Ammonia & Nitrate: Considering Nitrogen Removal when Upgrading to Meet Ammonia Standards

Kansas
Department of Health and Environment

2017 Nutrient Permitting Workshop

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Kansas has pushed Phosphorus as Nutrient of Concern

- Midwest Freshwater systems that are chock full of phosphorus
- Kansas overarching goals were 30% reduction in nitrogen and phosphorus loads leaving the State
  - Nitrogen viewed as the external issue – Gulf of Mexico
  - Phosphorus viewed as more critical local issue – Kansas reservoirs and streams
  - Almost all streams leaving Kansas wind up in an out-of-state reservoir or the Missouri River

- Push Major POTWs to evaluate installing nutrient reduction
  - Initially, Kansas BNR = 1.5 mg/l TP and 8 mg/l TN as rolling 12-mo average
  - Pushback by municipalities and consultants indicated space and energy issues with TN removal
  - Led to Option 2 BNR = 1 mg/l TP and 10 mg/l TN

On NPS front, phosphorus easier to control than nitrogen (sediment vs water)

Nitrate in Kansas is a ground water/drinking water issue – linked to fertilizer/manure applications

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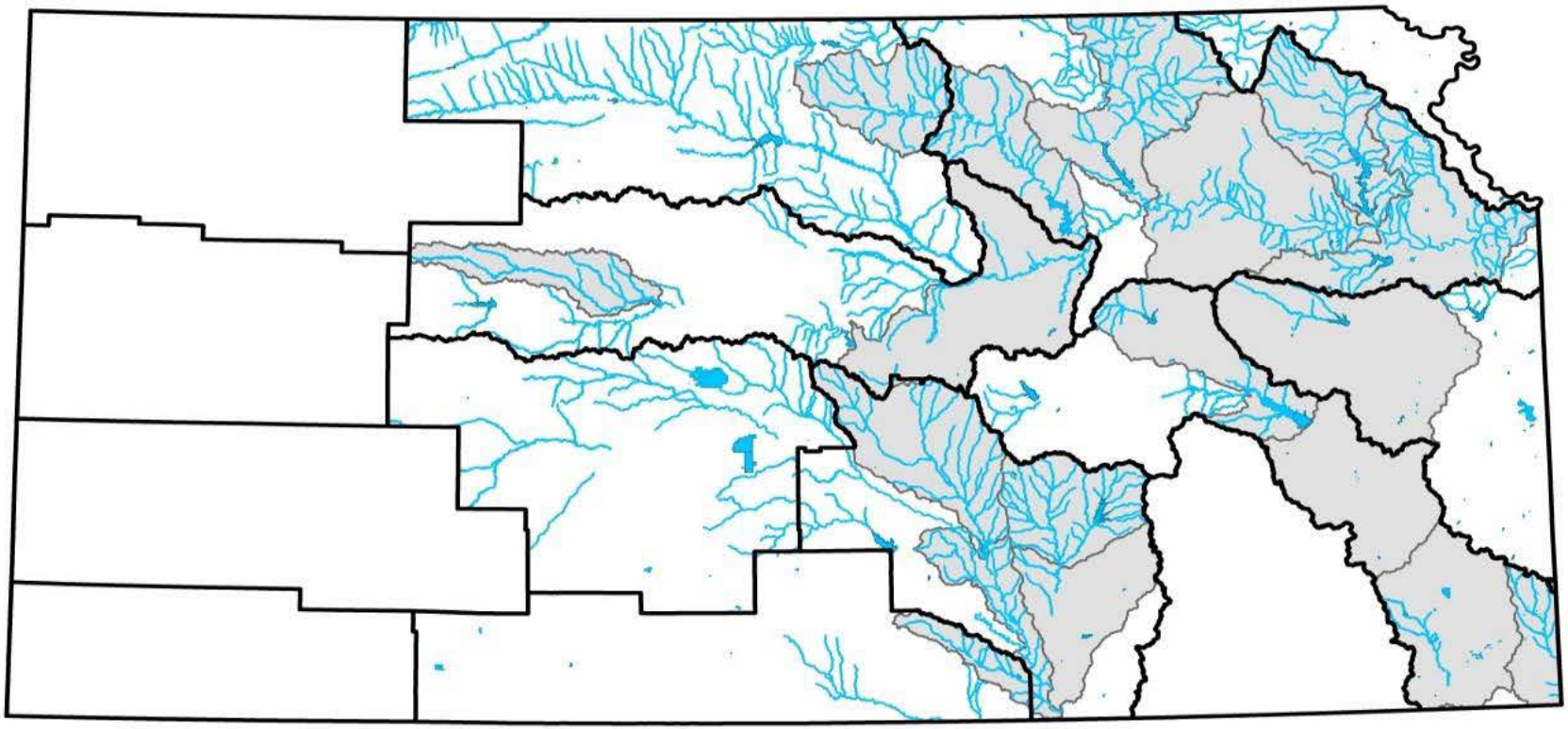
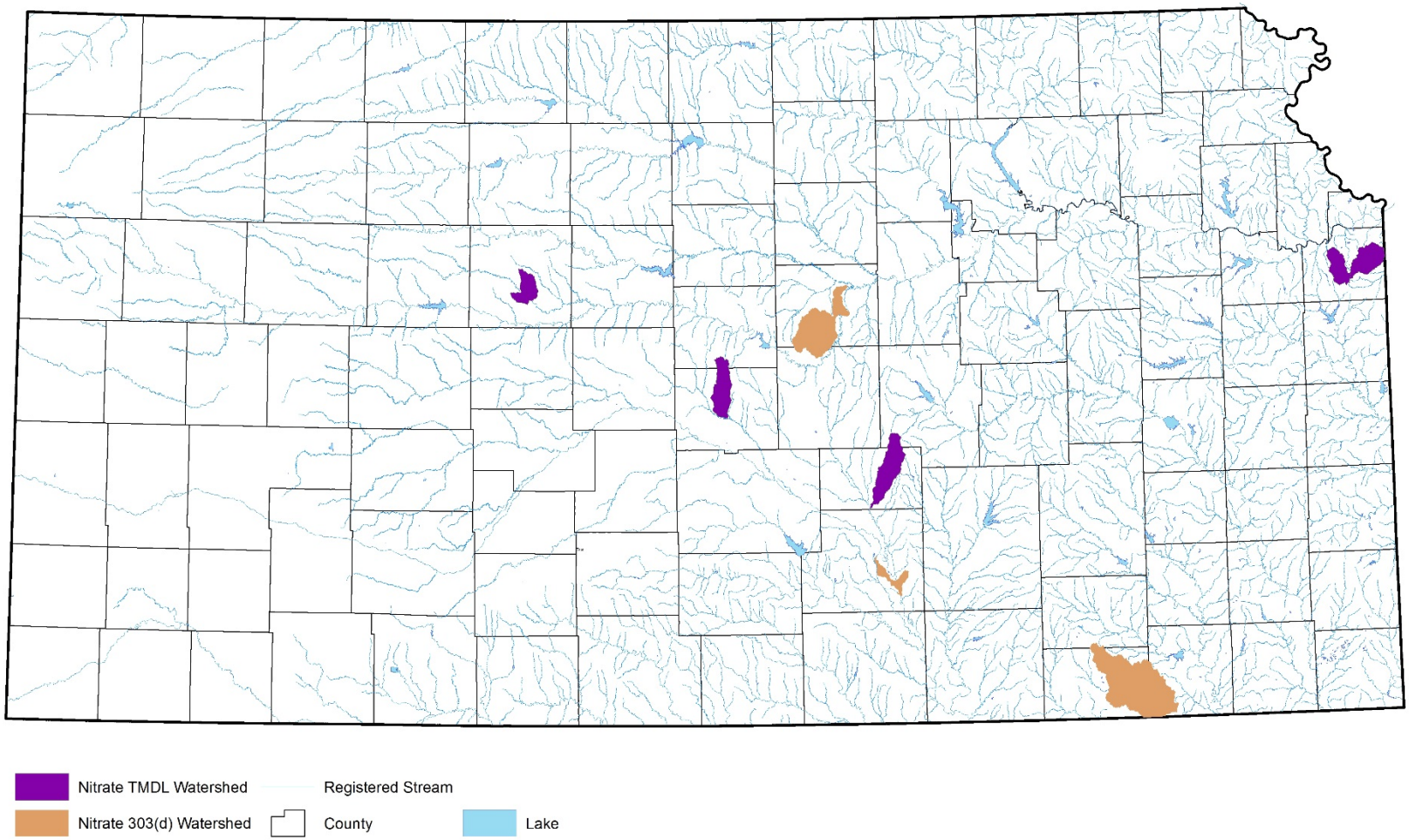
- TMDL Priority Basins 2012 – 2022 – Mostly TP stream issues



Stream Nitrate Impairments almost always linked



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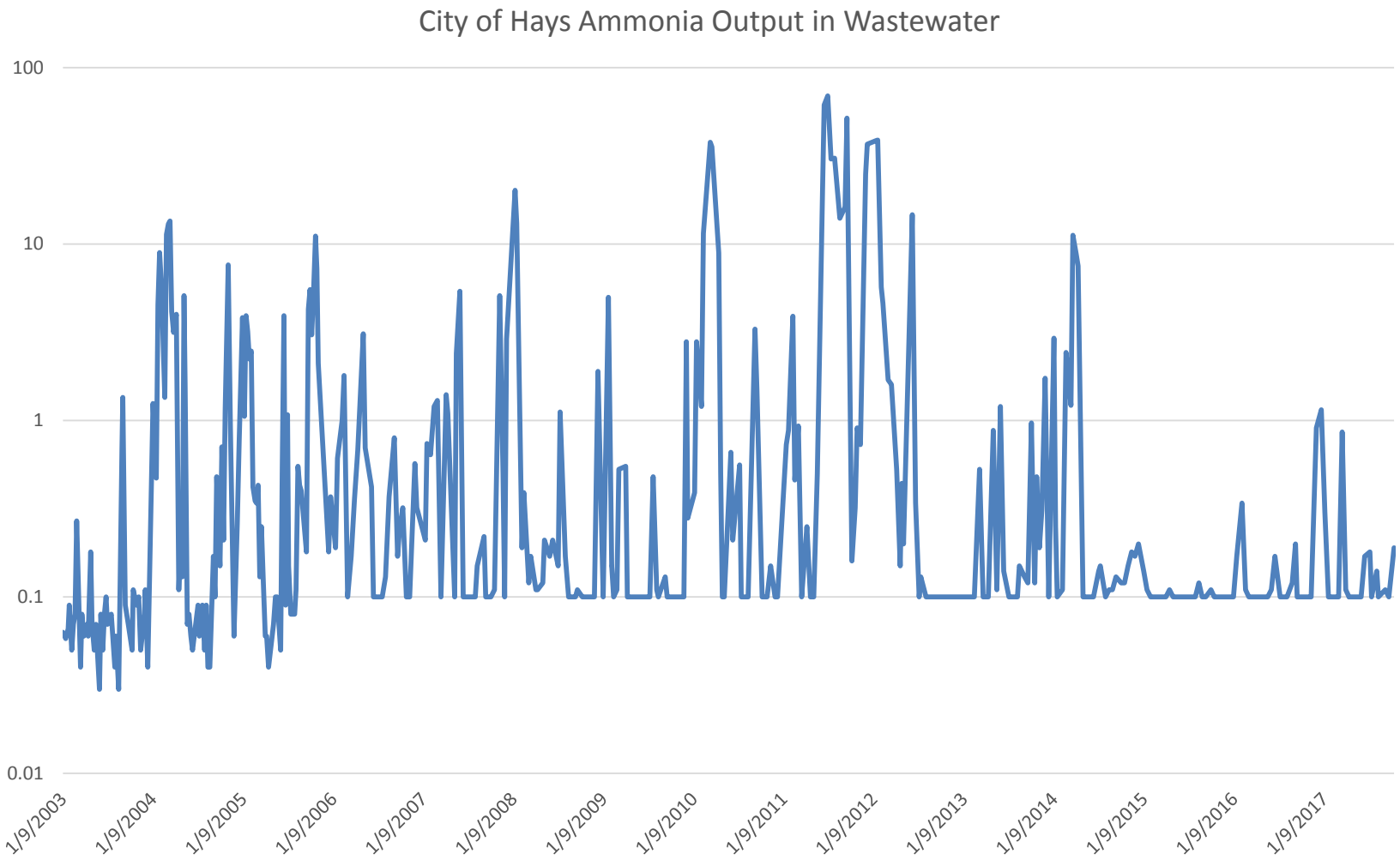
The Problem Started in the late 80's

- Revised the ammonia criteria in 1987 – toxic impacts
- Pushed NPDES to nitrify and lower ammonia through the 1990's at existing facilities
- Neglected to close the loop and require denitrification as well
- Hence, the ammonia issues of the 80's became the nitrate issues of the new millennium
- *Side note: ammonia is still a toxic as well as the preferred nitrogen source of stream biology; so the efforts of the 80's (Salina, Wichita) did see an uptick in the quality of the macroinvertebrate community in Kansas streams*
- Nitrate has retained its criterion of 10 mg/l for eons

Even Mediocre Performers did OK



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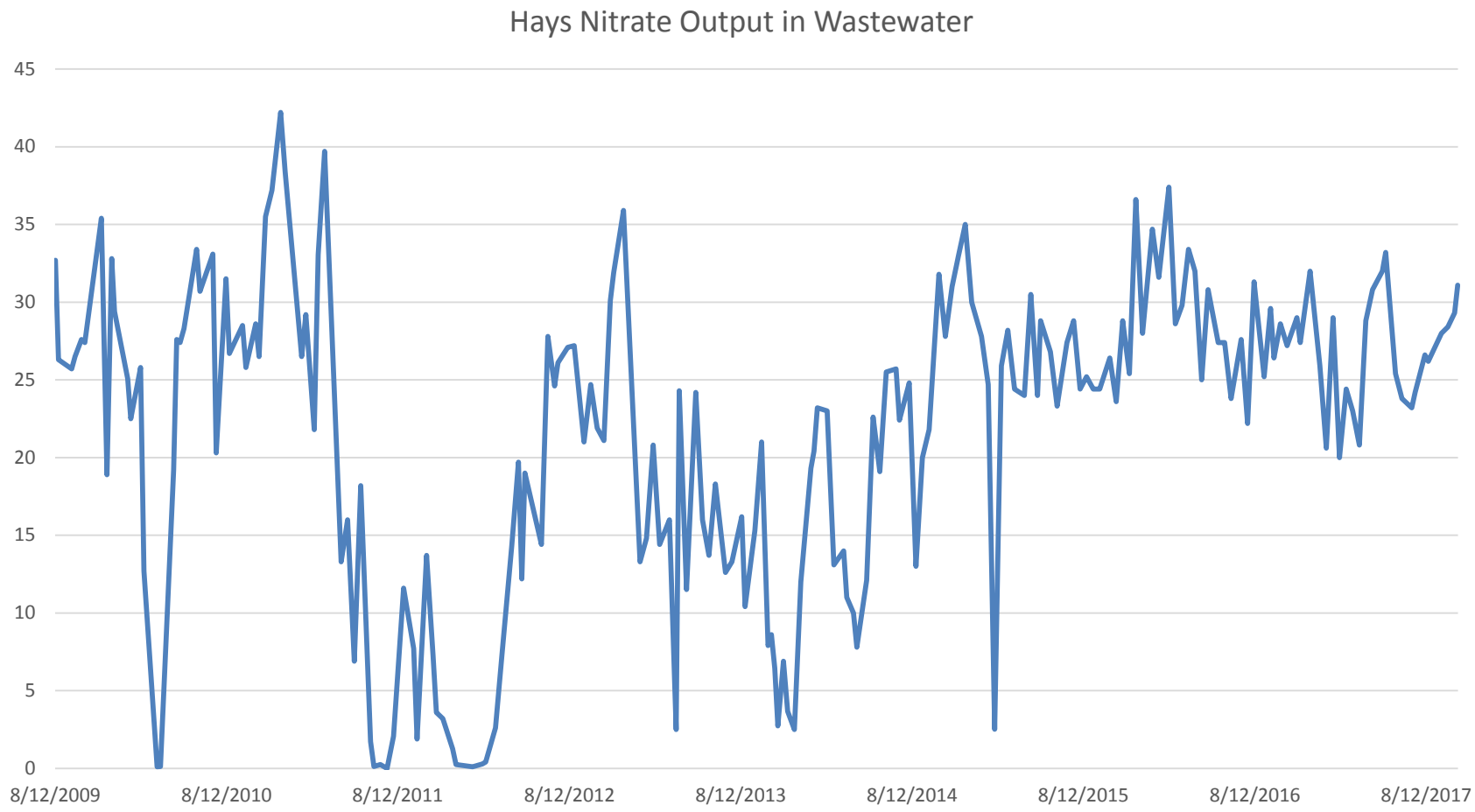
Unintended Consequences & Incomplete Thoughts



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Two Drivers for Nitrogen Reduction Now

- Kansas adopting the 2013 ammonia criteria – rich database of historic presence of mussel communities throughout state.
- Essentially ammonia will be at or below 1 mg/l in streams to avoid long term degradation
- Nitrate TMDLs push POTWs to upgrade operationally to denitrify < 10 mg/l

Success Story: City of Newton

Nitrate & TP TMDLs on Sand Creek

Nitrate (& Nitrite) WLA = 174 #/d (7 mg/l goal –MOS penalty)

Phosphorus WLA = 37.6 #/d
But both based on 3 MGD

And POTW plant expanded from 3 to 4.4 MGD (lowers effective goals for N & P)

Permit Expectations

Upgrades treatment to BNR; went online in Jan 16

Mass limits PLUS 10 mg/l NO3 limit

Ammonia remains non-issue now and forever….

2014-15 # of NH3 detects = 68% (1.8 mg/l avg)

2016-17 # of NH3 detects = 31% (0.25 mg/l avg)

Denitrification, wetland polishing, reuse all lead to lowered nitrate input into Sand Creek

Newton's Tale of the Tape

Parameter	2014 – 2015	2016 - 2017	Change
NO3 Conc.	6.2 mg/l	3.0 mg/l	- 52%
TN Load	128 #/d	61 #/d	- 55%
Downstream NO3	2.9 mg/l	1.1 mg/l	- 62%
TP Conc	3.3 mg/l	1.2 mg/l	- 64%
TP Load	43 #/d	13 #/d	- 70%
Downstream TP	1.56 mg/l	0.67 mg/l	-57%

Upgrades & Management of Concentration & Mass

- City of Manhattan upgraded POTW to 11 MGD
- Antidegradation imposed 8 mg/l TN and 1.5 mg/l TP LIMITS on upgraded plant
- BNR operations have been stellar
- No ammonia issues; TN ~ NO3 < 7 mg/l; TP ~ 0.3 mg/l

- City worried about seasonal upsets leading to TN > 8 mg/l will occur on occasion
- Kansas reissued NPDES permit with limits converted to mass (based on 8 mg/l TN and 1 mg/l TP)

- Creates larger compliance cushion while **continuing to reward** best nutrient output along the Kansas River.

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Sometimes it just takes some operational chops

- City of Concordia: 1.35 MGD Activated Sludge Plant
- Used Technical Assistance Provided by Jerry Grant of Ft Scott Community College to establish air on, air off sequences
- Produces very good nitrogen output without capital expenditures
- Non-detect NH3
- 2010 – 2015 NO3 = 11.3 mg/l
- 2016 – 2017 NO3 = 0.18 mg/l
- Shows value of operator experience, PLCs/SCADA and good monitoring of sewage conditions

The one complication: Lagoons

- Typical choice of small town Kansas
- Three, four or five cell detention systems
- Provide very good, very “green” wastewater treatment
  - KDHE Study: Well designed, well run facultative lagoon will produce 10 mg/l of TN and 2 mg/l of TP….Not Bad….
- But not likely to be able to meet new ammonia criteria
- Financial capabilities of small towns do not lend themselves to bringing on a mechanical plant
- Creating a Multi-Discharger Variance to cover these systems against new ammonia criteria; reset limit at historic 99% value of actual output
- No growth, no industry, no compliance jeopardy
- Probably < 2-5% of the statewide wasteload from Kansas municipalities – MDV is small price to pay for better effluent

Take away messages

- Phosphorus removal remains job #1 for Kansas NPDES
- Taking care of NH3 and NO3 lightens the need to worry about TN limits
- Good operations experience drives output far below goals/limits
- In time, biology data may indicate a need to revisit nitrogen output from NPDES
- In the meantime, the NPS influence will dominate attention; provided NPDES has taken care of its responsibility for baseflow nutrient levels

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