



Bacteria

Total Maximum Daily Load Analysis for Greenwich Bay Waters

<http://www.state.ri.us/dem/programs/benviron/water/quality/rest/pdfs/gbtmdl.pdf>

Rhode Island DEM, Office of Water Resources
Surface Water Assessments

Framework for Restoring Polluted Waters

Problem Identification

Assign Water Quality Standards to Each Waterbody

Monitor and Assess each Waterbody

List Impaired Waters (Using all Existing and Readily Available Data)

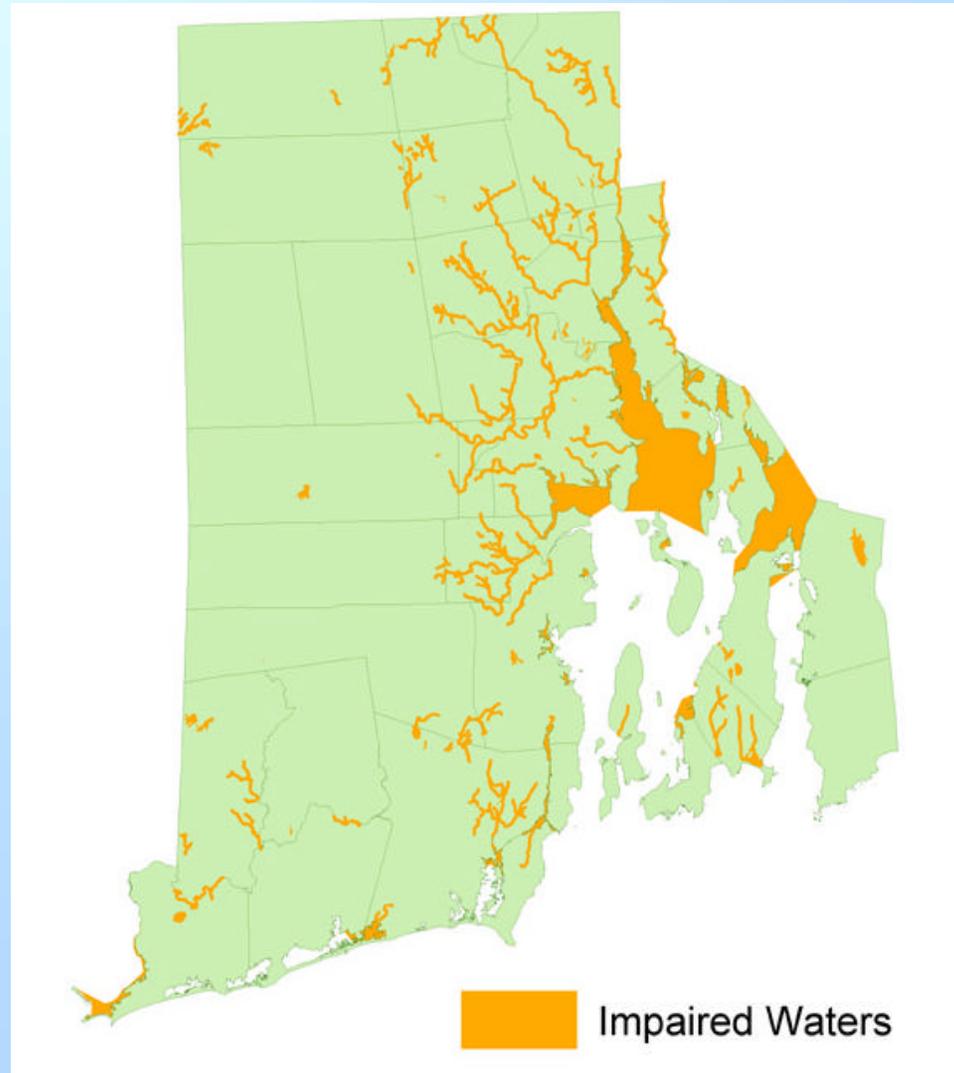
Problem Solving

Develop TMDL (or Equivalent), Determine Allowable Loading, and Allocate Loading Reductions Needed

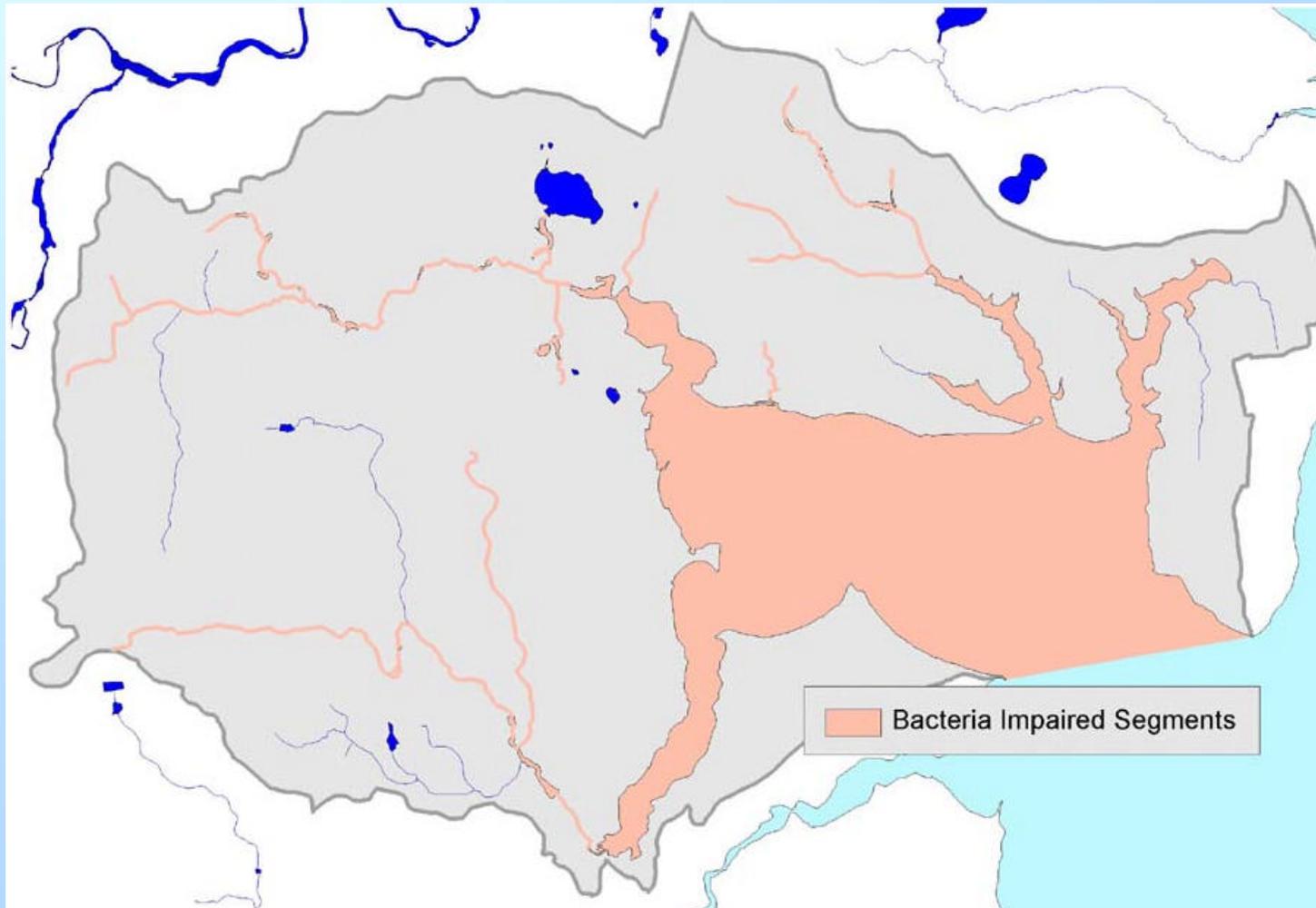
Point Sources
(RIPDES facilities and
storm water permits)

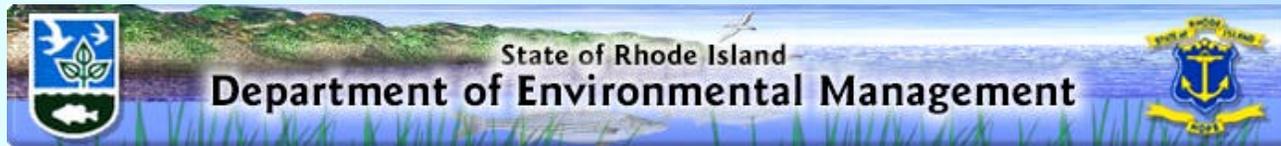
Nonpoint Sources
(BMPs, Technical Assistance,
Grants, Loans, etc.)

Impaired Waters



Greenwich Bay Bacteria Impairments





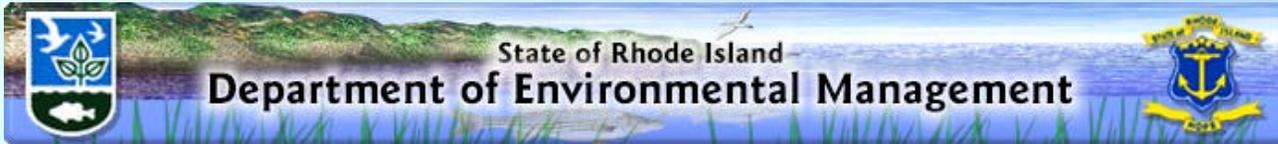
Greenwich Bay Pathogen (Fecal Coliform Bacteria) Impaired Waters

- DEM 2002 303(d) List of Impaired Waters

Greenwich Bay	Brush Neck Cove	Buttonwoods Cove
Warwick Cove	Hardig Brook	Tuscatucket Brook

- Other Waters found to be impaired during this study.

Apponaug Cove	Greenwich Cove	Baker Creek
Dark Entry Brook	Gorton Pond Tributary	Greenwood Creek
Maskerchugg River	Mill Brook	Southern Creek (Carpenter Brook)



TMDL Development Process

Use State Water Quality Standards to Set Limits for Pollutant

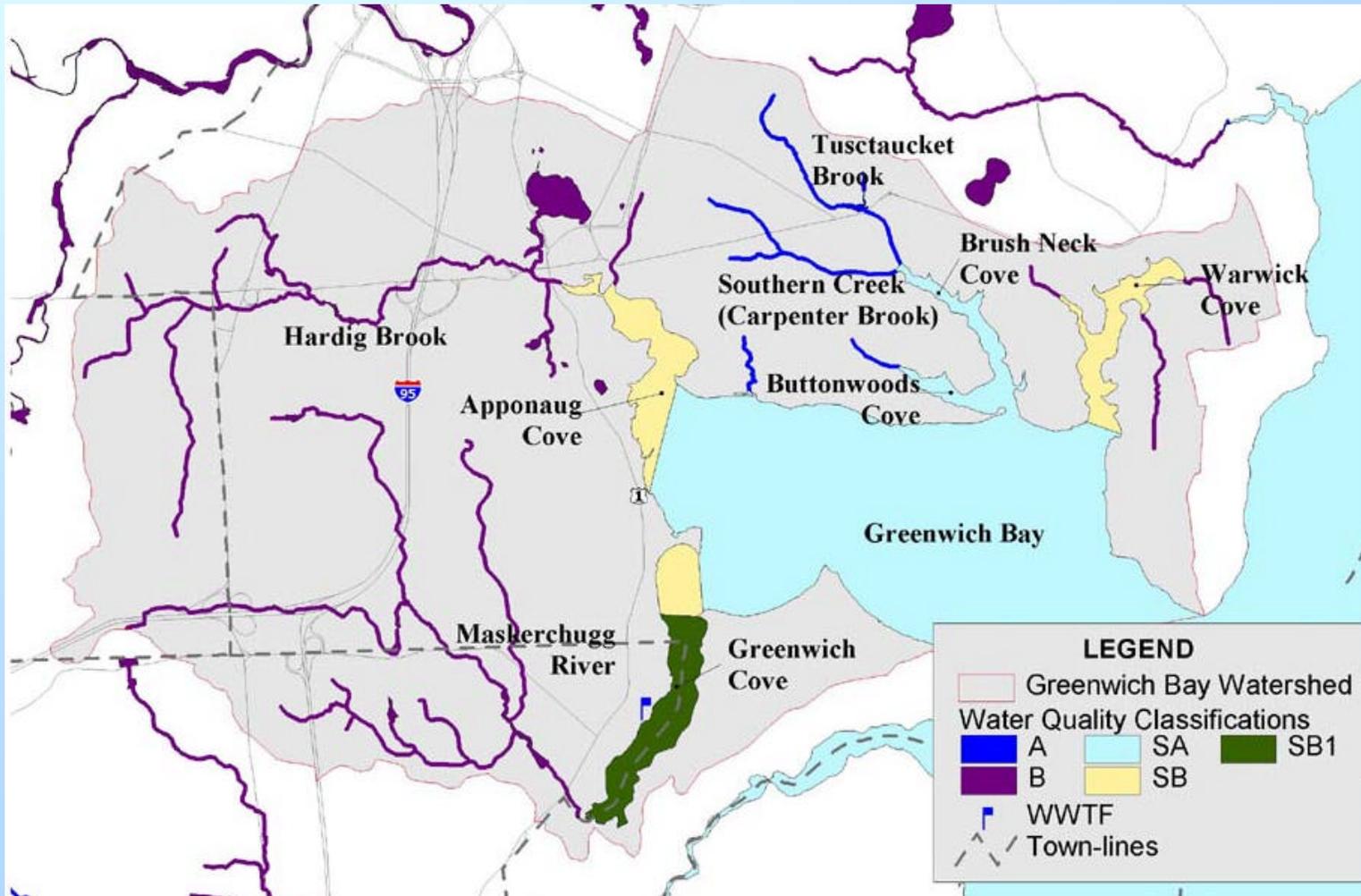
Measure or Evaluate Current Water Quality Targets
and Identify Pollutant Sources

Calculate the Percent Reductions Needed to Meet Water Quality Standards

Establish Mitigation Methods to Meet Target Reductions

Monitor Water Quality to Ensure that Goals are Met

Water Quality Classifications



Water Quality Standards

- Fecal Coliform Bacteria Criteria

Class	Salt Water		Fresh Water	
	SA	SB/SB1	A	B
Geometric Mean MPN / 100 mL	14	50	20	200
Variability MPN / 100 mL	Not more than 10 % to exceed 49	Not more than 10 % to exceed 500	Not more than 10 % to exceed 200	Not more than 20 % to exceed 500



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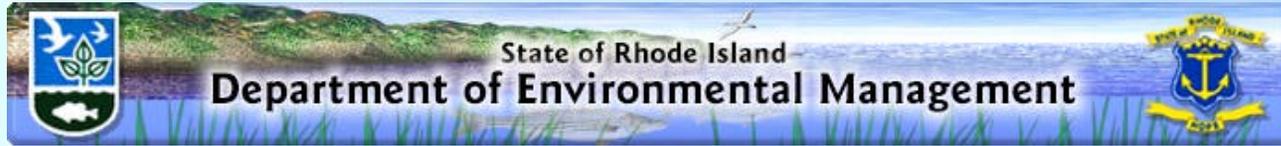
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Data Sources Used to Assess Current Water Quality Conditions

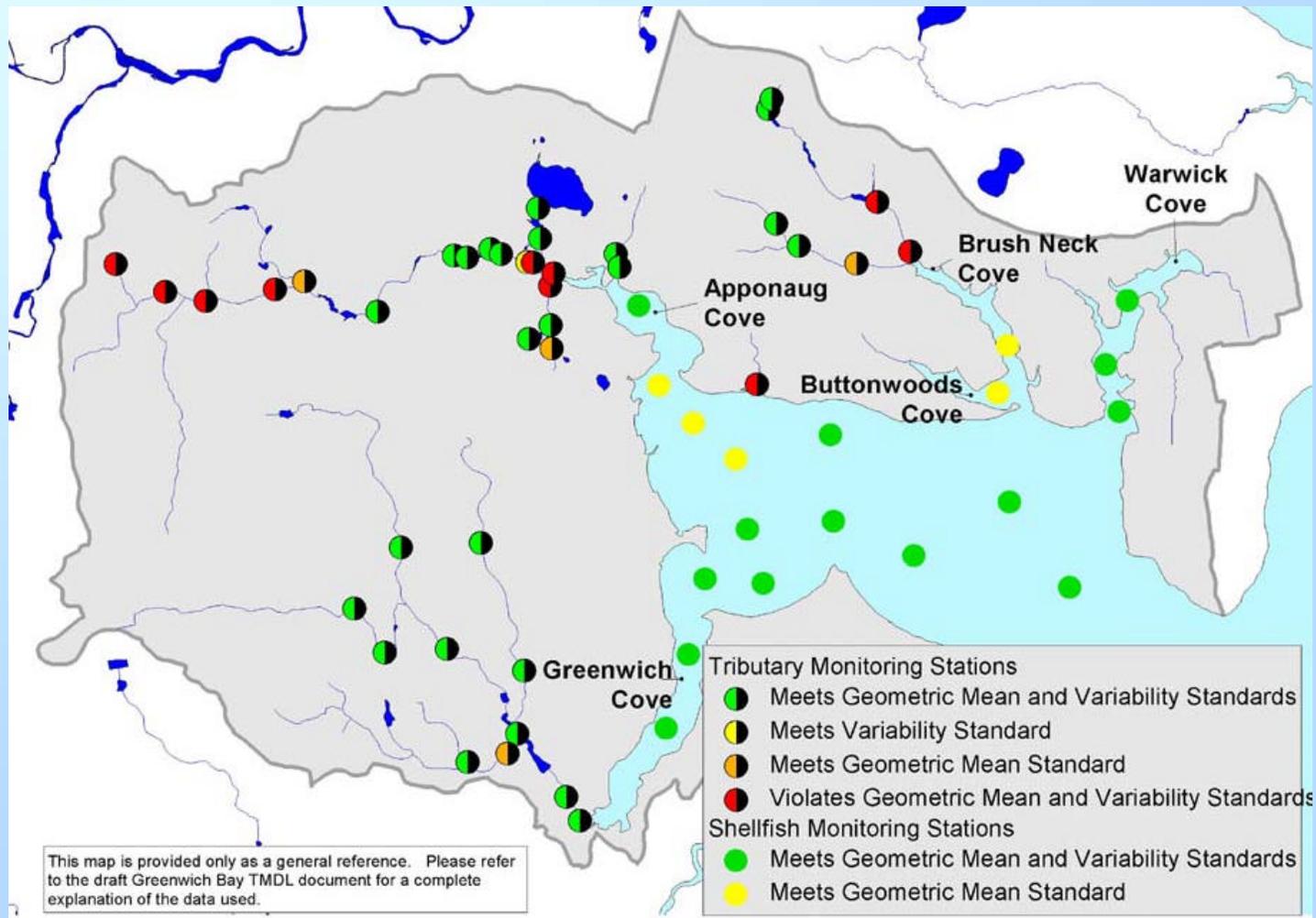
- Greenwich Bay Monitoring
 - DEM Shellfish Program
 - Dry weather monthly sampling of Greenwich Bay (October 2000 through December 2001)
 - DEM Shellfish and TMDL Programs
 - Wet weather monitoring of Greenwich Bay
 - RI Department of Health
 - Beach Monitoring



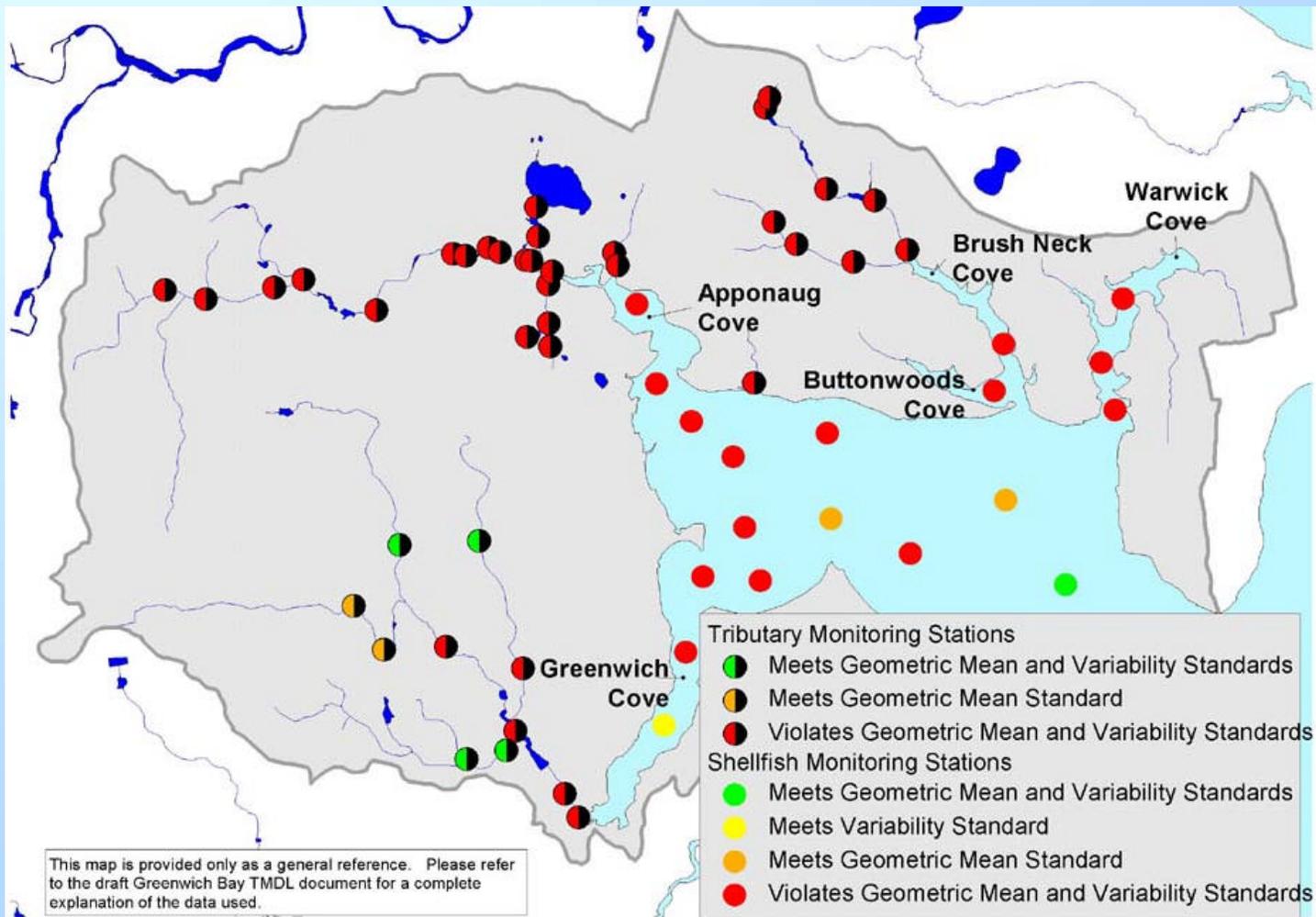
Data Sources Used to Assess Current Water Quality Conditions

- Tributary Monitoring
 - URI Civil and Environmental Engineering
 - Intensive dry and wet weather tributary sampling
 - Direct storm water discharge sampling
 - URI Watershed Watch
 - Volunteer monitoring of Maskerchugg River
 - DEM TMDL Program
 - Limited wet weather monitoring
 - Dry and wet weather monitoring of Hardig Brook
 - DEM Shellfish Program
 - Shoreline surveys

Dry Weather Water Quality



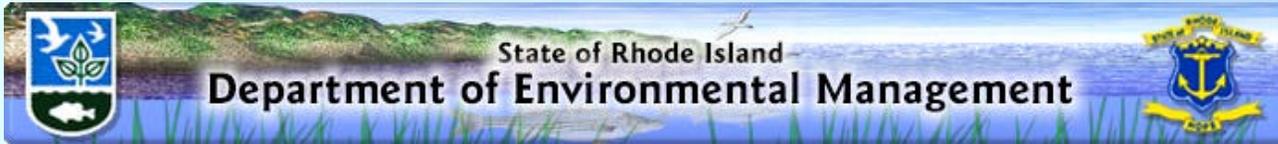
Wet Weather Water Quality





Water Quality Summary

- Greenwich Bay
 - Shellfishing
 - Beaches
- Tributaries
 - Same trend as Greenwich Bay
 - Flows increase significantly following rain events
 - Removal of known bacteria sources in Hardig Brook has resulted in bacteria reductions, but not enough to meet standards



TMDL Development Process

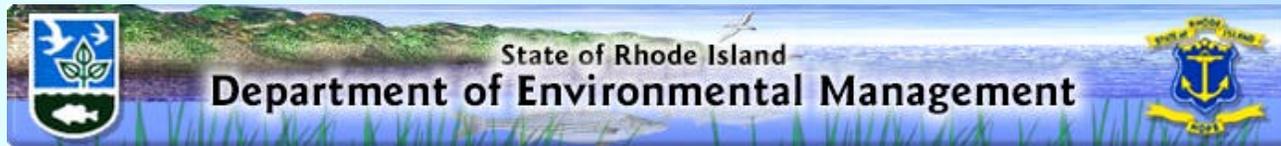
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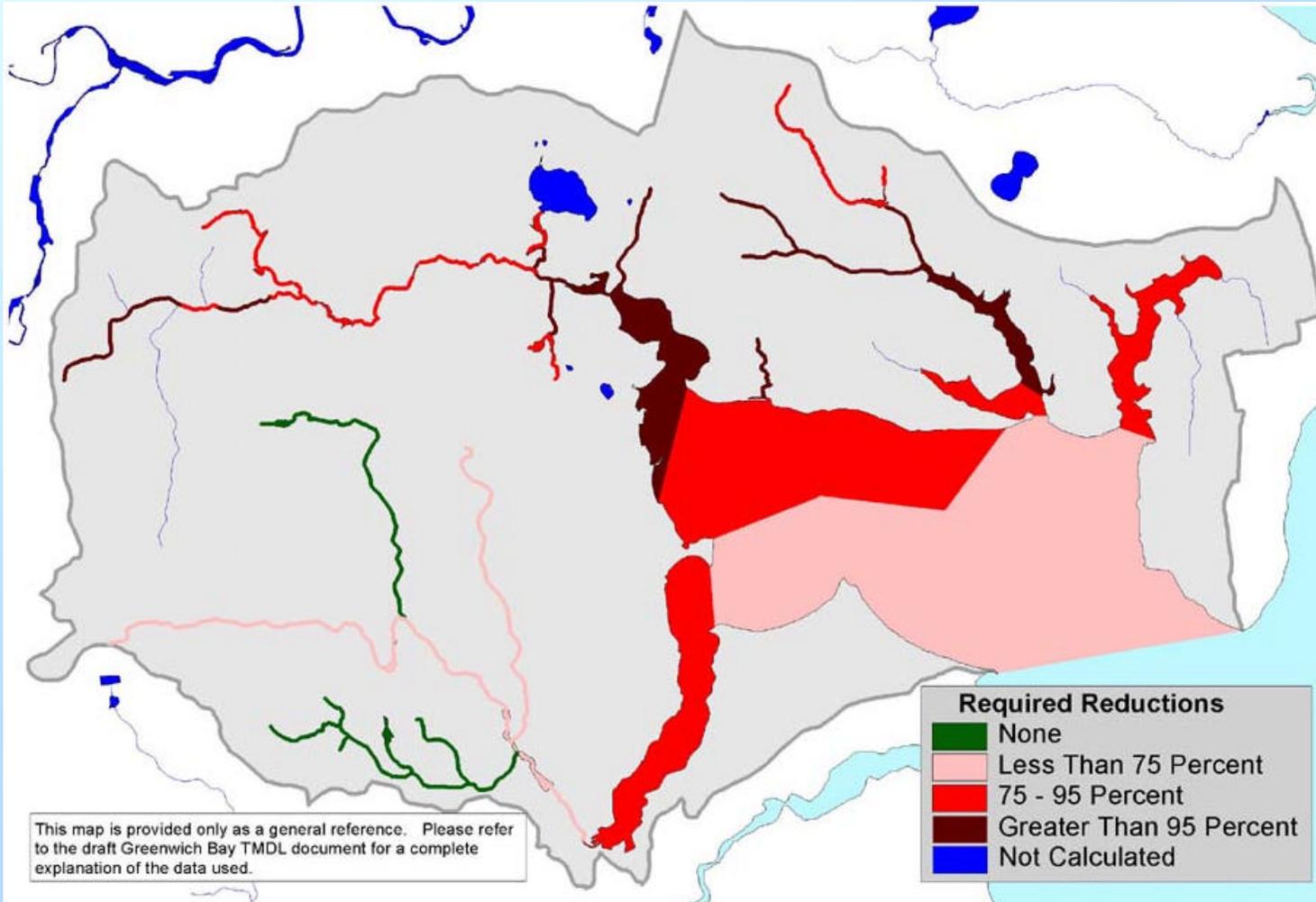
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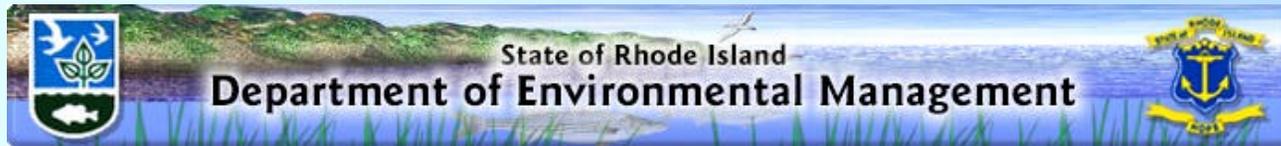


Calculate Percent Reductions

- Combine dry and wet data to calculate geometric mean and variability statistics.
- Calculate the required percent reduction for each part of the water quality standard.
- Required reduction is the highest needed to meet each percent reduction.

TMDL Reductions



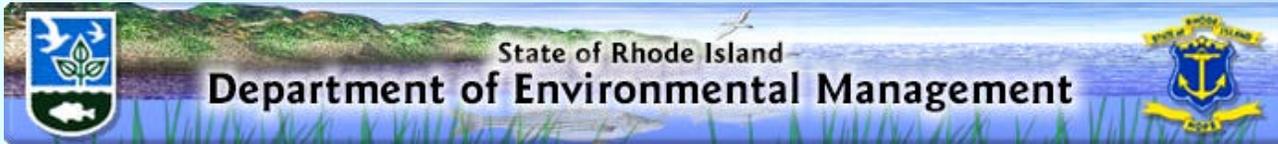


Bacteria Sources

- Humans
- Domestic Pets
- Waterfowl
- Wildlife

Bacteria Pathways

- Storm Sewer Network
- Overland Sheet Flow
- ISDS Seepage
- Direct



TMDL Development Process

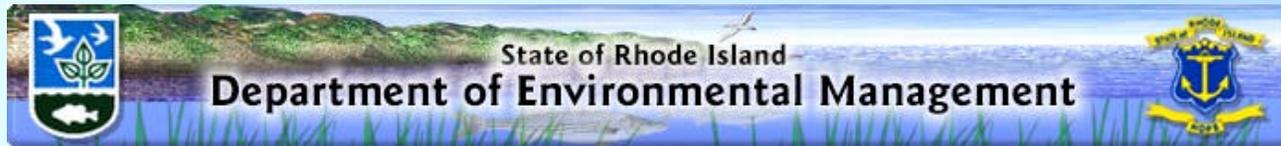
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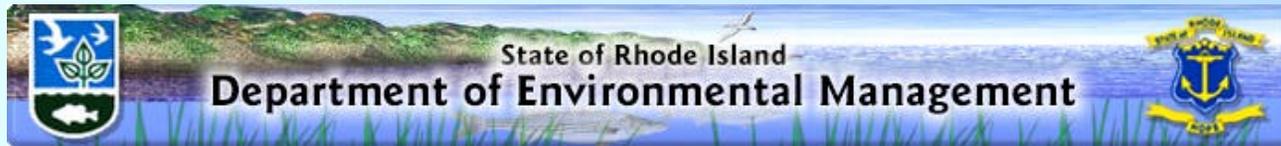
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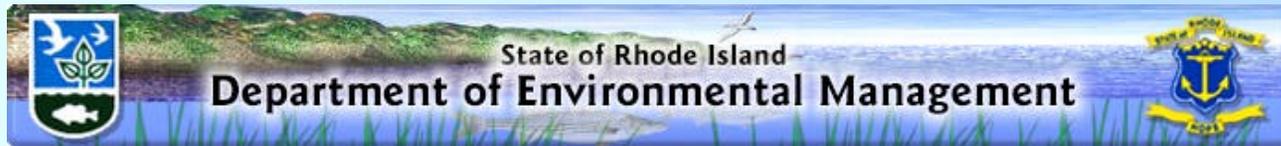
Storm Water Management Objectives

- Eliminating or treating bacteria in storm water.
- Reducing the volume of storm water.



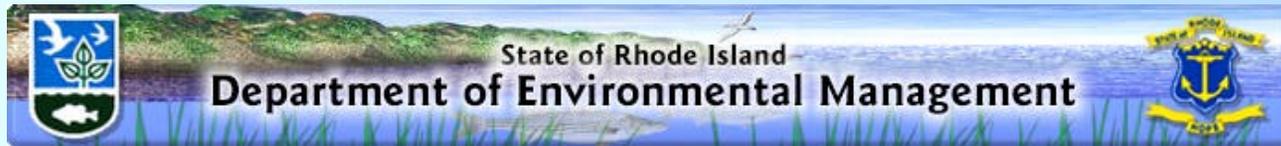
RIPDES Storm Water Phase II

- Storm Water Management Program Plan Minimum Measures
 - Public education and outreach program to inform the public about the impacts of storm water on surface waters
 - A public involvement/participation program
 - An illicit discharge detection and elimination program
 - A construction site storm water runoff control program for sites disturbing 1 or more acres
 - A post construction storm water runoff control program for new development and redevelopment sites disturbing 1 or more acres
 - A municipal pollution prevention/good housekeeping operation and maintenance program



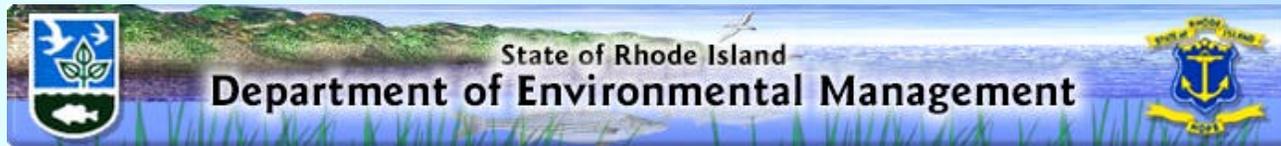
Storm Water BMPs

- Upland Flow Attenuation
 - Infiltrate roof runoff
 - Landscaping choices to minimize runoff
- End-of-Pipe Treatment
 - Infiltration Basins
- Development



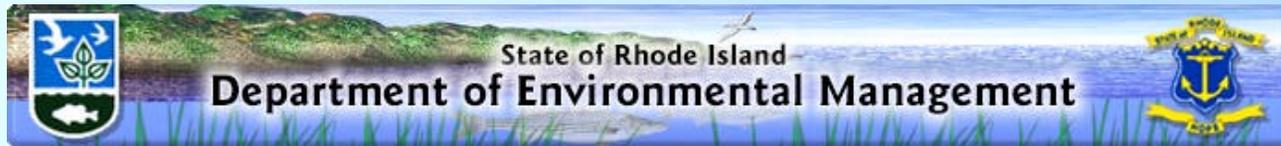
Priorities for Construction of Storm Water BMPs

- Warwick
 - Brush Neck Cove
 - Apponaug Cove
- East Greenwich
 - Greenwich Cove
- West Warwick
 - Headwaters of Hardig Brook
- Department of Transportation



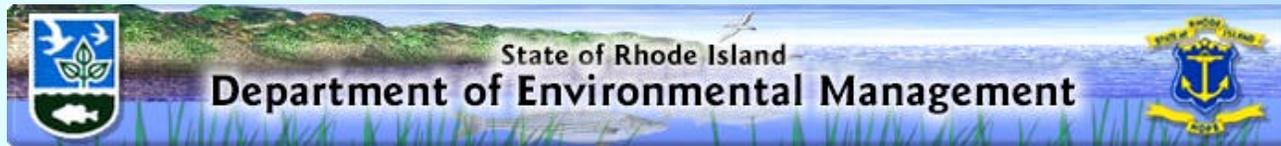
Wastewater Management

- Sewers
 - Warwick and East Greenwich are in the process of extending sewer lines throughout the watershed.
- Septic Systems
 - Communities should adopt enforceable mechanisms to:
 - Identify and Replace Sub-Standard Systems
 - Ensure Adequate Maintenance
 - Illicit discharge detection in areas without sewers



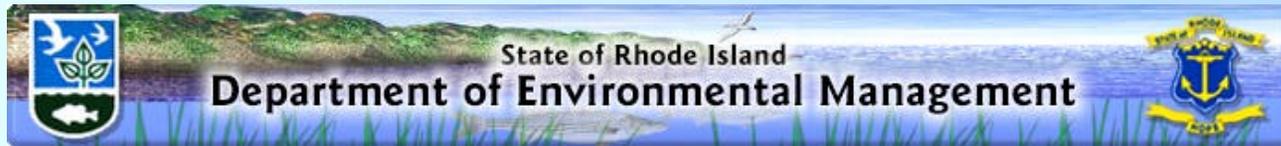
No Discharge Activities

- Current Activities
 - Clean Vessel Act Program provides grants for infrastructure construction, repair, and replacement.
 - DEM has coordinated outreach and education programs.
- Proposed Activities
 - Optimize use of the pump-out boat.
 - Develop a Pennant System.
 - Develop policies towards inspecting boats.
- SAMP will include further recommendations



Non-Human Bacteria Sources

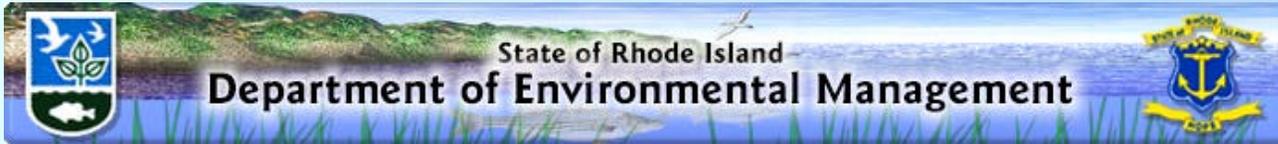
- Pets
 - Dispose of waste properly.
 - Make pet waste bags and containers available.
- Waterfowl
 - Eliminate feeding by humans.
 - Plant buffers to discourage *easy* access to the water.



Beach Management Options

- Control animal populations at beaches.
- Enforce ban on human feeding of waterfowl.
- Remove food sources (trash, debris, etc.).
- Rake seaweed from shoreline (Reports indicate that bacteria can stay viable in seaweed wracks for weeks).
- Prohibit dogs on beaches.

HEALTH Reg. R23-21-RF Section 3.0(a)



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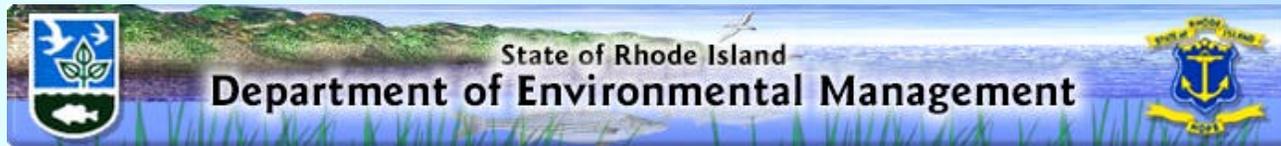
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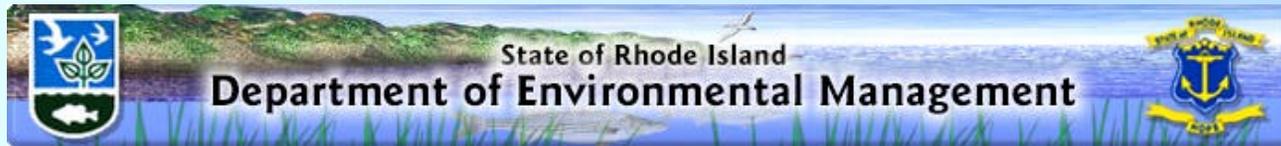
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Follow-Up Monitoring

- DEM Shellfish Program
 - Monthly Dry Weather Sampling
 - Shoreline Surveys
- Department of Health
 - Beach Monitoring Program
- Watershed Watch
 - Monthly Tributary Sampling (Summer)



Comments on the TMDL Document

<http://www.state.ri.us/dem/programs/benviron/water/quality/rest/pdfs/gbtmdl.pdf>

Send Comments before March 12, 2004 to:

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