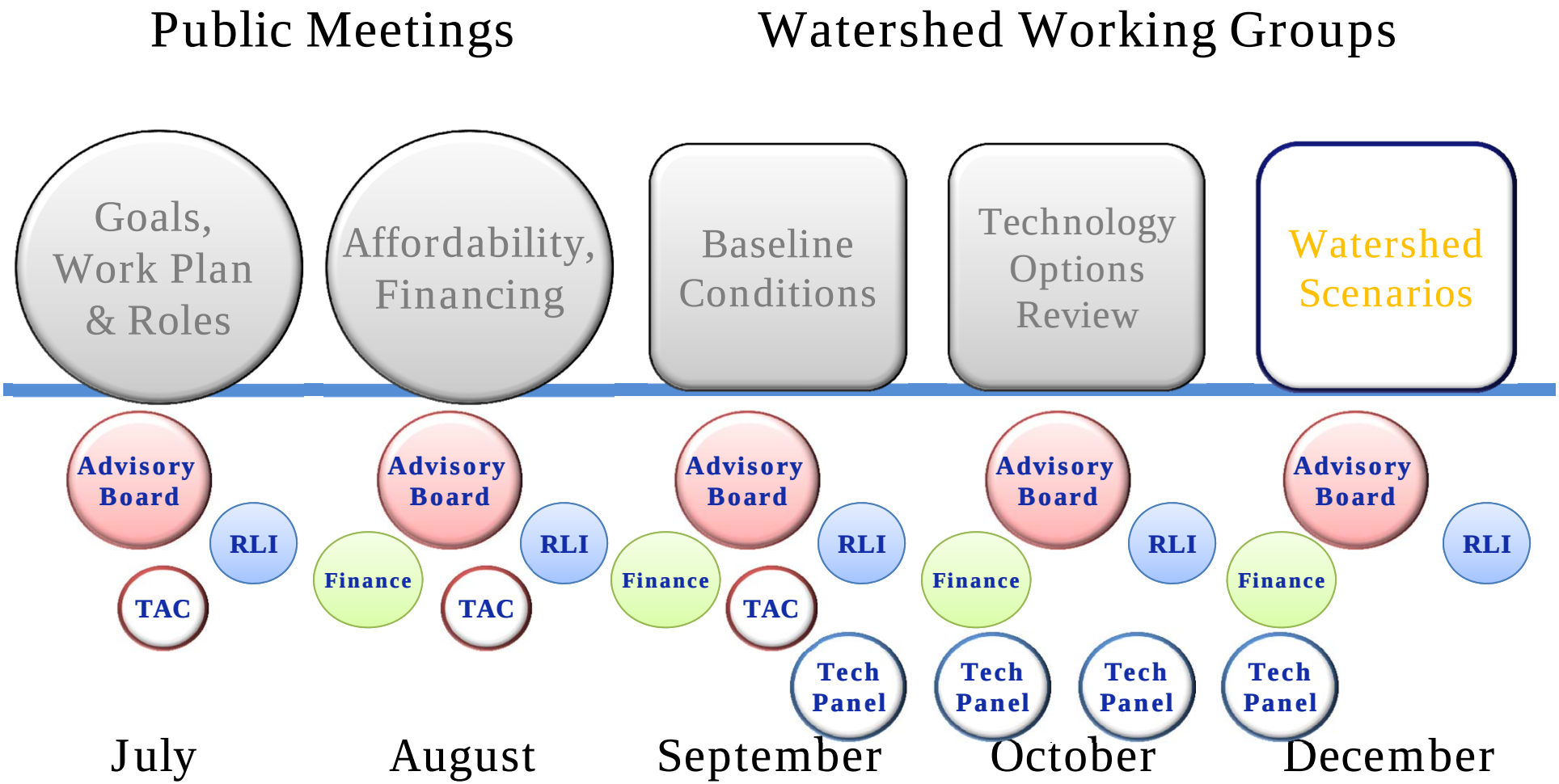
Herring River Group

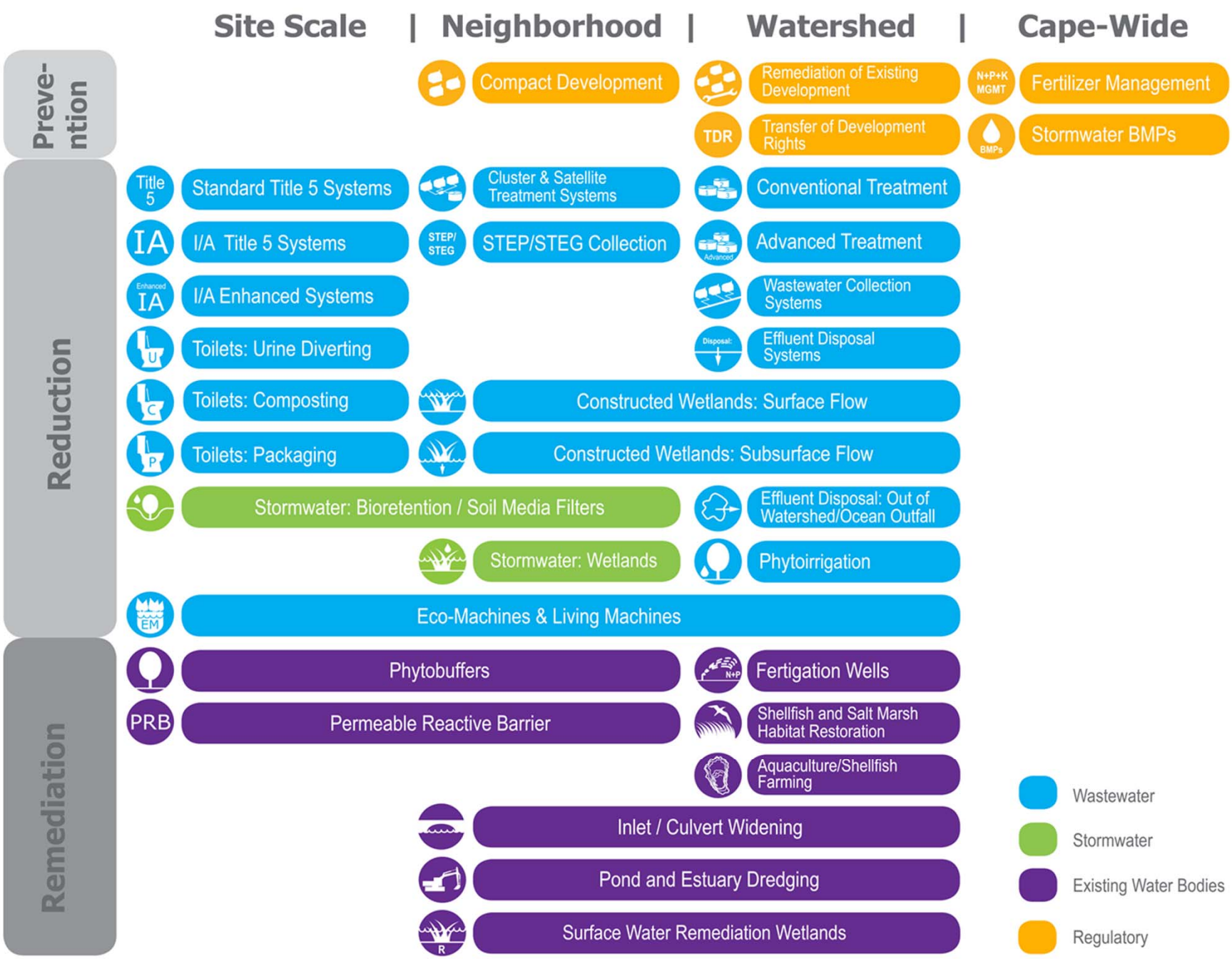
Watershed Scenarios



RLI — Regulatory, Legal & Institutional Work Group

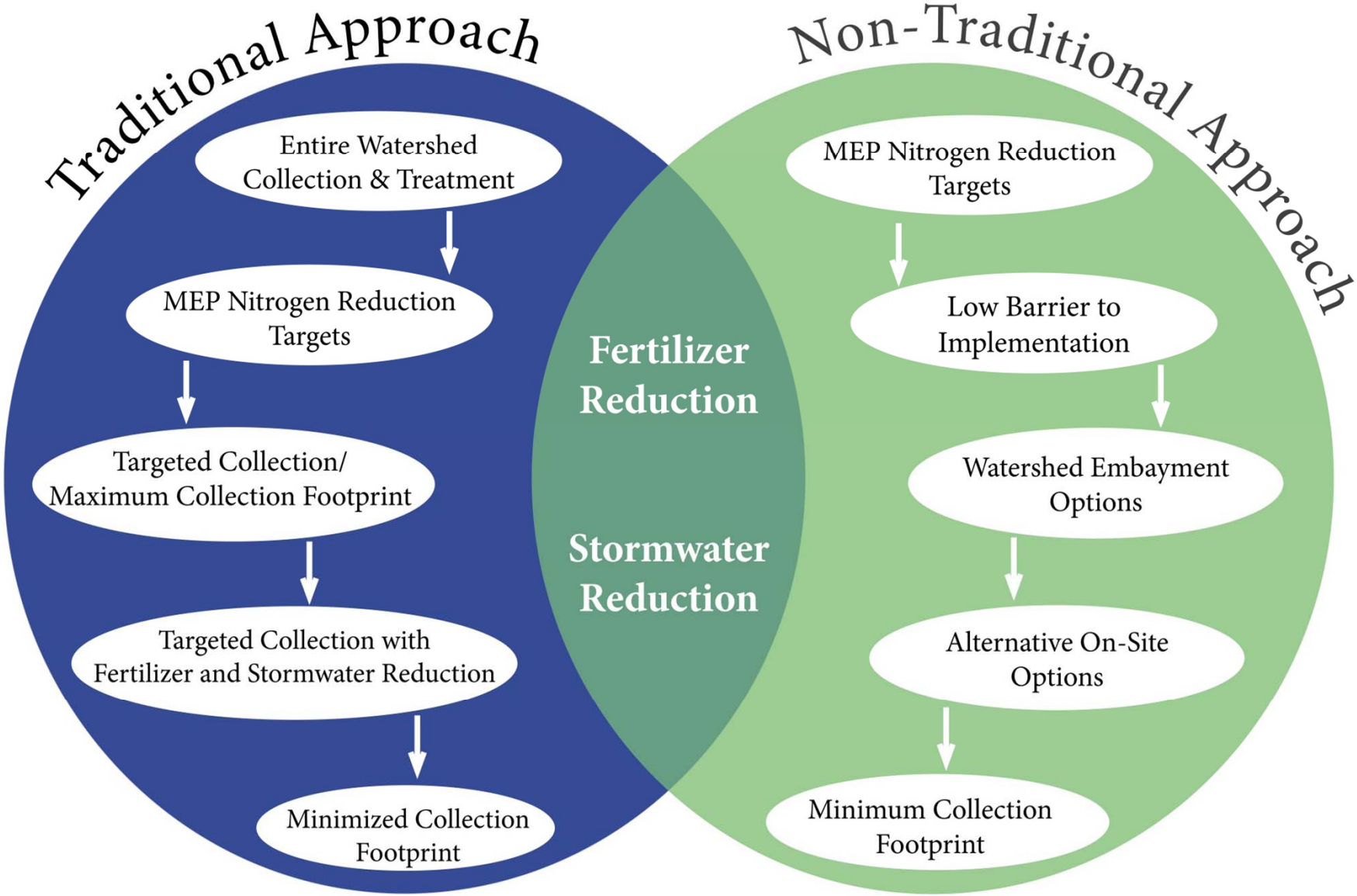
TAC — Technical Advisory Committee of Cape Cod Water Protection Collaborative

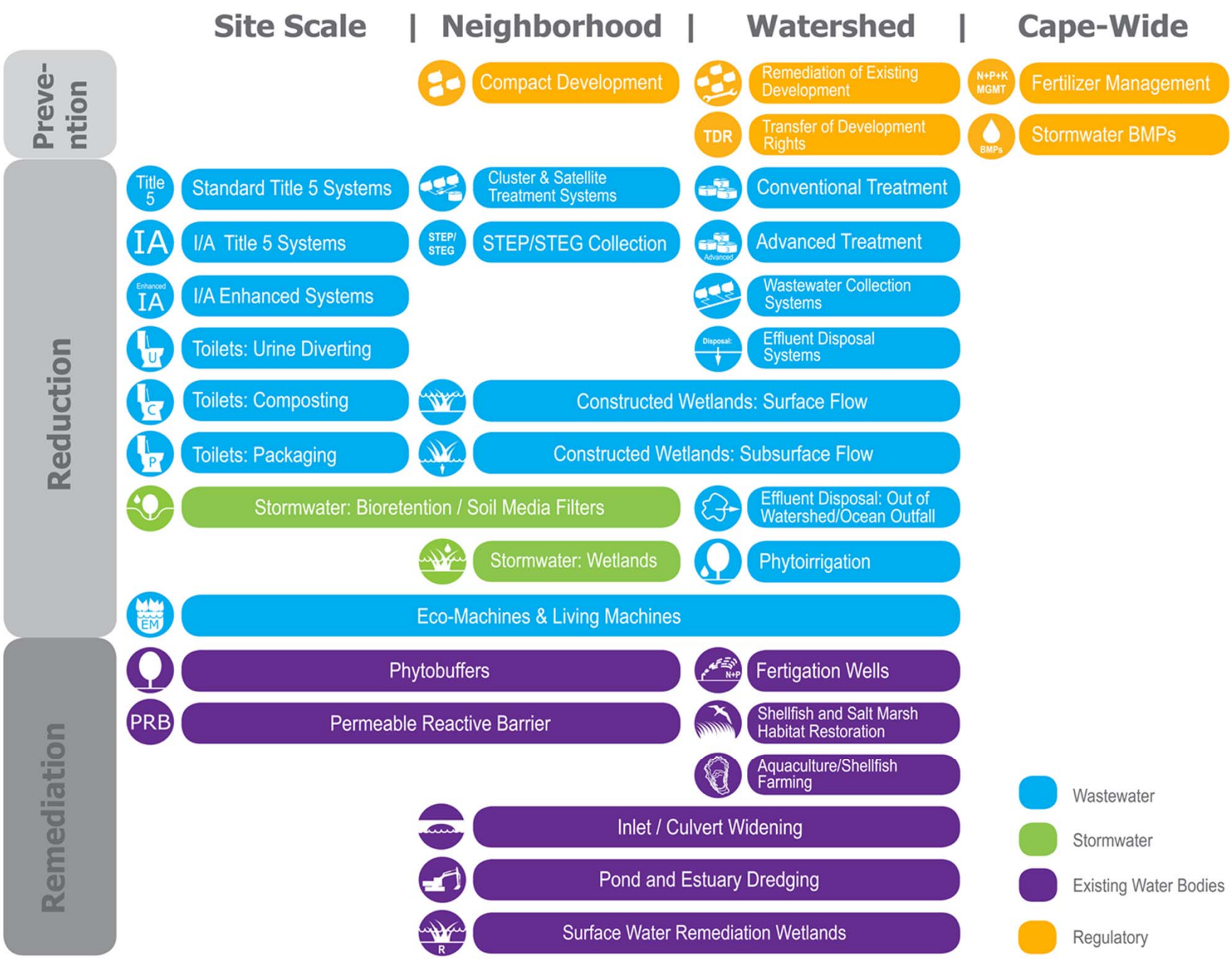
208 Planning Process

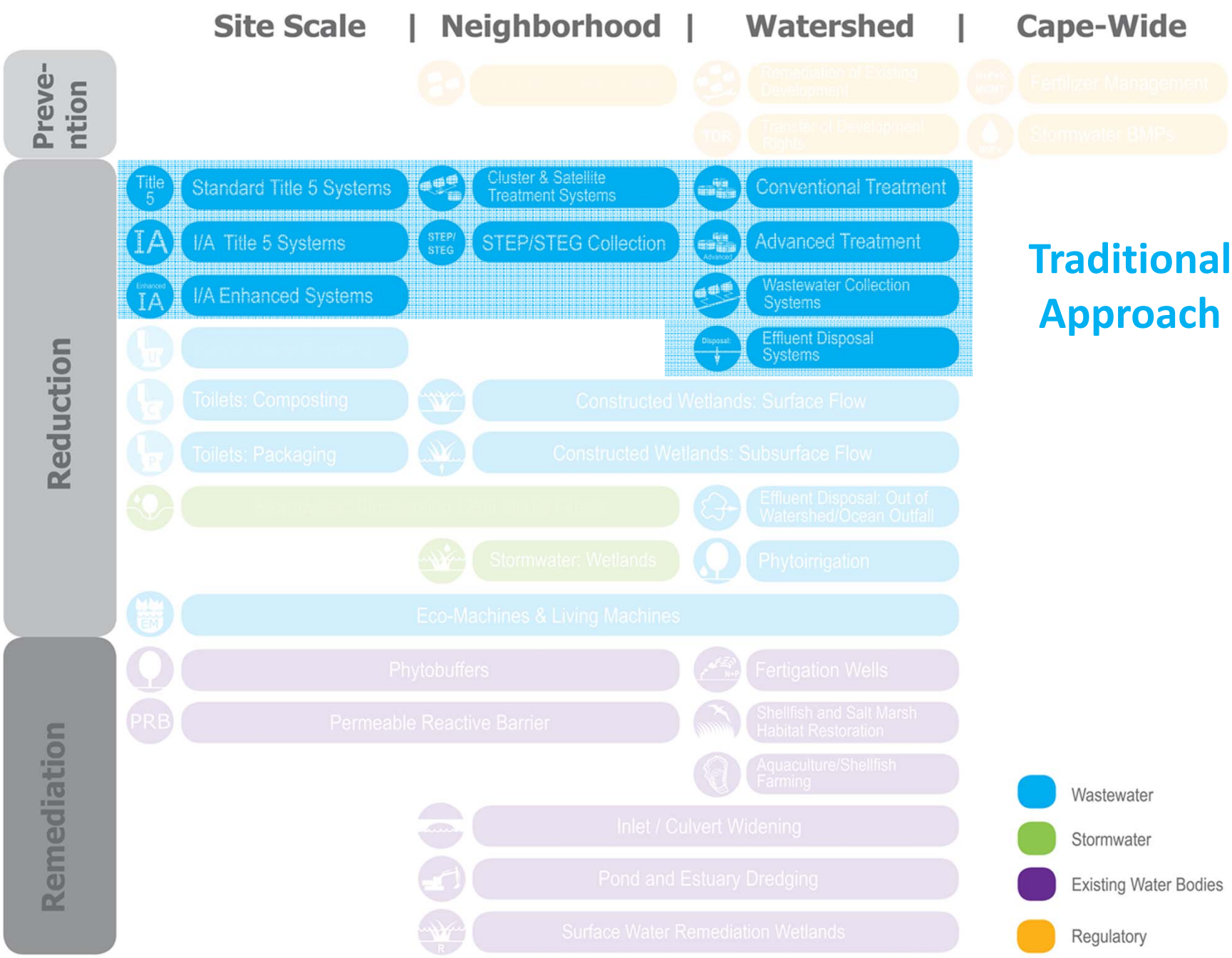

Site Scale | Neighborhood | Watershed | Cape-Wide
Preve-ntion
Reduction
Remediation
Compact Development
Remediation of Existing Development
Fertilizer Management
Transfer of Development Rights
Stormwater BMPs
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
I/A Title 5 Systems
STEP/STEG Collection
Advanced Treatment
I/A Enhanced Systems
Wastewater Collection Systems
Toilets: Urine Diverting
Effluent Disposal Systems
Toilets: Composting
Constructed Wetlands: Surface Flow
Toilets: Packaging
Constructed Wetlands: Subsurface Flow
Stormwater: Bioretention / Soil Media Filters
Effluent Disposal: Out of Watershed/Ocean Outfall
Stormwater: Wetlands
Phytoirrigation
Eco-Machines & Living Machines
Phytobuffers
Fertigation Wells
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands
Wastewater
Stormwater
Existing Water Bodies
Regulatory

Goal of Today's Meeting:

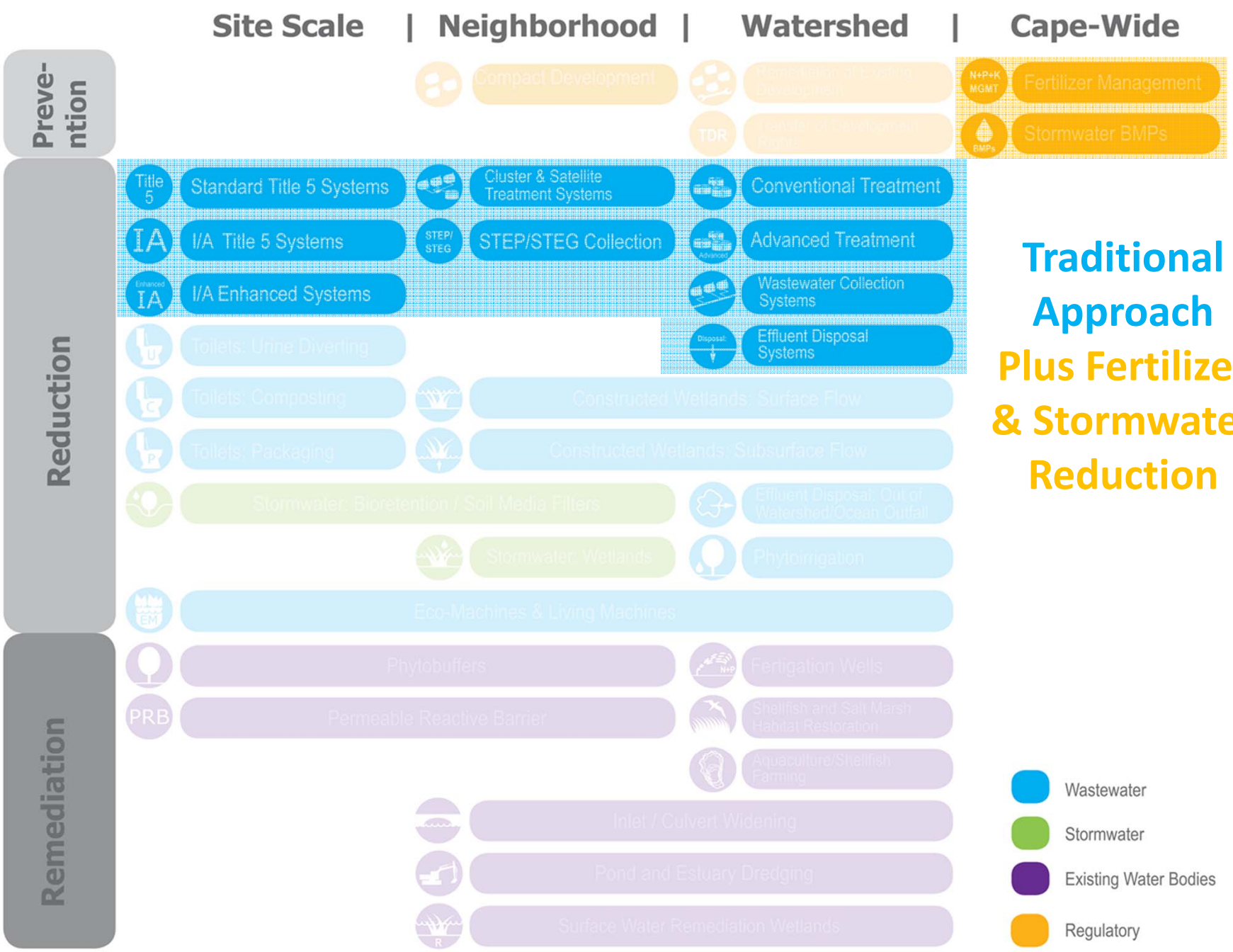
- To discuss the approach for developing watershed scenarios that will remediate water quality impairments in your watersheds.
- To identify preferences, advantages and disadvantages of a set of scenarios of different technologies and approaches, and
- To develop a set of adaptive management principles to guide sub-regional groups in refining scenarios for the 208 Plan.

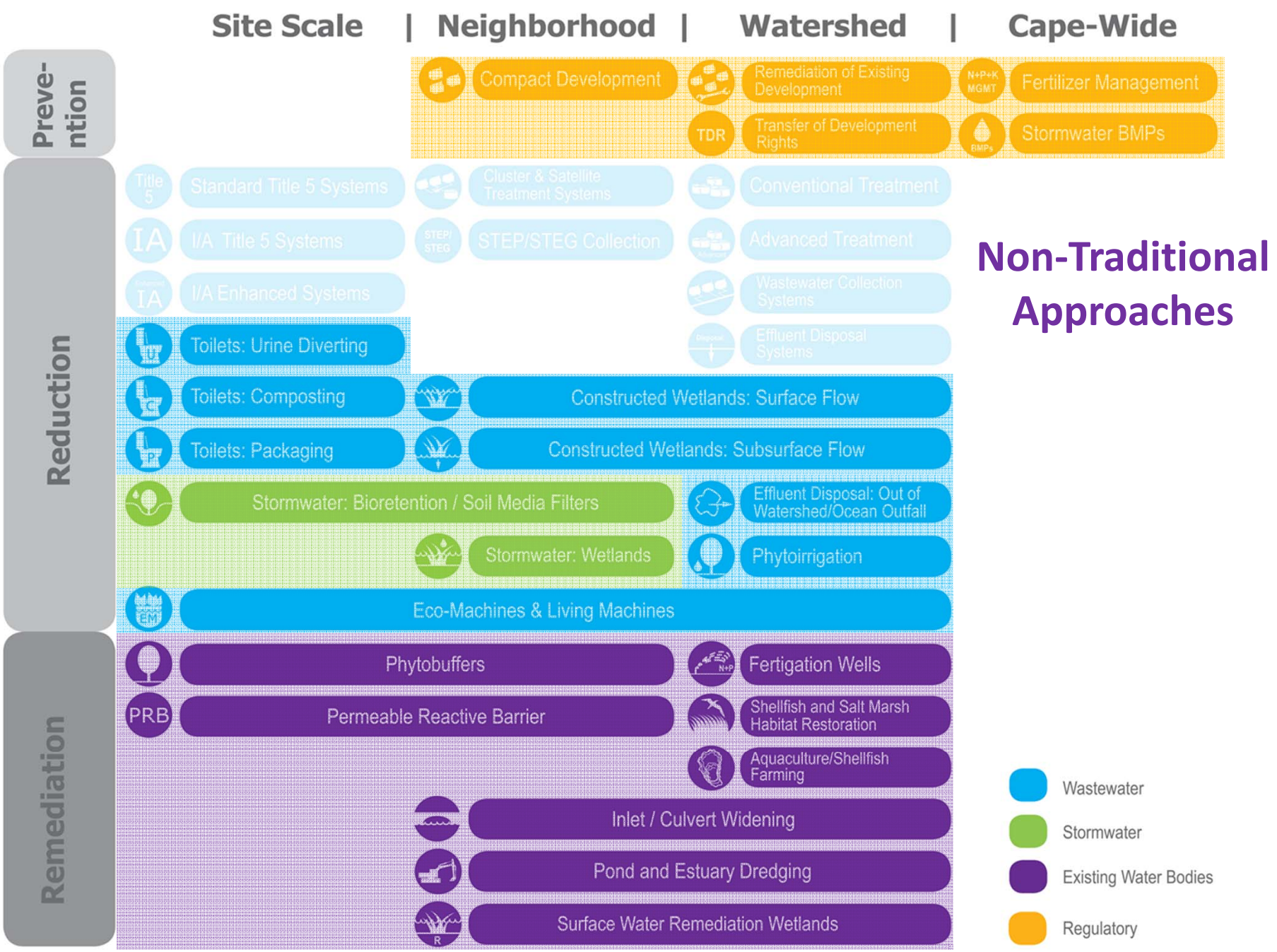

Traditional Approach
Entire Watershed Collection & Treatment
MEP Nitrogen Reduction Targets
Targeted Collection/ Maximum Collection Footprint
Targeted Collection with Fertilizer and Stormwater Reduction
Minimized Collection Footprint
Fertilizer Reduction
Stormwater Reduction
Non-Traditional Approach
MEP Nitrogen Reduction Targets
Low Barrier to Implementation
Watershed Embayment Options
Alternative On-Site Options
Minimum Collection Footprint


Site Scale | Neighborhood | Watershed | Cape-Wide
Preve-ntion
Reduction
Remediation
Compact Development
Remediation of Existing Development
Fertilizer Management
Transfer of Development Rights
Stormwater BMPs
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
I/A Title 5 Systems
STEP/STEG Collection
Advanced Treatment
I/A Enhanced Systems
Wastewater Collection Systems
Toilets: Urine Diverting
Effluent Disposal Systems
Toilets: Composting
Constructed Wetlands: Surface Flow
Toilets: Packaging
Constructed Wetlands: Subsurface Flow
Stormwater: Bioretention / Soil Media Filters
Effluent Disposal: Out of Watershed/Ocean Outfall
Stormwater: Wetlands
Phytoirrigation
Eco-Machines & Living Machines
Phytobuffers
Fertigation Wells
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands
Wastewater
Stormwater
Existing Water Bodies
Regulatory

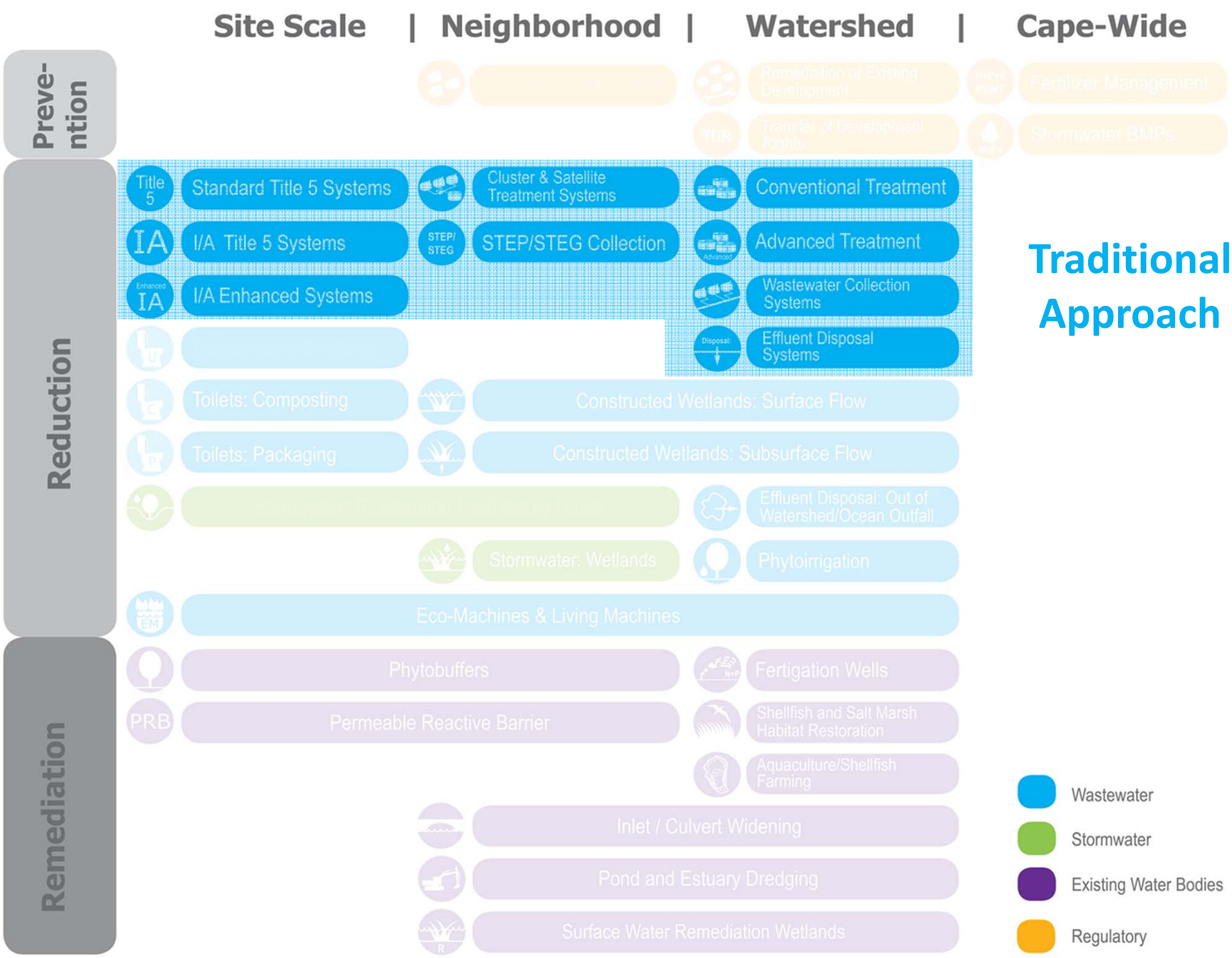


Traditional Approach


Site Scale | Neighborhood | Watershed | Cape-Wide
Preve-ntion
Reduction
Remediation
Compact Development
Fertilizer Management
Stormwater BMPs
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
I/A Title 5 Systems
STEP/STEG Collection
Advanced Treatment
I/A Enhanced Systems
Wastewater Collection Systems
Effluent Disposal Systems
Toilets: Urine Diverting
Toilets: Composting
Toilets: Packaging
Constructed Wetlands: Surface Flow
Constructed Wetlands: Subsurface Flow
Stormwater: Bioretention / Soil Media Filters
Effluent Disposal: Out of Watershed/Ocean Outfall
Stormwater: Wetlands
Phytorrigation
Eco-Machines & Living Machines
Phytobuffers
Fertigation Wells
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands
Traditional Approach Plus Fertilizer & Stormwater Reduction
Wastewater
Stormwater
Existing Water Bodies
Regulatory

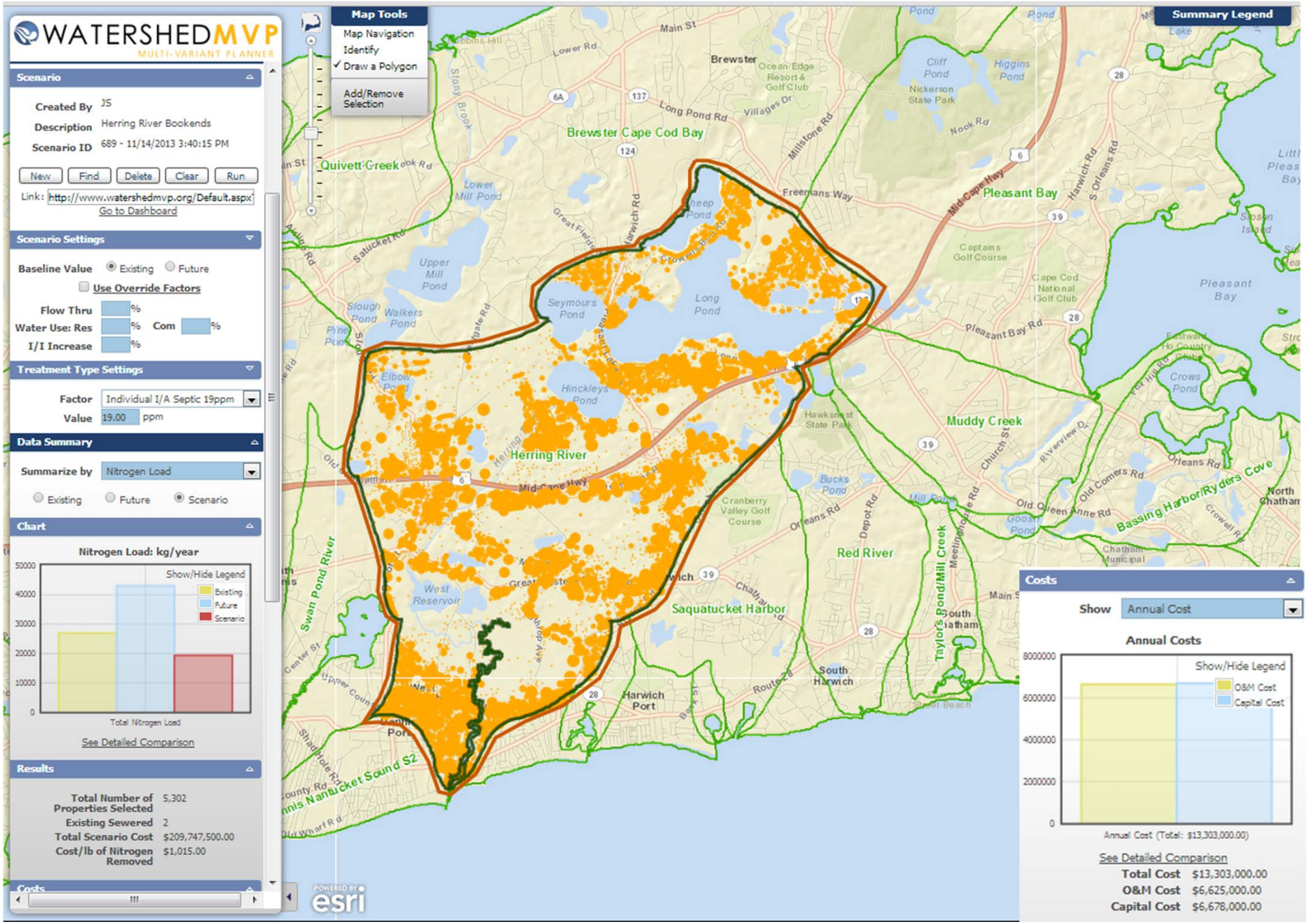


Non-Traditional Approaches

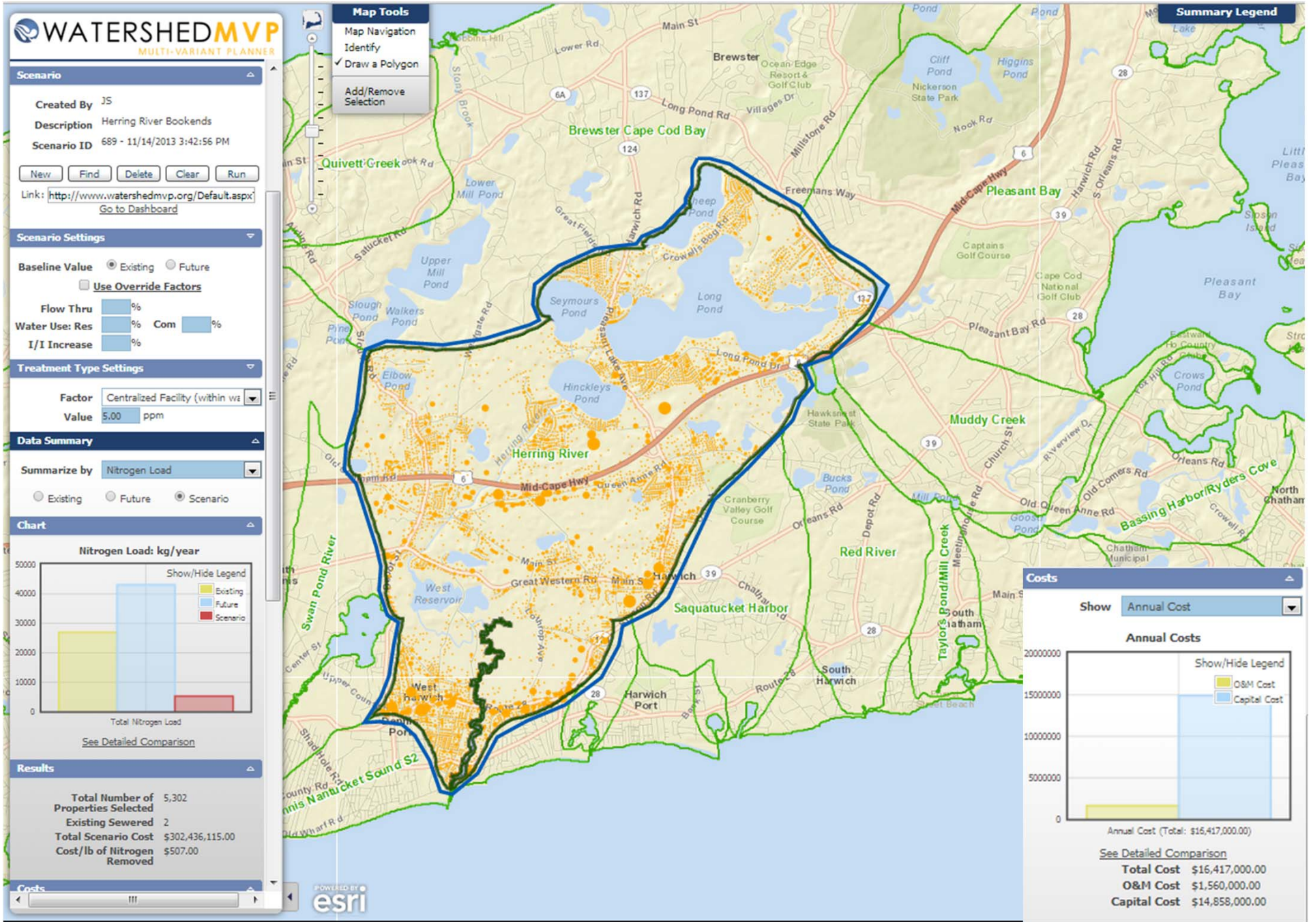


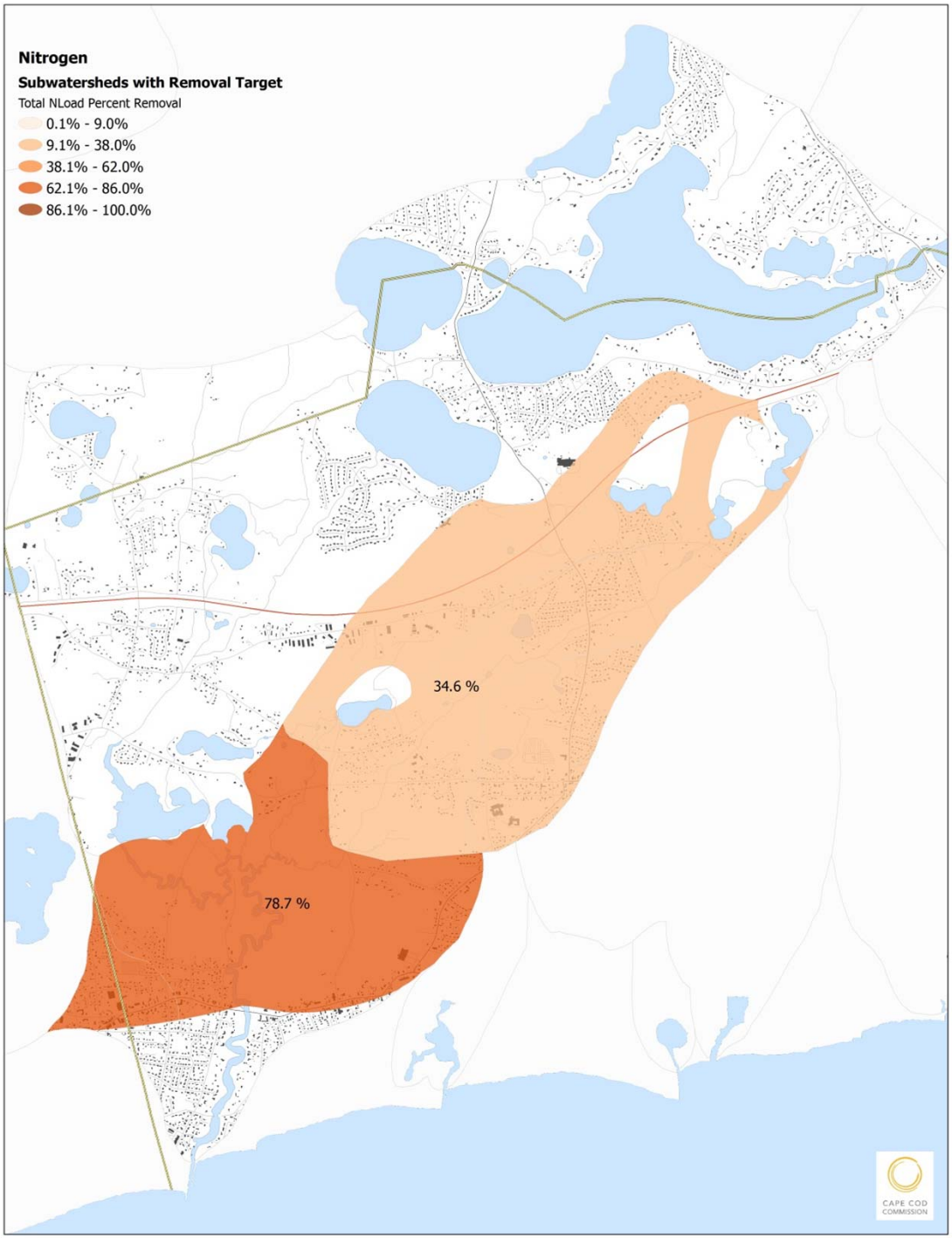
Traditional Approach

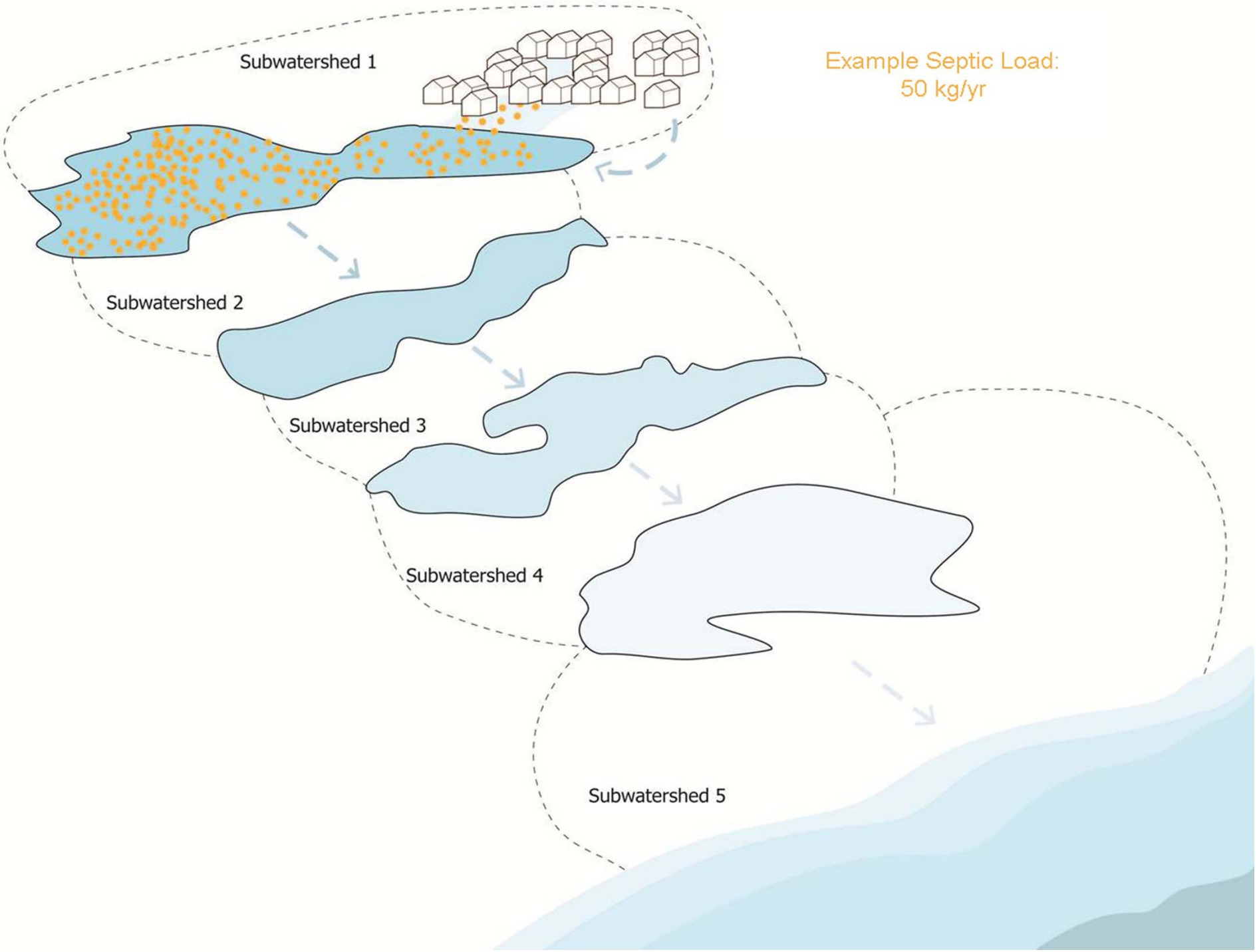
Watershed-Wide Innovative/Alternative (I/A) Onsite Systems

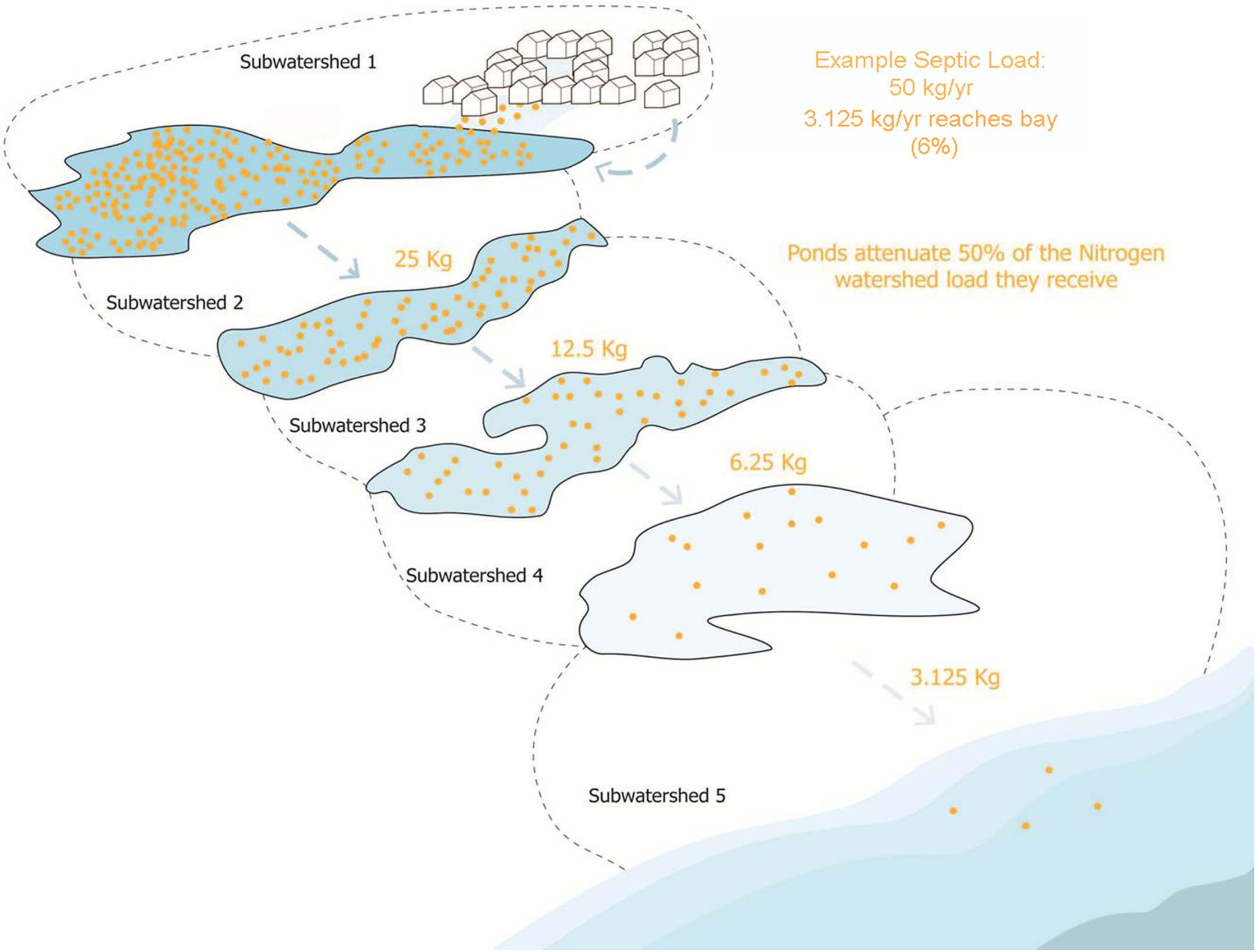


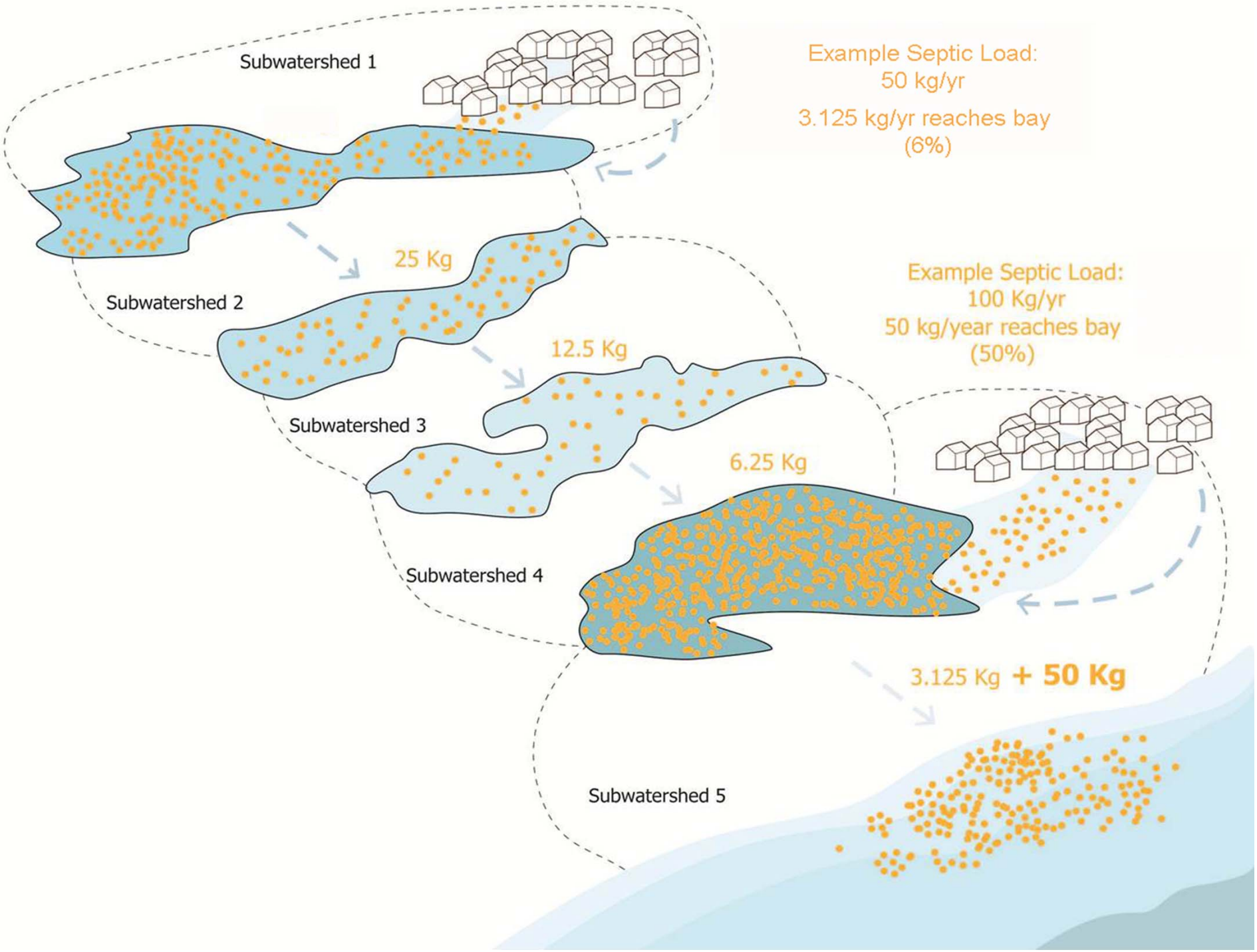
Watershed-Wide Centralized Treatment with Disposal Inside the Watershed



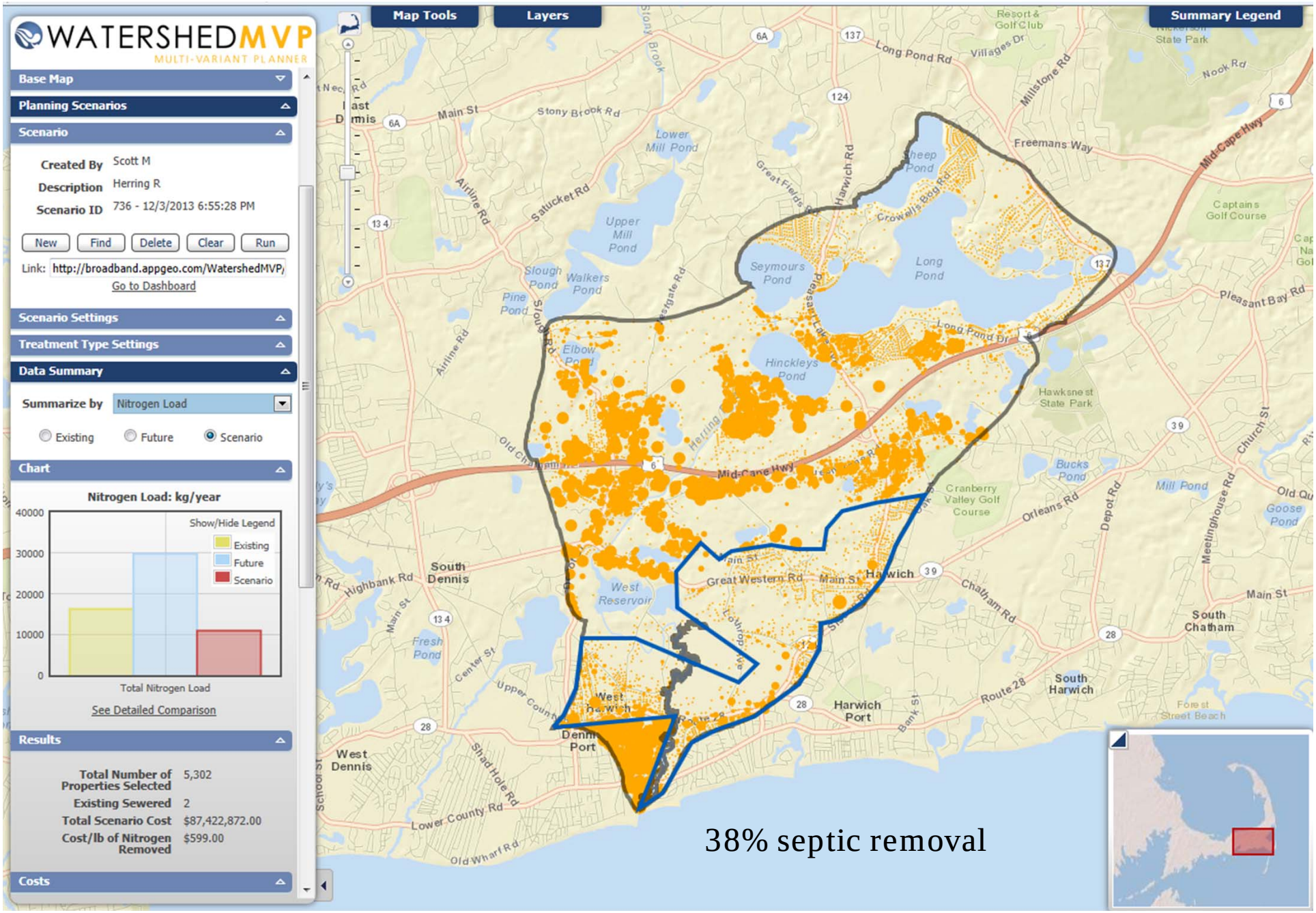

Nitrogen
Subwatersheds with Removal Target
Total NLoad Percent Removal
0.1% - 9.0%
9.1% - 38.0%
38.1% - 62.0%
62.1% - 86.0%
86.1% - 100.0%
34.6 %
78.7 %
CAPE COD COMMISSION

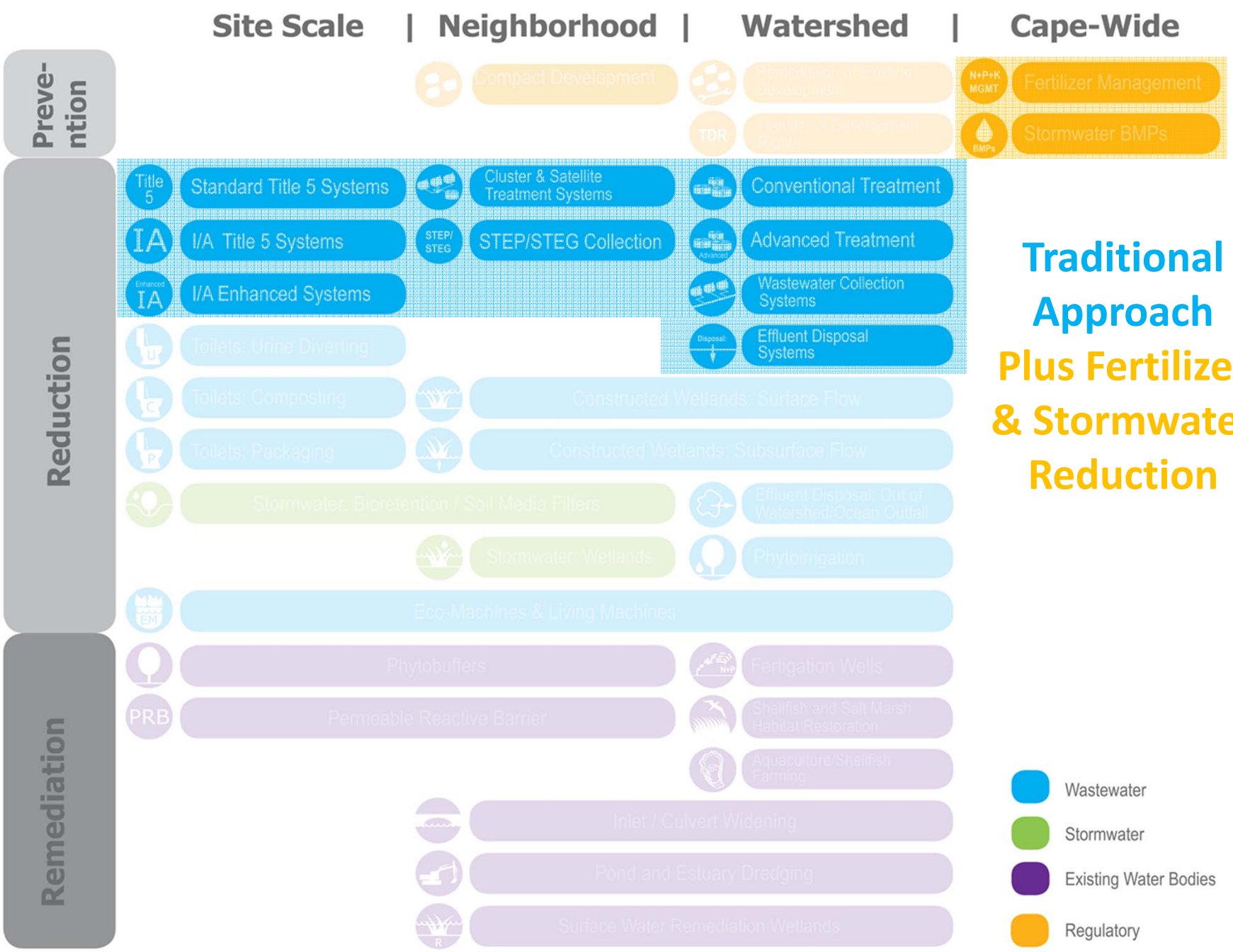

Subwatershed 1
Example Septic Load:
50 kg/yr
Subwatershed 2
Subwatershed 3
Subwatershed 4
Subwatershed 5


Subwatershed 1
Example Septic Load:
50 kg/yr
3.125 kg/yr reaches bay
(6%)
25 Kg
Subwatershed 2
Ponds attenuate 50% of the Nitrogen
watershed load they receive
12.5 Kg
Subwatershed 3
6.25 Kg
Subwatershed 4
3.125 Kg
Subwatershed 5

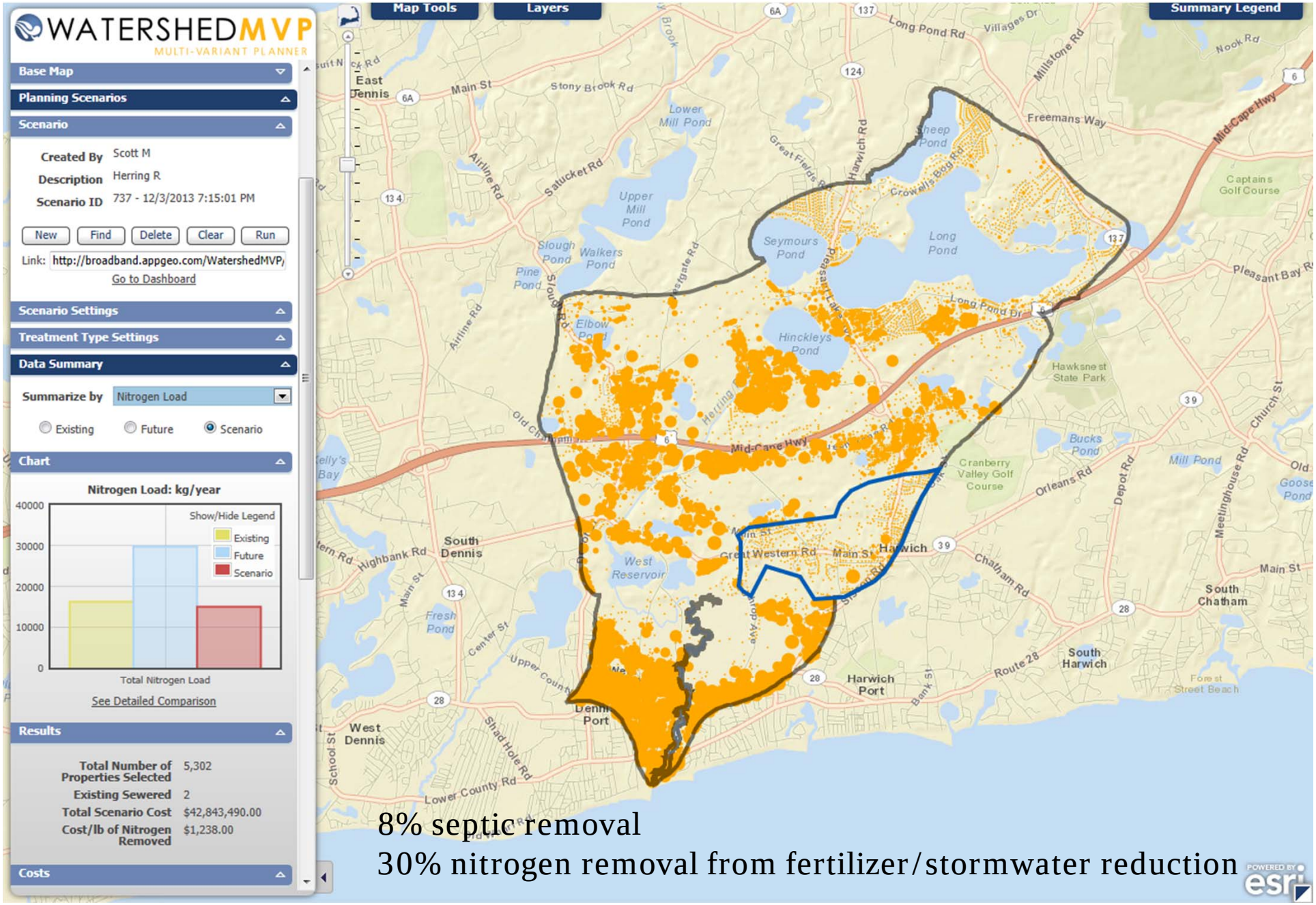

Subwatershed 1
Example Septic Load:
50 kg/yr
3.125 kg/yr reaches bay
(6%)
25 Kg
Subwatershed 2
Example Septic Load:
100 Kg/yr
50 kg/year reaches bay
(50%)
12.5 Kg
Subwatershed 3
6.25 Kg
Subwatershed 4
3.125 Kg + 50 Kg
Subwatershed 5

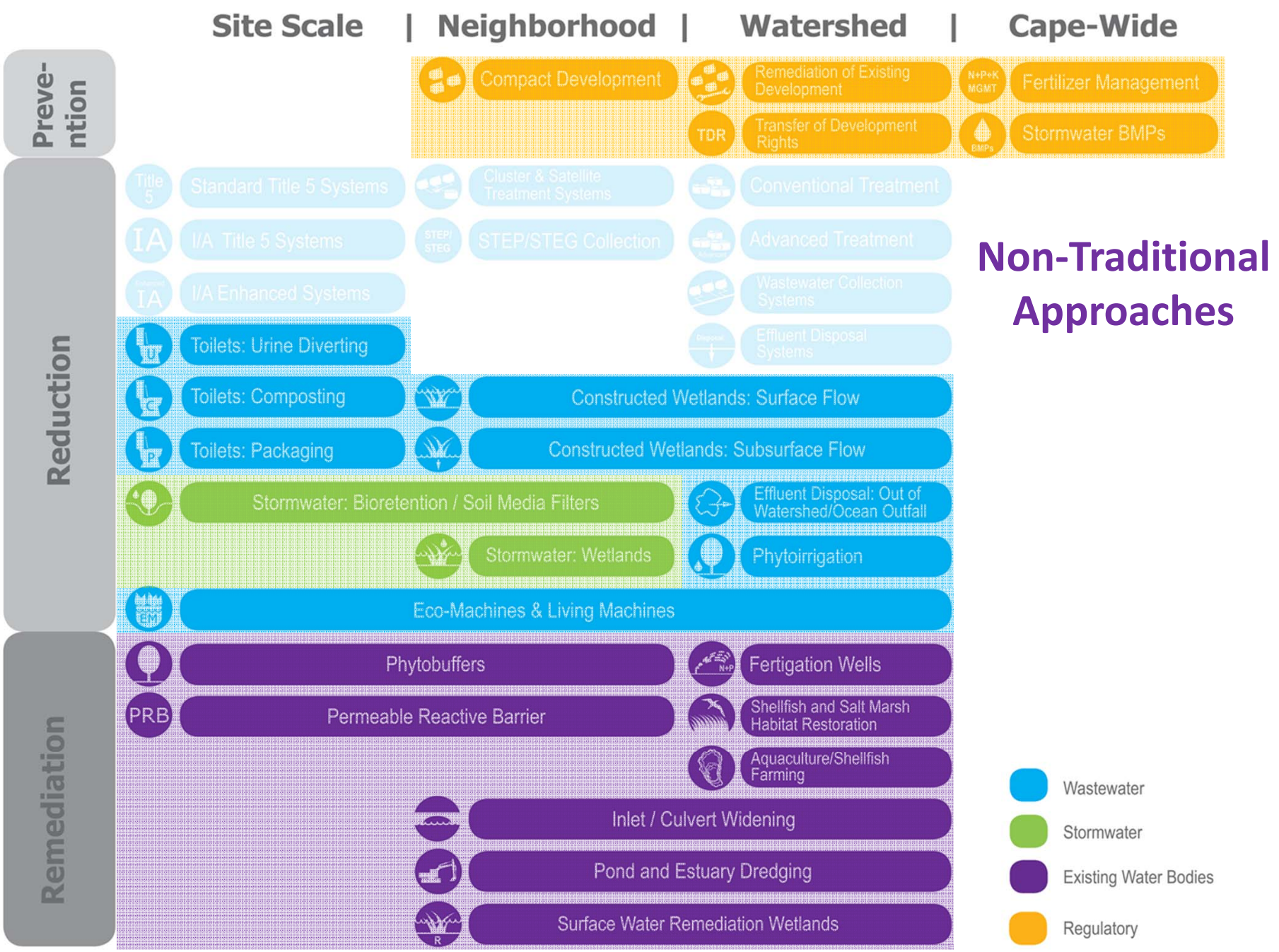
Targeted Centralized Treatment with Disposal Inside the Watershed




Site Scale | Neighborhood | Watershed | Cape-Wide
Preve-ntion
Reduction
Remediation
Compact Development
Fertilizer Management
Stormwater BMPs
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
I/A Title 5 Systems
STEP/STEG Collection
Advanced Treatment
I/A Enhanced Systems
Wastewater Collection Systems
Effluent Disposal Systems
Toilets: Urine Diverting
Toilets: Composting
Toilets: Packaging
Constructed Wetlands: Surface Flow
Constructed Wetlands: Subsurface Flow
Stormwater: Bioretention / Soil Media Filters
Effluent Disposal: Out of Watershed/Ocean Outfall
Stormwater: Wetlands
Phytorrigation
Eco-Machines & Living Machines
Phytobuffers
Fertigation Wells
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands
Traditional Approach Plus Fertilizer & Stormwater Reduction
Wastewater
Stormwater
Existing Water Bodies
Regulatory

Targeted Centralized Treatment with a 50% Reduction in Fertilizer and Stormwater





Non-Traditional Approaches


Problem Solving Approach
1
2
3
4
5
6
7
Wastewater
Existing Water Bodies
Regulatory
Targets/Reduction Goals
Present Load:
X kg/day
–
Target:
Y kg/day
=
Reduction Required:
N kg/day
Other Wastewater Management Needs
A. Title 5 Problem Areas
B. Pond Recharge Areas
C. Growth Management
Low Barrier to Implementation
A. Fertilizer Management
B. Stormwater Mitigation
N+P+K MGMT
BMPs
Watershed/Embayment Options
A. Permeable Reactive Barriers
B. Inlet/Culvert Openings
C. Constructed Wetlands
D. Aquaculture
PRB
R
Alternative On-Site Options
A. Eco-toilets (UD & Compost)
B. I/A Technologies
C. Enhanced I/A Technologies
D. Shared Systems
Title 5
Enhanced IA
IA
Priority Collection/High-Density Areas
A. Greater Than 1 Dwelling Unit/acre
B. Village Centers
C. Economic Centers
D. Growth Incentive Zones
Advanced
Disposal:
STEP/ STEG
Supplemental Sewering
Advanced

Watershed Calculator **Herring River**

MEP Targets and Goals:		**kg/day**	**Nitrogen (kg/yr)**
Present Total Nitrogen Load:		62.816	22,928
wastewater		38.602	14,090
fertilizer			5,027
stormwater			2,537
Target Nitrogen Load:		47.975	17,511
Nitrogen Removal Required:		**14.841**	**5,417**
Total Number of Properties:	5,302		

Watershed Calculator **Herring River**

MEP Targets and Goals:		**kg/day**	**Nitrogen (kg/yr)**
Present Total Nitrogen Load:		62.816	22,928
wastewater		38.602	14,090
fertilizer			5,027
stormwater			2,537
Target Nitrogen Load:		47.975	17,511
Nitrogen Removal Required:		**14.841**	**5,417**
Total Number of Properties:	5,302		

Other Wastewater Management Needs	Ponds	Title 5 Problem Areas	Growth Management

Watershed Calculator **Herring River**

MEP Targets and Goals:		**kg/day**	**Nitrogen (kg/yr)**
Present Total Nitrogen Load:		62.816	22,928
wastewater		38.602	14,090
fertilizer			5,027
stormwater			2,537
Target Nitrogen Load:		47.975	17,511
Nitrogen Removal Required:		**14.841**	**5,417**
Total Number of Properties:	5,302		

Other Wastewater Management Needs	Ponds	Title 5 Problem Areas	Growth Management

Low Barrier to Implementation:	**Reduction by Technology (Kg/yr)**	**Remaining to Meet Target (Kg/yr)**	**Unit Cost ($/lb N)**
Fertilizer Management	2,514	2,903	
Stormwater Mitigation	1,269	1,635	

Watershed Calculator **Herring River**

MEP Targets and Goals:		**kg/day**	**Nitrogen (kg/yr)**
Present Total Nitrogen Load:		62.816	22,928
wastewater		38.602	14,090
fertilizer			5,027
stormwater			2,537
Target Nitrogen Load:		47.975	17,511
Nitrogen Removal Required:		**14.841**	**5,417**
Total Number of Properties:	5,302		

Other Wastewater Management Needs	Ponds	Title 5 Problem Areas	Growth Management

Low Barrier to Implementation:		**Reduction by Technology (Kg/yr)**	**Remaining to Meet Target (Kg/yr)**	**Unit Cost ($/lb N)**
Fertilizer Management		2,514	2,903	
Stormwater Mitigation		1,269	1,635	
Watershed/Embayment Options:				
Permeable Reactive Barrier (PRB)	250 homes	770	865	$452

Watershed Calculator **Herring River**

MEP Targets and Goals:		**kg/day**	**Nitrogen (kg/yr)**
Present Total Nitrogen Load:		62.816	22,928
wastewater		38.602	14,090
fertilizer			5,027
stormwater			2,537
Target Nitrogen Load:		47.975	17,511
Nitrogen Removal Required:		**14.841**	**5,417**
Total Number of Properties:	5,302		

Other Wastewater Management Needs	Ponds	Title 5 Problem Areas	Growth Management

Low Barrier to Implementation:			**Reduction by Technology (Kg/yr)**	**Remaining to Meet Target (Kg/yr)**	**Unit Cost ($/lb N)**
Fertilizer Management			2,514	2,903	
Stormwater Mitigation			1,269	1,635	
Watershed/Embayment Options:					
Permeable Reactive Barrier (PRB)	250	homes	770	865	$452
Fertigation Wells	1	golf course	136	729	$438

Watershed Calculator **Herring River**

MEP Targets and Goals:		**kg/day**	**Nitrogen (kg/yr)**
Present Total Nitrogen Load:		62.816	22,928
wastewater		38.602	14,090
fertilizer			5,027
stormwater			2,537
Target Nitrogen Load:		47.975	17,511
Nitrogen Removal Required:		**14.841**	**5,417**
Total Number of Properties:	5,302		

Other Wastewater Management Needs	Ponds	Title 5 Problem Areas	Growth Management

Low Barrier to Implementation:			**Reduction by Technology (Kg/yr)**	**Remaining to Meet Target (Kg/yr)**	**Unit Cost ($/lb N)**
Fertilizer Management			2,514	2,903	
Stormwater Mitigation			1,269	1,635	
Watershed/Embayment Options:					
Permeable Reactive Barrier (PRB)	250	homes	770	865	$452
Fertigation Wells	1	golf course	136	729	$438
Phytoremediation	1	acres	266	463	$254

Watershed Calculator **Herring River**

MEP Targets and Goals:		**kg/day**	**Nitrogen (kg/yr)**
Present Total Nitrogen Load:		62.816	22,928
wastewater		38.602	14,090
fertilizer			5,027
stormwater			2,537
Target Nitrogen Load:		47.975	17,511
Nitrogen Removal Required:		**14.841**	**5,417**
Total Number of Properties:	5,302		

Other Wastewater Management Needs	Ponds	Title 5 Problem Areas	Growth Management

Low Barrier to Implementation:			**Reduction by Technology (Kg/yr)**	**Remaining to Meet Target (Kg/yr)**	**Unit Cost ($/lb N)**
Fertilizer Management			2,514	2,903	
Stormwater Mitigation			1,269	1,635	
Watershed/Embayment Options:					
Permeable Reactive Barrier (PRB)	250	homes	770	865	$452
Fertigation Wells	1	golf course	136	729	$438
Phytoremediation	1	acres	266	463	$254
Floating Constructed Wetlands	1000	cu feet	450	13	$61

Watershed Calculator **Herring River**

MEP Targets and Goals:		**kg/day**	**Nitrogen (kg/yr)**
Present Total Nitrogen Load:		62.816	22,928
wastewater		38.602	14,090
fertilizer			5,027
stormwater			2,537
Target Nitrogen Load:		47.975	17,511
Nitrogen Removal Required:		**14.841**	**5,417**
Total Number of Properties:	5,302		

Other Wastewater Management Needs		Ponds	Title 5 Problem Areas	Growth Management
Low Barrier to Implementation:			**Reduction by Technology (Kg/yr)**	**Remaining to Meet Target (Kg/yr)**	**Unit Cost ($/lb N)**
Fertilizer Management			2,514	2,903	
Stormwater Mitigation			1,269	1,635	
Watershed/Embayment Options:					
Permeable Reactive Barrier (PRB)	250	homes	770	865	$452
Fertigation Wells	1	golf course	136	729	$438
Phytoremediation	1	acres	266	463	$254
Floating Constructed Wetlands	1000	cu feet	450	13	$61
Alternative On-Site Options:					
I&A Technologies	25	homes	58	-45	$1,607

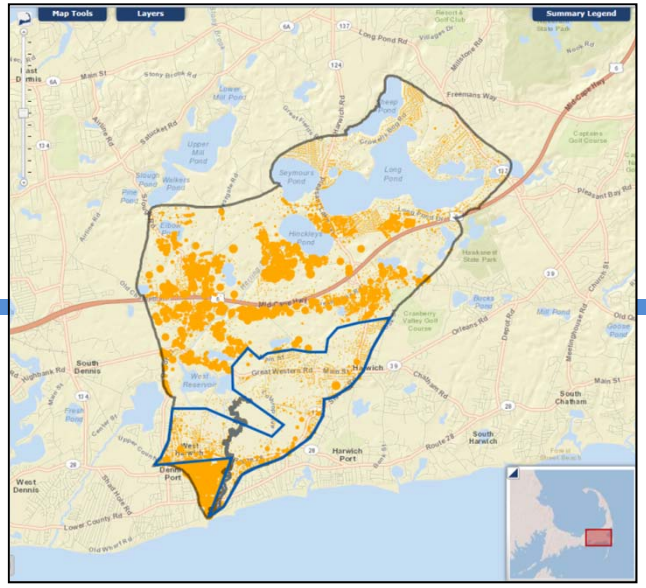
Watershed Calculator **Herring River**

MEP Targets and Goals:		**kg/day**	**Nitrogen (kg/yr)**
Present Total Nitrogen Load:		62.816	22,928
wastewater		38.602	14,090
fertilizer			5,027
stormwater			2,537
Target Nitrogen Load:		47.975	17,511
Nitrogen Removal Required:		**14.841**	**5,417**
Total Number of Properties:	5,302		

Other Wastewater Management Needs		Ponds	Title 5 Problem Areas	Growth Management
Low Barrier to Implementation:		**Reduction by Technology (Kg/yr)**	**Remaining to Meet Target (Kg/yr)**	**Unit Cost ($/lb N)**
Fertilizer Management		2,514	2,903	
Stormwater Mitigation		1,269	1,635	
Watershed/Embayment Options:				
Permeable Reactive Barrier (PRB)	250 homes	770	865	$452
Fertigation Wells	1 golf course	136	729	$438
Phytoremediation	1 acres	266	463	$254
Floating Constructed Wetlands	1000 cu feet	450	13	$61
Alternative On-Site Options:				
I&A Technologies	25 homes	58	-45	$1,607
Sewering	-10 homes	-45	0	$1,000
	Total To Meet Goal (Kg/yr):		0	$102

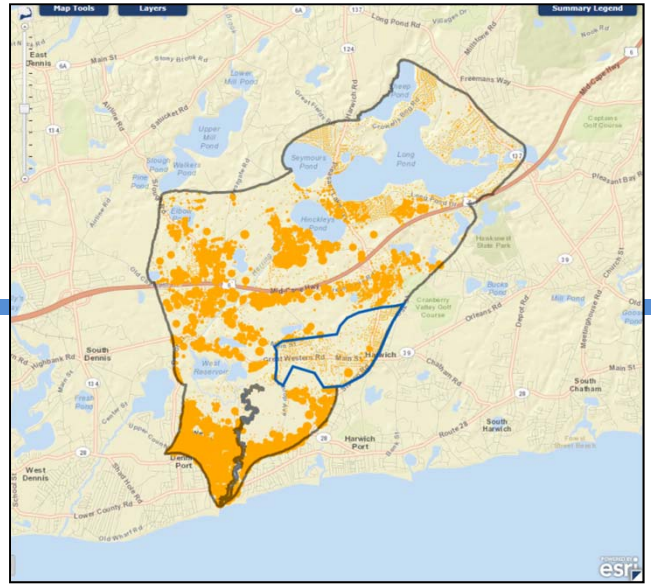
Scenario Comparison

Targeted Collection



- Achieves TMDL[1]
- Cost/lb N = $599
- Treated Flow = 222,000 gpd

Targeted Collection after a 50% reduction in fertilizer and stormwater



- Achieves TMDL[1]
- Cost/lb N = $1,238
- Treated Flow = 83,000 gpd

Collection is unnecessary is each alternative performs as presented in alternatives calculator.

[1] within 5% of goal

Adaptive Management:

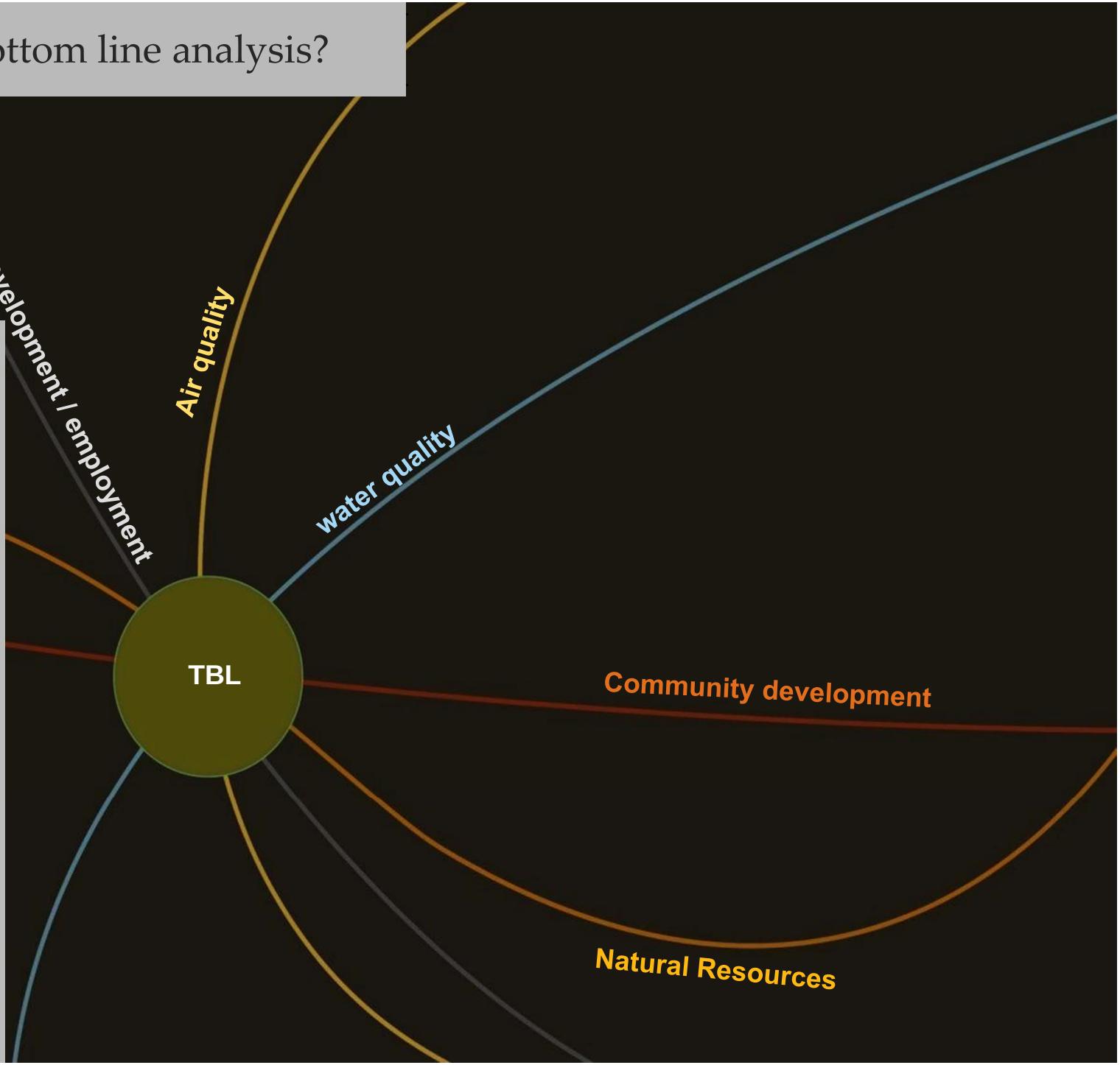
A structured approach for addressing uncertainties by linking science and monitoring to decision-making and adjusting implementation, as necessary, to increase the probability of meeting water quality goals in a cost effective and efficient way.

Triple Bottom Line (TBL) Introduction

What is triple bottom line analysis?

Triple Bottom Line Analysis
Provides a full accounting of the financial, social, and environmental consequences of investments or policies

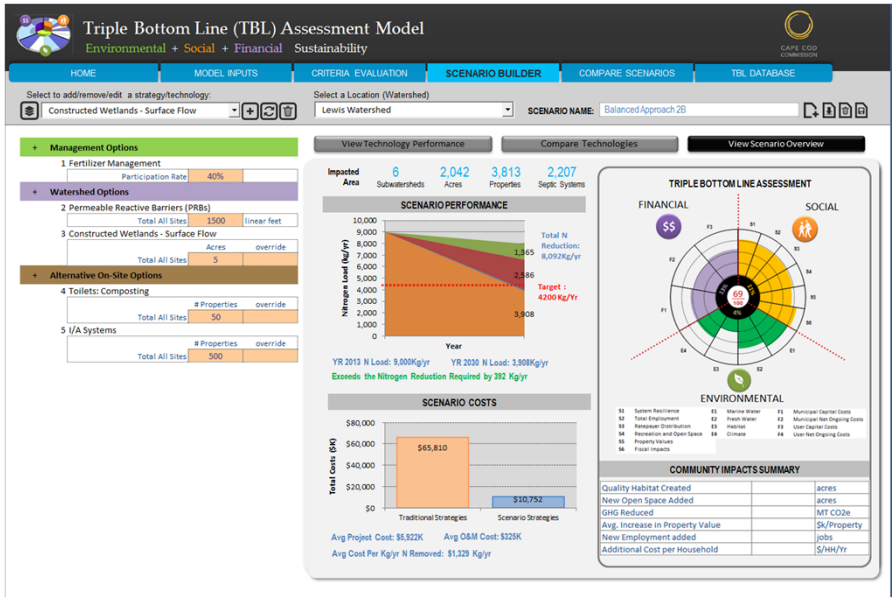
Often "TBL" analysis is used to identify the best alternative and to report to stakeholders on the public outcomes of a given investment.

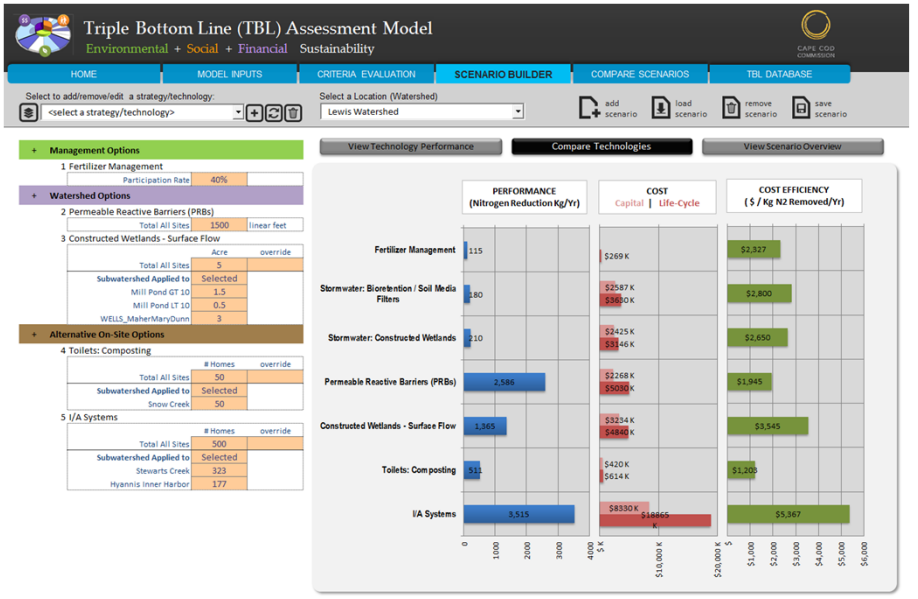


Why develop a TBL model?

- To consider the financial, environmental, and social consequences of water quality investments and policies in Cape Cod.

- TBL Model evaluates the “ancillary” or downstream consequences of water quality investments not the direct Phosphorous or Nitrogen levels.





Triple Bottom Line (TBL) Assessment Model

Environmental + Social + Financial Sustainability

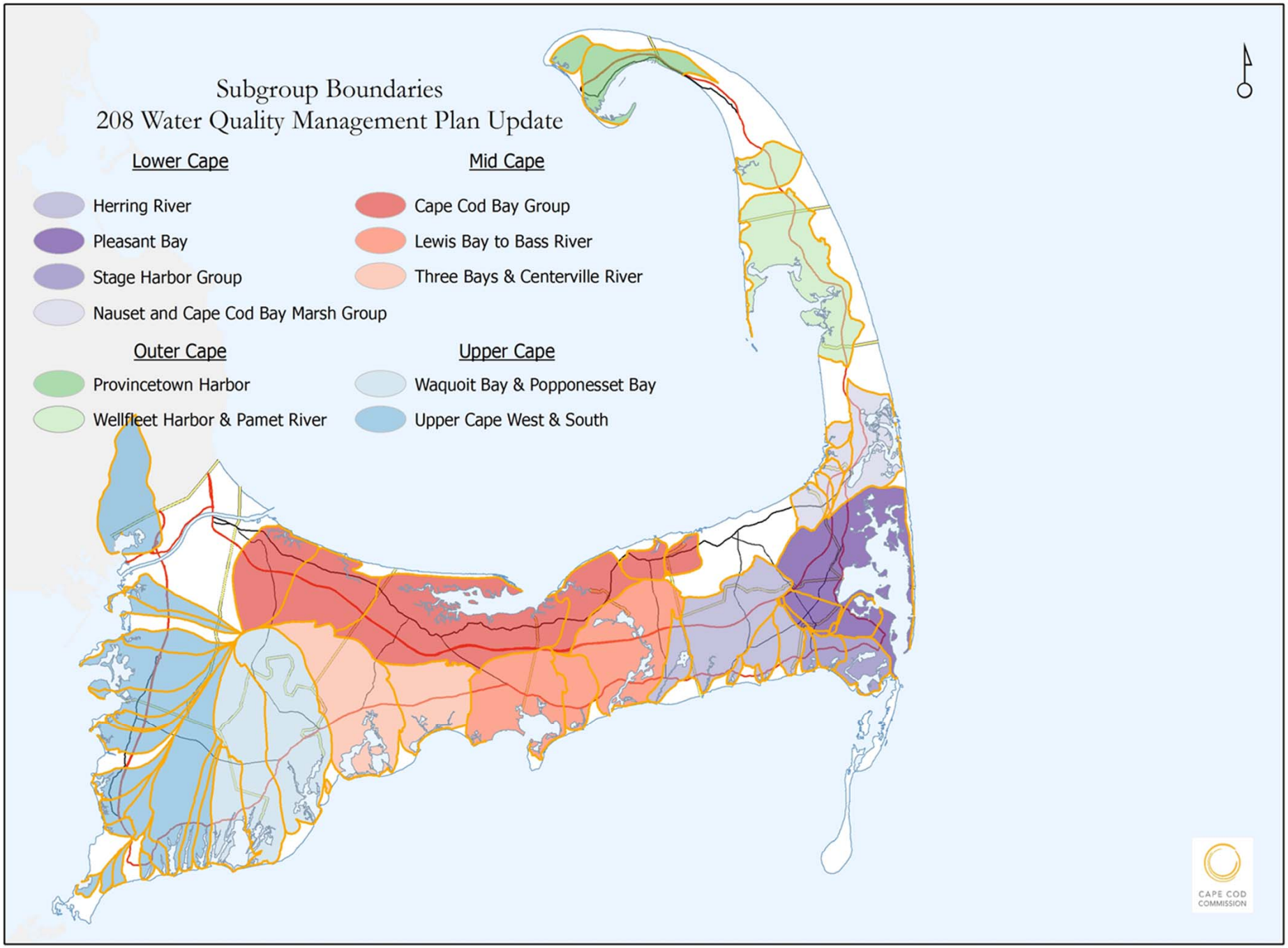
CAPE COD COMMISSION

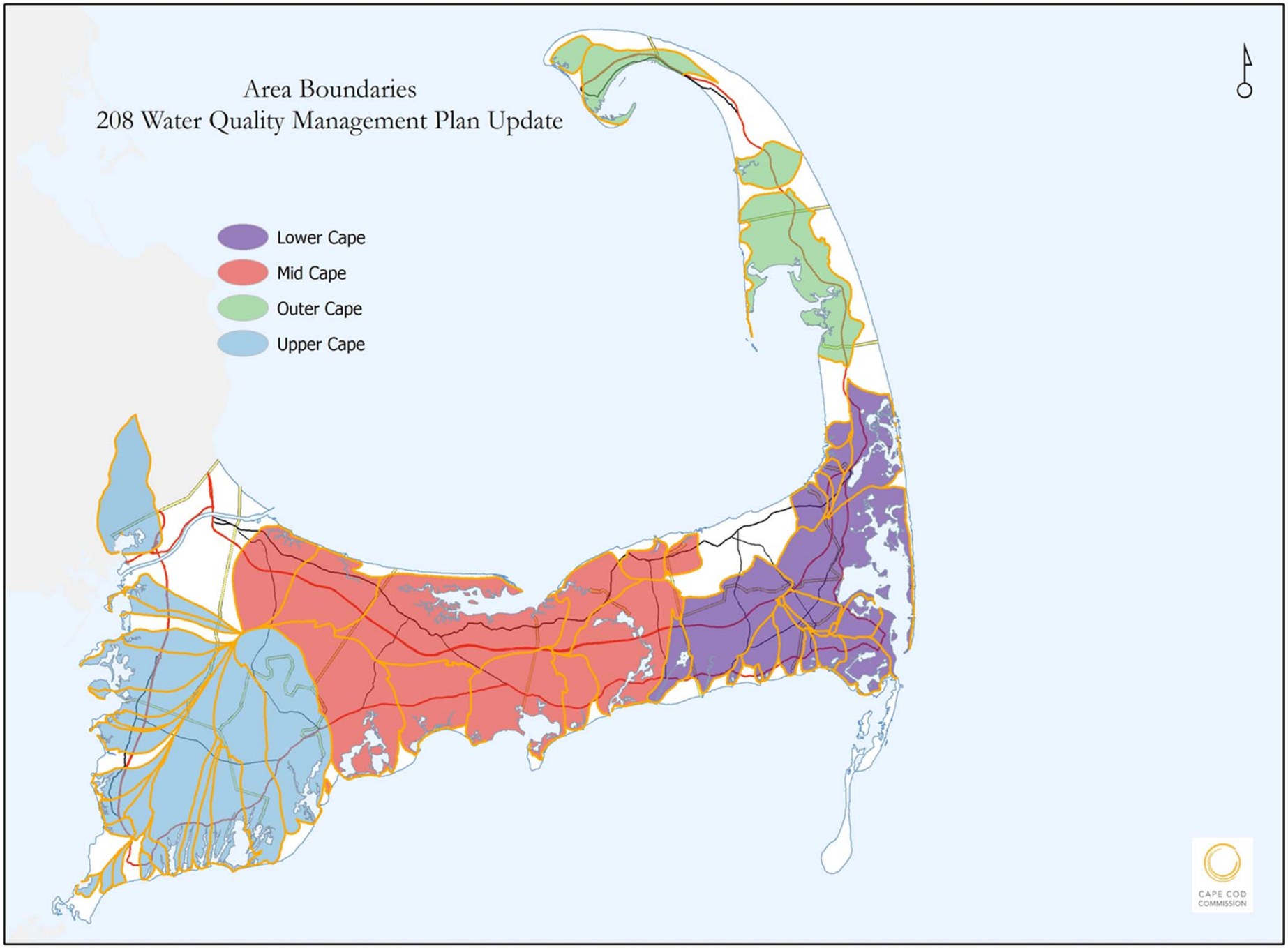
HOME | MODEL INPUTS | CRITERIA EVALUATION | SCENARIO BUILDER | COMPARE SCENARIOS | TBL DATABASE

Alternative Definition | Alternative Results | Alternative Scoring Rules

	Scenario 1	Scenario 2	Scenario 3
	Minimum Cost	Cost Effective	Maximum Performance
Criterion Scores			
Strategy/Technology Distribution			
COST & PERFORMANCE			
Nitrogen Reduction %	30%	52%	61%
Remaining Nitrogen Load (Kg N)	8,400	5,760	4,680
Life Cycle Costs ($K)	$5,922	$7,350	$9,800
Municipal O&M Cost ($K)	$325	$425	$610
Municipal Project Cost ($K)	$1,329	$1,600	$1,800
Property Owner O&M Cost ($K)	$98	$128	$183
Property Owner Project Cost ($K)	$397	$480	$540
COMMUNITY BENEFITS			
Quality Habitat (acres)	0.5	1.8	2.4
New Open Space Added (acres)	1.5	4.6	5.0
GHG Reduced (MT CO2e/yr)	2.1	3.1	3.3
Avg. Increase in Property Value ($/pty)	$200	$1,200	$2,000
New Employment Added (jobs)	152	188	252
Additional Cost per Household ($/HH/yr)	$20	$26	$37

Criterion Scores	
SOCIAL	
System Resilience	S1
Employment	S2
Ratepayer Distribution	S3
Recreation and Open Space	S4
Property Values	S5
Fiscal Impacts	S6
ENVIRONMENTAL	
Marine Water	E1
Fresh Water	E2
Habitat	E3
Climate	E4
FINANCIAL	
Municipal Capital Costs	F1
Municipal Other Costs	F2
Property Owner Capital Costs	F3
Property Owner Other Costs	F4


Subgroup Boundaries
208 Water Quality Management Plan Update
Lower Cape
Herring River
Pleasant Bay
Stage Harbor Group
Nauset and Cape Cod Bay Marsh Group
Mid Cape
Cape Cod Bay Group
Lewis Bay to Bass River
Three Bays & Centerville River
Outer Cape
Provincetown Harbor
Wellfleet Harbor & Pamet River
Upper Cape
Waquoit Bay & Popponesset Bay
Upper Cape West & South
CAPE COD COMMISSION


Area Boundaries
208 Water Quality Management Plan Update
Lower Cape
Mid Cape
Outer Cape
Upper Cape
CAPE COD
COMMISSION