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DRBC Water Audit Program: Status and Trends

Kenneth Najjar, Ph.D., P.E.
Director, Water Resource Management

June 21, 2018
Water Management Advisory Committee

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DRBC Water Audit Program: Status and Trends

Today's talk will cover…

- Overview of Water Use Trends in the Delaware River Basin
- The DRBC water audit program
  - Brief history
  - Program Results from CY2016 Audits
  - Status and trends

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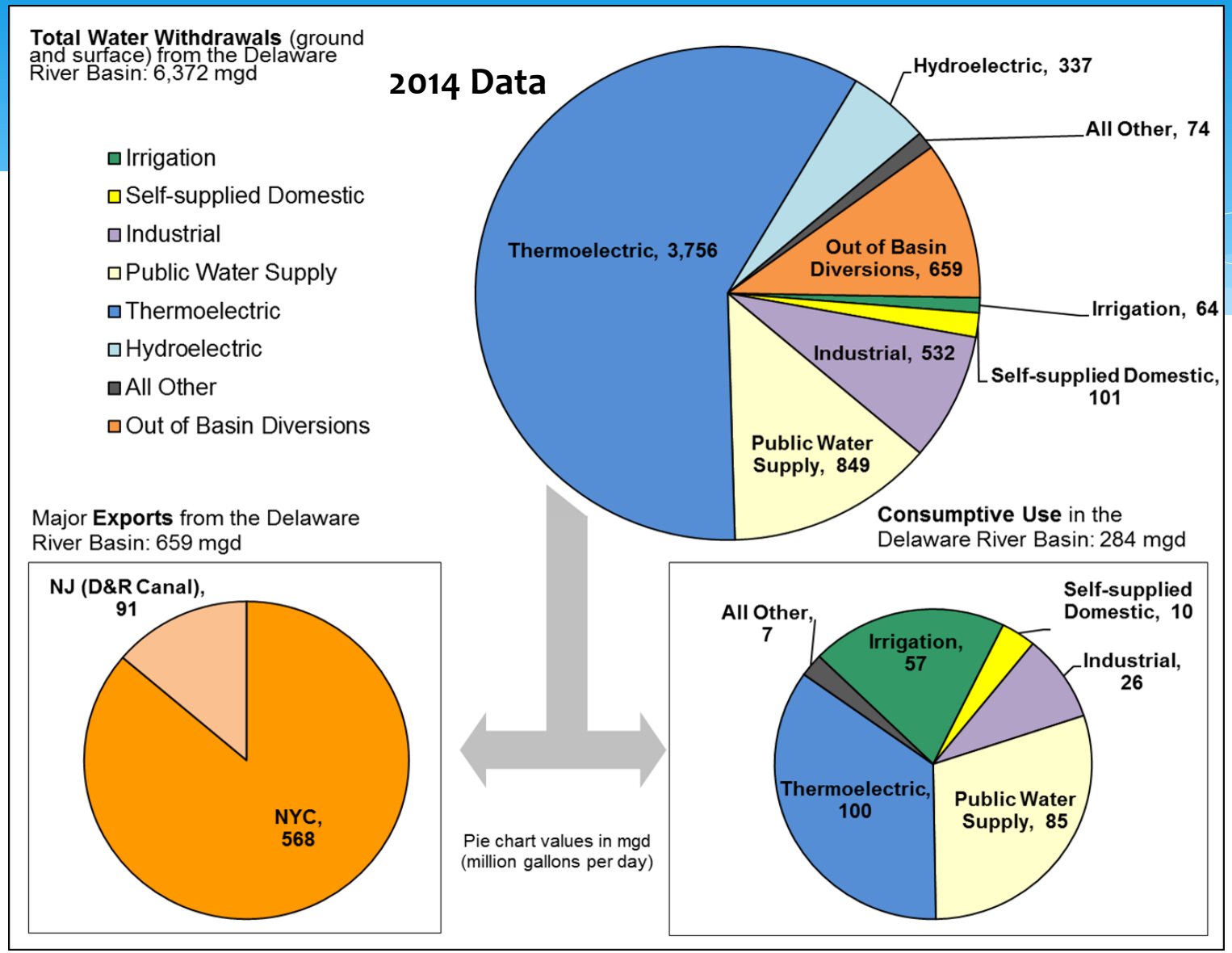

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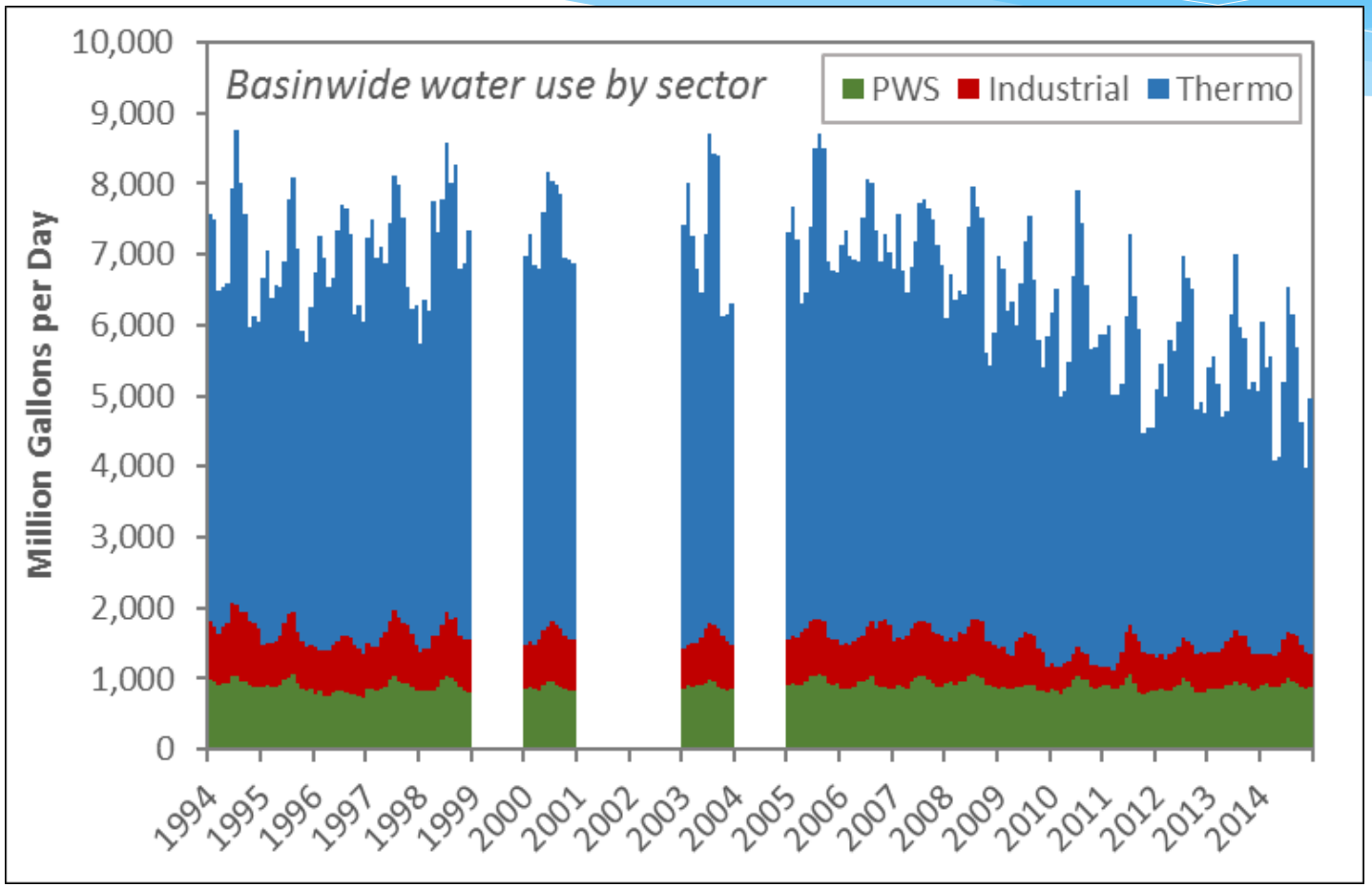
Monthly Total Water Withdrawals for Three Key Sectors in the Delaware River Basin



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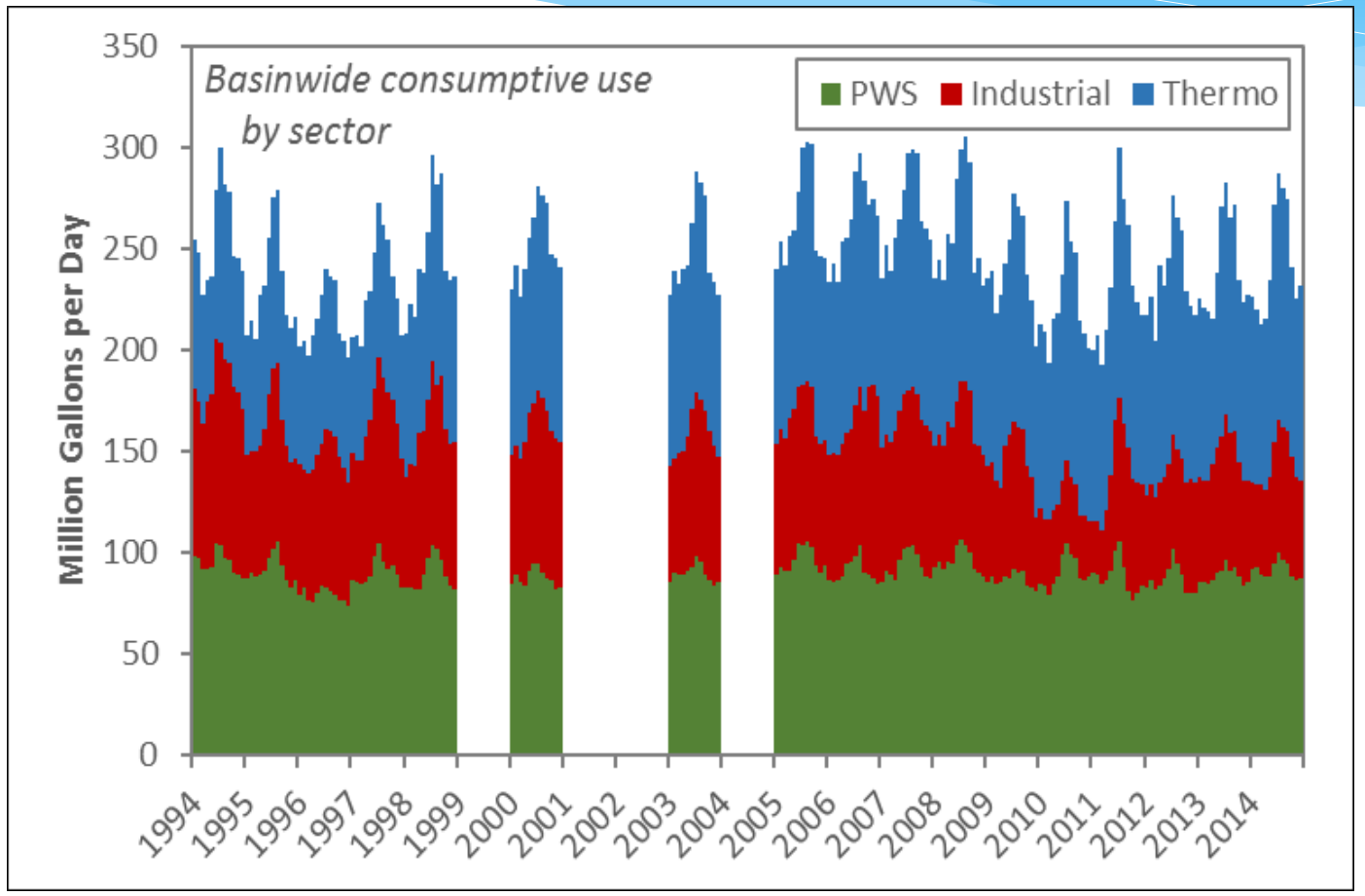
Monthly Consumptive Water Use for Three Key Sectors in the Delaware River Basin



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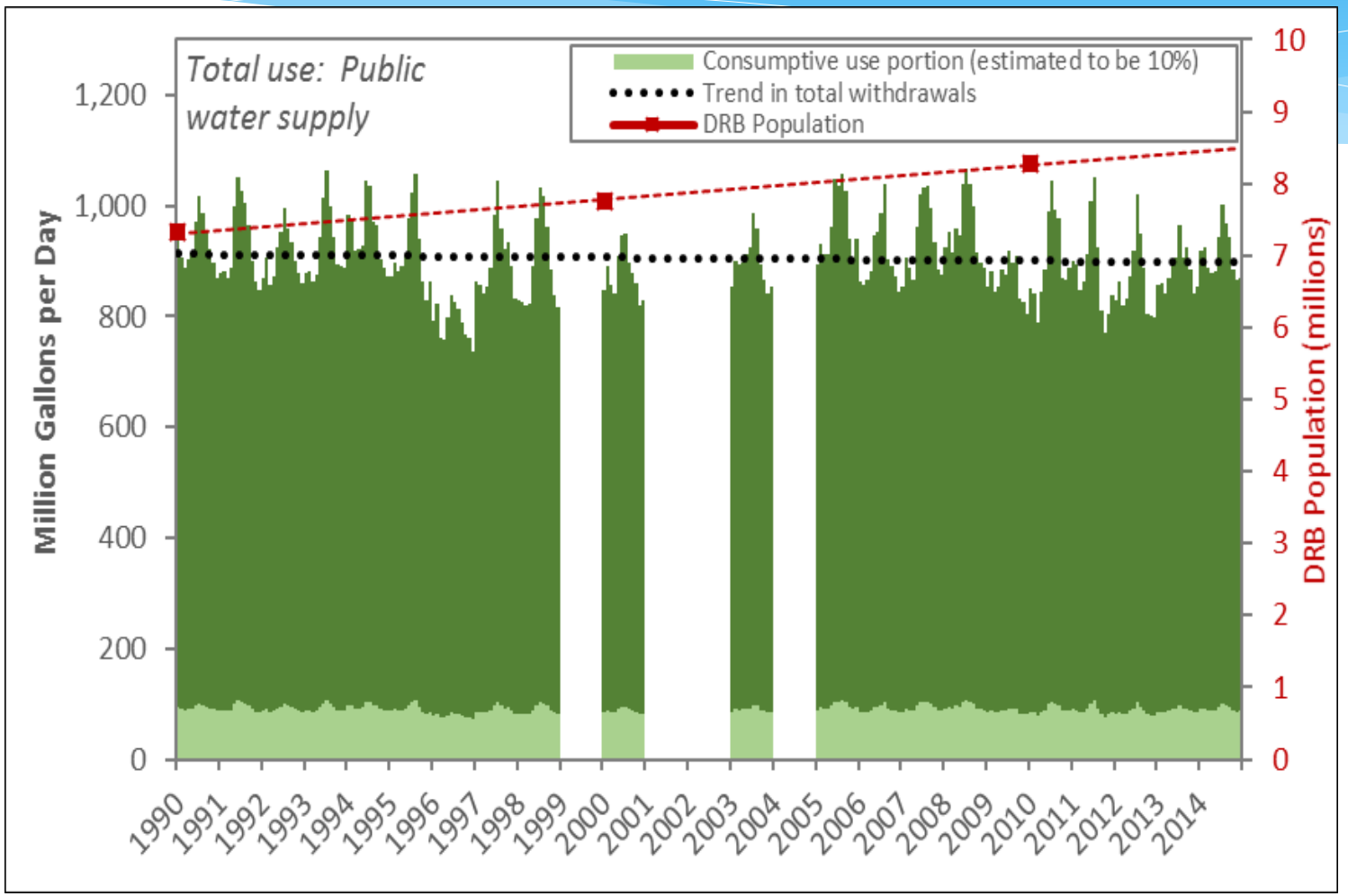
Monthly withdrawals of Public Water Systems in the Basin 1990-2014



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Consumptive Use Trends 1994 – 2014

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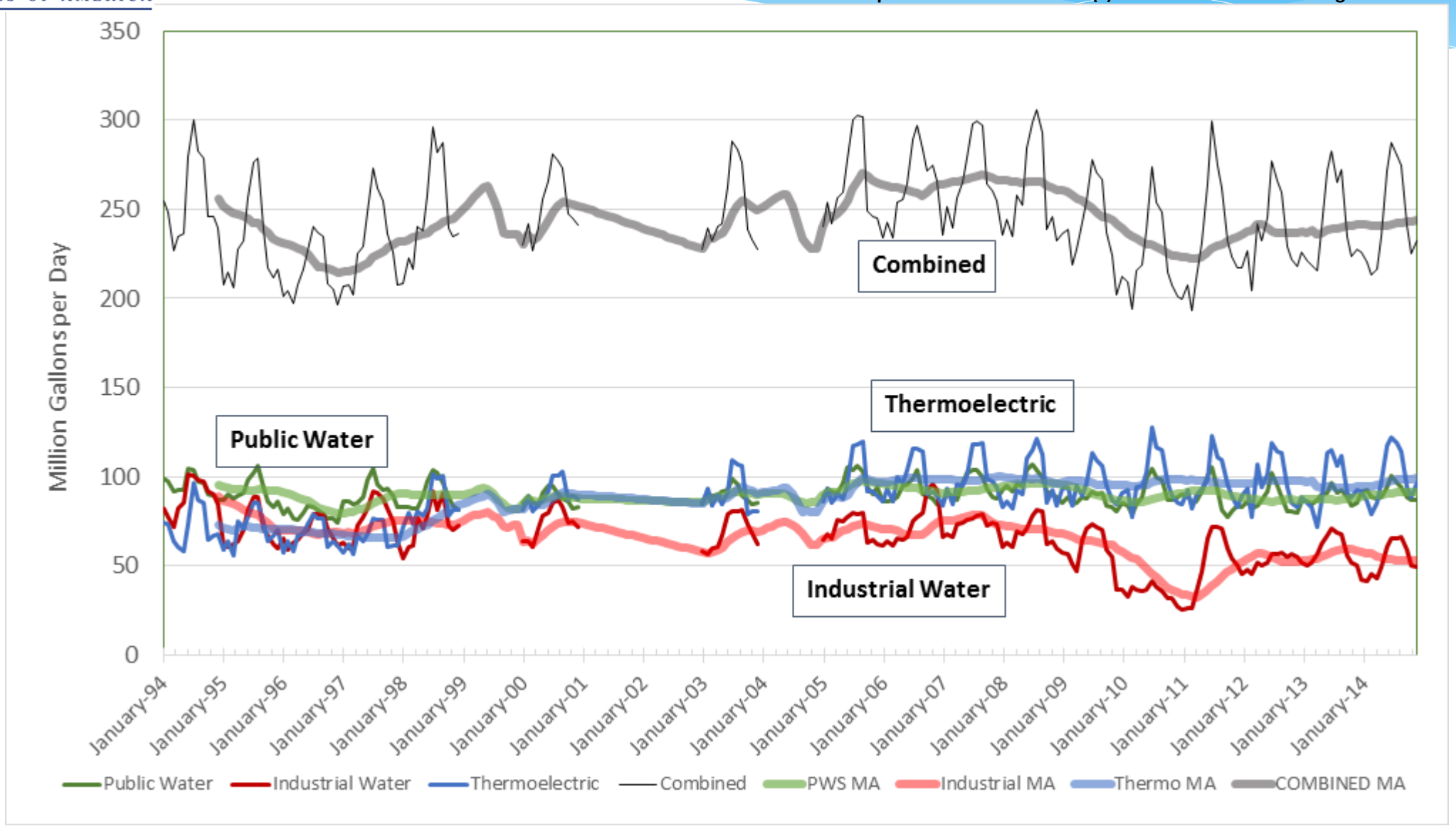

Water Exported to New York City from Delaware River Basin 1955 - 2015 (Annual Data)

Aerial view of NYC:
http://www.onlineatlas.us/gallery/new-york-city.htm

Annual Average NYC diversion

5 per. Mov. Avg. (Annual Average NYC diversion)

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MGD

1,000
900
800
700
600
500
400
300
200
100
0

1955 1957 1959 1961 1963 1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015

Water Exported via D & R Canal from Delaware River Basin 1990 - 2014 (Annual Data)

D&R Canal Trail in Lambertville, N.J.: https://en.wikipedia.org/wiki/D%26R_Canal_Trail

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What do these trends tell us?

- **Overall:** Relatively flat demand w/localized demand pressures
- **Power:**
  - Trend is away from Once Through Cooling to Evaporative Cooling , which results in much less total water use but increases in consumptive use
- **Industry:**
  - Decreased water use over time, sensitive to loss of large facilities
- **PWS:**
  - Conservation efforts are offsetting population growth, a trend that is likely to continue
  - Implementation of Water Auditing could continue this trend

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DRBC Water Audit Program: What is it?

The purpose of DRBC's water audit program is to track how ***efficiently*** water is moved from its source to the customer (within a public water supply system) and to ensure that systems quantify and are accountable for water losses.

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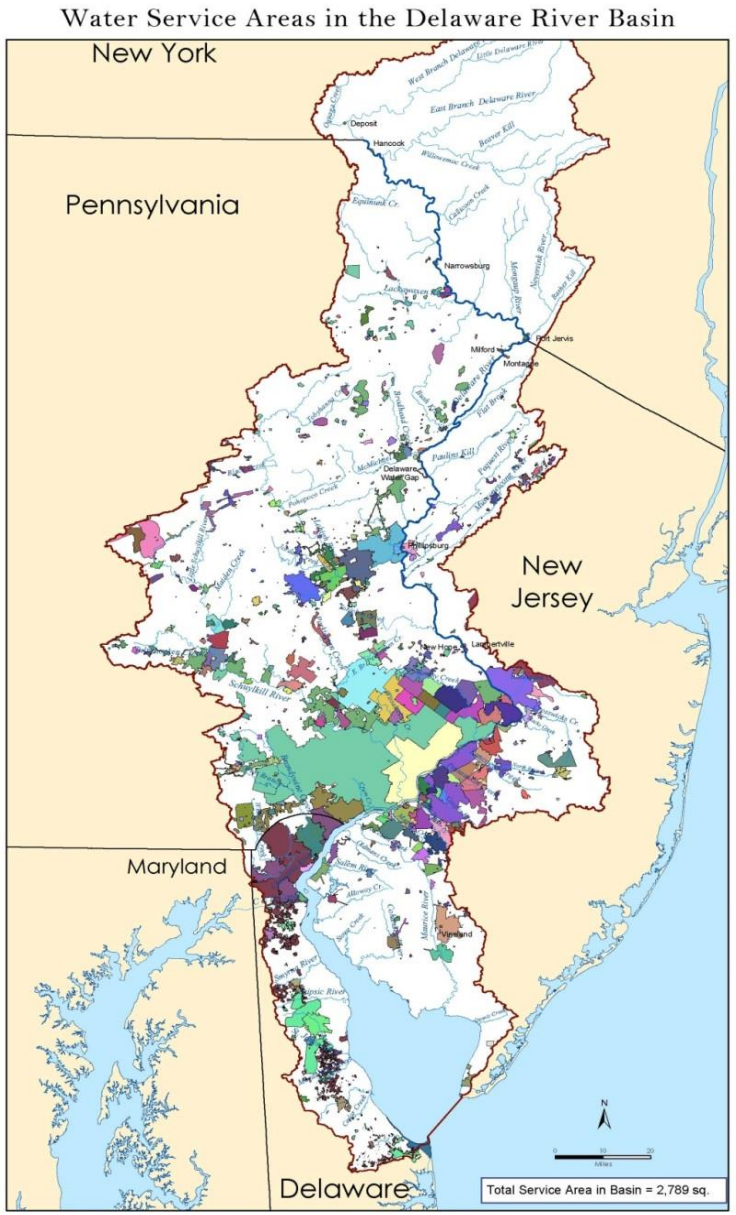
Public Water Supply Service Area in the Delaware River Basin



- Total PWS withdrawals:

  ~849 MGD (2014 data)

- 2nd largest water use sector in the Basin
- Approx. 21% of Basin covered by service area (see map)
- Serve 6.7 million customers (80% of basin residents)
- Approx. 300 systems subject to Water Audit Requirement

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History of DRBC Water Conservation Regulations

1986:	Source & Service Metering
1987:	Leak Detection & Repair (UFW)
1988:	Conservation Plumbing Standards
1992:	Water Conservation Pricing
2006-9:	Water Loss Accountability (Committee)
2009-11:	"Water Audit" Rule/Outreach
2012:	First year for new water audit format
2013:	First water audit reports due

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DRBC Rule change

~~Unaccounted for Water (UFW)~~

IWA/AWWA Water Audit Methodology

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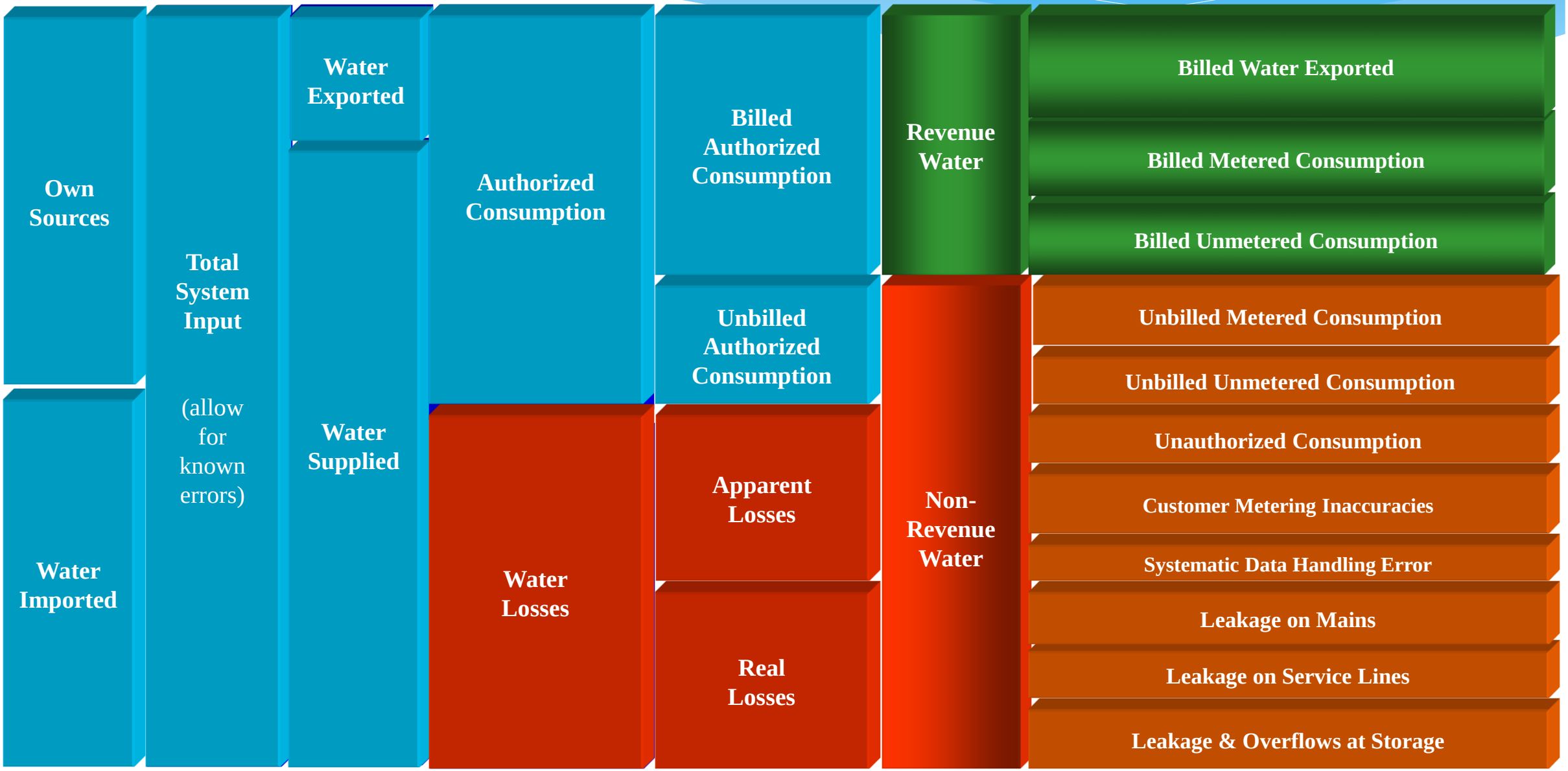
IWA/AWWA Water Audit Components



Benefits of the IWA/AWWA Water Audit Methodology

- UFW:
  - Vague / inconsistent definitions / value
  - Negative UFW values reported!?
- AWWA Method:
  - **Best Practice** Approach
  - Standardized definitions / terminology
  - Meaningful indicators (ILI, gpd/conn)
  - Real losses vs apparent losses
- Better Indicators = better water management

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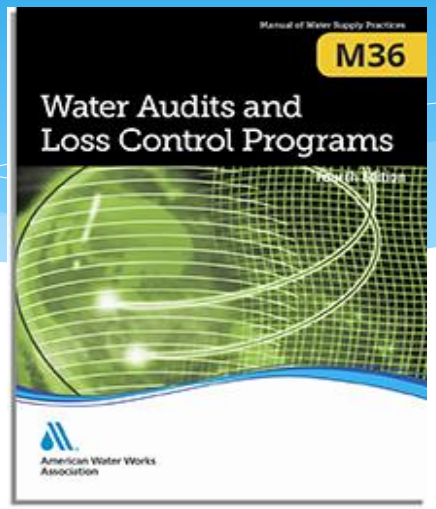
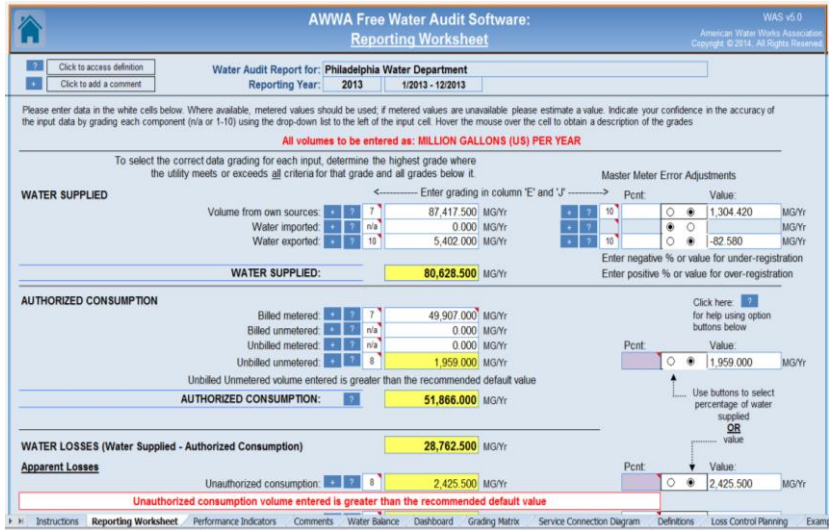
AWWA Resources / Software



- M36 Water Audit manual
- Free interactive audit software available
- DRBC provided a key role in software design and development
- Data grading capability assesses the validity of the input data
- Instructions, definitions provided in software

www.awwa.org



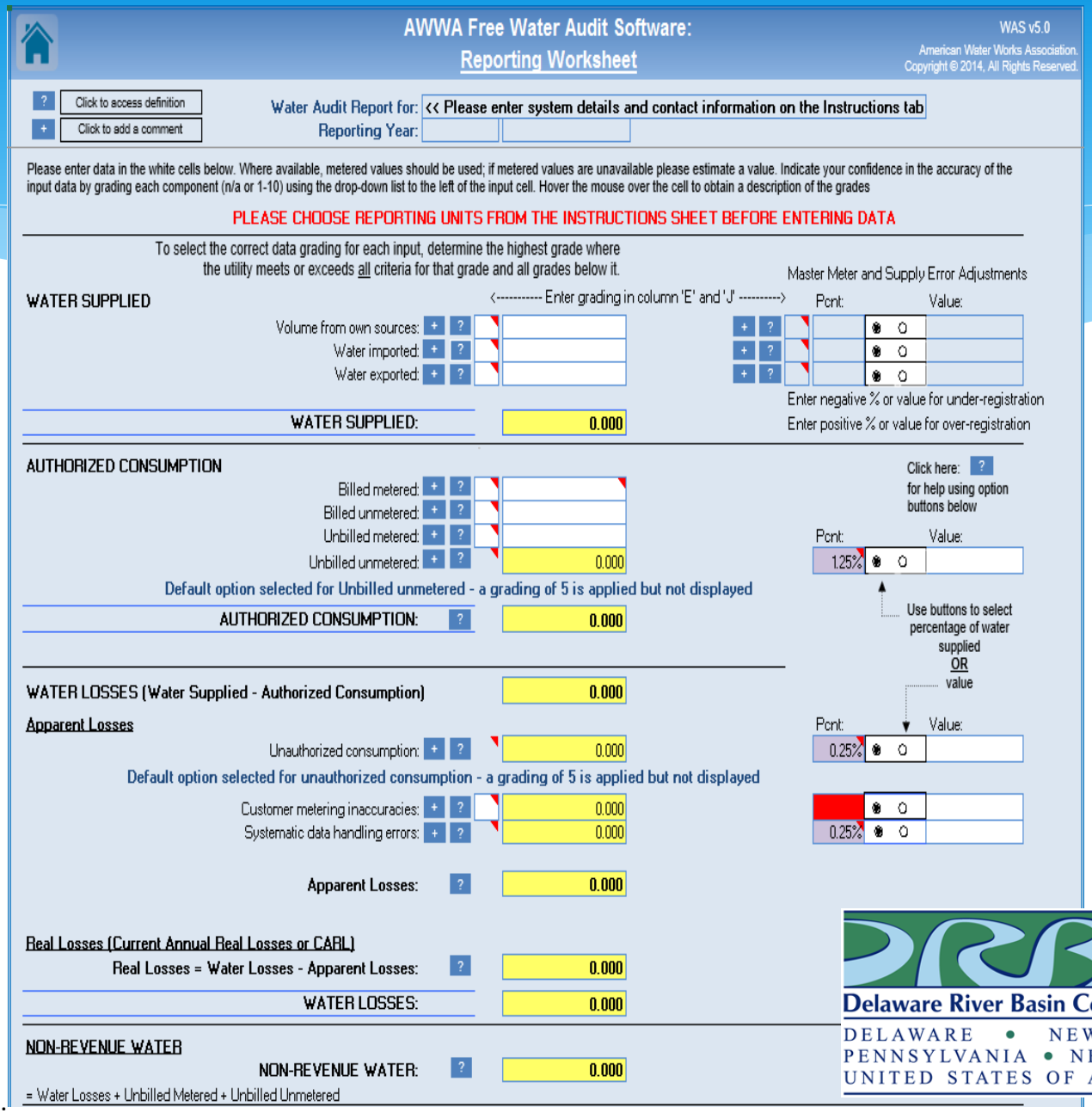
Collecting the Data

AWWA Free Water Audit Software Reporting Worksheet (Top Portion)

The Reporting Worksheet is the primary Data Input Worksheet.

Input data on this portion of the Reporting Worksheet include:

- Volumes of supply
- Consumption
- Apparent Loss
- Real Loss is calculated
- Data Gradings



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Collecting the Data

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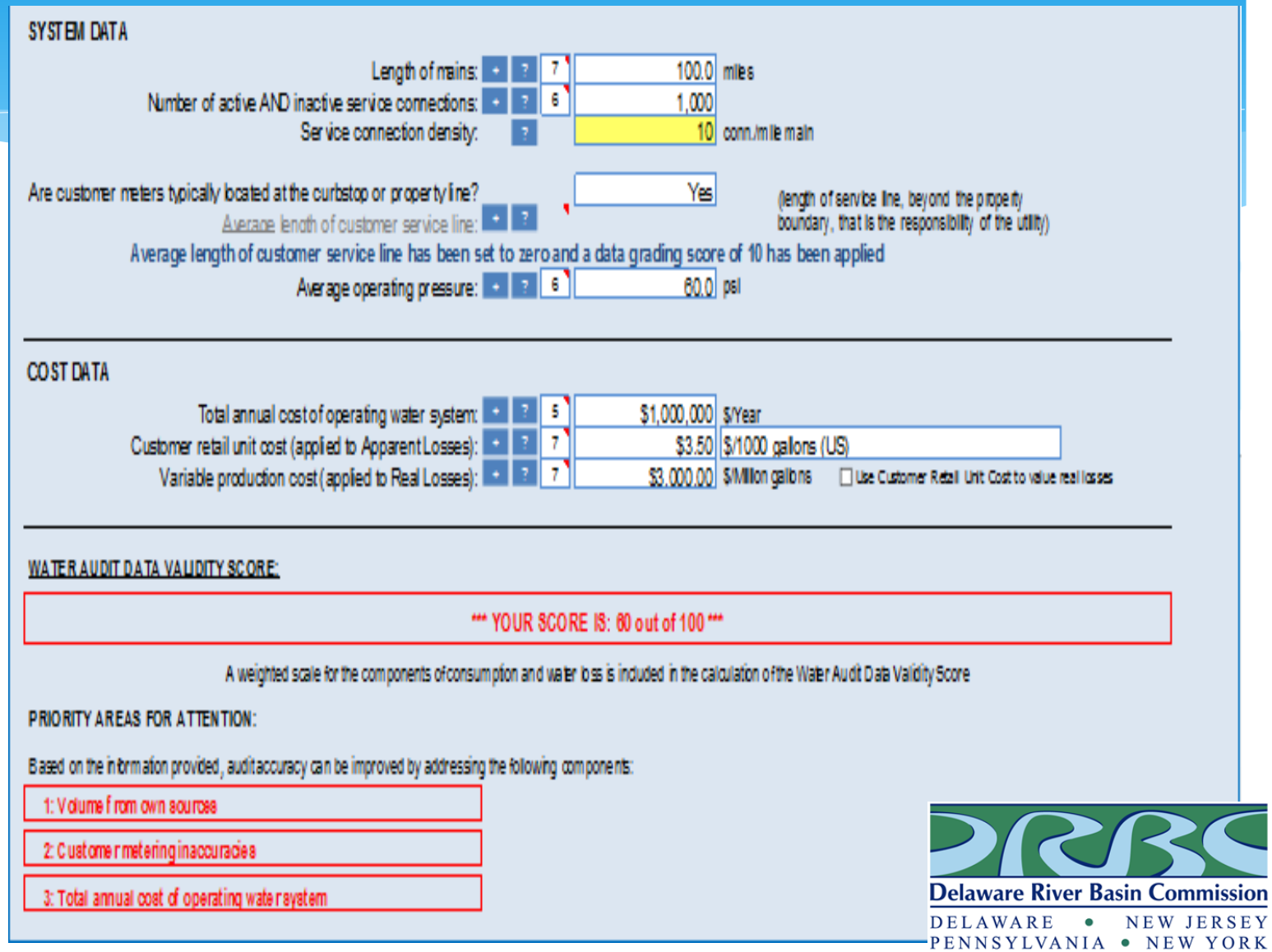
AWWA Free Water Audit Software
Reporting Worksheet
(Bottom Portion)

Inputs on this portion of the Reporting Worksheet include:

- System Data
- Cost Data
  - System Operating Cost
  - Customer Unit Retail Cost
  - Variable Production Cost
- Data Gradings



SYSTEM DATA

Length of mains: 100.0 miles
Number of active AND inactive service connections: 1,000
Service connection density: 10 conn./mile main

Are customer meters typically located at the curbstop or property line? Yes
Average length of customer service line: (length of service line, beyond the property boundary, that is the responsibility of the utility)
Average length of customer service line has been set to zero and a data grading score of 10 has been applied

Average operating pressure: 60.0 psi

COST DATA

Total annual cost of operating water system: $1,000,000 $/Year
Customer retail unit cost (applied to Apparent Losses): $3.50 $/1000 gallons (US)
Variable production cost (applied to Real Losses): $3,000.00 $/Million gallons ☐ Use Customer Retail Unit Cost to value real losses

WATER AUDIT DATA VALIDITY SCORE:

*** YOUR SCORE IS: 60 out of 100 ***

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources
2: Customer metering inaccuracies
3: Total annual cost of operating water system

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Water Audit Data Quality & Validation Levels

* The Data Validation Process includes five levels of data quality which are defined below:
  - **Self-reported** – data have been collected, but not been subject to any in-depth review
  - **Filtered** - have been checked for technical plausibility by employing a screening criteria, such as ILI < 1.0 or > 20.0
* Data validation conducts in-depth review of the data sources and practices of the water utility
  - **Level 1 validated** - focuses primarily on the suitability of the data gradings assigned to the various inputs, with scrutiny on the data inputs to flag gross or egregious errors
  - **level 2 validated** - in-depth investigation of various input data and information of one or more components of the water audit. This is still largely a desk-top activity.
  - **level 3 validated** - Bottom-up review and investigation into a single component or sub-component that collects new or additional data at a field/source level, and provides detailed analysis

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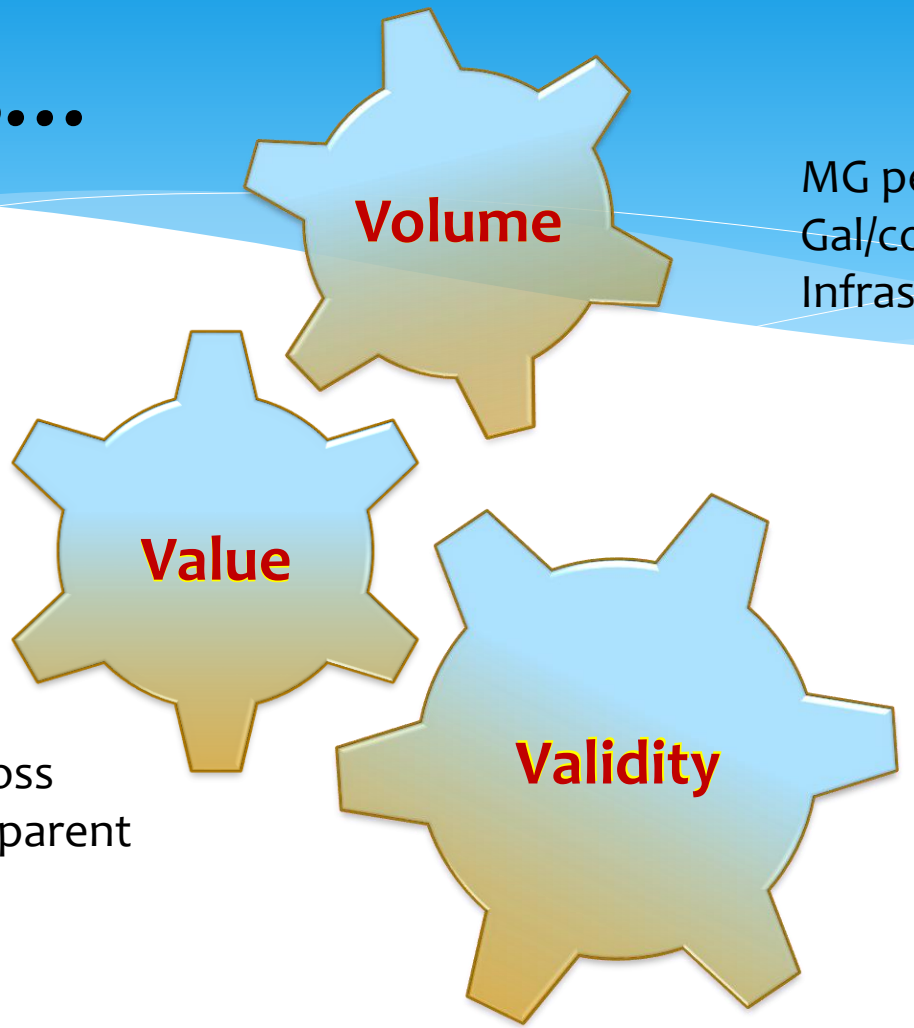
How to Assess Water Loss and Its Impacts

Three "V"s…



MG per Year
Gal/connection/day
Infrastructure Leakage Index

$ per Year
Economic Loss
Real and Apparent

Data Input Grading
Water Audit Data Validity
Score

Credit: George Kunkel

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How to Assess Water Loss and Its Impact

- **Volume**
  - Apparent Losses, annual volume
  - Normalized apparent losses, gallons/service connection/day
  - Real Losses, annual volume
  - Normalized real losses, gallons/service connection/day
  - Normalized real losses, gallons/mile of pipeline/day (for low density systems)
  - Infrastructure Leakage Index (ILI) = Real Loss volume/Unavoidable Annual Real Losses (the UARL is a calculated reference value that includes system specific data: length of mains, # of service connections, average pressure, and length of service lines owned by customers)
- **Value**
  - Customer Unit Retail Costs and Apparent Loss Costs
  - Variable Production Costs and Real Loss Costs
  - Non-revenue Water percent by cost
- **Validity**
  - Data Validity Score

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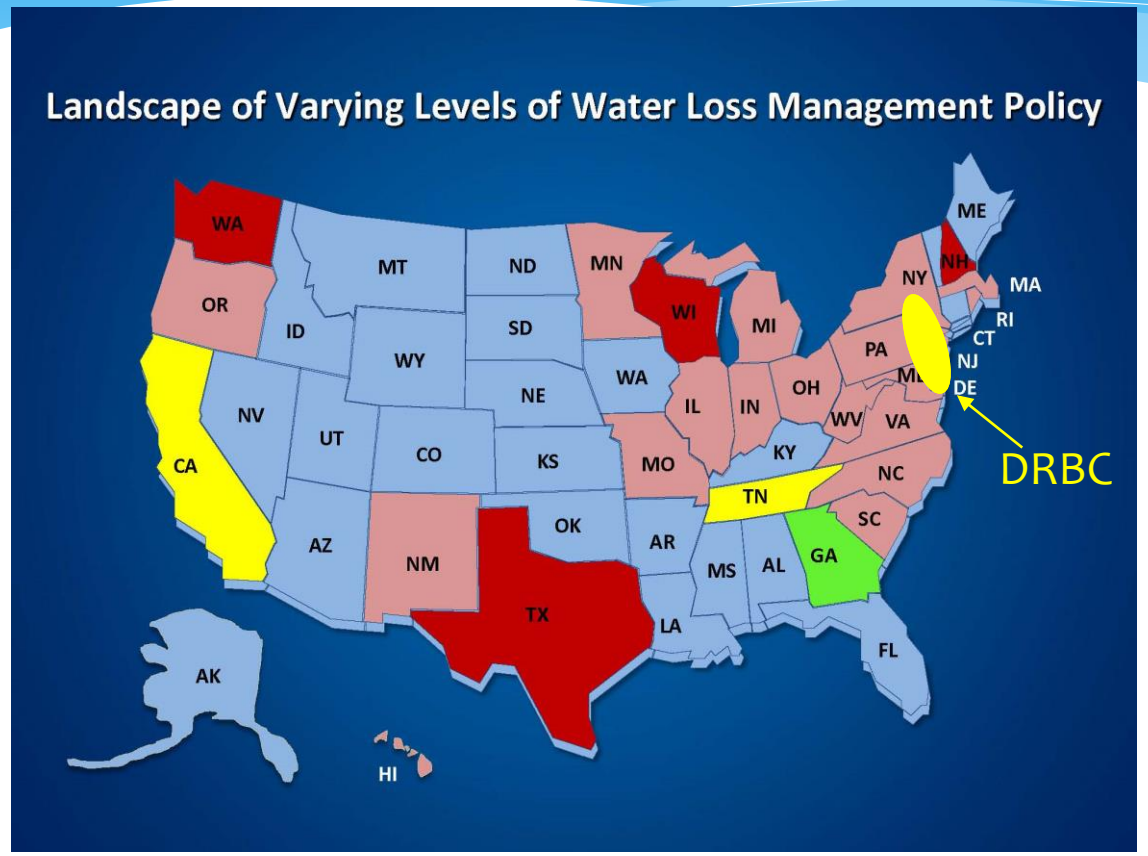
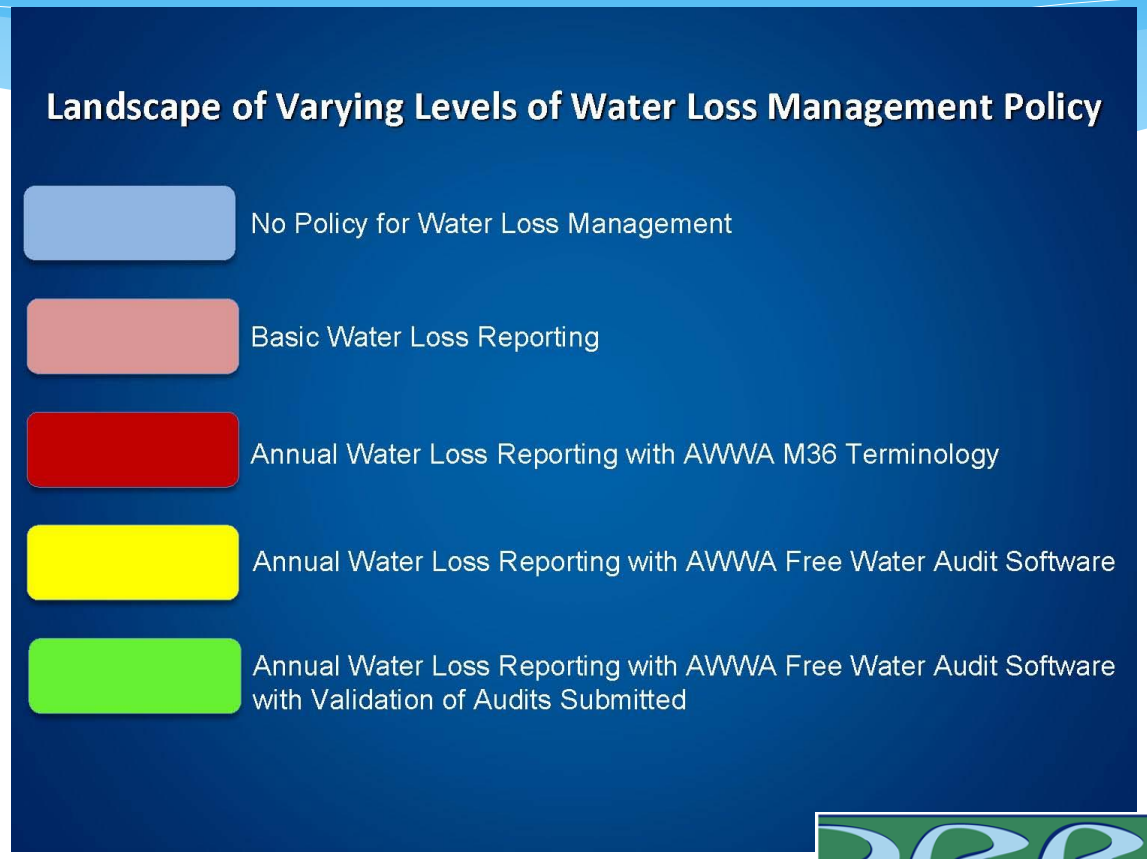
Water Loss – National Perspective





State By State Water Loss Policy Map. American Water Works Association, 2015. Web. 5 Feb. 2016. <https://www.awwa.org/Portals/0/files/resources/water%20knowledge/water%20loss%20control/state%20of%20the%20states_Apr2016.pdf>.

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Water Audit Data Analysis: CY2016 Results for the Delaware River Basin…

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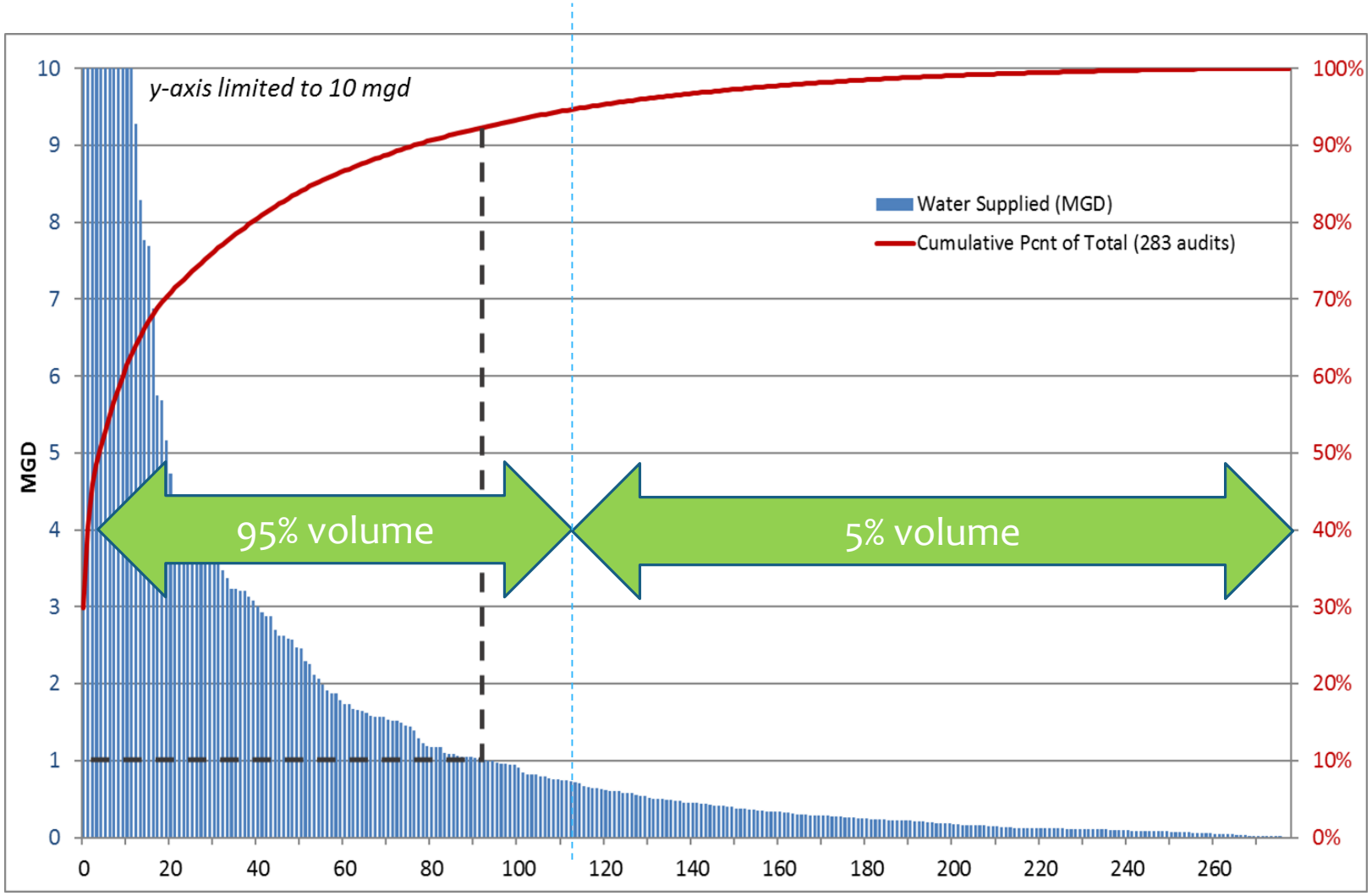
Water Supplied in CY2016 (MGD) - DRB



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Water Audit Data Validity Score
CY2016 - DRB

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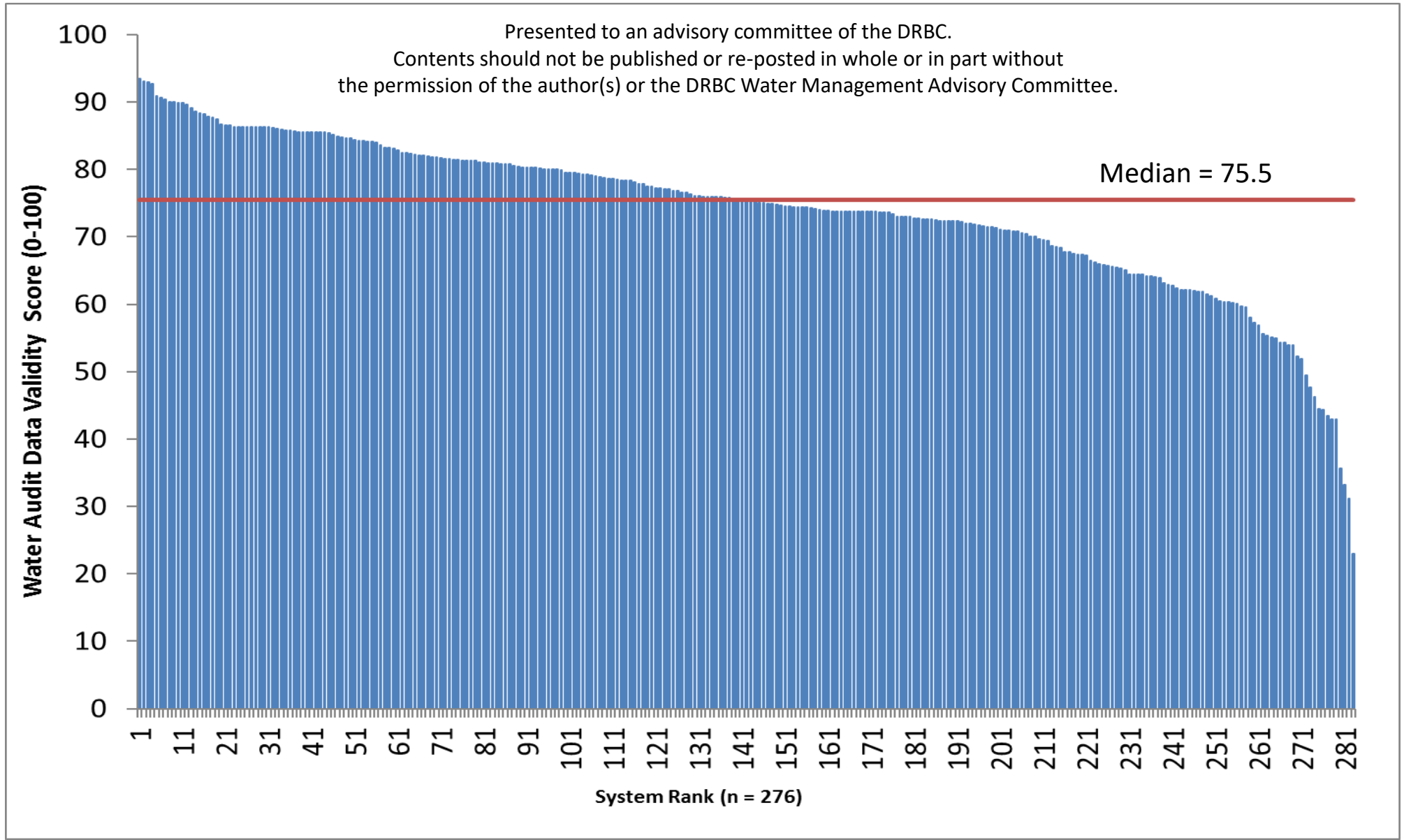

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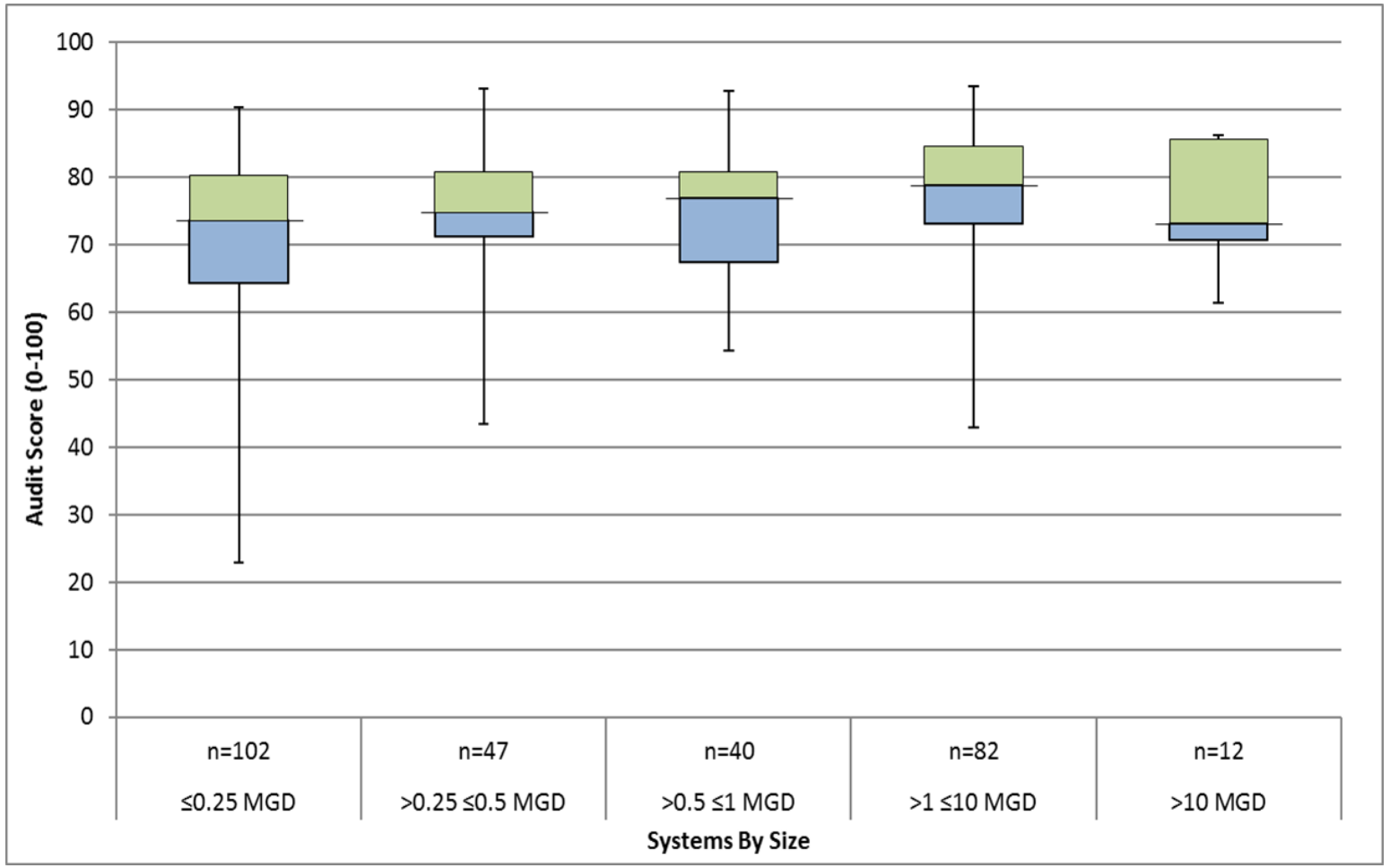
Water Audit Data Validity Score
CY2016 - DRB



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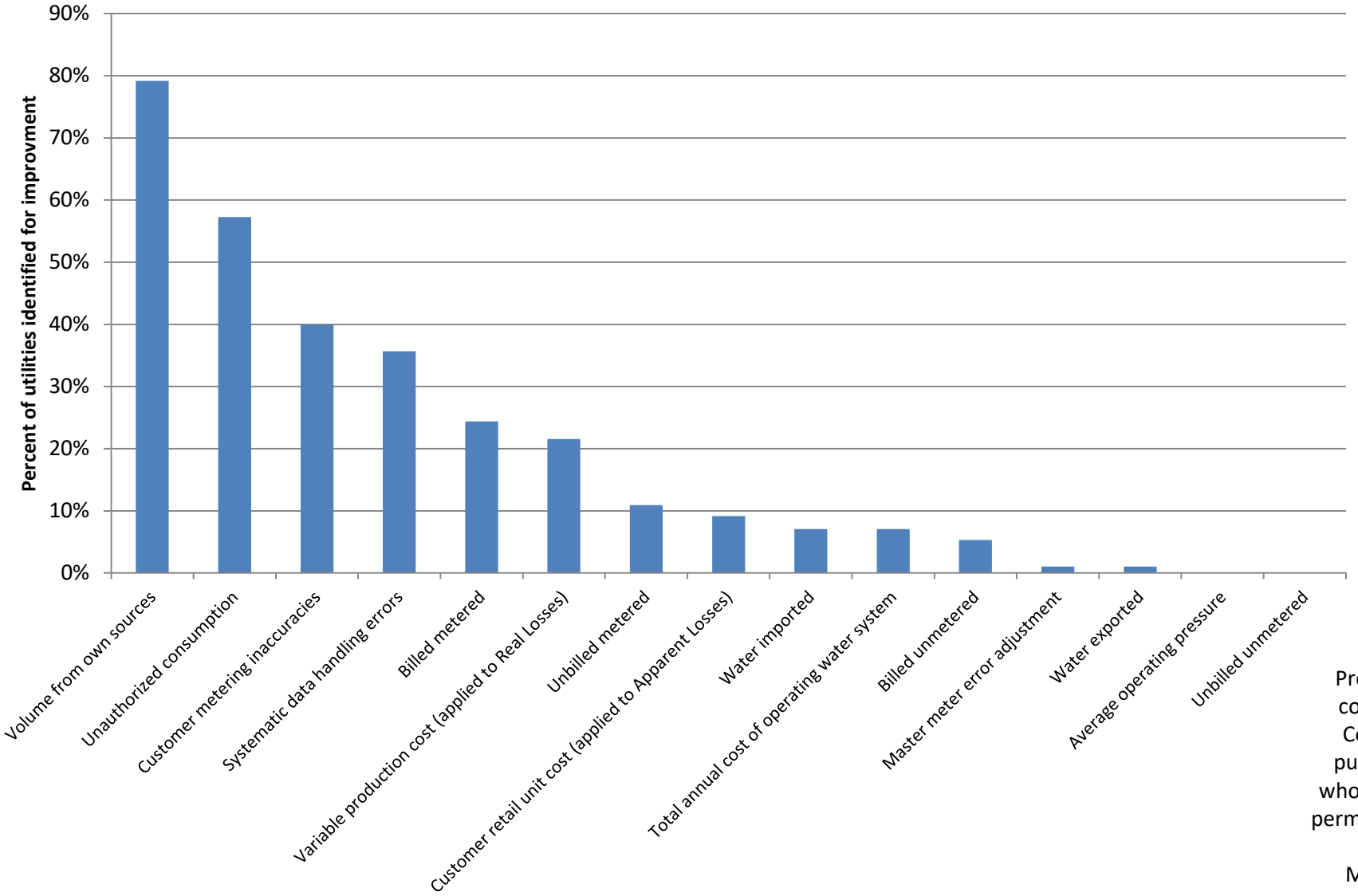
Priority Areas to Improve Grading Score
CY2016 - DRB



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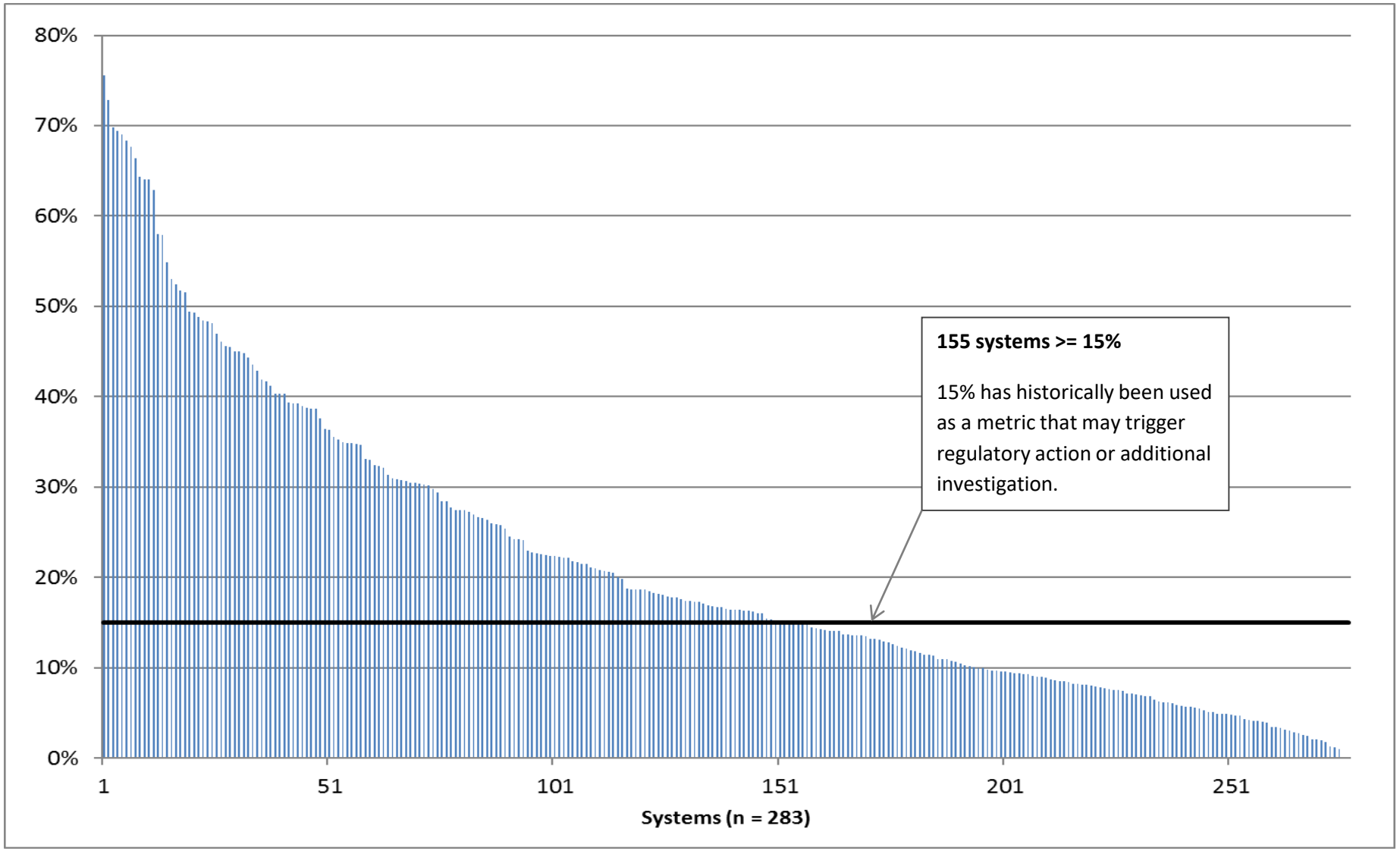
Non-Revenue Water as % of Water Supplied
CY2016 - DRB



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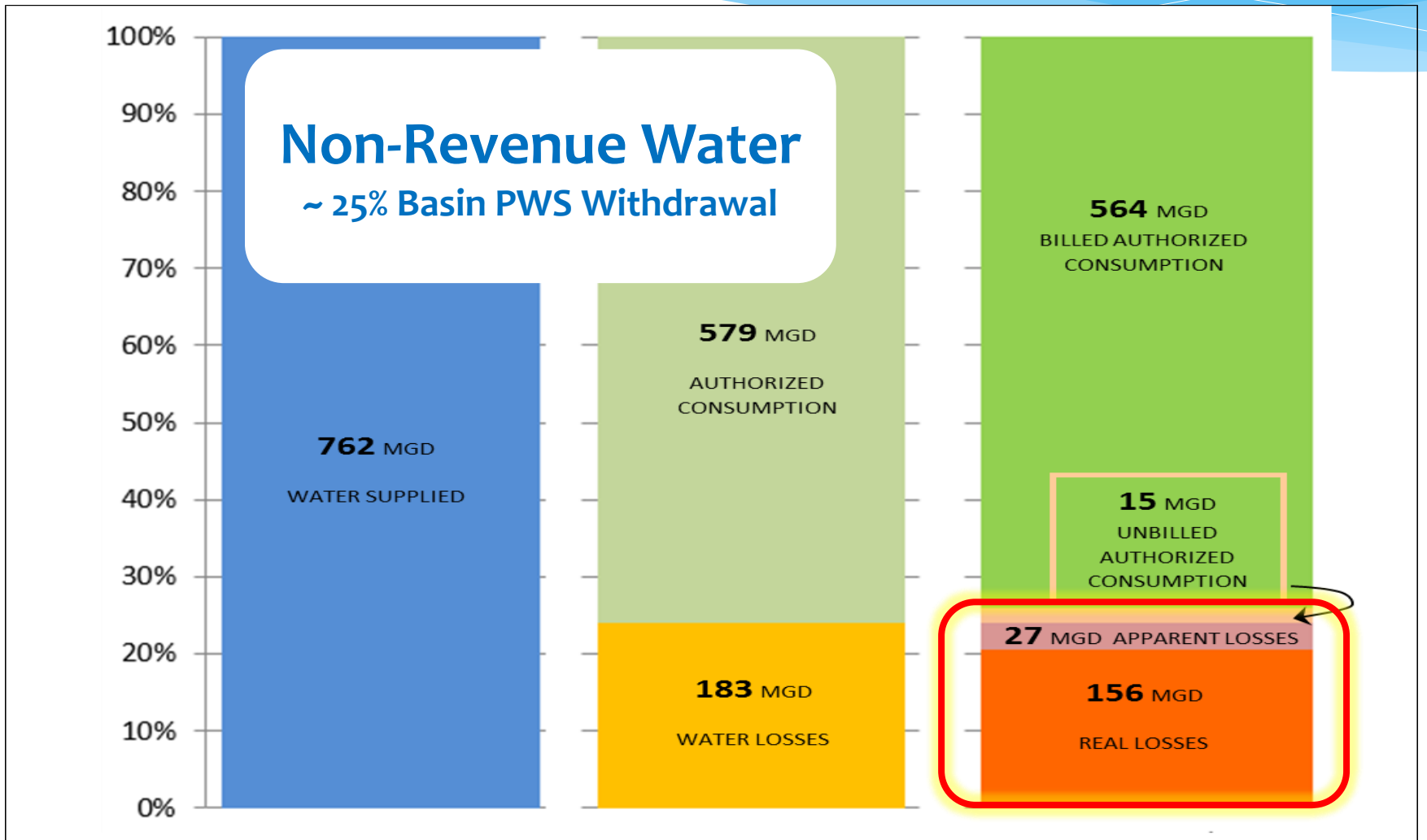
DRBC water audit program summary (CY2016)



Billed authorized: All consumption that is billed to customers of the utility; this includes metered and unmetered connections.

Unbilled Authorized: All consumption that is unbilled but is still authorized by the utility. This is likely to include water used in activities such as firefighting, flushing of mains and sewers, street cleaning and fire flow tests. It may also include water consumed by the utility itself in treatment or distribution operations, or metered water provided to civic or institutions free of charge.

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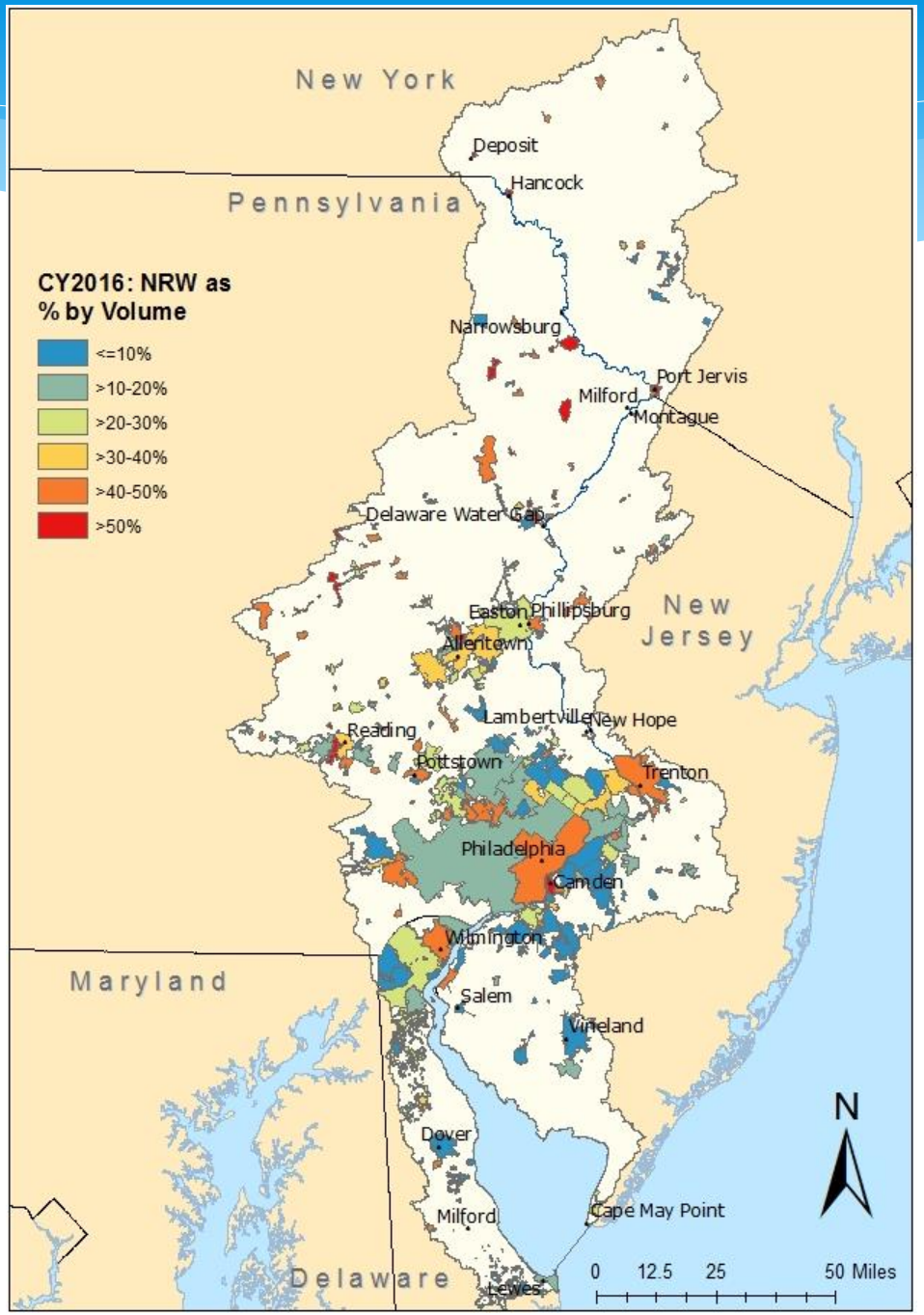
Water System Map of Non-Revenue Water (NRW) Percent by Volume



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Status / Lessons Learned

- No. of PWS in the basin reporting (100,000 gpd threshold)
- Compliance/trends
- Lessons learned

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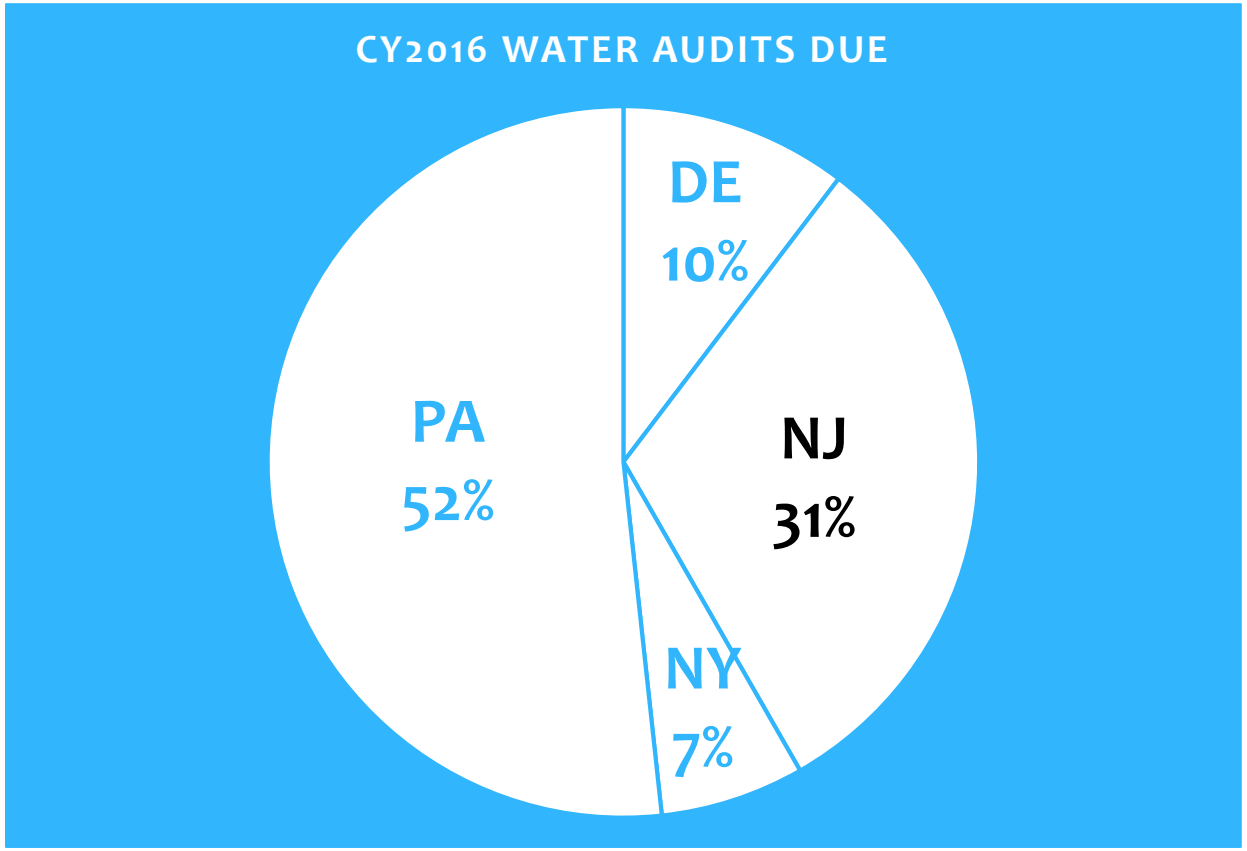

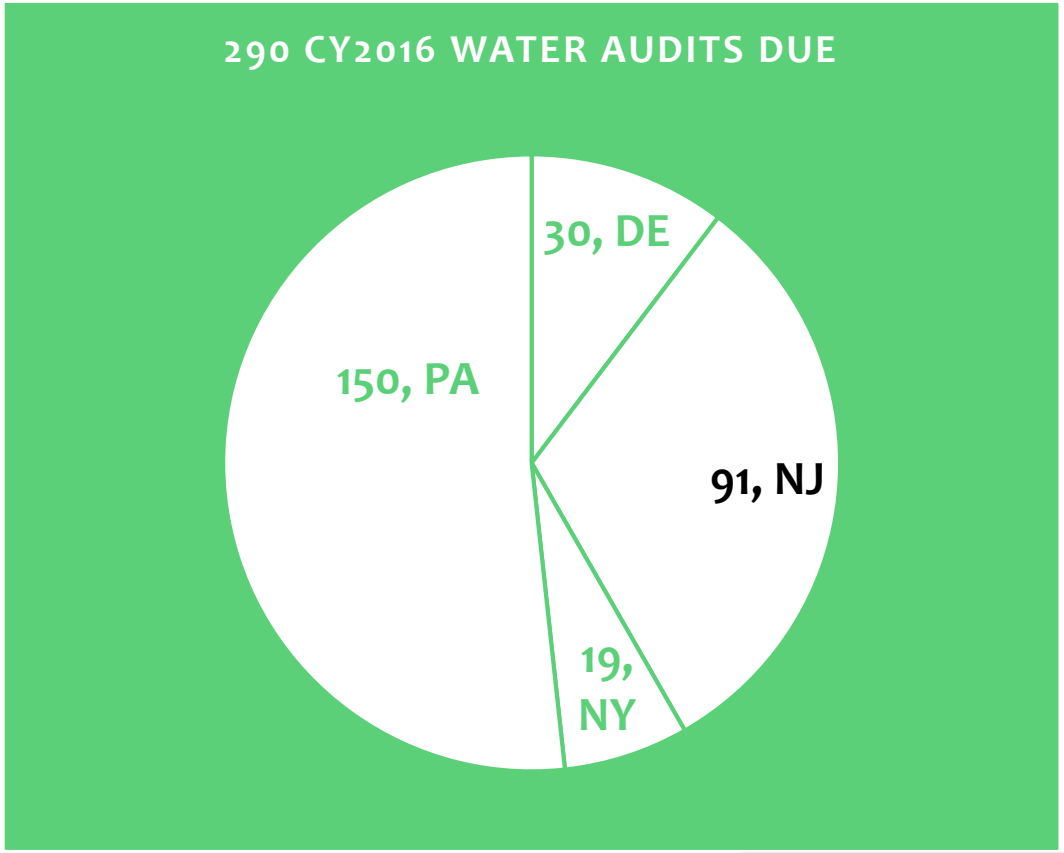

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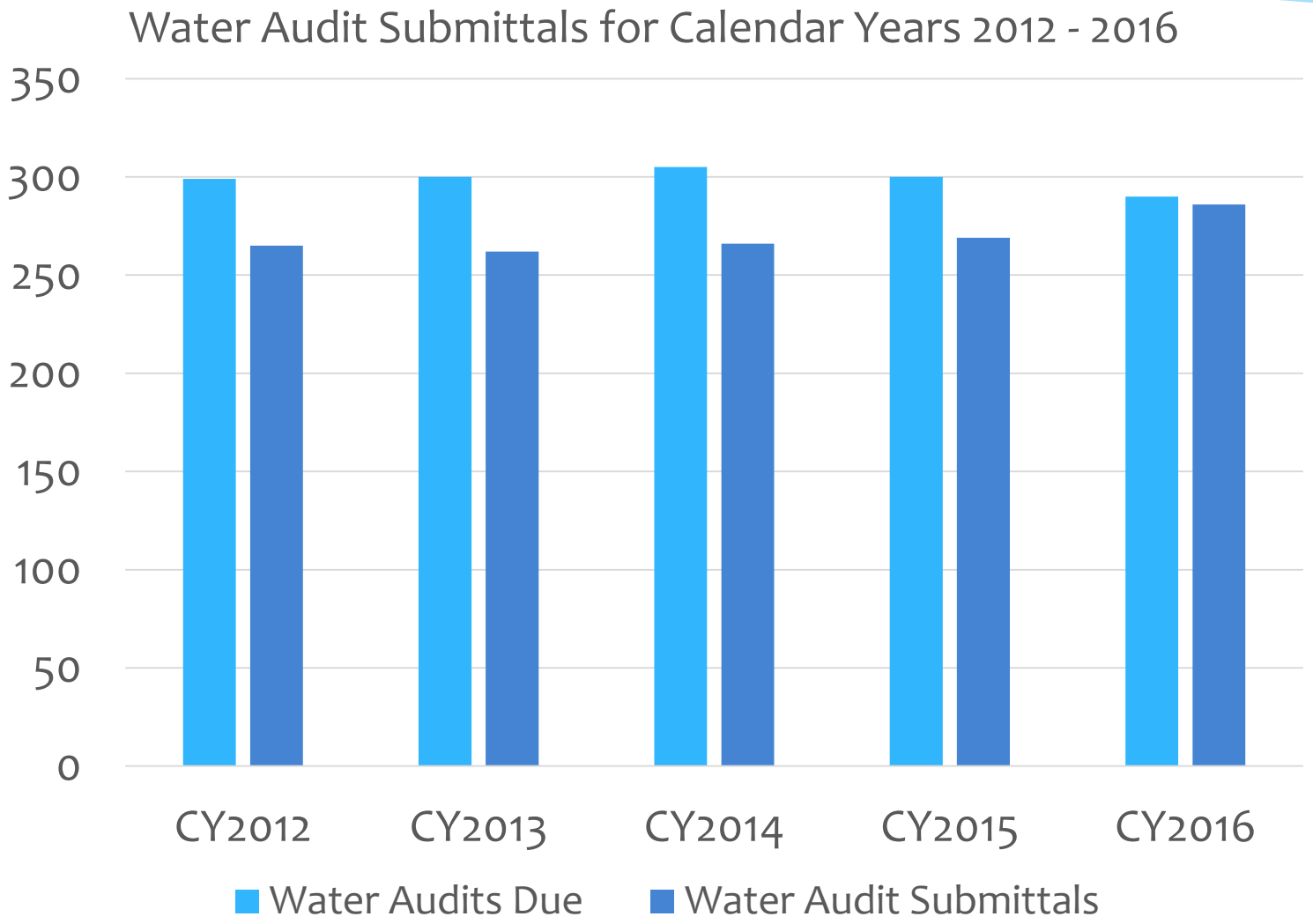
Status / Lessons Learned



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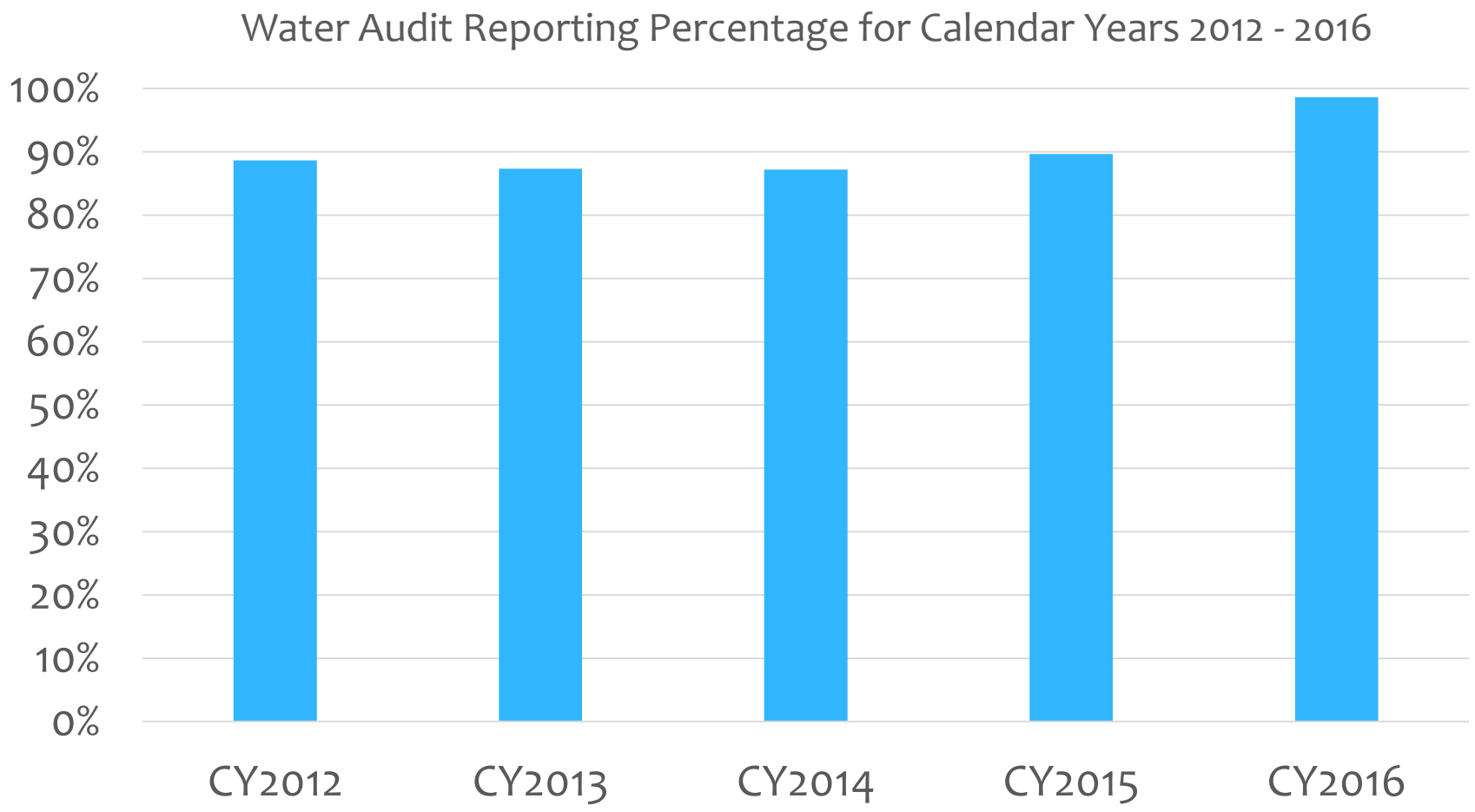
Status / Lessons Learned



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Status / Lessons Learned

- **Lessons learned**
  - Education & outreach to small utilities
  - Beneficial program for water efficiency and utility function/costs
  - Patience & persistence & a “stick”

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Conclusions / Next Steps

- **Water Use Trends:** basin export trends relatively flat while consumptive use trends vary for the 3 major sectors
- **Water Audit:**
  - Raising awareness of best practice & trends in conservation
  - Asset Management Tool
  - DRBC leadership in Water Auditing: Training / Support / QA/QC
  - DRBC involvement in AWWA Performance Indicators Task Force
  - Future indicators (ILI, gal/conn)for water management
  - Training:
    - NJ: August 8 (half-day), Rutgers, New Brunswick, NJ
    - PA: DRBC Hosting Training Series (9/27, 10/23, 11/28), BCCC, Newtown, PA

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Ken Najjar

Director, Water Resource Management

Ken.Najjar@drbc.nj.gov

www.drbc.net

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Managing Our Shared Water Resources since 1961

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