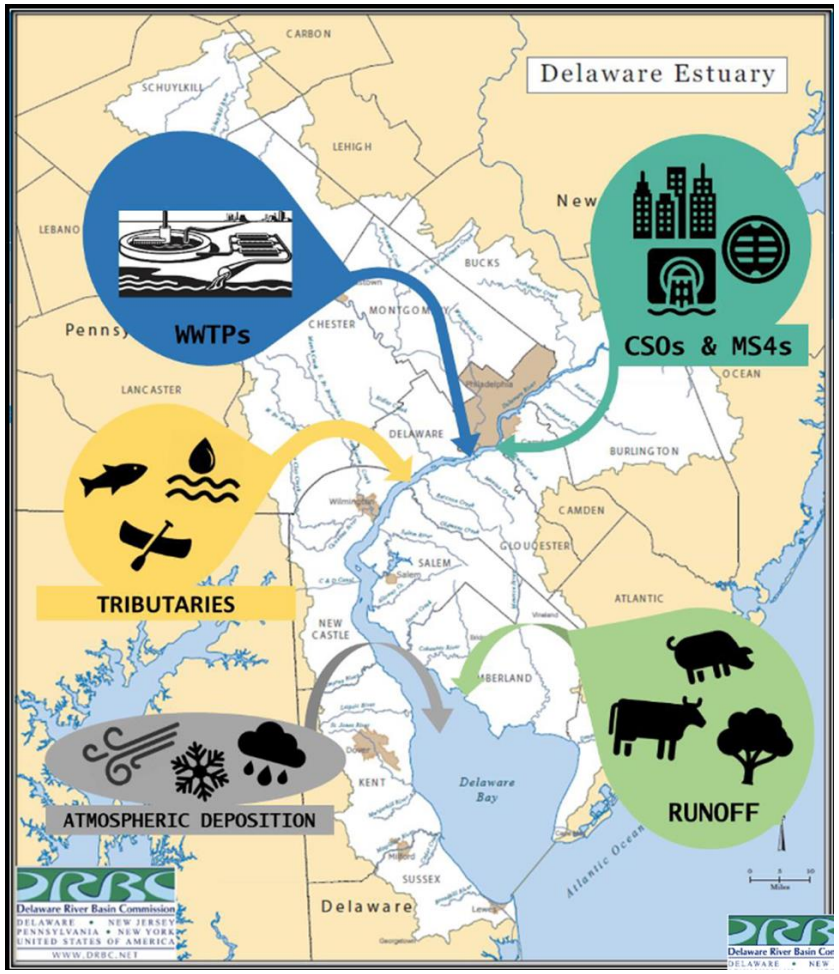
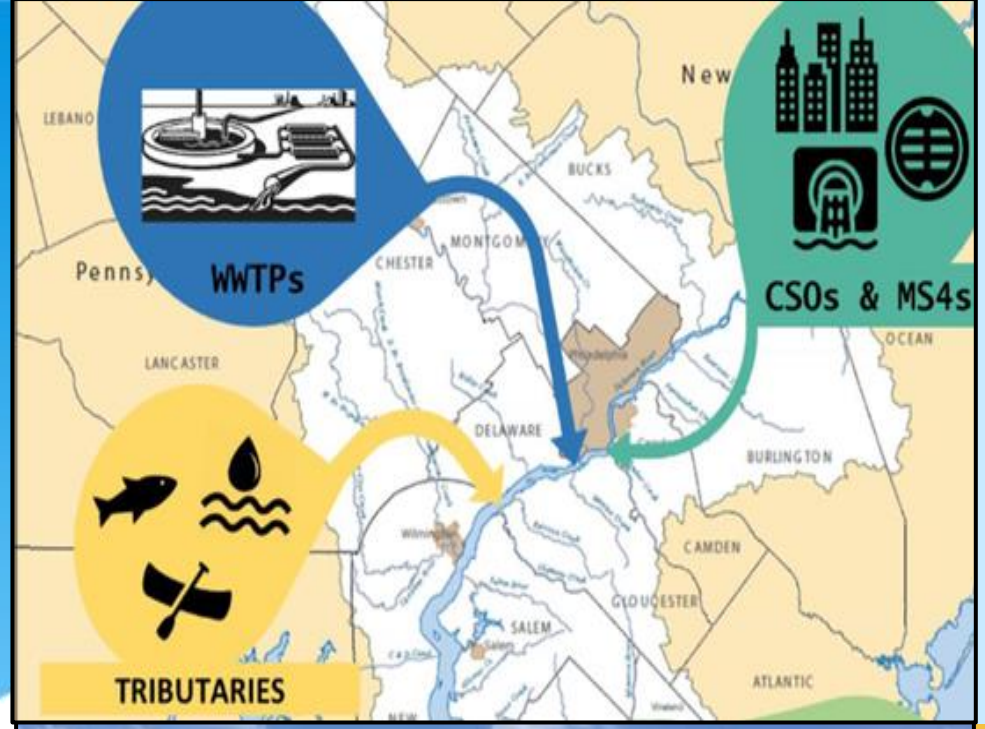




Load characterization:
Most Ammonia from Point Discharges (>90%)



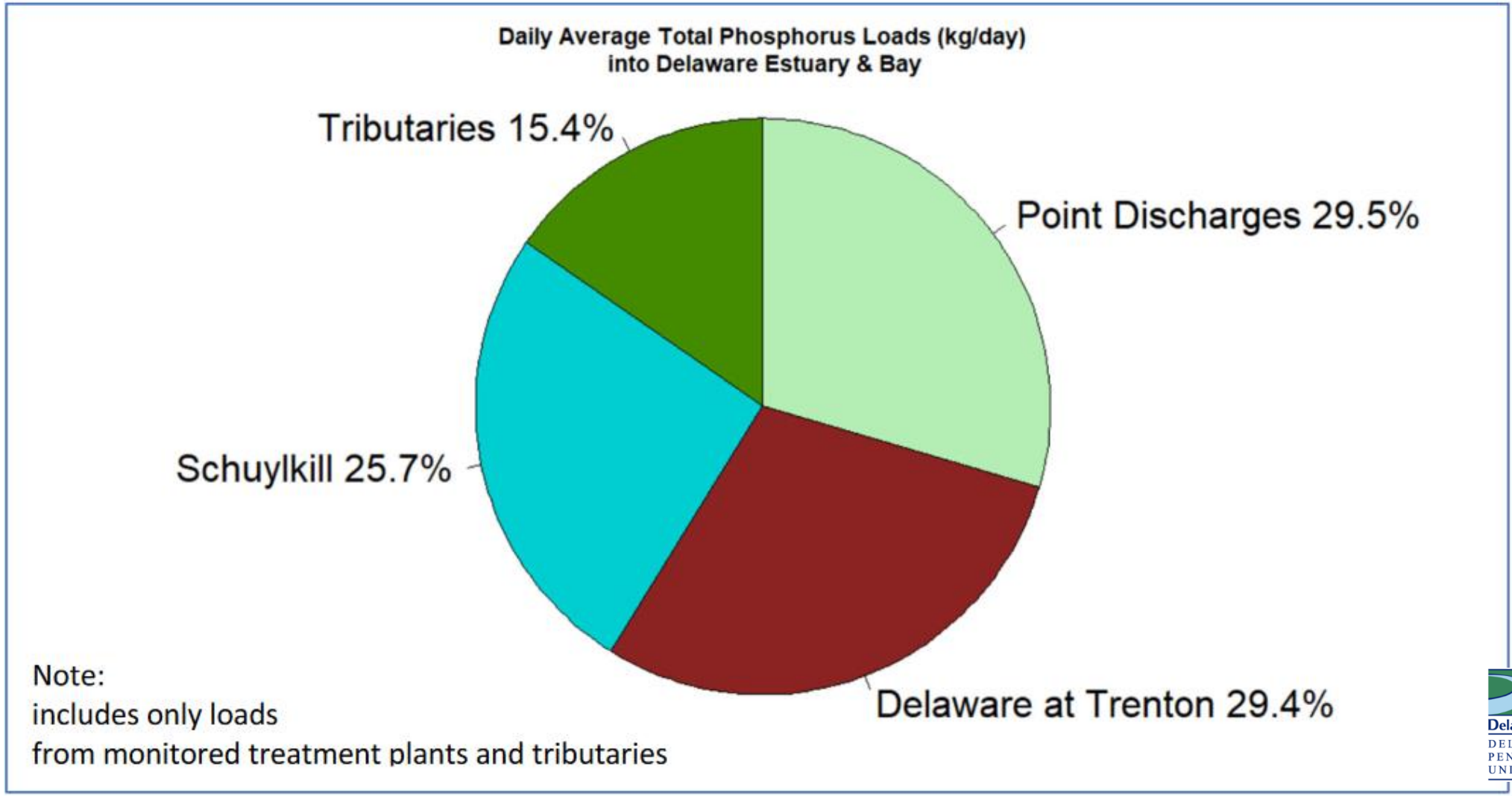




Wastewater treatment facilities account for **more than 90%** of ammonia inputs to the Delaware Estuary

DRBC characterized loads based on **actual measurements** of **32 point-discharge facilities** and **27 tributaries** during the 2018-2019 eutrophication model calibration period

Total phosphorus loads to the Delaware Estuary are not as drastically split between point-discharges and tributaries



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Improving Dissolved Oxygen and Aquatic Life Uses in the Delaware River Estuary

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Topic	Presenter
Why are we here?	Steve Tambini
How did DRBC address low dissolved oxygen in the Delaware Estuary - then and now?	Namsoo Suk
Where do ammonia and other nutrients in the Delaware Estuary originate, and how do we know?	John Yagecic
What is this estuary-wide eutrophication model and why do we need it?	**Li Zheng**
What matters and what doesn't with regard to low dissolved oxygen events in the Delaware Estuary?	Fanghui Chen
What combination of wastewater improvements will achieve the best dissolved oxygen outcome in the Delaware Estuary?	Sarah Beganskas
What is the highest attainable dissolved oxygen condition in the Delaware Estuary, and what will it mean for aquatic life uses?	Thomas Amidon
Q&A Panel: Enhancing support for aquatic life uses in the Delaware Estuary	**All**