

# **Point-Source Nutrient Loads to Streams using the Point-Source Load Estimation Tool (PSLoadEsT)**

**Kenneth Skinner  
Lily Gorman Sanisaca**

# Point-Source Loads/PSLoadEsT

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- **Background / differences from previous methods/study**
  - Loading program (SAS to R/Access)
  - Wastewater Treatment facility – treatment level
  - Variable Typical Pollutant Concentration (TPC) definition
- **PSLoadEsT**
- **TPC vs actual measurements**
- **Total Nitrogen and Total Phosphorus Loads**
- **Products/results: two reports, data, and software**

# Previous work

- Calculated annual total nitrogen (TN) and total phosphorus (TP) loads to streams from municipal and industrial facilities for 1992, 1997, and 2002.
- Developed typical pollutant concentrations (TPCs) to account for missing nutrient concentrations
- Produced for input to SPARROW models



## Methods for Estimating Annual Wastewater Nutrient Loads in the Southeastern United States

Open-File Report 2007–1040

By Gerard McMahon<sup>1</sup>, Larinda Tervelt<sup>2</sup>, and William Donehoo<sup>2</sup>



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October 2011

## NUTRIENT LOADINGS TO STREAMS OF THE CONTINENTAL UNITED STATES FROM MUNICIPAL AND INDUSTRIAL EFFLUENT<sup>1</sup>

*Molly A. Maupin and Tamara Ivahnenko<sup>2</sup>*

# SPARROW modeling: Estimating nutrient, sediment, and dissolved solids transport



## NEW RELEASE: Point Source Load Estimation Tool



Access software for annual wastewater nutrient data preparation and load estimation using the Point Source Load Estimation Tool (PSLoadEsT) and the accompanying report.

[Learn More](#)

[Overview](#) [Related Science](#) [Publications](#) [Data and Tools](#) [Maps](#) [Software](#) [Multimedia](#) [News](#)



SPARROW (SPAtially Referenced Regressions On Watershed attributes) models estimate the amount of a contaminant transported from inland watersheds to larger water bodies by linking monitoring data with information on watershed characteristics and contaminant sources. Explore relations between human activities, natural processes, and contaminant transport using interactive Mappers.

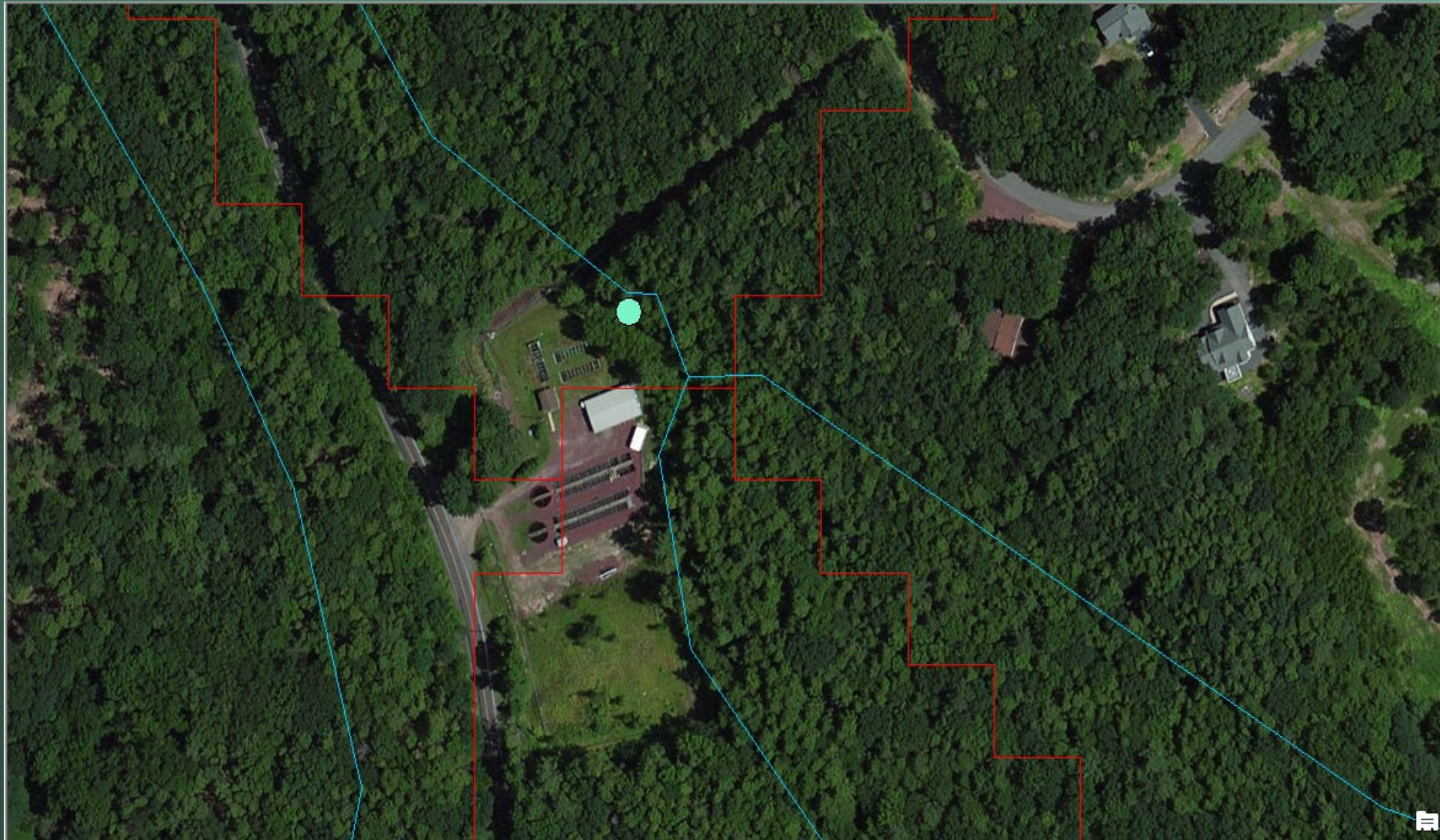
Status - Active

# Nutrient Load calculation (2012 data)

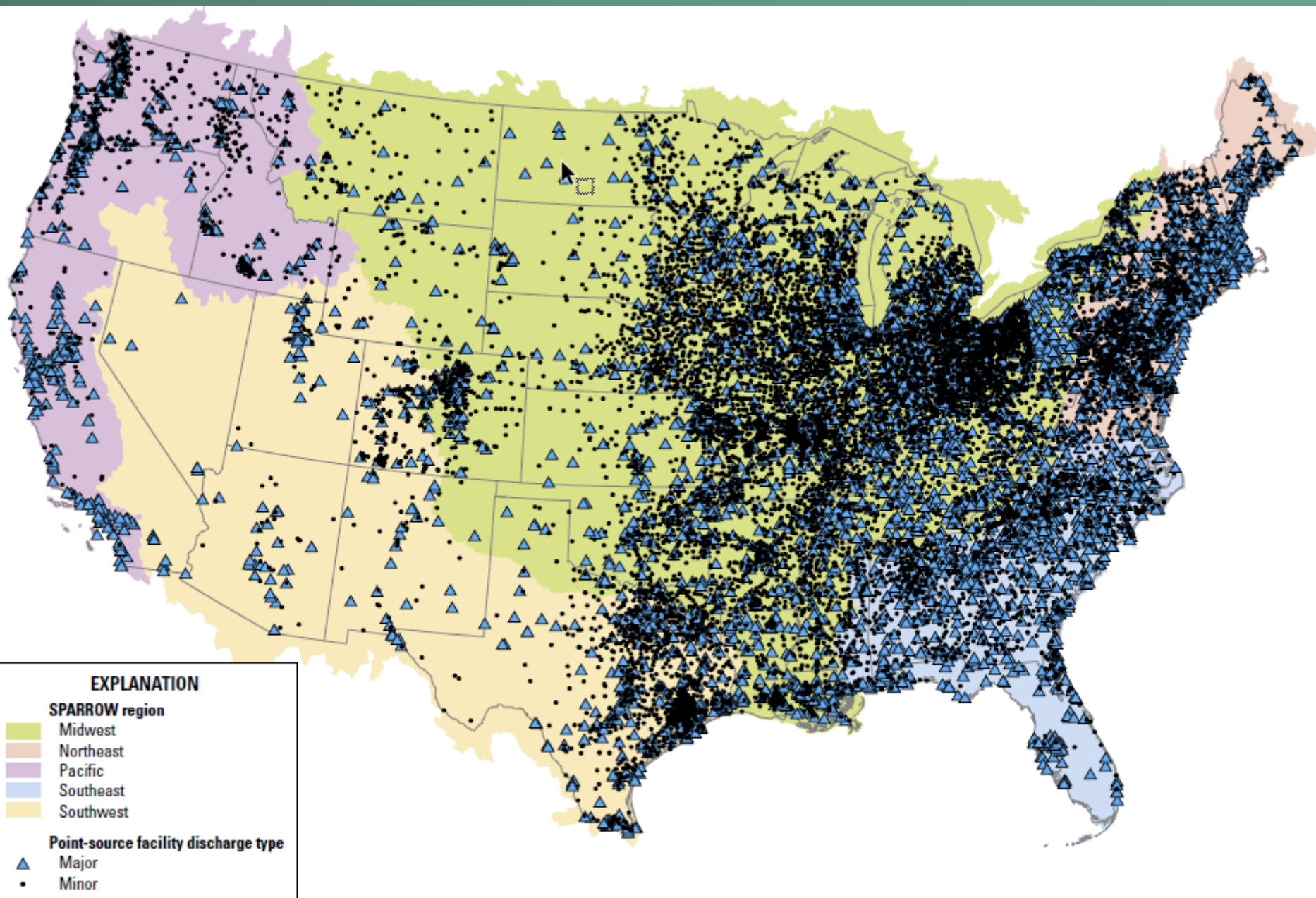
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- **Facility table**
  - Location, SIC, flow class, WWTP treatment level (from the Clean Watershed Needs Survey)
- **Flow table**
  - Average and maximum daily value, by month
  - Flow in million gallons per day, other units are converted
  - Multiple outfalls (pipes)--all considered in load
  - Monitoring locations (effluent to streams only)
- **DMR table**
  - Target nutrients: total nitrogen and phosphorus (parameter codes 00600 and 00665)
  - Monthly minimum, average, and maximum concentrations

# Outfall Location updates



5,430 Major facilities and 11,537 minor wastewater treatment facilities



# Nutrient Load Calculation – Flow data

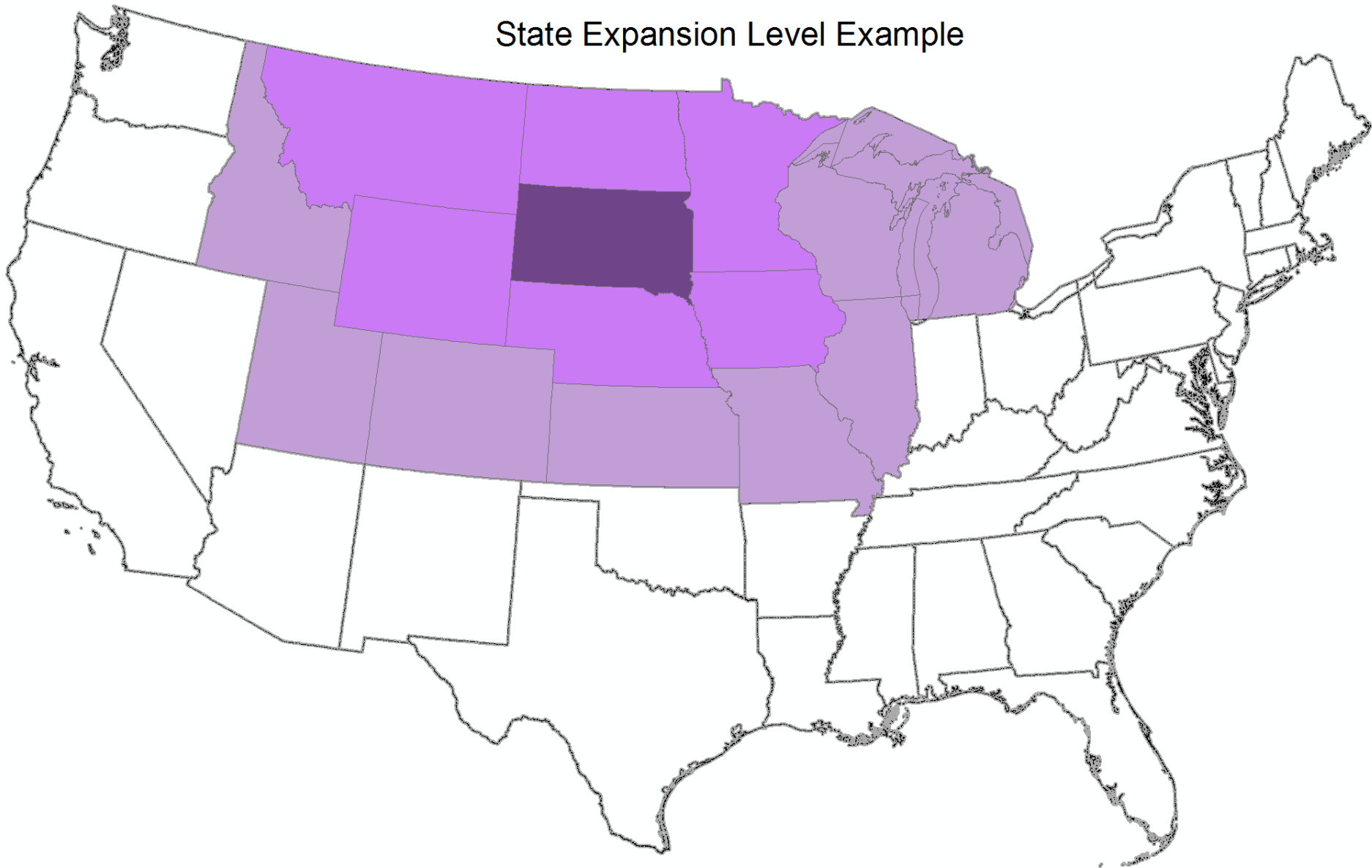
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- Loads calculated only if flow data is present
  - 12 months flow data – load calculated directly
  - <12 months but at least 3 quarters of the year
    - Assumed flow exists for 12 months but not available
    - Loads calculated from a seasonal medians
    - Previously derived median from three years data ('92, '97' '02)
  - < 3 quarters year – use only existing data
- All scenarios summed for annual load

# Nutrient Load Calculation – Concentration data

- **Concentration Data tables**
  - Original data - 12 months
  - Seasonal medians
    - Data present for at least 3 quarters of the year
- **Missing concentration values use Typical Pollutant Concentrations (TPC)**
  - **Facilities of the same:**
    - Type – SIC code (+ treatment level if a WWTF)
    - Size – Flow Class
    - Season
  - Previously used multiple years data now use data from expanding geographic areas

## State Expansion Level Example



# PSLoadEsT

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- **Original scripts in SAS**
- **R scripts using a Microsoft Access interface**
- **Minimum System Requirements**
  - Microsoft Windows® 7 or above
  - Microsoft Office® 2007–2016 with Microsoft Access® (32-bit)
  - Microsoft Access® Driver (\*.mdb, \*.accdb) (32-bit)
  - 64-bit Operating System

## Select Output Tables for LoadPrep\_part2.R



[Program Map](#)

\*Primary indicates that the table is directly derived from an Imported table

Number of Concentration Values Required for Substitution =

Number of Facilities Required for Substitution =

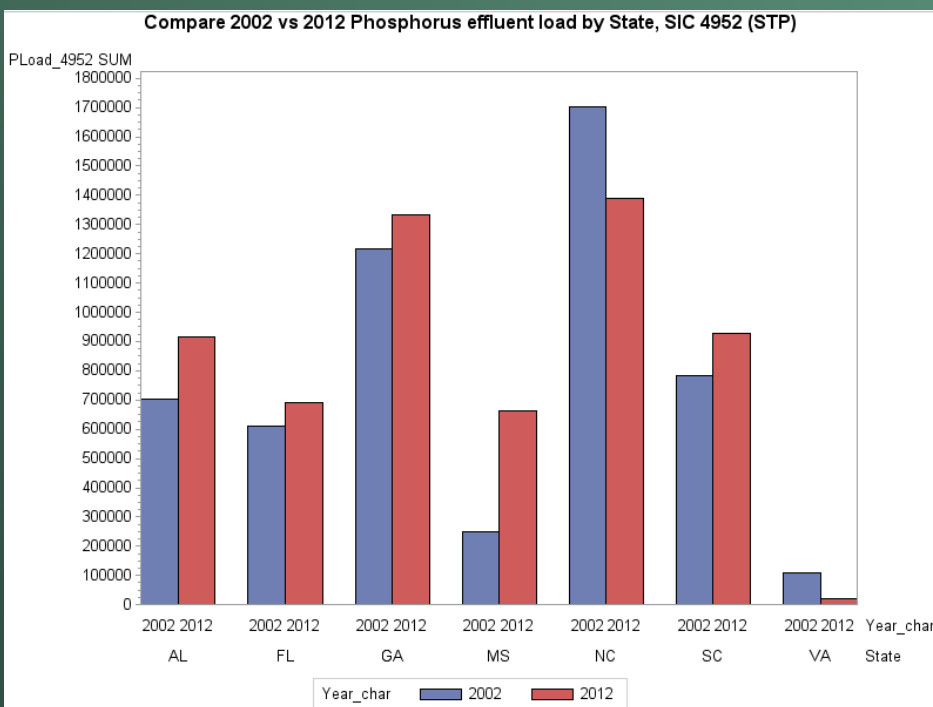
| Select                              | Output_DB                | Table       | Description                                                                                                                                                                                    |     |
|-------------------------------------|--------------------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | flowsicsea  | medians and counts of conc2, by flowclass, sic_code, season, and parameter, subsetting to median(conc2)>0 and count(conc2)>5                                                                   | pcs |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | flowsic     | medians and counts of conc2, by flowclass, sic_code, and parameter, subsetting to median(conc2)>0 and count(conc2)>5                                                                           | pcs |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | sic         | medians and counts of conc2, by sic_code, and parameter, subsetting to median(conc2)>0 and count(conc2)>5                                                                                      | pcs |
| <input type="checkbox"/>            | <input type="checkbox"/> | pcs8        | seasonal medians by npdes, outfall, year, season, parameter replacing missing concentration data if count>5, median season flow values also calculated and used to replace missing flow values | pcs |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | flowsub     | subset of pcs8 where season median flow values were substituted                                                                                                                                | pcs |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | pcs8Missing | count of missing concentration values in pcs8                                                                                                                                                  | pcs |

Continue

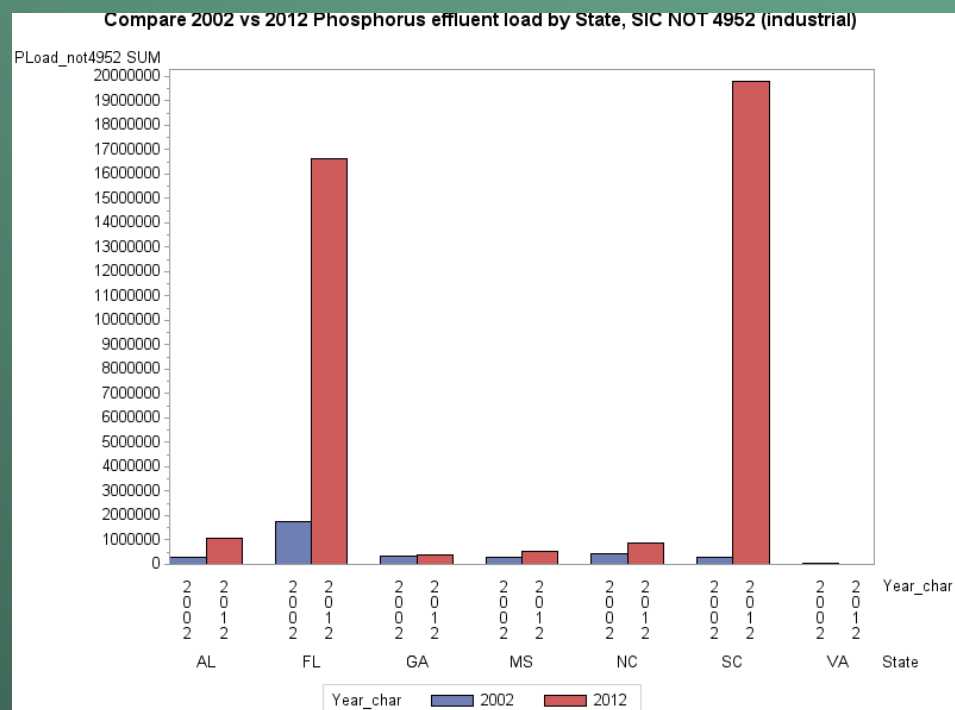
Cancel

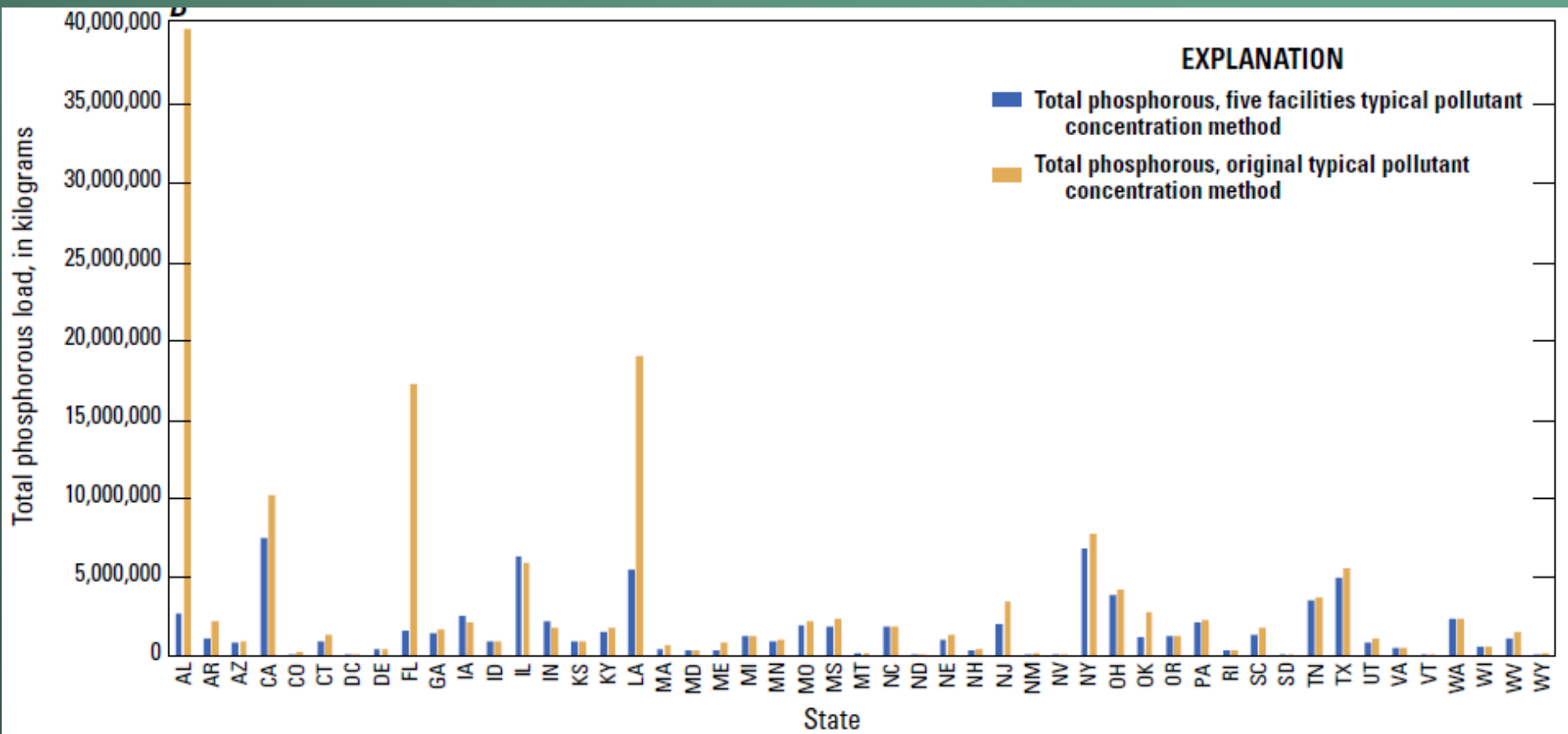
# Estimated inputs - wastewater

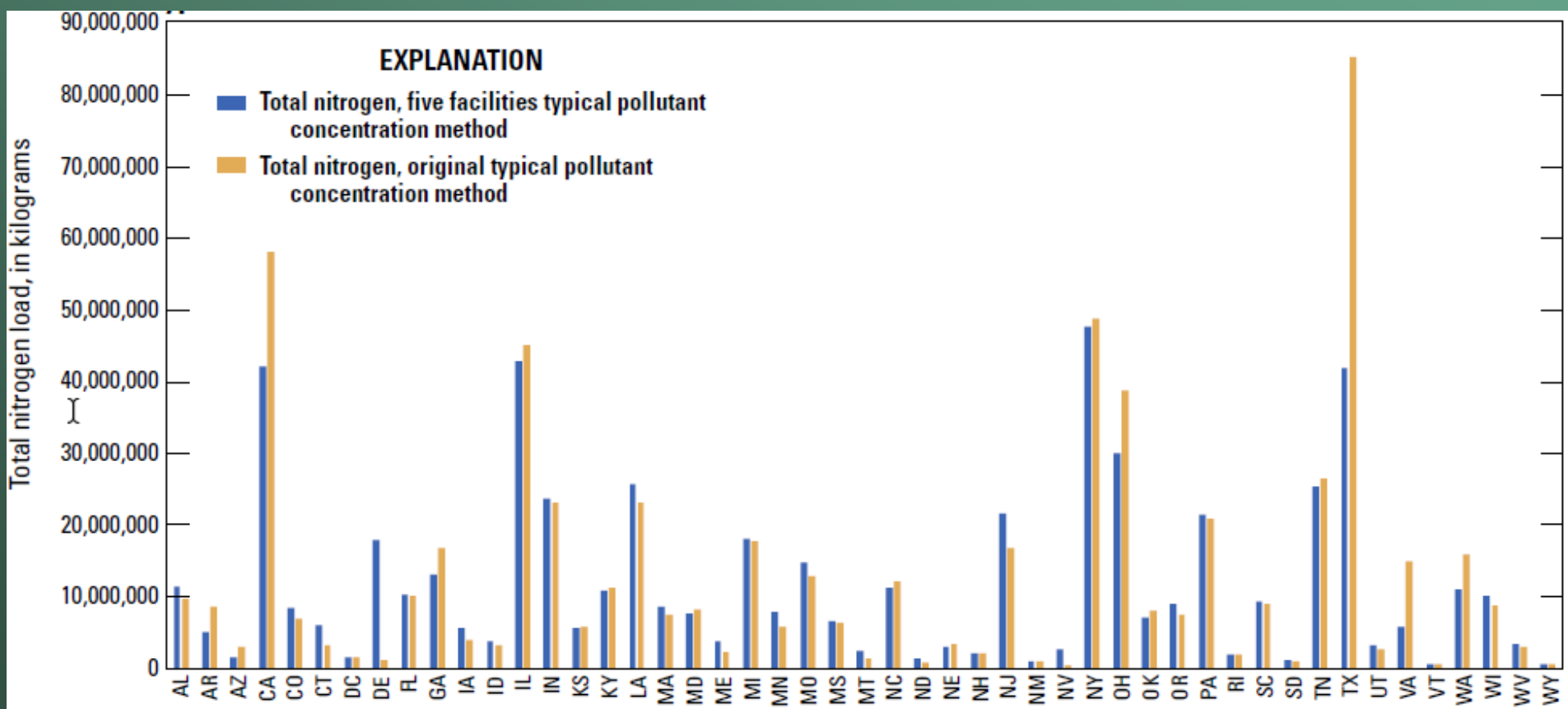
## Wastewater treatment plants (SIC 4952)



## NOT SIC 4952 (Industrial wastewater)







## Select Output Tables for LoadPrep\_part2.R



**Program Map**

\*Primary indicates that the table is directly derived from an Imported table

Number of Concentration Values Required for Substitution =

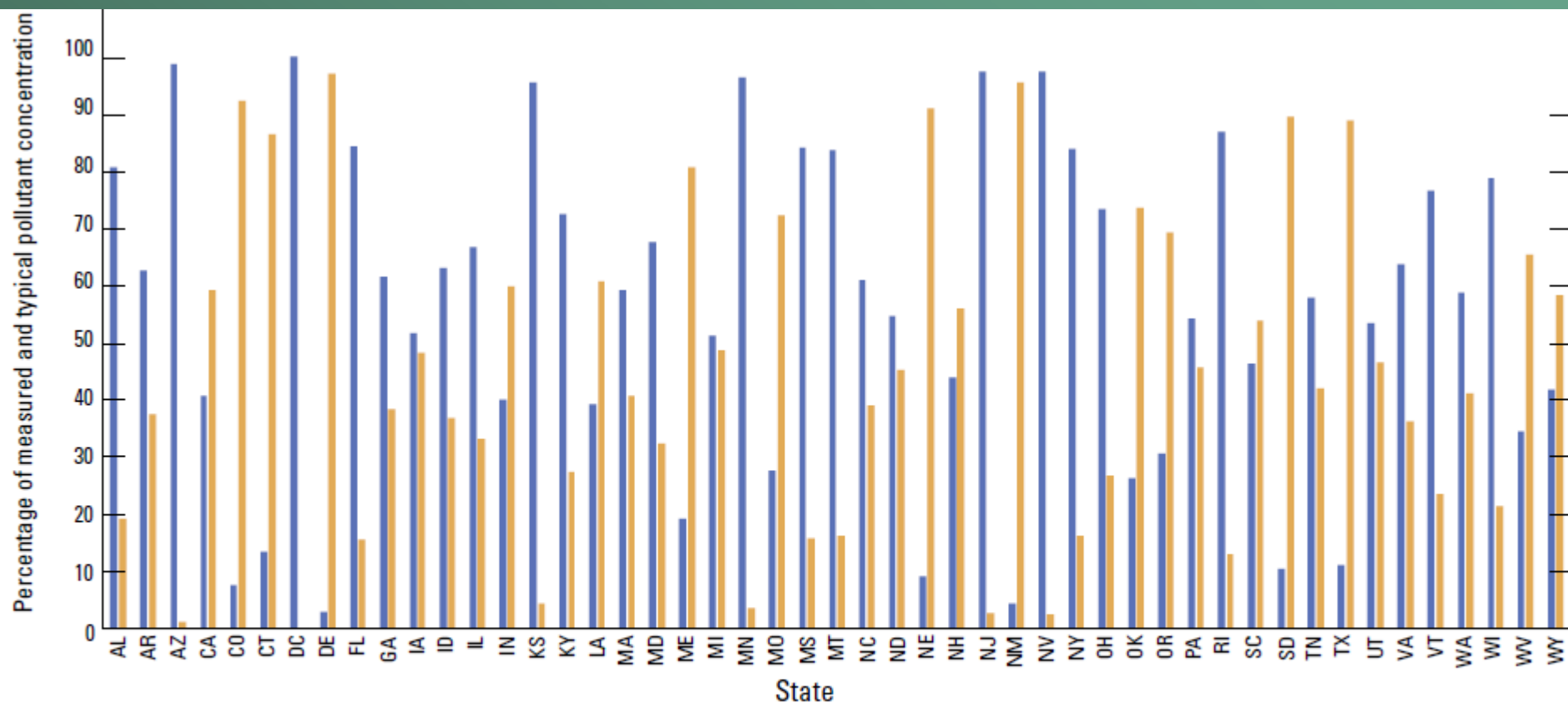
Number of Facilities Required for Substitution =

| Select                              | Output_DB                | Table       | Description                                                                                                                                                                                    |     |
|-------------------------------------|--------------------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | flowsicsea  | medians and counts of conc2, by flowclass, sic_code, season, and parameter, subsetting to median(conc2)>0 and count(conc2)>5                                                                   | pcs |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | flowsic     | medians and counts of conc2, by flowclass, sic_code, and parameter, subsetting to median(conc2)>0 and count(conc2)>5                                                                           | pcs |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | sic         | medians and counts of conc2, by sic_code, and parameter, subsetting to median(conc2)>0 and count(conc2)>5                                                                                      | pcs |
| <input type="checkbox"/>            | <input type="checkbox"/> | pcs8        | seasonal medians by npdes, outfall, year, season, parameter replacing missing concentration data if count>5, median season flow values also calculated and used to replace missing flow values | pcs |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | flowsub     | subset of pcs8 where season median flow values were substituted                                                                                                                                | pcs |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | pcs8Missing | count of missing concentration values in pcs8                                                                                                                                                  | pcs |

Continue

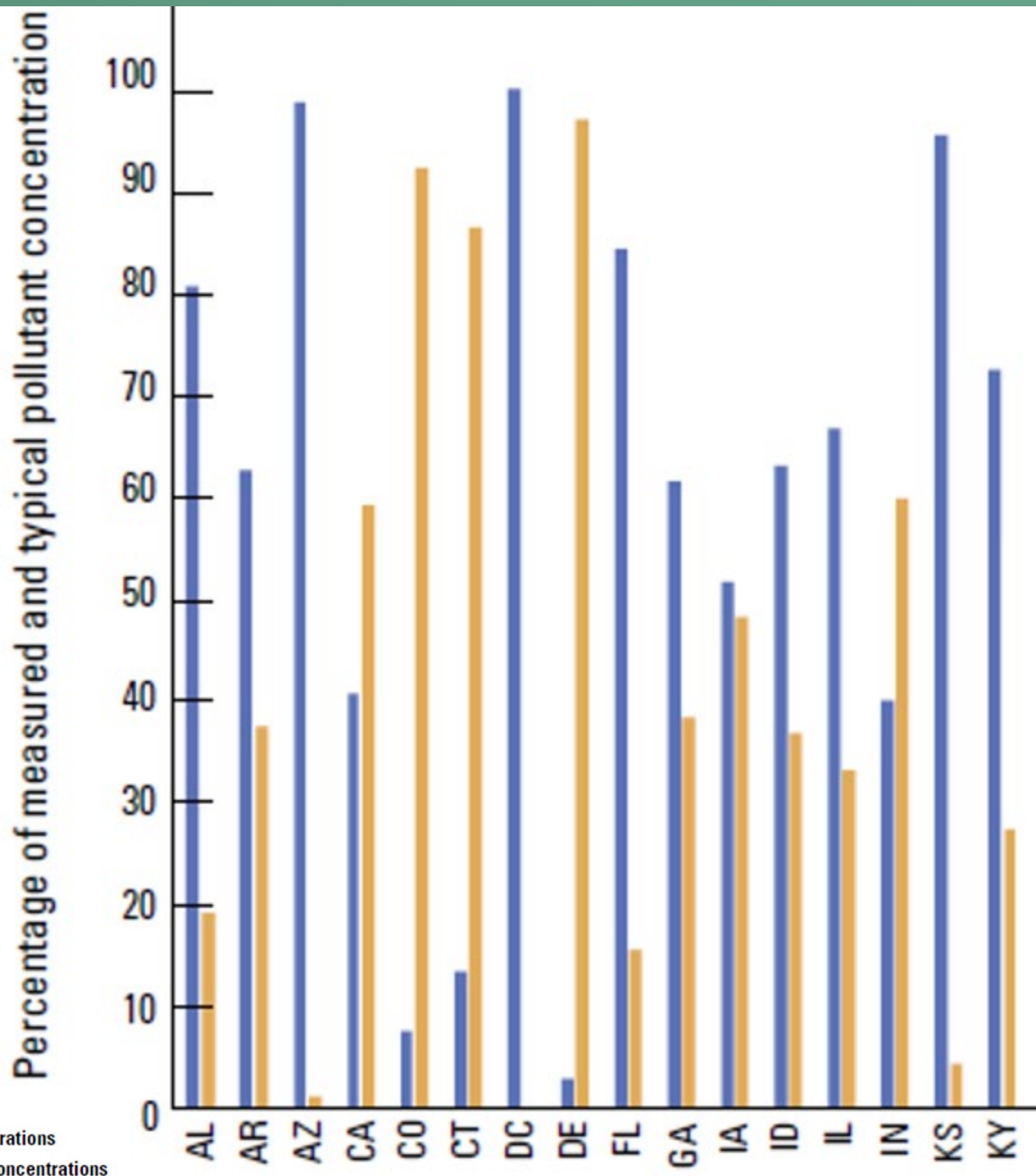
Cancel

# Original measurements vs. TPC



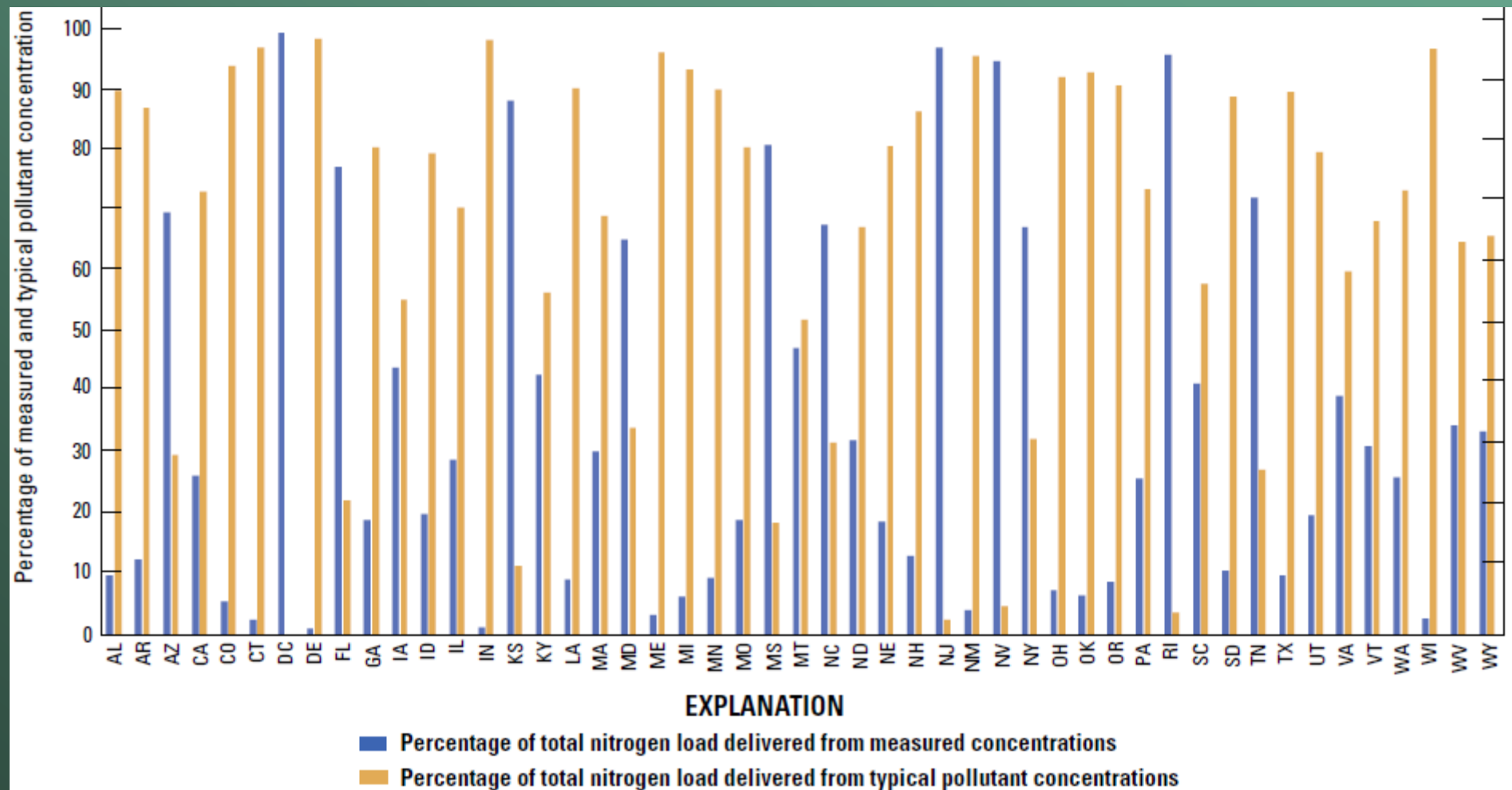
## EXPLANATION

- Percentage of total phosphorous load delivered from measured concentrations
- Percentage of total phosphorous load delivered from typical pollutant concentrations

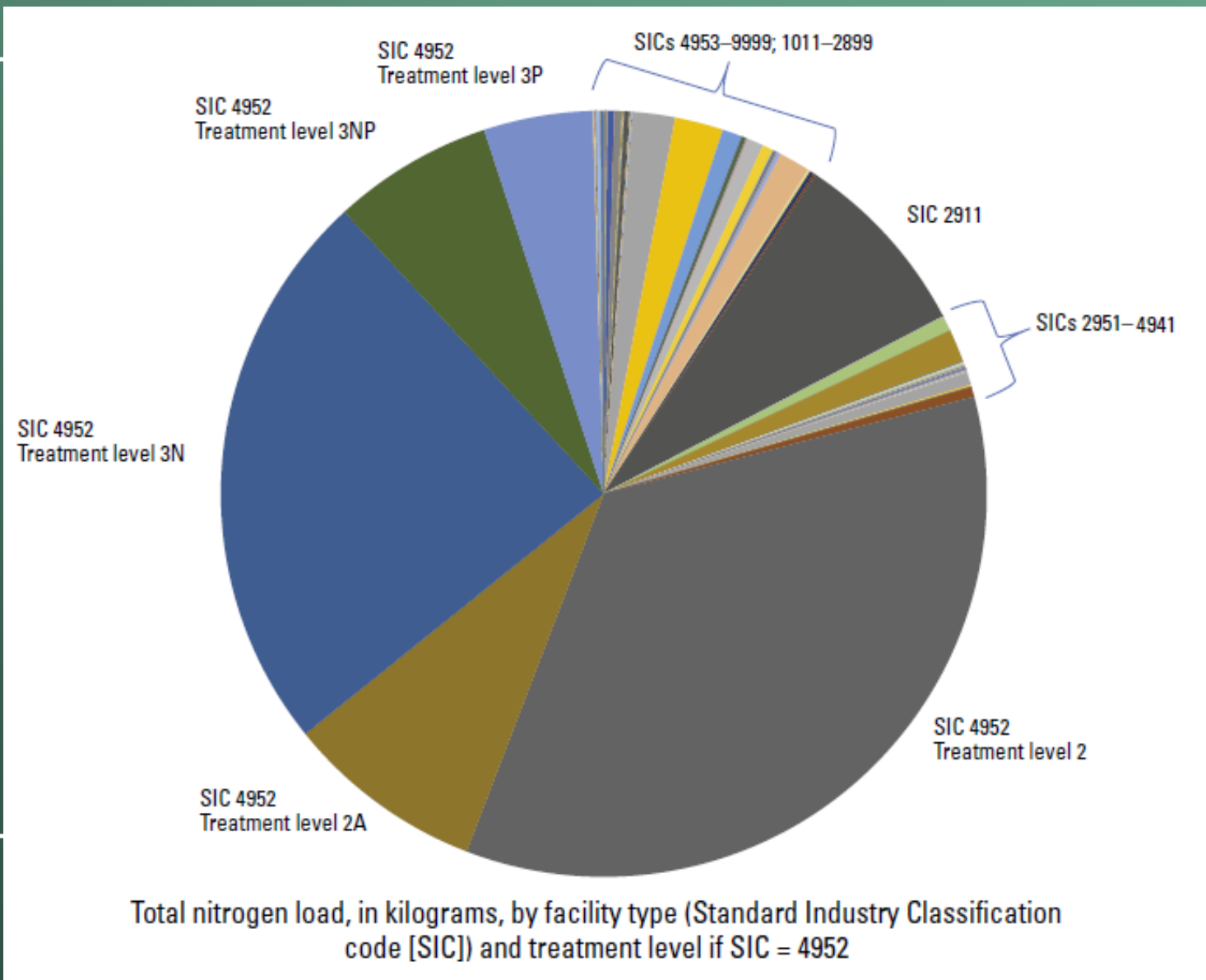


#### EXPLANATION

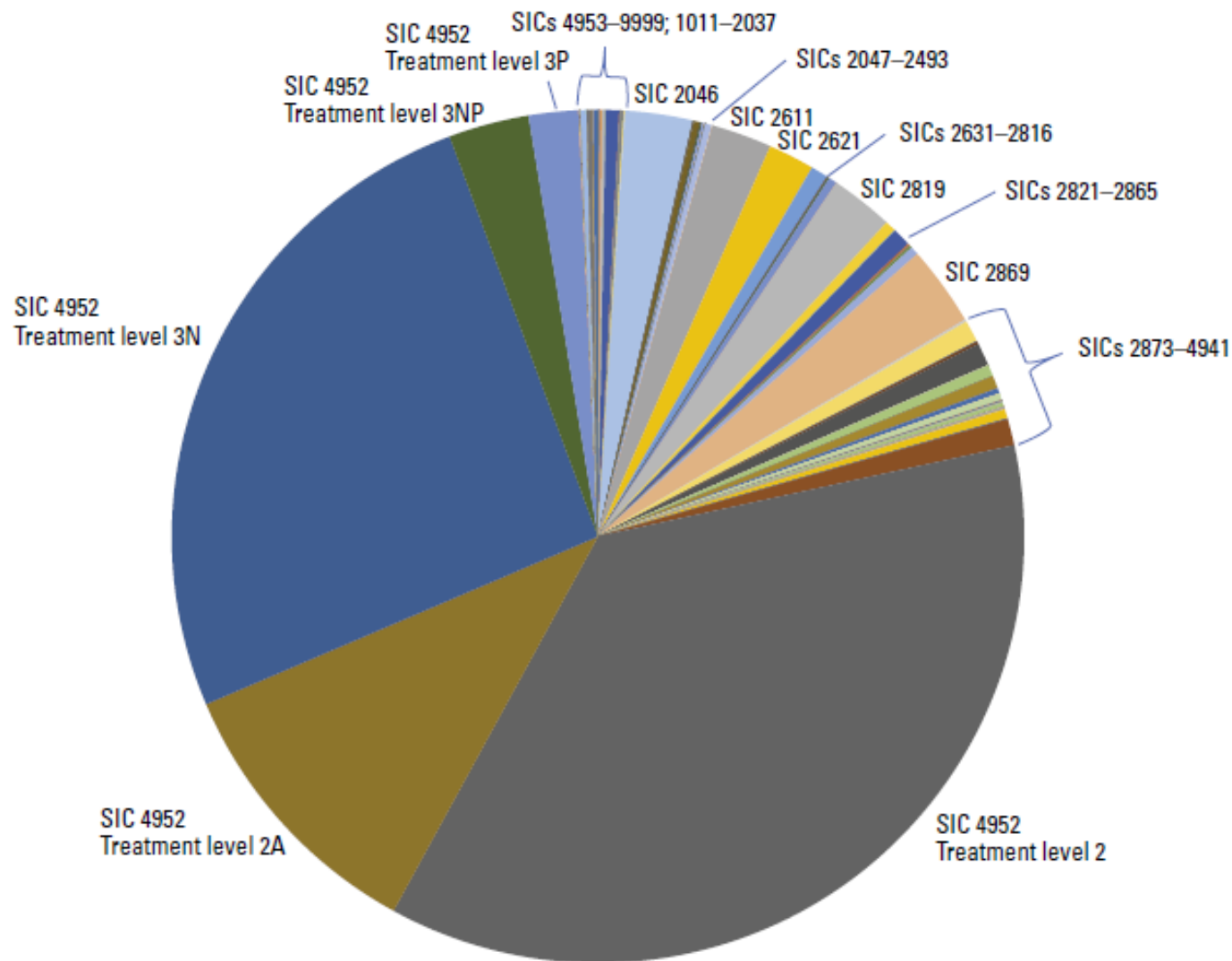
- Percentage of total phosphorous load delivered from measured concentrations
- Percentage of total phosphorous load delivered from typical pollutant concentrations



# Total nitrogen load mostly from WWTFs



# Total phosphorus load mostly from WWTFs



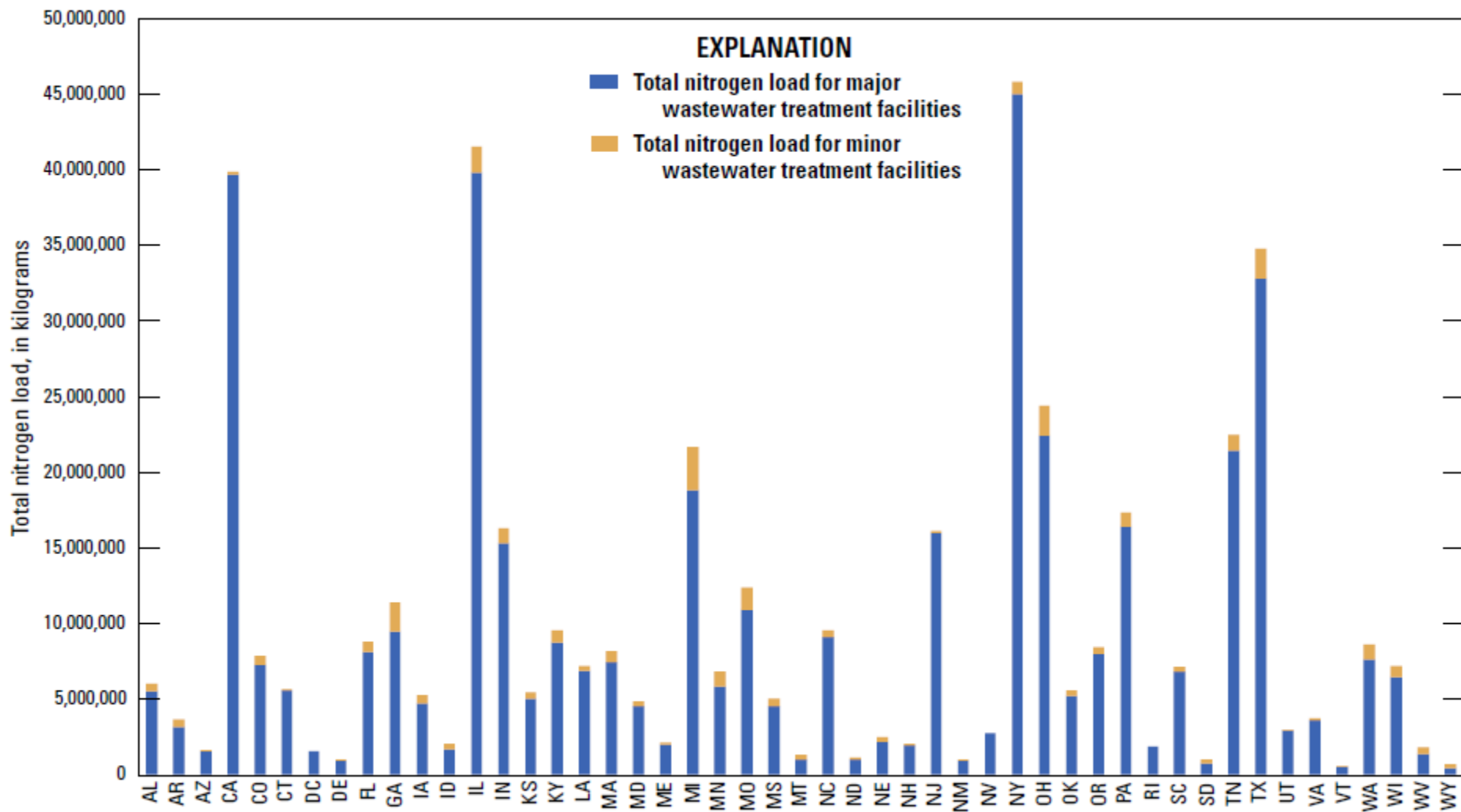
Total phosphorous load, in kilograms, by facility type (Standard Industry Classification code [SIC]) and treatment level if SIC = 4952

# CWNS Treatment Levels

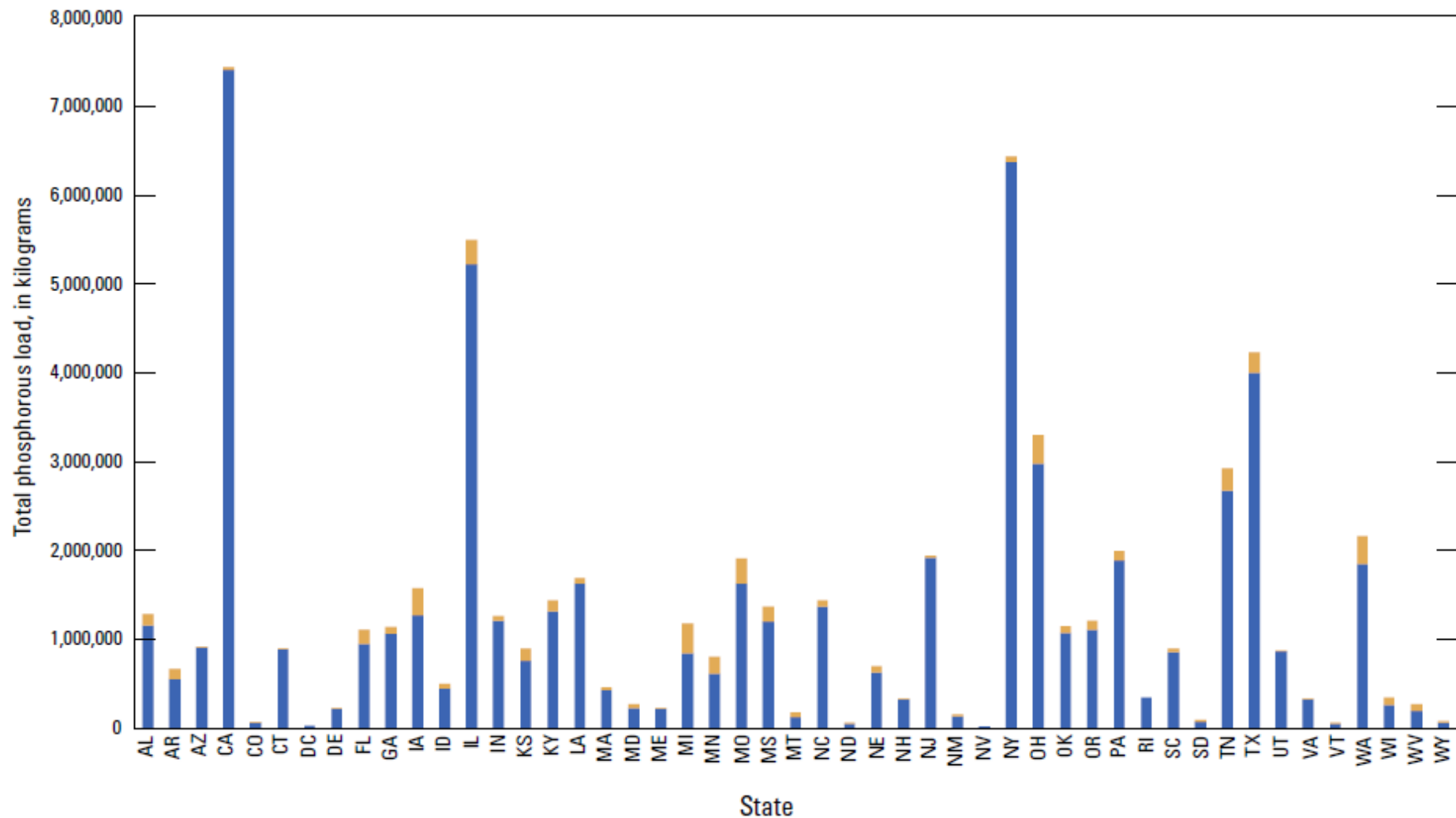
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- Level 1 - '0' - raw sewage discharge (none)
- Level 2 - '1' - primary treatment (settling) (13)
- Level 3 - '1A' - advanced primary treatment (13)
- Level 4 - '2' - secondary treatment (aeration, activated sludge) (7,495)
- Level 5 - '2A' - advanced secondary treatment (BOD removal only) (1,967)
- Level 6 - '3P' - tertiary treatment (phosphorus removal only) (358)
- Level 7 - '3N' - tertiary treatment (nitrogen removal only) (2,232)
- Level 8 - '3NP' - tertiary treatment (all nutrient removal) (793)
- Level 9 - 'U' - treatment level unknown. (8,678)
  - Converted to '2'

# Total nitrogen load from major/minor WWTF

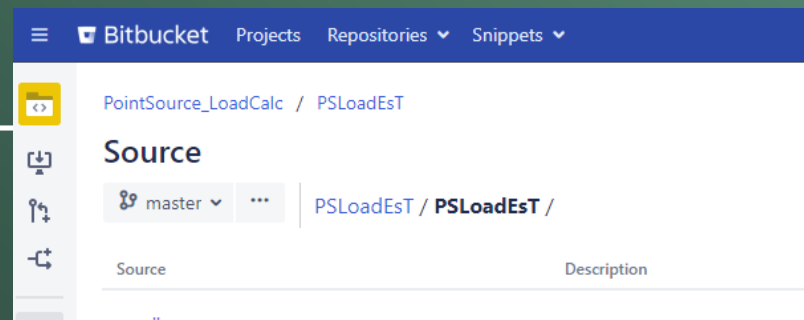
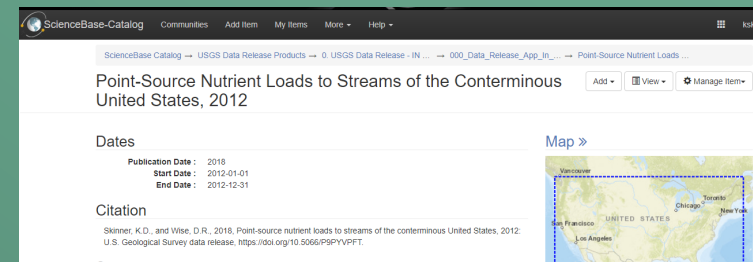


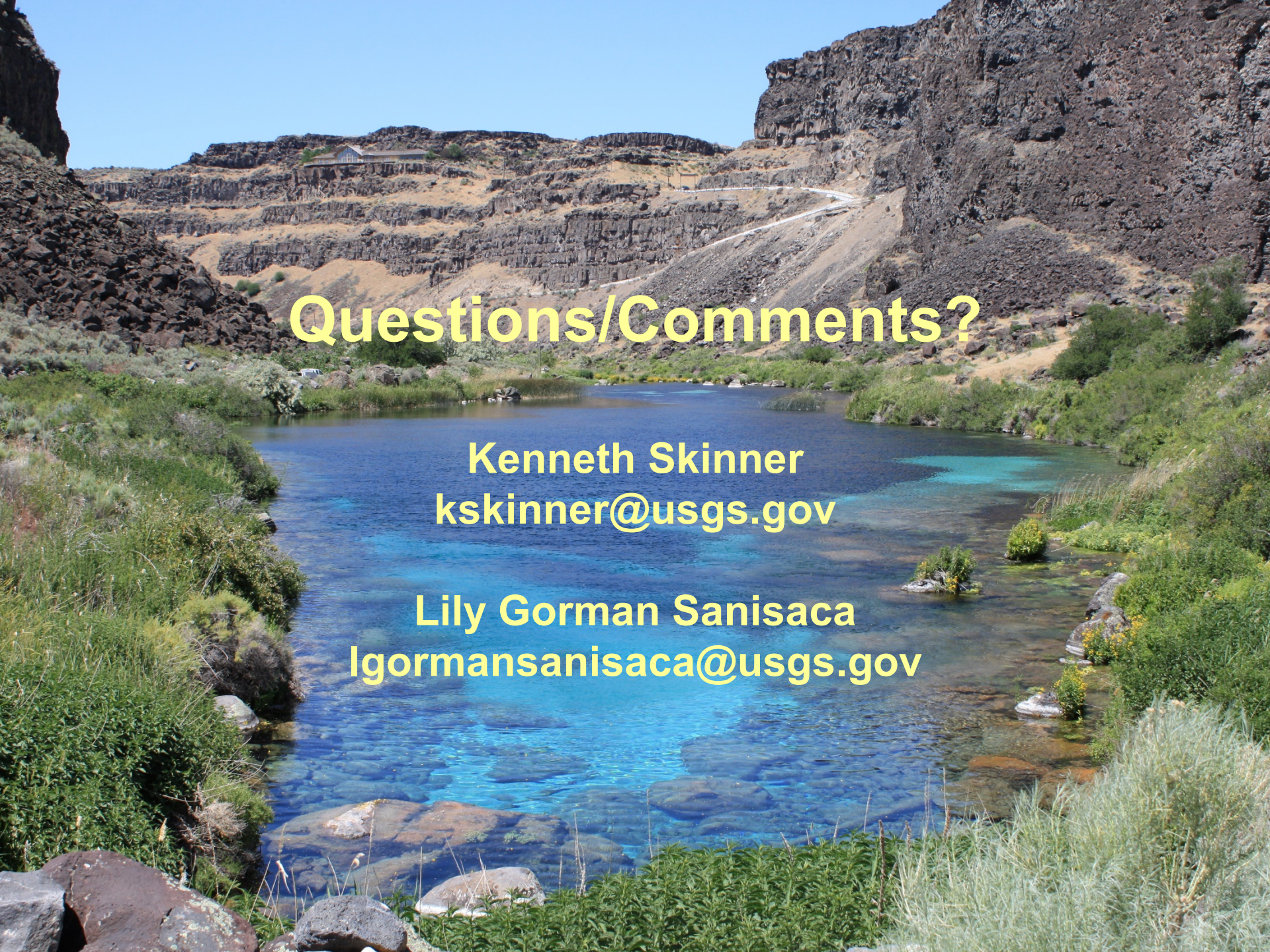
# Total phosphorus load from major/minor WWTF



# Products

- Data Series report – <https://pubs.er.usgs.gov/publication/ds1101>
  - “Point-Source Nutrient Loads to Streams of the Conterminous United States, 2012”
- Data Release via ScienceBase – <https://www.sciencebase.gov/catalog/item/5ba54362e4b08583a5c9d4e5>
- Program Open file report – <https://pubs.er.usgs.gov/publication/ofr20191025>
  - “Annual wastewater nutrient data preparation and load estimation using the Point Source Load Estimation Tool (PSLoadEsT)”
- Software release via bitbucket – <https://my.usgs.gov/bitbucket/projects/PSLC/repos/psloadest/browse>





**Questions/Comments?**

**Kenneth Skinner**  
**[kskinner@usgs.gov](mailto:kskinner@usgs.gov)**

**Lily Gorman Sanisaca**  
**[lgormansanisaca@usgs.gov](mailto:lgormansanisaca@usgs.gov)**

# Flow classes in MGD

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- Flow class 1 = 0.000 - 0.05
- Flow class 2 = 0.051 - 0.20
- Flow class 3 = 0.021 - 1.00
- Flow class 4 = 1.001 - 5.00
- Flow class 5 = > 5.00