BMP PERFORMANCE CURVE DEVELOPMENT

PTAPP Meeting
May 19, 2015

Water Integration for Squamscott-Exeter (WISE)

Town of Exeter, New Hampshire, Founded 1638 · Town of Newfields · Town of Stratham, New Hampshire, 1716 · Horsley Witten Group · Geosyntec consultants · University of New Hampshire · Rockingham Planning Commission · National Estuarine Research Reserve System Science Collaborative · cbi Consensus Building Institute

DRAFT PRELIMINARY MODEL RESULTS, NOT FOR DISTRIBUTION

WISE PROJECT TEAM

Robert Roseen, Project Lead
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Cliff Sinnott and Theresa Walker, Intended User Representatives

Doug Thompson and Eric Roberts, Collaboration Experts

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Sylvia VonAulock, Town Planner

Paul Deschaine, Town Administrator, Stratham
Lincoln Daley, Town Planner

Clay Mitchell, Town Planner, Newfields
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Rich Langan, Funding Agency Director
Kalle Matso, Program Manager

Ted Diers, Matt Wood, Phil Trowbridge, Barbara MacMillan, Sally Soule, Eric Williams

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- Doug Scamman
- Kirk Scamman
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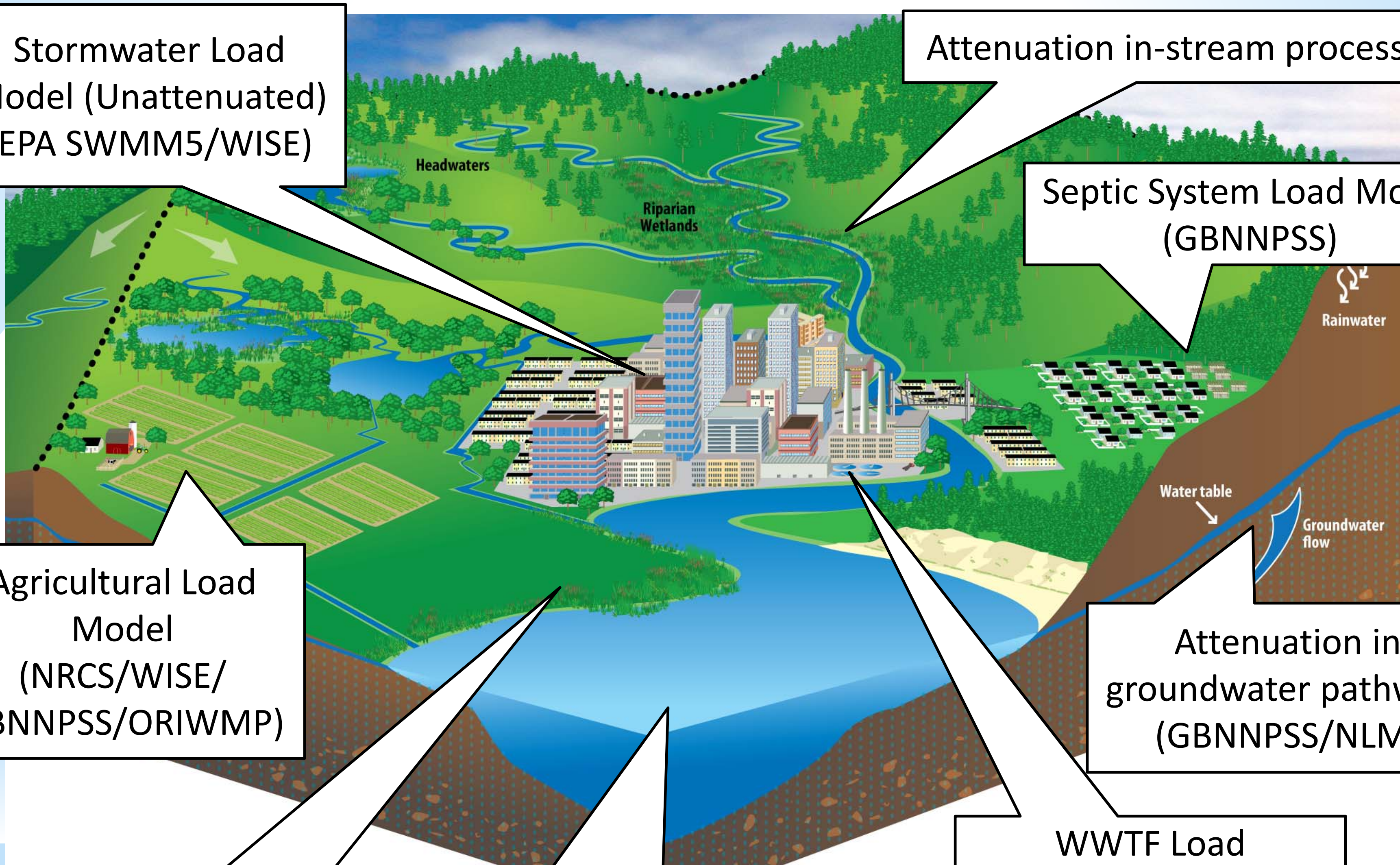
- Steve Miller
- Kalle Matso
- Richard Langan
- Steve Jones
- Michelle Daley
- Pete Richardson
- Sylvia VonAulock
- Kristen Murphy
- Phyllis Duffy
- Dean Peschel
- Eric Strecker
- Adrienne Nemura
- Marcus Quigley
- Bill Arcieri
- David Cedarholm

POLLUTANT LOAD ANALYSIS COMPONENTS



Stormwater Load Model (Unattenuated) (EPA SWMM5/WISE)

Attenuation in-stream processes

Septic System Load Model (GBNNPSS)

Agricultural Load Model (NRCS/WISE/ GBNNPSS/ORIWMP)

Attenuation in groundwater pathways (GBNNPSS/NLM)

Attenuation in buffer zones

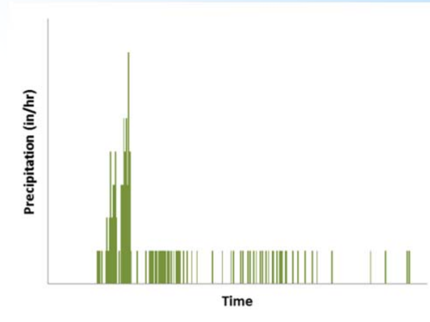
Attenuated Load To Estuary (GBNNPSS/NLM)

WWTF Load (Exeter/Wright Pierce)

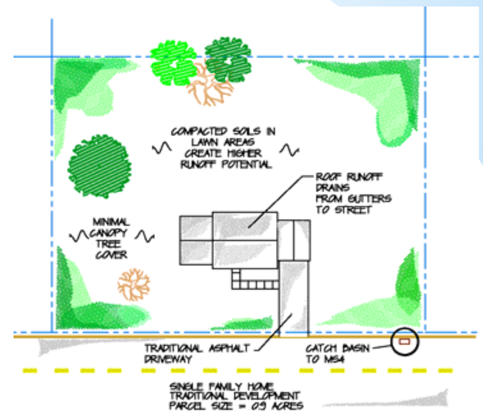
Source: Michigan Seagrant

COMPONENTS OF STORMWATER MODEL

- <u>Climate Data</u>
  - A long-term local precipitation and temperature record (NOAA Durham Gage, Station 00272174)
    - Evaluate a continuous simulation for the last 20 years

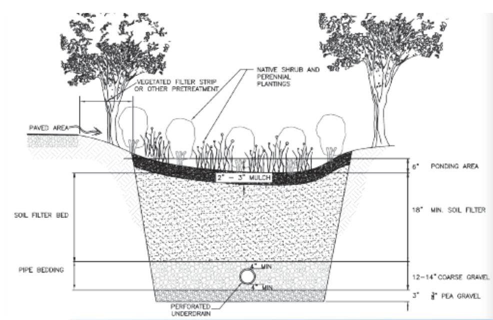


- <u>HRU (Hydrologic Response Unit):</u>
  - discrete units of land with similar:
    - land use (i.e., forest, commercial)
    - soils/geology
    - impervious cover (total and directly connected)
    - Area (1 acre parcel)



- <u>Water Quality:</u>
  - Buildup and Wash-off Coefficients

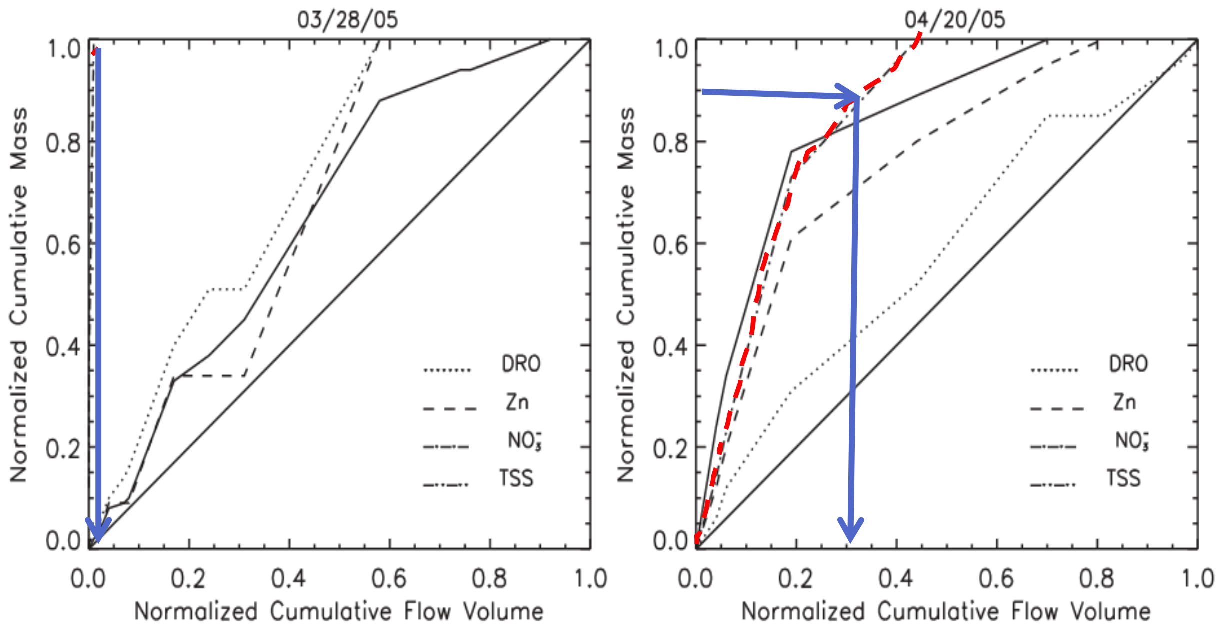
- <u>Best Management Practices--Control Strategies:</u>
  - Characterized by:
    - Contaminant Removal Performance
    - Storage Capacity
    - Outlet Configuration
    - Infiltration Rate/Recovery Time



WATER QUALITY MODELING – FIRST FLUSH

- Buildup and wash-off coefficients are based on literature review (UNH, ENSR, and others)
- Coefficients will be **calibrated** to local or national EMC (UNH, National Stormwater Quality Database) for specific land uses
- Rainfall type and distribution
  - 50% of storms are less than 0.17 inches in depth,
  - 75% are less than 0.45 inches in depth
  - 92% are less than 1inch in depth

100% of N mass in first 0.1 inches runoff or 10% of WQV



90% of N mass in first 0.2 inches runoff or 20% of WQV

* **Mass loading for DRO, Zn, NO3, TSS as a function of normalized storm volume for two storms: (a) a large 2.3 in rainfall over 1685 minutes; (b) a smaller 0.6 in storm depth over 490 minute. DRO=diesel range organics, Zn= zinc, NO3= nitrate, TSS= total suspended solids**

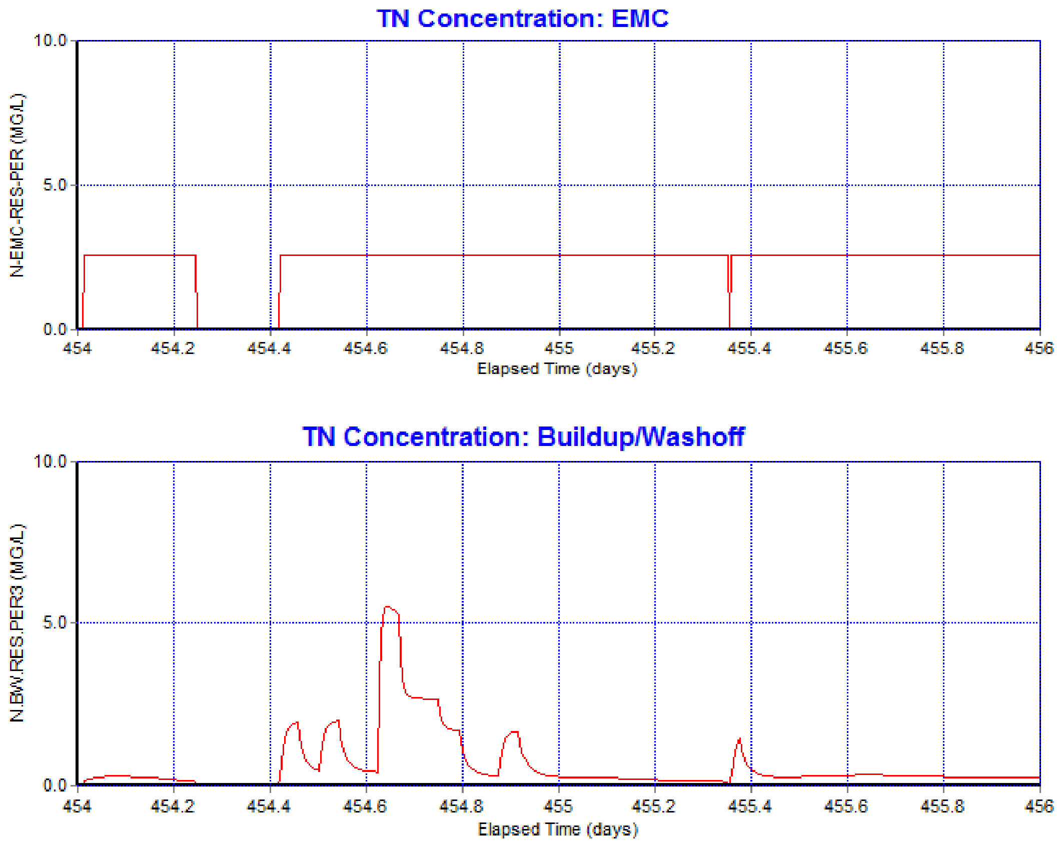
WATER QUALITY MODELING – FRIST FLUSH ANALYSES

- Major urban sources of nitrogen modeled with buildup/washoff functions
  - Residential
  - Commercial
  - Industrial
  - Institutional

$$B = Min(C_1, C_2 t^{C_3})$$

$$W = C_4 q^{C_5} B$$

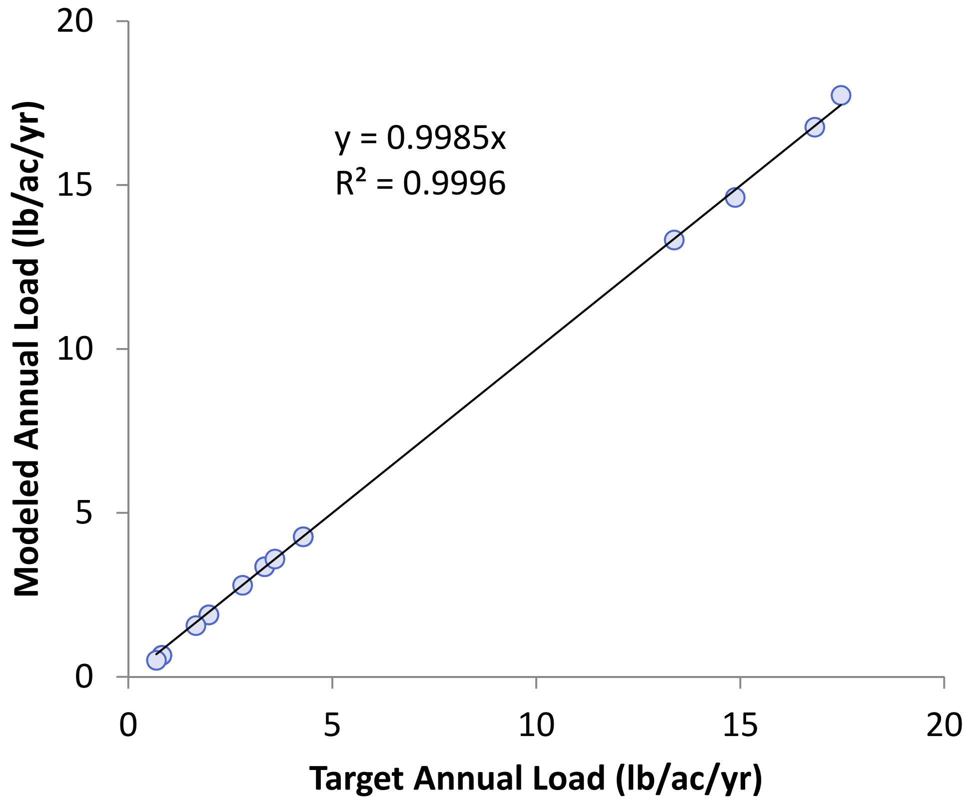
- Other nitrogen sources and other pollutants modeled with event mean concentrations (EMCs)



Comparison of modeled total nitrogen concentrations using EMCs and Buildup/Washoff functions

WATER QUALITY: BUILDUP/WASHOFF CALIBRATION

1. Run a 20-year simulation using EMCs and record the resulting pollutant load (target load).
2. Replace EMCs with buildup/washoff functions. Re-run the 20-year simulation.
3. Iteratively adjust buildup/washoff parameters until pollutant loads match target loads.



STRUCTURAL BMPs

Structural BMPs are represented by SWMM "Storage Units."

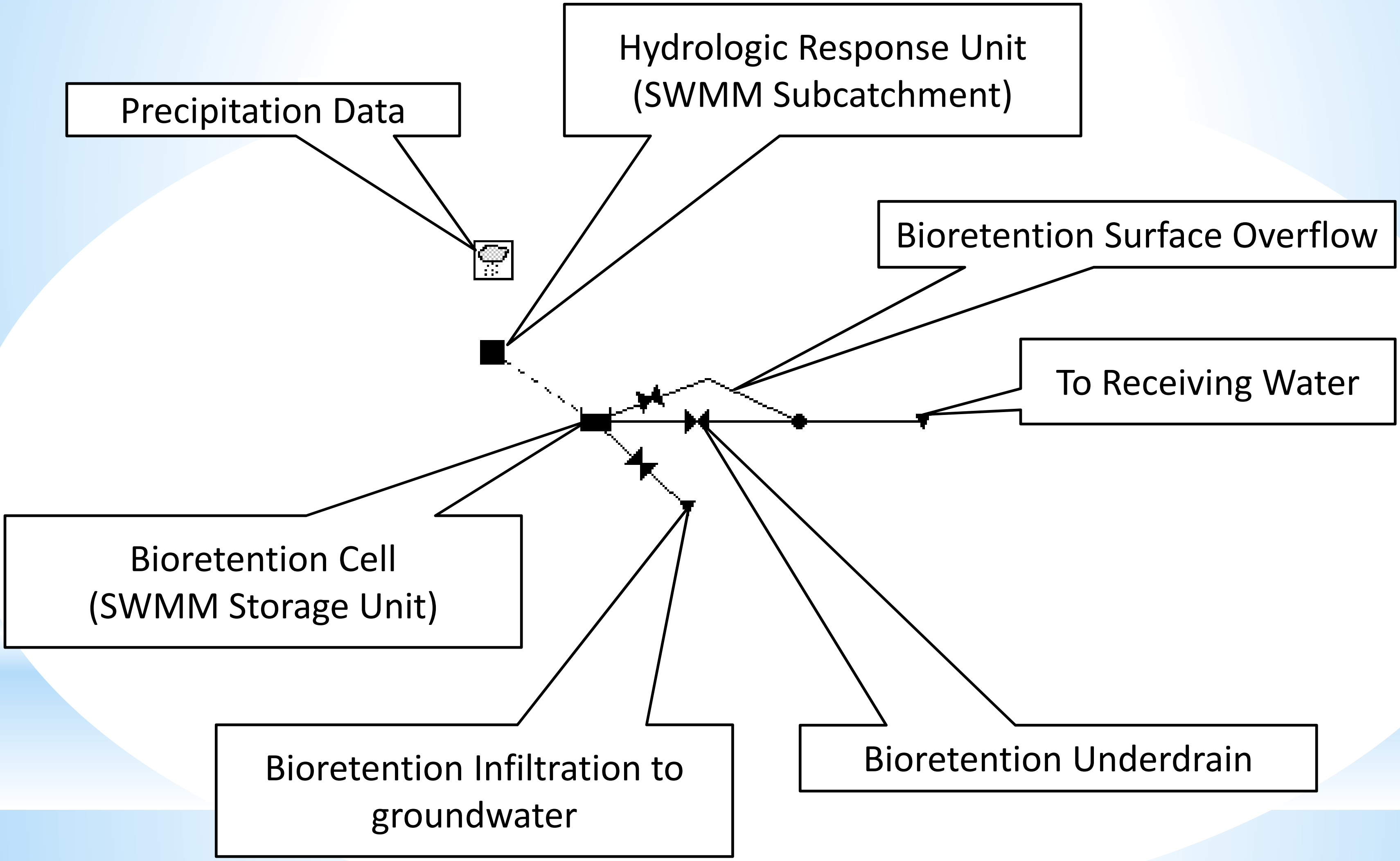
- BMP VOLUME:
  - Related to "Capture Depth," i.e. a given runoff depth that the BMP is capable of capturing/storing/treating.
  - Sizing and design based on best available designs sources (UNHSC, NH Stormwater Manual, etc)

  Examples:
    - Bioretention cell sized to capture 0.5 inches of runoff from a 1-acre HRU
    - Bioretention cell sized to capture 1.0 inches of runoff from a 1-acre HRU

- BMP POLLUTANT REMOVAL:
  - Removal through settling/filtering/biological processes, etc. represented by a fractional removal efficiency
  - Removal efficiencies obtained from International BMP Database, UNH Stormwater Center, and Center for Watershed Protection

- BMP OUTLETS
  - Surface effluent leaves BMP via a system of typical outlet configurations (underdrains, risers, weirs, etc.)
  - If the BMP is capable of infiltration, infiltrated water and pollutant load is tracked via a separate outlet to groundwater.

SWMM STORMWATER MODEL SCHEMATIC



STRUCTURAL BMPs

Preliminary list of modeled BMPs and Removal Efficiencies

BMP	TSS	TN	TP
Bioretention	77%	37%	34%
Retention Pond	71%	31%	34%
Sand Filter	74%	18%	44%
Infiltration Practices	89%	42%	65%
Porous Pavement	82%	3%	44%
Stormwater Wetland	55%	15%	42%
Gravel Wetland	96%	75%	58%

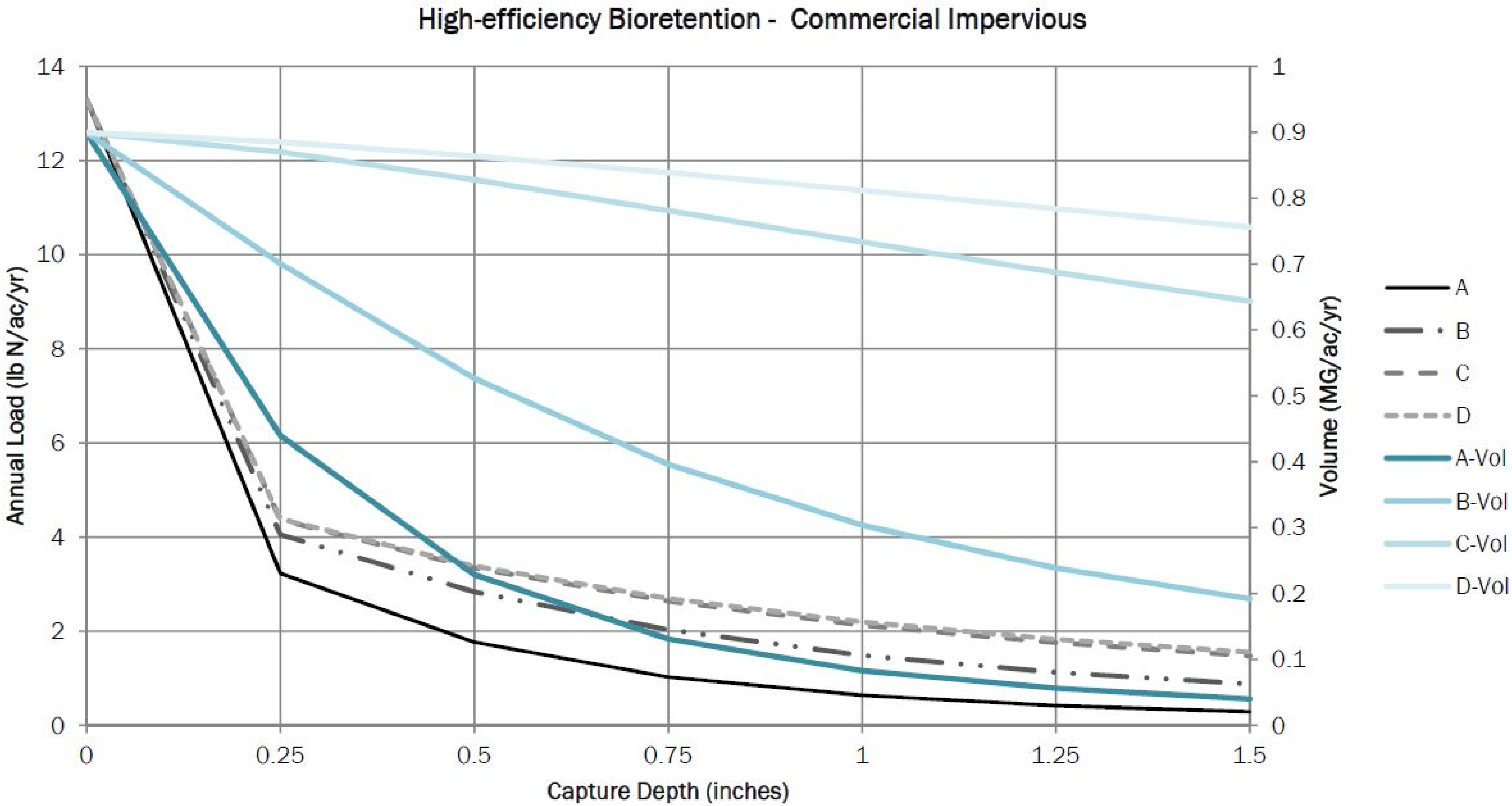
RE values above are an average of the following: (a) median RE values reported in International Stormwater BMP Database Summary Statistical Addendum 2012, (b) RE values reported in New Hampshire Stormwater Center Biennial Report 2012, and (c) median RE values listed in Center for Watershed Protection Runoff Reduction Method Technical Memo Appendix F: BMP Research Summary Tables

RESULTS

<u>The following type of results are provided by the model:</u>

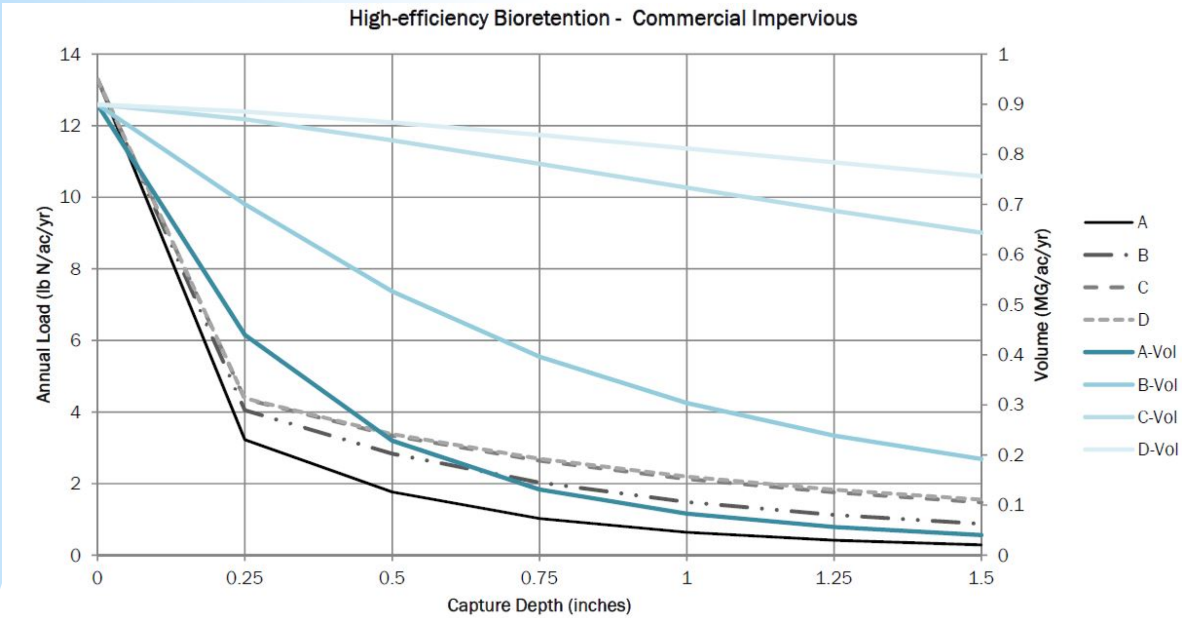
- Per-acre annual “untreated” load for given land use
- Per-acre annual “treated” load for given land use / BMP combination
  - Model tracks both surface and groundwater effluent from BMP
- Per-acre stormwater runoff volume for given land use / BMP combination
- Per-acre infiltrated volume for given land use / BMP combination
- Results are summarized and represented by a set of BMP PERFORMANCE CURVES

TREATMENT CURVE EXAMPLE: COMMERCIAL PARKING



BMP Performance Curve for high-efficiency bioretention on commercial impervious areas illustrating annual exported load (lbs Nitrogen/acre/year) and volume (million gallons/acre /year) based on water quality volume (aka capture depth)

BMP CURVE EXAMPLE: COMMERCIAL PARKING



For a type A soil, 4 systems designed to treat a 0.25" water quality volume in replace of one system to treat a 1" water quality volume would remove an additional 27 lbs of Nitrogen per year at nearly equivalent costs, or approximately 315% greater optimization.

- A single system treating a 1" water quality volume for 1 acre will remove approximately 12.7 lbs N/acre/year.
- Whereas 4 smaller systems across 4 acres designed to treat 0.25" water quality volume per acre will each remove 10 lbs N/acre/year for a total of 40 lbs N per year.

From the Project Team,
Thank You!!

Questions/ Comments?

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STRUCTURAL NUTRIENT CONTROL STRATEGIES

CATEGORY		COVER TYPE	STRUCTURAL NUTRIENT MANAGEMENT MEASURES									
			Wet Pond	Gravel Wetland	Subsurface Infiltration	Sand Filter	Biofiltration	High Efficiency Biofiltration	Tree Pits	Raingarden	Dry Well	Permeable Pavement
LAND USE	Residential	Pervious						•		•	•	
		Impervious						•		•	•	
		Roof						•		•	•	
	Residential Subdivision	Pervious					•	•				
		Impervious					•	•				•
		Roof					•	•			•	
	Commercial/ Industrial/ Institutional	Pervious	•	•	•	•	•	•	•			
		Impervious	•	•	•	•	•	•	•			•
		Roof			•		•	•			•	
	Road/ Freeway	Impervious	•	•			•					
	Outdoor/ Other Urban Land	Pervious		•	•	•	•	•	•			
		Impervious		•	•	•	•	•	•			•