CONSIDERING FUTURE CLIMATE CONDITIONS IN DEVELOPMENT OF TMDLS AND OTHER WATER QUALITY PLANS IN CONNECTICUT

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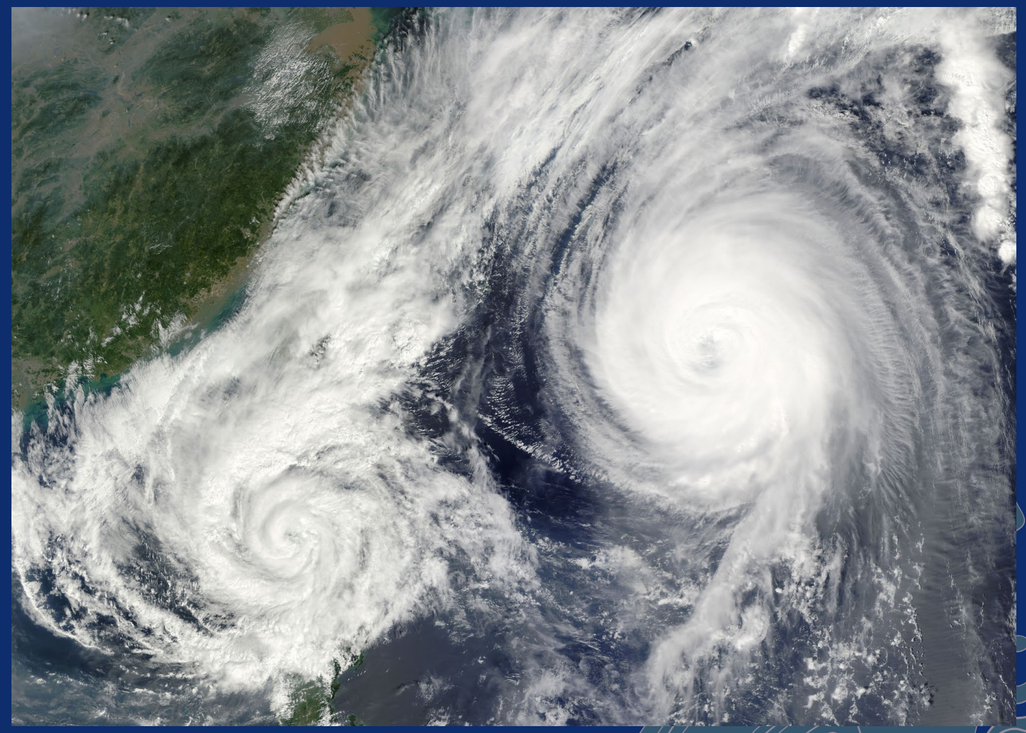
Incorporating Future Climate Conditions into TMDLs & Other Plans

Overview

- Connecticut is developing future weather scenarios using models to evaluate potential water quality impacts for freshwater and coastal surface waters
  - Models include HSPF, WASP and EFDC



Incorporating Future Climate Conditions into TMDLs & Other Plans

Discussion Topics

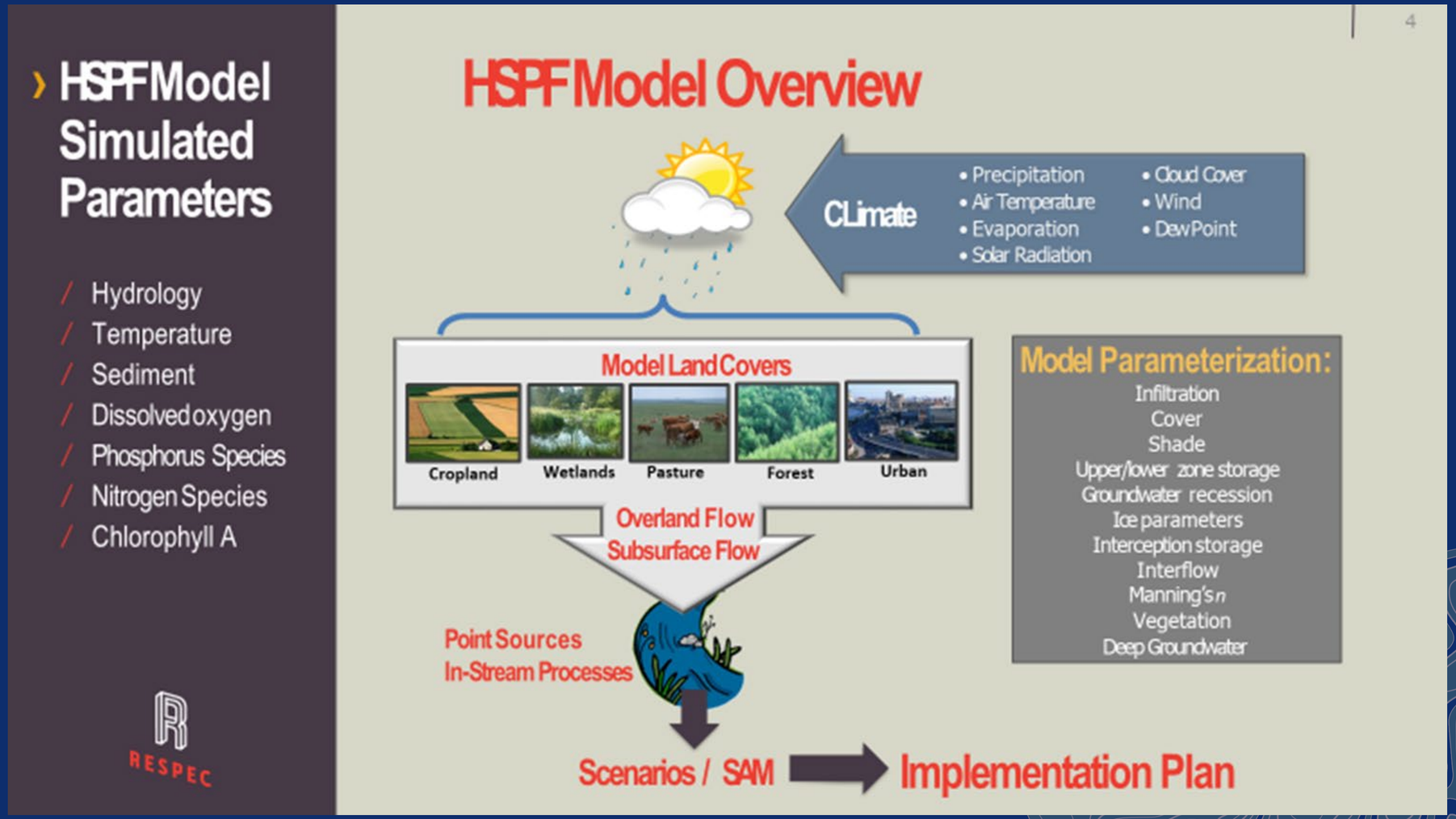
- Building the Model
  - Base components
  - Climate Components
- Building the Future Climate and Weather Scenarios
- Model Linkages
    - HPSF
    - WASP
    - EFDC
- Interpreting the scenarios

- Using Connecticut Watershed Models in Water Quality Action Plans
  - Incorporating modeled results into TMDLs
    - How the scenarios could impact WLA and LA
- Considering Climate Conditions within current TMDLs and Water Quality Standards

Incorporating Future Climate Conditions into TMDLs & Other Plans

Why the HSPF Model

- Versatility
- Comparability
- Cost Effective



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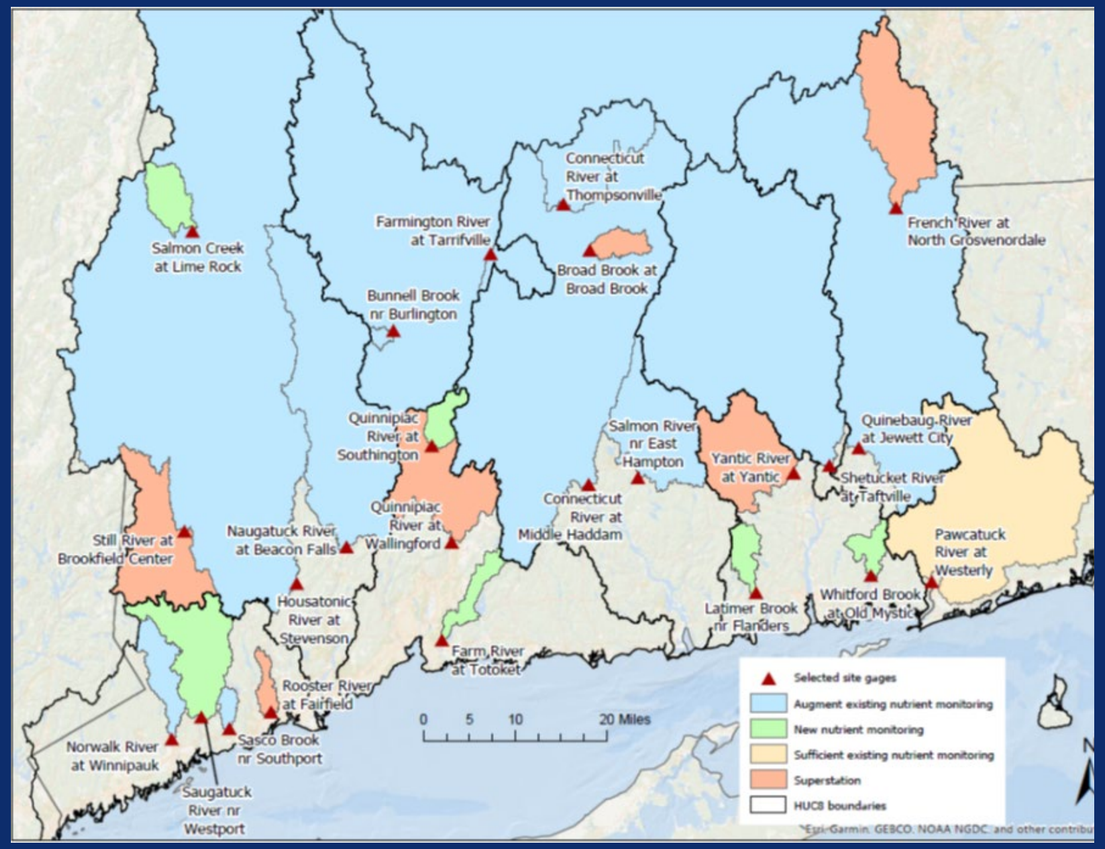
Building the Model



- Base Components:
  - Flow, Temp, Pollution Concentrations from Monitoring
  - Point Source Data
  - Meteorlogical Data
  - Land Cover and Soils
  - Physical Stream/Lake Charecteristics
- Scenario Components:
  - Population Projections
  - Efficiency Curves for Best Management Practices
- Climate Components:
  - Global Climate Model, CMIP5
  - MACA, Downscaling, Interpreting Climate into Weather.

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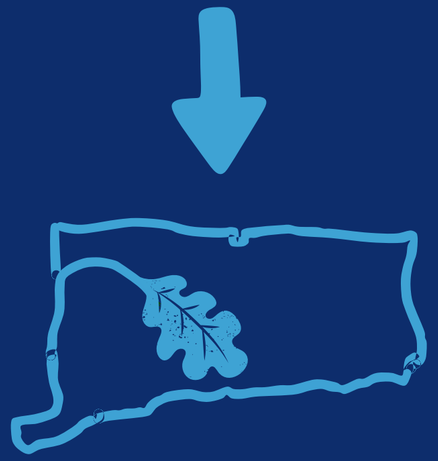
Building the Future Climate and Weather Scenarios

World Data Bank (Coupled Model Intercomparison Project - v5)



Choosing Appropriate Downscaling for Ones Region

- MACA v LOCA (method)
- Which of models of the method chosen are a best fit for your area.
- Multivariate Adaptive Constructed Analogs (MACA) - Matrix of 8 Models Performing best for our region.

Thank you to CIRCA, World Data Bank and RESPEC

Climate Change Knowledge Portal, Meta Data Report Climate Change Knowledge Portal, 2021

O'Donnell J. Sea Level Rise in Connecticut, CIRCA. 2019. https://circa.uconn.edu/wp -content/uploads/sites/1618/2019/10/Sea -Level -Rise-Connecticut -Final -Report -Feb-2019.pdf

Seth A.; Wang G.; Kirchhoff C.; Lombardo K.; Stephenson S.; Anyah R.; Wu J. Connecticut Physical Climate Science Assessment R eport (PCSAR), 2019. https://circa.uconn.edu/wp -content/uploads/sites/1618/2019/11/CTPCSAR -Aug2019.pdf

Wang G.; Kirchhoff C.; Seth A.; Abatzoglou J.; Livneh B.; Pierce D.; Fomenko L.; Ding T. Projected Changes of Precipitation C haracteristics Depend on Downscaling Method and Training Data: MACA versus LOCA Using the U.S. Northeast as an Example. American Meteorological Society 2020, 21, 2739 -2758.

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Interpreting Scenarios for a Shifting Climate and Extreme Weather

Averages vs Event Analyses

Climatic averages are great for overview but do **not** equate to averaging periods needed for standards (and thereby the periods effects are observed).

Flashy Storms/Saturated Seasons

Flashy Droughts/Low Flows

Changing Baselines

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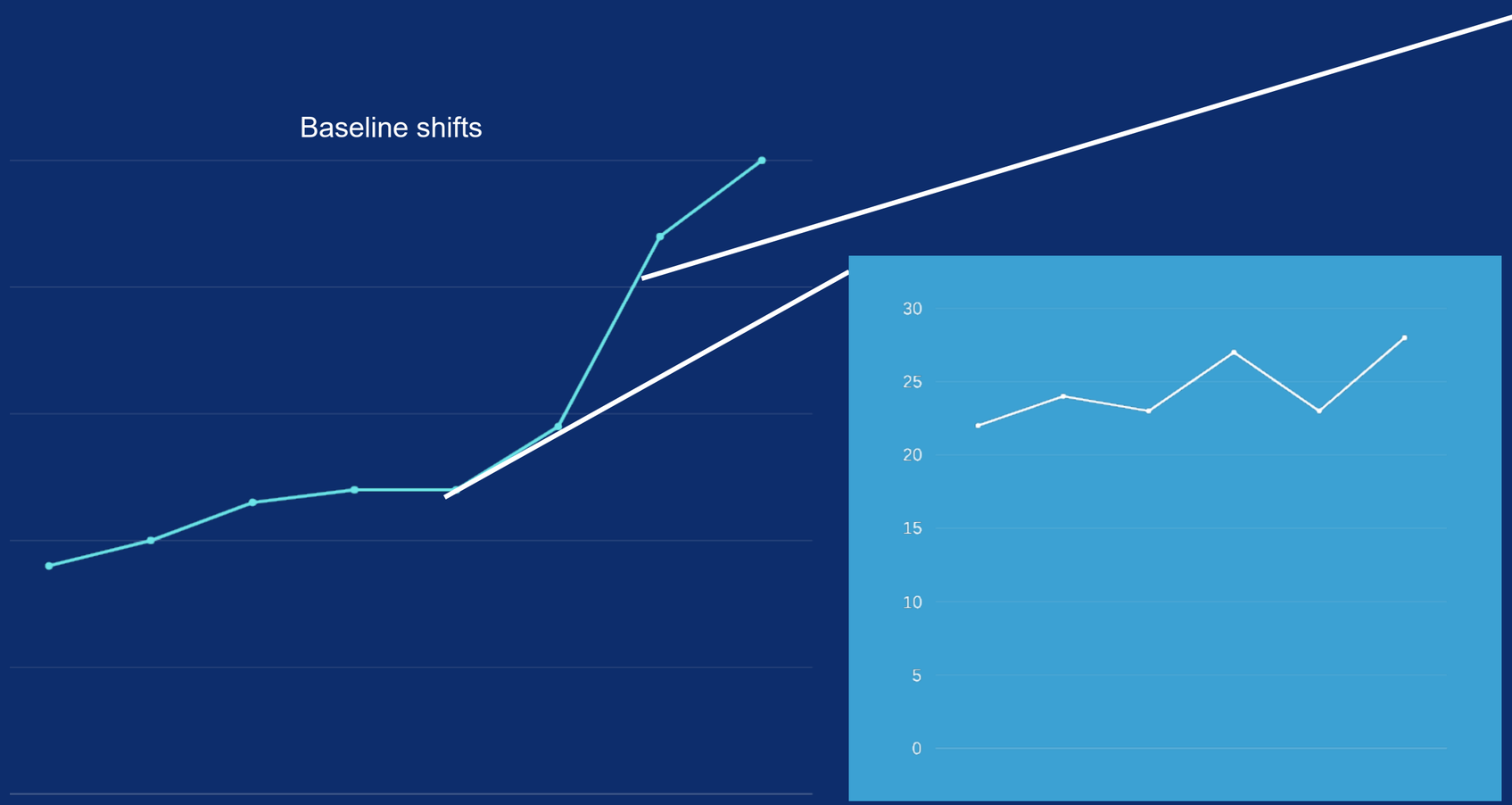

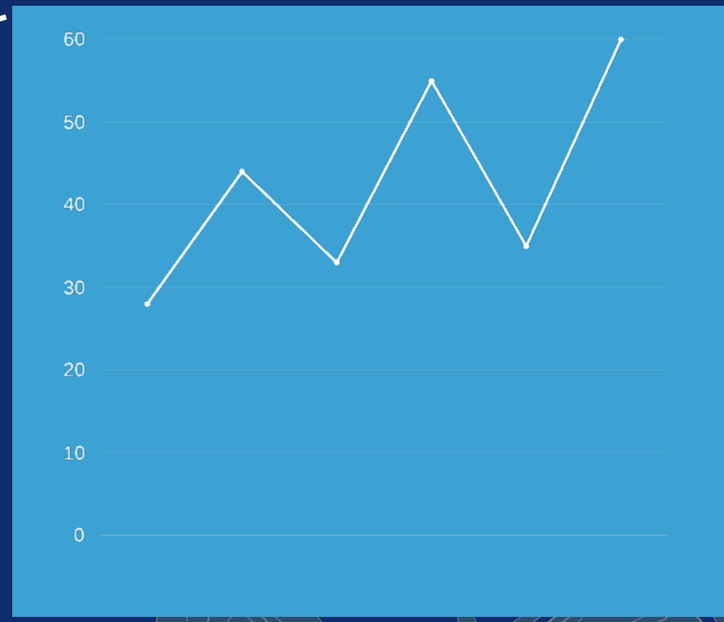

Differing variability than previously observed led to inclusion of event analyses too.

Concepts only not real data

Incorporating Future Climate Conditions into TMDLs & Other Plans

Linking Models for a Consistent Framework

Important: HSPF is Freshwater Model

Solution for a Coastal State: WQMODLink!

Table 1-3. Linkage Between the HSPF and WASP Models

HSPF Outflow Constituent	Constituents Included in the WASP Eutrophication Model	WASP System Type	Notes
ROVOL	Flow	N/A	To c... load
TAM-OUTTOT	Total Ammonia	NH-34	
NO3-OUTTOT	Nitrate-Nitrite	NO3O2	Add... WA
NO2-OUTTOT			
PO4-OUTTOT	Dissolved Inorganic Phosphorus	D-DIP	
N-TOTORG-OUT	Dissolved Organic Nitrogen	ORG-N	Ass... diss... nitr...
	Detrital Nitrogen	DET-N	
P-TOTORG-OUT	Dissolved Organic Phosphorus	ORG-P	
	Detrital Phosphorus	DET...	dis... pho...
C-TOTORG-OUT	Detrital Carbon	DET...	
N/A	Total Detritus	DTDE...	Calc...
BODOUTTOT	$CBOD_u$ – Watershed		
N/A	$CBOD_u$ – Point Sou...	CBDOU	Obtained from WDM
N/A	$CBOD_u$ ...	CBDOU	Calculated by WASP
DOXOUTTOT	DO	DISOX	—
ROSED-SAND	Sand	SOLID	—
ROSED-SILT	Silt	SOLID	—
ROSED-CLAY	Clay	SOLID	—
PHYTO-OUT	Phytoplankton	PHYTO	—
N/A	Benthic Algae	MALGA	
N/A	Benthic Algae Nitrogen	MALGN	Calculated by WASP
N/A	Benthic Algae Phosphorus	MALGP	
ROHEAT	Water Temperature	WTEMP	—

$CBOD_u$ = ultimate carbonaceous biochemical oxygen demand
N/A = Not applicable

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Pervious Land Surfaces (PERLNDs)

Impervious Land Surfaces (IMPLNDs)

Atmospheric Deposition

Point Sources

Other Local Sources

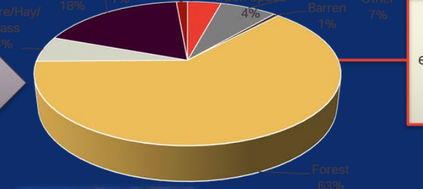
Reaches (RCHRES)

Little Narragansett Bay Estuary Model

Offshore Input

Loads are provided from the subwatershed land to each reach and then to the embayment or directly to the embayment.

- Precipitation
- Air Temperature
- Evaporation
- Solar Radiation
- Cloud Cover
- Wind
- Dew Point



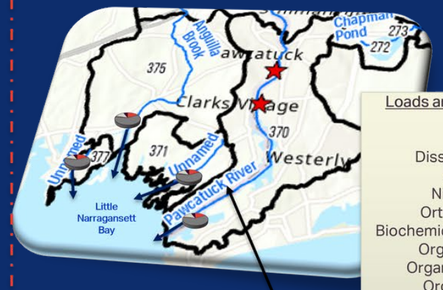
Each HSPF landuse has an associated loading rate in each subwatershed that can be applied to smaller subwatersheds as needed

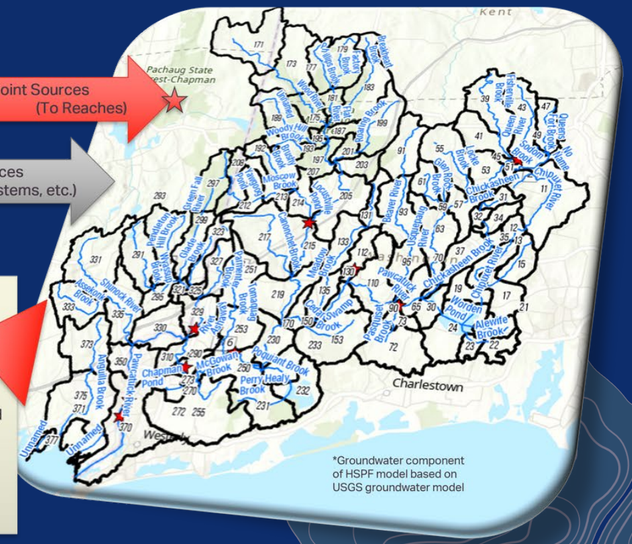
Drainage Area = 318 mi²

Atmospheric Deposition (To Land & Water Surfaces)

Point Sources (To Reaches)

Other Local Sources (Septic Systems, etc.)





*Groundwater component of HSPF model based on USGS groundwater model

Loads and Concentrations
Flow
Heat
Dissolved Oxygen
Ammonia
Nitrite Nitrate
Orthophosphate
Biochemical Oxygen Demand
Organic Nitrogen
Organic Phosphorus
Organic Carbon
Phytoplankton
Sand, Silt, Clay

Offshore Input (Long Island Sound Model and Other Data Sources)

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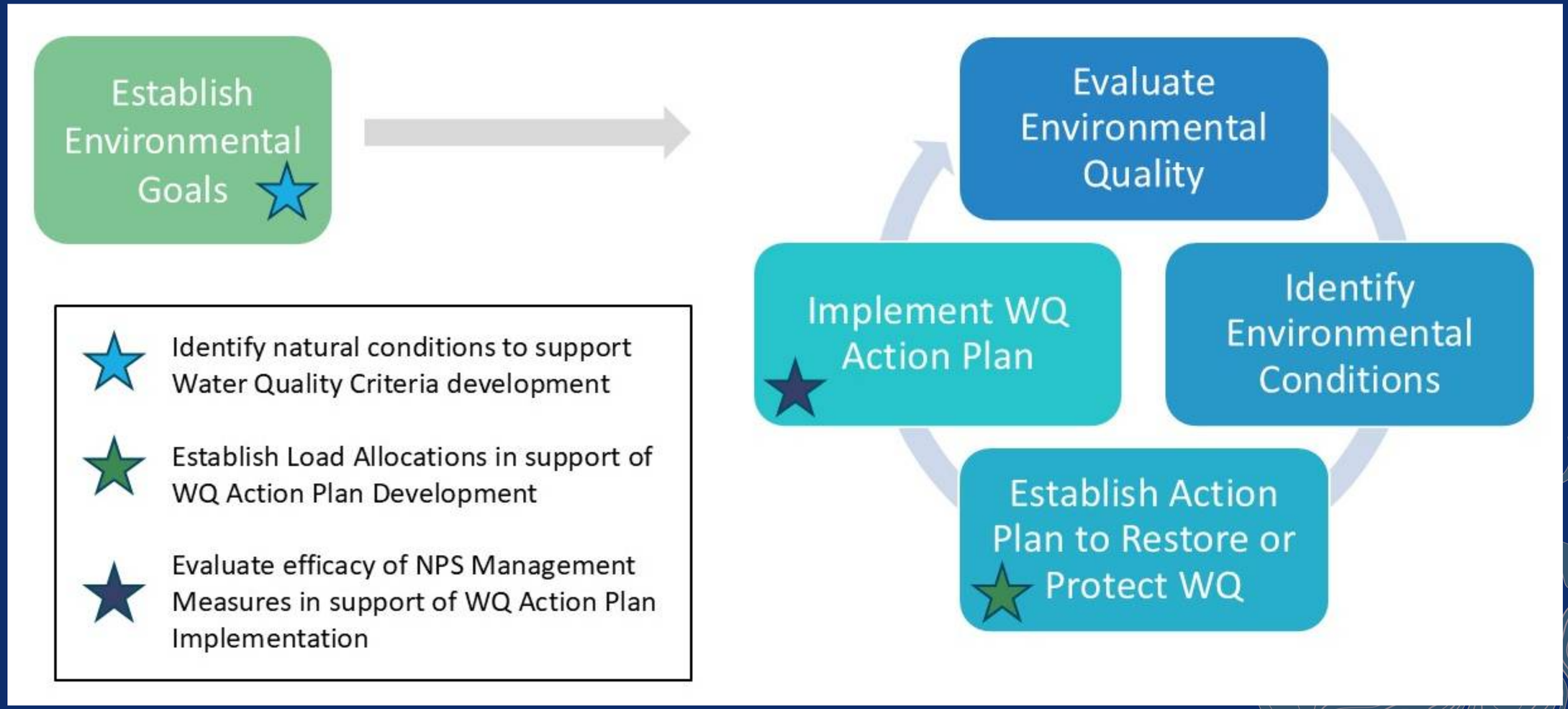
Use of the Connecticut Watershed Models in Water Quality Plans



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Using the Connecticut Watershed Models in Water Quality Plans

- CT will run models establish WLA and LA
- Run models under predicted climate conditions
  - Water Quality Results from future climate models will be compared with the TMDL
  - This comparison will identify whether future adjustments to WLA and LA would be needed if climate conditions were to change as predicted
- These Climate Change scenarios will be described in the TMDL.

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Considering Climate Conditions within TMDLs

Connecticut's TMDLs include a section on extreme weather, highlighting important points:

- Municipalities and landowners must adapt and assess climate threats.
- Different municipal departments and infrastructure could be impacted.
- Incorporating climate factors into water quality management will enhance sustainability and effectiveness long -term.

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Considering Climate Conditions within the CT Water Quality Standards

CT Antidegradation Policy: §22a-426-8 (g)(1)(C)

For new or increased discharges or activities resulting from stormwater the first inch of rainfall is not discharged to a surface water body and Best Management Practices deemed necessary to protect and maintain designated uses and meet state Standards and Criteria are implemented

- The current CT Water Quality Standard indicates to treat the first inch of stormwater.
- CT is planning to incorporate the term “Water Quality Storm” to allow for periodic updates in response to climate changes, rather than specifying a fixed amount.
- The “Water Quality Storm” has been adjusted to 1.3 inches within the most current CT Stormwater Management Manual

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QUESTIONS?

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