Baselines and Nonpoint Source Credits in North Carolina Nutrient Strategies

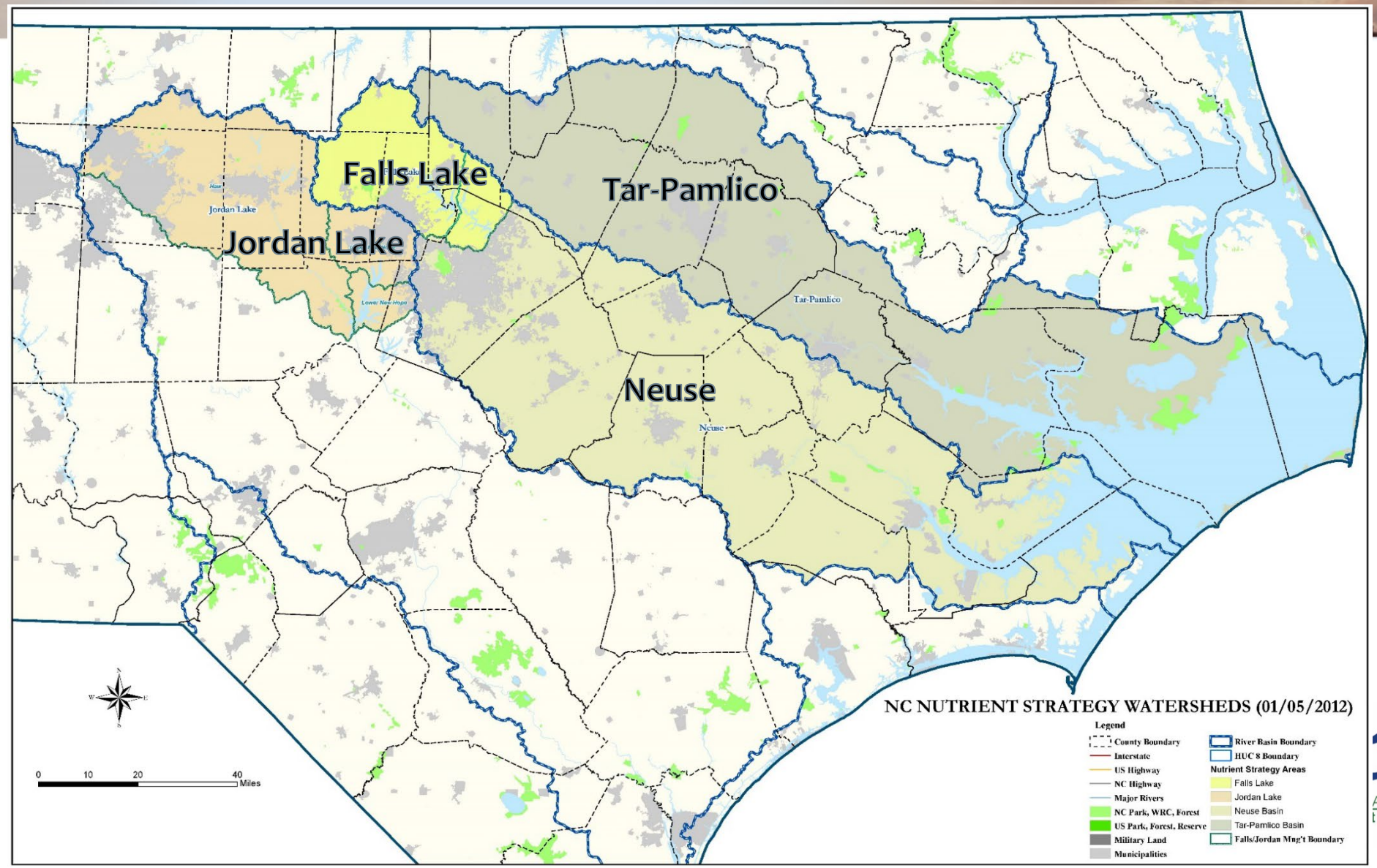
October 2020 ACWA Nutrients Permitting Workshop

Rich Gannon, NC DWR Nonpoint Source Planning Branch

NC's Nutrient Regulatory Foundation

- Federal + state authorities
- 1978 - Chlorophyll a criterion: 40 µg/L (10/90)
  - No numeric N or P criteria (yet)
- 1979 - NSW supplemental classification
- 1997 Clean Water Responsibility Act – EMC shall:
  - Set reduction goals for nutrient-impaired waters,
  - Establish plans with "fair, reasonable and proportionate" reductions from point and nonpoint sources
  - Adopt rules for above, and to implement TMDLs
- Modeling to set point/nonpoint source goals for N, P and guide wasteload allocations for dischargers

‘Modern’ Nutrient Strategy Watersheds



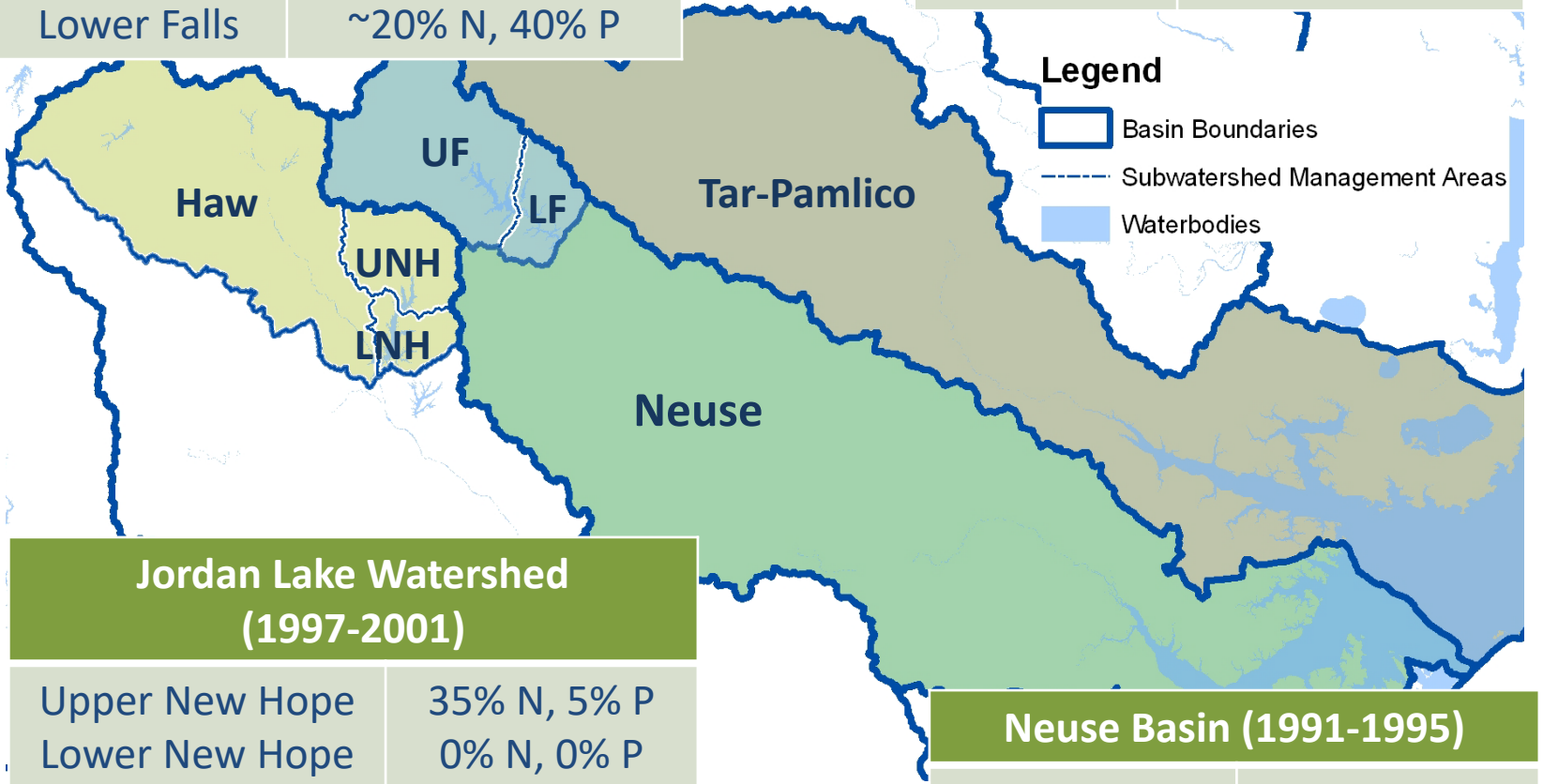
Rule Elements of Modern Nutrient Strategies

- Wastewater
- Agriculture
- Riparian buffer protection
- Stormwater
  - New development
  - Existing development (Jordan, Falls)
- Nutrient trading

Nutrient Strategy Reduction Goals

Falls Lake Watershed (2006)	
Upper Falls	40% N, 77% P
Lower Falls	~20% N, 40% P

Tar-Pamlico Basin (1991)	
Basinwide	30% N, 0% P



Jordan Lake Watershed (1997-2001)	
Upper New Hope	35% N, 5% P
Lower New Hope	0% N, 0% P
Haw River	8% N, 5% P

Neuse Basin (1991-1995)	
Basinwide	30% N

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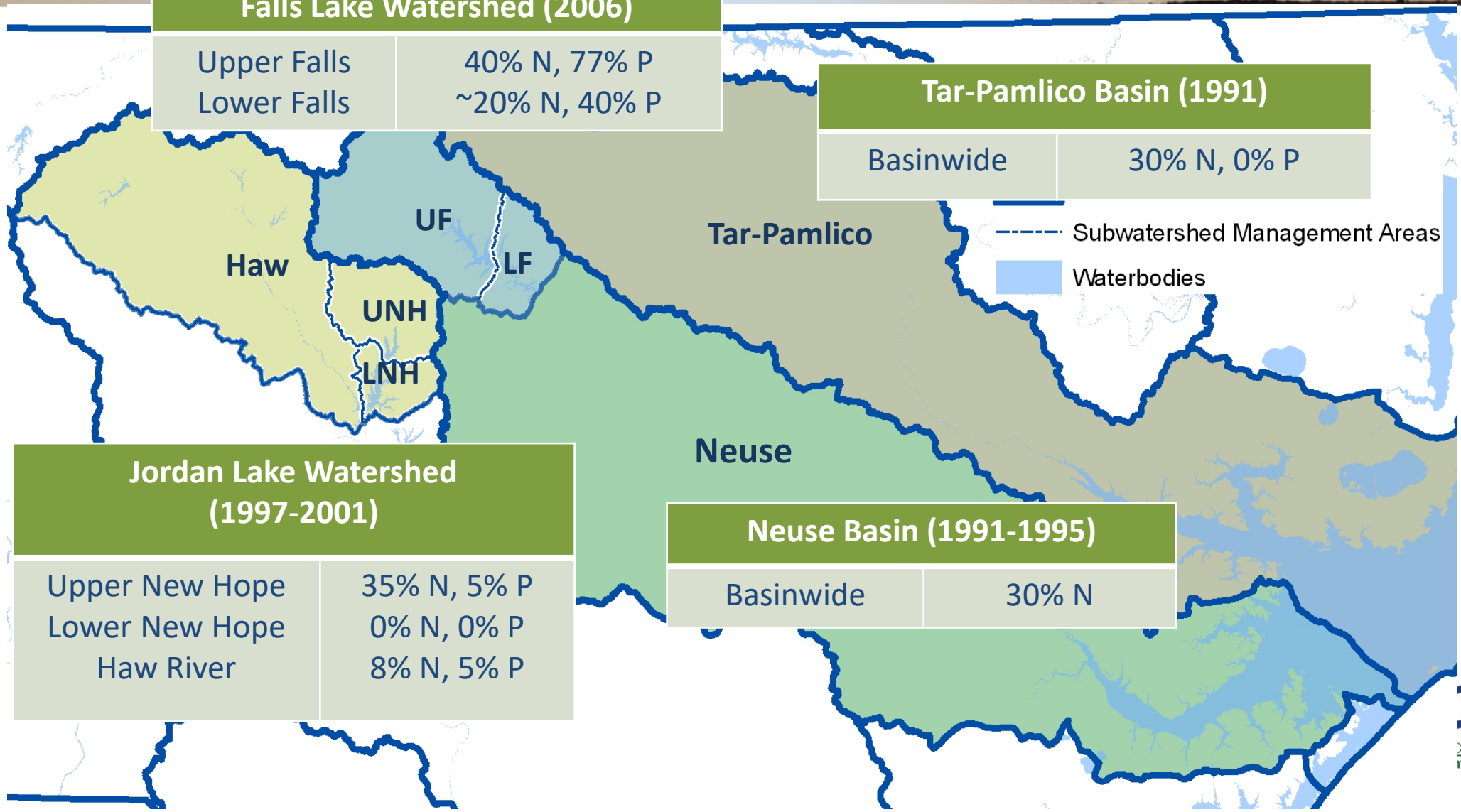

Wastewater Rules

- Individual TN, TP mass limits based on:

  WLA = ∑ equivalent [TN] * permitted flow * delivery factor

- Watershed group permits, compliance associations
- Trading options:
  - Allocation purchase – all facilities
  - NPS offset purchase - new/expanding facilities
- Trades done in delivered loads
- Trades may not create hot spots

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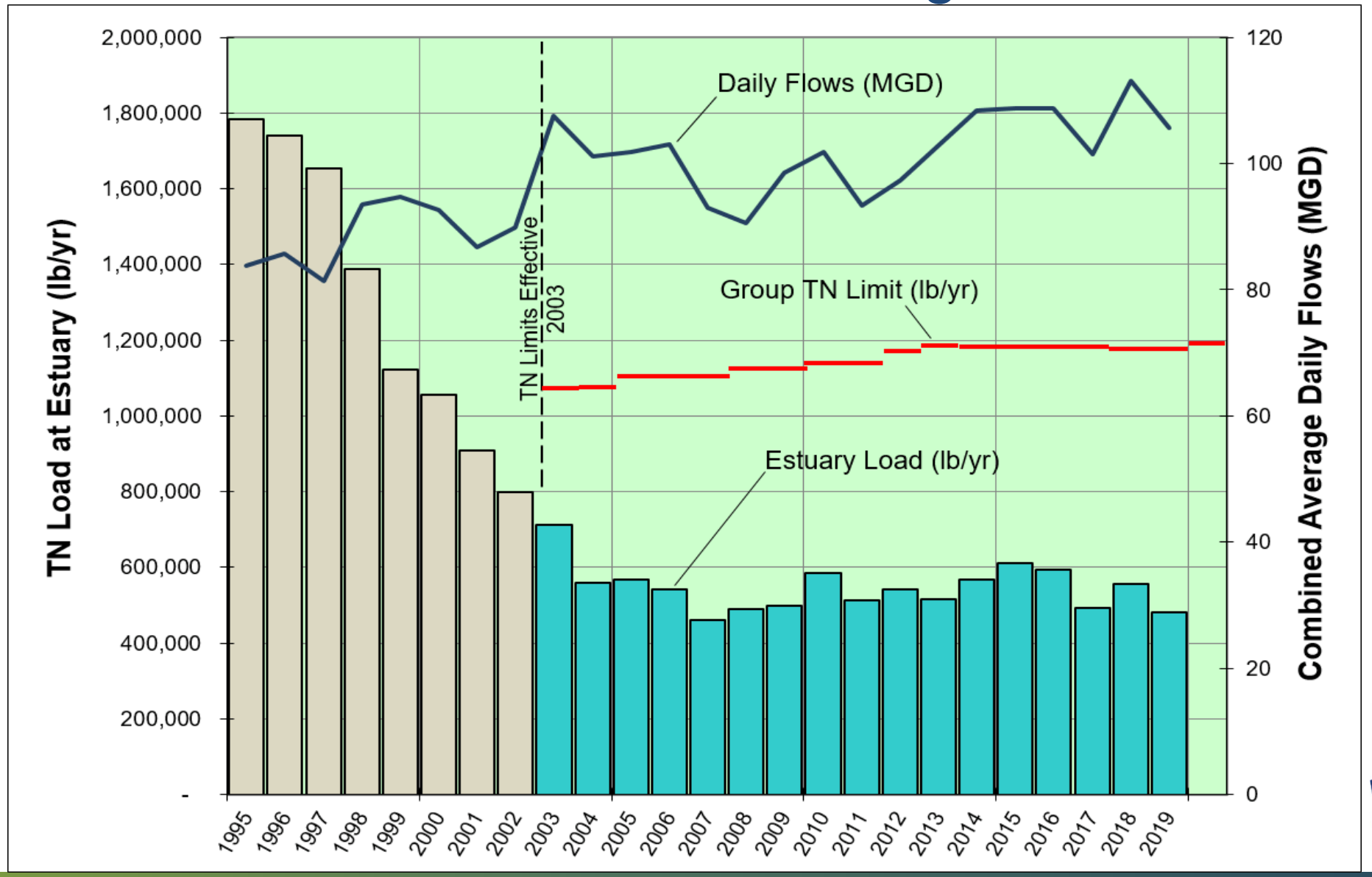
Aggregate Annual Estuary TN Loads, Neuse Basin Dischargers' Association



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Stormwater Rules

- New Development
  - Locally implemented
  - Developers meet nutrient rate targets
    - Onsite SCMs
    - Partial option - purchase offsets
    - Exclusive offset practice to date – rural riparian buffer restoration @ 76 lb N/ac
- Existing development (~~Jordan~~, Falls)
  - Local governments regulated
  - Reduce nutrient loading based on existing developed lands
  - DWR administers

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New Development Stormwater Nutrient SCMs
(As Retrofits, Candidate PS:NPS Offset Practices)

Previously Available

- Bioretention w/ or w/o IWS
- Infiltration
- Permeable pavement – 3
- Wet pond
- Stormwater wetland
- Sand filter – 2
- Rainwater Harvesting
- Green roof
- DIS
- LS-FS
- Grass Swale
- Dry pond

Added with SNAP Tool

- Bioretention variants
- Permeable pavement variants
- Wet pond floating wetlands
- LS-FS w/Virophos
- Grass swale - dry or wet
- StormFilter ®
- Silva Cell ® w/ or w/o IWS
- Over/undersizing: all SCMs except green roof, grass swale, StormFilter

Existing Development Practices Completed or Under Development (Candidate PS:NPS Offset Practices)

Available

- Soil amendment (ED)
- Illicit Discharge Elimination (ww)
- Cattle Exclusion (agriculture)
- Streetsweeping / Stormdrain Cleanout (ED)
- Remedy discharging sand filter (ww)

In Progress - Falls ED Model

- Developed land buffer restoration (ED)
- Built land reforestation (ED)
- WW Regionalization / Overtreatment
- Programmatic Septic Malfunction Reduction

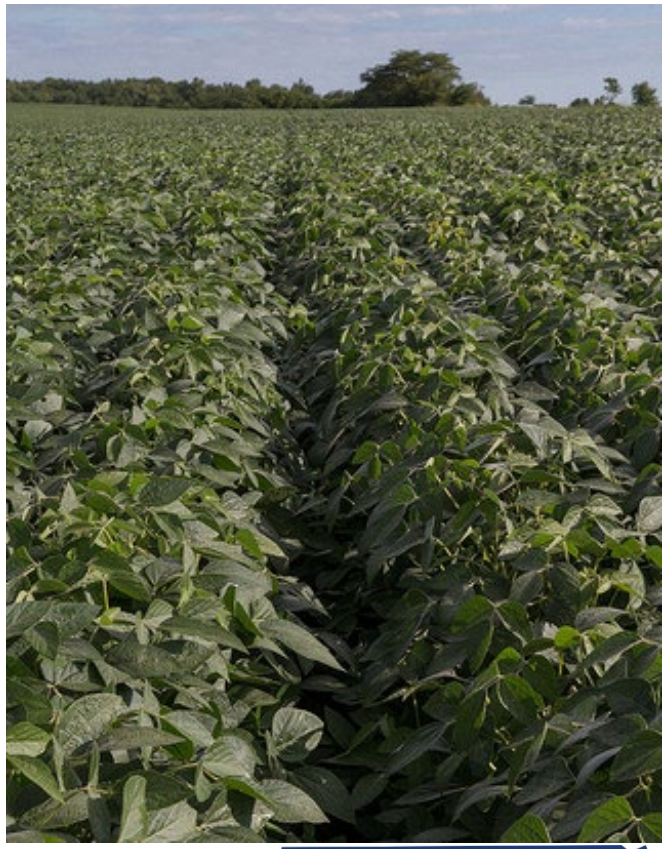
2021 or Later

- *Revise* Rural Buffer Restoration
- Stream Restoration:
  - Stem Sediment Loss
  - Floodplain Reconnect
- Bioswale
- Cropland Conversion to Trees
- Algal Turf Scrubber
- RSC

Agriculture Rules

- Collective annual compliance (not individual)
  - Meet strategy reduction percentages
- Cropland annual nutrient accounting (+ pasture in Jordan, Falls)
  - Nitrogen: Edge-of-field N loss reduction estimates*, county-scale, aggregated for basin

    * Not comparable to other sectors' load reduction estimates
  - Reductions: BMPs, fertilizer decreases, crop shifts, ag land lost
  - Phosphorus - qualitative risk evaluation



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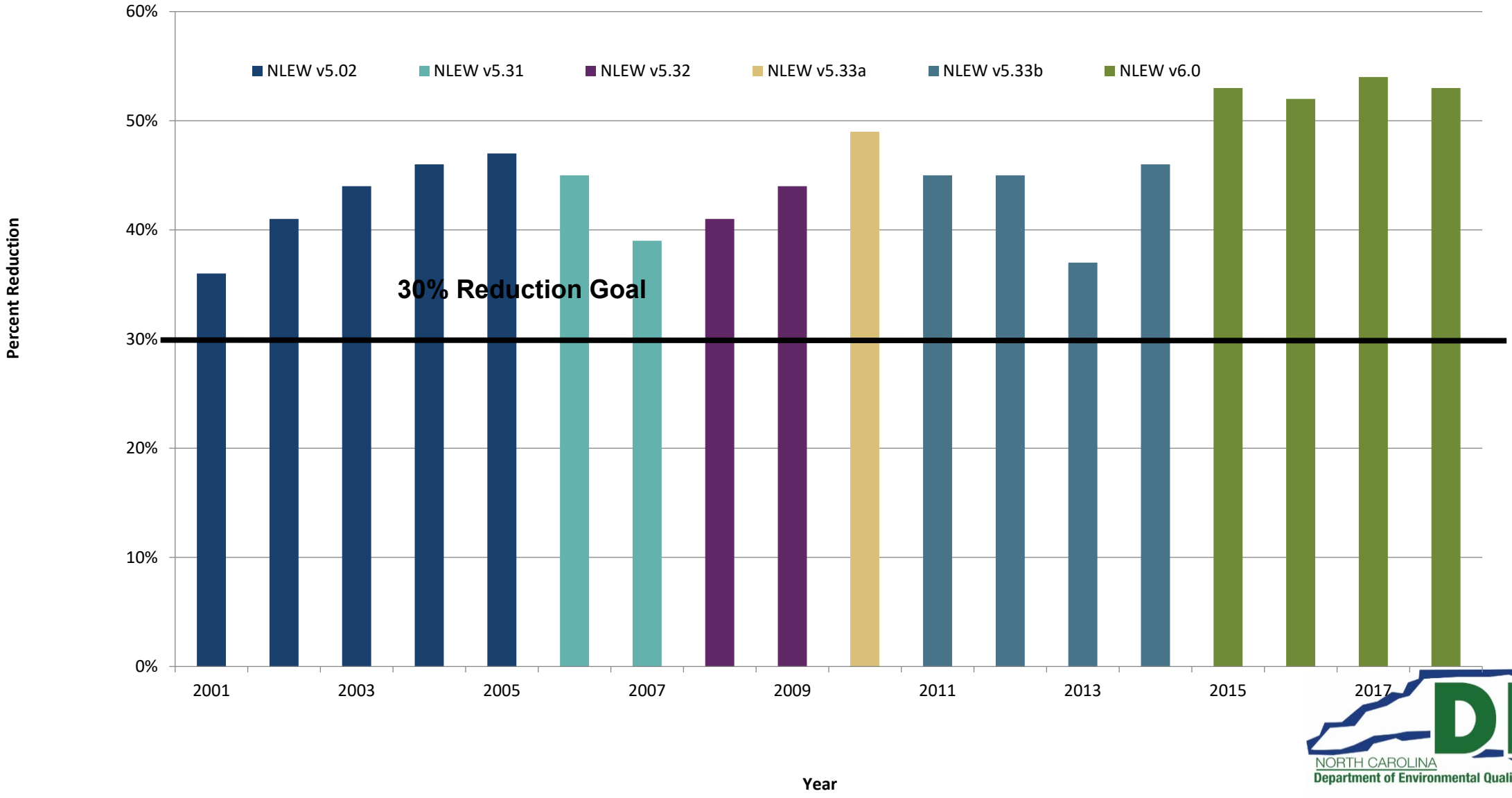
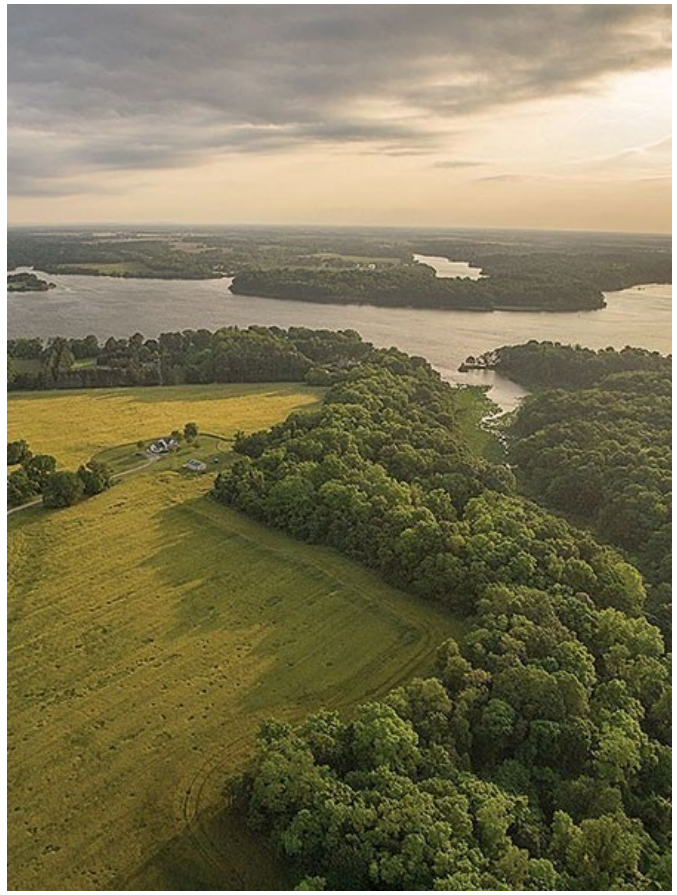
Annual Cropland TN Loss Reductions, Neuse River Basin



Riparian Buffer Rules

- Protects riparian buffers 50’ out
- Implemented by DWR
  - Local governments in Jordan
- Table of Uses – activities within buffer:
  - exempt,
  - prohibited,
  - allowable,
  - allowable with mitigation
- Driver for DMS compensatory mitigation program



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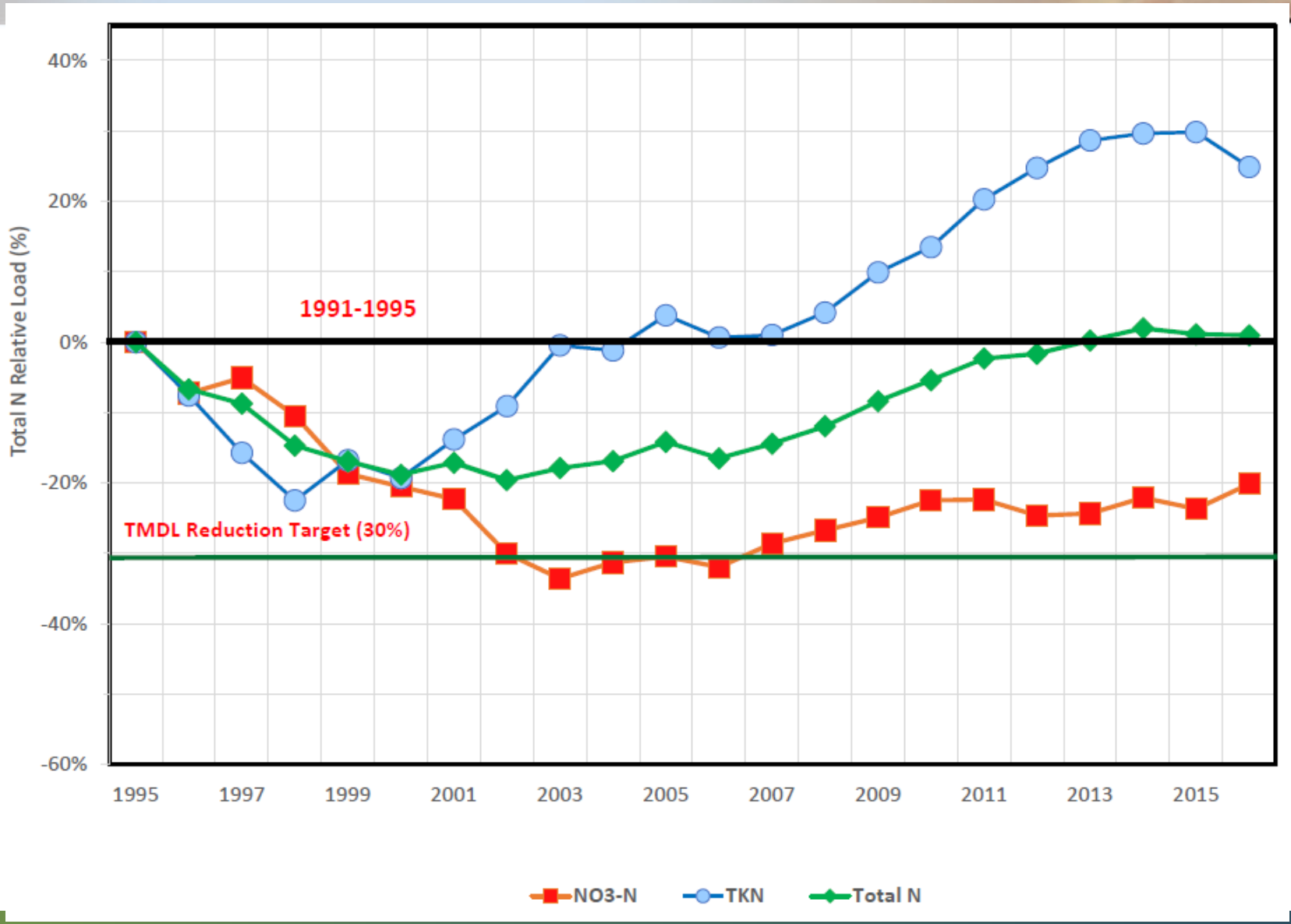
Flow-Normalized Nitrogen Loads (% vs. 1991-1995)

Neuse River at Fort Barnwell



A Few PS: NPS Trading Considerations

- Relative cost-effectiveness, PS vs NPS reductions
- Relative credit uncertainties, NPS vs PS reductions
- Long-term credit performance, stewardship, NPS vs PS
- Potential political forces, NPS vs PS

Cost-Effectiveness of Nitrogen Removal BMPs and Programs

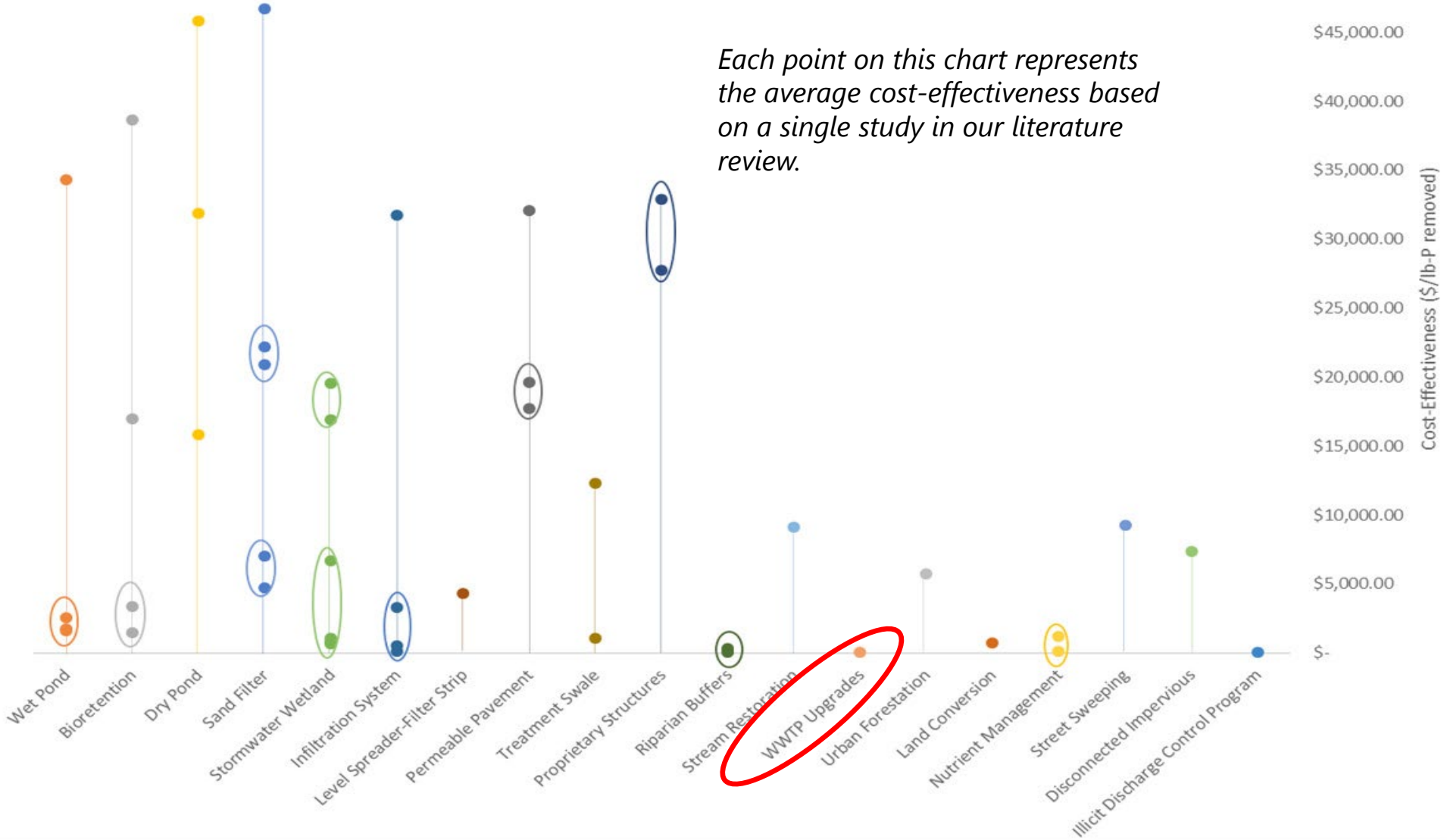
(2019, McManus, Kirk and Rosenfeld, UNC Environmental Finance Center)

Each point on this chart represents the average cost-effectiveness based on a single study in our literature review.

Cost-Effectiveness of Phosphorus Removal BMPs and Programs

(2019, McManus, Kirk and Rosenfeld, UNC Environmental Finance Center)

Each point on this chart represents the average cost-effectiveness based on a single study in our literature review.



Sources of Uncertainty in NPS Practice Crediting

- PS:NPS Uncertainty
  - Daily flow, nutrient monitoring vs. not monitored, research-based inferred performance
  - Daily performance oversight vs. annual o&m inspection
  - Operational control vs. passive design
  - Relatively low susceptibility to environmental variation vs. wholly subject to environmental variability

- Individual NPS Practice Credit Uncertainty
  - Available research data pool often limited; more so with ecosystem and ag practices
  - Applicability of research studies specifics often varies vs. credit-seeking installations
    - Practice designs, physiographic setting specifics, catchment land management, credit method elements addressed
  - Inter-study design variability; many design facets, often dissimilar across studies
  - Intra/Inter-study performance results often highly variable
    - Often stakeholder pressure to assign generous credit; e.g. to incentivize implementation
  - Performance often evolves vs. new practice bias in research

- Comparative differences by NPS practice type:
  - Engineered stormwater practices – more research, more control -> less uncertainty
  - Ecosystem restoration and agricultural practices – less research, less control, more variable land management, more susceptibility to environmental factors -> ***significantly greater*** uncertainty

Factors in Wastewater vs. NPS Load Estimation Uncertainty

Source of Uncertainty	Wastewater	Nonpoint Sources
Measurement Uncertainty		
Calibration drift of monitoring equipment	✔	✔
Laboratory errors	✔	✔
Omission of sampling data	✔	
Differing or novel data collection		✔
Small sample sizes		✔
Surrogate measurements		✔
Inherent NPS monitoring limitations		✔
Delivery Uncertainty		
Delivery or Transport factors (stream to lake/estuary)	✔	✔
Landscape factors (landscape to stream)		✔
Measurement vs. Estimation		
Generalized estimates from literature		✔
Credit Establishment Uncertainty		
Weather-driven: episodic, seasonal, increasingly variable loading		✔
Large number of site variables		✔
Limited studies, inclusion of poor applicability studies		✔
Untested assumptions underpinning credit or research		✔
Simplified credit methods		✔
Differences in design of studies		✔
New practice bias		✔
Practice Implementation Uncertainty		
Environmental variability • Slope • Soil type • Landscape position • Seasonal variation • Extreme events (flooding, droughts) • Floodplain connectivity		✔ ✔ ✔ ✔ ✔ ✔ ✔
Limited inputs for load reduction estimation tools		✔
Unforeseen variations in practice design		✔
Compliance with maintenance requirements		✔
Project failure rate		✔
Long term change in surrounding land uses		✔
Decreased practice performance over time		✔
Time lag between implementation and reductions		✔
Prior Crediting Inaccuracies		
Documented crediting inaccuracies		✔

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Baseline, Ratios: 2017-2020 Offset Rule Readoption

- PS:NPS offset uncertainty ratio
  - Initial proposal continued existing rule, 2:1
  - Public comment version - lead Hearing Officer revised to 1.1:1
  - Final 2020 adopted rule – 1.5:1

- Baseline – initial proposal
  - Practices on developed land: baseline = current loading condition
  - Practices on undeveloped land:
    - Highest loading condition in baseline period*, or
    - Current loading condition if:
      - Forested in baseline but maintained in deforested state >10 yrs, and
      - Credit seeking party had no involvement in or influence on deforestation

    * Managed forest land considered forest for loading purposes, regardless of prevailing cover condition during baseline period

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Baseline - Final 2020 Offset Rule

- Baseline:
  - Practices on developed land: baseline = current loading condition
  - Practices on other land: language ambiguous
    - Project plan requirements include documentation, or best available evidence, of site condition in baseline period

- Developed lands logic
  - Post-baseline, post-stormwater rule development – loading per strategy accounting; new reductions fair
  - Post-baseline, pre-rule development – increased loading, but not rule violation; new reductions fair

- Practices on other lands – expectations:
  - Continue using baseline time period as conceptual benchmark
  - Harvested managed forest – not eligible for reforestation credit
  - Other cases – best available evidence that current condition not "gamed" and not a regulatory compliance issue

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Other Crediting Criteria, 2020 Offset Rule

- Presumptive credit for DWR-approved practice types:
  - Use specified credit method
  - Meet design specifications
- Annual mass load reductions to-stream. Delivery factors are strategy-specific.
- Not eligible:
  - State/federal compensatory mitigation, including credit stacking
  - Practices to comply with other rules under strategy
- Project requirements include
  - Site suitability review by DWR
  - Plans, drainage or conservation easements, as-builts, O&M, financial assurances
  - Banks - banking instrument
    - Credit release schedule - for restoration 5-7 yrs. based on establishment
  - Responsible entity; permanent projects require perpetual steward
- Ecological restoration projects damaged by natural causes may passively restore

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Questions?

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Cost Effectiveness of BMPs

UNC Environmental Finance Center

McManus, Kirk, et al - 2019

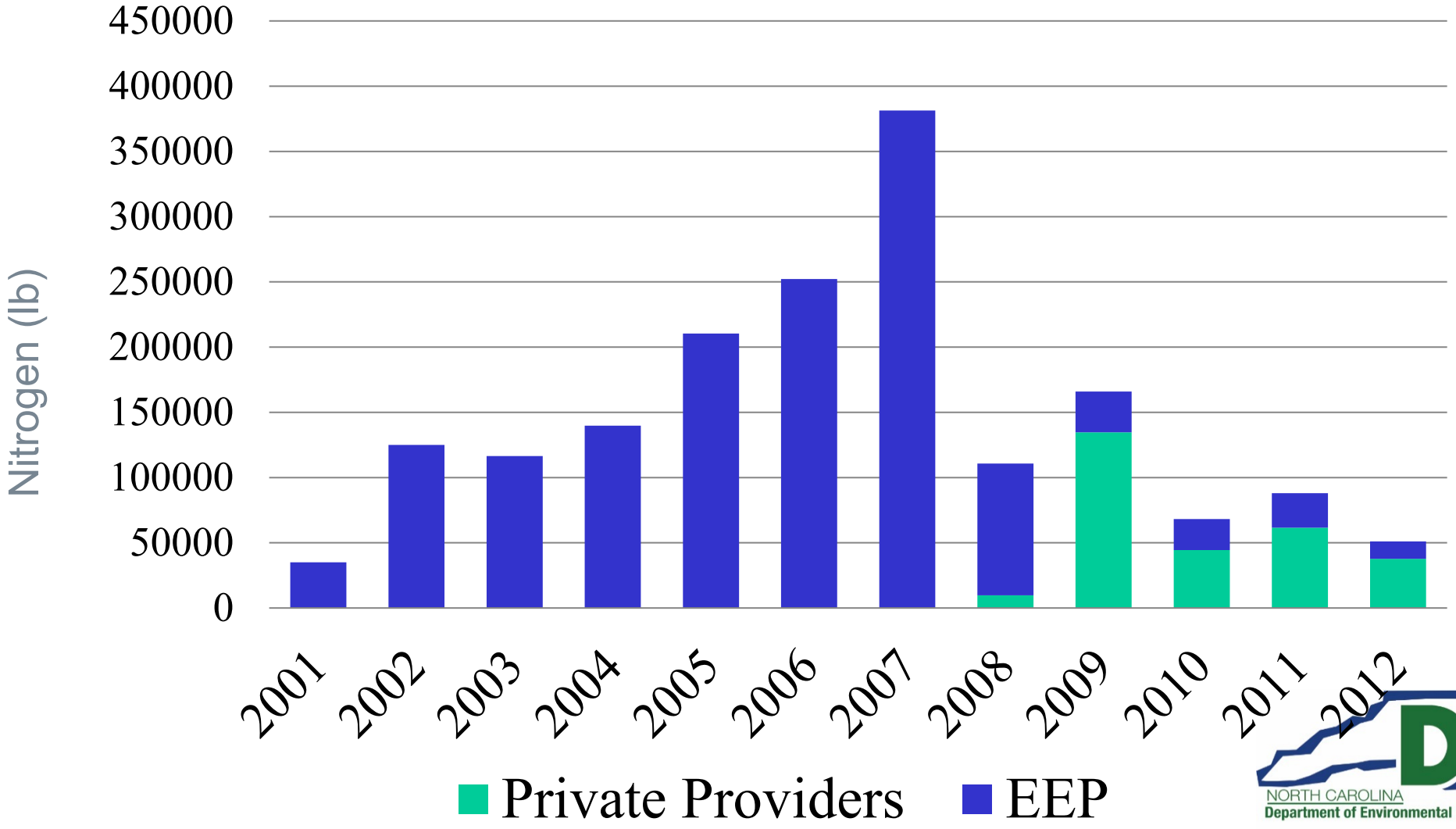
Buffers

WWTP Upgrades

Illicit Discharge Control Program

Strategy	Type	Avg. of TP Reduction [$/lb]	Avg. of TN Reduction [$/lb]	Avg. of TP Reduction [%]	Avg. of TN Reduction [%]	Count TP	Count TN
Bioretention	Physical	$ 10,637.79	$ 754.05	0.59	0.52	8	8
Dry Pond	Physical	$ 30,083.66	$ 659.10	0.16	0.08	10	16
Infiltration System	Physical	$ 10,183.49	$ 230.46	0.66	0.5	7	5
Land Conversion	Physical	$ 710.25	$ 228.13	0.56	0.64	4	4
Level Spreader-Filter Strip	Physical	$ 4,292.00	$ 199.44	0.38	0.35	2	3
Permeable Pavement	Physical	$ 34,956.95	$ 2,905.07	0.61	0.48	7	4
Proprietary Structure	Physical	$ 28,249.59	$ 7,148.10	0.46	0.08	10	1
Riparian Buffer	Physical	$ 164.50	$ 454.51	0.48	0.58	3	4
Sand filter	Physical	$ 16,195.37	$ 2,205.45	0.53	0.33	7	4
Stormwater Wetland	Physical	$ 4,348.10	$ 461.67	0.48	0.52	7	8
Stream Restoration	Physical	$ 9,095.00	$ 1,522.58	No Data	No Data	2	4
Treatment Swale	Physical	$ 3,134.12	$ 230.29	0.44	0.38	7	6
WWTP Upgrade	Physical	$ 50.84	$ 13.97	No Data	No Data	9	15
Wet Pond	Physical	$ 7,440.22	$ 438.67	0.44	0.28	6	15
Disconnected Impervious Surfaces	Policy	$ 7,354.09	$ 2,439.05	No Data	No Data	1	1
Illicit Discharge Control Program	Policy	$ 53.11	$ 13.28	1	1	2	2
Nutrient Management Programs	Policy	$ 626.60	$ 120.78	0.05	0.09	5	5
Street Sweeping	Policy	$ 9,595.35	$ 1,824.64	0.09	0.03	2	2
Urban Forestation	Policy	$ 5,736.24	$ 404.22	0.5	0.25	2	2

Offset Pounds N Purchased from EEP, Banks
Inception to July 2012, Neuse/Tar



Major Strategies' Discharger Limits

Watershed	Mass TN Limits Equivalent To:	Mass TP Limits Equivalent To:	Facilities Affected
Tar-Pamlico Estuary	6.85 mg/L	0.92 mg/L	15
Neuse River Estuary	3.75 to 5.5 mg/L 6.7 mg/L (no limit)	2.0 mg/L (conc.)	32 ≥ 0.5MGD 37 < 0.5 MGD
Jordan Lake ▪Haw River ▪Upper New Hope ▪Lower New Hope	 5.39 mg/L 3.04 mg/L 5.35 mg/L 12.0 mg/L (no limit)	 0.66 mg/L 0.37 mg/L 0.23 mg/L 2.0 mg/L (no limit)	 9 ≥ 0.1 MGD 4 ≥ 0.1 MGD 1 ≥ 0.1 MGD 33 < 0.1 MGD
Falls Lake (Stage 1) (Stage II)	3.0 - 3.6 mg/L* 1.13 mg/L 12.0 mg/L (no limit)	0.33 - 0.46 mg/L* 0.06 mg/L 12.0 mg/L (no limit)	3 ≥ 0.1 MGD 3 < 0.1 MGD

* At current flows + 10%

Nutrient Strategies Adaptation -
Some Sources Meriting Further Consideration

- Small dischargers (< 500k GPD)
- New Development – tighter onsite controls
- Existing Developed Lands
  - Runoff
  - Sanitary infrastructure
- Forest harvesting in SMZs (riparian zones)
- Livestock open stream access
- Dry litter poultry (legislation required)