Cape Cod 208 Area Water Quality Planning
Cape Cod Bay Watershed Working Group
Second Meeting

Cape Cod Commission Office
3225 Main St, Barnstable, MA 02630
November 5, 2013
8:30 a.m.-12:30 p.m.

Agenda

8:30 Welcome, Review 208 goals and Process and the Goals of today's meeting – *Cape Cod Commission*

8:40 Introductions, Agenda Overview, Updates and Action Items– *Facilitator and Working Group*

9:00 Range of Possible Solutions – *Cape Cod Commission and Working Group*

- Technology Matrix
- Technologies Overview
- Survey Questions and Comments
- Additional Questions and Discussion

10:30 Break

10:45 Problem Solving Process and Principles – *Cape Cod Commission and Working Group*

- Overview of 7-steps for Problem-Solving Process
- Examination of Categories of Solutions and their impacts on the Environment, Economy, and Community (triple bottom line)
- Discussion – Identify Considerations and Priorities for Application

12:00 Preparing for Meeting 3 and Beyond – *Cape Cod Commission*

- Review Tools, Alternatives Analysis Approach
- Evaluating Scenarios for Meeting Nitrogen Goals
- Other Process Next Steps

12:15 Public Comments

12:30 Adjourn

Cape Cod Bay Group

Technologies and Approaches

What is the stakeholder process?

Public Meetings

Goals, Work Plan & Roles

July

Affordability, Financing

August

Watershed Working Groups

Baseline Conditions

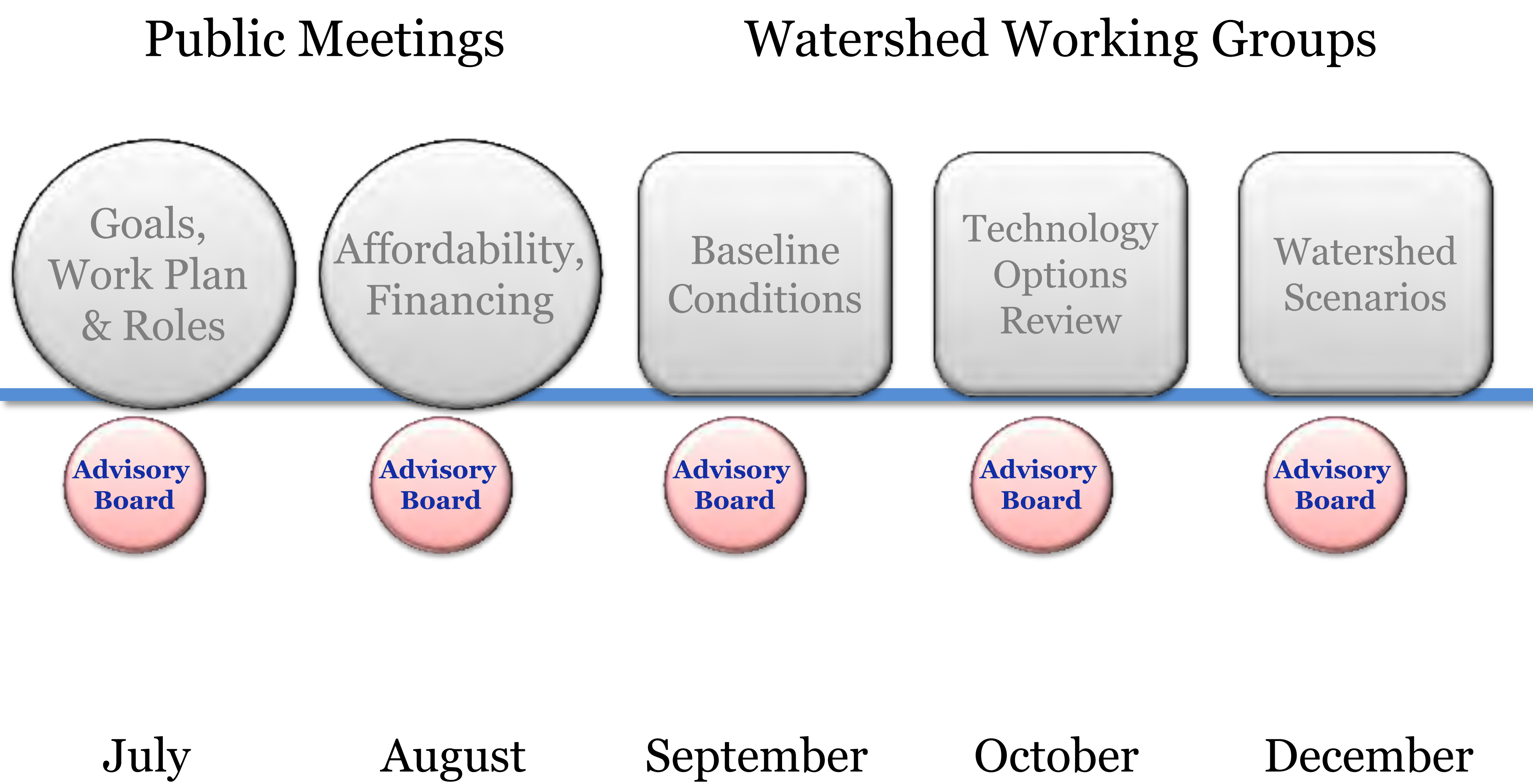
September

Technology Options Review

October

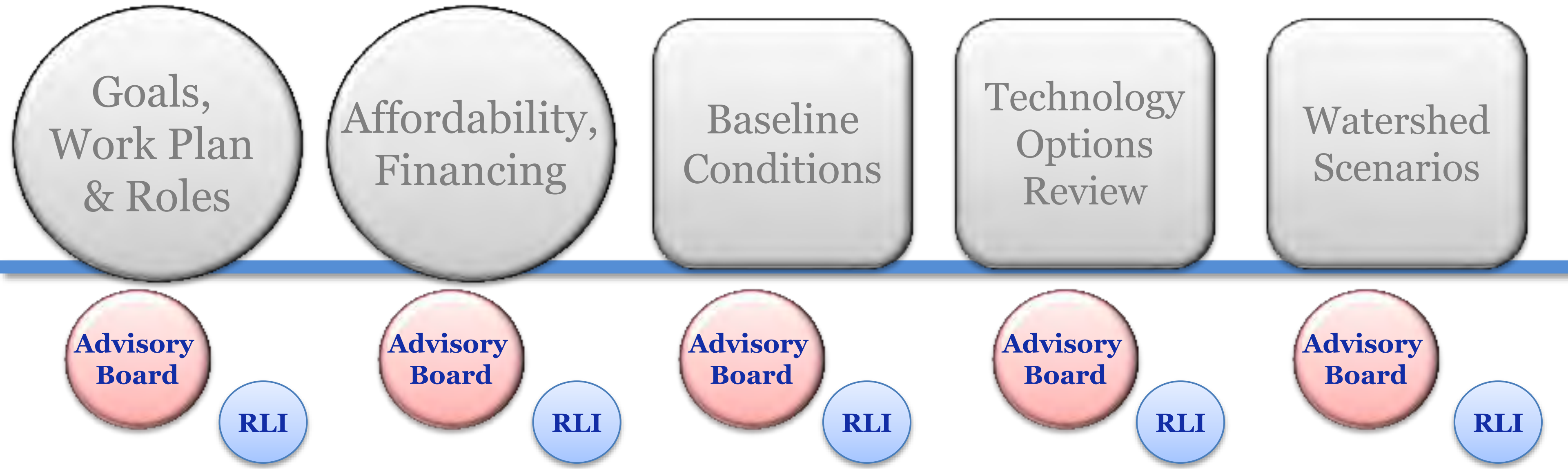
Watershed Scenarios

December



208 Planning Process

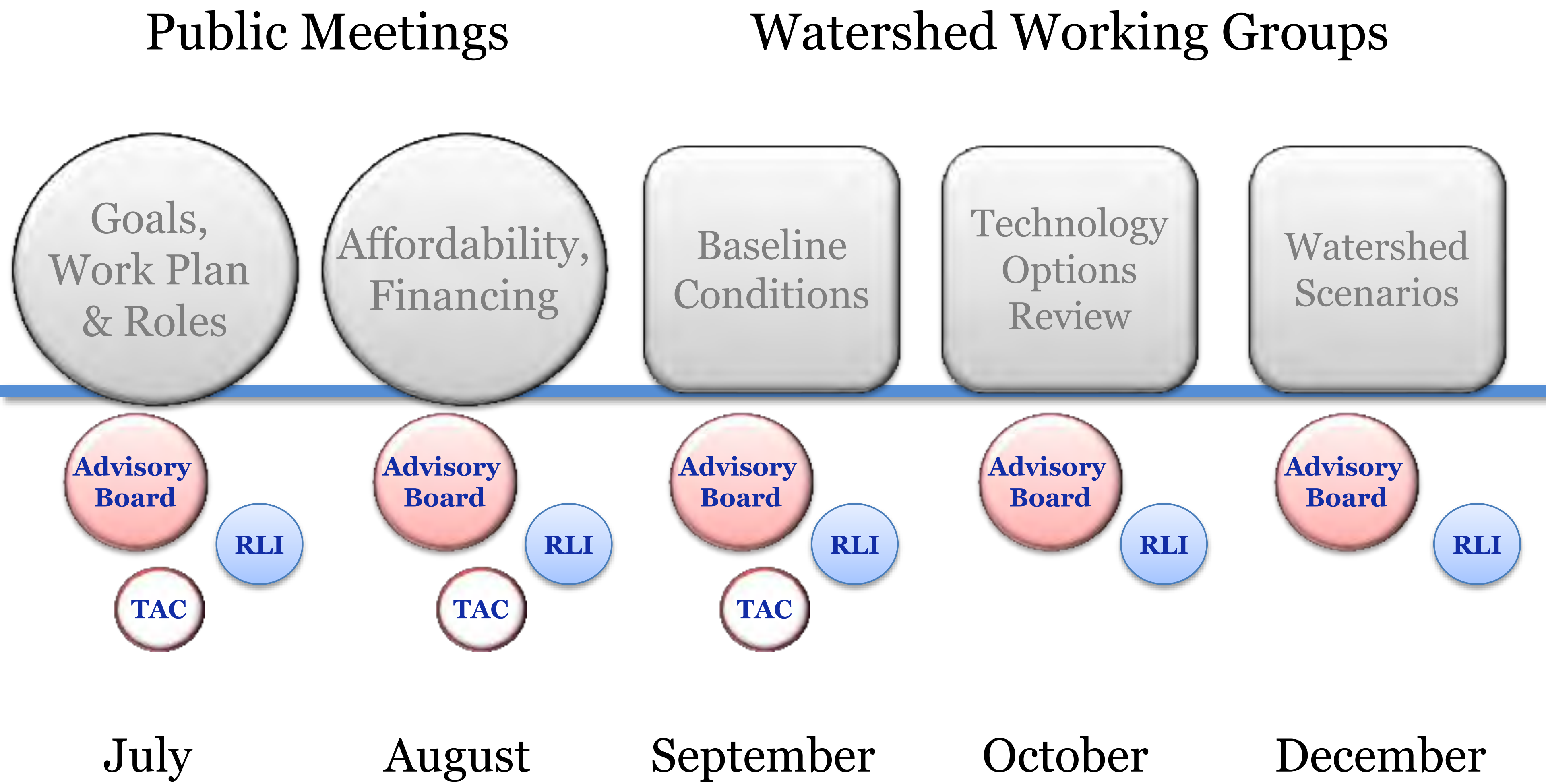
Public Meetings Watershed Working Groups



July August September October December

RLI Regulatory, Legal & Institutional Work Group

208 Planning Process

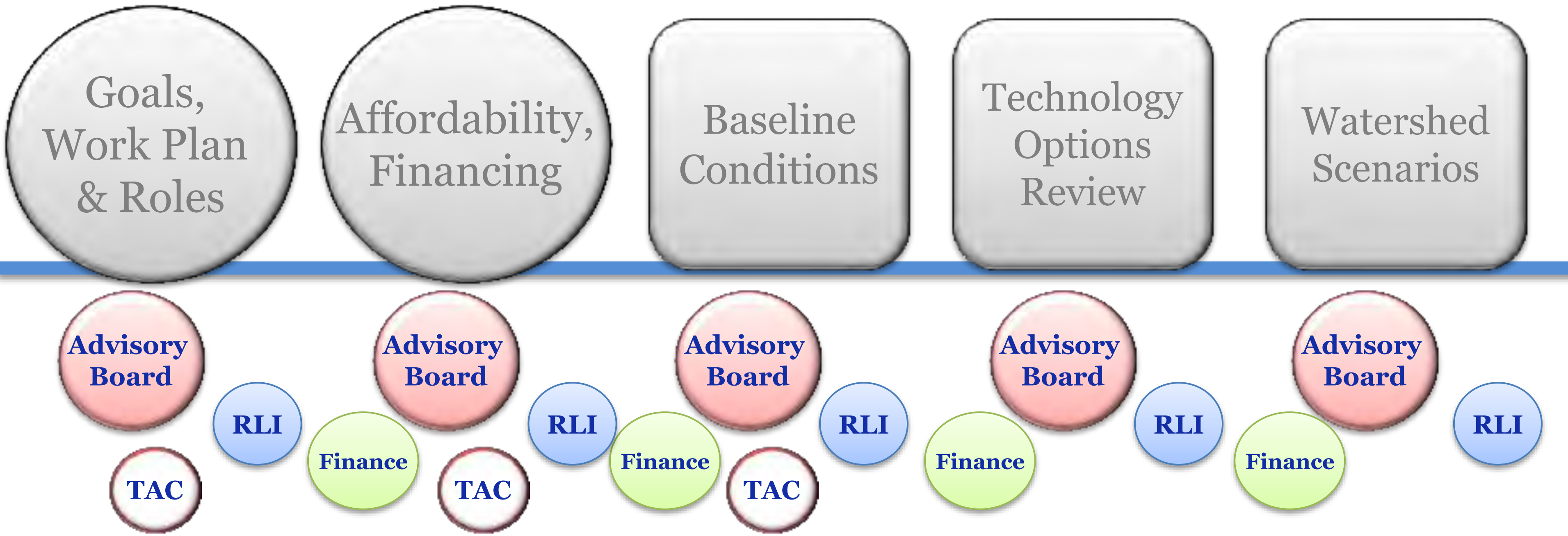


RLI Regulatory, Legal & Institutional Work Group

TAC Technical Advisory Committee of Cape Cod Water Protection Collaborative

208 Planning Process

Public Meetings
Watershed Working Groups



July August September October December

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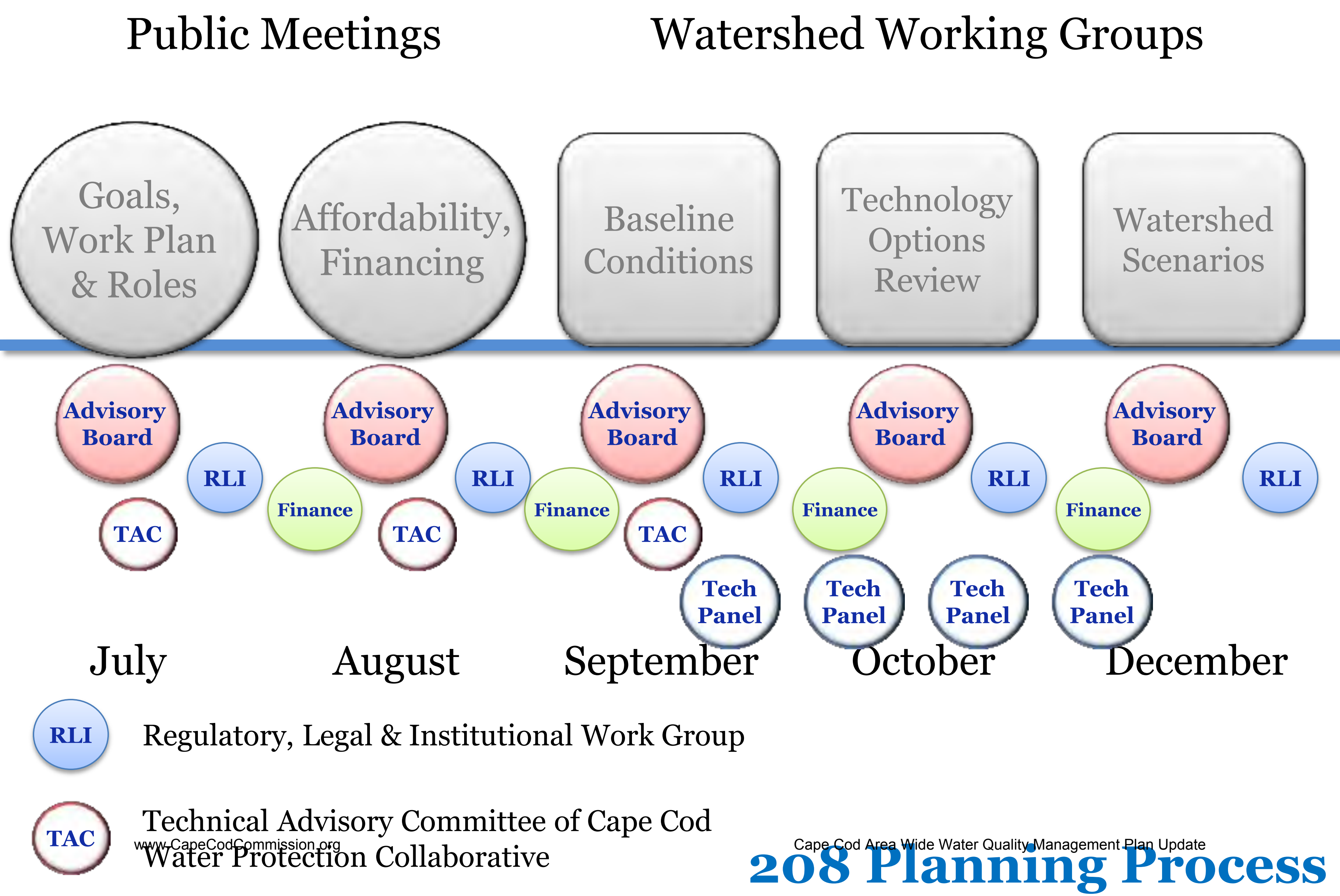
Public Meetings
Watershed Working Groups
Goals, Work Plan & Roles
Affordability, Financing
Baseline Conditions
Technology Options Review
Watershed Scenarios
Advisory Board
RLI
TAC
Finance
Tech Panel
July
August
September
October
December
RLI Regulatory, Legal & Institutional Work Group
TAC Technical Advisory Committee of Cape Cod Water Protection Collaborative
208 Planning Process

Baseline Conditions

11 Working Group Meetings: Sept 18-27

Goal of the First Meeting:

To review and develop shared understanding of the characteristics of these watersheds, the work done to date, existing data and information available, and how to apply all of this to planning for water quality improvements for these watersheds moving forward.

Progress since last meeting

- ❑ Meeting materials

Progress since last meeting

- ❑ Meeting materials
- ❑ GIS data layers

Progress since last meeting

- ❑ Meeting materials
- ❑ GIS data layers
- ❑ Chronologies

Baseline Conditions

11 Working Group Meetings: Sept 18-27

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

208 Planning Process

Baseline Conditions

11 Working Group Meetings: Sept 18-27

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Watershed Scenarios

11 Working Group Meetings: Dec 2-11

208 Planning Process

Baseline Conditions

11 Working Group Meetings: Sept 18-27

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Watershed Scenarios

11 Working Group Meetings: Dec 2-11

Watershed Event

November 13

Center for the Arts Dennis

Wrap up of Cape2O: ur in charge!

Summary of planning process to date

Outline of second 6 months of the 208 planning process

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Goal of Today's Meeting:

To develop a shared understanding of the potential technologies and approaches identified to date, and the benefits and limitations of each; to explore the environmental, economic, and community impacts of a range of categories of solutions; and to identify priorities and considerations for applying technologies and approaches to remediate water quality impairments in your watershed.

Technologies and Approaches for Improving Water Quality

Technologies and Approaches for Improving Water Quality

- The Fact Sheets present various information on the technologies being considered.
- Additional information is contained on the Technology Matrix including the following:
  - Site Requirements
  - Construction, Project and Operation and Maintenance Costs
  - Reference Information
  - Regulatory Comments
- Input from the Stakeholders is requested regarding a technology's Public Acceptance

Technologies and Approaches for Improving Water Quality

- Comprehensive analysis of nutrient control technologies and approaches.

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Technologies and Approaches for Improving Water Quality

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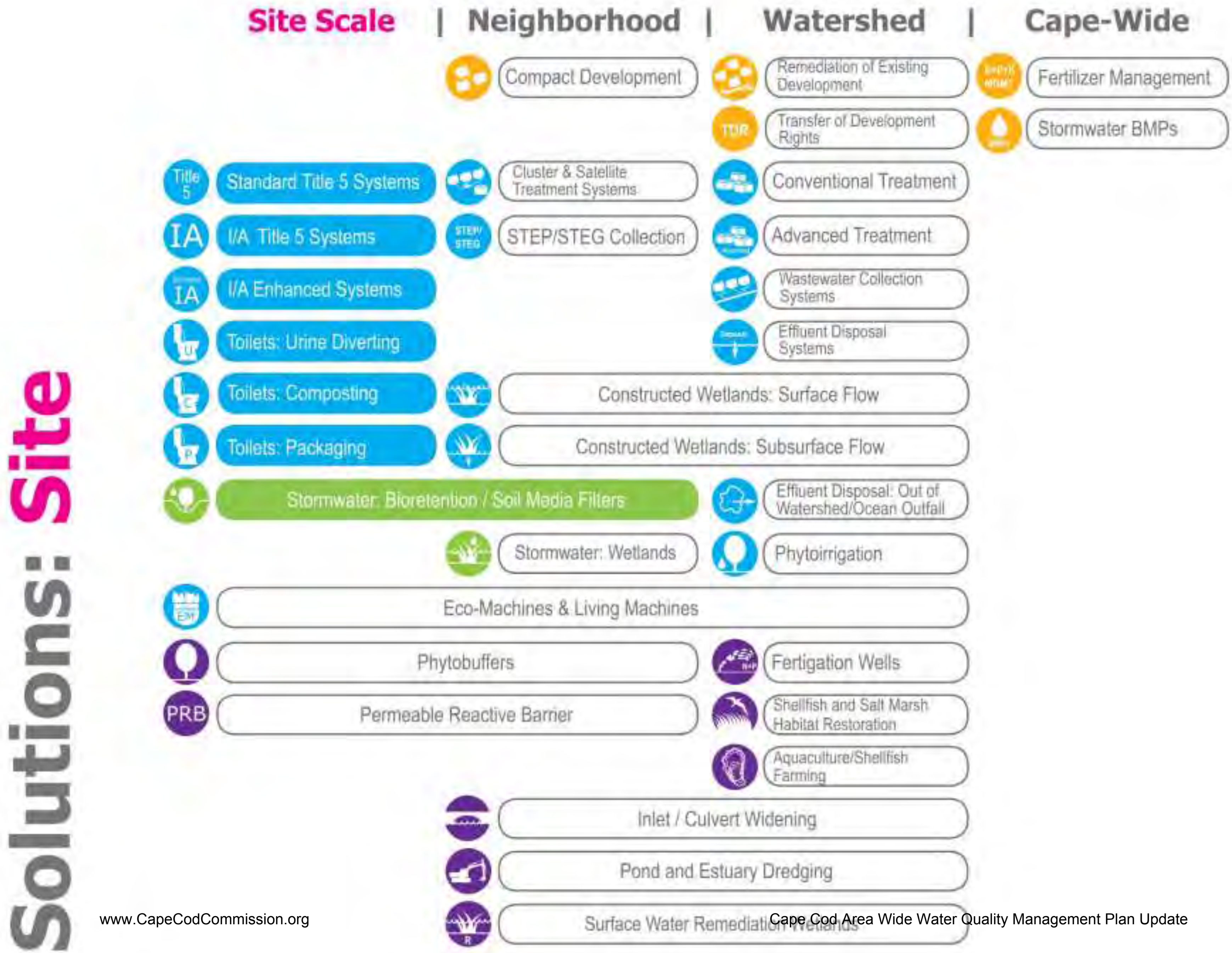
- Certain technologies or approaches will be effective at **preventing** nutrients from entering the water body. Others will be effective at **reducing** or **remediating** nutrients that are already in the groundwater or water body.
- Regulatory programs can address nutrient controls for both existing development and future development.


Site Scale | Neighborhood | Watershed | Cape-Wide
Solutions
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
IA
I/A Title 5 Systems
STEP/STEG
STEP/STEG Collection
Advanced Treatment
IA
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
EM
Eco-Machines & Living Machines
Phytobuffers
Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands


Solutions: Site
Site Scale | Neighborhood | Watershed | Cape-Wide
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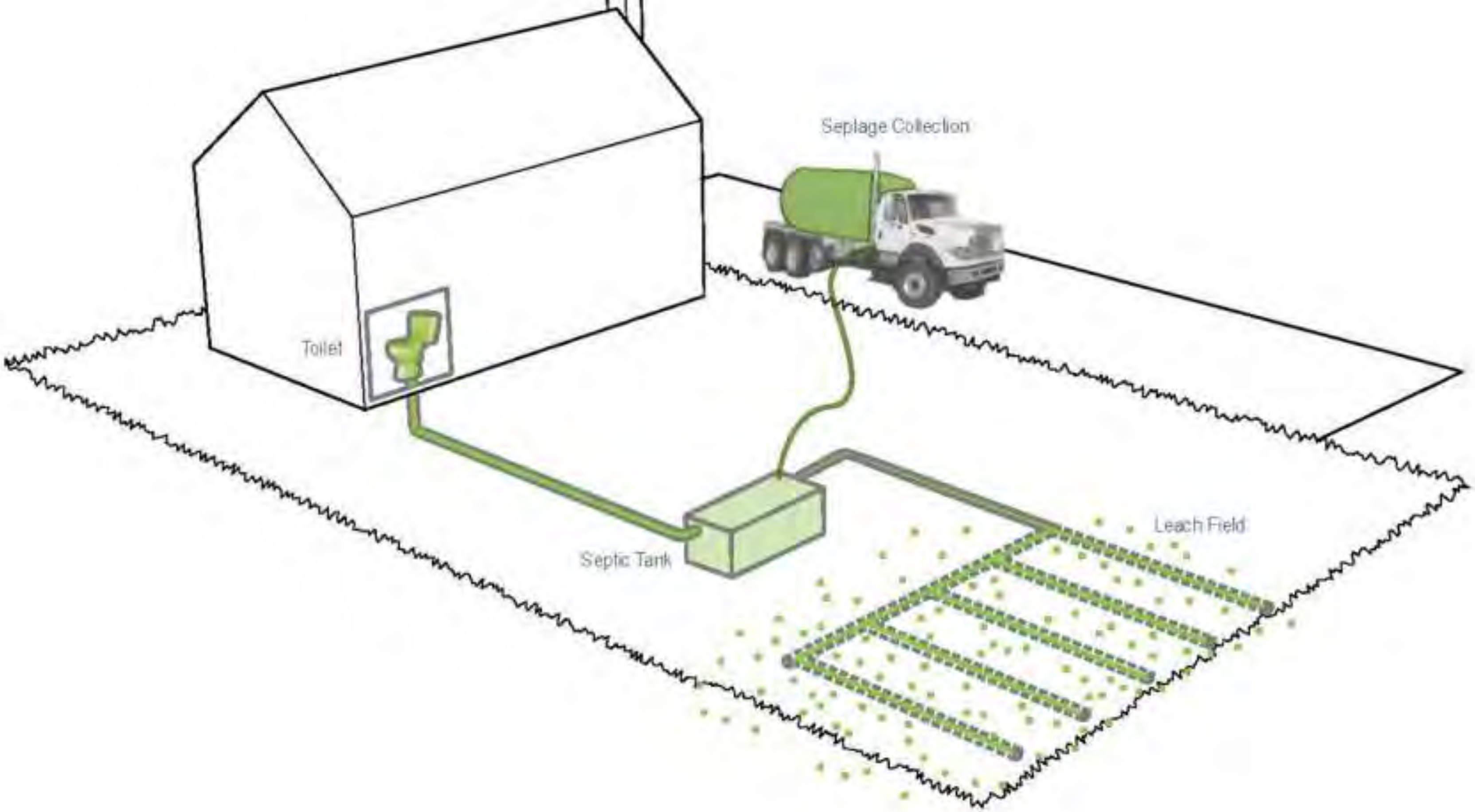
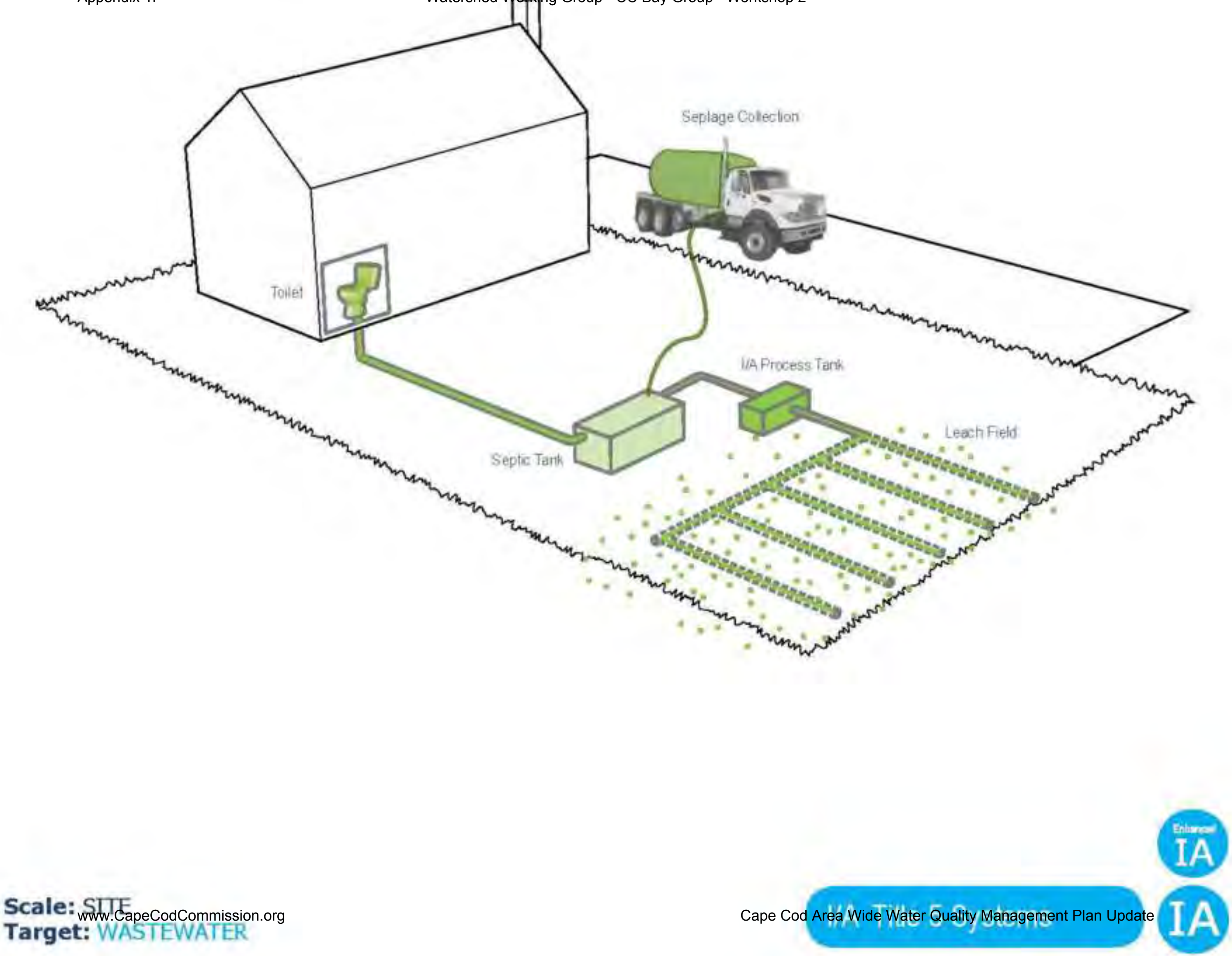
Surface Water Remediation Wetlands



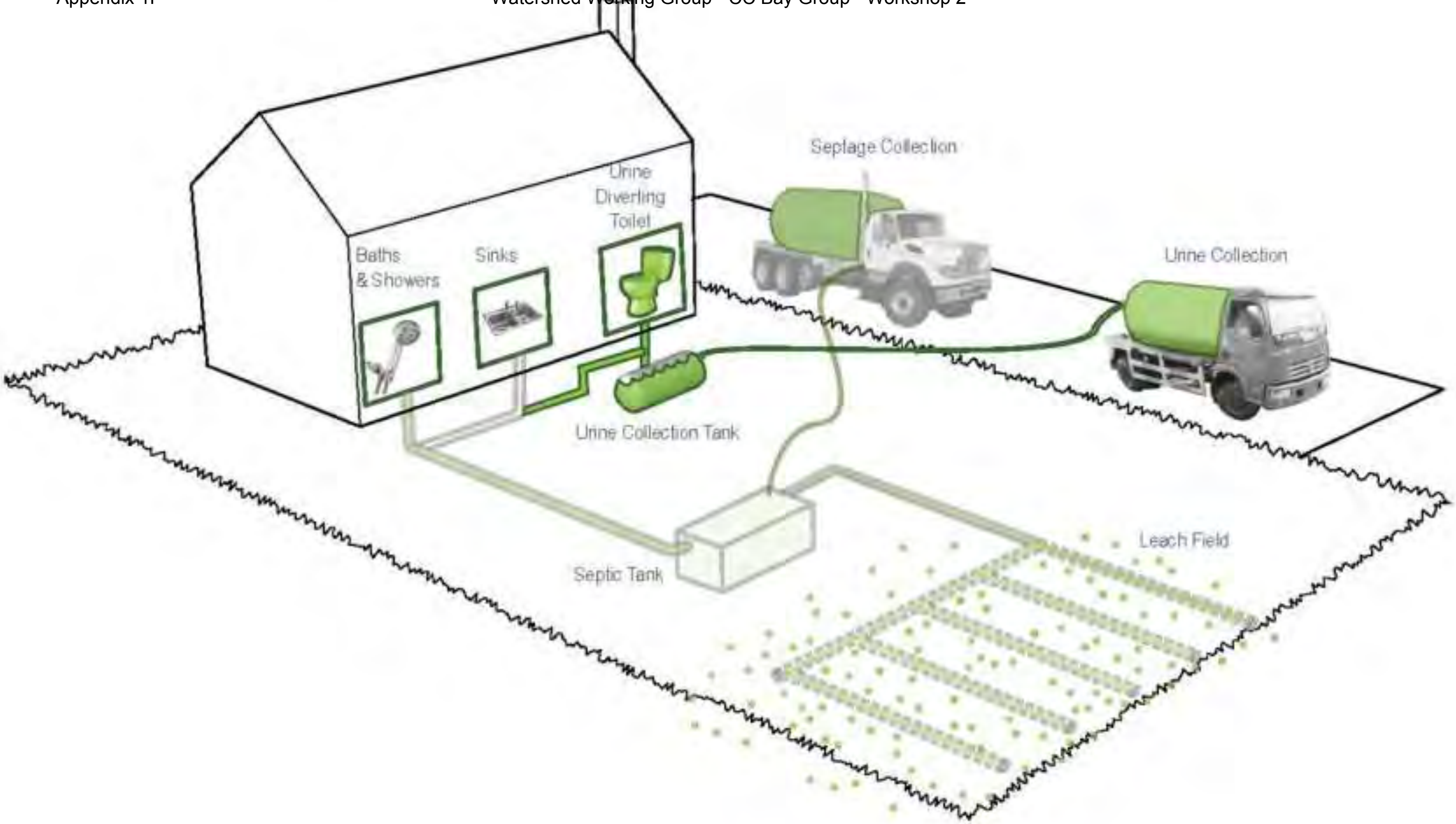
Scale: SITE
Target: WASTEWATER

Standard Title 5 Systems

Title 5



Septage Collection
Toilet
I/A Process Tank
Leach Field
Septic Tank
Scale: SITE
Target: WASTEWATER
I/A Title 5 Systems
IA
IA



Scale: SITE
Target: WASTEWATER

Toilets: Urine Diverting

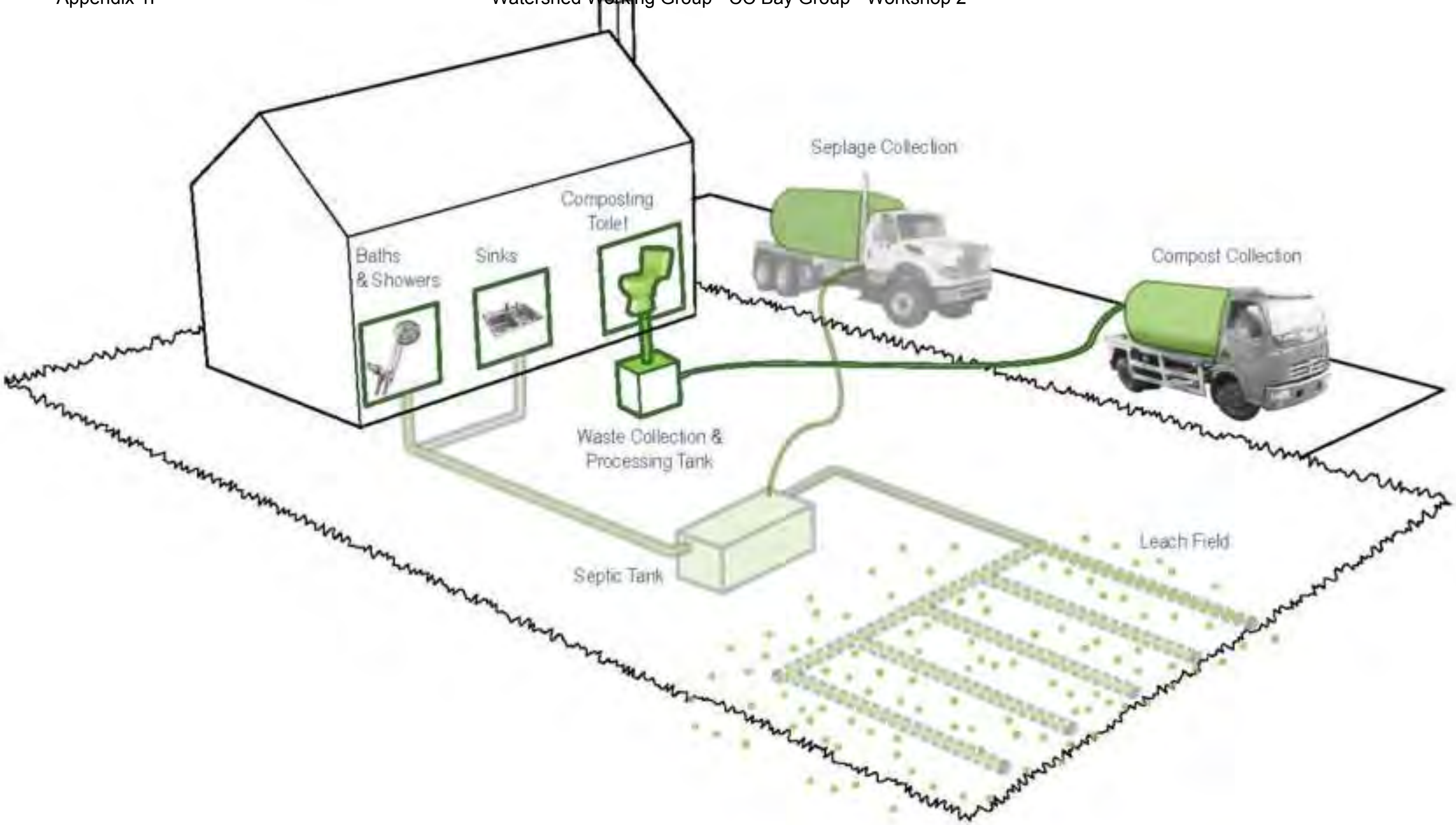
Waterless Urinal

IBC container (220 gallons)

40" x 40" x48"

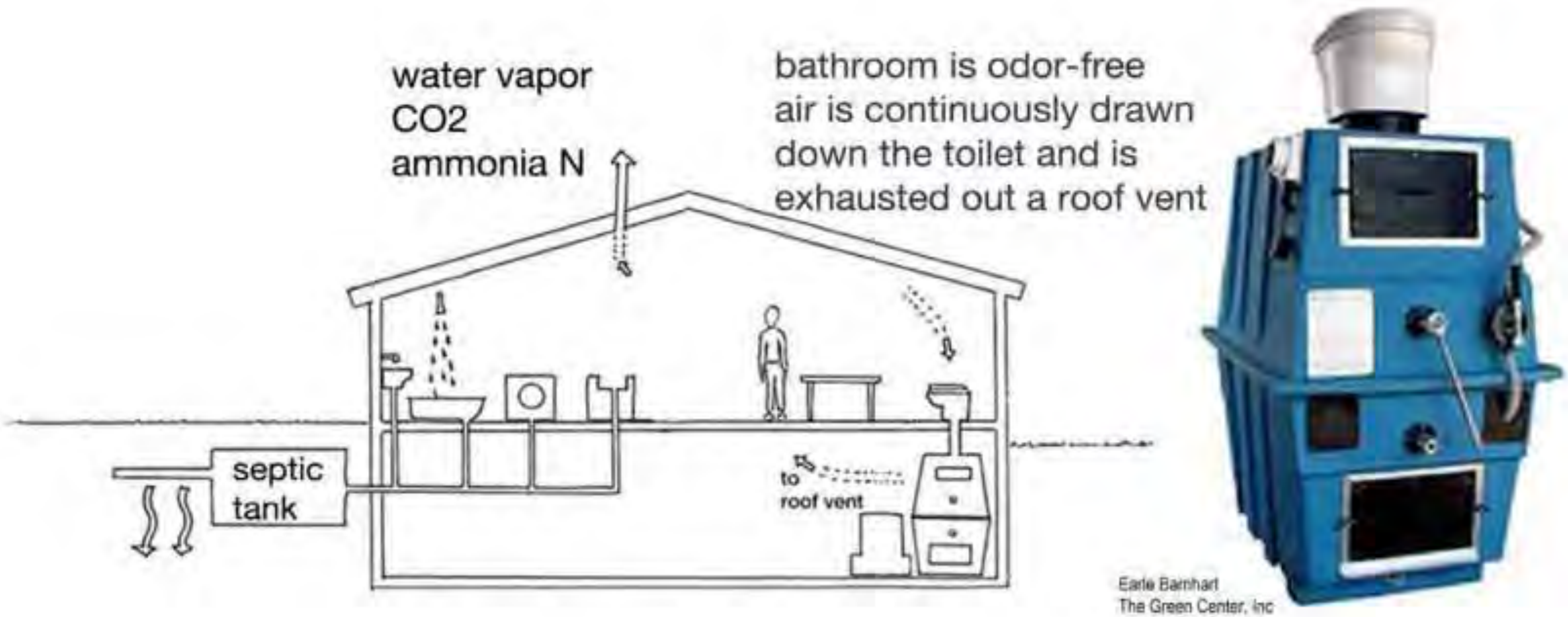
Source: Earle Barnhart, The Green Center Inc. and Horsley-Witten Group Inc.

Toilets: Urine Diverting



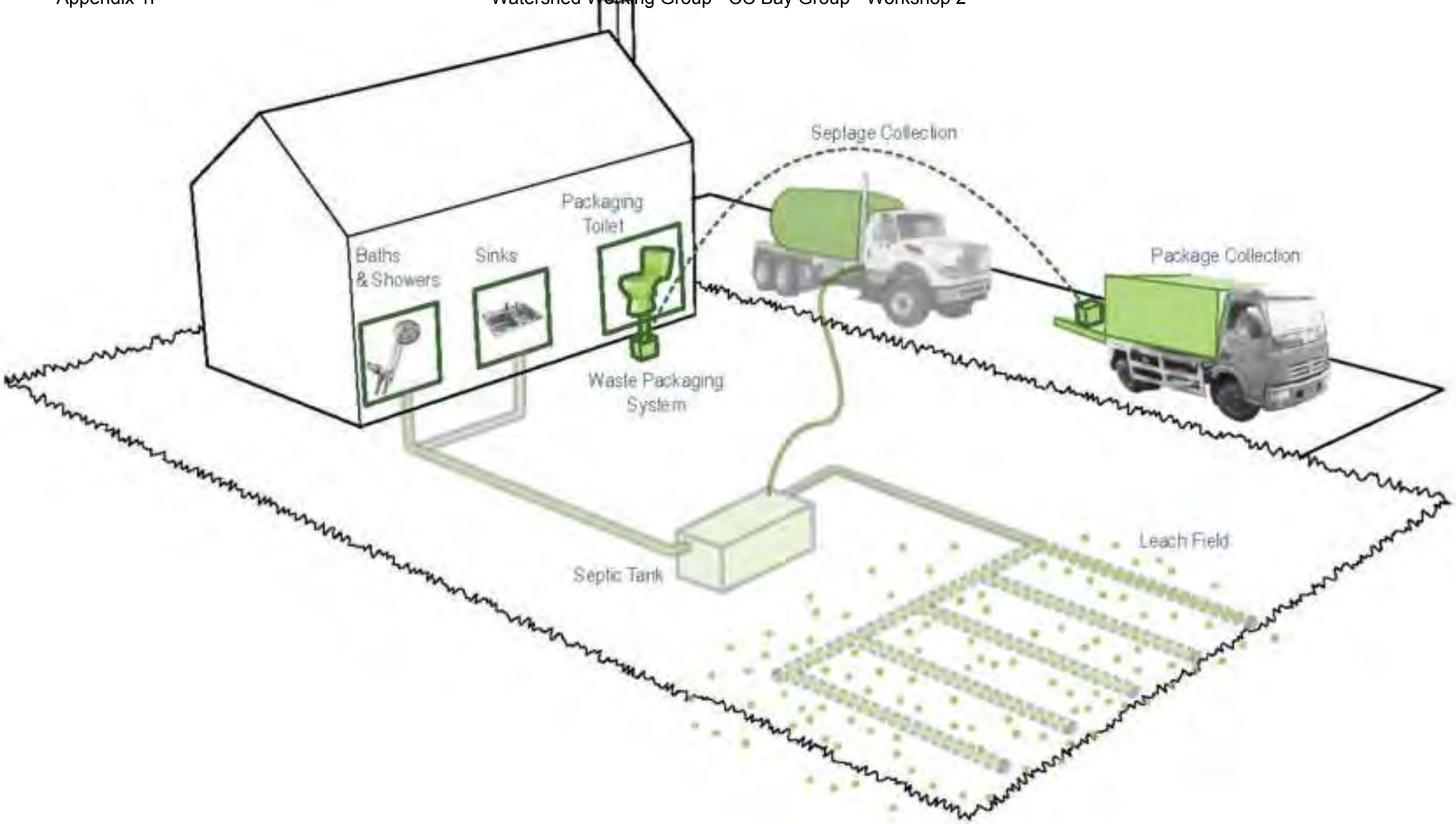
Scale: SITE
Target: WASTEWATER

Toilets: Composting



Source: Earle Barnhart, The Green Center Inc.

Toilets: Composting



Scale: SITE
Target: WASTEWATER

Toilets: Packaging

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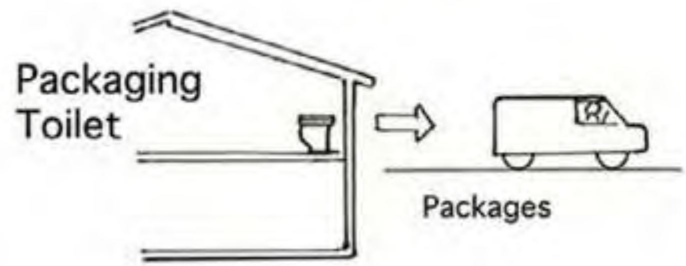
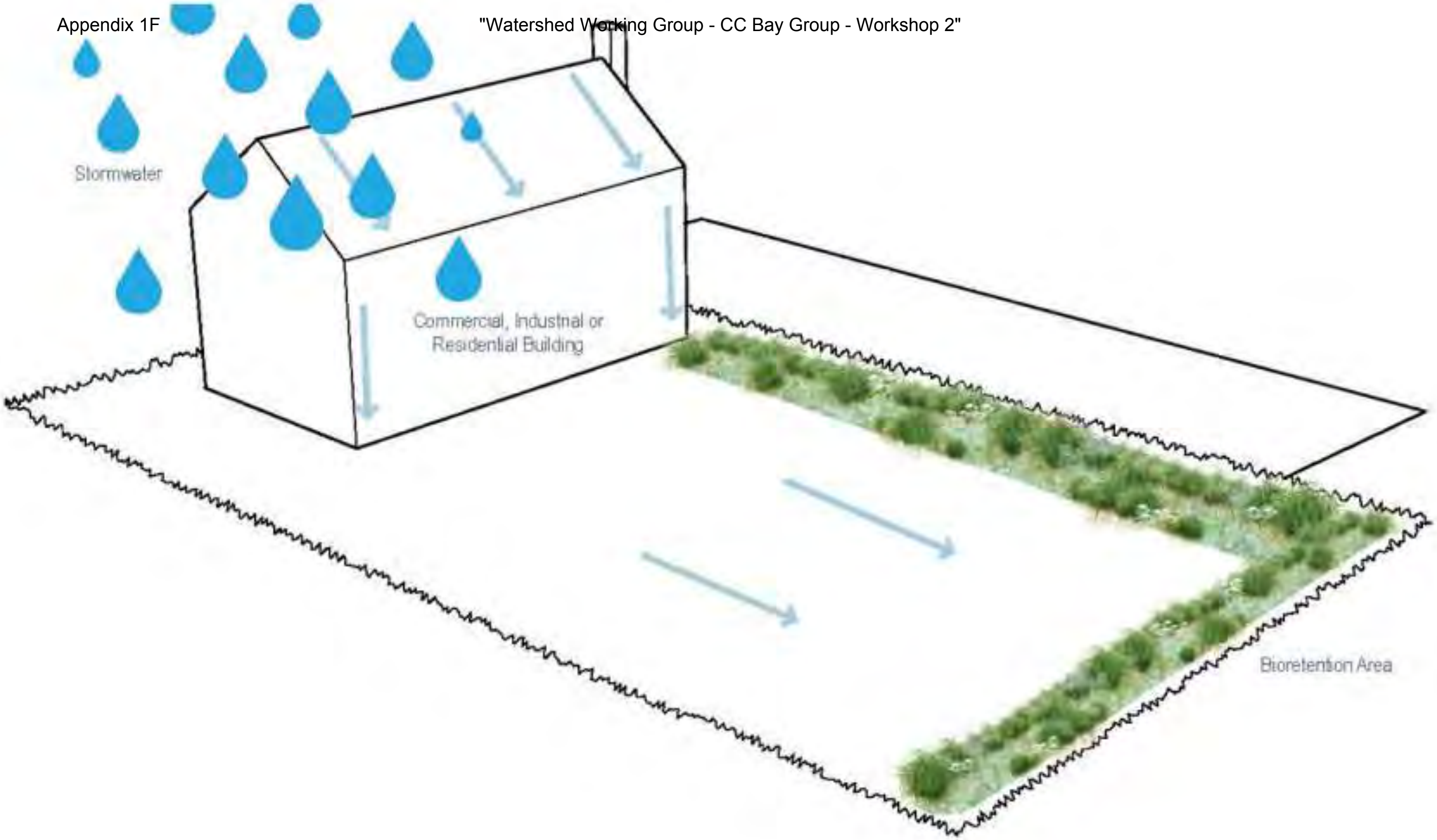


Source: Earle Barnhart, The Green Center Inc.

Toilets: Packaging



Scale: SITE
Target: STORMWATER

Stormwater Bioretention /
Soil Media Filters

Precedent: 12th Ave. Stormwater Project, Portland, OR

Source: City of Portland

Stormwater: Bioretention / Soil Media Filters

Rain Gardens


Solutions: Neighborhood
Site Scale | Neighborhood | Watershed | Cape-Wide
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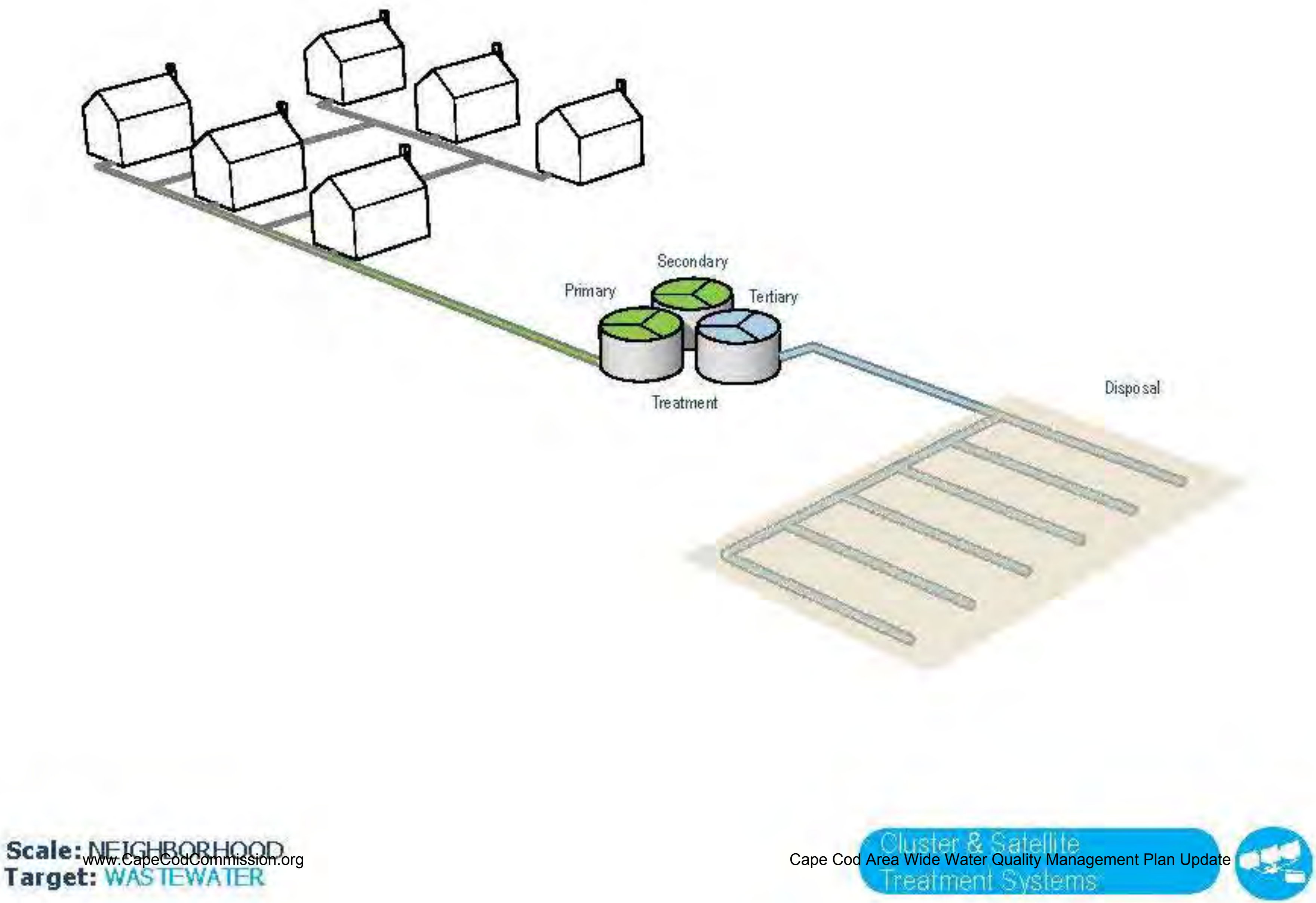
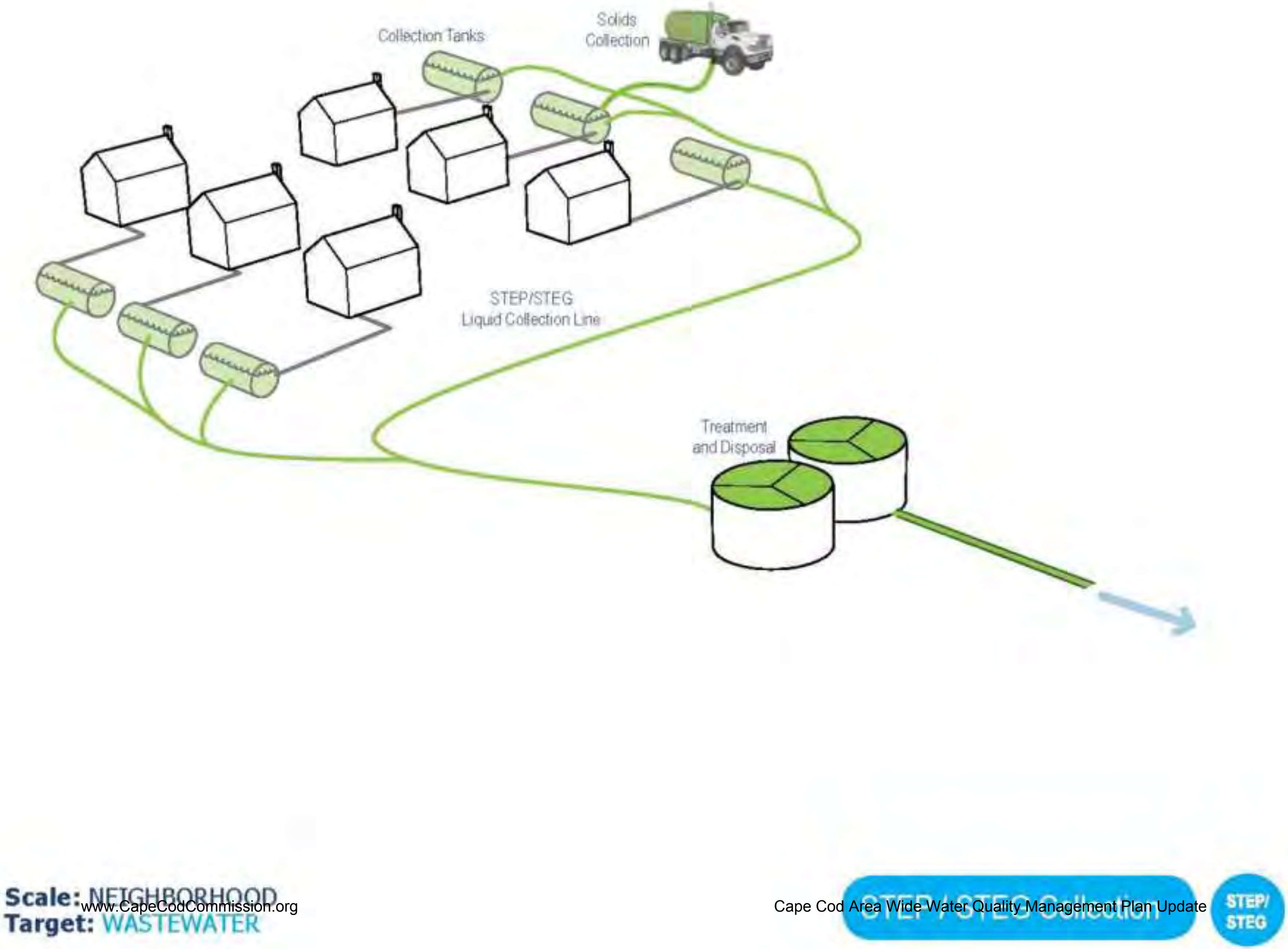
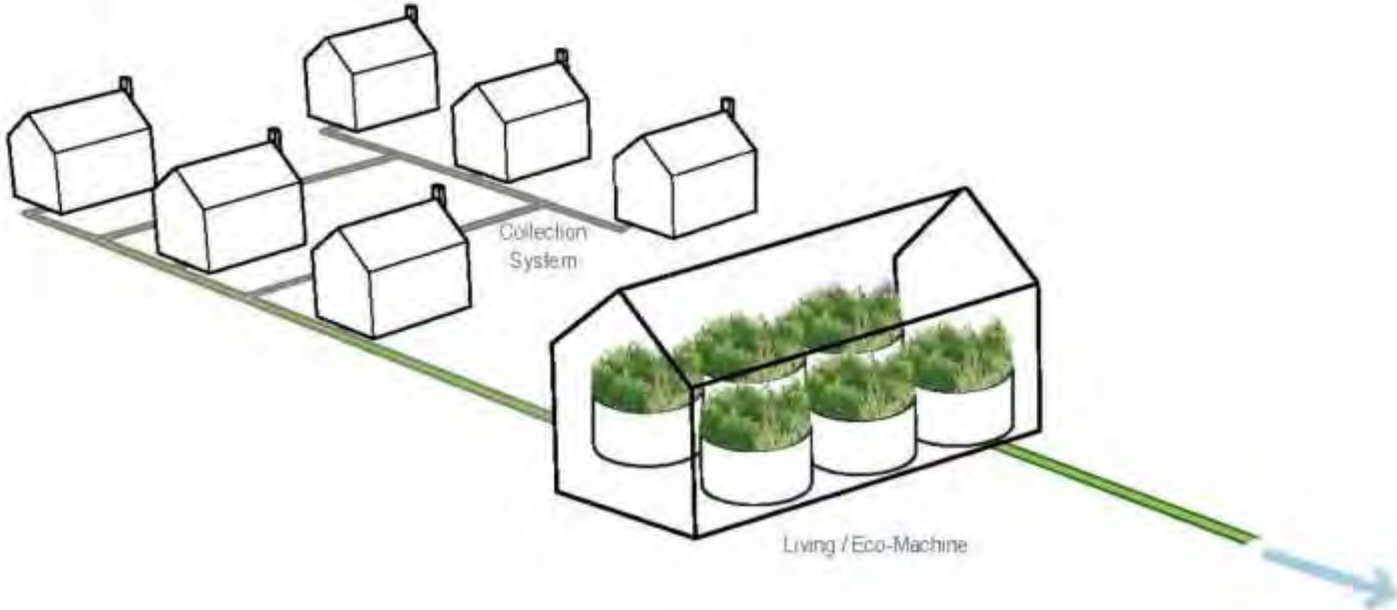
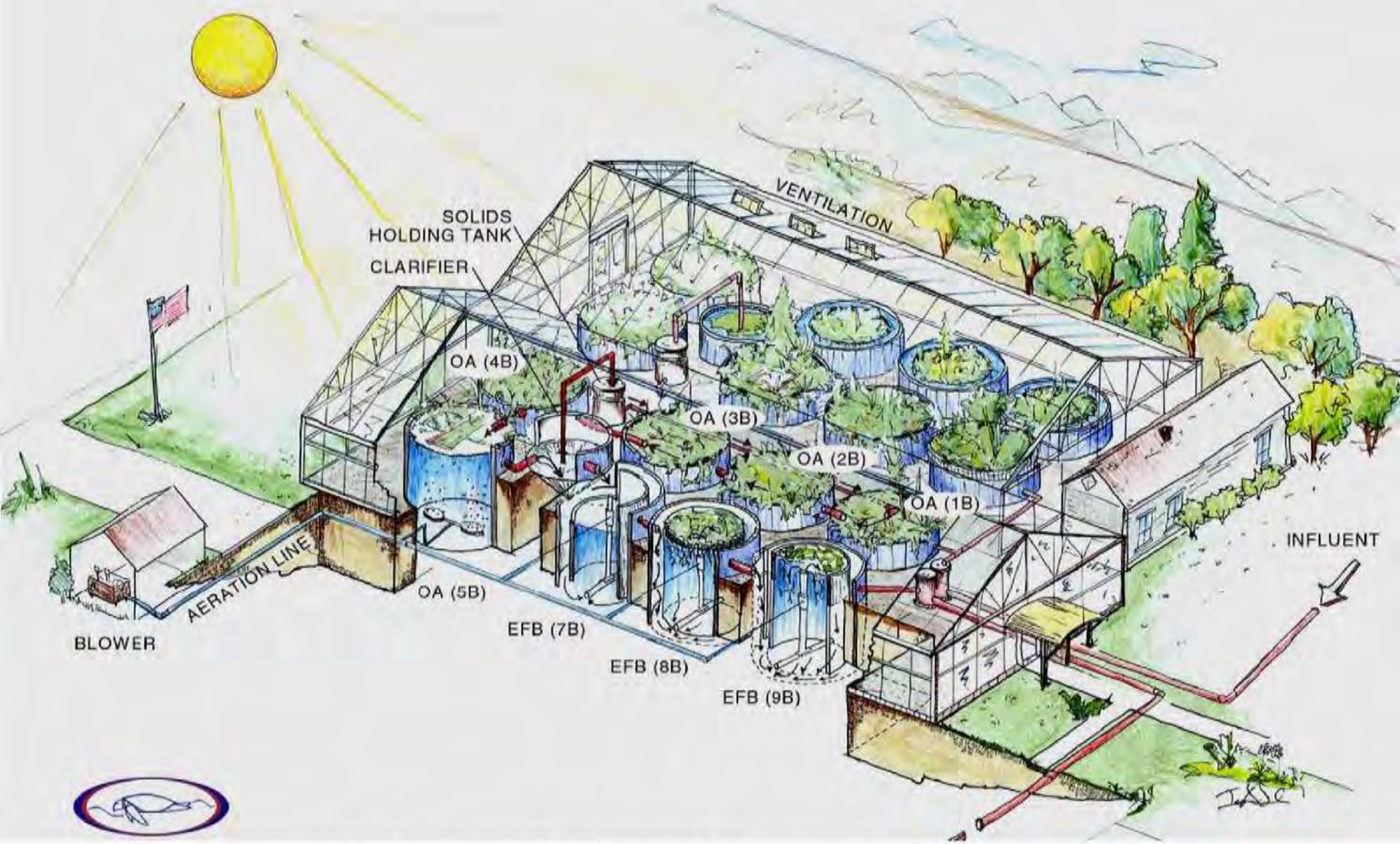

Secondary
Primary
Tertiary
Treatment
Disposal
Scale: NEIGHBORHOOD
Target: WASTEWATER
Cluster & Satellite
Treatment Systems


Collection Tanks
Solids
Collection
STEP/STEG
Liquid Collection Line
Treatment
and Disposal
Scale: NEIGHBORHOOD
Target: WASTEWATER
STEP / STEG Collection
STEP/
STEG



Scale: NEIGHBORHOOD
Target: WASTEWATER

Eco-Machines and
Living Machines

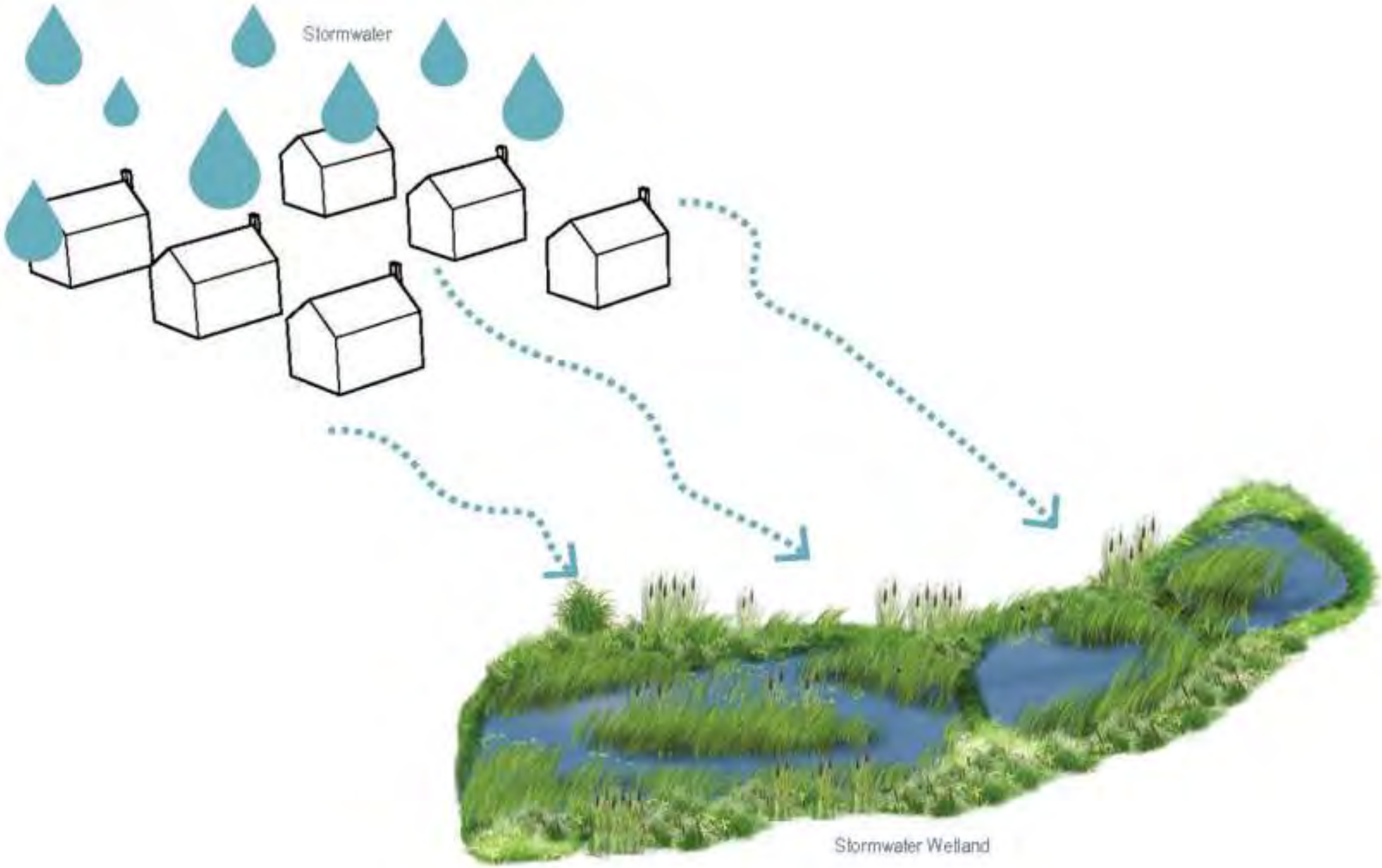


Precedent: Living Machine, South Burlington, VT
Source: Todd Ecological

Eco-Machines and Living Machines

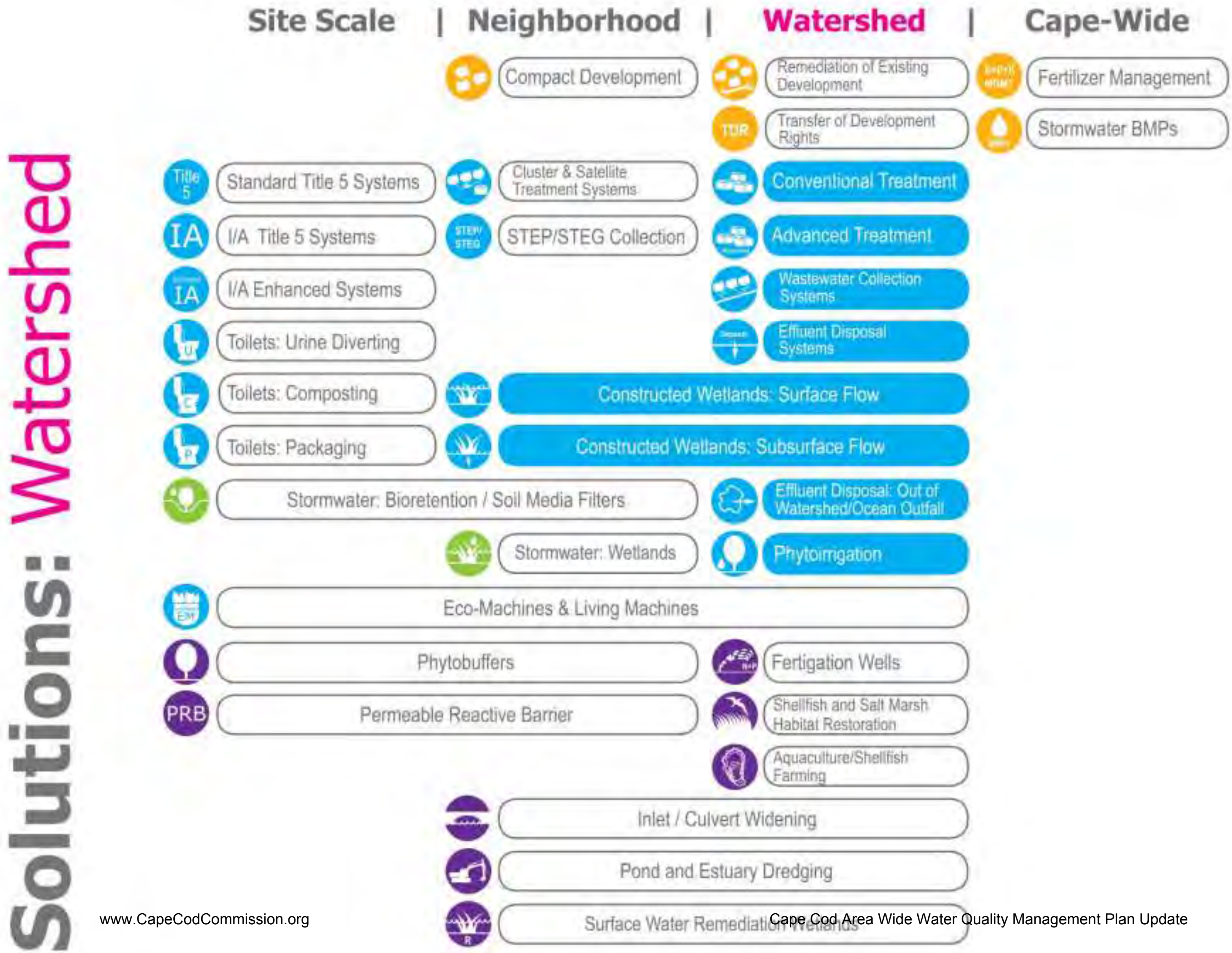
Precedent: Living Machine - South Burlington, VT + Photobioreactors - Falmouth, MA
Source: Todd Ecological and Tom Cambareri

Eco-Machines and Living Machines



Scale: NEIGHBORHOOD
Target: STORMWATER

Stormwater Wetlands


Solutions: Watershed
Site Scale | Neighborhood | Watershed | Cape-Wide
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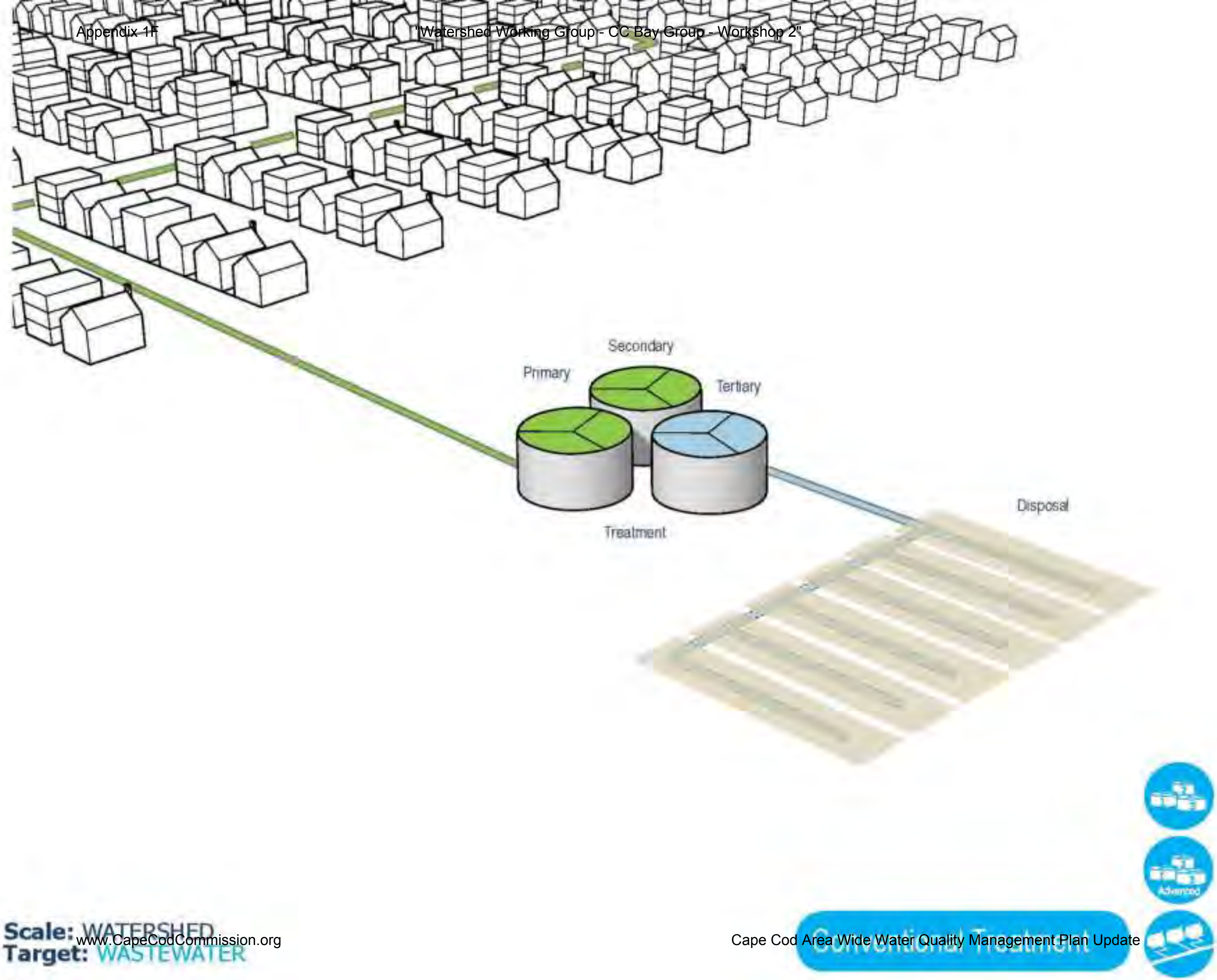
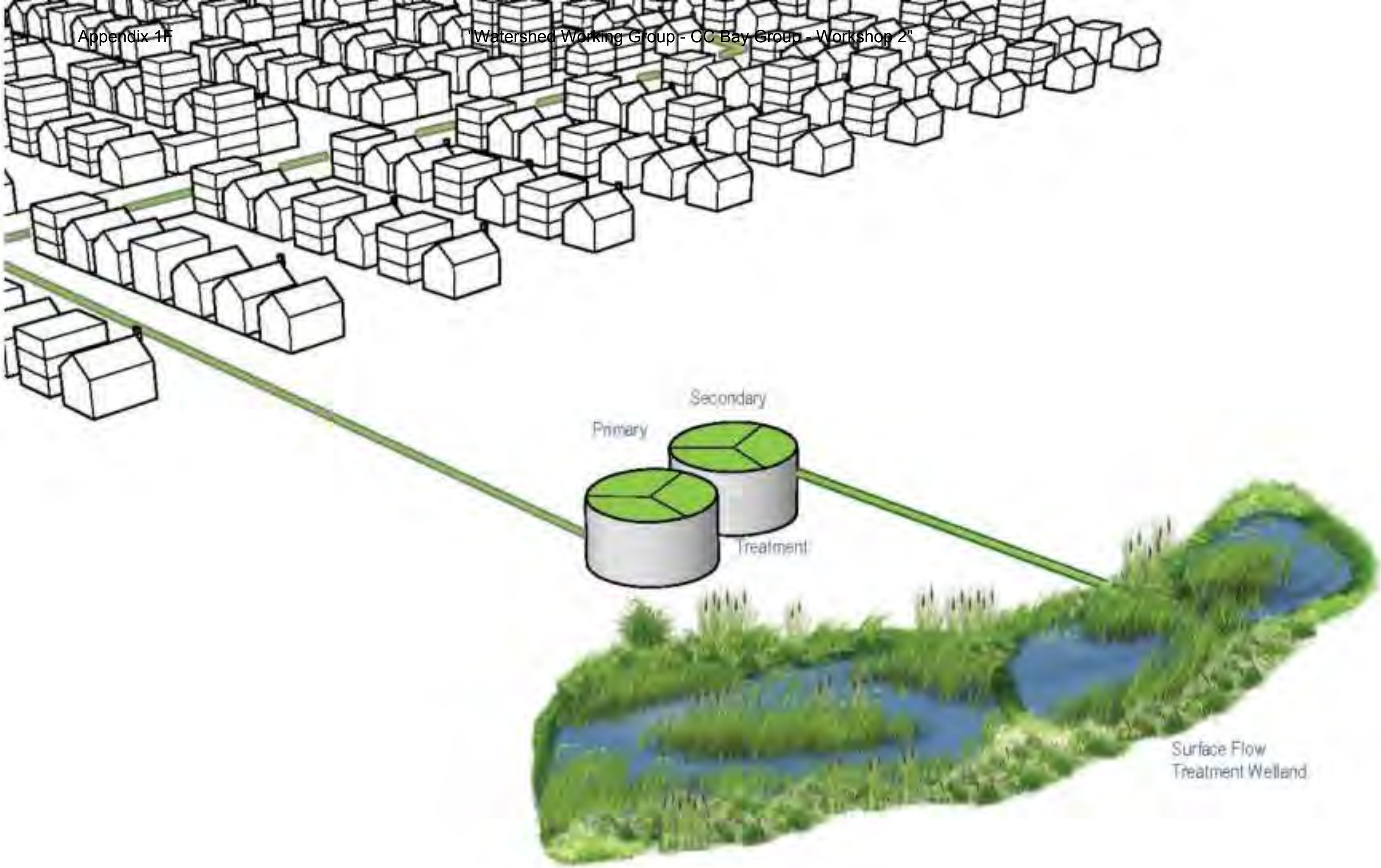
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands


Secondary
Primary
Tertiary
Treatment
Disposal
Advanced
Conventional Treatment
Scale: WATERSHED
Target: WASTEWATER

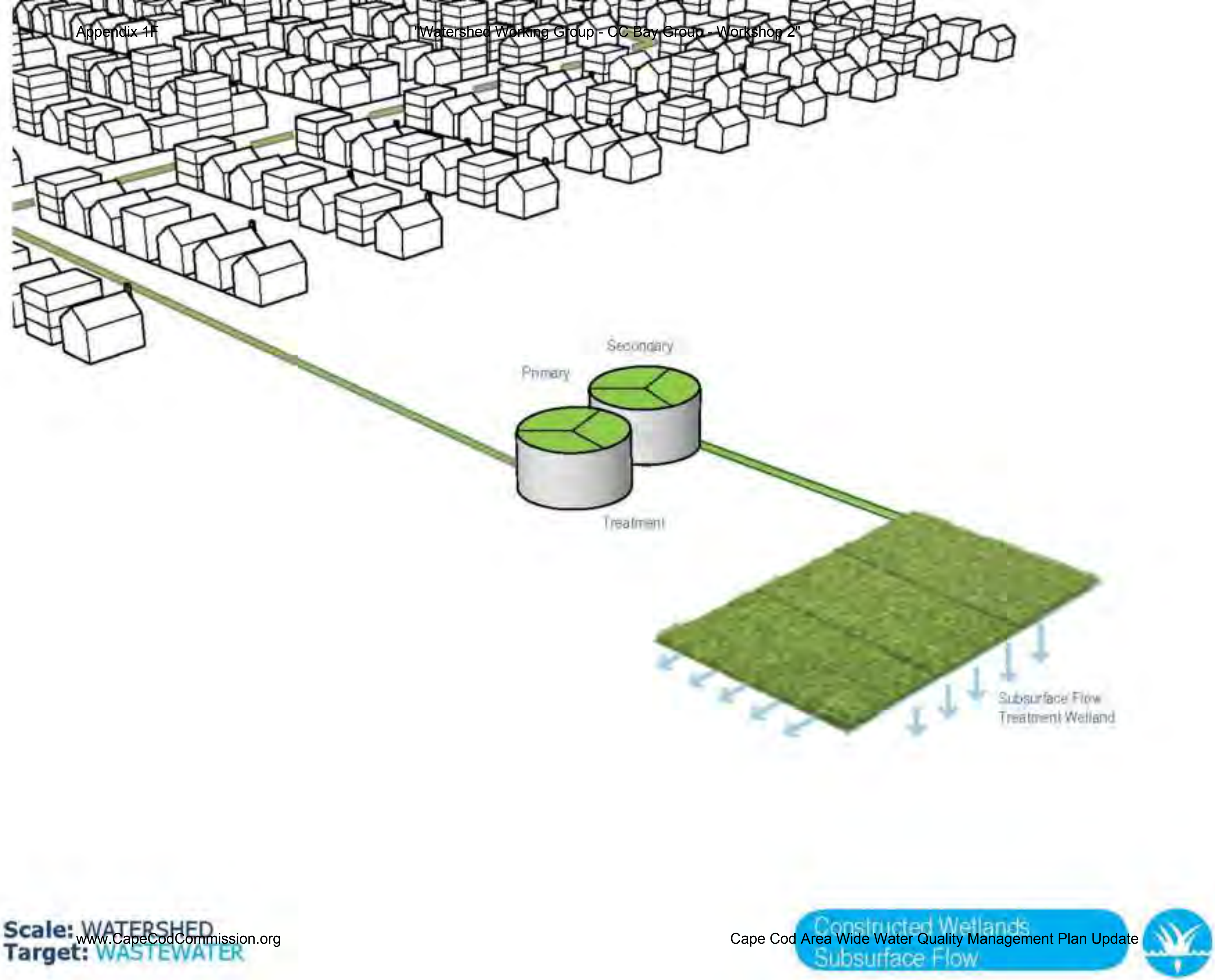


Scale: WATERSHED
Target: WASTEWATER

Constructed Wetlands
Surface Flow

Precedent: Talking Waters Garden - Albany, OR
Source: Kate Kennen

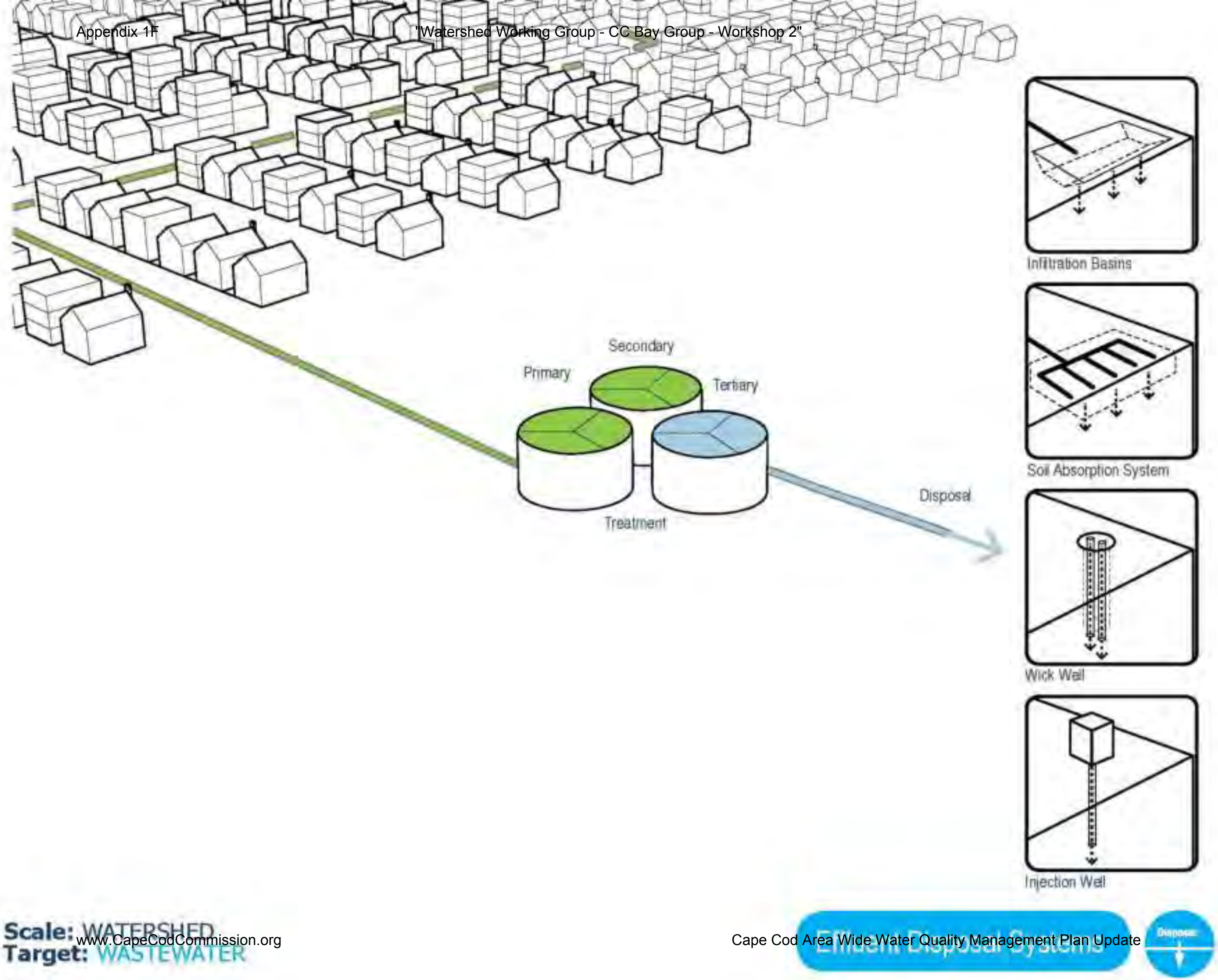
Constructed Wetlands: Surface Flow

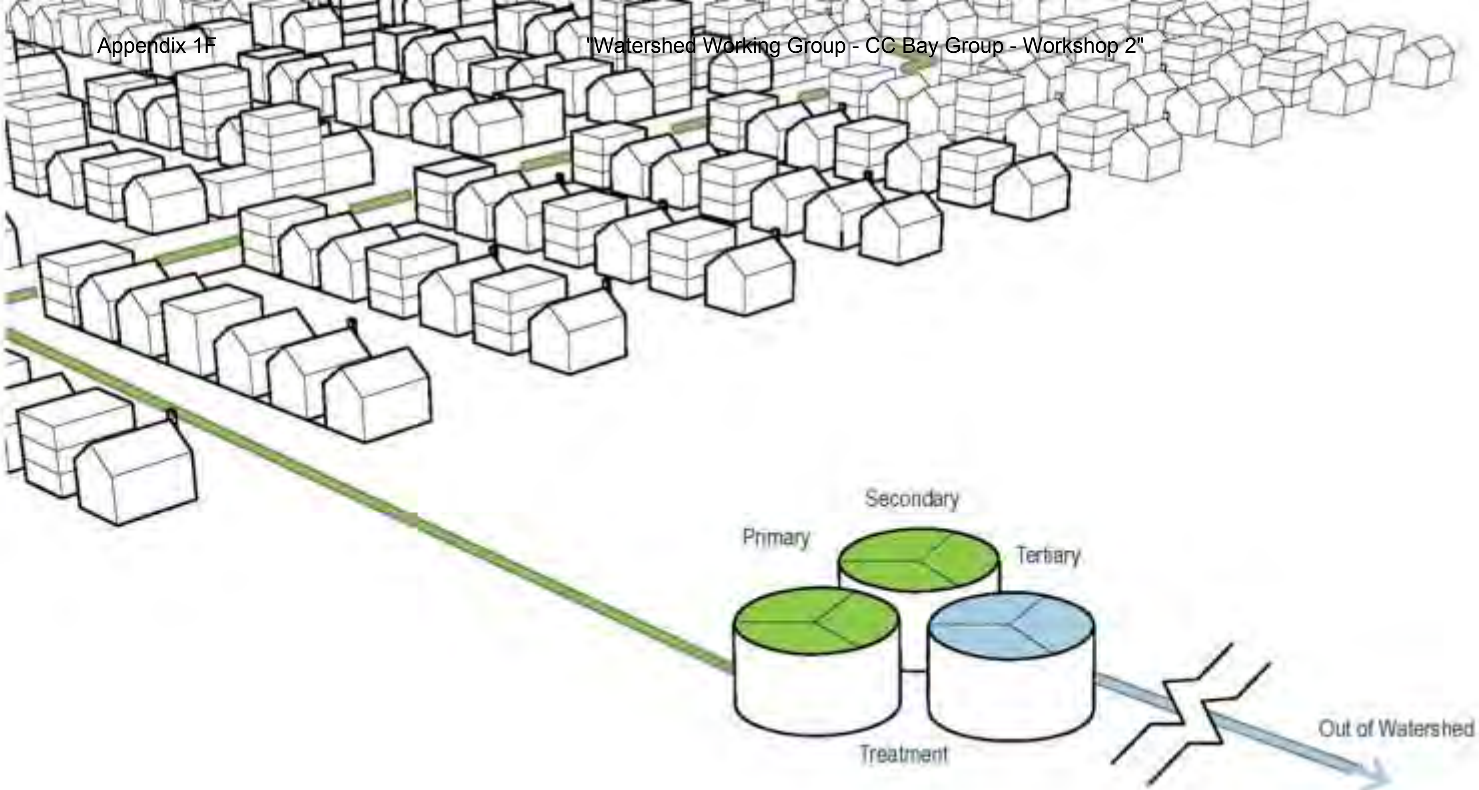

Secondary
Primary
Treatment
Subsurface Flow
Treatment Wetland
Scale: WATERSHED
Target: WASTEWATER
Constructed Wetlands
Subsurface Flow

Precedent: Koh Phi Phi Treatment Wetland, Thailand

Source: Hans Brix

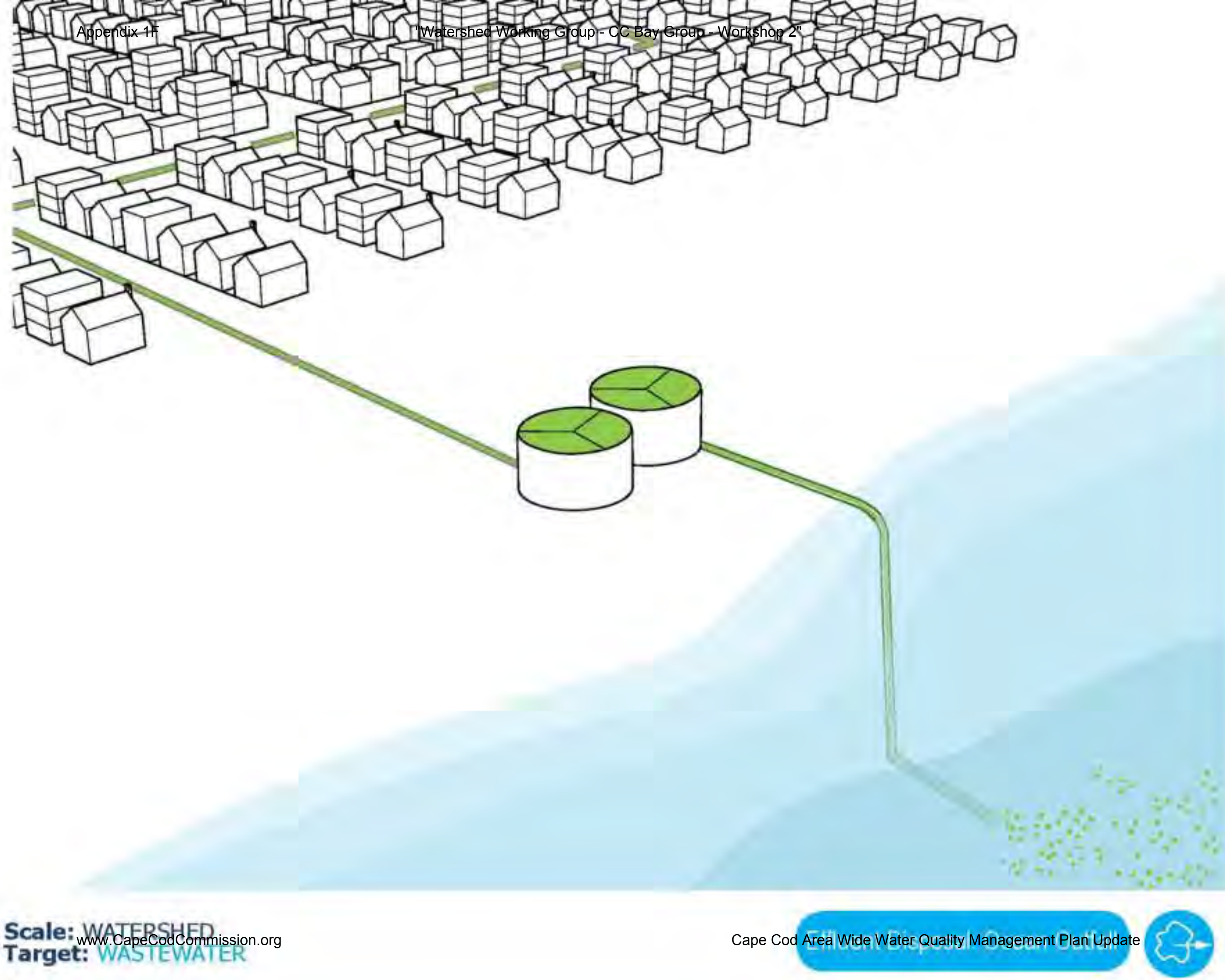
Constructed Wetlands: Subsurface Flow

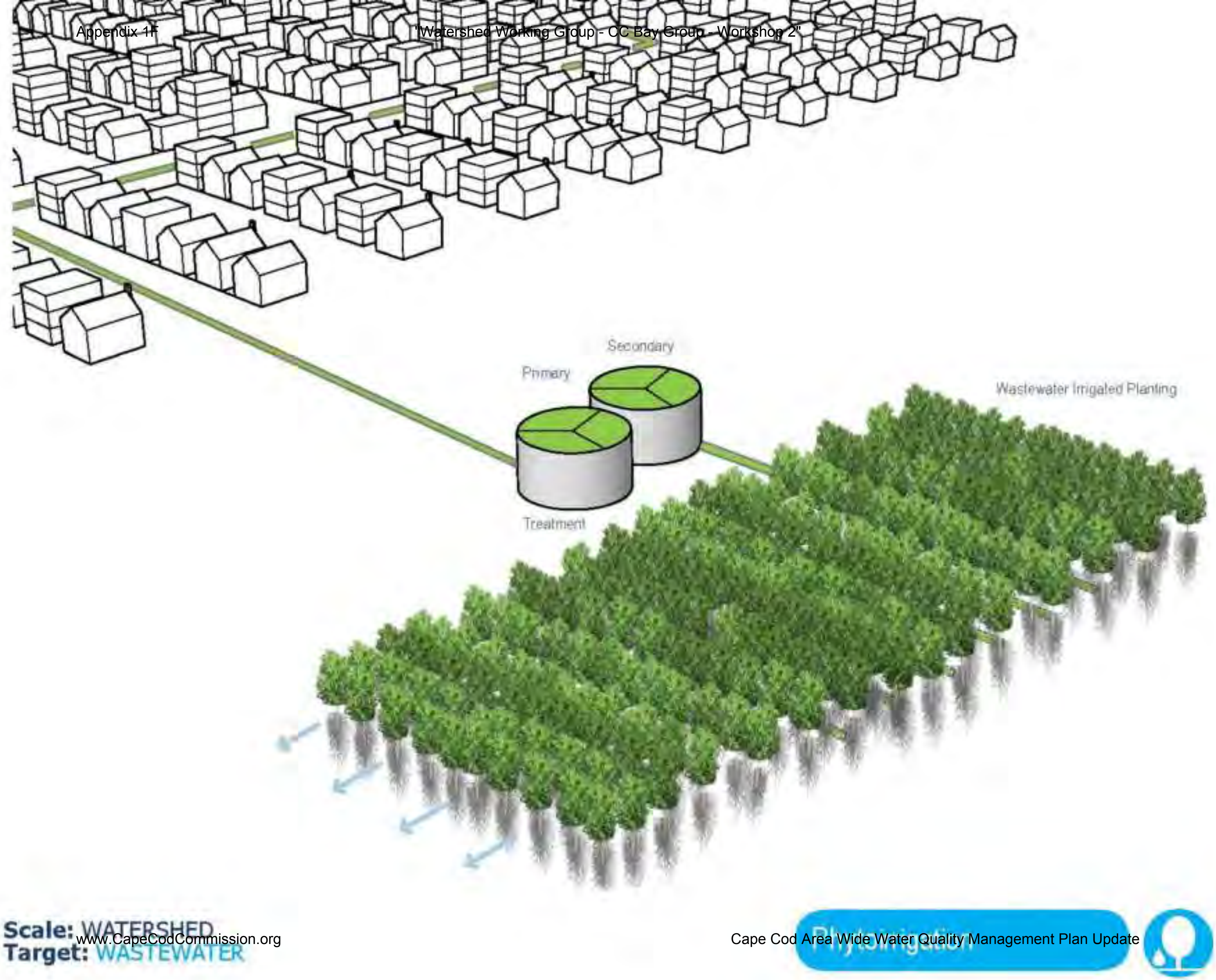

Secondary
Primary
Tertiary
Treatment
Disposal
Infiltration Basins
Soil Absorption System
Wick Well
Injection Well
Scale: WATERSHED
Target: WASTEWATER



Scale: WATERSHED
Target: WASTEWATER

Effluent Disposal: Out of Watershed


Scale: WATERSHED
Target: WASTEWATER

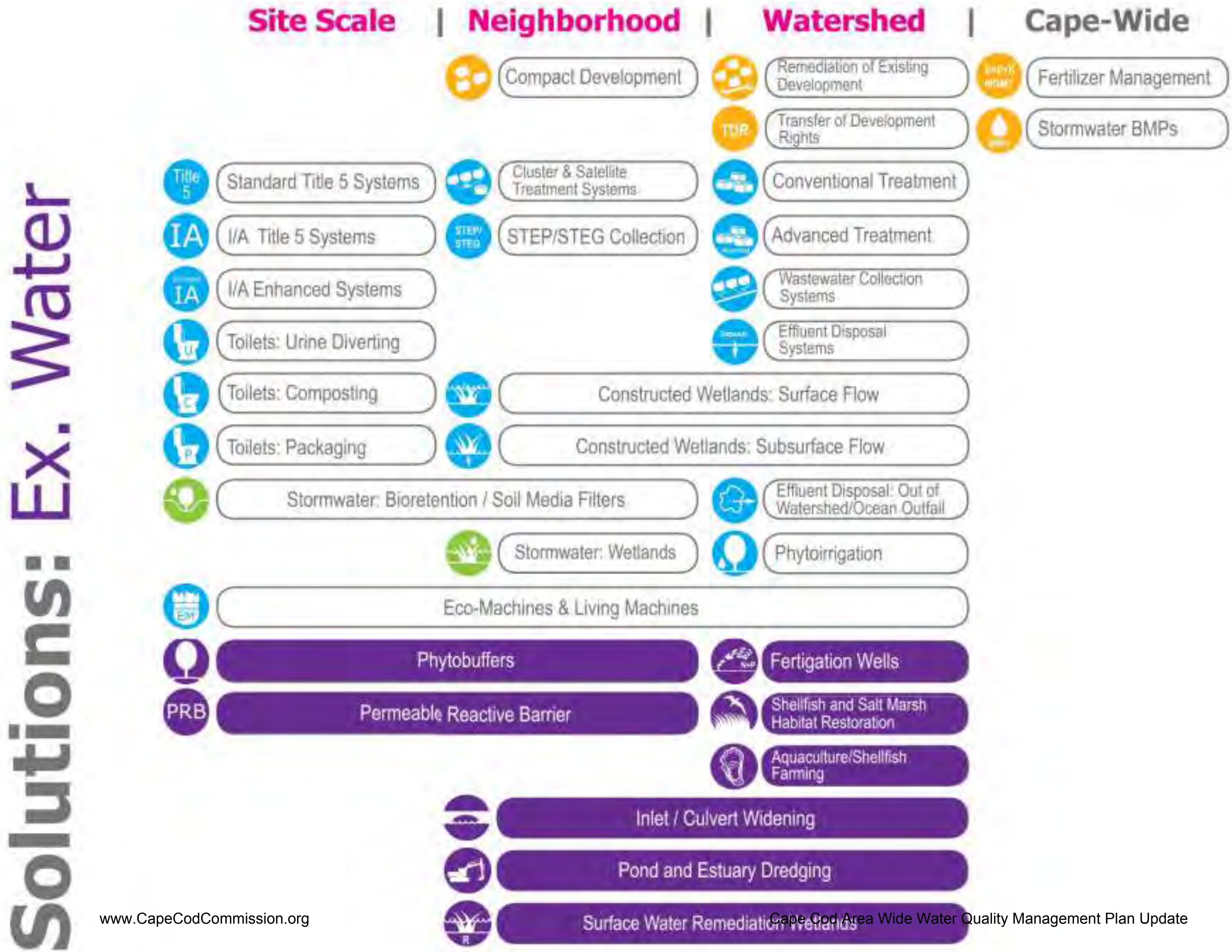

Secondary
Primary
Wastewater Irrigated Planting
Treatment
Scale: WATERSHED
Target: WASTEWATER

Precedent: Woodburn OR, Wastewater Treatment Facility
Source: CH2MHill

Phytoirrigation

Precedent: Woodburn OR, Wastewater Treatment Facility
Source: CH2MHill

Phytoirrigation


Solutions: Ex. Water
Site Scale
Neighborhood
Watershed
Cape-Wide
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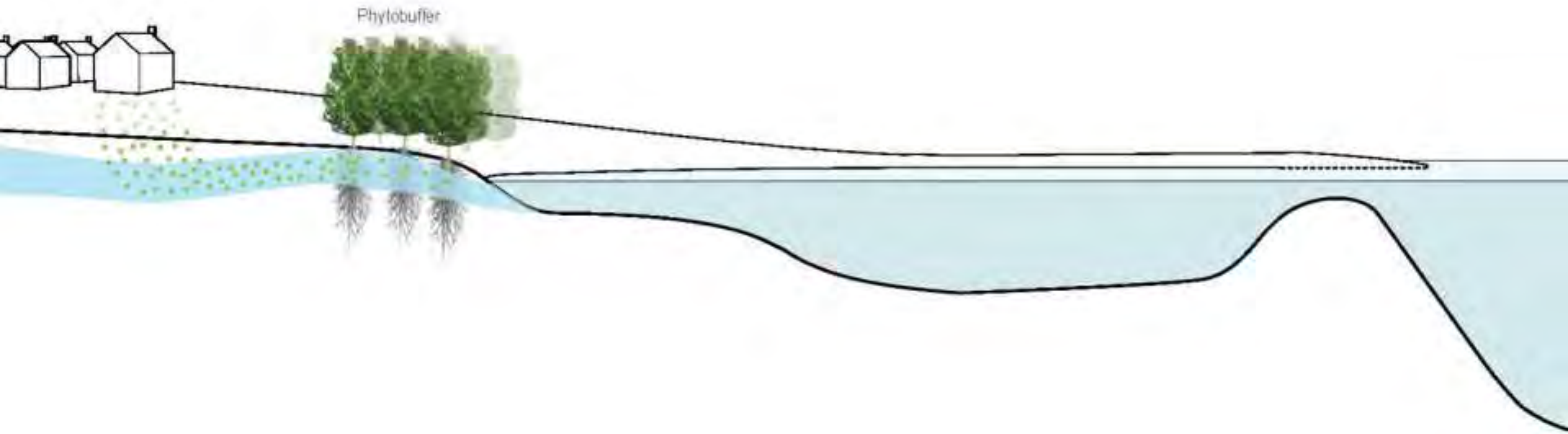


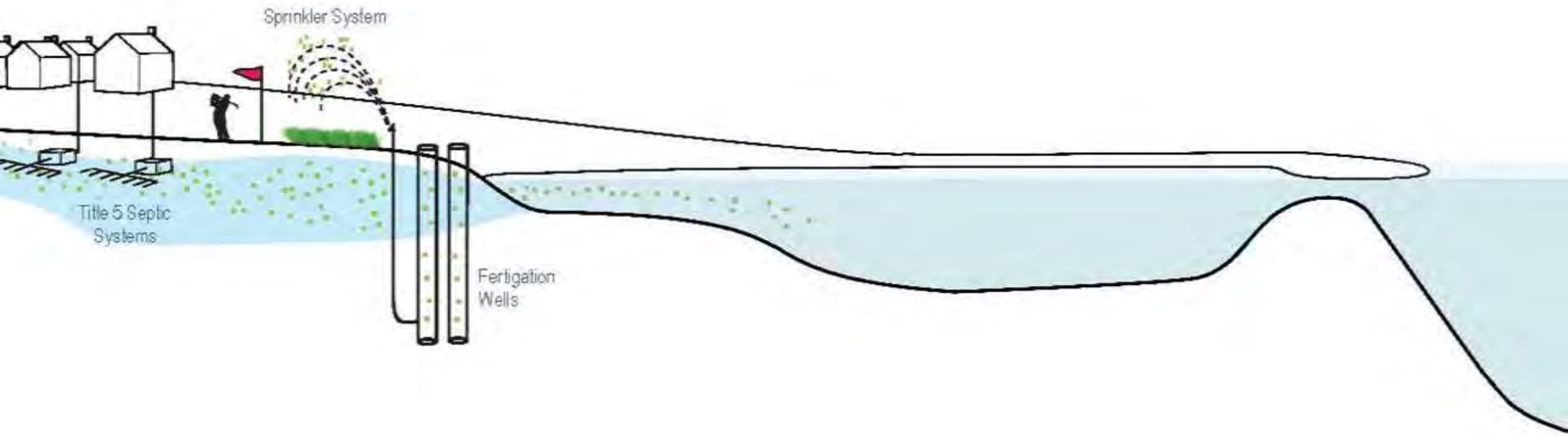
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Phytobuffers

Precedent: Phytobuffer - Kavcee, WY

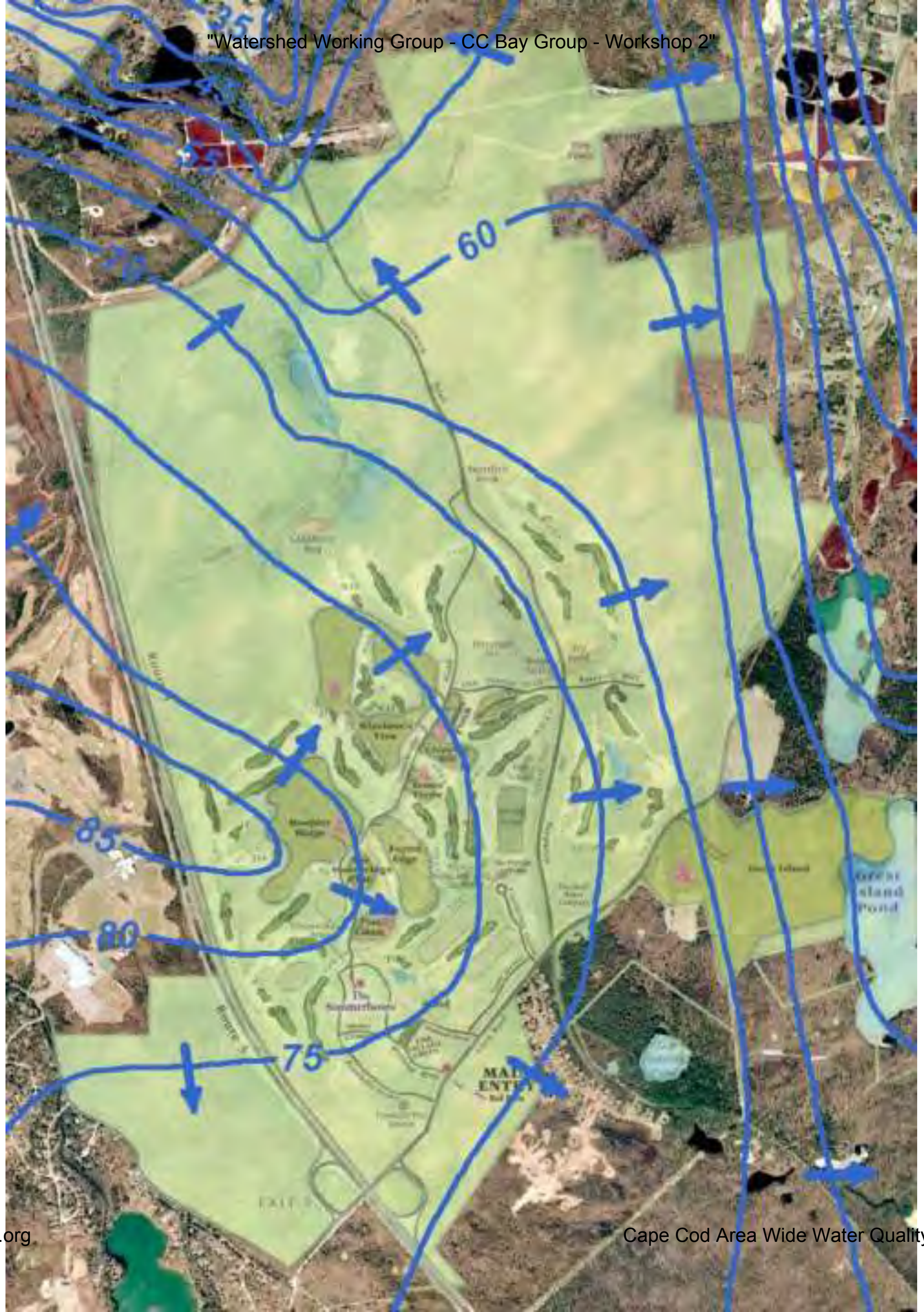
Source: Sand Creek Consultants

Phytobuffers

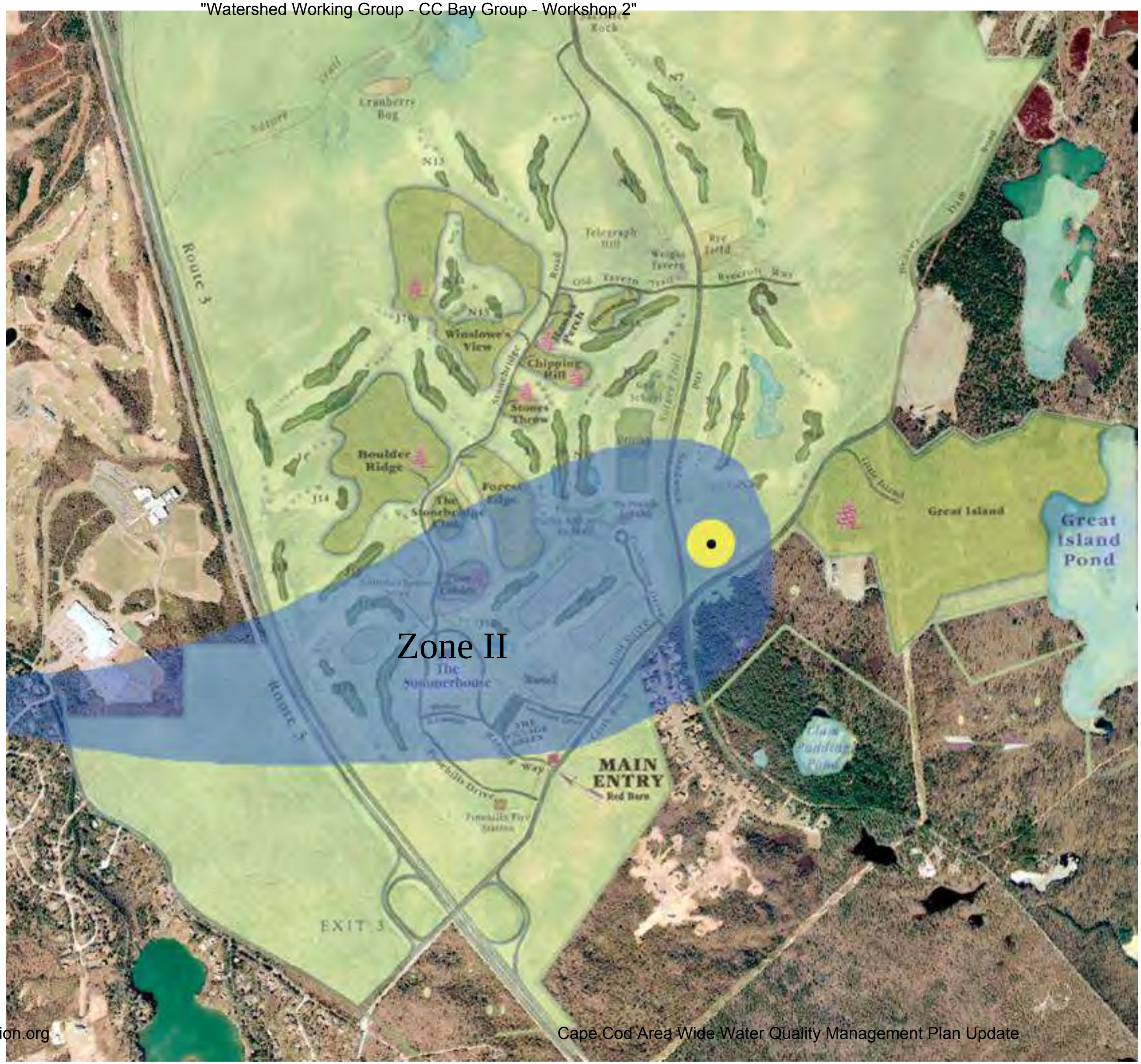


Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Fertigation Wells



Precedent:
Pine Hills
Plymouth, MA



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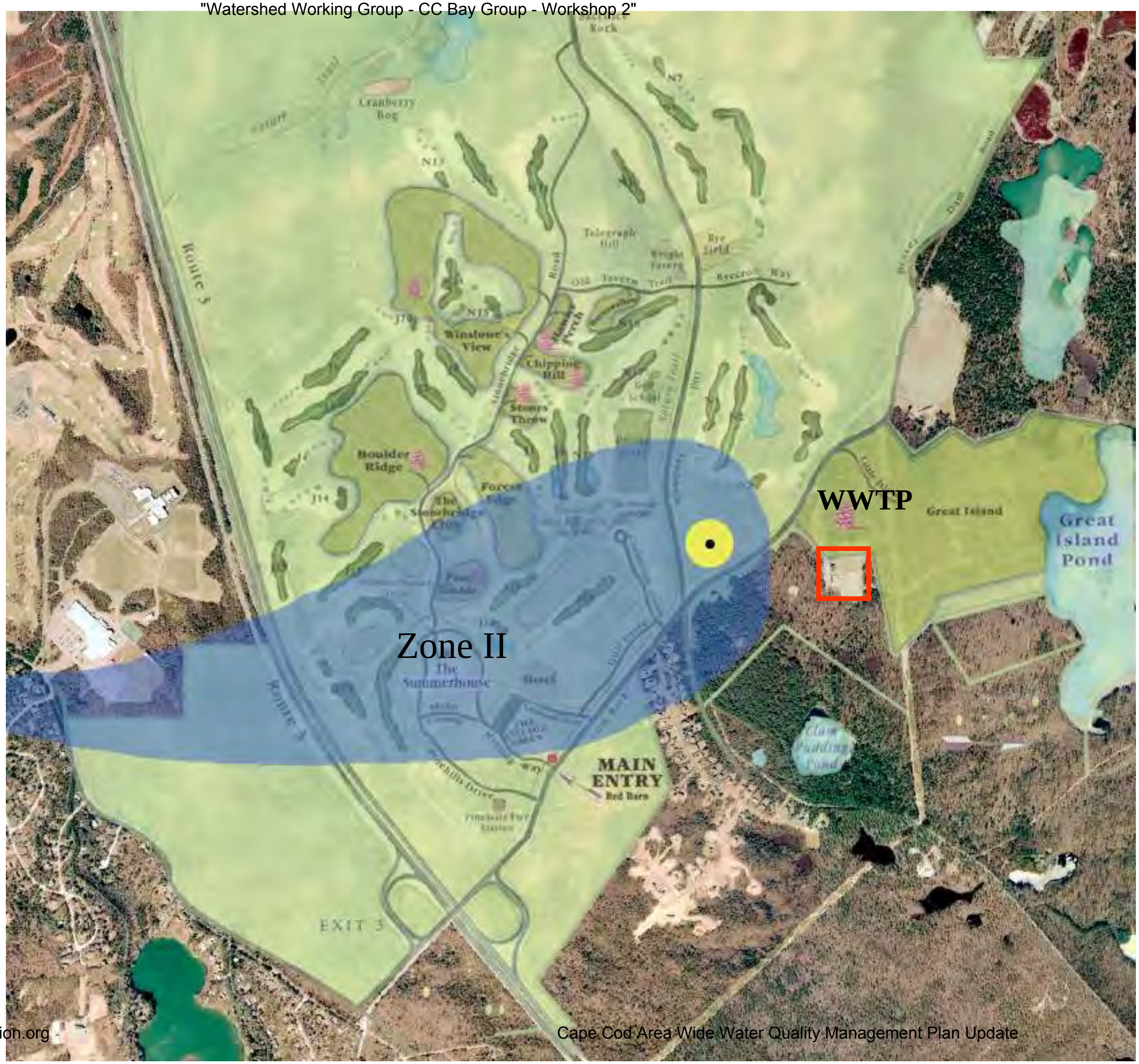

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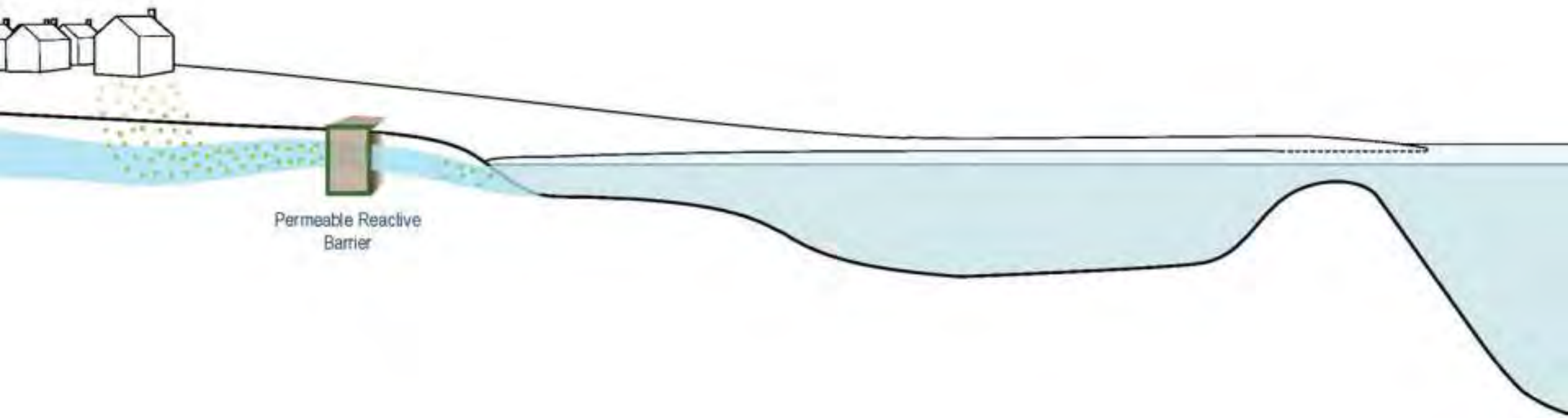
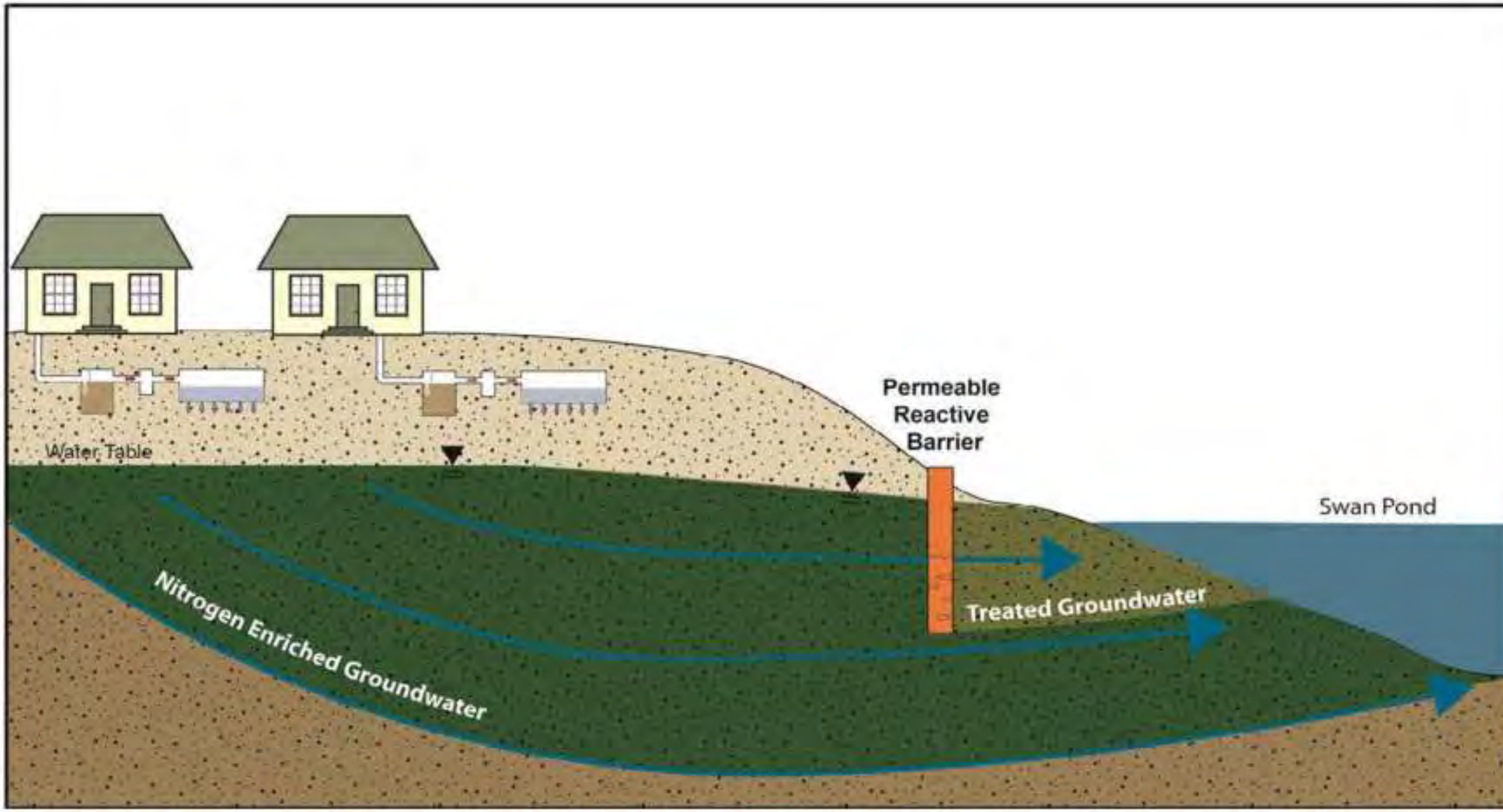


Scale: SITE / NEIGHBORHOOD / WATERSHED
Target: EXISTING WATER BODIES

Permeable Reactive Barrier PRB



Precedent: PRB
Source: Horsley Witten Group Inc.

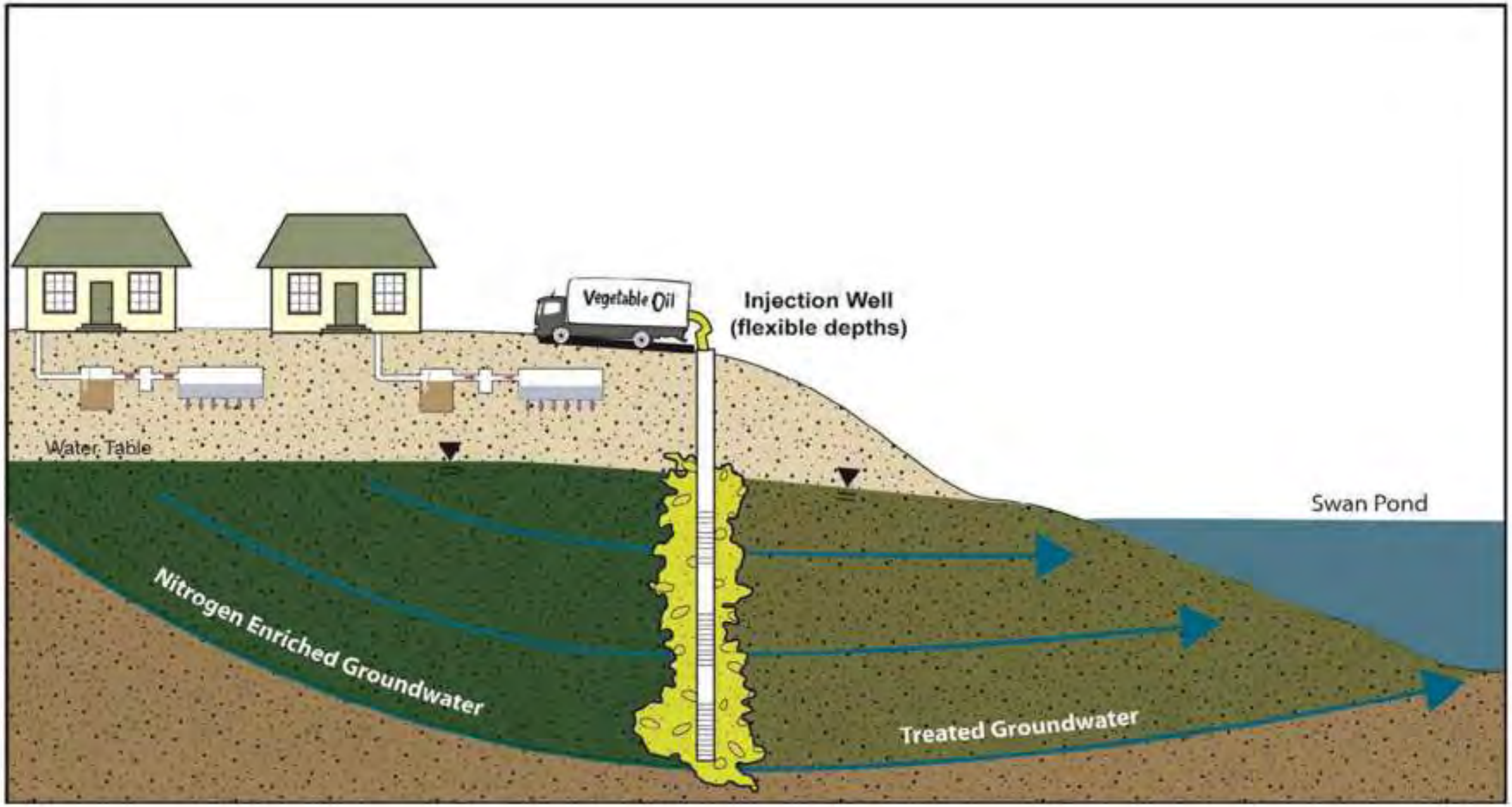
Permeable Reactive Barrier PRB

Precedent: Falmouth PRB

Source: Mike Domenica

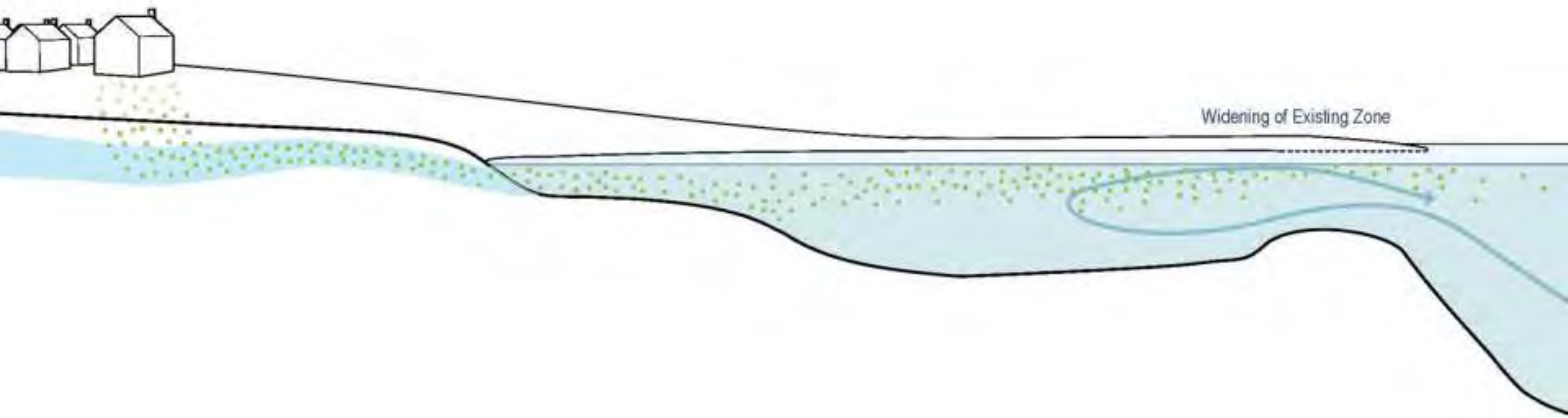
Permeable Reactive Barrier

PRB



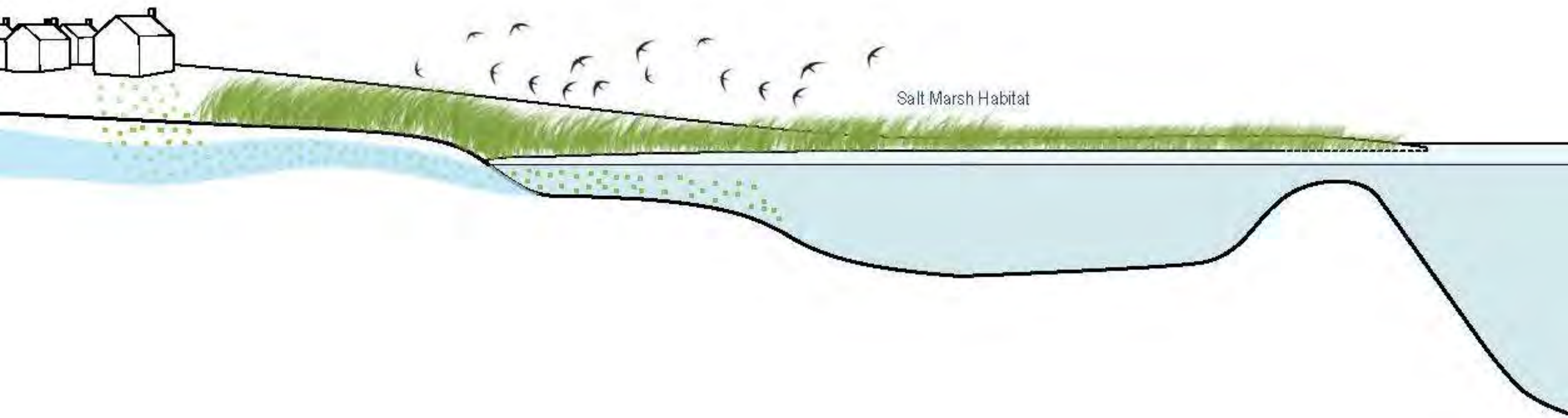
Precedent: PRB
Source: Horsley Witten Group Inc.

Permeable Reactive Barrier PRB



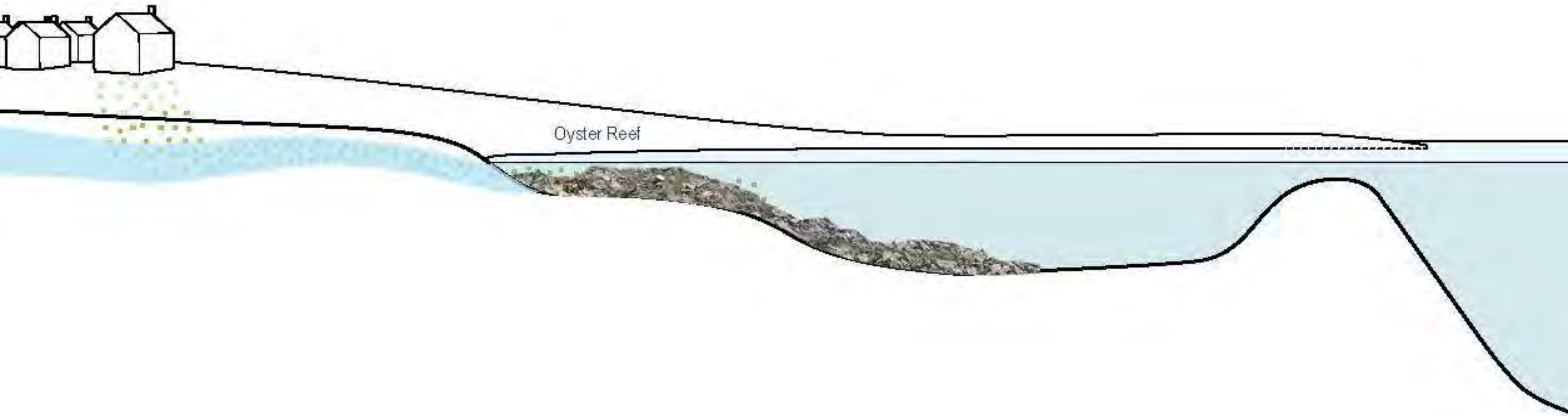
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Inlet and Culvert Widening



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Salt Marsh Habitat Restoration



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Shellfish Habitat Restoration

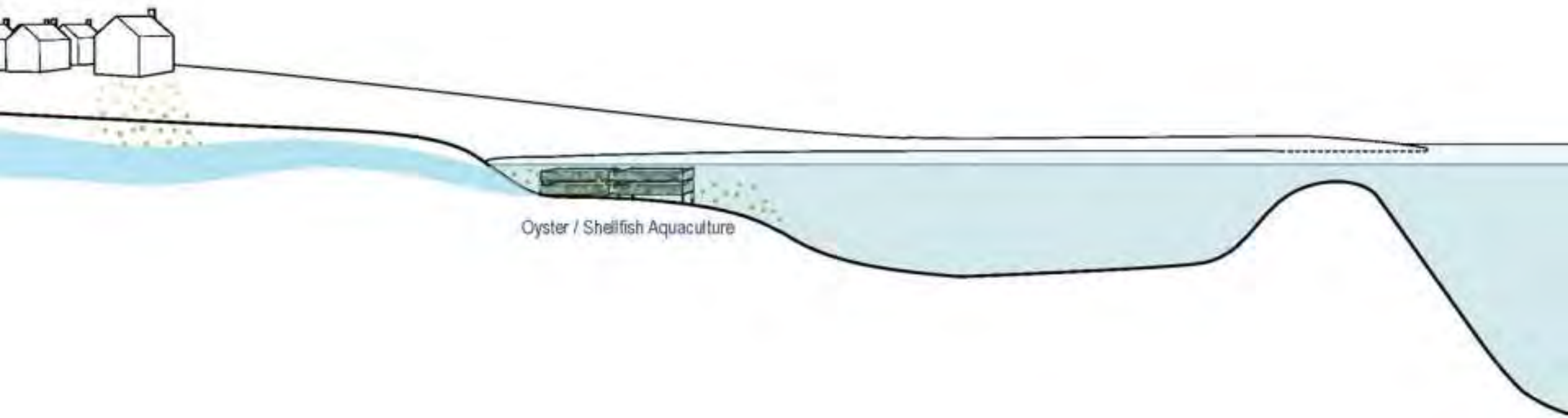
Precedent: Wellfleet Oyster Restoration Project

Shellfish Habitat Restoration

Precedent: Wellfleet Oyster Restoration Project

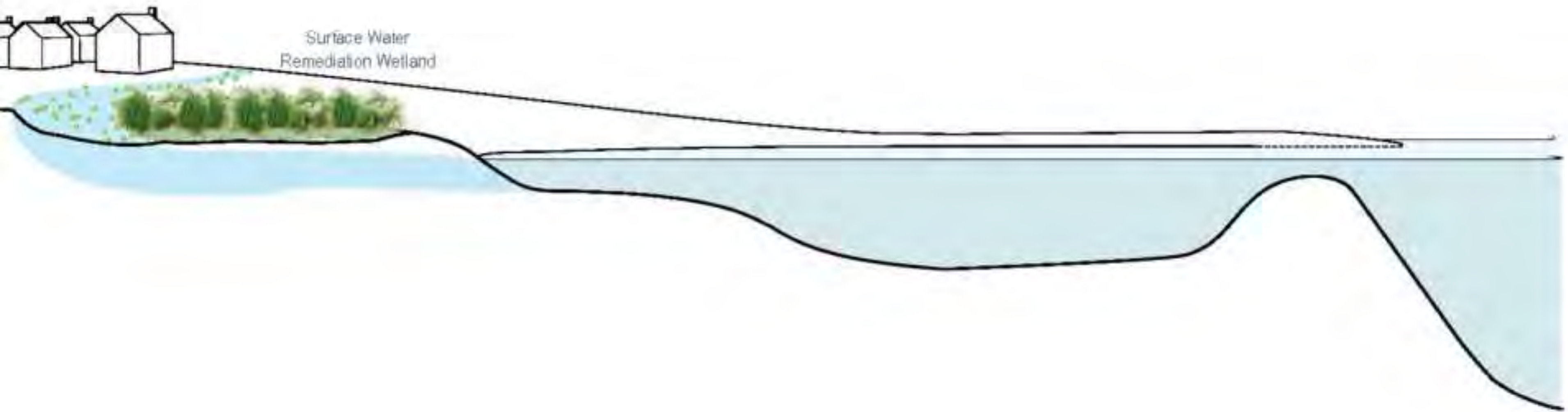
Source:

Shellfish Habitat Restoration



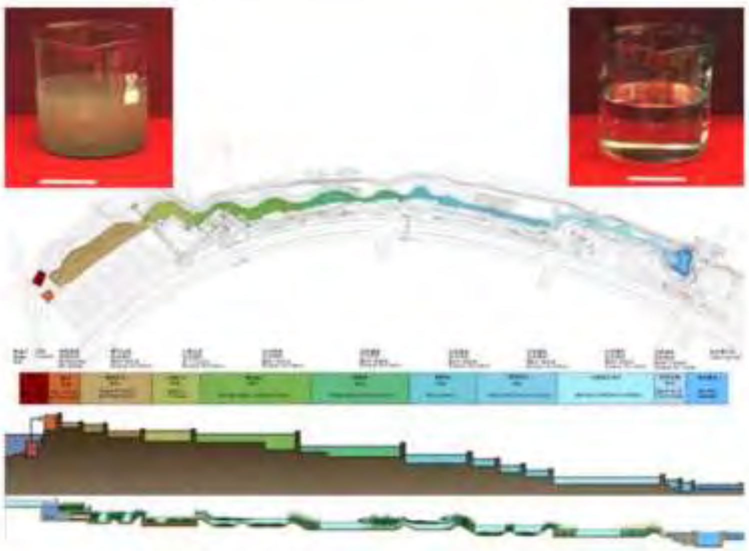
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Aquaculture / Shellfish Farming



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

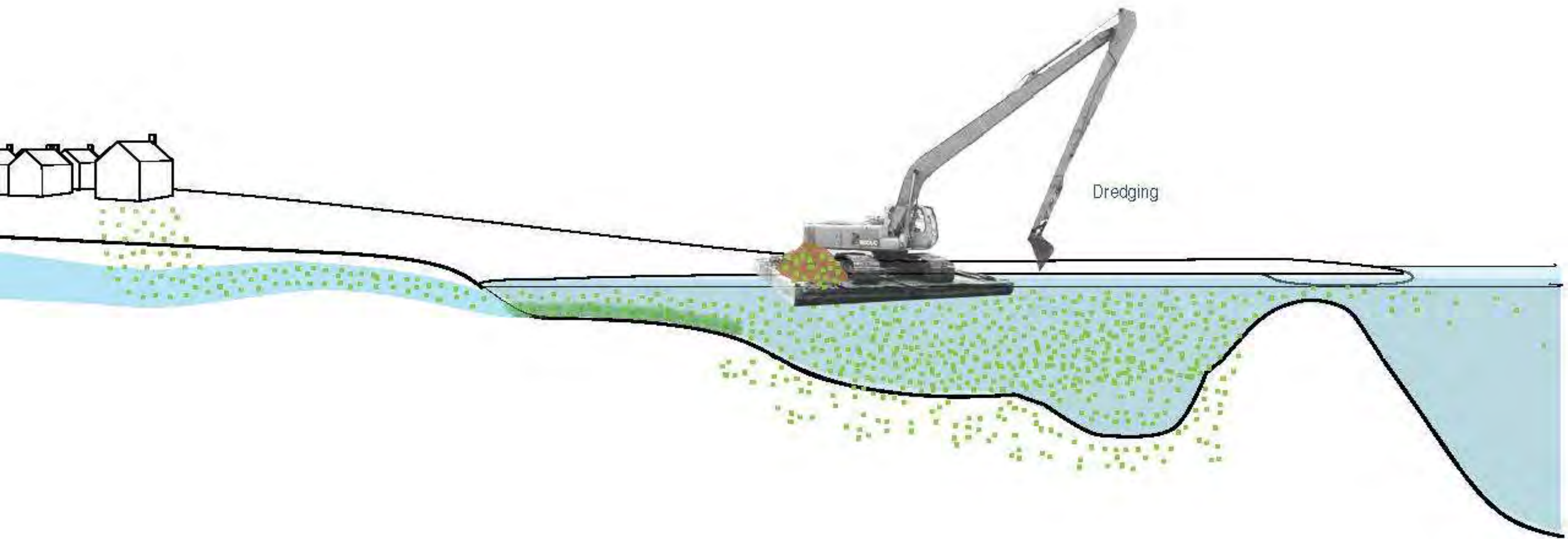
Surface Water
Remediation Wetlands



Precedent: Shanghai Houton Park

Source: Turenscape

Surface Water Remediation Wetlands

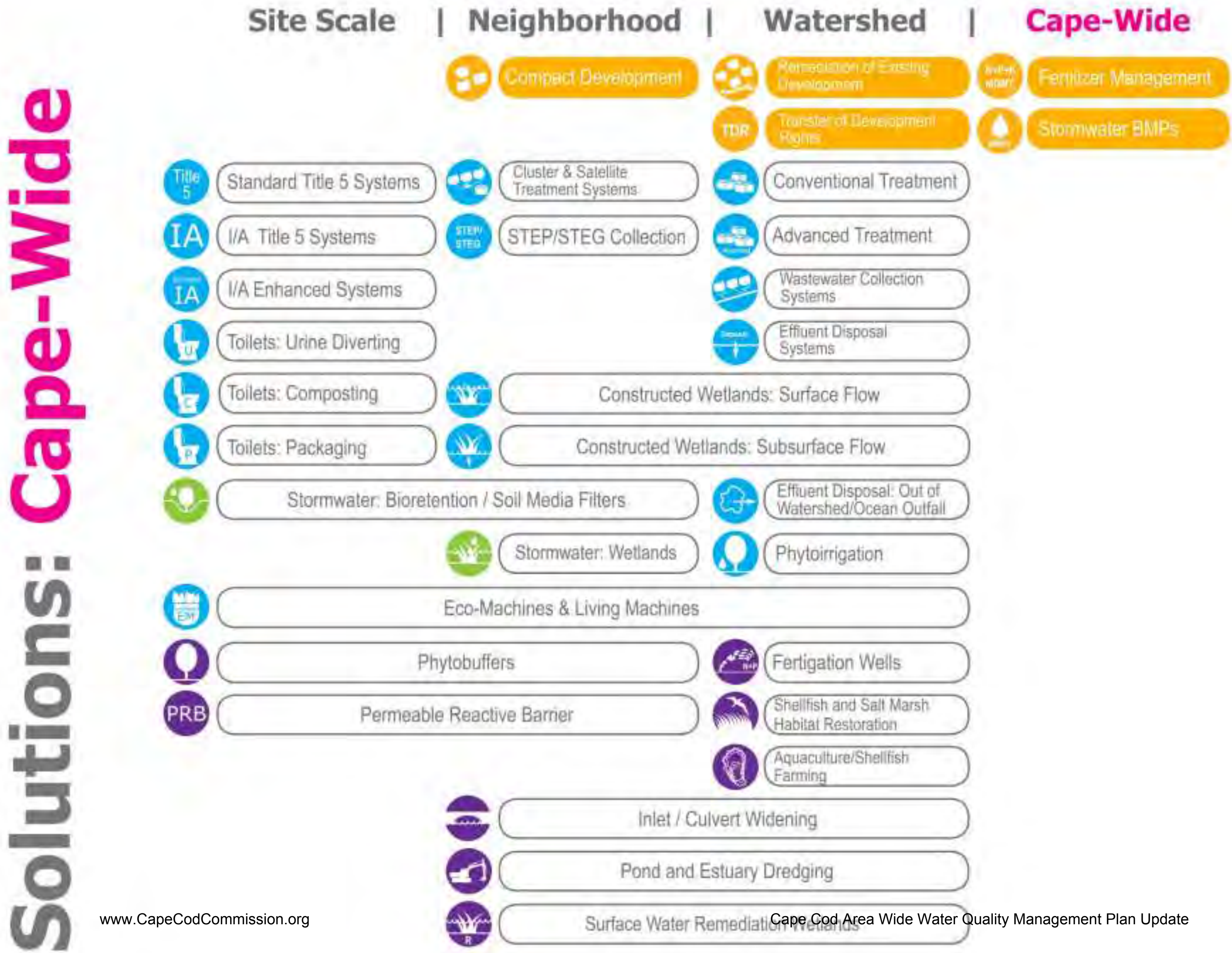


Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Pond and Estuary Dredging

Precedent: Pond and Estuary Dredging - Dennis, MA

Source: Cape Cod Times


Solutions: Cape-Wide
Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
IA
I/A Title 5 Systems
STEP/STEG
STEP/STEG Collection
Advanced Treatment
IA
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
EM
Eco-Machines & Living Machines
Phytobuffers
Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands

Scale: CAPE-WIDE
Target: REGULATORY

Compact Development

Scale: CAPE-WIDE
Target: REGULATORY

Fertilizer Management

N+P+K MGMT

Scale: CAPE-WIDE
Target: REGULATORY

Remediation of Existing Development


Scale: CAPE-WIDE
Target: REGULATORY


Transfer of Development Rights
TDR

Transfer of Developments Rights
The Concept

Owner of "sending" parcel sells development rights in exchange for permanent conservation easement.

Owner of "receiving" parcel buys development rights to build at densities higher than allowed under base zoning.

Source: Massachusetts Smart Growth Toolkit

Scale: CAPE-WIDE
Target: REGULATORY

Stormwater BMPs

Town Consideration of Alternative Technologies & Approaches

Wellfleet-	*Coastal habitat restoration & aquaculture*
Mashpee-	*Aquaculture & Expanding Existing Systems*
Brewster-	*PRB & Bioswales*
Orleans-	*Fertilizer Control By-Law*
Harwich &- Chatham	*Muddy Creek & Cold Brook Natural Attenuation*
Falmouth-	*Aquaculture* *Inlet Widening* *Eco-Toilet Demonstration Project* *PRBs* *Stormwater Management (Little Pond Watershed)* *Fertilizer Control By-Law* *Subsurface Nitrogen Removal Septic Systems*


Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
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P
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Constructed Wetlands: Subsurface Flow
Stormwater: Bioretention / Soil Media Filters
Effluent Disposal: Out of Watershed/Ocean Outfall
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Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
R
Surface Water Remediation Wetlands
Solutions

Problem Solving Approach

Wastewater | Existing Water Bodies | Regulatory

1 Targets/Reduction Goals

Present Load: X kg/day − **Target:** Y kg/day = **Reduction Required:** N kg/day

2 Other Wastewater Management Needs

A. Title 5 Problem Areas
B. Pond Recharge Areas
C. Growth Management

3 Low Barrier to Implementation

A. Fertilizer Management
B. Stormwater Mitigation

4 Watershed/Embayment Options

A. Permeable Reactive Barriers
B. Inlet/Culvert Openings
C. Constructed Wetlands
D. Aquaculture

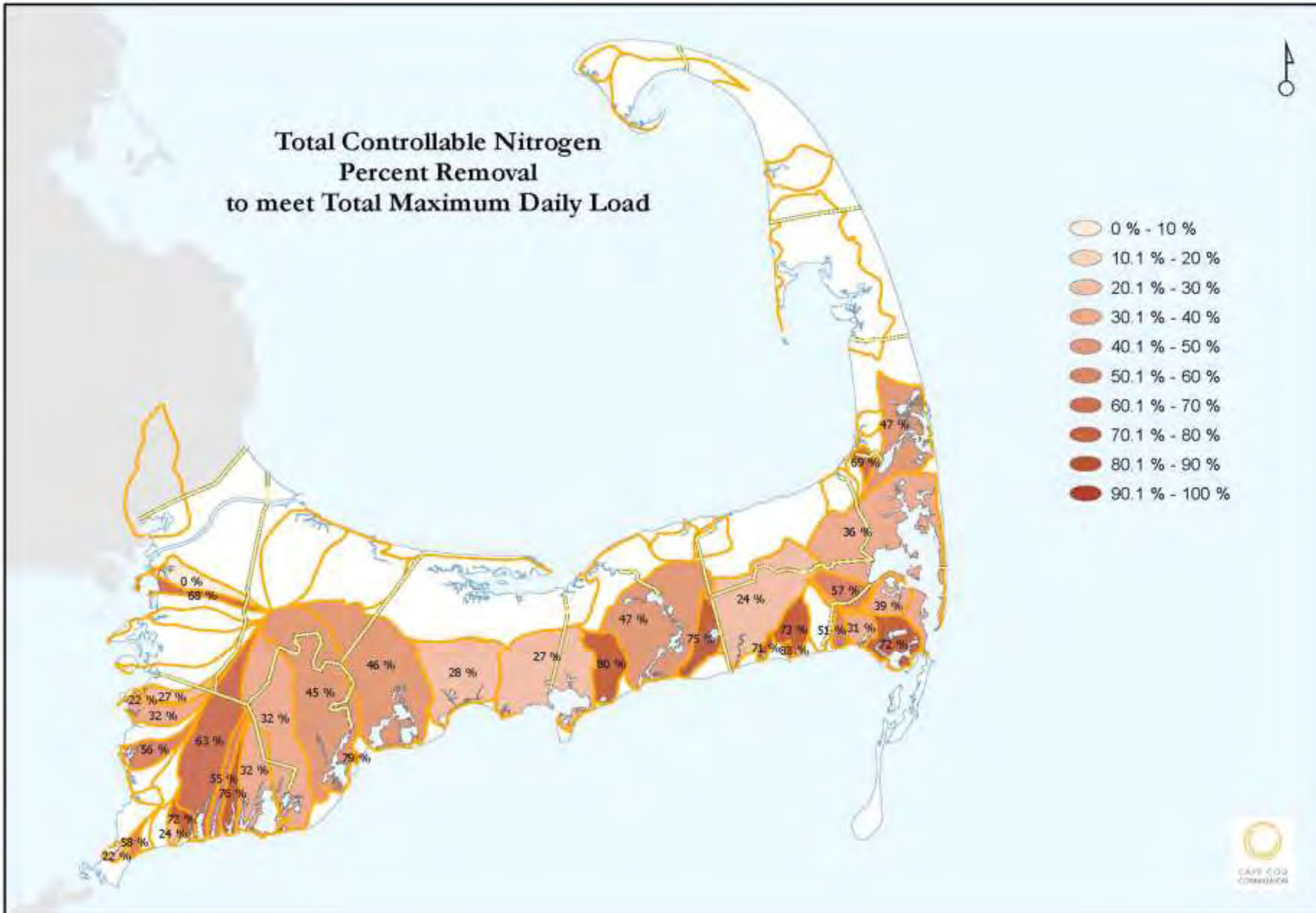
5 Alternative On-Site Options

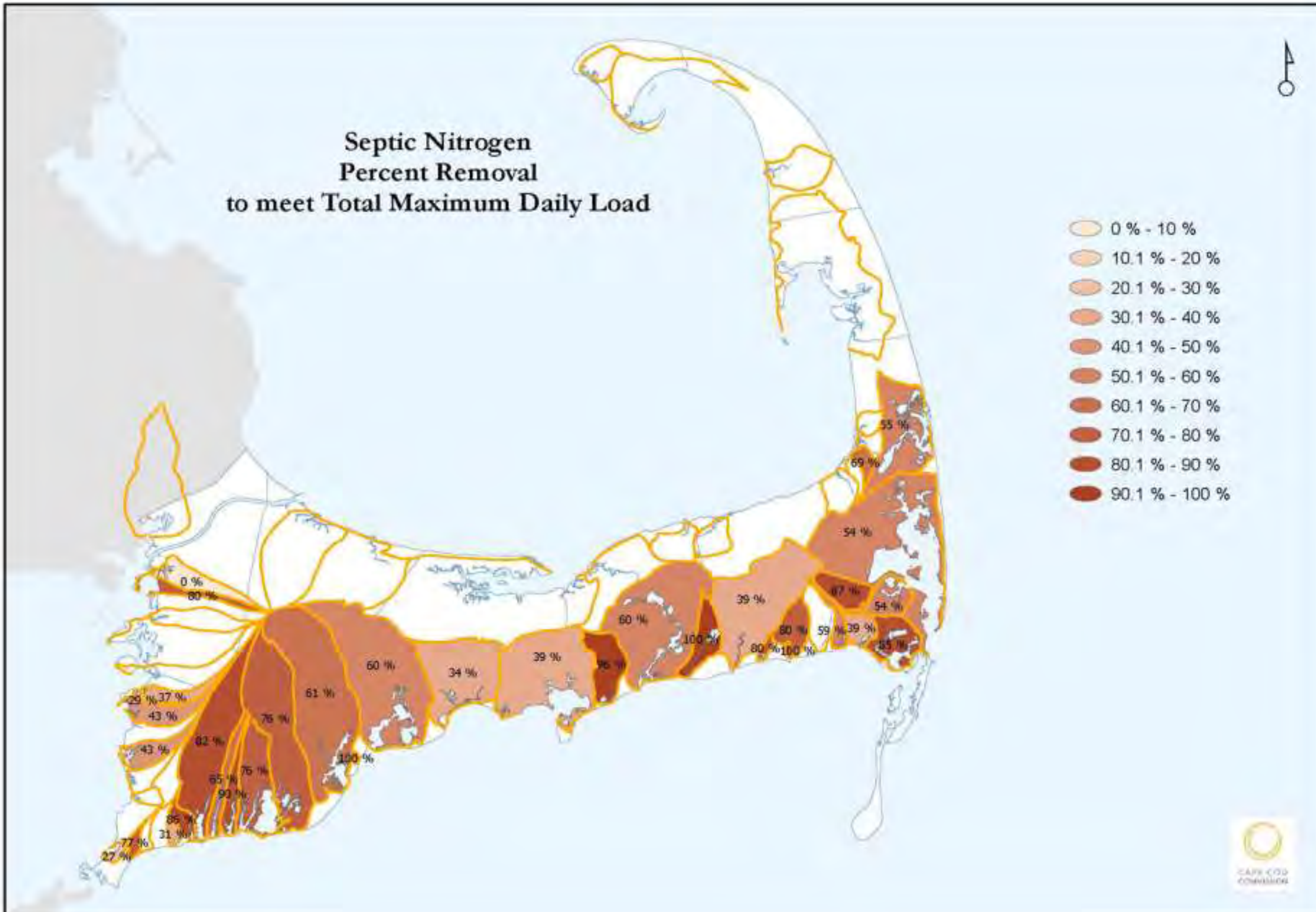
A. Eco-toilets (UD & Compost)
B. I/A Technologies
C. Enhanced I/A Technologies
D. Shared Systems

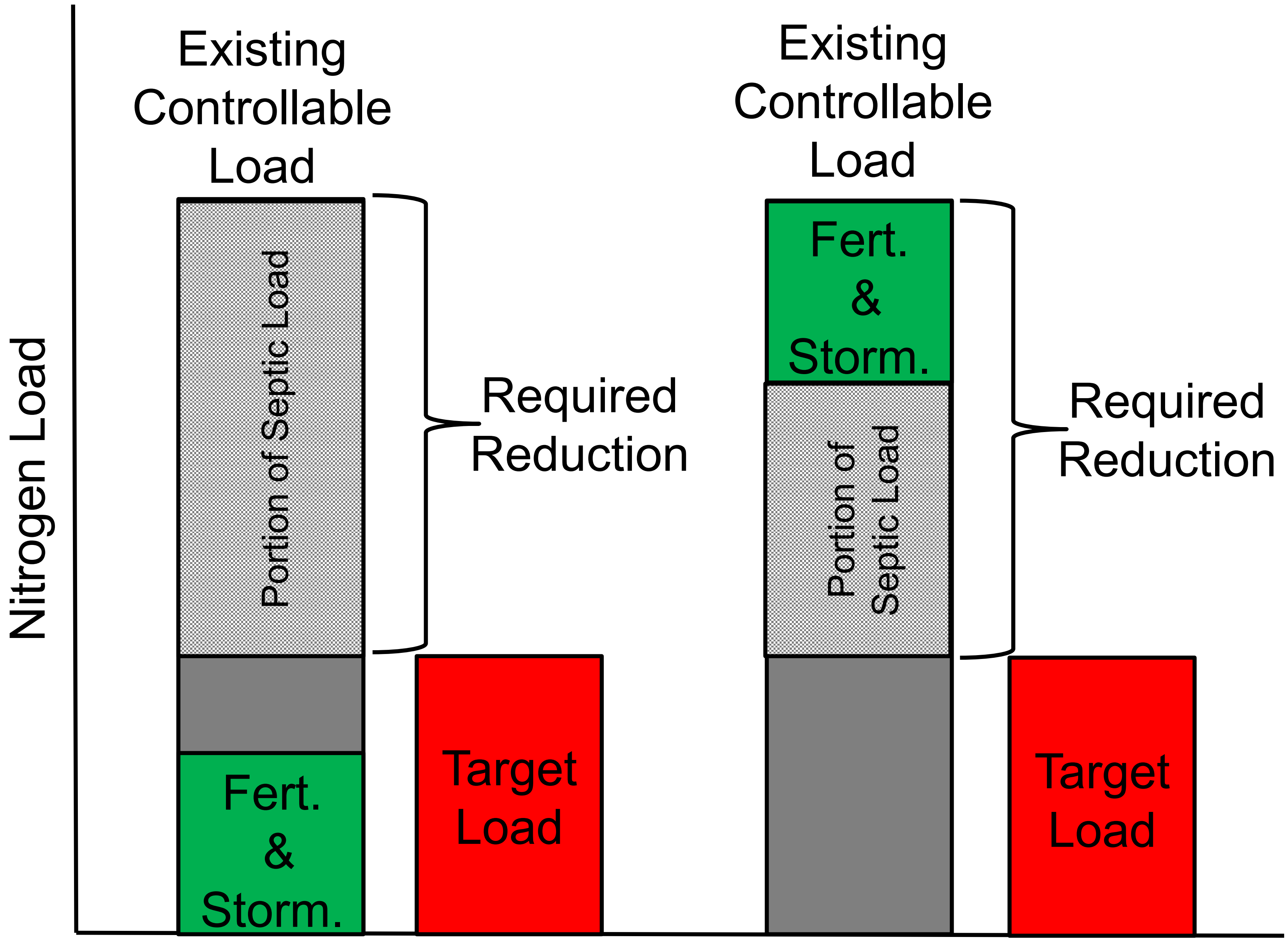
6 Priority Collection/High-Density Areas

A. Greater Than 1 Dwelling Unit/acre
B. Village Centers
C. Economic Centers
D. Growth Incentive Zones

7 Supplemental Sewering


Total Controllable Nitrogen
Percent Removal
to meet Total Maximum Daily Load
0 % - 10 %
10.1 % - 20 %
20.1 % - 30 %
30.1 % - 40 %
40.1 % - 50 %
50.1 % - 60 %
60.1 % - 70 %
70.1 % - 80 %
80.1 % - 90 %
90.1 % - 100 %


Septic Nitrogen
Percent Removal
to meet Total Maximum Daily Load
0 % - 10 %
10.1 % - 20 %
20.1 % - 30 %
30.1 % - 40 %
40.1 % - 50 %
50.1 % - 60 %
60.1 % - 70 %
70.1 % - 80 %
80.1 % - 90 %
90.1 % - 100 %


Nitrogen Load
Existing Controllable Load
Portion of Septic Load
Required Reduction
Fert. & Storm.
Target Load
Existing Controllable Load
Fert. & Storm.
Portion of Septic Load
Required Reduction
Target Load


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

Triple Bottom Line

Impacts of Technologies and Approaches

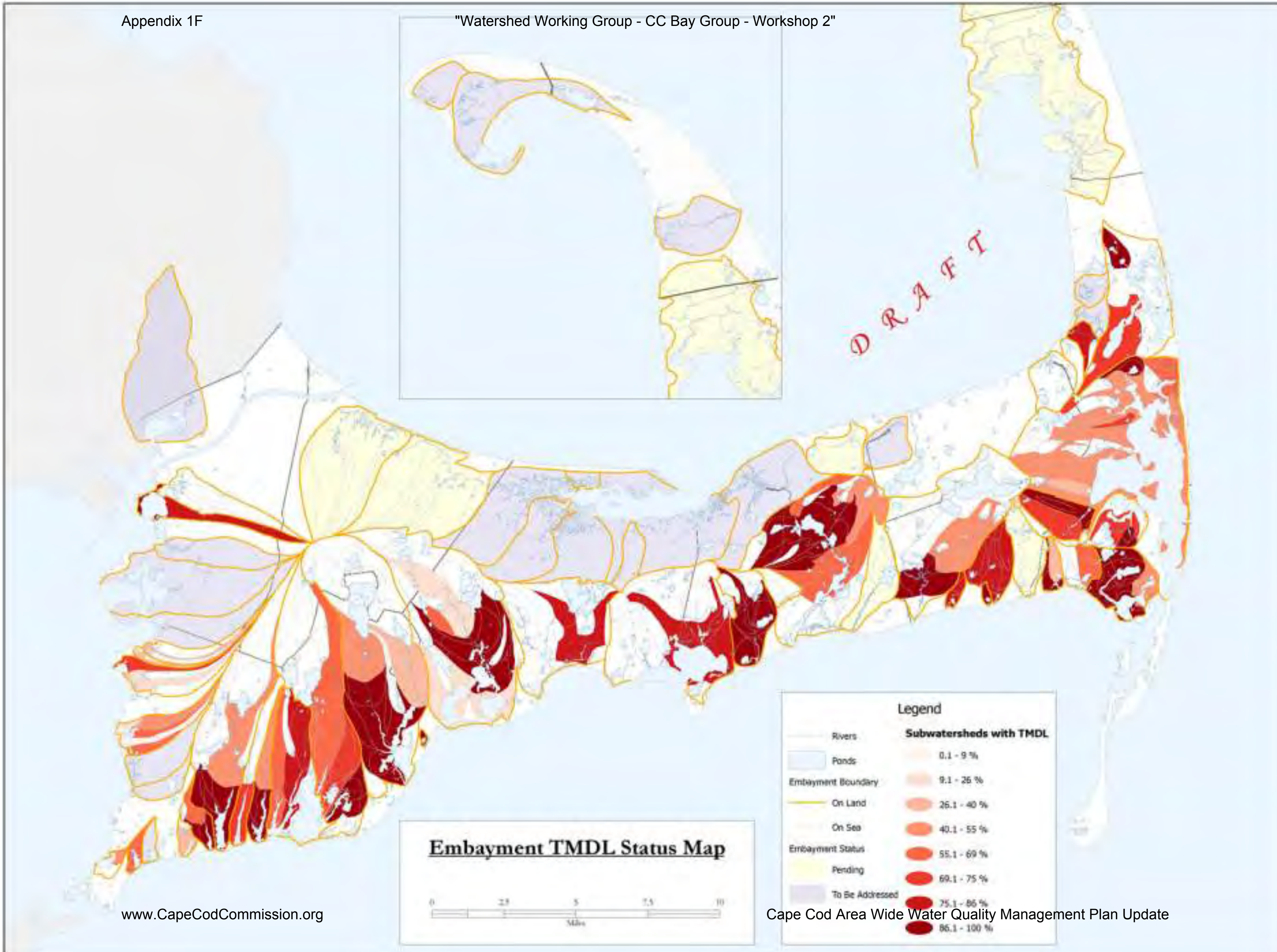
Environmental

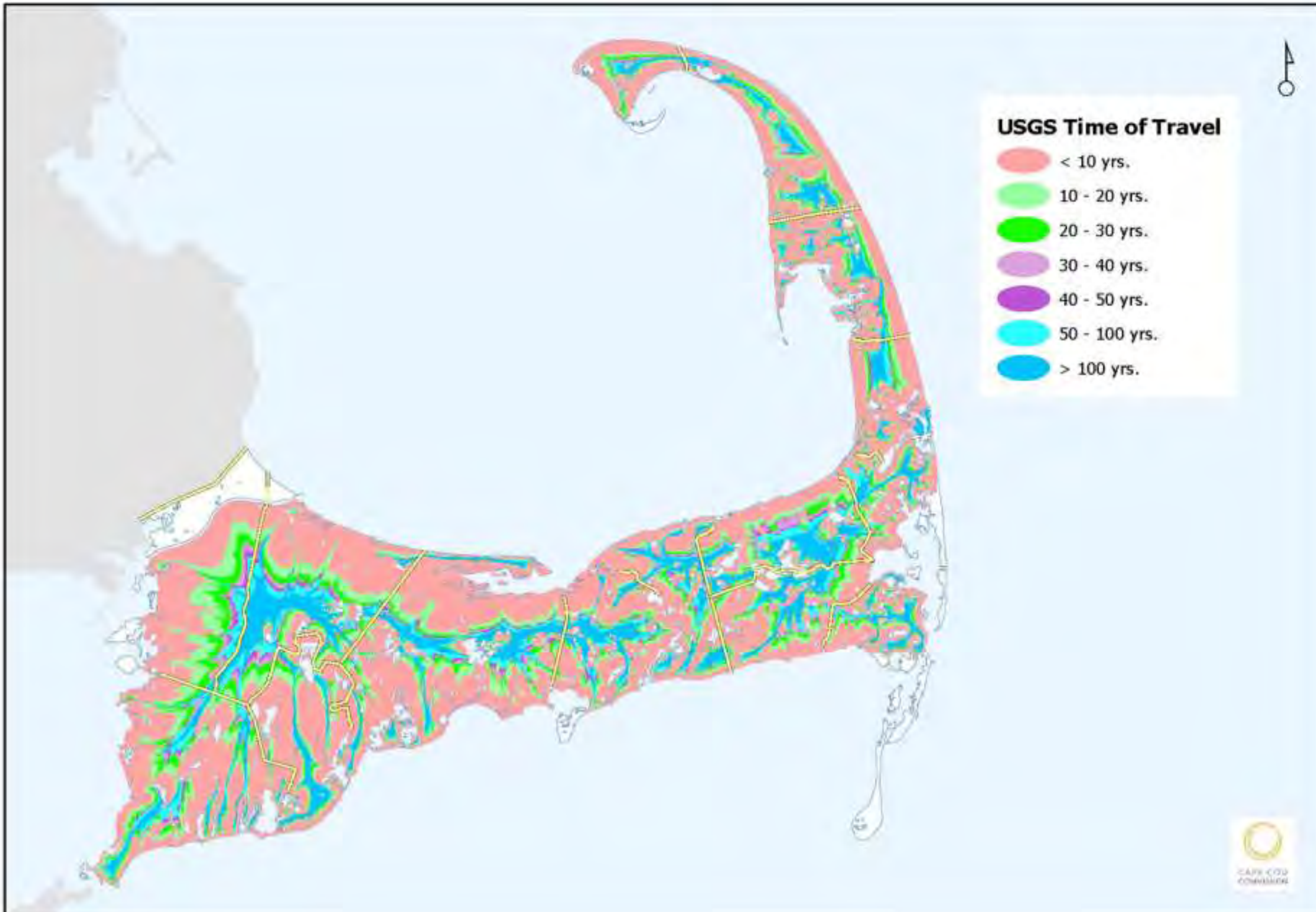
Economic

Social

Technology Selection: Process and Principles

- 100% septic removal subwatershed
- Scale: On-Site vs. Collection System vs. Natural System
- Nutrient intervention and time of travel
- Permitting Status
- Land use and Impacts of Growth


DRAFT
Embayment TMDL Status Map
0
2.5
5
7.5
10
Miles
Legend
Rivers
Ponds
Embayment Boundary
On Land
On Sea
Embayment Status
Pending
To Be Addressed
Subwatersheds with TMDL
0.1 - 9 %
9.1 - 26 %
26.1 - 40 %
40.1 - 55 %
55.1 - 69 %
69.1 - 75 %
75.1 - 86 %
86.1 - 100 %


USGS Time of Travel
< 10 yrs.
10 - 20 yrs.
20 - 30 yrs.
30 - 40 yrs.
40 - 50 yrs.
50 - 100 yrs.
> 100 yrs.

Preparing for Meeting 3 and Beyond

- Review tools and alternatives analysis approach
- Evaluating scenarios for meeting water quality goals
- Attend the November 13th meeting:

6:00
Cape Cod Museum of Art
Dennis, MA

Cape Cod 208 Area Water Quality Planning
Cape Cod Bay Watershed Working Group

Meeting Two
Tuesday, November 5, 2013
8:30 am- 12:30 pm
Cape Cod Commission, 3225 Main Street
Barnstable, MA 02630

Draft Meeting Summary Prepared by the Consensus Building Institute

I. ACTION ITEMS

Working Group

- Next meeting:
  Meeting Three
  Monday, December 9, 2013
  8:30AM -12:30PM
  Cape Cod Commission, 3225 Main Street, Barnstable, MA 02630
- Send Carri any additional comments on Meeting One Summary
- Continue to prepare thoughts about which technologies/approaches they would like to learn more about for application in the watershed. Different scenarios and options will be discussed during Meeting Three.

Consensus Building Institute

- Finalize Meeting One summary
- Draft and solicit feedback from Working Group on Meeting Two summary

Cape Cod Commission

- Share Technology Matrix with Working Groups
- Share updated Chronologies with Working Groups

II. WELCOME, REVIEW 208 GOALS AND PROCESS AND THE GOALS OF MEETING

Ms. Erin Perry, Special Projects Coordinator at the Cape Cod Commission, welcomed participants and offered an overview of the 208 Update stakeholder process.[1] In July, public meetings were held across the Cape to present the 208 Plan Update goals, work plan, and participant roles. Public meetings were also held in August to present information on the affordability and financing of the updated comprehensive 208 Plan. The first meetings of the eleven Watershed Working Groups were held in September and focused on baseline conditions in each of the watersheds. The second meetings of the Watershed Working Groups will be held in October and early November and are focused on exploring technology options and

[1] The PowerPoint Presentation made at this meeting is available at: http://watersheds.capecodcommission.org/index.php/watersheds/mid-cape/cape-cod-bay-group

approaches. The third meetings of the Watershed Working Groups will be held in December and focus on evaluating watershed scenarios which will be informed by Working Groups' discussions about baseline conditions, priority areas, and technology options/approaches. This conversation will also be informed by information shared in the Technology Matrix, which was developed by the Cape Cod Commission with technical input from the Technology Panel. The Technology Matrix builds on the information presented in the Technology Fact Sheets, which Working Group members reviewed in advance of the meeting.[2] Once the Cape Cod Commission finalizes it, the Technology Matrix will be shared with Working Group Members.

Ms. Perry shared 208 Plan team's progress since Meeting One, which includes:

- Meeting materials distributed to stakeholders and available at http://watersheds.capecodcommission.org
- GIS data layers accessible at: http://watersheds.capecodcommission.org
- Chronologies are being updated and will be made available soon

Ms. Perry also shared that the second round of Cape-2-O game launched on October 22. She noted that over 400 people registered for the first round of the Cape-2-O game and encouraged Working Group members to participate in the interactive, online game which provides valuable education and input to the Cape Cod Commission.

Ms. Perry announced that there will also be a Cape Cod wide event on November 13 at the Cape Cod Center for the Arts in Dennis. Participants from across the eleven Watershed Working Groups and the public are invited to attend the event which will include: Wrap up of Cape-2-O: ur in charge!; a summary of planning process to date; and discussion of the stakeholder role in the second 6 months of the 208 planning process.

Ms. Perry welcomed participants and reviewed the goal of the meeting:

- To develop a shared understanding of the potential technologies and approaches identified to date, and the benefits and limitations of each; to explore the environmental, economic, and community impacts of a range of categories of solutions; and to identify priorities and considerations for applying technologies and approaches to remediate water quality impairments in your watershed.

During the September meeting, nearly all the Watershed Working Groups had robust discussions about the buildout the Commission plans to use for the 208 Plan Update. The Commission will convene meetings in November to further discuss the buildout with the town representatives.[3]

Working group member asked the following questions about the 208 Plan Update process (italicized).

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[2] Technology Fact Sheets are available at: http://watersheds.capecodcommission.org/index.php/watersheds/mid-cape/cape-cod-bay-group

[3] This was not stated in the meeting but is included for general information.

- *Will the municipalities have influence over who pays for what or will the Cape Cod Commission or another authority order the municipalities to spend the money? Who will pay for this?* We do not know yet how this will work; but we hope the updated 208 plan will help attract funds. We also hope to identify ways to spread the cost and reduce the overall burden on the municipalities. The Cape Cod Commission does not have the authority to make municipalities do anything.
- *A member expressed hope that this process to review the various technologies will result in DEP's willingness to accept innovative solutions.*

Ms. Carri Hulet, the facilitator from the Consensus Building Institute, reviewed the agenda and led introductions. A participant list is found in Appendix A. She reminded the working group that they would also need to establish a clear water quality goal for the watershed since no MEP targets for nitrogen had ben established for the watersheds in this area.

III. RANGE OF POSSIBLE SOLUTIONS

Mr. Scott Horsley led the discussion of the range of possible solutions. As Working Groups learn more and consider the pros and cons of the technologies and approaches, he encouraged participants keep in mind that:

- The Cape Cod Commission has engaged in a comprehensive analysis of nutrient control technologies and approaches. This analysis is distilled into: the Technology Fact Sheets, which present various information on the technologies being considered; the Technology Matrix, which includes additional information on site requirements, construction, project and operation and maintenance costs, reference information, and regulatory comments; and ongoing input from stakeholders on the public acceptance of technology options and approaches.
- Not all of the technologies and approaches will be applicable to Cape Cod.
- Some technologies are so promising that we should identify them for demonstration and pilot projects.
- Meeting 3 will focus on hands-on problem solving in each watershed to meet target load reductions. However, target load reductions are not established for the watersheds of the Cape Cod Bay Working Group.
- Certain technologies or approaches will be effective at preventing nutrients from entering the water body. Others will be effective at reducing or remediating nutrients that are already in the groundwater or water body.
- Regulatory programs can address nutrient controls for both existing development and future development.

Mr. Horsley offered a brief overview of the technologies and approaches. The following section briefly describes each technology. Participants' questions and comments about the technologies are also discussed below (in *italics)*:

Site level technologies/approaches

Standard Title V System*:* This is a standard septic system that consists of a septic tank and soil adsorption system (leaching field). The system was primarily designed to address public health concerns related to waste in drinking water (e.g. coliform bacteria); they were not designed to remove nutrients (e.g. nitrogen).

I/A title V System: Innovative/Alternative (I/A) on-site nutrient reducing systems typically consist of standard septic system components augmented to remove more nutrients than a standard Title 5. I/A systems refer to a class of systems intended to be designed as recirculating sand filter (RSF) equivalents by meeting the same treatment limits in a smaller footprint. The DEP permits more than 20 technologies on general, provisional, and pilot basis. George Huefelder's (Barnstable County Department of Health and Environment) investigation of these technologies shows that performance is highly variable.

- *The slide on the standard title V system indicates a removal rate of 34%. The Cape Cod Commission may want to clarify this figure so people do not think that they will meet water quality standards if they achieve 34% nitrogen reduction. A correction should be applied if thinking about the percentage removal needed from each watershed.*

Ecotoilets:

Urine Diverting Toilets: Urine diversion systems send urine into a holding tank where the urine is stored and periodically collected by a servicing company. The servicing company empties the tank for disposal or recycling such as conversion to a fertilizer. Through these means, the nitrogen may be removed from the watershed. With urine diverting toilets, the remainder of the human waste and all other water uses (sink and shower) continue to go to the septic system. (Case example, Falmouth, MA).

- *With urine diverting toilets, one could link all bathrooms together with pipes. But with composting, a separate toilet system is needed for each bathroom, correct?* Mr. Horsley affirmed the member's statement and said that composting toilets may present architectural challenges.
- *Would it be feasible to install the urine diverter on the other side of the septic tank? Is it feasible to separate the urine from the solid waste after passing through the septic tank?* A group member said it is not feasible because the volume of grey water exiting the system at the same point would overwhelm the urine tank.
- *Australians use urine diversion. There is field aerator technology that can inject it into turf as a nutrient. This method can get rid of 90% of nutrients.* Mr. Horsley said the nutrient recovery and reuse idea is an interesting option
- *Has there been any work done in the treatment and removal of pharmaceuticals in urine diversion technologies?* Mr. Horsley was unaware of any urine diversion technologies that address removal of pharmaceuticals.
- Ms. Hulet said a stakeholder asked in the survey how often urine collection tanks need to be pumped. Mr. Horsley estimated it would need to be pumped once per year, depending on the size of the tank.

- *From a behavior change standpoint, it would be challenging or almost impossible to get people accustomed to use different toilets (or different spaces within toilets) for different kinds of waste.*

Composting toilets: A toilet system, which separates human waste from shower, sink, and other household water uses. The composting toilets use no or minimal water. The human waste captured by the composting toilets is decomposed and turned into compost. The compost generated is removed from the site and nutrients can be recycled. Composting toilets require the replacement of existing toilet(s) and room in the basement for a container to capture and compost the human waste. Household water use (sink and shower uses) continue to flow to the septic system. (Case example, Falmouth, MA).

Packaging toilets: A packaging toilet encapsulates human waste in a durable material for removal from the site. The package is stored beneath the toilet and removed and taken away when full. The nutrients can be recycled by the servicing company that picks up the packages.

Stormwater bioretention: Bioretention systems utilize natural plant and soil functions to capture and treat stormwater runoff for a variety of contaminants including nutrients. A typical system consists of an underdrain/gravel layer, a layer of bioretention soil mix (a mix of sand, compost, woodchips and loam), and a surface layer containing appropriate plantings. The treated water can be discharged into a water body or used for open space irrigation after treatment. The reclaimed water can also be discharged into a subsurface infiltration system for discharge to the groundwater. (Case example, Portland, OR).

Group members made the following comments and questions about the site level technologies and approaches:

- *How are seasonal variations factored into performance? For example, a rain garden with frozen ground in November is not as good at its job in the wintertime.* Mr. Horsley said research shows that nutrient removal declines in the winter, but the newer systems can achieve 40% removal year round due to root and soil based processes. Some of the I/A systems restart quicker than others after seasonal fluctuations.
- *If people are interested to learn more about composting systems, there is a program at Alchemy Farm in Falmouth and another program at the Green Center where composting toilets are set up in a room. It is open for the public.*

Neighborhood level technologies/approaches

Cluster and satellite treatment systems: A cluster or satellite system is a collection and treatment system treating wastewater flows from multiple properties.

- Ms. Hulet stated a question posed in the survey regarding cluster treatment systems: What factors affect the percentage of nitrogen and phosphorous removal, which vary from 55-90%? Mr. Horsley commented that the range of removal is very broad across some technologies and that the technologies with the tightest design also have the most accurate removal estimates. Pilot projects may be required to determine the percentage of nutrient removal on the Cape, if the DEP is to agree to provide credits for some of the technologies.

STEP/STEG collection: Septic Tank Effluent Pumping (STEP) and Septic Tank Effluent Gravity (STEG) systems convey liquid wastewater from on-site septic tanks to sewer systems; only the liquid component of the wastewater may be conveyed by pumps or by gravity.

Eco machines and living machines: Living or Eco-Machines are natural systems that treat septic tank effluent or primarily treated wastewater. In these systems, aeration and clarification chambers are combined with constructed wetlands to treat the influent. The wetlands are a series of chambers allowing for microbial communities to engage with and treat the wastewater. Plants are often suspended on racks with their roots systems doing the work. Solids removal is generally onsite, after which water is pumped through the gravel filled cells (similar to subsurface wetlands.) This process transfers more oxygen to the wastewater and completes the pollutant removal process. (Case example, South Burlington, VT).

- *There is an ecosystem in Weston Massachusetts, and dozens elsewhere outside of Massachusetts. Harwich had one as a pilot system but it is no longer in operation.*

Stormwater wetlands: Constructed wetlands provide aerobic chambers followed by subsurface anaerobic chambers that facilitate nitrification followed by denitrification, respectively. This process mimics that of natural systems coupled with engineering design guaranteeing residence time within a chamber containing anaerobic conditions.

- *These are permitted and promoted as stormwater policy. But the downside is the footprint requirement.*
- *There is an example of one of these in Cambridge near the Alewife T station.*

Watershed level technologies/approaches

Conventional treatment: A conventional wastewater treatment facility typically treats wastewater collected from homes and businesses. A groundwater discharge permit is required. Treatment generally results in less than 10 mg/L Nitrogen. Collection can be 50% or more of the cost of these systems. Density therefore is a huge key to this system.

Constructed wetlands: surface flow: After primary treatment in a septic tank or wastewater treatment facility or secondary treatment at a wastewater treatment facility, water is fed into a surface flow constructed wetland. Surface flow constructed wetlands closely mimic the ecosystem of a natural wetland by utilizing water loving plants to filter wastewater through their root zone, a planted medium, and open water zones. Surface flow wetlands are systems where open water is exposed much like in a natural marsh. The reclaimed water from the wetland can be discharged into a water body or used for open space irrigation after treatment as well as discharged into a leach field. (Case example, Albany, OR).

Constructed wetlands: subsurface flow: After primary treatment in a septic tank or wastewater treatment facility or secondary treatment at a wastewater treatment facility, wastewater is treated by pumping water slowly through subsurface gravel beds where it is filtered through plant root zones and soil media. Water flows 3-8" under the surface to prevent public exposure to wastewater and mosquito breeding. A combination of horizontal and vertical flow subsurface systems must be utilized to provide total nitrogen removal. This solution can also offer opportunities for recreation activities on land above the subsurface system. (Case example, Thailand).

Effluent disposal: out of watershed: Effluent disposal can take a variety of forms, including infiltration basins, a Soil Absorption System, Injection Wells or Wick Wells. These disposal methods place highly treated effluent back into groundwater. Effluent Transport out of the watershed has the advantage of removing the nitrogen load to another watershed. Transport to another watershed requires the receiving watershed to be able to accommodate the additional nitrogen load.

- Ms. Hulet said someone asked the following question in the survey: *What happens in regards to balancing the hydrology if effluent is moved from one watershed to another?* Mr. Horsley said the current systems already redistribute the water within and across systems.
- *Who has the legal authority to take wastewater from one watershed and move it to another?* Mr. Horsley said the DEP has this authority and exercises it at the basin level. But, since the Cape is considered one basin, there are not legal challenges to redistribute water.
- Mr. Horsley asked if the group might discuss transporting water from one watershed to another to take advantage of assimilative capacity. A member said this is the dilution is the solution approach, which only moves the problem from one location to another. Another member said it is worth discussing how it might work and the costs and benefits of it. Ms. Hulet said it seems as if the challenge would be deciding how to do cross jurisdictional distribution.

Effluent disposal: ocean outfall: Similar to out of watershed effluent disposal, highly treated effluent is transported out of the watershed and into the ocean. This solution requires a high level of regulatory oversight, but the solution is being considered because there is limited land availability for disposal on Cape Cod.

- *What is the impact of an ocean outfall on aquifer recharge?* Mr. Horsley commented that recharge is based on recharge rate and permeability of the sediments. If less water is entering, then the aquifer depletes and vice versa.
- *Is ocean outfall lawful in Massachusetts?* Yes, responded Mr. Horsley. *The Ocean Sanctuary Act was amended by the Ocean Management Act, which allow ocean outfalls. Ocean outfall regulations could be revisited through the Ocean Management Act review process. Is there anywhere else in state where ocean outfalls have been used?* Mr. Horsley said Essex, Manchester By the Sea, and Gloucester have outfalls.
- *How do outfalls compare in terms of cost*? Mr. Horsley said they are probably very site specific.

Phytoirrigation: After secondary treatment, wastewater treatment facility effluent is irrigated onto plants to remove nutrients and other contaminates. Fast growing poplar and willow trees are typically used. (Case example, Woodburn, OR).

- *There is an example of this in Sandwich, where effluent is used to fertigate rhododendrons.*
- *The Links at Bayberry Hills also use nutrient effluent for fertilization.*
- *Some of these technologies have been tried in places but are no longer used. For example, Canary grass was used in Yarmouth but not any more. Another member said the plant in Yarmouth was built much larger than it required and future growth did not occur as expected. The water from the plant was to be pumped to the water department and excess nitrogen was supposed to be applied to canary grass. But, it turned out there was not sufficient nitrogen coming from the plant to maintain growth of the canary grass. Some of the nitrogen effluent is now utilized on the golf course.*

Neighborhood or Watershed level technologies/approaches

Phytobuffers: Using trees with a deep root system to capture nutrients in the soil, particularly willows and poplars. Green plants with deep tap roots are planted as a buffer to intercept existing groundwater. The plants and their associated microorganisms reduce contamination in soils and ground water. Often phytohydraulics causes the groundwater plume to be redirected and pulled towards the plants. (Case example, Kavcee, WY).

Fertigation wells: Fertigation wells can capture nutrient enriched groundwater, typically from a wastewater treatment facility discharge, and recycle it back to irrigated and fertilized turf grass areas. These irrigated areas include golf courses, athletic fields and lawns. Fertigation can significantly reduce nutrient loads to downgradient surface waters while reducing fertilizer costs to the irrigated areas. (Case example, Plymouth, MA).

Permeable reactive barrier (PRB): A permeable reactive barrier (PRB) is an in-situ (installed within the aquifer) treatment zone designed to intercept nitrogen enriched groundwater. Through use of a carbon source, microbes in the groundwater uptake the nitrogen, denitrifying the groundwater. PRB systems typically use vertical trenches, sequences of bored columns or injection methods to introduce the carbon source into the groundwater to reduce the nitrogen load to an estuary, removing it from the watershed. The Cape Cod Commission is investigating the potential to install PRBs along roadways, which would avoid permitting issues associated with beaches and wetlands. (Case example, Falmouth, MA).

- *Can PRBs be set up to do capture both nitrogen and phosphorous or must you pick one or the other?* Mr. Horsley said he was uncertain but said different materials may be necessary to capture different nutrients.
- *A member noted that injection wells might allow injection of different materials on a periodic basis to capture different nutrients, and could perhaps be combined.*
- *Brewster started to look at this technology in two locations, one at a golf course and*

another closer to Pleasant Bay. The water table is sixty feet deep at the golf course, which presents added expense. Falmouth is discussing injection wells. In Brewster they also have a lot of ponds in various conditions, but they do not to have TMDLs. PRBs could be an interesting solution for phosphorous in Brewster.

Inlet and culvert widening: Re-engineering and reconstruction of bridge or culvert openings to increase the tidal flux through the culvert or inlet. This solution generally works better with a larger tidal range but could be feasible on both the Cape Cod Bay side (approximately nine feet tidal range) and Nantucket Sound side (approximately 3 feet of tidal range).

- This looks at increasing the flushing rate in the embayments, which in many cases would be restoring the flushing rate in the embayment. Larger culverts that present or than historical could be installed to increase flushing.
- *The new FEMA flood maps may present a large hurdle to this solution.*
- *In Dennis, the change in the flood plain delineation added six thousand more properties to the floodplain.*
- *If widening the culverts causes issues, why not just pump a specific number of gallons from up-estuary and shoot it out to the ocean as the tide goes out. This would help the nutrient laden waters pass out during appropriate times, and a greater quantity of ocean water would return with the tides.*

Salt marsh habitat restoration: Salt marsh is one of the most productive ecosystems in the world, surpassing rainforest in productivity per acre. Approximately 65% of historic salt marsh has been lost in MA. Salt marshes cycle and remove nitrogen as well as provide critical habitat and spawning sanctuary for a wide variety of birds, mammals and marine life in addition to hosting a range of plant species and important biogeochemical processes. The capacity of salt marsh to intercept nitrogen is significant and well researched worldwide. Substantial areas of former salt marsh on the Cape are either under consideration for restoration or could be restored providing storm surge and coastal flooding protection in addition to water quality benefits in certain watersheds.

Shellfish habitat restoration: Oyster reefs were historically one of the main consumers and recyclers of nitrogen in the coastal environment on Cape Cod. According to the Nature Conservancy, populations have declined by 95%. In conjunction with the natural transition from land to sea in estuaries, bays and inlets; salt marsh, oyster reef and eel grass function as critical buffer that can reduce eutrophication. Restoring Oyster populations leads to increased shellfish productivity as well as improved commercial and recreational fisheries for other species, increased protection from shoreline erosion and flooding, and buffering from ocean acidification. (Case example, Wellfleet, MA).

Aquaculture / shellfish farming: Oysters have been proposed as a potential method for reducing nitrogen levels and eutrophication in estuaries. Nitrogen removal rates from Oysters have been well documented and the harvest of oysters physically removes the nitrogen they sequester in addition to the nitrogen removed by their biological cycling which puts nitrogen directly back into the atmosphere. Aquaculture can be done on man-made structures (e.g. cages, floating bags) or natural reefs.

- *Shellfish habitat restoration and aquaculture/shellfish farming seem easily implemented.* Mr. Horsley commented that there are some permitting challenges to overcome, and that some people do not like these operations because they can impact their view in an embayment or along the coast.
- *Are there seasonality issues?* Mr. Horsley said that although the shellfish do filter feed year round, the animals feed less in winter. However, there is also less material and nitrogen in the water column in the winter.
- Ms. Hulet said she heard from another group that shellfish poaching could be an issue, too. Some working group members acknowledged this is a concern.
- Ms. Hulet posed the question of whether or not shellfish could be reestablished if the conditions in the embayment are the reason for their absence. A member replied that *shellfish bed closures were largely related to storm water issues and compliance with bacteria, so the beds could be reestablished provided these issues are addressed.*

<u>Surface water remediation wetlands</u>: Constructed to aid in water quality improvements to surface water bodies, usually streams or rivers. Water is pumped or allowed to flow naturally through treatment cells containing wetlands Surface water remediation wetlands are often used in combination with groundwater recharge or potable water reuse systems. Surface water remediation wetlands are generally used with Free-Water Surface wetlands due to their larger size, and lower capital and operation and maintenance costs. (Case example, China).

<u>Pond and estuary dredging</u>: Lakes, ponds, streams and estuaries store nutrients within their sediments. These sediments tend to accumulate over time. Subsequently, these nutrients can be release into the overlying water column and can become a major source of nitrogen and phosphorus. Dredging and removing these sediments and accumulated nutrients removes the nutrients from the water body and potentially the watershed. (Case example, Dennis, MA).

Cape-wide level technologies/approaches

<u>Compact development</u>: Both Compact Development and Open Space Residential Development (OSRD) of subdivisions result in smaller lots and less maintained lawn acres. The higher density development reduces wastewater collection costs while providing a common disposal area. Compact development is also referred to as "Smart Growth."

<u>Fertilizer management</u>: Managing fertilizer application rates to lawns, golf courses, athletic facilities and cranberry bogs. Residential lawn loading rates could be reduced on existing developed parcels through an intensive public education/outreach program. This could include a "Cape Cod Lawn" branding program, replacing some turf areas with native vegetation, establishing naturally-vegetated buffer strips on waterfront lots, and reducing application rates. Fertilizer loading rates for new development could be accomplished by reducing lot sizes (cluster development), by restricting lawn sizes and/or by incorporating more naturally-

vegetated open space areas. Municipalities could directly reduce fertilizer applications on athletic fields and other properties. Golf courses can significantly reduce nitrogen loading rates by using slow-release fertilizers and reducing application rates in rough areas. Cranberry bog fertilizer exports from the bogs can be reduced using tail water recovery systems. Site-specific assessments are needed to estimate load reductions. Recently the Cape Cod Commission designated a cape-wide Fertilizer Management District of Critical Planning Concern (DCPC) which authorizes the towns to adopt local fertilizer management regulations (state law prohibits local fertilizer management except under the DCPC). The DCPC does not require towns to adopt fertilizer regulations, but paves the way for their adoption. Barnstable County will be conducting a public education process around fertilizer use.

<u>Remediation of existing development</u>: Existing developments or schools with excess wastewater treatment capacity allow existing nearby developments to connect to their underutilized wastewater treatment infrastructure. A town can operate the wastewater treatment facility if the existing owner prefers to not take the responsibility for treating the off-site wastewater. An example of this is the Kingman Marina in Bourne, which was permitted to expand its development footprint in exchange for hooking up adjacent, existing homes to its wastewater treatment facility.

<u>Transfer of development rights</u>: A regulatory strategy that transfers development and development rights from one property (sending area) to another (receiving area) to direct growth and associated nutrient loading away from sensitive receiving watersheds or water bodies. The protected parcels (sending areas) receive a deed restriction that limits the level of future development. The deed restriction can limit the number of homes or tie development to the availability to future wastewater treatment facility infrastructure.

- *If some towns are better prepared to accept higher density population areas, what about the possibility of creating a preservation area or receiving zone in a different town than where the development occurs?* Mr. Horsley said that could be possible and noted that research shows it works well in areas with strong county governments.
- *Some communities would probably accept development for increased tax revenue. Another potential option is to transfer residential density to commercial.*

<u>Stormwater best management practices (BMP)</u>: Non-Structural Stormwater strategies include: street sweeping, maintenance of stormwater utilities, education and public outreach programs, land use planning, and impervious cover reduction and control.

Group members made these general questions and comments:

- *Thinking about all of the systems from a water conservation perspective, how does overall water volume use impact the different systems?* Mr. Horsley said some of the systems could reduce available water quantity. He noted that innovative solutions can reduce the impacts.
- *Should we have water conservation as a technology? It might help to put into perspective how much water we use today and how much water we might use with new approaches.*

- *We noticed in Orleans, Brewster, and Eastham that the plan assumed continual growth. But based on our calculations, population numbers are declining. We assumed people would eventually move into their seasonal home for the long term, but we are finding that people are buying second homes elsewhere and living there year round.*

IV. PROBLEM SOLVING PROCESS AND PRINCIPLES

Mr. Horsley noted that in many instances, one of the solutions may not achieve water quality goals, but pairings of multiple solutions may help to achieve the goals. For example, many towns are already using and pairing some of the technology options and approaches:

- Wellfleet- *Coastal habitat restoration & aquaculture*
- Mashpee- *Aquaculture & Expanding Existing Systems*
- Brewster- *PRB & Bioswales*
- Orleans- *Fertilizer Control By-Law*
- Harwich- *Muddy Creek & Cold Brook Natural Attenuation*
- Falmouth- *Aquaculture, Inlet Widening, Eco-Toilet Demonstration Project, PRBs, Stormwater Management (Little Pond Watershed), Fertilizer Control By-Law, Subsurface Nitrogen Removal Septic System*

Overview of 7-steps for Problem-Solving Process

Mr. Horsley said the the goal the Working Groups is to develop remediation options that would achieve water quality goals with a focus on first targeting low cost, low barrier options to reduce nitrogen and then considering more costly and traditional options later (e.g. sewering). Ms. Hulet reminded the group that phosphorous and freshwater quality maybe as much a concern as, if not more than, nitrogen in this watershed. Mr. Horsley then described the alternatives screening process the group will apply:

1) Establish targets and articulate project goals.
2) Identify priority geographic areas (e.g. high nitrogen reduction areas, Title V problem areas, pond recharge areas).
3) Determine which management activities should definitely be implemented. These might be the easiest and least costly management activities that should be undertaken regardless of other management actions (e.g. fertilizer management and stormwater mitigation – two approaches that Cape Cod towns are already actively pursuing).
4) Assess alternative options to implement at the watershed or embayment scale (e.g. innovative and lower-cost solutions)
5) Assess options to implement at the site-level
6) Examine priority collection/high density areas
7) Consider traditional sewering or other grey infrastructure management options

Mr. Horsley said that the Cape Cod Commission will present two scenarios at the next meeting. One scenario will use mostly grey infrastructure and the other scenario will use mostly green infrastructure to achieve water quality goals. The group will then discuss the scenarios and develop additional scenarios utilizing a mixture of grey and green infrastructure.

Mr. Horsley presented a map illustrating the percent of nitrogen removal required to meet TMDLs across the Cape and noted that this watershed does not have a TMDL target. He then presented a map indicating the percentage reductions required to meet TMDLs if only nitrogen from wastewater is removed. Noting that watershed groups will focus on the management total controllable nitrogen loads, Mr. Horsley then presented a bar graph showing the amount of nitrogen reduction required from the existing controllable nitrogen load to achieve a target nitrogen load. He said the selected technologies and approaches should aim to reduce the total controllable nitrogen load. Implementing storm water and fertilizer regulations reduces the amount of required nitrogen reduction from the existing controllable nitrogen load, thus minimizing the portion of septic load that needs to be reduced. Additionally, the percentages of controllable nitrogen that need to be removed to meet TMDLs change depending on the characteristics of the watershed, but this watershed does not have a TMDL.

Mr. Horsley next presented a map of percolation rates on the Cape. He noted that if sewers were installed today in the areas where percolation rates are 100 years, then it would take approximately 100 years to see the benefits of the sewer installation. But, aquaculture in the bay would show changes in months or years. He posed the question of whether or not pilot projects should be installed and monitored as part of a hypothetical plan A, then have a hypothetical plan B to adaptively manage nutrient reduction into the future.

A group member commented on the importance of choosing nutrient reduction activities in a phased approach. She noted that according to the percolation rate map, Brewster is looking at a minimum of 40 years for nutrient laden water to reach Pleasant Bay from inland locations. Therefore, if nutrient reduction activities are implemented where percolation rates are faster, quicker reductions will occur. Another member said they should start at the estuary's edge and work inland.

The group briefly discussed phosphorous management in freshwater systems. One member said the fertilizer regulations limit the amount of phosphorous unless soil tests show reduced phosphorous concentrations in the soil. Another member said the MEP reports note the connection between ponds and the water table. The member commented that changes in water quality should be seen quicker in the ponds than they will be seen on the coasts because of the percolation rates.

Categories of Solutions and their Impacts on the Environment, Economy, and Community

Ms. Hulet commented that evaluation of the technologies and approaches would be informed by their impacts (positive and negative) on the environment, economy, and community (Triple Bottom Line). She asked the participants what criteria they would use to decide whether or not they like a particular scenario. Working group members offered the following suggestions. They are grouped by theme where appropriate, but many categories are linked.

Financing

- *Who pays for it / how is it financed?*
- *What would you do if you owned the estuary and were spending your own money to clean it up?*
- *Amount of investment required to demonstrate that a pilot project works.*

Performance

- *Speed of impact relative to the technology*
- *How much impact can we have while using least cost technologies?*
- *Likelihood of success in a given time period, especially for pilot projects.*
- *Potential for phased implementation while also utilizing pilot projects—what actions will be taken to address the issue while we wait to collect data to verify effectiveness of pilot projects?*
- *Sustainability of the scenario – diverse infrastructure mix may be required to maintain system resiliency.*
- *How do we measure the sustainability of the infrastructure scenarios?*
- *How great is the margin of error?*

Regulatory and Political Feasibility

- *Which approaches or scenarios are most politically feasible?*
- *Which approaches or scenarios could be permitted quickly?*

Other

- *Barriers to implementation*
- *Consistency with local comprehensive wastewater management plans, especially in regards to planned and anticipated buildout.*
- *Citizens in some towns are not paying attention to this issue. In Yarmouth, a concern is that that no one will interest in this issue. It might be useful to provide towns with opportunities to take on leadership roles for specific technologies, i.e. "hallmark" pilot projects for each town.*
- *Common elements that could be done by all towns*

To conclude this segment of the meeting, Mr. Horsley asked participants to describe what they believe should be the water quality goal or goals in this watershed, given the fact that we do not have MEP data. Participants did not have a clear set of recommendations. At one point Sandwich suggested suing the targets they have previously estimated, but then later (in an email after the meeting), they asked for the Commission to wait until MEP data is available.

Technology Selection: Process and Principles

Mr. Horsley noted that the Working Group had identified some of the principles that the Cape Cod Commission hoped would guide technology/approaches selection. These process and principles include:

- *100% septic removal subwatershed*: Combinations of technologies can be used to reduce septic load that needs to be removed.

- *Scale: On-Site vs. Collection System vs. Natural System*: There will be tradeoffs between the scale of systems that can be used. On-site, collection, and natural systems all have their pros and cons and all require different levels of investment and infrastructure. These tradeoffs will be important from an implementation and public acceptance point of view.
- *Nutrient intervention and time of travel*: Some technologies/approaches intercept nutrients at their point of entry into the system, while others deal with it later on (e.g. once it is in the watershed). There are pros/cons to each approach which need to be considered.
- *Permitting Status*: The level of effort required to permit technologies will be a consideration.
- *Land use and Impacts of Growth*: Unintended consequences and opportunities for planned growth are important to consider.

V. PLANNING FOR THE NEXT MEETING

Meeting Three will be held:
Monday, December 9, 2013
8:30AM -12:30PM
Cape Cod Commission, 3225 Main Street, Barnstable, MA 02630

During this meeting the Working Groups will examine various scenarios (i.e. combinations of solutions) and their potential impacts (e.g. nutrient reduction, economic impacts, environmental impacts, social impacts, etc.). During the meeting, the Cape Cod Commission will use tools to calculate ideas/options and their impacts. Working Group participants should come prepared to offer their ideas about what solutions they'd like to explore further given their understanding of the baseline conditions, issues, and priorities in this watershed.

VI. PUBLIC COMMENTS

There were no public comments.

APPENDIX ONE: MEETING PARTICIPANTS

Name	**Affiliation**
Working Group Members	
Elizabeth Jenkins	Principle Planner, Town of Barnstable
Ed Leonard	Consultant engineer with Town of Sandwich
Sue Leven	Town of Brewster, Planner
David Mason	Sandwich Public Health Department
Peter McDowell	Dennis Water District Wastewater Committee
Ed Nash	Golf Course Superintendents Association
Sue Phelan	Barnstable
Dan Santos	Barnstable DPW
Charles Spooner	Yarmouth Port
Staff and Consultants	
Scott Horsley	Area Manager for the Mid Cape Groups and Consultant to the Cape Cod Commission
Erin Perry	Cape Cod Commission
Maria McCauley	Cape Cod Commission
Carri Hulet	Consensus Building Institute
Eric Roberts	Consensus Building Institute

Cape Cod 208 Area Water Quality Planning
Upper Cape, West/South Watershed Working Group
Second Meeting

Falmouth Town Hall
59 Town Hall Square, Falmouth, MA 02540
October 25, 2013
8:30 a.m.-12:30 p.m.

Agenda

8:30 Welcome, Review 208 goals and Process and the Goals of today's meeting – *Cape Cod Commission*

8:40 Introductions, Agenda Overview, Updates and Action Items– *Facilitator and Working Group*

9:00 Range of Possible Solutions – *Cape Cod Commission and Working Group*

- Technology Matrix
- Technologies Overview
- Survey Questions and Comments
- Additional Questions and Discussion

10:30 Break

10:45 Problem Solving Process and Principles – *Cape Cod Commission and Working Group*

- Overview of 7-steps for Problem-Solving Process
- Examination of Categories of Solutions and their impacts on the Environment, Economy, and Community (triple bottom line)
- Discussion – Identify Considerations and Priorities for Application

12:00 Preparing for Meeting 3 and Beyond – *Cape Cod Commission*

- Review Tools, Alternatives Analysis Approach
- Evaluating Scenarios for Meeting Nitrogen Goals
- Other Process Next Steps

12:15 Public Comments

12:30 Adjourn

Upper Cape West & South

Technologies and Approaches

What is the stakeholder process?

Public Meetings

Goals, Work Plan & Roles

Affordability, Financing

Watershed Working Groups

Baseline Conditions

Technology Options Review

Watershed Scenarios

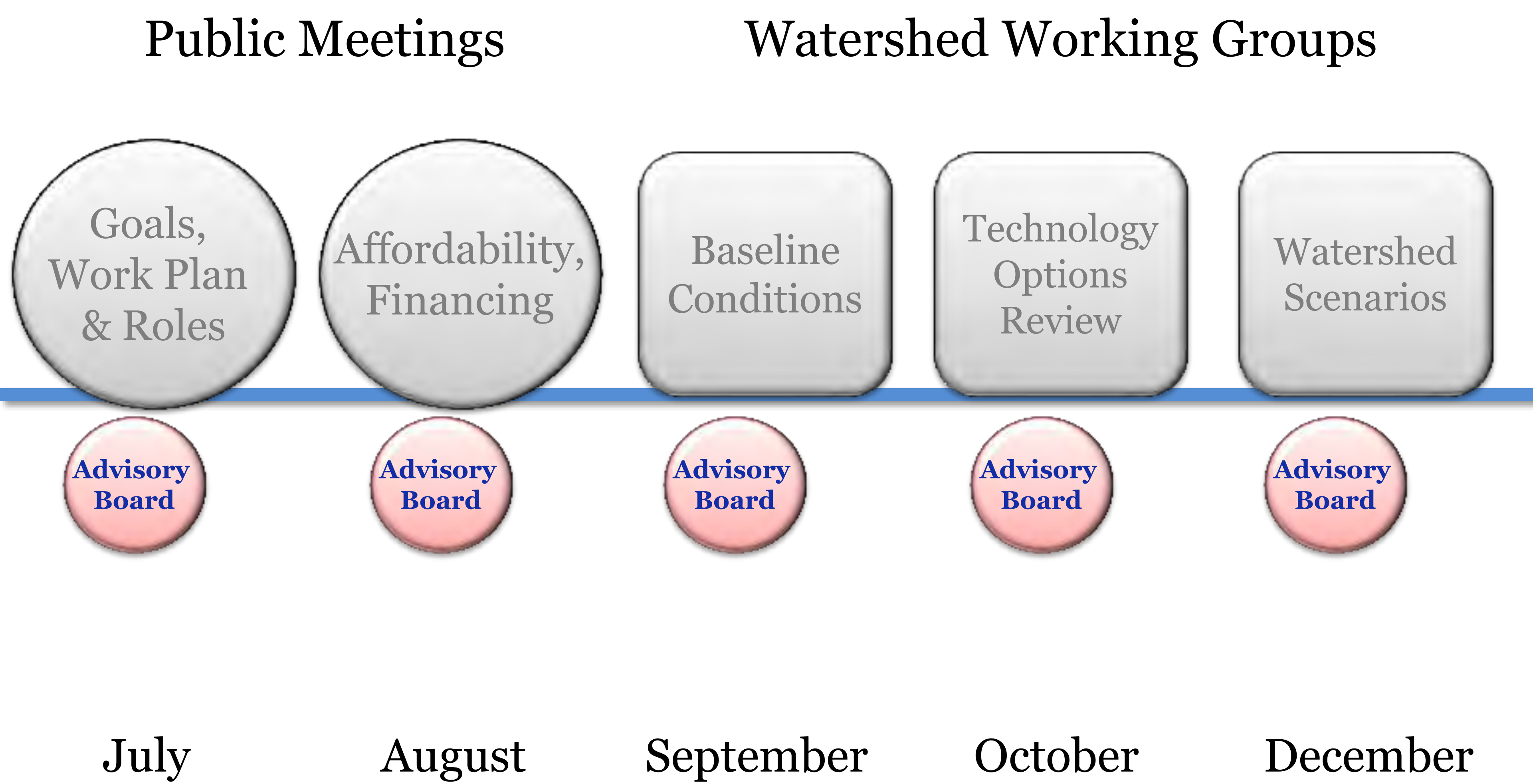
July

August

September

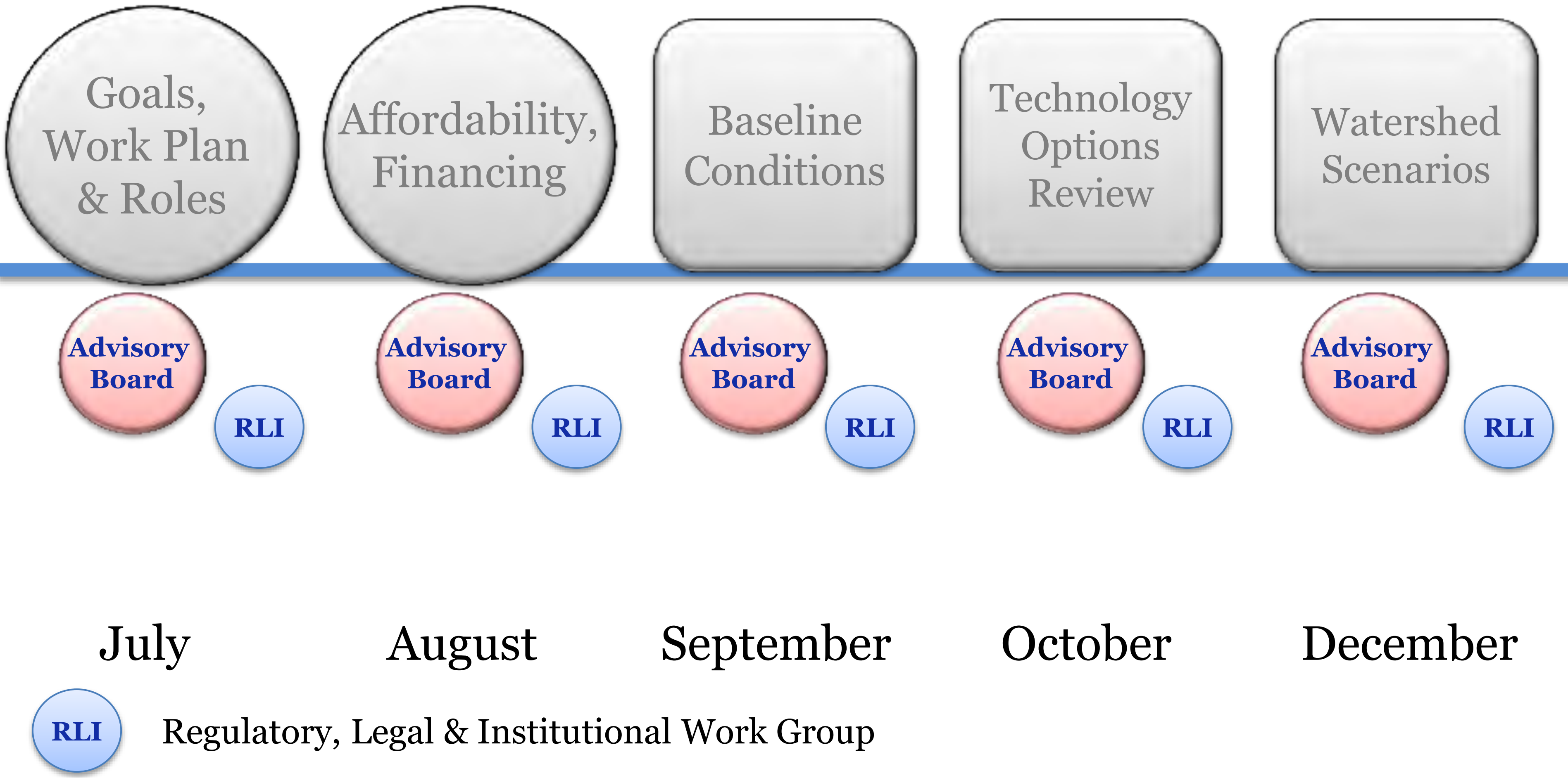
October

December

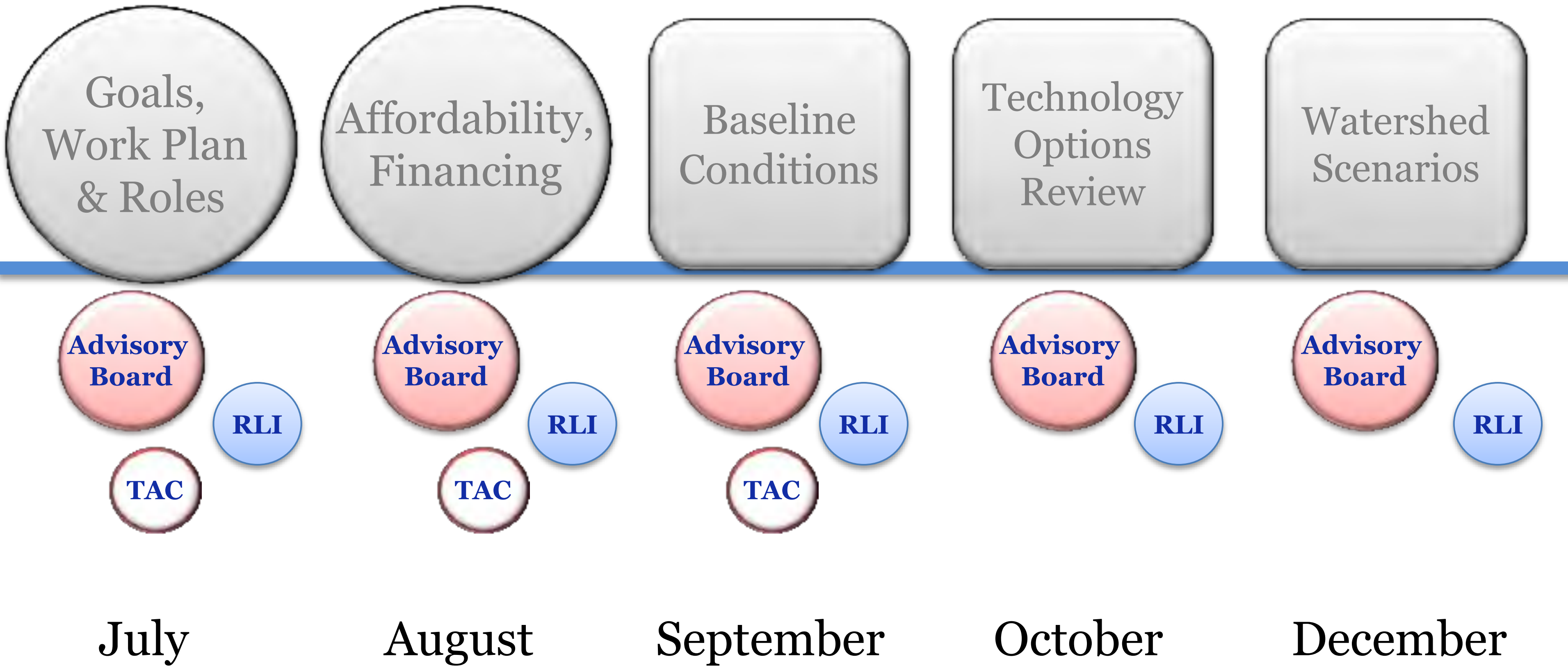


208 Planning Process

Public Meetings | Watershed Working Groups



Public Meetings Watershed Working Groups



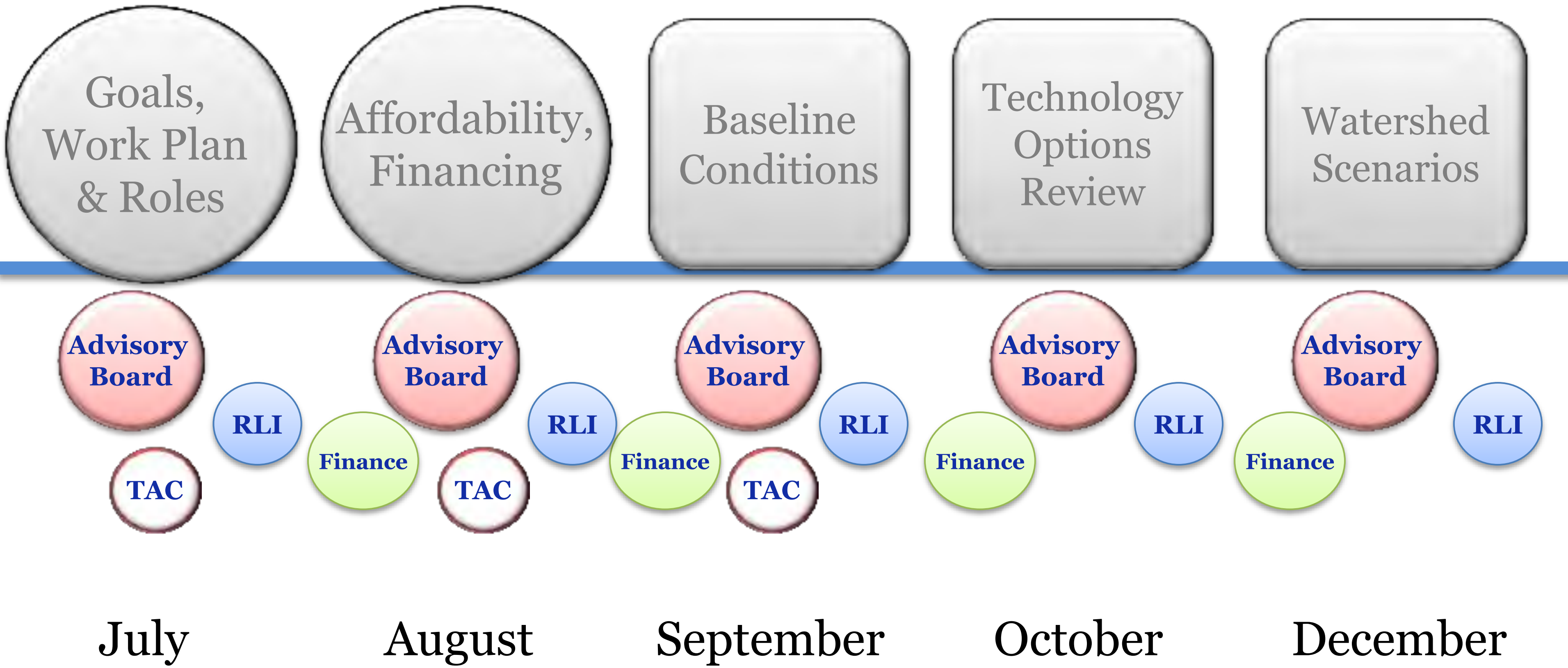
RLI Regulatory, Legal & Institutional Work Group

TAC Technical Advisory Committee of Cape Cod Water Protection Collaborative

208 Planning Process

Public Meetings

Watershed Working Groups



RLI — Regulatory, Legal & Institutional Work Group

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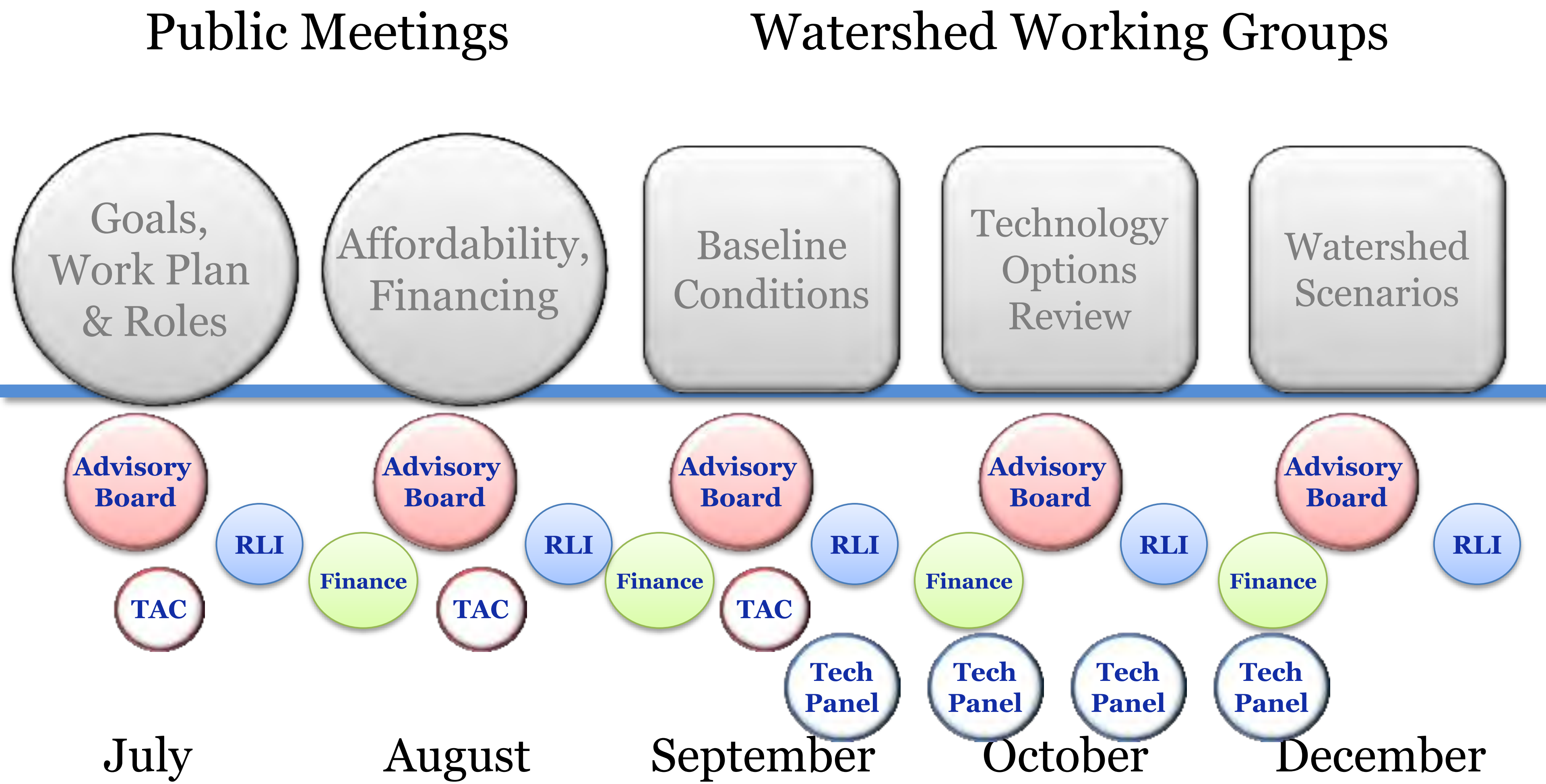

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TAC Technical Advisory Committee of Cape Cod Water Protection Collaborative

208 Planning Process

Baseline Conditions

11 Working Group Meetings: Sept 18-27

Goal of the First Meeting:

To review and develop shared understanding of the characteristics of these watersheds, the work done to date, existing data and information available, and how to apply all of this to planning for water quality improvements for these watersheds moving forward.

Progress since last meeting

- ❑ Meeting materials

Progress since last meeting

- ❑ Meeting materials
- ❑ GIS data layers

Progress since last meeting

- ❑ Meeting materials
- ❑ GIS data layers
- ❑ Chronologies

Baseline Conditions

11 Working Group Meetings: Sept 18-27

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

208 Planning Process

Baseline Conditions

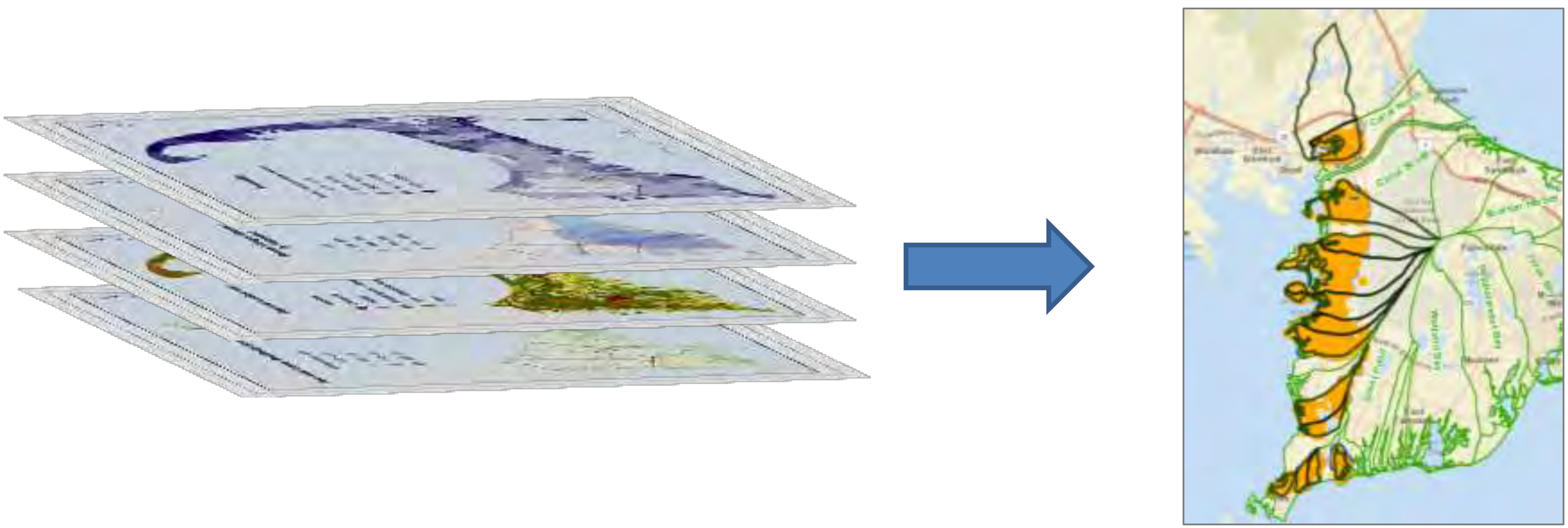
11 Working Group Meetings: Sept 18-27

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Watershed Scenarios

11 Working Group Meetings: Dec 2-11



208 Planning Process

Baseline Conditions

11 Working Group Meetings: Sept 18-27

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Watershed Scenarios

11 Working Group Meetings: Dec 2-11

Watershed Event

November 13

Center for the Arts Dennis

Wrap up of Cape2O: ur in charge!

Summary of planning process to date

Outline of second 6 months of the 208 planning process

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Goal of Today's Meeting:

To develop a shared understanding of the potential technologies and approaches identified to date, and the benefits and limitations of each; to explore the environmental, economic, and community impacts of a range of categories of solutions; and to identify priorities and considerations for applying technologies and approaches to remediate water quality impairments in your watershed.

Technologies and Approaches for Improving Water Quality

Technologies and Approaches for Improving Water Quality

- The Fact Sheets present various information on the technologies being considered.
- Additional information is contained on the Technology Matrix including the following:
  - Site Requirements
  - Construction, Project and Operation and Maintenance Costs
  - Reference Information
  - Regulatory Comments
- Input from the Stakeholders is requested regarding a technology's Public Acceptance

Technologies and Approaches for Improving Water Quality

- Comprehensive analysis of nutrient control technologies and approaches.

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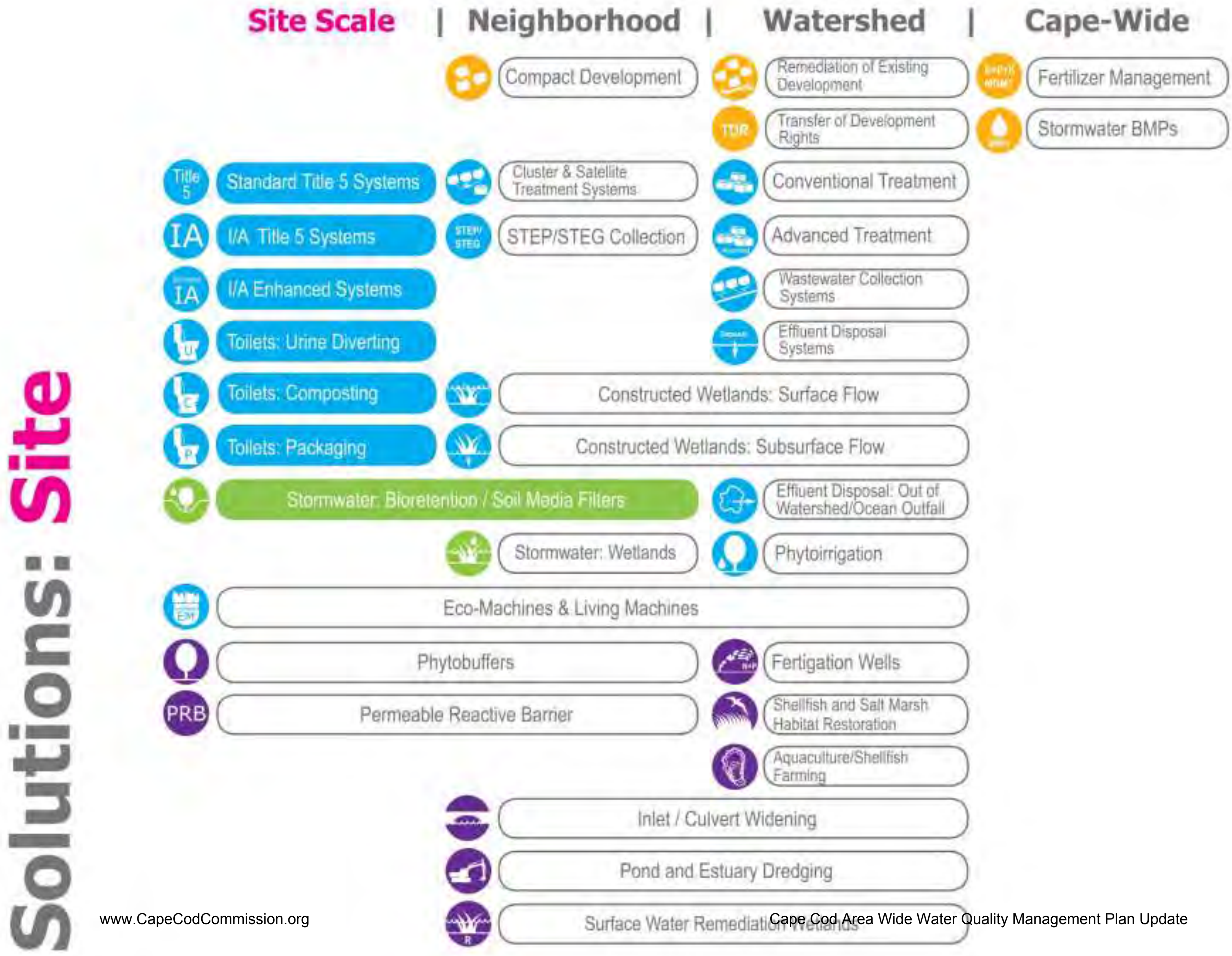
- Regulatory programs can address nutrient controls for both existing development and future development.


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


Solutions: Site
Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
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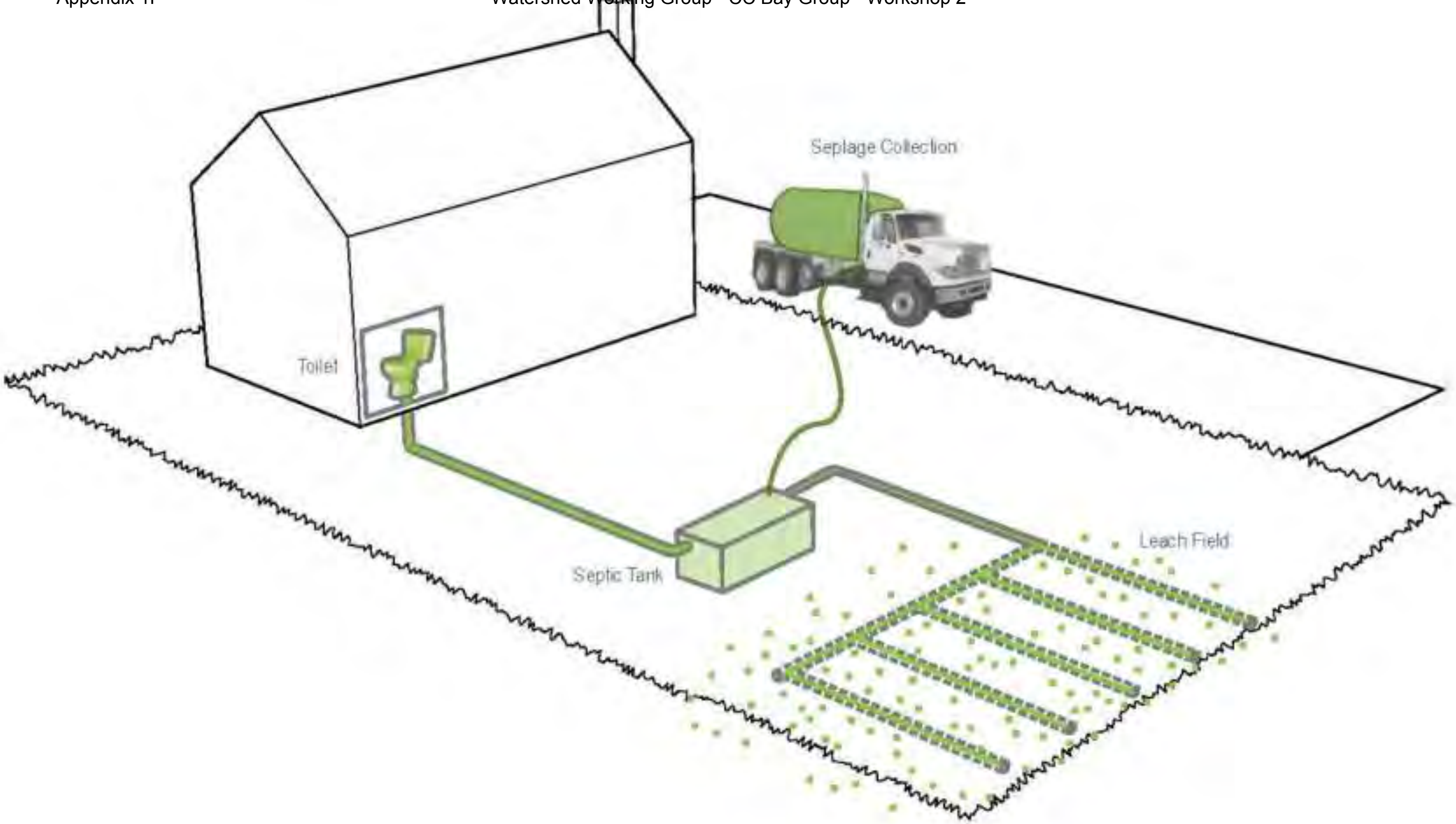
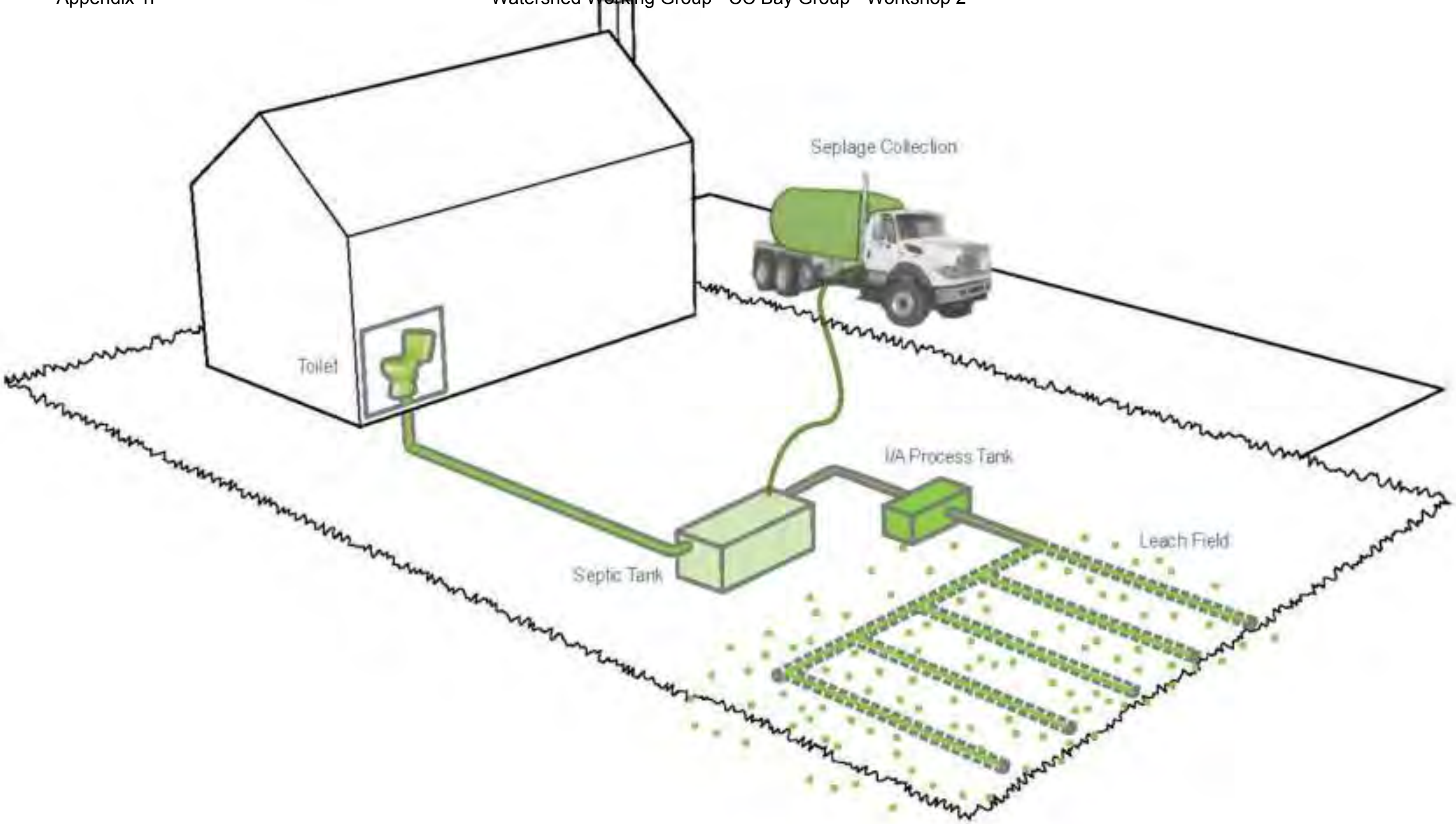


Scale: SITE
Target: WASTEWATER

Standard Title 5 Systems

Title 5



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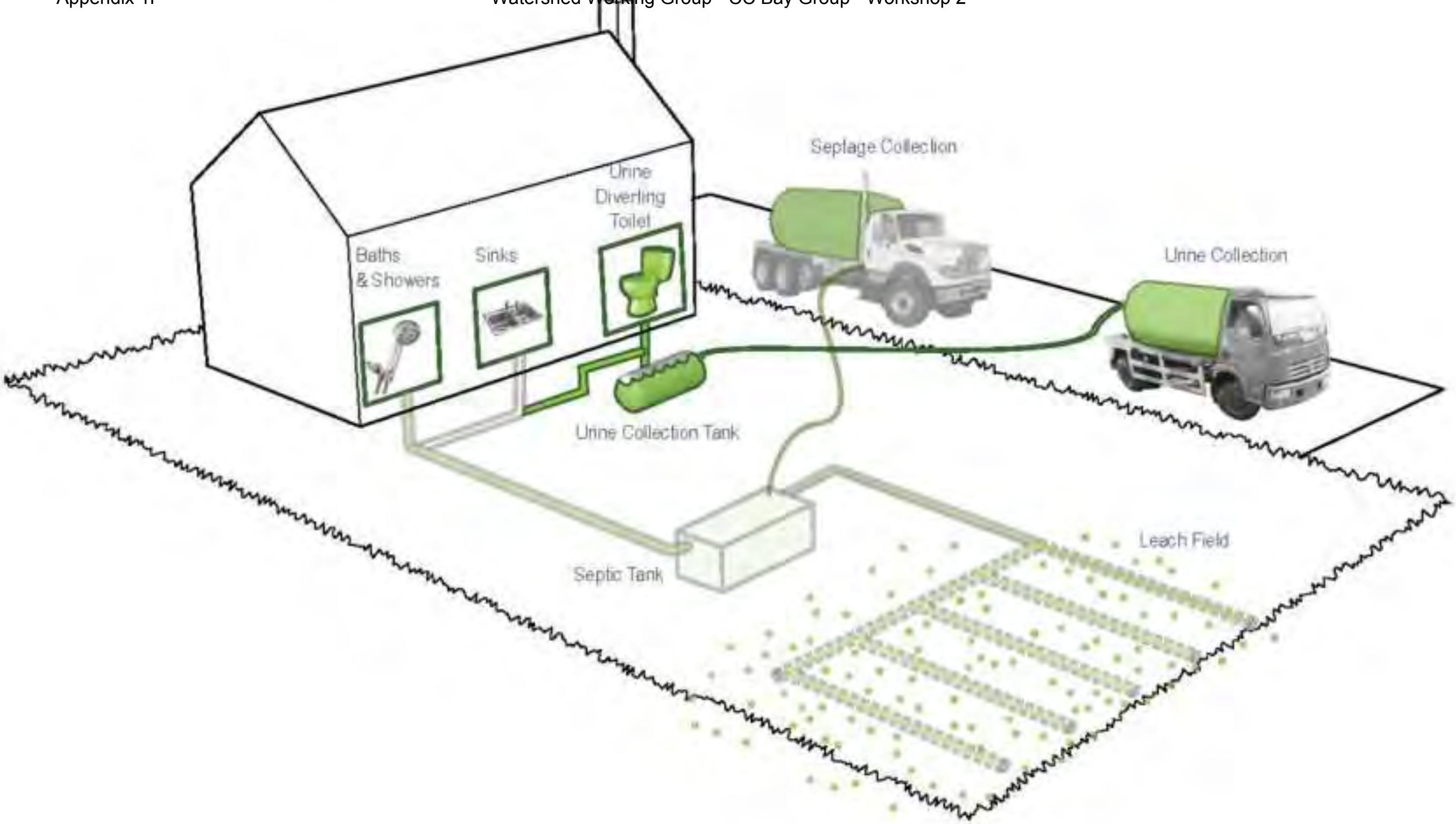


Scale: SITE
Target: WASTEWATER

Toilets: Urine Diverting

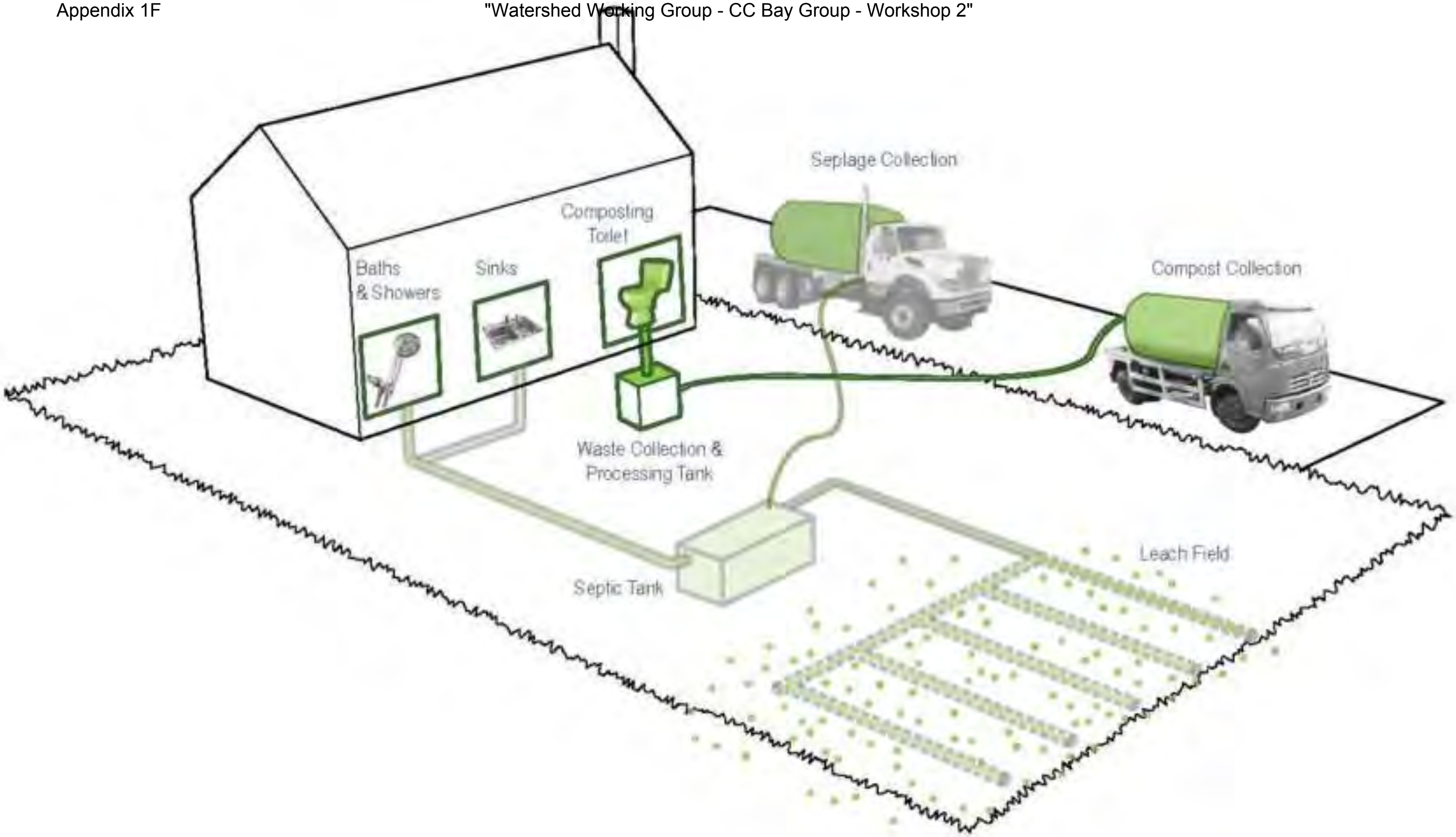
Waterless
Urinal

IBC container
(220 gallons)

40" x 40" x48"

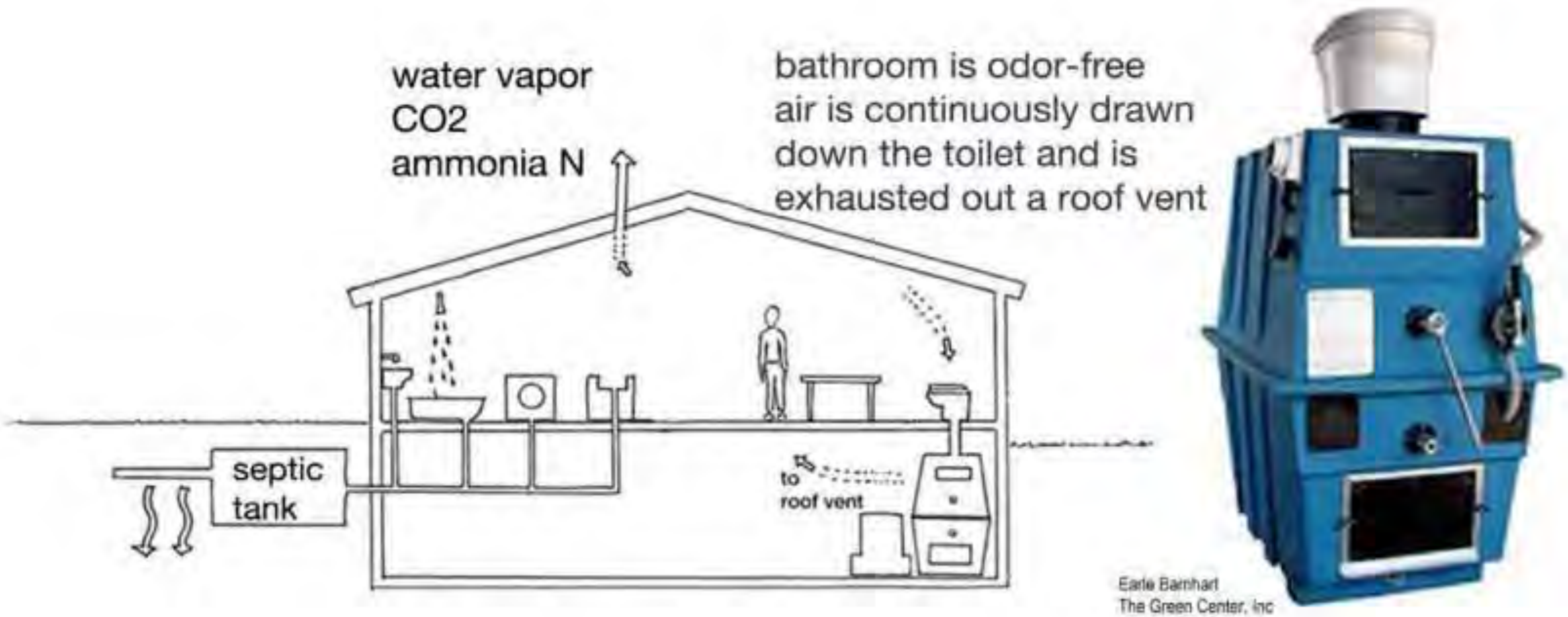
Source: Earle Barnhart, The Green Center Inc. and Horsley-Witten Group Inc.

Toilets: Urine Diverting



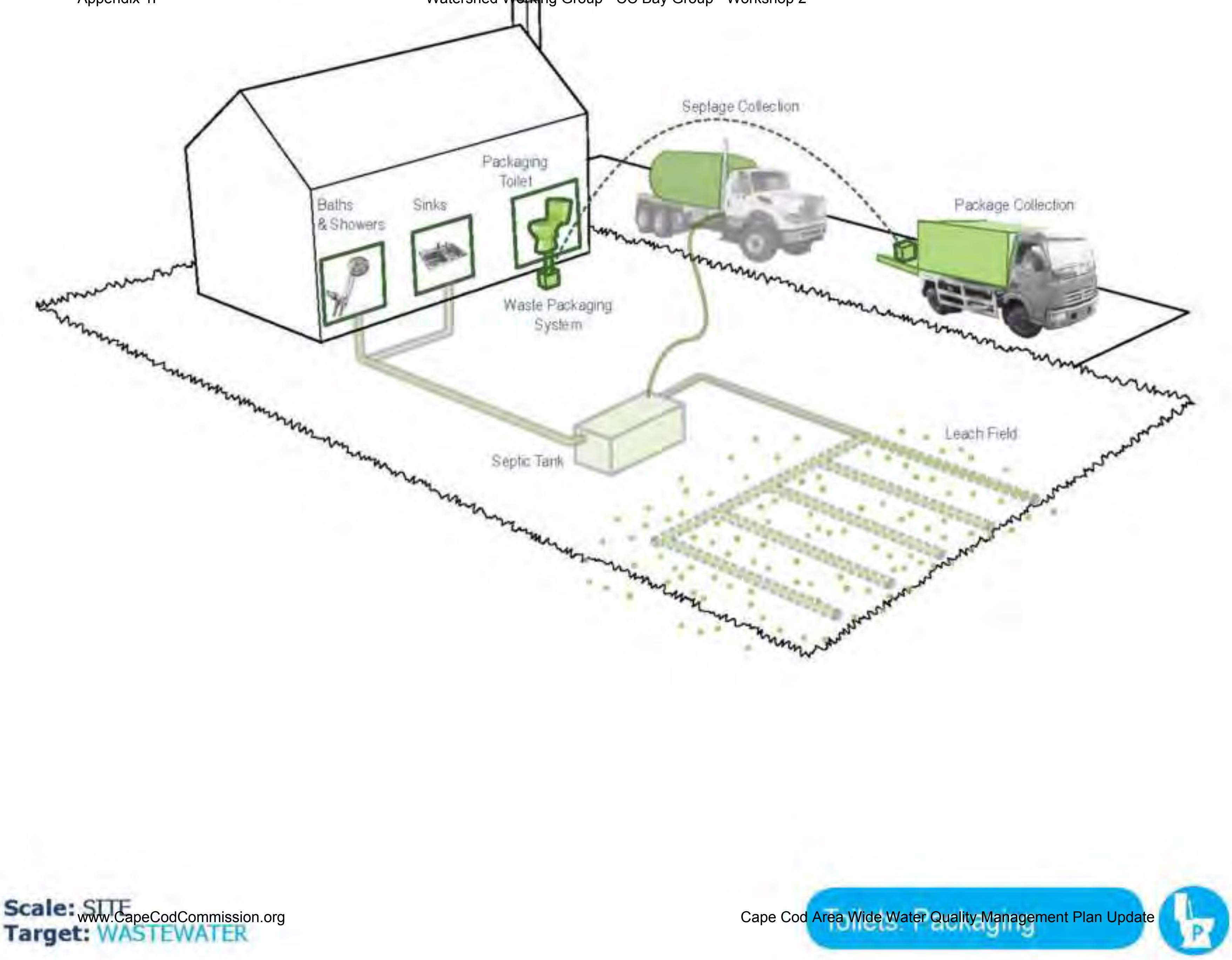
Scale: SITE
Target: WASTEWATER

Toilets: Composting

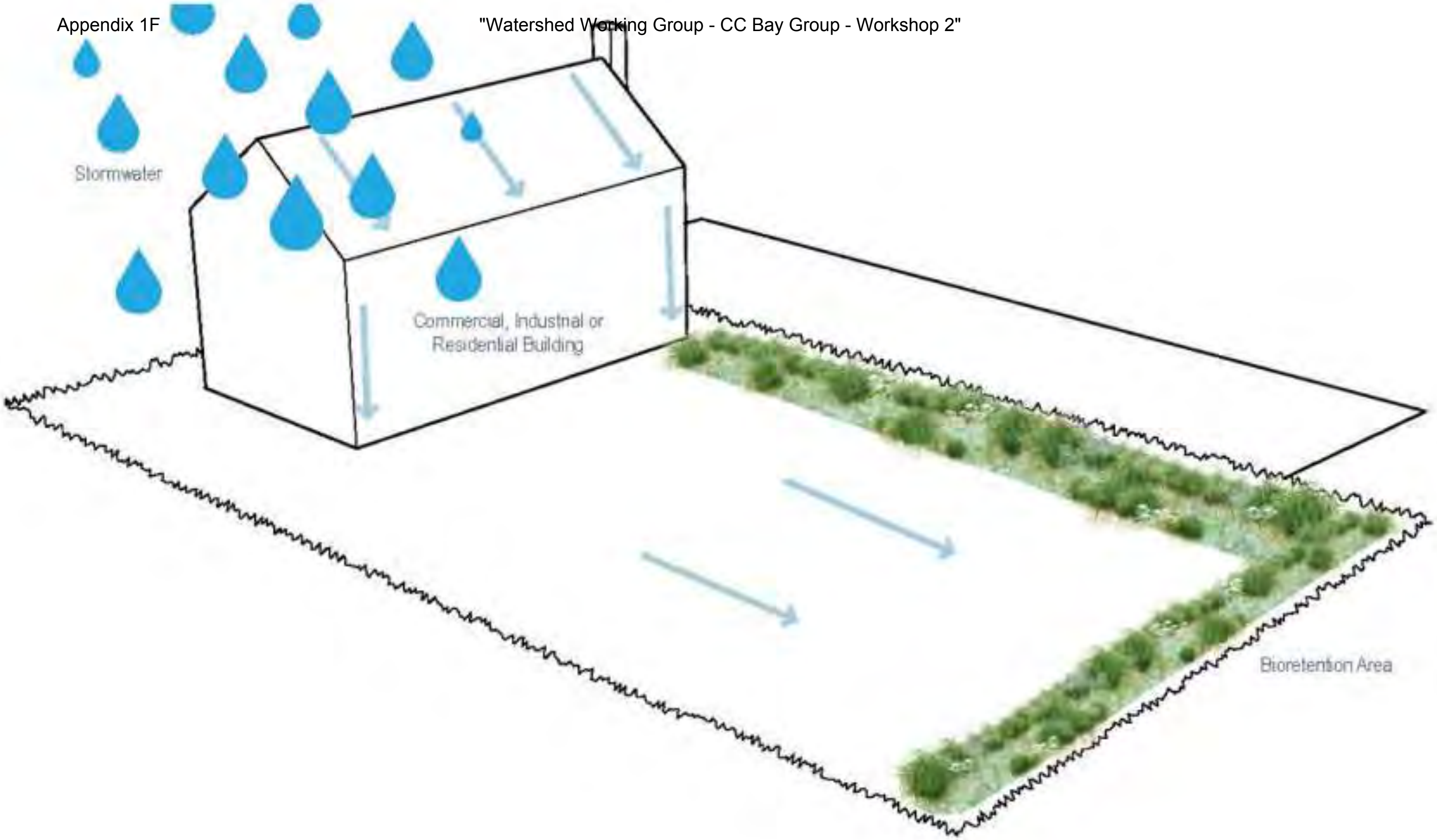


Source: Earle Barnhart, The Green Center Inc.

Toilets: Composting


Septage Collection
Packaging Toilet
Baths & Showers
Sinks
Package Collection
Waste Packaging System
Septic Tank
Leach Field
Scale: SITE
Target: WASTEWATER
Toilets: Packaging


PACTO®
LOOWATT
Packaging
Toilet
Packages
Toilets: Packaging



Scale: SITE
Target: STORMWATER

Stormwater Bioretention /
Soil Media Filters

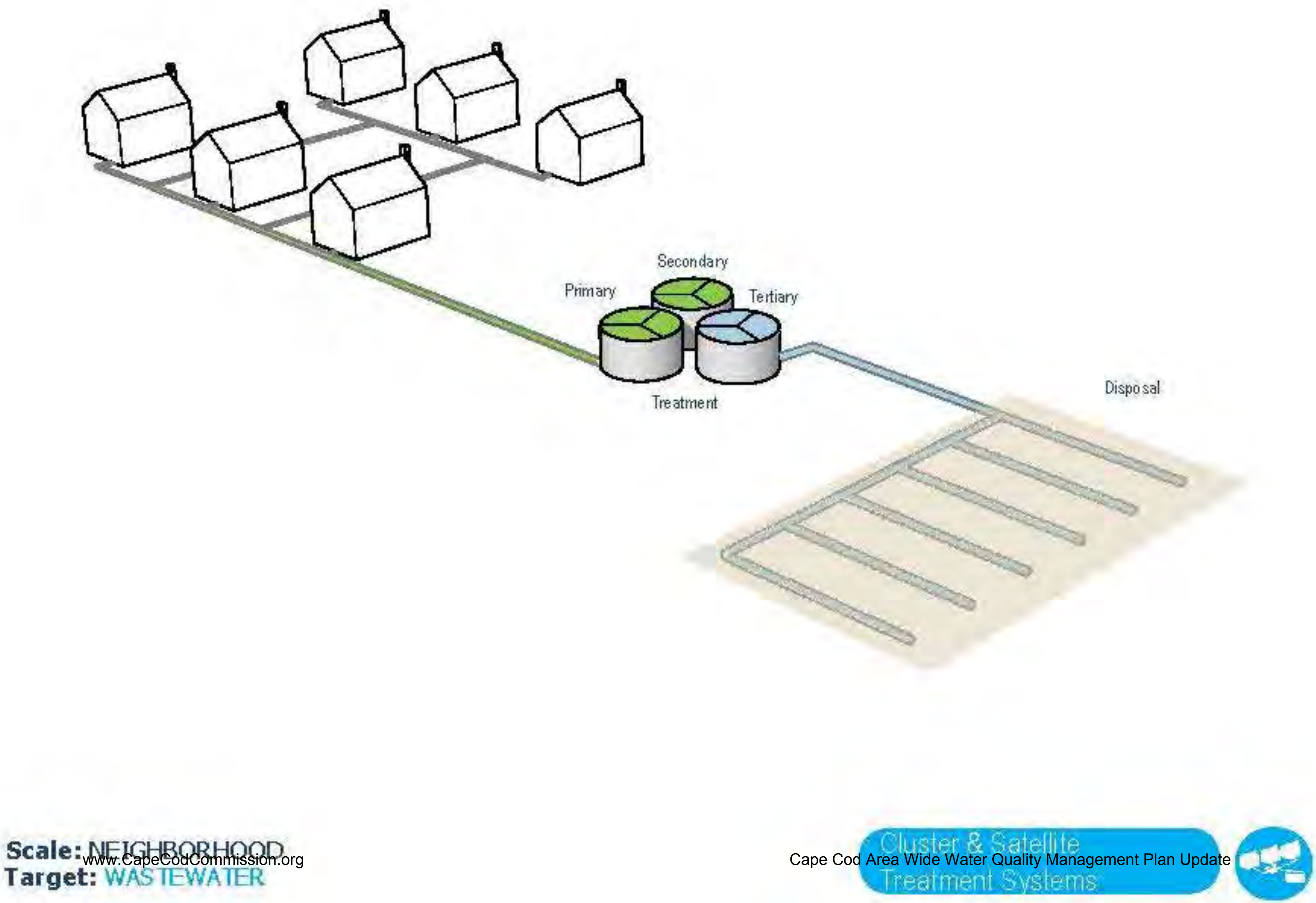
Precedent: 12th Ave. Stormwater Project, Portland, OR

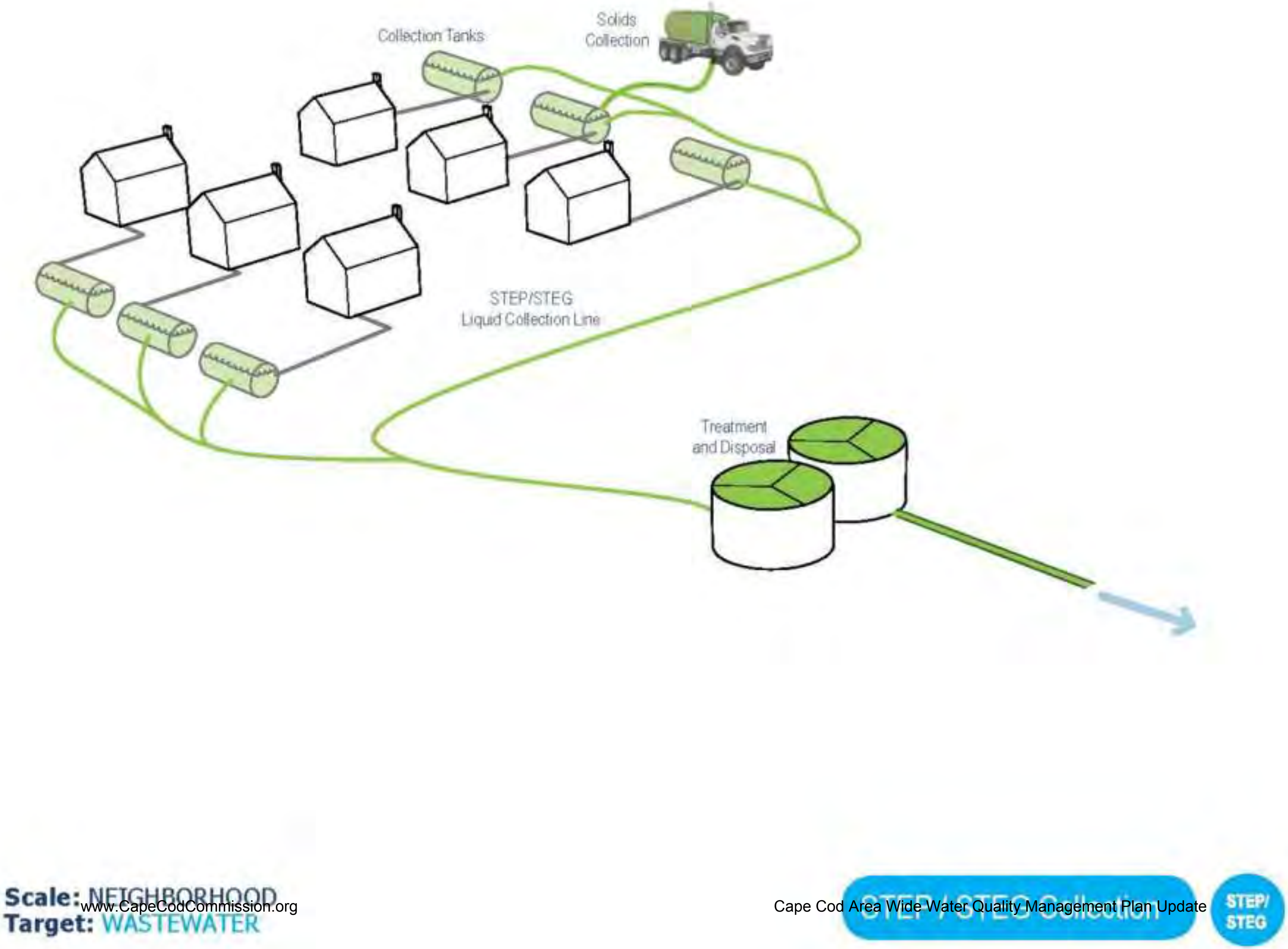
Source: City of Portland

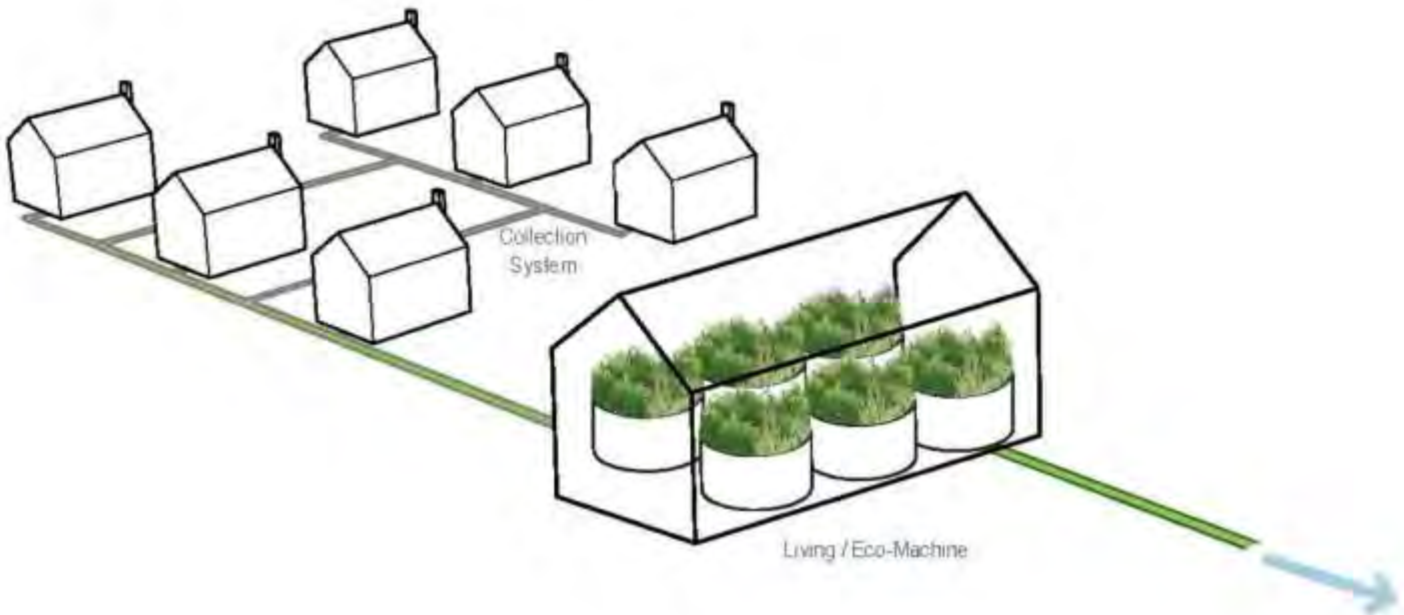
Stormwater: Bioretention / Soil Media Filters

Rain Gardens


Site Scale | Neighborhood | Watershed | Cape-Wide
Solutions: Neighborhood
Compact Development
Remediation of Existing Development
Transfer of Development Rights
TDR
Fertilizer Management
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
IA
I/A Title 5 Systems
STEP/STEG
STEP/STEG Collection
Advanced Treatment
IA
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
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands

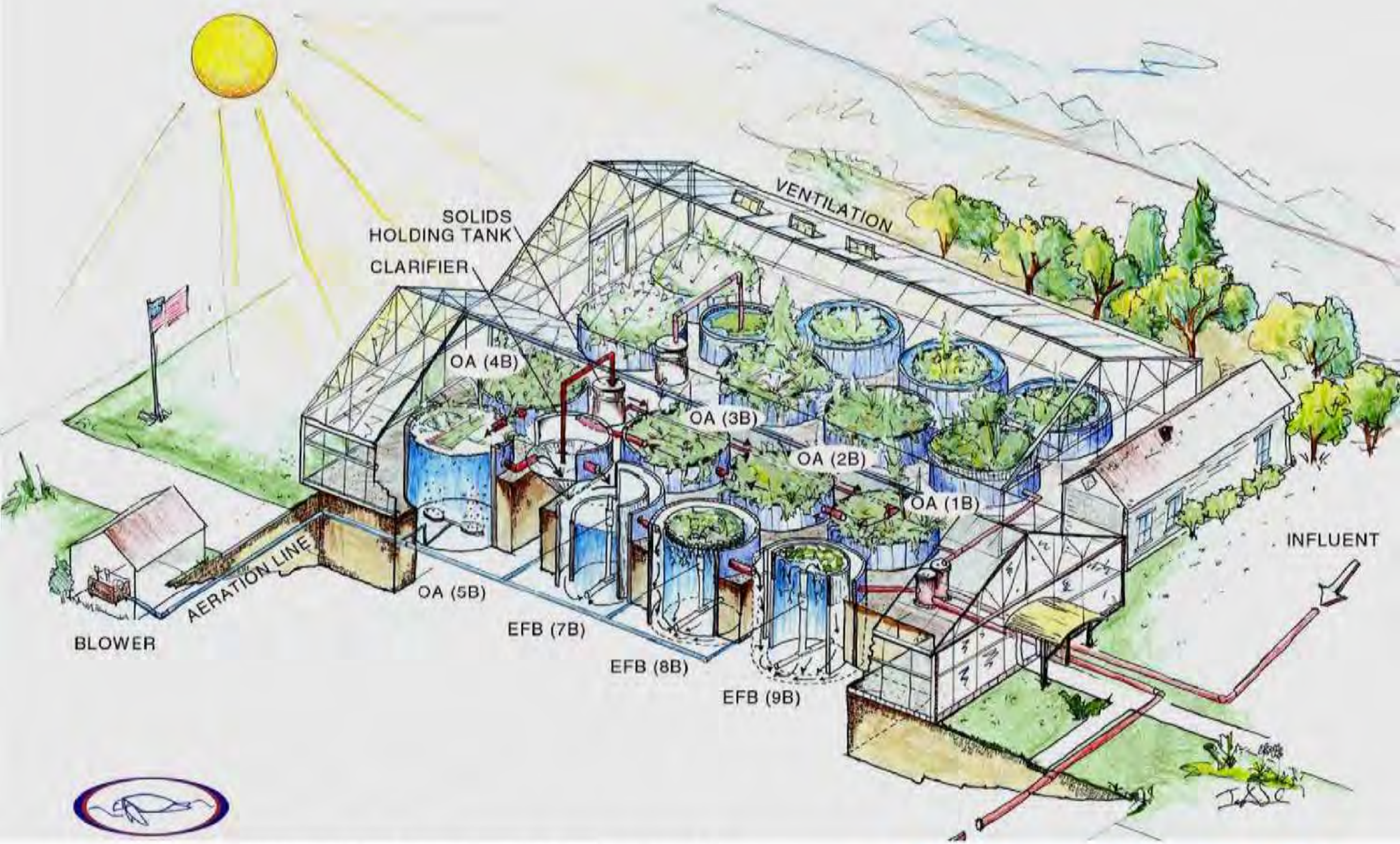

Secondary
Primary
Tertiary
Treatment
Disposal
Scale: NEIGHBORHOOD
Target: WASTEWATER
Cluster & Satellite
Treatment Systems


Collection Tanks
Solids
Collection
STEP/STEG
Liquid Collection Line
Treatment
and Disposal
Scale: NEIGHBORHOOD
Target: WASTEWATER
STEP / STEG Collection
STEP/
STEG



Scale: NEIGHBORHOOD
Target: WASTEWATER

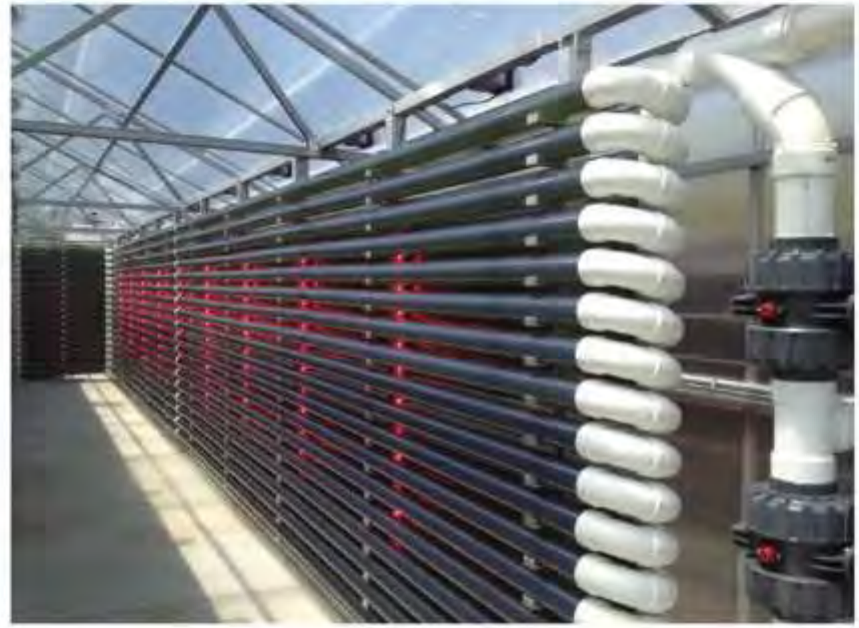
Eco-Machines and
Living Machines



Precedent: Living Machine, South Burlington, VT

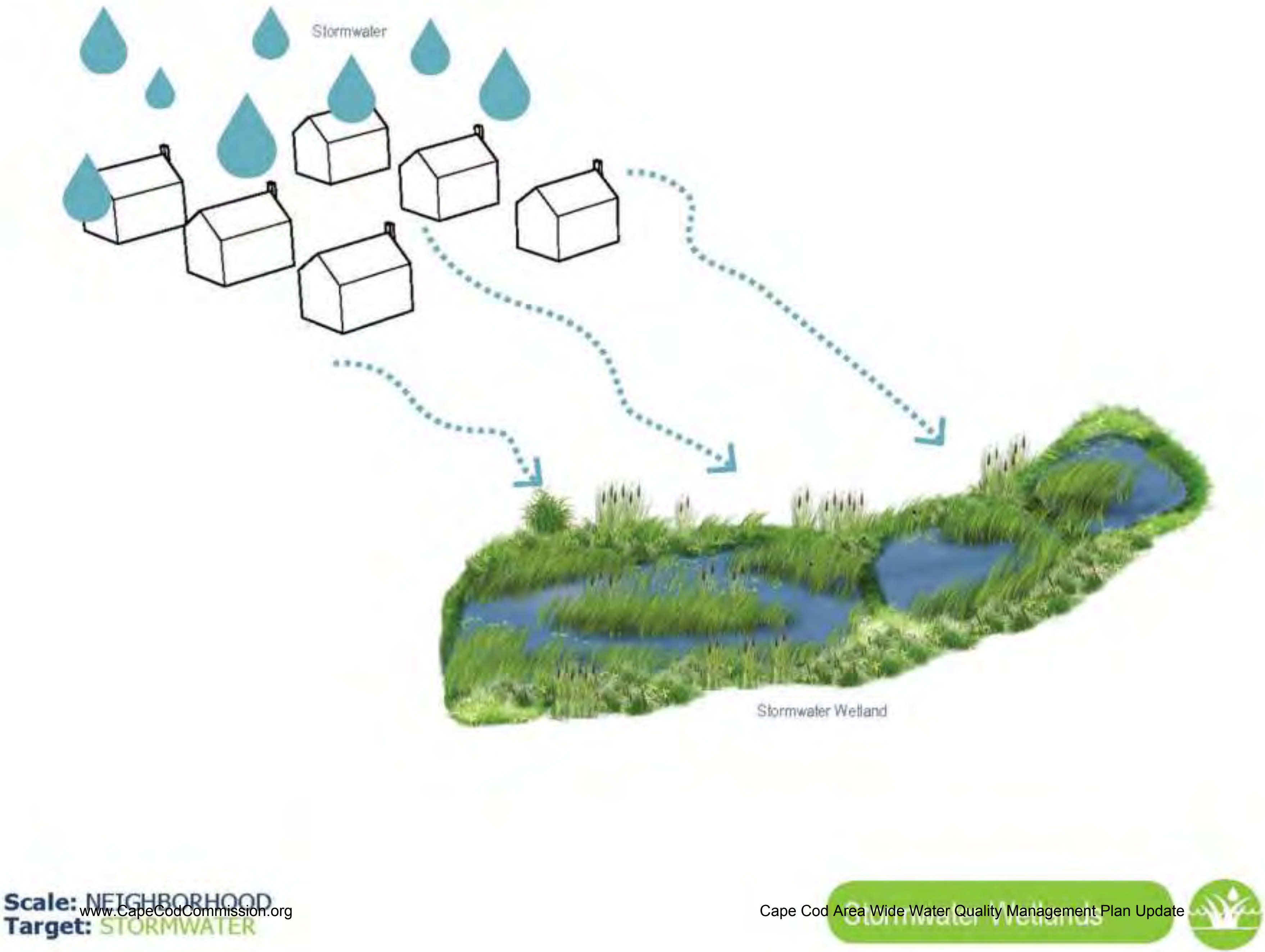
Source: Todd Ecological

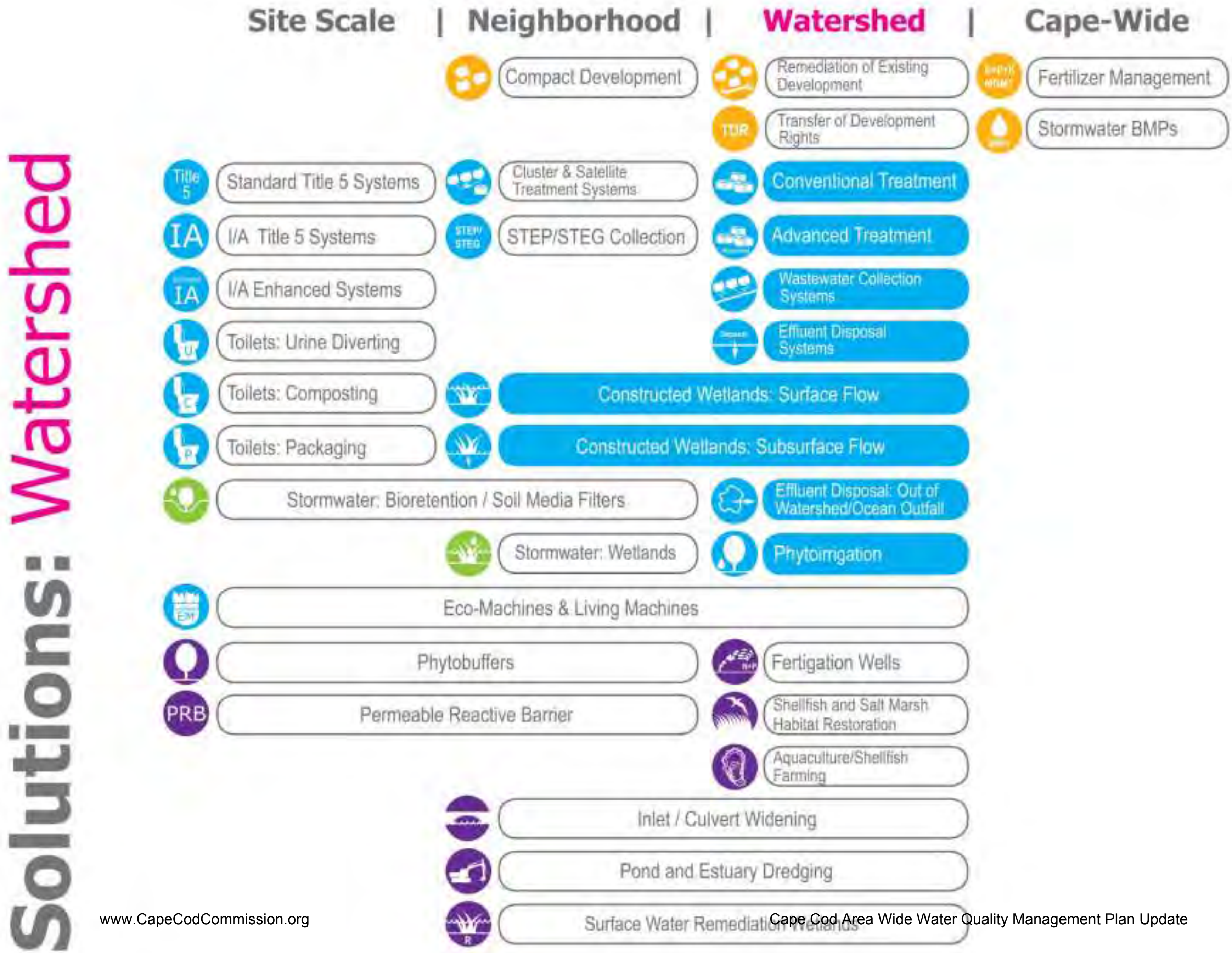
Eco-Machines and Living Machines

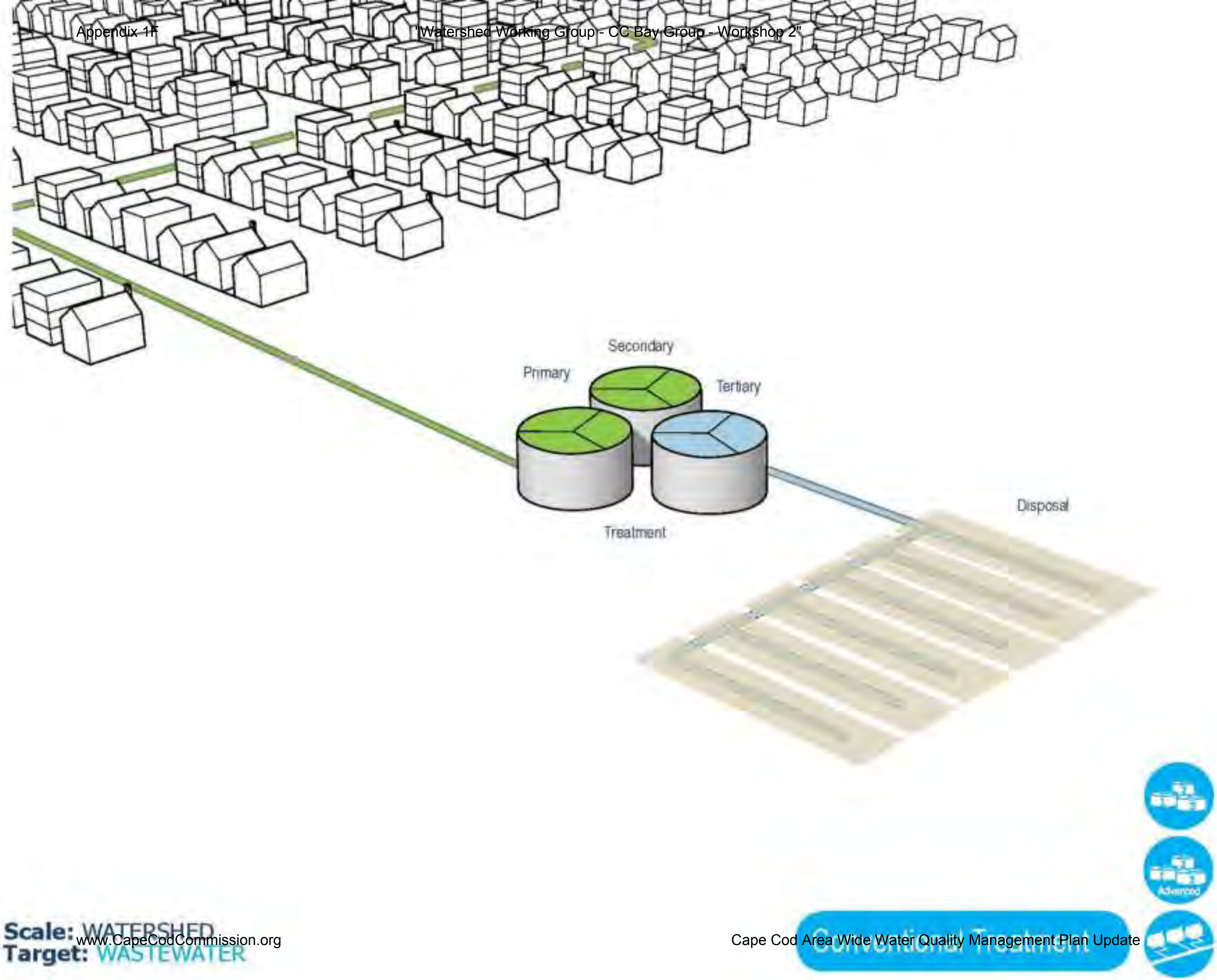


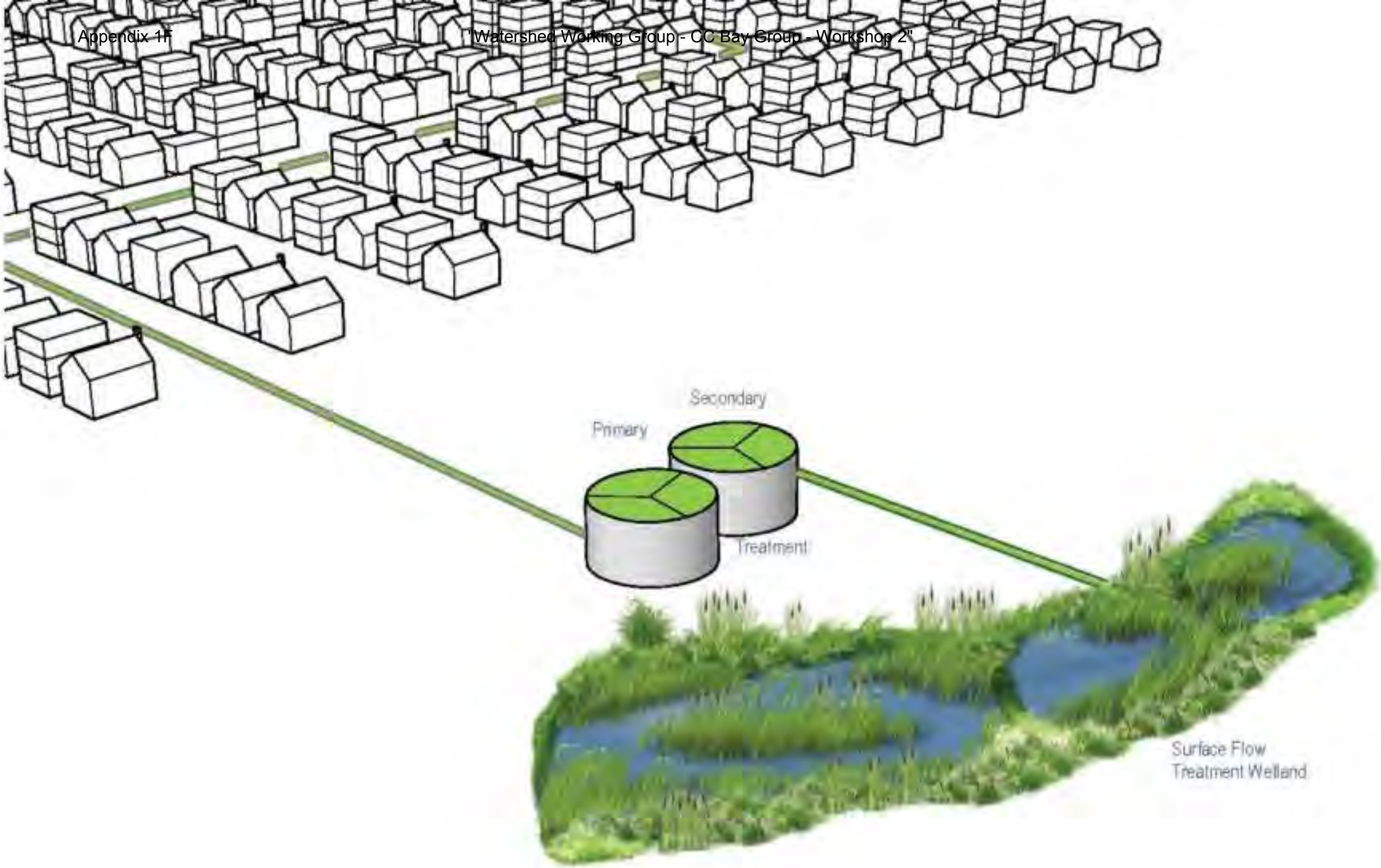
Precedent: Living Machine - South Burlington, VT + Photobioreactors - Falmouth, MA
Source: Todd Ecological and Tom Cambareri

Eco-Machines and Living Machines


Stormwater
Stormwater Wetland
Scale: NEIGHBORHOOD
Target: STORMWATER
Stormwater Wetlands


Site Scale | Neighborhood | Watershed | Cape-Wide
Solutions: Watershed
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
IA
I/A Title 5 Systems
STEP/STEG
STEP/STEG Collection
Advanced Treatment
IA
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
EM
Eco-Machines & Living Machines
Phytobuffers
Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands


Secondary
Primary
Tertiary
Treatment
Disposal
Advanced
Conventional Treatment
Scale: WATERSHED
Target: WASTEWATER

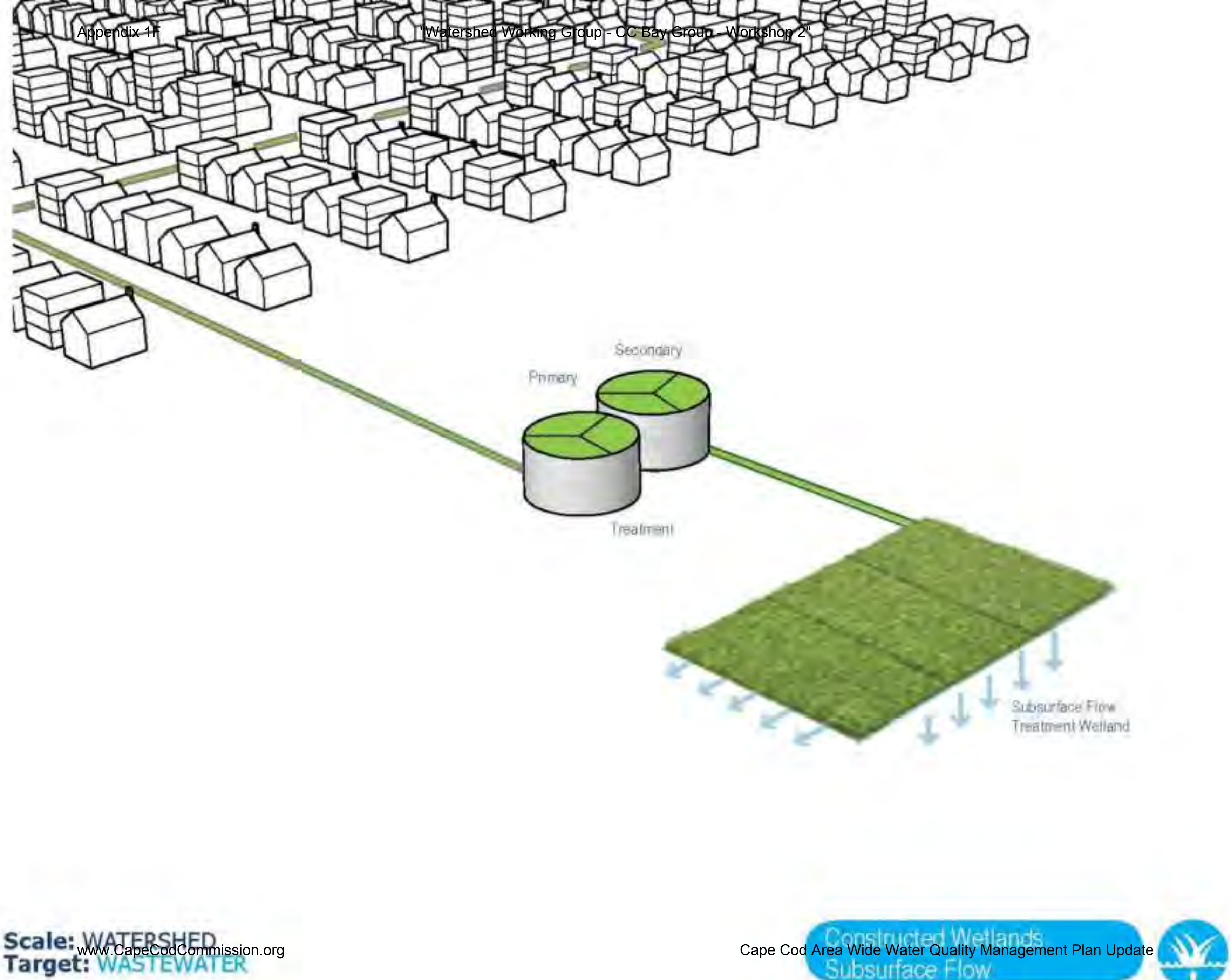


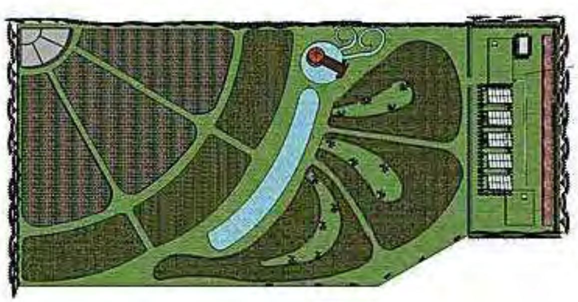
Scale: WATERSHED
Target: WASTEWATER

Constructed Wetlands
Surface Flow

Precedent: Talking Waters Garden - Albany, OR
Source: Kate Kennen

Constructed Wetlands:
Surface Flow

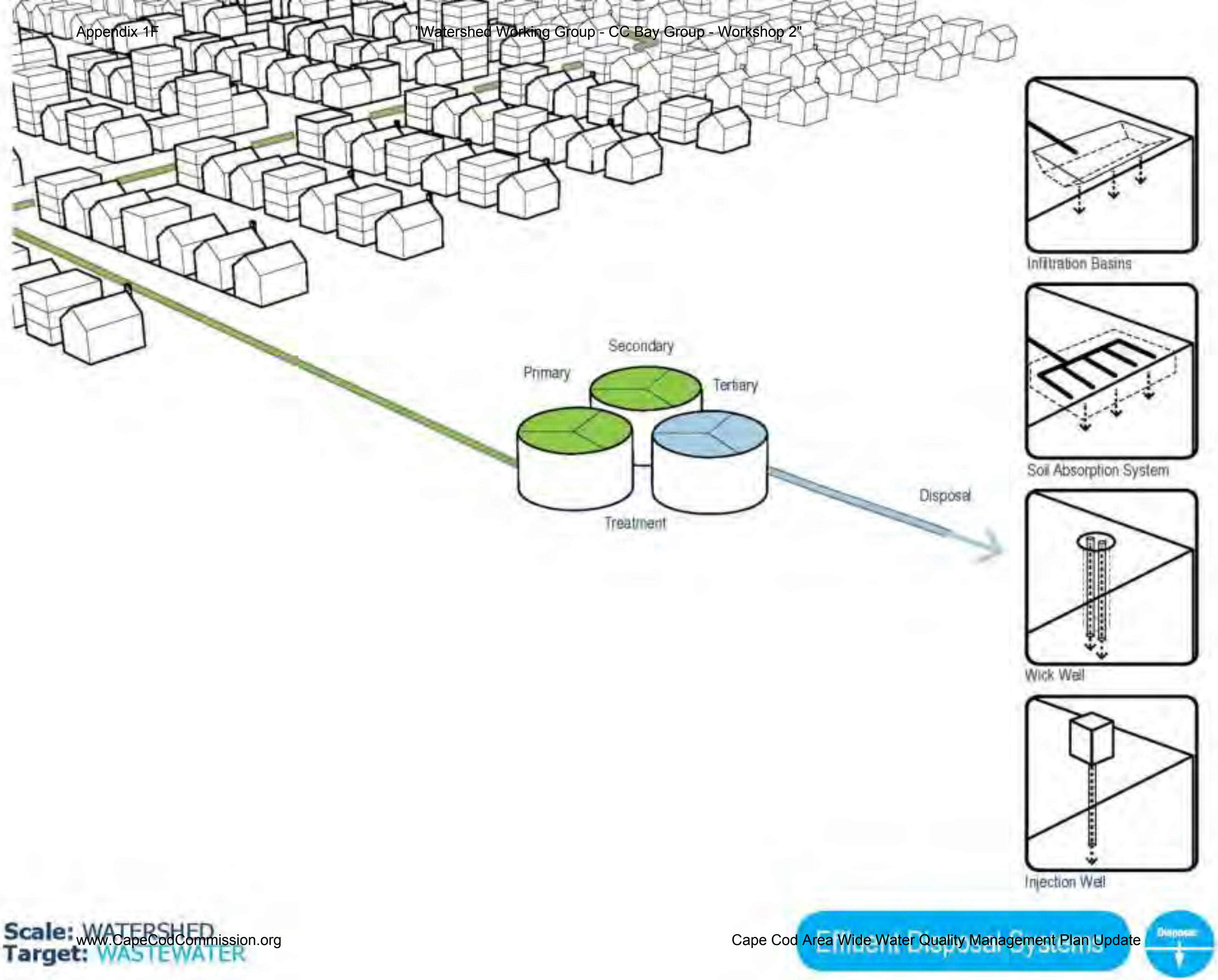

Secondary
Primary
Treatment
Subsurface Flow
Treatment Wetland
Scale: WATERSHED
Target: WASTEWATER
Constructed Wetlands
Subsurface Flow

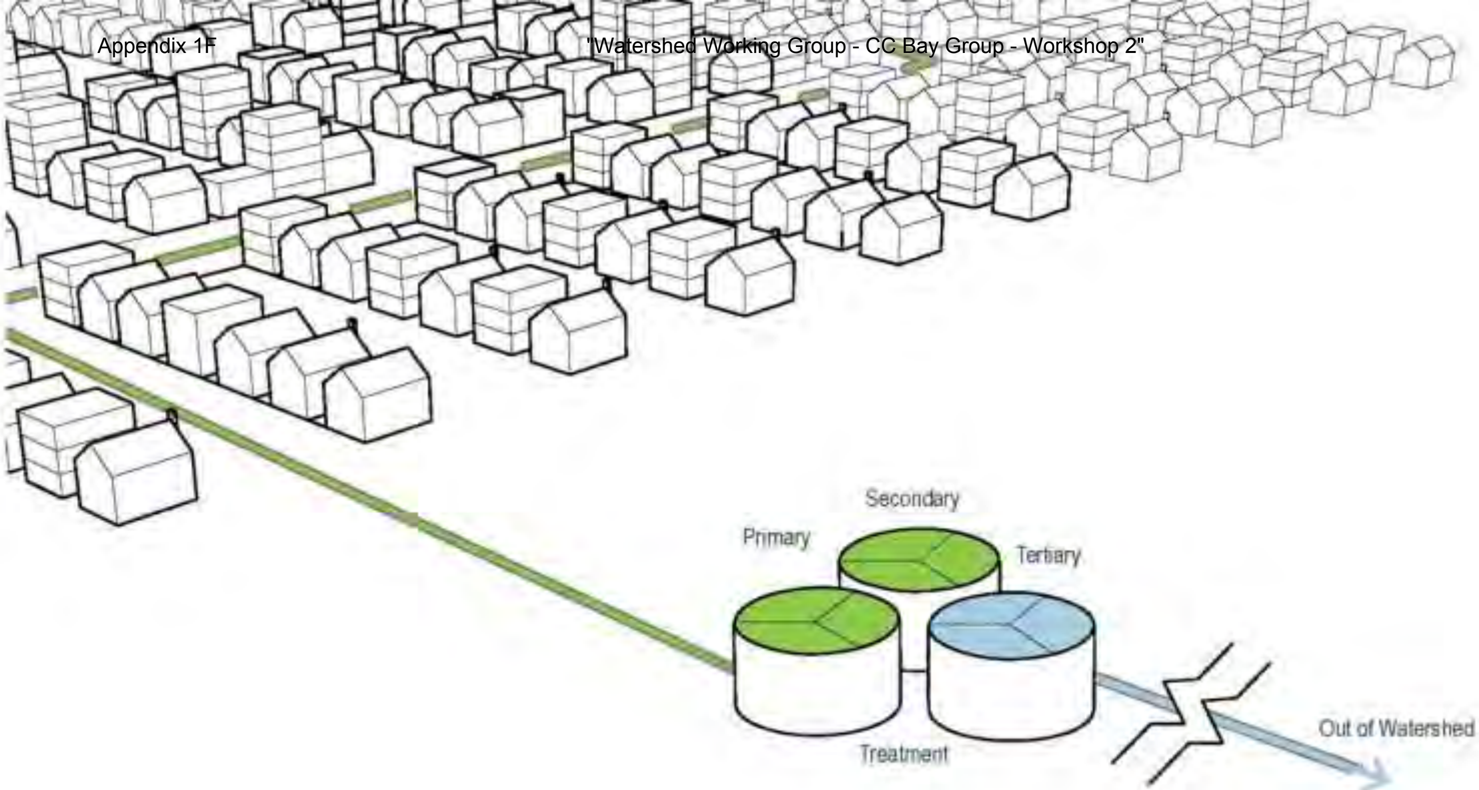


Precedent: Koh Phi Phi Treatment Wetland, Thailand

Source: Hans Brix

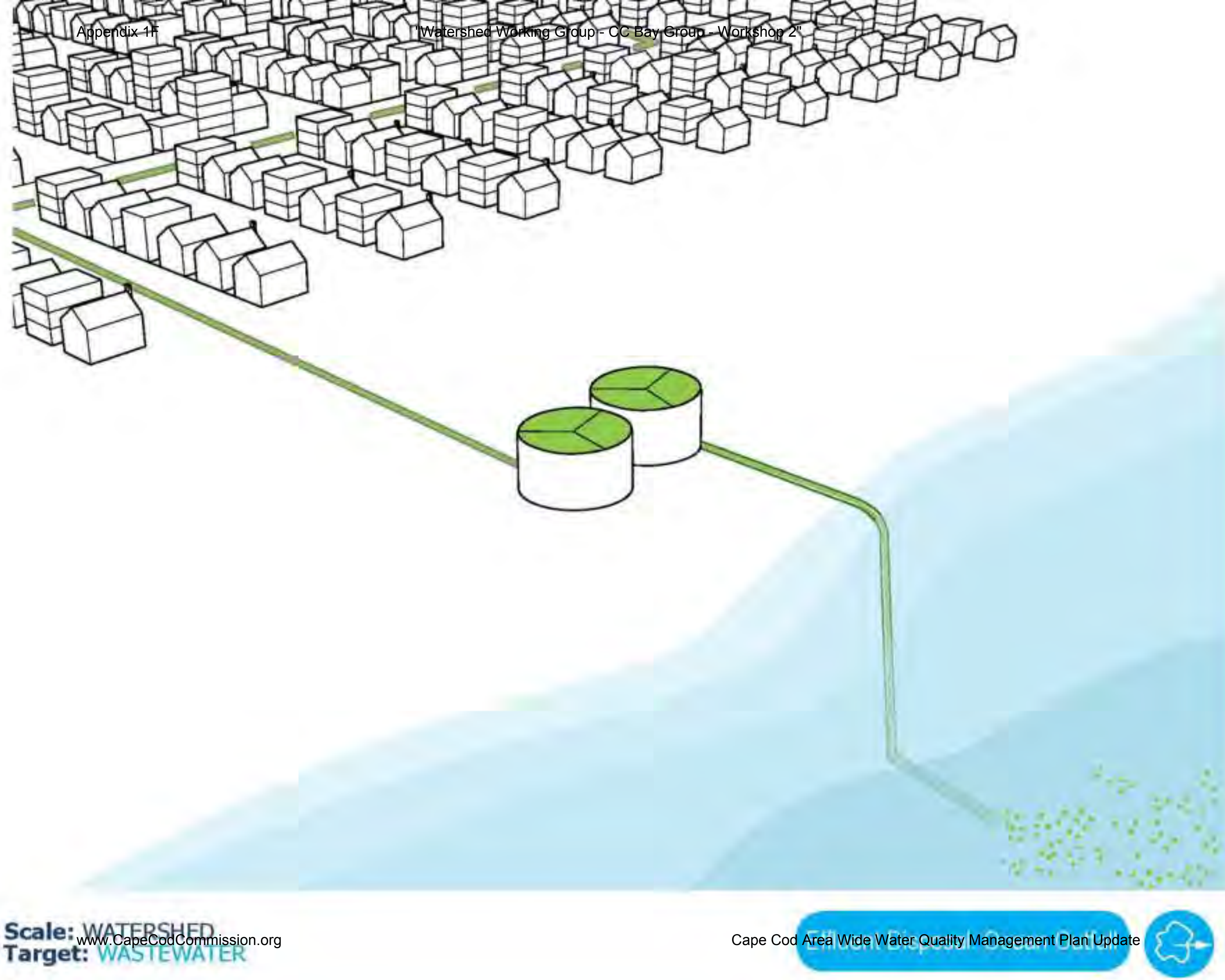
Constructed Wetlands: Subsurface Flow

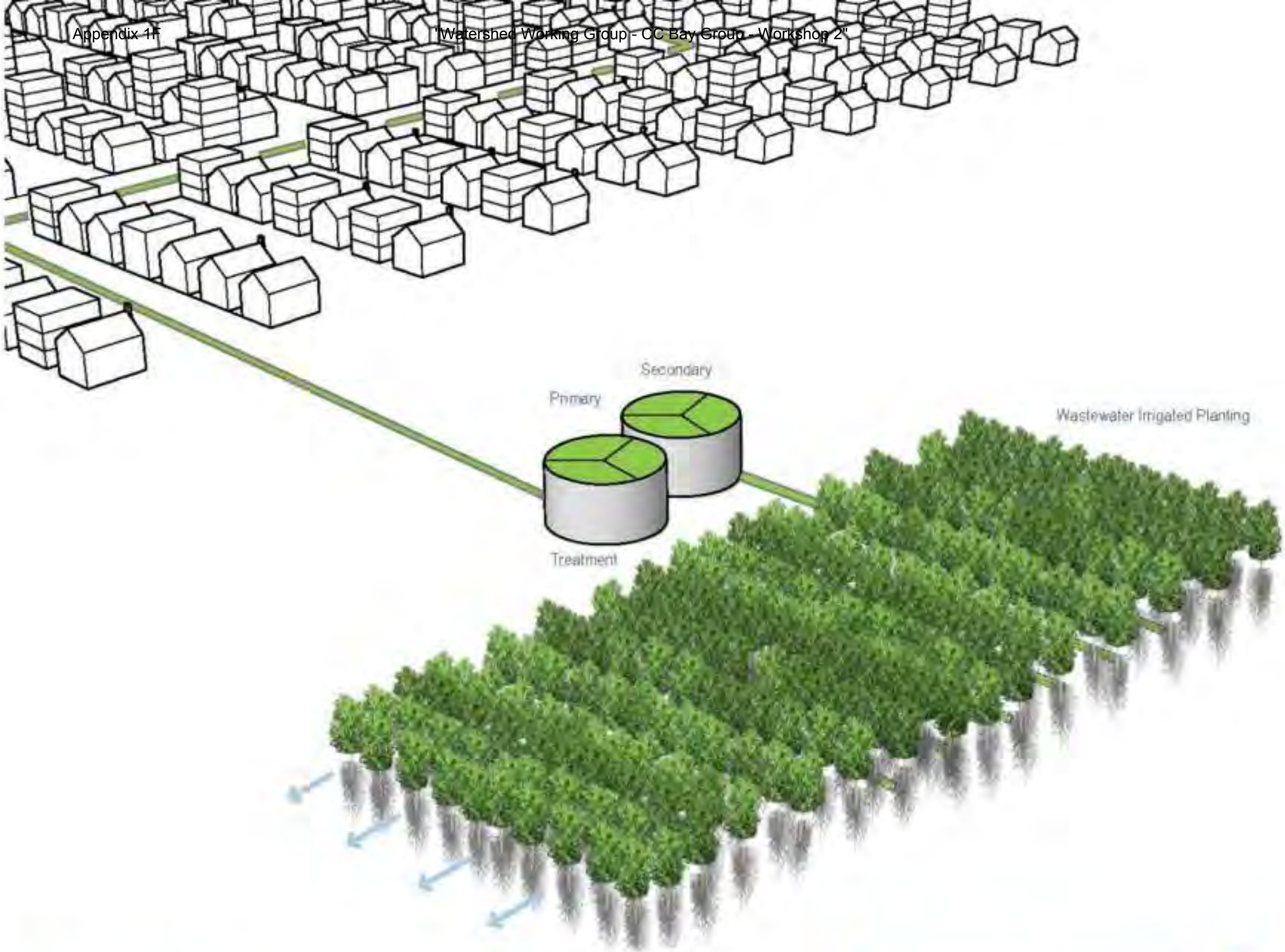

Secondary
Primary
Tertiary
Treatment
Disposal
Infiltration Basins
Soil Absorption System
Wick Well
Injection Well
Scale: WATERSHED
Target: WASTEWATER
Effluent Disposal Systems
Disposal



Scale: WATERSHED
Target: WASTEWATER

Effluent Disposal: Out of Watershed


Scale: WATERSHED
Target: WASTEWATER



Scale: WATERSHED
Target: WASTEWATER

Precedent: Woodburn OR, Wastewater Treatment Facility

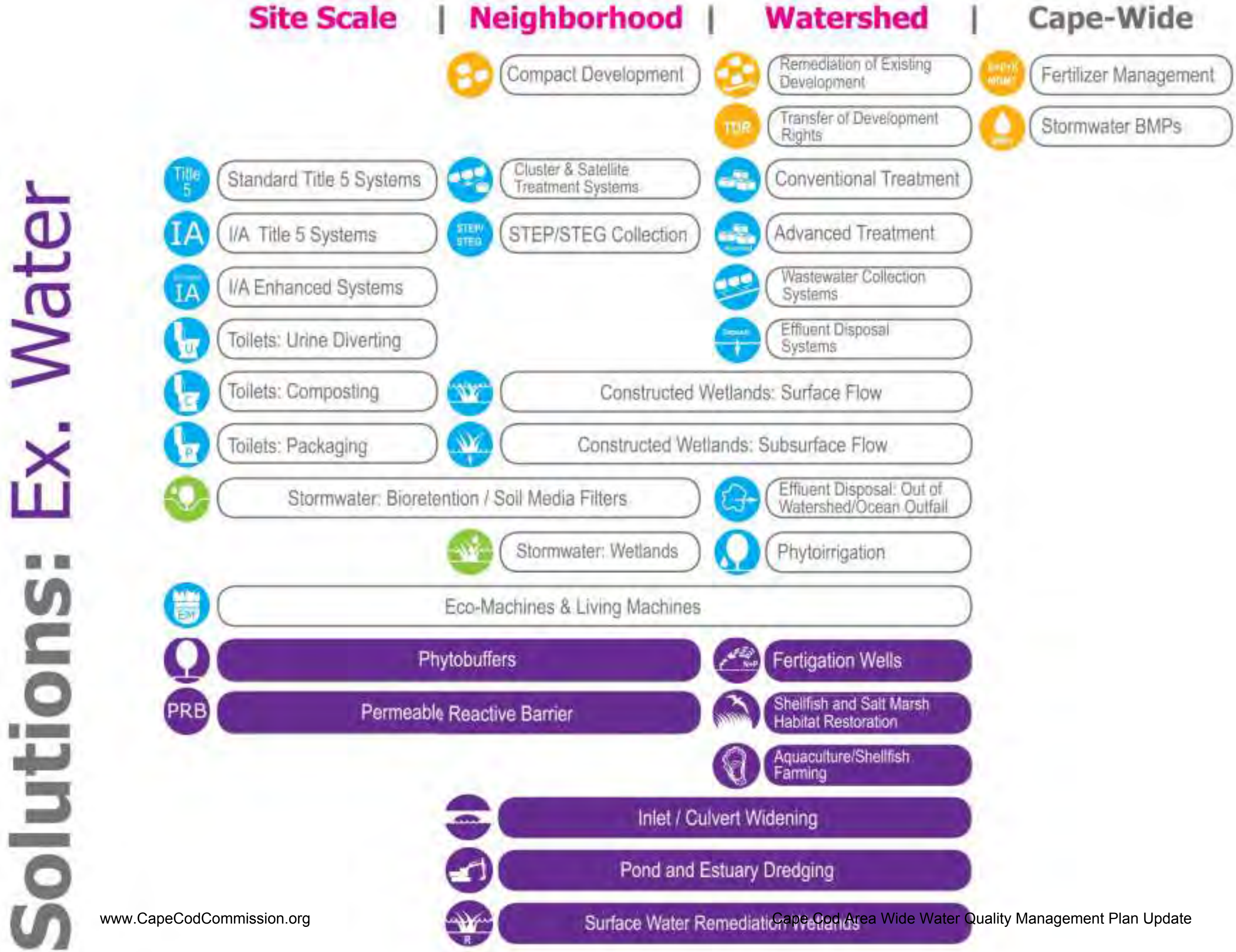
Source: CH2MHill

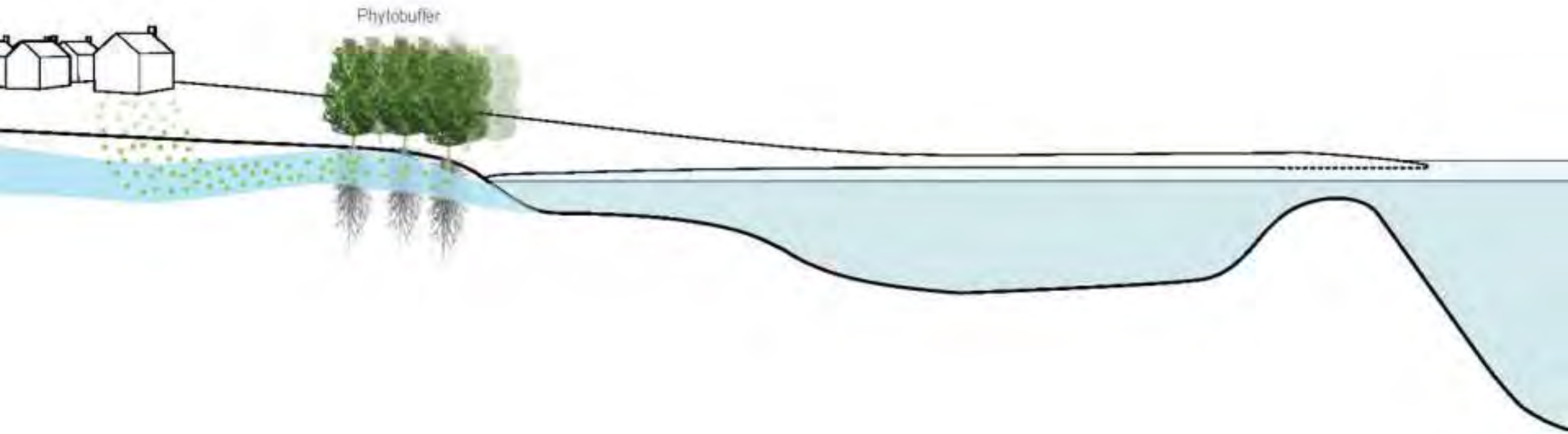
Phytoirrigation

Precedent: Woodburn OR, Wastewater Treatment Facility

Source: CH2MHill

Phytoirrigation


Solutions: Ex. Water
Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
IA
I/A Title 5 Systems
STEP/ STEG
STEP/STEG Collection
Advanced Treatment
IA
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
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands



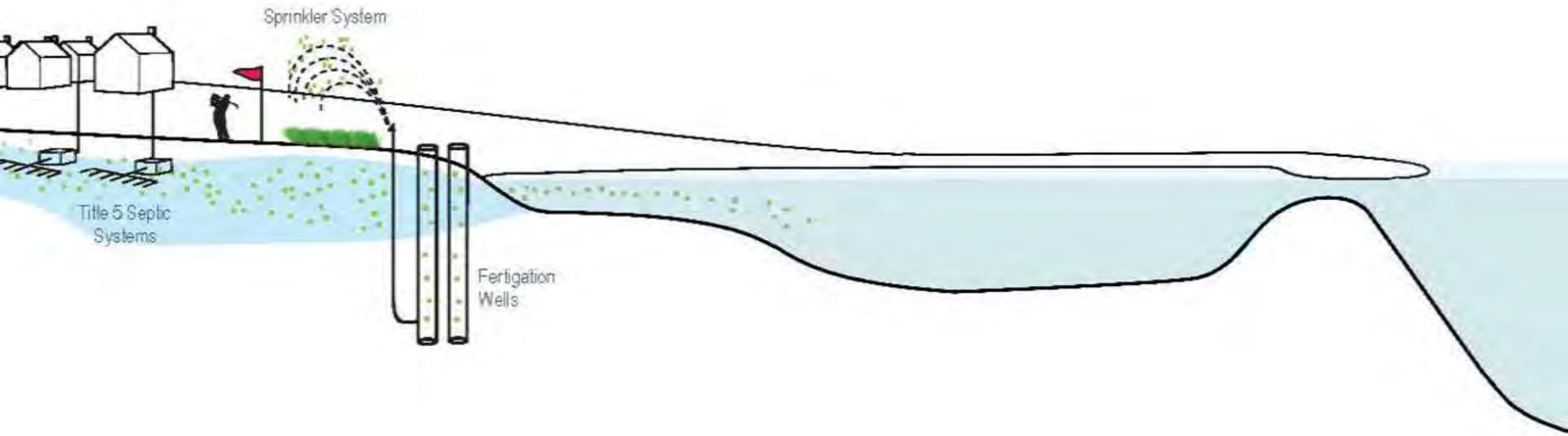
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Phytobuffers

Precedent: Phytobuffer - Kavcee, WY

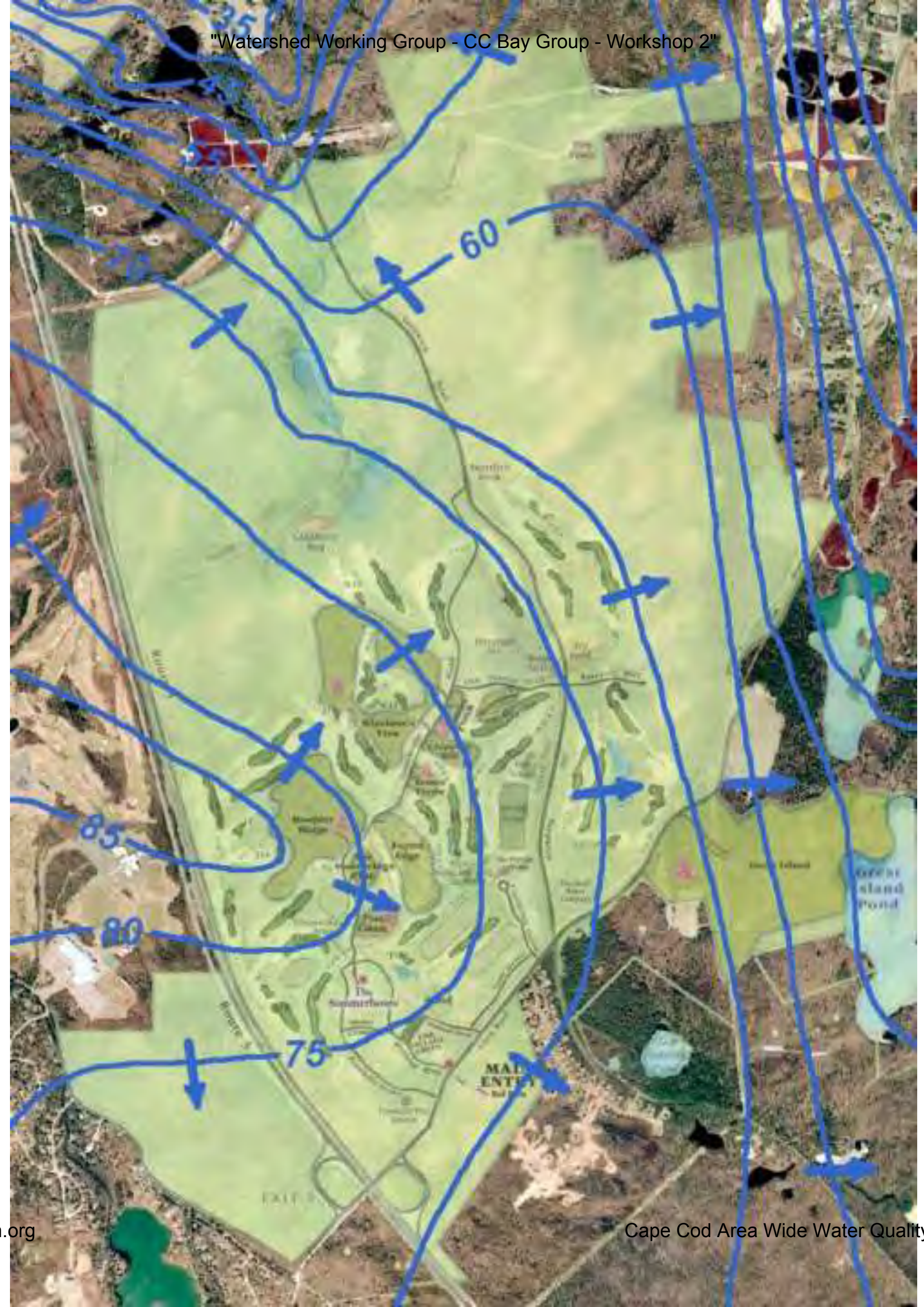
Source: Sand Creek Consultants

Phytobuffers

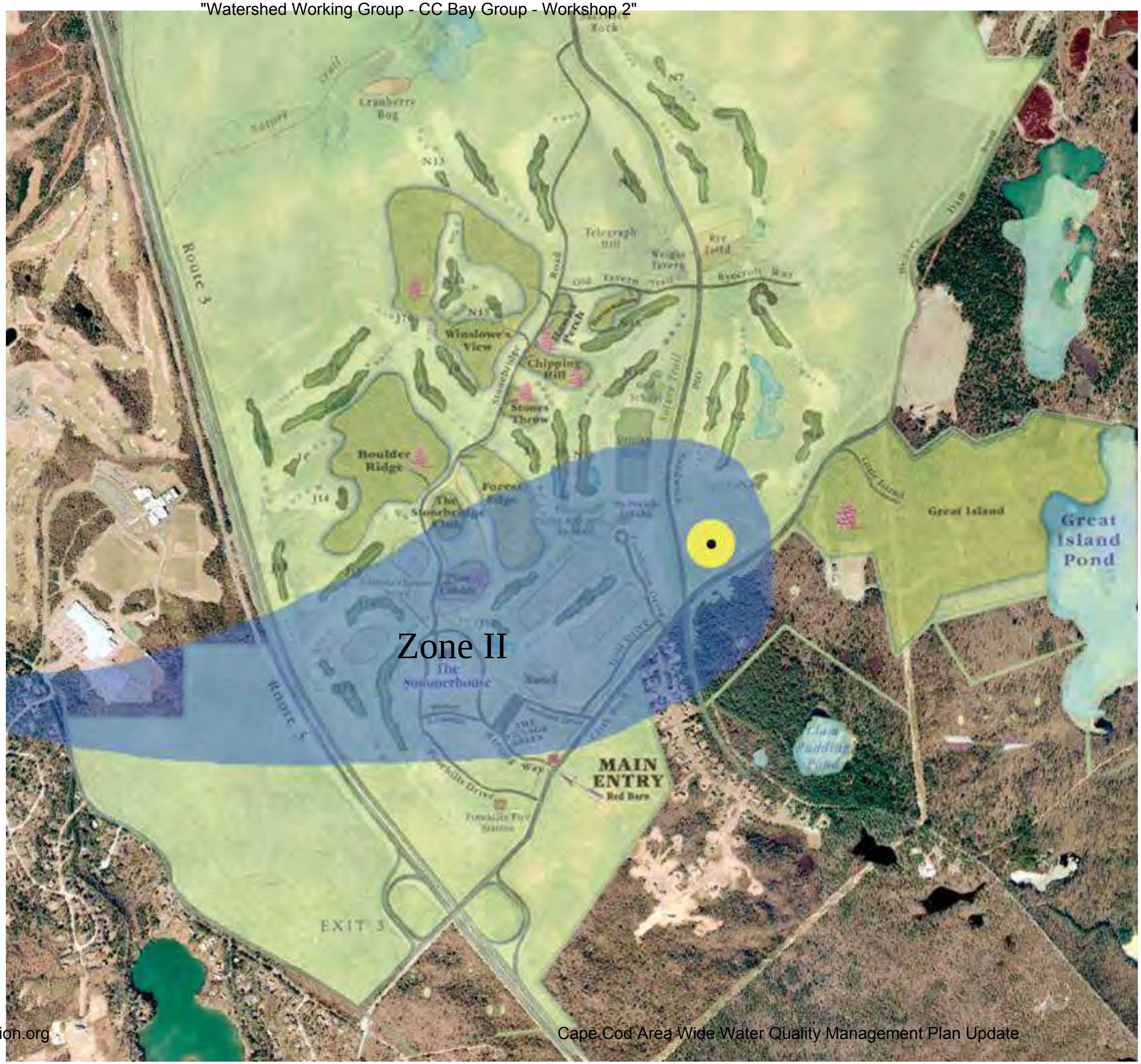


Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

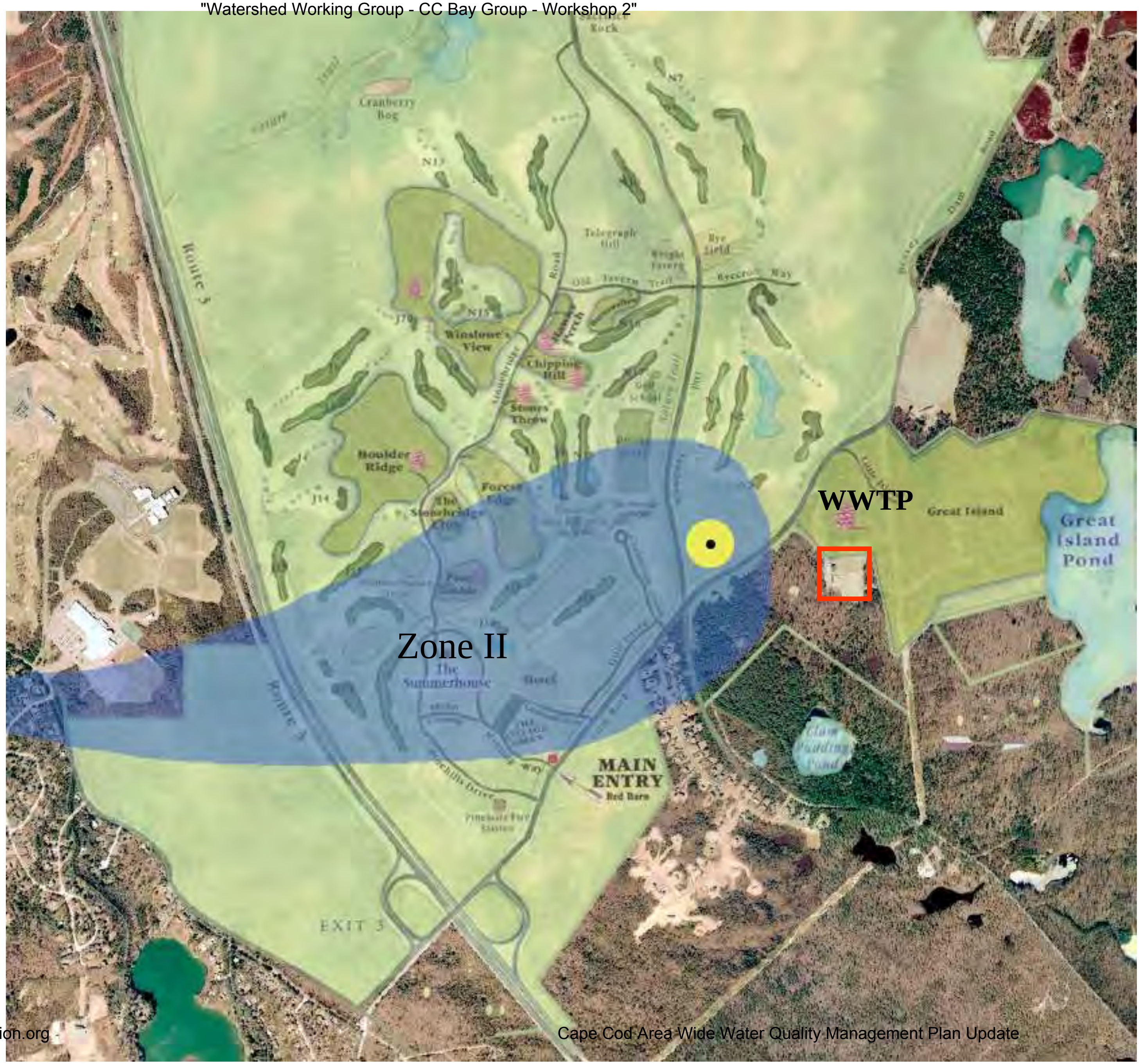
Fertigation Wells



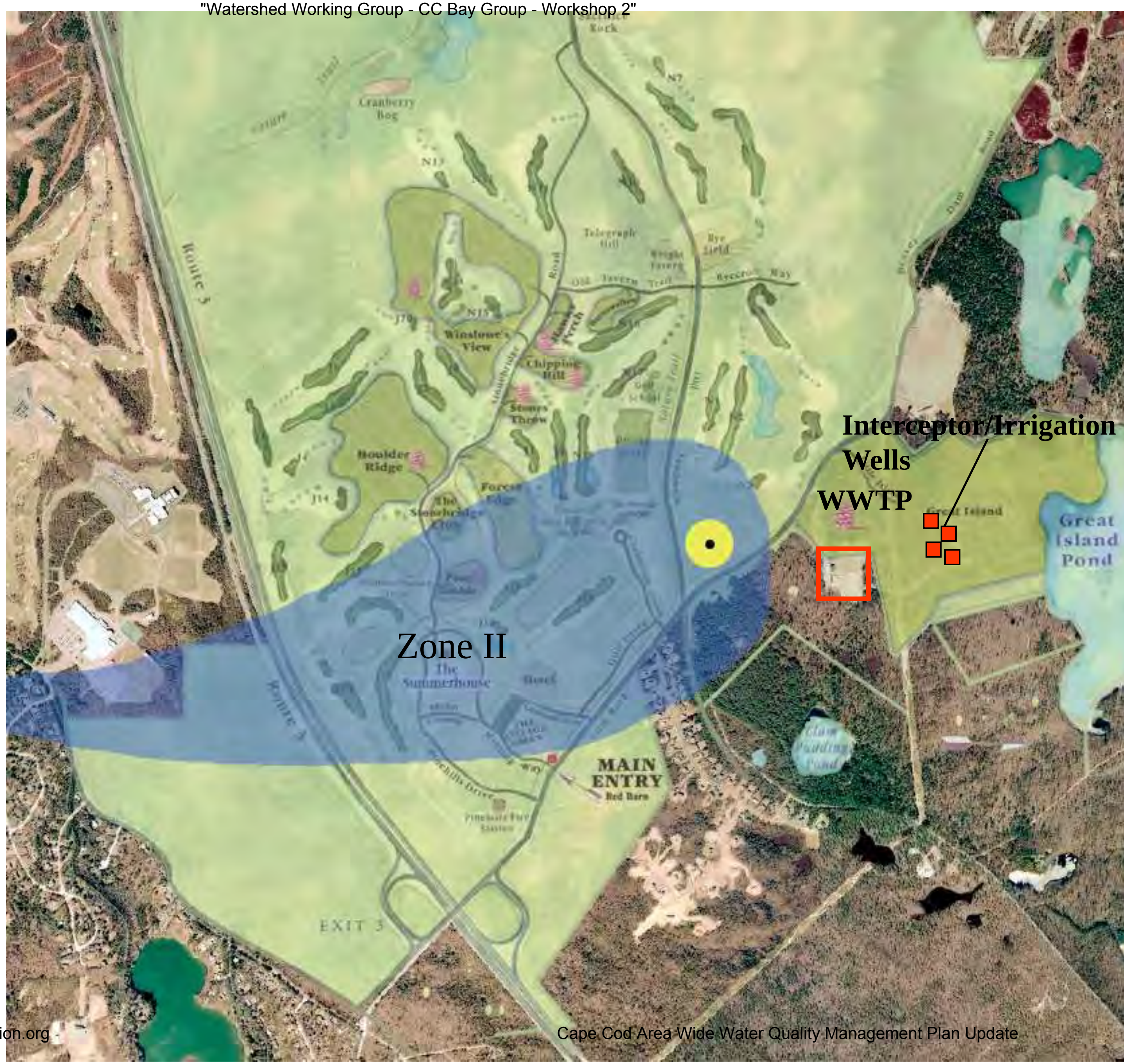
Precedent:
Pine Hills
Plymouth, MA



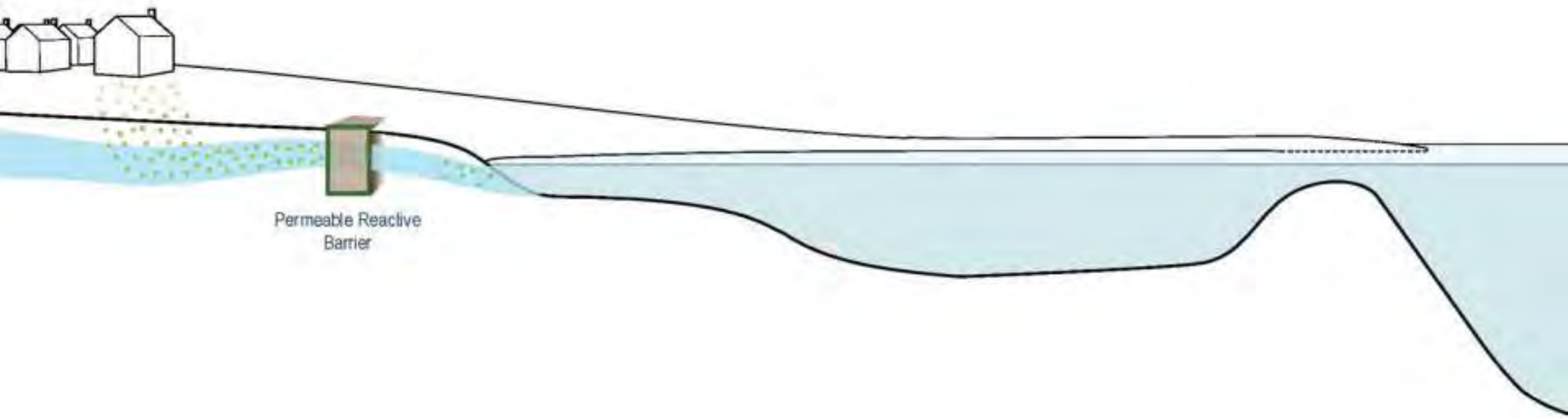
Precedent:
Pine Hills
Plymouth, MA



Precedent:
Pine Hills
Plymouth, MA

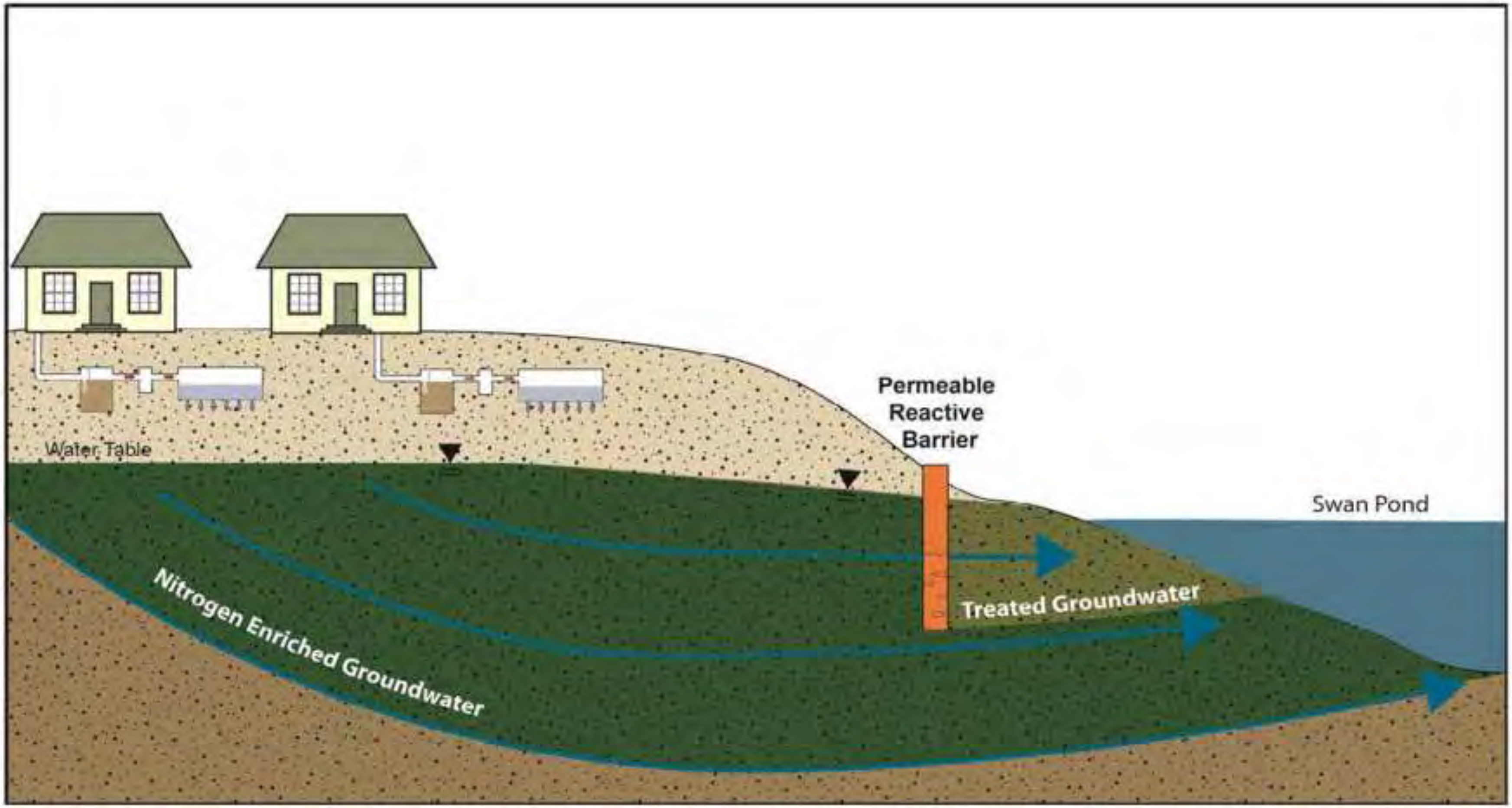


Precedent:
Pine Hills
Plymouth, MA



Scale: SITE / NEIGHBORHOOD / WATERSHED
Target: EXISTING WATER BODIES

PRB



Precedent: PRB
Source: Horsley Witten Group Inc.

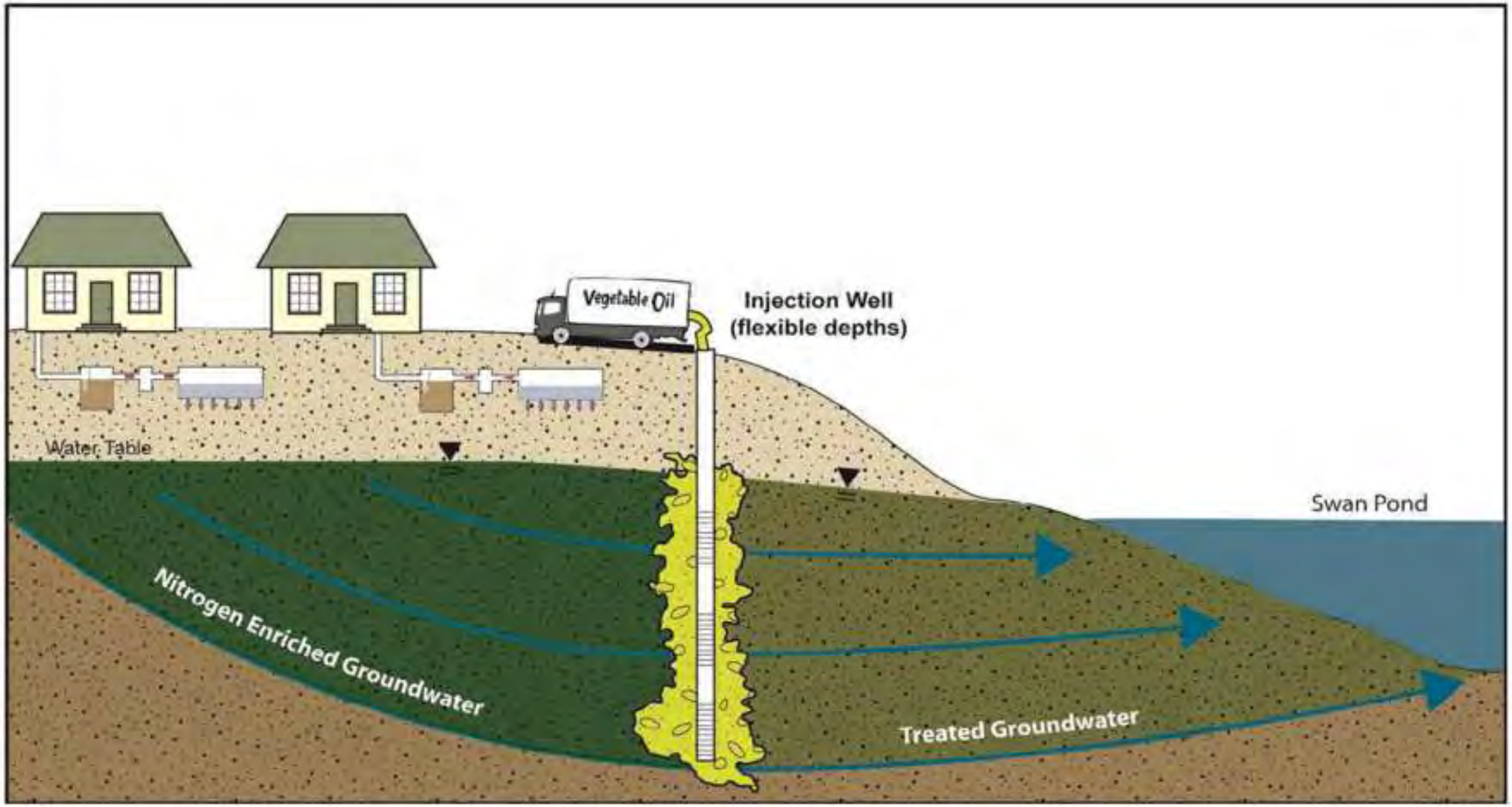
Permeable Reactive Barrier
PRB

Precedent: Falmouth PRB

Source: Mike Domenica

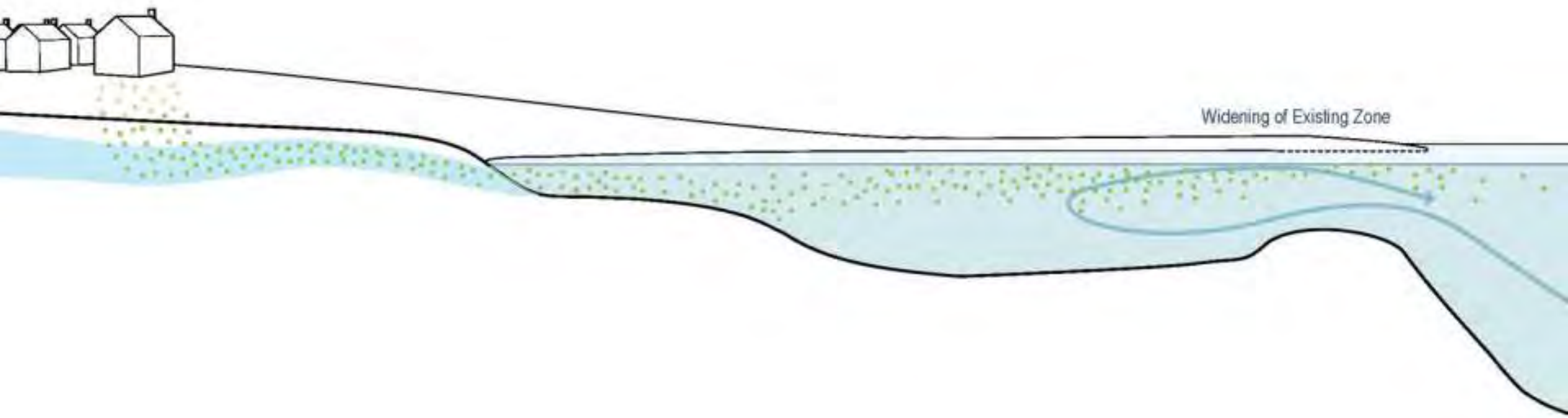
Permeable Reactive Barrier

PRB



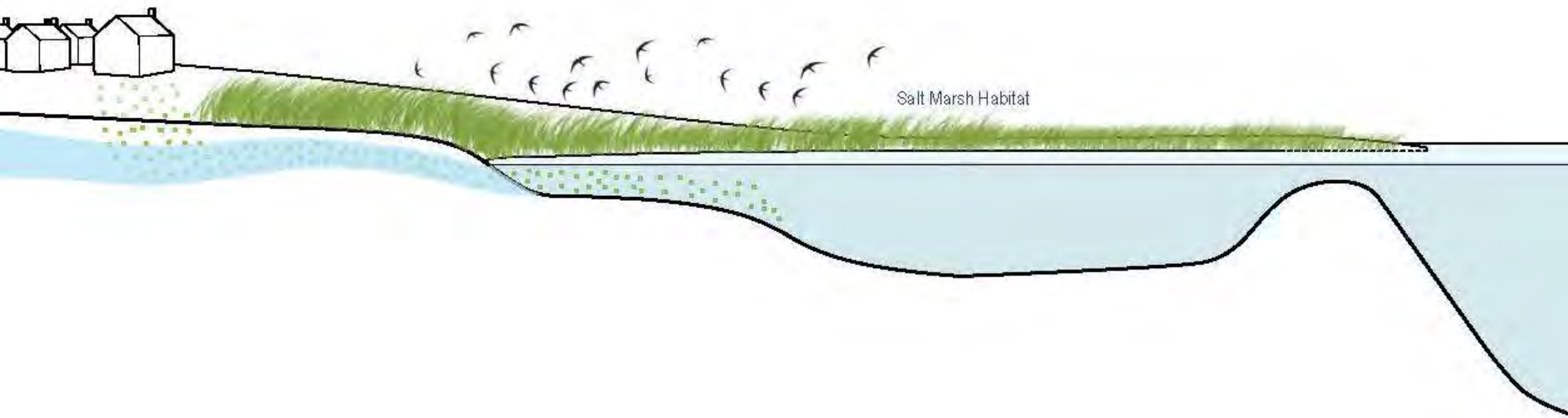
Precedent: PRB
Source: Horsley Witten Group Inc.

Permeable Reactive Barrier PRB



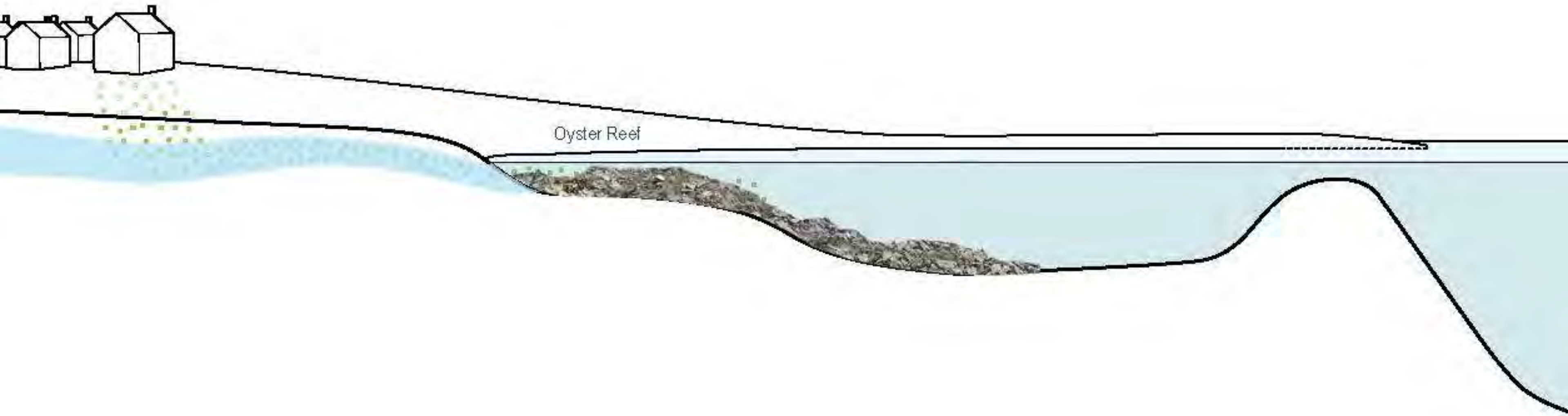
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Inlet and Culvert Widening



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Salt Marsh Habitat Restoration



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Shellfish Habitat Restoration

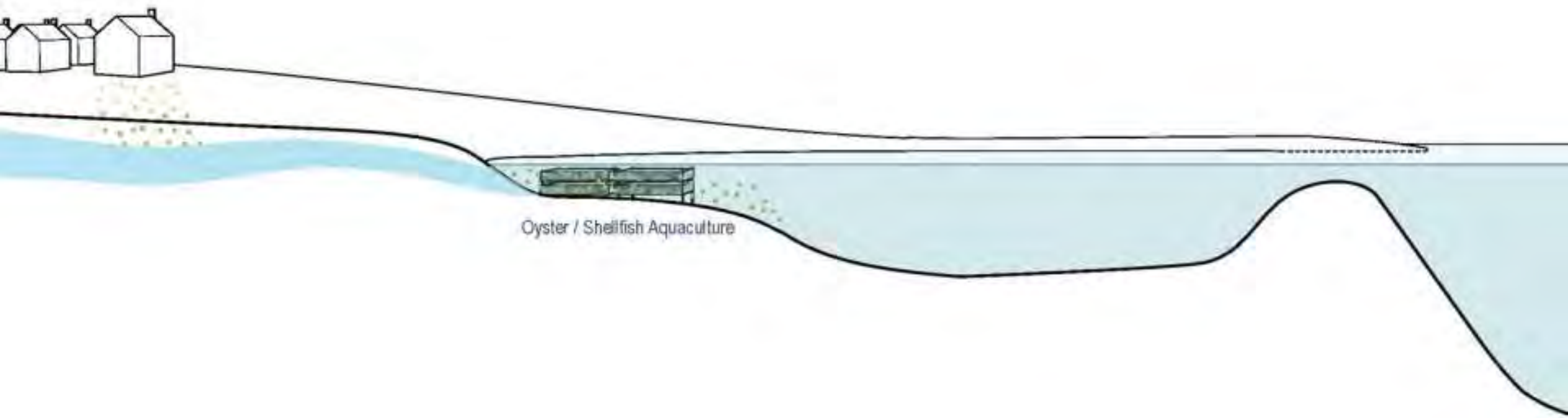
Precedent: Wellfleet Oyster Restoration Project

Shellfish Habitat Restoration

Precedent: Wellfleet Oyster Restoration Project

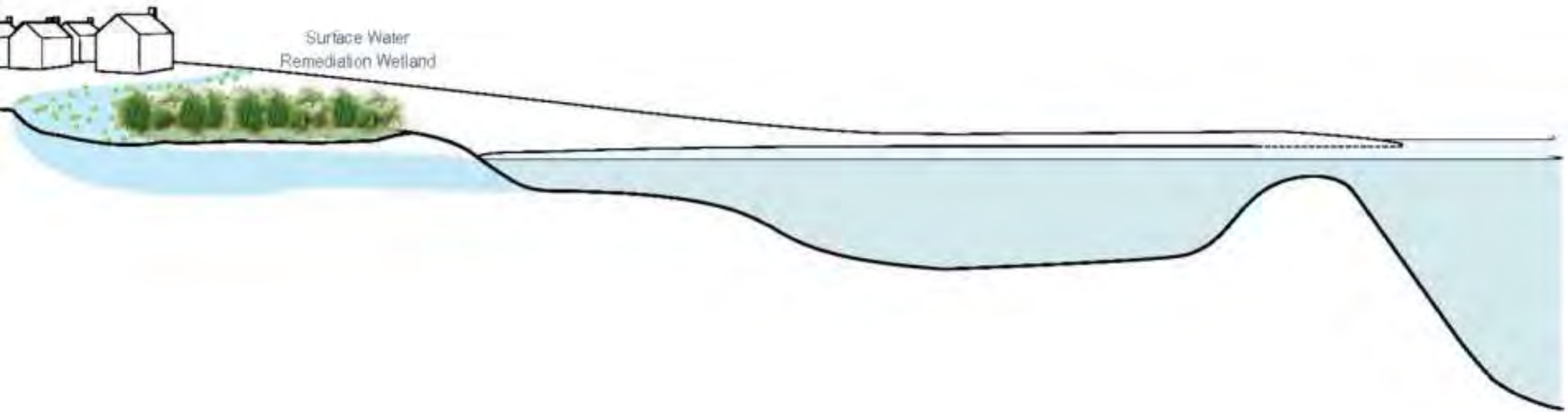
Source:

Shellfish Habitat Restoration



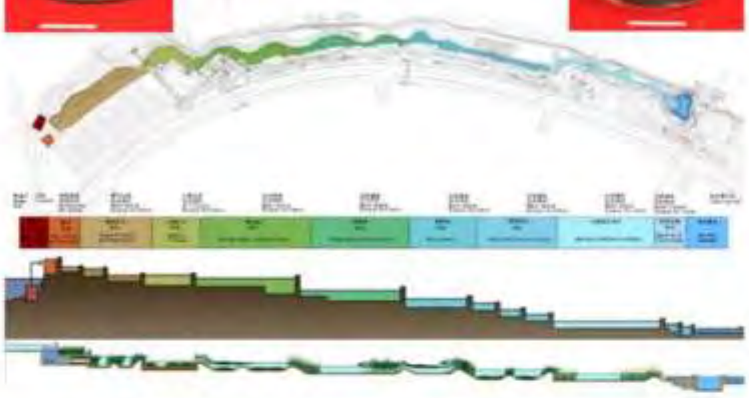
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Aquaculture / Shellfish Farming



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

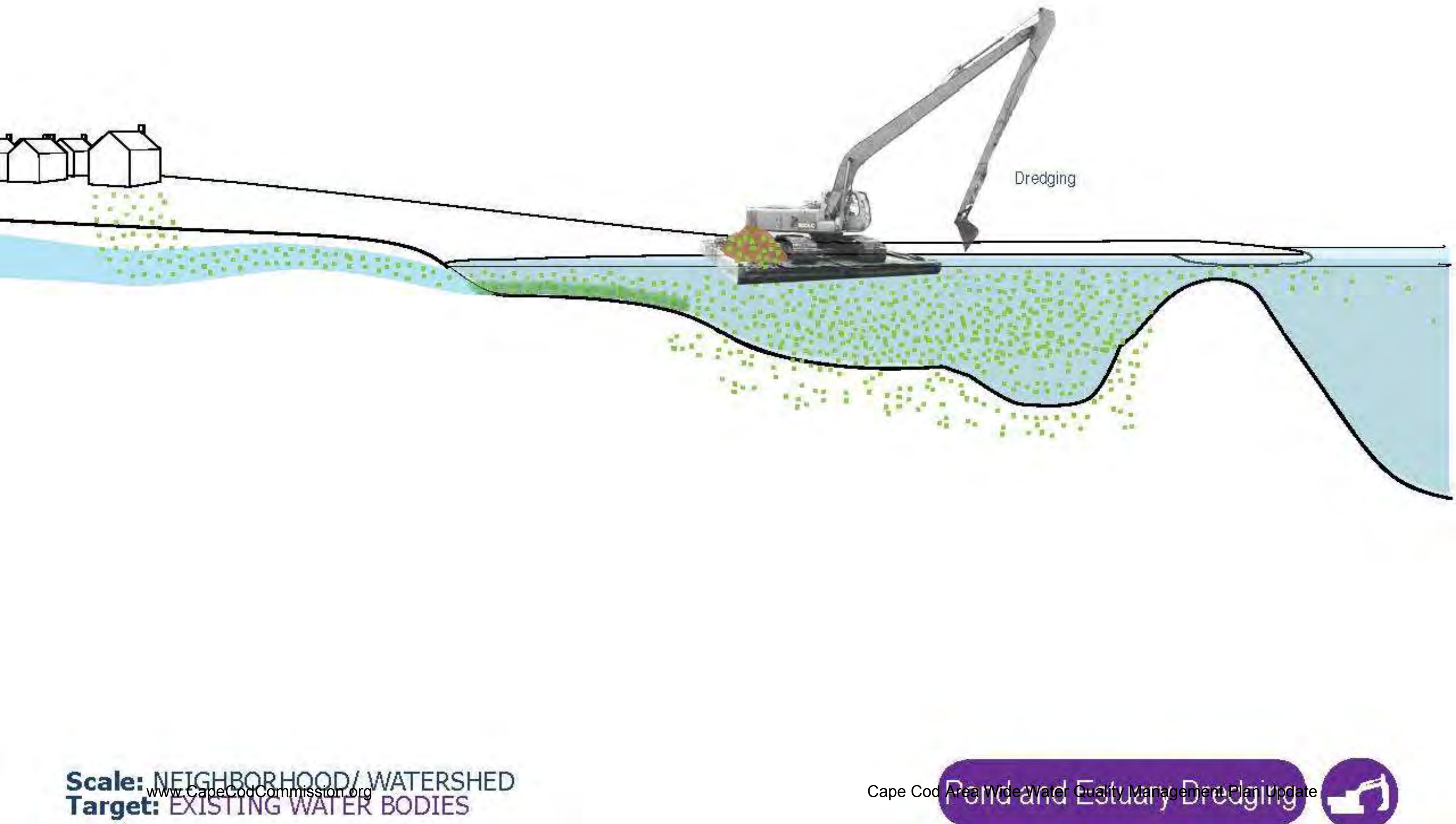
Surface Water
Remediation Wetlands



Precedent: Shanghai Houton Park

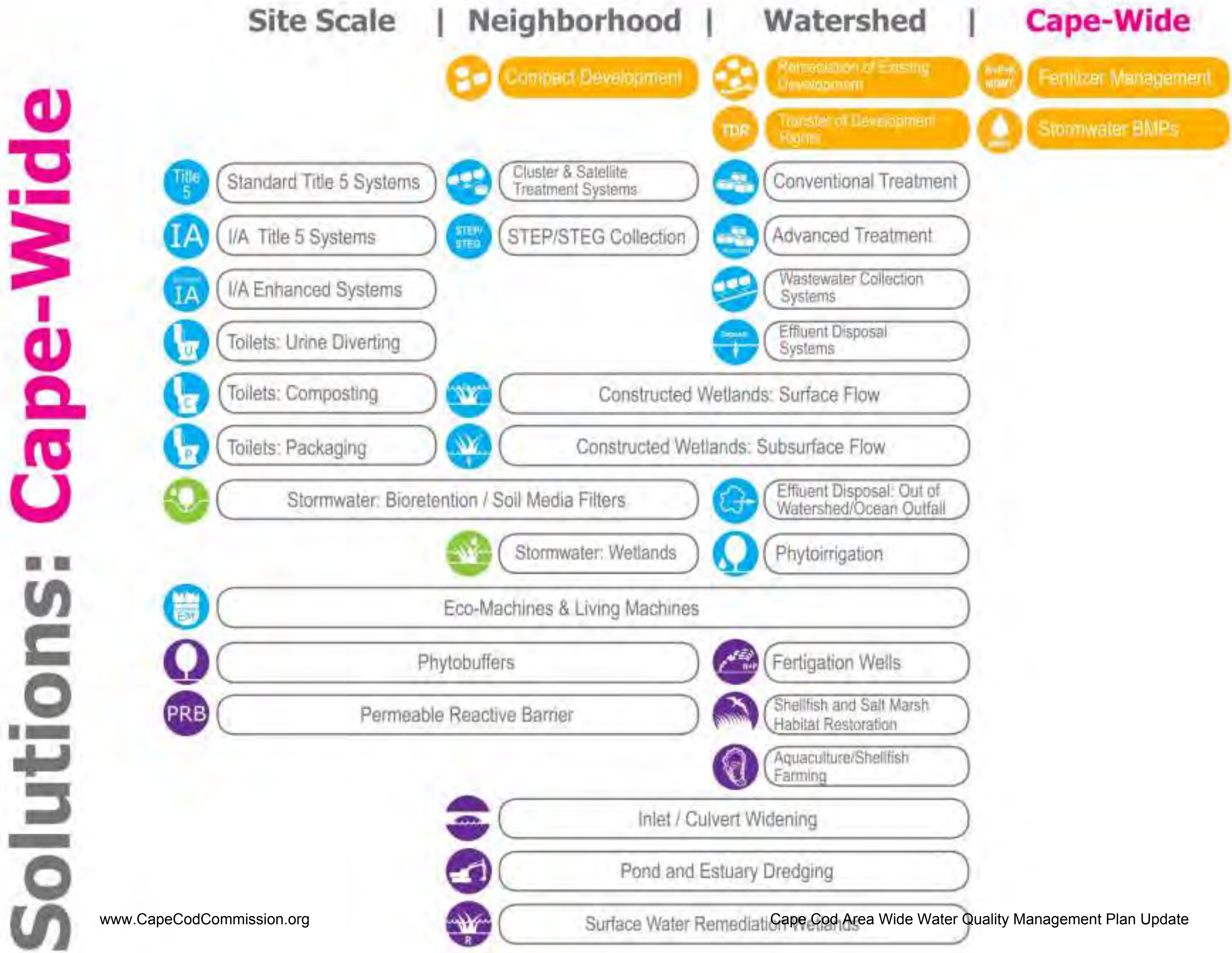
Source: Turenscape

Surface Water Remediation Wetlands


Dredging
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES
Pond and Estuary Dredging

Precedent: Pond and Estuary Dredging - Dennis, MA

Source: Cape Cod Times


Solutions: Cape-Wide
Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
IA
I/A Title 5 Systems
STEP/STEG
STEP/STEG Collection
Advanced Treatment
IA
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
EM
Eco-Machines & Living Machines
Phytobuffers
Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands

Scale: CAPE-WIDE
Target: REGULATORY

Compact Development

Scale: CAPE-WIDE
Target: REGULATORY

Fertilizer Management

N+P+K MGMT

Scale: CAPE-WIDE
Target: REGULATORY

Remediation of Existing Development

Scale: CAPE-WIDE
Target: REGULATORY

Transfer of Development Rights

TDR

Transfer of Developments Rights
The Concept

Owner of "sending" parcel sells development rights in exchange for permanent conservation easement.

Owner of "receiving" parcel buys development rights to build at densities higher than allowed under base zoning.

Source: Massachusetts Smart Growth Toolkit

Scale: CAPE-WIDE
Target: REGULATORY

Stormwater BMPs

Town Consideration of Alternative Technologies & Approaches

Wellfleet- *Coastal habitat restoration & aquaculture*

Mashpee- *Aquaculture & Expanding Existing Systems*

Brewster- *PRB & Bioswales*

Orleans- *Fertilizer Control By-Law*

Harwich- *Muddy Creek & Cold Brook Natural Attenuation*

Falmouth- *Aquaculture*
Inlet Widening
Eco-Toilet Demonstration Project
PRBs
Stormwater Management (Little Pond Watershed)
Fertilizer Control By-Law
Subsurface Nitrogen Removal Septic Systems


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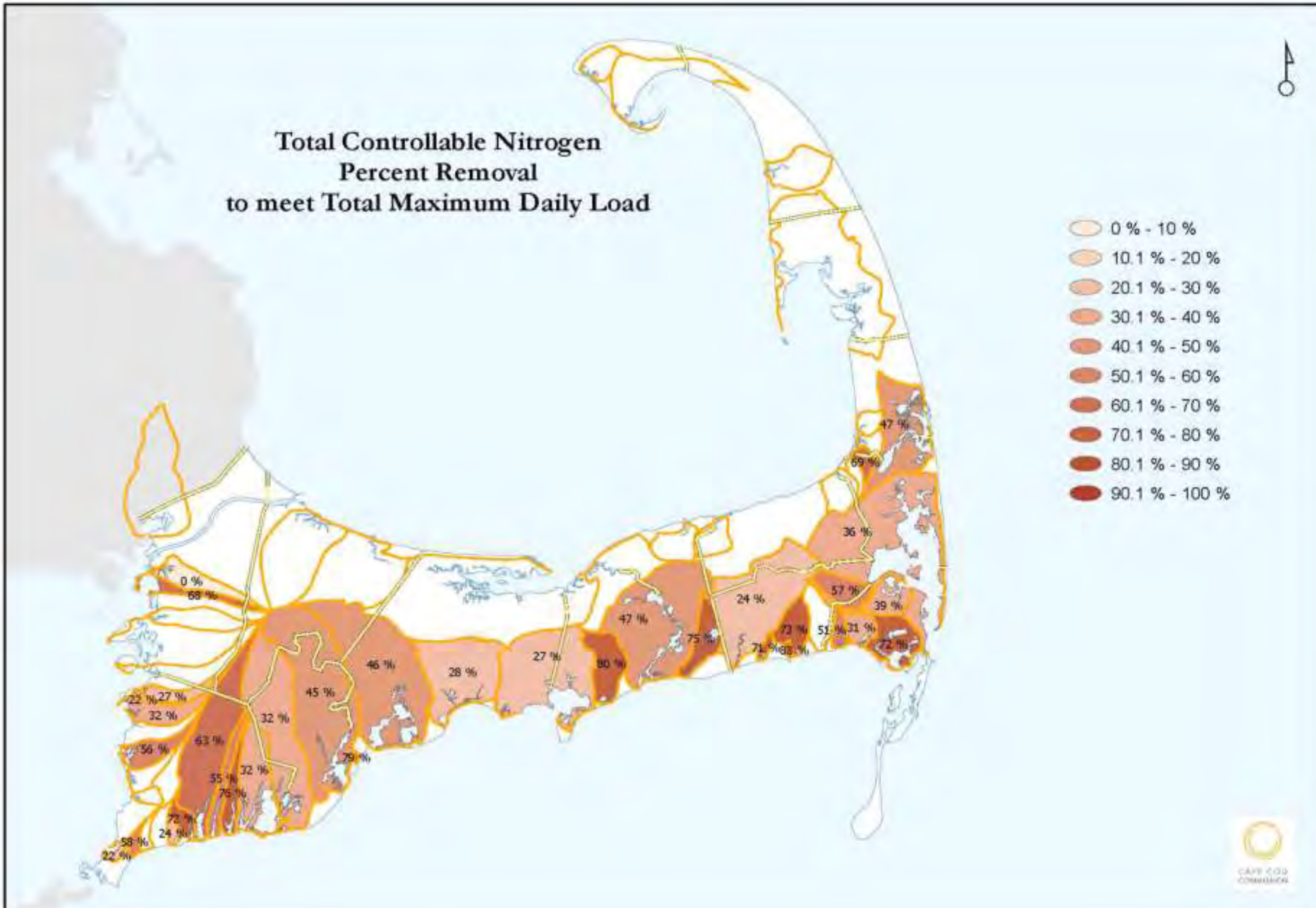
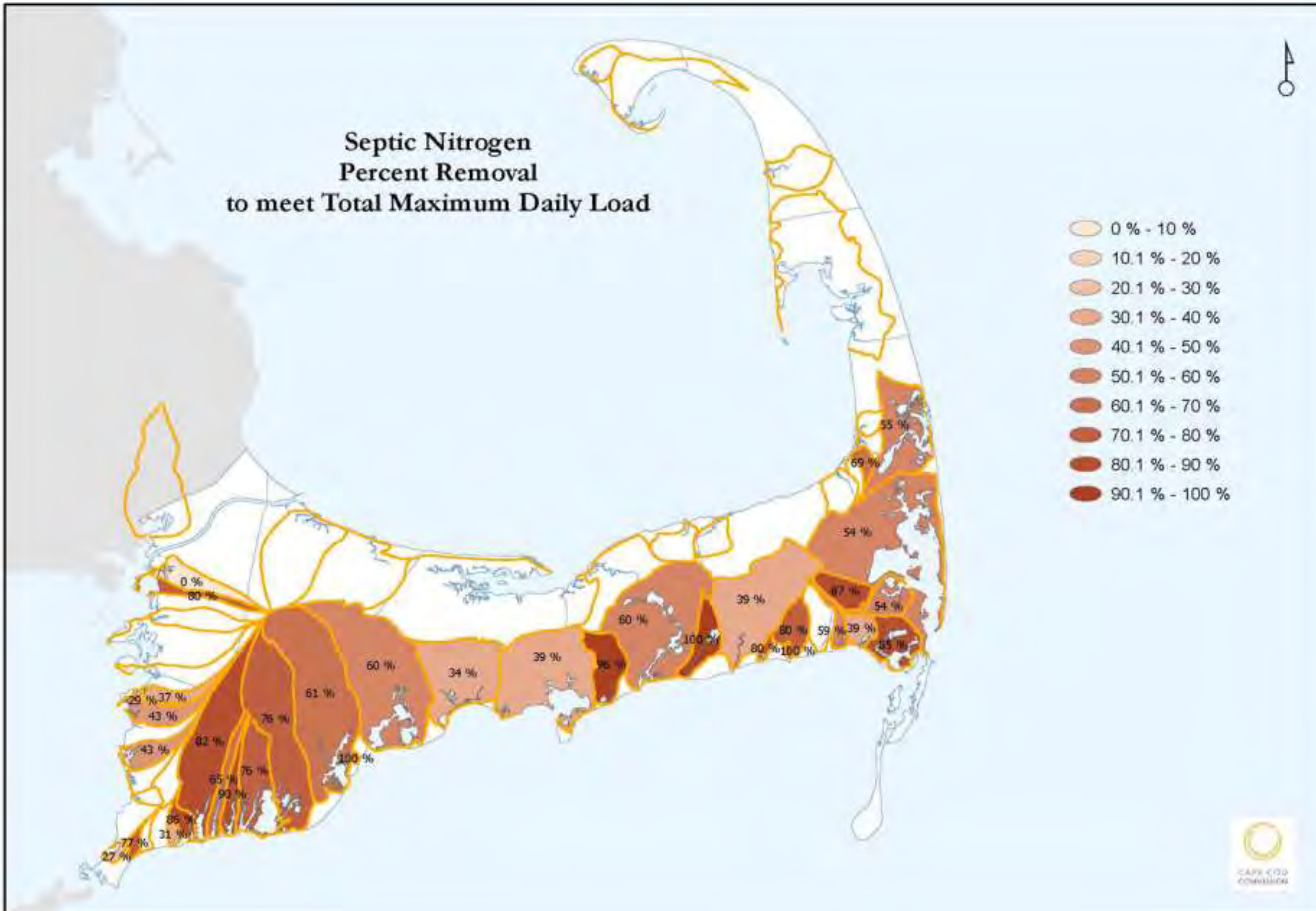
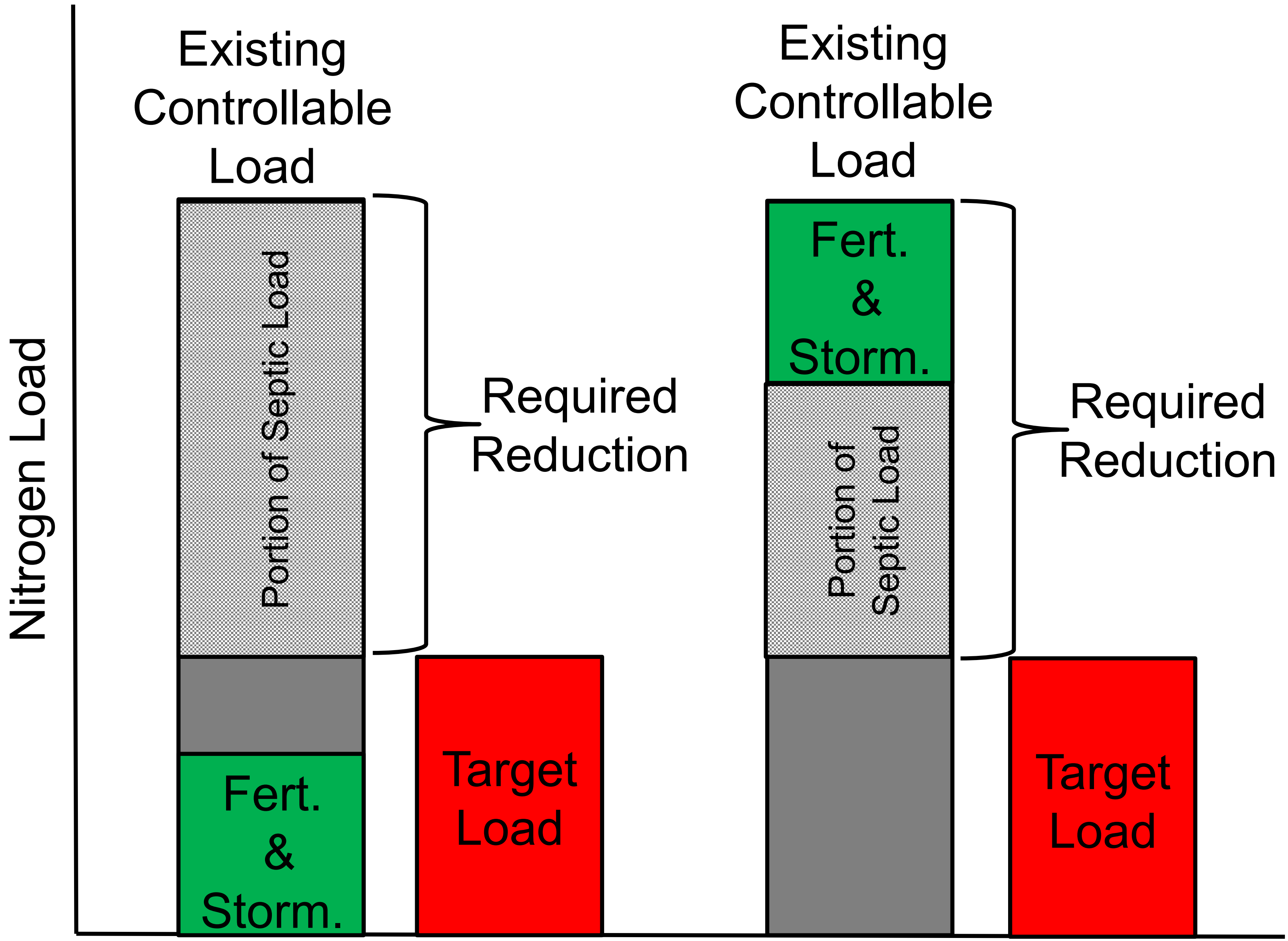
Constructed Wetlands: Surface Flow
Toilets: Packaging
Constructed Wetlands: Subsurface Flow
Stormwater: Bioretention / Soil Media Filters
Effluent Disposal: Out of Watershed/Ocean Outfall
Stormwater: Wetlands
Phytoirrigation
EM
Eco-Machines & Living Machines
Phytobuffers
Fertigation Wells
PRB
Permeable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


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


Total Controllable Nitrogen
Percent Removal
to meet Total Maximum Daily Load
0 % - 10 %
10.1 % - 20 %
20.1 % - 30 %
30.1 % - 40 %
40.1 % - 50 %
50.1 % - 60 %
60.1 % - 70 %
70.1 % - 80 %
80.1 % - 90 %
90.1 % - 100 %
47 %
69 %
36 %
57 %
39 %
24 %
51 %
31 %
72 %
73 %
71 %
75 %
47 %
80 %
27 %
28 %
46 %
45 %
32 %
79 %
0 %
68 %
22 %
27 %
32 %
56 %
63 %
55 %
76 %
32 %
72 %
24 %
58 %
22 %


Septic Nitrogen
Percent Removal
to meet Total Maximum Daily Load
0 % - 10 %
10.1 % - 20 %
20.1 % - 30 %
30.1 % - 40 %
40.1 % - 50 %
50.1 % - 60 %
60.1 % - 70 %
70.1 % - 80 %
80.1 % - 90 %
90.1 % - 100 %


Nitrogen Load
Existing Controllable Load
Portion of Septic Load
Fert. & Storm.
Required Reduction
Target Load
Existing Controllable Load
Fert. & Storm.
Portion of Septic Load
Required Reduction
Target Load

Problem Solving Approach

Wastewater | Existing Water Bodies | Regulatory

1 Targets/Reduction Goals

Present Load: X kg/day − **Target:** Y kg/day = **Reduction Required:** N kg/day

2 Other Wastewater Management Needs

A. Title 5 Problem Areas
B. Pond Recharge Areas
C. Growth Management

3 Low Barrier to Implementation

A. Fertilizer Management
B. Stormwater Mitigation

4 Watershed/Embayment Options

A. Permeable Reactive Barriers
B. Inlet/Culvert Openings
C. Constructed Wetlands
D. Aquaculture

5 Alternative On-Site Options

A. Eco-toilets (UD & Compost)
B. I/A Technologies
C. Enhanced I/A Technologies
D. Shared Systems

6 Priority Collection/High-Density Areas

A. Greater Than 1 Dwelling Unit/acre
B. Village Centers
C. Economic Centers
D. Growth Incentive Zones

7 Supplemental Sewering

Triple Bottom Line

Impacts of Technologies and Approaches

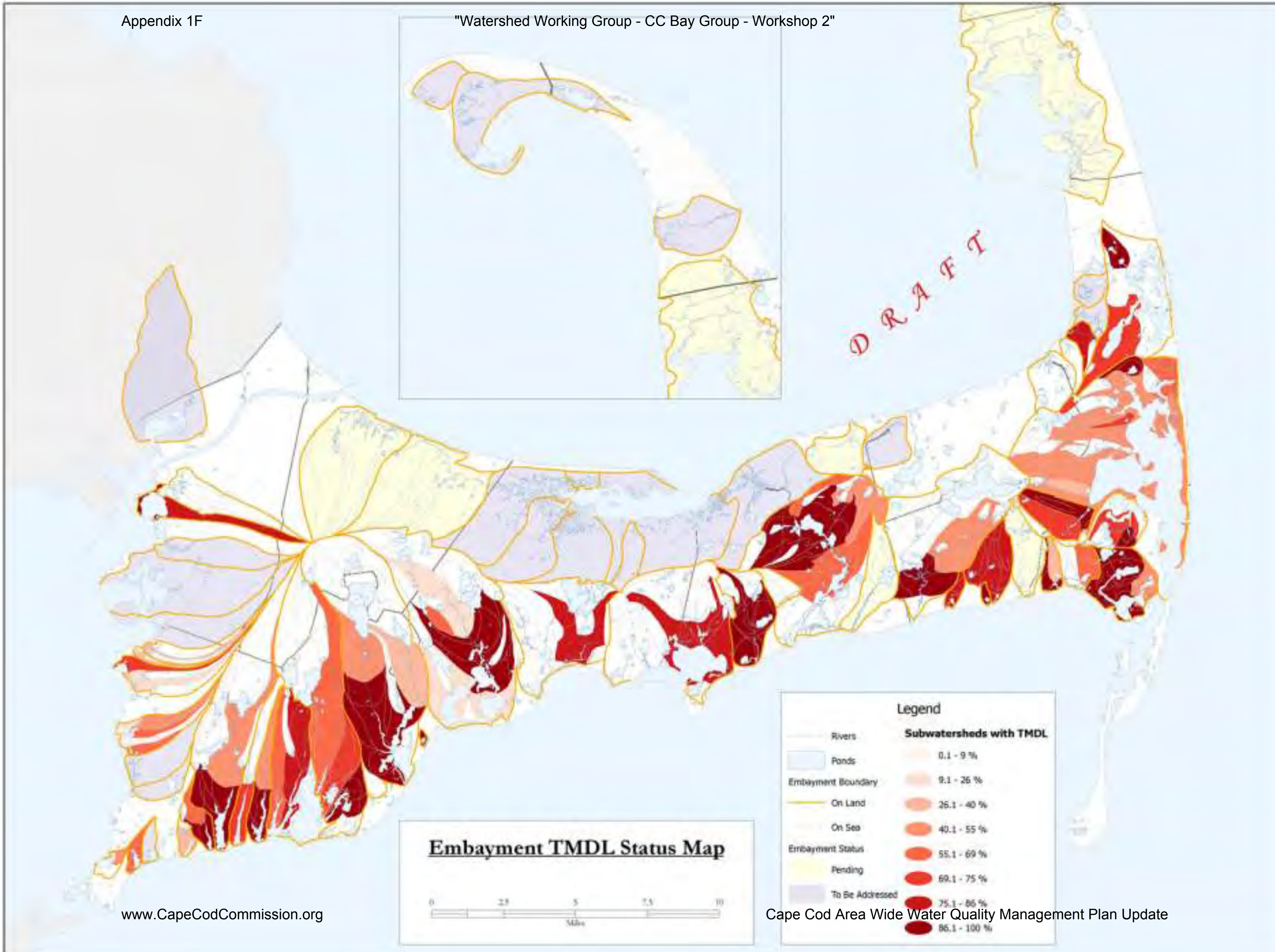
Environmental

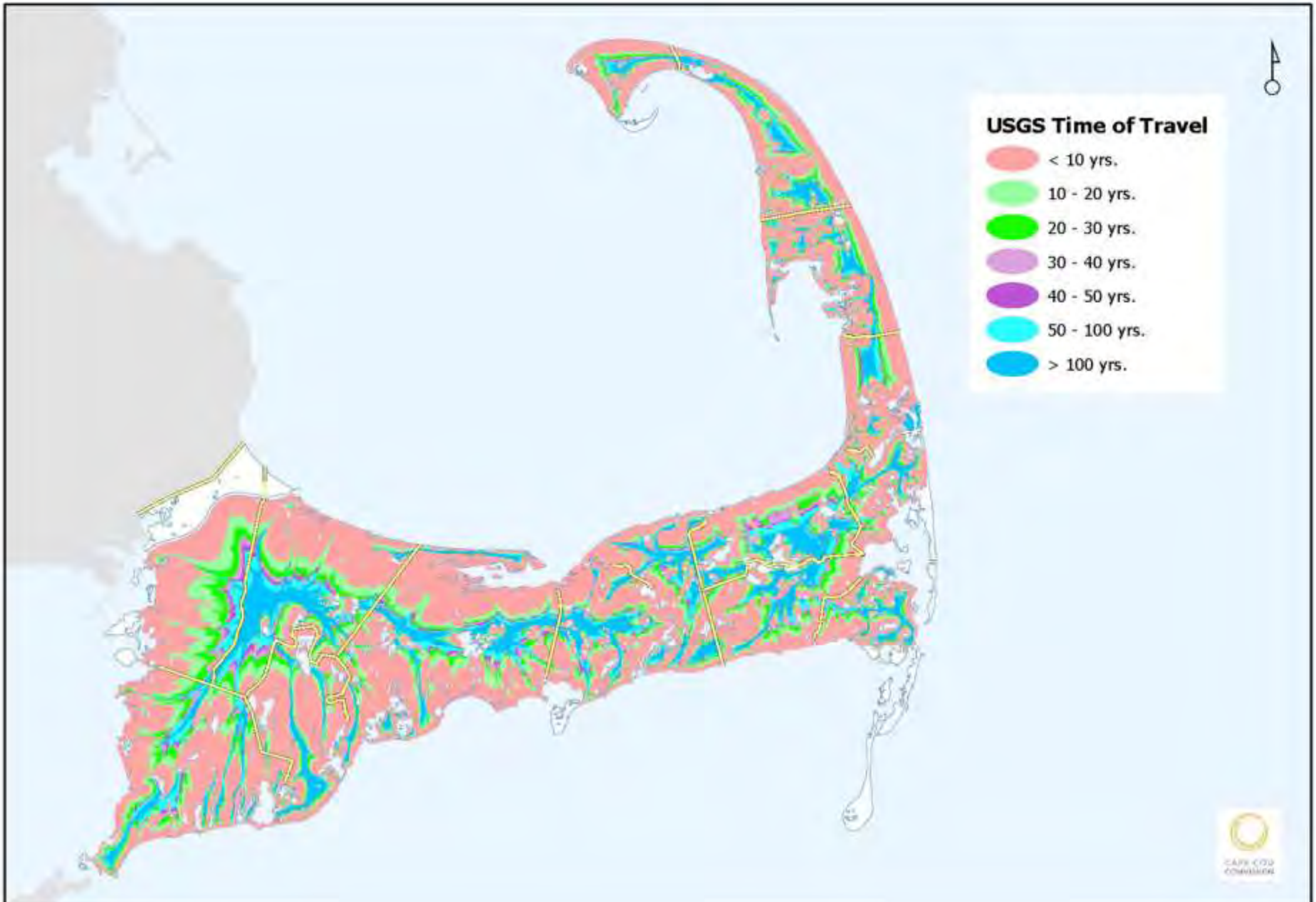
Economic

Social

Technology Selection: Process and Principles

- 100% septic removal subwatershed
- Scale: On-Site vs. Collection System vs. Natural System
- Nutrient intervention and time of travel
- Permitting Status
- Land use and Impacts of Growth


DRAFT
Embayment TMDL Status Map
0 2.5 5 7.5 10
Miles
Legend
Rivers
Ponds
Embayment Boundary
On Land
On Sea
Embayment Status
Pending
To Be Addressed
Subwatersheds with TMDL
0.1 - 9 %
9.1 - 26 %
26.1 - 40 %
40.1 - 55 %
55.1 - 69 %
69.1 - 75 %
75.1 - 86 %
86.1 - 100 %


USGS Time of Travel
< 10 yrs.
10 - 20 yrs.
20 - 30 yrs.
30 - 40 yrs.
40 - 50 yrs.
50 - 100 yrs.
> 100 yrs.

Preparing for Meeting 3 and Beyond

- Review tools and alternatives analysis approach
- Evaluating scenarios for meeting water quality goals
- Attend the November 13th meeting:

6:00
Cape Cod Museum of Art
Dennis, MA

Cape Cod 208 Area Water Quality Planning
Upper Cape West and South Watershed Working Group

Meeting Two
Friday October 25, 2013
8:30 am- 12:30 pm
Falmouth Town Hall, 59 Town Hall Square, Falmouth, MA 02540

I. ACTION ITEMS

Working Group

- Next meeting: Meeting Three
  Monday, December 2, 2013; 8:30AM -12:30PM
  Falmouth Town Hall, 59 Town Hall Square, Falmouth, MA 02540
- Send CBI any additional comments on meeting one draft summary by November 1
- Review the Technology Matrix and continue to prepare thoughts about which technologies/approaches of interest for application in the watersheds of the Upper Cape West and South. Different scenarios and options will be discussed during Meeting Three.

Consensus Building Institute

- Finalize meeting one summary and distribute to the working group.
- Draft and solicit feedback from the working group on meeting two draft summary.

Cape Cod Commission

- Share the technology matrix and updated chronologies with the working group.
- Add incinerating toilets to the matrix of technologies.
- Verify whether or not the eco machine example from South Burlington, Vermont was abandoned.
- Add tertiary treatment to ocean outfall slide
- Add to the technology matrix biomass accumulation data and maintenance information for phytobuffers.

II. WELCOME, REVIEW 208 GOALS AND PROCESS AND THE GOALS OF MEETING

Mr. Doug Thompson, the facilitator from the Consensus Building Institute, and Ms. Erin Perry, Special Projects Coordinator at the Cape Cod Commission, welcomed participants. Ms. Perry offered an overview of the 208 Update stakeholder process.[1] In July, public meetings were held

[1] The PowerPoint Presentation made at this meeting is available at: http://watersheds.capecodcommission.org/index.php/watersheds/upper-cape/upper-cape-west-south

across the Cape to present the 208 Plan Update goals, work plan, and participant roles. Public meetings were also held in August to present information on the affordability and financing of the updated comprehensive 208 Plan. The first meetings of the eleven Watershed Working Groups were held in September and focused on baseline conditions in each of the watersheds. The second meeting of each Watershed Working Groups will be held in October and early November and are focused on exploring technology options and approaches. The third meeting of each Watershed Working Groups will be held in December and focus on evaluating watershed scenarios which will be informed by Working Groups' discussions about baseline conditions, priority areas, and technology options/approaches. This conversation will also be informed by information shared in the Technology Matrix, which was developed by the Cape Cod Commission with technical input from the Technical Advisory Committee of the Cape Cod Water Protection Collaborative and the Technology Panel. The Technology Matrix builds on the information presented in the Technology Fact Sheets, which Working Group members reviewed in advance of the meeting.[2] Once finalized by the Cape Cod Commission, the Technology Matrix will be shared with Working Group Members.

Ms. Perry shared the 208 Plan team's progress since Meeting One, which includes:

- Meeting materials distributed to stakeholders and available at: http://watersheds.capecodcommission.org
- GIS data layers accessible at: http://watersheds.capecodcommission.org
- Chronologies are being updated and will be made available soon.

Ms. Perry also shared that the second round of Cape$_2$O game launched on October 22. She noted that over 400 people registered for the first round of the Cape$_2$O game and encouraged Working Group members to participate in the interactive, online game, which provides valuable education and input to the Cape Cod Commission.

Ms. Perry announced a Cape Cod wide event on November 13 at the Cape Cod Center for the Arts in Dennis. Participants from across the eleven Watershed Working Groups and the public are invited to attend the event which will include: Wrap up of Cape$_2$O: ur in charge; a summary of planning process to date; and discussion of the stakeholder role in the second six months of the 208 planning process

Ms. Perry reviewed the goal of the meeting:

- To develop a shared understanding of the potential technologies and approaches identified to date, and the benefits and limitations of each; to explore the environmental, economic, and community impacts of a range of categories of solutions;

[2] Technology Fact Sheets are available at: http://watersheds.capecodcommission.org/index.php/groupjive/pluginclass?plugin=cbgroupjive&action=plugin&func=file_download&cat=1&grp=19&id=30

and to identify priorities and considerations for applying technologies and approaches to remediate water quality impairments in your watershed.

Ms. Patty Daley, Deputy Director at the Cape Cod Commission and Area Manager for the Upper Cape West and South Watershed Working Group, commented that during the September meetings all the Watershed Working Groups had robust discussions about the buildout the Commission plans to use for the 208 Plan Update. She indicated the Commission will convene meetings in November to further discuss the buildout with the town representatives.

The facilitator reviewed the agenda and led introductions. A participant list is found in Appendix A. Mr. Dan Milz, a doctoral student from University of Illinois at Chicago, introduced himself and announced he would be filming the meetings as part of his dissertation research on regional environmental planning and stakeholder decision making on issues that cross jurisdictional boundaries. He said he will not publish the film or identify anyone by name in any of the documents he will produce. He will attend many meetings and is available to answer group member questions about his research.

The facilitator reviewed the meeting guidelines and spoke briefly about communication protocols. Noting that group members should not be dissuaded from communicating between themselves, he requested group members send communications about group processes to him rather than sending them to the entire group. He will then forward germane emails to the group as a whole. Questions about substantive issues should be sent to both Ms. Daley and him.

III. RANGE OF POSSIBLE SOLUTIONS

Ms. Daley led the discussion of the range of possible solutions. As Working Groups learn more and consider the pros and cons of the technologies and approaches, she encouraged participants keep in mind that:

- The Cape Cod Commission has engaged in a comprehensive analysis of nutrient control technologies and approaches. This analysis is distilled into: the Technology Fact Sheets, which present various information on the technologies being considered; the Technology Matrix, which includes additional information on site requirements, construction, project and operation and maintenance costs, reference information, and regulatory comments; and ongoing input from stakeholders on the public acceptance of technology options and approaches.
- Not all of the technologies and approaches will be applicable to Cape Cod.
- Some technologies are so promising that we should identify them for demonstration and pilot projects.
- Workshop three will embark on hands on problem solving in each watershed to meet target load reductions.
- Certain technologies or approaches will be effective at preventing nutrients from

entering the water body. Others will be effective at reducing or remediating nutrients that are already in the groundwater or water body.
- Regulation can address nutrient controls for both existing and future development.

Ms. Daley offered a brief overview of the technologies and approaches. The following section briefly describes each technology. Participants' questions and comments about the technologies are also discussed below (in *italics)*:

Site level technologies/approaches

Standard Title V System*:* This is a standard septic system that consists of a septic tank and soil adsorption system (leaching field). The system was primarily designed to address public health concerns related to waste in drinking water (e.g. coliform bacteria); they were not designed to remove nutrients (e.g. nitrogen).

I/A title V System: Innovative/Alternative (I/A) on-site nutrient reducing systems typically consist of standard septic system components augmented to remove more nutrients than a standard Title 5. I/A systems refer to a class of systems intended to be designed as recirculating sand filter (RSF) equivalents by meeting the same treatment limits in a smaller footprint. The Cape Cod Commission will post George Huefelder's (Barnstable County Department of Health and Environment) baseline data soon.
- *We should note that there is an ever widening range of I/A systems, some of which may be Title V compliant and others that may not be compliant. We are fortunate to have access to Huefelder's research, but given the wide range of I/A systems that are encompassed in the slide describing I/A's, there may be use in applying a weighting scheme to different I/A system alternatives*.

Urine Diverting Toilets: Urine diversion systems send urine into a holding tank where the urine is stored and periodically collected by a servicing company. The servicing company empties the tank for disposal or recycling such as conversion to a fertilizer. Through these means, the nitrogen may be removed from the watershed. With urine diverting toilets, the remainder of the human waste and all other water uses (sink and shower) continue to go to the septic system. (Case example: Falmouth, MA).

Composting toilets: A toilet system that separates human waste from shower, sink and other household water uses. The composting toilets use no or minimal water. The human waste captured by the composting toilets is decomposed and turned into compost. The compost generated is removed from the site and nutrients can be recycled. Composting toilets require the replacement of existing toilet(s) and room in the basement for a container to capture and compost the human waste. Household water uses (sink and shower uses) continue to flow to the septic system. (Case example: Falmouth, MA).
- *It was mentioned the residuals go to a disposal site, but some eco-toilets recycle and recover nutrients.*

Packaging toilets: A packaging toilet encapsulates human waste in a durable material for removal from the site. The package is stored beneath the toilet and removed and taken away when full. The nutrients can be recycled by the servicing company that picks up the packages.

Stormwater bioretention: Bioretention systems utilize natural plant and soil functions to capture and treat stormwater runoff for a variety of contaminants including nutrients. A typical system consists of an underdrain/gravel layer, a layer of bioretention soil mix (a mix of sand, compost, woodchips and loam), and a surface layer containing appropriate plantings. The treated water can be discharged into a water body or used for open space irrigation after treatment. The reclaimed water can also be discharged into a subsurface infiltration system for discharge to the groundwater. (Case example: Portland, OR).

The group made the following general comments and questions about site based technologies:

- The group discussed the need for an enforceable monitoring system of site-based technologies: One member said *the optimal functioning of several of the onsite technologies is heavily user dependent and questioned how the state could enforce proper operation and maintenance*. Another member said *this project should to try to drive industry to create systems that enable remote monitoring and ensure proper use*. A third member commented that *the project could help develop a standardized adaptive monitoring program for site based technologies that is driven by optimization of a system's performance rather than regulatory requirements.*
- Participants made the following comments about affordability of site based systems: *The delineation of floodplains in the new FEMA flood maps will add additional insurance costs for some, which will influence the affordability of the site-based systems. The cost of insurance could compromise a homeowner's ability to install a site-based system.*
- The group discussed adaptability of systems given changing social and environmental conditions: one member commented that *any options the group proposes should consider the potential impacts caused by climate change. Nitrogen removal, while important in the near term, is not the long-term problem.* A second member said *systems should be resilient to fluctuating populations as well as changes in climate.*
- *We will need to develop a methodology that enables us to standardize the characteristics of each system, then compare and contrast the systems based on this standardized information.*
- *It would be useful to provide contractors looking for building permits and homeowners with a field card of each technology that details information on cost, maintenance and operation and vendor locations. Educating them on the technologies will be important.*

Neighborhood level technologies/approaches

Cluster and satellite treatment systems: A cluster or satellite system is a collection and treatment system treating wastewater flows from multiple properties.

STEP/STEG collection: Septic Tank Effluent Pumping (STEP) and Septic Tank Effluent Gravity (STEG) systems convey liquid wastewater from on-site septic tanks to sewer systems; only the liquid component of the wastewater may be conveyed by pumps or by gravity.

Eco machines and living machines: Living or Eco-Machines are natural systems treat septic tank effluent or primarily treated wastewater. In these systems, aeration and clarification chambers combine with constructed wetlands to treat the influent. The wetlands are a series of chambers allowing for microbial communities to engage with and treat the wastewater. Plants are often suspended on racks with their roots systems doing the work. Solids removal is generally onsite, after which water is pumped through the gravel filled cells (similar to subsurface wetlands.) This process transfers more oxygen to the wastewater and completes the pollutant removal process. (Case example: South Burlington, VT).

- *It might make sense to not use trademarked names.*
- *Yarmouth constructed a microalgae system.*
- *The South Burlington system was abandoned. It was originally constructed as an EPA pilot project but was decommissioned after pilot phase concluded. There is a system in Weston that is still operating.*

Stormwater wetlands: Constructed wetlands provide aerobic chambers followed by subsurface anaerobic chambers that facilitate nitrification followed by denitrification, respectively. This process mimics that of natural systems coupled with engineering design guaranteeing residence time within a chamber containing anaerobic conditions. (Case example: China).

The group made the following general comments and questions about the neighborhood scale technologies:

- *These technologies all look residential based. If someone develops a small hotel or a mid-sized building, are these technologies economically efficient? How do growth zones or economic development areas fit into the consideration?* Ms. Daley responded that the size and location would inform whether or not a collection and disposal system might be required. Dense development areas could be sewered, but it would still depend upon nutrient removal requirements. *Another member said that such development could be served by new toilet technologies.*
- The group briefly discussed the ultimate goal of the project and nitrogen reduction credits. Some group members said the ultimate goal of addressing the nutrients was to restore the ecosystem. Another member said the ultimate goal is to reduce nitrogen in accordance with the regulation and that ecosystem restoration is a secondary goal. A third person noted the TMDL requires nitrogen reduction but said the ultimate goal is to restore estuaries and freshwater quality. This person questioned whether Towns would only consider those systems for which nitrogen reduction credits can be received or if the Towns would consider systems that have yet to be assigned nitrogen reduction credits. The member also asked how it might be possible to assign nitrogen reduction

credits to new technologies.

- Referring to a previous statement, a member said *the group might need to understand how close some of the systems are to becoming mainstream in terms of commercial development. Ecotoilets are feasible in a dense area, but the group may need to help the technology and industry by providing contractors with information about where to buy these technologies, how to install them properly, who will maintain them and how, etc. to make the technologies commercially available.*
- *Could there be state endorsed financial incentives to adopt new technologies similar to alternative energy development incentives?*

Watershed level technologies/approaches

Conventional treatment: A conventional wastewater treatment facility treats wastewater collected from homes and businesses. A groundwater discharge permit is required. Treatment generally results in less than 10 mg/L Nitrogen.

Constructed wetlands: surface flow: After primary treatment in a septic tank or wastewater treatment facility or secondary treatment at a wastewater treatment facility, water is fed into a surface flow constructed wetland. Surface flow constructed wetlands closely mimic the ecosystem of a natural wetland by utilizing water loving plants to filter wastewater through their root zone, a planted medium, and open water zones. Surface flow wetlands are systems where open water is exposed much like in a natural marsh. The reclaimed water from the wetland can be discharged into a water body or used for open space irrigation after treatment as well as discharged into a leach field. (Case example: Albany, OR).

Constructed wetlands: subsurface flow: After primary treatment in a septic tank or wastewater treatment facility or secondary treatment at a wastewater treatment facility, wastewater is treated by pumping water slowly through subsurface gravel beds where it is filtered through plant root zones and soil media. Water flows 3-8" under the surface to prevent public exposure to wastewater and mosquito breeding. A combination of horizontal and vertical flow subsurface systems must be utilized to provide total nitrogen removal. This solution can also offer opportunities for recreation activities on land above the subsurface system. (Case example, Thailand).

Effluent disposal: out of watershed: Effluent disposal can take a variety of forms, including infiltration basins, a Soil Absorption System, Injection Wells or Wick Wells. These disposal methods place highly treated effluent back into groundwater and may require less land area for disposal than the traditional collection and treatment facility. Effluent transport out of the watershed has the advantage of removing the nitrogen load to another watershed. Transport to another watershed requires the receiving watershed to be able to accommodate the additional nitrogen load.

- *The infiltration basin and the soil absorption systems discharge the effluent above the water table and the wick well and injection well discharge the effluent into the water* *table. The distinction is important because the location of the discharge impacts soils differently.*

Effluent disposal: ocean outfall: Similar to out of watershed effluent disposal, highly treated effluent is transported out of the watershed and into the ocean. This solution requires a high level of regulatory oversight. The solution is considered due to limited land availability for disposal on Cape Cod.

- *Ocean outfalls will face significant regulatory hurdles because both the DEP and EPA would be involved.*
- *Ocean outfalls require tertiary treatment too—this could be added to the slide. An estimate should also be added into the technology matrix for the length of pipe required to dispose into the ocean.* Ms. Daley said this would be site specific.

Phytoirrigation: After secondary treatment, wastewater treatment facility effluent is irrigated onto plants to remove nutrients and other contaminates. Fast growing poplar and willow trees are typically used. (Case example: Woodburn, OR).

- *A more regionally applicable example was started at Penn State forty years ago.* Another commenter said *this project was spraying effluent on trees and other vegetation but it was stopped due to unexpected consequences.*

The group made the following general comments and questions about the watershed level technologies and approaches:

- *Conventional treatment is misleading title since septic systems are the conventional treatment option on the Cape.* Ms. Daley said conventional treatment was selected because this is the term most engineers use to refer to that type of system.
- *Depending on the scale, we might also consider whether or not energy generation from waste, similar to the Deer Island Biogas generation station, could be applicable to our systems. Is this possible with modular systems and at what scale does this make financial sense?* Ms. Daley said Littleton was looking at building a modular central treatment center that could expand with increasing population. Another group member said *according to the Federal Energy Management Program, approximately a million gallons of waste per day are needed to make it reasonable to install.*
- *We are testing sites for subsurface disposal in Bourne. The sites were selected outside the floodplain, but now one of the sites is included in the floodplain due to the new FEMA floodplain delineations. To what extent is the Cape Cod Commission considering floodplains in the analysis?* Ms. Daley said the Cape Cod Commission has GIS maps of the flood plains and will include this in the analysis.
- *The University of Pennsylvania example—they were spraying treated effluent on trees and woods. This was stopped due to unexpected consequences. But this is a good example to look at.*
- *Other contaminants in the system too need to be considered.*

Neighborhood or Watershed level technologies/approaches

Phytobuffers: Using trees with a deep root system to capture nutrients in the soil, particularly willows and poplars. Green plants with deep tap roots are planted as a buffer to intercept existing groundwater. The plants and associated microorganisms reduce contamination in soils and ground water. Often phytohydraulics causes the groundwater plume to be redirected and pulled towards the plants. (Case example: Kavcee, WY).

- *Any idea how much biomass you get from these systems? Can we include this information as well as information about maintenance such as trimming and harvesting?* Ms. Daley said they could include biomass data and maintenance information in the technology matrix.
- *We could consider using bamboo.* Another member responded *bamboo is invasive.*

Fertigation wells: Fertigation wells can capture nutrient enriched groundwater, typically from a wastewater treatment facility discharge, and recycle it back to irrigated and fertilized turf grass areas. These irrigated areas include golf courses, athletic fields and lawns. Fertigation can significantly reduce nutrient loads to downgradient surface waters while curtailing fertilizer costs to the irrigated areas. (Case example: Plymouth, MA).

- *Since this is recovering nutrients from the groundwater, the particulars differ from other approaches. The regulatory climate for extracting this water from the ground is very different than if you were to dispose of effluent into a wetland.*
- *Nitrogen is now calculated in the groundwater in the Midwest and included as a resource for irrigation.*

Permeable reactive barrier (PRB): A permeable reactive barrier (PRB) is an *in-situ* (installed within the aquifer) treatment zone designed to intercept nitrogen enriched groundwater. Through use of a carbon source, microbes in the groundwater uptake the nitrogen, denitrifying the groundwater. PRB systems typically use vertical trenches, sequences of bored columns or injection methods to introduce the carbon source into the groundwater to reduce the nitrogen load to an estuary, removing it from the watershed. (Case example: Falmouth, MA).

- *PRBs can be used to remove phosphorous too. One foot of freshwater can hold back about 40 feet of salt water.*
- *Brewster is considering a PRB injection well.*

Inlet and culvert widening: Re-engineering and reconstruction of bridge or culvert openings to increase the tidal flux through the culvert or inlet. This solution generally works better with a larger tidal range but could be feasible on both the Cape Cod Bay side (approximately nine feet tidal range) and Nantucket Sound side (approximately three feet of tidal range).

Salt marsh habitat restoration: Salt marsh is one of the most productive ecosystems in the world, surpassing rainforest in productivity per acre. Approximately 65% of historic salt marsh has been lost in MA. Salt marshes cycle and remove nitrogen as well as provide critical habitat and spawning sanctuary for a wide variety of birds, mammals and marine life in addition to hosting a range of plant species and important biogeochemical processes. The capacity of salt marsh to intercept nitrogen is significant and well researched worldwide. Substantial areas of former salt marsh on the Cape are either under consideration for restoration or could be restored providing storm surge and coastal flooding protection in addition to water quality benefits in certain watersheds.

<u>Shellfish habitat restoration</u>: Oyster reefs were historically one of the main consumers and recyclers of nitrogen in the coastal environment on Cape Cod. According to the Nature Conservancy, populations have declined by 95%. In conjunction with the natural transition from land to sea in estuaries, bays and inlets; salt marsh, oyster reef and eel grass function as critical buffer that can reduce eutrophication. Restoring oyster populations leads to increased shellfish productivity as well as improved commercial and recreational fisheries for other species, increased protection from shoreline erosion and flooding, and buffering from ocean acidification. (Case example: Wellfleet, MA).

<u>Aquaculture / shellfish farming</u>: Oysters have been proposed as a potential method for reducing nitrogen levels and eutrophication in estuaries. Nitrogen removal rates from oysters have been well documented and the harvest of oysters physically removes the nitrogen they sequester in addition to that removed by their biological cycling which puts nitrogen directly back into the atmosphere. Aquaculture can be done in man-made structures (e.g. cages, floating bags) or natural reefs.

- *The bags are viewable now in Little Pond on Narragansett Street*
- *There is no odor, the water is clear, and birdlife is coming back.*
- Ms. Daley said shellfish and aquaculture projects show a lot of promise but a member of another group who was a shellfish warden pointed out that they are living animals, which can present some hazards if relied upon too heavily. In response, a group member said *activated treatment sludge systems, which sometimes fail, are also comprised of living organisms.*

<u>Surface water remediation wetlands</u>: Constructed to aid in water quality improvements to surface water bodies, usually streams or rivers. Water is pumped or allowed to flow naturally through treatment cells containing wetlands Surface water remediation wetlands are often used in combination with groundwater recharge or potable water reuse systems. Surface water remediation wetlands are generally used with Free-Water Surface wetlands due to their larger size, and lower capital and operation and maintenance costs. (Case example: China).

<u>Pond and estuary dredging</u>: Lakes, ponds, streams and estuaries store nutrients within their sediments. These sediments tend to accumulate over time. Subsequently, these nutrients can be released into the overlying water column and can become a major source of nitrogen and phosphorus. Dredging and removing these sediments and accumulated nutrients removes the nutrients from the water body and potentially the watershed. (Case example: Dennis, MA).

- *Are there any examples of dredging being done to reduce nitrogen?* Mr. Mark Owen, consultant for the Cape Cod Commission, said there is a proposal in Barnstable to dredge Mill Pond with the though that deepening it will increase the freshwater in the system and help to naturally attenuate the nitrogen. But, an endangered species in the pond may preclude this measure.
- *Disposal of the dredged material is costly, too.*

Cape-wide level technologies/approaches

<u>Compact development</u>: Both Compact Development and Open Space Residential Development (OSRD) of subdivisions result in smaller lots and less maintained lawn acres. The higher density development reduces wastewater collection costs while providing a common disposal area. Compact development is also referred to as “Smart Growth”.

- *A 120 home dense development with an RUC system was planned in Yarmouth; only sixty homes were built due to the economic decline.*

<u>Fertilizer management</u>: Managing fertilizer application rates to lawns, golf courses, athletic facilities and cranberry bogs. Residential lawn loading rates could be reduced on existing developed parcels through an intensive public education/outreach program. This could include a “Cape Cod Lawn” branding program, replacing some turf areas with native vegetation, establishing naturally vegetated buffer strips on waterfront lots, and reducing application rates. Fertilizer loading rates for new development could be accomplished by reducing lot sizes (cluster development), by restricting lawn sizes and/or by incorporating more naturally vegetated open space areas. Municipalities could directly reduce fertilizer applications on athletic fields and other properties. Golf courses can significantly reduce nitrogen loading rates by using slow-release fertilizers and reducing application rates in rough areas. Cranberry bog fertilizer exports can be reduced using tail water recovery systems. Site-specific assessments are needed to estimate load reductions. Ms. Daley added that the Cape Cod Commission designated a cape-wide Fertilizer Management District of Critical Planning Concern (DCPC) that authorizes the towns to adopt local fertilizer management regulations (state law prohibits local fertilizer management except under the DCPC). The DCPC does not require towns to adopt fertilizer regulations, but paves the way for their adoption. She said Falmouth already has a bylaw in place. Barnstable County will be conducting a public education process around fertilizer use.

- *Is there a timeframe by when adoption of the regulations must be complete?* Ms. Daley said it must be done by the end of December; but new legislation may extend the adoption period.
- *Most boards of health are looking into this regulation. The enforcement part is not feasible, but it is a step in the right direction for education purposes.* Ms. Daley commented that the Cape Cod Commission released a pesticide and fertilizer study for

public comment. The study includes quantities and types of materials used by utilities, homeowners, and municipalities.

- *Fertilizer regulations should be reasonable and practical for golf courses. They are in a tough position because the greens must look a certain way or their jobs are on the line; yet they do not want to use nitrogen because it is expensive.*
- *The fertilizer regulation in Falmouth is slightly stalled due to a lack of manpower.*

<u>Remediation of existing development</u>: Existing developments or schools with excess wastewater treatment capacity allow existing nearby developments to connect to their underutilized wastewater treatment infrastructure. A town can operate the wastewater treatment facility if the existing owner prefers to not take the responsibility for treating the off-site wastewater. An example of this is the Kingman Marina in Bourne, which was permitted to expand its development footprint in exchange for hooking up adjacent, existing homes to its wastewater treatment facility.

<u>Transfer of development rights</u>: A regulatory strategy that transfers development and development rights from one property (sending area) to another (receiving area) to direct growth and associated nutrient loading away from sensitive receiving watersheds or water bodies. The protected parcels (sending areas) receive a deed restriction that limits the level of future development. The deed restriction can limit the number of homes or tie development to the availability to future wastewater treatment facility infrastructure.

- *Is this a form of nitrogen trading?* Ms. Daley said trading could occur on many different things provided the right market incentives are in place.

<u>Stormwater best management practices (BMP)</u>: Non-Structural Stormwater strategies include: street sweeping, maintenance of stormwater utilities, education and public outreach programs, land use planning, and impervious cover reduction and control.

Ms. Daley noted that in many instances, one of the solutions may not achieve the TMDL, but pairs of solutions could help to reach the goal. For example, many towns are already using and pairing some of the technology options and approaches:

- Wellfleet- *Coastal habitat restoration & aquaculture*
- Mashpee- *Aquaculture & Expanding Existing Systems*
- Brewster- *PRB & Bioswales*
- Orleans- *Fertilizer Control By-Law*
- Harwich/Chatham- *Muddy Creek & Cold Brook Natural Attenuation*
- Falmouth- *Aquaculture, Inlet Widening, Eco-Toilet Demonstration Project, PRBs, Stormwater Management (Little Pond Watershed), Fertilizer Control By-Law, Subsurface Nitrogen Removal Septic System*

General questions and comments:

Comments made throughout the presentation:

- *Can you please add incinerating toilets to the matrix?* Ms. Daley responded that incinerating toilets could be added to the matrix.
- *We need more comparative analysis and a deeper review of the nitrogen removal rates associated with the technologies since there seems to be some inaccuracies and omissions in the data sheets. For example, the 85-90 percent nitrogen removal rate for urine diverting toilets is not correct. Grey water streams should also be noted as sources of nutrients from homes. One data sheet indicates that central sewer systems remove nitrogen, but this is not true.*
- *We should remember that the nitrogen removal rates associated with some of these technologies differ from what the state will give credit for without intense monitoring. If we are looking to acquire nitrogen removal credits, we will likely need to do pilot tests and prove their removal capacity.*
- *Will the issues we raised be added to the Technology Matrix?* Ms. Perry said the Technology Panel had yet to complete their work so some of these issue may be added to or corrected in the matrix. The final matrix will be distributed prior to the December meeting.
- *It would be good to include the dollar per pound of nitrogen removed, the amount of carbon dioxide emissions per pound of nitrogen removed, and the amount of water used per pound of nitrogen removed on the Technology Matrix.* Ms. Daley said the Technology Panel plans to include nutrient recovery, water use, energy use, and cost per pound for nitrogen removed in the Technology Matrix.
- *Aquaculture in Falmouth is only a demonstration site. Nothing has yet to start in Little Pond.*
- *Resource recovery is a very interesting idea at the regional level but incorporated at sub watersheds.*
- *Resource recovery from wastewater bio-solids could be added to the matrix--it could work regionally.* In response, another group member said that *resource recovery from sludge does not require a lot of space. Some systems can allow you to compost the waste if it is dried.* Another member *said dewatering the waste would not be feasible here.*

IV. PROBLEM SOLVING PROCESS AND PRINCIPLES

Ms. Daley explained that the Working Groups will focus on total controllable nitrogen load. The technologies and approaches selected should aim to reduce the total controllable nitrogen load by identifying options that reduce the portion of *septic* load that needs to be reduced. For example, the portion of septic load that needs to be reduced could be made smaller if Cape Cod takes on fertilizer and stormwater solutions first. Additionally, the percentages of controllable nitrogen that need to be removed to meet TMDLs change depending on the characteristics of the watershed.

A group member noted that until 1990 the amount of nitrogen deposited from the atmosphere appeared to be a steady input, but since then it appears the amount in rainfall is decreasing. This decrease is presumably due to emissions control technologies in the Midwest. The group member requested the Cape Cod Commission help communities on the Cape to collect consistent data on nitrogen in rainfall.

Overview of 7-steps for Problem-Solving Process

Ms. Daley reiterated that the goal the Working Groups is to develop remediation options that would achieve water quality targets with a focus on first targeting low cost, low barrier options to reduce nitrogen and then considering more costly and complex traditional options later (e.g. sewering). She then described the alternatives screening process the group will apply. The process is as follows:

1) Establish targets and articulate project goals.
2) Identify priority geographic areas (e.g. high nitrogen reduction areas, Title V problem areas, pond recharge areas).
3) Determine which management activities should definitely be implemented. These might be the easiest and least costly management activities that should be undertaken regardless of other management actions (e.g. fertilizer management and stormwater mitigation – two approaches that Cape Cod towns are already actively pursuing).
4) Assess alternative options to implement at the watershed or embayment scale (e.g. innovative and lower-cost solutions)
5) Assess options to implement at the site-level
6) Examine priority collection/high density areas
7) Consider traditional sewering or other grey infrastructure management options

Ms. Daley said two scenarios will be presented at the third workshop. The first will look at a more traditional approach with permitted technologies to meet the TMDLs. The second approach will look at the target reduction goals and other wastewater management needs and address them first with technologies presenting low barriers to implementation. The group will discuss these scenarios and develop an approach to meet the goals using both green and grey infrastructure.

Ms. Daley displayed a USGS map of ground water percolation rates on the Cape. She noted that the different percolation rates across the Cape might suggest mixing and matching technologies to achieve impact in a specific timeframe. *A member questioned whether the map was accurate, stating the Woods Hole time of travel didn't look right.*

Categories of Solutions and their Impacts on the Environment, Economy, and Community

Ms. Daley commented that evaluation of the technologies and approaches would be informed by their impacts (positive and negative) on the environment, economy, and community (Triple Bottom Line). The facilitator then asked the group to think about the environmental, social and economic impacts and discuss how the technologies might help or hinder each of these elements. Group members made the following comments. They are grouped by theme where appropriate while recognizing many categories are linked:

Speed/Timing:

- *I like the top down and bottom up reverse logic. Timeframes are very important. We have to meet them and must give adequate chance for things to prove themselves. But at some point in time there will be a regulatory control that spurs us to move on.*
- *Speed of impact is relative to the technology—which technologies take a long time to remediate the problem and which will be more quickly adopted by the population.*
- *Given the difference in percolation rates across the region, we can implement some actions that will improve the waters of the coastal ecosystem while simultaneously taking other actions to remedy the problem up stream. This way we would deal with the immediate problem and the upstream, longer-term problem too.*

Reasonable Growth Assumptions:

- The group discussed buildout after a group member asked if the seven-step approach considers buildout. Ms. Daley said the scenarios to be presented at the third workshop will only consider existing development. *A group member said it seems more practical to consider buildout. Another group member mentioned there are two types of buildout, theoretical and practical; the difference between the two, respectively, is what is possible and what is likely. The member suggested it would be useful to gear the scenarios toward the practical buildout. Several other members agreed.*
- *A flow neutral by-law that would control flow at 110 gallons per bedroom is on Falmouth's Town Warrant. This is a low barrier method to reduce nitrogen and temper growth. The seventh step of the seven-step process are low barrier technologies because they are approved by the state, but it may not show the fastest impact or be affordable. The speed of impact and affordability should be considered when selecting treatment options.*

Performance Ranges:

- *Some technologies labeled as ecotoilets should be categorized separately since performance varies across the systems under this label. Another group member asked how they will determine the effectiveness of each technology and whether or not a margin of error would be applied to account for technologies used incorrectly.* Ms. Daley said the technology matrix will contain information to determine effectiveness and margins of error.

Real Costs:

- *Some of the standard eoctoilets have a footprint of 2x3 feet. It is important to recognize the size limitations of installing some of these systems into homes and to think about what really must take place for them to be adopted.*

Adaptability and Resilience:

- *Preference should be given to systems adaptable to future regulations that may address contaminants of emerging concern.*

Multiple-Benefits:

- *Options or combinations of options that provide multiple benefits should be particularly valued (e.g., those that both reduce controllable nitrogen and provide other ecological benefits or avoid the environmental harm associated with other choices).*

Low-hanging fruit:

- Several group members suggested starting with strategies and approaches that are easily implemented, have systemic benefits and are least expensive.

Regulatory/Permittable:

- *Important to understand the regulatory hurdles each option faces in obtaining "credit" for nitrogen reduction.*

Social Aspects:

- *Community outreach and education will be necessary to build acceptance. Supporting the local contractors and average citizen will be key to gaining public buy-in.*
- *Familiarizing the community with the technologies will be critical to community acceptance. Community members should be involved early so they know what they will face long before it is actually here.*

Incentives/Disincentives

- *Incentives in the form of nitrogen credits or taxes for nitrogen produced could help incentivize people to adopt new technologies. For example, perhaps we could use the money that would otherwise be spent on sewers and develop a grant program for adoption of specific technologies.*

Affordability

- *Government subsidies are sometimes needed to spur adoption. How can we incentivize companies to get involved? Since the Cape is a potentially large market for the companies making these technologies, it would be worthwhile investigating whether or not they would help set up pilot projects at reduced costs.*
- *We tried to get sewering in Buzzards Bay, but the public did not accept it because many of them had already invested money into Title V systems. We will need to consider that some people will be reluctant to implement other technologies because they already spent money on septic systems.*
- *For affordability, we need to look at what is the cheapest option that will achieve regulatory limits.*

Other

- *When selecting technologies, we should think about the scale of waste in comparison to trash. The amount of human waste produced per person per year is much smaller than the amount of trash produced per person per year. Given how small this amount of waste is per year—approximately 5 medium garbage cans per year—packaging toilets are a feasible option.*
- *It might be valuable to do a "thought experiment" with a technology like packaging toilets. This would allow us to determine the reasons for using packaging toilets, the challenges it would face, how to deal with questions of regulatory changes to make it work, etc.*
- *There is no guarantee the ecosystem will recover if we achieve the TMDL targets. Therefore, perhaps we should first focus on those areas in decline and attempt to restore dead ecosystems second. We are likely to see greater impact in systems that are still somewhat functioning. A group member responded we* should take care *to be careful about how we characterize ecosystems—calling a system dead may not be accurate.*
- *Please use a different symbol for the composting toilets since they do not have water tanks. It would also be good to distinguish between permittable and non-permittable technologies on the fact sheets.*

Technology Selection: Process and Principles

Ms. Daley noted that the Working Group had identified many of the principles that the Cape Cod Commission hoped would guide technology/approaches selection. These process and principles include:

- *100% septic removal subwatershed*: Combinations of technologies can be used to reduce septic load that needs to be removed.
- *Scale: On-Site vs. Collection System vs. Natural System*: There will be tradeoffs between the scale of systems that can be used. On-site, collection, and natural systems all have their pros and cons and all require different levels of investment and infrastructure. These tradeoffs will be important from an implementation and public acceptance point of view.
- *Nutrient intervention and time of travel*: Some technologies/approaches intercept nutrients at their point of entry into the system, while others deal with it later on (e.g. once it is in surface or groundwater). There are pros/cons to each approach to be considered.
- *Permitting Status*: The level of effort required to permit technologies will be a consideration.
- *Land use and Impacts of Growth*: Unintended consequences and opportunities for planned growth are important to consider.

V. PLANNING FOR THE NEXT MEETING

Meeting Three will be held:
Monday, December 2, 2013
8:30AM -12:30PM
Falmouth Town Hall, 59 Town Hall Square, Falmouth, MA 02540

During this meeting the Working Groups will examine various scenarios (i.e. combinations of solutions) and their potential impacts (e.g. nutrient reduction, economic impacts, environmental impacts, social impacts, etc.). During the meeting, the Cape Cod Commission will use tools to calculate ideas/options and their impacts. Working Group participants should come prepared to offer ideas about what solutions they'd like to explore further given their understanding of the baseline conditions, issues, and priorities in this watershed.

VI. PUBLIC COMMENTS

- A group member asked how the watersheds on the military base will be addressed. Ms. Daley said this topic is being addressed internally.
- Dan Milz, University of Illinois at Chicago, asked the group members if anyone had tried to use the GIS layers on the Cape Cod Commission's website. One member said he had tried but had some difficulties working with it. Ms. Daley said she was aware others were having issues too and requested people to contact her if they also encounter difficulties accessing the data.

APPENDIX ONE: MEETING PARTICIPANTS

Upper Cape West & South Workshop 2
October 25, 2013
Attendance

1. Earle Barnhardt	-	
2. Michael Ciaranca	-	Sate of MA, Joint Base Cape Cod
3. Cynthia Coffin	-	Bourne BOH
4. Wesley Ewell	-	Bourne Wastewater Coordinator
5. Cheryl Holdren	-	FACES
6. Nate Jones	-	Health Agent, Town of Sandwich
7. Sia Karplus	-	CWMP, Falmouth
8. Hilde Maingay	-	
9. Dan Milz	-	University of Illinois, Inst. of Envir. Science and Policy
10. Ed Nash	-	Golf Course Supt. Assoc.
11. Mark Owen	-	AECOM
12. Korrin Petersen	-	Senior Attorney, Buzzards Bay Coalition
13. Jerry Potamis	-	Wastewater Superintendent, Falmouth
14. Sallie Riggs	-	Wastewater Advisory Committee, Bourne
15. Julian Suso (from 10:30am)	-	Town Manager, Town of Falmouth
16. Virginia Valiela	-	CWMP, Falmouth

Cape Cod 208 Area Water Quality Planning
Herring River Watershed Working Group

Meeting Two
Monday, October 21, 2013
8:30 am- 12:30 pm
Harwich Town Hall, Selectmen's Meeting Room

Meeting Agenda

8:30 Welcome, Review 208 goals and Process and the Goals of today's meeting – *Cape Cod Commission*

8:40 Introductions, Agenda Overview, Updates and Action Items– *Facilitator and Working Group*

9:00 Range of Possible Solutions – *Cape Cod Commission and Working Group*

- Technology Matrix
- Technologies Overview
- Survey Questions and Comments
- Additional Questions and Discussion

10:30 Break

10:45 Problem Solving Process and Principles – *Cape Cod Commission and Working Group*

- Overview of 7-steps for Problem-Solving Process
- Examination of Categories of Solutions and their impacts on the Environment, Economy, and Community (triple bottom line)
- Discussion – Identify Considerations and Priorities for Application

12:00 Preparing for Meeting 3 and Beyond – *Cape Cod Commission*

- Review Tools, Alternatives Analysis Approach
- Evaluating Scenarios for Meeting Nitrogen Goals
- Other Process Next Steps

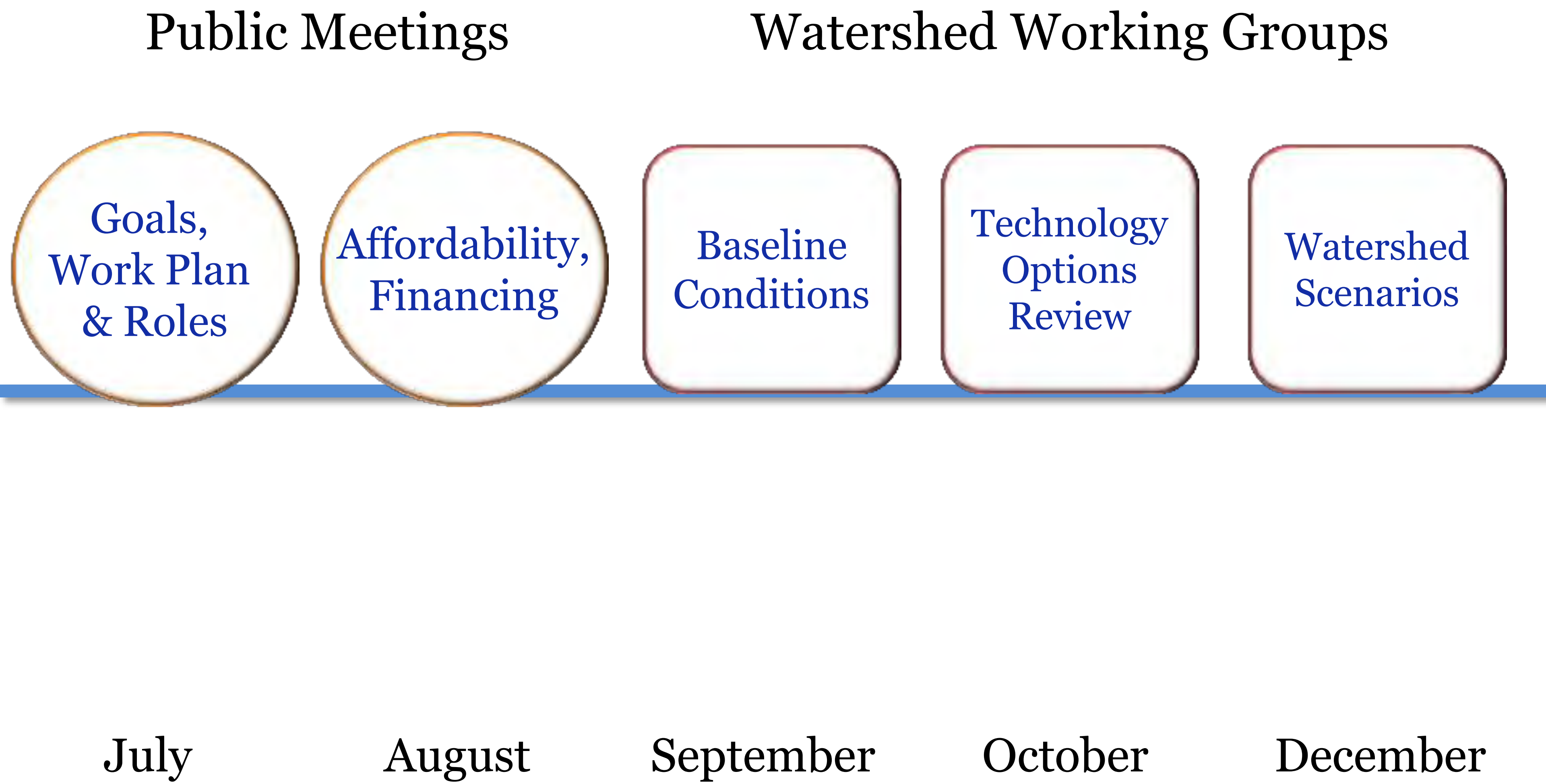
12:15 Public Comments

12:30 Adjourn

Herring River Group

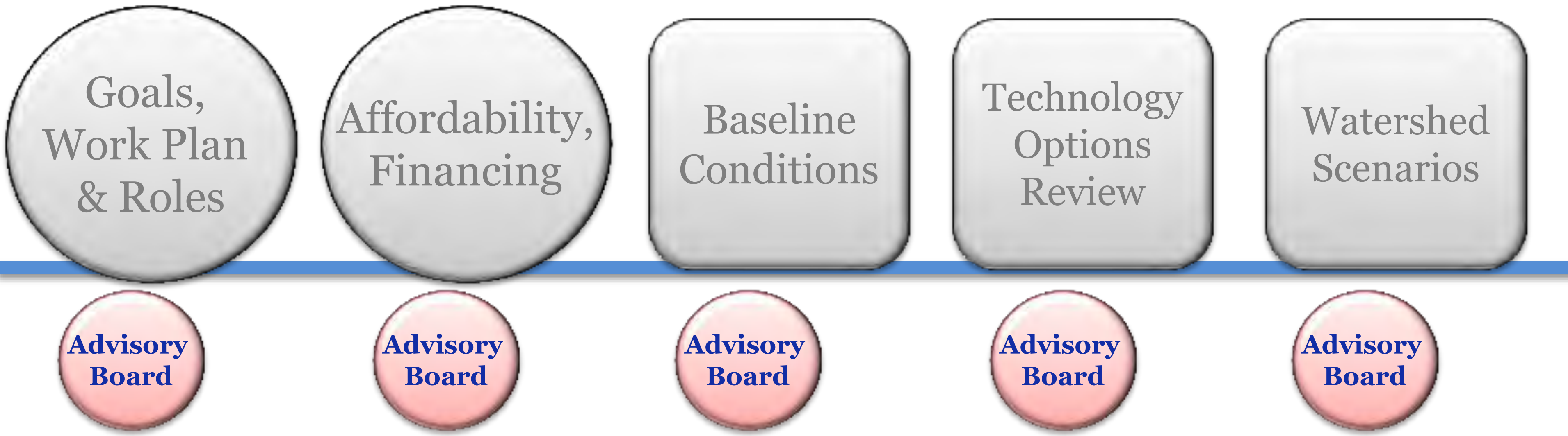
Technologies and Approaches

What is the stakeholder process?



208 Planning Process

Public Meetings Watershed Working Groups

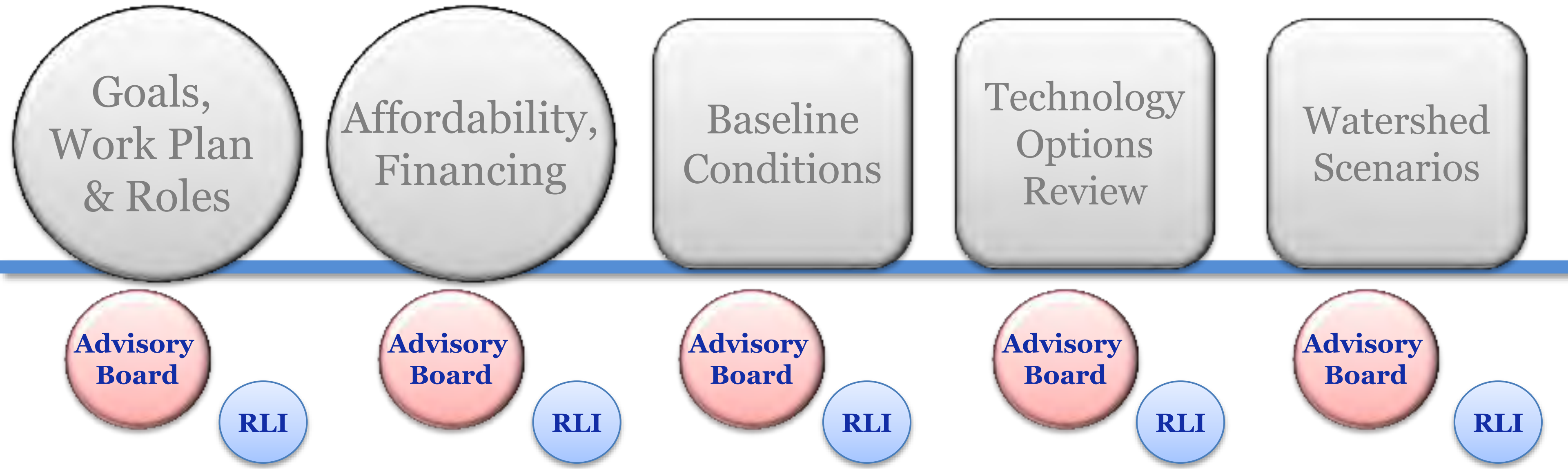


July August September October December

208 Planning Process

Public Meetings

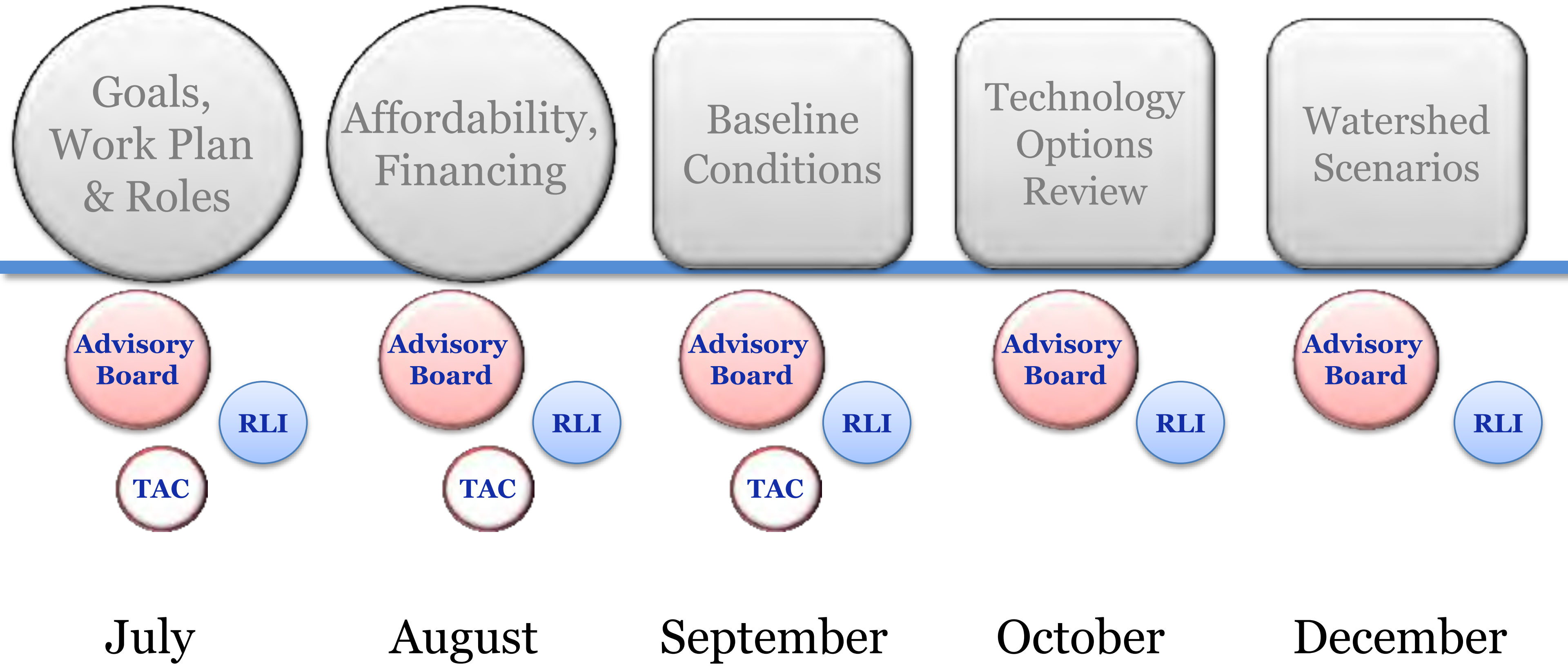
Watershed Working Groups



July August September October December

RLI Regulatory, Legal & Institutional Work Group

Public Meetings Watershed Working Groups

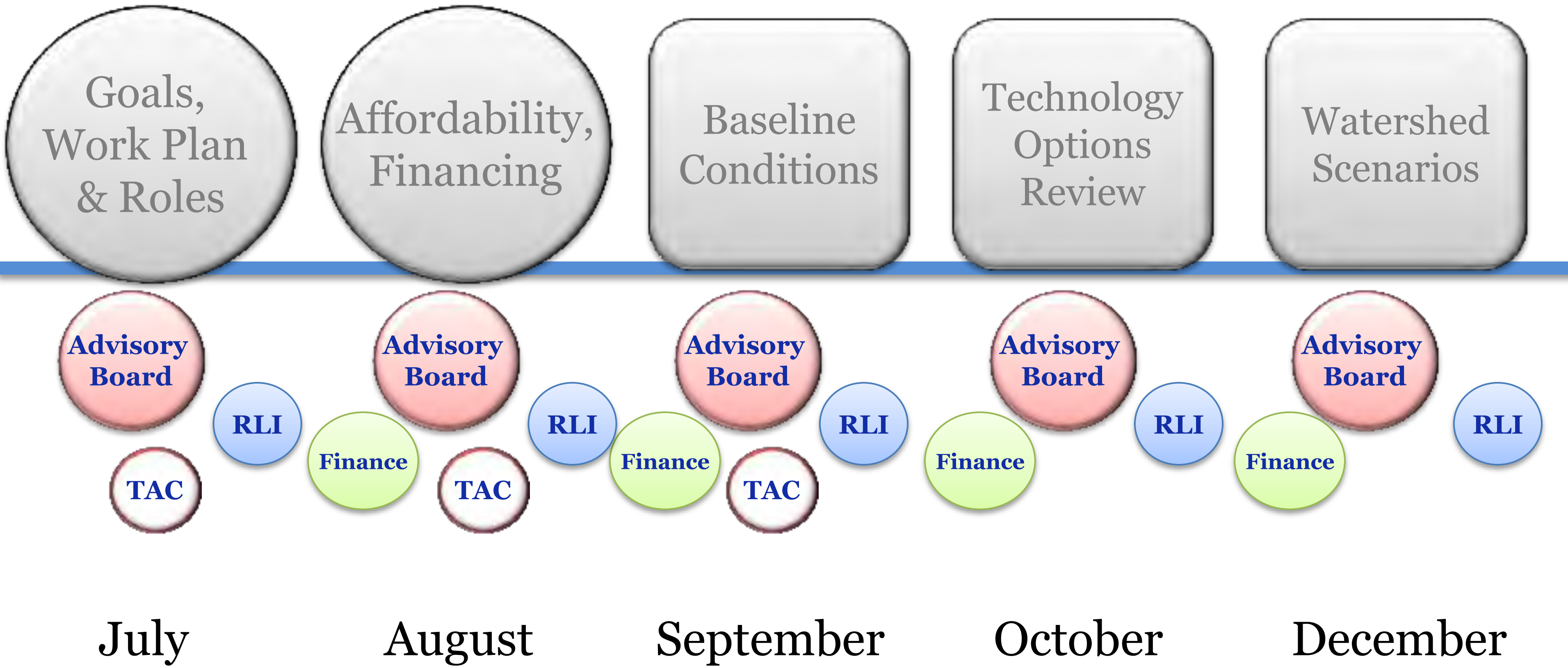


RLI Regulatory, Legal & Institutional Work Group

TAC Technical Advisory Committee of Cape Cod Water Protection Collaborative

208 Planning Process

Public Meetings Watershed Working Groups



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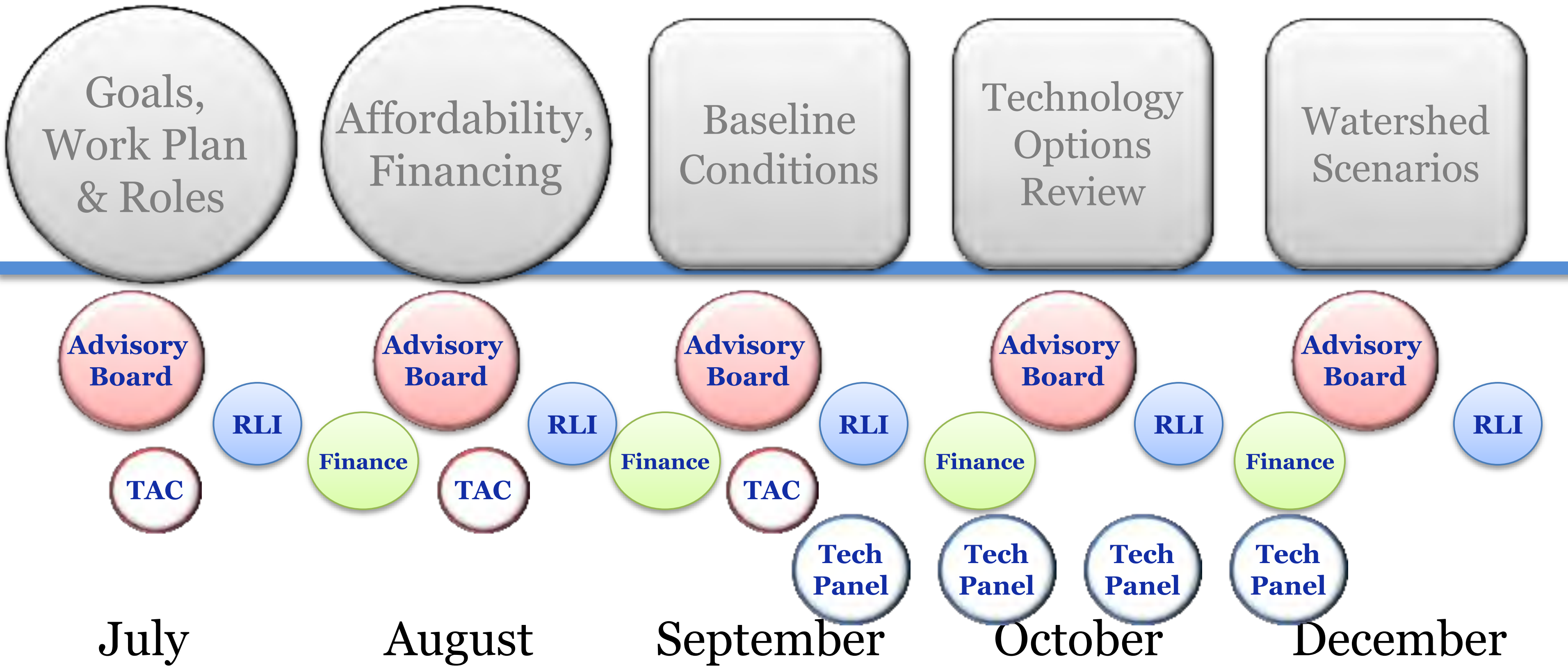


RLI Regulatory, Legal & Institutional Work Group

TAC Technical Advisory Committee of Cape Cod Water Protection Collaborative

Baseline Conditions

11 Working Group Meetings: Sept 18-27

Goal of the First Meeting:

To review and develop shared understanding of the characteristics of these watersheds, the work done to date, existing data and information available, and how to apply all of this to planning for water quality improvements for these watersheds moving forward.

Progress since last meeting

- ❑ Meeting materials

Progress since last meeting

- ❑ Meeting materials
- ❑ GIS data layers

Progress since last meeting

- ❑ Meeting materials
- ❑ GIS data layers
- ❑ Chronologies

Baseline Conditions

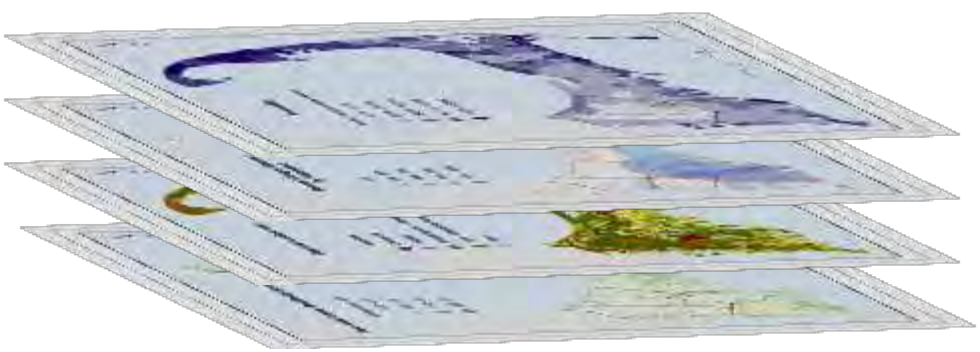
11 Working Group Meetings: Sept 18-27

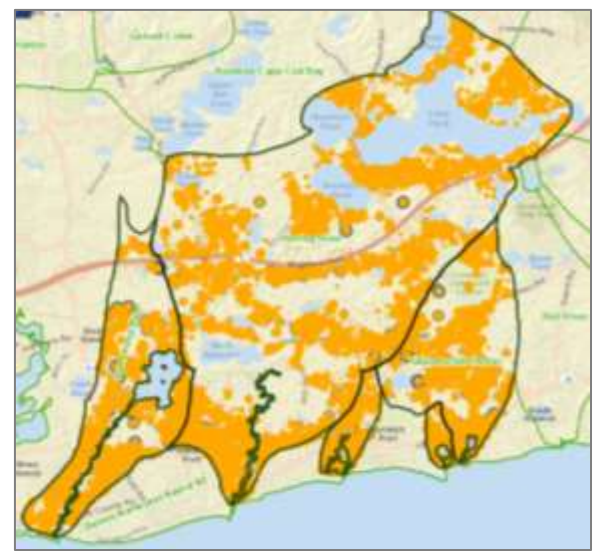
Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

208 Planning Process

Baseline Conditions	Technology Options Review	Watershed Scenarios
11 Working Group Meetings: Sept 18-27	11 Working Group Meetings: Oct 21-Nov 5	11 Working Group Meetings: Dec 2-11





Baseline Conditions

11 Working Group Meetings: Sept 18-27

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Watershed Scenarios

11 Working Group Meetings: Dec 2-11

Watershed Event

November 13

Center for the Arts Dennis

Wrap up of Cape2O: ur in charge!

Summary of planning process to date

Outline of second 6 months of the 208 planning process

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Goal of Today's Meeting:

To develop a shared understanding of the potential technologies and approaches identified to date, and the benefits and limitations of each; to explore the environmental, economic, and community impacts of a range of categories of solutions; and to identify priorities and considerations for applying technologies and approaches to remediate water quality impairments in your watershed.

Technologies and Approaches for Improving Water Quality

Technologies and Approaches for Improving Water Quality

- The Fact Sheets present various information on the technologies being considered.
- Additional information is contained on the Technology Matrix including the following:
  - Site Requirements
  - Construction, Project and Operation and Maintenance Costs
  - Reference Information
  - Regulatory Comments
- Input from the Stakeholders is requested regarding a technology's Public Acceptance

Technologies and Approaches for Improving Water Quality

- Comprehensive analysis of nutrient control technologies and approaches.

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- Certain technologies or approaches will be effective at **preventing** nutrients from entering the water body. Others will be effective at **reducing** or **remediating** nutrients that are already in the groundwater or water body.

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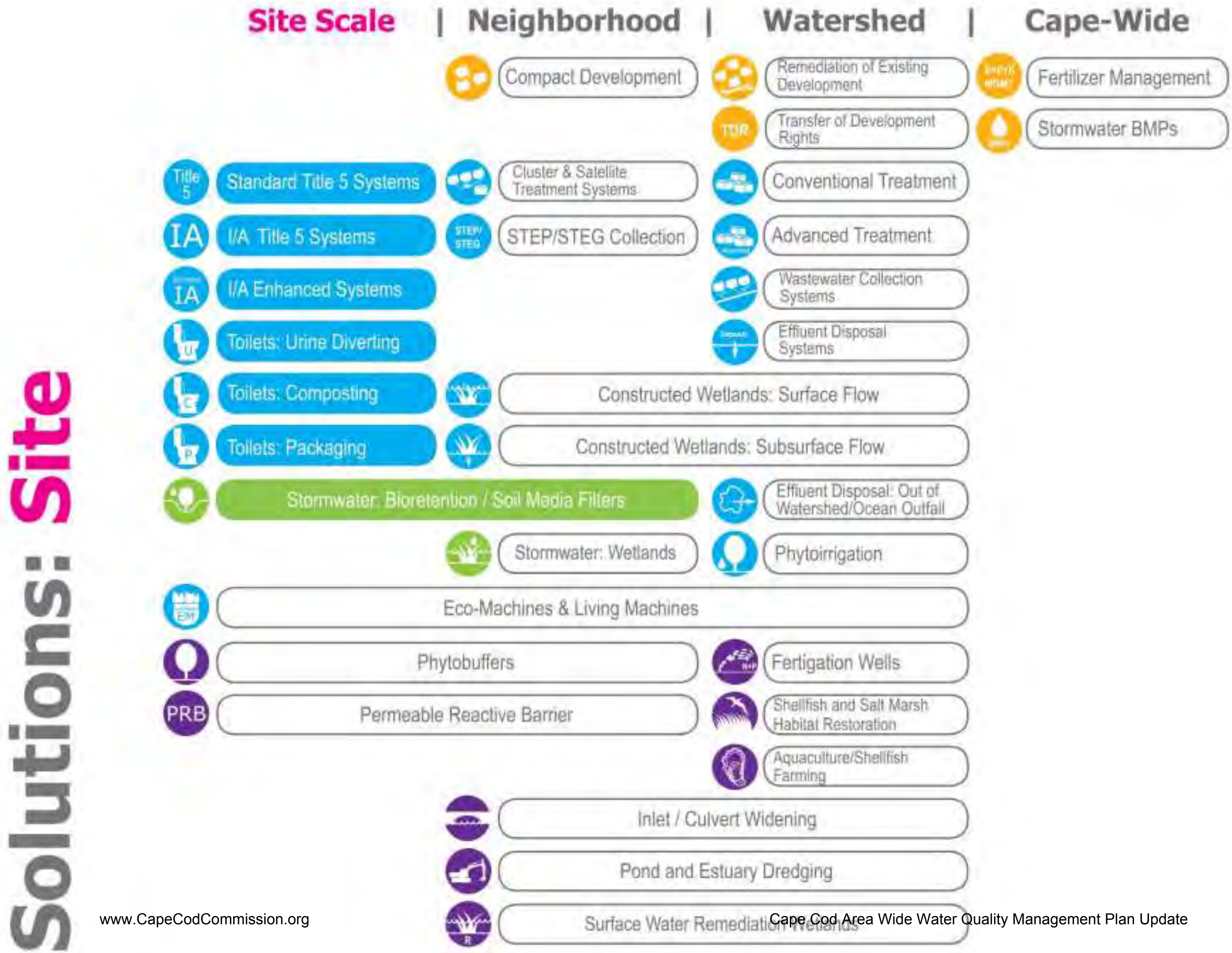
- Certain technologies or approaches will be effective at **preventing** nutrients from entering the water body. Others will be effective at **reducing** or **remediating** nutrients that are already in the groundwater or water body.
- Regulatory programs can address nutrient controls for both existing development and future development.


Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
IA
I/A Title 5 Systems
STEP/STEG
STEP/STEG Collection
Advanced Treatment
IA
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
EM
Eco-Machines & Living Machines
Phytobuffers
Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands
Solutions


Site Scale | Neighborhood | Watershed | Cape-Wide
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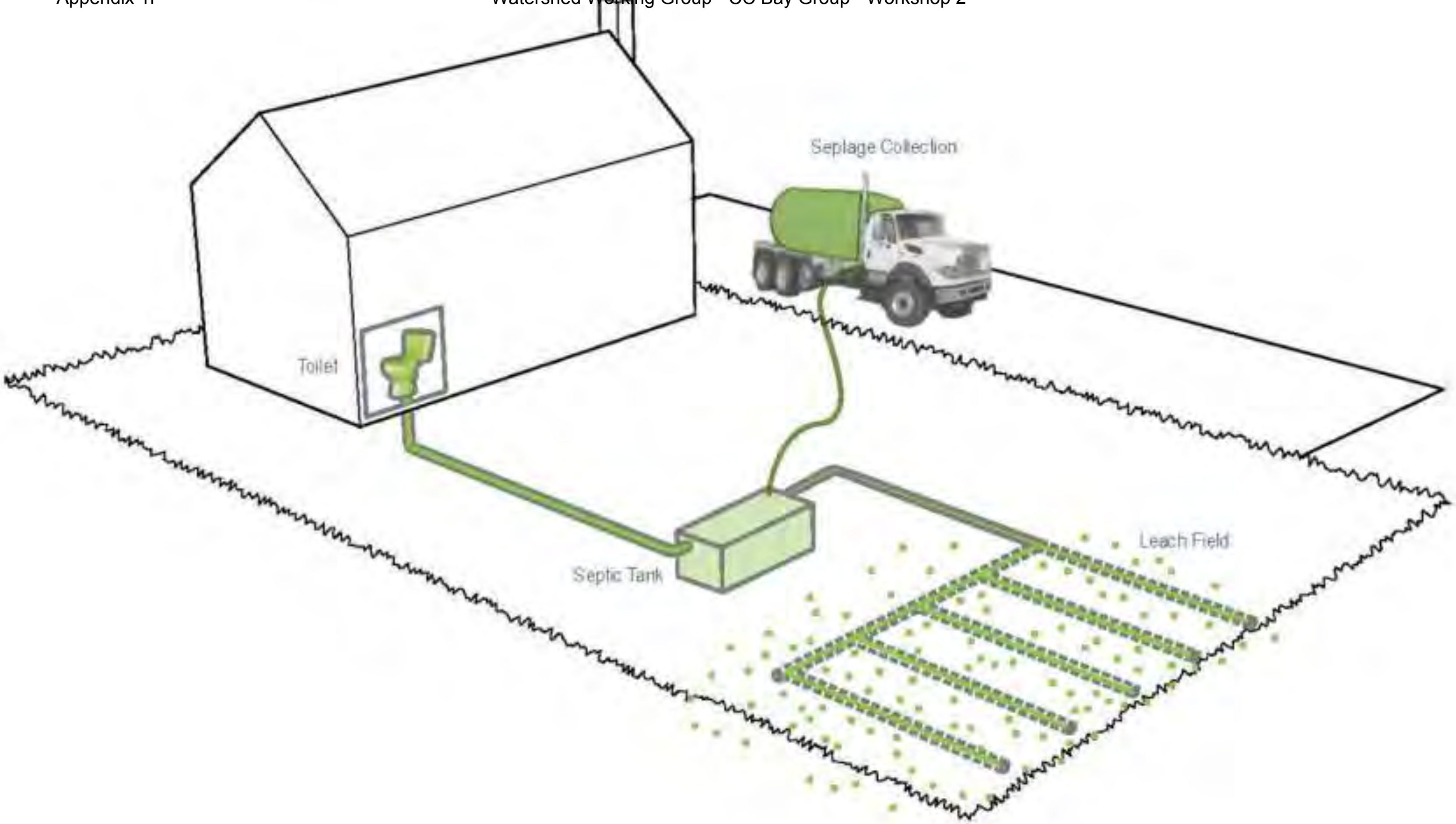
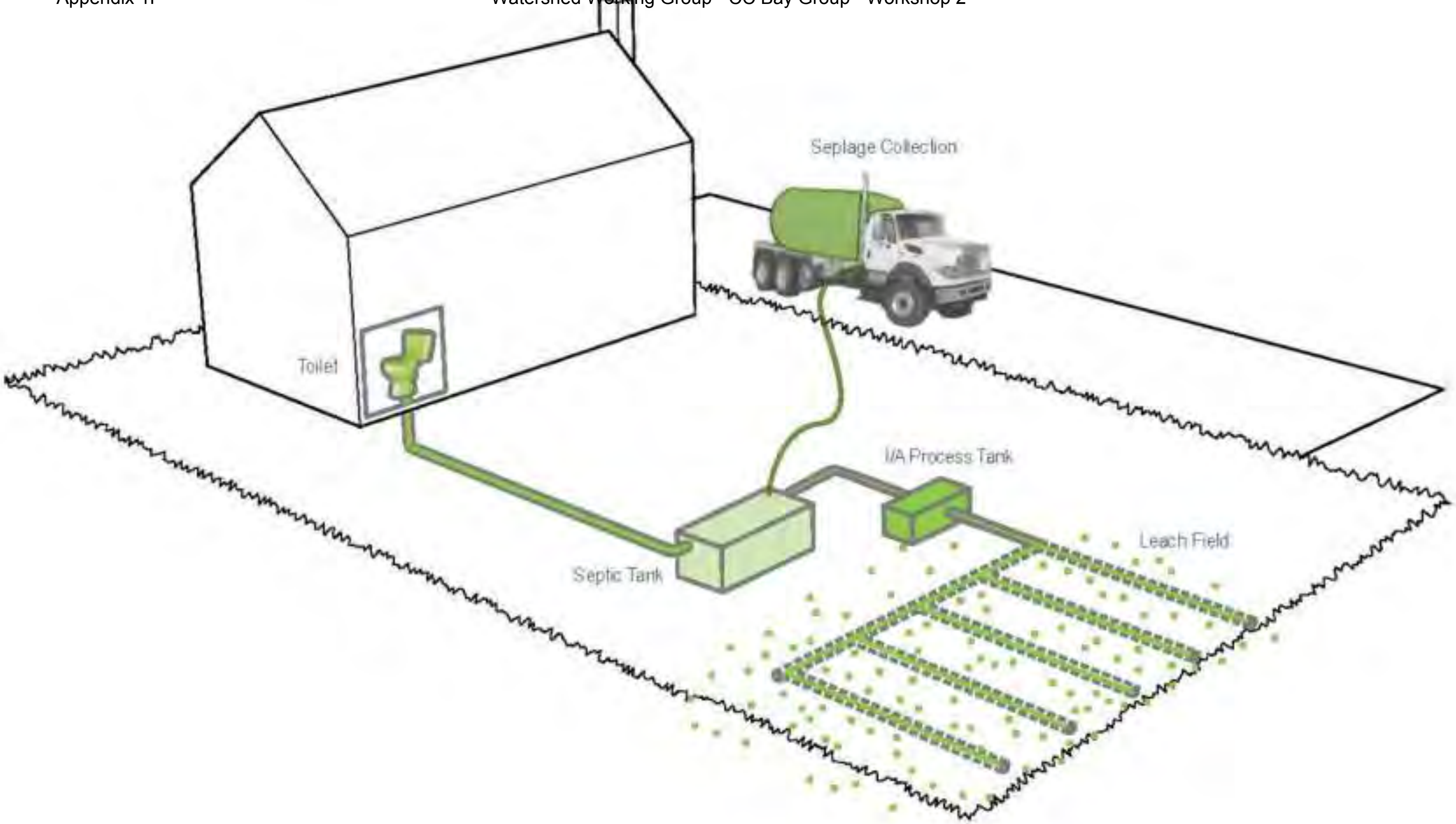


Scale: SITE
Target: WASTEWATER

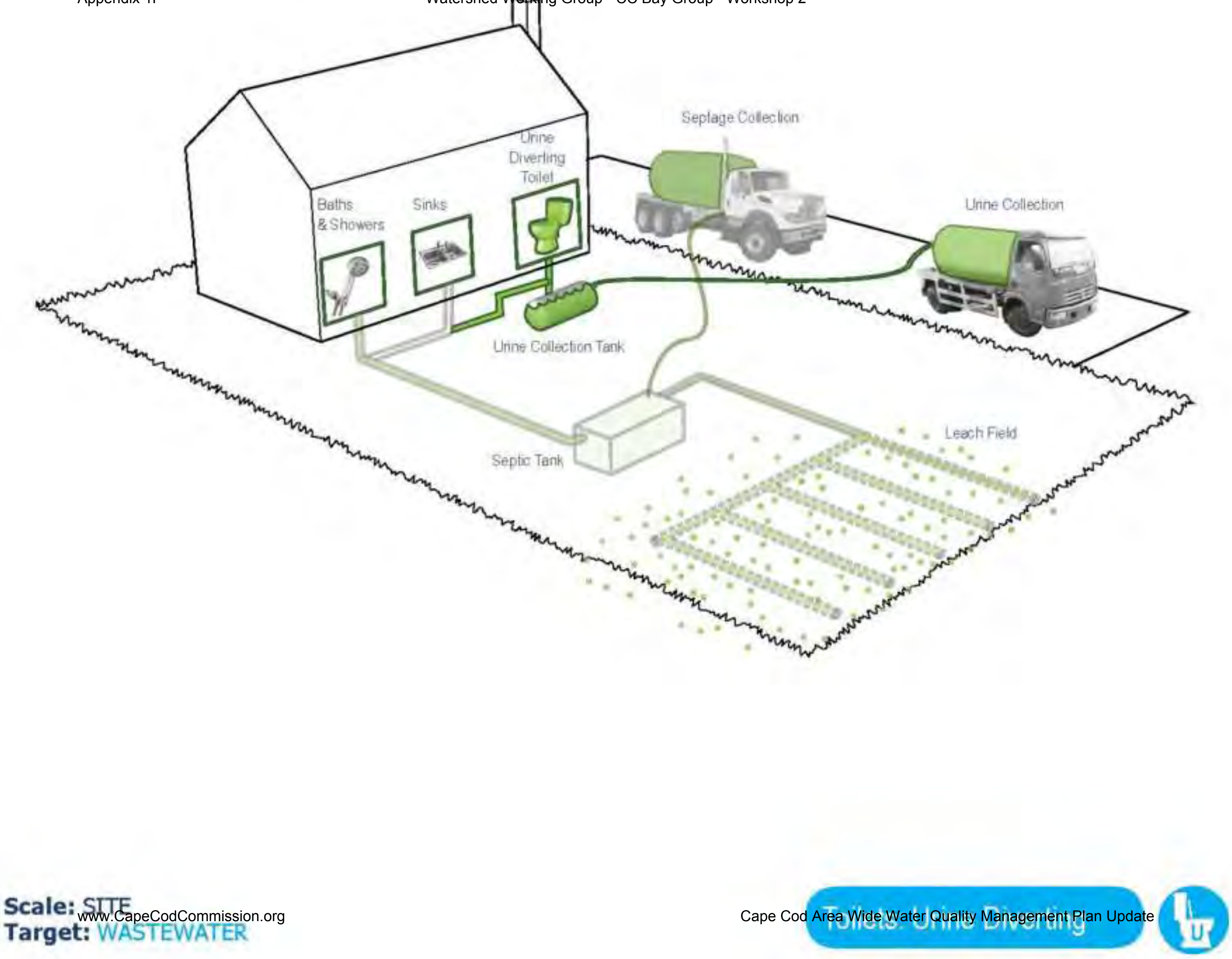
Standard Title 5 Systems

Title 5



Scale: SITE
Target: WASTEWATER

I/A Title 5 Systems


Septage Collection
Urine Diverting Toilet
Baths & Showers
Sinks
Urine Collection
Urine Collection Tank
Septic Tank
Leach Field
Scale: SITE
Target: WASTEWATER
Toilets: Urine Diverting

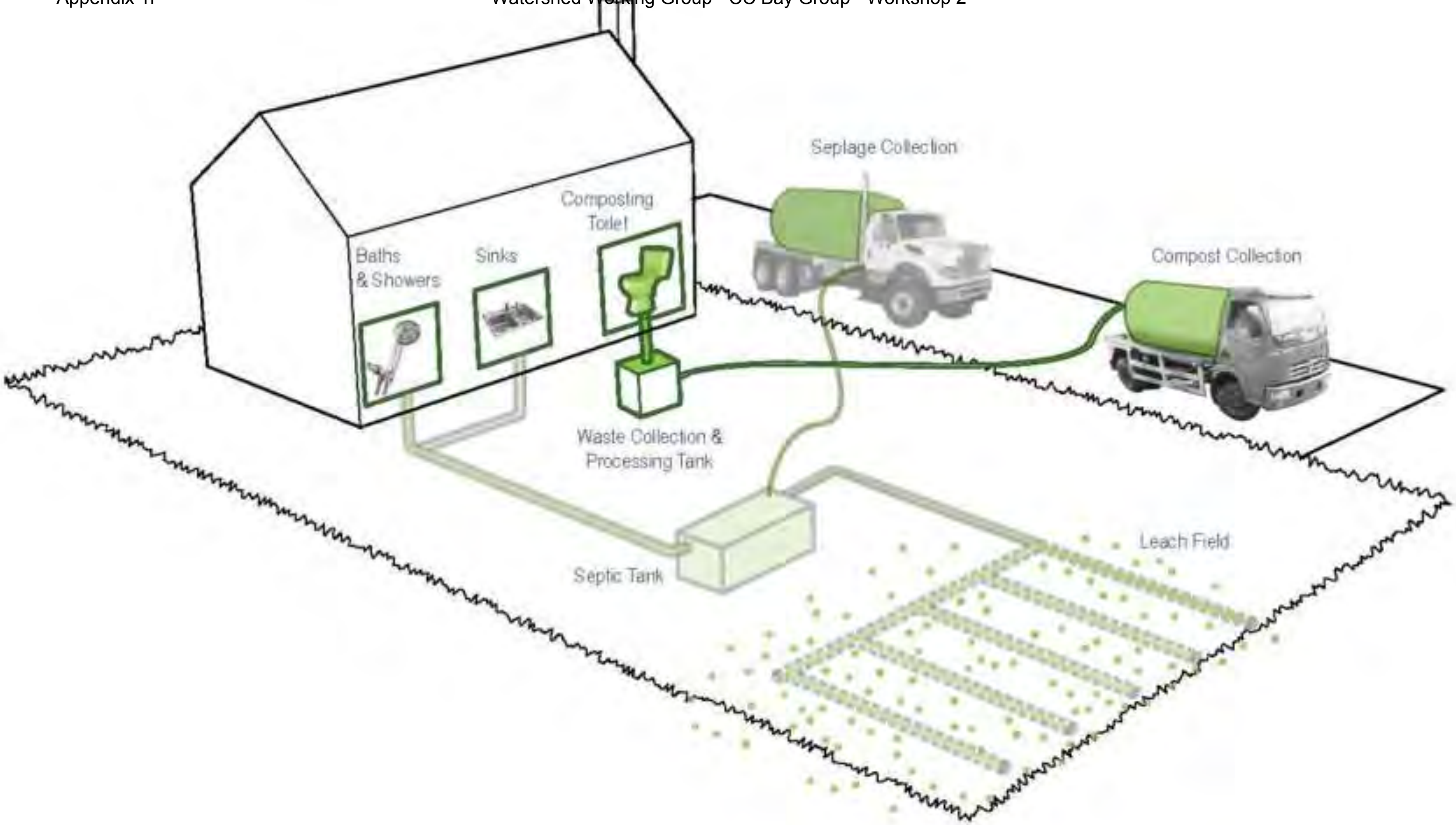
Waterless Urinal

IBC container (220 gallons)

40" x 40" x48"

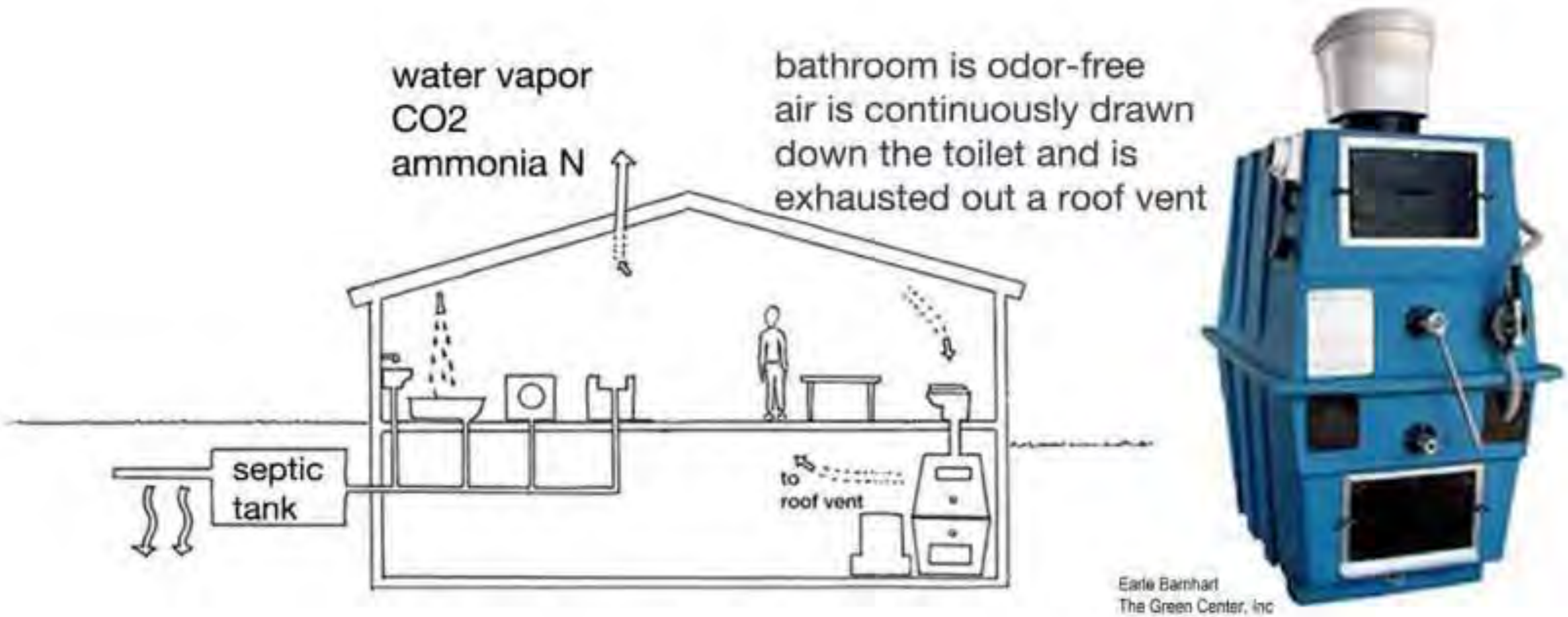
Source: Earle Barnhart, The Green Center Inc. and Horsley-Witten Group Inc.

Toilets: Urine Diverting



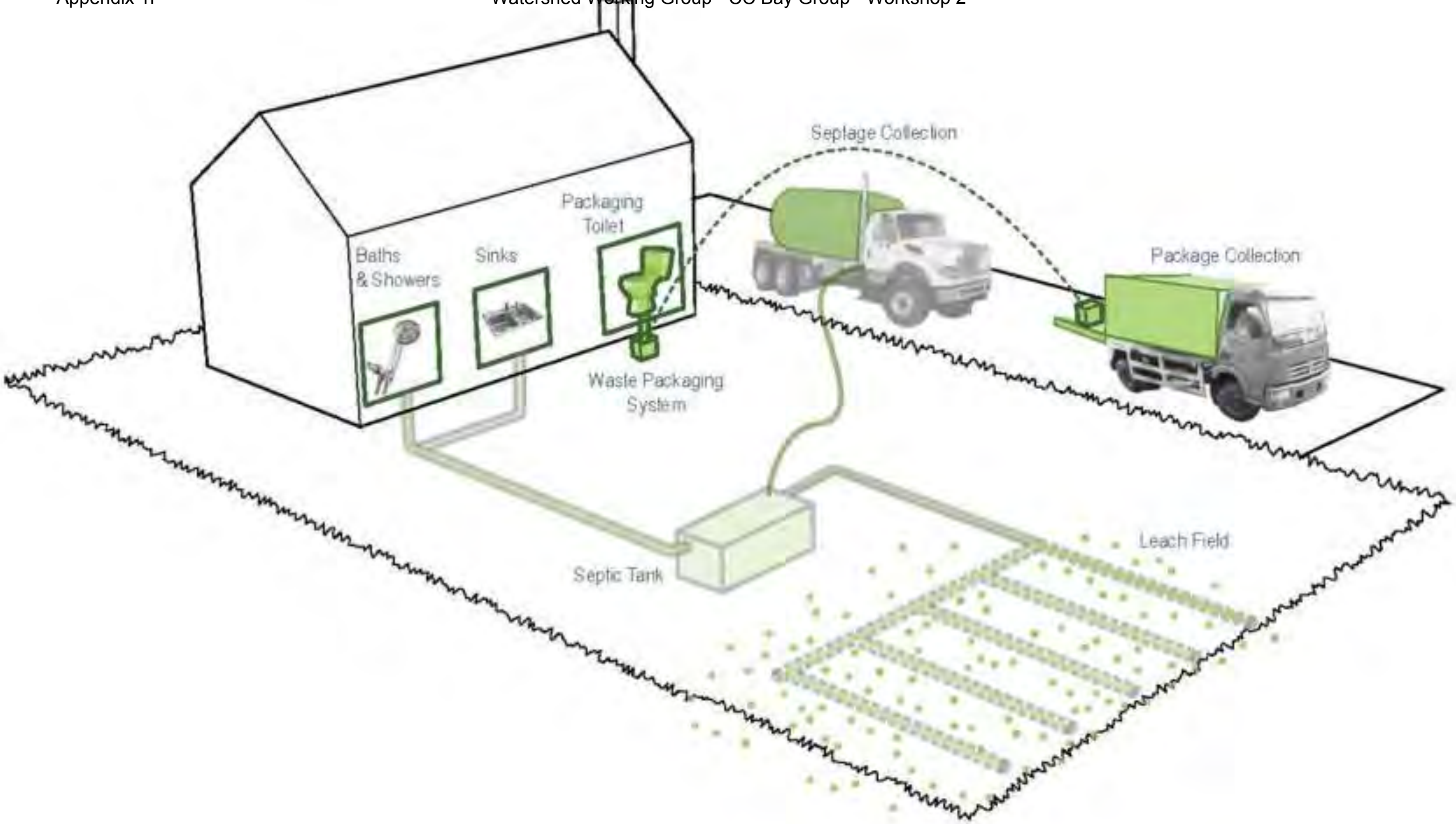
Scale: SITE
Target: WASTEWATER

Toilets: Composting



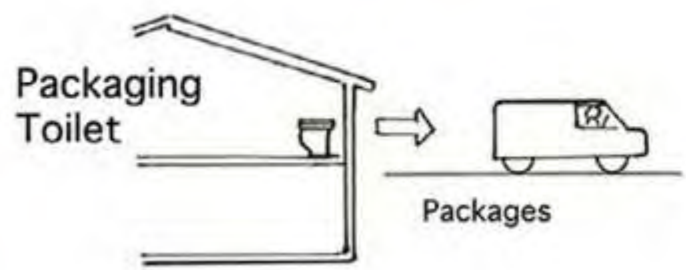
Source: Earle Barnhart, The Green Center Inc.

Toilets: Composting



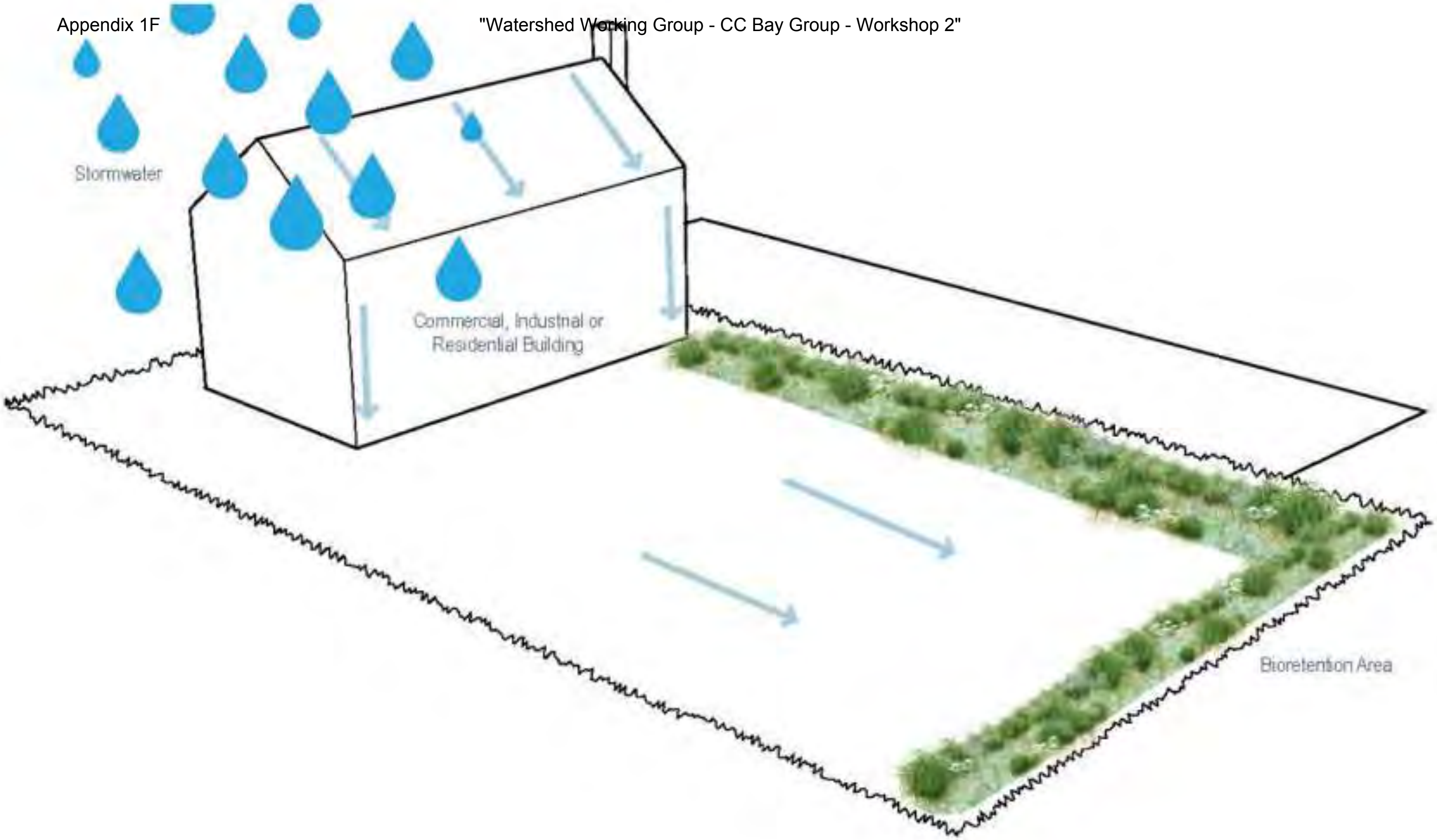
Scale: SITE
Target: WASTEWATER

Toilets: Packaging



Source: Earle Barnhart, The Green Center Inc.

Toilets: Packaging



Scale: SITE
Target: STORMWATER

Stormwater Bioretention /
Soil Media Filters

Precedent: 12th Ave. Stormwater Project, Portland, OR

Source: City of Portland

Stormwater: Bioretention / Soil Media Filters

Rain Gardens


Site Scale | Neighborhood | Watershed | Cape-Wide
Solutions: Neighborhood
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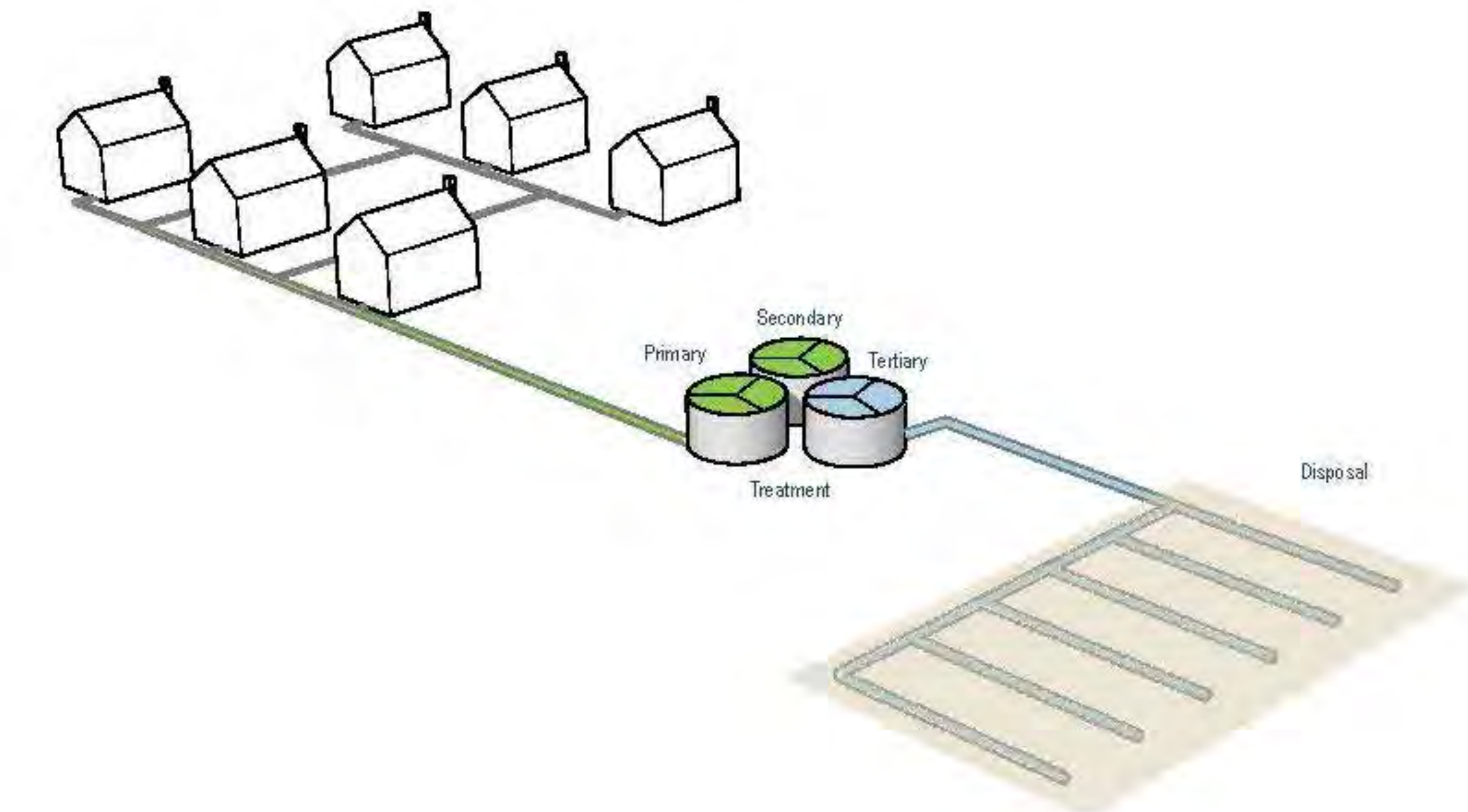
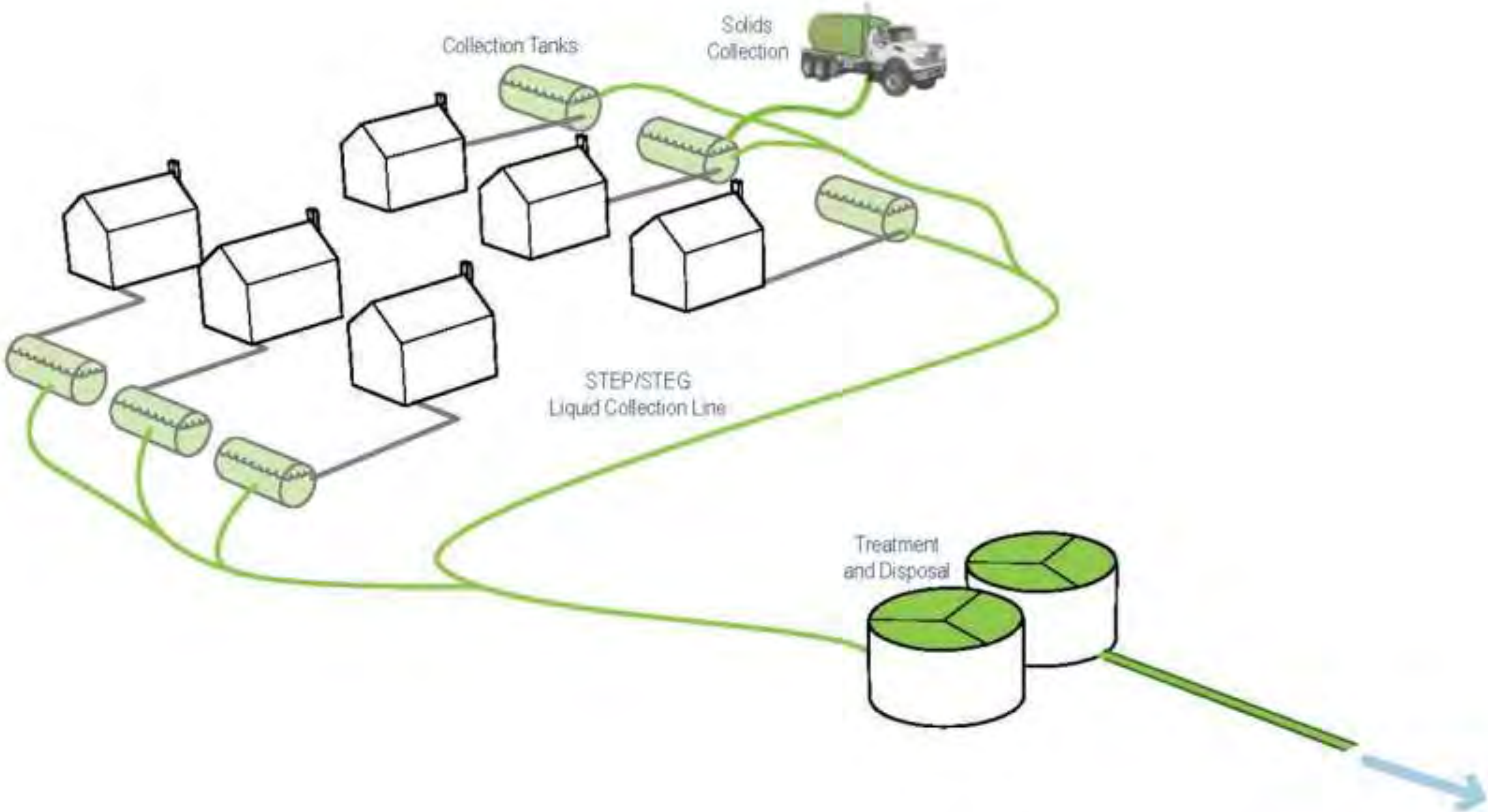


Scale: NEIGHBORHOOD
Target: WASTEWATER

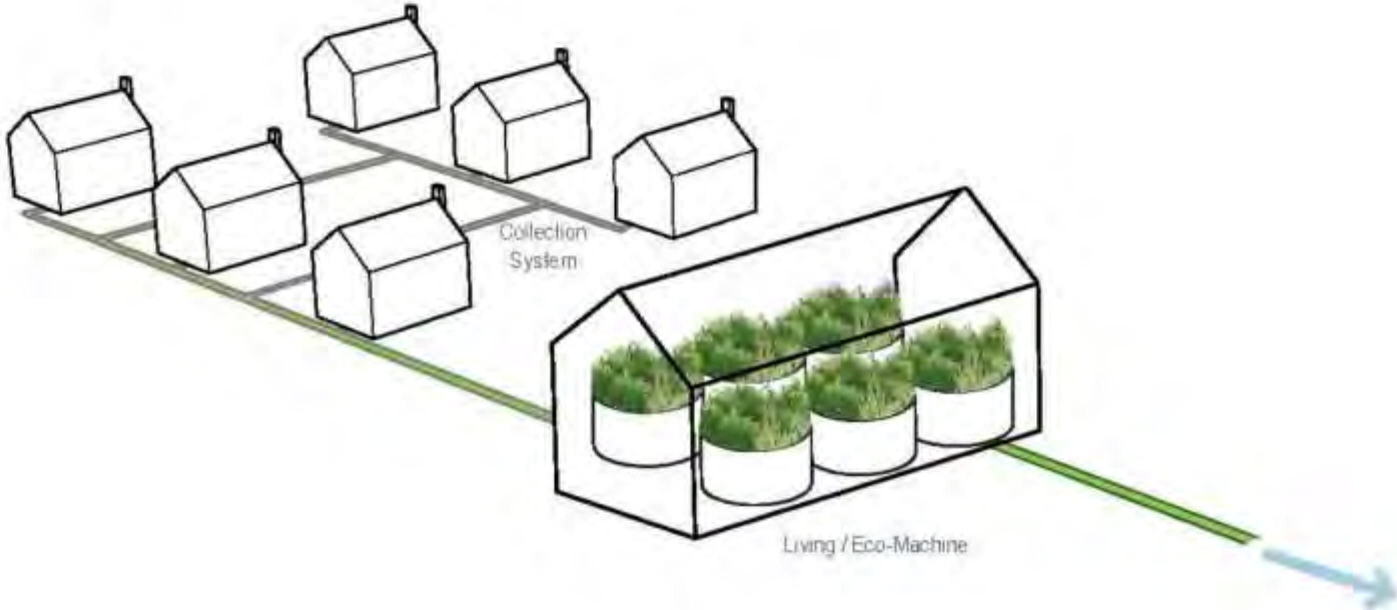
Cluster & Satellite
Treatment Systems



Scale: NEIGHBORHOOD
Target: WASTEWATER

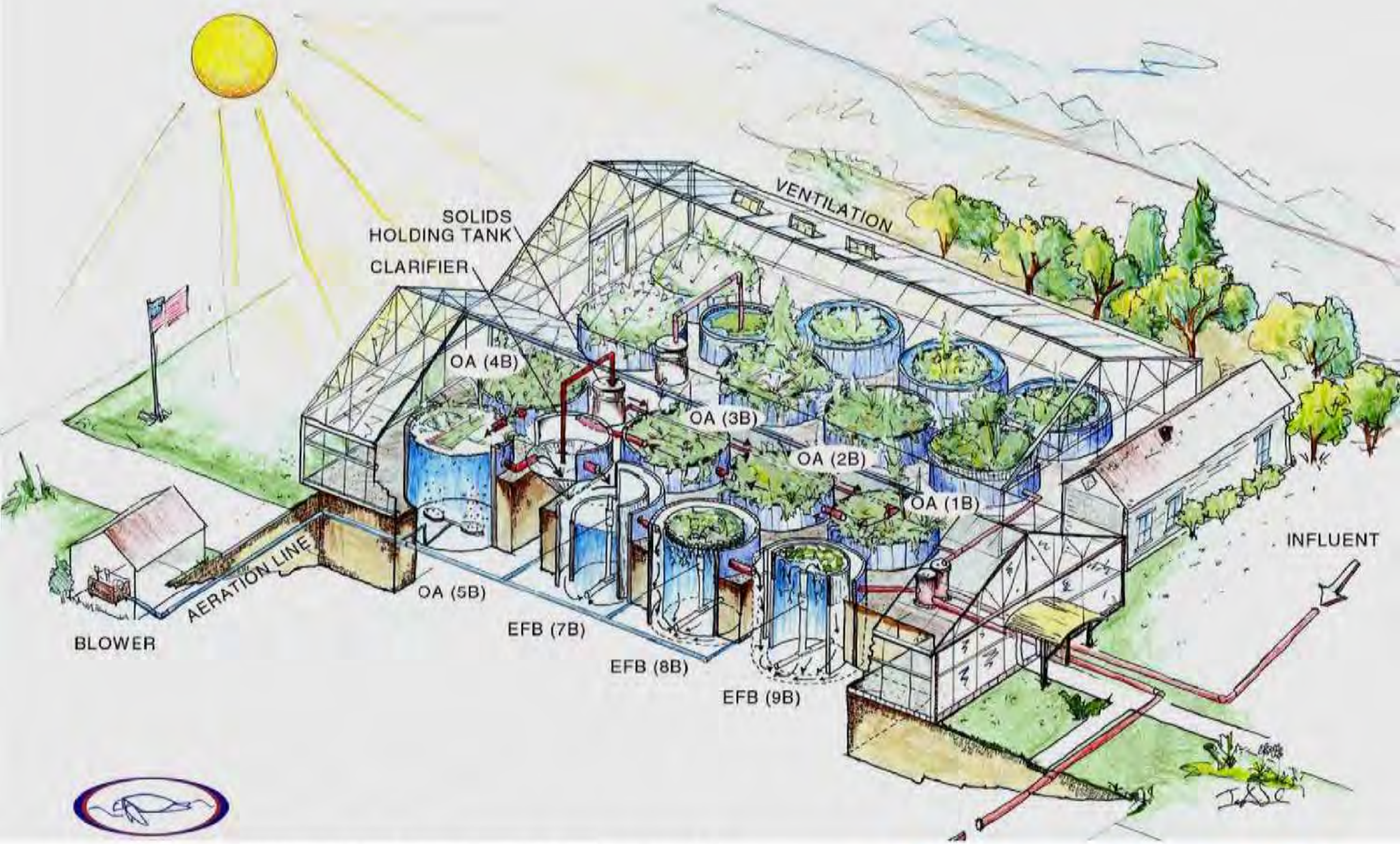
STEP / STEG Collection

STEP/ STEG



Scale: NEIGHBORHOOD
Target: WASTEWATER

Eco-Machines and
Living Machines



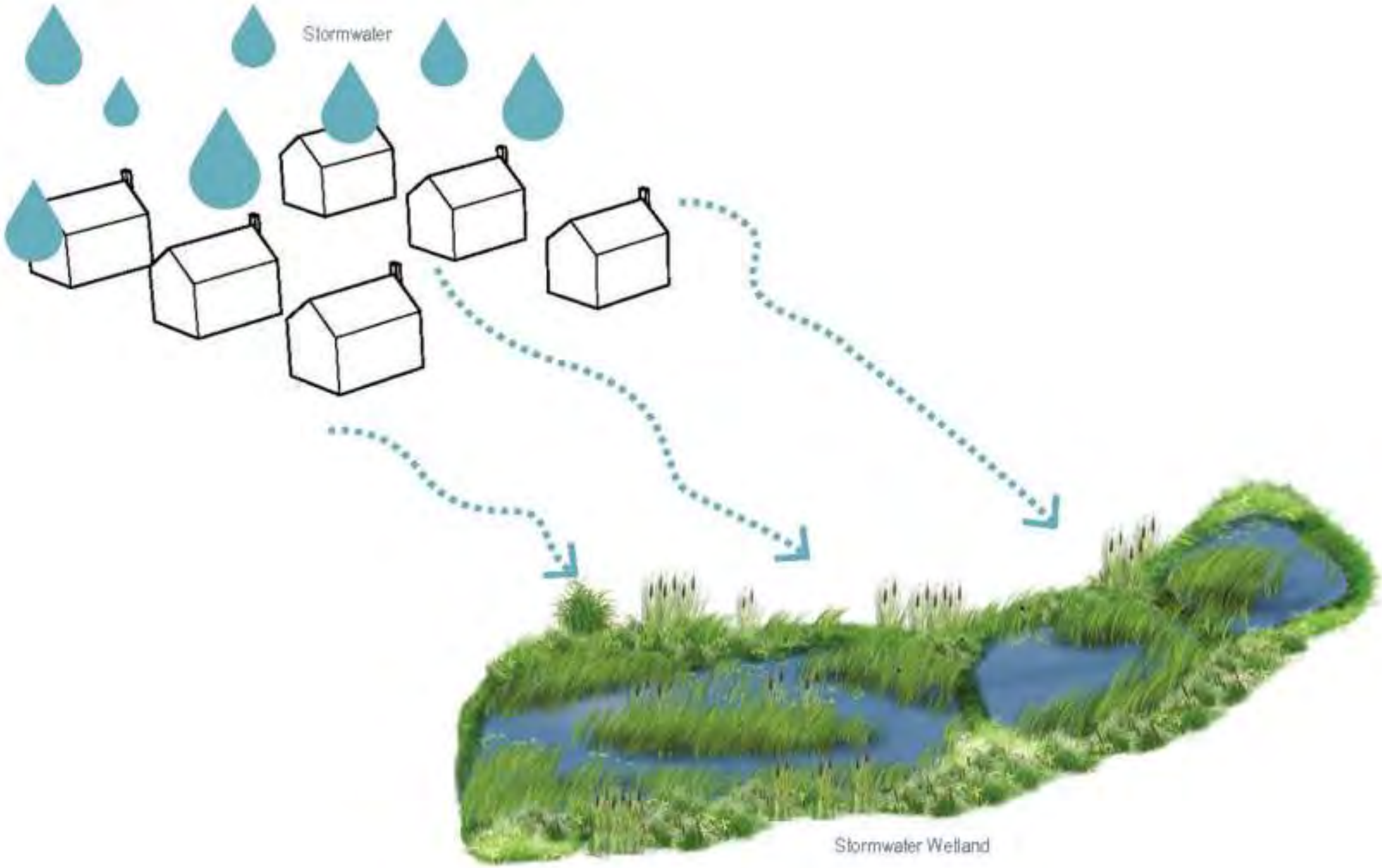
Precedent: Living Machine, South Burlington, VT

Source: Todd Ecological

Eco-Machines and Living Machines

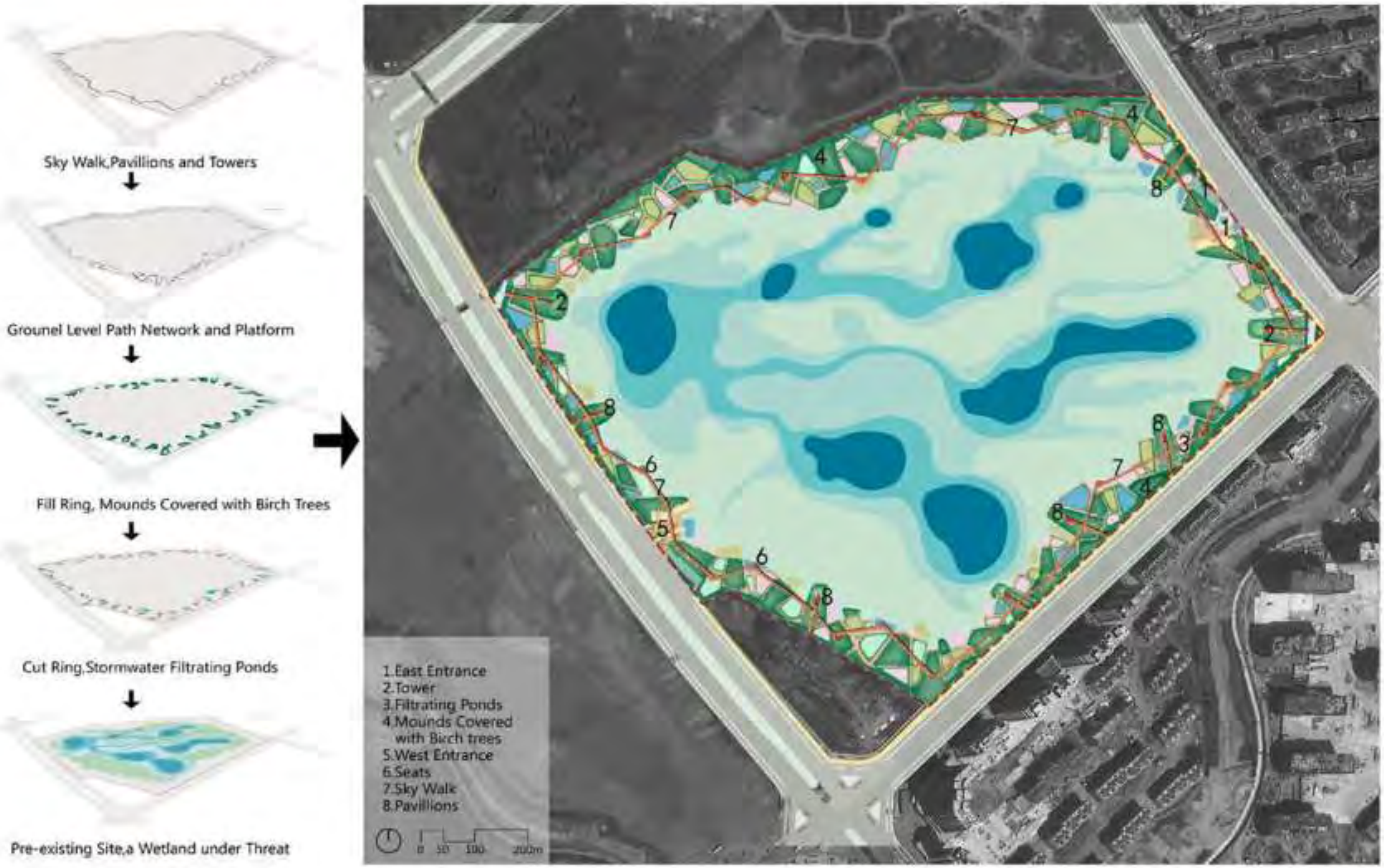
Precedent: Living Machine - South Burlington, VT + Photobioreactors - Falmouth, MA
Source: Todd Ecological and Tom Cambareri

Eco-Machines and Living Machines



Scale: NEIGHBORHOOD
Target: STORMWATER

Stormwater Wetlands

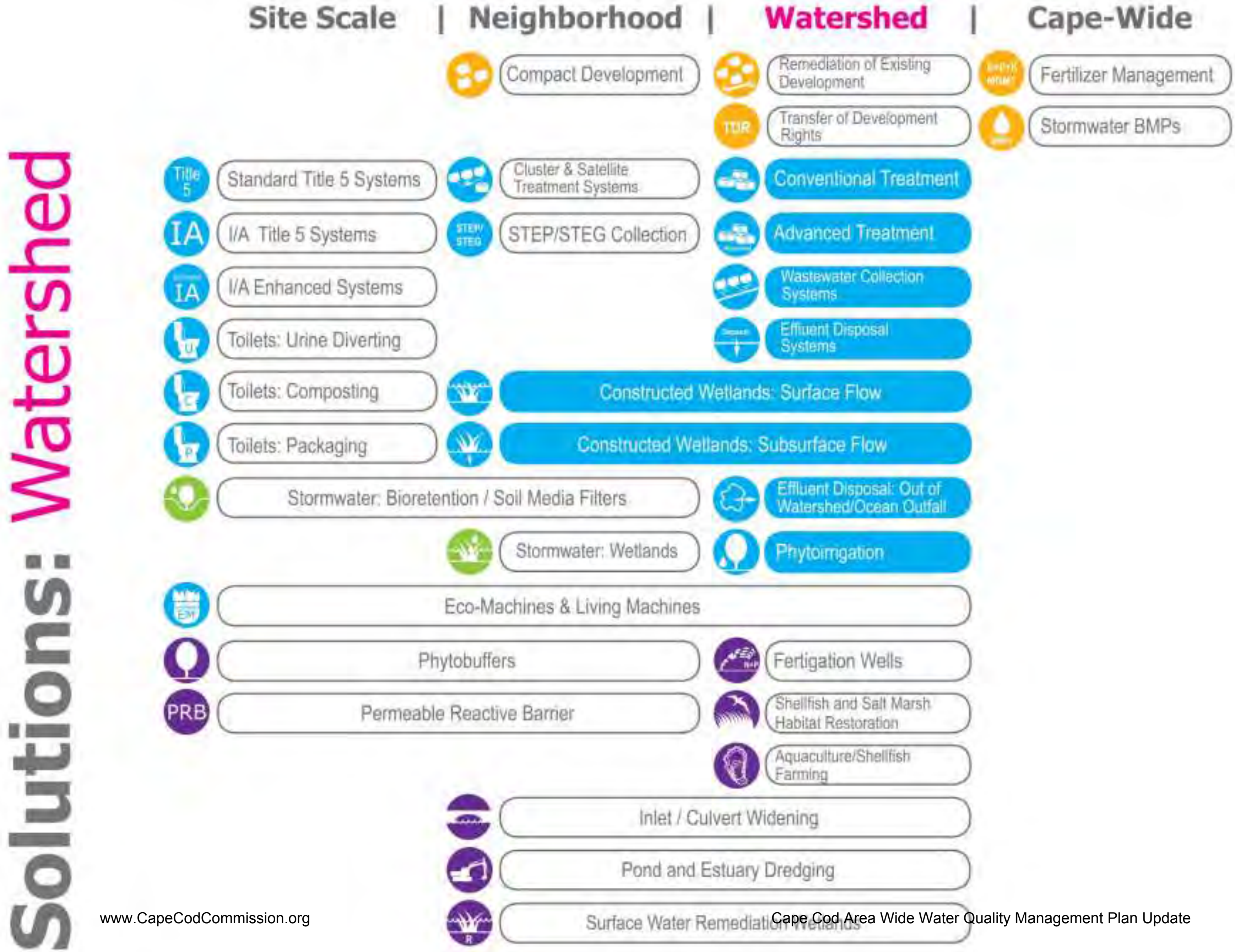


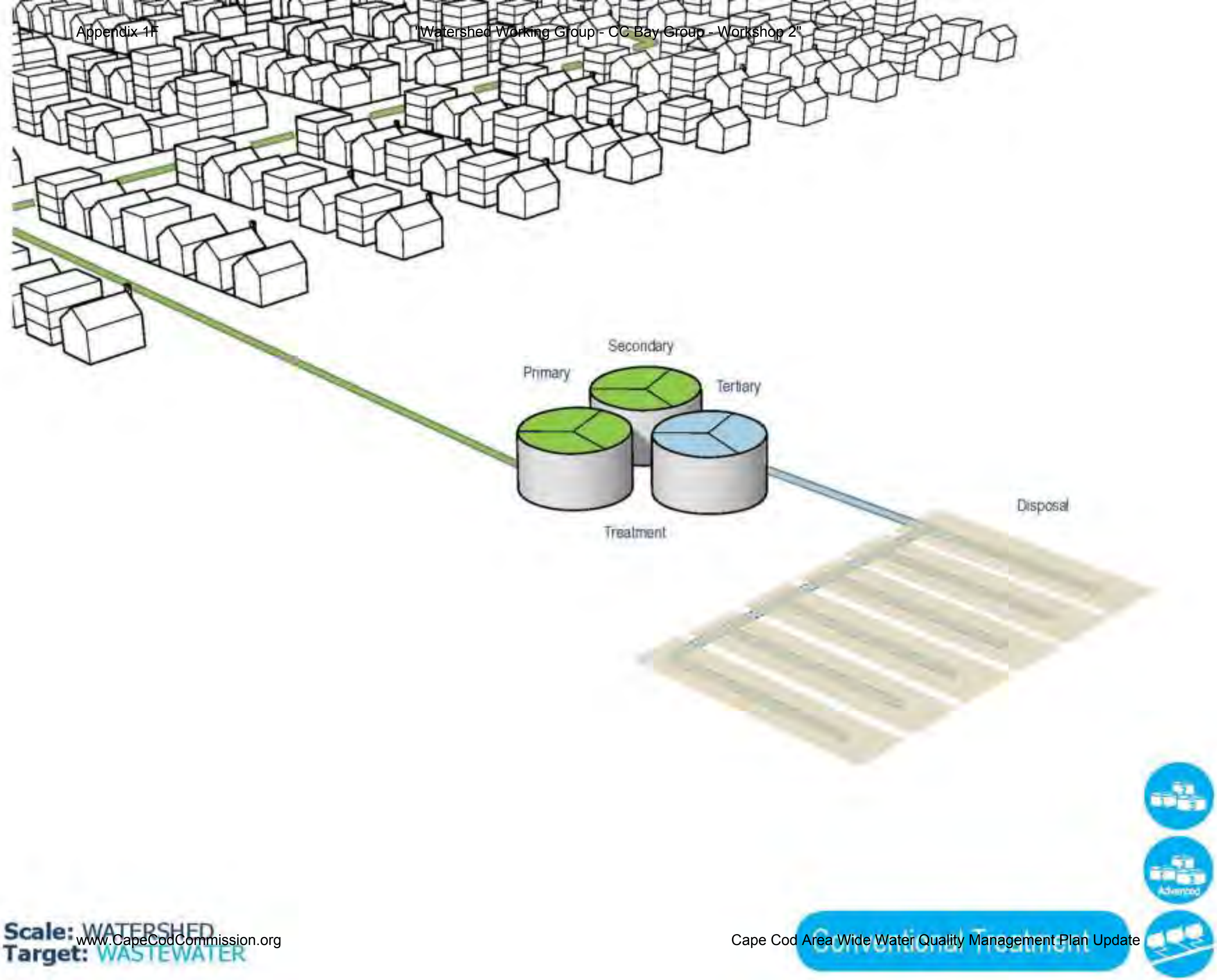
Precedent: Quinli Stormwater Park, China

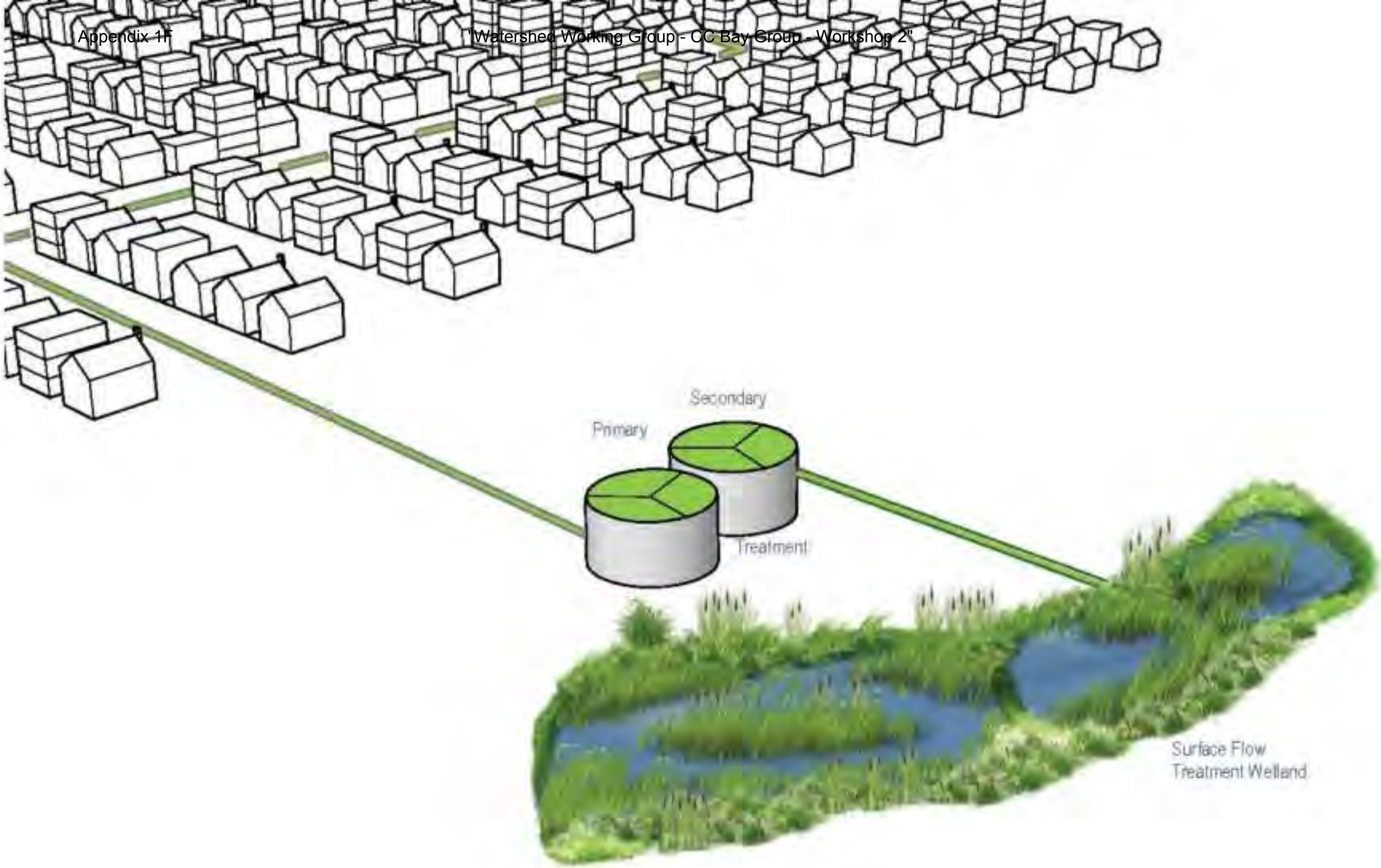
Source: Turenscape

Stormwater Wetlands

Stormwater Wetlands


Solutions: Watershed
Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
IA
I/A Title 5 Systems
STEP/STEG
STEP/STEG Collection
Advanced Treatment
IA
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
EM
Eco-Machines & Living Machines
Phytobuffers
Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands


Secondary
Primary
Tertiary
Treatment
Disposal
Advanced
Conventional Treatment
Scale: WATERSHED
Target: WASTEWATER



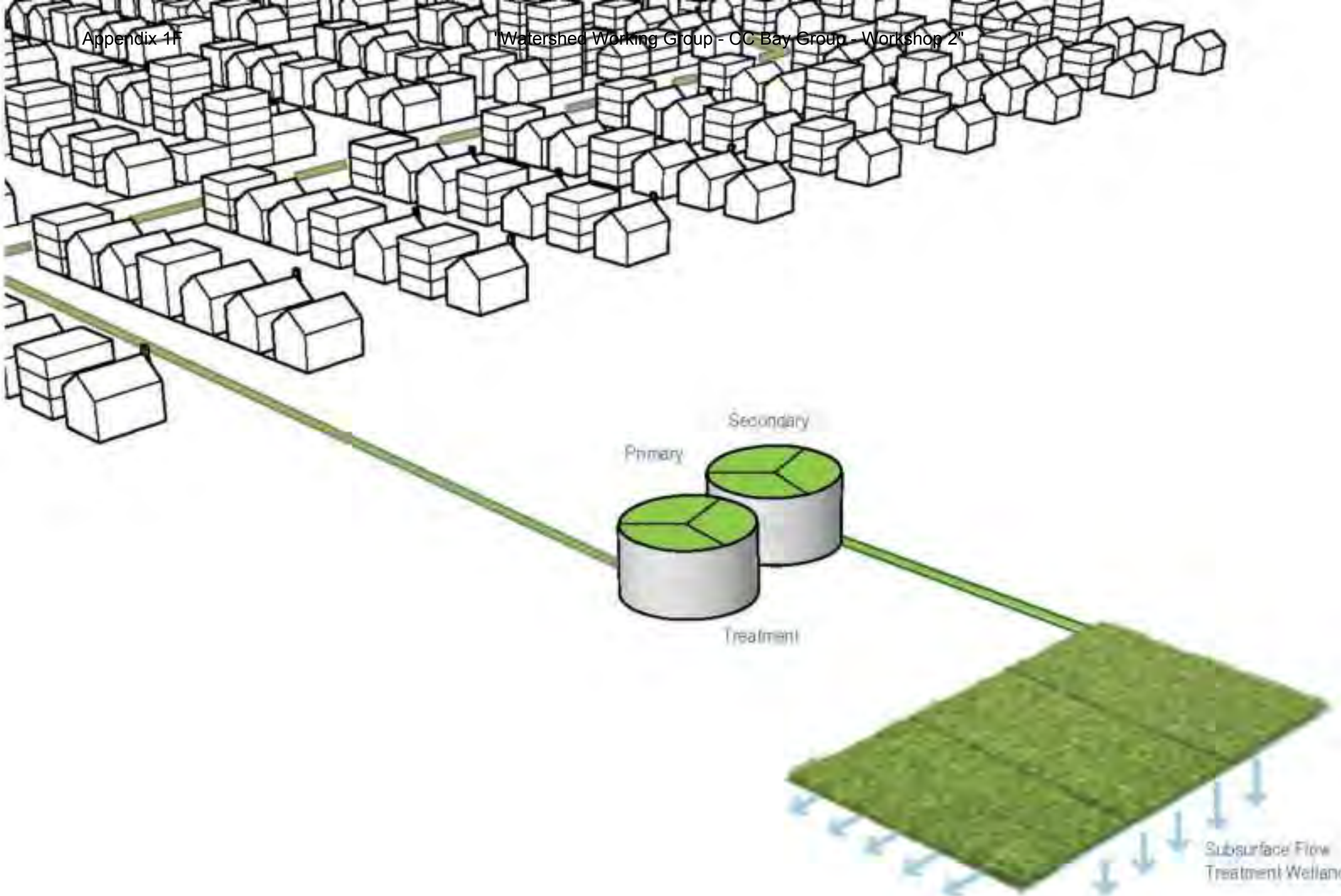
Scale: WATERSHED
Target: WASTEWATER

Constructed Wetlands
Surface Flow

Precedent: Talking Waters Garden - Albany, OR

Source: Kate Kennen

Constructed Wetlands: Surface Flow



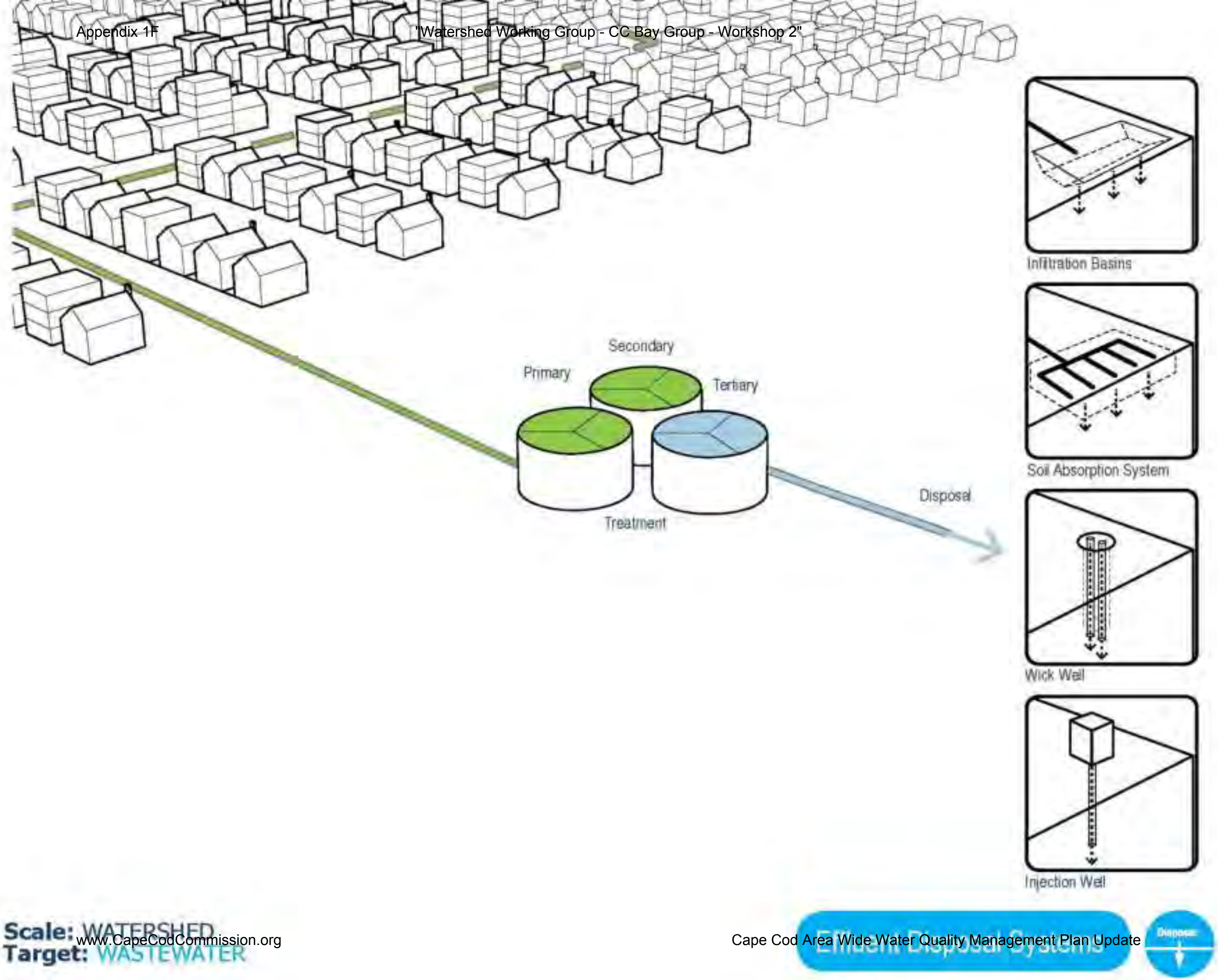
Scale: WATERSHED
Target: WASTEWATER

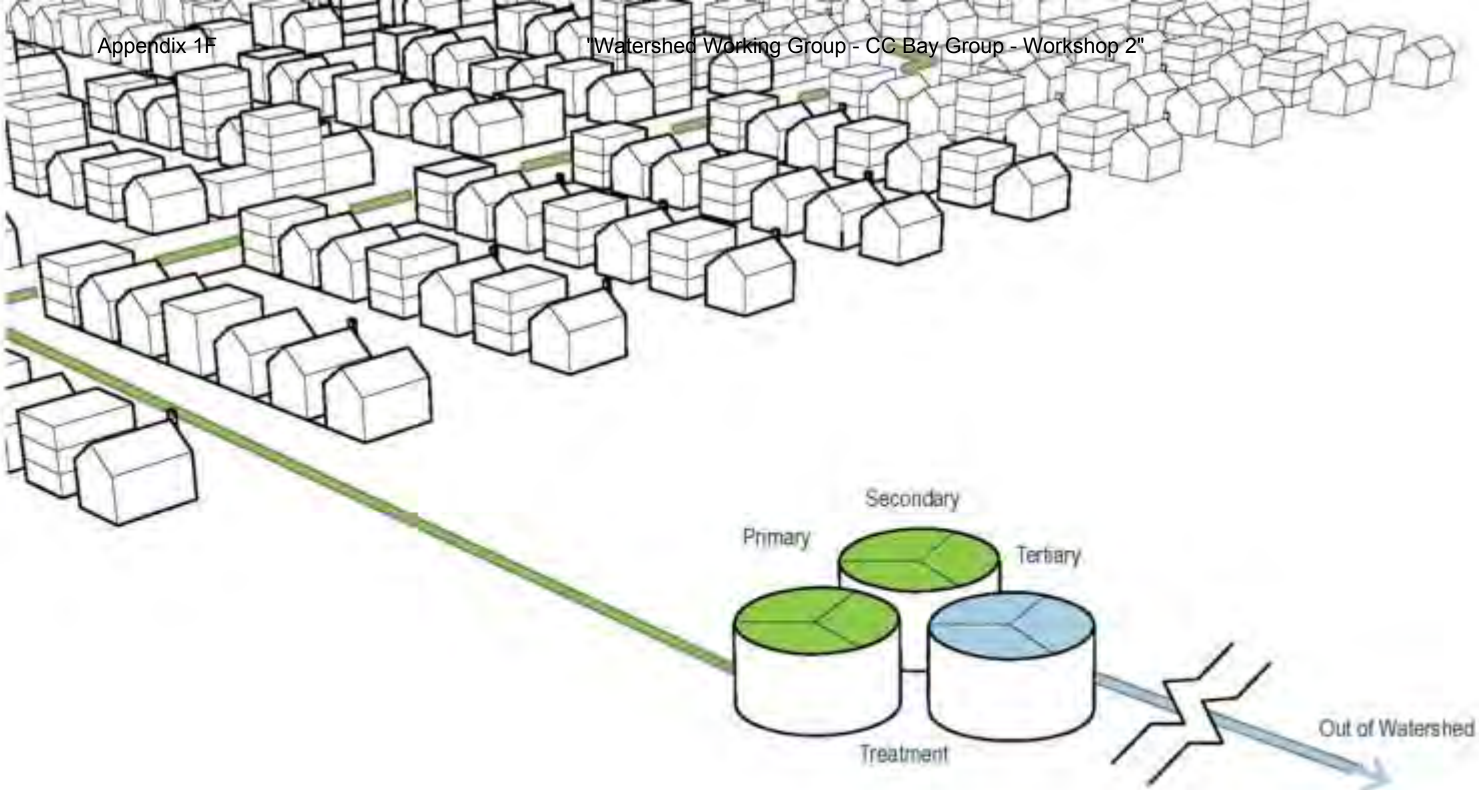
Constructed Wetlands
Subsurface Flow

Precedent: Koh Phi Phi Treatment Wetland, Thailand

Source: Hans Brix

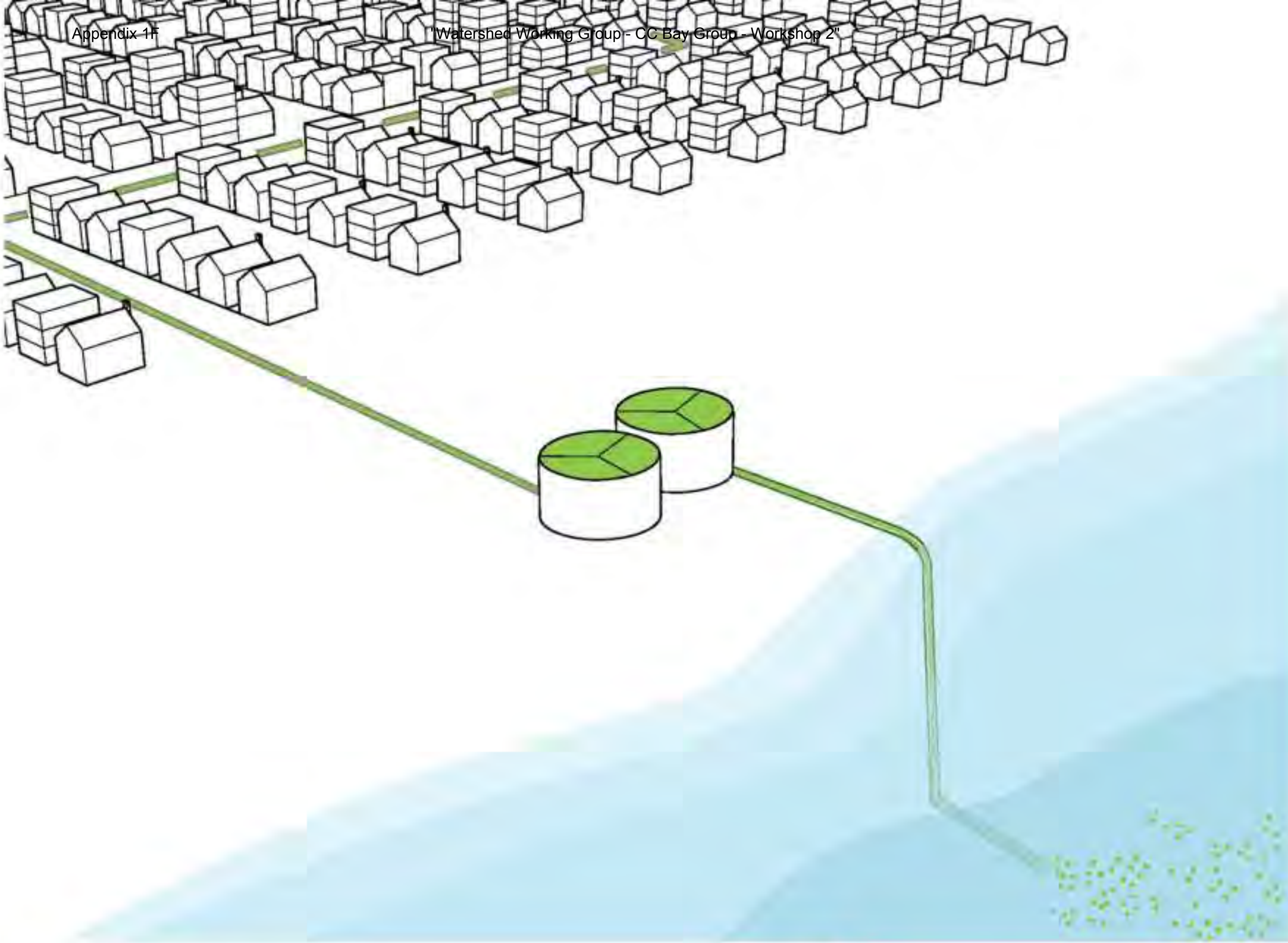
Constructed Wetlands: Subsurface Flow


Secondary
Primary
Tertiary
Treatment
Disposal
Infiltration Basins
Soil Absorption System
Wick Well
Injection Well
Scale: WATERSHED
Target: WASTEWATER
Effluent Disposal Systems
Disposal

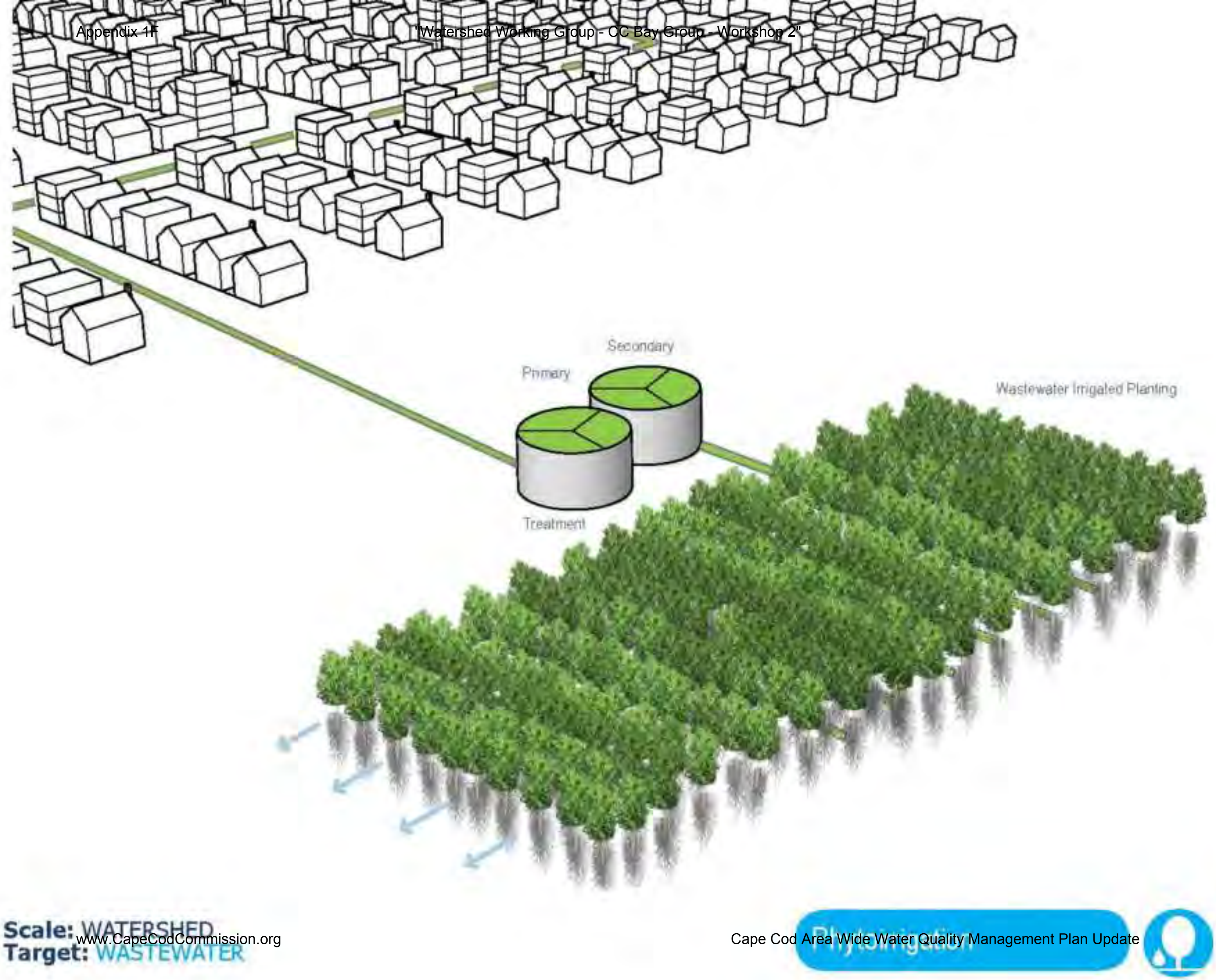


Scale: WATERSHED
Target: WASTEWATER

Effluent Disposal: Out of Watershed



Scale: WATERSHED
Target: WASTEWATER


Secondary
Primary
Treatment
Wastewater Irrigated Planting
Scale: WATERSHED
Target: WASTEWATER

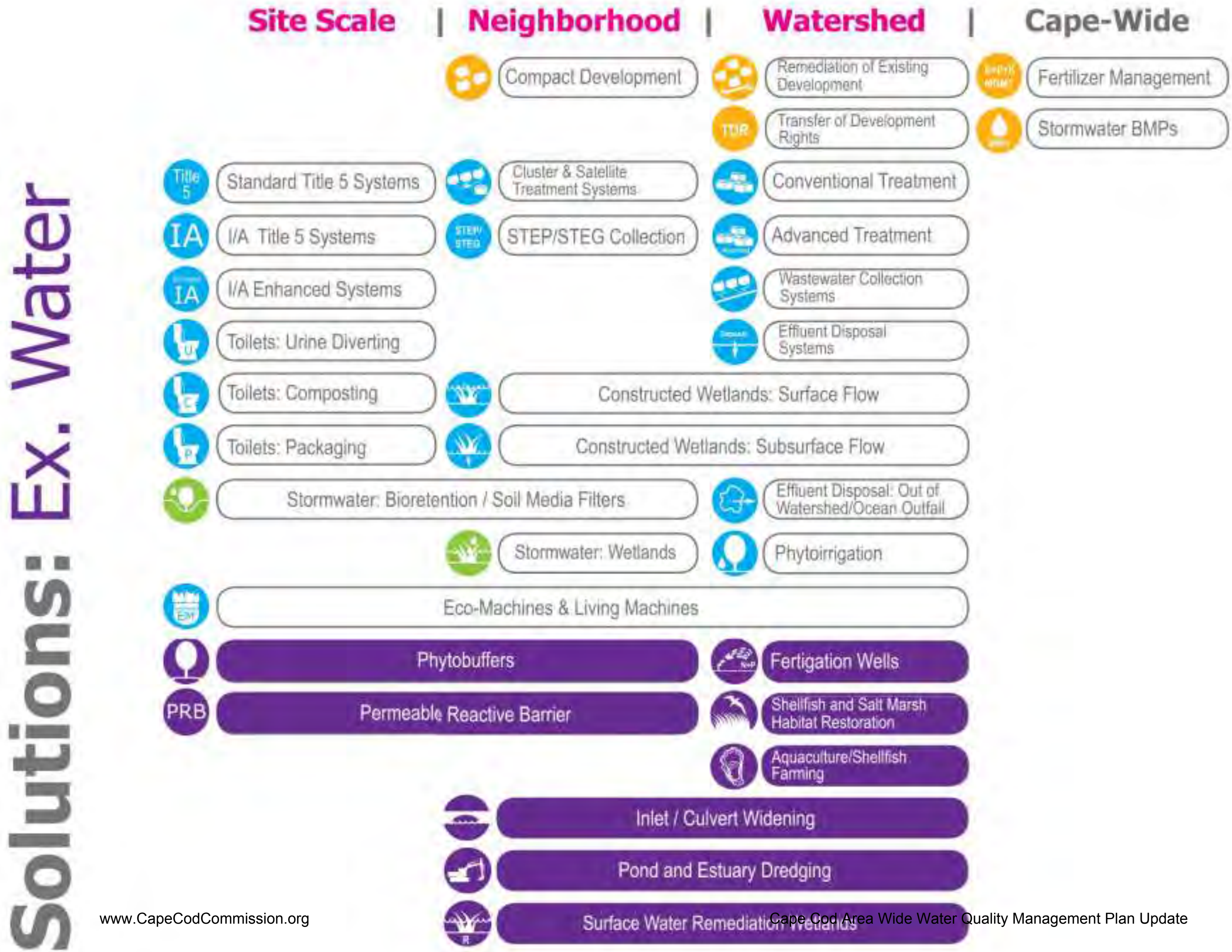
Precedent: Woodburn OR, Wastewater Treatment Facility
Source: CH2MHill

Phytoirrigation

Precedent: Woodburn OR, Wastewater Treatment Facility

Source: CH2MHill

Phytoirrigation


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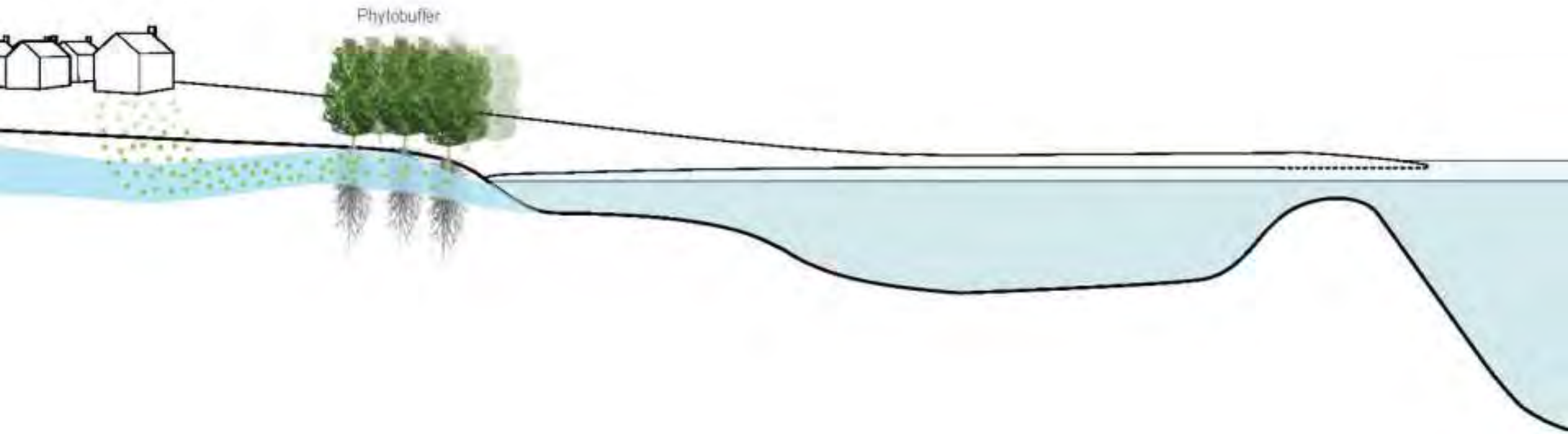
I/A Enhanced Systems
Wastewater Collection Systems
Toilets: Urine Diverting
Effluent Disposal Systems
Toilets: Composting
Constructed Wetlands: Surface Flow
Toilets: Packaging
Constructed Wetlands: Subsurface Flow
Stormwater: Bioretention / Soil Media Filters
Effluent Disposal: Out of Watershed/Ocean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



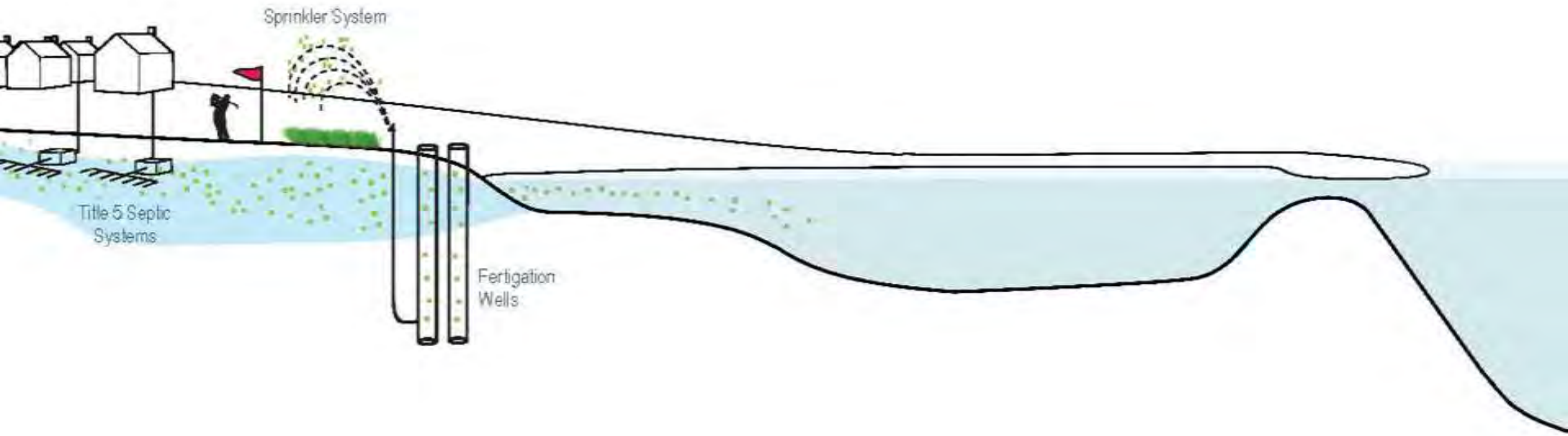
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Phytobuffers

Precedent: Phytobuffer - Kavcee, WY

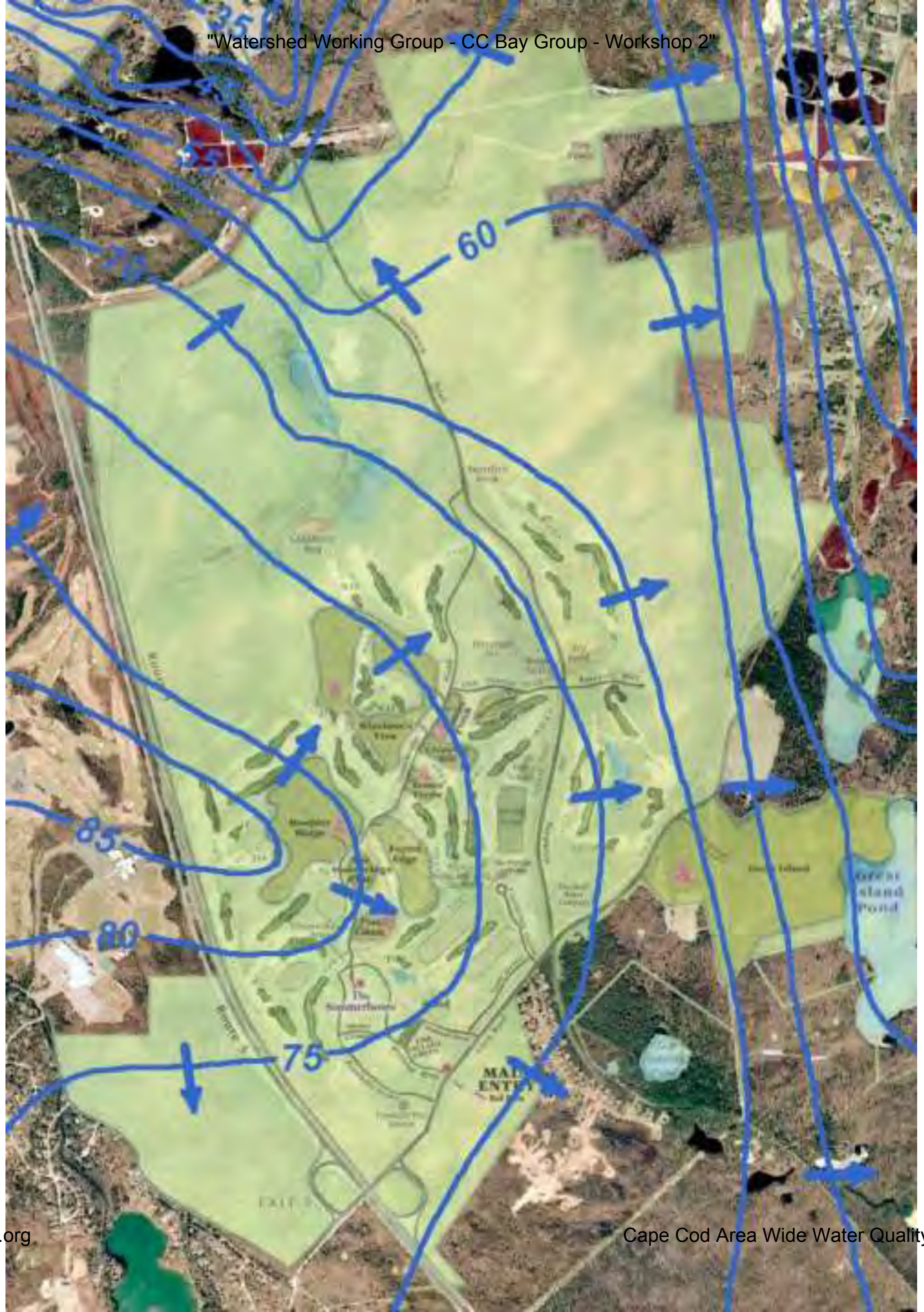
Source: Sand Creek Consultants

Phytobuffers

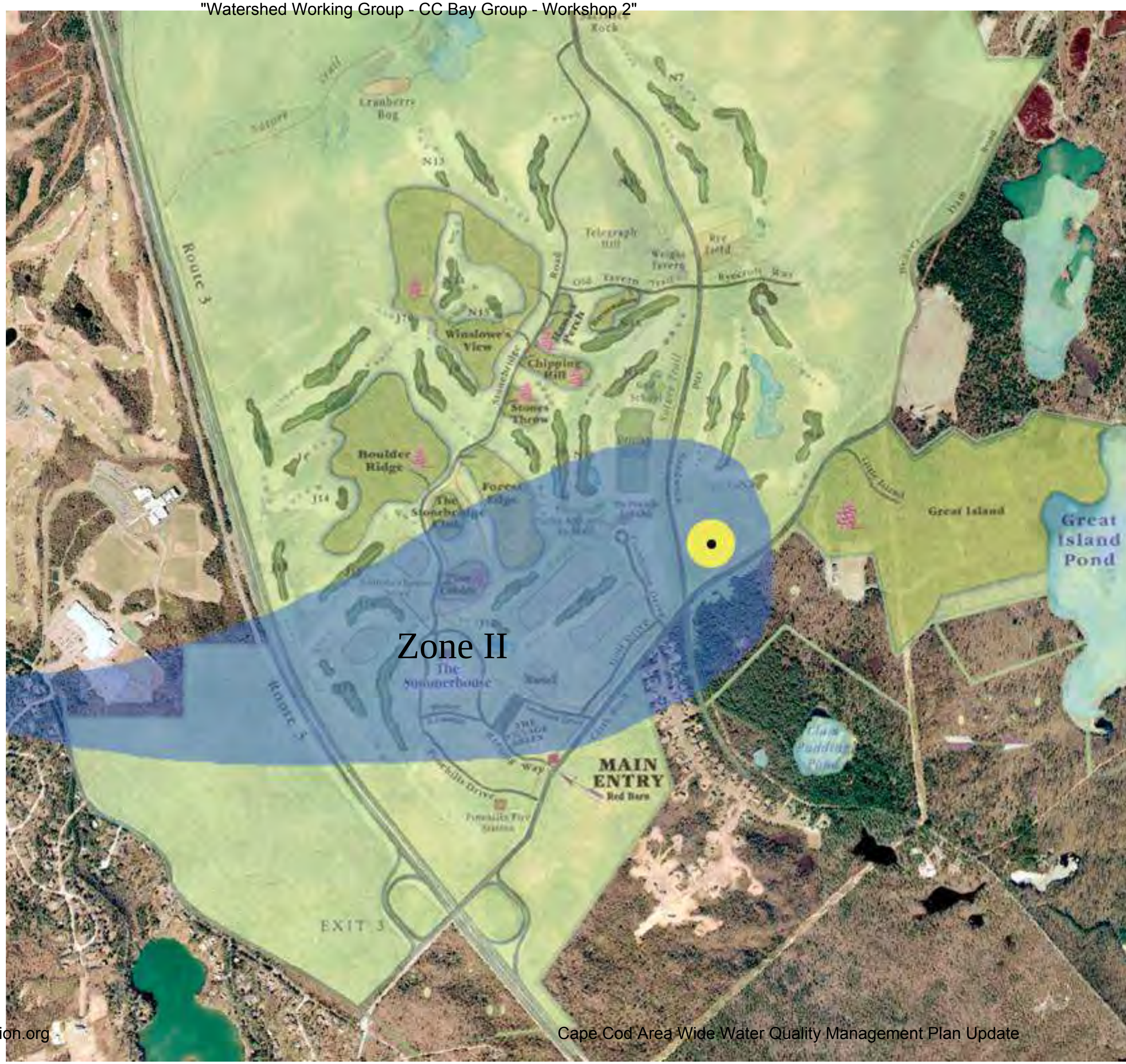


Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

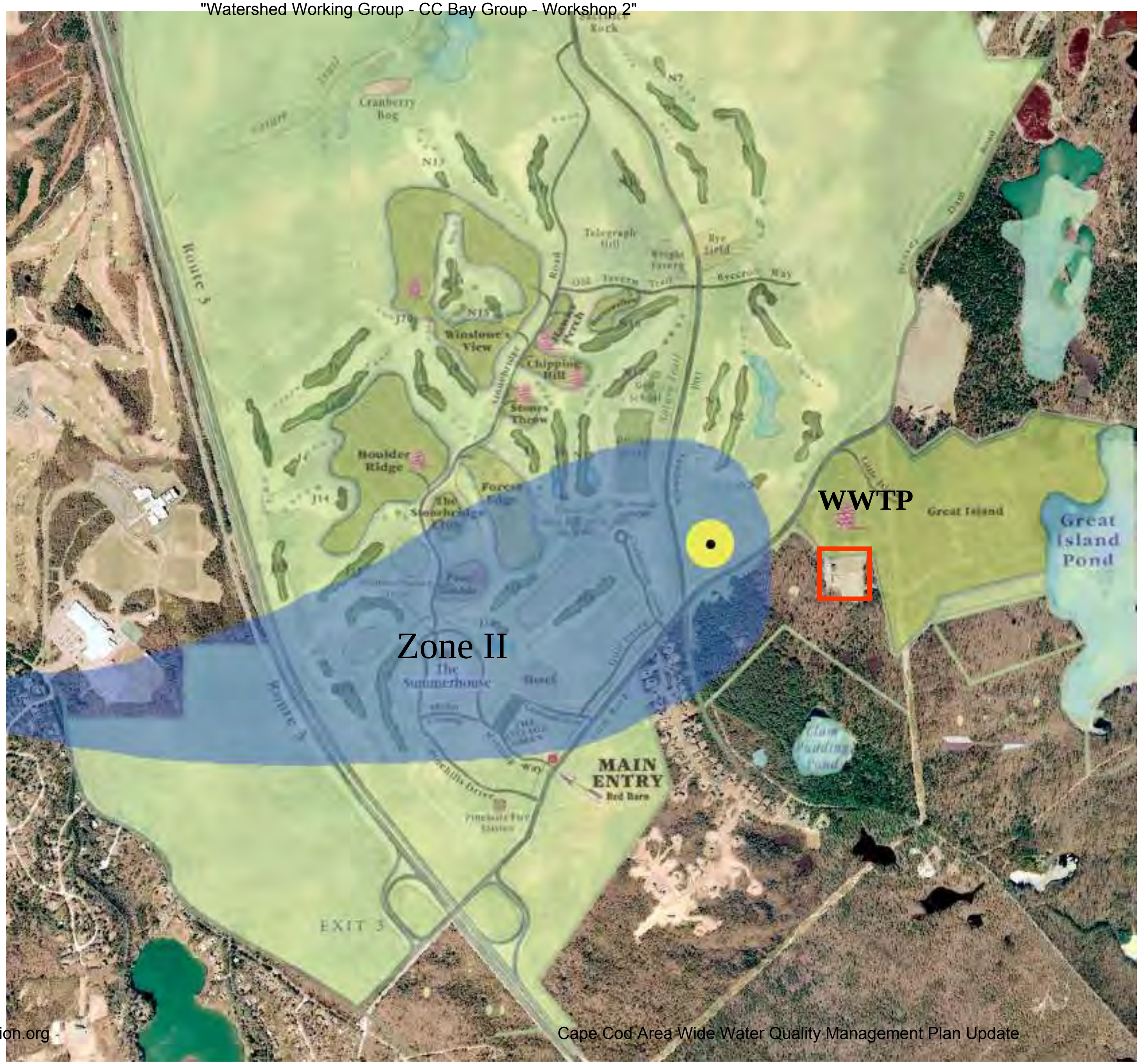
Fertigation Wells



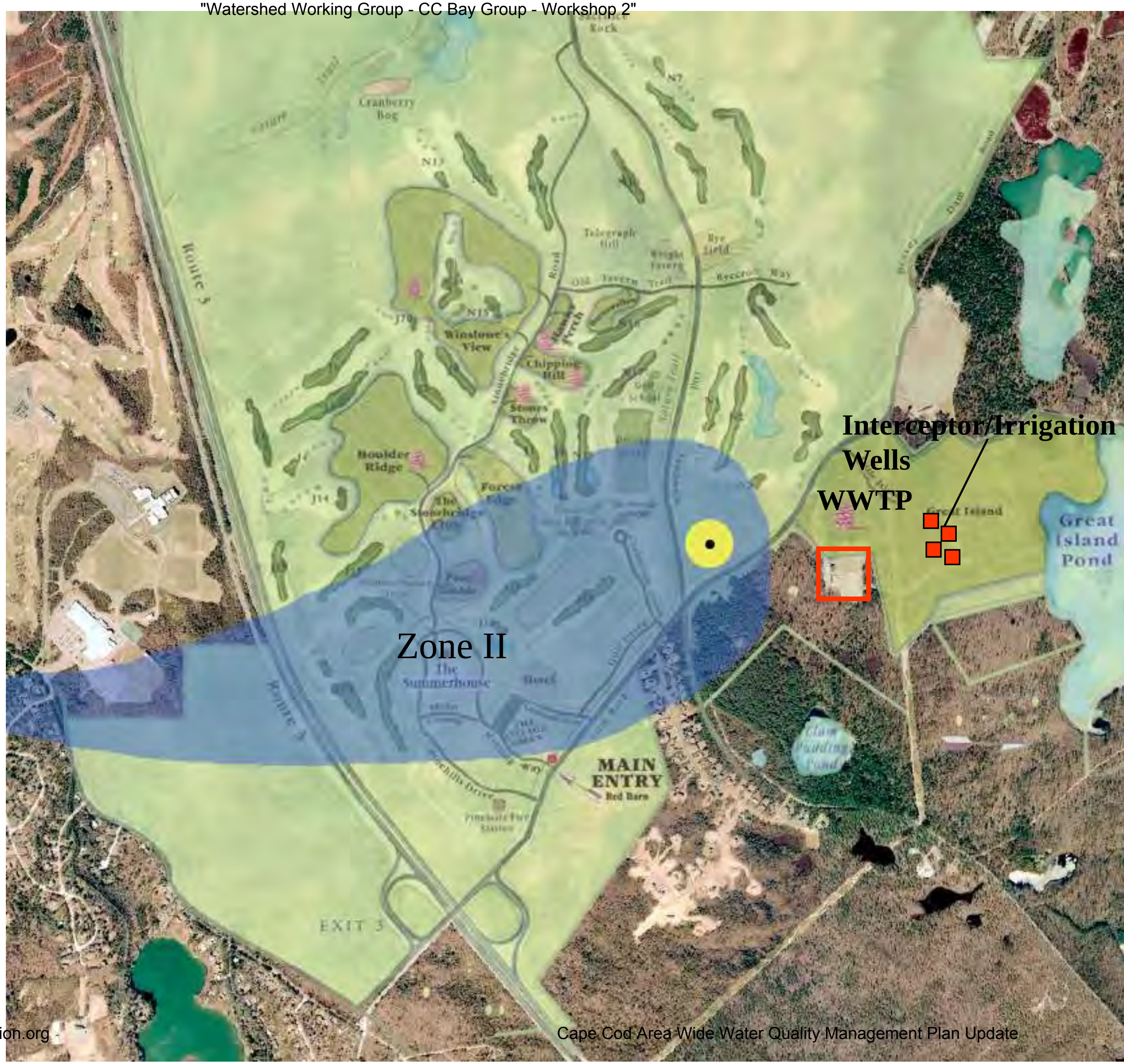
Precedent:
Pine Hills
Plymouth, MA



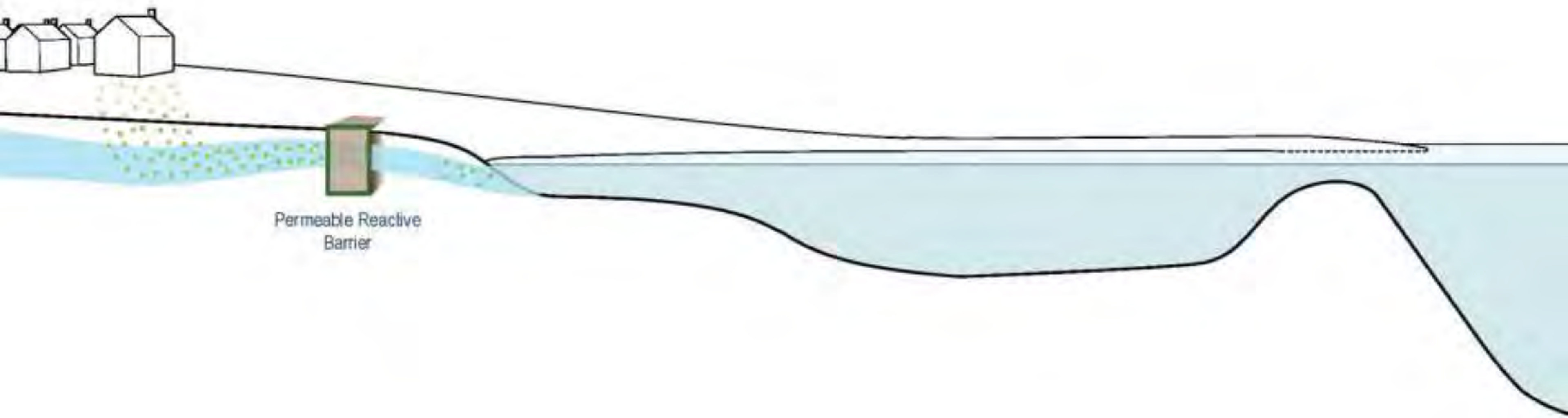
Precedent:
Pine Hills
Plymouth, MA



Precedent:
Pine Hills
Plymouth, MA



Precedent:
Pine Hills
Plymouth, MA



Scale: SITE / NEIGHBORHOOD / WATERSHED
Target: EXISTING WATER BODIES

Permeable Reactive Barrier

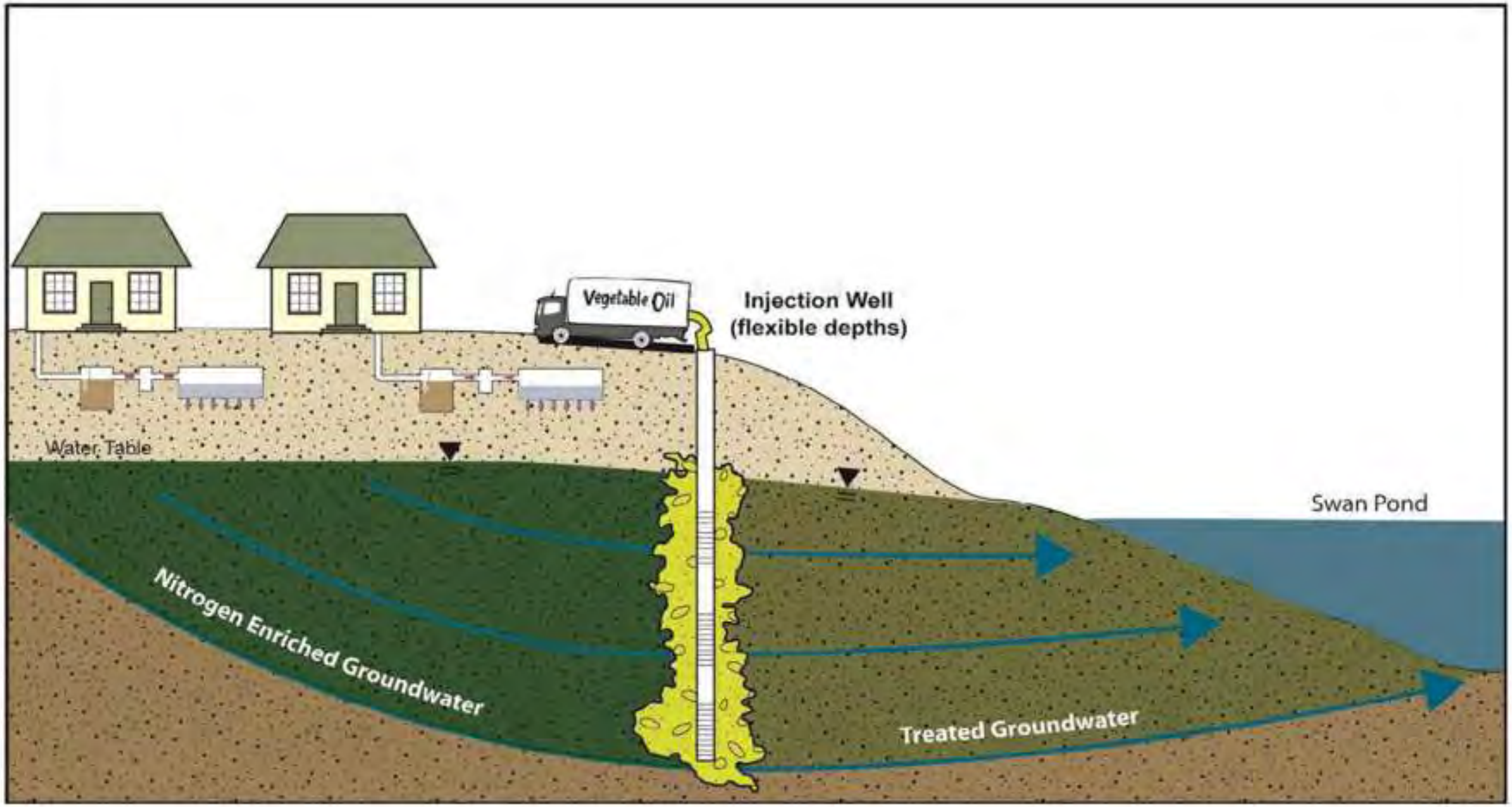
PRB

Precedent: Falmouth PRB

Source: Mike Domenica

Permeable Reactive Barrier

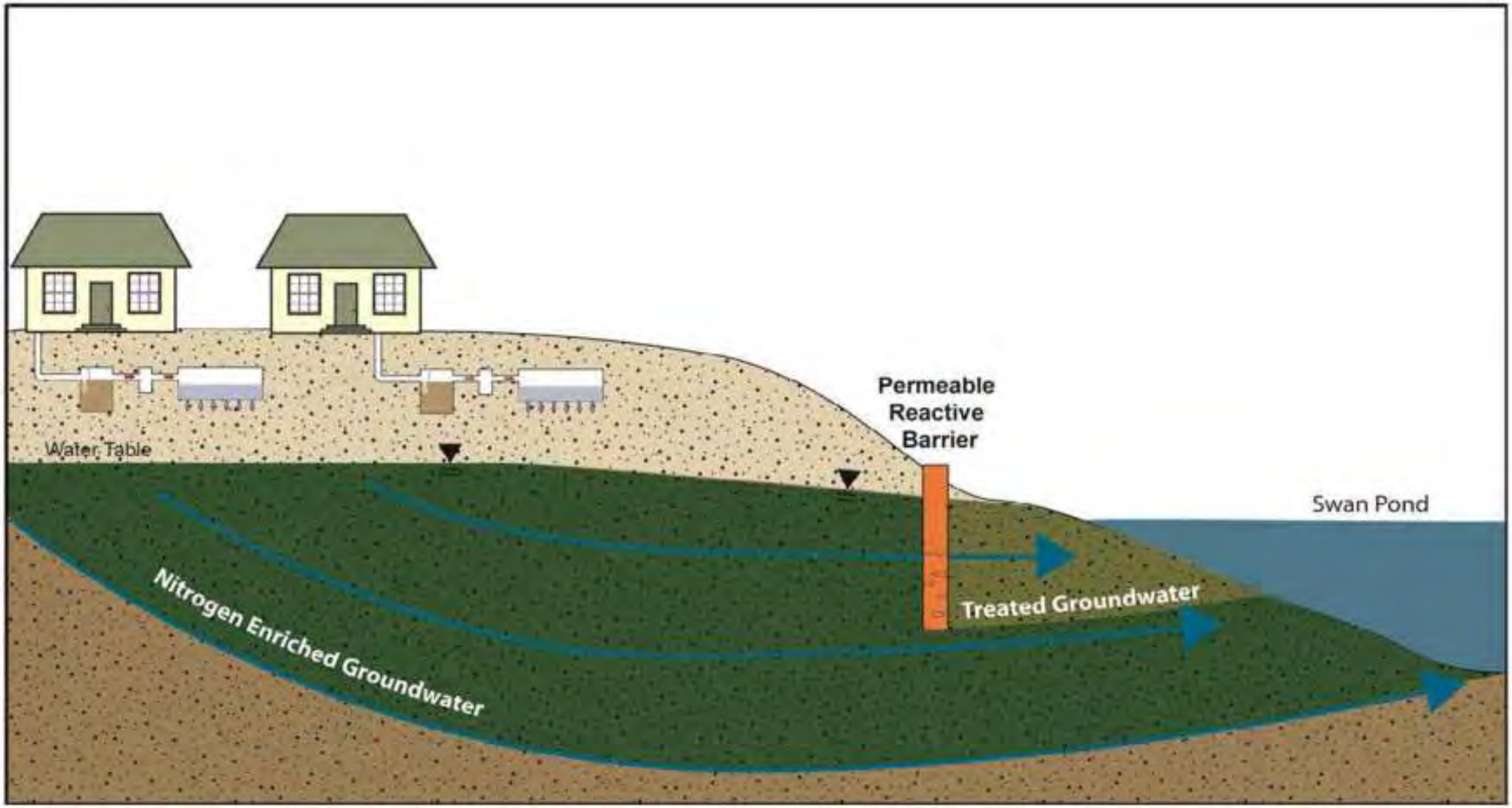
PRB



Precedent: PRB

Source: Horsley Witten Group Inc.

Permeable Reactive Barrier PRB

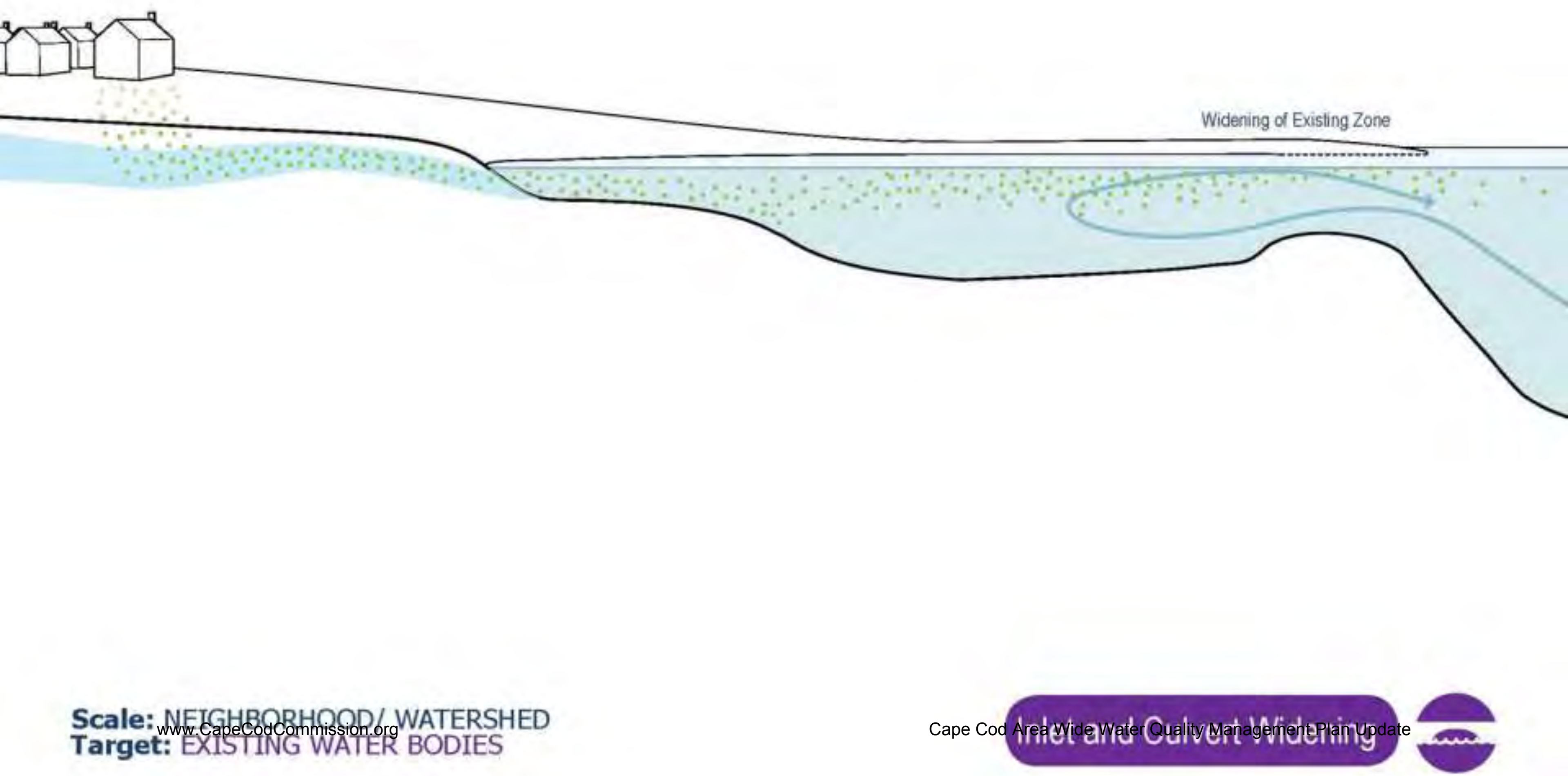


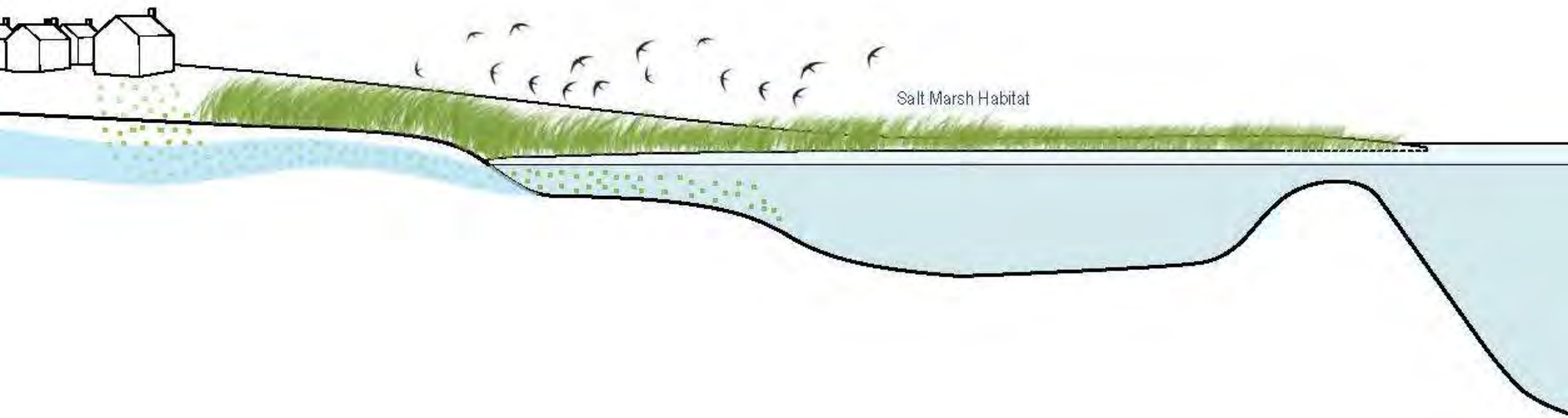
Precedent: PRB

Source: Horsley Witten Group Inc.

Permeable Reactive Barrier

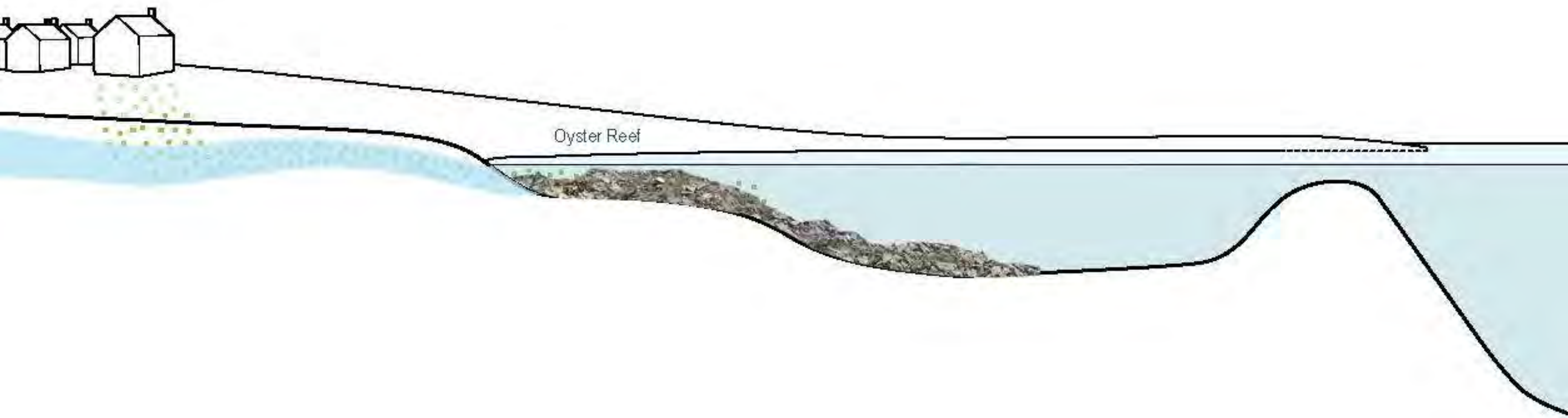
PRB


Widening of Existing Zone
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES
Inlet and Culvert Widening



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Salt Marsh Habitat Restoration



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Shellfish Habitat Restoration

Precedent: Wellfleet Oyster Restoration Project

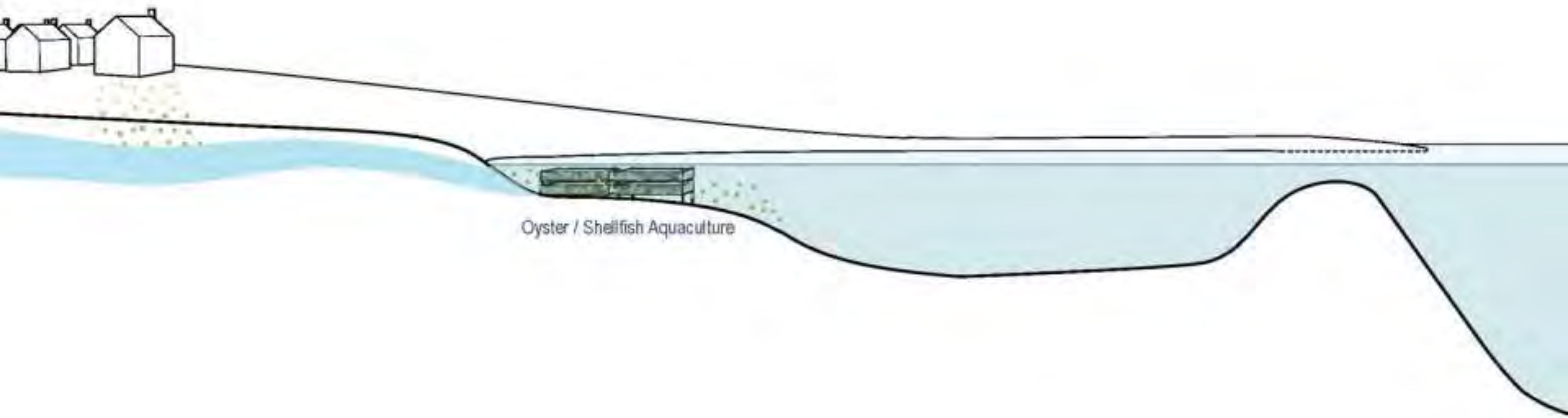
Source: A[illegible]

Shellfish Habitat Restoration

Precedent: Wellfleet Oyster Restoration Project

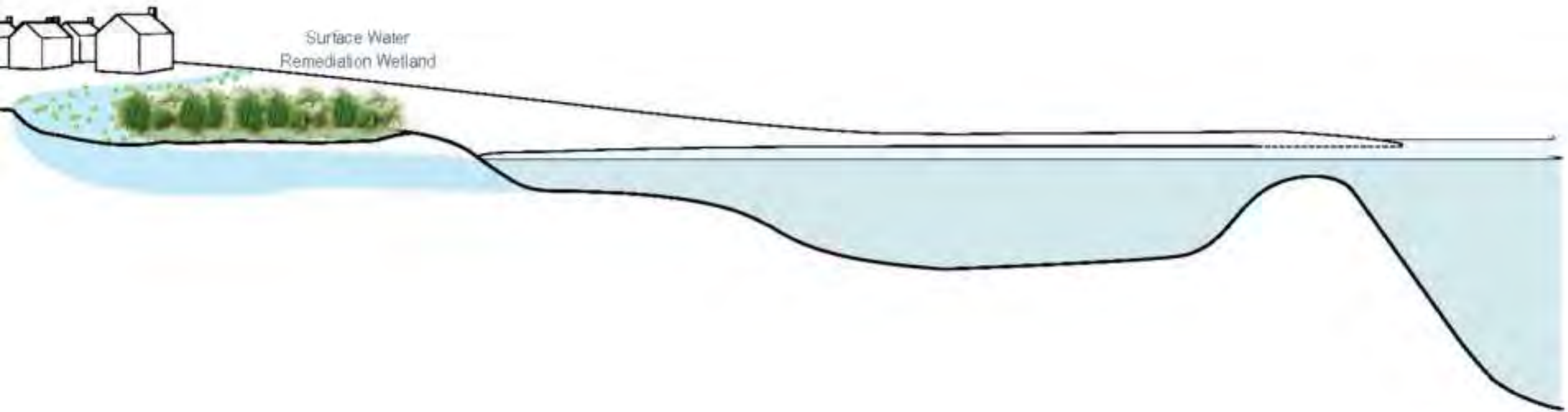
Source: Anamarija Frankic

Shellfish Habitat Restoration



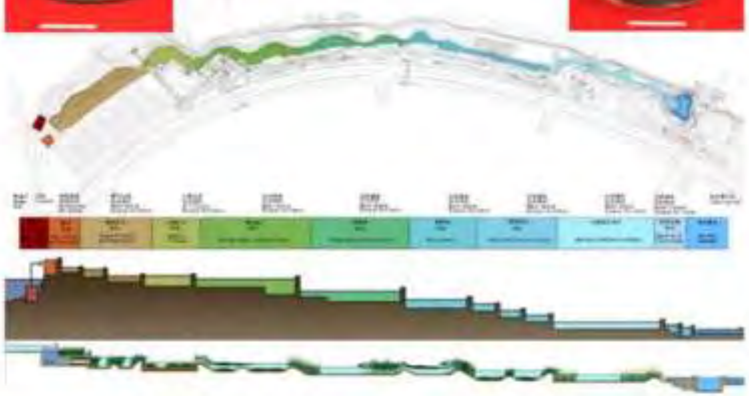
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Aquaculture / Shellfish Farming



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

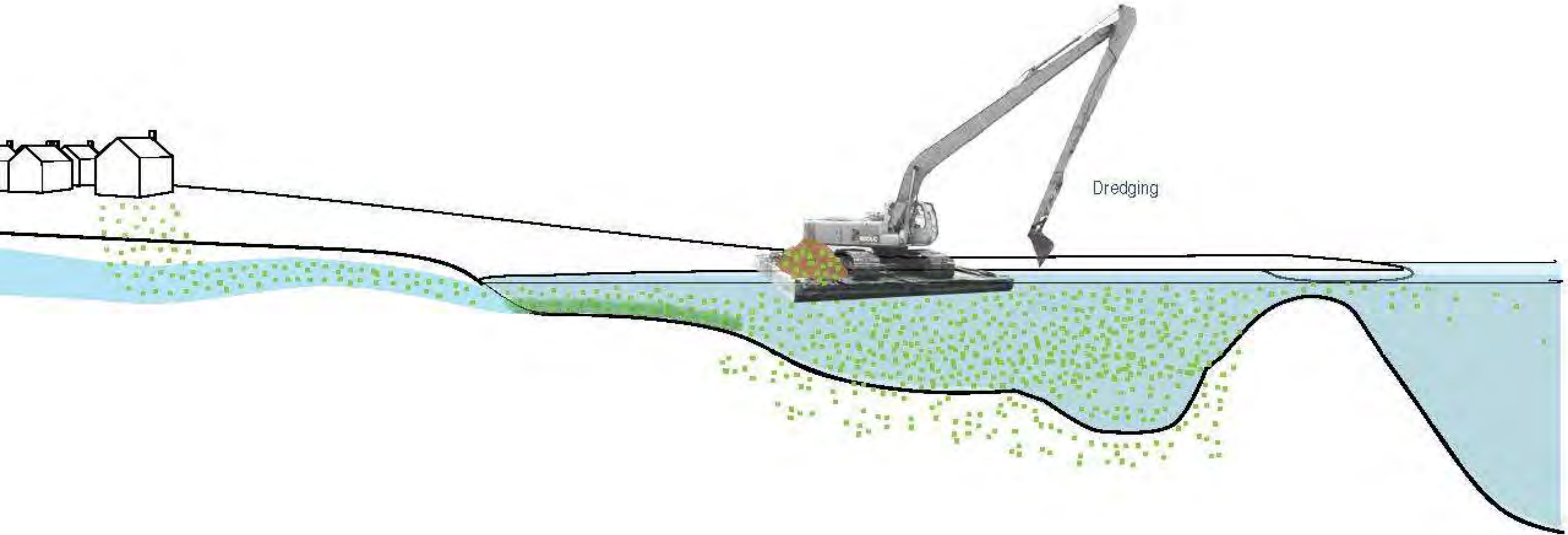
Surface Water
Remediation Wetlands



Precedent: Shanghai Houton Park

Source: Turenscape

Surface Water
Remediation Wetlands

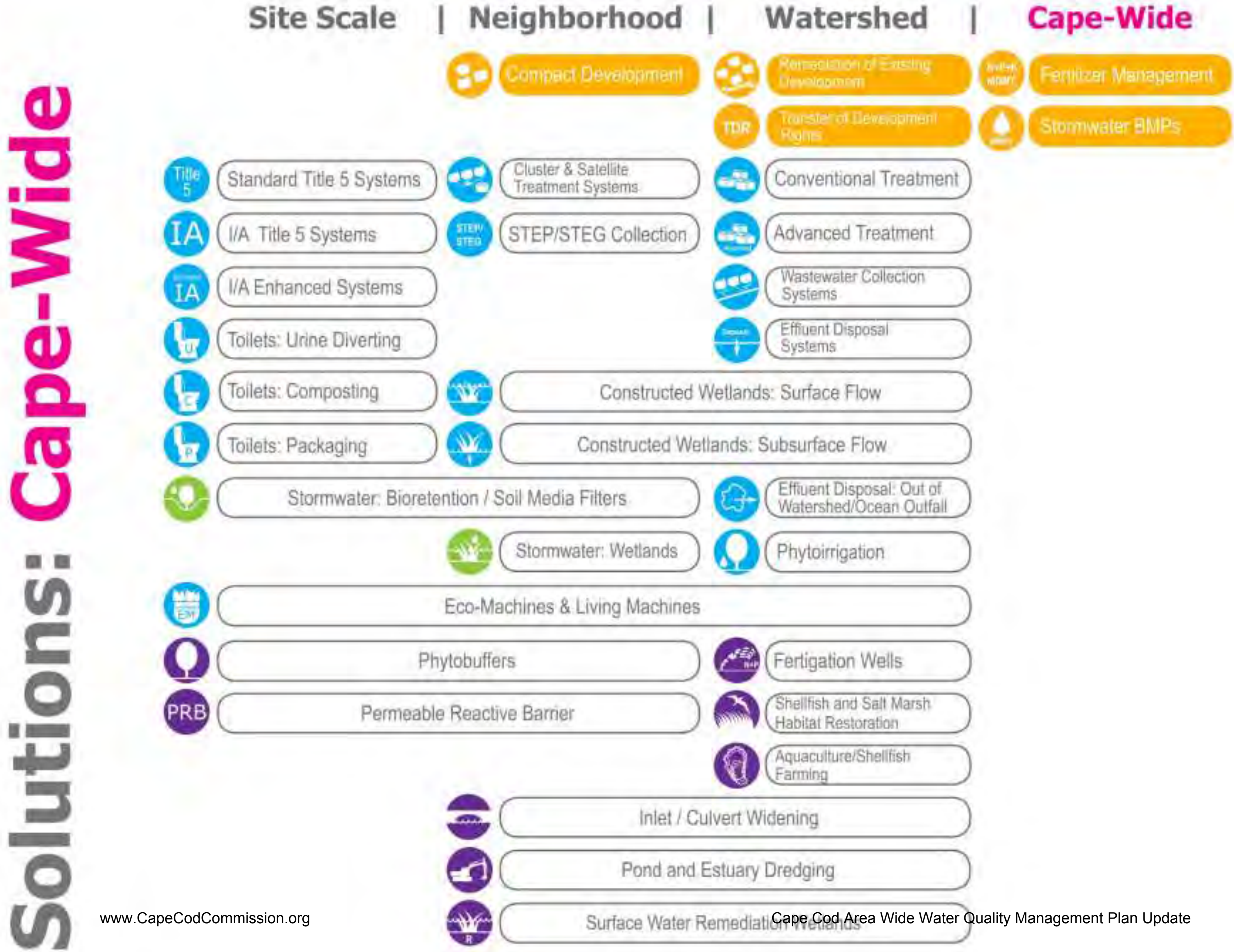


Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Pond and Estuary Dredging

Precedent: Pond and Estuary Dredging - Dennis, MA

Source: Cape Cod Times


Solutions: Cape-Wide
Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
IA
I/A Title 5 Systems
STEP/STEG
STEP/STEG Collection
Advanced Treatment
IA
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
EM
Eco-Machines & Living Machines
Phytobuffers
Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands

Scale: CAPE-WIDE
Target: REGULATORY

Compact Development

Scale: CAPE-WIDE
Target: REGULATORY

Fertilizer Management

N+P+K MGMT

Scale: CAPE-WIDE
Target: REGULATORY

Remediation of Existing Development

Scale: CAPE-WIDE
Target: REGULATORY

Transfer of Development Rights
TDR

Transfer of Developments Rights
The Concept

Owner of "sending" parcel sells development rights in exchange for permanent conservation easement.

Owner of "receiving" parcel buys development rights to build at densities higher than allowed under base zoning.

Source: Massachusetts Smart Growth Toolkit

Scale: CAPE-WIDE
Target: REGULATORY

Stormwater BMPs


Site Scale | Neighborhood | Watershed | Cape-Wide
Solutions
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
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Toilets: Urine Diverting
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Constructed Wetlands: Surface Flow
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Stormwater: Bioretention / Soil Media Filters
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Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands

Problem Solving Approach

Wastewater | Existing Water Bodies | Regulatory

1 Nitrogen Targets/Goals

Present Load: X kg/day − **Target**: Y kg/day = **Reduction Required**: N kg/day

2 Other Wastewater Management Needs

A. Title 5 Problem Areas
B. Pond Recharge Areas

3 Low Barrier to Implementation

A. Fertilizer Management
B. Stormwater Mitigation

4 Watershed/Embayment Options

A. Permeable Reactive Barriers
B. Inlet/Culvert Openings
C. Constructed Wetlands
D. Aquaculture

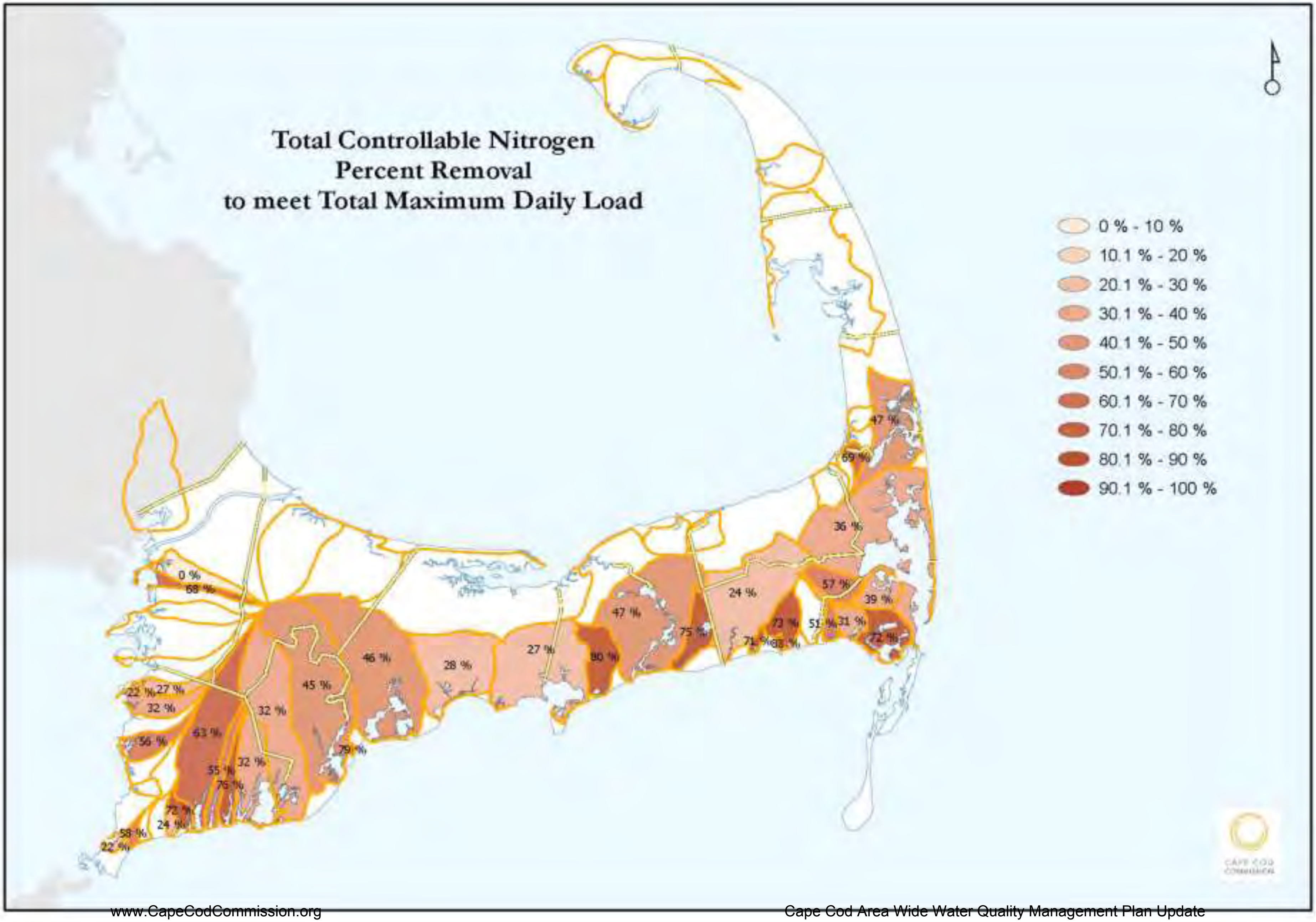
5 Alternative On-Site Options

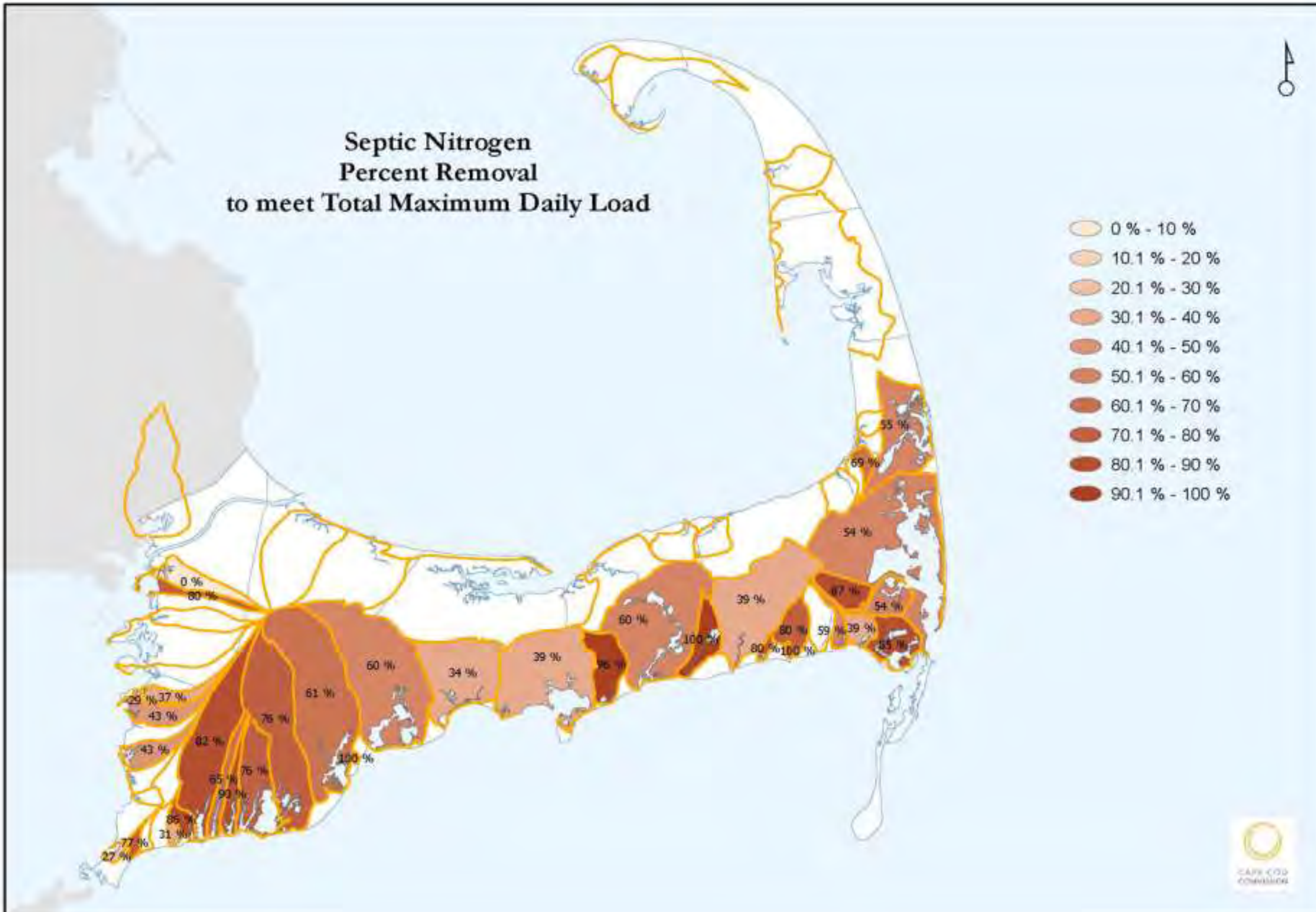
A. Eco-toilets (UD & Compost)
B. I/A Technologies
C. Enhanced I/A Technologies
D. Shared Systems

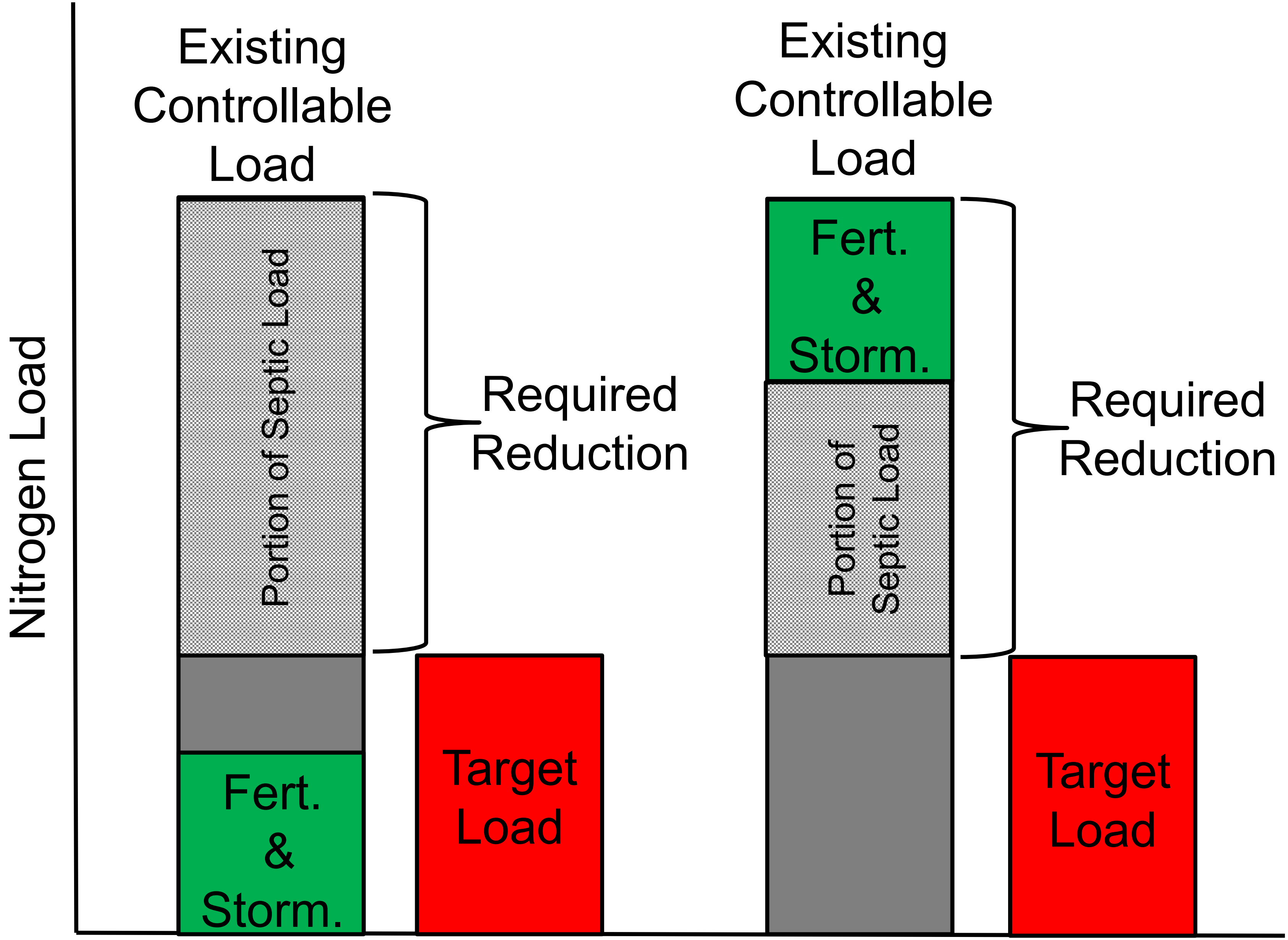
6 Priority Collection/High-Density Areas

A. Greater Than 1 Dwelling Unit/acre
B. Village Centers
C. Economic Centers
D. Growth Incentive Zones

7 Supplemental Sewering


Total Controllable Nitrogen
Percent Removal
to meet Total Maximum Daily Load
0 % - 10 %
10.1 % - 20 %
20.1 % - 30 %
30.1 % - 40 %
40.1 % - 50 %
50.1 % - 60 %
60.1 % - 70 %
70.1 % - 80 %
80.1 % - 90 %
90.1 % - 100 %


Septic Nitrogen
Percent Removal
to meet Total Maximum Daily Load
0 % - 10 %
10.1 % - 20 %
20.1 % - 30 %
30.1 % - 40 %
40.1 % - 50 %
50.1 % - 60 %
60.1 % - 70 %
70.1 % - 80 %
80.1 % - 90 %
90.1 % - 100 %


Nitrogen Load
Existing Controllable Load
Portion of Septic Load
Fert. & Storm.
Required Reduction
Target Load
Existing Controllable Load
Fert. & Storm.
Portion of Septic Load
Required Reduction
Target Load

Town Consideration of Alternative Technologies & Approaches

Wellfleet- *Coastal habitat restoration & aquaculture*

Mashpee- *Aquaculture & Expanding Existing Systems*

Brewster- *PRB & Bioswales*

Orleans- *Fertilizer Control By-Law*

Harwich- *Muddy Creek & Cold Brook Natural Attenuation*

Falmouth- *Aquaculture*
Inlet Widening
Eco-Toilet Demonstration Project
PRBs
Stormwater Management (Little Pond Watershed)
Fertilizer Control By-Law
Subsurface Nitrogen Removal Septic Systems

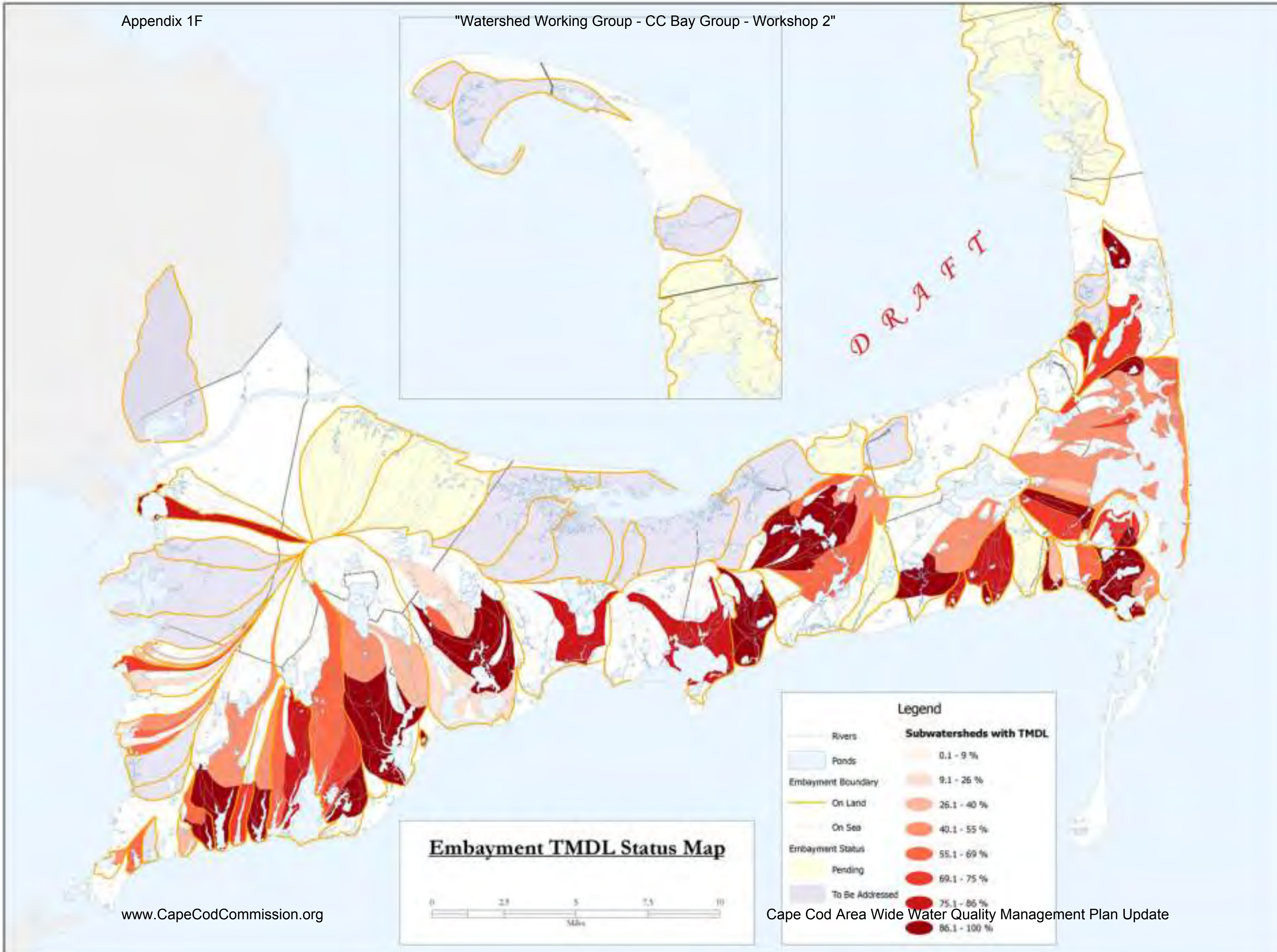
Triple Bottom Line

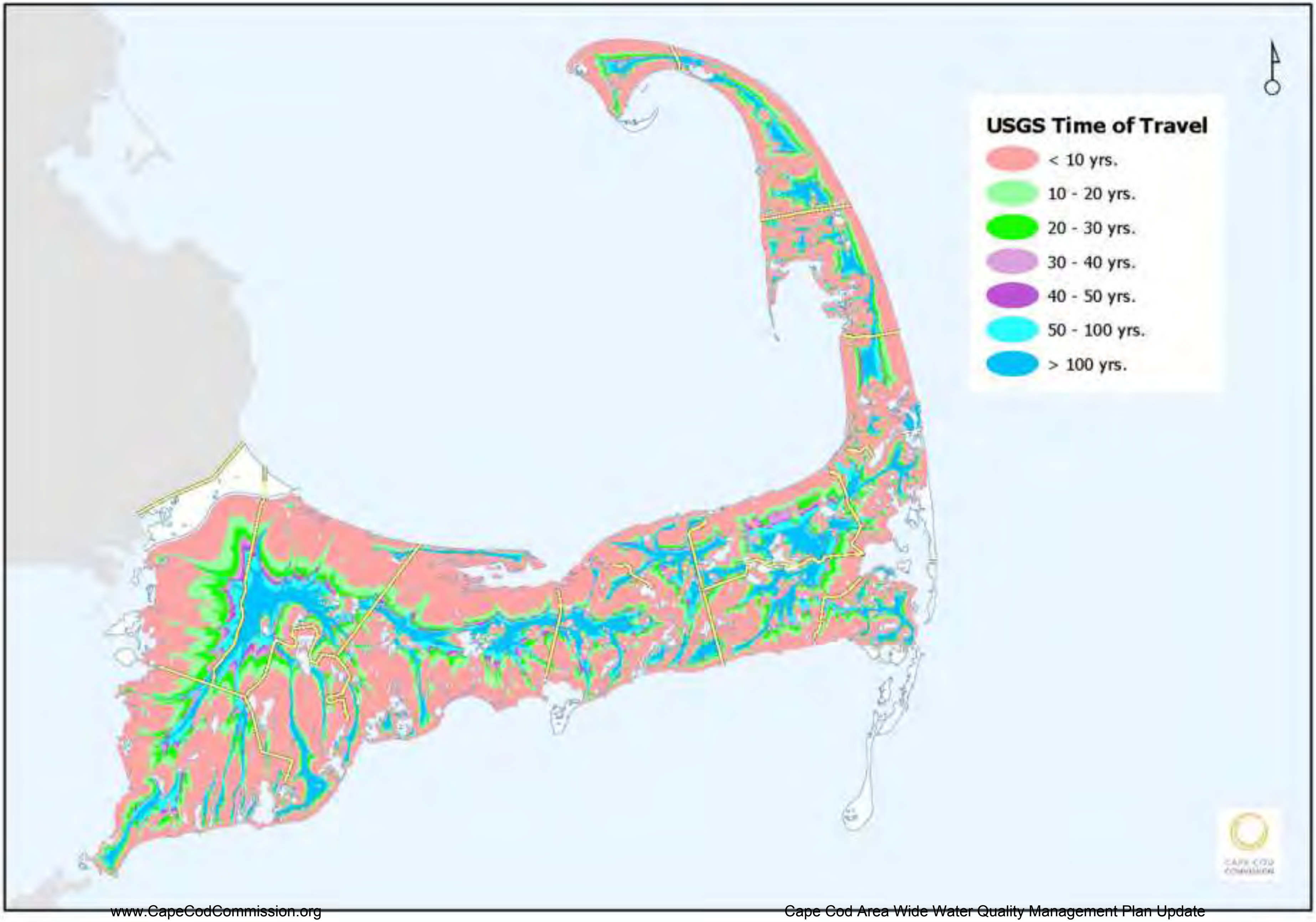
Impacts of Technologies and Approaches

Environmental

Economic

Social


DRAFT
Embayment TMDL Status Map
0
2.5
5
7.5
10
Miles
Legend
Rivers
Ponds
Embayment Boundary
On Land
On Sea
Embayment Status
Pending
To Be Addressed
Subwatersheds with TMDL
0.1 - 9 %
9.1 - 26 %
26.1 - 40 %
40.1 - 55 %
55.1 - 69 %
69.1 - 75 %
75.1 - 86 %
86.1 - 100 %


USGS Time of Travel
< 10 yrs.
10 - 20 yrs.
20 - 30 yrs.
30 - 40 yrs.
40 - 50 yrs.
50 - 100 yrs.
> 100 yrs.

Technology Selection: Process and Principles

- 100% septic removal subwatershed
- Scale: On-Site vs. Collection System vs. Natural System
- Nutrient intervention and time of travel
- Permitting Status
- Land use and Impacts of Growth

November 13th

Phase 2 of the stakeholder process

6:00
Cape Cod Museum of Art
Dennis, MA

Cape Cod 208 Area Water Quality Planning
Herring River Watershed Working Group

Meeting Two
Monday, October 21, 2013
8:30 am- 12:30 pm
Harwich Town Hall, Selectmen's Meeting Room

Final Meeting Summary Prepared by the Consensus Building Institute

I. ACTION ITEMS

Working Group

- Next meeting: Meeting Three
  Thursday, December 5, 2013
  8:30AM -12:30PM
  Harwich Community Center, 100 Oak Street, Harwich, MA 02645
- Send Kate any additional comments on Meeting One Summary (by Oct 25)
- Continue to prepare thoughts about which technologies/approaches they would like to learn more about for application in the Herring River Watershed. Different scenarios and options will be discussed during Meeting Three.

Consensus Building Institute

- Conduct analysis of all stakeholder groups to present breakdown of interests and stakeholder groups represented; include description of how we're reaching out to groups who may not be at the table
- Send link with presentation to participants
- Finalize Meeting One summary (by Oct 28)
- Draft and solicit feedback from Working Group on Meeting Two summary.

Cape Cod Commission

- Share Technology Matrix with Working Groups
- Share updated Chronologies with Working Groups

II. WELCOME, REVIEW 208 GOALS AND PROCESS AND THE GOALS OF MEETING

Kristy Senatori, Deputy Director at the Cape Cod Commission, welcomed participants and offered an overview of the 208 Update stakeholder process.[1] In July, public meetings were held across the Cape to present the 208 Plan Update goals, work plan, and participant roles. Public meetings were also held in August to present information on the affordability and financing of the updated comprehensive 208 Plan. The first meetings of the eleven Watershed Working

[1] The PowerPoint Presentation made at this meeting is available at: http://watersheds.capecodcommission.org/index.php/watersheds/lower-cape/herring-river

Groups were held in September and focused on baseline conditions in each of the watersheds. The second meetings of the Watershed Working Groups will be held in October and early November and are focused on exploring technology options and approaches. The third meetings of the Watershed Working Groups will be held in December and focus on evaluating watershed scenarios which will be informed by Working Groups' discussions about baseline conditions, priority areas, and technology options/approaches. This conversation will also be informed by information shared in the Technology Matrix, which was developed by the Cape Cod Commission with technical input from the Technology Panel. The Technology Matrix builds on the information presented in the Technology Fact Sheets, which Working Group members reviewed in advance of the meeting[2]. Once it is finalized by the Cape Cod Commission, the Technology Matrix will be shared with Working Group Members.

Ms. Senatori, shared 208 Plan team's progress since Meeting One which includes:

- Meeting materials distributed to stakeholders and available at http://watersheds.capecodcommission.org
- GIS data layers accessible at: http://watersheds.capecodcommission.org
- Chronologies are being updated and will be made available soon

Ms. Senatori also shared that the second round of Cape2O game is launching on October 22. She noted that over 400 people registered for the first round of the Cape2O game and encouraged Working Group members to participate in the interactive, online game which provides valuable education and input to the Cape Cod Commission.

Ms. Senatori announced that there will also be a Cape Cod wide event on November 13 at the Cape Cod Center for the Arts in Dennis. Participants from across the eleven Watershed Working Groups and the public are invited to attend the event which will include: Wrap up of Cape2O: ur in charge!; a summary of planning process to date; discussion of the stakeholder role in the second 6 months of the 208 planning process

Patty Daley, Deputy Director at the Cape Cod Commission and Area Manager for the Herring River Watershed Working Group, welcomed participants and reviewed the goal of the meeting:

- To develop a shared understanding of the potential technologies and approaches identified to date , and the benefits and limitations of each; to explore the environmental, economic, and community impacts of a range of categories of solutions; and to identify priorities and considerations for applying technologies and approaches to remediate water quality impairments in your watershed.

Kate Harvey, the facilitator from the Consensus Building Institute, reviewed the agenda and led introductions. A participant list is found in Appendix A.

[2] Technology Fact Sheets are available at: http://watersheds.capecodcommission.org/index.php/watersheds/lower-cape/herring-river.

III. RANGE OF POSSIBLE SOLUTIONS

Ms. Daley led the discussion of the range of possible solutions. As Working Groups learn more and consider the pros and cons of the technologies and approaches, she encouraged participants keep in mind that:

- The Cape Cod Commission has engaged in a comprehensive analysis of nutrient control technologies and approaches. This analysis is distilled into: the Technology Fact Sheets, which present various information on the technologies being considered; the Technology Matrix, which includes additional information on site requirements, construction, project and operation and maintenance costs, reference information, and regulatory comments; and ongoing input from stakeholders on the public acceptance of technology options and approaches.
- Not all of the technologies and approaches will be applicable to Cape Cod.
- Some technologies are so promising that we should identify them for demonstration and pilot projects.
- Workshop 3 will embark on hands on problem solving in each watershed to meet target load reductions.
- Certain technologies or approaches will be effective at preventing nutrients from entering the water body. Others will be effective at reducing or remediating nutrients that are already in the groundwater or water body.
- Regulatory programs can address nutrient controls for both existing development and future development.

Ms. Daley offered a brief overview of the technologies and approaches. The following section briefly describes each technology. Participants' questions and comments about the technologies are also discussed below (in *italics)*:

Site level technologies/approaches

Standard Title V System*:* This is a standard septic system that consists of a septic tank and soil adsorption system (leaching field). The system was primarily designed to address public health concerns related to waste in drinking water (e.g. coliform bacteria); they were not designed to remove nutrients (e.g. nitrogen).

- *Can any of technologies be used to enhance existing systems (e.g. Title V systems)?* Ms. Daley responded that the Cape Cod Commission does not know of any technologies that can enhance existing systems, including Title V systems, and would allow them to remove nutrients. In the case of Title V systems, the next step would be to install a new I/A Title V system.
- *How are Title V systems regulated and maintained?* Title V systems are regulated primarily at the local level, consistent with state regulations. Local regulations generally require that the systems be pumped every three years. Some towns ask septic pumping companies to report on the systems that they service, but in most cases, regular

maintenance is not monitored and is the responsibility of the homeowner.

- *A benefit to some of Title V is the possibility of having multiple houses using one Title V plan.*

I/A title V System: Innovative/Alternative (I/A) on-site nutrient reducing systems typically consist of standard septic system components augmented to remove more nutrients than a standard Title 5. I/A systems refer to a class of systems intended to be designed as recirculating sand filter (RSF) equivalents by meeting the same treatment limits in a smaller footprint.

- *How many I/A systems are there on Cape Cod?* Ms. Daley noted that the Cape Cod Commission is beginning to map I/A systems on Cape Cod, and she estimated that there are about 1500 existing systems. The Commission plans on adding a GIS layer to the 208 Plan Reference Map to show where I/A systems are located.[3]

Urine Diverting Toilets: Urine diversion systems send urine into a holding tank where the urine is stored and periodically collected by a servicing company. The servicing company empties the tank for disposal or recycling such as conversion to a fertilizer. Through these means, the nitrogen may be removed from the watershed. With urine diverting toilets, the remainder of the human waste and all other water uses (sink and shower) continue to go to the septic system. (Case example, Falmouth, MA).

Composting toilets: A toilet system which separates human waste from shower, sink and other household water uses. The composting toilets use no or minimal water. The human waste captured by the composting toilets is decomposed and turned into compost. The compost generated is removed from the site and nutrients can be recycled. Composting toilets require the replacement of existing toilet(s) and room in the basement for a container to capture and compost the human waste. Household water use (sink and shower uses) continue to flow to the septic system. (Case example, Falmouth, MA).

Packaging toilets: A packaging toilet encapsulates human waste in a durable material for removal from the site. The package is stored beneath the toilet and removed and taken away when full. The nutrients can be recycled by the servicing company that picks up the packages.

Stormwater bioretention: Bioretention systems utilize natural plant and soil functions to capture and treat stormwater runoff for a variety of contaminants including nutrients. A typical system consists of an underdrain/gravel layer, a layer of bioretention soil mix (a mix of sand, compost, woodchips and loam), and a surface layer containing appropriate plantings. The treated water can be discharged into a water body or used for open space irrigation after treatment. The reclaimed water can also be discharged into a subsurface infiltration system for discharge to the groundwater. (Case example, Portland, OR).

Neighborhood level technologies/approaches

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[3] The 208 Plan Reference Map is available at: http://watersheds.capecodcommission.org/docs/frames/

Cluster and satellite treatment systems: A cluster or satellite system is a collection and treatment system treating wastewater flows from multiple properties.

STEP/STEG collection: Septic Tank Effluent Pumping (STEP) and Septic Tank Effluent Gravity (STEG) systems convey liquid wastewater from on-site septic tanks to sewer systems; Only the liquid component of the wastewater may be conveyed by pumps or by gravity.

Eco machines and living machines: Living or Eco-Machines are natural systems that treat septic tank effluent or primarily treated wastewater. In these systems, aeration and clarification chambers are combined with constructed wetlands to treat the influent. The wetlands are a series of chambers allowing for microbial communities to engage with and treat the wastewater. Plants are often suspended on racks with their roots systems doing the work. Solids removal is generally onsite, after which water is pumped through the gravel filled cells (similar to subsurface wetlands.) This process transfers more oxygen to the wastewater and completes the pollutant removal process. (Case example, South Burlington, VT).

Stormwater wetlands: Constructed wetlands provide aerobic chambers followed by subsurface anaerobic chambers that facilitate nitrification followed by denitrification, respectively. This process mimics that of natural systems coupled with engineering design guaranteeing residence time within a chamber containing anaerobic conditions. (Case example, China).

Watershed level technologies/approaches

Conventional treatment: A conventional wastewater treatment facility typically treats wastewater collected from homes and businesses. A groundwater discharge permit is required. Treatment generally results in less than 10 mg/L Nitrogen.

Constructed wetlands: surface flow: After primary treatment in a septic tank or wastewater treatment facility or secondary treatment at a wastewater treatment facility, water is fed into a surface flow constructed wetland. Surface flow constructed wetlands closely mimic the ecosystem of a natural wetland by utilizing water loving plants to filter wastewater through their root zone, a planted medium, and open water zones. Surface flow wetlands are systems where open water is exposed much like in a natural marsh. The reclaimed water from the wetland can be discharged into a water body or used for open space irrigation after treatment as well as discharged into a leach field. (Case example, Albany, OR).

Constructed wetlands: subsurface flow: After primary treatment in a septic tank or wastewater treatment facility or secondary treatment at a wastewater treatment facility, wastewater is treated by pumping water slowly through subsurface gravel beds where it is filtered through plant root zones and soil media. Water flows 3-8” under the surface to prevent public exposure to wastewater and mosquito breeding. A combination of horizontal and vertical flow subsurface systems must be utilized to provide total nitrogen removal. This solution can also offer opportunities for recreation activities on land above the subsurface system. (Case example, Thailand).

- *Why does phosphorus removal in constructed wetlands versus in conventional treatment vary?* Mr. Owen responded that the level of phosphorus removal in wetlands depends on how much acreage you have; if you want to remove more nitrogen AND phosphorus in a constructed wetland then you'd need a large area of land. With a treatment plant, you can get high levels of phosphorus removal but at great expense and with a lot of chemicals. Since phosphorus is really not an issue in the estuaries- rather it is an issue in surface waters – it is important to consider where the phosphorus is likely to end up to determine the best treatment option. If it is going into stormwater, then a more aggressive treatment process is needed. If it is going into groundwater, the soil has a good capacity to uptake phosphorus, so it is less of a concern.
- *Why are phosphorus levels more likely to reduce over time with subsurface flow constructed wetlands rather than surface flow constructed wetlands?* Tom Cambareri, Cape Cod Commission, responded that the subsurface flow wetland is more anaerobic so you have a different group of microbes. As the wastewater moves through the wetland, it goes through more slowly and the microbes have more time to tackle the phosphorus.

<u>Effluent disposal: out of watershed</u>: Effluent disposal can take a variety of forms, including infiltration basins, a Soil Absorption System, Injection Wells or Wick Wells. These disposal methods place highly treated effluent back into groundwater. Effluent Transport out of the watershed has the advantage of removing the nitrogen load to another watershed. Transport to another watershed requires the receiving watershed to be able to accommodate the additional nitrogen load.

- *Is effluent disposal in other watersheds the same as sending trash off Cape?* Mr. Cambareri responded that transfers of effluent between the watersheds on Cape Cod are considered by the Massachusetts Department of Environmental Protection (MassDEP) to be transfers within a single basin because the Cape is a single source aquifer. Because the transfer would occur within a single basin, there would not be significant state regulatory challenges related to moving treated effluent between watersheds, however, the potential local impacts would still need to be considered by Cape Cod decision-makers.

<u>Effluent disposal: ocean outfall:</u> Similar to out of watershed effluent disposal, highly treated effluent is transported out of the watershed and into the ocean. This solution requires a high level of regulatory oversight. The solution is considered due to limited land availability for disposal on Cape Cod.

- *If the nitrogen were sent out into the ocean, how far out would it go and has anyone studied the effects?* Ms. Daley responded that the reason that there are many regulatory hurdles associated with this solution is because site-specific effects must be studied. Were this option to be seriously considered, there would be many studies required. Mr. Cambareri noted that the ocean outfall associated with the Massachusetts

Water Resources Authority (MWRA) goes out about nine miles into 150 feet of water and disposes of 300 million gallons of effluent per day. He estimated that Cape Cod would need to dispose of significantly smaller effluents amounts, which would need to be treated to a high level before being discharged. However, these effluents would be discharged into near shore waters that are more shallow than 150 feet.

- *There could be significant ecosystem effects that could impact the whole Atlantic seashore, not just Massachusetts Bay.*

Phytoirrigation: After secondary treatment, wastewater treatment facility effluent is irrigated onto plants to remove nutrients and other contaminates. Fast growing poplar and willow trees are typically used. (Case example, Woodburn, OR).

Neighborhood or Watershed level technologies/approaches

Phytobuffers: Using trees with a deep root system to capture nutrients in the soil, particularly willows and poplars. Green plants with deep tap roots are planted as a buffer to intercept existing groundwater. The plants and their associated microorganisms reduce contamination in soils and ground water. Often phytohydraulics causes the groundwater plume to be redirected and pulled towards the plants. (Case example, Kavcee, WY).

Fertigation wells: Fertigation wells can capture nutrient enriched groundwater, typically from a wastewater treatment facility discharge, and recycle it back to irrigated and fertilized turf grass areas. These irrigated areas include golf courses, athletic fields and lawns. Fertigation can significantly reduce nutrient loads to downgradient surface waters while reducing fertilizer costs to the irrigated areas. (Case example, Plymouth, MA).

Permeable reactive barrier (PRB): A permeable reactive barrier (PRB) is an in-situ (installed within the aquifer) treatment zone designed to intercept nitrogen enriched groundwater. Through use of a carbon source, microbes in the groundwater uptake the nitrogen, denitrifying the groundwater. PRB systems typically use vertical trenches, sequences of bored columns or injection methods to introduce the carbon source into the groundwater to reduce the nitrogen load to an estuary, removing it from the watershed. (Case example, Falmouth, MA).

- *A participant expressed concerned about technologies that require a lot of maintenance, such as PRBs.* Ms. Daley noted that for PRBs, there is data from Canada on barriers that have been installed for 15 years which are still working.
- *PRBs would not be installed along the whole coast, correct?* Ms. Daley affirmed that you would site a PRB perpendicular to the groundwater flow and also correlated with roadways and powerlines.

Inlet and culvert widening: Re-engineering and reconstruction of bridge or culvert openings to increase the tidal flux through the culvert or inlet. This solution generally works better with a larger tidal range but could be feasible on both the Cape Cod Bay side (approximately nine feet tidal range) and Nantucket Sound side (approximately 3 feet of tidal range).

Salt marsh habitat restoration: Salt marsh is one of the most productive ecosystems in the world, surpassing rainforest in productivity per acre. Approximately 65% of historic salt marsh has been lost in MA. Salt marshes cycle and remove nitrogen as well as provide critical habitat and spawning sanctuary for a wide variety of birds, mammals and marine life in addition to hosting a range of plant species and important biogeochemical processes. The capacity of salt marsh to intercept nitrogen is significant and well researched worldwide. Substantial areas of former salt marsh on the Cape are either under consideration for restoration or could be restored providing storm surge and coastal flooding protection in addition to water quality benefits in certain watersheds.

Shellfish habitat restoration: Oyster reefs were historically one of the main consumers and recyclers of nitrogen in the coastal environment on Cape Cod. According to the Nature Conservancy, populations have declined by 95%. In conjunction with the natural transition from land to sea in estuaries, bays and inlets; salt marsh, oyster reef and eel grass function as critical buffer that can reduce eutrophication. Restoring Oyster populations leads to increased shellfish productivity as well as improved commercial and recreational fisheries for other species, increased protection from shoreline erosion and flooding, and buffering from ocean acidification. (Case example, Wellfleet, MA).

- *Are the oysters edible?* Ms. Daley responded that it depends on the water quality in the embayment. If the water quality is good, the oysters can be harvested for food, however, if you have coliform bacteria or other contaminants, then they can't be eaten.

Aquaculture / shellfish farming: Oysters, has been proposed as a potential method for reducing nitrogen levels and eutrophication in estuaries. Nitrogen removal rates from Oysters have been well documented and the harvest of oysters physically removes the nitrogen they sequester in addition to the nitrogen removed by their biological cycling which puts nitrogen directly back into the atmosphere. Aquaculture can be done on man-made structures (e.g. cages, floating bags) or natural reefs.

Surface water remediation wetlands: Constructed to aid in water quality improvements to surface water bodies, usually streams or rivers. Water is pumped or allowed to flow naturally through treatment cells containing wetlands Surface water remediation wetlands are often used in combination with groundwater recharge or potable water reuse systems. Surface water remediation wetlands are generally used with Free-Water Surface wetlands due to their larger size, and lower capital and O+M Costs. (Case example, China).

Pond and estuary dredging: Lakes, ponds, streams and estuaries store nutrients within their sediments. These sediments tend to accumulate over time. Subsequently, these nutrients can be release into the overlying water column and can become a major source of nitrogen and phosphorus. Dredging and removing these sediments and accumulated nutrients removes the nutrients from the water body and potentially the watershed. (Case example, Dennis, MA).

- *It seems like many towns are already dredging for other reason or doing projects that* *increase flushing. Is there a way to get credit for this work as a nitrogen reducing method?* Mr. Cambareri responded that state agencies are looking at how to permit and credit these types of projects; the requirements will be monitoring and will require that detailed engineering solutions be presented. They're considering both pre and post monitoring and it is expected that these measures will get a nitrogen credit.

Cape-wide level technologies/approaches

Compact development: Both Compact Development and Open Space Residential Development (OSRD) of subdivisions result in smaller lots and less maintained lawn acres. The higher density development reduces wastewater collection costs while providing a common disposal area. Compact development is also referred to as "Smart Growth".

- *It is nice to see alternatives being presented. In the Herring River watershed, if you want to achieve certain levels of buildout, it is important to consider the simplest way to achieve the desired growth? Growth planning and wastewater planning should also be paired with planning for open space recreation.*

Fertilizer management: Managing fertilizer application rates to lawns, golf courses, athletic facilities and cranberry bogs. Residential lawn loading rates could be reduced on existing developed parcels through an intensive public education/outreach program. This could include a "Cape Cod Lawn" branding program, replacing some turf areas with native vegetation, establishing naturally-vegetated buffer strips on waterfront lots, and reducing application rates. Fertilizer loading rates for new development could be accomplished by reducing lot sizes (cluster development), by restricting lawn sizes and/or by incorporating more naturally-vegetated open space areas. Municipalities could directly reduce fertilizer applications on athletic fields and other properties. Golf courses can significantly reduce nitrogen loading rates by using slow-release fertilizers and reducing application rates in rough areas. Cranberry bog fertilizer exports from the bogs can be reduced using tail water recovery systems. Site-specific assessments are needed to estimate load reductions.

- *What is happening with fertilizer regulation on Cape Cod?* Ms. Daley responded that the Cape Cod Commission designated a cape-wide Fertilizer Management District of Critical Planning Concern (DCPC) which authorizes the towns to adopt local fertilizer management regulations (state law prohibits local fertilizer management except under the DCPC). The DCPC does not require towns to adopt fertilizer regulations, but paves the way for their adoption. Barnstable County will be conducting a public education process around fertilizer use.
- *The golf industry has trended downward in its use of fertilizers with an estimated 40% less use today than in the past. Additionally, most modern man-made fertilizers do not contain phosphorus (organic fertilizers do), so moving forward, phosphorus load from fertilizers across Cape Cod should be reduced which would improve phosphorus in catch basins.*

<u>Remediation of existing development</u>: Existing developments or schools with excess wastewater treatment capacity allow existing nearby developments to connect to their underutilized wastewater treatment infrastructure. A town can operate the wastewater treatment facility if the existing owner prefers to not take the responsibility for treating the off-site wastewater. An example of this is the Kingman Marina in Bourne, which was permitted to expand its development footprint in exchange for hooking up adjacent, existing homes to its wastewater treatment facility.

<u>Transfer of development rights</u>: A regulatory strategy that transfers development and development rights from one property (sending area) to another (receiving area) to direct growth and associated nutrient loading away from sensitive receiving watersheds or water bodies. The protected parcels (sending areas) receive a deed restriction that limits the level of future development. The deed restriction can limit the number of homes or tie development to the availability to future wastewater treatment facility infrastructure.

<u>Stormwater best management practices (BMP)</u>: Non-Structural Stormwater strategies include: street sweeping, maintenance of stormwater utilities, education and public outreach programs, land use planning, and impervious cover reduction and control.

- *Do towns map existing stormwater utilities*? Ms. Daley responded that many towns do map existing stormwater utilities. She suggested that the Commission would try to add those data to the 208 Plan Reference Map.
- *Have there been any studies that look at surface stormwater runoff catch basins?* Sue Leven, Brewster, responded that towns across Cape Cod are just starting to look at catch basins in their communities with funding from state programs. In Brewster, there are 1,800 catch basins identified so far and the town is in process to identify direct outfalls, which will take several years. She noted that most towns clean the catch basins on a regular, but not yearly basis. Ms. Senatori added that in March-April 2014, the Cape Cod Commission will begin a project to do flyover photography of the whole Cape, which will help towns to map all catch basins on GIS. Mr. Cambareri added that on Cape Cod, we should be more focused on treating stormwater run off rather than just getting rid of it. He noted that the stormwater percentage in embayments is usually about 5-10% but by routing stormwater through natural and manmade green systems, nutrient loads can be reduced significantly before being discharge in the embayments.

General questions and comments:

- *What is the difference between primary, secondary, tertiary treatment levels and what levels are currently required?* Mark Owen, Consultant from AECOM, responded that primary treatment results in nitrogen removal of 20-30 mg/L, secondary treatment results in nitrogen removal of 10 mg/L, and tertiary treatment results in nitrogen removal of 2-5 mg/L. The level of treatment required depends on the watershed or subwatershed and how much nitrogen needs to be removed. In many of the Cape's watersheds, secondary or tertiary treatment is necessary.

- *Do any of these technologies remove heavy metals or pharmaceuticals*? Mr. Owen responded that as a general rule, the more treatment that is done, the more heavy metals are removed. However, for pharmaceuticals or containments of emerging concern (CECs), the removal rate is dependant on the chemical composition because some compositions are resistant to removal while others are easy to remove. He added that, in general, if you were to compare a septic system to a treatment plant, you would achieve a higher percentage of removal from a treatment system. However, some chemicals do not really get removed and others are just beginning to be studied, including the human impacts of low levels of exposure and options for removing them from wastewater. Ms. Daley added that some of the phytoremediation or subsurface wetlands remove some CECs and that trees are sometimes used to remove chemicals from hazardous waste sites.

- *The fact that they are contaminants of "emerging" concern, does not mean that we should ignore them until more information is available. There are already studies that demonstrate that they are a big problem. We should pursue solutions that we know remove CECs and reduce human and animal exposure to them.* Ms. Daley added that there are currently no regulatory standards to drive removal of CECs, so the 208 Plan update currently focuses on nitrogen and phosphorus removal. However, the plan will still consider the additional ability of specific solutions to deal with CECs or other concerns beyond nitrogen and phosphors removal.

- *Are communities using wireless technologies to monitor systems?* Ms. Daley responded that Wellfleet is using a wireless monitoring system, however, she was not aware of other towns using similar systems. She noted that such monitoring systems would be very helpful for communities across the Cape to better understand how their systems and/or new technologies are performing.

- *In general, technologies/approaches with fewer moving parts that remove target substances earlier rather than later seem preferable. There are also significant political questions since society generally does not want to pay to address the problems we've created. As a result, what we put in place will need to be there for 50-100 years, so some of the newer technologies and approaches might not have been tested enough.*

- *Most of the solutions seem to lack a definable path through regulatory obstacles. Is the RLI looking at this issue, and will there be more information about it by the December meeting?* Ms. Senatori responded that the RLI group is looking at whether the different technologies are permitable under current regulatory environments and will focus on developing strategies for permitting and implementing promising technologies. Ms. Daley added that if the Working Groups identify specific solutions that seem very promising, the Cape Cod Commission will let the regulatory agencies know that there is a great deal of support and push for demonstration projects or funding for these solutions.

- *A stakeholder raised a concern about the fact that builders, developers, and fisherman are not at the table in this Working Group and expressed concern that once the working groups finish coming up with solutions, and the builders and developers will fight back.* Ms. Harvey explained that the Herring River group is one of eleven Working Groups across Cape Cod and the facilitators worked to achieve stakeholder diversity all of the groups. She added that it has been hard to get every perspective at every group, and that CBI reached out to builders, fisherman, and developers in every watershed. She suggested that the facilitation team would do an analysis of all of the groups to ensure that there is adequate stakeholder representation across the groups. Ms. Senatori added that the Cape Cod Commission has reached out to builders and last week attended an event with 150 builders where they shared information and solicited input.

IV. PROBLEM SOLVING PROCESS AND PRINCIPLES

Overview of 7-steps for Problem-Solving Process

Ms. Daley reiterated that the goal the Working Groups is to develop remediation options that would achieve water quality targets with a focus on first targeting low cost, low barrier options to reduce nitrogen and then considering more costly and traditional options later (e.g. sewering). She then described the alternatives screening process the group will apply. The process is as follows:

1) Establish targets and articulate project goals.
2) Identify priority geographic areas (e.g. high nitrogen reduction areas, Title V problem areas, pond recharge areas).
3) Determine which management activities should definitely be implemented. These might be the easiest and least costly management activities that should be undertaken regardless of other management actions (e.g. fertilizer management and stormwater mitigation – two approaches that Cape Cod towns are already actively pursuing).
4) Assess alternative options to implement at the watershed or embayment scale (e.g. innovative and lower-cost solutions)
5) Assess options to implement at the site-level
6) Examine priority collection/high density areas
7) Consider traditional sewering or other grey infrastructure management options

She further explained that the Working Groups will focus on total controllable nitrogen load. The technologies and approaches selected should aim to reduce the total controllable nitrogen load by identifying options that reduce the portion of *septic* load that needs to be reduced. For example, the portion of septic load that needs to be reduced could be made smaller if Cape Cod takes on fertilizer and stormwater solutions first. Additionally, the percentages of controllable nitrogen that need to be removed to meet TMDLs change depending on the characteristics of the watershed.

She noted that in many instances, one of the solutions may not achieve the TMDL, but if you pair multiple solutions you may be able to reach the goal. For example, many towns are already using and pairing some of the technology options and approaches:

- Wellfleet- *Coastal habitat restoration & aquaculture*
- Mashpee- *Aquaculture & Expanding Existing Systems*
- Brewster- *PRB & Bioswales*
- Orleans- *Fertilizer Control By-Law*
- Harwich- *Muddy Creek & Cold Brook Natural Attenuation*
- Falmouth- *Aquaculture, Inlet Widening, Eco-Toilet Demonstration Project, PRBs, Stormwater Management (Little Pond Watershed), Fertilizer Control By-Law, Subsurface Nitrogen Removal Septic System*

A stakeholder added that the Muddy Creek project is a cooperative project between the towns of Harwich and Chatham.

Categories of Solutions and their Impacts on the Environment, Economy, and Community

Ms. Daley commented that evaluation of the technologies and approaches would be informed by their impacts (positive and negative) on the environment, economy, and community (Triple Bottom Line). Ms. Harvey asked participants to consider the environmental, economic, and community impacts of the possible technologies and approaches and asked them what evaluation criteria/factors they might consider when evaluating the range of possible solutions. Working Group members offered the following suggestions:

<u>Environmental</u>

- *Shellfish:* Participants noted that the health of the region's shellfish habitat would be important to consider given its important cultural and economic roles in the community.
- *Contaminants of emerging concern (CECs)*: As noted earlier, participants felt that the impact of solutions on CECs should be considered. Technologies that address CECs might be worth considering more heavily.
- *Time of travel:* Some options address the problem before it enters the groundwater. These might be preferable in many circumstances.
- *Phosphorus vs. nitrogen impacts*: Ponds are important and some technologies are better at removing phosphorus while others better at removing nitrogen.

<u>Economic</u>

- *Shellfish*: As noted earlier, the impact of technologies on shellfish businesses is important because shellfish businesses are among the few economic drivers in the watershed.
- *Efficiency*: Stakeholders noted that technologies should be efficient in terms of cost, impact, and resources used. Towns will not support options that are not efficient over

the long and short term.

- *Operations and maintenance (O&M)*: In addition to installation costs, the long term costs for O&M should be considered because towns might not be able to support costly O&M.
- *Costs:* Costs will always be important. It might be worth pursing options with the least cost first. Or exploring options that have a lower cost per unit of nitrogen removed.
- *Agriculture:* How do technologies impact agricultural sectors in the watershed?

<u>Social</u>

- *Secondary benefits/opportunities*: It might be valuable to explore options that create useful secondary benefits for communities, such as additional recreational space or conservation area.
- *Unintended consequences*: There may be unintended consequences to people (e.g. higher costs for low income residents), businesses (e.g. tourism) or other which should be anticipated, to the extent possible.
- *Economies of scale*: Some options may create opportunity for scaling up, which could provide cost benefits for the towns and/or residents (e.g. multiple units using a single Title V system).

<u>Implementation</u>

- *Retrofit or New Requirements*: To what extent will technologies be retrofits or be required for new construction? At what cost and what are the mechanisms for implementation?
- *Seasonal variability*: How do the technologies work with seasonal variability (e.g. I/A systems don’t work as well if they are not run regularly).

<u>Politics</u>

- *Buy-in*: It will important to know how what interests decision-makers have and be able to sell options that are correlated to communities’ goals and interests. Also important is understanding the political implications and consequences (intended or unintended) of options.

<u>Siting</u>

- *Size/Space Requirements*: The size of the technology may sway public acceptance. Generally, the smaller the better.
- *Abutters*: The potential impacts and reactions of abutters to specific technologies should be considered. Some may be opposed to land clearing, hard infrastructure or clearing.
- *Long-term buildout and land use*: The impact of technologies on land use and build out should be considered. There may be unintended consequences (positive and negative) that could result from certain technologies (e.g. smart growth, sprawl, growth neutral, etc.)

- *Risk management*: Technologies should consider flood zones and climate change infrastructure needs and changes.

Priorities for this Watershed

Ms. Harvey asked participants to hone in on the specific environmental, economic, and social trade-offs or consequences that they felt would be important to consider for this watershed? Working Group members offered the following suggestions:

- *Who pays- users vs. whole town*: Residents will want to know who pays and who benefits. Equalizing costs and spreading the costs across users, towns, and watersheds could be an important principle to pursue (e.g. Harwich has worked hard to equalize costs associated with water system.)

- *Who is responsible*: There are risks associated with options/systems if they are not maintained or used properly. Who has responsibility for maintaining the systems and ensuring that they are used responsibly (e.g. not turning off I/A systems because they have higher energy costs)? There is a balance between individual responsibility and municipal responsibility; testing and monitoring often fall under town permitting processes, but individuals should also hold some responsibility. Implementation of shared systems may result in “commons” problems where individuals shirk personal responsibility at the expense of the greater group. There is a need for public education because some technologies require changing long-term behaviors of residents and systems users.

- *Space requirements (small area vs. larger systems):* The size of the technology will influence public acceptance. Some residents will support smaller systems that take less room and are located in less visable areas, while others may be okay with larger systems. In general, participants indicated that smaller systems would likely be preferable.

- *Adaptability*: It could be helpful to have technologies that are adaptable over time and can be modified to meet changing conditions or needs.

- *Costs:* In addition to who pays questions, the installation costs and the long term costs for O&M will be important because towns might not be able to support costly O&M.

- *Regulatory consistency*: There may be unintended inconsistencies between existing regulations and new technologies. New systems may require updates to health, building codes, land use regulations, etc. Technologies that are more consistent with current land use regulations and other existing codes and plans may be more acceptable to the public. These include current visions for growth and open space management.

Technology Selection: Process and Principles
Ms. Daley noted that the Working Group had identified many of the principles that the Cape Cod Commission hoped would guide technology/approaches selection. These process and principles include:

- *100% septic removal subwatershed*: Combinations of technologies can be used to reduce septic load that needs to be removed.
- *Scale: On-Site vs. Collection System vs. Natural System*: There will be tradeoffs between the scale of systems that can be used. On-site, collection, and natural systems all have their pros and cons and all require different levels of investment and infrastructure. These tradeoffs will be important from an implementation and public acceptance point of view.
- *Nutrient intervention and time of travel*: Some technologies/approaches intercept nutrients at their point of entry into the system, while others deal with it later on (e.g. once it is in the watershed). There are pros/cons to each approach which need to be considered.
- *Permitting Status*: The level of effort required to permit technologies will be a consideration.
- *Land use and Impacts of Growth*: Unintended consequences and opportunities for planned growth are important to consider.

V. PLANNING FOR THE NEXT MEETING

Meeting Three will be held:
Thursday, December 5, 2013
8:30AM -12:30PM
Harwich Community Center, 100 Oak Street, Harwich, MA 02645

During this meeting the Working Groups will examine various scenarios (i.e. combinations of solutions) and their potential impacts (e.g. nutrient reduction, economic impacts, environmental impacts, social impacts, etc.). During the meeting, the Cape Cod Commission will use tools to calculate ideas/options and their impacts. Working Group participants should come prepared to offer their ideas about what solutions they'd like to explore further given their understanding of the baseline conditions, issues, and priorities in this watershed.

VI. PUBLIC COMMENTS

Hilde Maingay, (Falmouth, MA). There are errors and issues of concern in the fact sheets. She has shared these concerns with the Commission and would like this list of errors/concerns to be sent to all stakeholders. One example: Composing toilets have already been permitted in MA for decades. She would also like to see other issues added to the list of how solutions are evaluated:

- Energy consumption: how much fossil fuel does each solution use, CO2 emissions, other

factors
- Resource recovery: the “waste” is very valuable and should be recovered and reused rather than “disposed of”.
- Feels that people need to think more broadly about what can be done and be more willing to make sacrifices and behavior changes.

Shawn Fernandez, (Cranberry Valley Golf Course) Golf courses have changed the way operated over the past 15 years. They have reduced the amount of nitrogen, reduced fertilizer use, and have returned to more cultural practices. At Cranberry Valley, they are currently applying to become an Audubon sanctuary which involves a lot of planning and nutrient/pesticide reduction.

Bob Kingsbury, (Harwich Port Golf Course). All superintendents of golf courses view themselves as environmental stewards and take it very seriously. Contrary to public opinion, they don’t simply dump products onto the turf. We do the best we can. Some do it better than others. At Harwich Port we have reduced fertilizer usage substantially, and have also reduced the amount of turf they have; has led to 41% reduction in nitrogen. Reduction can be achieved partly through mandates, but largely through education. Education should be held in higher regard as part of this process.

APPENDIX ONE: MEETING PARTICIPANTS

Name	Affiliation
Working Group Members	
Larry Ballantine	Harwich Board of Selectman
Peter deBakker	Harwich Water Quality Task Force
Diane Chamberlain	Dennis Board of Health and Comprehensive Water Management Task Force
Joan Kozar	Harwich Planning Board
Jason Klump	Brewster Planning Board
Michael Lach	Harwich Land Trust
Sue Leven	Town of Brewster, Planner
Ed Nash	Golf Course Superintendents Association
Russell Schell	Brewster Comprehensive Water Planning Committee
Steve Swain	Concerned Citizen
Brooke Williams	Harwich Civic Association
Public	
Shawn Fernandez	Cranberry Valley Golf Course
Bob Kingsbury	Harwich Port Golf Course
Hilde Maingay	Upper Cape North and South Watershed Working Group member
David Stott	Chequessett Golf Course
Staff and Consultants	
Tom Cambareri	Cape Cod Commission
Patty Daley	Cape Cod Commission
Kate Harvey	Consensus Building Institute
Carly Ipken	Consensus Building Institute
Maria McCauley	Cape Cod Commission
Scott Michaud	Cape Cod Commission
Mark Owen	AECOM
Kristy Senatori	Cape Cod Commission

Cape Cod 208 Area Water Quality Planning
Lewis Bay to Bass River Watershed Working Group
Dennis Town Hall
Second Meeting

485 Main St, South Dennis, MA 02660
November 4, 2013
8:30 a.m.-12:30 p.m.

Agenda

8:30 Welcome, Review 208 goals and Process and the Goals of today's meeting – *Cape Cod Commission*

8:40 Introductions, Agenda Overview, Updates and Action Items– *Facilitator and Working Group*

9:00 Range of Possible Solutions – *Cape Cod Commission and Working Group*
- Technology Matrix
- Technologies Overview
- Survey Questions and Comments
- Additional Questions and Discussion

10:30 Break

10:45 Problem Solving Process and Principles – *Cape Cod Commission and Working Group*
- Overview of 7-steps for Problem-Solving Process
- Examination of Categories of Solutions and their impacts on the Environment, Economy, and Community (triple bottom line)
- Discussion – Identify Considerations and Priorities for Application

12:00 Preparing for Meeting 3 and Beyond – *Cape Cod Commission*
- Review Tools, Alternatives Analysis Approach
- Evaluating Scenarios for Meeting Nitrogen Goals
- Other Process Next Steps

12:15 Public Comments

12:30 Adjourn

Lewis Bay to Bass River Group

Technologies and Approaches

What is the stakeholder process?

Public Meetings

Watershed Working Groups

Goals, Work Plan & Roles

Affordability, Financing

Baseline Conditions

Technology Options Review

Watershed Scenarios

July

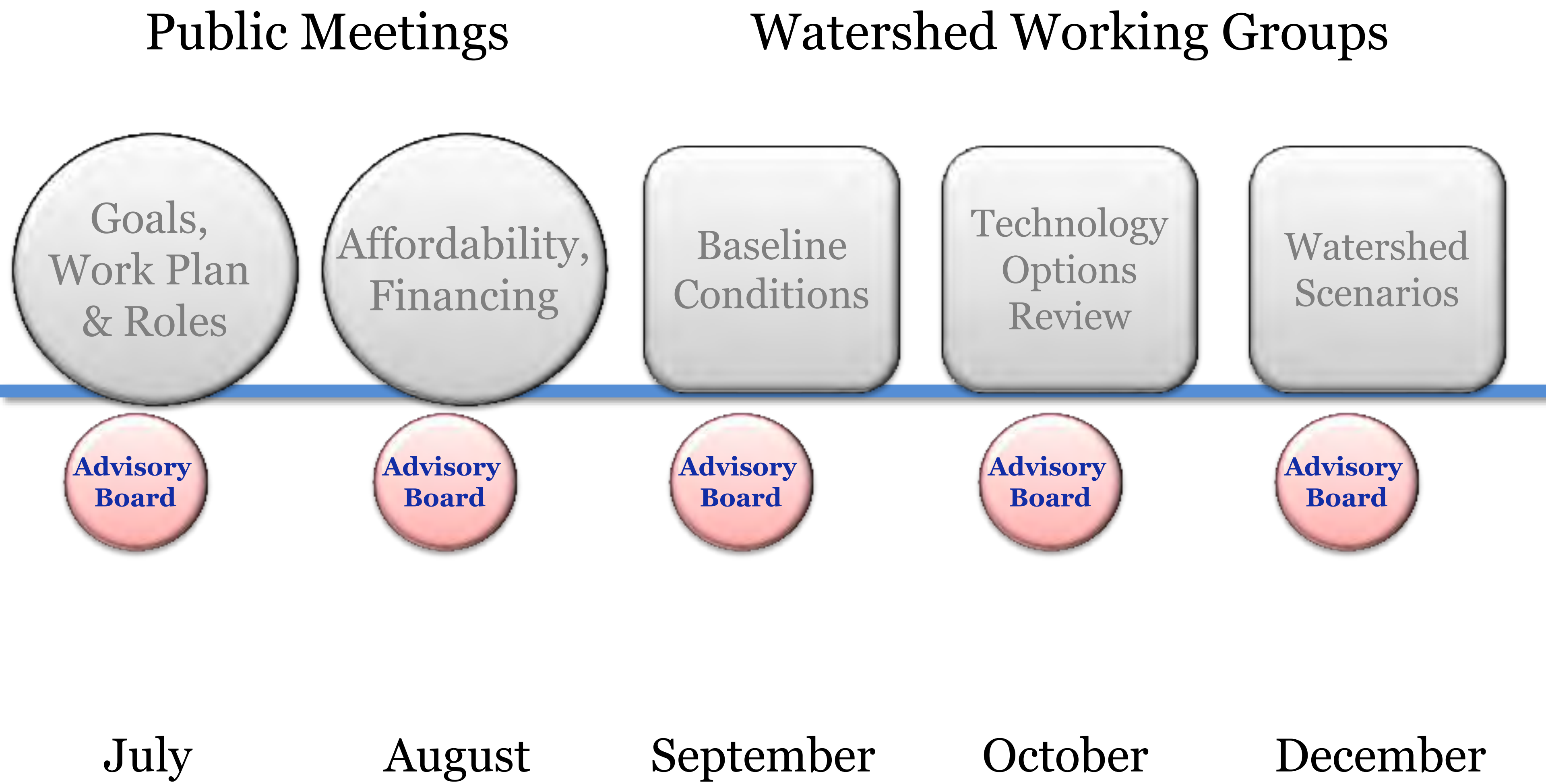
August

September

October

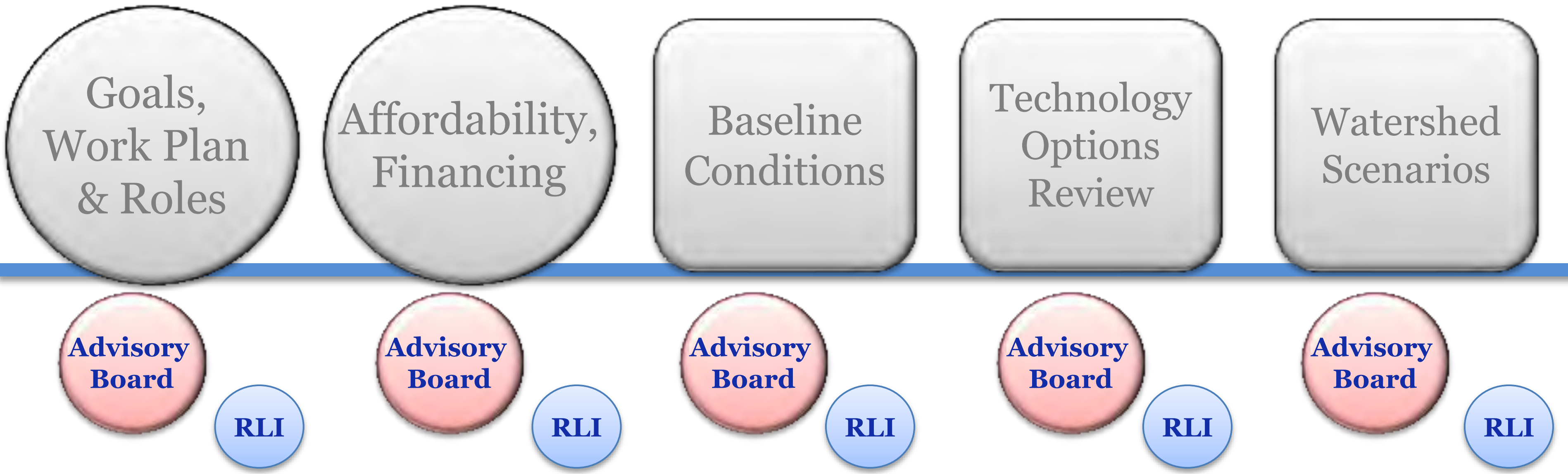
December

208 Planning Process



208 Planning Process

Public Meetings Watershed Working Groups



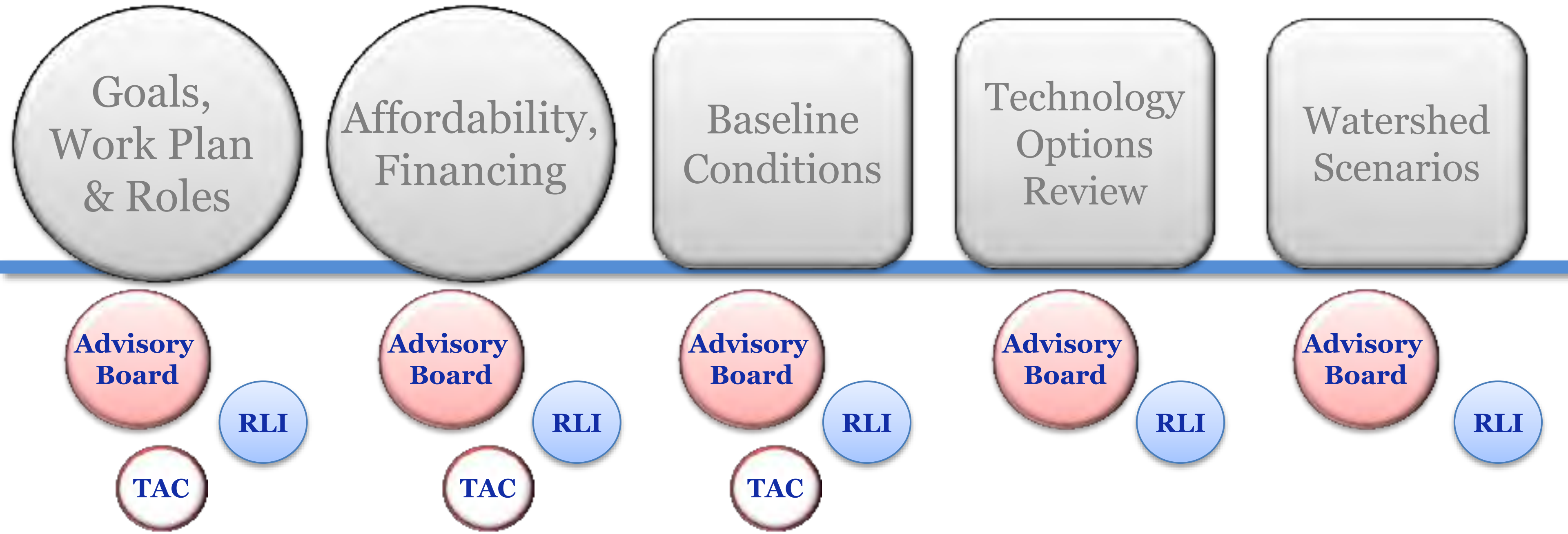
July August September October December

RLI Regulatory, Legal & Institutional Work Group

208 Planning Process

Public Meetings

Watershed Working Groups

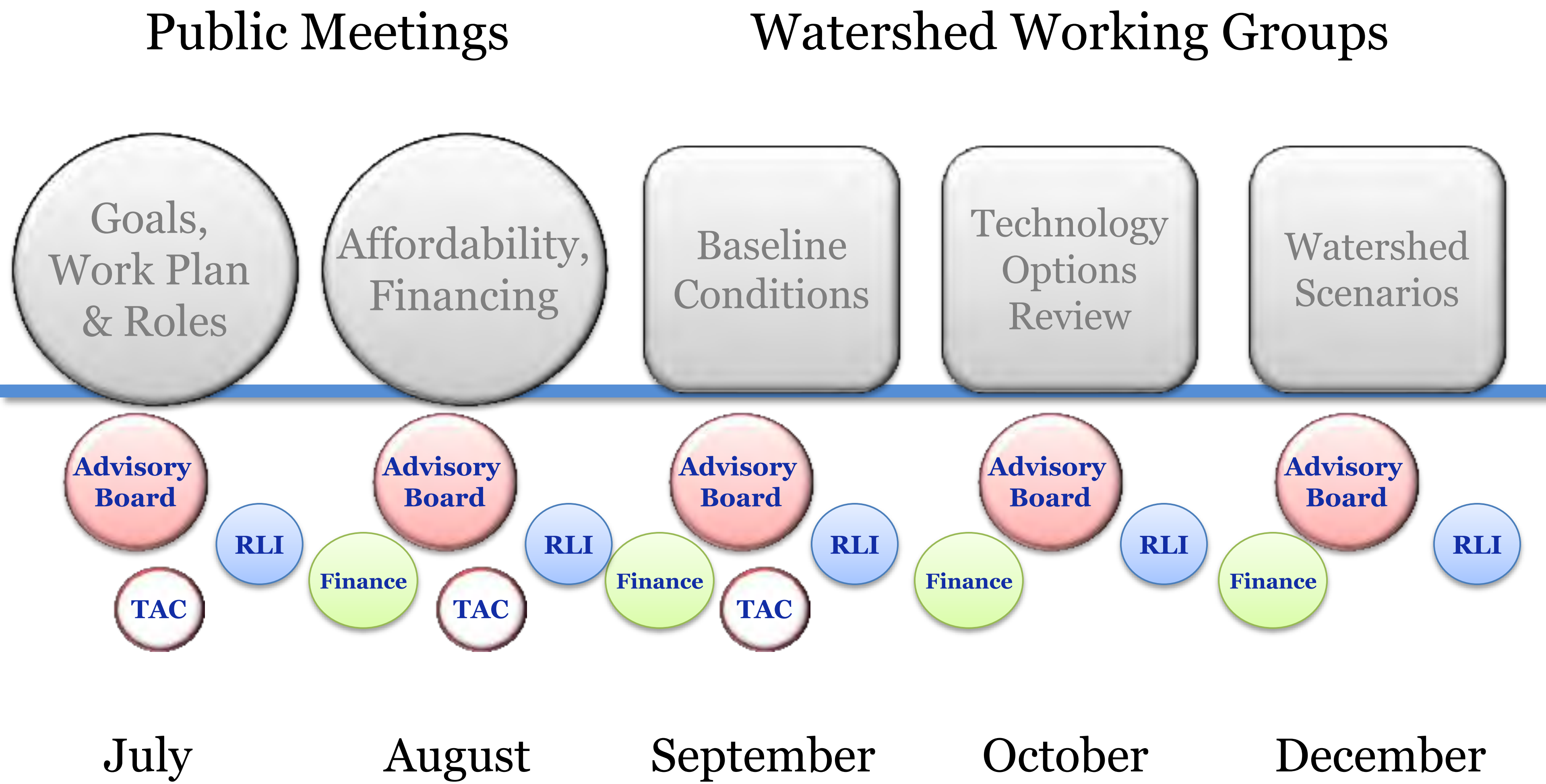


July August September October December

RLI Regulatory, Legal & Institutional Work Group

TAC Technical Advisory Committee of Cape Cod Water Protection Collaborative

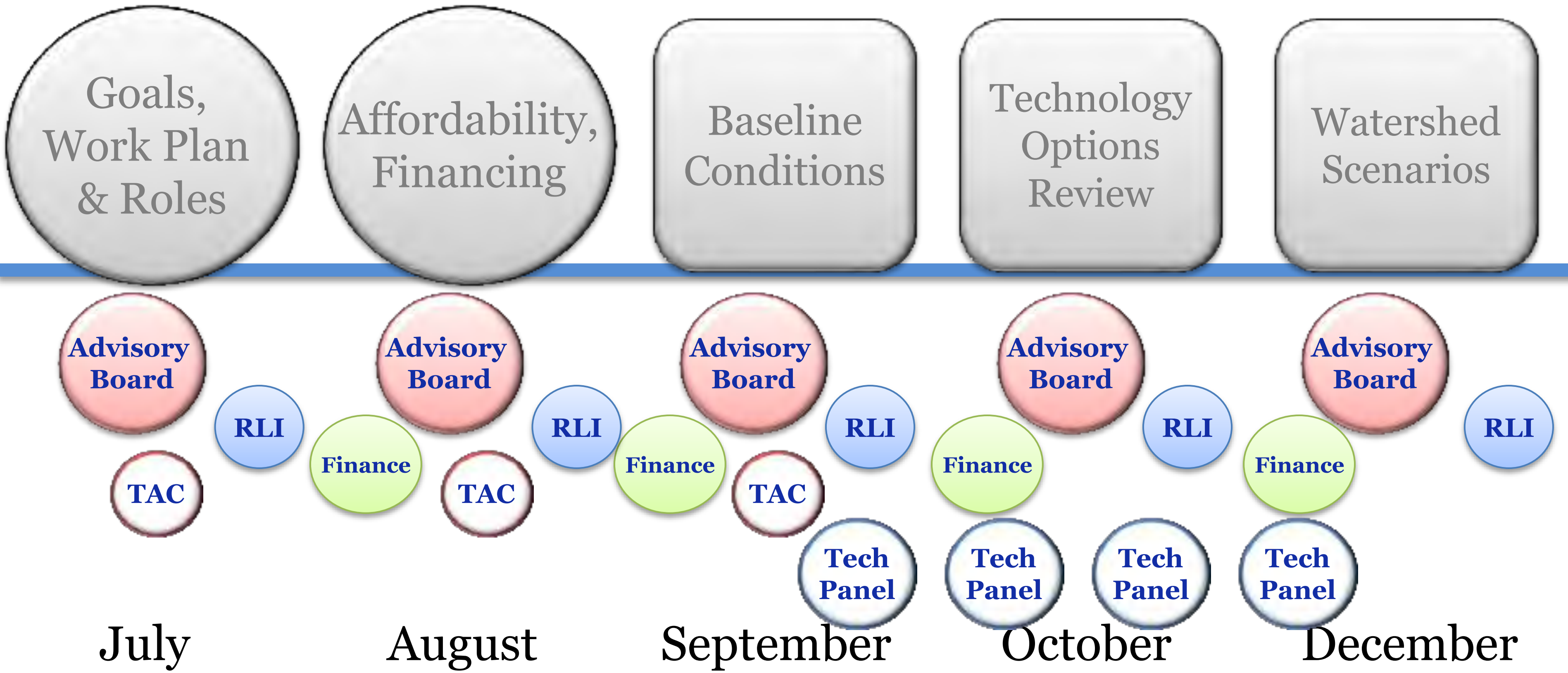
208 Planning Process



RLI Regulatory, Legal & Institutional Work Group

TAC Technical Advisory Committee of Cape Cod Water Protection Collaborative

Public Meetings Watershed Working Groups



RLI Regulatory, Legal & Institutional Work Group

TAC Technical Advisory Committee of Cape Cod Water Protection Collaborative

208 Planning Process

Baseline Conditions

11 Working Group Meetings: Sept 18-27

Goal of the First Meeting:

To review and develop shared understanding of the characteristics of these watersheds, the work done to date, existing data and information available, and how to apply all of this to planning for water quality improvements for these watersheds moving forward.

Progress since last meeting

- Meeting materials

Progress since last meeting

- ❑ Meeting materials
- ❑ GIS data layers

Progress since last meeting

- ❑ Meeting materials
- ❑ GIS data layers
- ❑ Chronologies

Baseline Conditions

11 Working Group Meetings: Sept 18-27

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

208 Planning Process

Baseline Conditions

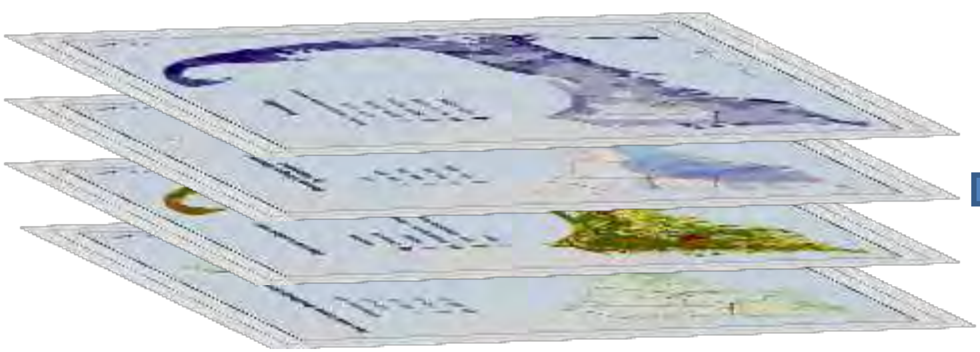
11 Working Group Meetings: Sept 18-27

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Watershed Scenarios

11 Working Group Meetings: Dec 2-11



208 Planning Process

Baseline Conditions

11 Working Group Meetings: Sept 18-27

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Watershed Scenarios

11 Working Group Meetings: Dec 2-11

Watershed Event

November 13

Center for the Arts Dennis

Wrap up of Cape2O: ur in charge!

Summary of planning process to date

Outline of second 6 months of the 208 planning process

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Goal of Today's Meeting:

To develop a shared understanding of the potential technologies and approaches identified to date, and the benefits and limitations of each; to explore the environmental, economic, and community impacts of a range of categories of solutions; and to identify priorities and considerations for applying technologies and approaches to remediate water quality impairments in your watershed.

Technologies and Approaches for Improving Water Quality

Technologies and Approaches for Improving Water Quality

- The Fact Sheets present various information on the technologies being considered.
- Additional information is contained on the Technology Matrix including the following:
  - Site Requirements
  - Construction, Project and Operation and Maintenance Costs
  - Reference Information
  - Regulatory Comments
- Input from the Stakeholders is requested regarding a technology's Public Acceptance

Technologies and Approaches for Improving Water Quality

- Comprehensive analysis of nutrient control technologies and approaches.

Technologies and Approaches for Improving Water Quality

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- Not all of the technologies and approaches will be applicable to Cape Cod.

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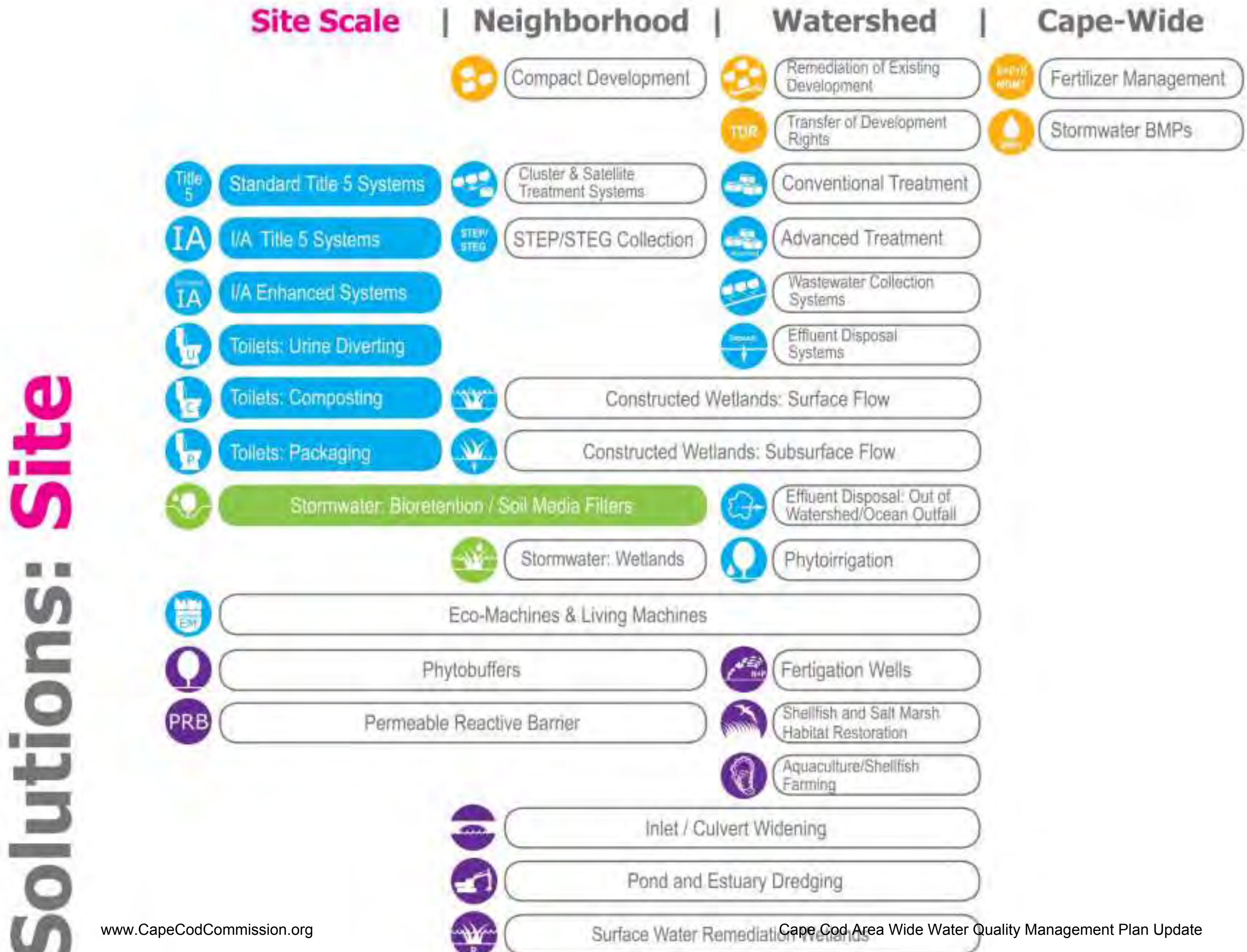
- Some technologies are so promising that we should identify them for demonstration and pilot projects.
- Workshop 3 will embark on hands on problem solving in each watershed to meet target load reductions.
- Certain technologies or approaches will be effective at **preventing** nutrients from entering the water body. Others will be effective at **reducing** or **remediating** nutrients that are already in the groundwater or water body.

Technologies and Approaches for Improving Water Quality

- ❑ Comprehensive analysis of nutrient control technologies and approaches.
- ❑ Not all of the technologies and approaches will be applicable to Cape Cod.
- ❑ Some technologies are so promising that we should identify them for demonstration and pilot projects.
- ❑ Workshop 3 will embark on hands on problem solving in each watershed to meet target load reductions.
- ❑ Certain technologies or approaches will be effective at **preventing** nutrients from entering the water body. Others will be effective at **reducing** or **remediating** nutrients that are already in the groundwater or water body.
- ❑ Regulatory programs can address nutrient controls for both existing development and future development.


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


Solutions: Site
Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
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STEP/STEG Collection
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Toilets: Composting
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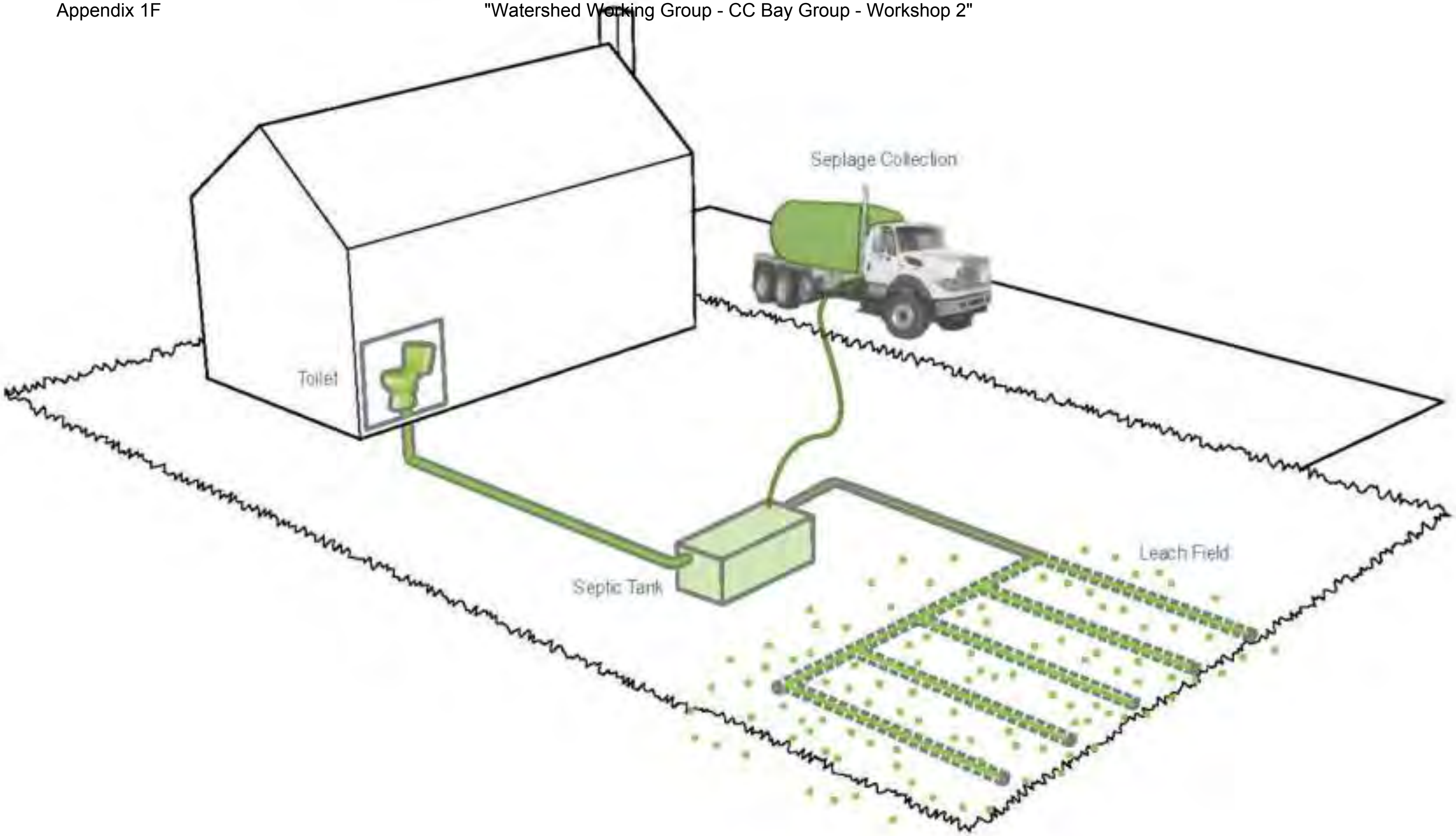
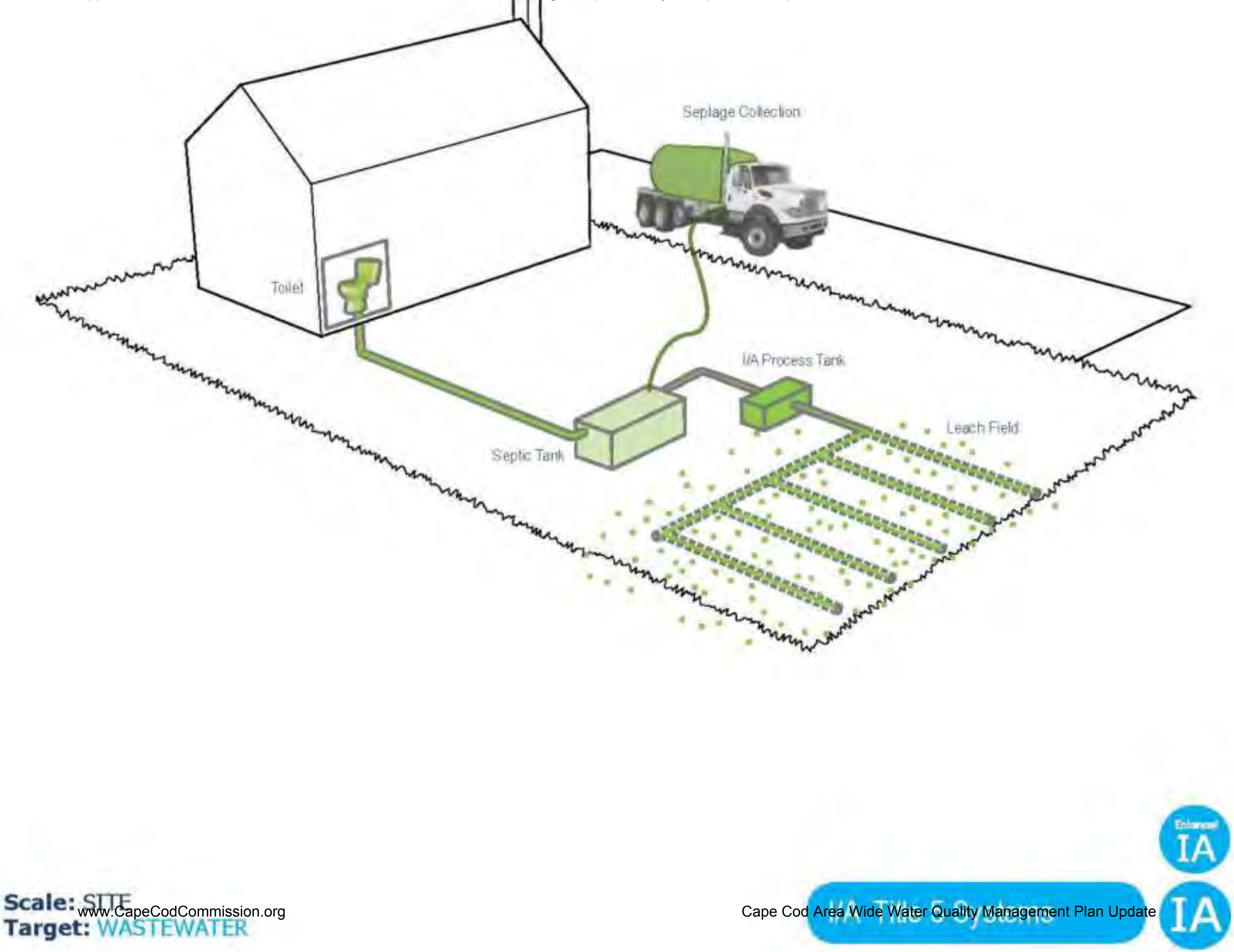
P
Toilets: Packaging
Constructed Wetlands: Subsurface Flow
Stormwater: Bioretention / Soil Media Filters
Effluent Disposal: Out of Watershed/Ocean Outfall
Stormwater: Wetlands
Phytoirrigation
EM
Eco-Machines & Living Machines
Phytobuffers
Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
R
Surface Water Remediation Wetlands

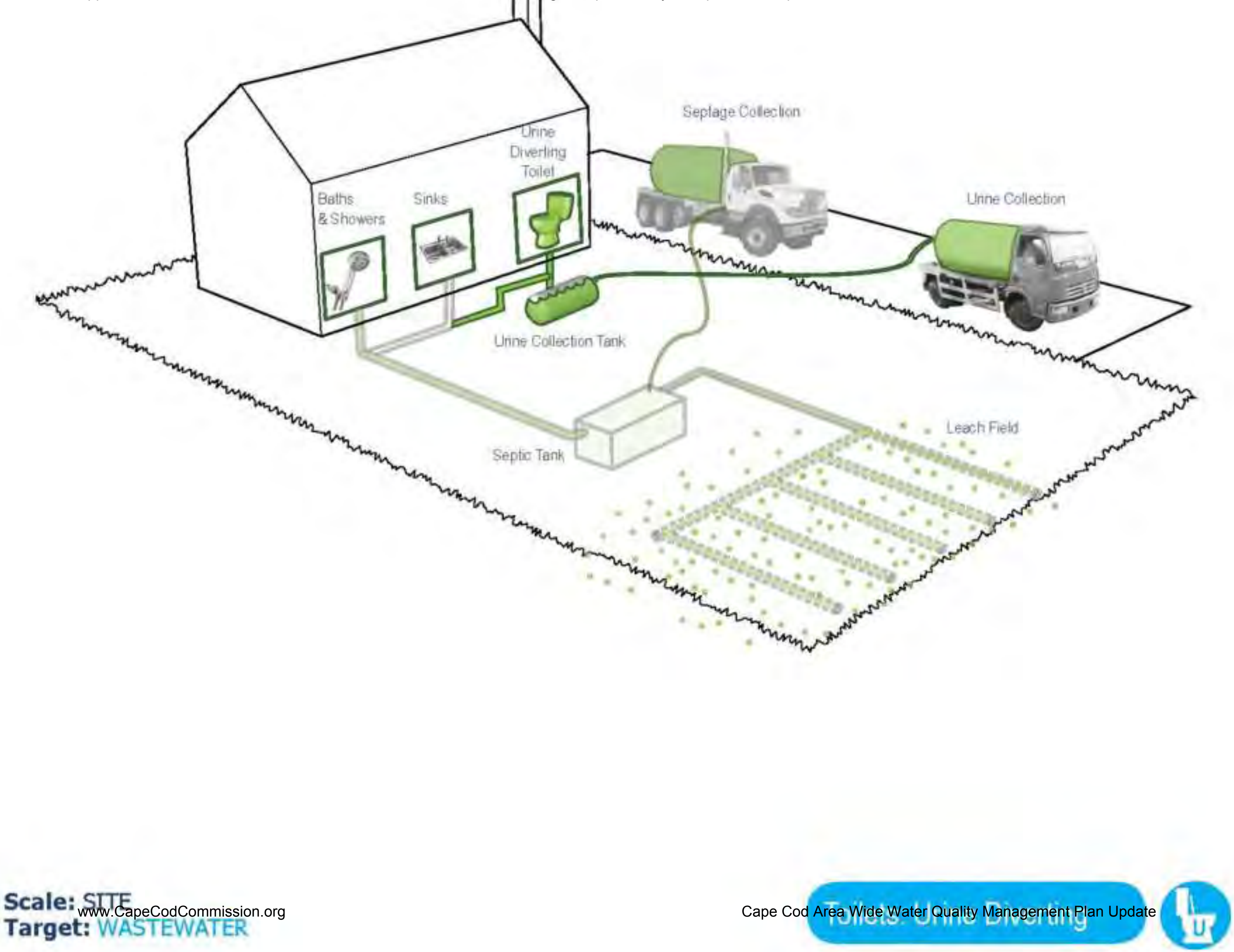


Scale: SITE
Target: WASTEWATER

Standard Title 5 Systems

Title 5


Septage Collection
Toilet
I/A Process Tank
Leach Field
Septic Tank
Scale: SITE
Target: WASTEWATER
I/A Title 5 Systems
Enhanced IA
IA


Septage Collection
Urine Diverting Toilet
Baths & Showers
Sinks
Urine Collection
Urine Collection Tank
Leach Field
Septic Tank
Scale: SITE
Target: WASTEWATER
Toilets: Urine Diverting

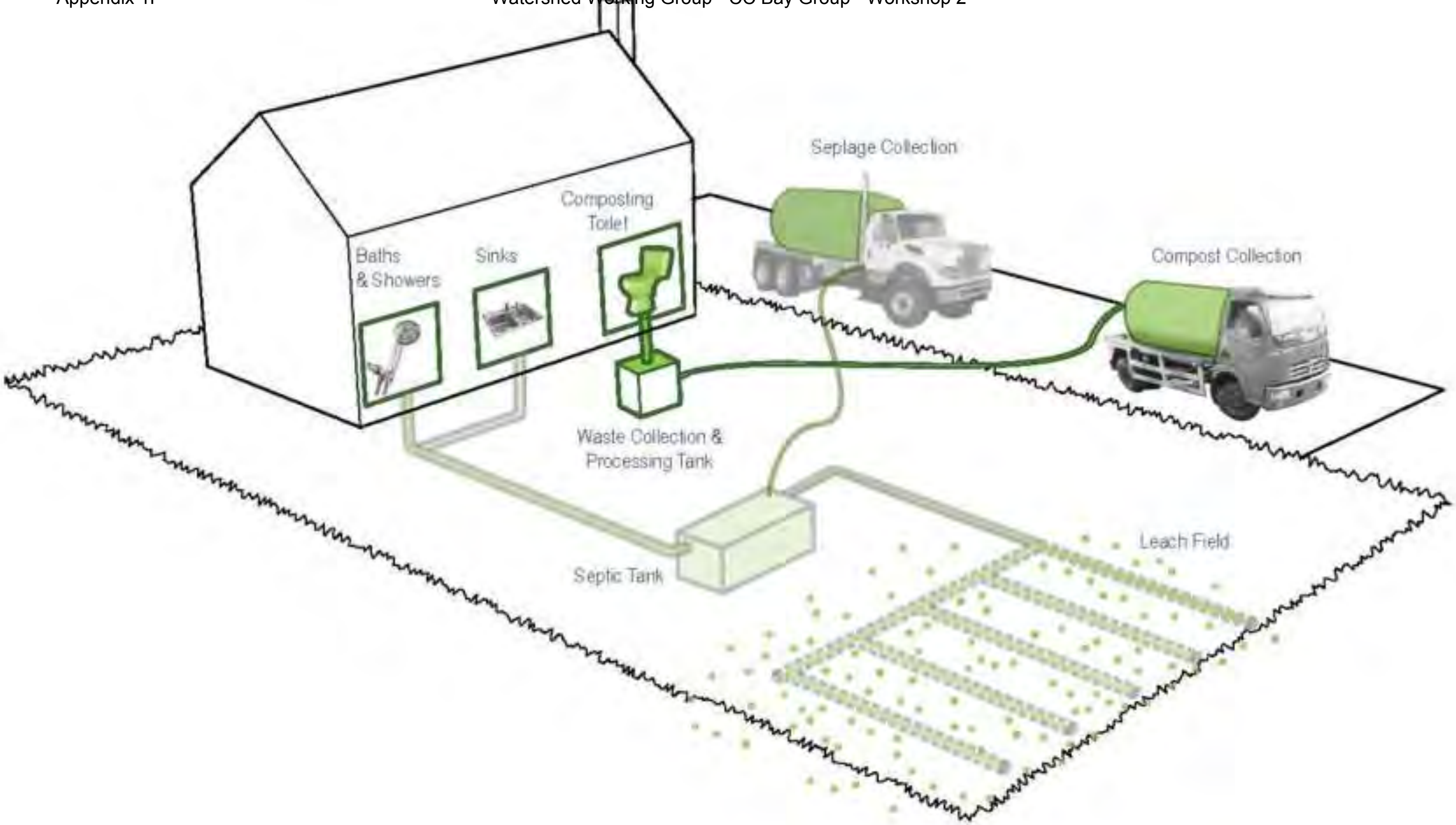
Waterless Urinal

IBC container (220 gallons)

40" x 40" x48"

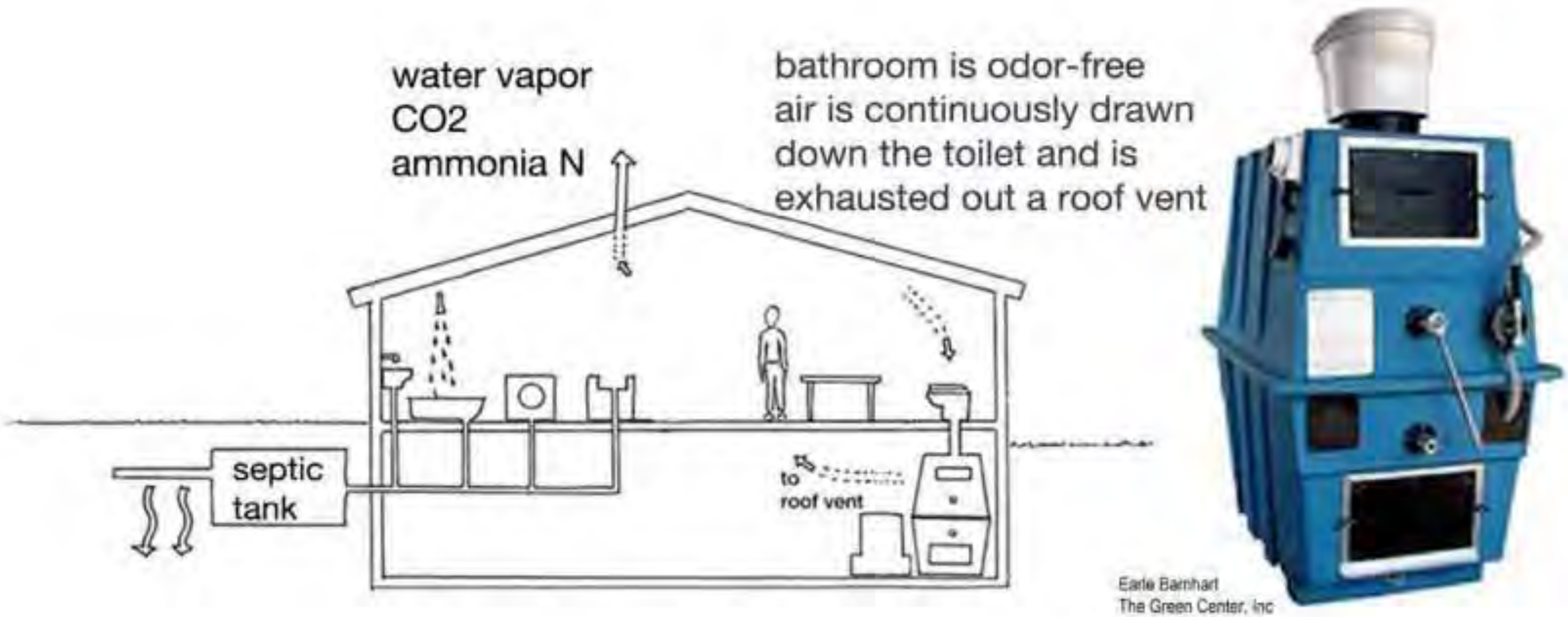
Source: The Green Center Inc. and Horsley-Witten Group Inc.

Toilets: Urine Diverting

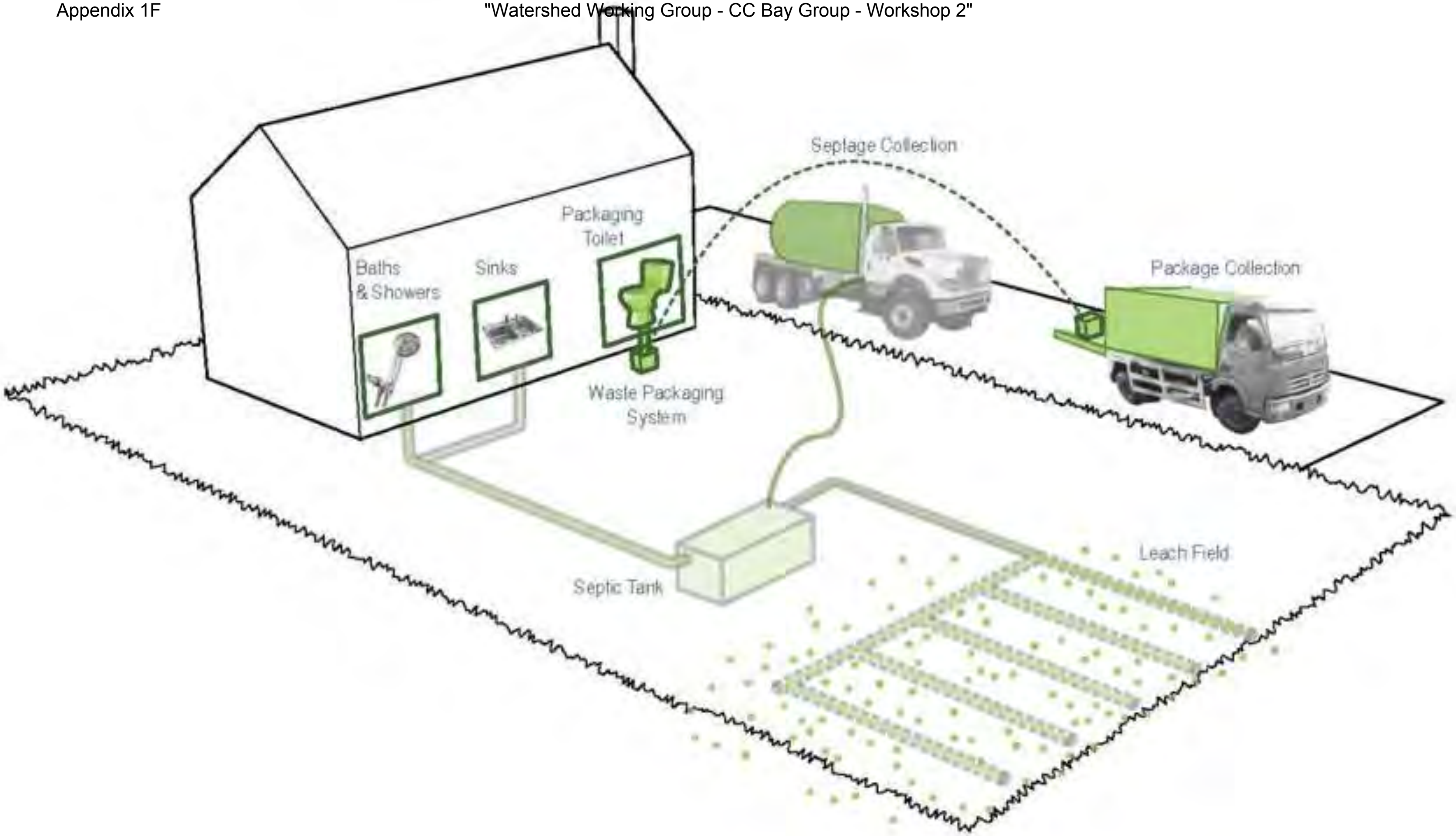


Scale: SITE
Target: WASTEWATER

Toilets: Composting



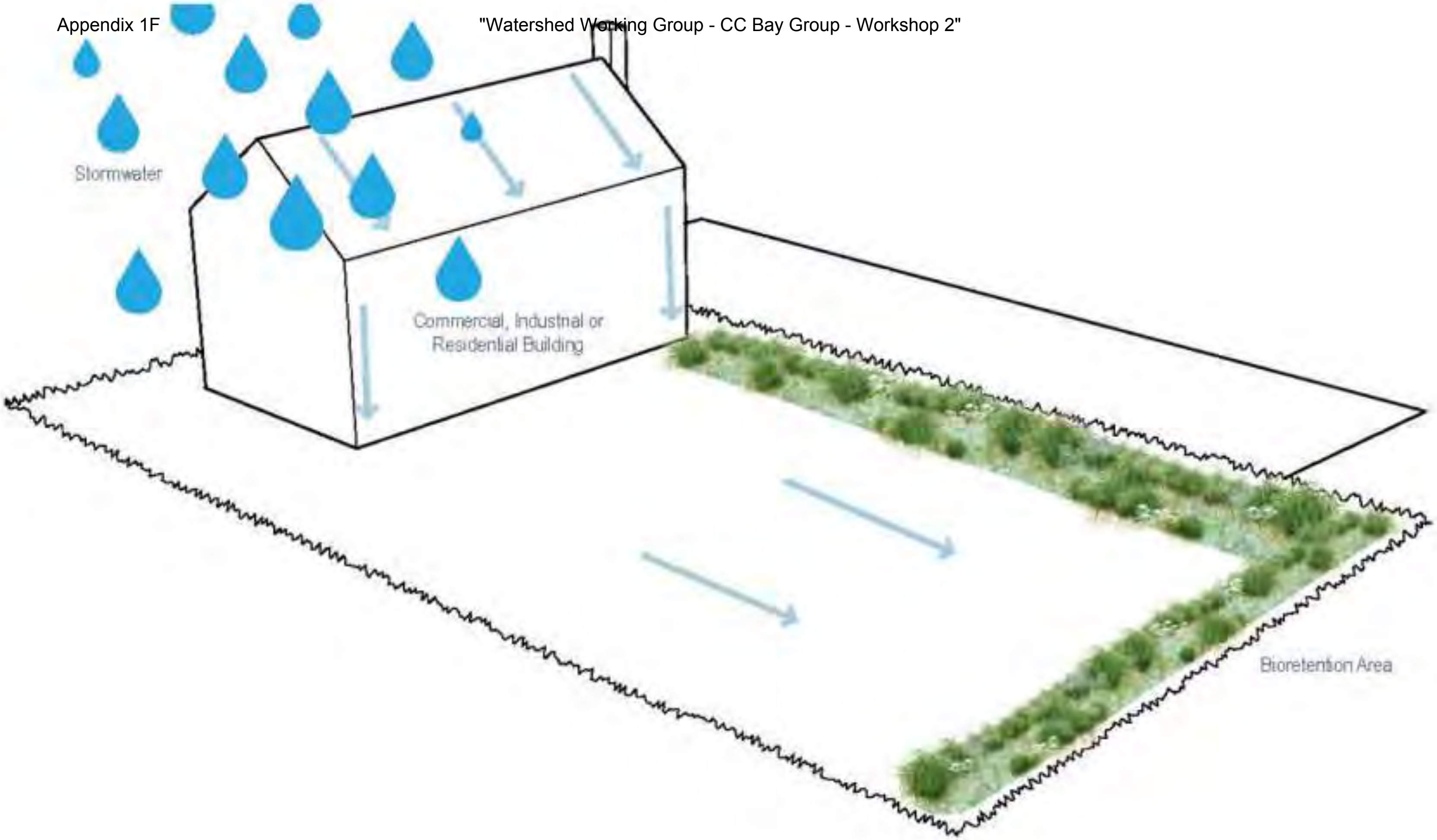
Source: Earle Barnhart, The Green Center Inc.



Scale: SITE
Target: WASTEWATER

Toilets: Packaging


PACTO®
LOOWATT
Packaging
Toilet
Packages



Scale: SITE
Target: STORMWATER

Stormwater Bioretention / Soil Media Filters

Precedent: 12th Ave. Stormwater Project, Portland, OR

Source: City of Portland

Stormwater: Bioretention / Soil Media Filters

Rain Gardens


Site Scale | Neighborhood | Watershed | Cape-Wide
Solutions: Neighborhood
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
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STEP/STEG Collection
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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
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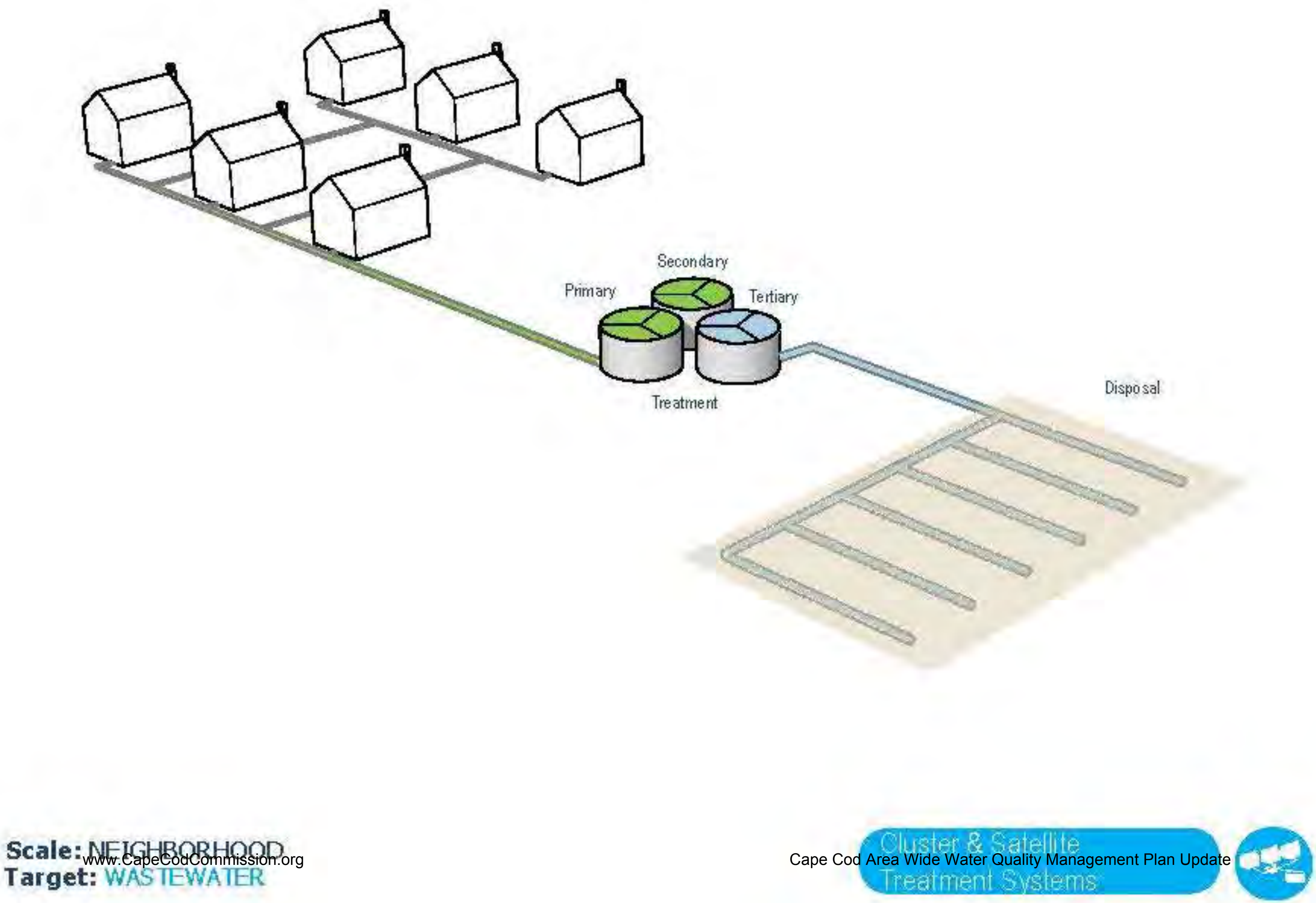
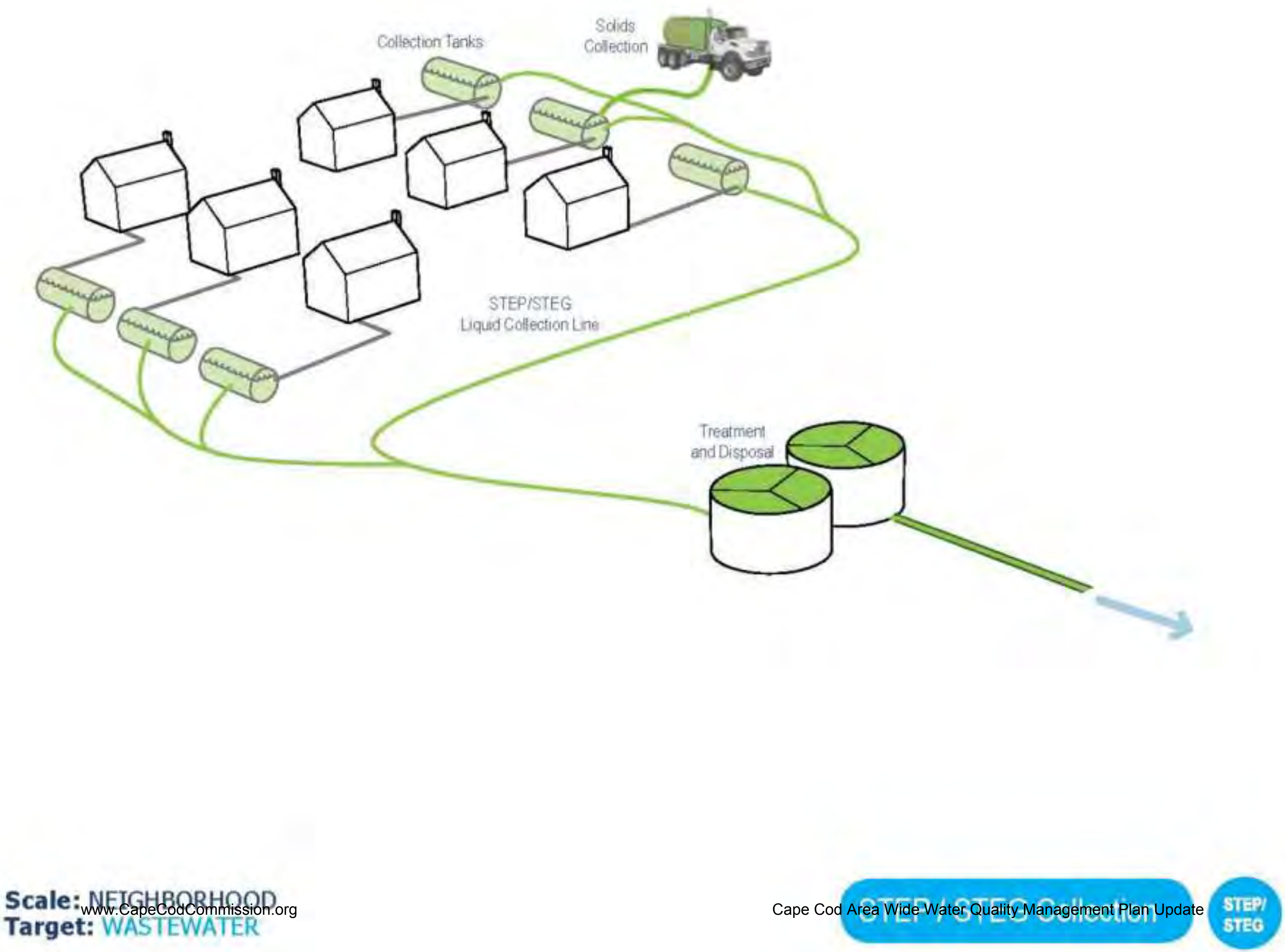
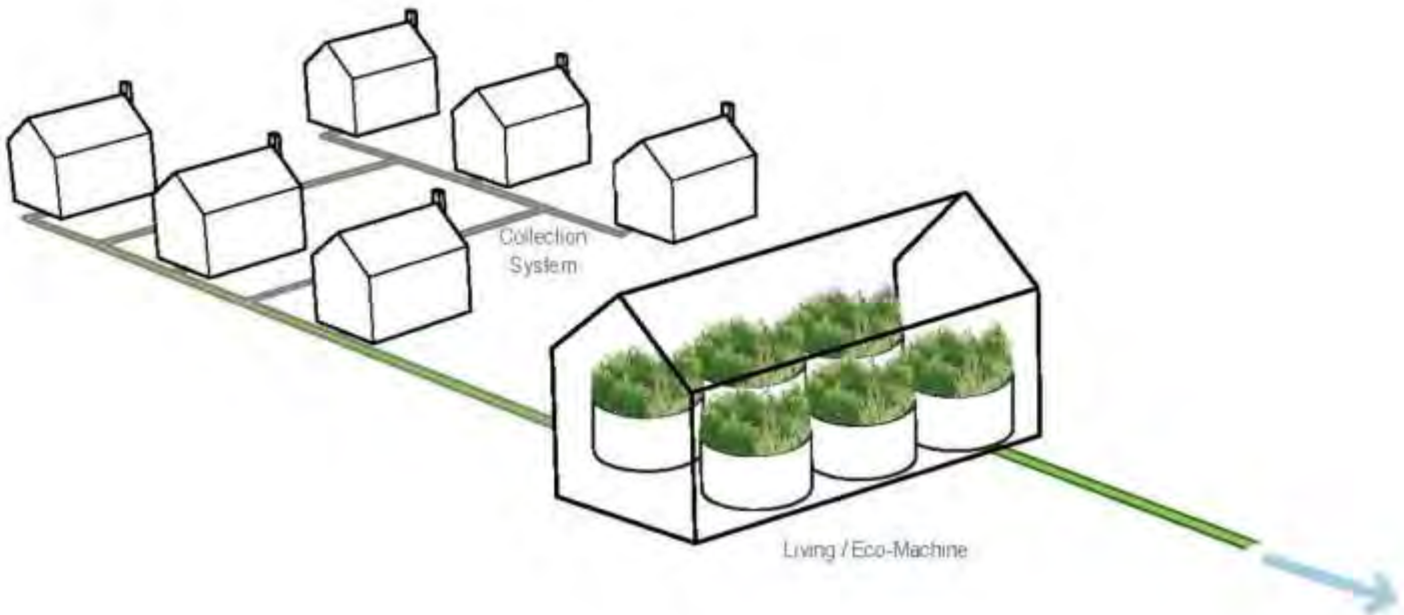
Phytoirrigation
Eco-Machines & Living Machines
Phytobuffers
Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands

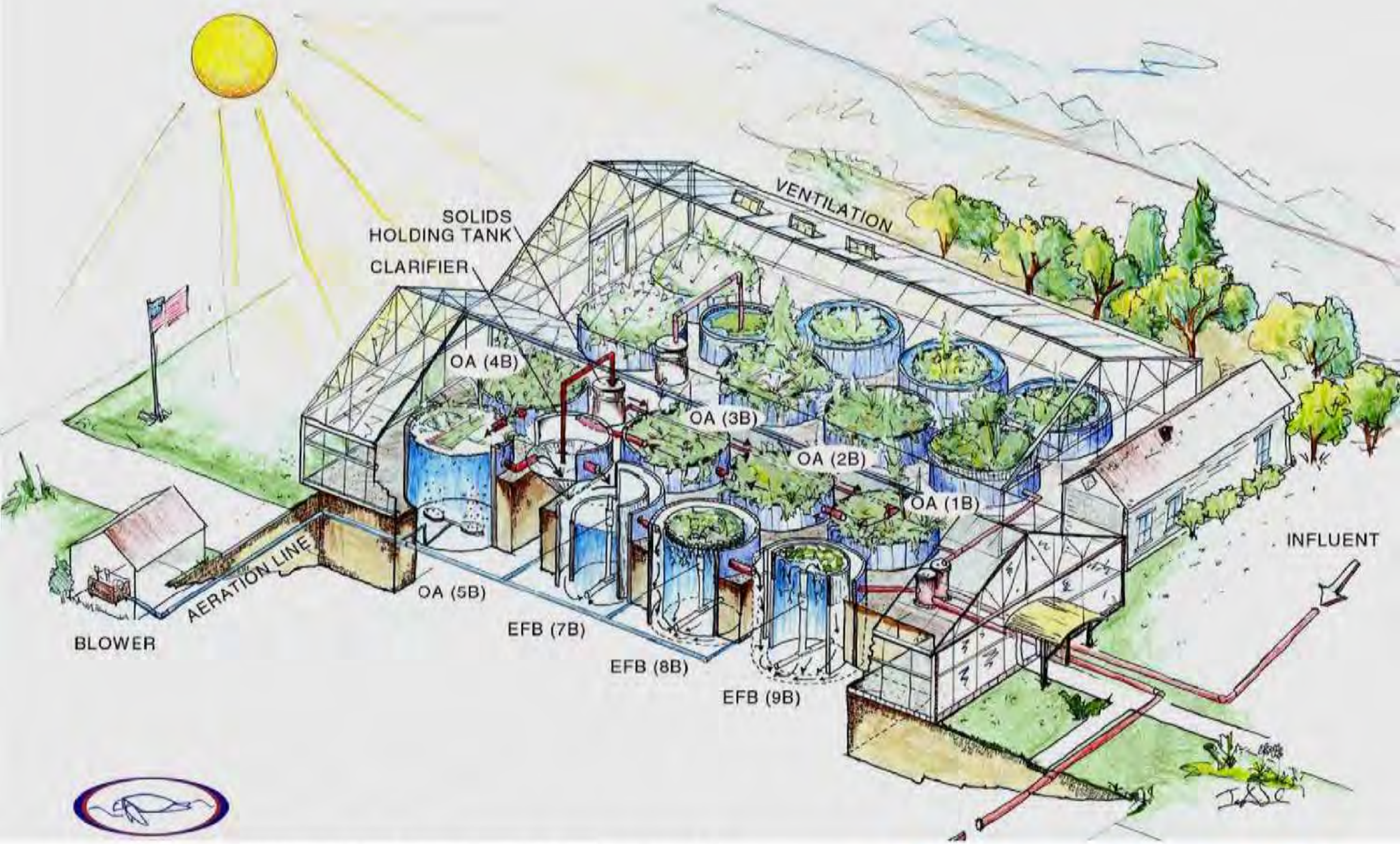

Secondary
Primary
Tertiary
Treatment
Disposal
Scale: NEIGHBORHOOD
Target: WASTEWATER
Cluster & Satellite
Treatment Systems


Collection Tanks
Solids Collection
STEP/STEG Liquid Collection Line
Treatment and Disposal
Scale: NEIGHBORHOOD
Target: WASTEWATER
STEP / STEG Collection
STEP/ STEG



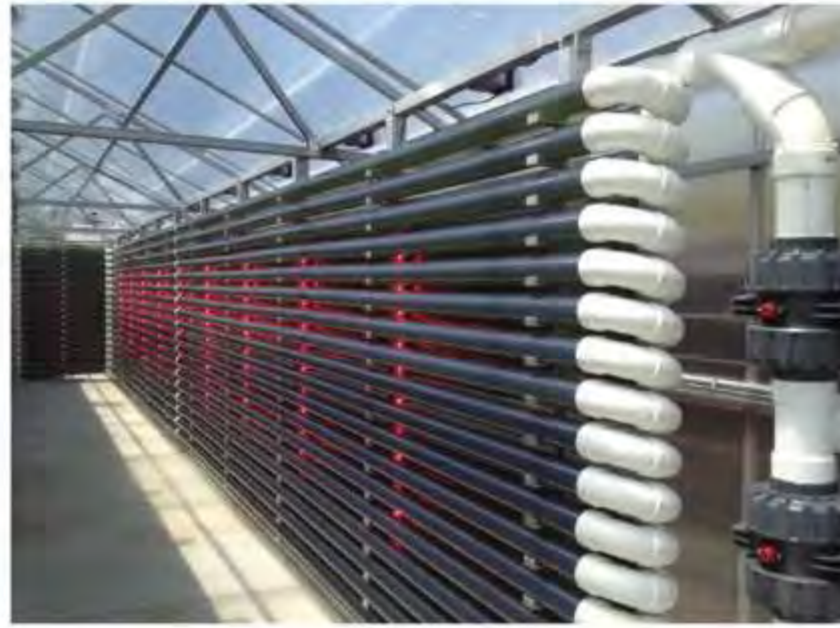
Scale: NEIGHBORHOOD
Target: WASTEWATER

Eco-Machines and
Living Machines



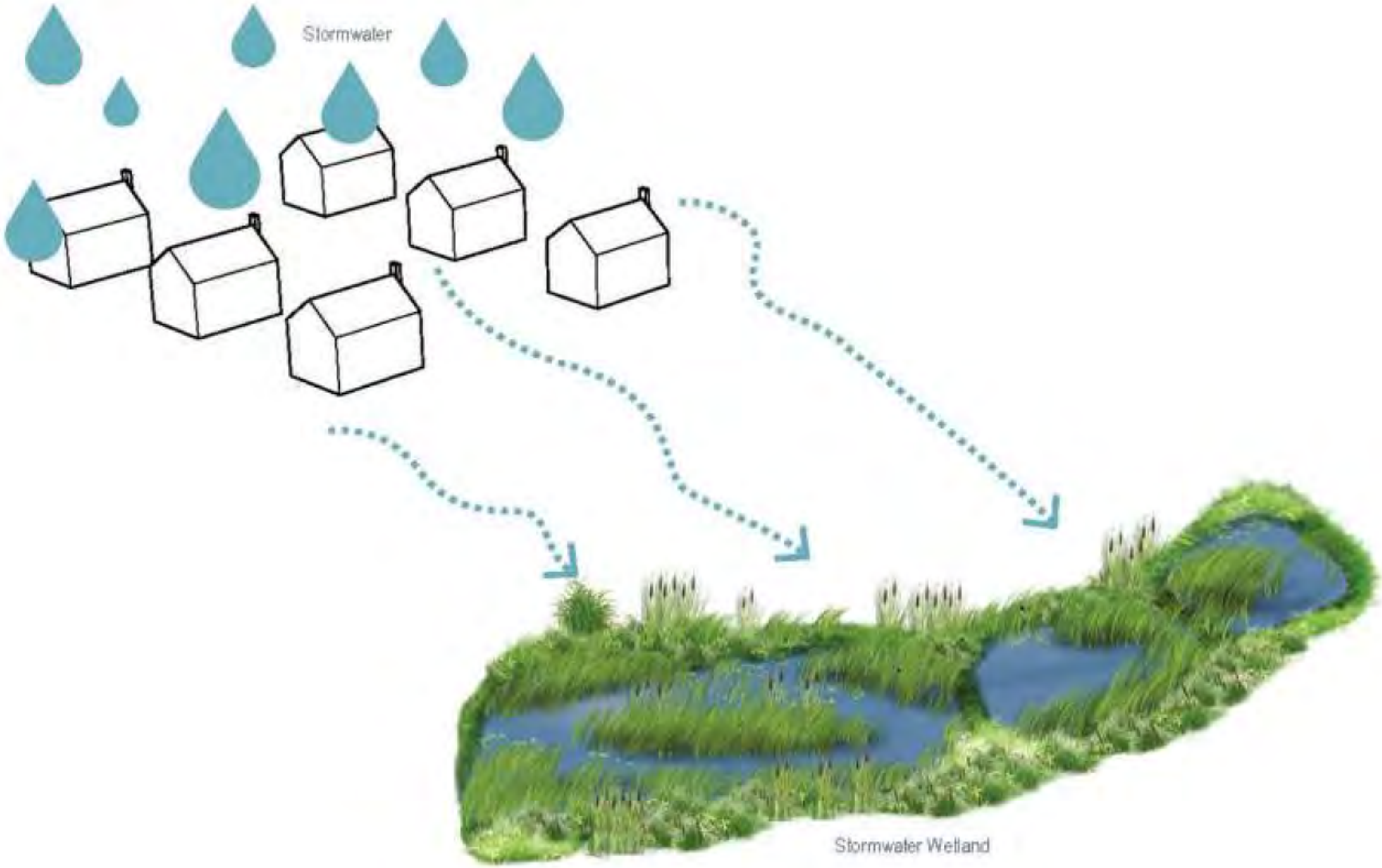
Precedent: Living Machine, South Burlington, VT
Source: Todd Ecological

Eco-Machines and Living Machines



Precedent: Living Machine - South Burlington, VT + Photobioreactors - Falmouth, MA
Source: Todd Ecological and Tom Cambareri

Eco-Machines and Living Machines

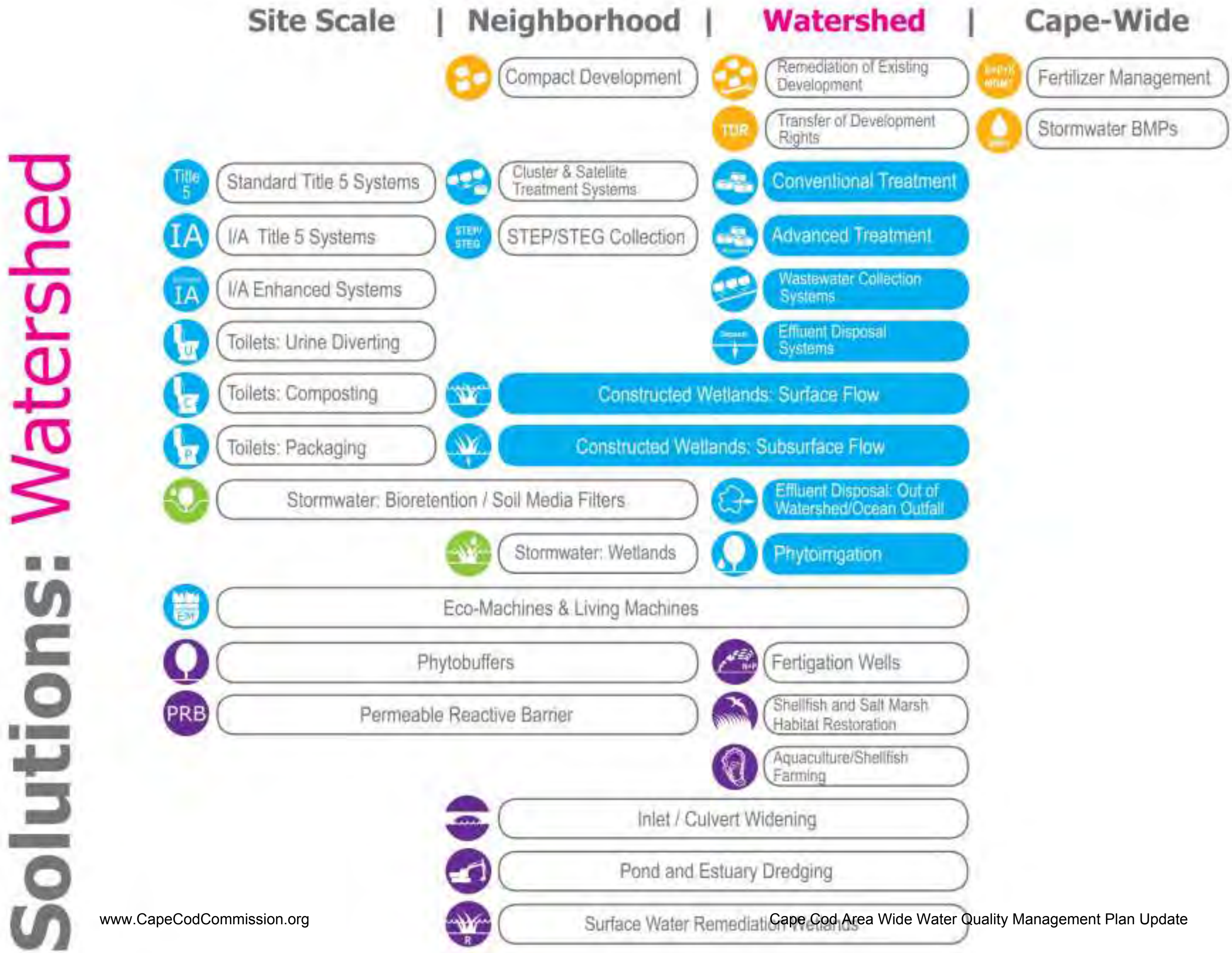


Scale: NEIGHBORHOOD
Target: STORMWATER

Stormwater Wetlands

Precedent: Missouri
Source: AECOM

Stormwater Wetlands


Solutions: Watershed
Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
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Constructed Wetlands: Subsurface Flow
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Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
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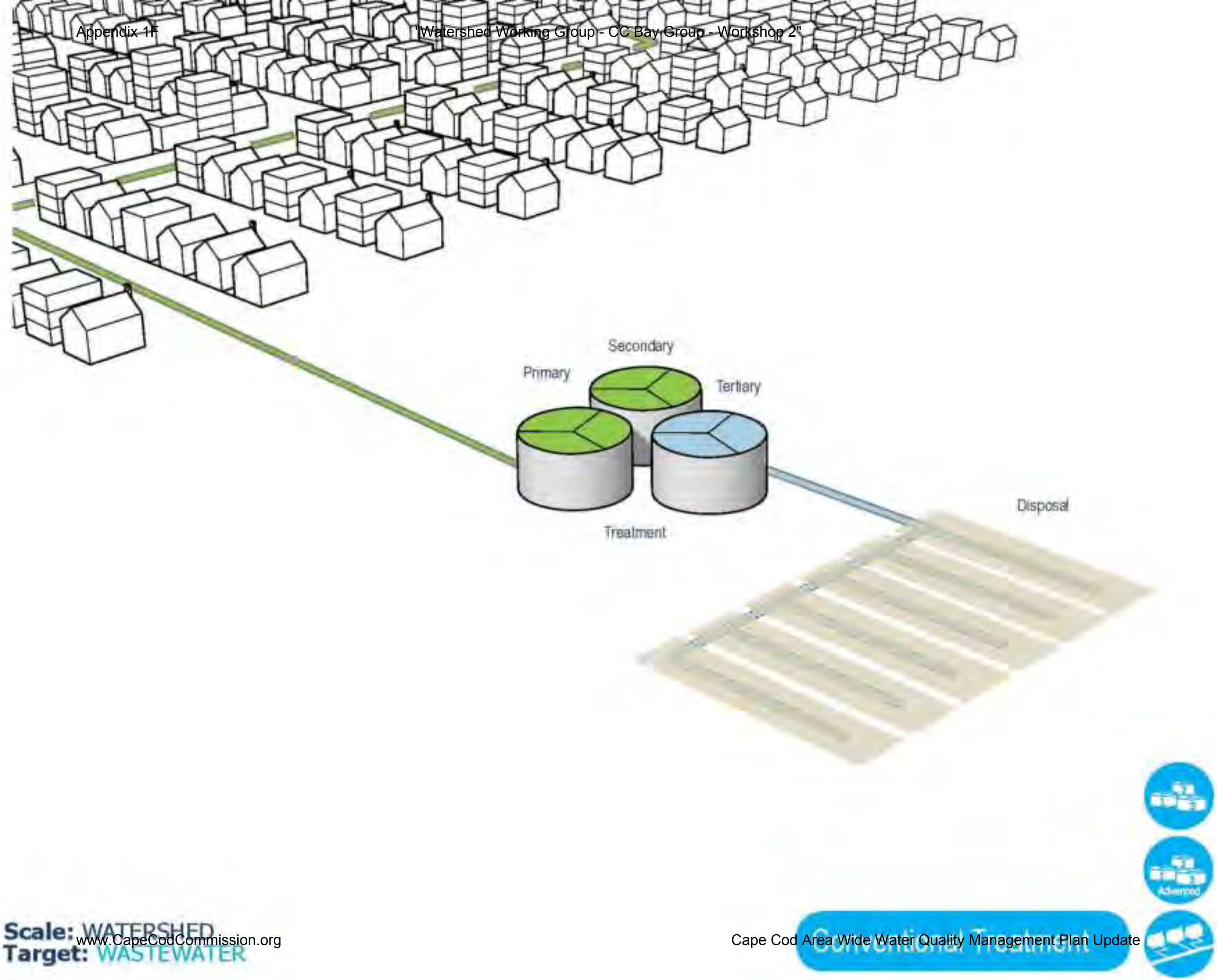
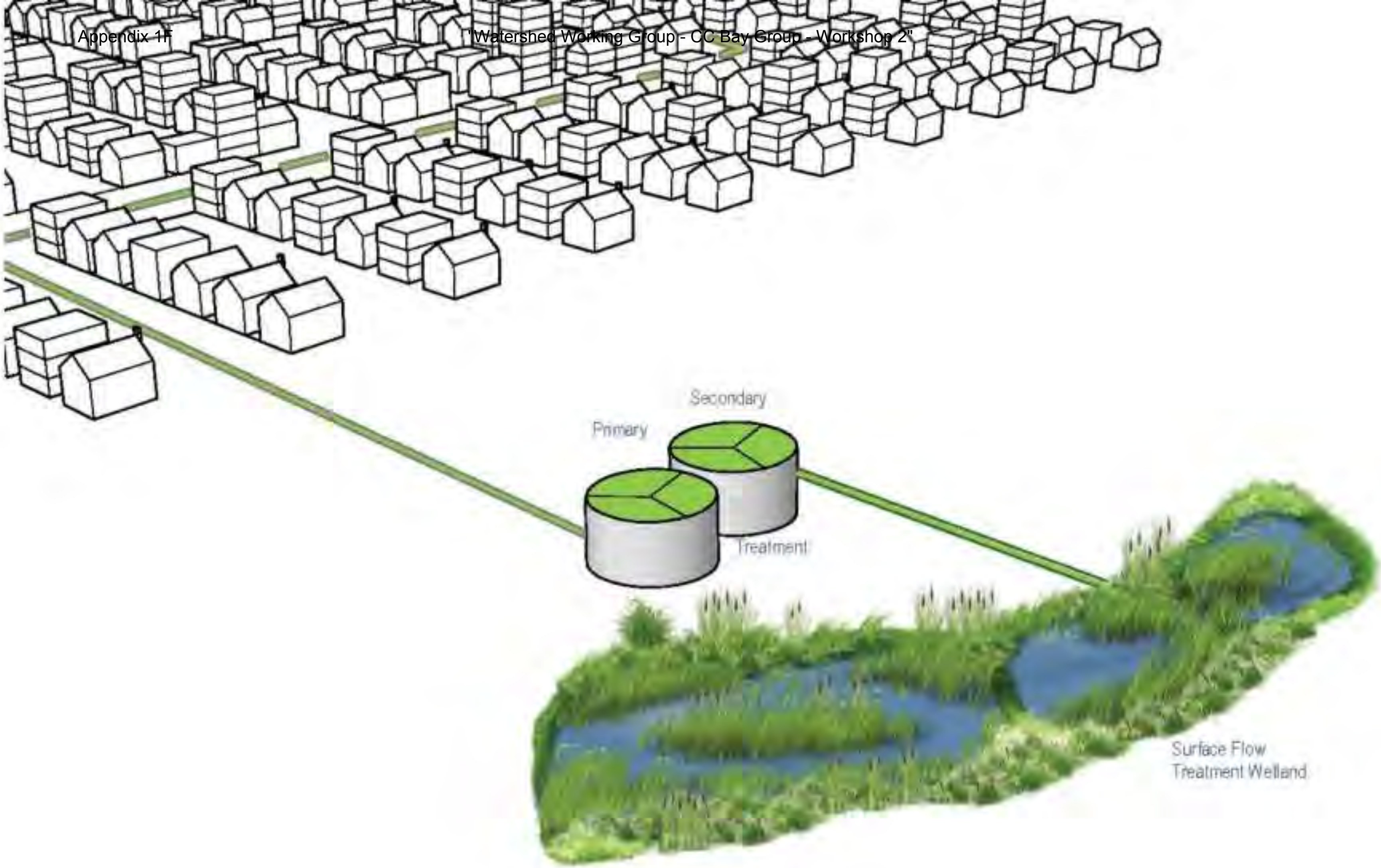
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands



Scale: WATERSHED
Target: WASTEWATER

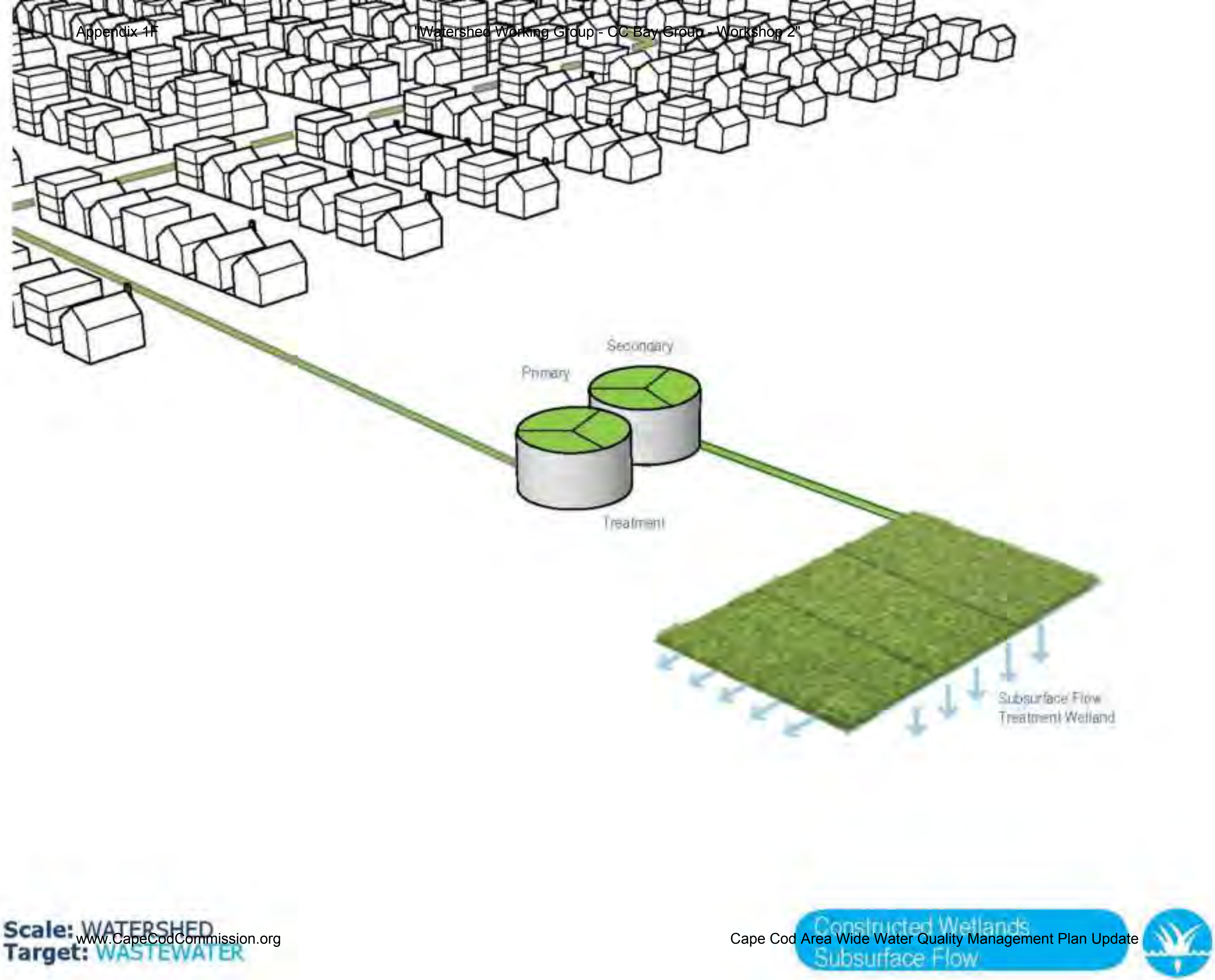


Scale: WATERSHED
Target: WASTEWATER

Constructed Wetlands
Surface Flow

Precedent: Talking Waters Garden - Albany, OR
Source: Kate Kennen

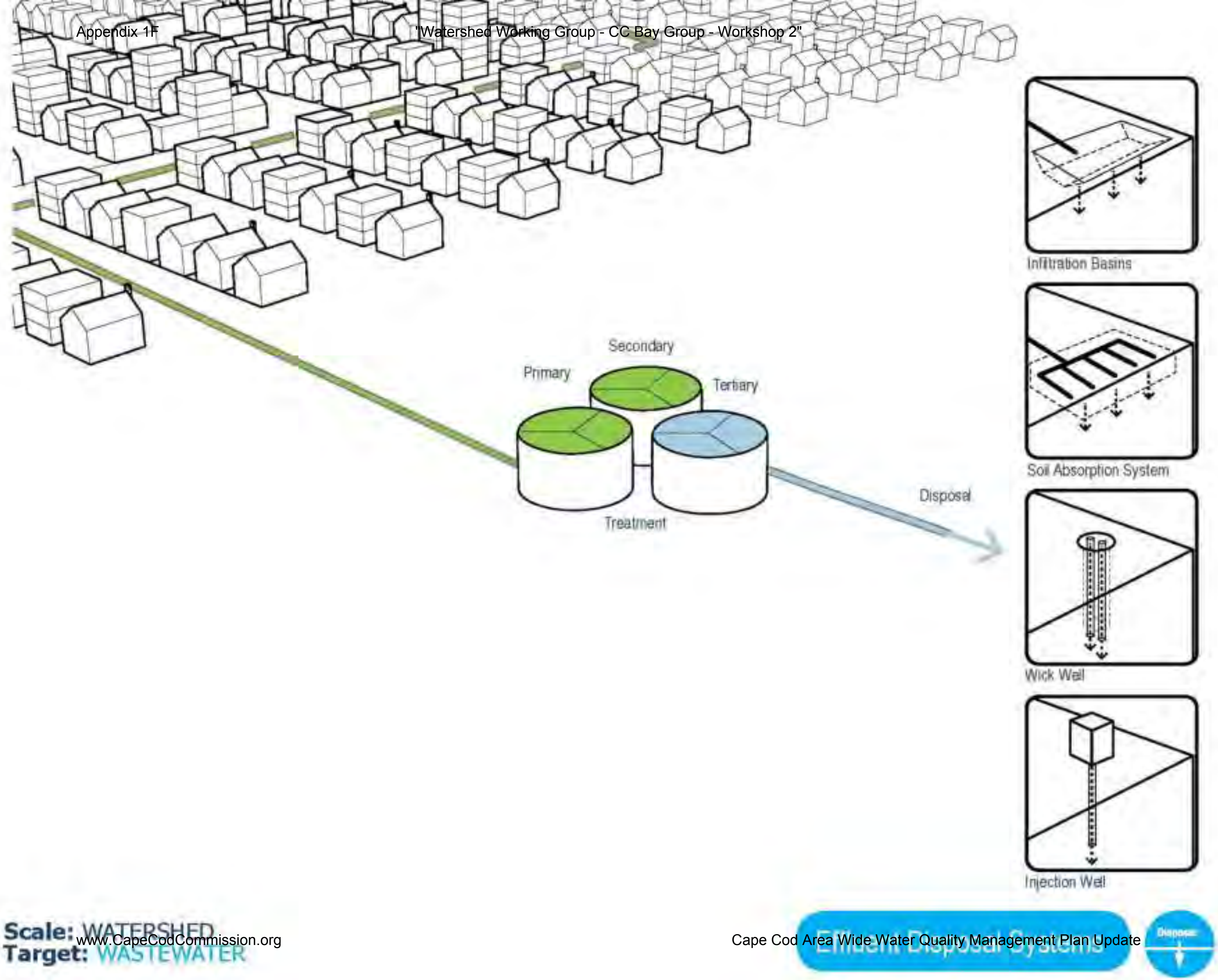
Constructed Wetlands: Surface Flow

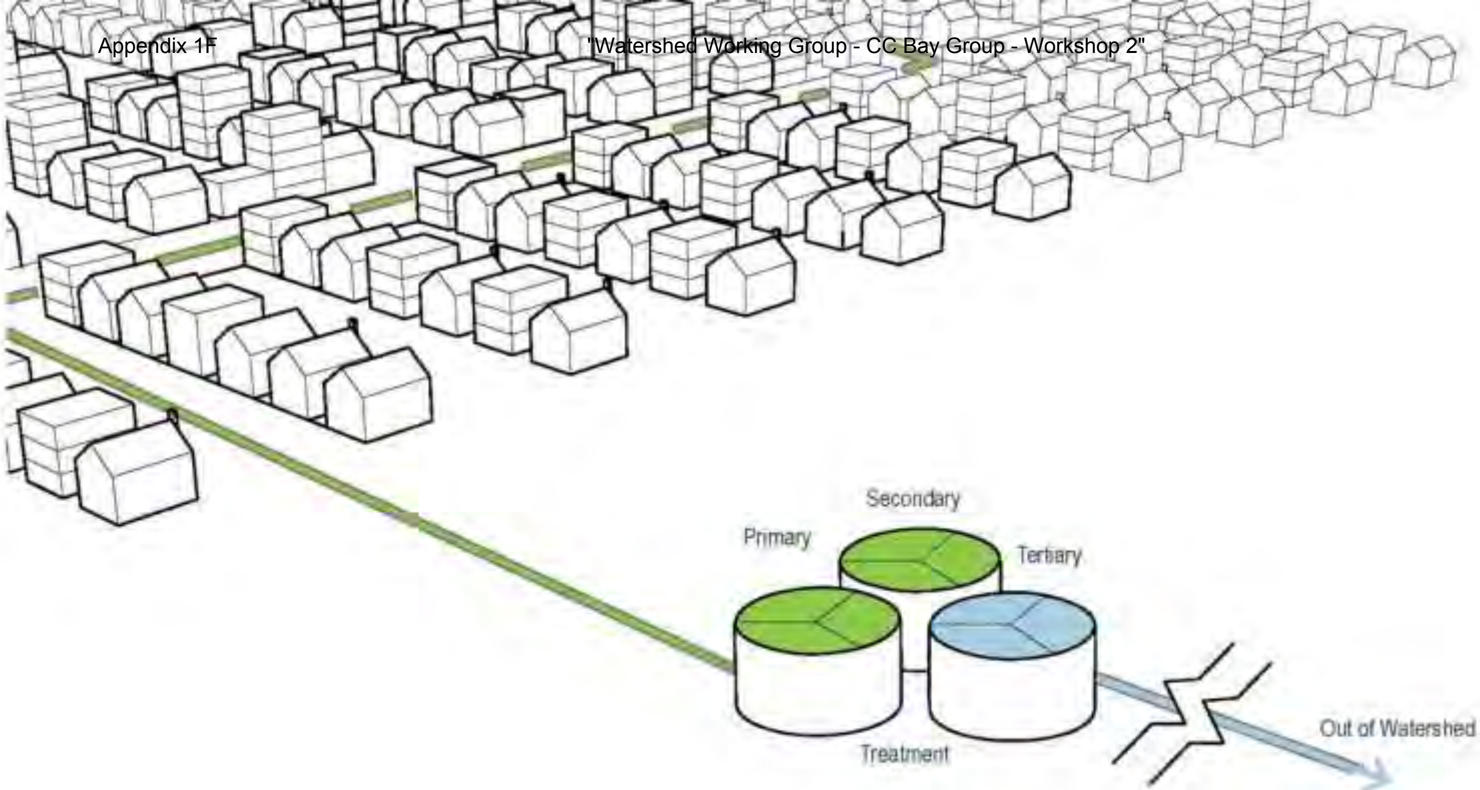

Secondary
Primary
Treatment
Subsurface Flow
Treatment Wetland
Scale: WATERSHED
Target: WASTEWATER
Constructed Wetlands
Subsurface Flow

Precedent: Koh Phi Phi Treatment Wetland, Thailand

Source: Hans Brix

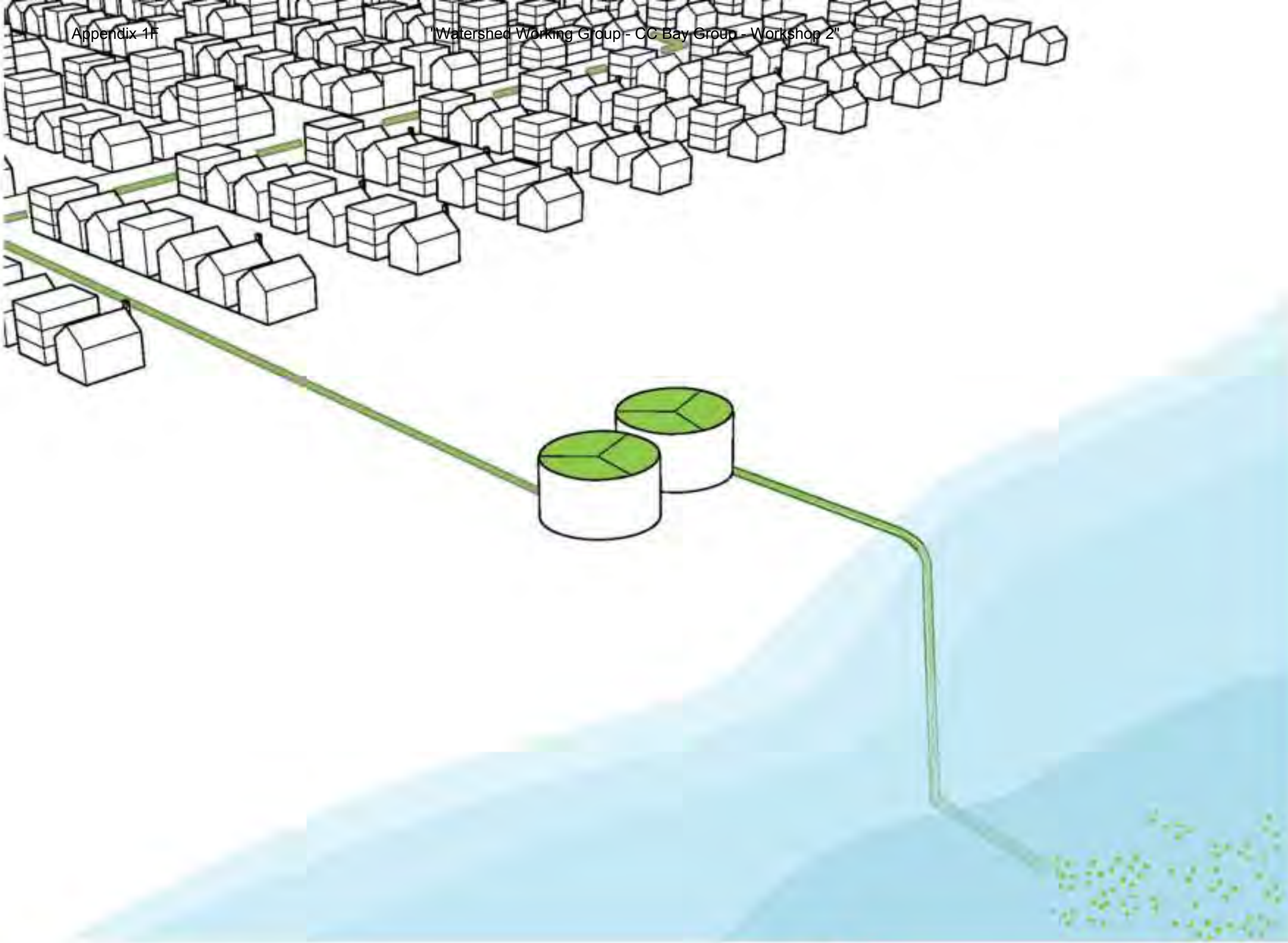
Constructed Wetlands:
Subsurface Flow


Secondary
Primary
Tertiary
Treatment
Disposal
Infiltration Basins
Soil Absorption System
Wick Well
Injection Well
Scale: WATERSHED
Target: WASTEWATER
Effluent Disposal Systems

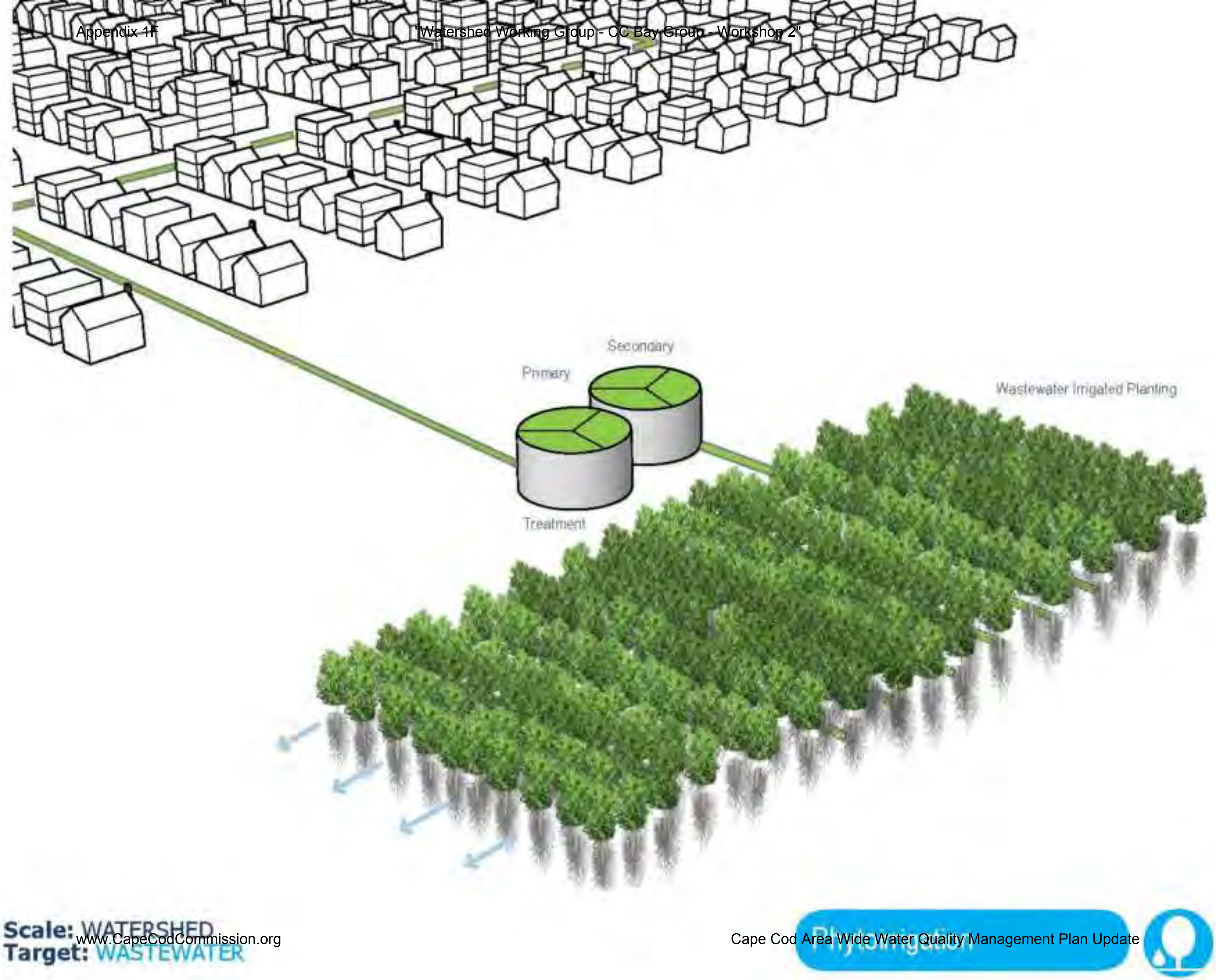


Scale: WATERSHED
Target: WASTEWATER

Effluent Disposal: Out of Watershed



Scale: WATERSHED
Target: WASTEWATER


Secondary
Primary
Treatment
Wastewater Irrigated Planting
Scale: WATERSHED
Target: WASTEWATER
Phytoirrigation

Precedent: Woodburn OR, Wastewater Treatment Facility

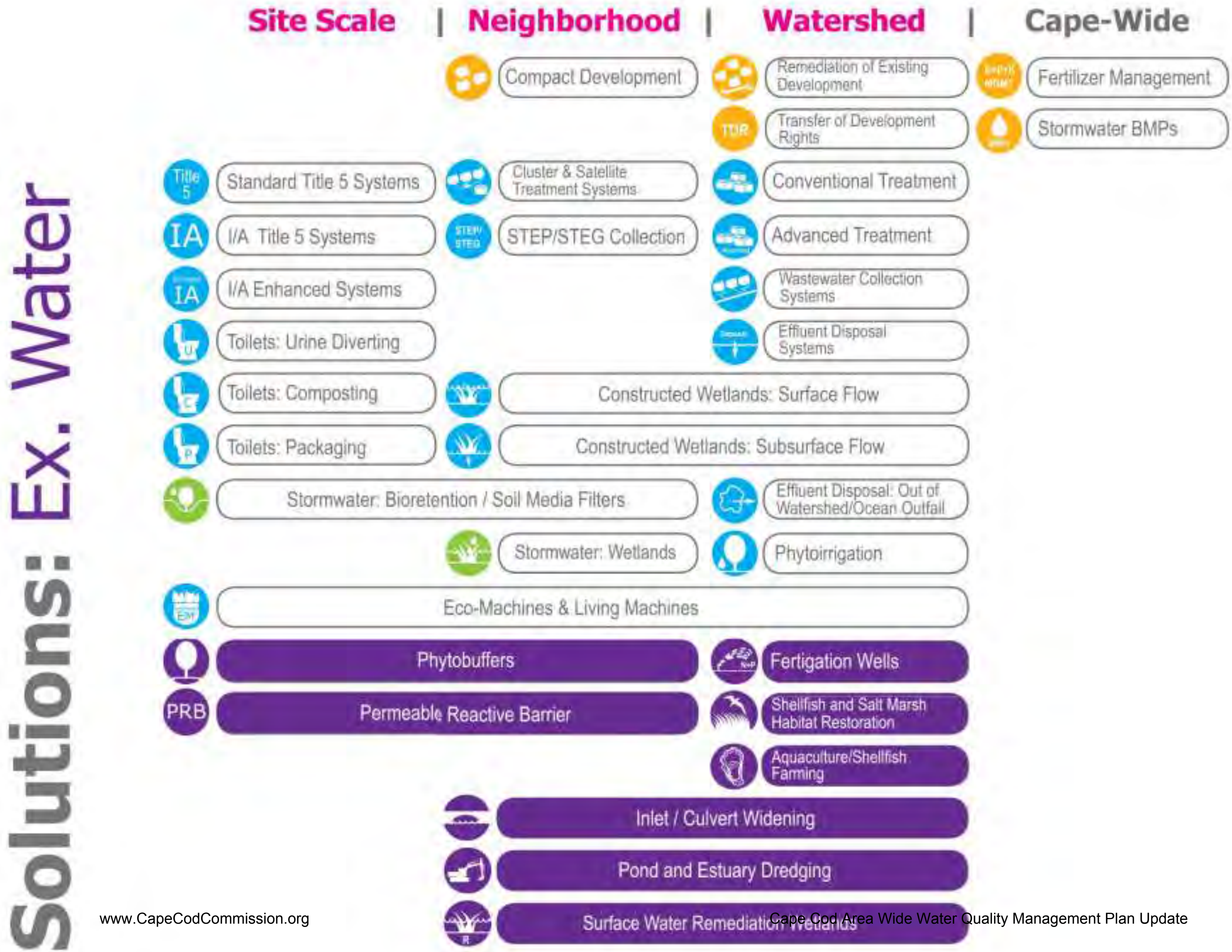
Source: CH2MHill

Phytoirrigation

Precedent: Woodburn OR, Wastewater Treatment Facility

Source: CH2MHill

Phytoirrigation


Solutions: Ex. Water
Site Scale
Neighborhood
Watershed
Cape-Wide
Compact Development
Remediation of Existing Development
Fertilizer Management
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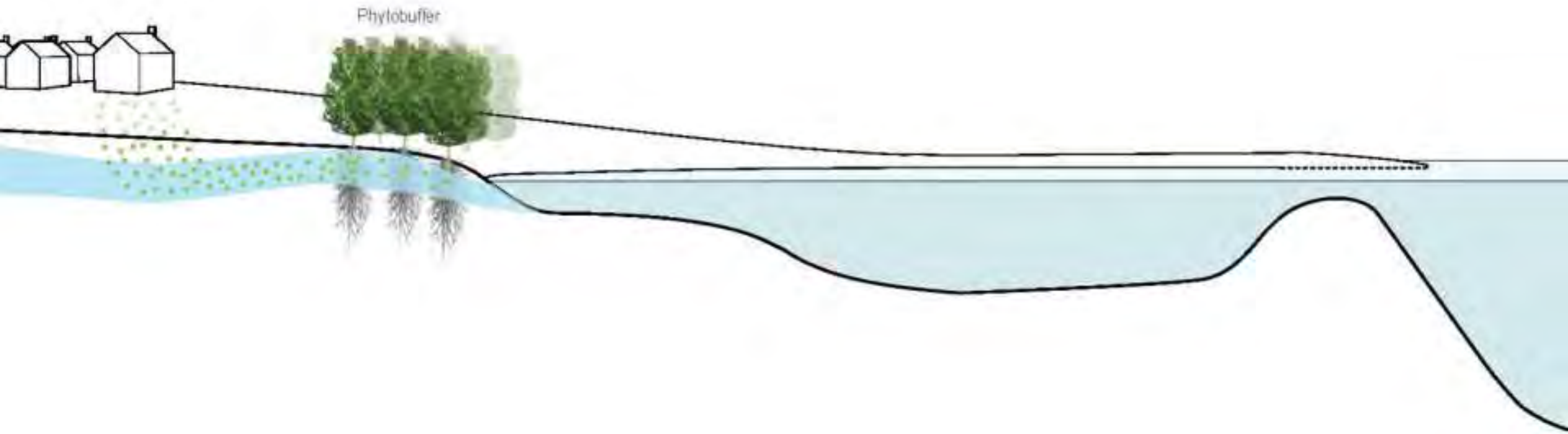
Constructed Wetlands: Subsurface Flow
Stormwater: Bioretention / Soil Media Filters
Effluent Disposal: Out of Watershed/Ocean Outfall
Stormwater: Wetlands
Phytoirrigation
EM
Eco-Machines & Living Machines
Phytobuffers
Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
R
Surface Water Remediation Wetlands



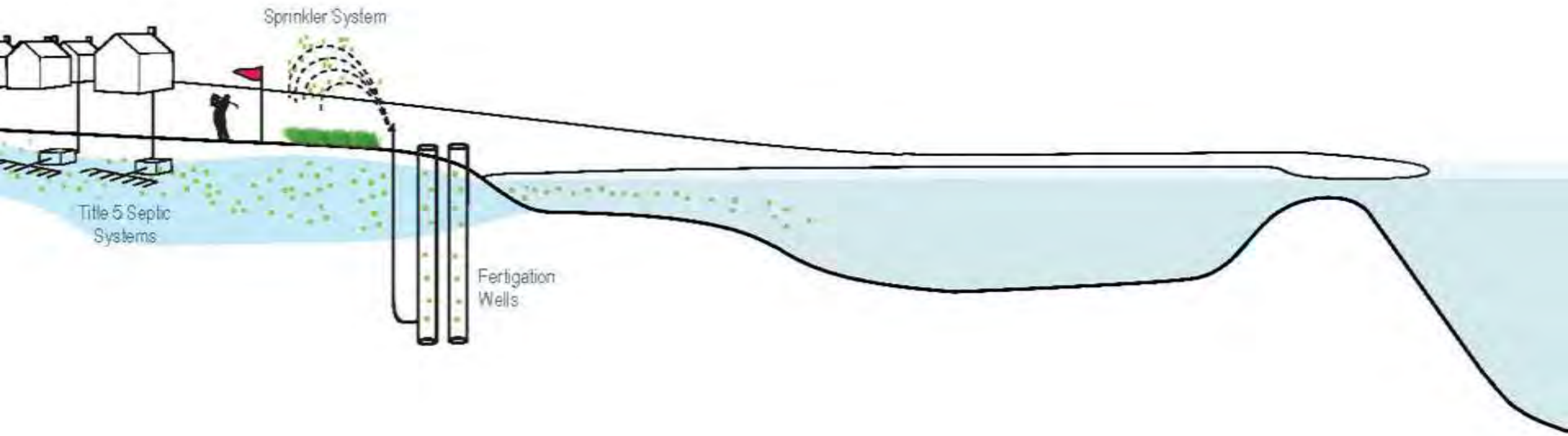
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Phytobuffers

Precedent: Phytobuffer - Kavcee, WY

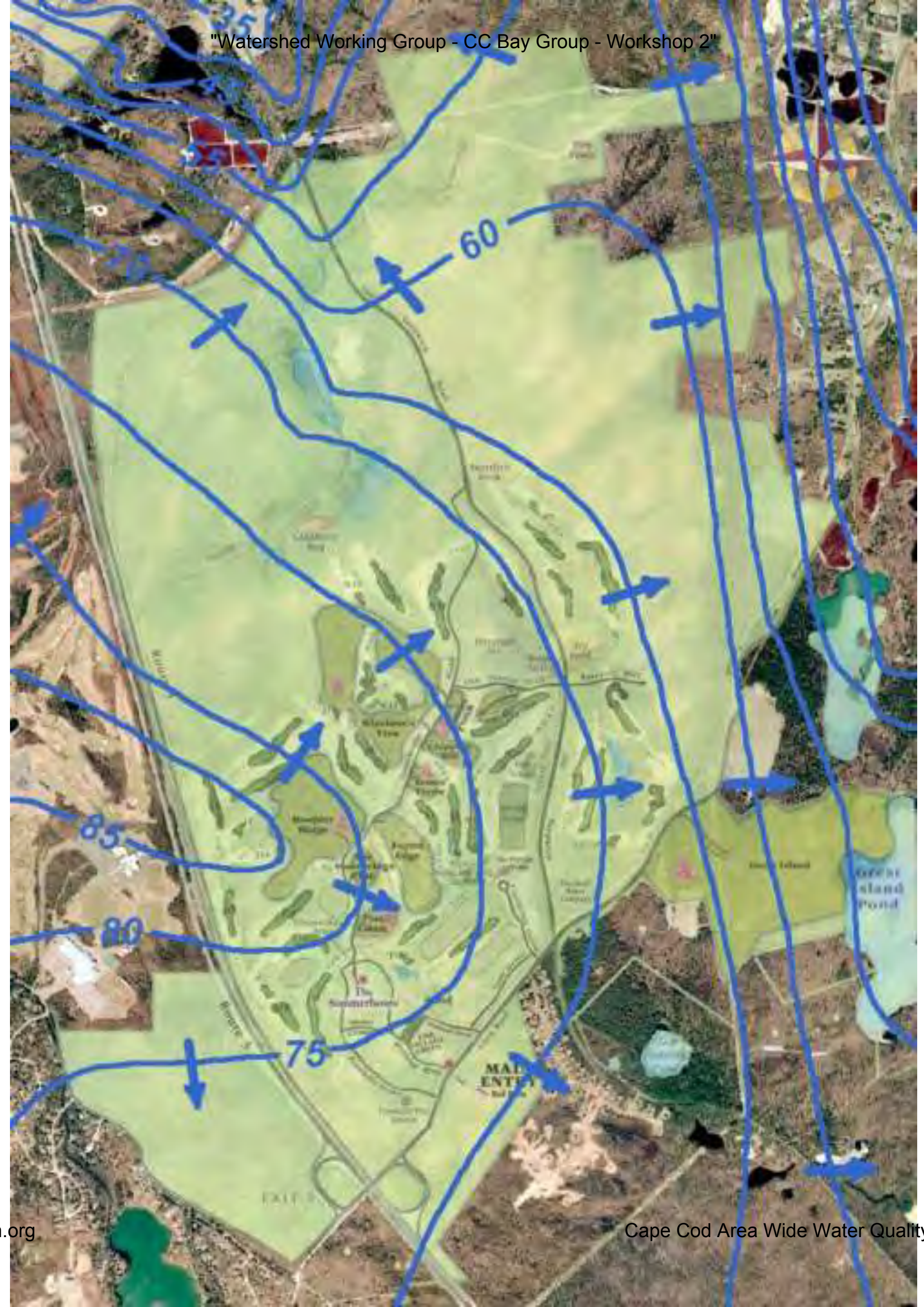
Source: Sand Creek Consultants

Phytobuffers

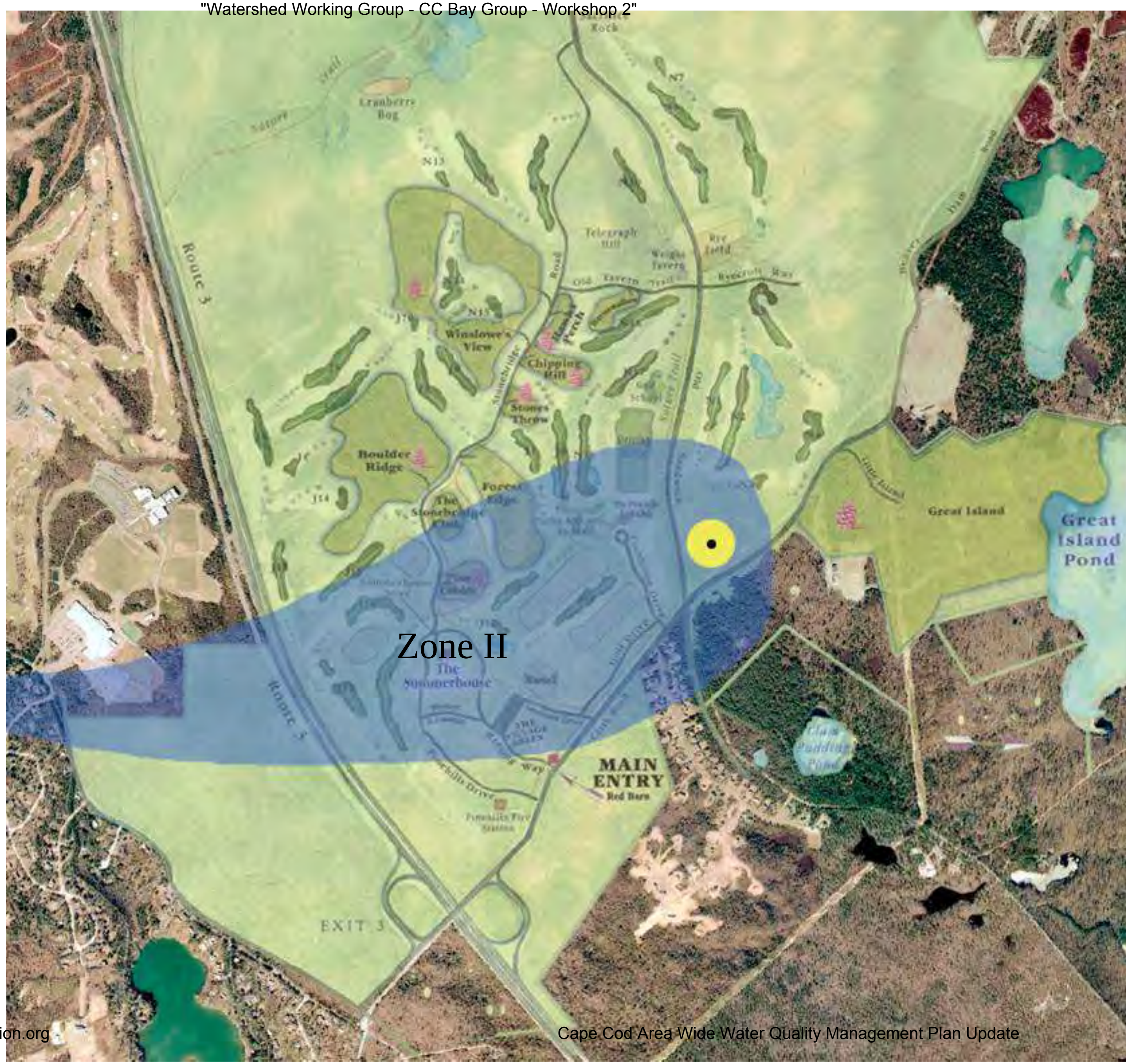


Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

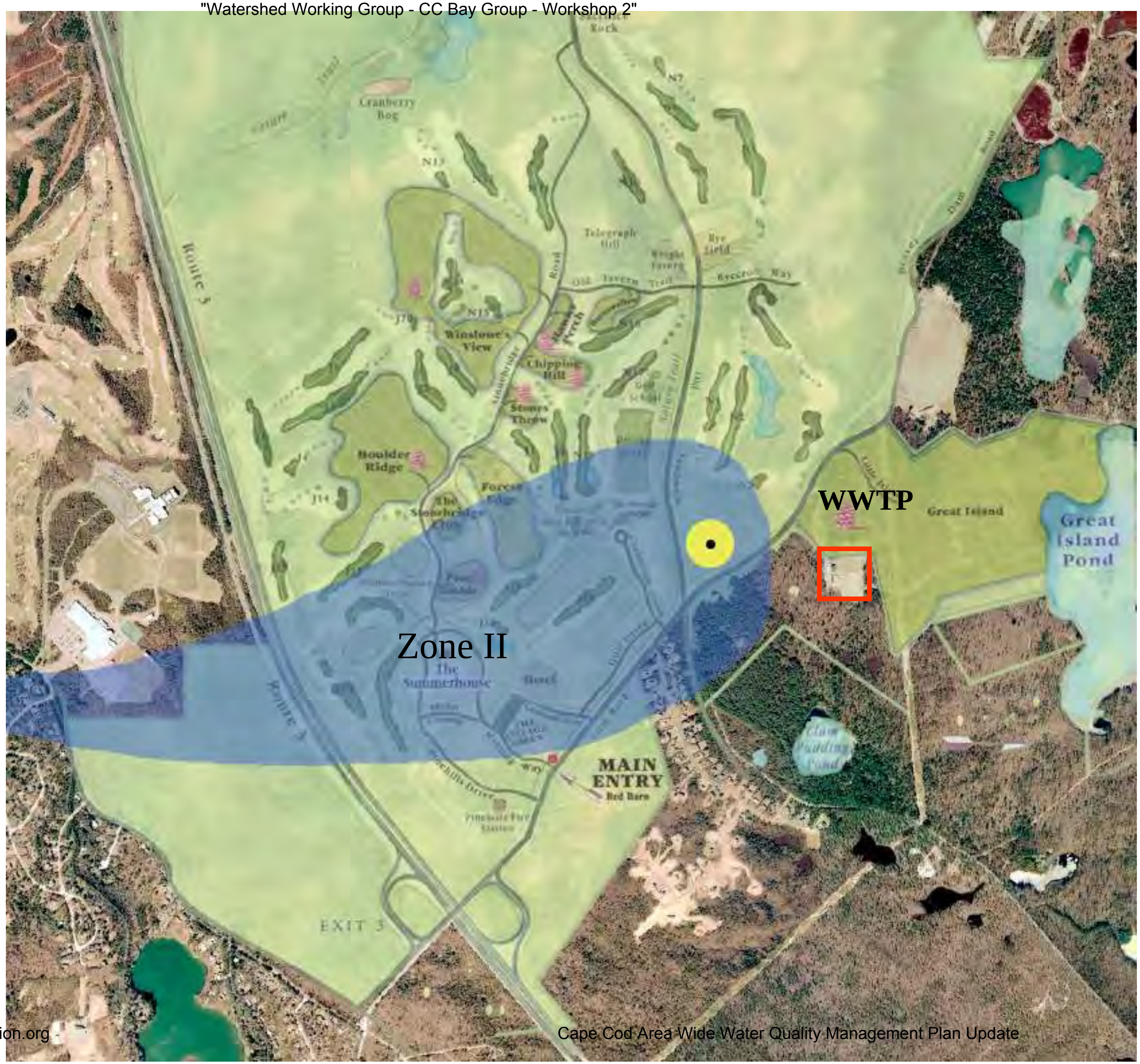
Fertigation Wells



Precedent:
Pine Hills
Plymouth, MA



Precedent:
Pine Hills
Plymouth, MA



Precedent:
Pine Hills
Plymouth, MA

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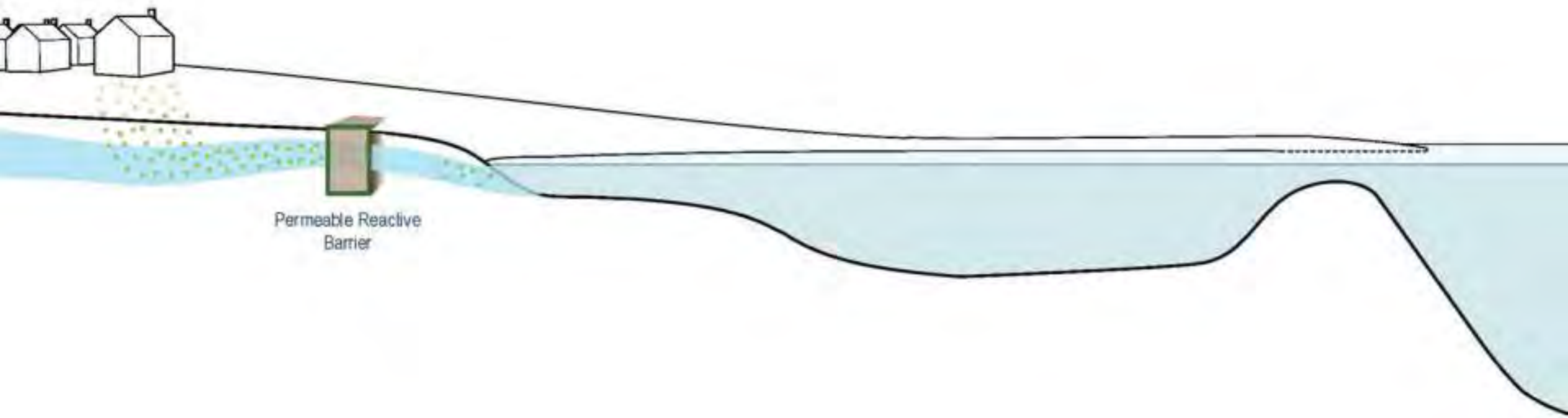
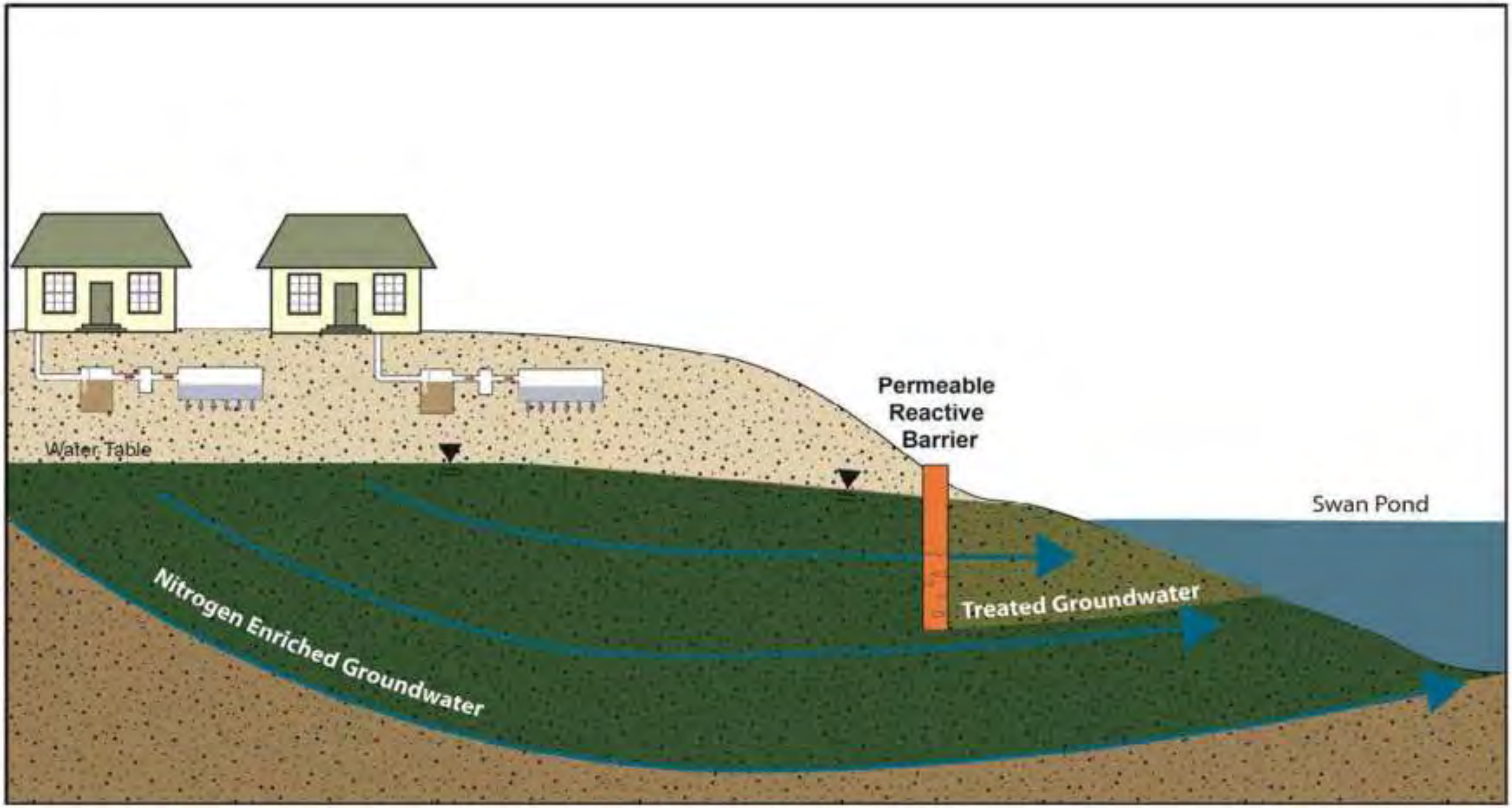
Pine Hills
Plymouth, MA



Scale: SITE / NEIGHBORHOOD / WATERSHED
Target: EXISTING WATER BODIES

Permeable Reactive Barrier PRB



Precedent: PRB

Source: Horsley Witten Group Inc.

Permeable Reactive Barrier

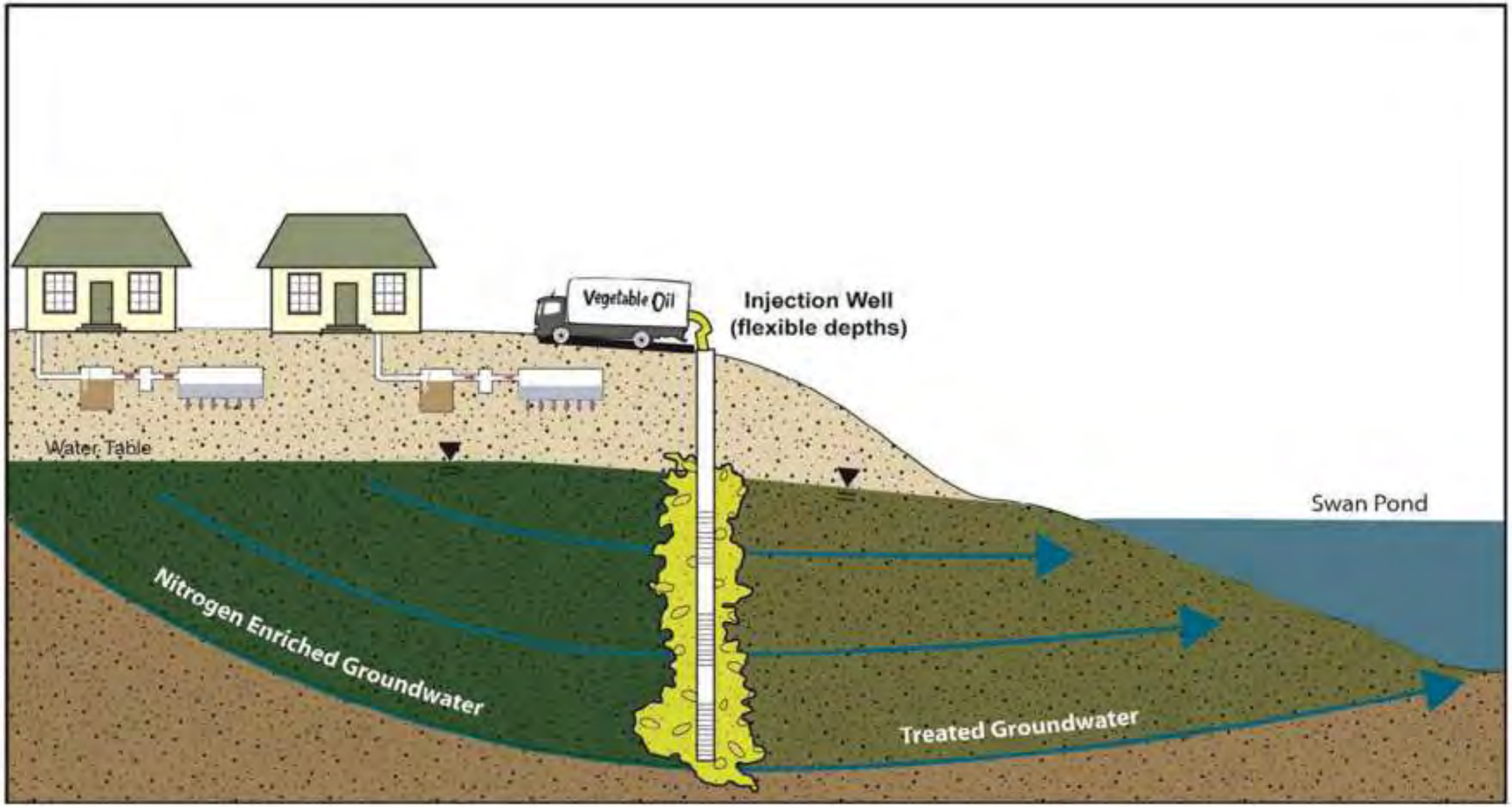
PRB

Precedent: Falmouth PRB

Source: Mike Domenica

Permeable Reactive Barrier

PRB

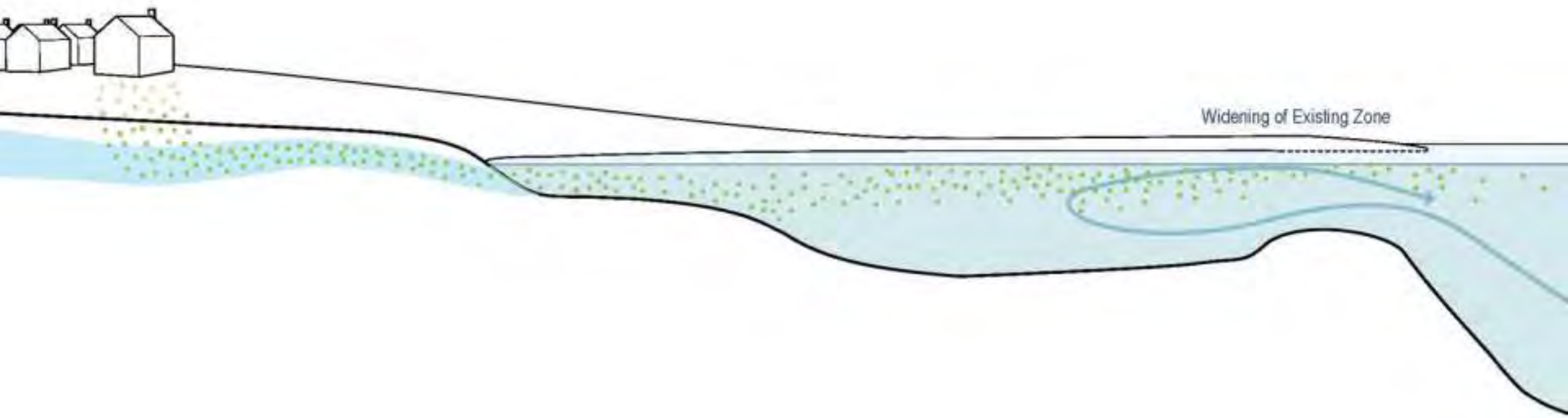


Precedent: PRB

Source: Horsley Witten Group Inc.

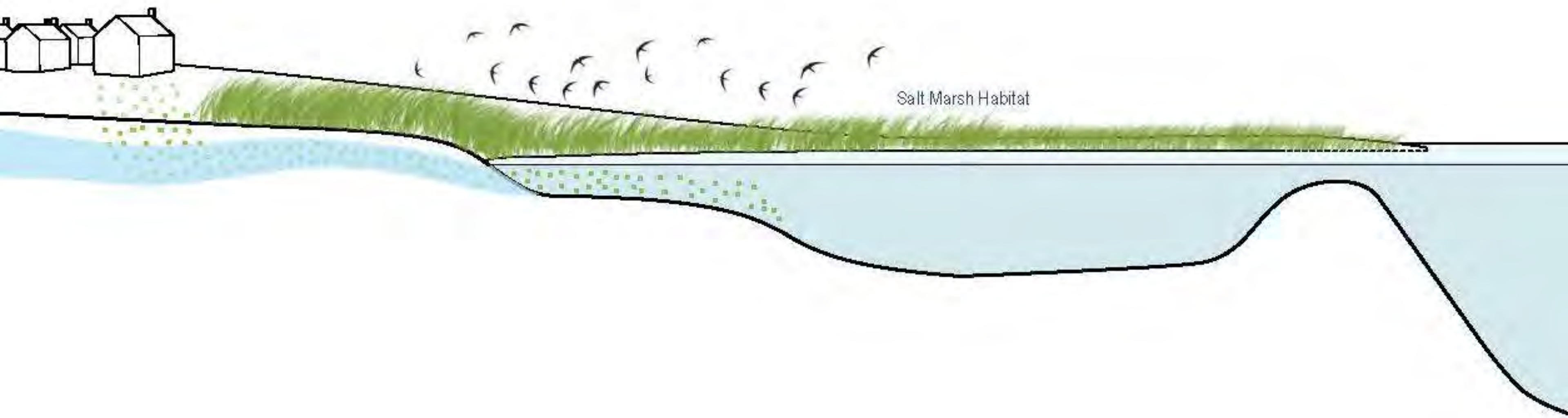
Permeable Reactive Barrier

PRB



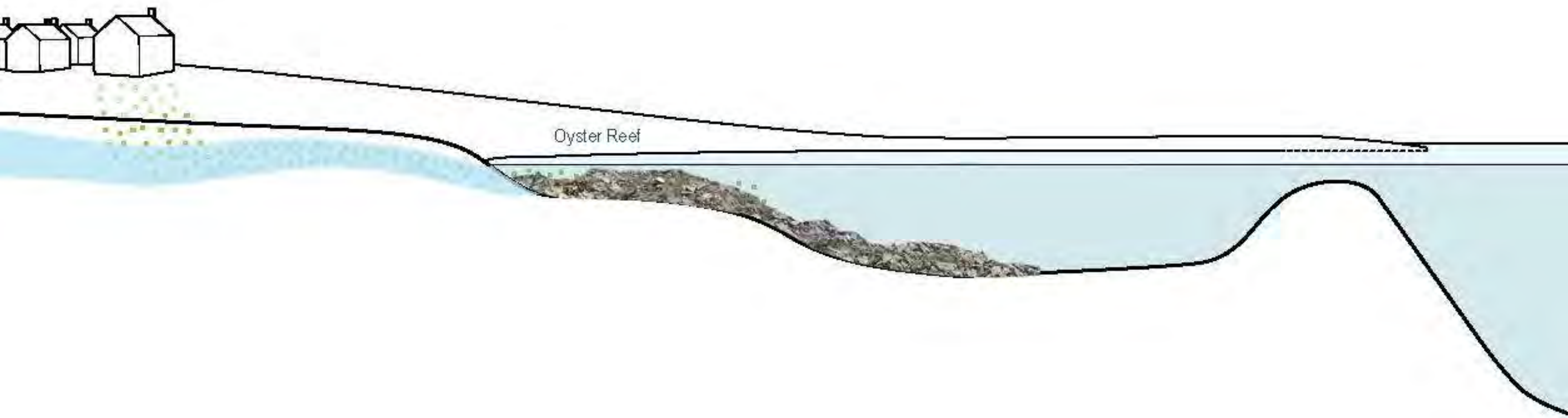
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Inlet and Culvert Widening



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Salt Marsh Habitat Restoration



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Shellfish Habitat Restoration

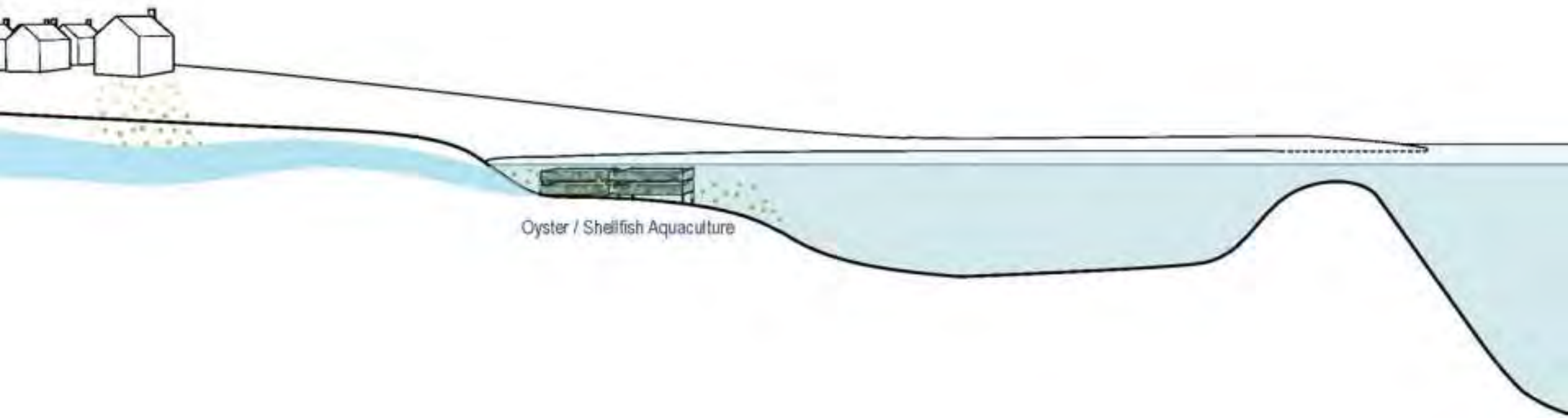
Precedent: Wellfleet Oyster Restoration Project

Shellfish Habitat Restoration

Precedent: Wellfleet Oyster Restoration Project

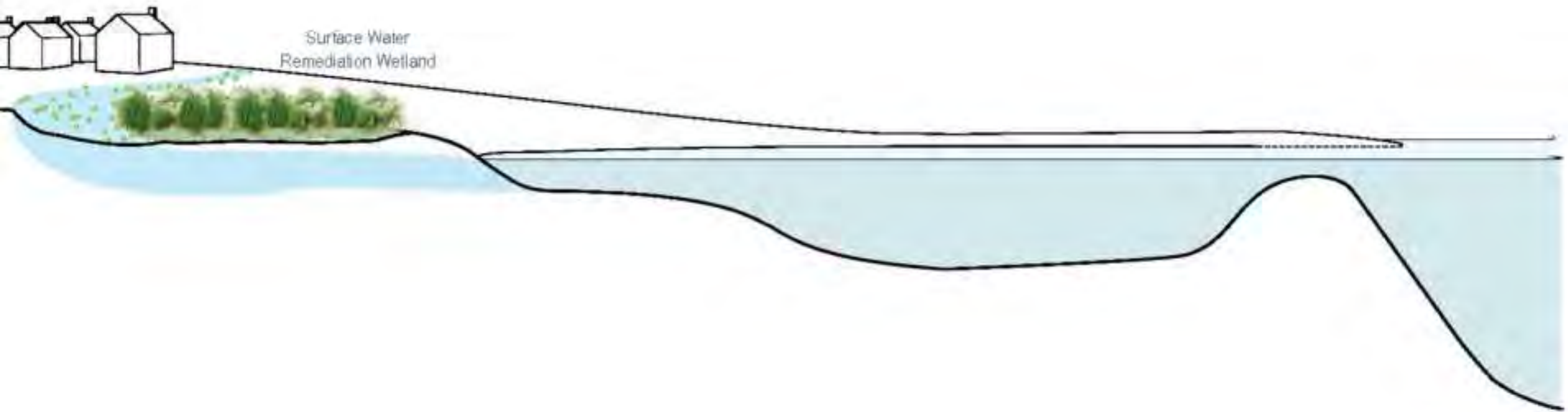
Source: Anamarija Francik

Shellfish Habitat Restoration



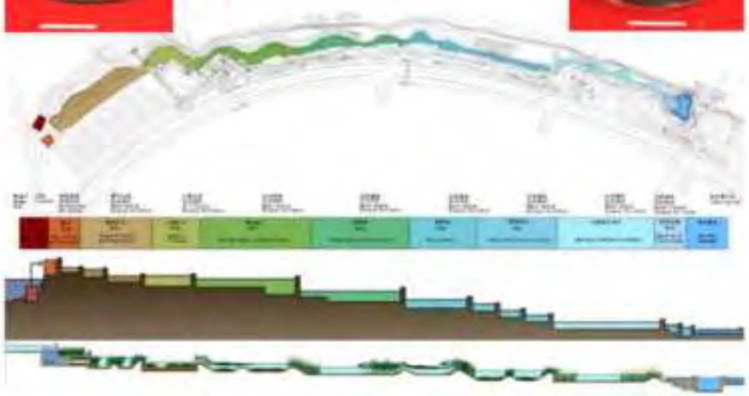
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Aquaculture / Shellfish Farming



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

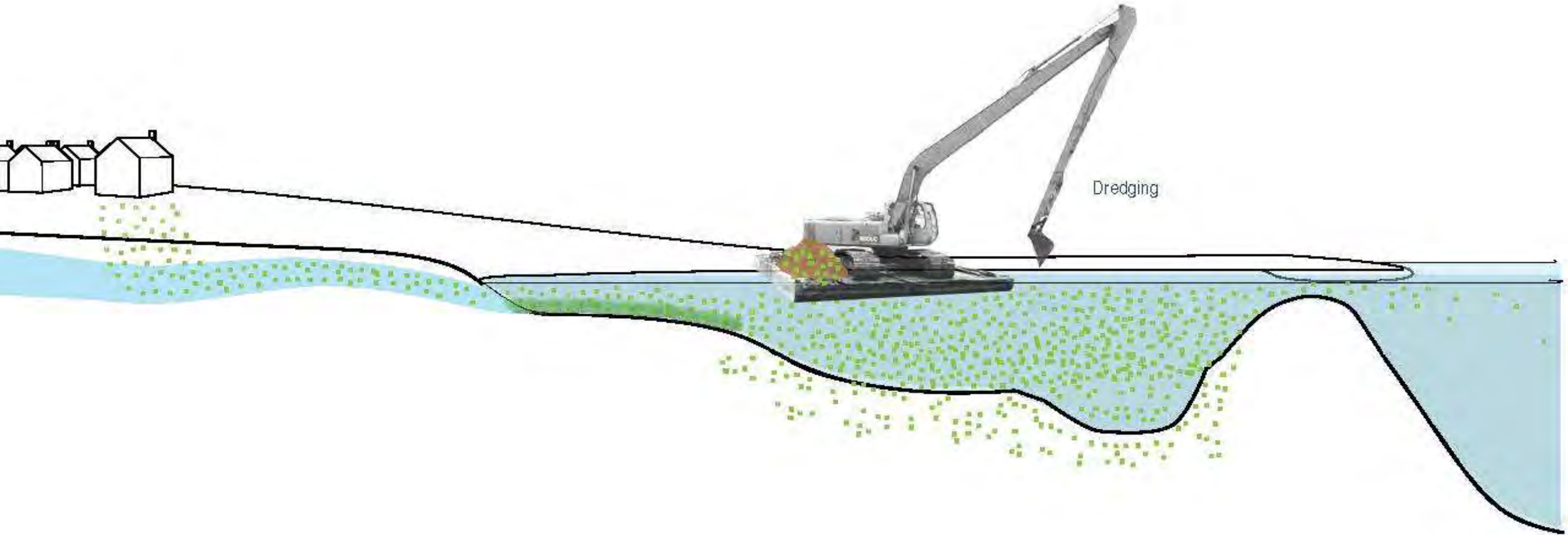
Surface Water
Remediation Wetlands



Precedent: Shanghai Houton Park

Source: Turenscape

Surface Water Remediation Wetlands

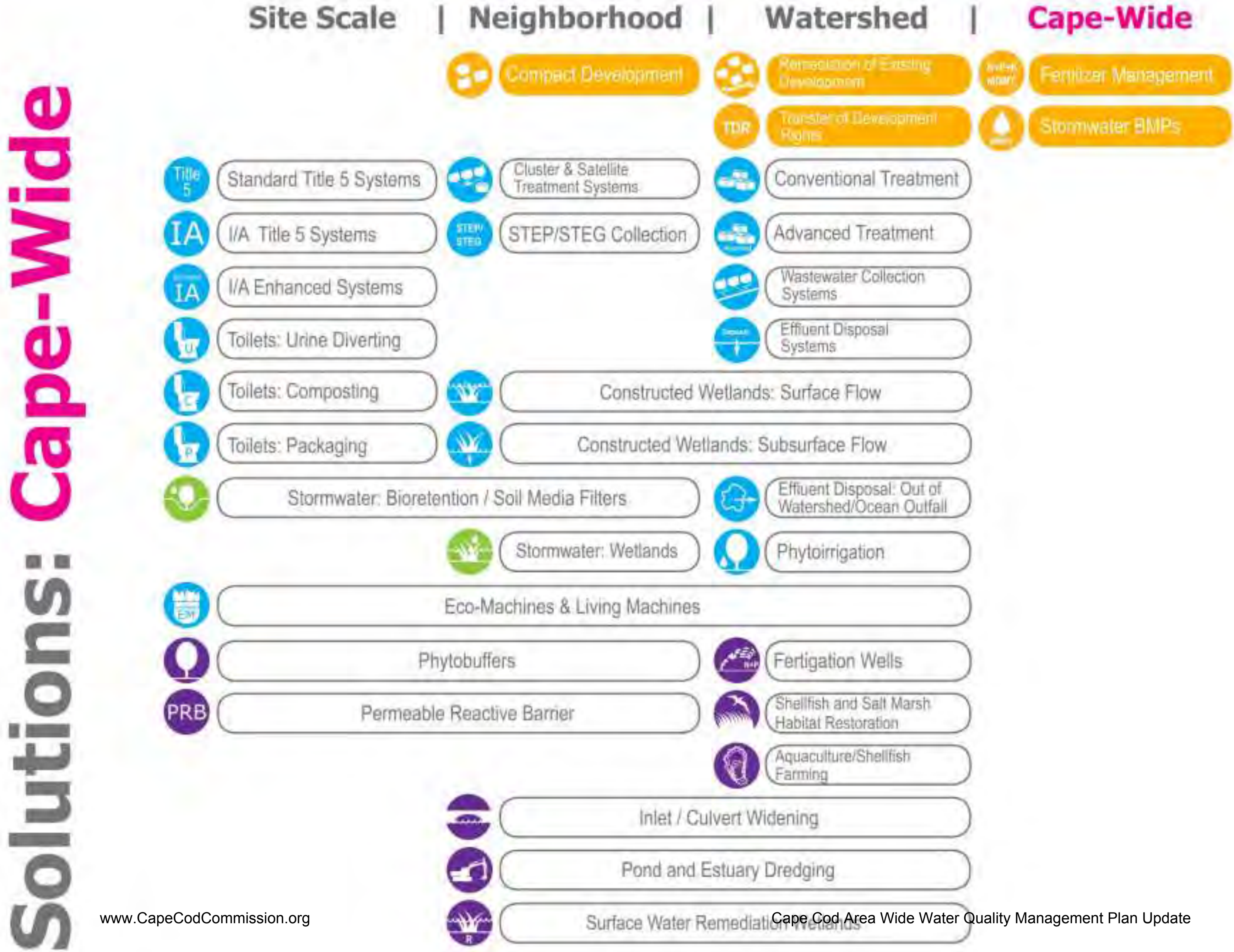


Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Pond and Estuary Dredging

Precedent: Pond and Estuary Dredging - Dennis, MA

Source: Cape Cod Times


Solutions: Cape-Wide
Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
IA
I/A Title 5 Systems
STEP/STEG
STEP/STEG Collection
Advanced Treatment
IA
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
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Phytoirrigation
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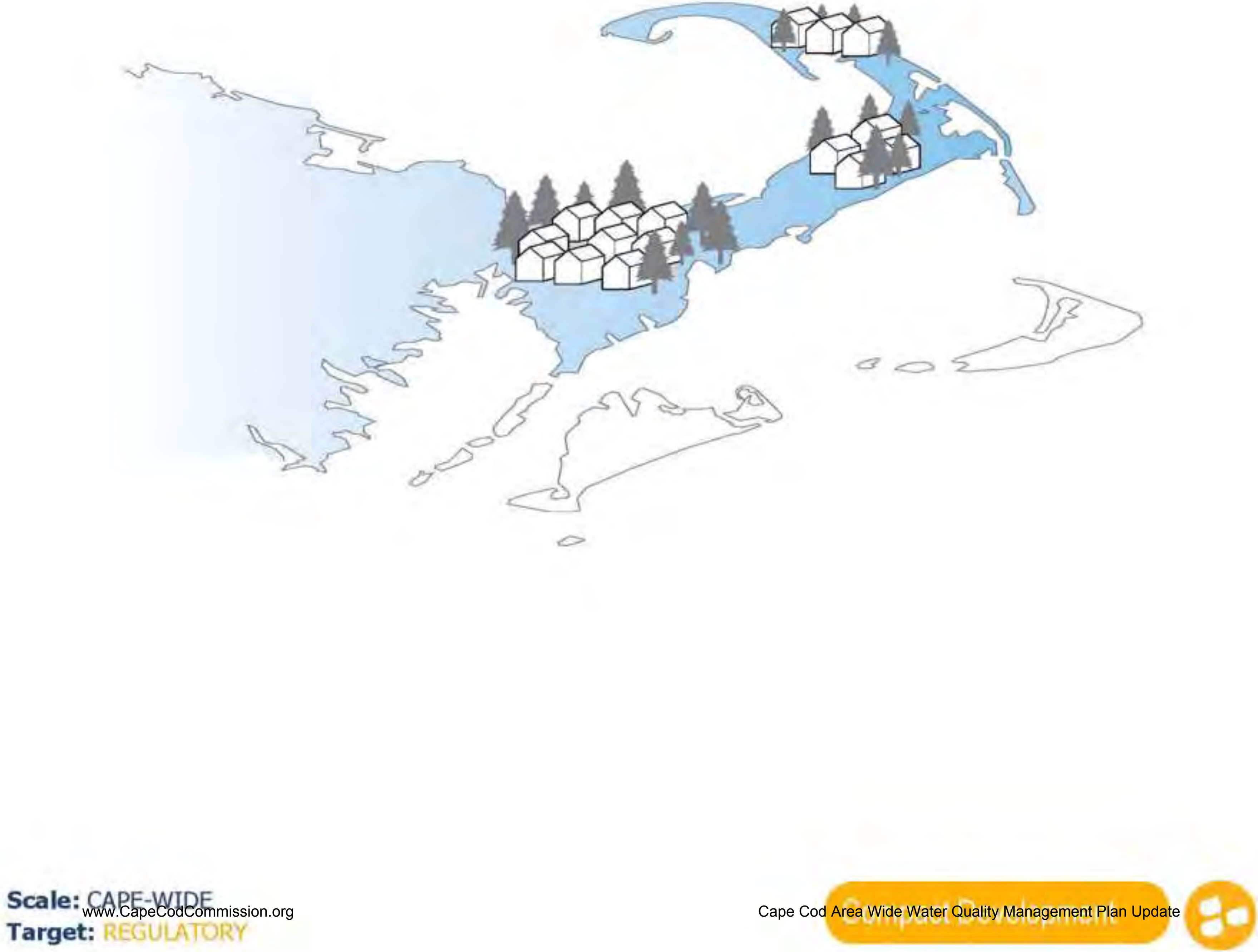
R
Surface Water Remediation Wetlands


Scale: CAPE-WIDE
Target: REGULATORY
Compact Development

Scale: CAPE-WIDE
Target: REGULATORY

Fertilizer Management

N+P+K MGMT

Scale: CAPE-WIDE
Target: REGULATORY

Remediation of Existing Development

Scale: CAPE-WIDE
Target: REGULATORY

Transfer of Development Rights

TDR

Transfer of Developments Rights
The Concept

Owner of "sending" parcel sells development rights in exchange for permanent conservation easement.

Owner of "receiving" parcel buys development rights to build at densities higher than allowed under base zoning.

Source: Massachusetts Smart Growth Toolkit

Scale: CAPE-WIDE
Target: REGULATORY

Stormwater BMPs

Town Consideration of Alternative Technologies & Approaches

Wellfleet-	*Coastal habitat restoration & aquaculture*
Mashpee-	*Aquaculture & Expanding Existing Systems*
Brewster-	*PRB & Bioswales*
Orleans-	*Fertilizer Control By-Law*
Harwich &- Chatham	*Muddy Creek & Cold Brook Natural Attenuation*
Falmouth-	*Aquaculture* *Inlet Widening* *Eco-Toilet Demonstration Project* *PRBs* *Stormwater Management (Little Pond Watershed)* *Fertilizer Control By-Law* *Subsurface Nitrogen Removal Septic Systems*


Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
IA
I/A Title 5 Systems
STEP/STEG
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Phytobuffers
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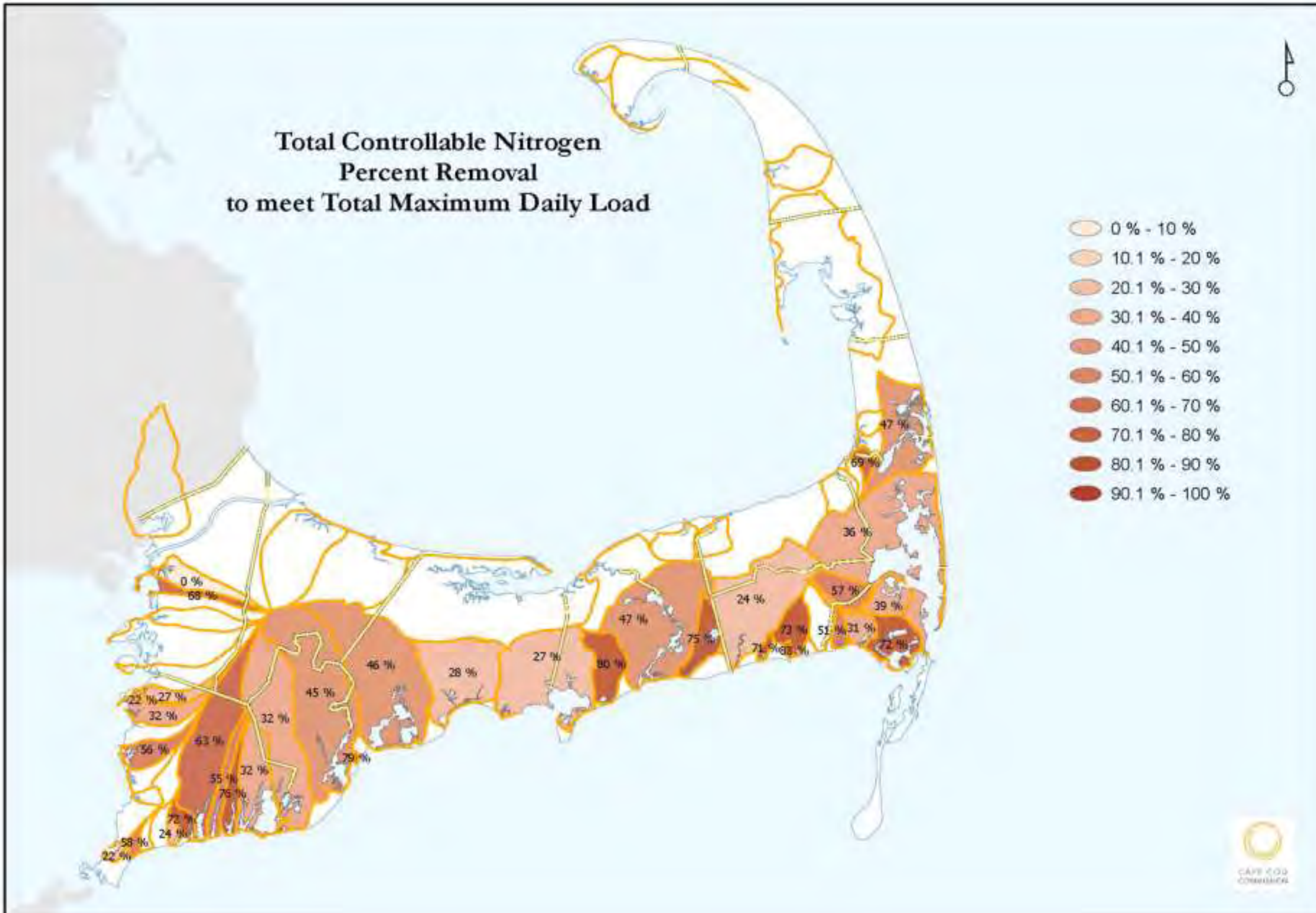
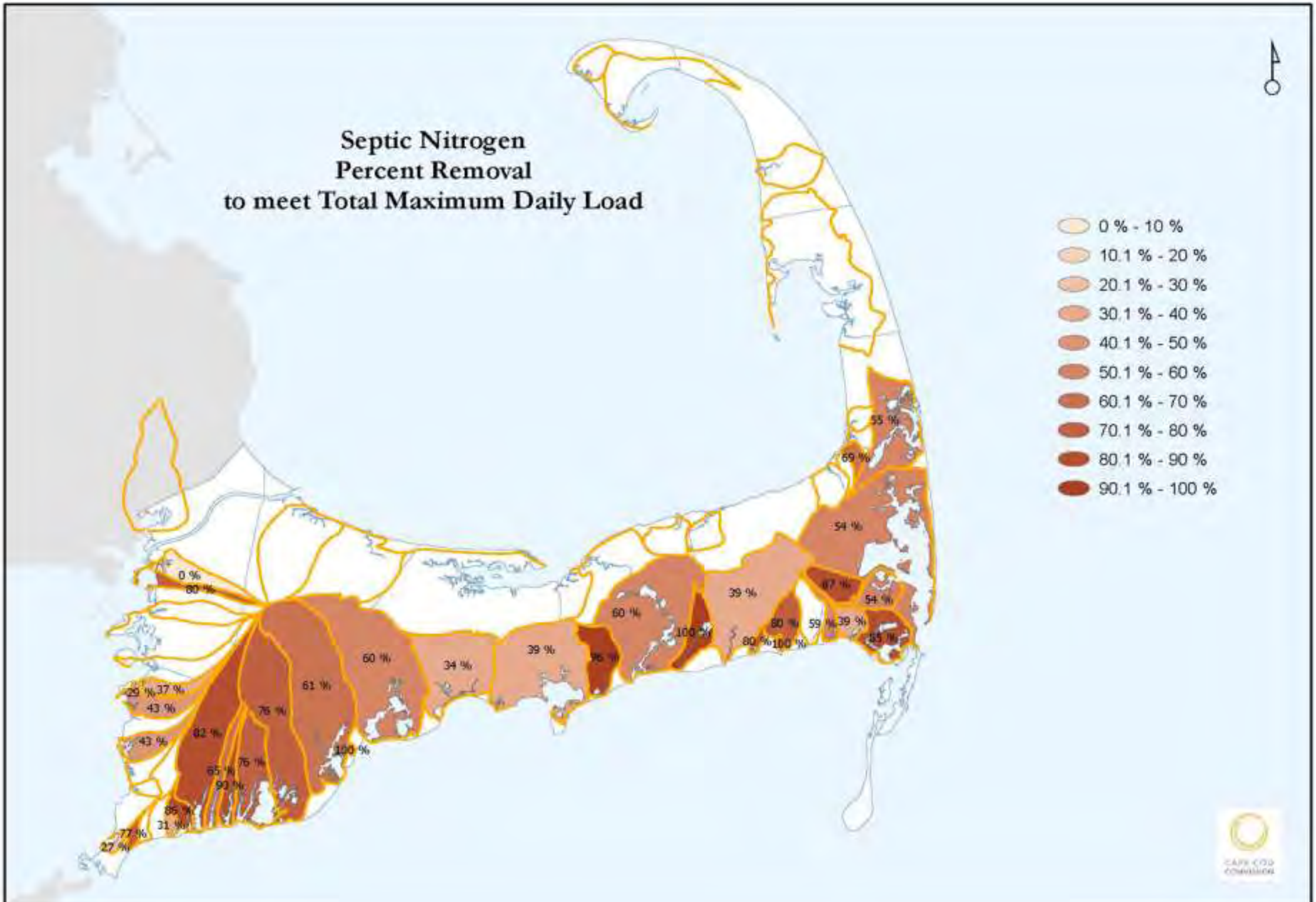
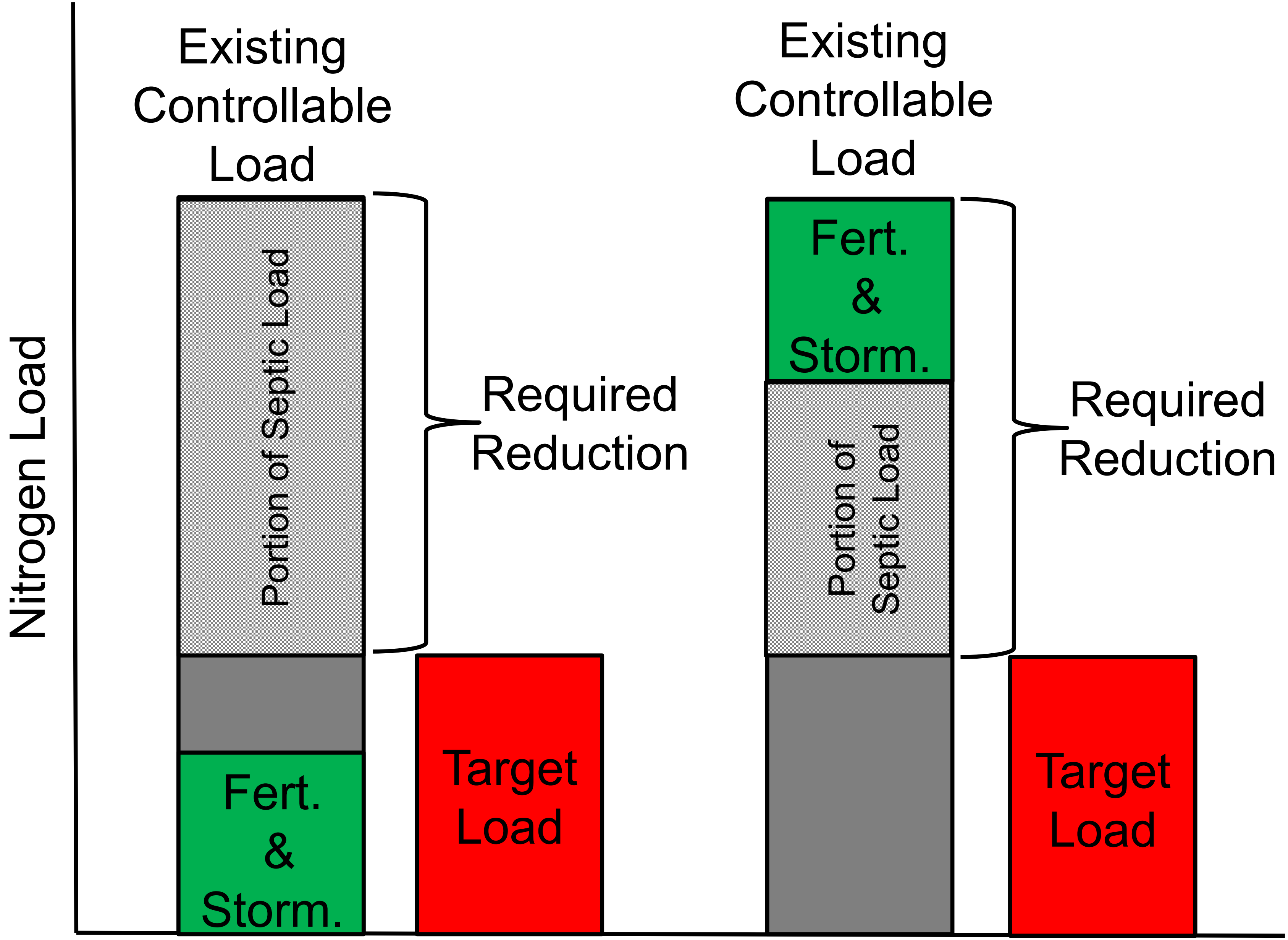
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands
Solutions


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


Total Controllable Nitrogen
Percent Removal
to meet Total Maximum Daily Load
0 % - 10 %
10.1 % - 20 %
20.1 % - 30 %
30.1 % - 40 %
40.1 % - 50 %
50.1 % - 60 %
60.1 % - 70 %
70.1 % - 80 %
80.1 % - 90 %
90.1 % - 100 %


Septic Nitrogen
Percent Removal
to meet Total Maximum Daily Load
0 % - 10 %
10.1 % - 20 %
20.1 % - 30 %
30.1 % - 40 %
40.1 % - 50 %
50.1 % - 60 %
60.1 % - 70 %
70.1 % - 80 %
80.1 % - 90 %
90.1 % - 100 %
55 %
69 %
54 %
87 %
54 %
39 %
60 %
100 %
80 %
59 %
39 %
85 %
80 %
100 %
96 %
39 %
34 %
60 %
61 %
76 %
82 %
100 %
0 %
80 %
29 %
37 %
43 %
43 %
65 %
76 %
90 %
85 %
31 %
77 %
27 %


Nitrogen Load
Existing Controllable Load
Portion of Septic Load
Fert. & Storm.
Required Reduction
Target Load
Existing Controllable Load
Fert. & Storm.
Portion of Septic Load
Required Reduction
Target Load


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

Triple Bottom Line

Impacts of Technologies and Approaches

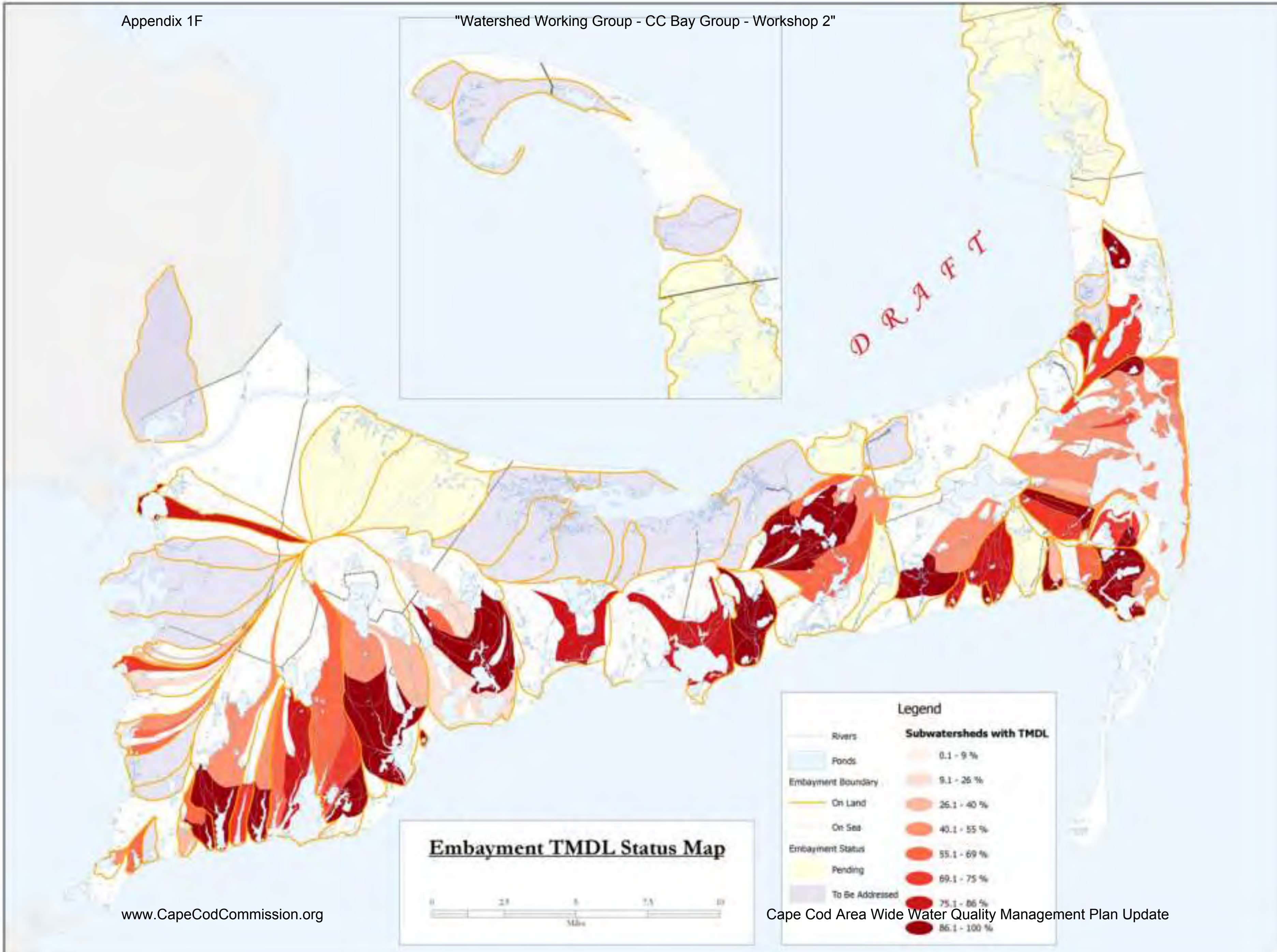
Environmental

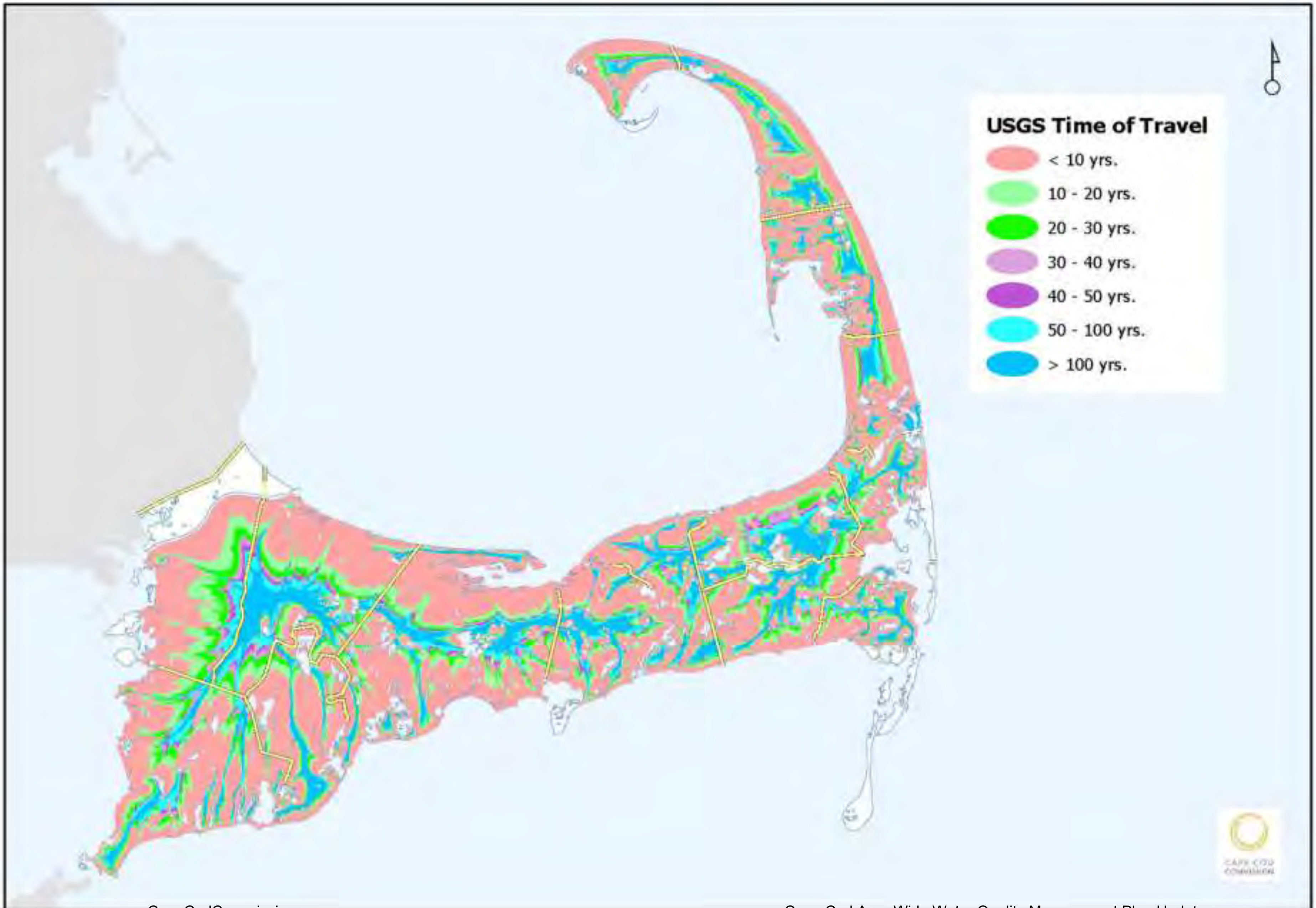
Economic

Social

Technology Selection: Process and Principles

- 100% septic removal subwatershed
- Scale: On-Site vs. Collection System vs. Natural System
- Nutrient intervention and time of travel
- Permitting Status
- Land use and Impacts of Growth


DRAFT
Embayment TMDL Status Map
0
2.5
5
7.5
10
Miles
Legend
Rivers
Ponds
Embayment Boundary
On Land
On Sea
Embayment Status
Pending
To Be Addressed
Subwatersheds with TMDL
0.1 - 9 %
9.1 - 26 %
26.1 - 40 %
40.1 - 55 %
55.1 - 69 %
69.1 - 75 %
75.1 - 86 %
86.1 - 100 %


USGS Time of Travel
< 10 yrs.
10 - 20 yrs.
20 - 30 yrs.
30 - 40 yrs.
40 - 50 yrs.
50 - 100 yrs.
> 100 yrs.

Preparing for Meeting 3 and Beyond

- ❑ Review tools and alternatives analysis approach
- ❑ Evaluating scenarios for meeting water quality goals
- ❑ Attend the November 13th meeting:

6:00
Cape Cod Museum of Art
Dennis, MA

Cape Cod 208 Area Water Quality Planning
Lewis Bay to Bass River Watershed Working Group

Meeting Two
Monday, November 4, 2013
8:30 am- 12:30 pm
Dennis Town Office

Draft Meeting Summary Prepared by the Consensus Building Institute

I. ACTION ITEMS

Next meeting:
Thursday, December 5th, 2013
8:30am - 12:30pm
485 Main Street; Dennis Town Hall; South Dennis

Working Group
- Send Carri Hulet any comments on the Meeting One summary

Consensus Building Institute
- Finalize Meeting 1 Summary
- Send Meeting 2 draft summary

Cape Cod Commission
- When preparing scenarios, take into account:
    - Helpful to know how many cluster and satellite systems there are currently operating in Cape Cod.
    - Consistency on solids management
    - Consistency on operation and maintenance (long term)
    - Issues of seasonality
    - Public education
    - Costs per site where feasible
    - In these watersheds, there is a higher median age and fixed incomes so approaches with pay-out in the long term are less attractive.

II. WELCOME, REVIEW 208 GOALS AND PROCESS AND THE GOALS OF MEETING

Carri Hulet, the facilitator from the Consensus Building Institute, welcomed participants and reviewed the agenda. Erin Perry, Special Projects Coordinator, Cape Cod Commission, offered an overview of the 208 Update stakeholder process.[1] In July, public meetings were held across the

[1] The PowerPoint Presentation made at this meeting is available at: http://watersheds.capecodcommission.org/index.php/watersheds/mid-cape/lewis-bay-to-bass-river

Cape to present the 208 Plan Update goals, work plan, and participant roles. Public meetings were also held in August to present information on the affordability and financing of the updated comprehensive 208 Plan. The first meetings of the eleven Watershed Working Groups were held in September and focused on baseline conditions in each of the watersheds. The second meetings of the Watershed Working Groups are now being held in October and early November and are focused on exploring technology options and approaches. The third meetings of the Watershed Working Groups will be held in December and focus on evaluating watershed scenarios which will be informed by Working Groups' discussions about baseline conditions, priority areas, and technology options/approaches. This conversation will also be informed by information shared in the Technology Matrix, which was developed by the Cape Cod Commission with technical input from the Technology Panel. The Technology Matrix builds on the information presented in the Technology Fact Sheets, which Working Group members reviewed in advance of the meeting[2]. Once it is finalized by the Cape Cod Commission, the Technology Matrix will be shared with Working Group Members.

Ms. Perry shared the 208 Plan team's progress since Meeting One which includes:

- Meeting materials distributed to stakeholders and available at http://watersheds.capecodcommission.org
- GIS data layers accessible at: http://watersheds.capecodcommission.org
- Chronologies are being updated and will be made available soon

Ms. Perry also shared that the second round of Cape2O game is launching on October 22. She noted that over 400 people registered for the first round of the Cape2O game and encouraged Working Group members to participate in the interactive, online game which provides valuable education and input to the Cape Cod Commission.

Ms. Perry announced that there will also be a Cape Cod wide event on November 13 at the Cape Cod Center for the Arts in Dennis. Participants from across the eleven Watershed Working Groups and the public are invited to attend the event which will include: Wrap up of Cape2O: ur in charge!; a summary of planning process to date; discussion of the stakeholder role in the second 6 months of the 208 planning process

Ms. Perry reviewed the goal of the meeting:

- To develop a shared understanding of the potential technologies and approaches identified to date, and the benefits and limitations of each; to explore the environmental, economic, and community impacts of a range of categories of solutions; and to identify priorities and considerations for applying technologies and approaches to remediate water quality impairments in your watershed.

Ms. Hulet led introductions. A participant list is found in Appendix A.

III. RANGE OF POSSIBLE SOLUTIONS

[2] Technology Fact Sheets are available at: http://watersheds.capecodcommission.org/index.php/watersheds/mid-cape/lewis-bay-to-bass-river

Scott Horsley, Area Manager and Consultant to the Cape Cod Commission, led the discussion of the range of possible solutions. As Working Groups learn more and consider the pros and cons of the technologies and approaches, he encouraged participants keep in mind that:

- The Cape Cod Commission has engaged in a comprehensive analysis of nutrient control technologies and approaches. This analysis is distilled into: the Technology Fact Sheets, which present various information on the technologies being considered; the Technology Matrix, which includes additional information on site requirements, construction, project and operation and maintenance costs, reference information, and regulatory comments; and ongoing input from stakeholders on the public acceptance of technology options and approaches.
- Not all of the technologies and approaches will be applicable to Cape Cod.
- Some technologies are so promising that we should identify them for demonstration and pilot projects.
- Meeting Three will focus on hands-on problem solving in each watershed to meet target load reductions.
- Certain technologies or approaches will be effective at preventing nutrients from entering the water body. Others will be effective at reducing or remediating nutrients that are already in the groundwater or water body.
- Regulatory programs can address nutrient controls for both existing development and future development.

Mr. Horsley offered a brief overview of the technologies and approaches. The following section briefly describes each technology. Participants' questions and comments about the technologies are also discussed below (in *italics)*:

Site level technologies/approaches

Standard Title V System*:* This is a standard septic system that consists of a septic tank and soil adsorption system (leaching field). The system was primarily designed to address public health concerns related to waste in drinking water (e.g. coliform bacteria); they were not designed to remove nutrients (e.g. nitrogen).

I/A title V System: Innovative/Alternative (I/A) on-site nutrient reducing systems typically consist of standard septic system components augmented to remove more nutrients than a standard Title 5. I/A systems refer to a class of systems intended to be designed as recirculating sand filter (RSF) equivalents by meeting the same treatment limits in a smaller footprint.

Urine Diverting Toilets: Urine diversion systems send urine into a holding tank where the urine is stored and periodically collected by a servicing company. The servicing company empties the tank for disposal or recycling such as conversion to a fertilizer. Through these means, the nitrogen may be removed from the watershed. With urine diverting toilets, the remainder of the human waste and all other water uses (sink and shower) continue to go to the septic system. (Case example, Falmouth, MA).

- *What is done with the urine?* Mr. Horsley responded that it is pumped, much like septic tanks, and then delivered to a centralized processing facility. There might be the possibility of processing it into fertilizer for golf courses and other turf areas. This has been done in Europe and Australia.
- *The slides and presentation do not clearly acknowledge the infrastructure necessary for dealing with solids and other waste.*
- *What about treating the urine for drinking water?* This is technologically possible, but there are easier solutions for managing the urine waste.

<u>Composting toilets</u>: A toilet system which separates human waste from shower, sink and other household water uses. The composting toilets use no or minimal water. The human waste captured by the composting toilets is decomposed and turned into compost. The compost generated is removed from the site and nutrients can be recycled. Composting toilets require the replacement of existing toilet(s) and room in the basement for a container to capture and compost the human waste. Household water use (sink and shower uses) continue to flow to the septic system. (Case example, Falmouth, MA).

- *How "idiot proof" are composting and urine diverting toilets? This is especially important for landlords installing them in rentals.* There are various homeowner errors (e.g. unplugging the electric pump to reduce electricity costs) that are important to take into account.
- *The composting toilet emits carbon dioxide, so, if these were used on a large scale, this could have an effect on air quality.*

<u>Packaging toilets</u>: A packaging toilet encapsulates human waste in a durable material for removal from the site. The package is stored beneath the toilet and removed and taken away when full. The nutrients can be recycled by the servicing company that picks up the packages.

Questions from the online survey:

- *How would these alternative toilets affect the resale value of a house?* Mr. Horsley responded that the answer to this question would be different in 2013 vs. 2030. The group discussed the fact that it may be difficult to get widespread acceptance of these alternative toilets now, but may change in the future.
- *Would the composting toilet smell?* The newer system is said to have less of a chance of smelling than a flush toilet.

<u>Stormwater bioretention</u>: Bioretention systems utilize natural plant and soil functions to capture and treat stormwater runoff for a variety of contaminants including nutrients. A typical system consists of an underdrain/gravel layer, a layer of bioretention soil mix (a mix of sand, compost, woodchips and loam), and a surface layer containing appropriate plantings. The treated water can be discharged into a water body or used for open space irrigation after treatment. The reclaimed water can also be discharged into a subsurface infiltration system for discharge to the groundwater. (Case example, Portland, OR).

- *Are rain gardens currently required in any Cape towns?* Mr. Horsley responded that they are not required now, but it would be an option for towns to pass regulation on this.

- *How do rain gardens affect groundwater recharge?* They allow a lot of water to flow back into the water table.

Neighborhood level technologies/approaches

Cluster and satellite treatment systems: A cluster or satellite system is a collection and treatment system treating wastewater flows from multiple properties.

- *Are there any land savings on the size of the leach field if treating a cluster of properties?* No, more houses require a larger leach field.
- *Would a variable flow (for instance, higher in some seasons than others) make it more difficult to run treatment systems like this?* Cape Cod is very seasonal, but these plants can be designed with variable operation and maintenance to meet seasonal needs.
- *It would be helpful if the CCC could provide information on examples of where this is already working and the total number of systems like this that are currently in place on the Cape.*

STEP/STEG collection: Septic Tank Effluent Pumping (STEP) and Septic Tank Effluent Gravity (STEG) systems convey liquid wastewater from on-site septic tanks to sewer systems; Only the liquid component of the wastewater may be conveyed by pumps or by gravity.

Eco machines and living machines: Living or Eco-Machines are natural systems that treat septic tank effluent or primarily treated wastewater. In these systems, aeration and clarification chambers are combined with constructed wetlands to treat the influent. The wetlands are a series of chambers allowing for microbial communities to engage with and treat the wastewater. Plants are often suspended on racks with their roots systems doing the work. Solids removal is generally onsite, after which water is pumped through the gravel filled cells (similar to subsurface wetlands.) This process transfers more oxygen to the wastewater and completes the pollutant removal process. (Case example, South Burlington, VT).

- *Why is solids management especially highlighted for this technology, is it more difficult than with others?* Another participant responded that this could be because, in addition to solid waste, this technology can generate so much plant matter that it can be difficult to know what to do with it.
- *Are these plants contaminated?* This is an outstanding research and development question. A participant explained that it depends on the wastewater that is used in the system (strictly residential vs. industrial waste with toxins) and what you're using the plants for. There are places in Connecticut where they sell the plants from eco machines for landscaping and make a profit.
- *Solids management needs to be taken into account for each of these technologies.* Mr. Horsley responded that they have added a category for residuals management to every technology on the matrix.

Stormwater wetlands: Constructed wetlands provide aerobic chambers followed by subsurface anaerobic chambers that facilitate nitrification followed by denitrification, respectively. This process mimics that of natural systems coupled with engineering design guaranteeing residence time within a chamber containing anaerobic conditions. (Case example, China).

- *Can these also be used to control flooding?* Yes, however when designing them for flood control and water quality treatment they require different amounts of land area. Mr. Horsely cited an example of a constructed wetland near Alewife in Cambridge that addresses both runoff and flood problems, and is also a nice recreational area.
- *What sort of maintenance do these wetlands require? If there is a dry year, will the plants die and stop the wetland from functioning?* Mr. Horsley responded that it depends on the design. If they are designed well, they will function almost like a natural wetland and need minimal maintenance.
- *Do solids get into these wetlands?* Massachusetts requires wastewater to go through a lot of pre-treatment before solids go into these wetlands. Small organic particles make their way into the wetland, and these are taken up by the ecosystem.

Watershed level technologies/approaches

<u>Conventional treatment</u>: A conventional wastewater treatment facility typically treats wastewater collected from homes and businesses. A groundwater discharge permit is required. Treatment generally results in less than 10 mg/L Nitrogen.

<u>Constructed wetlands: surface flow</u>: After primary treatment in a septic tank or wastewater treatment facility or secondary treatment at a wastewater treatment facility, water is fed into a surface flow constructed wetland. Surface flow constructed wetlands closely mimic the ecosystem of a natural wetland by utilizing water loving plants to filter wastewater through their root zone, a planted medium, and open water zones. Surface flow wetlands are systems where open water is exposed much like in a natural marsh. The reclaimed water from the wetland can be discharged into a water body or used for open space irrigation after treatment as well as discharged into a leach field. (Case example, Albany, OR).

<u>Constructed wetlands: subsurface flow</u>: After primary treatment in a septic tank or wastewater treatment facility or secondary treatment at a wastewater treatment facility, wastewater is treated by pumping water slowly through subsurface gravel beds where it is filtered through plant root zones and soil media. Water flows 3-8" under the surface to prevent public exposure to wastewater and mosquito breeding. A combination of horizontal and vertical flow subsurface systems must be utilized to provide total nitrogen removal. This solution can also offer opportunities for recreation activities on land above the subsurface system. (Case example, Thailand).

- *Do you need to keep introducing bacteria to subsurface wetlands?* No, you can take measures to encourage its growth, but it is naturally occurring.
- *Can subsurface flow wetlands also treat surface water?* They can be designed to do so (e.g. to catch stormwater).
- *These types of solutions are fairly land intensive.*
- *It is against regulation to use natural wetlands to do these sorts of treatments. If there were a natural wetland nearby, you would have to construct an artificial one upstream from it.*

<u>Effluent disposal: out of watershed</u>: Effluent disposal can take a variety of forms, including

infiltration basins, a Soil Absorption System, Injection Wells or Wick Wells. These disposal methods place highly treated effluent back into groundwater. Effluent Transport out of the watershed has the advantage of removing the nitrogen load to another watershed. Transport to another watershed requires the receiving watershed to be able to accommodate the additional nitrogen load.

- *This option could be very relevant to this watershed because it is next to Hyannis, which already has a sewer disposal system.*

Effluent disposal: ocean outfall: Similar to out of watershed effluent disposal, highly treated effluent is transported out of the watershed and into the ocean. This solution requires a high level of regulatory oversight, but is being considered because there is limited land availability for disposal on Cape Cod.

- *Depending on how much you're removing from the Cape Cod aquifer and depositing in the ocean, this could have hydrologic implications. Another participant responded that the amount of water Cape residents use is only a very small percentage of the aquifer, so this would probably not have a large hydrologic effect, though it should still be taken into account.*

Phytoirrigation: After secondary treatment, wastewater treatment facility effluent is irrigated onto plants to remove nutrients and other contaminates. Fast growing poplar and willow trees are typically used. (Case example, Woodburn, OR).

Neighborhood or Watershed level technologies/approaches

Phytobuffers: Using trees with a deep root system to capture nutrients in the soil, particularly willows and poplars. Green plants with deep tap roots are planted as a buffer to intercept existing groundwater. The plants and their associated microorganisms reduce contamination in soils and ground water. Often phytohydraulics causes the groundwater plume to be redirected and pulled towards the plants. (Case example, Kavcee, WY).

Fertigation wells: Fertigation wells can capture nutrient enriched groundwater, typically from a wastewater treatment facility discharge, and recycle it back to irrigated and fertilized turf grass areas. These irrigated areas include golf courses, athletic fields and lawns. Fertigation can significantly reduce nutrient loads to downgradient surface waters while reducing fertilizer costs to the irrigated areas. (Case example, Plymouth, MA).

Permeable reactive barrier (PRB): A permeable reactive barrier (PRB) is an in-situ (installed within the aquifer) treatment zone designed to intercept nitrogen enriched groundwater. Through use of a carbon source, microbes in the groundwater uptake the nitrogen, denitrifying the groundwater. PRB systems typically use vertical trenches, sequences of bored columns or injection methods to introduce the carbon source into the groundwater to reduce the nitrogen load to an estuary, removing it from the watershed. (Case example, Falmouth, MA).

Inlet and culvert widening: Re-engineering and reconstruction of bridge or culvert openings to increase the tidal flux through the culvert or inlet. This solution generally works better with a larger tidal range but could be feasible on both the Cape Cod Bay side (approximately nine feet tidal range) and Nantucket Sound side (approximately 3 feet of tidal range).

Salt marsh habitat restoration: Salt marsh is one of the most productive ecosystems in the world, surpassing rainforest in productivity per acre. Approximately 65% of historic salt marsh has been lost in MA. Salt marshes cycle and remove nitrogen as well as provide critical habitat and spawning sanctuary for a wide variety of birds, mammals and marine life in addition to hosting a range of plant species and important biogeochemical processes. The capacity of salt marsh to intercept nitrogen is significant and well researched worldwide. Substantial areas of former salt marsh on the Cape are either under consideration for restoration or could be restored providing storm surge and coastal flooding protection in addition to water quality benefits in certain watersheds.

Shellfish habitat restoration: Oyster reefs were historically one of the main consumers and recyclers of nitrogen in the coastal environment on Cape Cod. According to the Nature Conservancy, populations have declined by 95%. In conjunction with the natural transition from land to sea in estuaries, bays and inlets; salt marsh, oyster reef and eel grass function as critical buffer that can reduce eutrophication. Restoring Oyster populations leads to increased shellfish productivity as well as improved commercial and recreational fisheries for other species, increased protection from shoreline erosion and flooding, and buffering from ocean acidification. (Case example, Wellfleet, MA).

Aquaculture / shellfish farming: Oysters have been proposed as a potential method for reducing nitrogen levels and eutrophication in estuaries. Nitrogen removal rates from Oysters have been well documented and the harvest of oysters physically removes the nitrogen they sequester in addition to the nitrogen removed by their biological cycling which puts nitrogen directly back into the atmosphere. Aquaculture can be done on man-made structures (e.g. cages, floating bags) or natural reefs.

Surface water remediation wetlands: Constructed to aid in water quality improvements to surface water bodies, usually streams or rivers. Water is pumped or allowed to flow naturally through treatment cells containing wetlands Surface water remediation wetlands are often used in combination with groundwater recharge or potable water reuse systems. Surface water remediation wetlands are generally used with Free-Water Surface wetlands due to their larger size, and lower capital and operation and maintenance costs. (Case example, China).

Pond and estuary dredging: Lakes, ponds, streams and estuaries store nutrients within their sediments. These sediments tend to accumulate over time. Subsequently, these nutrients can be release into the overlying water column and can become a major source of nitrogen and phosphorus. Dredging and removing these sediments and accumulated nutrients removes the nutrients from the water body and potentially the watershed. (Case example, Dennis, MA).

Cape-wide level technologies/approaches

Compact development: Both Compact Development and Open Space Residential Development (OSRD) of subdivisions result in smaller lots and less maintained lawn acres. The higher density development reduces wastewater collection costs while providing a common disposal area. Compact development is also referred to as “Smart Growth”.

Fertilizer management: Managing fertilizer application rates to lawns, golf courses, athletic facilities and cranberry bogs. Residential lawn loading rates could be reduced on existing developed parcels through an intensive public education/outreach program. This could include a “Cape Cod Lawn” branding program, replacing some turf areas with native vegetation, establishing naturally-vegetated buffer strips on waterfront lots, and reducing application rates. Fertilizer loading rates for new development could be accomplished by reducing lot sizes (cluster development), by restricting lawn sizes and/or by incorporating more naturally-vegetated open space areas. Municipalities could directly reduce fertilizer applications on athletic fields and other properties. Golf courses can significantly reduce nitrogen loading rates by using slow-release fertilizers and reducing application rates in rough areas. Cranberry bog fertilizer exports from the bogs can be reduced using tail water recovery systems. Site-specific assessments are needed to estimate load reductions.

Remediation of existing development: Existing developments or schools with excess wastewater treatment capacity allow existing nearby developments to connect to their underutilized wastewater treatment infrastructure. A town can operate the wastewater treatment facility if the existing owner prefers to not take the responsibility for treating the off-site wastewater. An example of this is the Kingman Marina in Bourne, which was permitted to expand its development footprint in exchange for hooking up adjacent, existing homes to its wastewater treatment facility.

Transfer of development rights: A regulatory strategy that transfers development and development rights from one property (sending area) to another (receiving area) to direct growth and associated nutrient loading away from sensitive receiving watersheds or water bodies. The protected parcels (sending areas) receive a deed restriction that limits the level of future development. The deed restriction can limit the number of homes or tie development to the availability to future wastewater treatment facility infrastructure.

Stormwater best management practices (BMP): Non-Structural Stormwater strategies include: street sweeping, maintenance of stormwater utilities, education and public outreach programs, land use planning, and impervious cover reduction and control.

General questions and comments:

- *Are some of these technologies innovative enough to merit retrofitting, or are you planning to reserve innovative technologies for new development? We need to address our water quality problem now, not only in the future.* Mr. Horsley responded that some of these technologies are more “retrofittable” than others. Another factor is the cost of innovative technologies in relation to the cost of sewering. The cost of sewering depends on density.
- *Participants discussed the importance of ensuring that renters, vacationers, and seasonal residents are educated in the proper operation and management of any technologies that are installed. Operation and management and education require funding; who will pay for*

these costs? Ms. Perry said the commission is attempting to take these things into account, but are still working out how to capture all of the pieces.

- *Regarding the issue of reusing nutrients to make fertilizer, these fertilizer products can be much more expensive than other fertilizer.*
- *Participants discussed numerous issues around oysters: For public education, you can bring a cloudy tank of oysters to a meeting, and by the end of the meeting it will be clear, illustrating how well oysters filter water. Many of the estuary areas that have the lowest water quality and would be most benefited by oysters are closed to shellfish. They are sometimes closed because of stormwater and sometimes because of worries about septic systems that are not working properly. Whenever oysters are grown, people steal them, even if the oysters are not safe to be harvested. If people sell contaminated oysters on the market, the state government is worried that this could impact the whole state's shellfish industry.*
- *Are there other shellfish that also filter the water?* Yes, most of them do, however oysters are probably the most efficient.
- *A participant requested that costs of collection systems, both vacuum and gravity-fed, be added to the technology matrix. Add costs per site where feasible.*
- *Most people have already committed to a Title 5 cost. Whether they use it or not, it's in their mortgage and could be a sunk cost. Thinking about these various solutions, we need to take into account the fact that we still have to address pathogens and so we will likely keep using our Title 5 systems.*
- *What are the impacts of sea level rise?* The water table is rising at the same rate as sea-level rise. If you add two to three feet to the groundwater level, the groundwater will get much closer to people's Title 5 systems. One of the I/A technologies can be installed only 6 inches below the surface rather than 2-3 feet as most systems are currently installed.
- *A participant raised concerns about road runoff pollutants.*
- *Regarding permeable reactive barriers, how deep do the high levels of nitrogen in groundwater go?* This is still being studied. Some studies have shown (e.g. in Waquoit) that the higher levels of nitrogen are down near the bottom of the groundwater, and therefore possibly below the barrier. It can vary a lot depending on the area. If we decide to go with the innovative solutions, there will be more testing required. These solutions will have to have a flexible and adaptive management system.

IV. PROBLEM SOLVING PROCESS AND PRINCIPLES

Overview of 7-steps for Problem-Solving Process

Mr. Horsley reiterated that the goal the Working Groups is to develop remediation options that would achieve water quality targets with a focus on first targeting low cost, low barrier options to reduce nitrogen and then considering more costly and traditional options later (e.g. sewering). He then described the alternatives screening process the group will apply:

1) Establish targets and articulate project goals.
2) Identify priority geographic areas (e.g. high nitrogen reduction areas, Title V problem areas, pond recharge areas).

3) Determine which management activities should definitely be implemented. These might be the easiest and least costly management activities that should be undertaken regardless of other management actions (e.g. fertilizer management and stormwater mitigation – two approaches that Cape Cod towns are already actively pursuing).
4) Assess alternative options to implement at the watershed or embayment scale (e.g. innovative and lower-cost solutions)
5) Assess options to implement at the site-level
6) Examine priority collection/high density areas
7) Consider traditional sewering or other grey infrastructure management options

He further explained that the Working Groups will focus on total controllable nitrogen load. The technologies and approaches selected should aim to reduce the total controllable nitrogen load by identifying options that reduce the portion of *septic* load that needs to be reduced. For example, the portion of septic load that needs to be reduced could be made smaller if Cape Cod takes on fertilizer and stormwater solutions first. Additionally, the percentages of controllable nitrogen that need to be removed to meet TMDLs change depending on the characteristics of the watershed.

He noted that in many instances, one of the solutions may not achieve the TMDL, but if you pair multiple solutions you may be able to reach the goal. For example, many towns are already using and pairing some of the technology options and approaches:

- Wellfleet- *Coastal habitat restoration & aquaculture*
- Mashpee- *Aquaculture & Expanding Existing Systems*
- Brewster- *PRB & Bioswales*
- Orleans- *Fertilizer Control By-Law*
- Harwich- *Muddy Creek & Cold Brook Natural Attenuation*
- Falmouth- *Aquaculture, Inlet Widening, Eco-Toilet Demonstration Project, PRBs, Stormwater Management (Little Pond Watershed), Fertilizer Control By-Law, Subsurface Nitrogen Removal Septic System*

Participants offered the following comments:

- *A participant voiced support for step four of the problem solving process (Assess alternative options to implement at the watershed or embayment scale) because the earlier we target the problematic estuaries, the cheaper it will be overall. The participant also raised the concern that steps five, six, and seven should be taken collectively.*
- *A participant commented that, given long flow times, we may not have seen the worst impact on the embayments yet.* Mr. Horsley added the comment that different options have different timelines in terms of how soon improvements occur. E.g. oysters will show benefits in the first year. Sewering may have over ten or fifteen years of flow time before you'll see a change in the embayment.
- *Participants discussed the possibility of offering incentives for the people who want to implement alternative solutions individually. In addition to incentives, there is also the option of changing the law. What entity would be giving these incentives out to people? There also need to be protections for people who take these early risks, so that they don't take a hit in the future if, for instance, the town later decides to sewer their area.*

Categories of Solutions and their Impacts on the Environment, Economy, and Community

Mr. Horsley commented that evaluation of the technologies and approaches would be informed by their impacts (positive and negative) on the environment, economy, and community (Triple Bottom Line).

A participant raised the issue of focusing overmuch on the technological or engineering aspects and highlighted the importance of dealing with the political system. How can we implement these good ideas in a way that compels people to make good decisions? How can we reintroduce remediation, reduction and production? How can we separate private costs from community leadership when a lot of the prevention stuff is only done at the town level? What is the guiding principle that will allow the communities to institute prevention processes, zoning, etc?

Ms. Hulet asked participants to consider the environmental, economic, and community impacts of the possible technologies and approaches and asked them what evaluation criteria/factors they might consider in guiding evaluation of the range of possible solutions. She asked that participants focus specifically on the environmental, economic, and social trade-offs or consequences that they felt would be important to consider for this watershed. Working Group members offered the following suggestions:

Timeline considerations:

- The working group is attempting to answer two questions: 1) what we'll do for remediation immediately; and, 2) what will we do long-term so that these problems don't occur again. We have a way to evaluate our near term plan after a few years and then adapt the long-term plan (adaptive management).
- What will the town do after all the remediation takes place? Does the town have any continuing stewardship; will costs to taxpayers go up in the future? Should the town be assigned a cost and can that run on a different cost-timeframe than individual costs?
- Be realistic about people's view of the long term: it's hard for most people to think beyond their lifetimes.

Cost-benefit analysis:

- Is this solution giving us "the biggest bang for our buck" in the near term, and does it make sense in the overall long-term context?
- When measuring costs and benefits, take into account:
  - The "softer" side of costs and benefits: people's risk and vulnerability.
  - The costs and benefits of educating people and getting public buy-in.
  - The benefit of an incremental approach: start with visible, high impact projects to increase public acceptance and make it easier to get buy-in to tackle more difficult issues later.
  - The cost of doing nothing.

Political

- Develop a process/plan for public buy-in
  - There have been examples of other projects on the Cape where policy-makers have made decisions that seemed in the best interest of everybody, but, because they didn't have public buy-in, the public rejected the decisions.
- Figure out how to reach people with information. In some projects, the CCC does everything they can think of to publicize information, and some people still don't receive it.
- Internalize costs
- How to work across and between towns?
  - The planning process is taking place at the watershed level, but decision processes and regulation will happen exclusively at the town level. Ms. Hulet responded that in some places on the Cape, towns have come together to do the decision making jointly. One thing this planning process can aim to do is to provide examples of how towns have worked together in the past, and encouragements for them to do so more. There is no way to require it.

Social:
- Target large contributors first
- How to get smaller contributors (individual homeowners) to make behavior changes?
  - The general public is not very aware of the problem and therefore doesn't understand the incentive to try to solve it.
- Important factors when dealing with individual contributors in this watershed:
  - Median age
  - Cannot absorb high costs for changes
  - Little equity in houses now

General:
- Ongoing evaluation and review of the plan (for adaptive management)
- How do we include in each watershed's plan the things that are common to all: education, monitoring, demonstration, model regulations, etc?
- Take into account what's already being done around water quality remediation

Technology Selection: Process and Principles
Mr. Horsley noted that the Working Group had identified many of the principles that the Cape Cod Commission hoped would guide technology/approaches selection. These process and principles include:
- *100% septic removal subwatershed*: Combinations of technologies can be used to reduce septic load that needs to be removed.
- *Scale: On-Site vs. Collection System vs. Natural System*: There will be tradeoffs between the scale of systems that can be used. On-site, collection, and natural systems all have their pros and cons and all require different levels of investment and infrastructure. These tradeoffs will be important from an implementation and public acceptance point of view.
- *Nutrient intervention and time of travel*: Some technologies/approaches intercept nutrients at their point of entry into the system, while others deal with it later on (e.g. once it is in the watershed). There are pros/cons to each approach which need to be considered.

- *Permitting Status*: The level of effort required to permit technologies will be a consideration.
- *Land use and Impacts of Growth*: Unintended consequences and opportunities for planned growth are important to consider.

V. PLANNING FOR THE NEXT MEETING

Meeting Three will be held:
Thursday, December 5th, 2013
8:30am - 12:30pm
485 Main Street; Dennis Town Hall; South Dennis

During this meeting the Working Groups will examine various scenarios (i.e. combinations of solutions) and their potential impacts (e.g. nutrient reduction, economic impacts, environmental impacts, social impacts, etc.). During the meeting, the Working Group will be able to use tools to calculate ideas/options and their impacts. Working Group participants should come prepared to offer their ideas about what solutions they'd like to explore further, given their understanding of the baseline conditions, issues, and priorities in this watershed.

VI. PUBLIC COMMENTS

There were no additional public comments.

APPENDIX ONE: MEETING PARTICIPANTS

Name	**Affiliation**
Working Group Members	
George Allaire	Town of Yarmouth, Public Works
Linda Bollinger	Hyannis Park Civic Association
Debra Dagwan	Barnstable Town Council
Steven Didsbury	Nitrogen Neutral, Centreville
Jan Hively	Civic Groups, Yarmouth
Scott Horsley	Consultant, Watershed Area Manager
Rick Lawlor	Golf Course Superintendents Assoc., Yarmouth
Spiro Mitrokostas	Dennis Chamber of Commerce
Ed Nash	Golf Course Superintendents Assoc.
Dale Saad	Barnstable DPW
Charles Spooner	Resident of Yarmouth
Mike Trovato	Town of Barnstable
Sam Wilson	Sotheby Realty, Barnstable
CCC Staff / Facilitators	
Tom Cambareri	Cape Cod Commission
Erin Perry	Cape Cod Commission
Maria McCauley	Cape Cod Commission
Carri Hulet	Consensus Building Institute
Carly Inkpen	Consensus Building Institute
Public/observers	
Dan Milz	University of IL, Inst. of Envir. Science & Policy

Cape Cod 208 Area Water Quality Planning
Nauset and Cape Cod Bay Marsh Group Watershed Working Group

Meeting Two
Tuesday, October 22, 2013
Eastham Town Hall, 2500 State Hwy, Eastham, MA 02642
8:30 am - 12:30 pm

8:30 Welcome, Review 208 goals and Process and the Goals of today's meeting – *Cape Cod Commission*

8:40 Introductions, Agenda Overview, Updates and Action Items– *Facilitator and Working Group*

9:00 Range of Possible Solutions – *Cape Cod Commission and Working Group*

- Technology Matrix
- Technologies Overview
- Survey Questions and Comments
- Additional Questions and Discussion

10:30 Break

10:45 Problem Solving Process and Principles – *Cape Cod Commission and Working Group*

- Overview of 7-steps for Problem-Solving Process
- Examination of Categories of Solutions and their impacts on the Environment, Economy, and Community (triple bottom line)
- Discussion – Identify Considerations and Priorities for Application

12:00 Preparing for Meeting 3 and Beyond – *Cape Cod Commission*

- Review Tools, Alternatives Analysis Approach
- Evaluating Scenarios for Meeting Nitrogen Goals
- Other Process Next Steps

12:15 Public Comments

12:30 Adjourn

Nauset and Cape Cod Bay Marsh Group

Technologies and Approaches

What is the stakeholder process?

Public Meetings

Goals, Work Plan & Roles

Affordability, Financing

Watershed Working Groups

Baseline Conditions

Technology Options Review

Watershed Scenarios

July

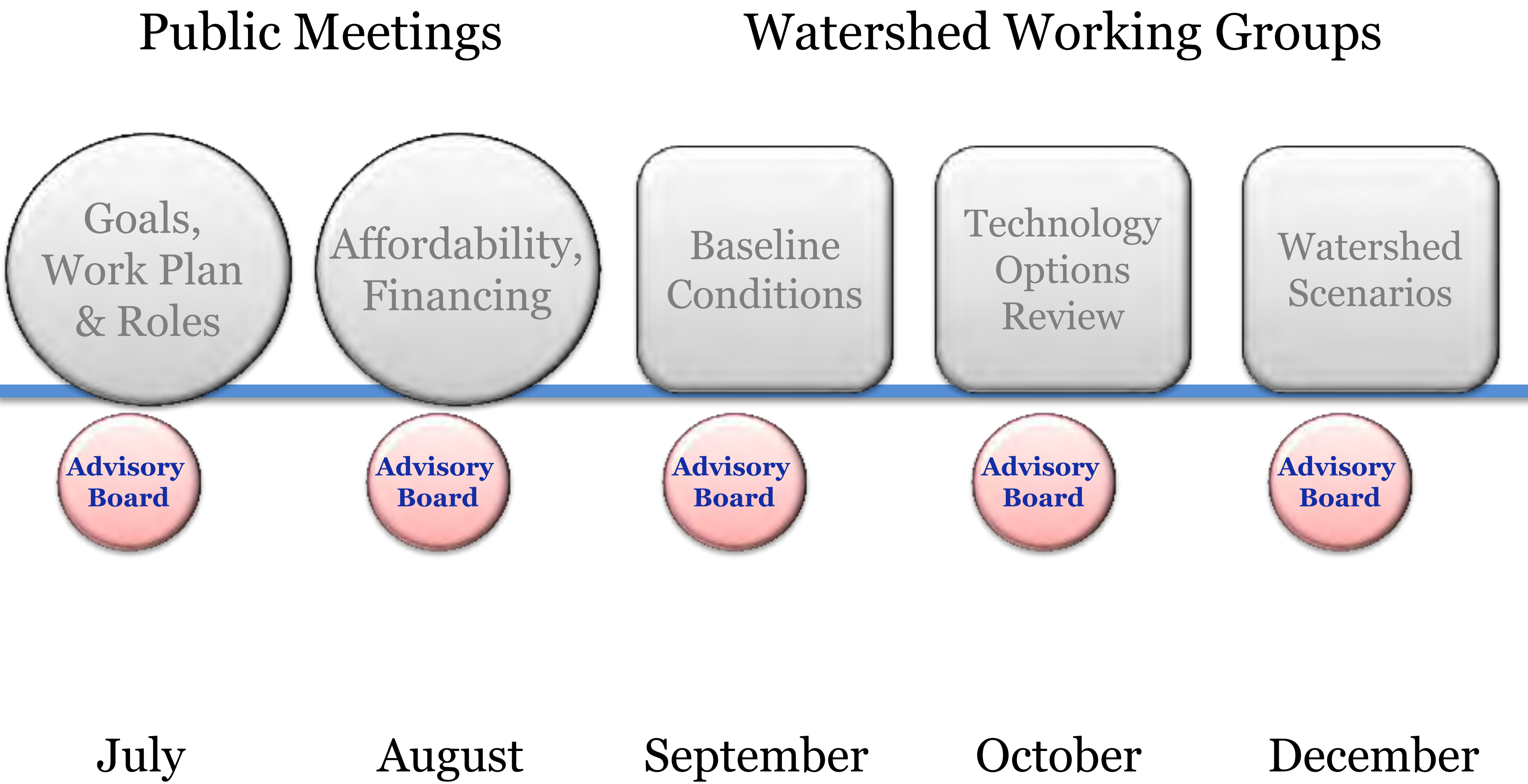
August

September

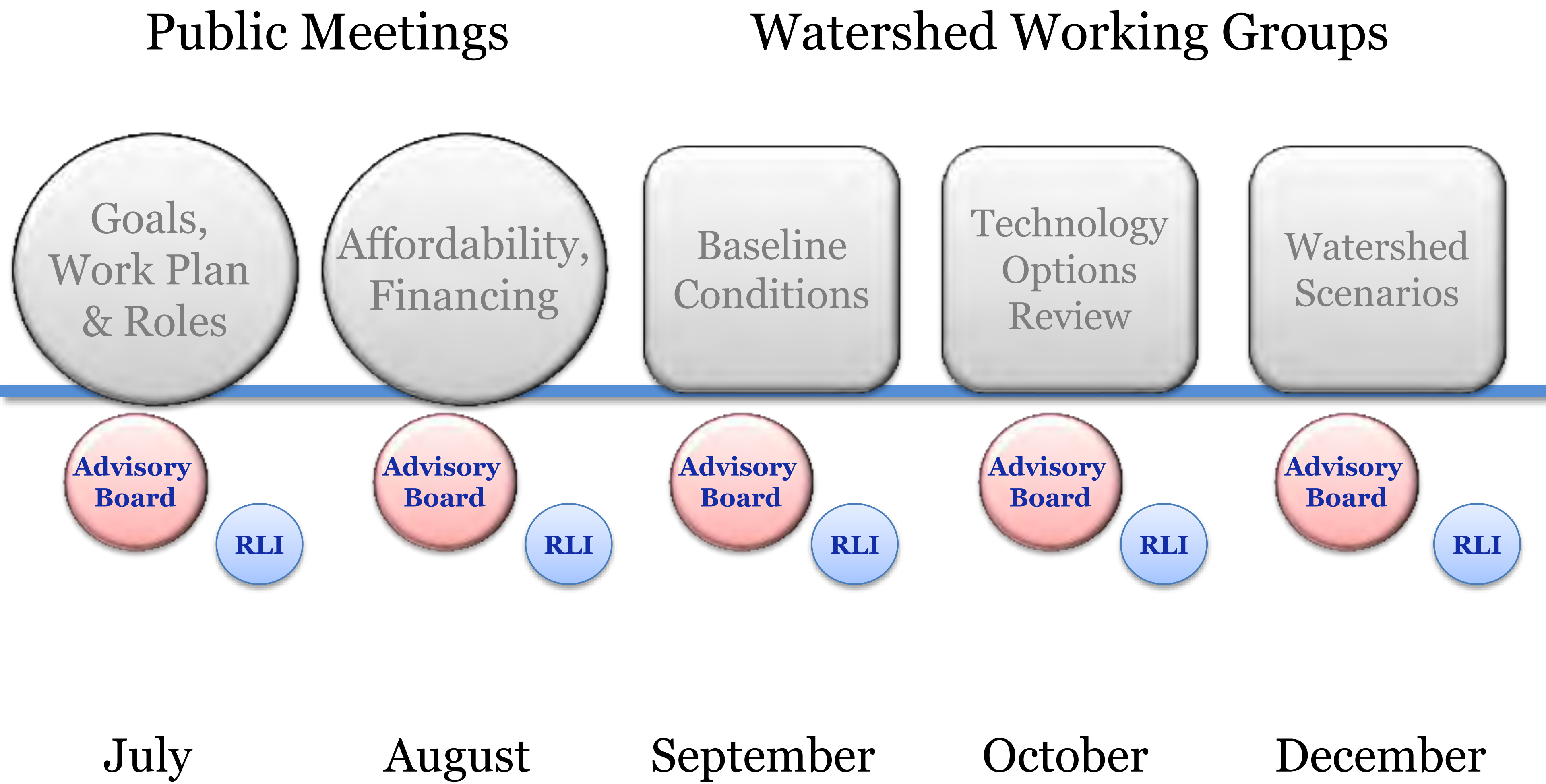
October

December

208 Planning Process



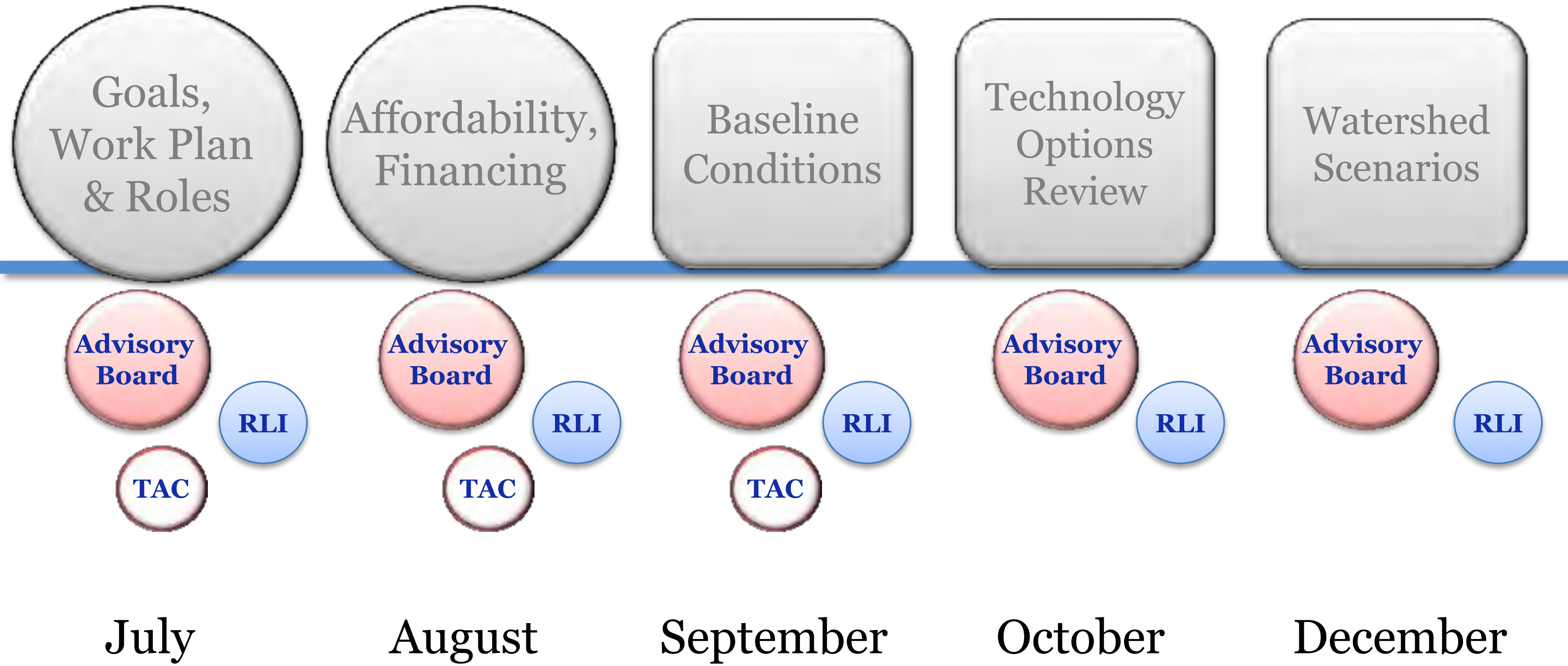
208 Planning Process



RLI Regulatory, Legal & Institutional Work Group

208 Planning Process

Public Meetings   Watershed Working Groups

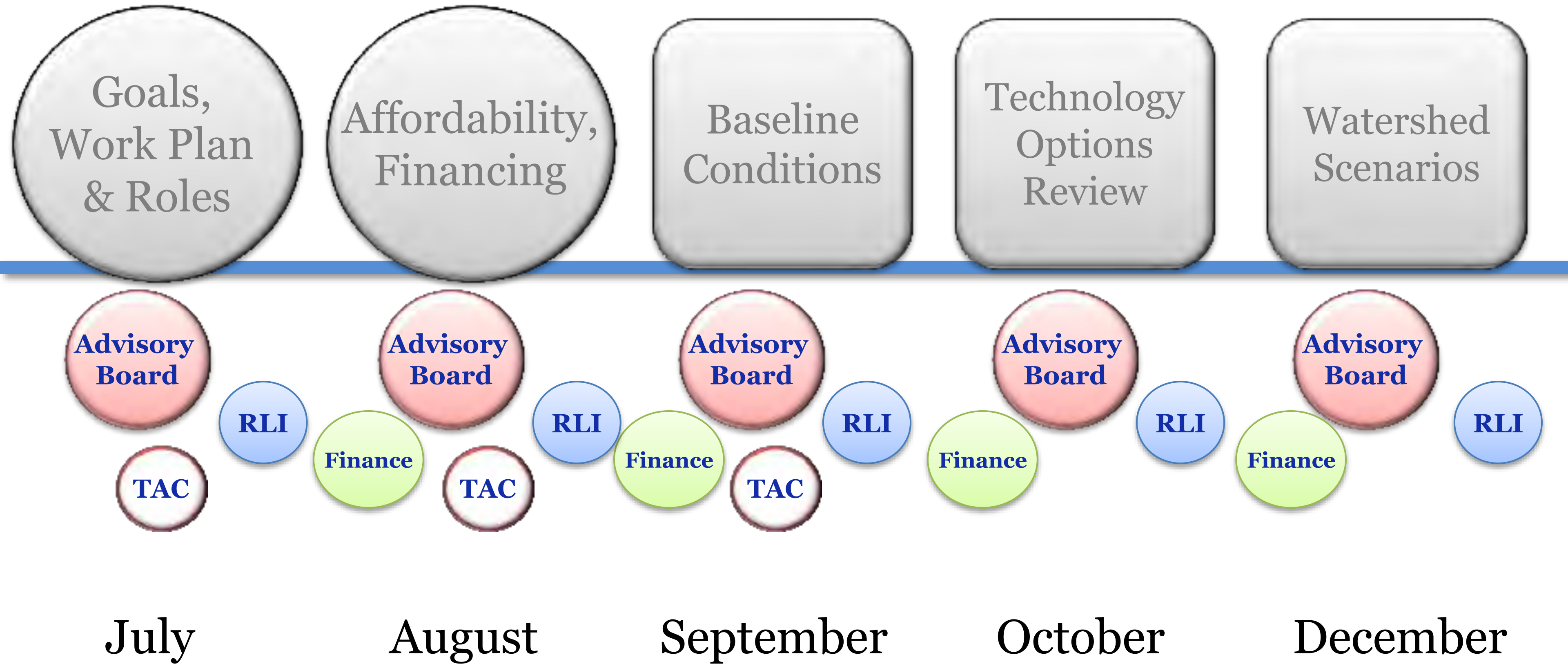


RLI Regulatory, Legal & Institutional Work Group

TAC Technical Advisory Committee of Cape Cod Water Protection Collaborative

208 Planning Process

Public Meetings Watershed Working Groups



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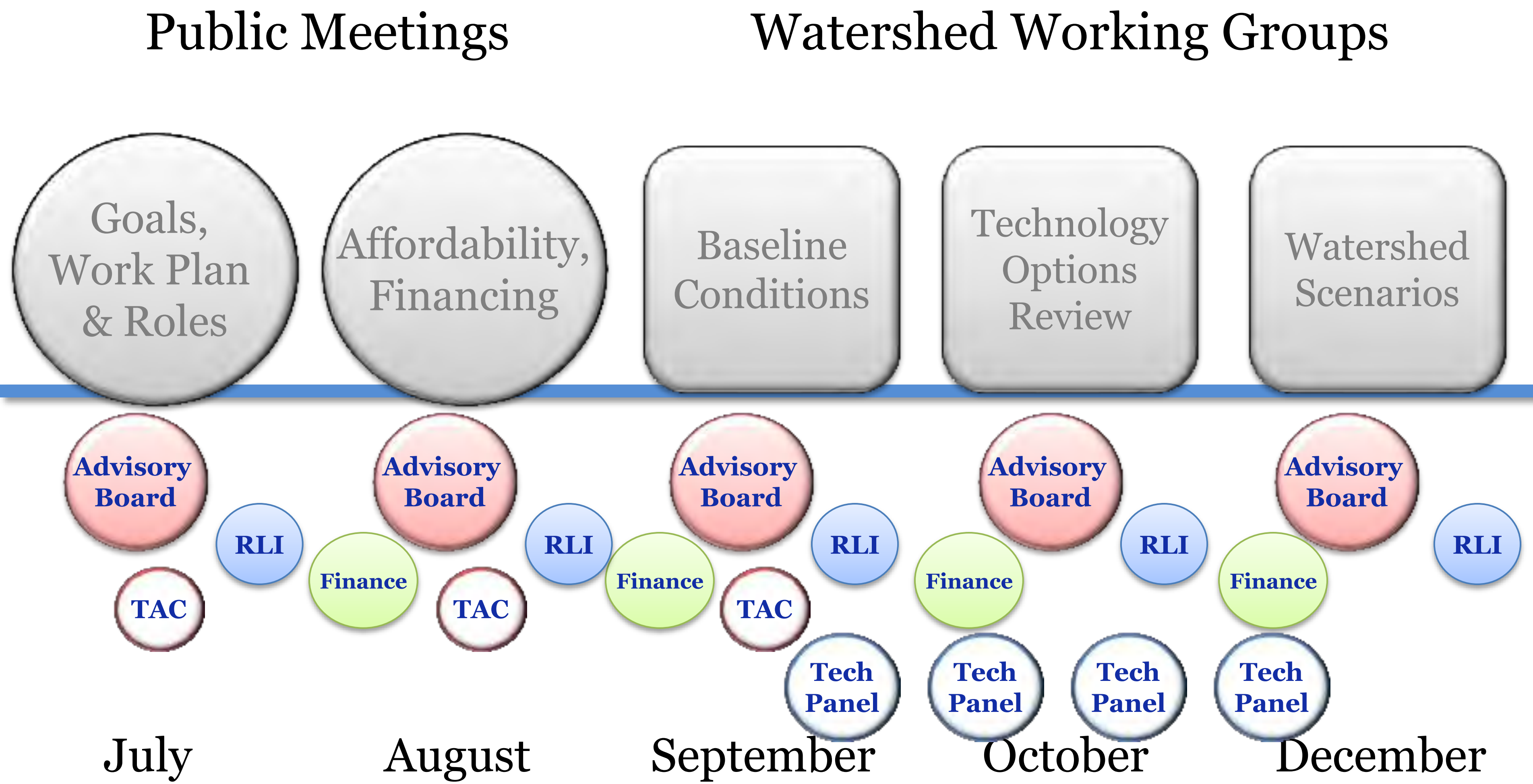

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TAC Technical Advisory Committee of Cape Cod Water Protection Collaborative

208 Planning Process

Baseline Conditions

11 Working Group Meetings: Sept 18-27

Goal of the First Meeting:

To review and develop shared understanding of the characteristics of these watersheds, the work done to date, existing data and information available, and how to apply all of this to planning for water quality improvements for these watersheds moving forward.

Progress since last meeting

- ❑ Meeting materials

Progress since last meeting

- ❑ Meeting materials
- ❑ GIS data layers

Progress since last meeting

- ❑ Meeting materials
- ❑ GIS data layers
- ❑ Chronologies

Baseline Conditions

11 Working Group Meetings: Sept 18-27

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

208 Planning Process

Baseline Conditions

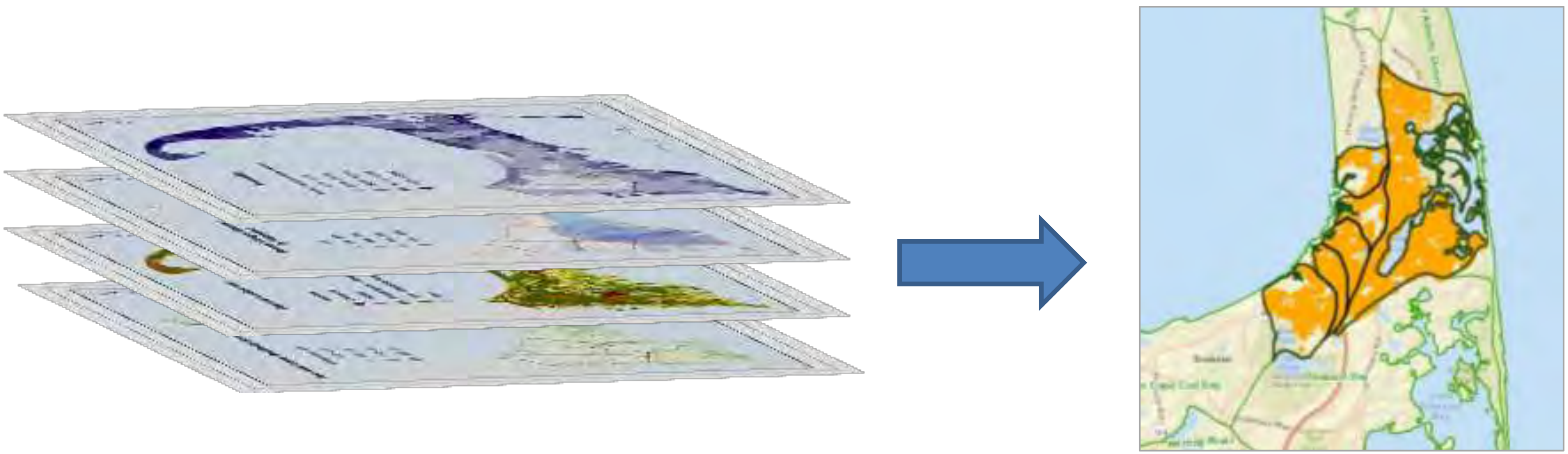
11 Working Group Meetings: Sept 18-27

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Watershed Scenarios

11 Working Group Meetings: Dec 2-11



208 Planning Process

Baseline Conditions

11 Working Group Meetings: Sept 18-27

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Watershed Scenarios

11 Working Group Meetings: Dec 2-11

Watershed Event

November 13

Center for the Arts Dennis

Wrap up of Cape2O: ur in charge!

Summary of planning process to date

Outline of second 6 months of the 208 planning process

208 Planning Process

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Goal of Today's Meeting:

To develop a shared understanding of the potential technologies and approaches identified to date, and the benefits and limitations of each; to explore the environmental, economic, and community impacts of a range of categories of solutions; and to identify priorities and considerations for applying technologies and approaches to remediate water quality impairments in your watershed.

Technologies and Approaches for Improving Water Quality

Technologies and Approaches for Improving Water Quality

- The Fact Sheets present various information on the technologies being considered.
- Additional information is contained on the Technology Matrix including the following:
  - Site Requirements
  - Construction, Project and Operation and Maintenance Costs
  - Reference Information
  - Regulatory Comments
- Input from the Stakeholders is requested regarding a technology's Public Acceptance

Technologies and Approaches for Improving Water Quality

- Comprehensive analysis of nutrient control technologies and approaches.

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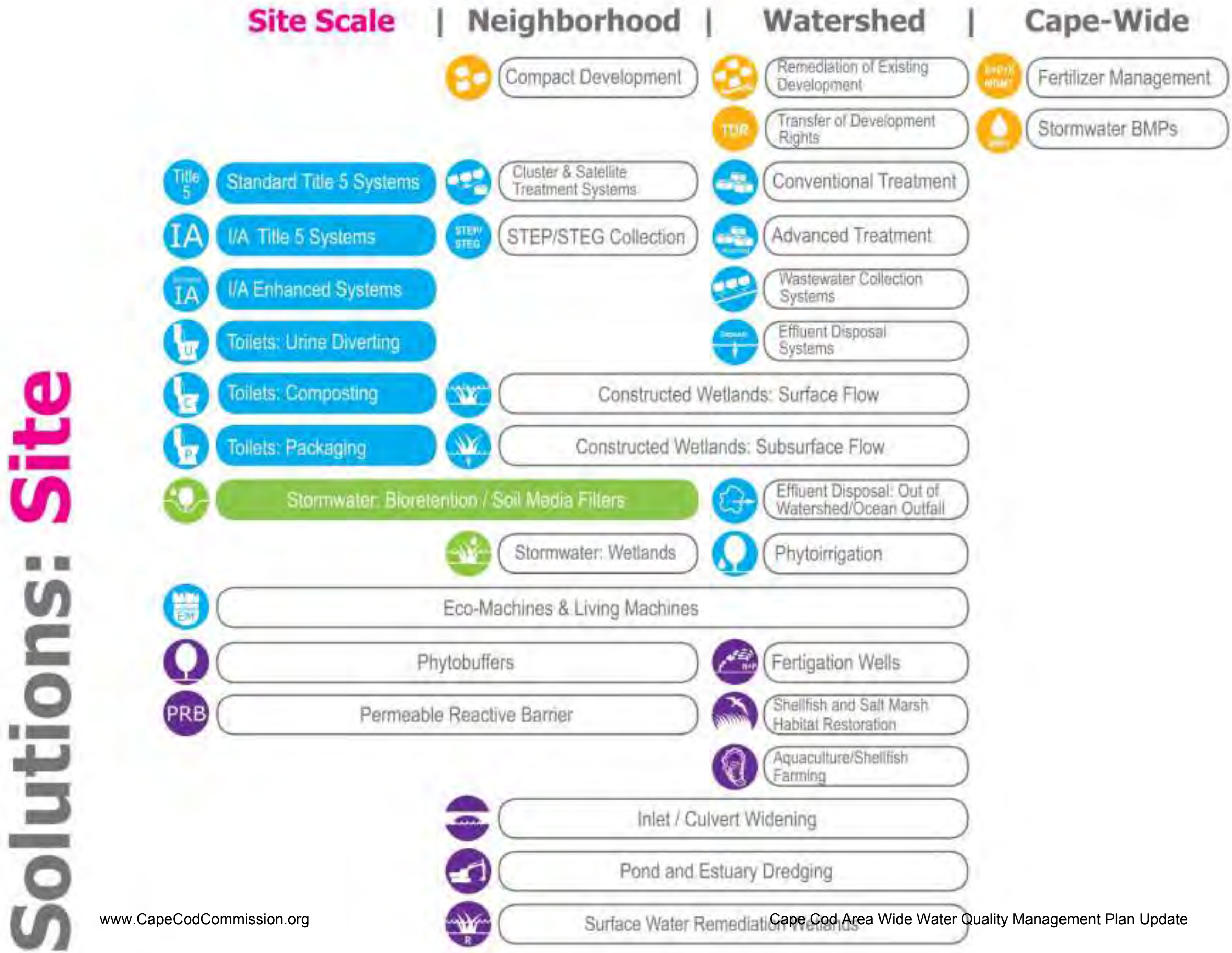
- Workshop 3 will embark on hands on problem solving in each watershed to meet target load reductions.
- Certain technologies or approaches will be effective at **preventing** nutrients from entering the water body. Others will be effective at **reducing** or **remediating** nutrients that are already in the groundwater or water body.
- Regulatory programs can address nutrient controls for both existing development and future development.


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


Solutions: Site
Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
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Toilets: Composting
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Toilets: Packaging
Constructed Wetlands: Subsurface Flow
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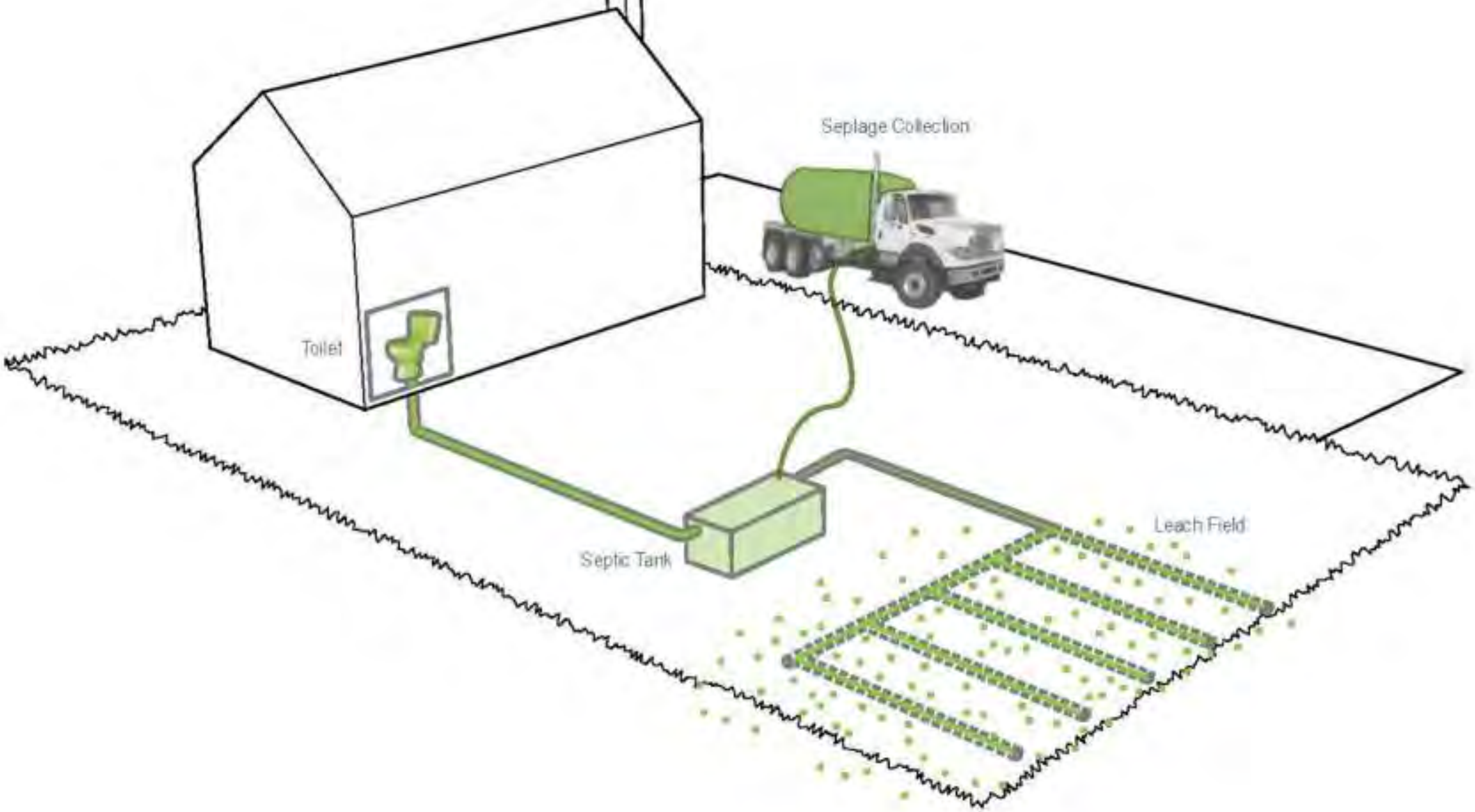
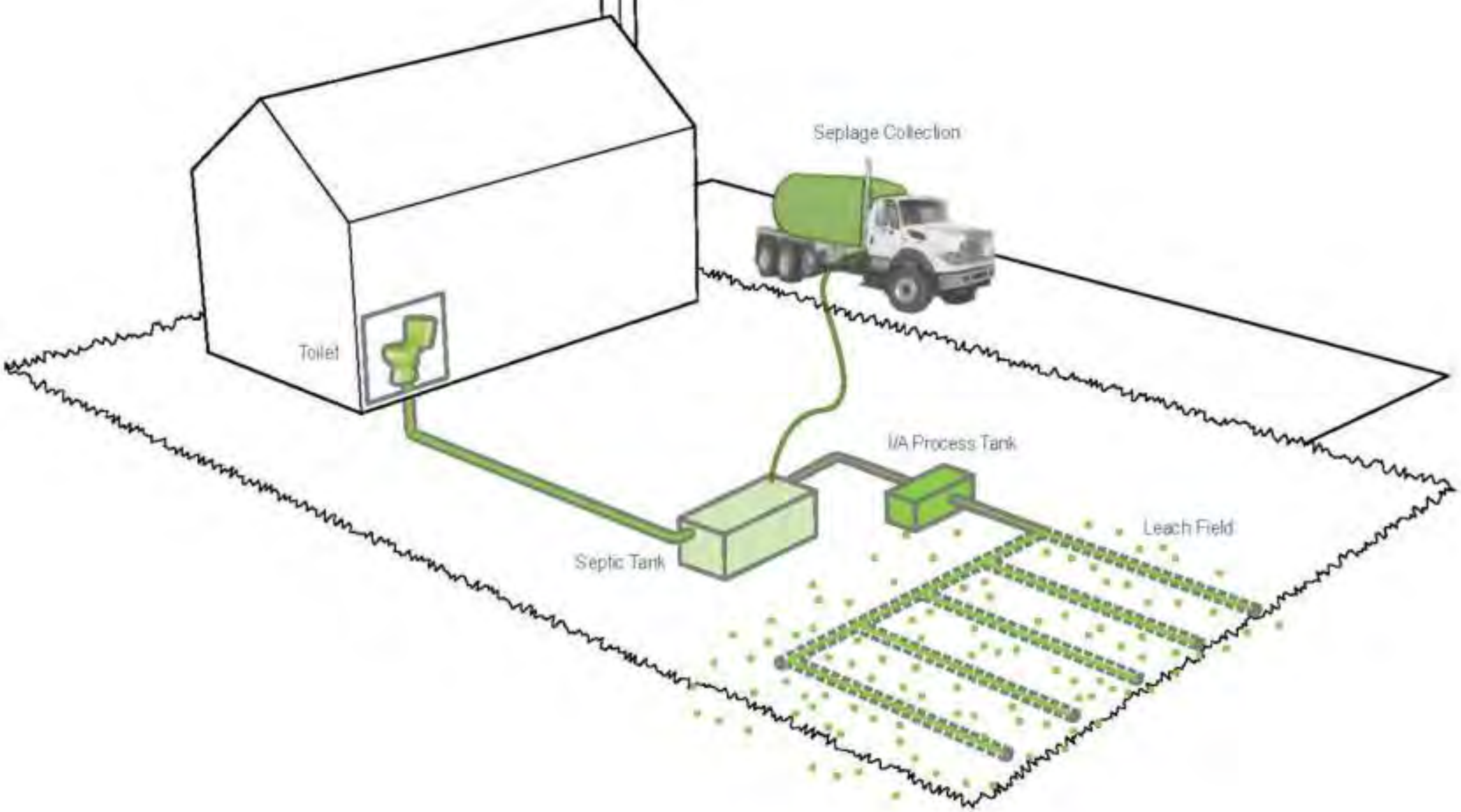
Eco-Machines & Living Machines
Phytobuffers
Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands



Scale: SITE
Target: WASTEWATER

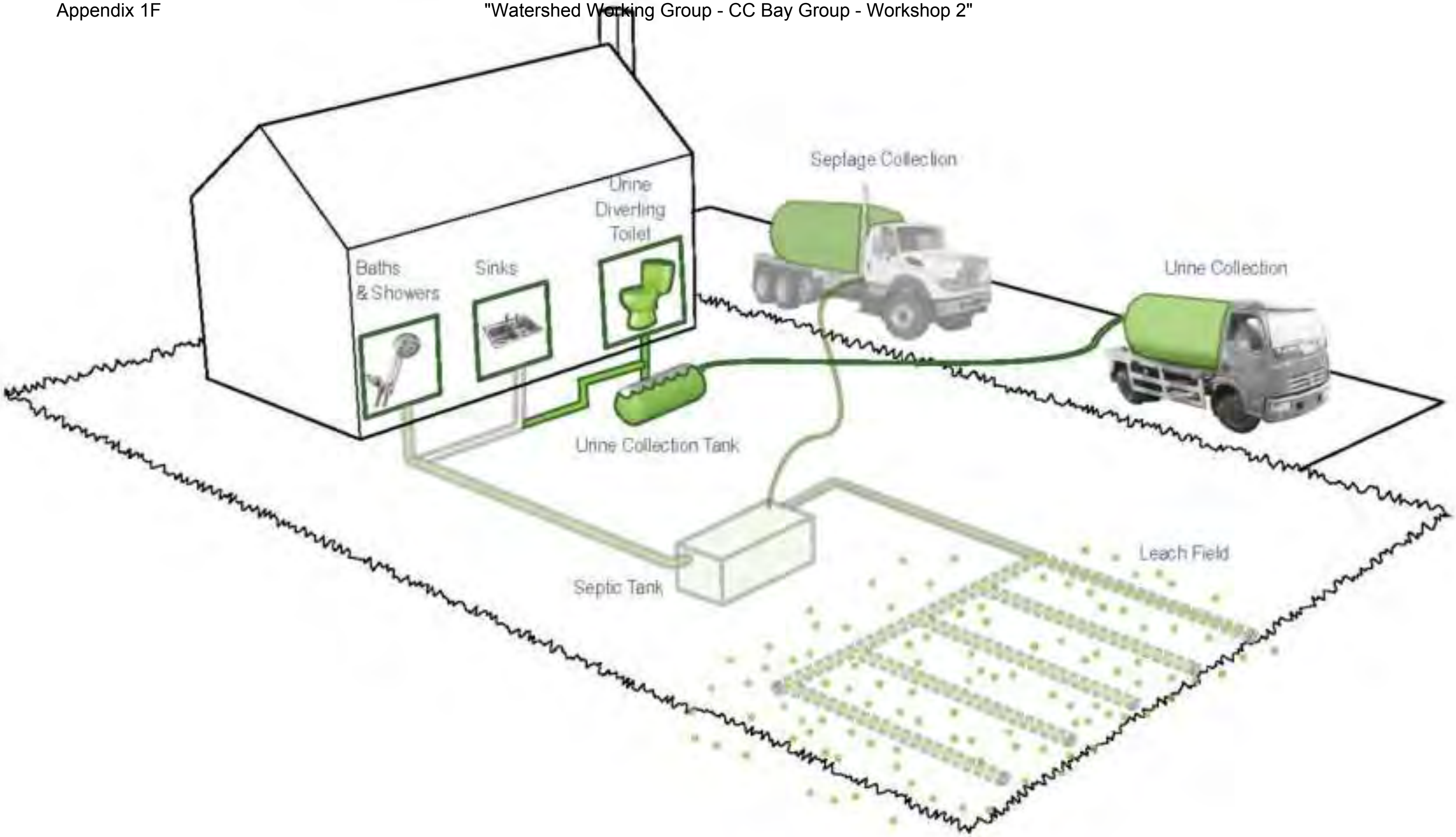
Standard Title 5 Systems

Title 5



Scale: SITE
Target: WASTEWATER

I/A Title 5 Systems



Scale: SITE
Target: WASTEWATER

Toilets: Urine Diverting

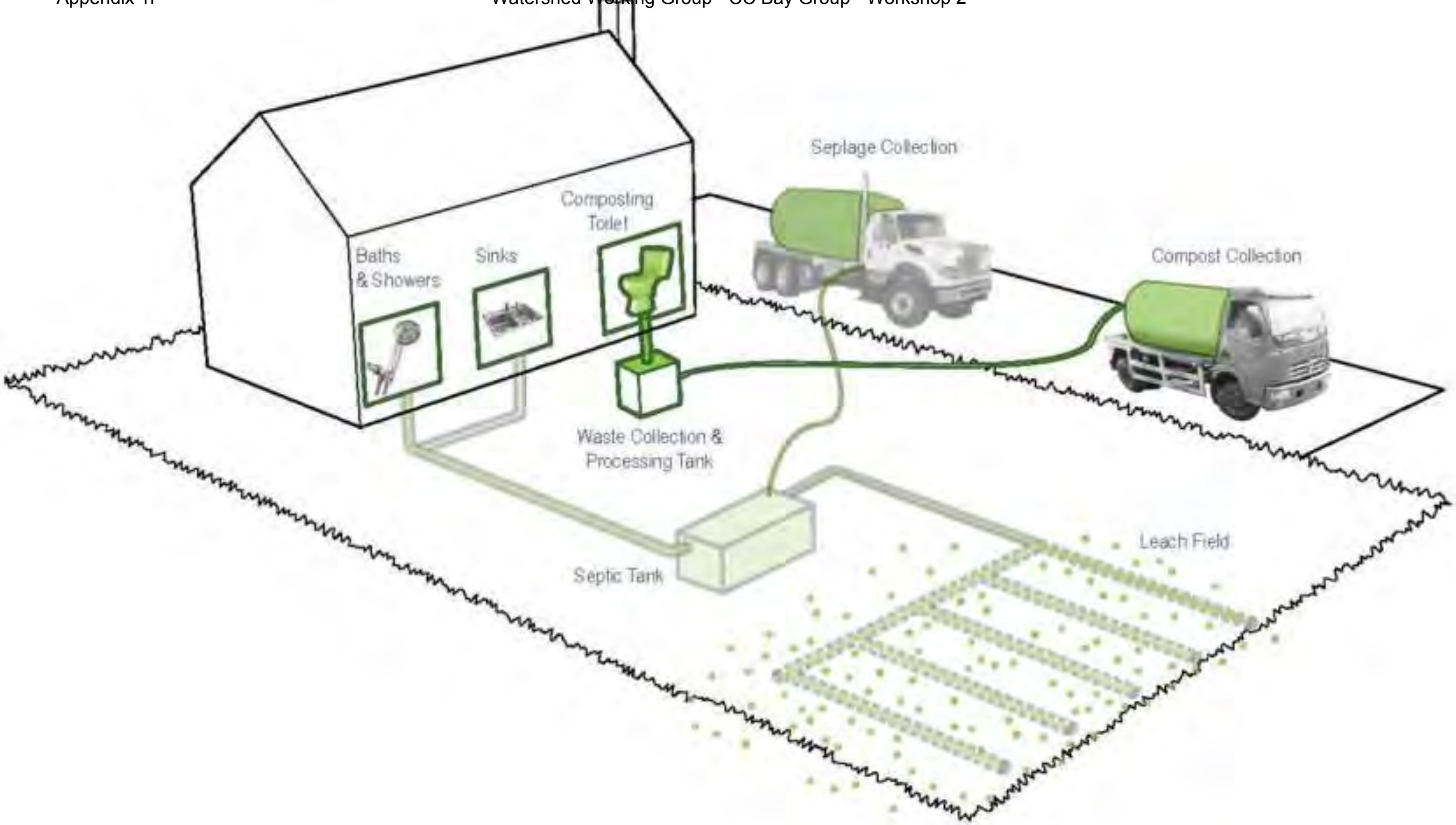
Waterless
Urinal

IBC container
(220 gallons)

40" x 40" x48"

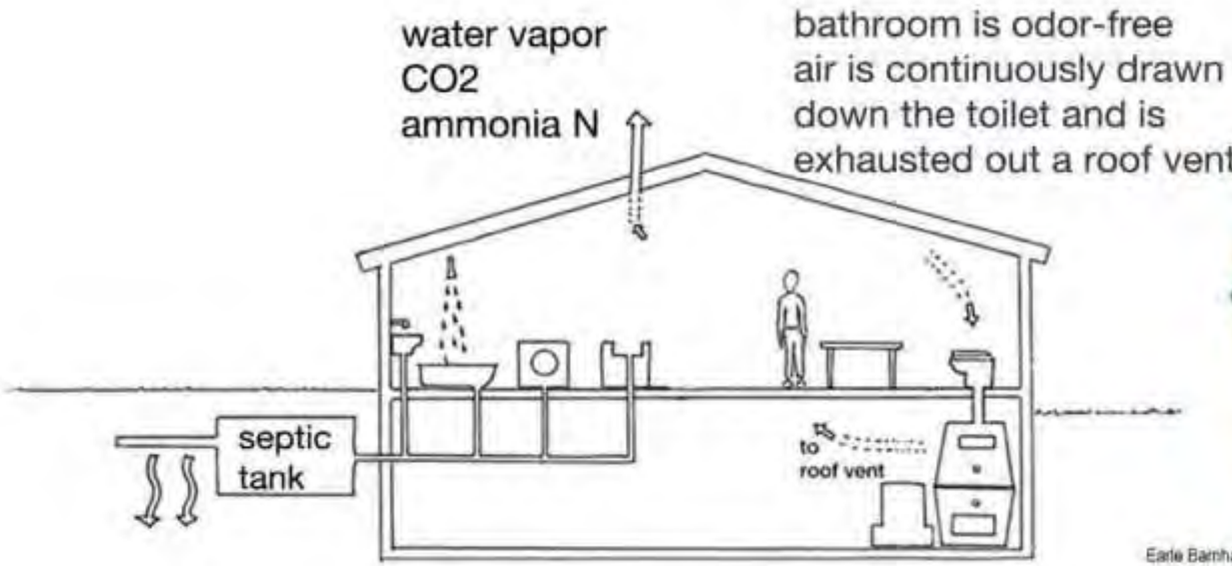
Source: Earle Barnhart, The Green Center Inc. and Horsley-Witten Group Inc.

Toilets: Urine Diverting



Scale: SITE
Target: WASTEWATER

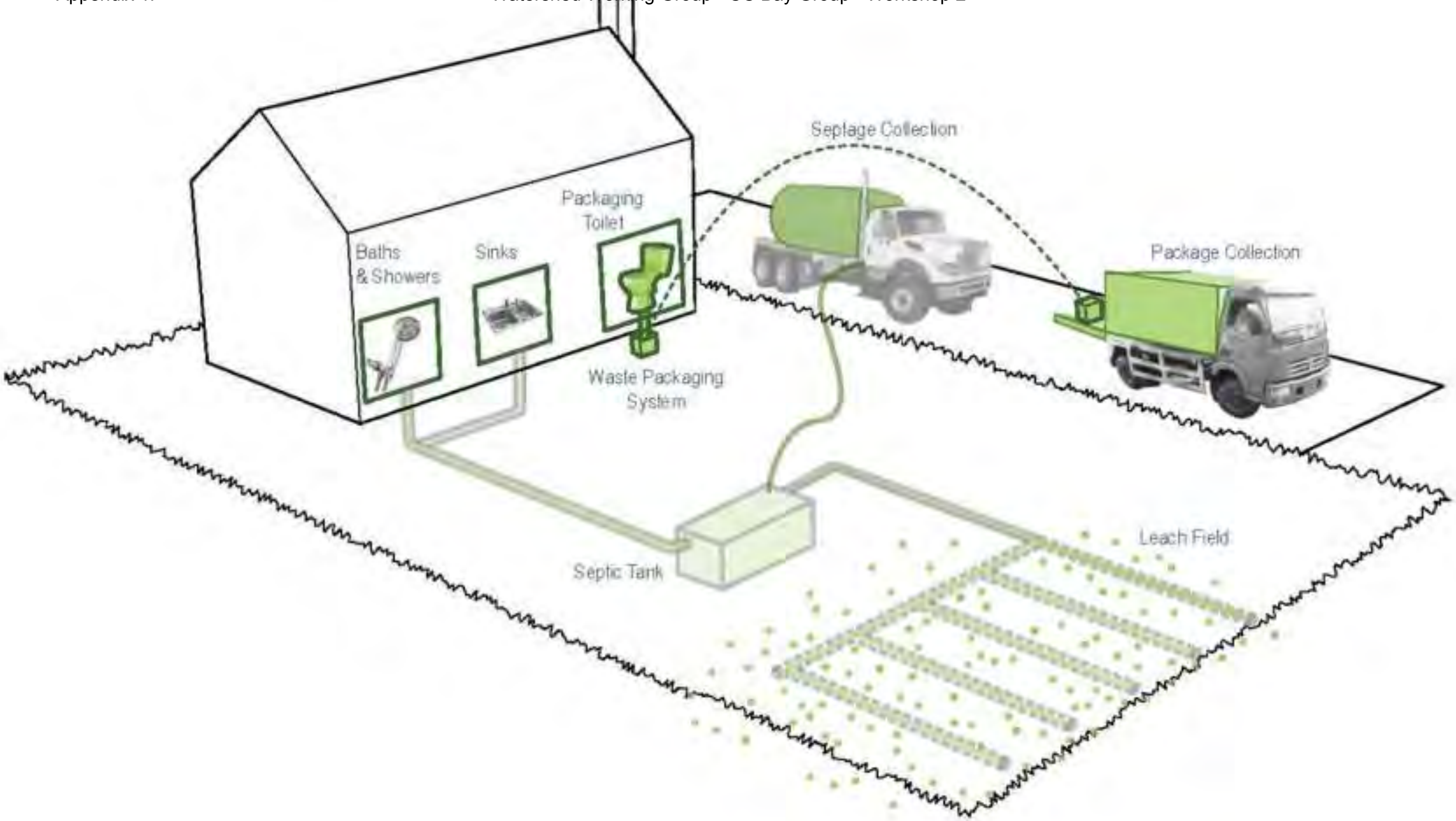
Toilets: Composting



Earle Barnhart
The Green Center, Inc

Source: Earle Barnhart, The Green Center Inc.

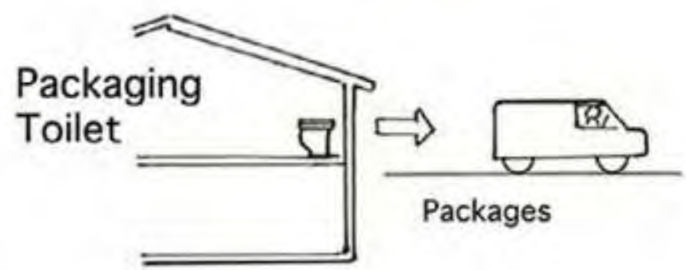
Toilets: Composting



Scale: SITE
Target: WASTEWATER

Toilets: Packaging

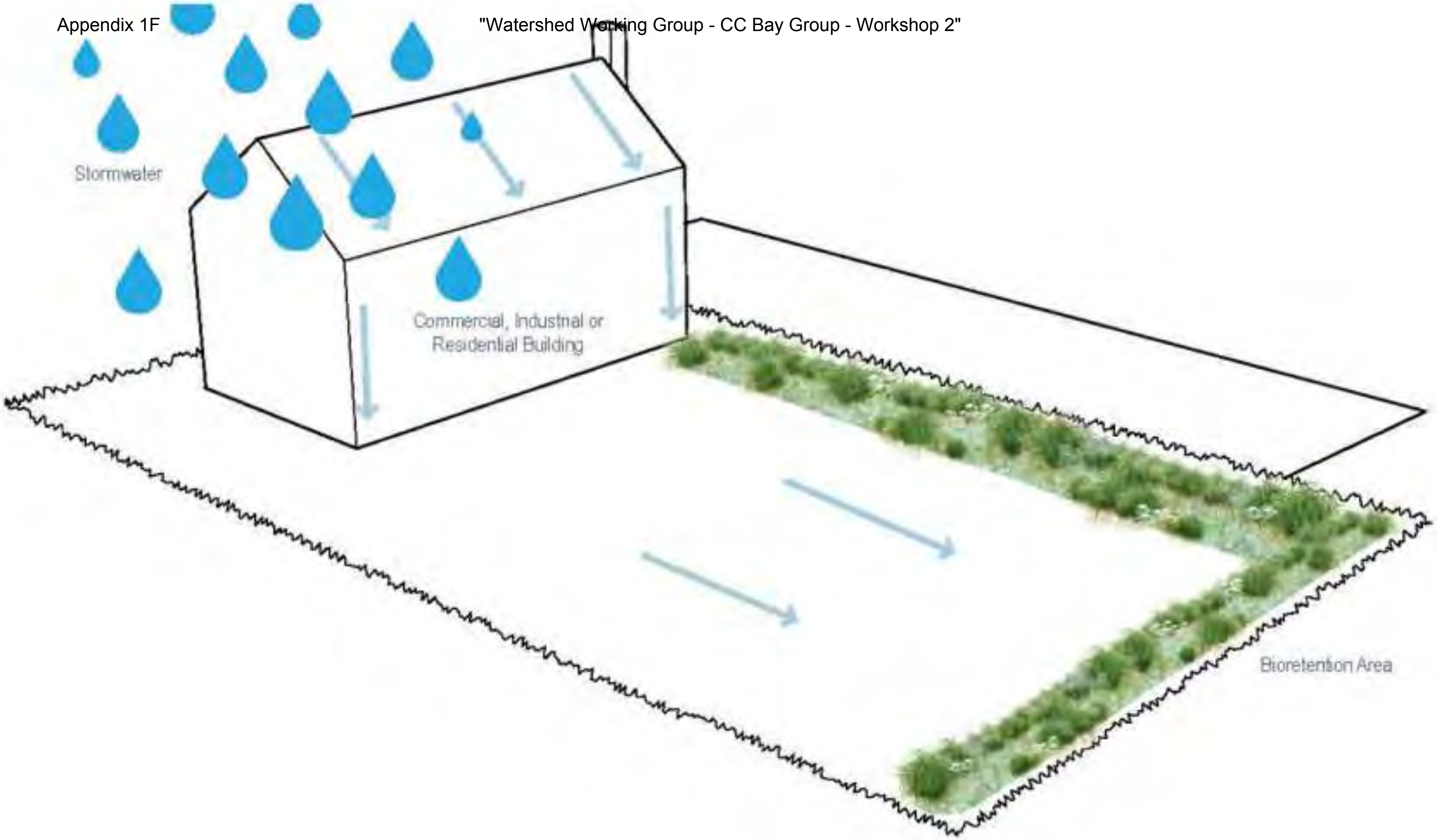
PACTO®



LOOWATT

Source: Earle Barnhart, The Green Center Inc.

Toilets: Packaging



Scale: SITE
Target: STORMWATER

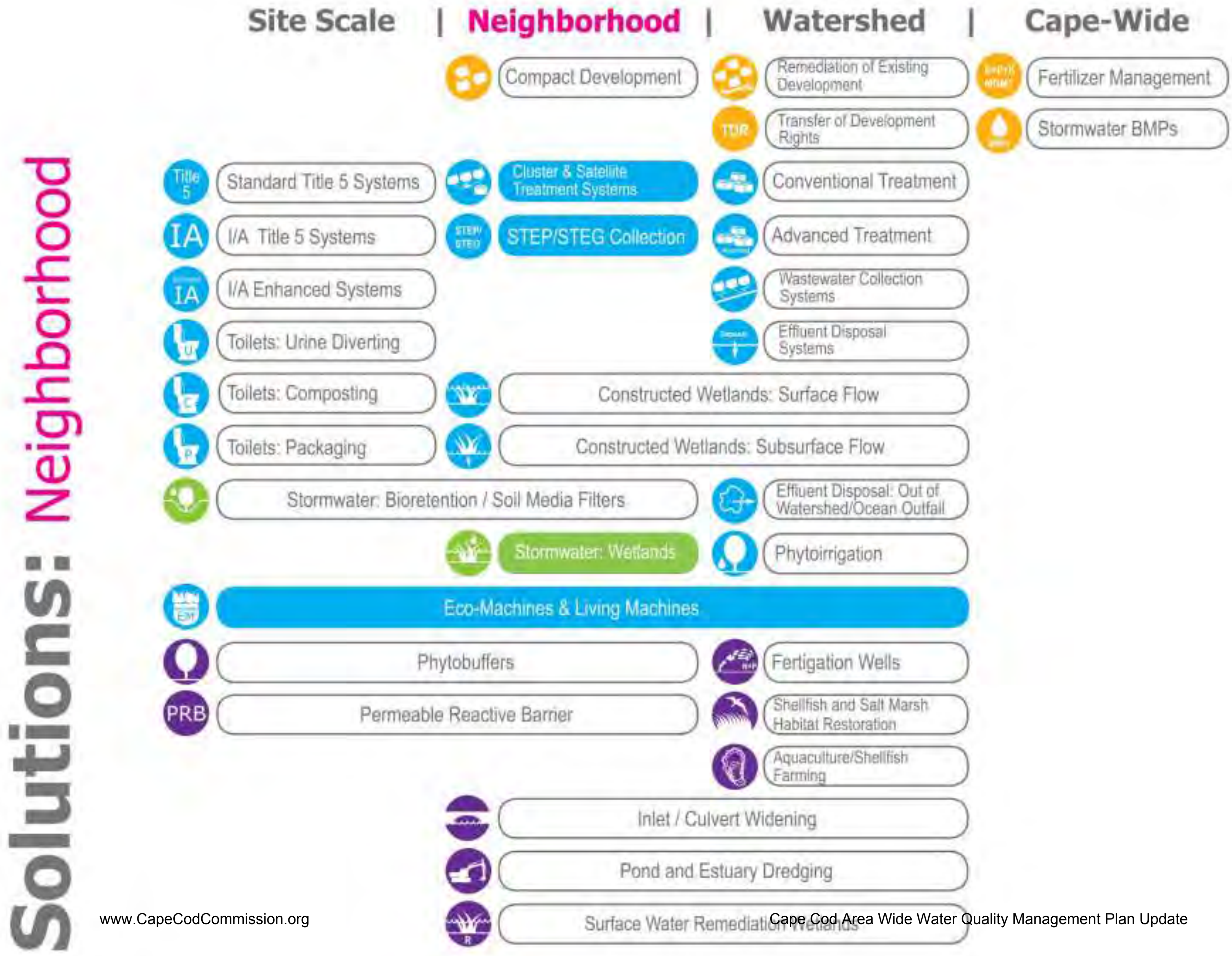
Stormwater Bioretention /
Soil Media Filters

Precedent: 12th Ave. Stormwater Project, Portland, OR

Source: City of Portland

Stormwater: Bioretention / Soil Media Filters

Rain Gardens


Site Scale | Neighborhood | Watershed | Cape-Wide
Solutions: Neighborhood
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
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Toilets: Packaging
Constructed Wetlands: Subsurface Flow
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Effluent Disposal: Out of Watershed/Ocean Outfall
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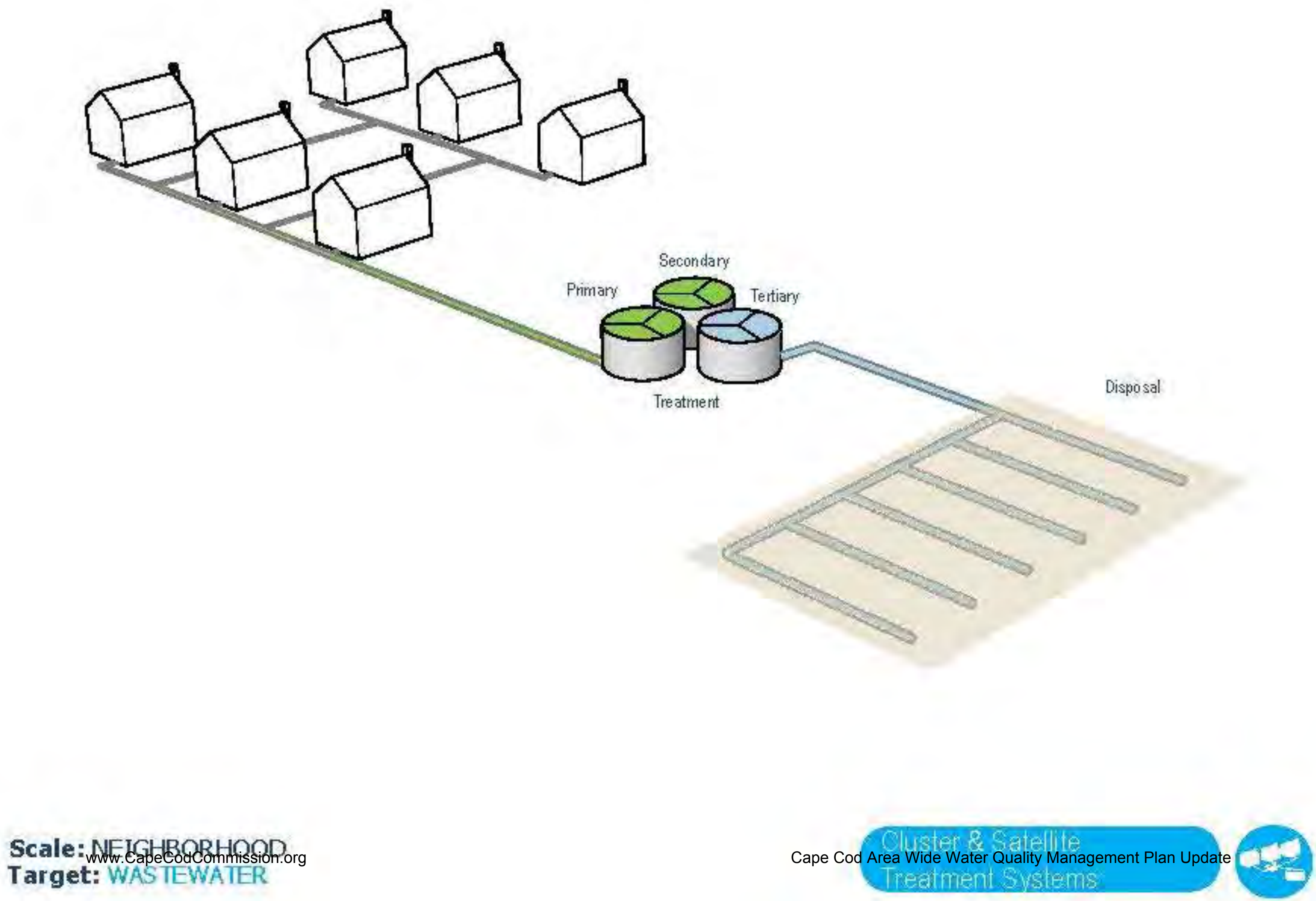
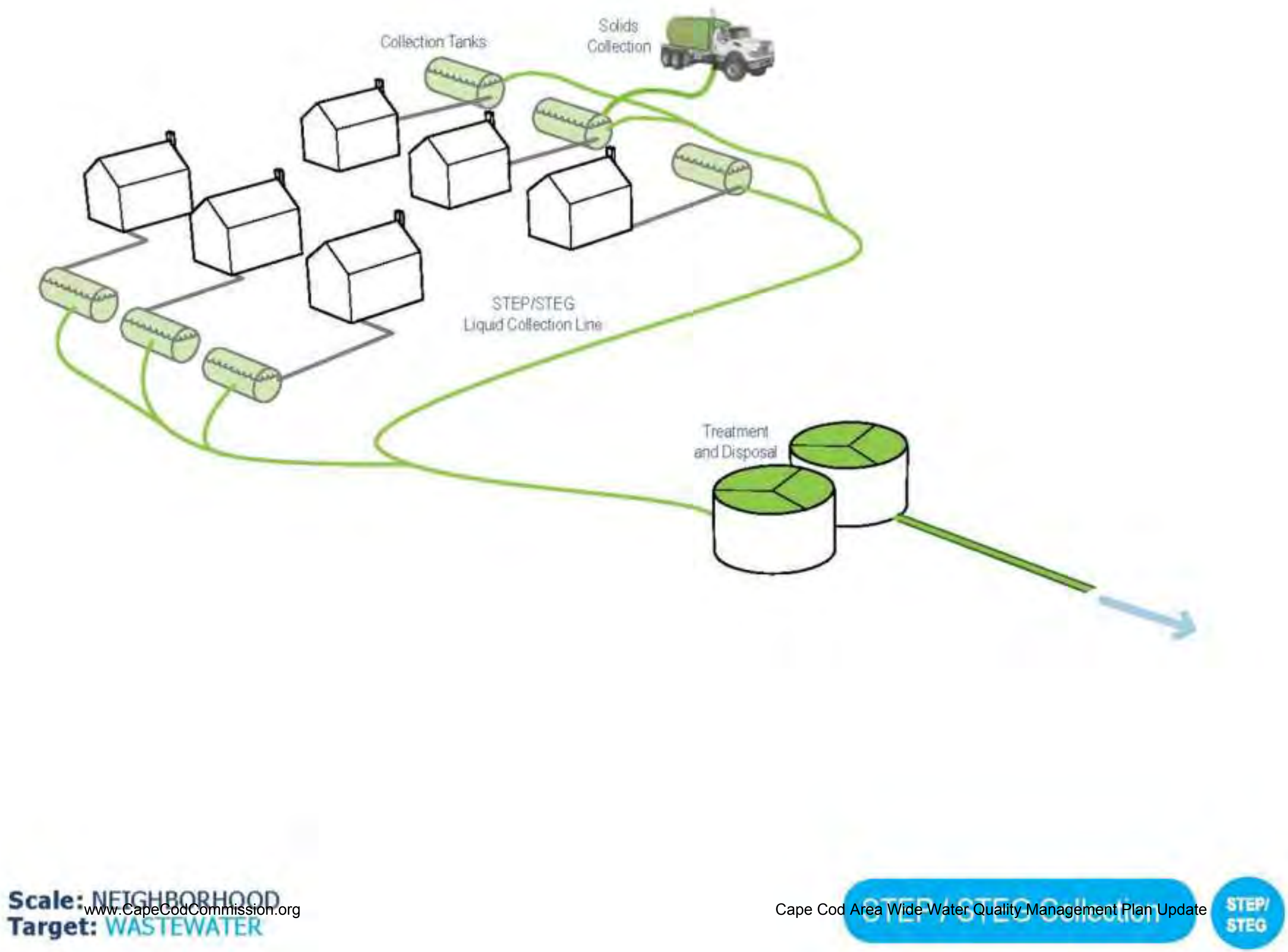
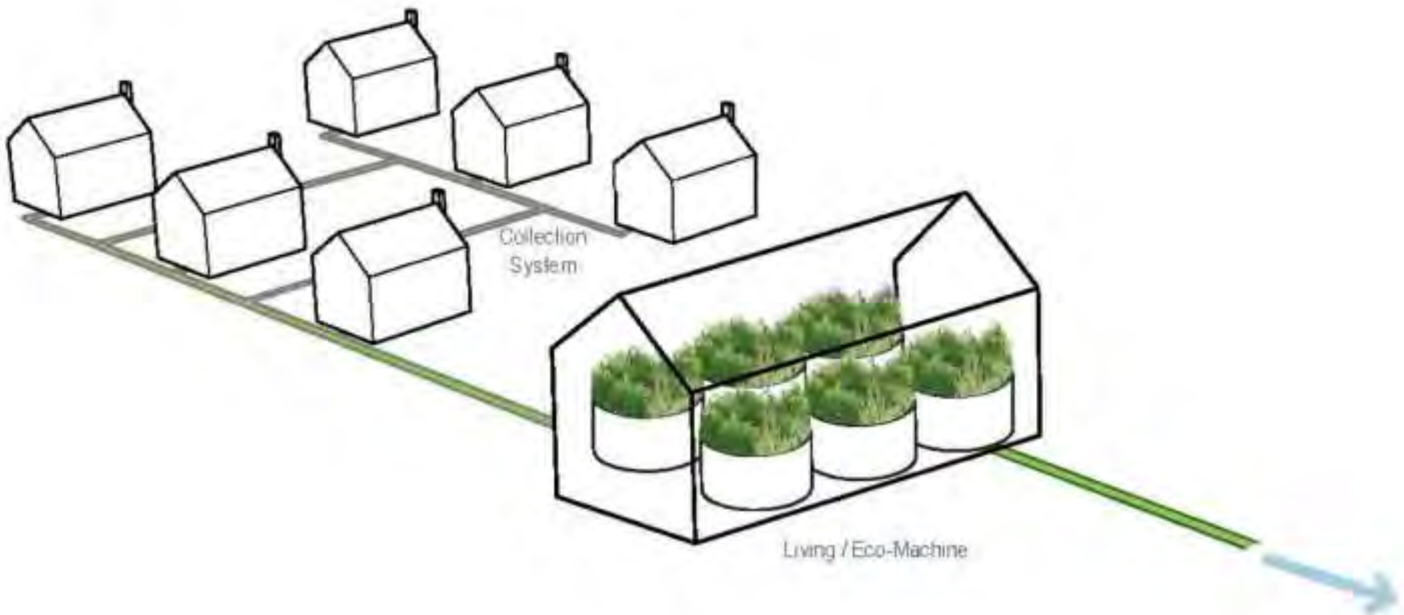
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
R
Surface Water Remediation Wetlands

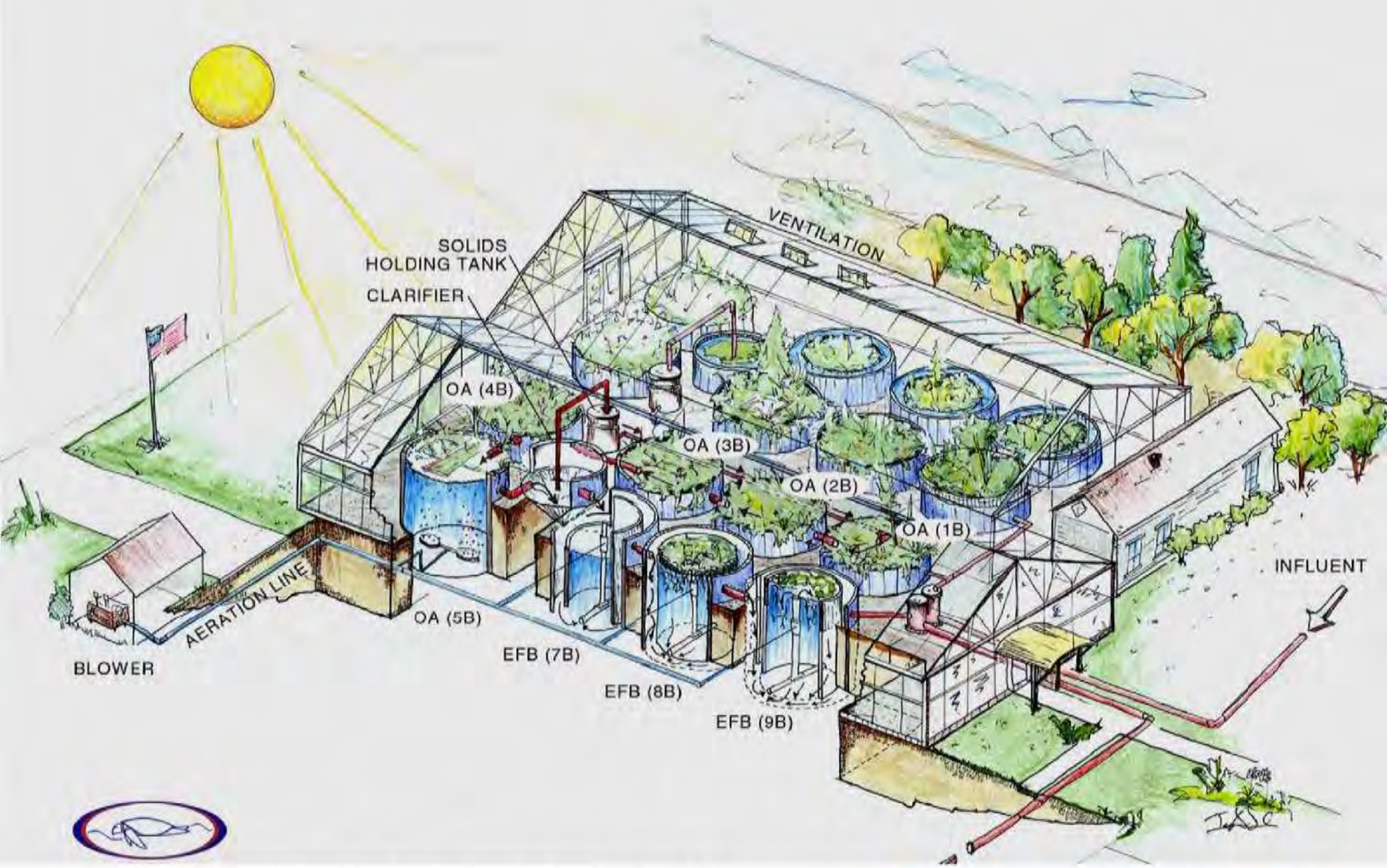

Secondary
Primary
Tertiary
Treatment
Disposal
Scale: NEIGHBORHOOD
Target: WASTEWATER
Cluster & Satellite
Treatment Systems


Collection Tanks
Solids
Collection
STEP/STEG
Liquid Collection Line
Treatment
and Disposal
Scale: NEIGHBORHOOD
Target: WASTEWATER
STEP / STEG Collection
STEP/
STEG



Scale: NEIGHBORHOOD
Target: WASTEWATER

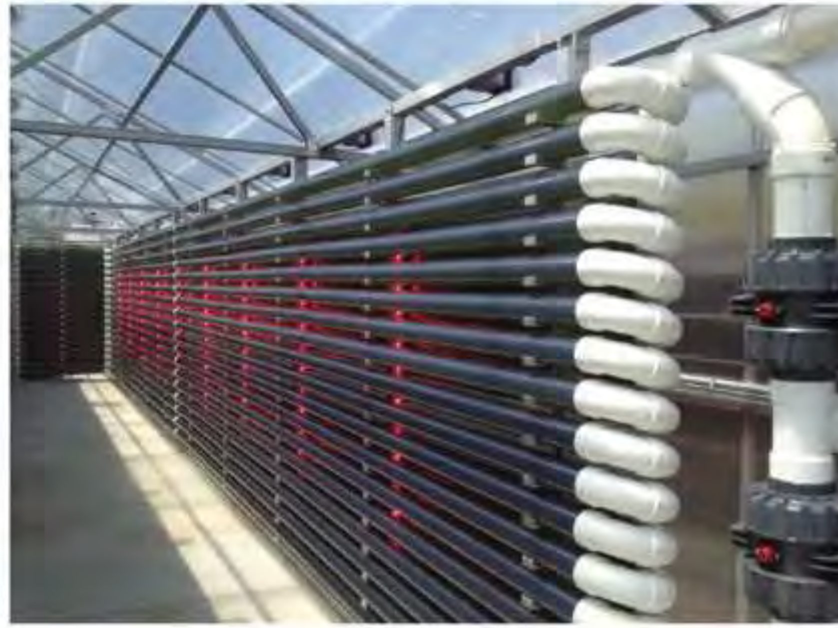
Eco-Machines and
Living Machines



Precedent: Living Machine, South Burlington, VT

Source: Todd Ecological

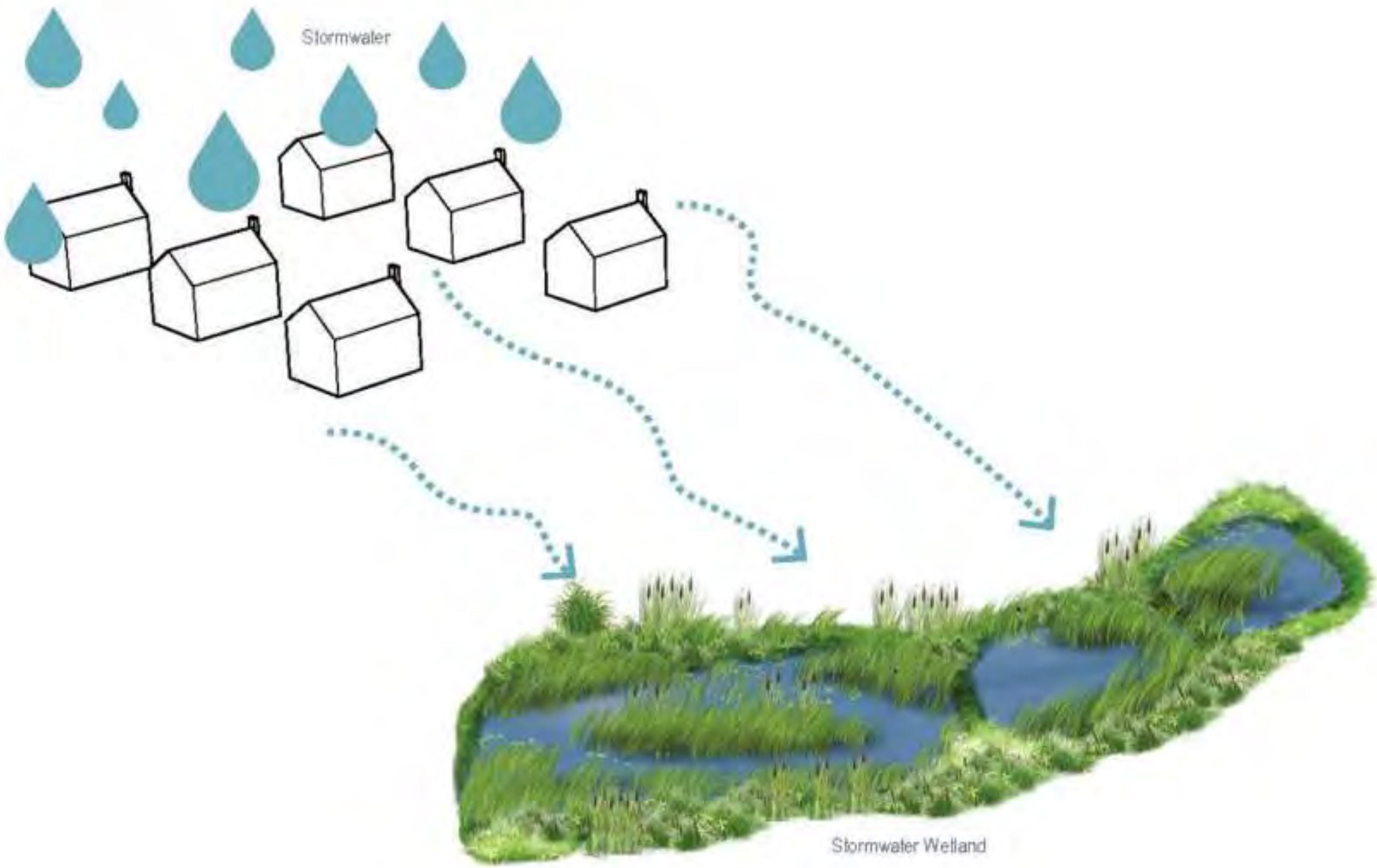
Eco-Machines and Living Machines



Precedent: Living Machine - South Burlington, VT + Photobioreactors - Falmouth, MA

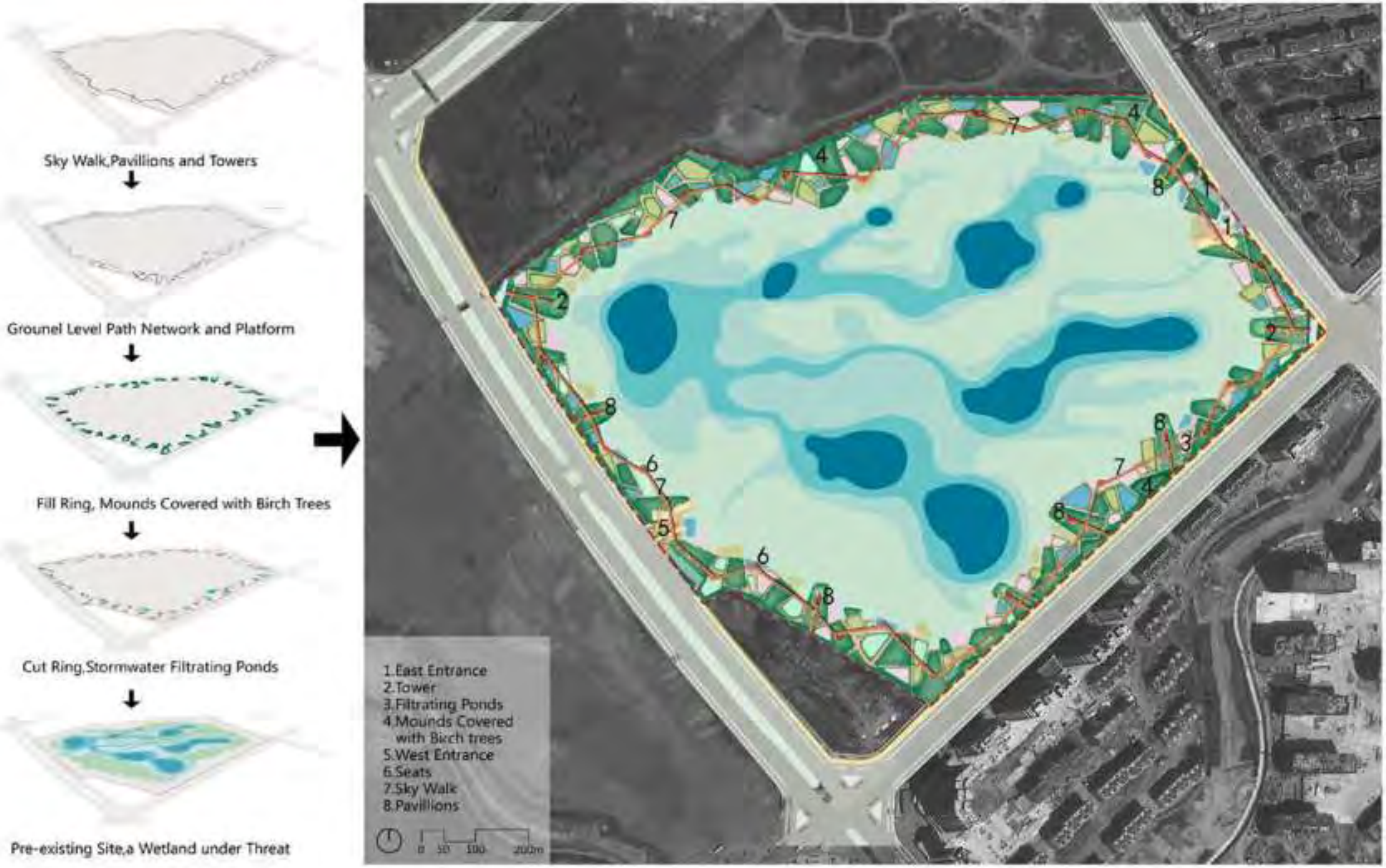
Source: Todd Ecological and Tom Cambareri

Eco-Machines and Living Machines



Scale: NEIGHBORHOOD
Target: STORMWATER

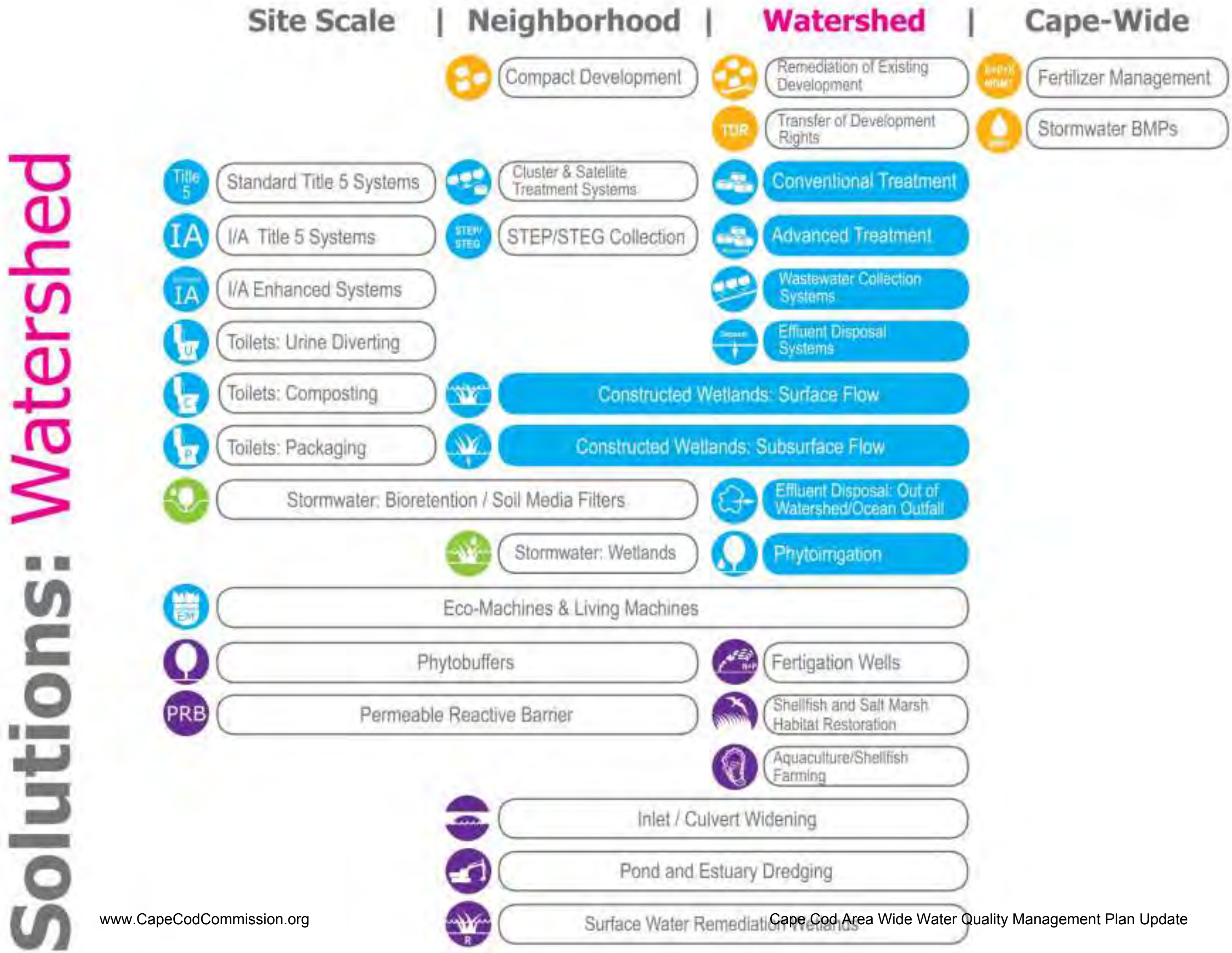
Stormwater Wetlands



Precedent: Quinli Stormwater Park, China

Source: Turenscape

Stormwater Wetlands


Solutions: Watershed
Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
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Toilets: Composting
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Toilets: Packaging
Constructed Wetlands: Subsurface Flow
Stormwater: Bioretention / Soil Media Filters
Effluent Disposal: Out of Watershed/Ocean Outfall
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PRB
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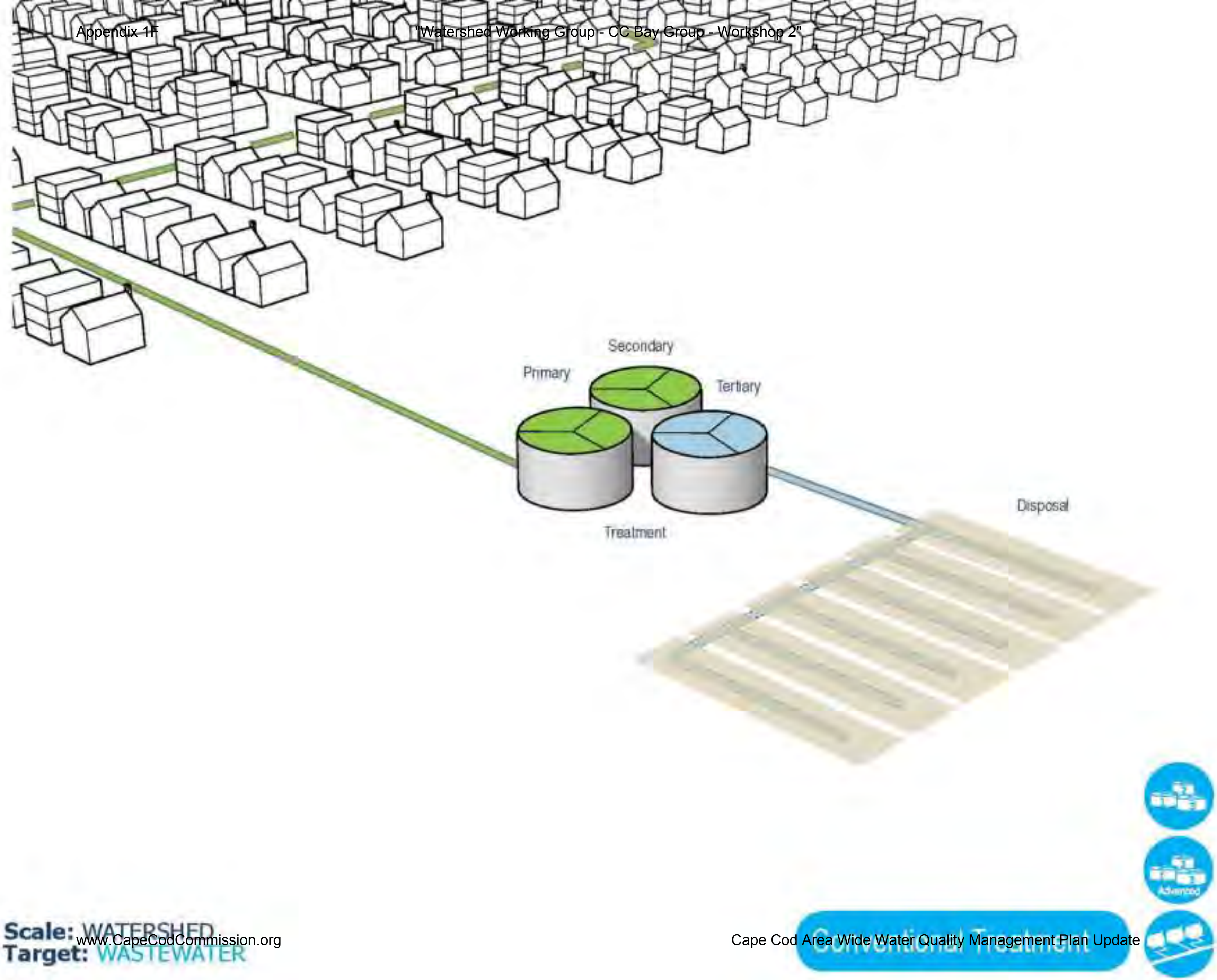
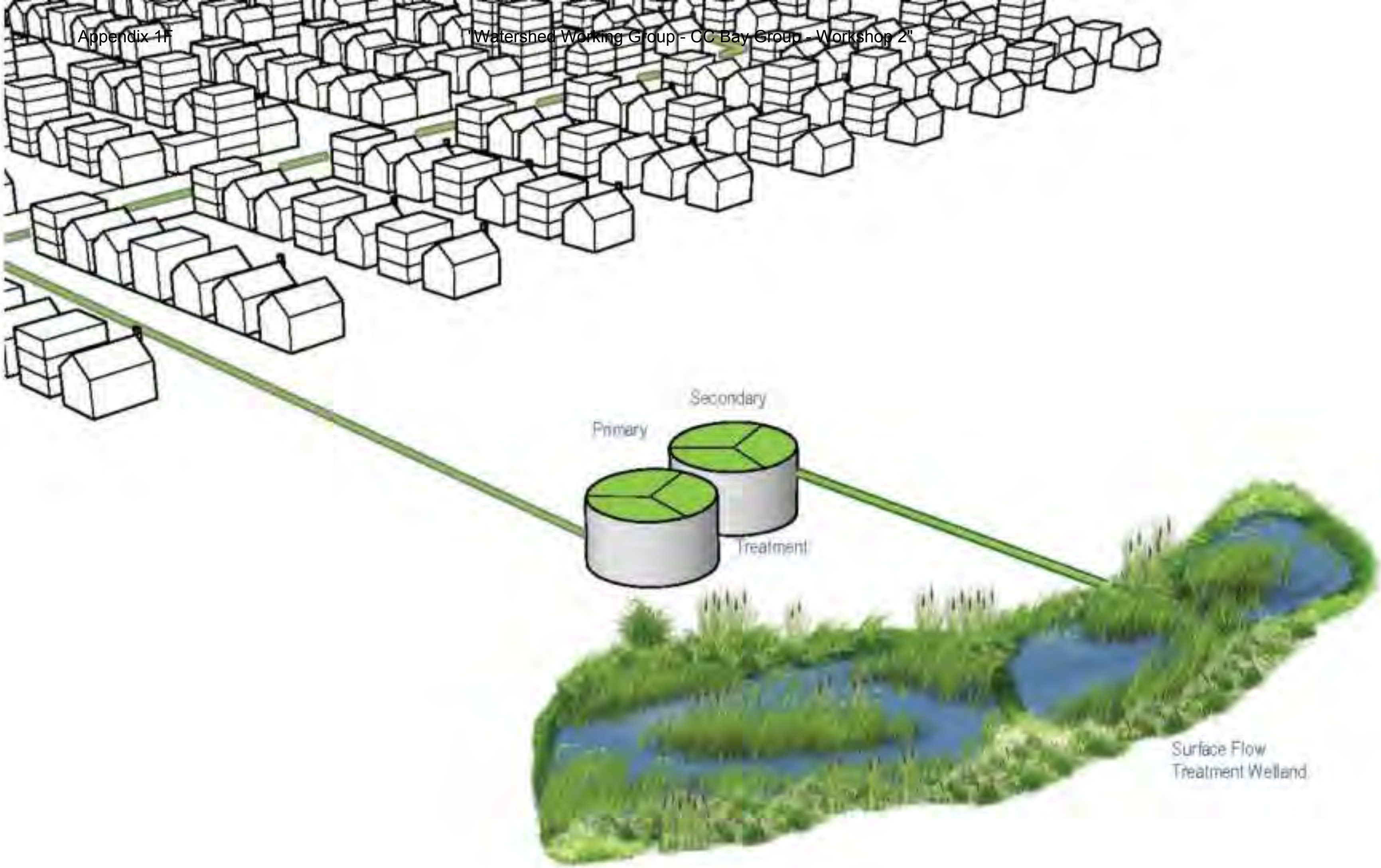
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands


Secondary
Primary
Tertiary
Treatment
Disposal
Advanced
Conventional Treatment
Scale: WATERSHED
Target: WASTEWATER

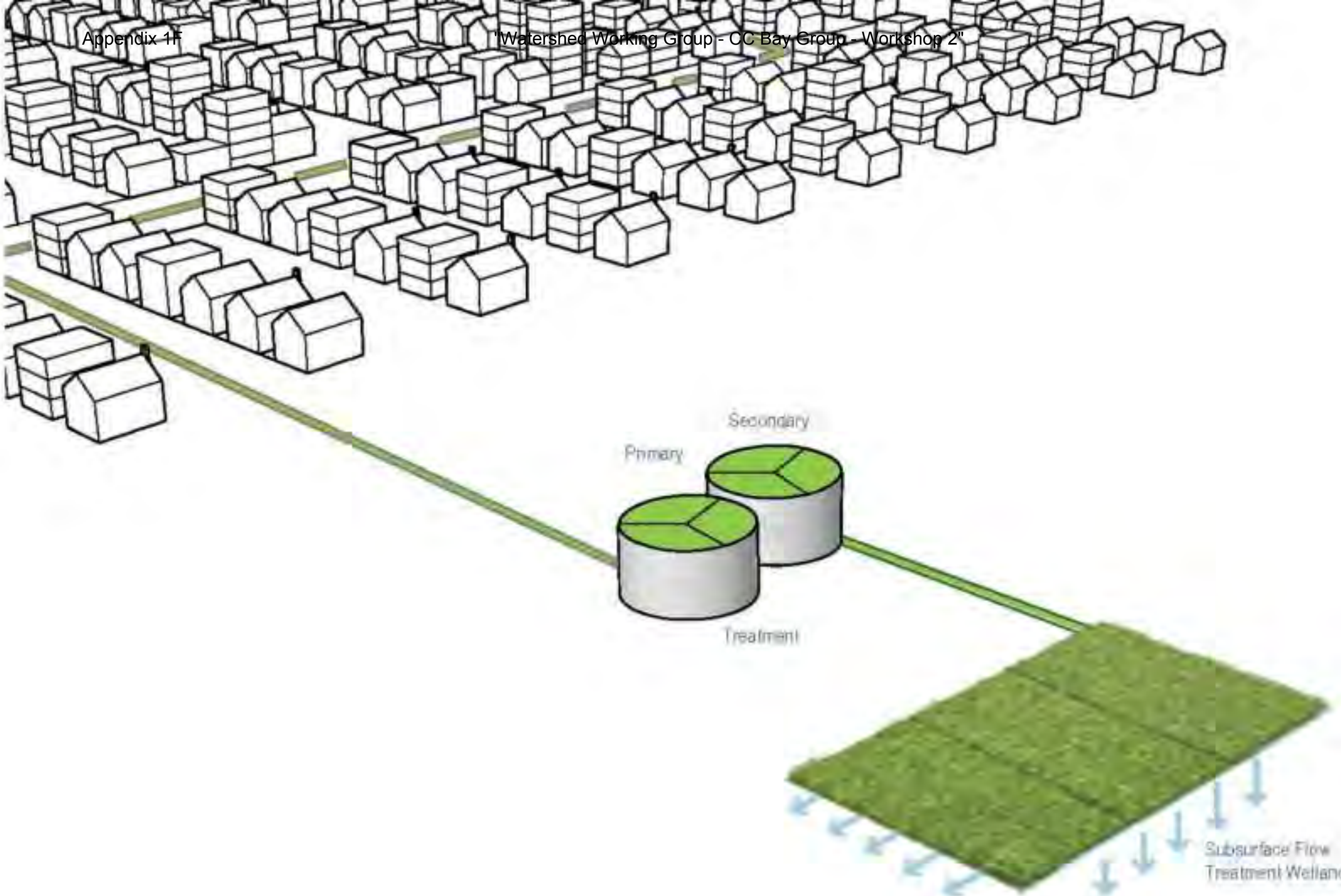


Scale: WATERSHED
Target: WASTEWATER

Constructed Wetlands
Surface Flow

Precedent: Talking Waters Garden - Albany, OR
Source: Kate Kennen

Constructed Wetlands: Surface Flow



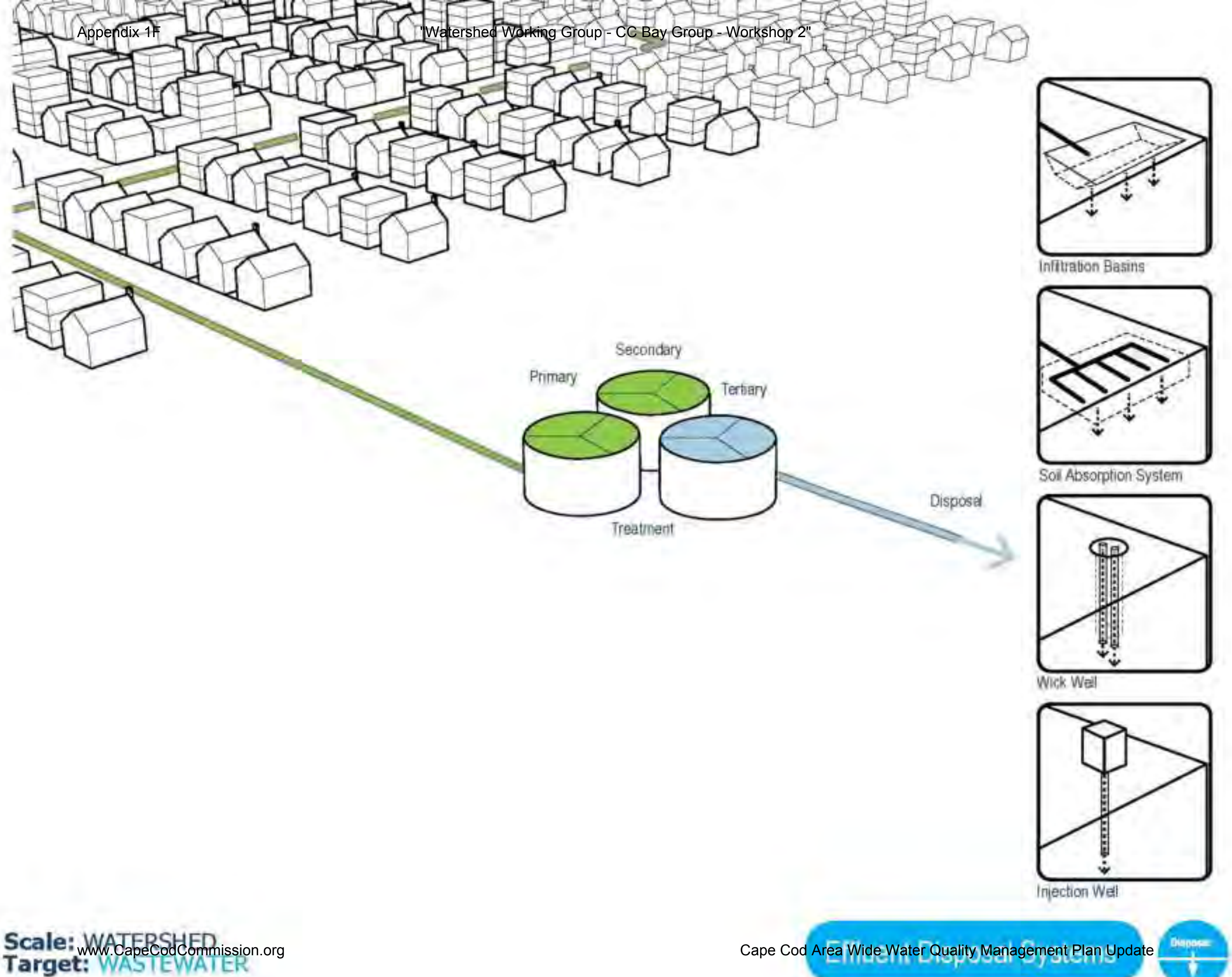
Scale: WATERSHED
Target: WASTEWATER

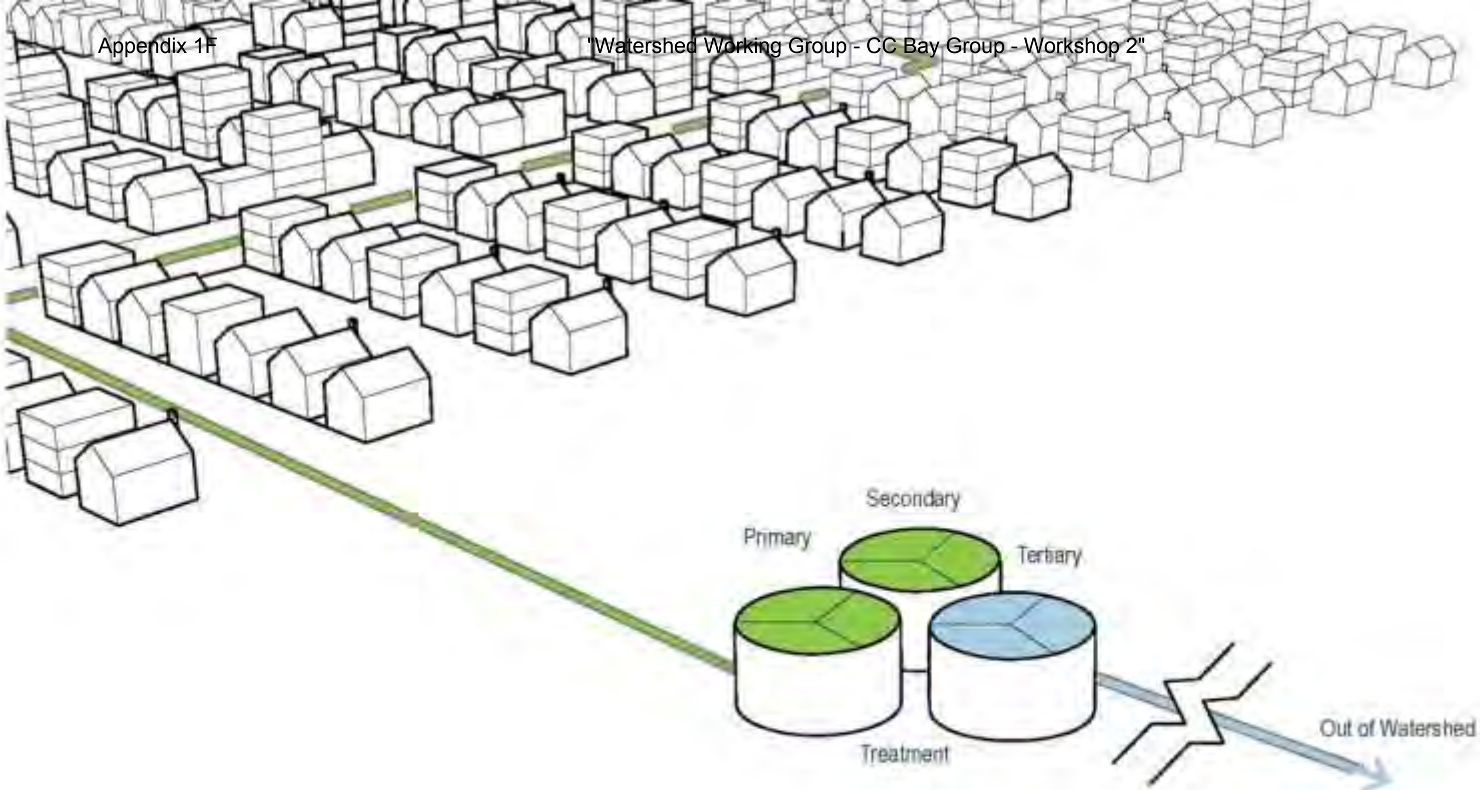
Constructed Wetlands
Subsurface Flow

Precedent: Koh Phi Phi Treatment Wetland, Thailand

Source: Hans Brix

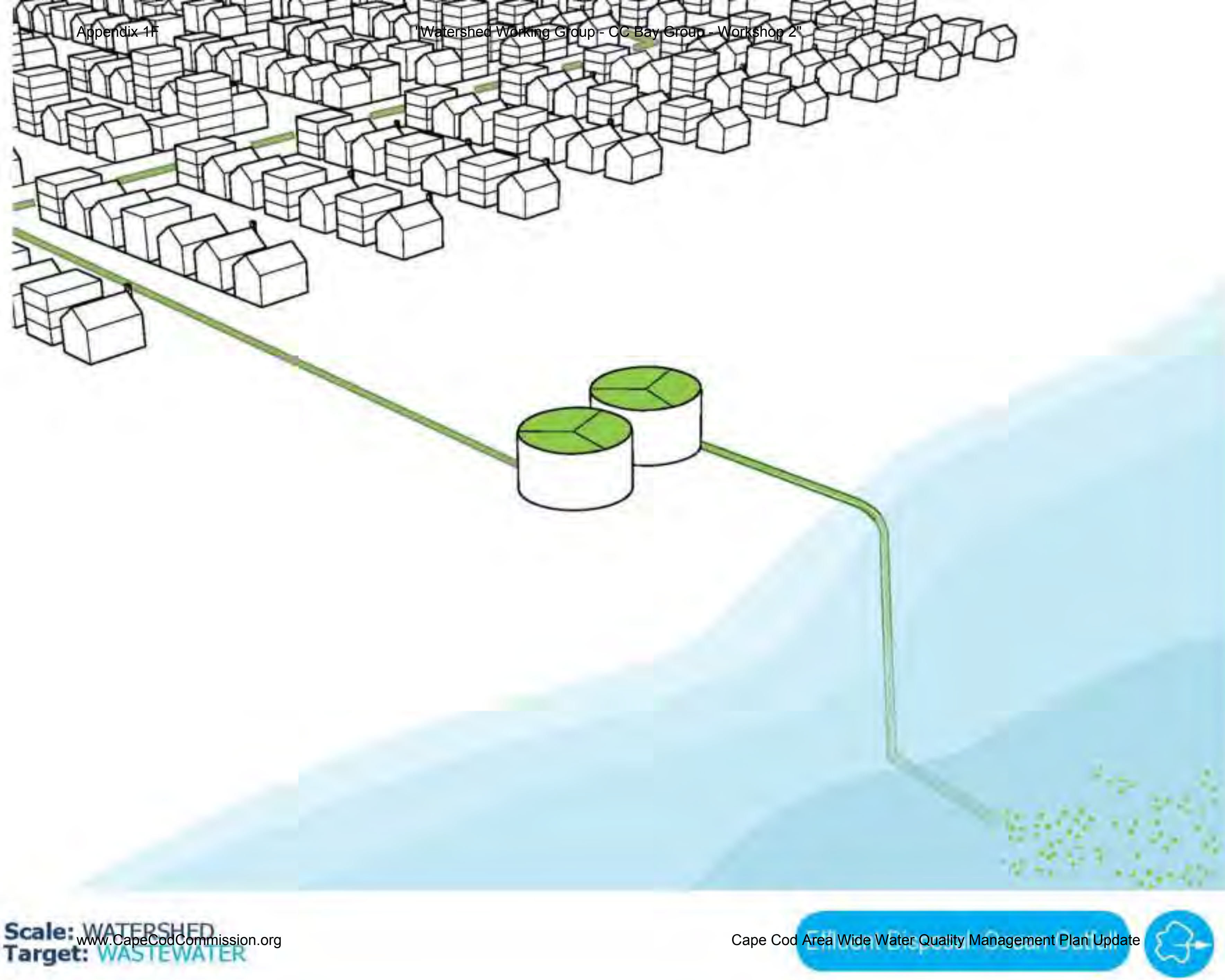
Constructed Wetlands: Subsurface Flow

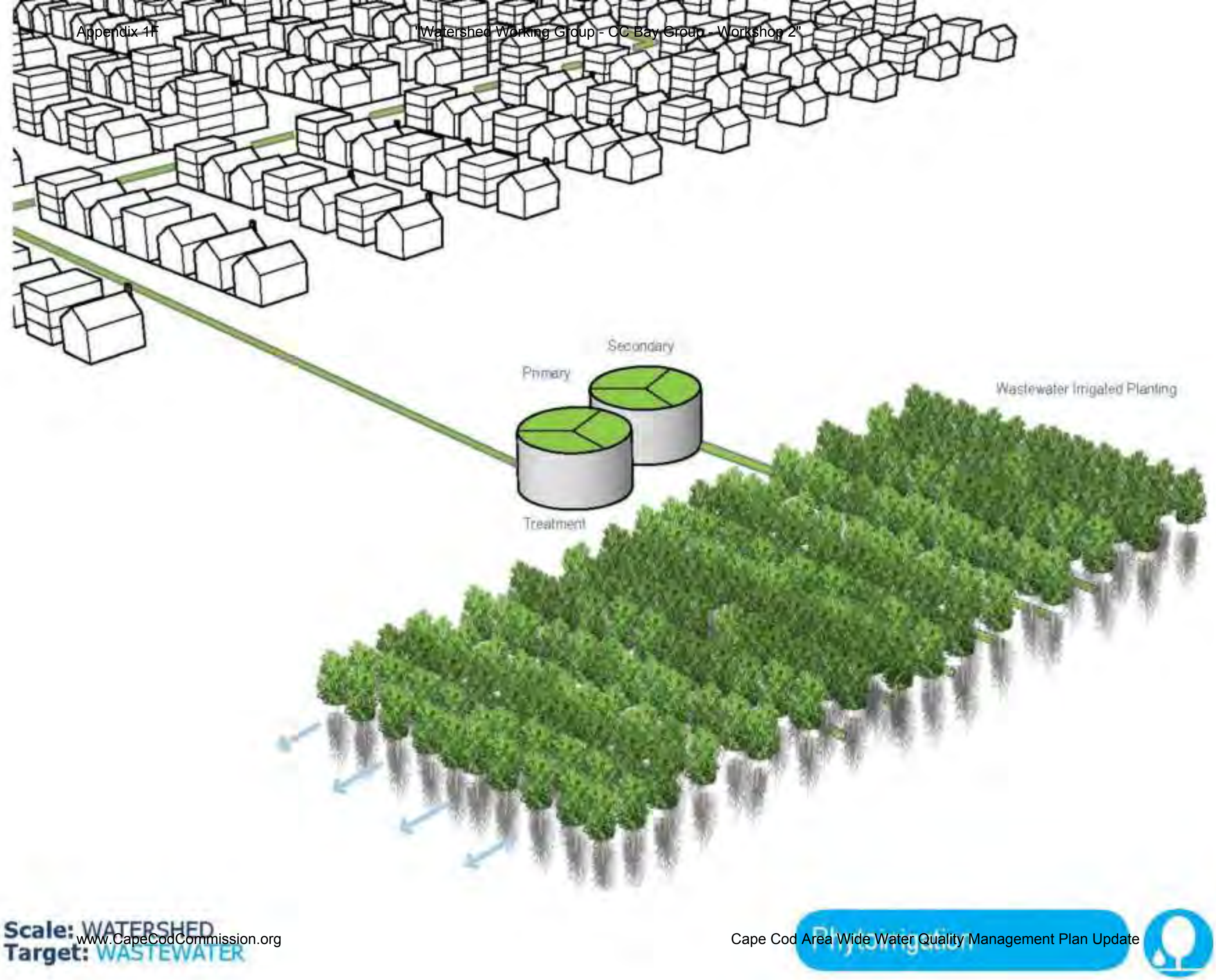

Secondary
Primary
Tertiary
Treatment
Disposal
Infiltration Basins
Soil Absorption System
Wick Well
Injection Well
Scale: WATERSHED
Target: WASTEWATER
Effluent Disposal Systems
Disposal



Scale: WATERSHED
Target: WASTEWATER

Effluent Disposal: Out of Watershed


Scale: WATERSHED
Target: WASTEWATER


Secondary
Primary
Treatment
Wastewater Irrigated Planting
Scale: WATERSHED
Target: WASTEWATER
Phytoirrigation

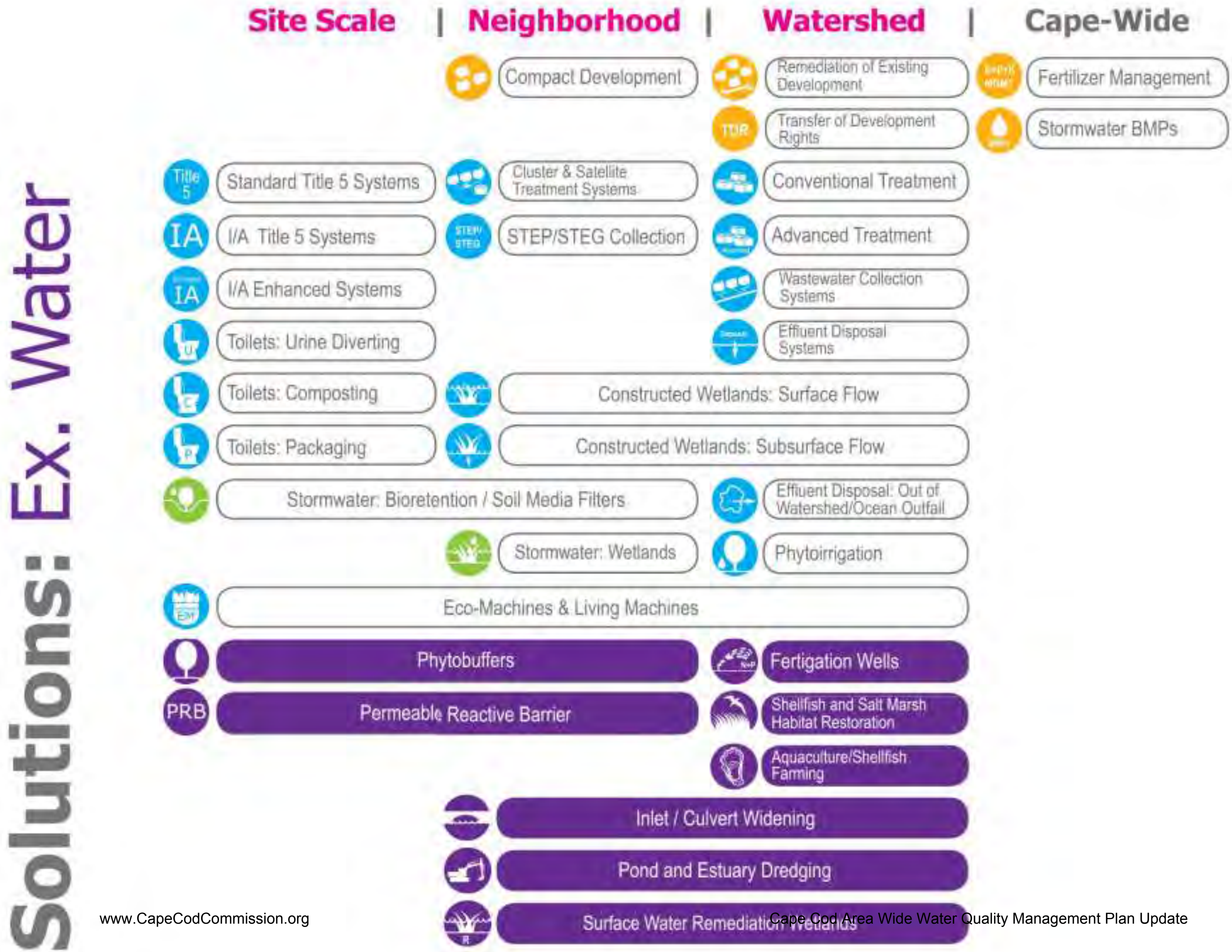
Precedent: Woodburn OR, Wastewater Treatment Facility

Source: CH2MHill

Phytoirrigation

Precedent: Woodburn OR, Wastewater Treatment Facility
Source: CH2MHill

Phytoirrigation


Solutions: Ex. Water
Site Scale
Neighborhood
Watershed
Cape-Wide
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
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Toilets: Packaging
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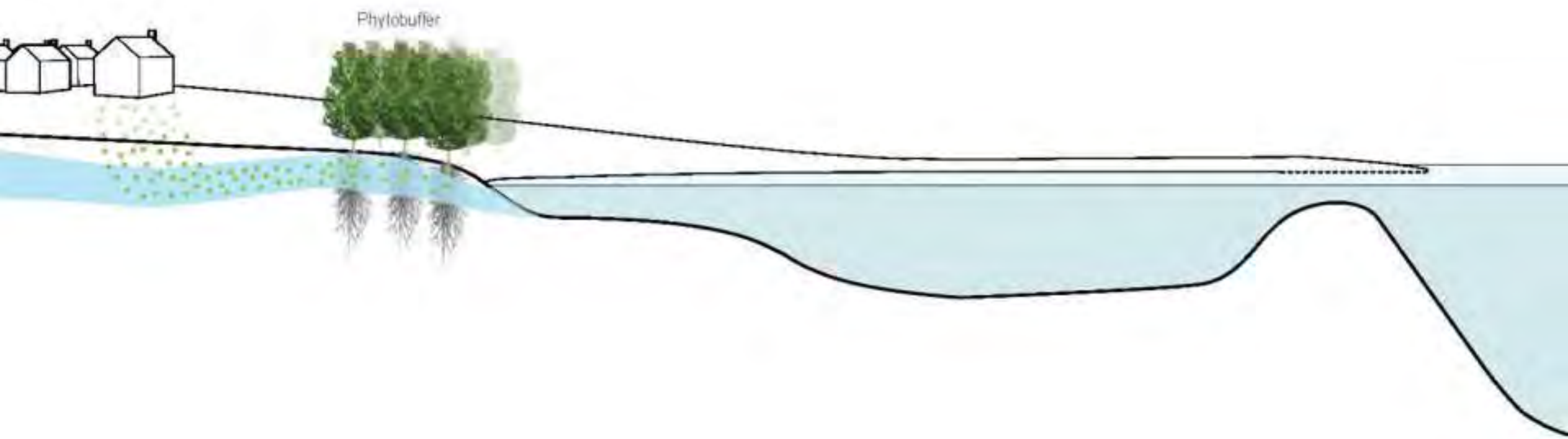
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands



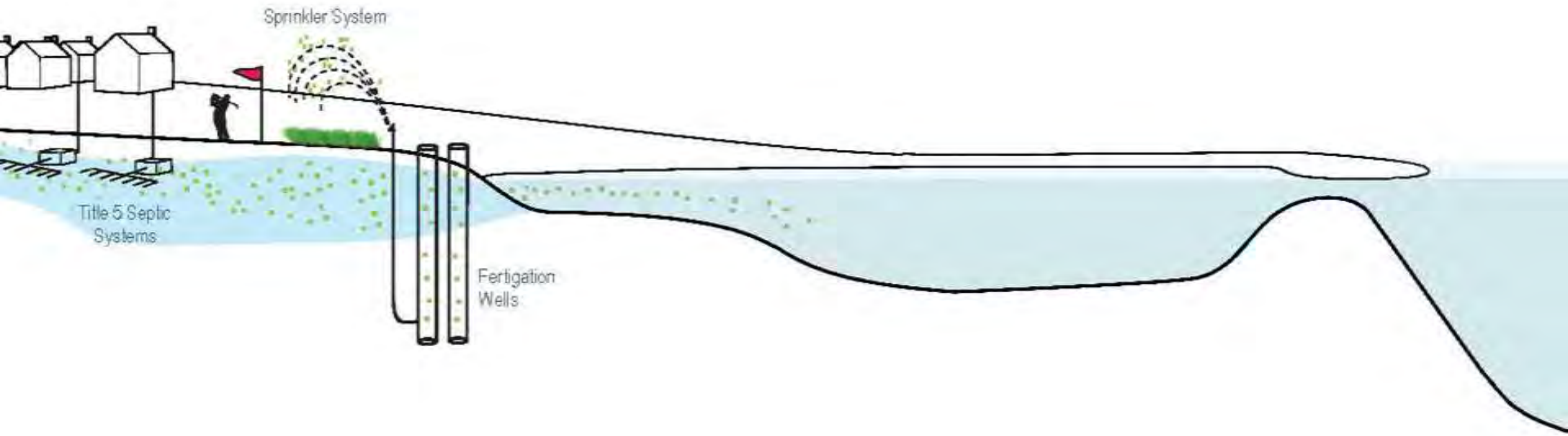
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Phytobuffers

Precedent: Phytobuffer - Kavcee, WY

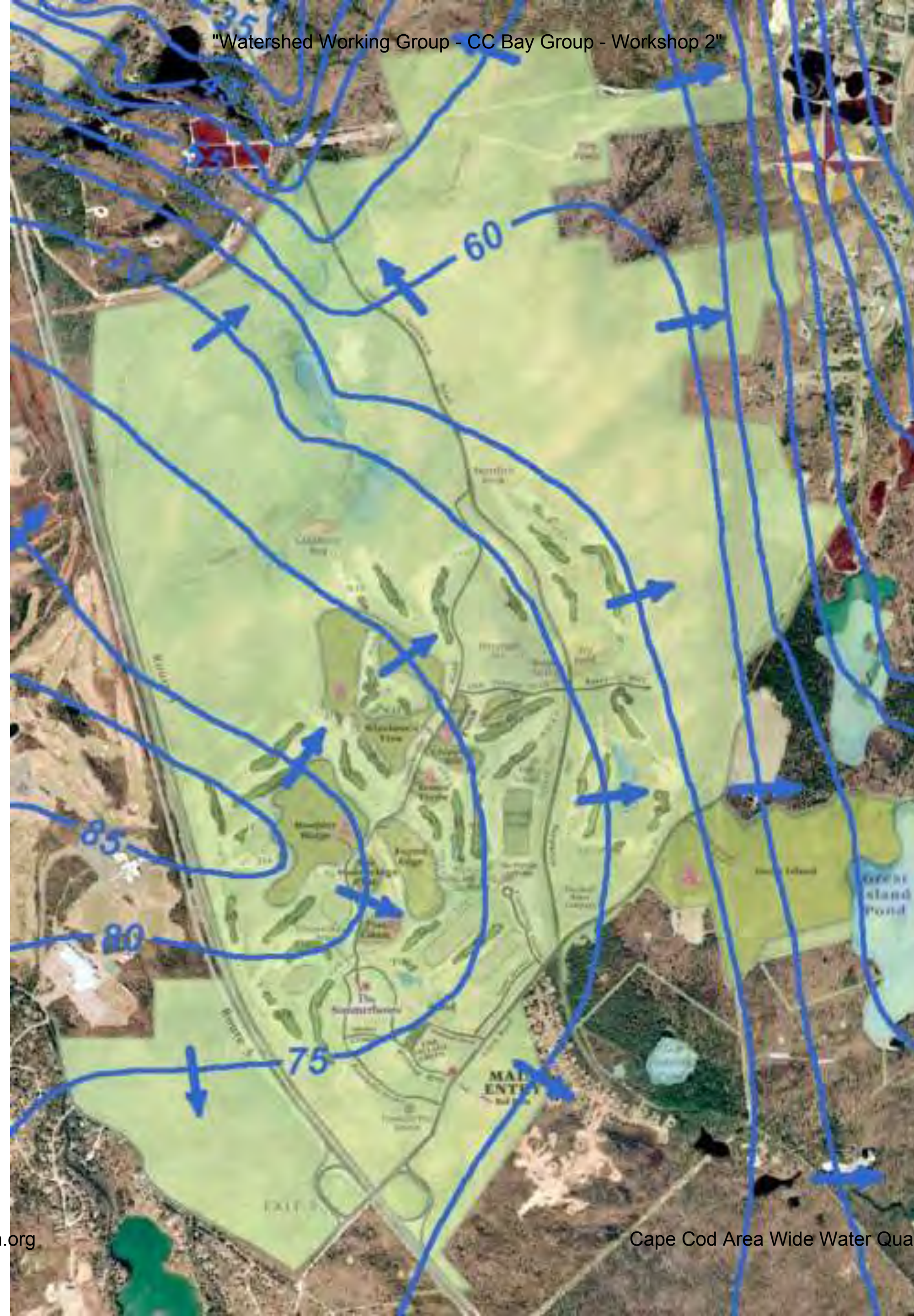
Source: Sand Creek Consultants

Phytobuffers

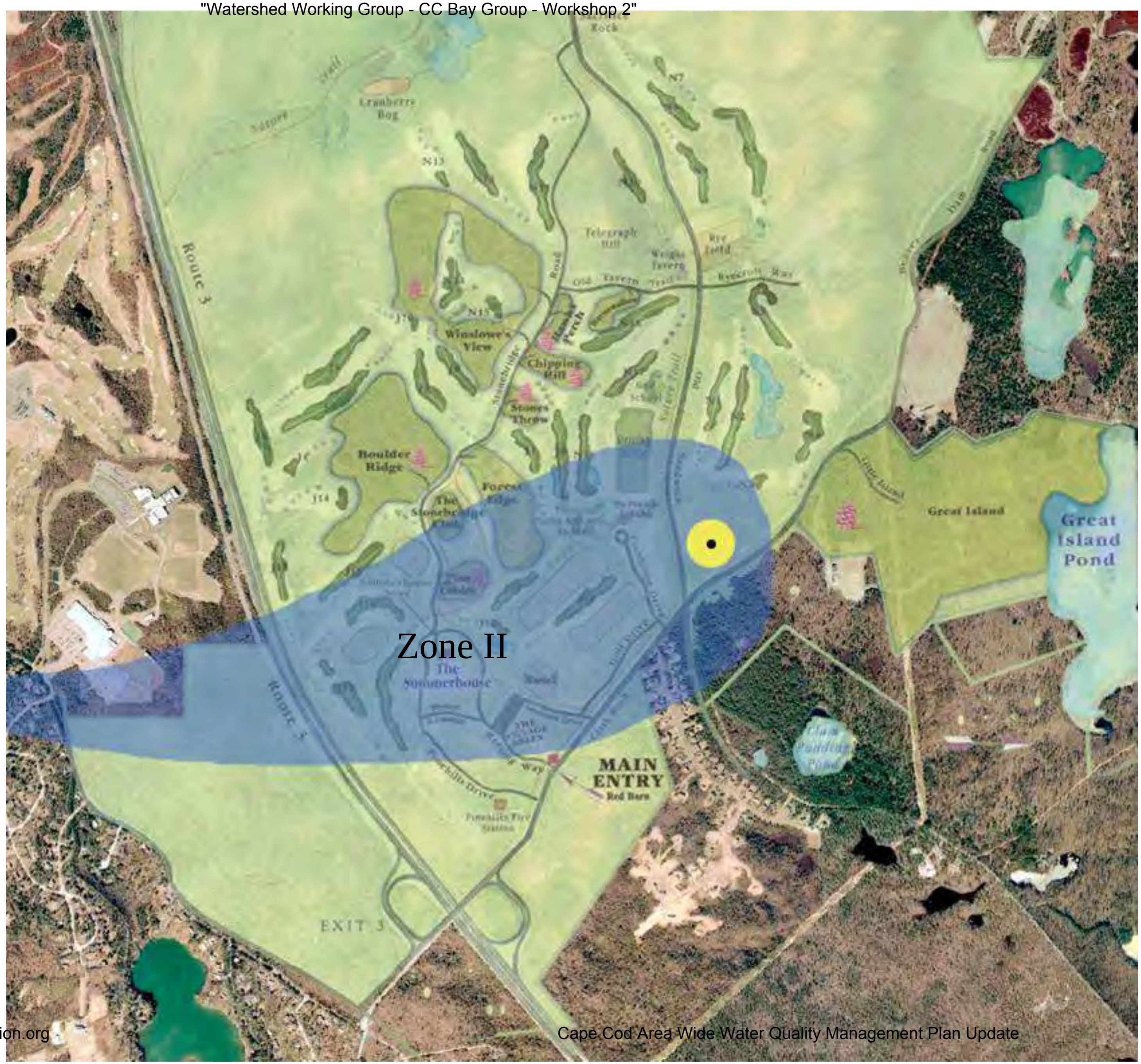


Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

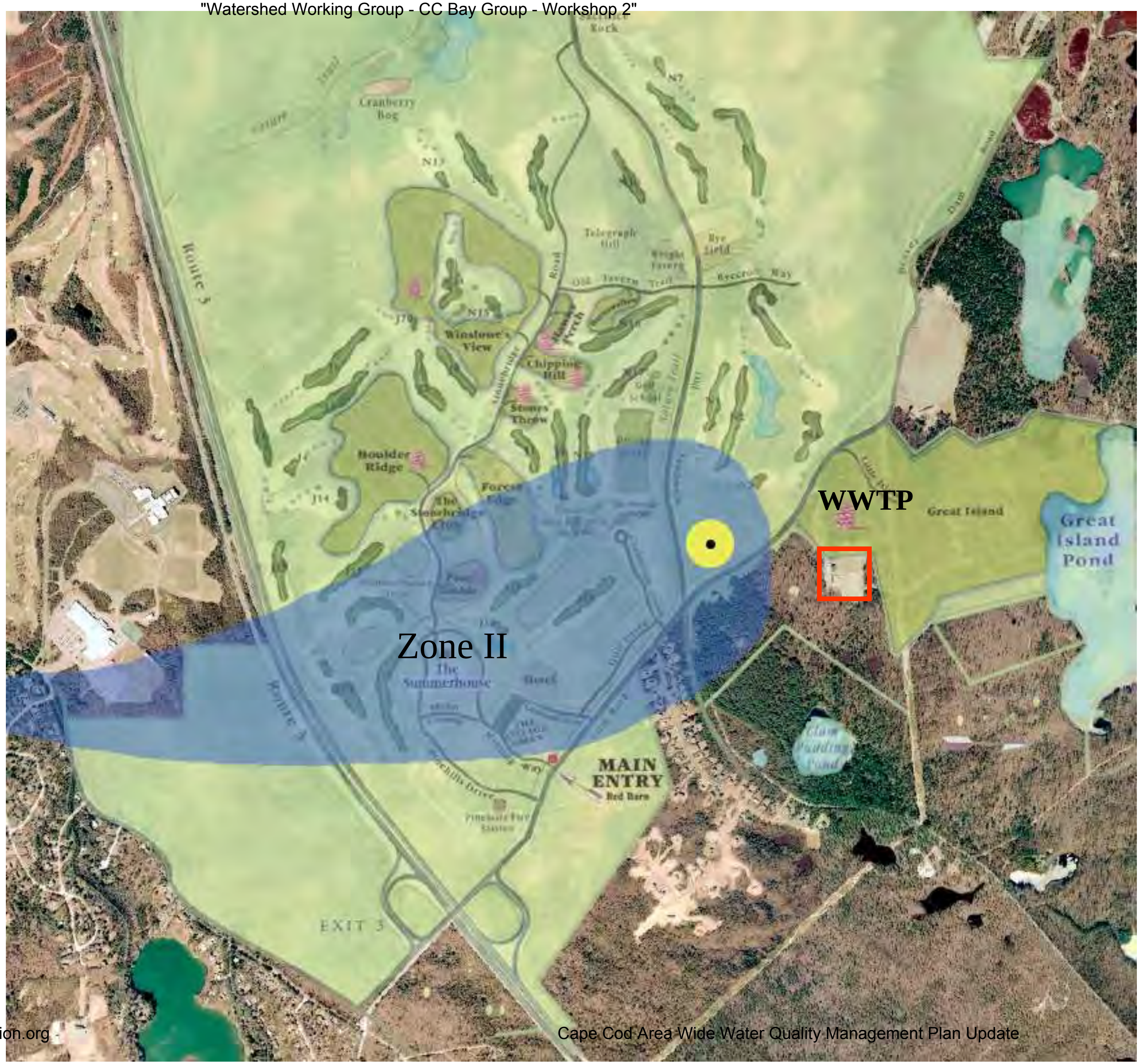
Fertigation Wells



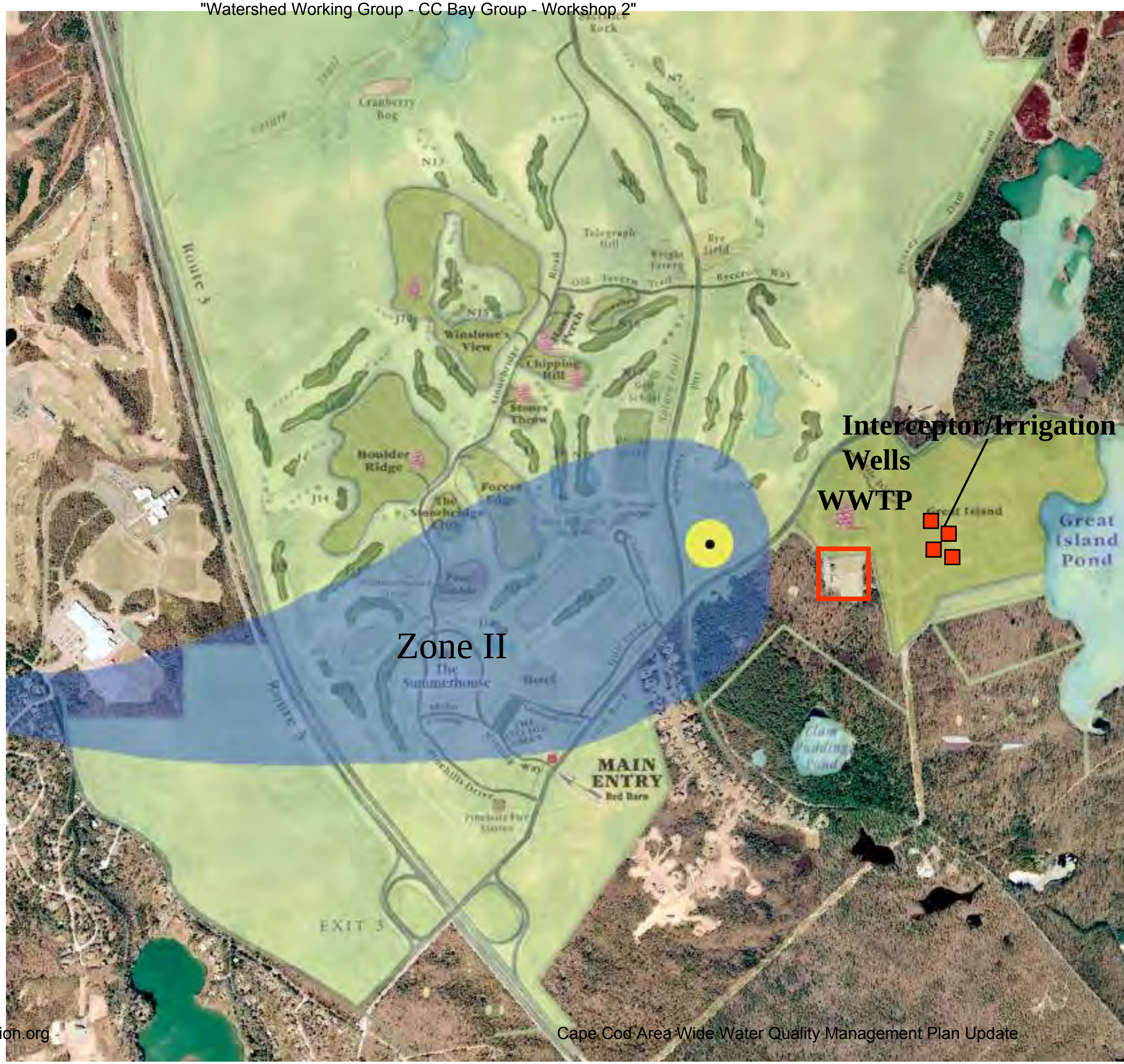
Precedent:
Pine Hills
Plymouth, MA



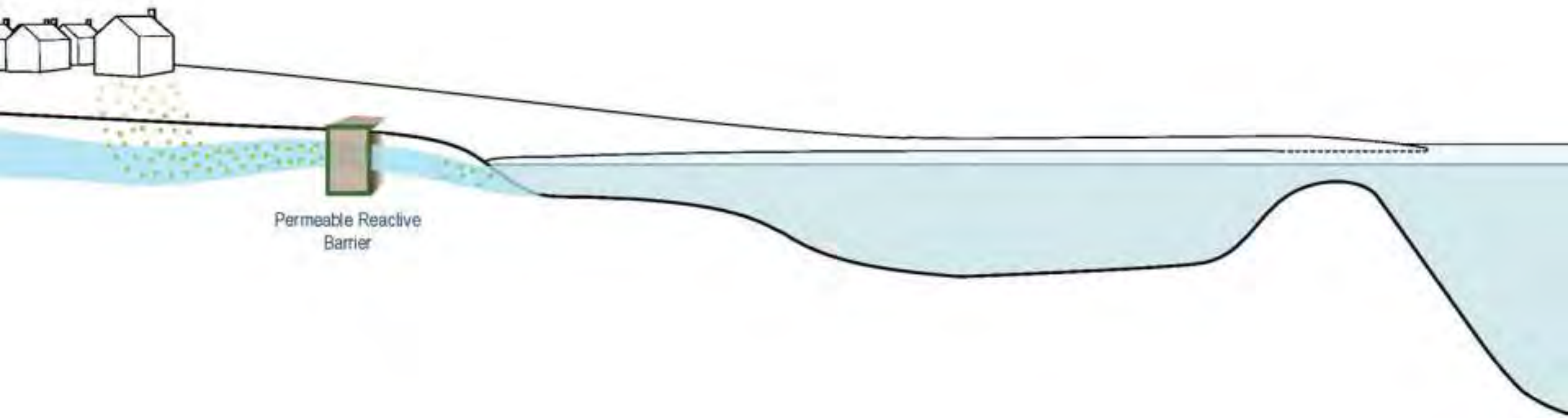
Precedent:
Pine Hills
Plymouth, MA



Precedent:
Pine Hills
Plymouth, MA



Precedent:
Pine Hills
Plymouth, MA



Scale: SITE / NEIGHBORHOOD / WATERSHED
Target: EXISTING WATER BODIES

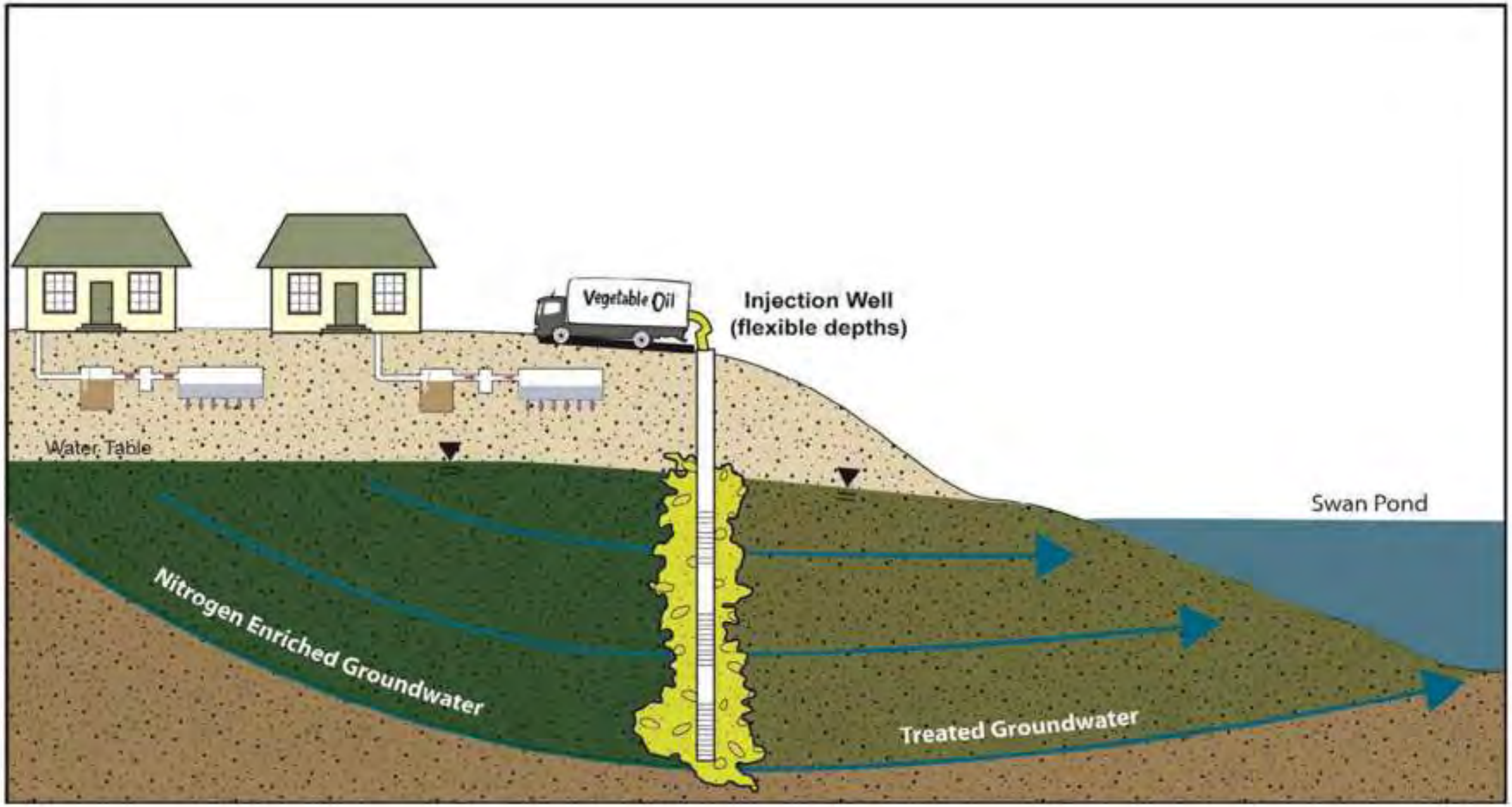
Permeable Reactive Barrier PRB

Precedent: Falmouth PRB

Source: Mike Domenica

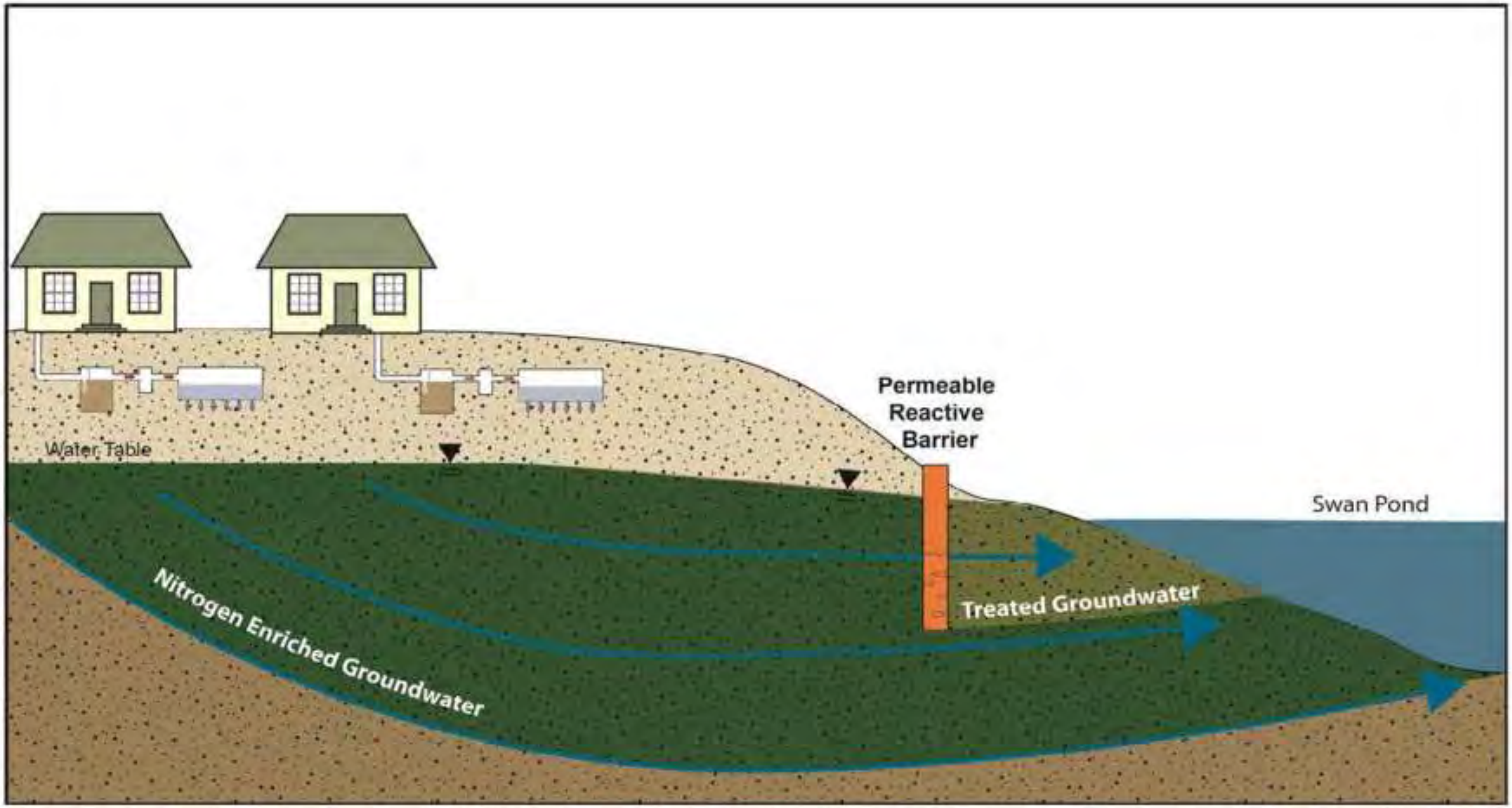
Permeable Reactive Barrier

PRB



Precedent: PRB

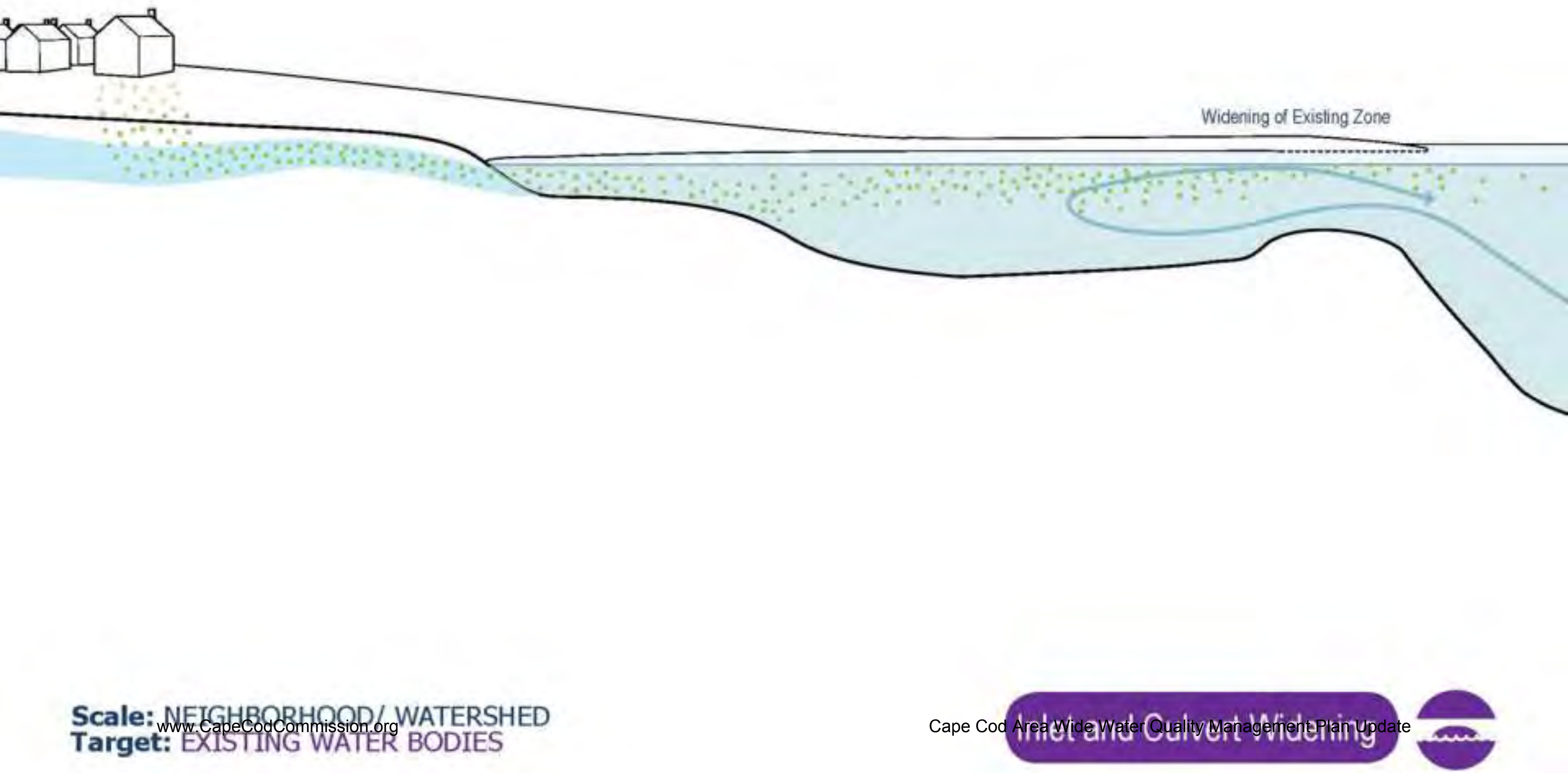
PRB

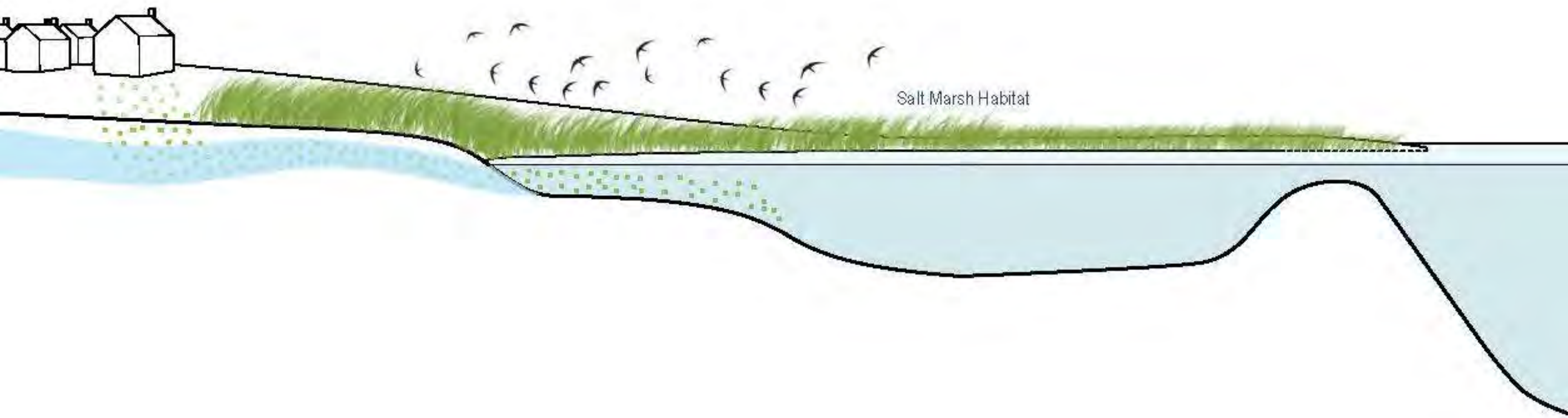


Precedent: PRB

Source: Horsley Witten Group Inc.

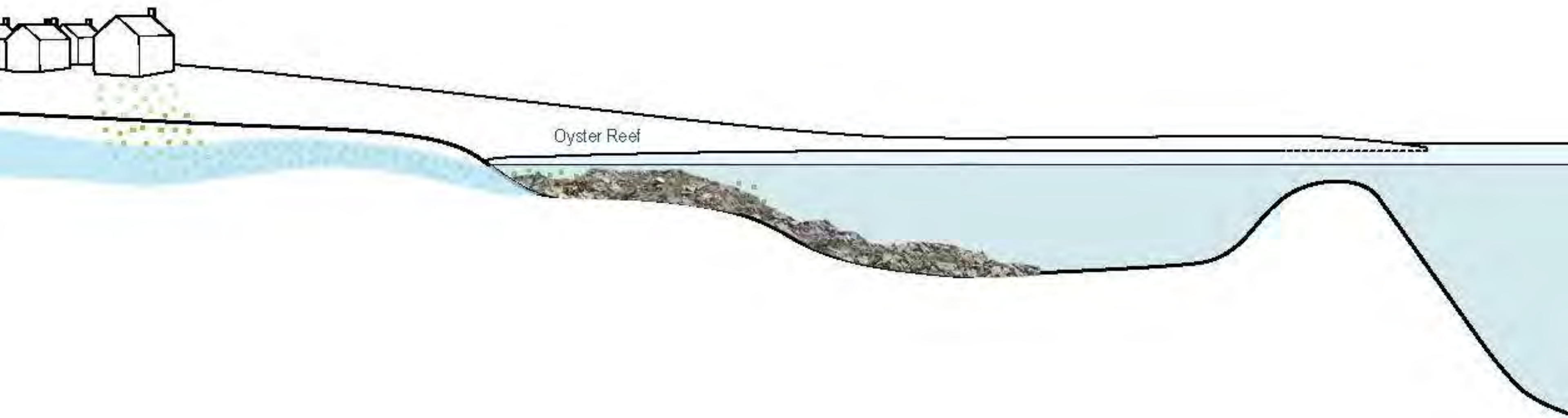
Permeable Reactive Barrier PRB


Widening of Existing Zone
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES
Inlet and Culvert Widening



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Salt Marsh Habitat Restoration



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Shellfish Habitat Restoration

Precedent: Wellfleet Oyster Restoration Project

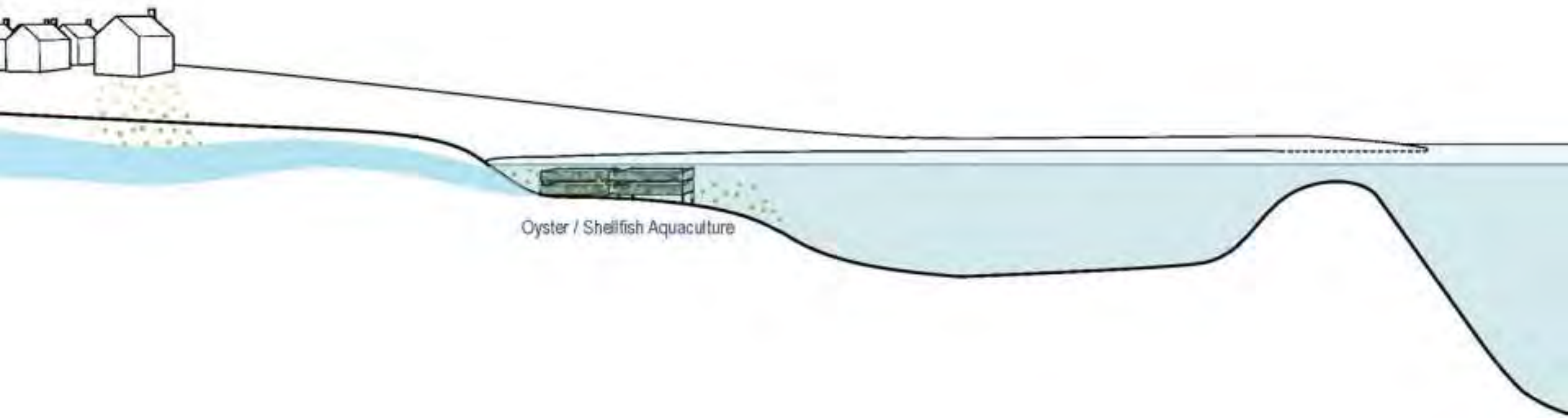
Source:

Shellfish Habitat Restoration

Precedent: Wellfleet Oyster Restoration Project

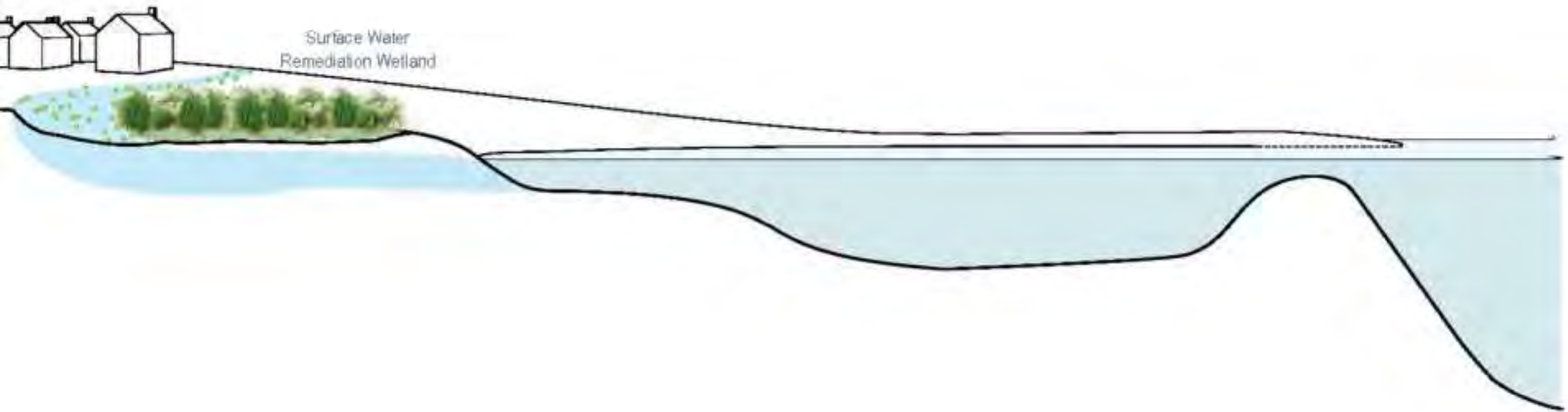
Source: A[illegible]

Shellfish Habitat Restoration



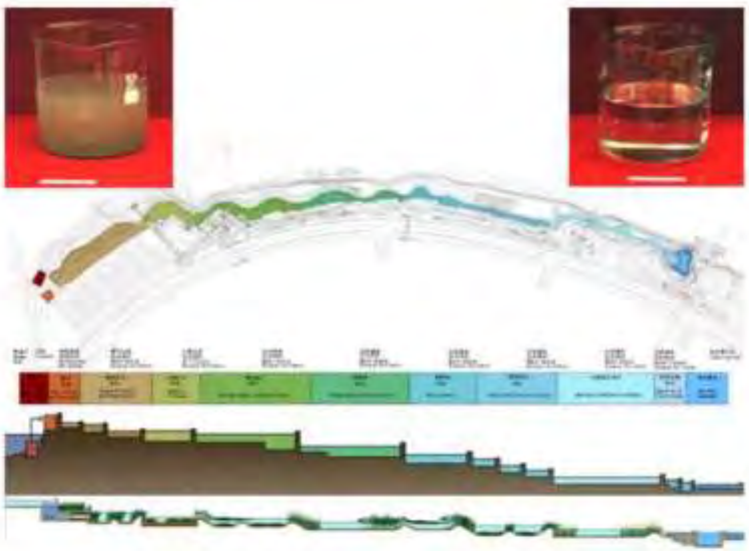
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Aquaculture / Shellfish Farming



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

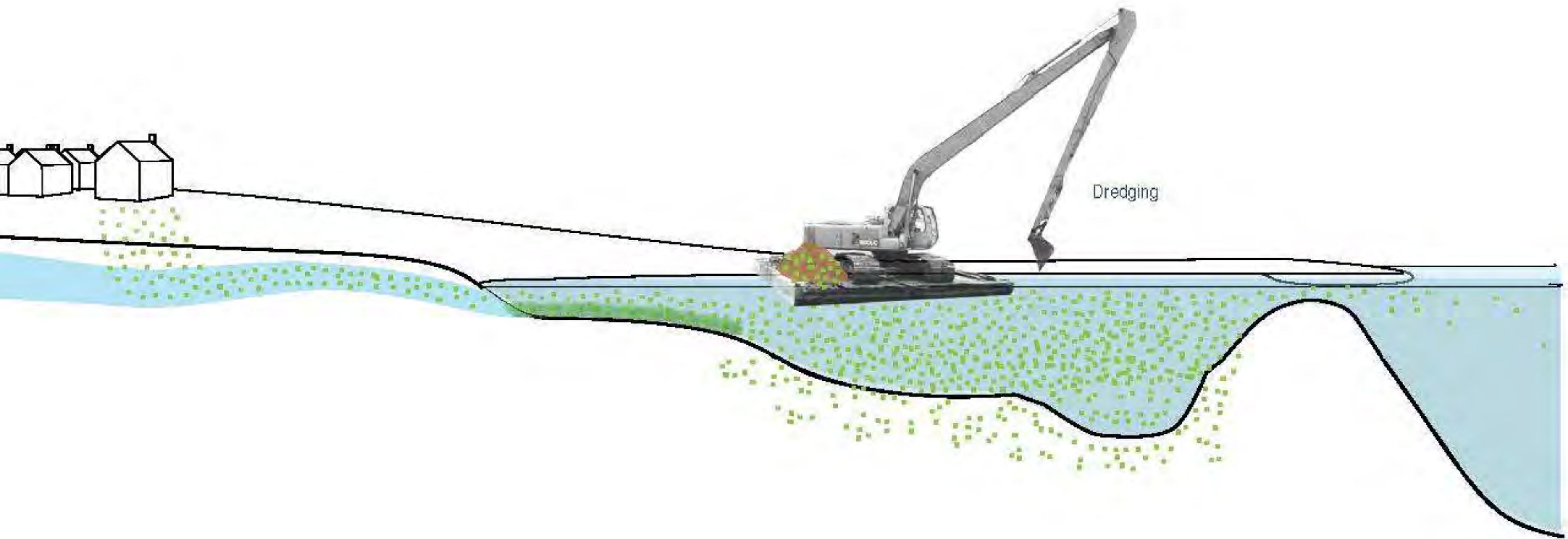
Surface Water
Remediation Wetlands



Precedent: Shanghai Houton Park

Source: Turenscape

Surface Water Remediation Wetlands

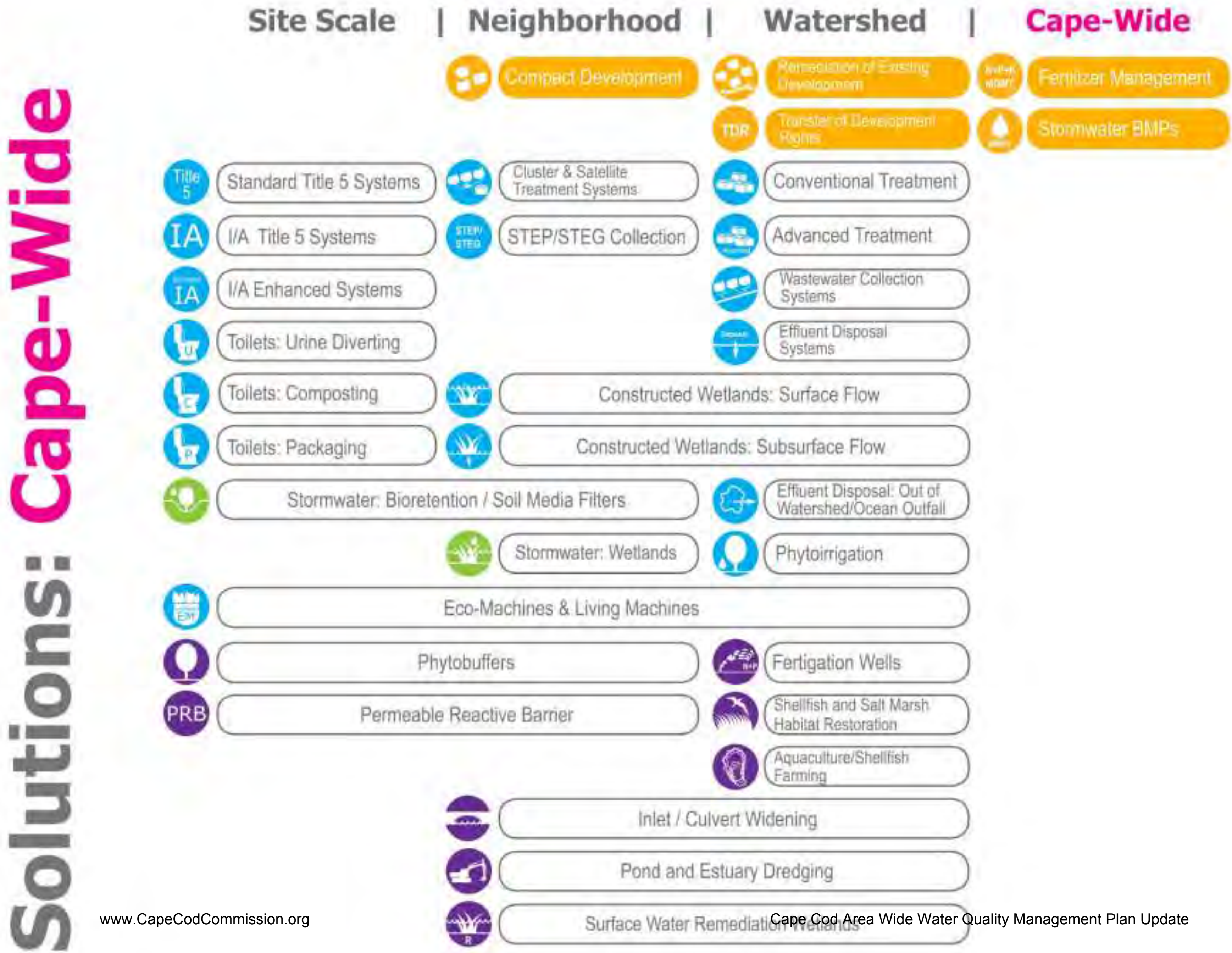


Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Pond and Estuary Dredging

Precedent: Pond and Estuary Dredging - Dennis, MA

Source: Cape Cod Times


Solutions: Cape-Wide
Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
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Effluent Disposal: Out of Watershed/Ocean Outfall
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Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
R
Surface Water Remediation Wetlands

Scale: CAPE-WIDE
Target: REGULATORY

Compact Development

Scale: CAPE-WIDE
Target: REGULATORY

Scale: CAPE-WIDE
Target: REGULATORY

Remediation of Existing Development

Scale: CAPE-WIDE
Target: REGULATORY

Transfer of Development Rights

TDR

Transfer of Developments Rights
The Concept

Owner of "sending" parcel sells development rights in exchange for permanent conservation easement.

Owner of "receiving" parcel buys development rights to build at densities higher than allowed under base zoning.

Source: Massachusetts Smart Growth Toolkit

Scale: CAPE-WIDE
Target: REGULATORY

Stormwater BMPs


Site Scale | Neighborhood | Watershed | Cape-Wide
Solutions
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
IA
I/A Title 5 Systems
STEP/STEG
STEP/STEG Collection
Advanced Treatment
IA
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
EM
Eco-Machines & Living Machines
Phytobuffers
Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands

Problem Solving Approach

Wastewater | Existing Water Bodies | Regulatory

1 Nitrogen Targets/Goals

Present Load: X kg/day − **Target:** Y kg/day = **Reduction Required:** N kg/day

2 Other Wastewater Management Needs

A. Title 5 Problem Areas
B. Pond Recharge Areas

3 Low Barrier to Implementation

A. Fertilizer Management
B. Stormwater Mitigation

4 Watershed/Embayment Options

A. Permeable Reactive Barriers
B. Inlet/Culvert Openings
C. Constructed Wetlands
D. Aquaculture

PRB

5 Alternative On-Site Options

A. Eco-toilets (UD & Compost)
B. I/A Technologies
C. Enhanced I/A Technologies
D. Shared Systems

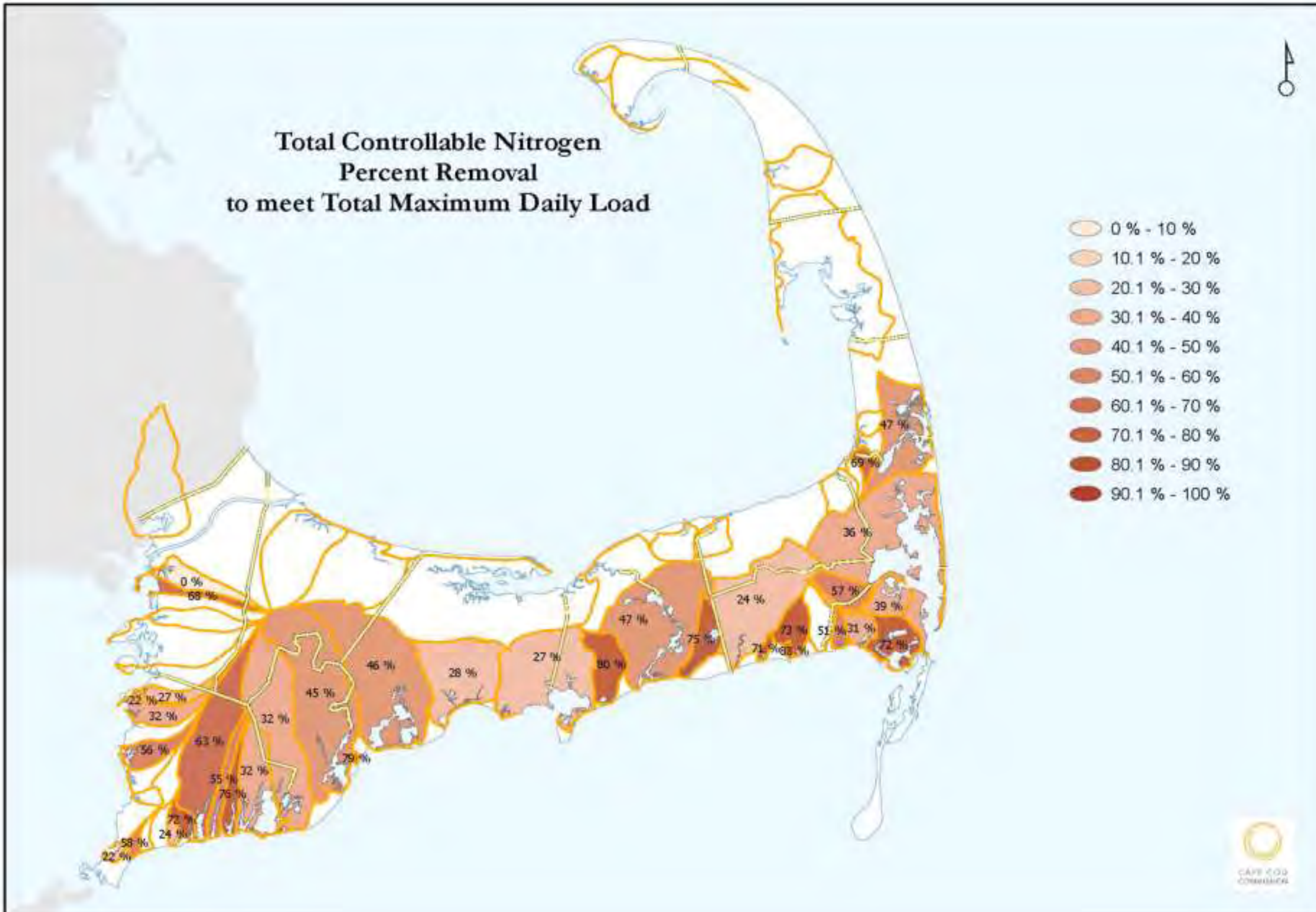
Title 5 | IA | IA

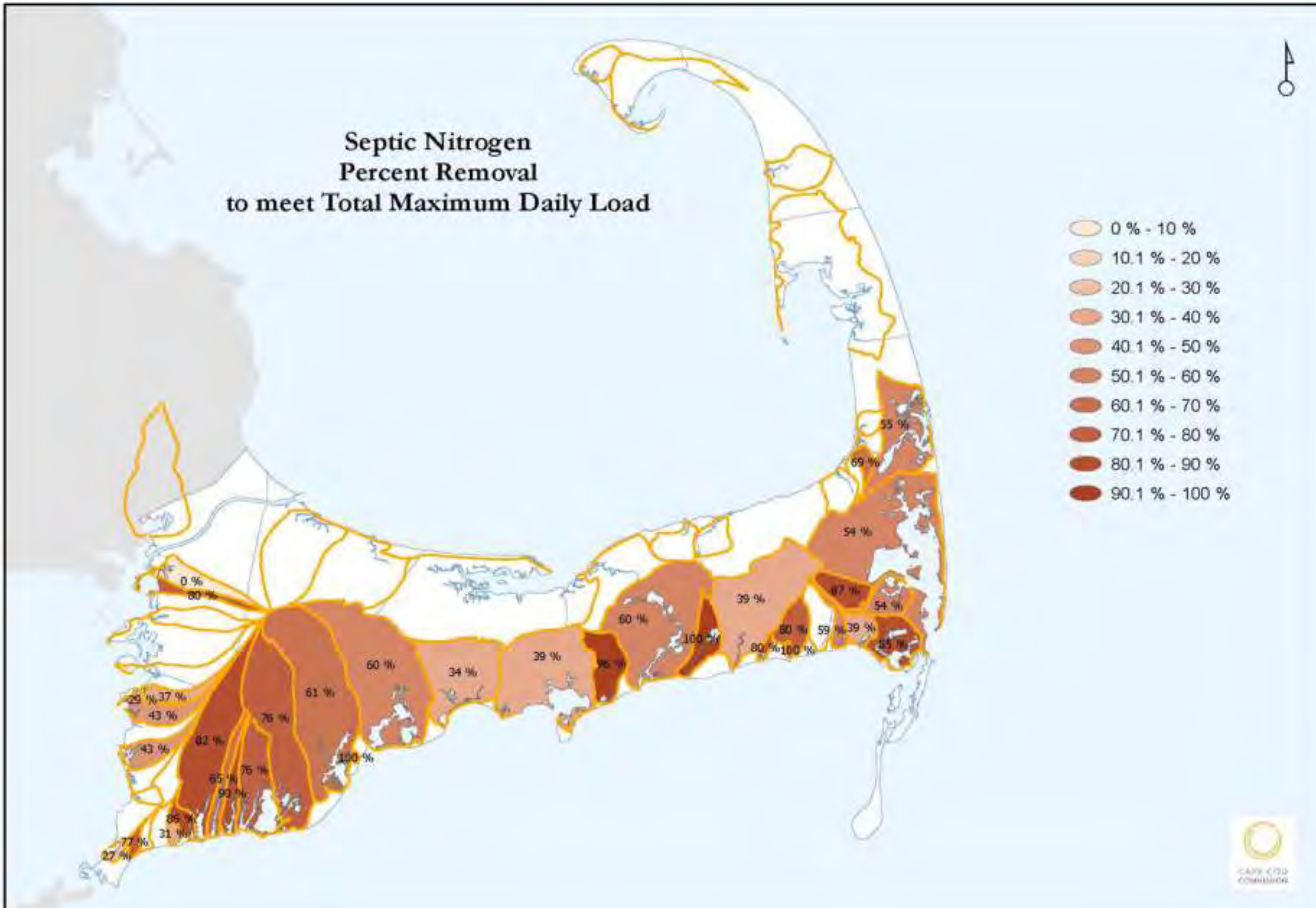
6 Priority Collection/High-Density Areas

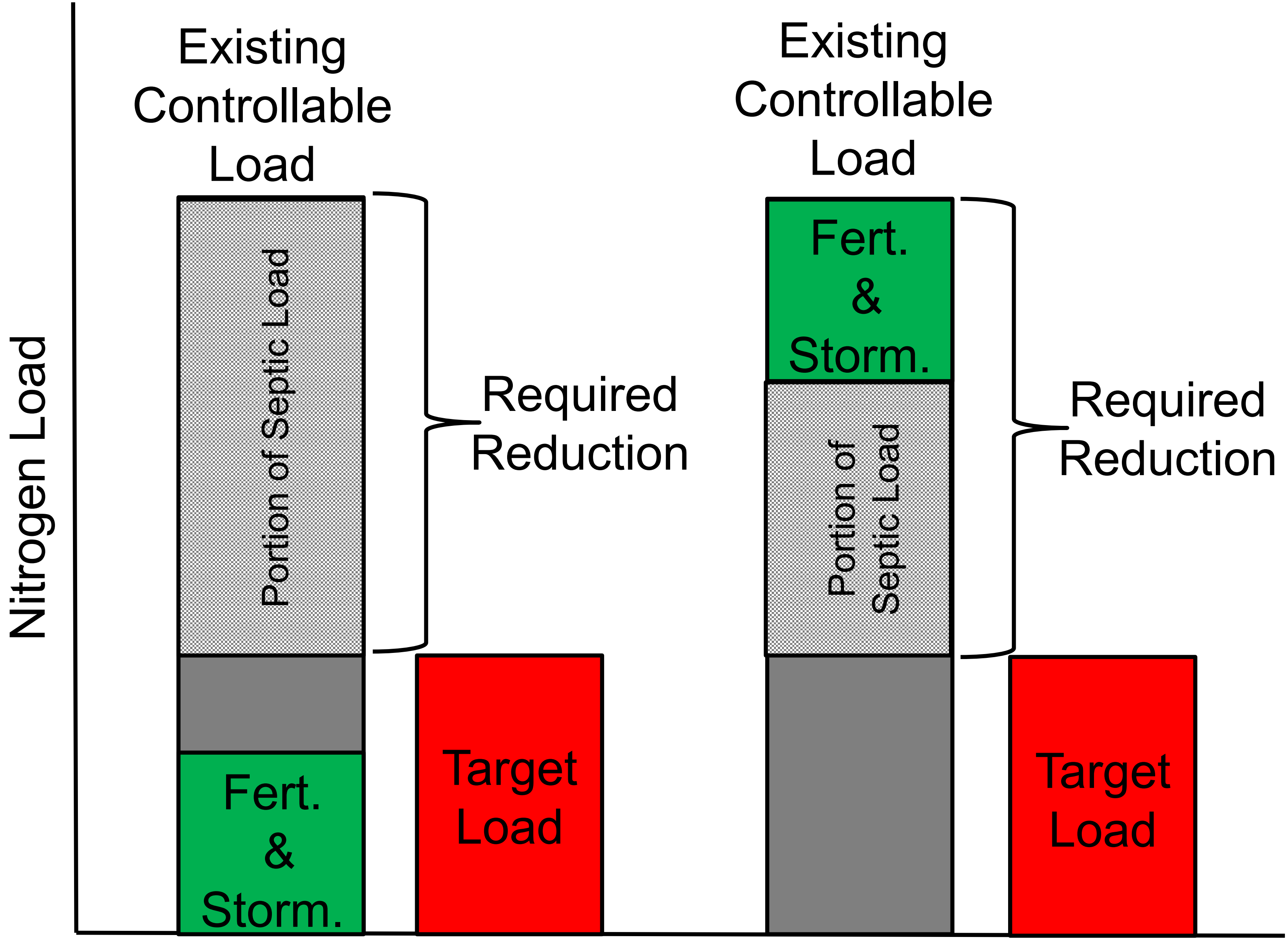
A. Greater Than 1 Dwelling Unit/acre
B. Village Centers
C. Economic Centers
D. Growth Incentive Zones

STEP/STEG

7 Supplemental Sewering


Total Controllable Nitrogen
Percent Removal
to meet Total Maximum Daily Load
0 % - 10 %
10.1 % - 20 %
20.1 % - 30 %
30.1 % - 40 %
40.1 % - 50 %
50.1 % - 60 %
60.1 % - 70 %
70.1 % - 80 %
80.1 % - 90 %
90.1 % - 100 %


Septic Nitrogen
Percent Removal
to meet Total Maximum Daily Load
0 % - 10 %
10.1 % - 20 %
20.1 % - 30 %
30.1 % - 40 %
40.1 % - 50 %
50.1 % - 60 %
60.1 % - 70 %
70.1 % - 80 %
80.1 % - 90 %
90.1 % - 100 %


Nitrogen Load
Existing Controllable Load
Portion of Septic Load
Fert. & Storm.
Required Reduction
Target Load
Existing Controllable Load
Fert. & Storm.
Portion of Septic Load
Required Reduction
Target Load

Wastewater | Existing Water Bodies | Regulatory

Problem Solving Approach

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Present Load: X kg/day − **Target:** Y kg/day = **Reduction Required:** N kg/day

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B. Village Centers
C. Economic Centers
D. Growth Incentive Zones

7 Supplemental Sewering

Town Consideration of Alternative Technologies & Approaches

Wellfleet- *Coastal habitat restoration & aquaculture*

Mashpee- *Aquaculture & Expanding Existing Systems*

Brewster- *PRB & Bioswales*

Orleans- *Fertilizer Control By-Law*

Harwich- *Muddy Creek & Cold Brook Natural Attenuation*

Falmouth- *Aquaculture*
Inlet Widening
Eco-Toilet Demonstration Project
PRBs
Stormwater Management (Little Pond Watershed)
Fertilizer Control By-Law
Subsurface Nitrogen Removal Septic Systems

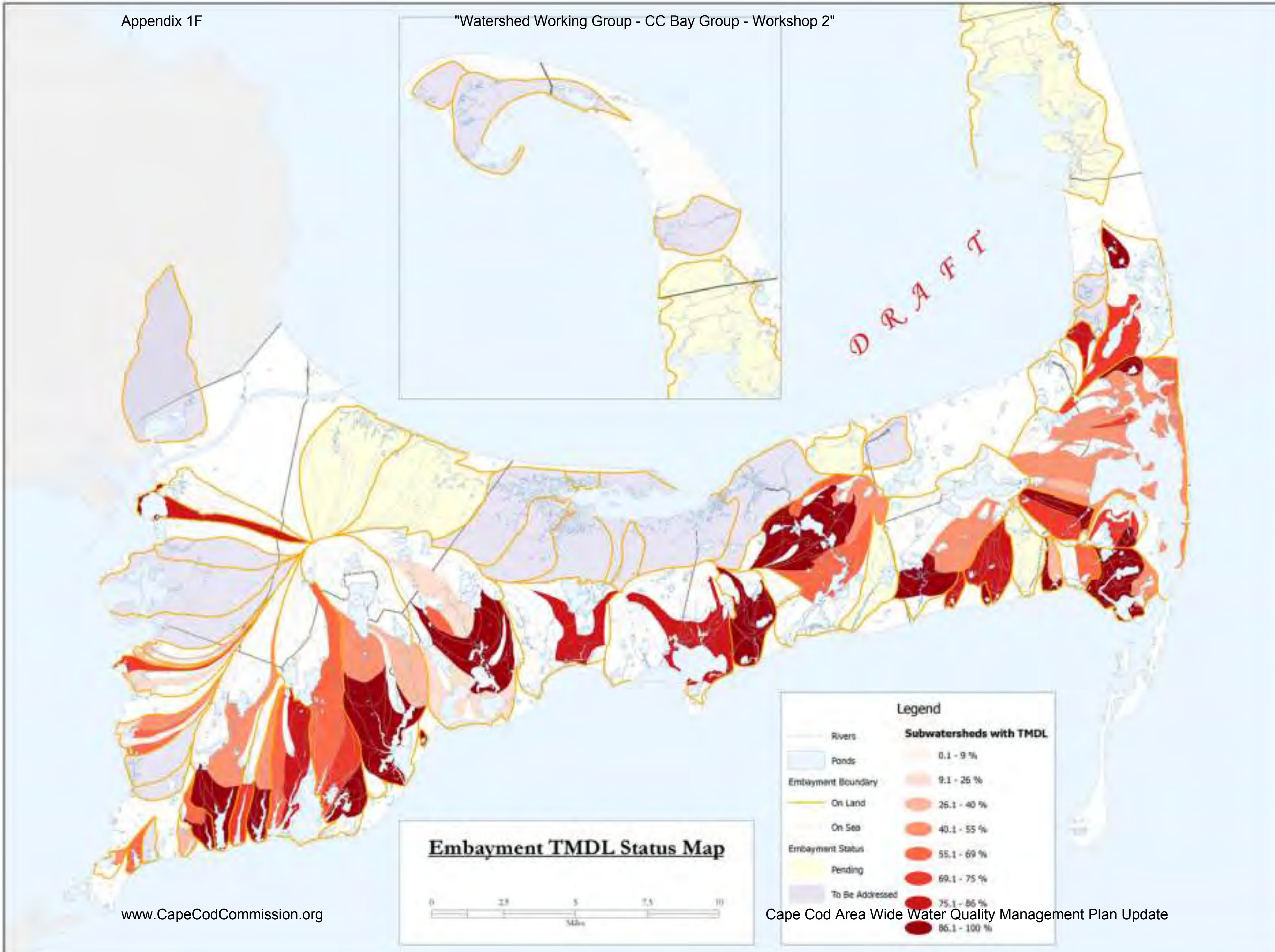
Triple Bottom Line

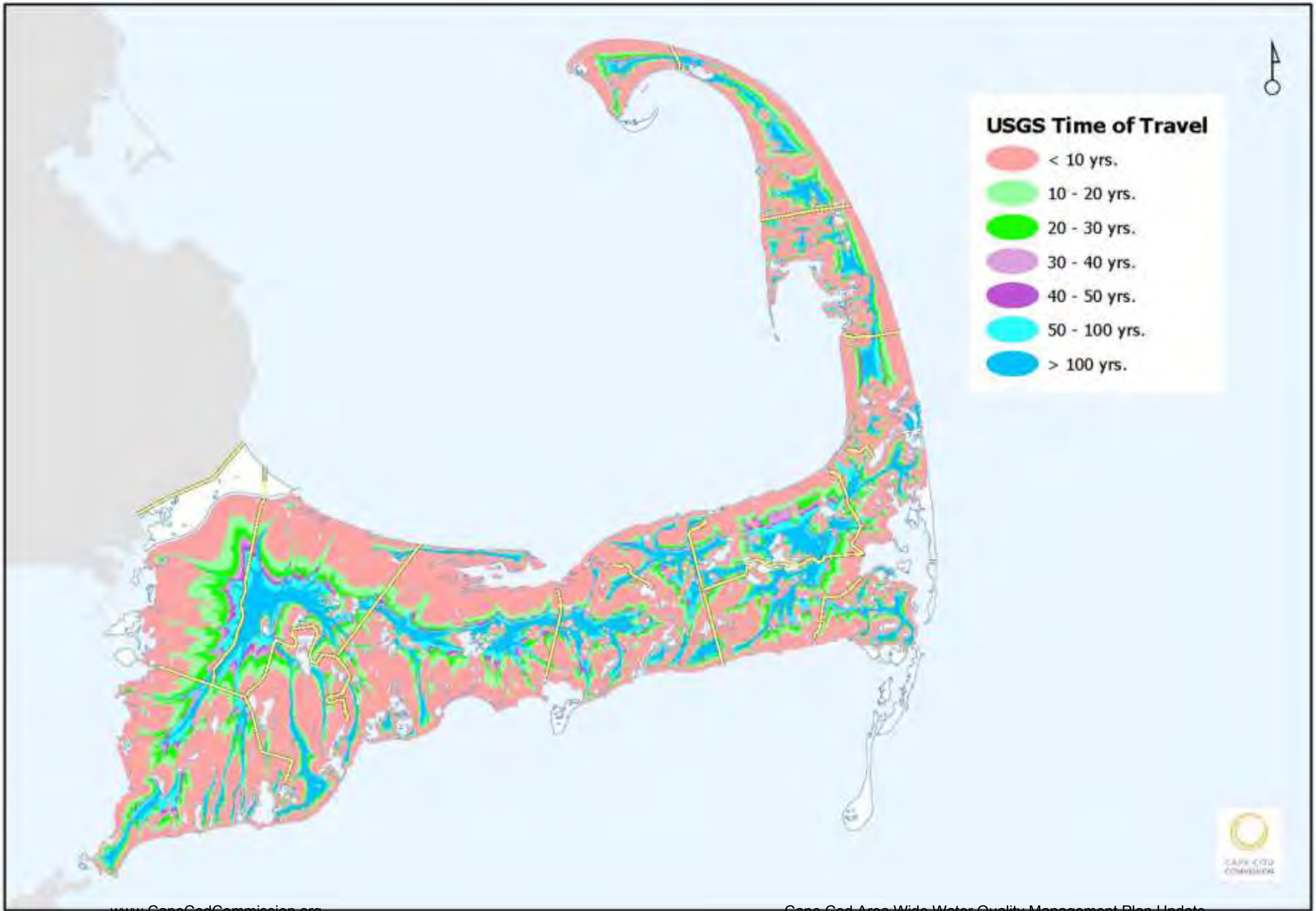
Impacts of Technologies and Approaches

Environmental

Economic

Social


DRAFT
Embayment TMDL Status Map
0
2.5
5
7.5
10
Miles
Legend
Rivers
Ponds
Embayment Boundary
On Land
On Sea
Embayment Status
Pending
To Be Addressed
Subwatersheds with TMDL
0.1 - 9 %
9.1 - 26 %
26.1 - 40 %
40.1 - 55 %
55.1 - 69 %
69.1 - 75 %
75.1 - 86 %
86.1 - 100 %


USGS Time of Travel
< 10 yrs.
10 - 20 yrs.
20 - 30 yrs.
30 - 40 yrs.
40 - 50 yrs.
50 - 100 yrs.
> 100 yrs.

Technology Selection: Process and Principles

- 100% septic removal subwatershed
- Scale: On-Site vs. Collection System vs. Natural System
- Nutrient intervention and time of travel
- Permitting Status
- Land use and Impacts of Growth

Preparing for Meeting 3 and Beyond

- Review tools and alternatives analysis approach
- Evaluating scenarios for meeting water quality goals
- Attend the November 13th meeting:

6:00
Cape Cod Museum of Art
Dennis, MA

Cape Cod 208 Area Water Quality Planning
Nauset and Cape Cod Bay Marsh Watershed Working Group

Meeting Two
Monday, October 22, 2013
8:30 am- 12:30 pm
Eastham Town Hall, 2500 State Highway
Eastham, Massachusetts 02642

Meeting Summary Prepared by the Consensus Building Institute

I. ACTION ITEMS

<u>Working Group</u>

- Next meeting: Meeting Three
  Wednesday, December 4, 2013
  8:30AM -12:30PM
  Eastham Town Hall, 2500 State Highway, Eastham, Massachusetts 02642
- Send Stacie any additional comments on Meeting One Summary (by Oct 28)
- Review the Technology Matrix and continue to prepare thoughts about which technologies/approaches they would like to learn more about for application in the Nauset and Cape Cod Bay Marsh Watershed. Different scenarios and options will be discussed during Meeting Three.

<u>Consensus Building Institute</u>

- Send link with presentation to participants
- Finalize Meeting One summary (by Oct 28)
- Draft and solicit feedback from Working Group on Meeting Two summary

<u>Cape Cod Commission</u>

- Share Technology Matrix with Working Groups
- Share updated Chronologies with Working Groups
- Post George Huefelder's data on the website.
- Add information about incinerating toilets to the fact sheet and matrix.

II. WELCOME, REVIEW 208 GOALS AND PROCESS AND THE GOALS OF MEETING

Ms. Patty Daley, Deputy Director at the Cape Cod Commission and Area Manager for the Nauset and Cape Cod Bay Marsh Watershed Working Group, and Ms. Erin Perry, Special Project Coordinator, welcomed participants and offered an overview of the 208 Update stakeholder process.[1] In July, public meetings were held across the Cape to present the 208 Plan Update goals, work plan, and participant roles. Public meetings were also held in August to present information on the affordability and financing of the comprehensive 208 Plan Update. The first meetings of the eleven Watershed Working Groups were held in September and focused on baseline conditions in each of the watersheds. The second meetings of the Watershed Working Groups will be held in October and early November and are focused on exploring technology options and approaches. The third meetings of the Watershed Working Groups will be held in December and focus on evaluating watershed scenarios which will be informed by Working Groups' discussions about baseline conditions, priority areas, and technology options/approaches. This conversation will also be informed by information shared in the Technology Matrix, which was developed by the Cape Cod Commission with technical input from the Technical Advisory Committee of the Cape Cod Water Protection Collaborative and the Technology Panel. The Technology Matrix builds on the information presented in the Technology Fact Sheets, which Working Group members reviewed in advance of the meeting[2]. Once it is finalized by the Cape Cod Commission, the Technology Matrix will be shared with Working Group Members.

Ms. Perry shared the 208 Plan team's progress since Meeting One which includes:

- Meeting materials distributed to stakeholders and available at http://watersheds.capecodcommission.org
- GIS data layers accessible at: http://watersheds.capecodcommission.org
- Chronologies are being updated and will be made available soon

Ms. Perry also shared that the second round of Cape2O game is launching on October 22 and encouraged Working Group members to participate in the interactive, online game which provides valuable education and input to the Cape Cod Commission. She announced that there will also be a Cape Cod wide event on November 13 at the Cape Cod Center for the Arts in Dennis. Participants from across the eleven Watershed Working Groups and the public are invited to attend the event which will include: Wrap up of "Cape2-O: ur in charge!"; a summary of planning process to date; and a discussion of the stakeholder role in the second 6 months of the 208 planning process.

Ms. Perry described the goal of today's meeting:

- To develop a shared understanding of the potential technologies and approaches identified to date , and the benefits and limitations of each; to explore the environmental, economic, and community impacts of a range of categories of solutions;

[1] The PowerPoint Presentation made at this meeting is available at: http://watersheds.capecodcommission.org/index.php/watersheds/lower-cape/nauset-and-cape-cod-bay

[2] Technology Fact Sheets are available at: http://watersheds.capecodcommission.org/index.php/watersheds/lower-cape/nauset-and-cape-cod-bay

and to identify priorities and considerations for applying technologies and approaches to remediate water quality impairments in your watershed.

Ms. Daley noted that during the September meetings, all the Watershed Working Groups had robust discussions about the buildout the Commission plans to use for the 208 Plan Update. She indicated that the Commission is reaching out to Towns to further discuss how the plan will address buildout.

Ms. Stacie Smith, the facilitator from the Consensus Building Institute, reviewed the agenda, the ground rules, action items from the previous meeting, and led introductions. A participant list is found in Appendix A. Ms. Smith thanked group members for the comments on the draft meeting summary and indicated that revisions will be made to correct inaccuracies, address omissions, or to clarify statements made in the meeting.

Participants' questions and comments about the 208 Plan Update goals and process are below (in *italics)*:

- *The Orleans buildout numbers in the CWMP are inaccurate and will lead to greater costs. The meeting to discuss buildout should be transparent and open to all concerned parties.* Ms. Daley said a review of the buildout discussion with towns could be incorporated into the December meeting when the group will look at various scenarios.
- *Are meeting notes and slides available from the other Watershed Working Groups, the October 3 meeting, the financial meetings, and the technology panel meetings?* Ms. Daley said all meeting notes from other working groups, the financial meetings, and the technology panels are on the website or should be there soon. A video of the first and second technology panel meeting is also available. Ms. Smith commented that a meeting summary was not produced for the October 3 meeting. Ms. Daley said the Commission took notes during the meeting and plans to respond in writing to the questions and concerns that were raised, and that the slides will be made available upon request.

III. RANGE OF POSSIBLE SOLUTIONS

Ms. Daley led the discussion of the range of possible solutions. As Working Groups learn more and consider the pros and cons of the technologies and approaches, she encouraged participants keep in mind that:

- The Cape Cod Commission undertook a comprehensive analysis of nutrient control technologies and approaches. This analysis is distilled into: the Technology Fact Sheets, which present various summary information on the technologies being considered; the Technology Matrix, which includes additional information on site requirements, construction, project and operation and maintenance costs (in units of cost per pound of nitrogen removed), reference information, and regulatory comments; and ongoing input from stakeholders on the public acceptance of technology options and approaches.
- Not all of the technologies and approaches will be applicable to Cape Cod or to all

watersheds in Cape Cod.

- Some technologies seem very promising and we would like to hear which of these the group members think could be useful for demonstration and pilot projects.
- Workshop 3 will embark on hands on problem solving in each watershed to meet target load reductions.
- Certain technologies or approaches will be effective at preventing nutrients from entering the water body. Others will be effective at reducing or remediating nutrients that are already in the groundwater or water body.
- Regulatory programs can address nutrient controls for both existing development and future development.

Ms. Daley offered a brief overview of the technologies and approaches. The following section briefly describes each technology. Participants' asked questions and made comments about the technologies after each technology scale. Their questions and comments (in *italics)* have been placed under the appropriate technology or in the general comments and questions section following this section:

Site level technologies/approaches

Standard Title V System*:* This is a standard septic system that consists of a septic tank and soil adsorption system (leaching field). The system was primarily designed to address public health concerns related to waste in drinking water (e.g. pathogens such as coliform bacteria); they were not designed to remove nutrients (e.g. nitrogen).

I/A Title V System: Innovative/Alternative (I/A) on-site nutrient reducing systems typically consist of standard septic system components augmented to remove more nutrients than a standard Title 5. I/A systems refer to a class of systems intended to be designed as recirculating sand filter (RSF) equivalents by meeting the same treatment limits in a smaller footprint. The Cape Cod Commission is beginning to map IA systems and estimates there are about 1500 existing systems on the Cape. A GIS layer will be added to the 208 Plan Reference Map to show their locations.[3]

Urine Diverting Toilets: Urine diversion systems send urine into a holding tank where the urine is stored and periodically collected by a servicing company. The servicing company empties the tank for disposal or conversion to a fertilizer. Through these means, the nitrogen from the urine may be removed from the watershed. With urine diverting toilets, the remainder of the human waste and all other water uses (sink and shower) continue to go to the septic system. (Case example, Falmouth, MA).

Composting Toilets: A toilet system which separates human waste from shower, sink and other household water uses. The composting toilets use no or minimal water. The human waste

[3] The 208 Plan Reference Map is available at: http://watersheds.capecodcommission.org/docs/frames/

captured by the composting toilets is decomposed and turned into compost. The compost generated is removed from the site and nutrients can be recycled. Composting toilets require the replacement of existing toilet(s) and room in the basement for a container to capture and compost the human waste. Household water use (sink and shower uses) continue to flow to the septic system. (Case example, Falmouth, MA).

Packaging Toilets: A packaging toilet encapsulates human waste in a durable material for removal from the site. The package is stored beneath the toilet and removed and taken away when full. The servicing company that picks up the packages can recycle the nutrients.

Stormwater Bioretention: Bioretention systems utilize natural plant and soil functions to capture and treat stormwater runoff for a variety of contaminants including nutrients. A typical system consists of an underdrain/gravel layer, a layer of bioretention soil mix (a mix of sand, compost, woodchips and loam), and a surface layer containing appropriate plantings. The treated water can be discharged into a water body or used for open space irrigation after treatment. The reclaimed water can also be discharged into a subsurface infiltration system for discharge to the groundwater. (Case example, Portland, OR).

Participants' questions and comments about the site level technologies are indicated below (in *italics)*:

- *Why are incinerating toilets not considered in these options?* Ms. Daley said incinerating toilets could be investigated and added to the matrix.

Neighborhood level technologies/approaches

Cluster and satellite treatment systems: A cluster or satellite system is a collection and treatment system treating wastewater flows from multiple properties.

STEP/STEG collection: Septic Tank Effluent Pumping (STEP) and Septic Tank Effluent Gravity (STEG) systems convey liquid wastewater from on-site septic tanks to sewer systems; Only the liquid component of the wastewater may be conveyed by pumps or by gravity.

Eco machines and living machines: Living or Eco-Machines are natural systems that treat septic tank effluent or primarily treated wastewater. In these systems, aeration and clarification chambers are combined with constructed wetlands to treat the influent. The wetlands are a series of chambers allowing for microbial communities to engage with and treat the wastewater. Plants are often suspended on racks with their roots systems doing the work. Solids removal is generally onsite, after which water is pumped through the gravel filled cells (similar to subsurface wetlands.) This process transfers more oxygen to the wastewater and completes the pollutant removal process. (Case example, South Burlington, VT).

Stormwater wetlands: Constructed wetlands provide aerobic chambers followed by subsurface anaerobic chambers that facilitate nitrification followed by de-nitrification, respectively. This process mimics that of natural systems coupled with engineering design guaranteeing residence time within a chamber containing anaerobic conditions. (Case example, China).

Participants' questions and comments about the neighborhood level technologies are indicated below (in *italics)*:

- *What are the space and environmental requirements for each system, such as whether or not artificial wetlands would be created or existing wetlands would be utilized?* Ms. Daley responded that the technology matrix includes land use requirements for each individual technology and approach.
- *It would be useful to include information to understand when the scale of the system makes it cost effective.*
- *Is nitrogen from atmospheric deposition a large source of nitrogen on the Cape? If so, it heightens the importance of doing something on natural systems based technology.* Ms. Daley said some of this information is viewable in the slides from the September meeting and agreed with the value of addressing non-controllable sources of nitrogen.

Watershed level technologies/approaches

<u>Conventional treatment</u>: A conventional wastewater treatment facility typically treats wastewater collected from homes and businesses. A groundwater discharge permit is required. Treatment generally results in less than 10 mg/L Nitrogen.

<u>Constructed wetlands: surface flow</u>: After primary treatment in a septic tank or wastewater treatment facility or secondary treatment at a wastewater treatment facility, water is fed into a surface flow constructed wetland. Surface flow constructed wetlands closely mimic the ecosystem of a natural wetland by utilizing water loving plants to filter wastewater through their root zone, a planted medium, and open water zones. Surface flow wetlands are systems where open water is exposed much like in a natural marsh. The reclaimed water from the wetland can be discharged into a water body or used for open space irrigation after treatment as well as discharged into a leach field. (Case example, Albany, OR).

- *Another potential disadvantage to add to the list on the constructed wetlands is the possible impact of freshwater effluent on a saline marsh.* Mr. Cambareri said this is a concern and thoughtful placement of the technology would be required. Additionally, it may be a question of how much additional freshwater could be added without changing the ecosystem since the aquifer discharges freshwater into the system, too.

<u>Constructed wetlands: subsurface flow</u>: After primary treatment in a septic tank or wastewater treatment facility or secondary treatment at a wastewater treatment facility, wastewater is treated by pumping water slowly through subsurface gravel beds where it is filtered through plant root zones and soil media. Water flows 3-8" under the surface to prevent public exposure to wastewater and mosquito breeding. A combination of horizontal and vertical flow subsurface systems must be utilized to provide total nitrogen removal. This solution can also offer opportunities for recreation activities on land above the subsurface system. (Case

example, Thailand – it was noted that this example is underperforming due to illicit contributions).

Effluent disposal: out of watershed: Effluent disposal can take a variety of forms, including infiltration basins, a Soil Absorption System, Injection Wells or Wick Wells. These disposal methods place highly treated effluent back into groundwater. Effluent Transport out of the watershed has the advantage of removing the nitrogen load to another watershed. Transport to another watershed requires the receiving watershed to be able to accommodate the additional nitrogen load.

Effluent disposal: ocean outfall: Similar to out of watershed effluent disposal, highly treated effluent is transported out of the watershed and into the ocean. This solution requires changes in regulatory restrictions and a high level of regulatory oversight. The solution is considered due to limited land availability for disposal on Cape Cod.

Phytoirrigation: After secondary treatment, wastewater treatment facility effluent is irrigated onto plants to remove nutrients and other contaminates. Fast growing poplar and willow trees are typically used. (Case example, Woodburn, OR).

Participants' questions and comments about the watershed level technologies are indicated below (in *italics)*:

- *How well do some of these systems remove nitrogen?* Mr. Owen responded that in general, these systems reduce nitrogen concentrations to less than 10 mg/L, but this depends on the size of the treatment area. The larger the acreage per amount of flow, the greater the treatment reduction.
- *Percolation rates through the soil could also be an advantage or disadvantage if it impacts the efficiency of a treatment technology.*

Neighborhood or Watershed level technologies/approaches

Phytobuffers: Using trees with a deep root system to capture nutrients in the soil, particularly willows and poplars (or native plant alternatives.) Green plants with deep tap roots are planted as a buffer to intercept existing groundwater. The plants and their associated microorganisms reduce contamination in soils and ground water. Often phytohydraulics causes the groundwater plume to be redirected and pulled towards the plants. (Case example, Kavcee, WY).

Fertigation wells: Fertigation wells can capture nutrient enriched groundwater, typically from a wastewater treatment facility discharge, and recycle it back to irrigated and fertilized turf grass areas. These irrigated areas include golf courses, athletic fields and lawns. Fertigation can significantly reduce nutrient loads to downgradient surface waters while reducing fertilizer costs to the irrigated areas. (Case example, Plymouth, MA).

Permeable reactive barrier (PRB): A permeable reactive barrier (PRB) is an in-situ (installed within the aquifer) treatment zone designed to intercept nitrogen enriched groundwater. Through use of a carbon source, microbes in the groundwater uptake the nitrogen, denitrifying the groundwater. PRB systems typically use vertical trenches, sequences of bored columns or injection methods to introduce the carbon source into the groundwater to reduce the nitrogen load to an estuary, removing it from the watershed. (Case example, Falmouth, MA).

- *The TMDLs in Eastham will require 100 percent removal of phosphorous. Will PRBs address phosphorus in pond systems?* Mr. Cambareri said it may be possible to implement surface PRBs to capture phosphorous instead of digging deep trenches or injection wells. Mr. Scott Horsley, Area Manager for the Outer Cape, said PRBs could also be implemented along roadways to avoid permitting issues in wetlands. Ms. Daley mentioned the Cape Cod Commission is using GIS to identify roadways perpendicular to water flow where it may be feasible to install PRBs.
- *How do the costs associated with a mile of PRB compare to a mile of sewer?* Mr. Cambareri said the cost comparison is difficult to make since costs would be site specific. Mr. Horsley said it is like comparing apples to oranges--PRB would be approximately $800 per foot while sewer would be approximately $150 per foot to install, but this does not compare the total costs of treatment per unit of nitrogen. Density is the key since it is easier to treat areas of higher density.
- *How long does a PRB last? Does it have a carrying capacity?* Mr. Owens responded that current data suggests they will last a long time because the wood and mulch placed in PRBs is slow to decay. Mr. Horsley said the estimate is that material will work for 20 years or more, and the environment on the Cape seems to indicate the material would endure for some time, but it is unclear exactly how long a PRB will last.

Inlet and culvert widening: Re-engineering and reconstruction of bridge or culvert openings to increase the tidal flux through the culvert or inlet. This solution generally works better with a larger tidal range but could be feasible on both the Cape Cod Bay side (approximately nine feet tidal range) and Nantucket Sound side (approximately 3 feet of tidal range).

- *What are the parameters necessary to make culvert widening an effective method of reducing nutrients?* Mr. Owen said the MEP project looked for opportunities to widen culverts to achieve reductions or increase assimilative capacity. Not all projects to widen culverts will work, but another benefit of widening a culvert is habitat restoration. Another participant said *the DEP requires detailed hydraulic studies to determine whether or not culvert widening would achieve target levels.*

Salt marsh habitat restoration: Salt marsh is one of the most productive ecosystems in the world, surpassing rainforest in productivity per acre. Approximately 65% of historic salt marsh has been lost in MA. Salt marshes cycle and remove nitrogen as well as provide critical habitat and spawning sanctuary for a wide variety of birds, mammals and marine life in addition to hosting a range of plant species and important biogeochemical processes. The capacity of salt marsh to intercept nitrogen is significant and well researched worldwide. Substantial areas of former salt marsh on the Cape are either under consideration for restoration or could be restored providing storm surge and coastal flooding protection in addition to water quality benefits in certain watersheds.

Shellfish habitat restoration: Oyster reefs were historically one of the main consumers and recyclers of nitrogen in the coastal environment on Cape Cod. According to the Nature Conservancy, populations have declined by 95%. In conjunction with the natural transition from land to sea in estuaries, bays and inlets; salt marsh, oyster reef and eel grass function as critical buffer that can reduce eutrophication. Restoring Oyster populations leads to increased shellfish productivity as well as improved commercial and recreational fisheries for other species, increased protection from shoreline erosion and flooding, and buffering from ocean acidification. (Case example, Wellfleet, MA).

Aquaculture / shellfish farming: Oysters, has been proposed as a potential method for reducing nitrogen levels and eutrophication in estuaries. Nitrogen removal rates from Oysters have been well documented and the harvest of oysters physically removes the nitrogen they sequester in addition to the nitrogen removed by their biological cycling which puts nitrogen directly back into the atmosphere. Aquaculture can be done on man-made structures (e.g. cages, floating bags) or natural reefs.

- *A disadvantage of shellfish is that they are living animals, which are subject to pathogens and other variables that could negatively impact the entire population. Although they are efficient at removing nitrogen, it is not wise to use them as the primary component of a water quality program due to their susceptibility to other environmental factors.* Ms. Daley said this point gets to the idea that some technologies may be useful when paired with other technologies, but may be less valuable if used independently.
- *How does the DEP give nitrogen reduction credits for shellfish?* Mr. Cambareri responded that credit has yet to be given to shellfish. However, the DEP is aware that groups want to use shellfish and other in-situ technologies like wetlands, aquaculture, and PRBs to reduce nitrogen and receive credits. A DEP regulatory group is currently drafting guidance for how to permit and monitor these systems to determine the amount of credit that could be received.

Surface water remediation wetlands: Constructed to aid in water quality improvements to surface water bodies, usually streams or rivers. Water is pumped or allowed to flow naturally through treatment cells containing wetlands Surface water remediation wetlands are often used in combination with groundwater recharge or potable water reuse systems. Surface water remediation wetlands are generally used with Free-Water Surface wetlands due to their larger size, and lower capital and O+M Costs. (Case example, China).

Pond and estuary dredging: Lakes, ponds, streams and estuaries store nutrients within their sediments. These sediments tend to accumulate over time. Subsequently, these nutrients can be release into the overlying water column and can become a major source of nitrogen and phosphorus. Dredging and removing these sediments and accumulated nutrients removes the nutrients from the water body and potentially the watershed. (Case example, Dennis, MA).

- It was noted that dredge material can be difficult to dispose of due to heavy metal or hydrocarbon components.

Cape-wide level technologies/approaches

Compact development: Both Compact Development and Open Space Residential Development (OSRD) of subdivisions result in smaller lots and less maintained lawn acres. The higher density development reduces wastewater collection costs while providing a common disposal area. Compact development is also referred to as “Smart Growth”.

Fertilizer management: Managing fertilizer application rates to lawns, golf courses, athletic facilities and cranberry bogs. Residential lawn loading rates could be reduced on existing developed parcels through an intensive public education/outreach program. This could include a “Cape Cod Lawn” branding program, replacing some turf areas with native vegetation, establishing naturally-vegetated buffer strips on waterfront lots, and reducing application rates. Fertilizer loading rates for new development could be accomplished by reducing lot sizes (cluster development), by restricting lawn sizes and/or by incorporating more naturally-vegetated open space areas. Municipalities could directly reduce fertilizer applications on athletic fields and other properties. Golf courses can significantly reduce nitrogen loading rates by using slow-release fertilizers and reducing application rates in rough areas. Cranberry bog fertilizer exports from the bogs can be reduced using tail water recovery systems. Site-specific assessments are needed to estimate load reductions.

Regarding the fertilizer regulation on Cape Cod, Ms. Daley said the Cape Cod Commission designated a cape-wide Fertilizer Management District of Critical Planning Concern (DCPC) which authorizes the towns to adopt local fertilizer management regulations (state law prohibits local fertilizer management except under the DCPC). The DCPC does not require towns to adopt fertilizer regulations, but paves the way for their adoption. Barnstable County will be conducting a public education process around fertilizer use.

Remediation of existing development: Existing developments or schools with excess wastewater treatment capacity allow existing nearby developments to connect to their underutilized wastewater treatment infrastructure. A town can operate the wastewater treatment facility if the existing owner prefers to not take the responsibility for treating the off-site wastewater. An example of this is the Kingman Marina in Bourne, which was permitted to expand its development footprint in exchange for hooking up adjacent, existing homes to its wastewater treatment facility.

Transfer of development rights: A regulatory strategy that transfers development and development rights from one property (sending area) to another (receiving area) to direct growth and associated nutrient loading away from sensitive receiving watersheds or water bodies. The protected parcels (sending areas) receive a deed restriction that limits the level of future development. The deed restriction can limit the number of homes or tie development to the availability to future wastewater treatment facility infrastructure.

Stormwater best management practices (BMP): Non-Structural Stormwater strategies include: street sweeping, maintenance of stormwater utilities, education and public outreach programs, land use planning, and impervious cover reduction and control.

General questions and comments:

- Group members discussed the nutrient removal rates indicated on the fact sheets and suggested the need for more detailed information. One member requested clarification on the sources of the data and questioned whether the reduction levels would be the same on the Cape as they were in the test locations. Mr. Mark Owen, Consultant from AECOM, said the baseline data is from several different sources, including the DEP, but reduction rates vary across the studies. Variability in reduction rates is also likely to occur across multiple systems of the same make and model. For Title V I/A systems, nitrogen reduction percentages are based on raw influent concentrations of 40 mg/L. A member noted George Heufelder's research on effectiveness of I/A systems, which showed that they had the potential to be very effective. Members suggested that his data should be incorporated in the analysis rather than just listing average nutrient removal rates. A TAC member, who helped develop the fact sheets, explained that they tried to provide a range of nutrient removal rates for each system to account for the variability, for purposes of discussion, and recognized that averages do not provide the full story. Ms. Daley said the Cape Cod Commission can post George Heufelder's I/A data to the website.
- Group members also suggested including the following information on the fact sheets or at least using the information to inform their decisions: Capital costs of each techonology compared to capital costs of a typical Title V system; costs of operating and maintaining a technology; whether or not the technology requires electricity, and; seasonal variability that may impact system operation. Tom Cambareri, Cape Cod Commission Water Resources Program Manager, said the Commission has the capital cost information and will share it with the watershed working groups. Ms. Daley noted that the technologies matrix will include a cost per pound of nitrogen removal by technology.
- *The DEP indicated to the town of Orleans that hitting a specific nutrient concentration level is not as important as restoring water quality in the estuary.* Ms. Smith said that hopefully a regional conversation with the DEP rather than town-by-town conversations will lead to more clarity on how to achieve water quality targets.
- *The DEP approach tends to direct communities to centralized sewer systems, but the towns reject this due to cost. It is commendable the Cape Cod Commission is looking at alternative options to address this issue. Regarding the ultimate goal of the DEP and EPA, the desired condition they are seeking remains undefined, which puts a lot of risk on the towns. The Cape Cod Commission should ask the DEP to define what success*

means.

- *Is the Cape Cod National Seashore involved in these discussions?* Ms. Smith responded that the Seashore is being kept up to date on the meetings that are applicable to them, but limited resources prevent them from attending all of the meetings.

IV. PROBLEM SOLVING PROCESS AND PRINCIPLES

Overview of 7-steps for Problem-Solving Process

Ms. Daley reiterated that the goal the Working Groups is to develop remediation options that would achieve water quality targets with a focus on first targeting low cost, low barrier options to reduce nitrogen and then considering more costly and traditional options later (e.g. installing sewers). She then described the alternatives screening process the group will apply. The process is as follows:

1) Establish targets and articulate project goals.
2) Identify priority geographic areas (e.g. high nitrogen reduction areas, Title V problem areas, pond recharge areas).
3) Determine which management activities should definitely be implemented. These might be the easiest and least costly management activities that should be undertaken regardless of other management actions (e.g. fertilizer management and stormwater mitigation – two approaches that Cape Cod towns are already actively pursuing).
4) Assess alternative options to implement at the watershed or embayment scale (e.g. innovative and lower-cost solutions)
5) Assess options to implement at the site-level
6) Examine priority collection/high density areas
7) Consider traditional sewers or other grey infrastructure management options

She further explained that the Working Groups will focus on the total controllable nitrogen load. The technologies and approaches selected should aim to reduce the total controllable nitrogen load by identifying options that reduce the portion of *septic* load that requires reduction. For example, the portion of septic load that requires reduction could be made smaller if towns implement fertilizer and stormwater solutions first. Additionally, the percentages of controllable nitrogen that need to be removed to meet TMDLs change depending on the characteristics of the watershed.

She noted that in many instances, one of the solutions may not achieve the TMDL, but multiple solutions paired together could achieve the goal. For example, many towns are already using and pairing some of the technology options and approaches:

- Wellfleet- *Coastal habitat restoration & aquaculture*
- Mashpee- *Aquaculture & Expanding Existing Systems*
- Brewster- *PRB & Bioswales*
- Orleans- *Fertilizer Control By-Law*
- Harwich- *Muddy Creek & Cold Brook Natural Attenuation*

- Falmouth- *Aquaculture, Inlet Widening, Eco-Toilet Demonstration Project, PRBs, Stormwater Management (Little Pond Watershed), Fertilizer Control By-Law, Subsurface Nitrogen Removal Septic System*

(It is noted that both Harwich and Chatham are participating in the Muddy Creek restoration effort.)

Categories of Solutions and their Impacts on the Environment, Economy, and Community

Ms. Daley commented that evaluation of the technologies and approaches would be informed by their impacts (positive and negative) on the environment, economy, and community (also known as the Triple Bottom Line). Ms. Smith asked participants which solutions they thought were promising and to identify the issues they foresee, while keeping in mind the environmental, economic, and community impacts of the possible technologies and approaches. She also invited them to share criteria that might help the group evaluate the technologies. Working Group members noted the following, which have been organized here into categories:

Environmental:

- Speed or time it takes for results to be realized – Some approaches can be implemented more quickly and may show results faster than other approaches.

Economic:

- Cost is really important, so would like to maximize lower-cost opportunities . Really like the 7-step approach, to the extent it corresponds with cost-effectiveness.
- Mechanisms to incentivize participation – approaches requiring resident actions will need to offer incentives, such as exemptions on property taxes for early adopters/risk takers who install eco toilets, or a cost-mechanism that charges based on the nutrients discharged by their system
- Affordability – The cost of implementing the measure must be reasonable.
- Opportunity to leverage economies of scale – Could regional management and oversight of operations and maintenance help reach the ultimate performance level of technologies while reducing the economic burden faced by any single town?

Social:

- Social acceptability – consideration of whether or not people will adopt a practice (i.e., installation of eco toilets in upscale homes), be agreeable to seeing it in the environment (e.g., oyster bags floating in the water), or buy into the trade offs between the cost and the benefits.
- Lifestyle impacts on system function – The seasonality of residency could impact a system's functioning.
- Adaptability to fluctuations in occupancy – Systems that are installed should be able to accommodate greater or fewer occupants as properties change hands.

- Education – education of residents is a critical component of the success of any approach, and especially ones that require citizen participation both short and long term. The education needs to be continuous because of frequent turn-over. It should include getting them to accept new ideas and understand the impacts of their actions (e.g., fertilizer and their ponds.)

Implementation

- Need a bundle of solutions, not just one at a time.
- Different sub-watersheds will require different approaches – Some locations may still require removal of 100% of the nitrogen from septic systems, even with successful reduction of nutrients from fertilizers and stormwater.
- Consideration of Operations and Maintenance as well as installation – some of the site-based systems really require oversight for O&M. May need a town or regional function to establish accountability for upkeep. Costs would include enforcement and monitoring
- Priority actions that can be implemented as soon as possible – Towns and residents will favor options that are easy to implement and least expensive. Some of these options may include stormwater and aquaculture projects. What actions are most easily implemented by residents? By towns? Which actions will be most easily and quickly permitted by the DEP? How can we work with DEP to be more agile while still protecting the public?

Additional Factors

- Secondary benefits/opportunities – Ideal approaches will produce multiple benefits (for example, nutrient reduction and help nature.)
- Retrofit for already constructed buildings vs. new development – Given costs of retrofitting, some technologies are more likely to be adopted by (or required for) new development (for example, eco-toilets.)
- Balance risks of new technology – Greater flexibility and opportunity to speed approval and credit for new technologies is important. At the same time, homeowners will want assurance that they money they invest into a new system will achieve the reductions required by state agencies. Also, some towns might be more risk adverse than others.
- Seasonality of use – need to consider impacts of a range of habitation patterns when considering site-based technologies, to make sure they are compatible, and keep in mind that usage might change.
- We should be weighing costs and benefits, including risks, for leaders and for the public.

Ms. Daley showed a GIS map of percolation rates in the soils of Cape Cod. She noted that much of the Cape is within a rather quick groundwater travel time of less than 10 years. She said this may influence considerations about the type of technologies that are more attuned to a quick fix and rapid restoration versus a longer term solution. Ms. Smith asked the group if this would lead the group to think that certain technologies may be more or less valuable or useful in a specific location. Group members responded with the following comments:

- *Some areas, such as those in blue may require specific treatments due to density. But overall, we will need a whole spectrum of solutions since nutrients are already in the ground.*
- *It may make sense to focus on areas immediately up gradient of a water body, especially when thinking about applying fertilizer regulations. We could use technical information to identify and prioritize these areas.*

The group then discussed fertilizer use regulations and the importance of public education. One member said enforcement of fertilizer use regulations is very difficult. Another member stated that Orleans employs the 100-foot buffer indicated in the wetlands protection act to protect wetlands and water bodies from fertilizer. The town also has a fertilizer regulation that only applies to municipally owned property; but a new town bylaw will provide more general application. Another member stressed the importance of educating the public on the options and their challenges as the Watershed Group develops the plan. The public should also have the opportunity to provide input on the solutions, added the group member. Another member noted that public education will be a continuous, long-term activity as new residents move to the Cape.

Technology Selection: Process and Principles

Ms. Daley presented some of the principles that could guide technology/approaches selection. These process and principles include:

- *100% septic removal subwatershed*: Combinations of technologies can be used to reduce septic load that needs to be removed in some sub-watersheds, though others will require all septic nitrogen plus other nitrogen removal to meet required levels.
- *Scale: On-Site vs. Collection System vs. Natural System*: There will be tradeoffs between the scale of systems that can be used. On-site, collection, and natural systems all have their pros and cons and all require different levels of investment and infrastructure. These tradeoffs will be important from an implementation and public acceptance point of view.
- *Nutrient intervention and time of travel*: Some technologies/approaches intercept nutrients at their point of entry into the system, while others deal with it later on (e.g. once it is in the watershed). There are pros/cons to each approach which need to be considered.
- *Permitting Status*: The level of effort required to permit technologies will be a consideration.
- *Land use and Impacts of Growth*: Unintended consequences and opportunities for planned growth are important to consider.

V. PLANNING FOR THE NEXT MEETING

Meeting Three will be held:
Thursday, December 4, 2013
8:30AM - 12:30PM
Eastham Town Hall, 2500 State Highway, Eastham, Massachusetts 02642

During this meeting the Working Groups will examine various scenarios (i.e. combinations of solutions) and their potential impacts (e.g. nutrient reduction, economic impacts, environmental impacts, social impacts, etc.) and the Cape Cod Commission will use tools to calculate ideas/options and their impacts. Ms. Daley said two analyses will also be presented: one analysis is through the seven step process described above and the second analysis is more a direct engineering perspective to see what a system would look like if required to use only permitted approaches. These two scenarios are bookends to a variety of approaches, which the Working Group will examine during the next meeting. Working Group participants should come prepared to offer their ideas about what solutions they'd like to explore further given their understanding of the baseline conditions, issues, and priorities in this watershed.

VI. PUBLIC COMMENTS

Members of the pubic made the following comments

- A member of the public posed several questions for consideration: *Can permeable barriers be done for individual homes? If there are stringent guidelines within 100 feet of ponds in Orleans, is this not a natural place to put in more stringent guidelines? If so, what might the cost be? At what point do you go to the planning board and ask them to say that the 4th or 5th toilet added to a home must be an ecotoilet? At what point do we engage the planning board and require them to engage with new town residents?* Mr. Horsley responded that PRB could be done on a home basis, but it would be expensive. A group member said the bathrooms question would be decided by the Board of Health on a case by case basis.
- *A member of the public commented that George Huefelder's research shows some IA systems are very effective and resilient and recover quickly from seasonal fluctuations. The commenter referred to the conversation on cost and noted that the EPA is working on this relative to Life Cycle Analysis (LCA). The commenter observed that LCA was not addressed in today's conversation and said that the triple bottom line was named but not really addressed. Noting the outstanding question about DEP's definition of success, he said this is an important piece of the puzzle that needs to be quantified so the town knows what it must achieve. Additionally, the definition is needed before the establishment of baseline data. Commenting on the Technology Panel meetings, he said it was interesting the in-situ nitrogen removal options were the first options the panel reviewed and noted that Falmouth and Wellfleet are doing these types of projects. He then stated that the MEP model is an input output model and that taking a pound of nitrogen out is not the same as putting in a pound. Regarding the October 3 meeting, he commented the meeting was about showing that changes in water bodies are being controlled by nature, not about presenting different data points. He said one way to look*

at controlling nitrogen is to control it by managing nitrogen in-situ to address the TMDL rather than attempting to control nitrogen from entering the system. Ms. Daley said LCA costs would be included in the Technology Matrix.

Appendix A: Attendance

Primary Members:

	Name	Title
Local Elected Official	Dale Fuller (for John Hodgson)	Orleans Finance Committee (for Orleans Selectman)
	Sims McGrath	Orleans Selectman
	Martin McDonald	Eastham Selectman
Appointed/Committee	Charles Harris	Eastham, Chair, Water Management Committee
	Judith Bruce	Orleans, Former Wastewater Committee
Town Staff	Thomas Daley	Orleans, DPW Director
	Jane Crowley	Eastham Health Agent
	Sue Leven	Brewster Planner
Environmental and Civic Groups	Ed Daly (for Paul Ammann)	Orleans Citizens Peer Review Group
	Gary Furst	Orleans Water Alliance
	Bruce Taub	Orleans Water Alliance
	Sandy Bayne	Eastham, Orleans Ponds Coalition
	Sandy MacFarlaine	Orleans
	Lynn Bruneau	Orleans Conservation Trust
	Doug Fromm	Orleans CAN
	Amy Costa	Eastham, PCCS
Business	Judy Scanlon	Orleans, Small Farm, Orleans Conservation Trust
	Sid Snow	Orleans Business Owner
Open/Other	Kenneth Ainsworth	Eastham
	Lori Roueche	Orleans

Alternates and Members of the Public:

Katie Blakeley
Don Cameron
Karin Delaney
Jeff Eagles
Cheryl Eisner
Steven Hertz
Charles Ketchuck
Dan Milz
Ed Nash
Ginia Pati
Russell Schell
Len Short

Cape Cod 208 Area Water Quality Planning
Pleasant Bay Group Watershed Working Group

Meeting Two
Wednesday, October 23, 2013
Orleans Town Hall, 19 School Road, Orleans, MA 02653
8:30 am - 12:30 pm

8:30 Welcome, Review 208 goals and Process and the Goals of today's meeting – *Cape Cod Commission*

8:40 Introductions, Agenda Overview, Updates and Action Items– *Facilitator and Working Group*

9:00 Range of Possible Solutions – *Cape Cod Commission and Working Group*

- Technology Matrix
- Technologies Overview
- Survey Questions and Comments
- Additional Questions and Discussion

10:30 Break

10:45 Problem Solving Process and Principles – *Cape Cod Commission and Working Group*

- Overview of 7-steps for Problem-Solving Process
- Examination of Categories of Solutions and their impacts on the Environment, Economy, and Community (triple bottom line)
- Discussion – Identify Considerations and Priorities for Application

12:00 Preparing for Meeting 3 and Beyond – *Cape Cod Commission*

- Review Tools, Alternatives Analysis Approach
- Evaluating Scenarios for Meeting Nitrogen Goals
- Other Process Next Steps

12:15 Public Comments

12:30 Adjourn

Pleasant Bay

Technologies and Approaches

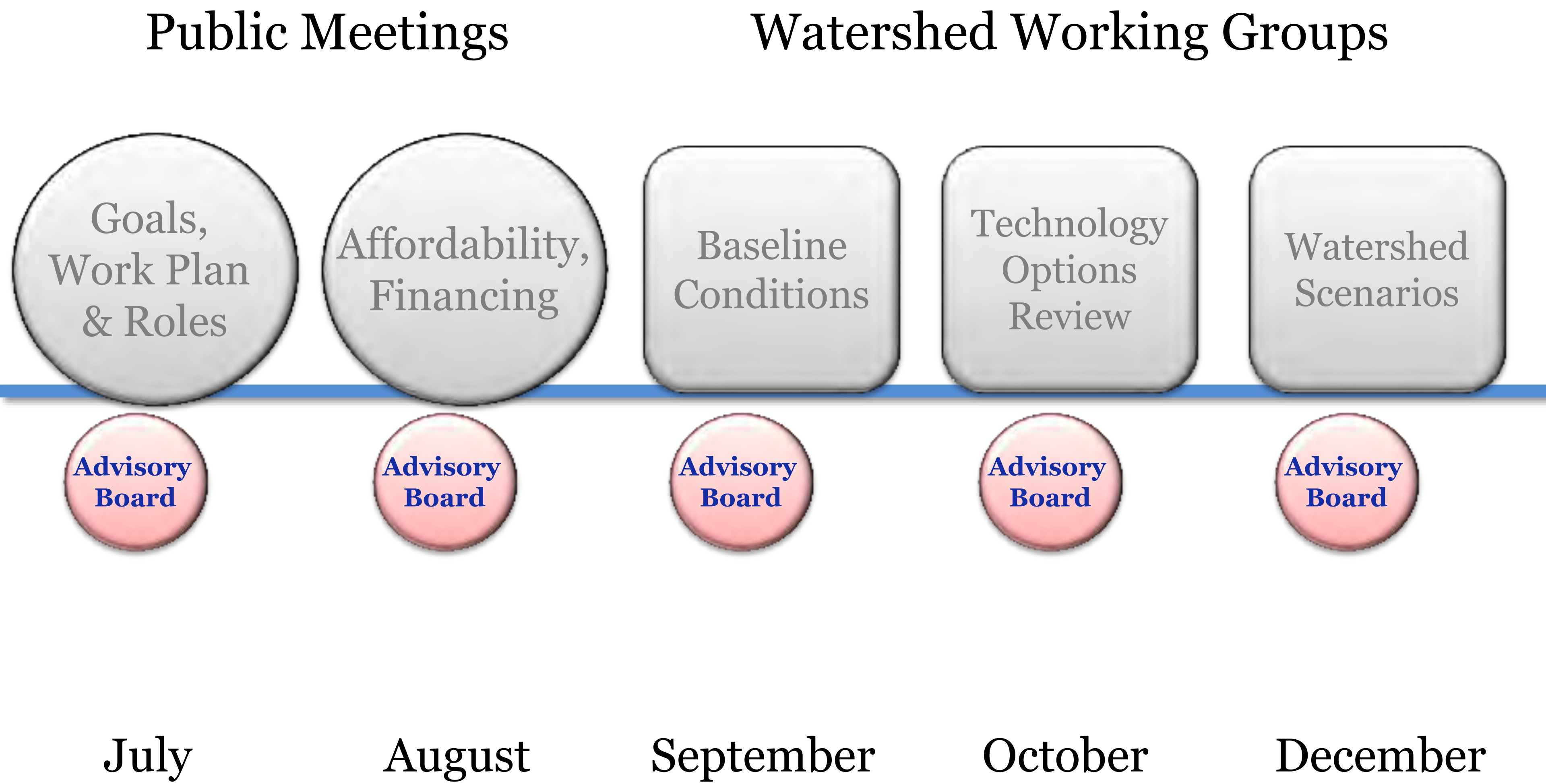
What is the stakeholder process?

Public Meetings

- July: Goals, Work Plan & Roles
- August: Affordability, Financing

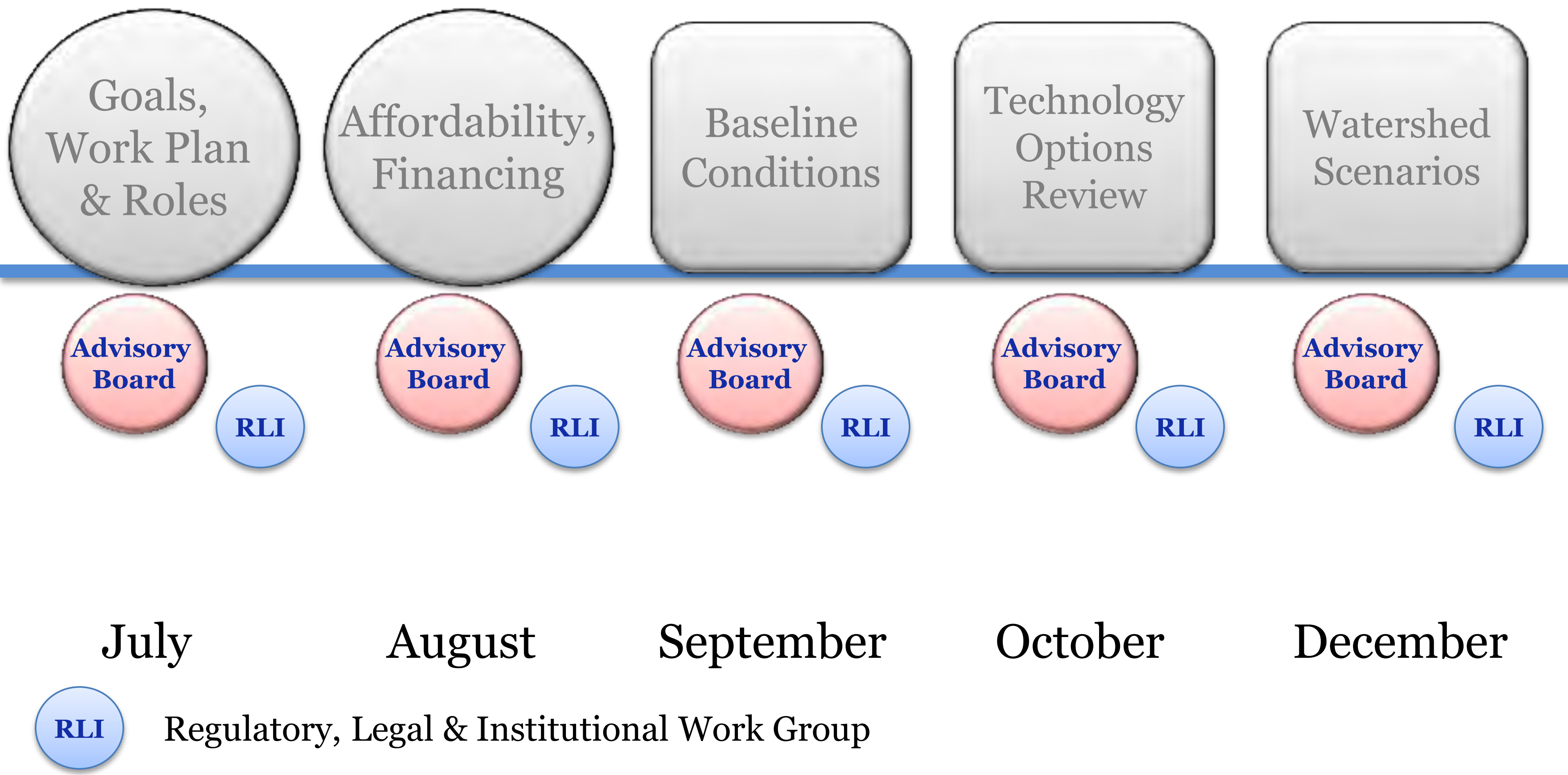
Watershed Working Groups

- September: Baseline Conditions
- October: Technology Options Review
- December: Watershed Scenarios



208 Planning Process

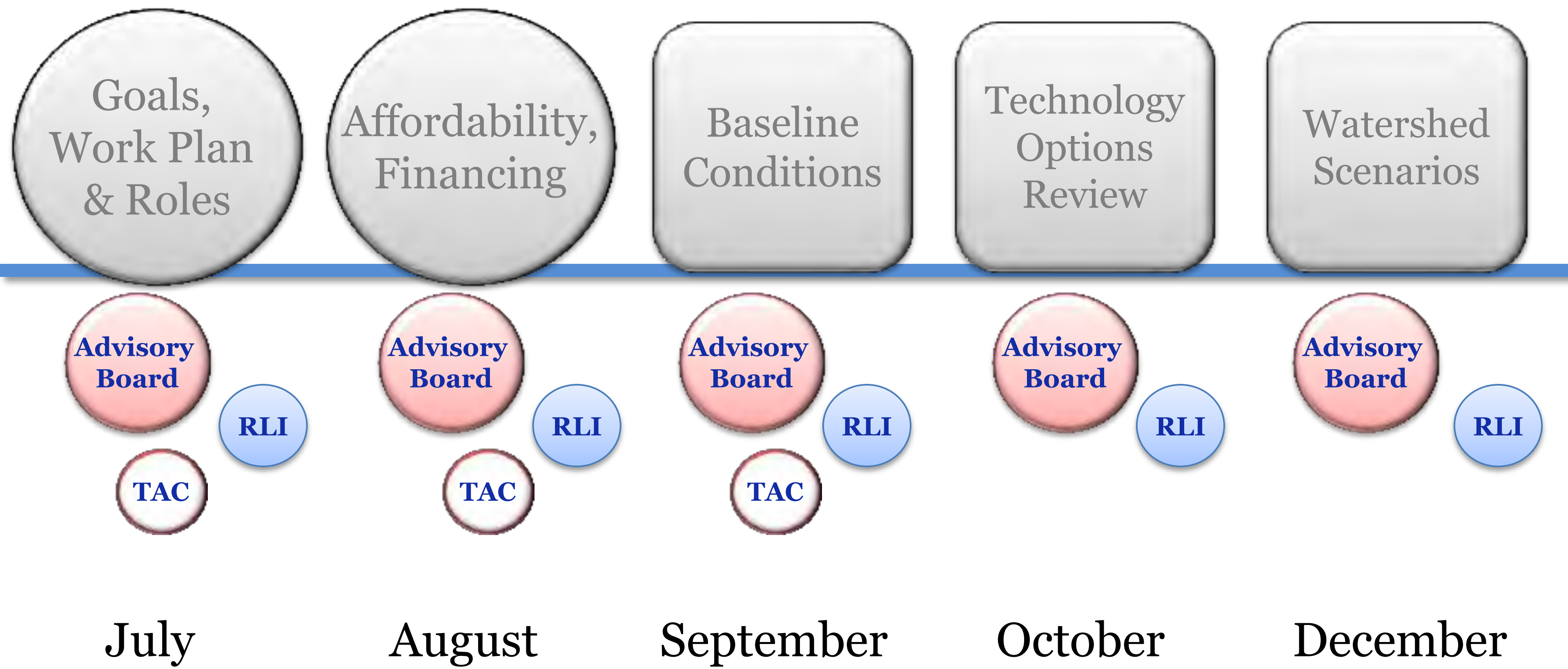
Public Meetings Watershed Working Groups



Regulatory, Legal & Institutional Work Group

208 Planning Process

Public Meetings — Watershed Working Groups



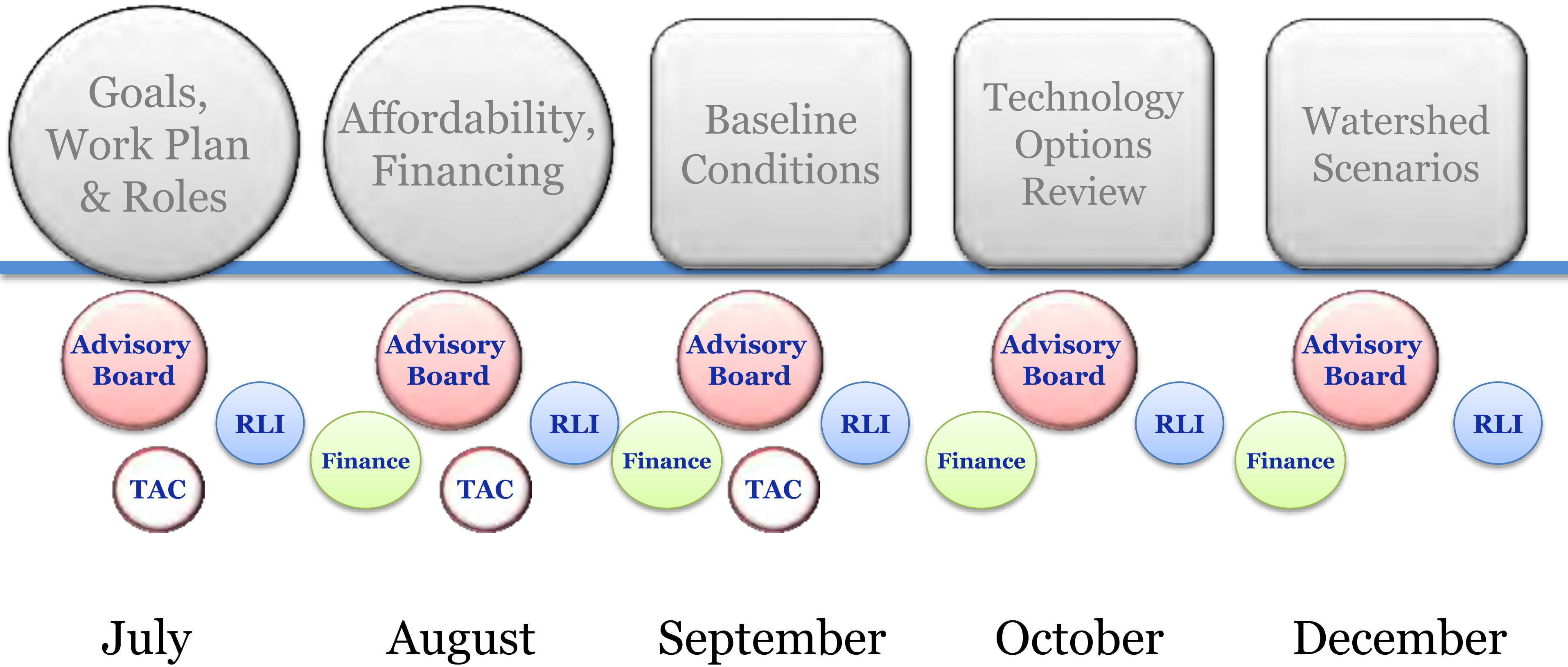
RLI — Regulatory, Legal & Institutional Work Group

TAC — Technical Advisory Committee of Cape Cod Water Protection Collaborative

208 Planning Process

Public Meetings

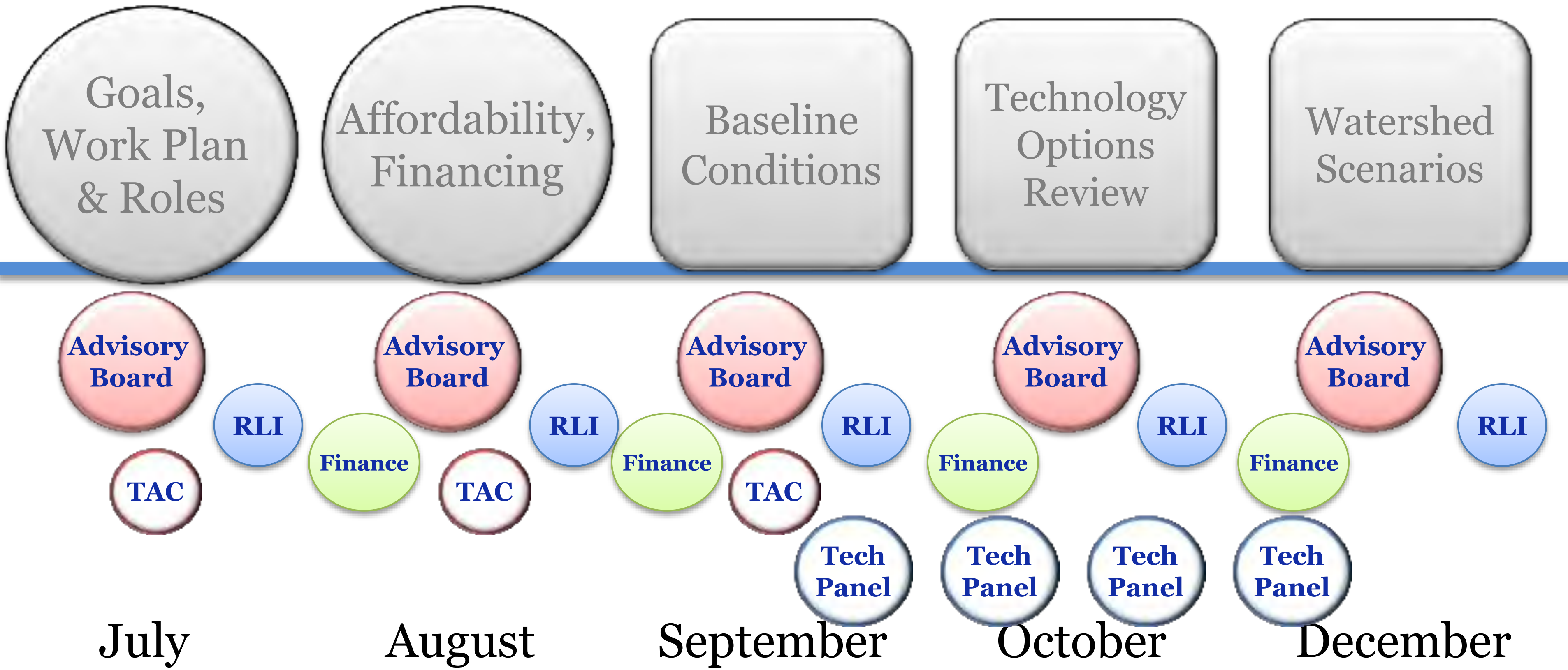
Watershed Working Groups



RLI Regulatory, Legal & Institutional Work Group

TAC Technical Advisory Committee of Cape Cod Water Protection Collaborative

Public Meetings Watershed Working Groups



RLI Regulatory, Legal & Institutional Work Group

TAC Technical Advisory Committee of Cape Cod Water Protection Collaborative

208 Planning Process

Baseline Conditions

11 Working Group Meetings: Sept 18-27

Goal of the First Meeting:

To review and develop shared understanding of the characteristics of these watersheds, the work done to date, existing data and information available, and how to apply all of this to planning for water quality improvements for these watersheds moving forward.

Progress since last meeting

- ❑ Meeting materials

Progress since last meeting

- ❑ Meeting materials
- ❑ GIS data layers

Progress since last meeting

- ❑ Meeting materials
- ❑ GIS data layers
- ❑ Chronologies

Baseline Conditions

11 Working Group Meetings: Sept 18-27

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

208 Planning Process

Baseline Conditions

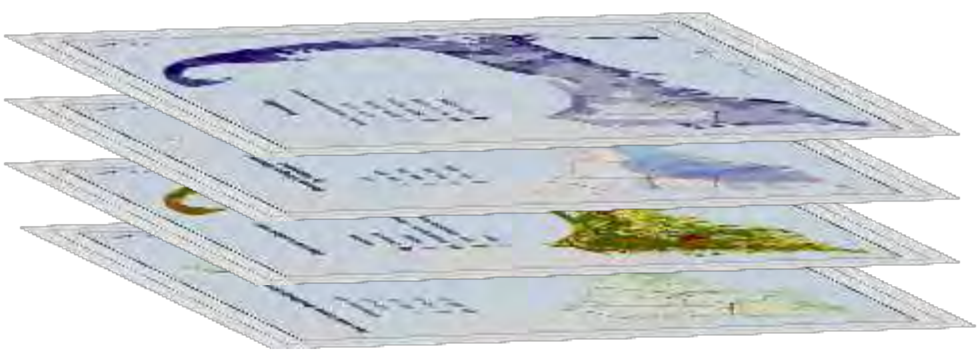
11 Working Group Meetings: Sept 18-27

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Watershed Scenarios

11 Working Group Meetings: Dec 2-11



208 Planning Process

Baseline Conditions

11 Working Group Meetings: Sept 18-27

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Watershed Scenarios

11 Working Group Meetings: Dec 2-11

Watershed Event

November 13

Center for the Arts Dennis

Wrap up of Cape2O: ur in charge!

Summary of planning process to date

Outline of second 6 months of the 208 planning process

208 Planning Process

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Goal of Today's Meeting:

To develop a shared understanding of the potential technologies and approaches identified to date, and the benefits and limitations of each; to explore the environmental, economic, and community impacts of a range of categories of solutions; and to identify priorities and considerations for applying technologies and approaches to remediate water quality impairments in your watershed.

Technologies and Approaches for Improving Water Quality

Technologies and Approaches for Improving Water Quality

- The Fact Sheets present various information on the technologies being considered.
- Additional information is contained on the Technology Matrix including the following:
  - Site Requirements
  - Construction, Project and Operation and Maintenance Costs
  - Reference Information
  - Regulatory Comments
- Input from the Stakeholders is requested regarding a technology's Public Acceptance

Technologies and Approaches for Improving Water Quality

- Comprehensive analysis of nutrient control technologies and approaches.

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- Not all of the technologies and approaches will be applicable to Cape Cod.

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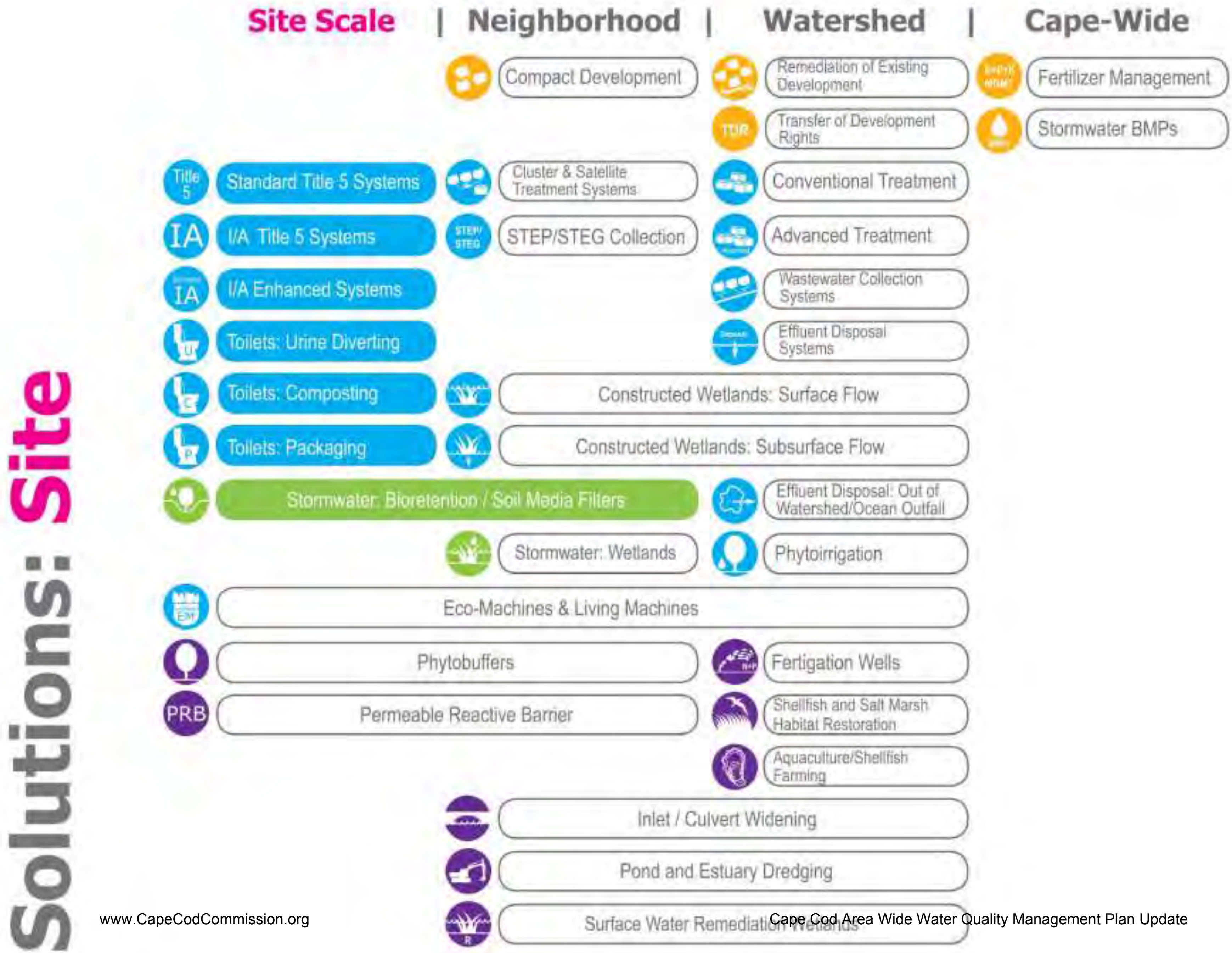
- Certain technologies or approaches will be effective at **preventing** nutrients from entering the water body. Others will be effective at **reducing** or **remediating** nutrients that are already in the groundwater or water body.
- Regulatory programs can address nutrient controls for both existing development and future development.


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


Solutions: Site
Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
Remediation of Existing Development
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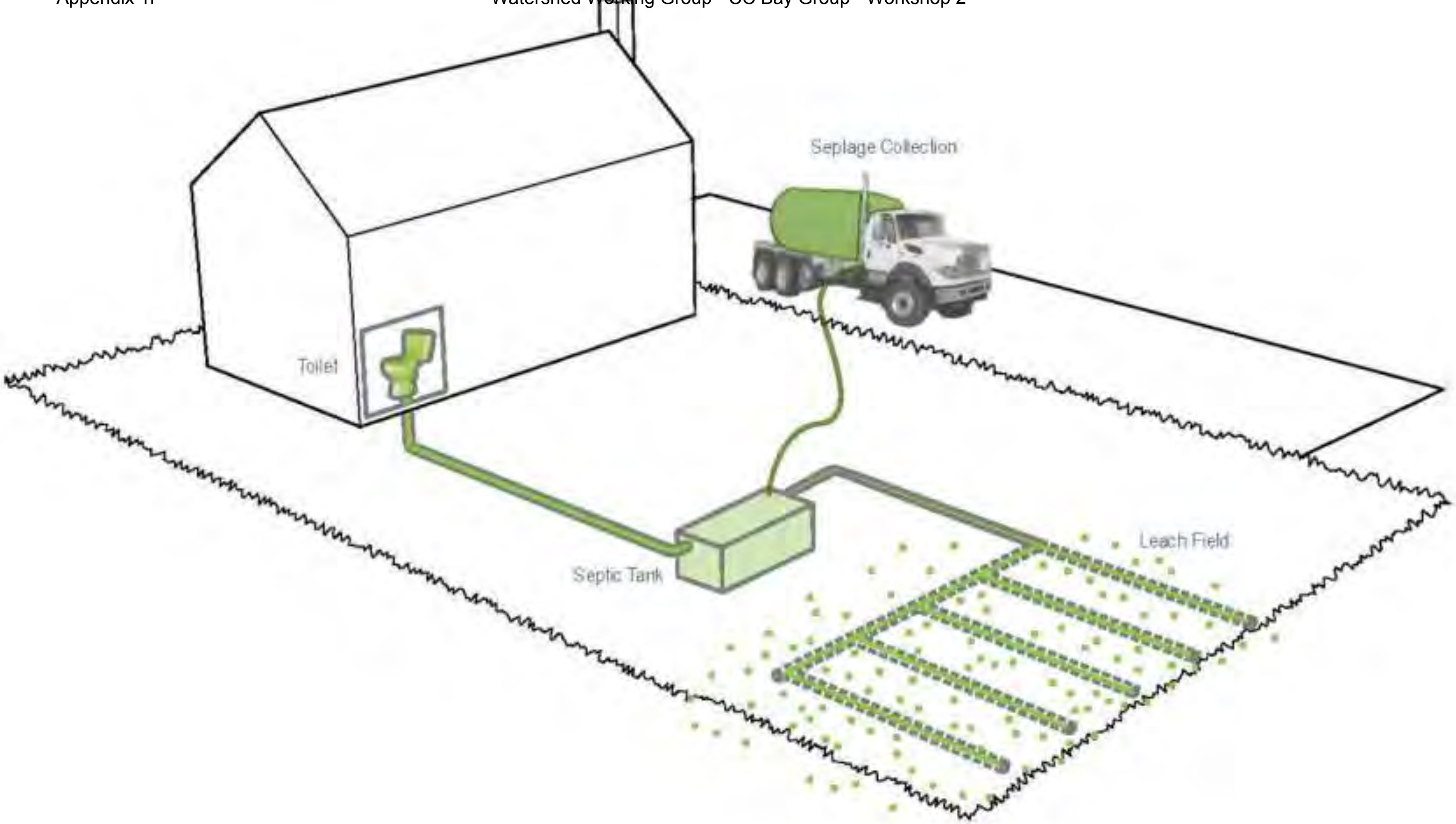
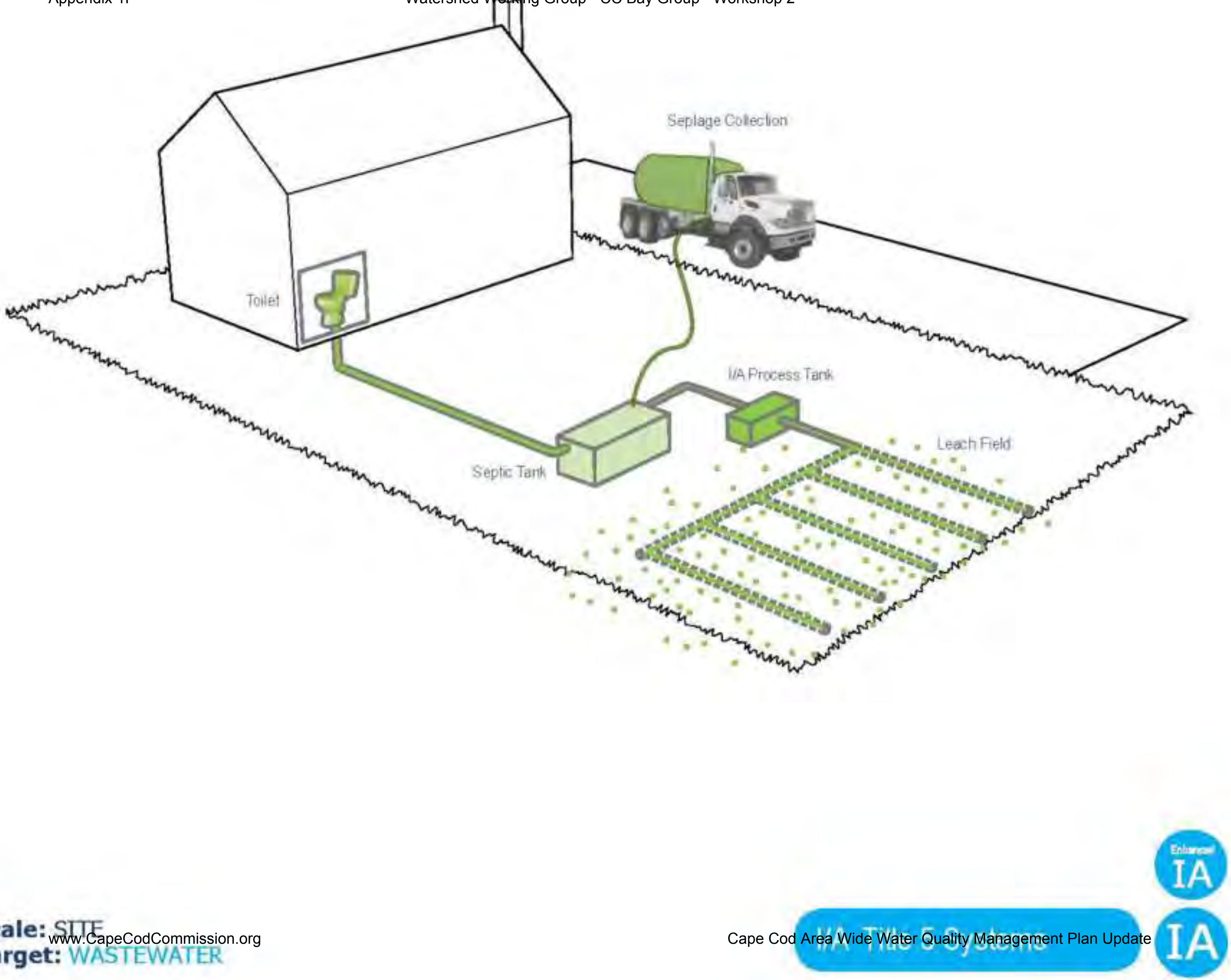


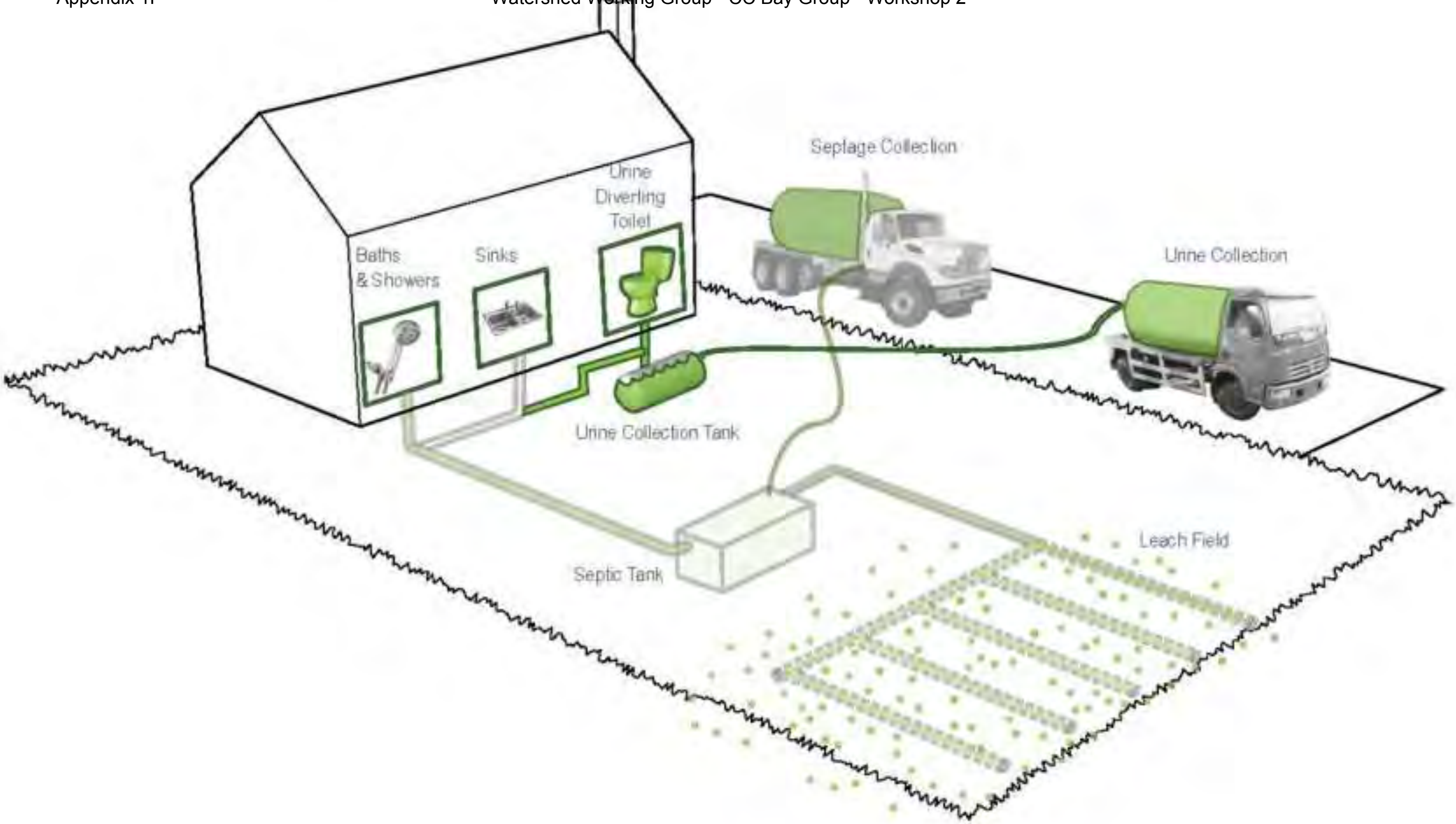
Scale: SITE
Target: WASTEWATER

Standard Title 5 Systems
Title 5



Scale: SITE
Target: WASTEWATER

I/A Title 5 Systems



Scale: SITE
Target: WASTEWATER

Toilets: Urine Diverting

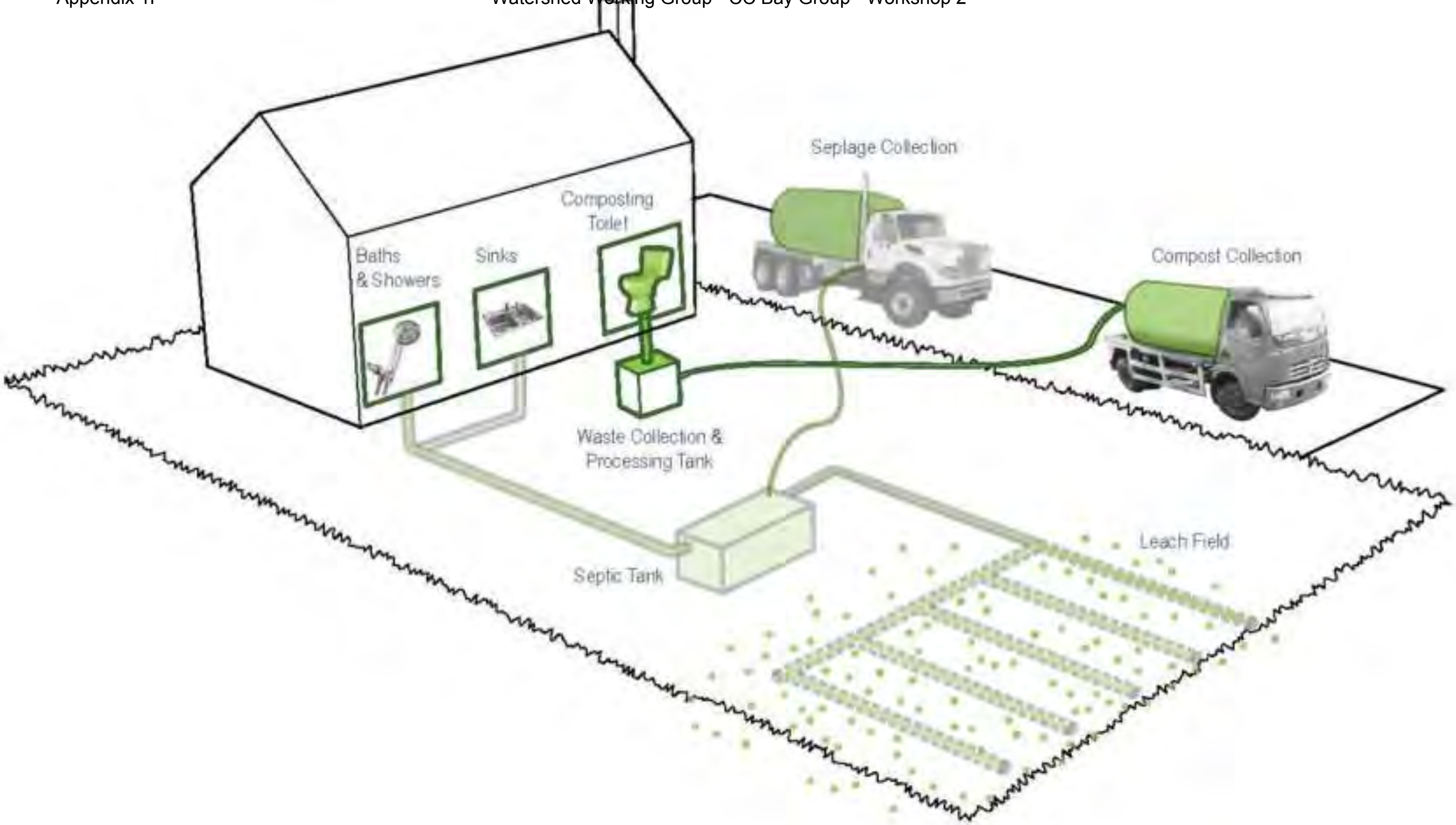
Waterless Urinal

IBC container (220 gallons)

40" x 40" x48"

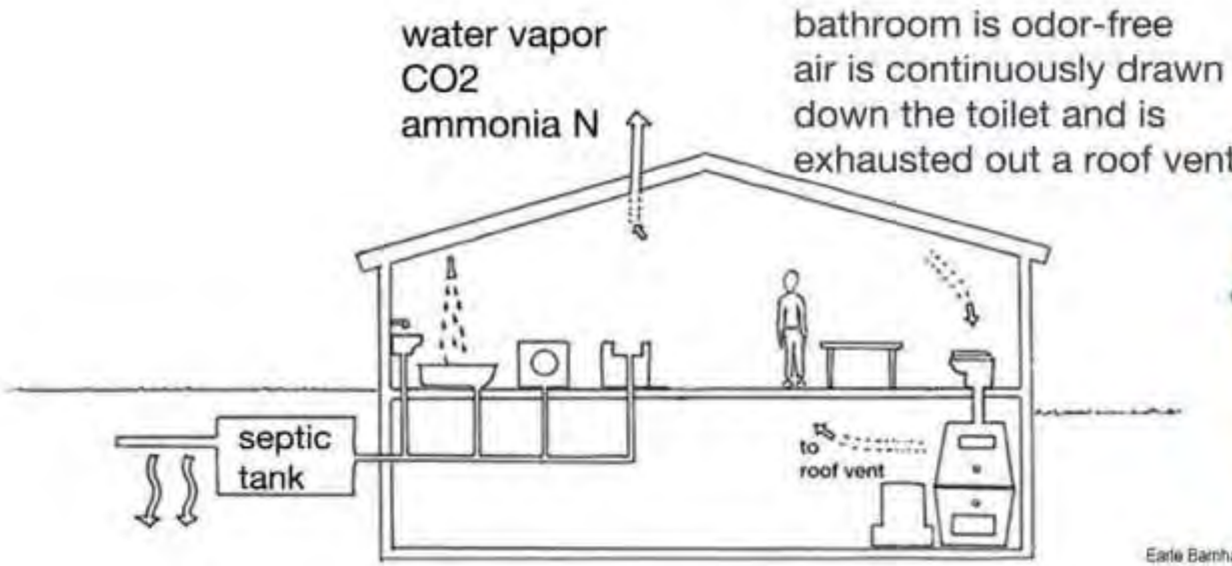
Source: Earle Barnhart, The Green Center Inc. and Horsley-Witten Group Inc.

Toilets: Urine Diverting



Scale: SITE
Target: WASTEWATER

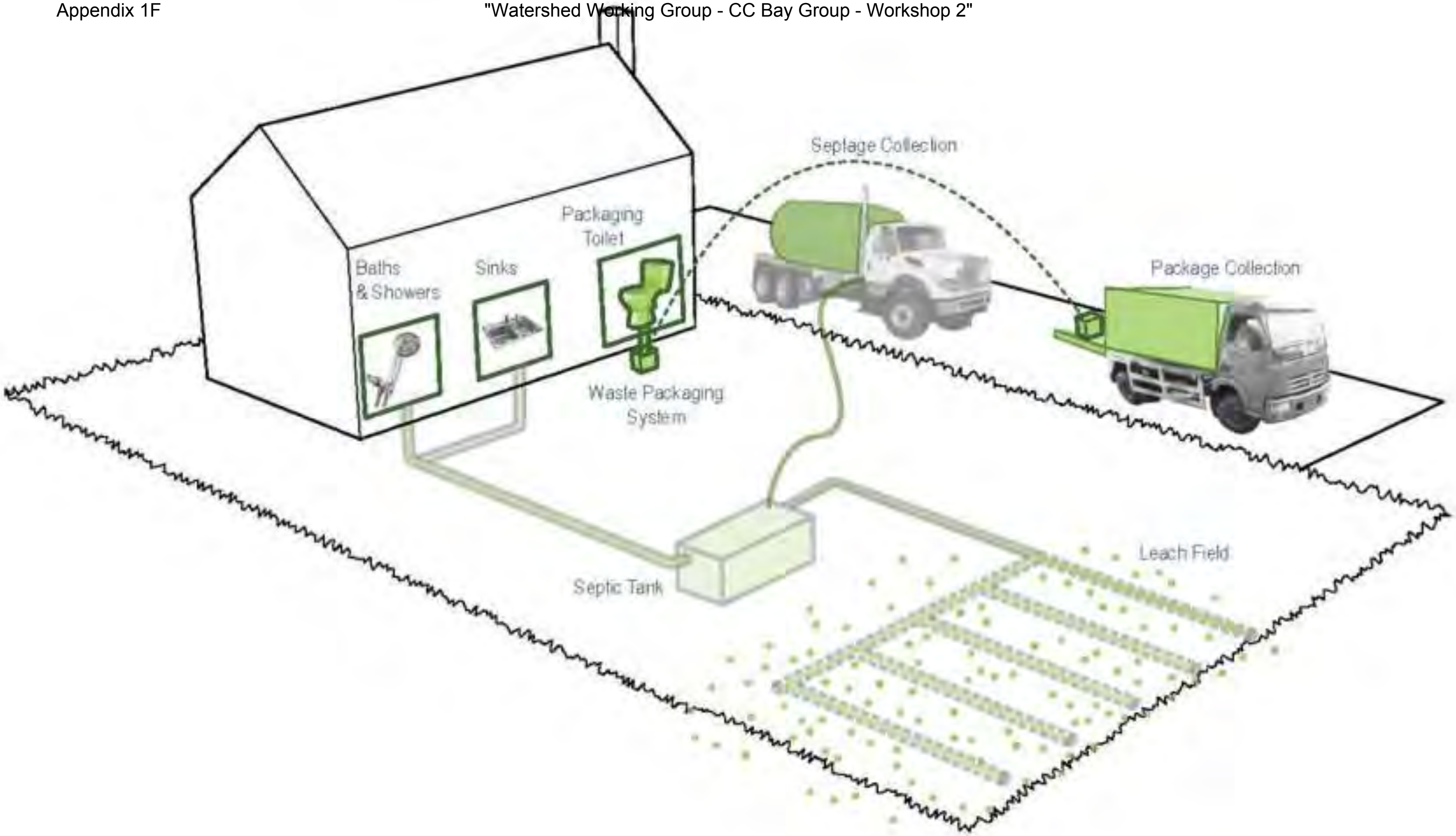
Toilets: Composting



Earle Barnhart
The Green Center, Inc

Source: Earle Barnhart, The Green Center Inc.

Toilets: Composting

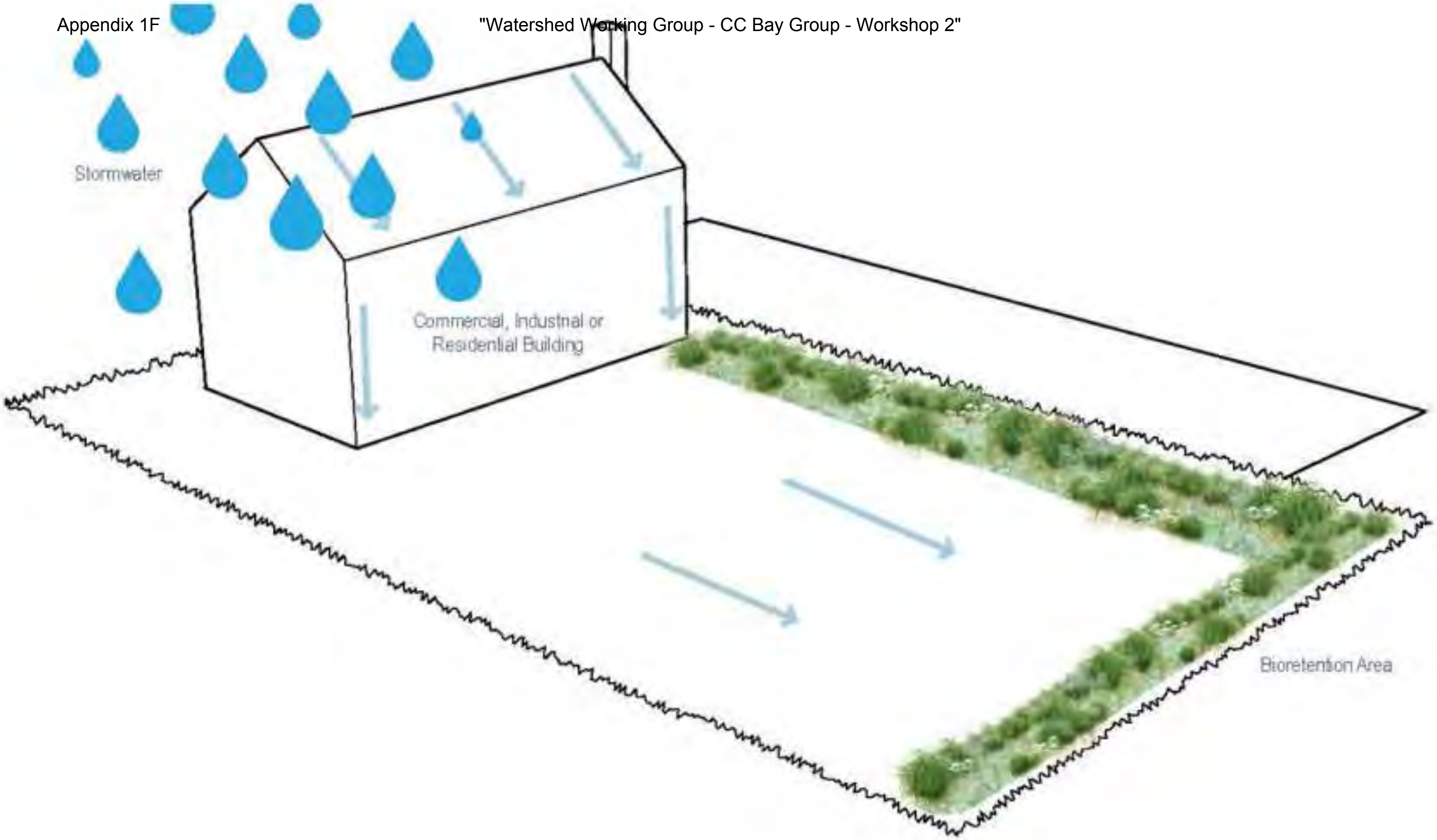


Scale: SITE
Target: WASTEWATER

Toilets: Packaging

Source: Earle Barnhart, The Green Center Inc.

Toilets: Packaging



Scale: SITE
Target: STORMWATER

Stormwater Bioretention / Soil Media Filters

Precedent: 12th Ave. Stormwater Project, Portland, OR
Source: City of Portland

Stormwater: Bioretention / Soil Media Filters

Rain Gardens


Site Scale | Neighborhood | Watershed | Cape-Wide
Solutions: Neighborhood
Compact Development
Remediation of Existing Development
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Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
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Toilets: Urine Diverting
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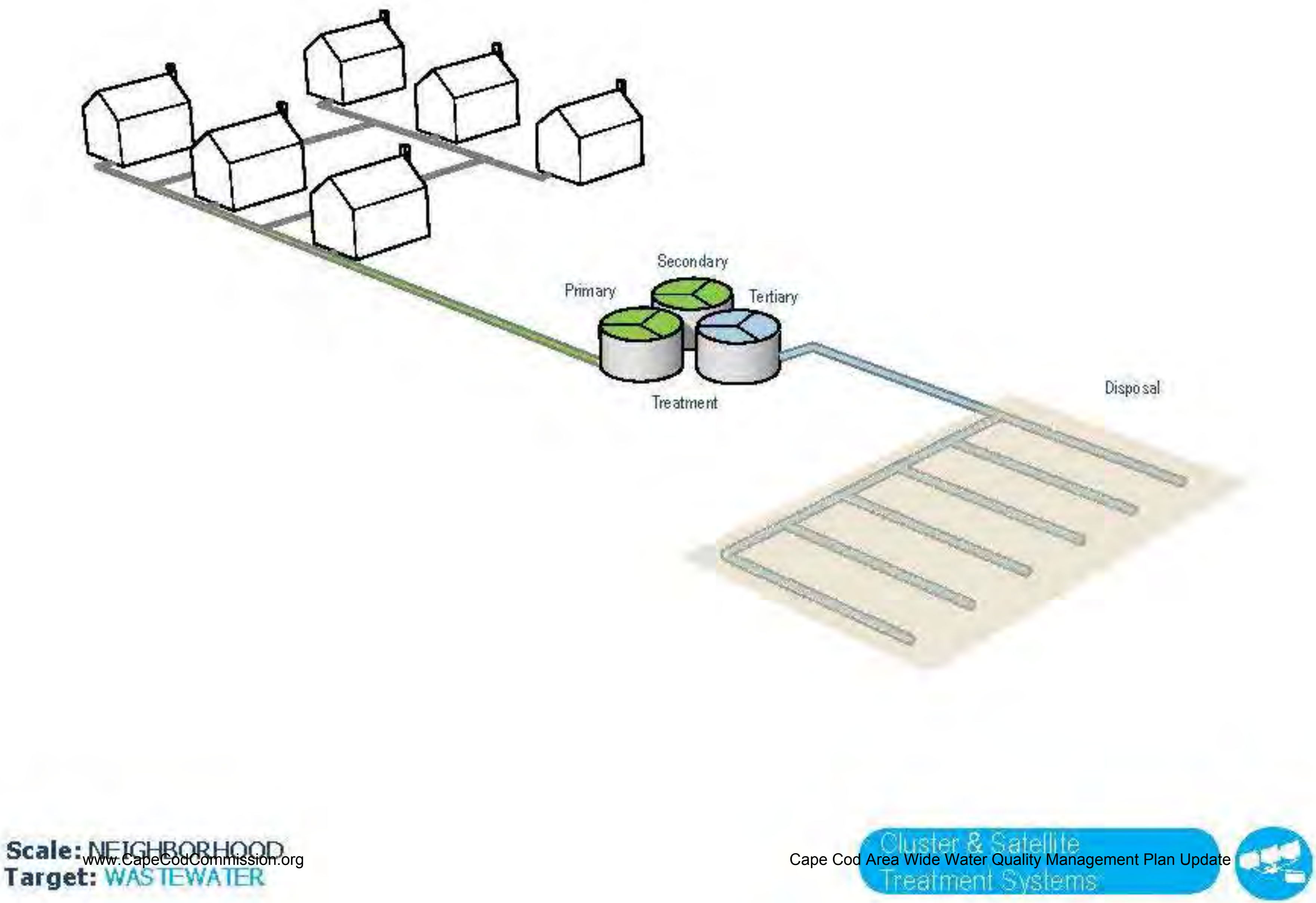
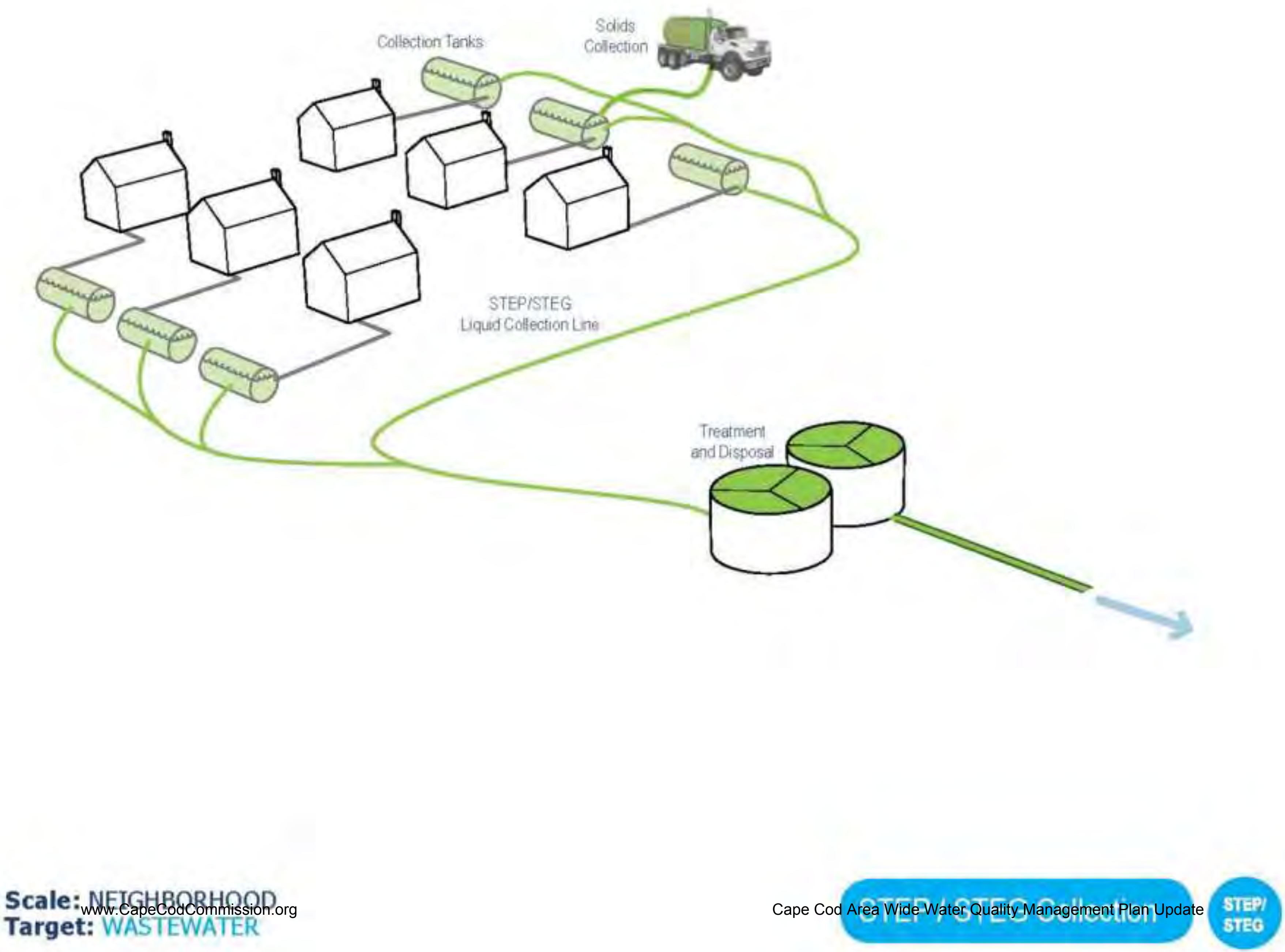
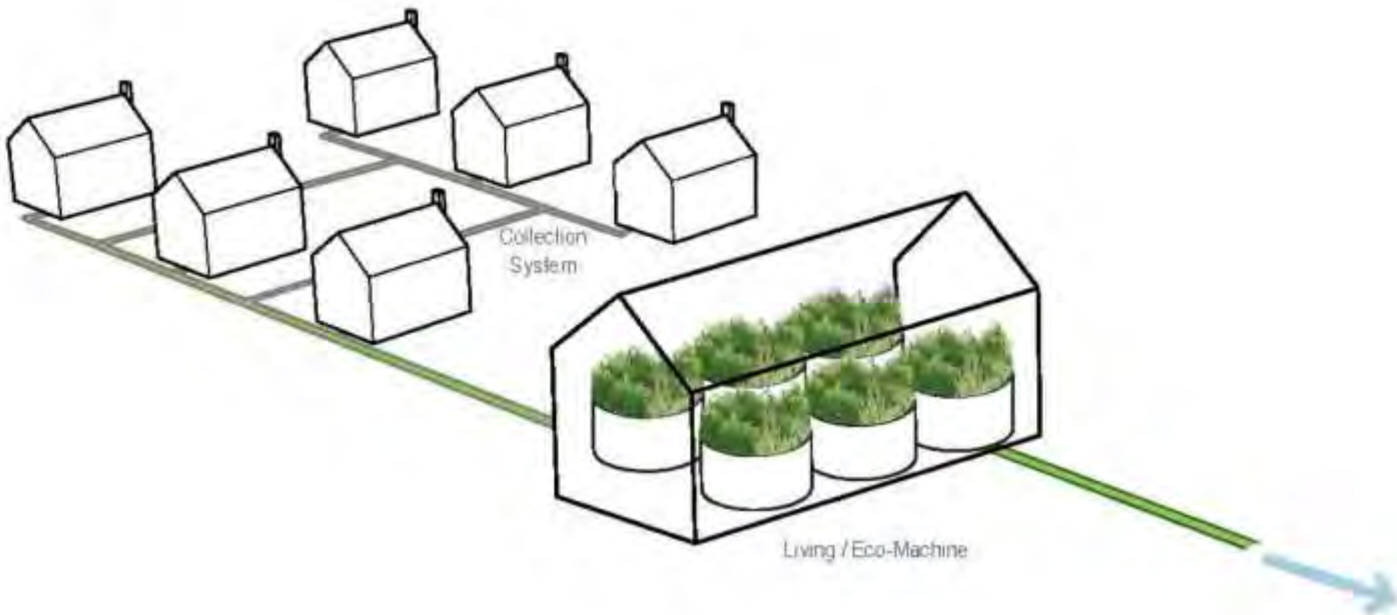
Phytoirrigation
Eco-Machines & Living Machines
Phytobuffers
Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands

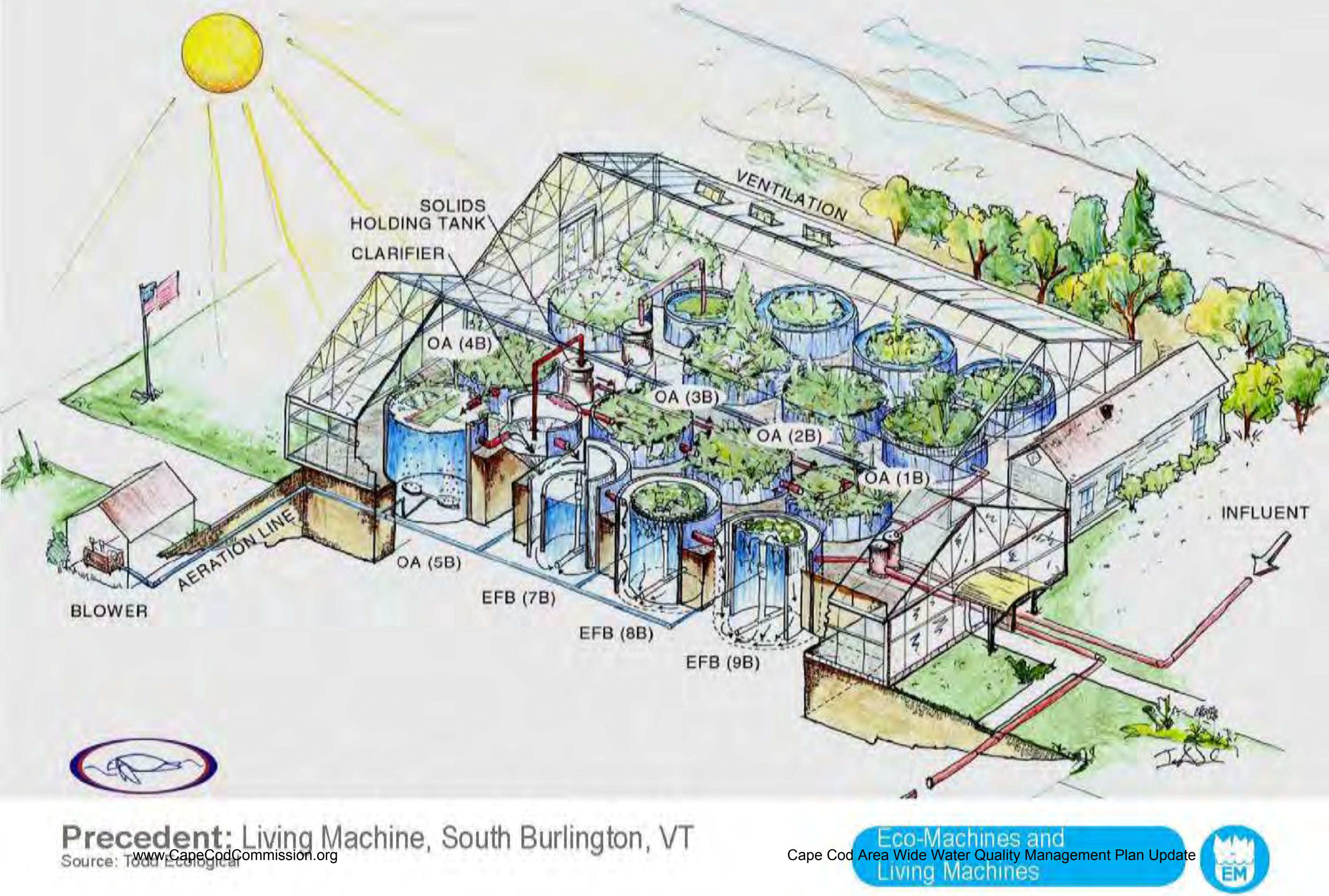

Secondary
Primary
Tertiary
Treatment
Disposal
Scale: NEIGHBORHOOD
Target: WASTEWATER
Cluster & Satellite
Treatment Systems


Collection Tanks
Solids
Collection
STEP/STEG
Liquid Collection Line
Treatment
and Disposal
Scale: NEIGHBORHOOD
Target: WASTEWATER
STEP / STEG Collection
STEP/
STEG

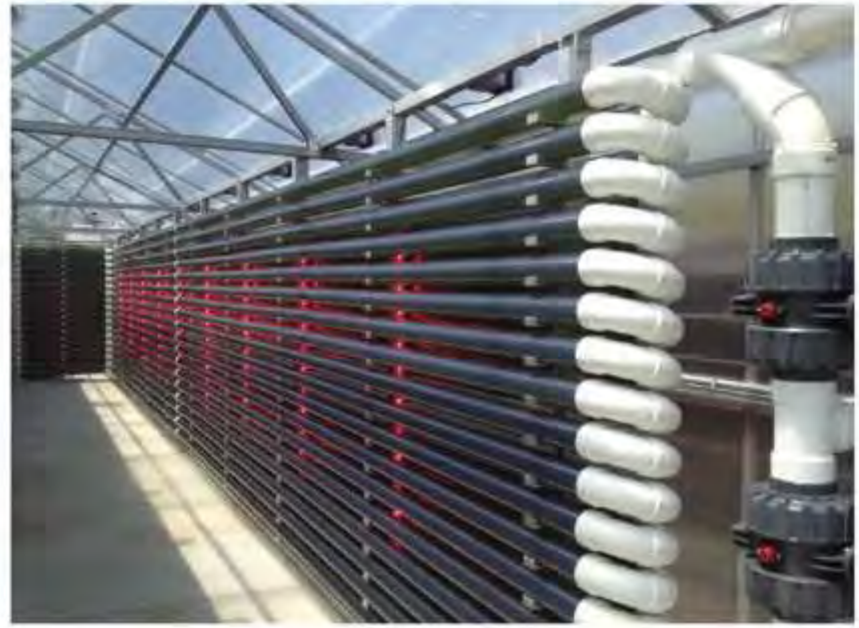


Scale: NEIGHBORHOOD
Target: WASTEWATER

Eco-Machines and
Living Machines

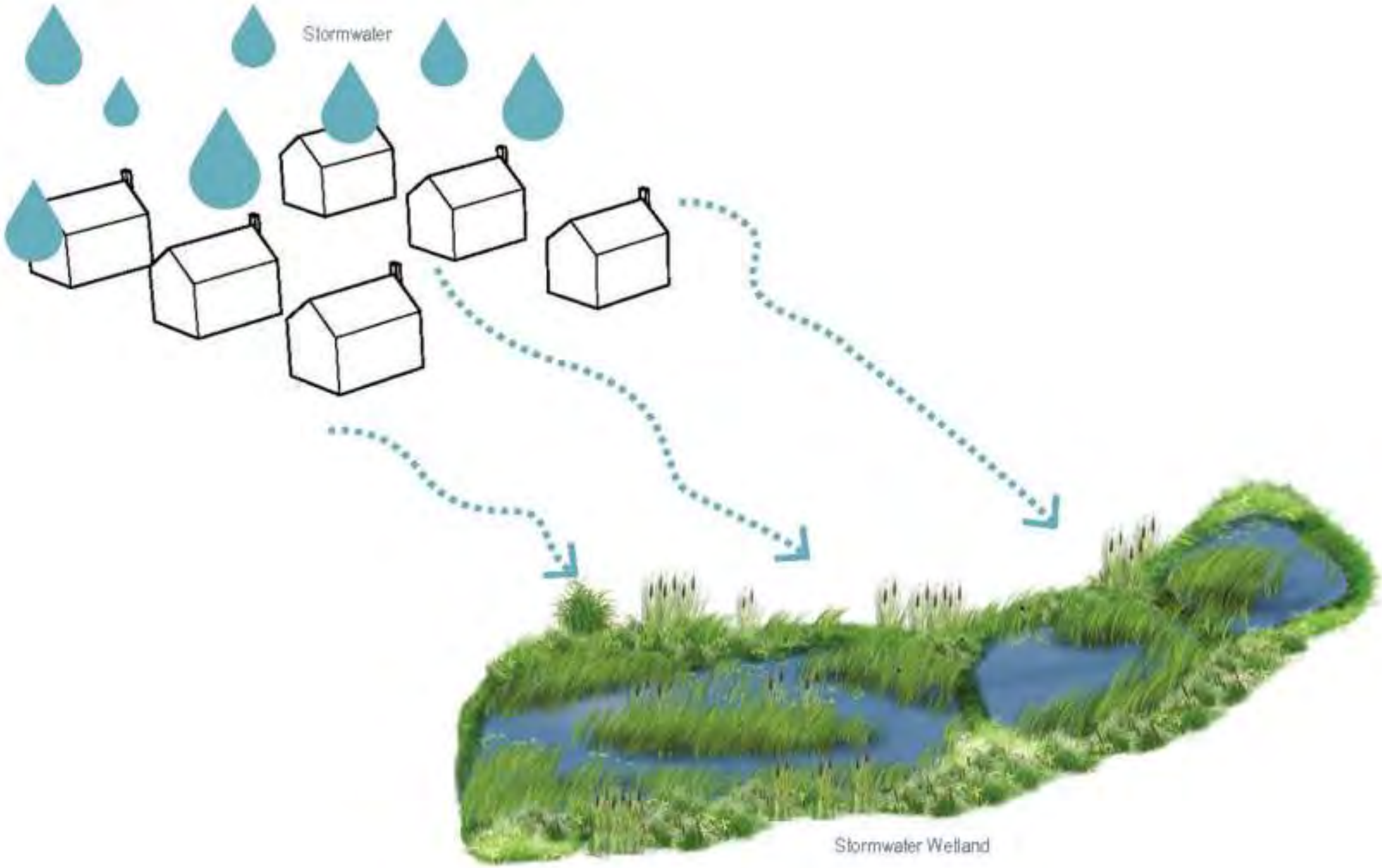


Precedent: Living Machine, South Burlington, VT
Source: Todd Ecological



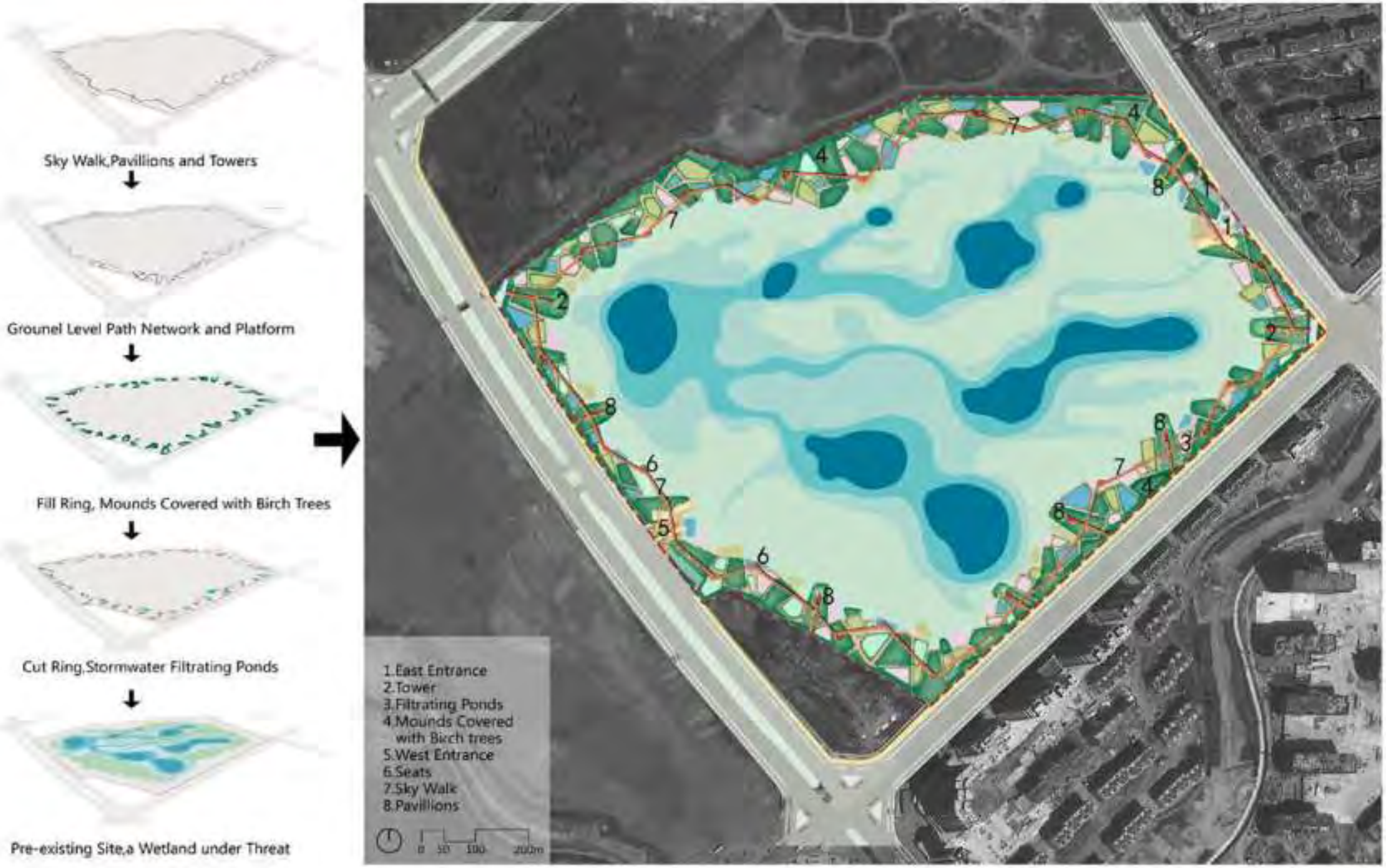
Precedent: Living Machine - South Burlington, VT + Photobioreactors - Falmouth, MA
Source: Todd Ecological and Tom Cambareri

Eco-Machines and Living Machines



Scale: NEIGHBORHOOD
Target: STORMWATER

Stormwater Wetlands

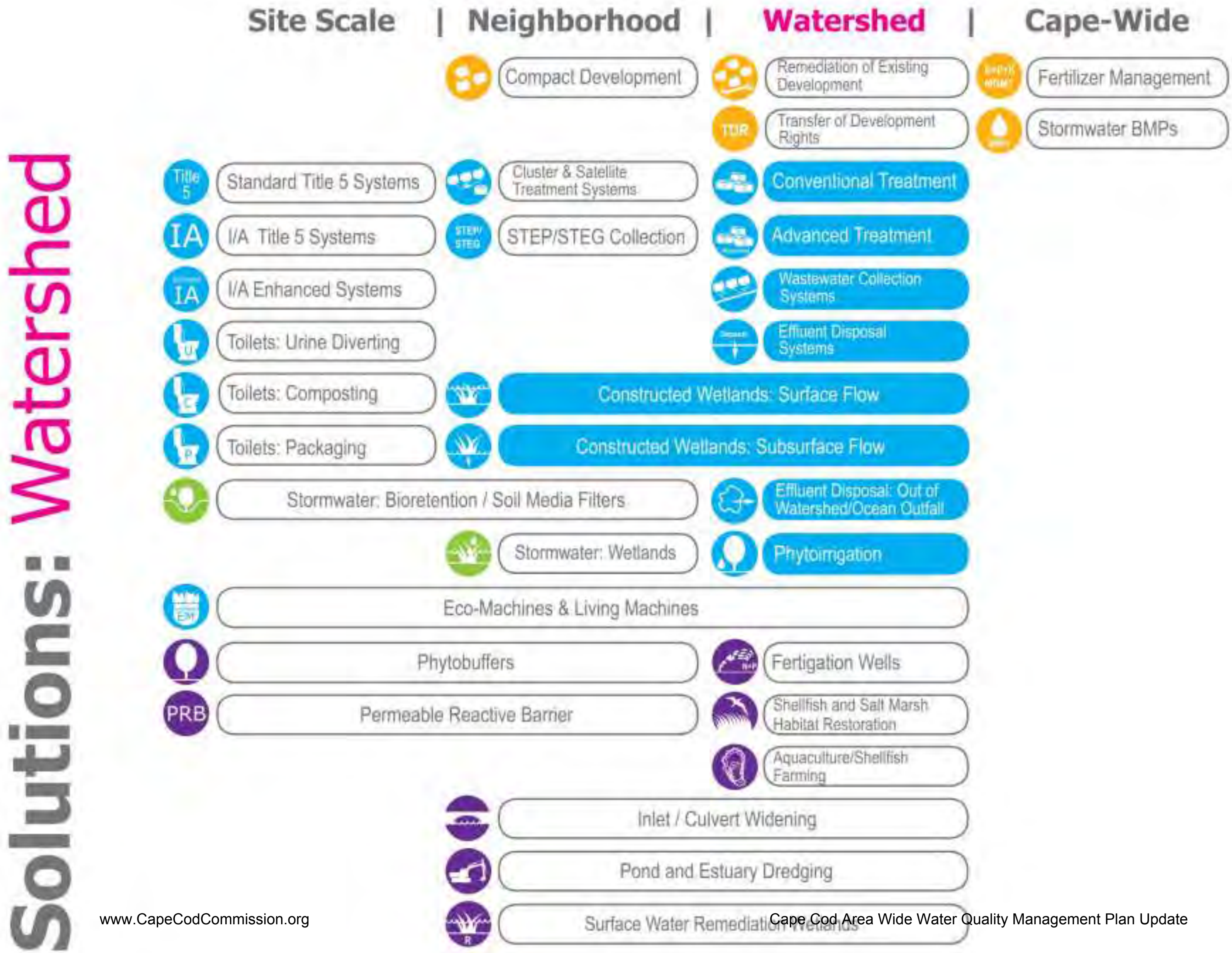


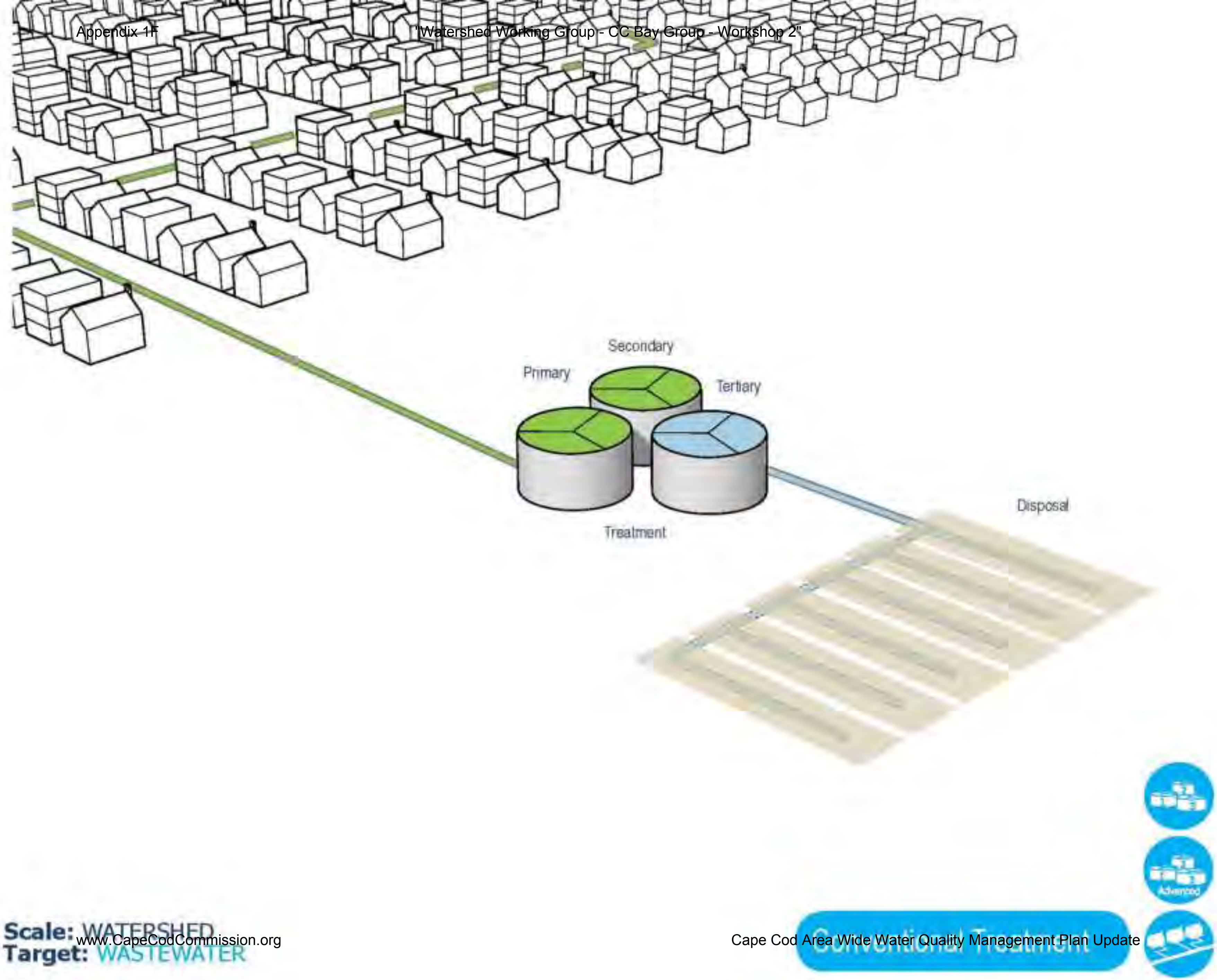
Precedent: Quinli Stormwater Park, China

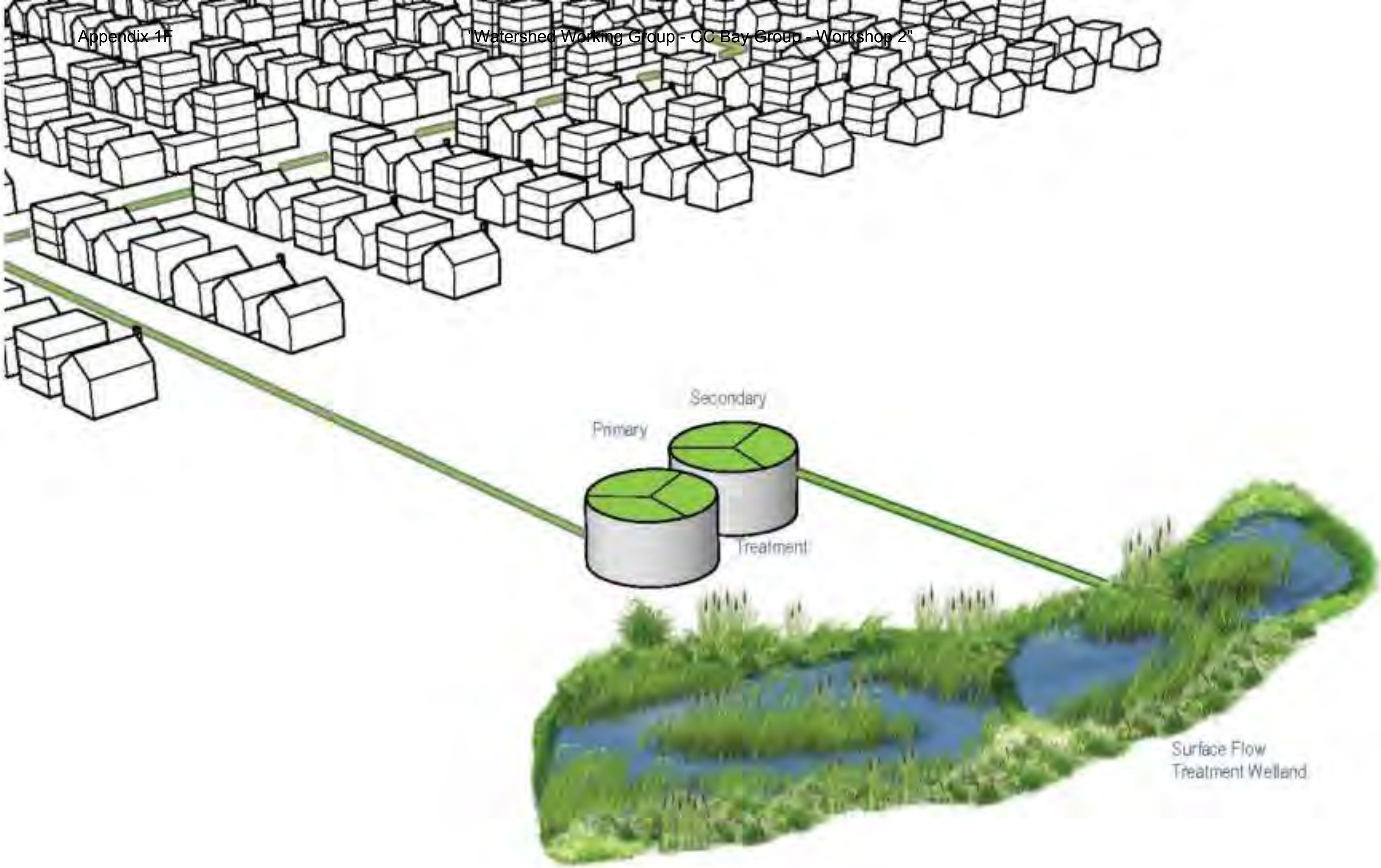
Source: Turenscape

Stormwater Wetlands

Stormwater Wetlands


Solutions: Watershed
Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
IA
I/A Title 5 Systems
STEP/STEG
STEP/STEG Collection
Advanced Treatment
IA
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
EM
Eco-Machines & Living Machines
Phytobuffers
Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands


Secondary
Primary
Tertiary
Treatment
Disposal
Advanced
Conventional Treatment
Scale: WATERSHED
Target: WASTEWATER



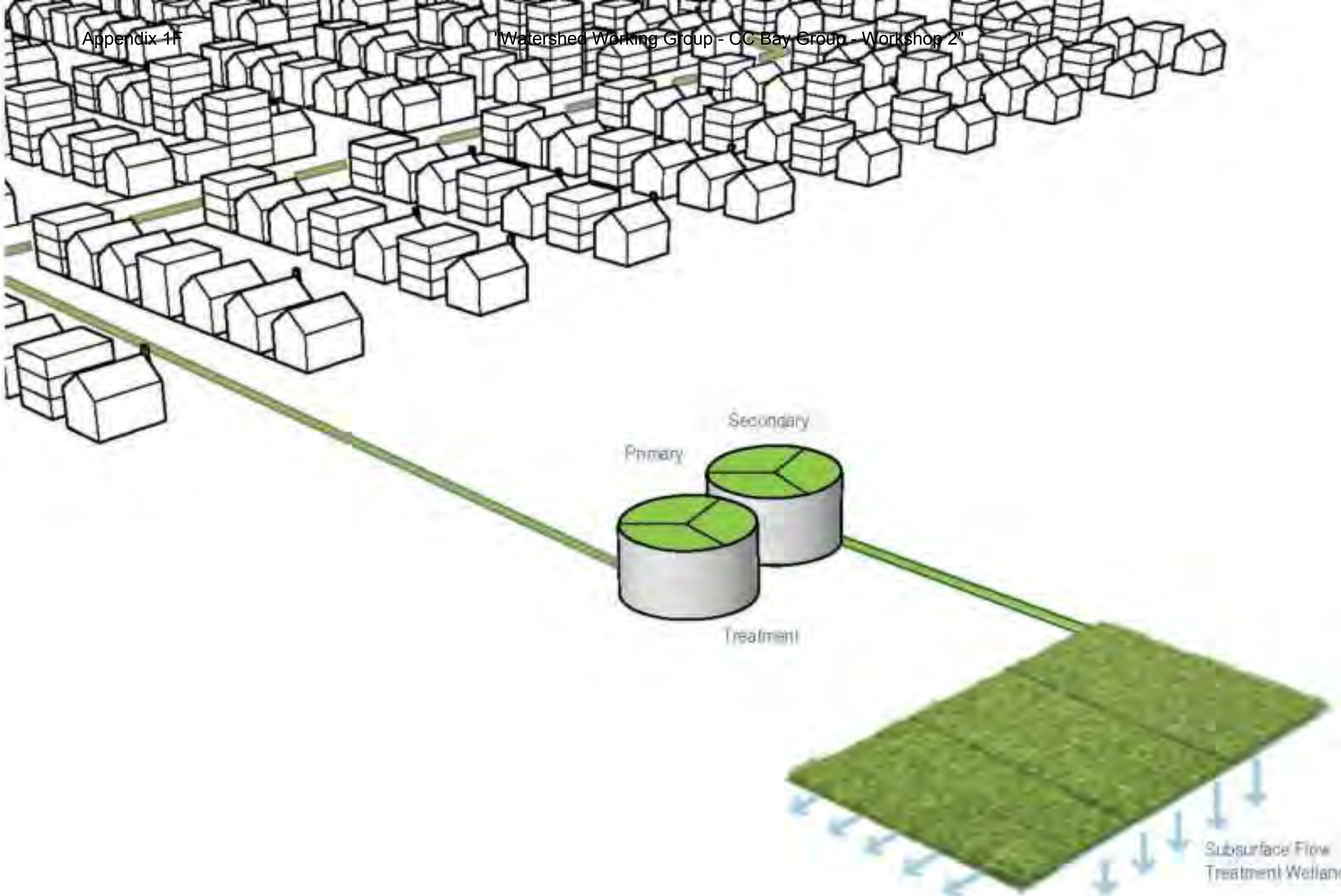
Scale: WATERSHED
Target: WASTEWATER

Constructed Wetlands
Surface Flow

Precedent: Talking Waters Garden - Albany, OR

Source: Kate Kennen

Constructed Wetlands: Surface Flow



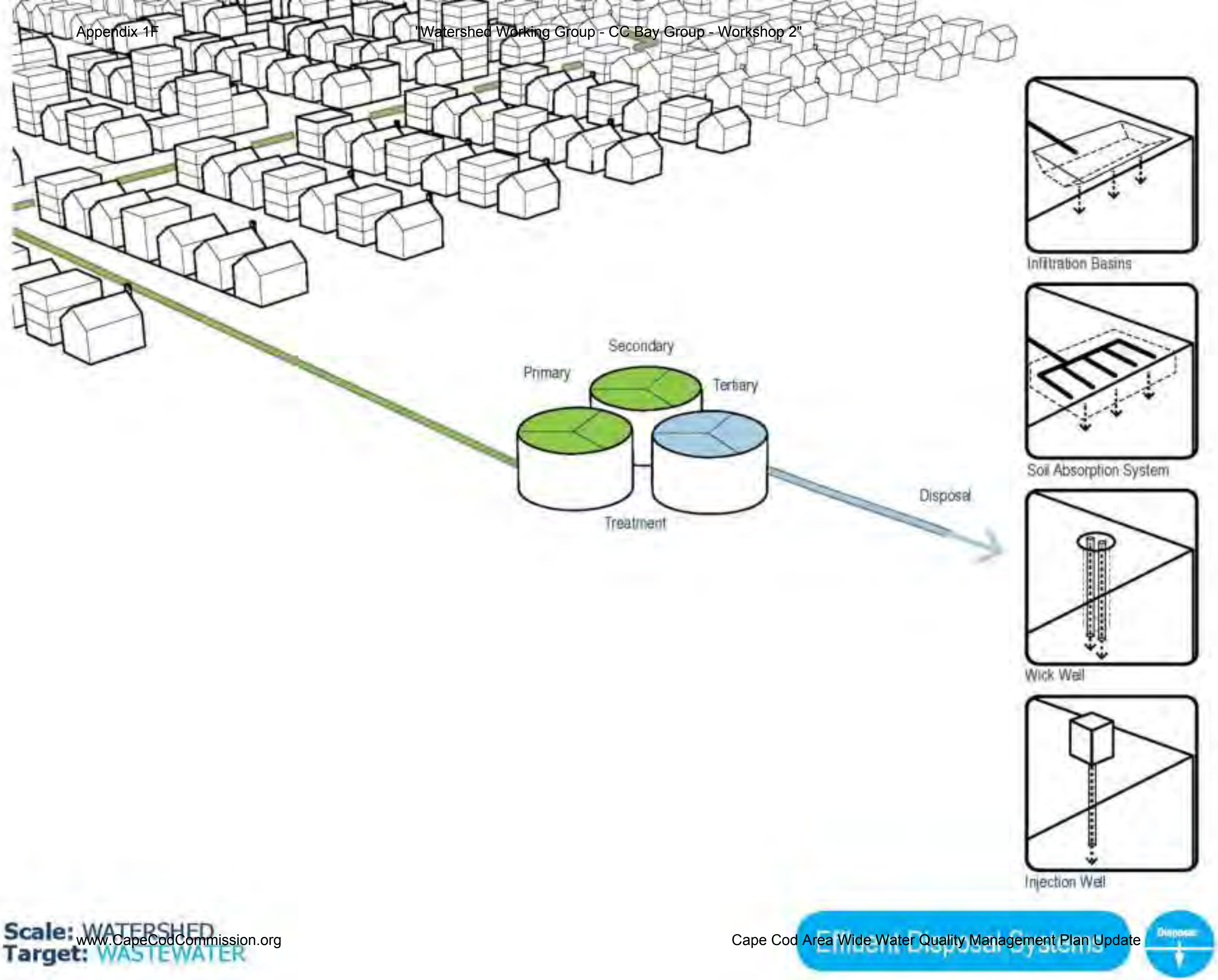
Scale: WATERSHED
Target: WASTEWATER

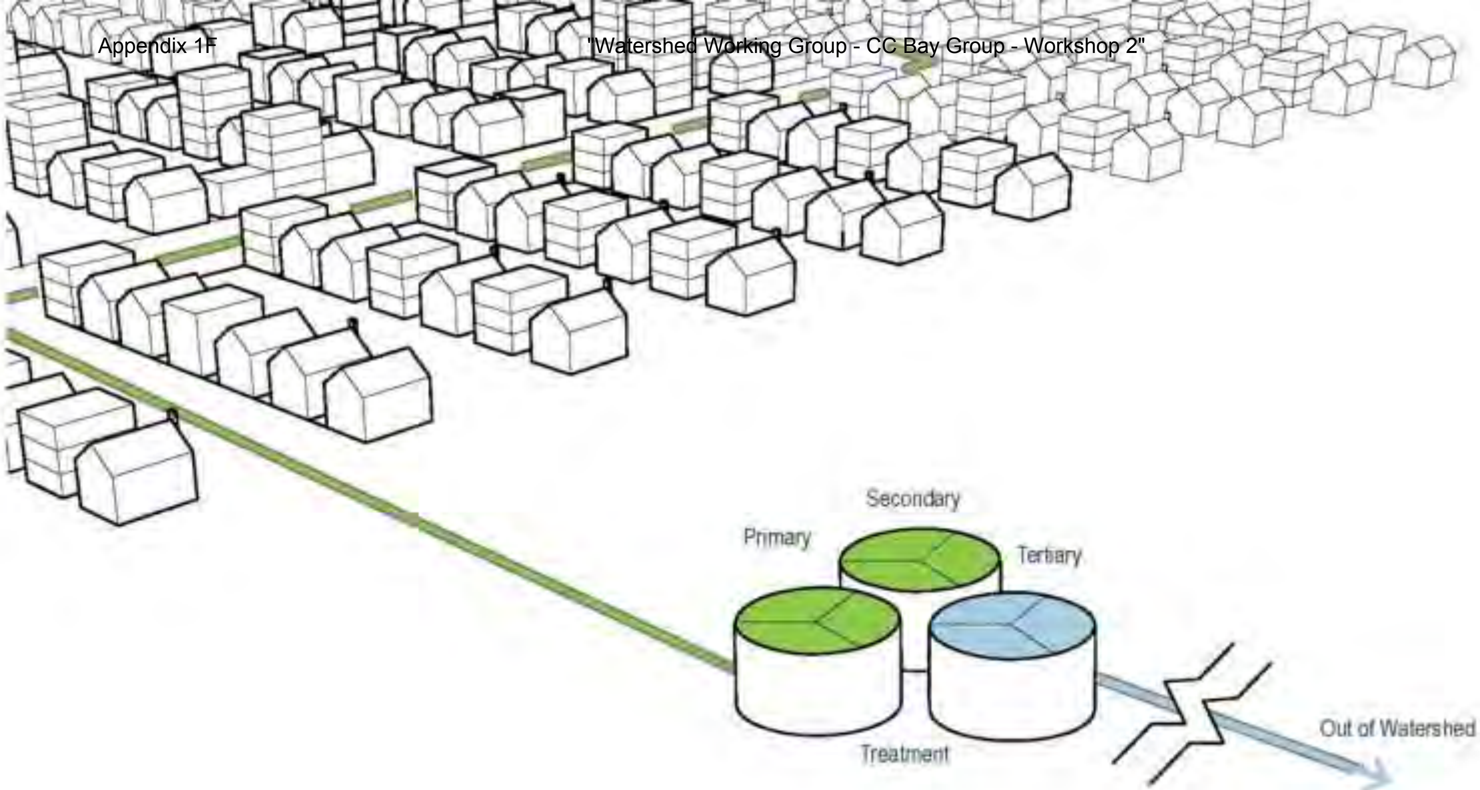
Constructed Wetlands
Subsurface Flow

Precedent: Koh Phi Phi Treatment Wetland, Thailand

Source: Hans Brix

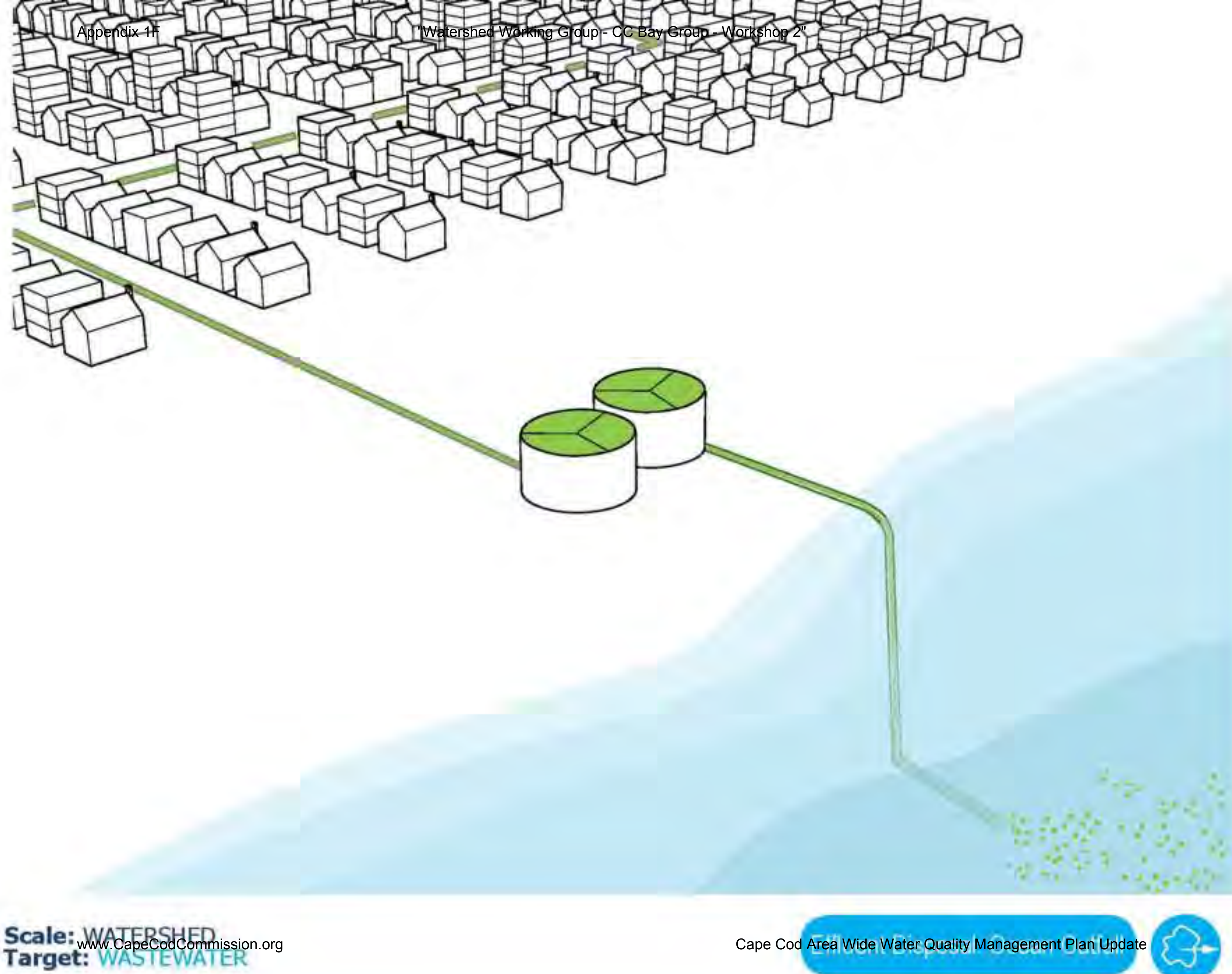
Constructed Wetlands: Subsurface Flow

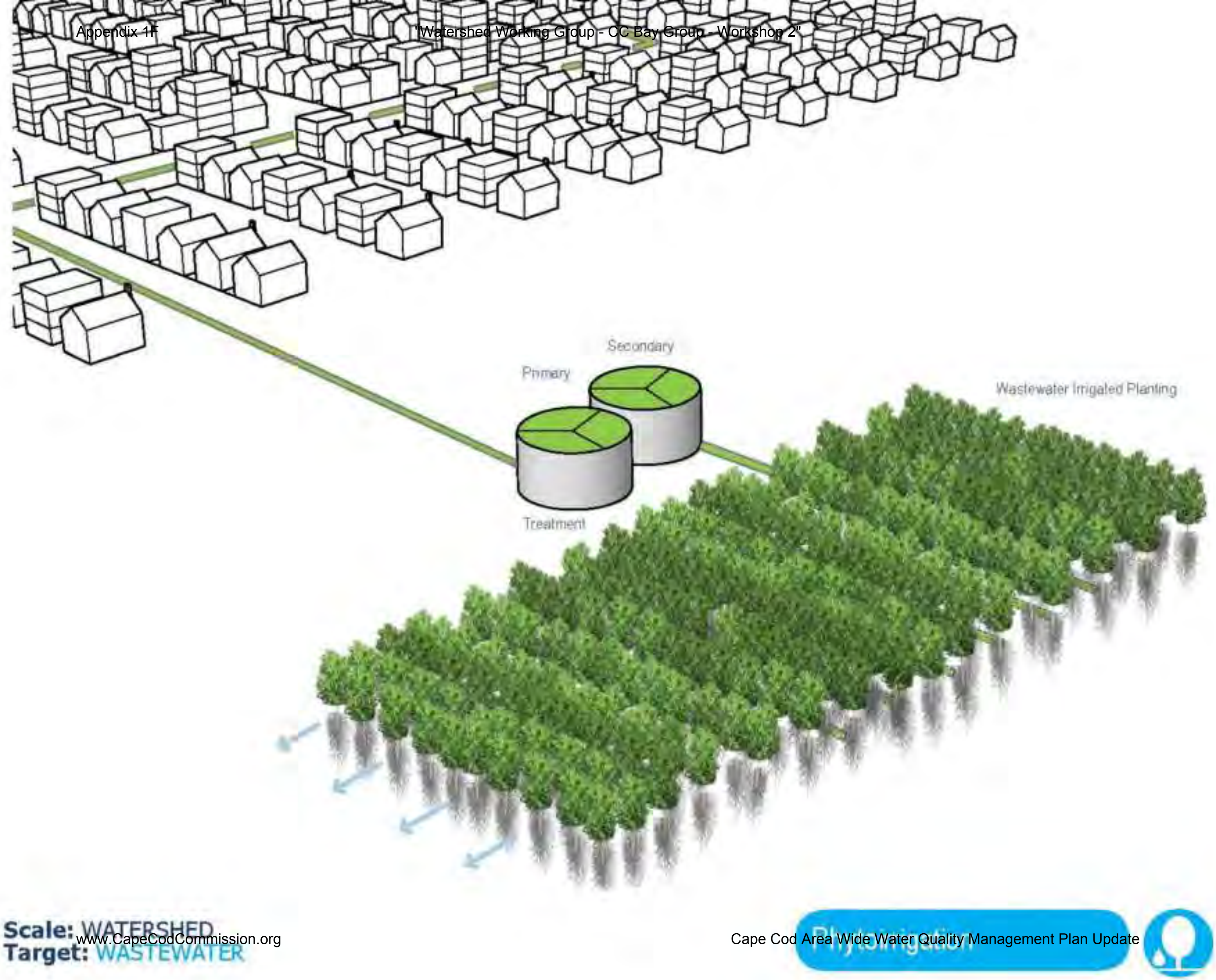

Infiltration Basins
Soil Absorption System
Wick Well
Injection Well
Secondary
Primary
Tertiary
Treatment
Disposal
Scale: WATERSHED
Target: WASTEWATER
Efficient Disposal Systems
Disposal



Scale: WATERSHED
Target: WASTEWATER

Effluent Disposal: Out of Watershed


Scale: WATERSHED
Target: WASTEWATER
Effluent Disposal: Ocean Outfall

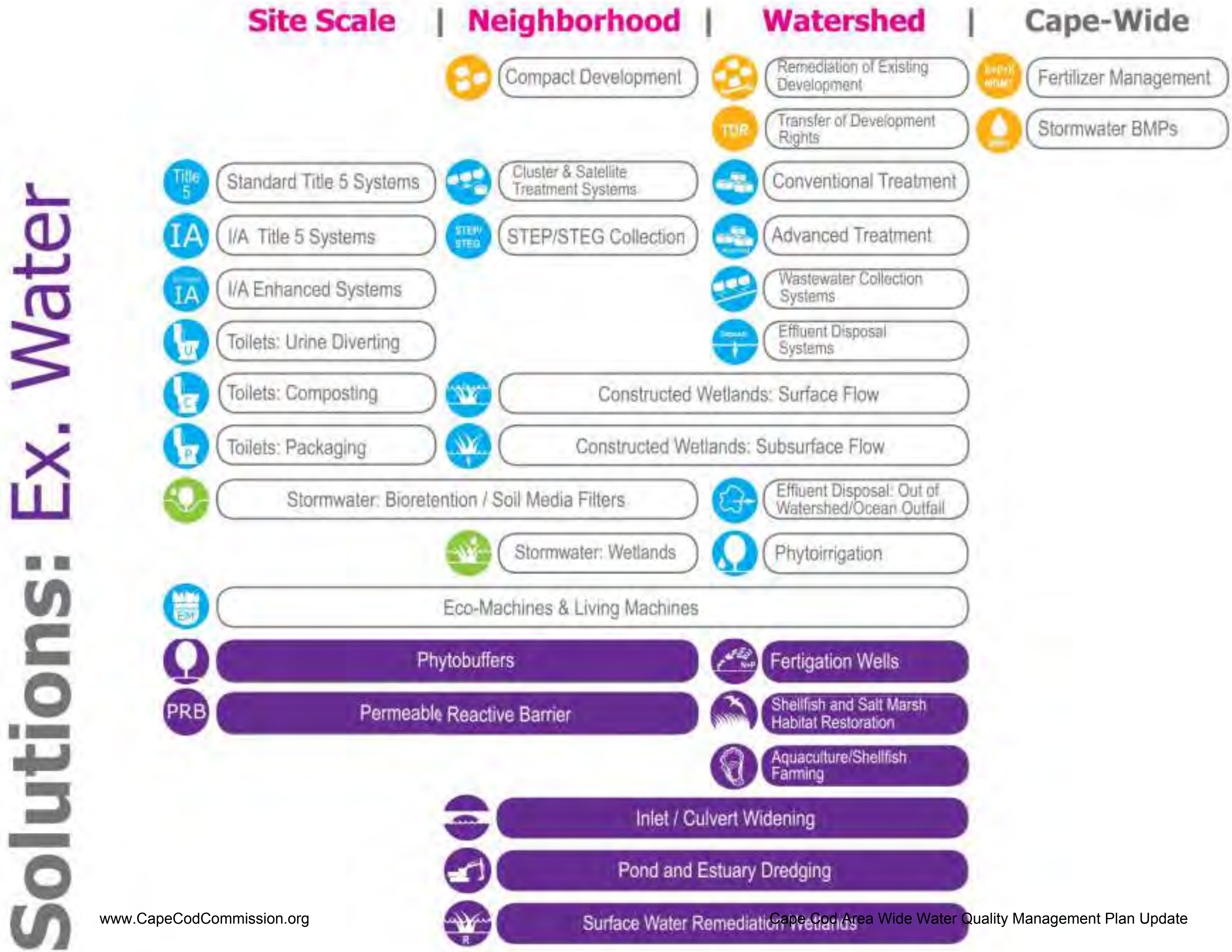

Secondary
Primary
Wastewater Irrigated Planting
Treatment
Scale: WATERSHED
Target: WASTEWATER

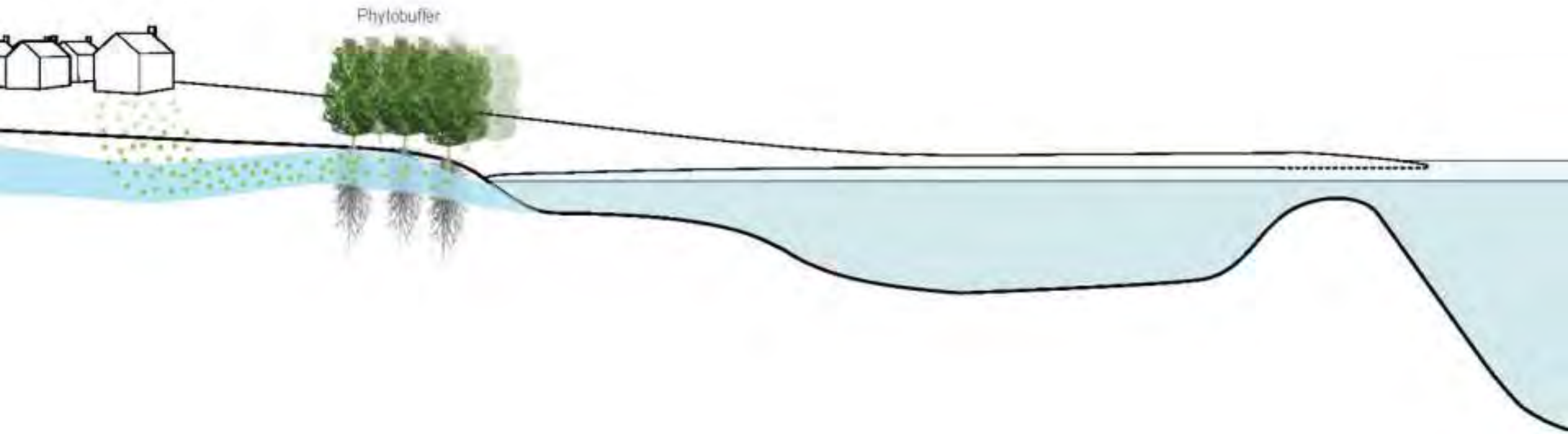
Precedent: Woodburn OR, Wastewater Treatment Facility
Source: CH2MHill

Phytoirrigation

Precedent: Woodburn OR, Wastewater Treatment Facility
Source: CH2MHill

Phytoirrigation


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



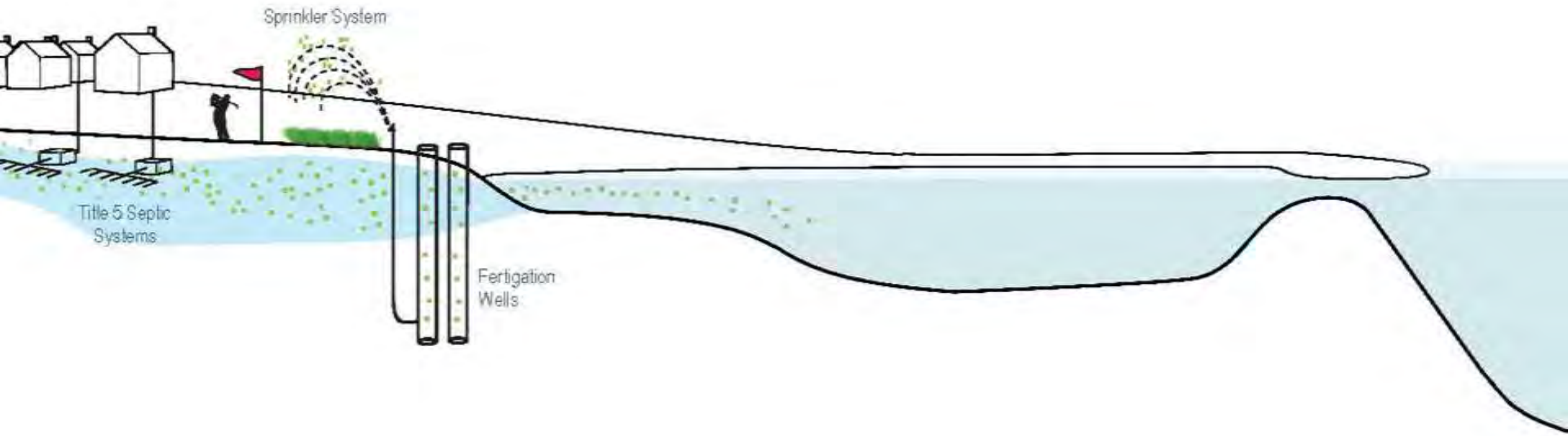
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Phytobuffers

Precedent: Phytobuffer - Kavcee, WY

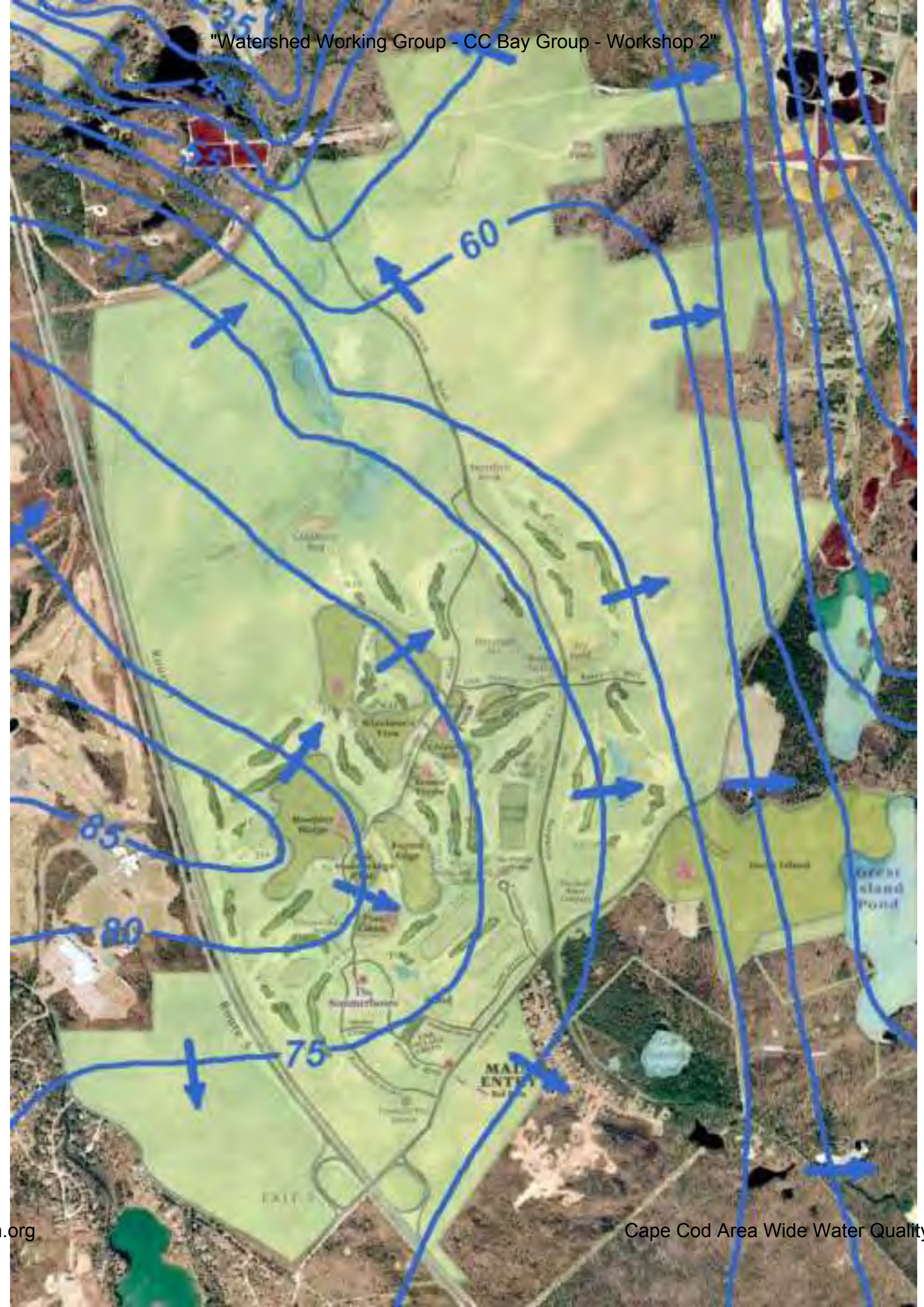
Source: Sand Creek Consultants

Phytobuffers

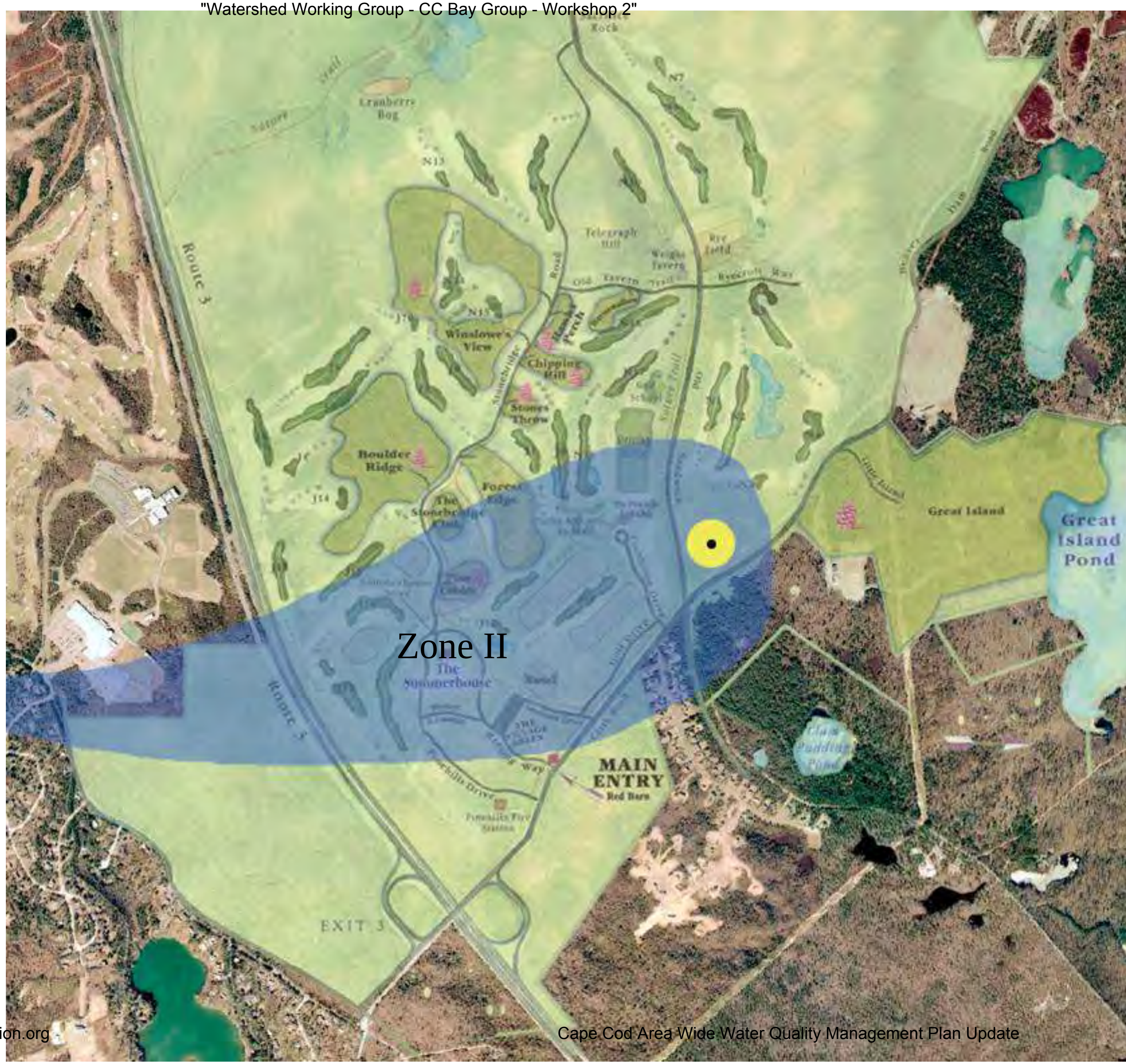


Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

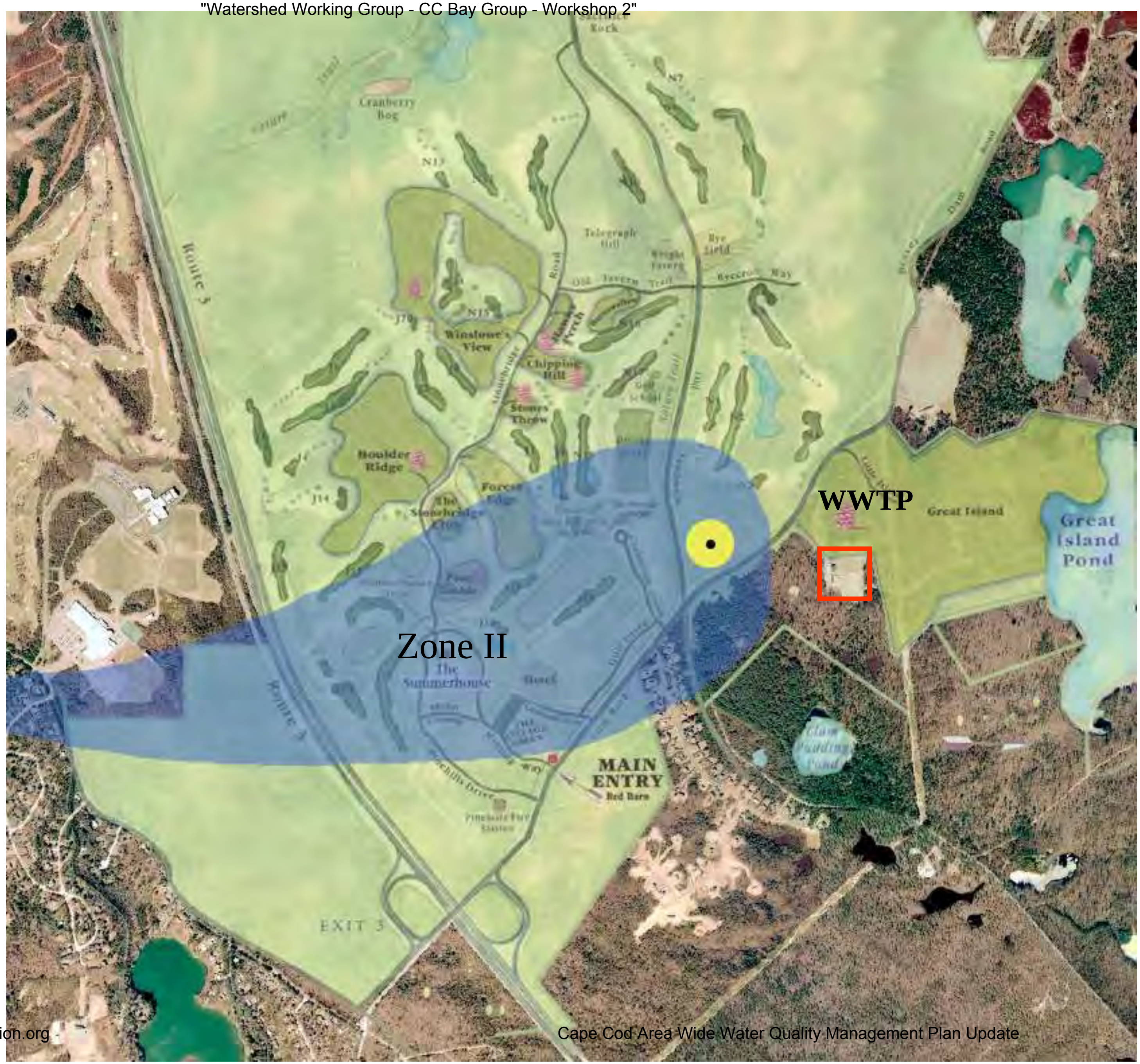
Fertigation Wells



Precedent:
Pine Hills
Plymouth, MA

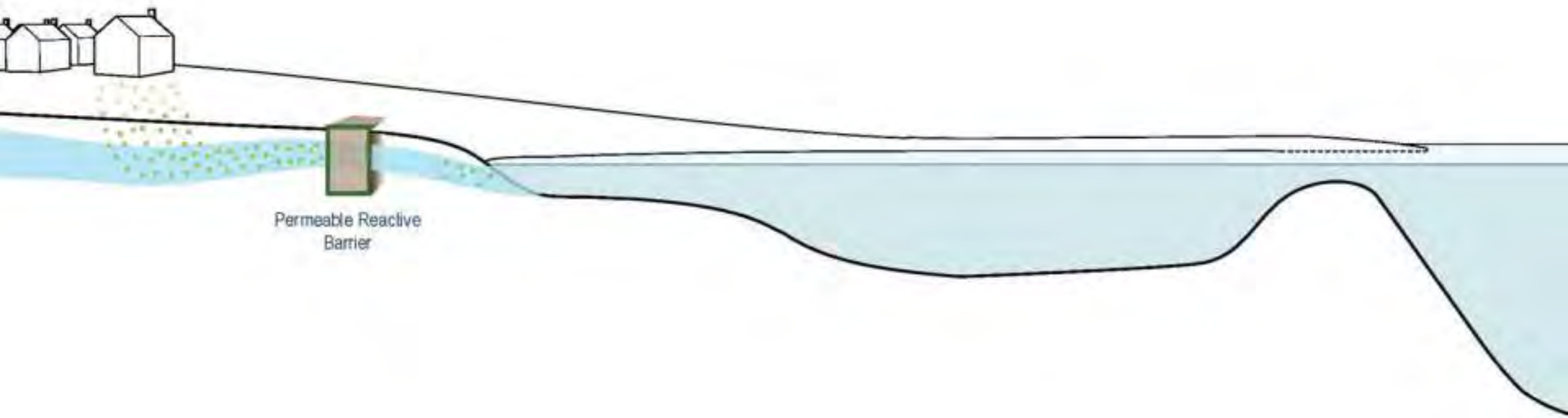


Precedent:
Pine Hills
Plymouth, MA



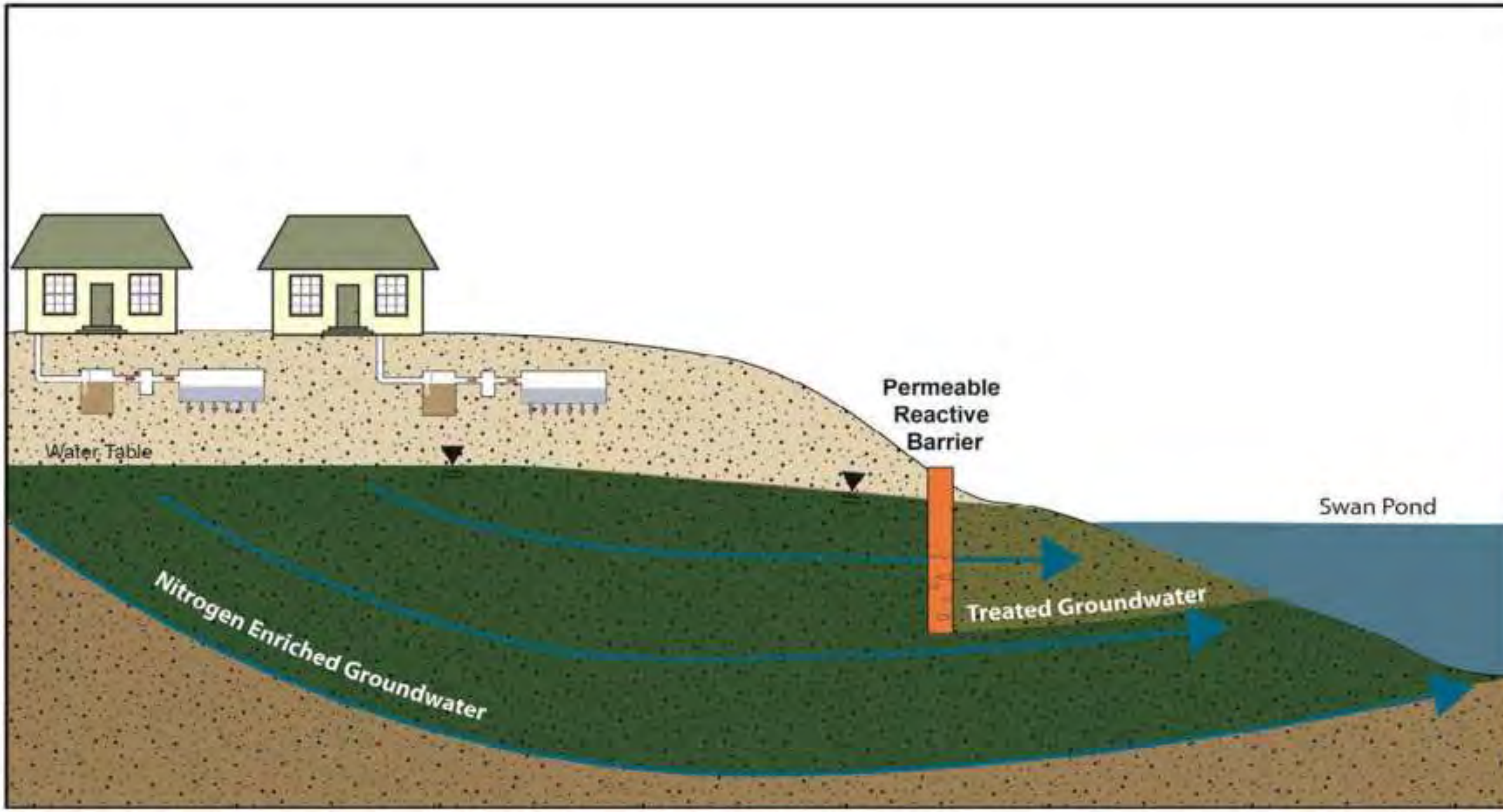
Precedent:
Pine Hills
Plymouth, MA

Precedent:
Pine Hills
Plymouth, MA



Scale: SITE / NEIGHBORHOOD / WATERSHED
Target: EXISTING WATER BODIES

Permeable Reactive Barrier PRB



Precedent: PRB
Source: Horsley Witten Group Inc.

Permeable Reactive Barrier

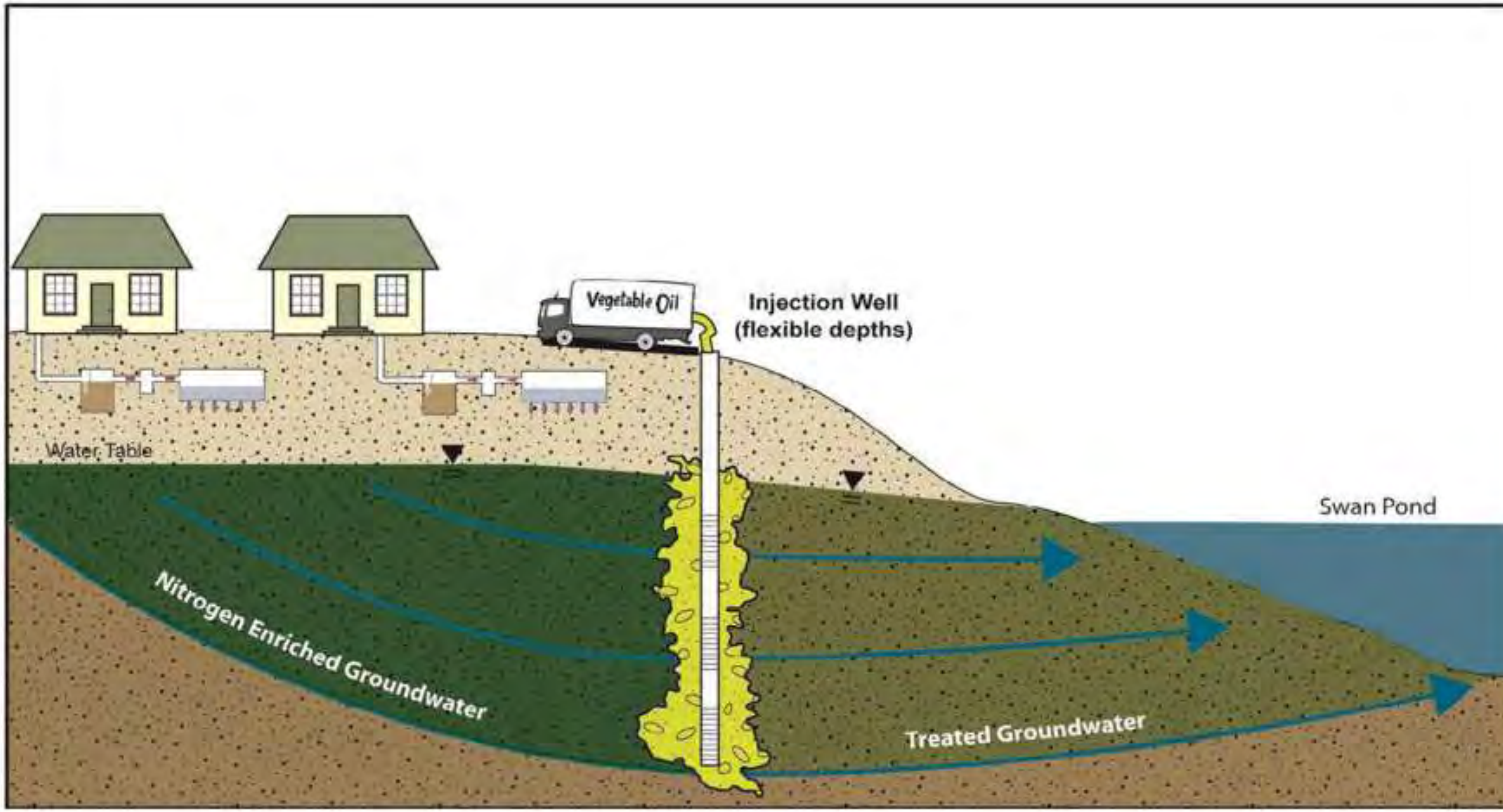
PRB

Precedent: Falmouth PRB

Source: Mike Domenica

Permeable Reactive Barrier

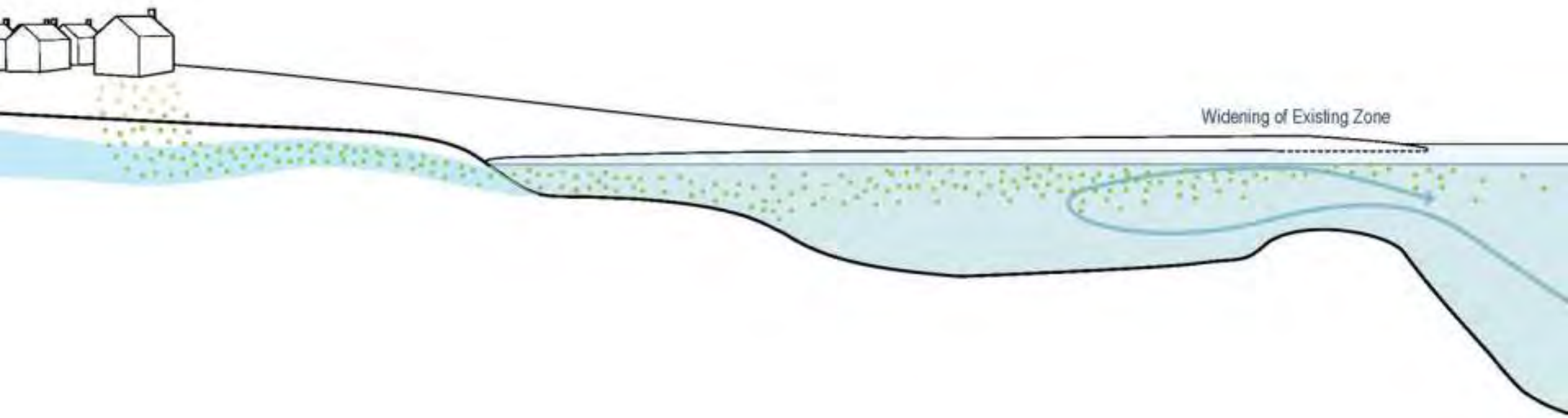
PRB



Precedent: PRB

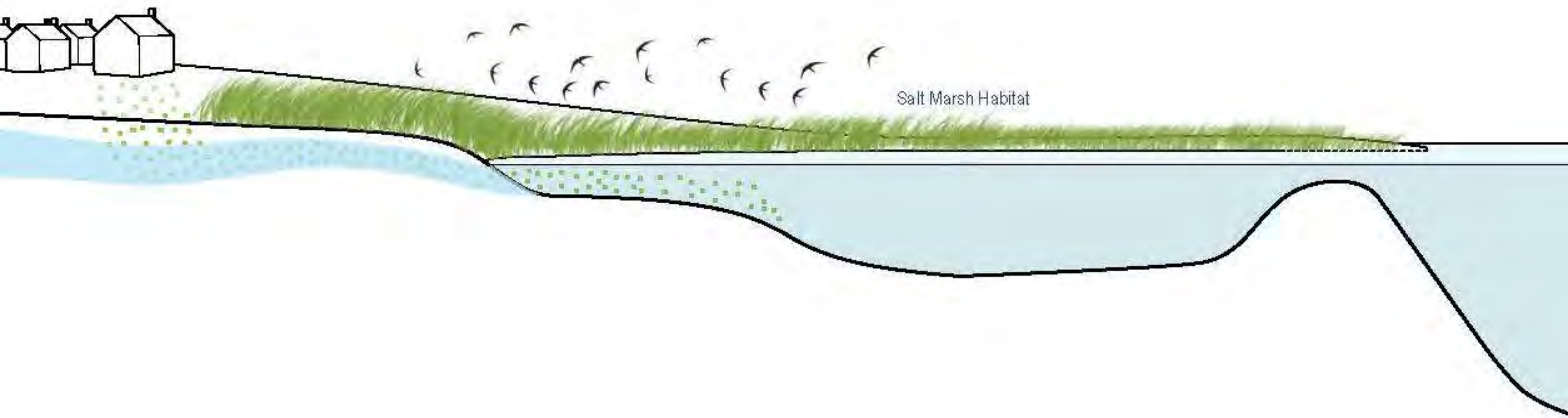
Source: Horsley Witten Group Inc.

PRB



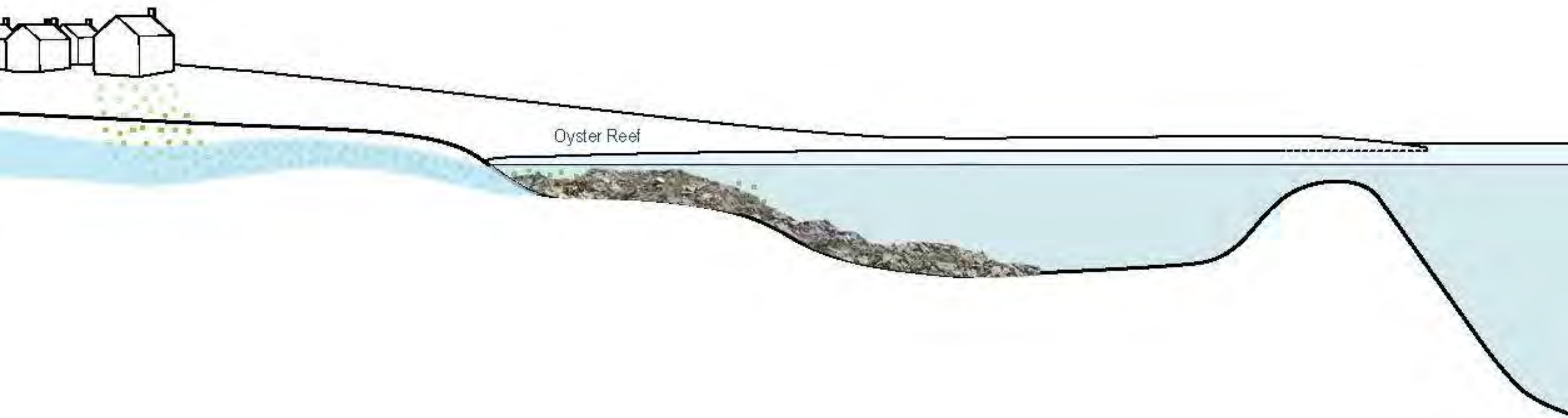
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Inlet and Culvert Widening



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Salt Marsh Habitat Restoration



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Shellfish Habitat Restoration

Precedent: Wellfleet Oyster Restoration Project

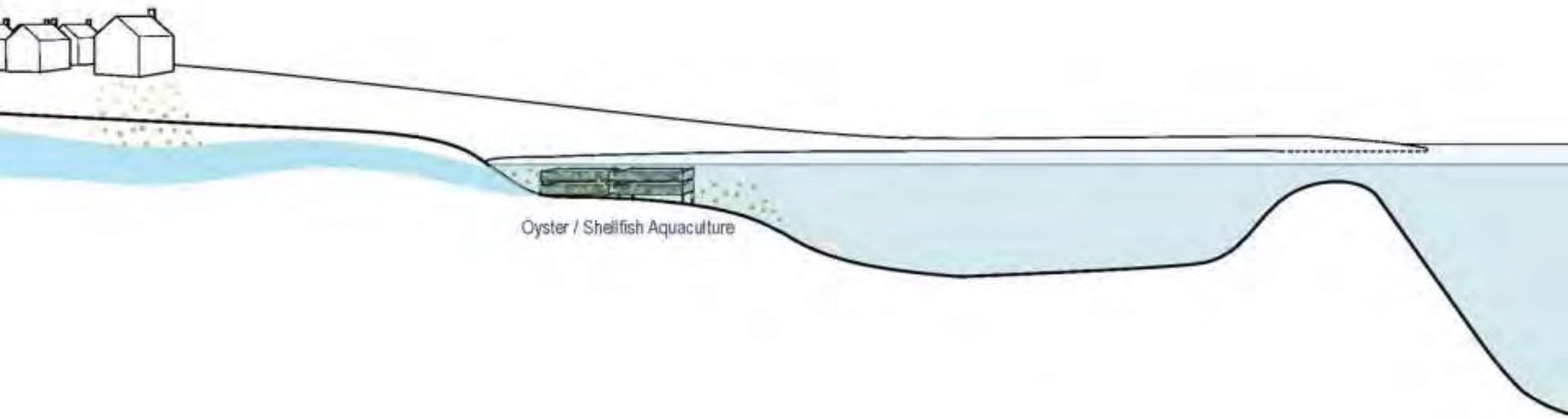
Shellfish Habitat Restoration




Precedent: Wellfleet Oyster Restoration Project

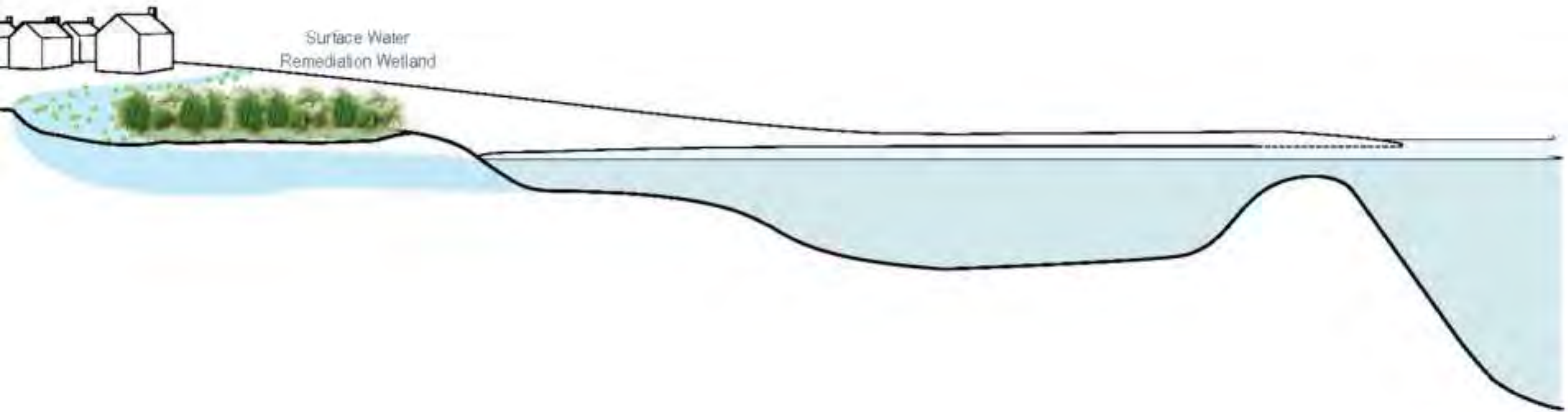
Source:

Shellfish Habitat Restoration



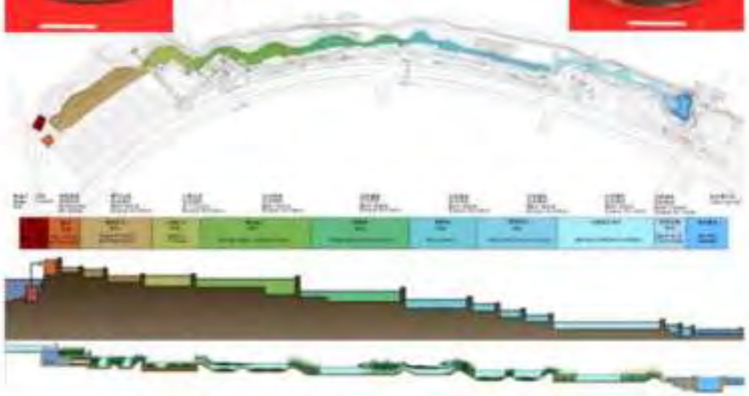
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Aquaculture / Shellfish Farming



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

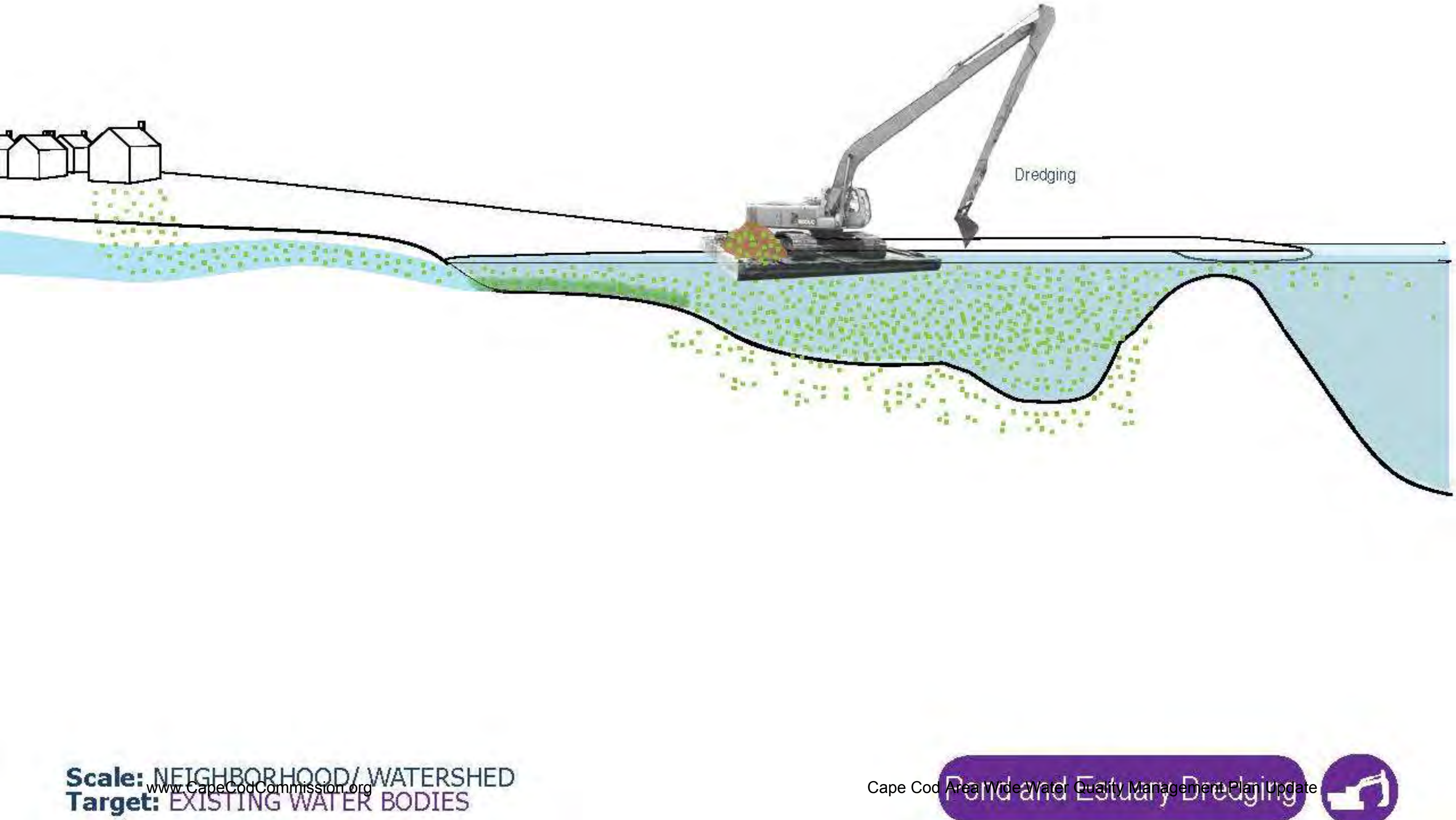
Surface Water
Remediation Wetlands



Precedent: Shanghai Houton Park

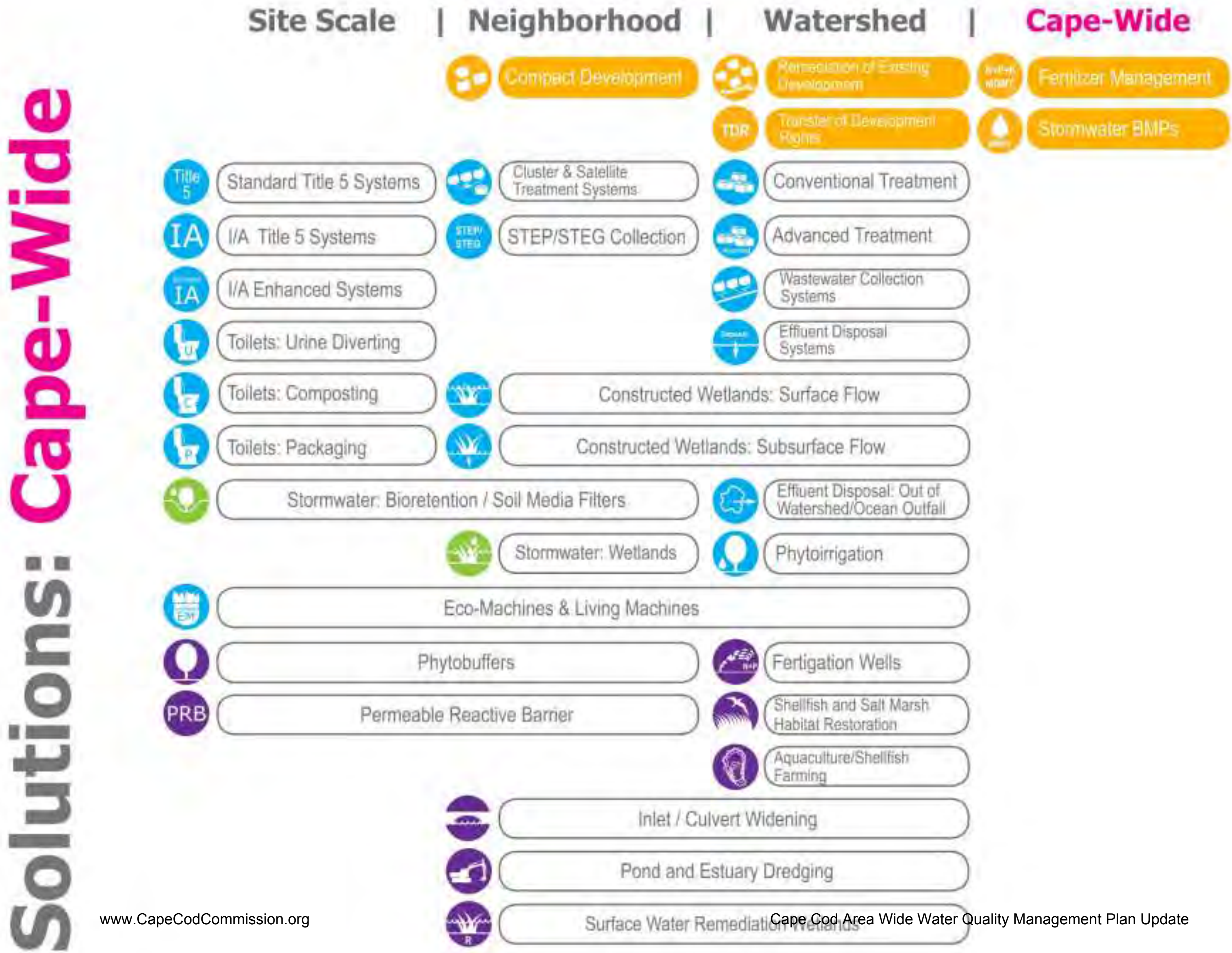
Source: Turenscape

Surface Water Remediation Wetlands


Dredging
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES
Pond and Estuary Dredging

Precedent: Pond and Estuary Dredging - Dennis, MA

Source: Cape Cod Times


Solutions: Cape-Wide
Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
IA
I/A Title 5 Systems
STEP/STEG
STEP/STEG Collection
Advanced Treatment
IA
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
EM
Eco-Machines & Living Machines
Phytobuffers
Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands

Scale: CAPE-WIDE
Target: REGULATORY

Compact Development

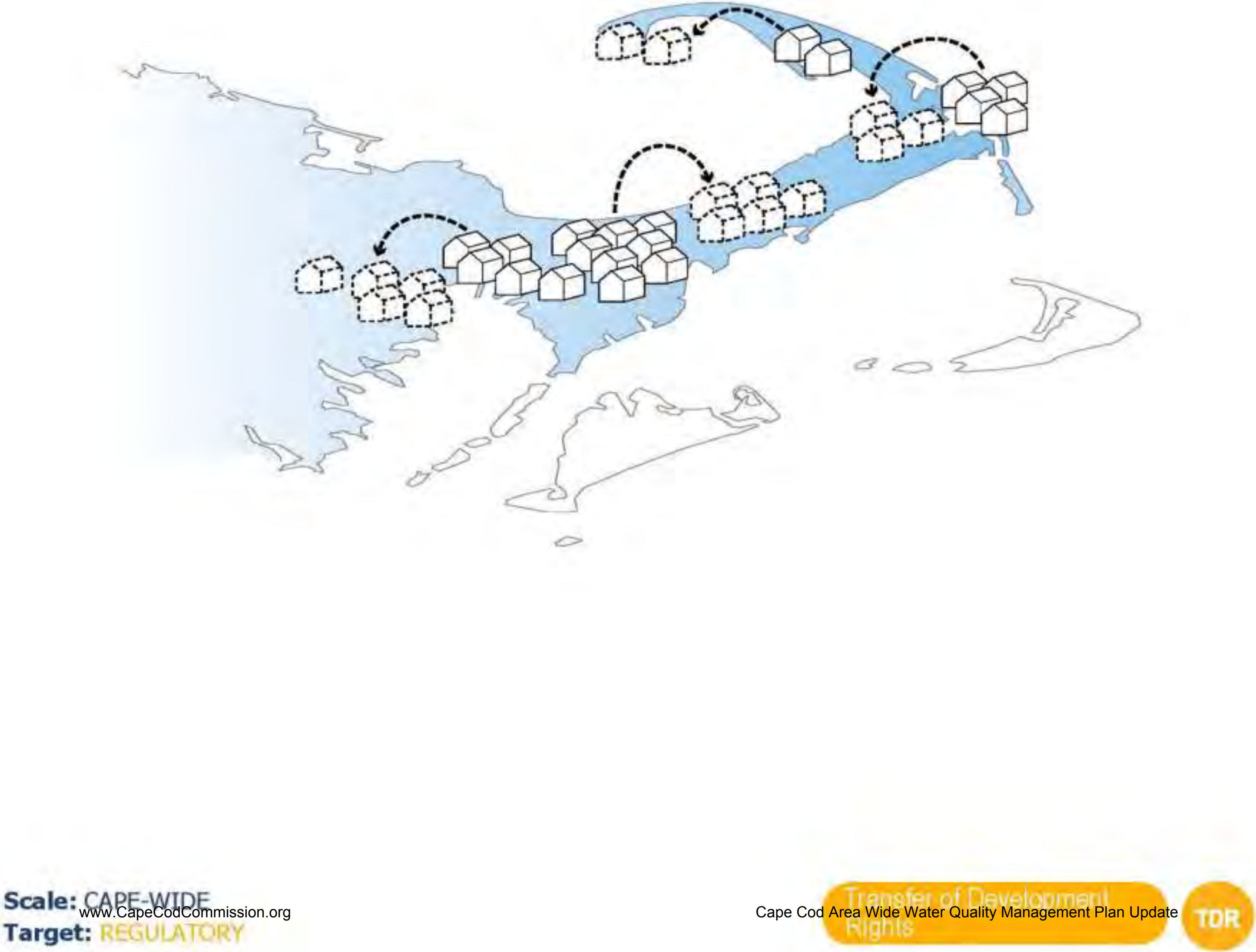
Scale: CAPE-WIDE
Target: REGULATORY

Fertilizer Management

N+P+K MGMT

Scale: CAPE-WIDE
Target: REGULATORY

Remediation of Existing Development


Scale: CAPE-WIDE
Target: REGULATORY
Transfer of Development Rights
TDR

Transfer of Developments Rights
The Concept

Owner of "sending" parcel sells development rights in exchange for permanent conservation easement.

Owner of "receiving" parcel buys development rights to build at densities higher than allowed under base zoning.

Source: Massachusetts Smart Growth Toolkit

Scale: CAPE-WIDE
Target: REGULATORY

Town Consideration of Alternative Technologies & Approaches

Wellfleet- *Coastal habitat restoration & aquaculture*

Mashpee- *Aquaculture & Expanding Existing Systems*

Brewster- *PRB & Bioswales*

Orleans- *Fertilizer Control By-Law*

Harwich- *Muddy Creek & Cold Brook Natural Attenuation*

Falmouth- *Aquaculture*
Inlet Widening
Eco-Toilet Demonstration Project
PRBs
Stormwater Management (Little Pond Watershed)
Fertilizer Control By-Law
Subsurface Nitrogen Removal Septic Systems


Site Scale | Neighborhood | Watershed | Cape-Wide
Solutions
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
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STEP/STEG
STEP/STEG Collection
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Wastewater Collection Systems
U
Toilets: Urine Diverting
Effluent Disposal Systems
C
Toilets: Composting
Constructed Wetlands: Surface Flow
P
Toilets: Packaging
Constructed Wetlands: Subsurface Flow
Stormwater: Bioretention / Soil Media Filters
Effluent Disposal: Out of Watershed/Ocean Outfall
Stormwater: Wetlands
Phytoirrigation
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Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
R
Surface Water Remediation Wetlands

Problem Solving Approach

Wastewater | Existing Water Bodies | Regulatory

1 Nitrogen Targets/Goals

Present Load: X kg/day − **Target**: Y kg/day = **Reduction Required**: N kg/day

2 Other Wastewater Management Needs

A. Title 5 Problem Areas
B. Pond Recharge Areas

3 Low Barrier to Implementation

A. Fertilizer Management
B. Stormwater Mitigation

4 Watershed/Embayment Options

A. Permeable Reactive Barriers
B. Inlet/Culvert Openings
C. Constructed Wetlands
D. Aquaculture

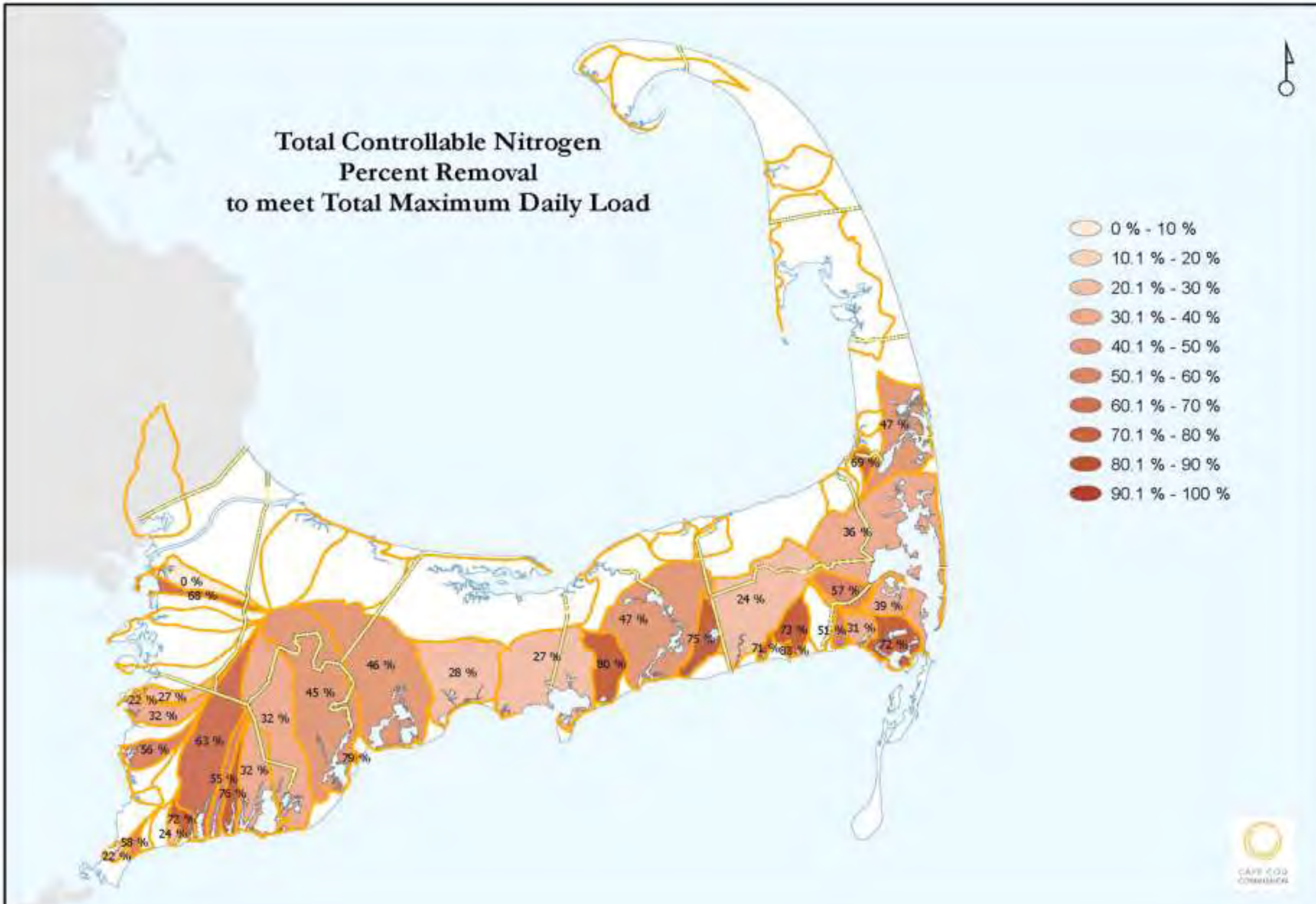
5 Alternative On-Site Options

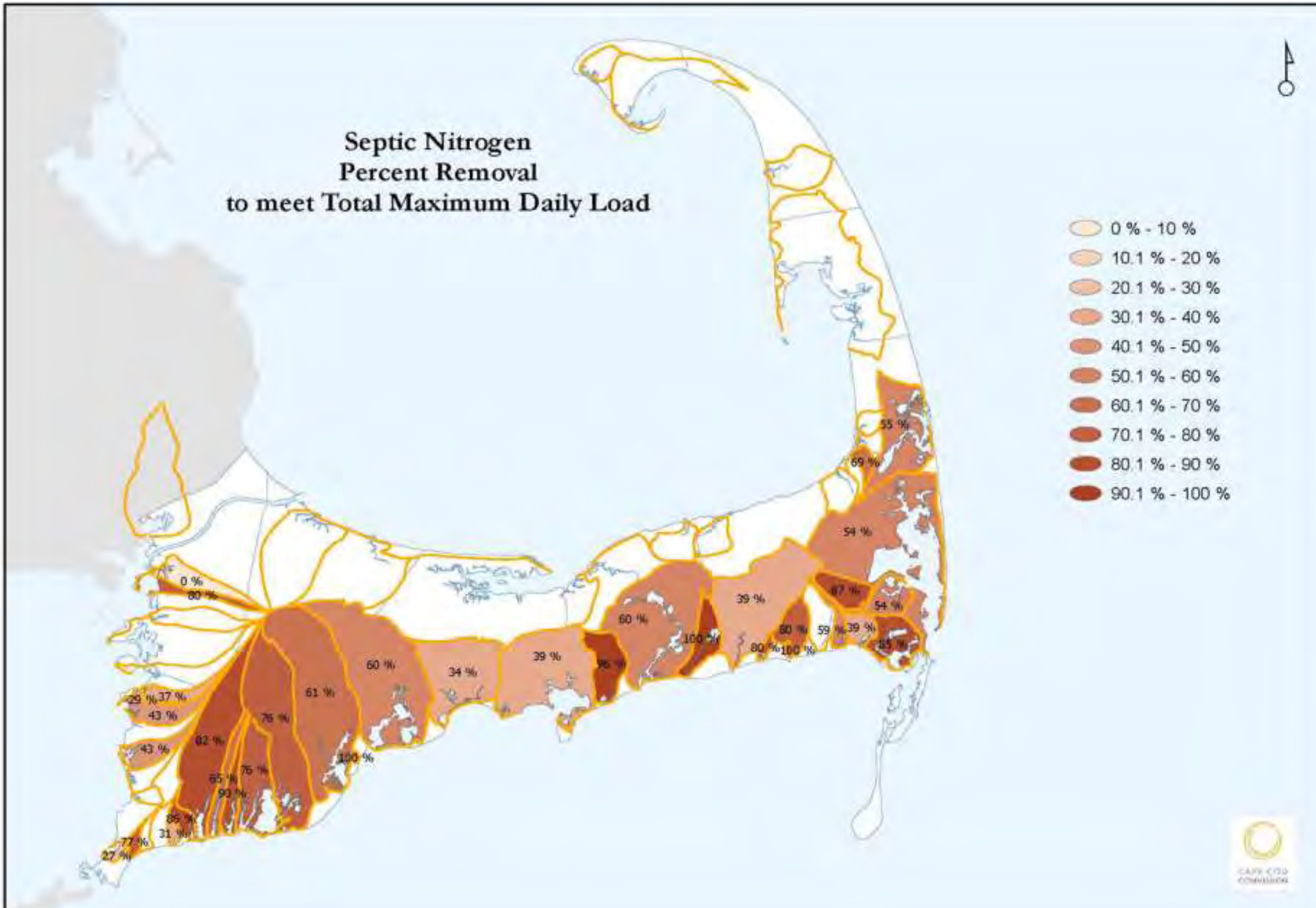
A. Eco-toilets (UD & Compost)
B. I/A Technologies
C. Enhanced I/A Technologies
D. Shared Systems

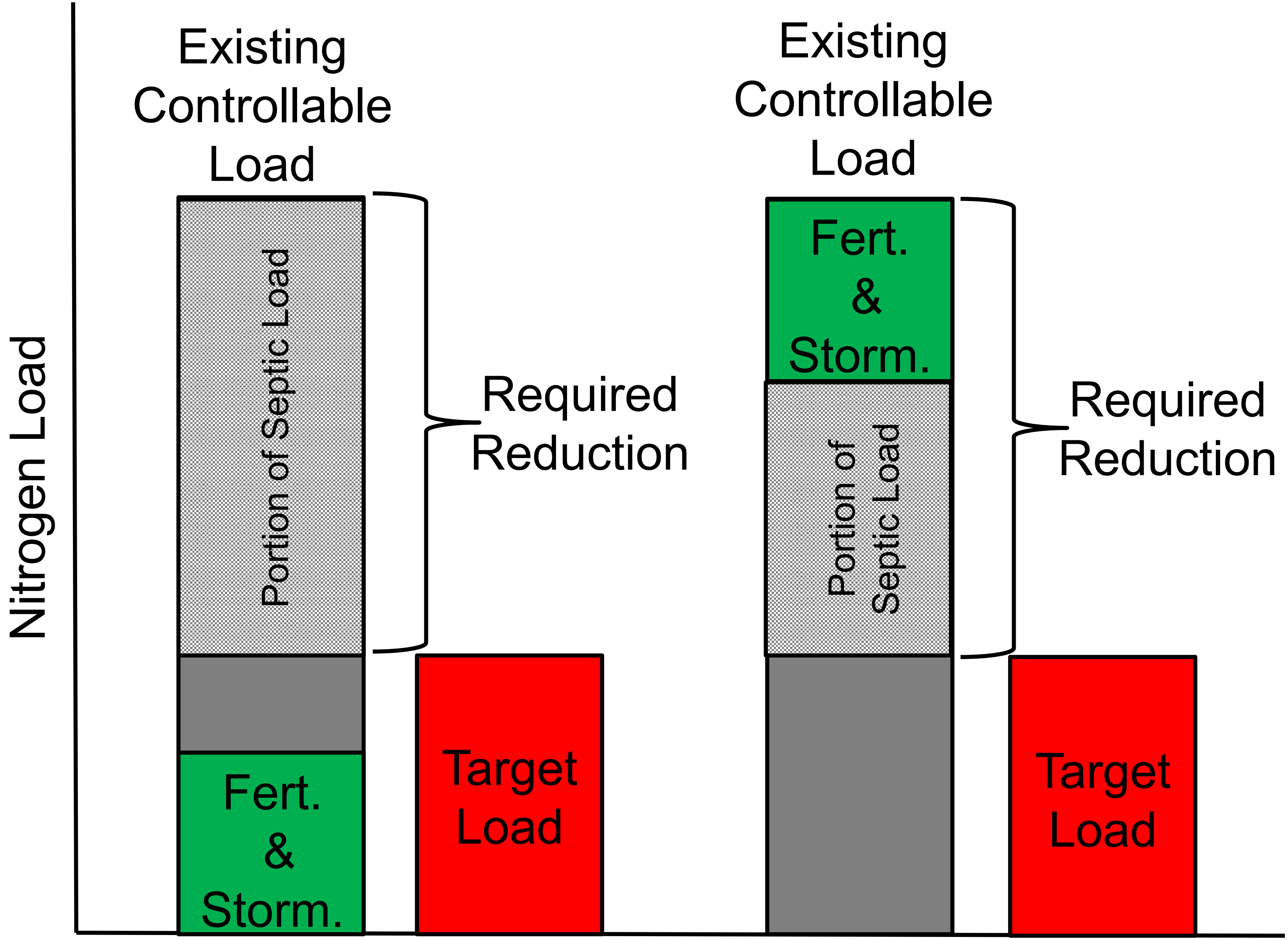
6 Priority Collection/High-Density Areas

A. Greater Than 1 Dwelling Unit/acre
B. Village Centers
C. Economic Centers
D. Growth Incentive Zones

7 Supplemental Sewering


Total Controllable Nitrogen
Percent Removal
to meet Total Maximum Daily Load
0 % - 10 %
10.1 % - 20 %
20.1 % - 30 %
30.1 % - 40 %
40.1 % - 50 %
50.1 % - 60 %
60.1 % - 70 %
70.1 % - 80 %
80.1 % - 90 %
90.1 % - 100 %


Septic Nitrogen
Percent Removal
to meet Total Maximum Daily Load
0 % - 10 %
10.1 % - 20 %
20.1 % - 30 %
30.1 % - 40 %
40.1 % - 50 %
50.1 % - 60 %
60.1 % - 70 %
70.1 % - 80 %
80.1 % - 90 %
90.1 % - 100 %


Nitrogen Load
Existing Controllable Load
Portion of Septic Load
Fert. & Storm.
Required Reduction
Target Load
Existing Controllable Load
Fert. & Storm.
Portion of Septic Load
Required Reduction
Target Load

Wastewater | Existing Water Bodies | Regulatory

Problem Solving Approach

1 Nitrogen Targets/Goals

Present Load: X kg/day − **Target:** Y kg/day = **Reduction Required:** N kg/day

2 Other Wastewater Management Needs

A. Title 5 Problem Areas
B. Pond Recharge Areas

3 Low Barrier to Implementation

A. Fertilizer Management
B. Stormwater Mitigation

4 Watershed/Embayment Options

A. Permeable Reactive Barriers
B. Inlet/Culvert Openings
C. Constructed Wetlands
D. Aquaculture

PRB

5 Alternative On-Site Options

A. Eco-toilets (UD & Compost)
B. I/A Technologies
C. Enhanced I/A Technologies
D. Shared Systems

Title 5 | IA | IA

6 Priority Collection/High-Density Areas

A. Greater Than 1 Dwelling Unit/acre
B. Village Centers
C. Economic Centers
D. Growth Incentive Zones

STEP/STEG

7 Supplemental Sewering

Triple Bottom Line

Impacts of Technologies and Approaches

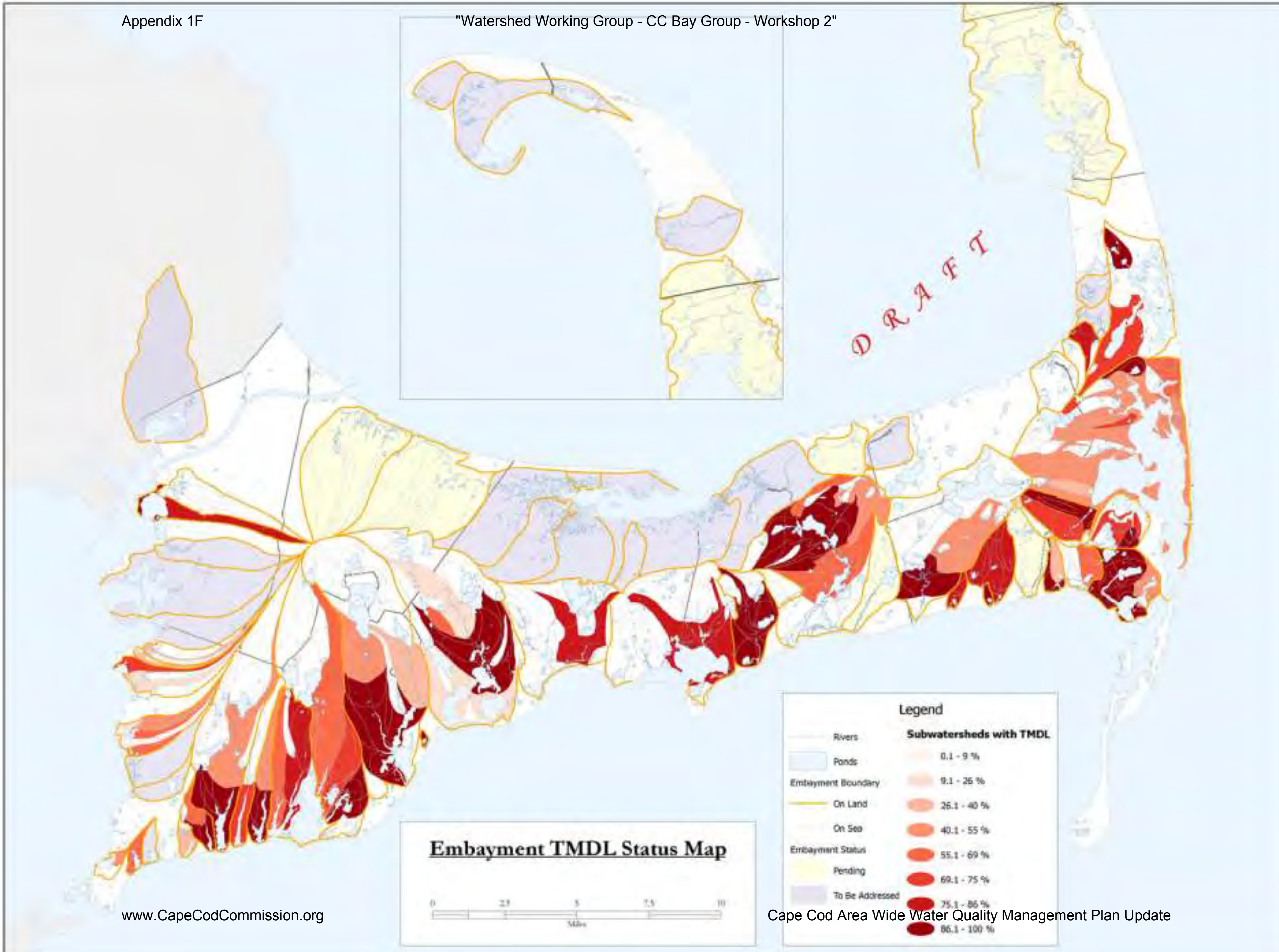
Environmental

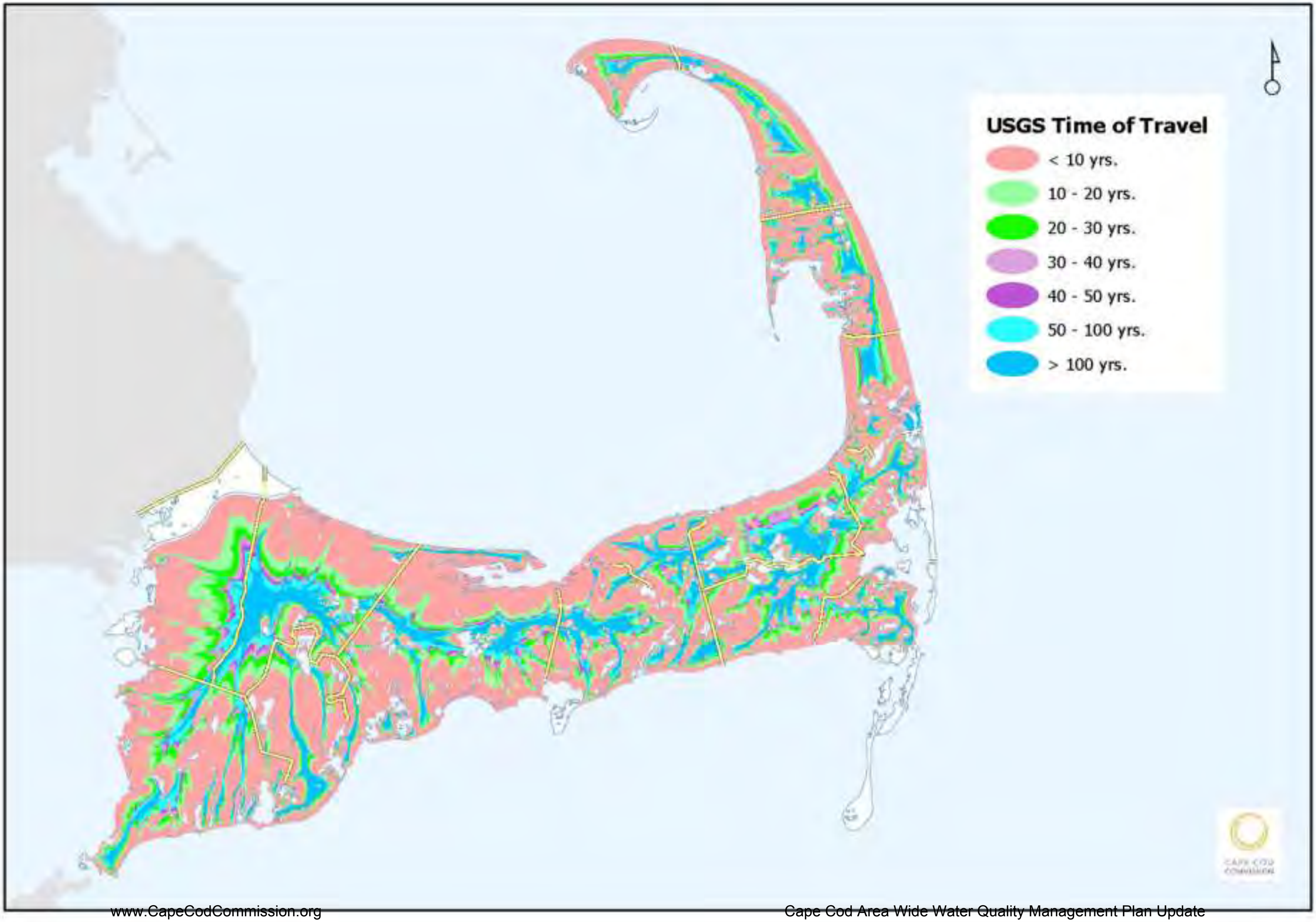
Economic

Social

Technology Selection: Process and Principles

- 100% septic removal subwatershed
- Scale: On-Site vs. Collection System vs. Natural System
- Nutrient intervention and time of travel
- Permitting Status
- Land use and Impacts of Growth


DRAFT
Embayment TMDL Status Map
0
2.5
5
7.5
10
Miles
Legend
Rivers
Ponds
Embayment Boundary
On Land
On Sea
Embayment Status
Pending
To Be Addressed
Subwatersheds with TMDL
0.1 - 9 %
9.1 - 26 %
26.1 - 40 %
40.1 - 55 %
55.1 - 69 %
69.1 - 75 %
75.1 - 86 %
86.1 - 100 %


USGS Time of Travel
< 10 yrs.
10 - 20 yrs.
20 - 30 yrs.
30 - 40 yrs.
40 - 50 yrs.
50 - 100 yrs.
> 100 yrs.

Preparing for Meeting 3 and Beyond

- ❑ Review tools and alternatives analysis approach
- ❑ Evaluating scenarios for meeting water quality goals
- ❑ Attend the November 13th meeting:

6:00

Cape Cod Museum of Art

Dennis, MA

Cape Cod 208 Area Water Quality Planning
Pleasant Bay Watershed Working Group

Meeting Two
Wednesday, October 23, 2013
8:30 am- 12:30 pm
Orleans Town Hall, 19 School Road, Orleans, MA 02653

Meeting Summary prepared by the Consensus Building Institute

I. ACTION ITEMS

Working Group

- Next meeting: Meeting Three
  Monday, December 9, 2013
  8:30AM -12:30PM
  Orleans Town Hall, 19 School Road, Orleans, MA 02653
- Send Stacie any additional comments on Meeting One Summary
- Continue to prepare thoughts about which technologies/approaches it would like to learn more about for application in the Pleasant Bay Watershed. Different scenarios and options will be discussed during Meeting Three.
- Go to 208 website and access GIS layers[1]

Consensus Building Institute

- Finalize Meeting One summary
- Draft, solicit feedback from Working Group, and finalize Meeting Two summary.

Cape Cod Commission

- Provide PowerPoint presentation to Working Groups
- Share Technology Matrix with Working Groups
- Add information on incinerating toilets to technology matrix
- Share information on George Heufelder's I/A data with Working Group
- Include growth management as an option under the 'low barriers for implementation' section in the 7-steps for Problem-Solving Process
- Resolve website issue with the interactive GIS layers feature

II. WELCOME, REVIEW 208 GOALS, AND PROCESS AND THE GOALS OF MEETING

Erin Perry, Special Projects Coordinator from the Cape Cod Commission, offered an overview of the 208 Update stakeholder process.[2] In July, public meetings were held across the Cape to

[1] Available at: http://watersheds.capecodcommission.org/docs/frames/
[2] The PowerPoint Presentation made at this meeting is available at: http://watersheds.capecodcommission.org/index.php/watersheds/lower-cape/pleasant-bay

present the 208 Plan Update goals, work plan, and participant roles. Public meetings were also held in August to present information on the affordability and financing of the updated comprehensive 208 Plan. The first meetings of the eleven Watershed Working Groups were held in September and focused on baseline conditions in each of the watersheds. The second meetings of the Watershed Working Groups are being held in October and early November and are focused on exploring technology options and approaches. The third meetings of the Watershed Working Groups will be held in December and focus on evaluating watershed scenarios which will be informed by Working Groups' discussions about baseline conditions, priority areas, and technology options/approaches. This conversation will also be informed by information shared in the Technology Matrix, which was developed by the Cape Cod Commission with technical input from Technical Advisory Committee of the Cape Cod Water Protection Collaborative and the Technology Panel. The Technology Matrix builds on the information presented in the Technology Fact Sheets, which Working Group members reviewed in advance of the meeting[3]. Once the Cape Cod Commission finalizes it, the Technology Matrix will be shared with Working Group Members. The 208 process also builds on the work of the Cape Cod Commission's Advisory Board; Regulatory, Legal, and Institutional Working Group; Technology Advisory Committee of Cape Cod Water Protection Collaborative; and Finance Committee. The meetings held by these groups are videotaped and available on the Comission's website.

Ms. Perry shared the 208 Plan team's progress since Meeting One that includes:

- Meeting materials distributed to stakeholders and available at http://watersheds.capecodcommission.org
- GIS data layers accessible at: http://watersheds.capecodcommission.org
- Chronologies are being updated and will be made available soon

Ms. Perry also shared that the second round of the Cape2O game is launching on October 22. She noted that over 400 people registered for the first round of the Cape2O game and encouraged Working Group members to participate in the interactive, online game, which provides valuable education and input to the Cape Cod Commission.

In addition, Ms. Perry announced that there will also be a Cape Cod wide event on November 13 at the Cape Cod Center for the Arts in Dennis. Participants from across the eleven Watershed Working Groups and the public are invited to attend the event which will include: Wrap up of "Cape2O: ur in charge!"; and a discussion of the stakeholder role in the second 6 months of the 208 planning process.

Patty Daley, Deputy Director at the Cape Cod Commission and Area Manager for the Pleasant Bay Watershed Working Group, informed the Working Group that there will also be an upcoming meeting focusing on build out on Cape Cod. The meeting date is yet to be set.

[3] Technology Fact Sheets are available at:
http://watersheds.capecodcommission.org/index.php/watersheds/lower-cape/pleasant-bay

Ms. Perry reviewed the goal of the meeting:

- To develop a shared understanding of the potential technologies and approaches identified to date and the benefits and limitations of each; to explore the environmental, economic, and community impacts of a range of categories of solutions; and to identify priorities and considerations for applying technologies and approaches to remediate water quality impairments in your watershed.

Stacie Smith, the facilitator from the Consensus Building Institute, led the Working Group through introductions, reviewed the goal of the meeting and the meeting agenda, and went over the progress of the action items established in meeting one.

III. RANGE OF POSSIBLE SOLUTIONS

Ms. Daley led the discussion of the range of possible solutions. As Working Groups learn more and consider the pros and cons of the technologies and approaches, she encouraged participants keep in mind that:

- The Cape Cod Commission has engaged in a comprehensive analysis of nutrient control technologies and approaches. This analysis is distilled into: the Technology Fact Sheets, which present various summary information on the technologies being considered; the Technology Matrix, which includes additional information on site requirements, construction, project, operation and maintenance costs, reference information, and regulatory comments; and ongoing input from stakeholders on the public acceptance of technology options and approaches.
- Not all of the technologies and approaches will be applicable to Cape Cod.
- Particularly promising technologies should be identified for demonstration and pilot projects.
- Workshop 3 will embark on hands on problem solving in each watershed to meet target load reductions.
- Certain technologies and approaches will be effective at preventing nutrients from entering the water body. Others will be effective at reducing or remediating nutrients that are already in the groundwater or water body.
- Regulatory programs can address nutrient controls for both existing development and future development.

Ms. Daley offered a brief overview of the technologies and approaches categorized into site, neighborhood, watershed, and Cape-wide (technical and regulatory) solutions. The following section briefly describes each technology. Participants' questions and comments about the technologies are also discussed below (questions in *italics;* Cape Cod Commission or facilitator responses to questions or comments in plain text*)*:

Site level technologies/approaches

Standard Title V System*:* This is a standard septic system that consists of a septic tank and soil adsorption system (leaching field). The system was primarily designed to address public health concerns related to waste in drinking water (e.g. coliform bacteria); they were not designed to remove nutrients (e.g. nitrogen).

- *Do you have a sense of how many septic systems are failed or failing?* This information is not currently available, but the Cape Cod Commission is working with a consultant to obtain this information from town health departments.
- *Would one of these failed systems leak nitrogen?* Title V systems all release nitrogen as they are intended to control pathogen escape intro the environment, not control nitrogen.
- *Is it true there are cesspools on the Cape that also have not been improved?* This is true, and the Commission is trying to obtain this data; cesspools do not need to be replaced until a new owner buys the property, or the system fails.
- *What year was this law put in place? Title 5 was originally adopted in 1978, with a major amendment in* 1995.

I/A title V System: Innovative/Alternative (I/A) on-site nutrient reducing systems typically consist of standard septic system components augmented to remove more nutrients than a standard Title V. All I/A systems require collection of waste.

- *Incinerating (Insolet) toilets work well for preventing nitrogen escape.* Ms. Daley said incinerating toilets could be investigated and added to the matrix.
- *How do these different systems compare with one another?* There is a broad range of nitrogen reduction depending on a range of factors, including what technology is being used, the maintenance and upkeep, and impacts of seasonality potentially requiring restarting the biological process.
- *There is a range of nitrogen removal in Title V I/A systems, which is not clearly shown on the factsheets, and systems can be upgraded (enhanced I/A systems) to reduce more nitrogen by using soil and other measures. There are also I/A systems out there that can reduce phosphorous. It would be helpful to share information about effectiveness and costs across these technologies.*
- *The county tracks I/A systems by technology, so are there opportunities to use the data to see which systems are operated on a more seasonal basis and which technologies are successful regionally on an intermittent use?* George Heufelder's data provided through the Barnstable County Health and Environment Department (BCHED) provides an overview of this. Ms. Daley said the Cape Cod Commission can post George Heufelder's data to the website.
- *I would prefer real world data.* George Heufelder's latest report reflects real world data, and the purpose of these fact sheets is to provide a basic overview; there is advanced I/A data in the Technology Matrix.
- *The challenge is deciding what is the most effective way to meet TMDL regulations. Assuming pilots for these technologies are successful, how do you anticipate that voluntary adoption by homeowners will be integrated into a community plan*? Pumping

by individuals does not happen as much as it should. The county could oversee this; this is a good question.

- *EPA guidelines and other sources emphasize the importance of a management entity for these nonconventional systems. When talking about seasonal variation, there is some benefit that people are not around all year, and systems can respond to this.*
- *The BCHED Carmody database has a good overview of these technologies. These technologies were not being operated or maintained appropriately, and due to this lack of maintenance, the efficiency of some systems were decreased. The Carmody database is now reporting on this, and advanced systems can correct themselves. Some also have telemetry devices, which allows them to be operated remotely. All of this technology is currently available.*
- *With respect to I/A systems, it seems that owners often get these to have a bigger home in nitrogen sensitive areas. What fractions of I/A system installations are motivated by this?* This is not known, though there are some people who put them in due to concern for the environment. However, most systems are installed to make formerly unbuildable lots buildable, or allow for the construction of additional bedrooms.
- *Towns and the Commission should better understand seasonal habitation by monitoring water usage. Real-estate brokers would have a lot of information on this. Seasonal homeowners could then be required to have I/A technology and provide funding.*

Urine Diverting Toilets: Urine diversion systems send urine into a holding tank where the urine is stored and periodically collected by a servicing company. The servicing company empties the tank for disposal or recycling such as conversion to a fertilizer. Through these means, the nitrogen may be removed from the watershed. With urine diverting toilets, the remainder of the human waste and all other water uses (sink and shower) continue to go to the septic system. (Case example, Falmouth, MA).

Composting toilets: A toilet system that separates human waste from shower, sink and other household water uses. The composting toilets use no or minimal water. The human waste captured by the composting toilets is decomposed and turned into compost. The compost generated is removed from the site and nutrients can be recycled. Composting toilets require the replacement of existing toilet(s) and room in the basement for a container to capture and compost the human waste. Household water (sink and shower uses) continues to flow to the septic system. (Case example, Falmouth, MA).

- *There is an ecotoilet demonstration project in Falmouth; do you have number and cost data for this project?* There are probably five so far, fewer than expected as the cost of the retrofit is expensive.
- *We got a quote to retrofit our house for eco-toilets, and it was $40,000.*
- *These don't remove less nitrogen than urine diverting toilets.*

Packaging toilets: A packaging toilet encapsulates human waste in a durable material for removal from the site. The package is stored beneath the toilet and removed and taken away when full.

Stormwater bioretention: Bioretention systems utilize natural plant and soil functions to capture and treat stormwater runoff for a variety of contaminants including nutrients. A typical system consists of an underdrain/gravel layer, a layer of bioretention soil mix (a mix of sand, compost, woodchips and loam), and a surface layer containing appropriate plantings. The treated water can be discharged into a water body or used for open space irrigation after treatment. The reclaimed water can also be discharged into a subsurface infiltration system for discharge to the groundwater. (Case example, Portland, OR).

- *Does the twenty-five percent removal rate mean the overall reduction in nitrogen or just the rate of reduction in stormwater, and why is there such a large range in possible reduction values?* It is only for nitrogen reduction in stormwater. The range represents levels of uncertainty for the technologies; the range of nitrogen reduction would likely be different across sites.

Neighborhood level technologies/approaches

Cluster and satellite treatment systems: A cluster or satellite system is a collection and treatment system treating wastewater flows from multiple properties.

STEP/STEG collection: Septic Tank Effluent Pumping (STEP) and Septic Tank Effluent Gravity (STEG) systems convey liquid wastewater from on-site septic tanks to sewer systems; only the liquid component of the wastewater may be conveyed by pumps or by gravity.

- *For STEP systems, you need to have easements, so pipes could go through adjacent properties and go downhill to maximize efficiency. Are there regulatory efforts to simplify this?* Falmouth is starting to look at small pipes, local control, and pump systems. Their efforts could be used as a model. Provincetown is using STEP as part of their reduction efforts. These systems are easier to install than traditional sewers, but you need user agreements and easements. That said, they can be very effective.
- *I do not see average nitrogen reduction rates for STEP systems.* These are purely collection systems; there is no nitrogen reduction.
- *In urban situations, these systems can save the town a lot of work. The excavations are pretty easy, and they require less water.*
- *For STEP systems it should be noted that there could be odor, upkeep, and cost issues as seen in Orleans.*

Eco machines and living machines: Living or Eco-Machines are natural systems that treat septic tank effluent or primarily treated wastewater. In these systems, aeration and clarification chambers are combined with constructed wetlands to treat the influent. The wetlands are a series of chambers allowing microbial communities to engage with and treat the wastewater. Plants are often suspended on racks with their roots systems doing the work. Solids removal is generally onsite, after which water is pumped through the gravel filled cells (similar to subsurface wetlands.) This process transfers more oxygen to the wastewater and completes the pollutant removal process. (Case example, South Burlington, VT).

- *What is the size requirement for these systems?* They normally have a fairly small footprint; a system for six houses would likely be the size of a two-car garage.
- *Can these systems be split up and managed individually?* It is more cost effective to construct these systems on a larger scale. The drawback is that these require water and heating.

Stormwater wetlands: Constructed wetlands provide aerobic chambers followed by subsurface anaerobic chambers that facilitate nitrification followed by denitrification, respectively. This process mimics that of natural systems coupled with engineering design guaranteeing residence time within a chamber containing anaerobic conditions. (Case example, China).

- *Are stormwater wetlands and vegetated swales the same thing?* Yes, swales are just smaller in size.
- *What is the nitrogen removal rate for a typical subsurface disposal system, and what scale of improvement do these represent over current systems?* These bio systems are a significant improvement because traditional ones (catch basins leaching directly to groundwater) only remove nitrogen attached to particulates.

Watershed level technologies/approaches

Conventional treatment: A conventional wastewater treatment facility typically treats wastewater collected from homes and businesses. A groundwater discharge permit is required. Treatment generally results in less than 10 mg/L Nitrogen.

Constructed wetlands: surface flow: After primary treatment in a septic tank or wastewater treatment facility or secondary treatment at a wastewater treatment facility, water is fed into a surface flow constructed wetland. Surface flow constructed wetlands closely mimic the ecosystem of a natural wetlands by utilizing hydrophilic plants to filter wastewater through their root zone, a planted medium, and open water zones. In surface flow wetlands systems, open water is exposed much like in a natural marsh. The reclaimed water from the wetland can be discharged into a water body or used for open space irrigation after treatment as well as discharged into a leach field. (Case example, Albany, OR).

Constructed wetlands: subsurface flow: After primary treatment in a septic tank or wastewater treatment facility or secondary treatment at a wastewater treatment facility, wastewater is treated by pumping water slowly through subsurface gravel beds where it is filtered through plant root zones and soil media. Water flows 3-8” under the surface to prevent public exposure to wastewater and mosquito breeding. A combination of horizontal and vertical flow subsurface systems must be utilized to provide total nitrogen removal. This solution can also offer opportunities for recreational activities on land above the subsurface system. (Case example, Thailand).

Effluent disposal: out of watershed: Effluent disposal can take a variety of forms, including infiltration basins, a Soil Absorption System, Injection Wells or Wick Wells. These disposal methods place highly treated effluent back into groundwater. Effluent transport out of the watershed has the advantage of removing the nitrogen load to another watershed. Transport to another watershed requires that the receiving watershed be able to accommodate the additional nitrogen load.

- *What do you mean by the term 'highly treated?'* In most cases, this would mean water coming from a treatment facility after tertiary treatment.
- *Are there other problems with out of watershed systems?* Yes, many studies are required, though Cape Code is considered a single basin so transfers among watersheds would not be out of basin transfers. Any solution like this would need a groundwater discharge permit. Furthermore, most of the transfers would be from one sub-watershed to another, which can easily be done and can represent an insignificant transfer of water. Transfers would also be dependent on local watershed conditions.
- *Orleans has a large watershed, which is a benefit.*
- *For perspective, we already do a lot of this inter-watershed transport for water supply delivery.*
- *We should be careful about wasting fresh water, as it is a scarce resource. I do not believe in robbing from Peter and discharging to Paul. This should not be considered without a lot of study and evaluation, and freshwater aquifers should be maintained.*
- *While I sympathize with that, if one has a salt marsh that is an excellent sink for wastewater effluent, it is an option that should be considered. Orleans has considered this.*
- *It is important to have a sense of context. There is a variable amount of rain each year. What percentage of total rainwater might be transported?* This might be around five percent of total rainwater. Before transport permits are approved, the impact of moving the water around is studied. It is normally very localized. There is also a public comment session during the permit review process.

<u>Effluent disposal: ocean outfall:</u> Similarly to out of watershed effluent disposal, highly treated effluent is transported out of the watershed and into the ocean. This approach requires a high level of regulatory oversight. The solution is considered due to limited land availability for disposal on Cape Cod.

- *The outfall plan would entail a huge amount of bureaucracy.* That is true, and Nantucket Sound is also shallow, which could further complicate permitting. .

<u>Phytoirrigation:</u> After secondary treatment, wastewater treatment facility effluent is irrigated onto plants to remove nutrients and other contaminates. Fast growing poplar and willow trees are typically used. (Case example, Woodburn, OR).

Cape-wide level technological approaches

<u>Phytobuffers</u>: Using trees with a deep root system to capture nutrients in the soil, particularly willows and poplars. Green plants with deep taproots are planted as a buffer to intercept existing groundwater. The plants and their associated microorganisms reduce contamination in

soils and ground water. Often phytohydraulics causes the groundwater plume to be redirected and pulled towards the plants. (Case example, Kavcee, WY).

- *Phytobuffer seem like they would require substantially less infrastructure for having a high rate of nitrogen removal, but aren't poplars and willows invasive?* There are native species with similar nitrogen removal capacities.

Fertigation wells: Fertigation wells can capture nutrient enriched groundwater, typically from a wastewater treatment facility discharge and recycle it back to irrigated and fertilized turf grass areas. These irrigated areas include golf courses, athletic fields, and lawns. Fertigation can significantly reduce nutrient loads to downgradient surface waters while reducing fertilizer costs to the irrigated areas. (Case example, Plymouth, MA).

- *We would need empirical evidence to look at specific lawn fertigation systems.*

Permeable reactive barrier (PRB): A permeable reactive barrier (PRB) is an in-situ (installed within the aquifer) treatment zone designed to intercept nitrogen-enriched groundwater. Through use of a carbon source, microbes in the groundwater uptake the nitrogen, denitrifying the groundwater. PRB systems typically use vertical trenches, sequences of bored columns, or injection methods to introduce the carbon source into the groundwater, reducing the nitrogen load to an estuary and removing it from the watershed. The CCC is considering pilot projects, initial screenings, and a full hydro-geologic evaluation to study the efficacy of this approach. (Case example, Falmouth, MA).

- *There is a successful example of a PRB filled with zero valence iron next to Ashumet Pond. However, there were specific local conditions that made it successful. In PRB injection projects, there might be problems if specific conditions are not present. It is important to make sure these projects will work before funds are spent to figure out if it is a cost effective option. Does the Cape Cod Commission have experience with this?* If you have to construct a PRB below 40 feet in the ground, only wells can be considered as groundwater nitrogen could go underneath it. There is a system in Canada that has worked well for over fifteen years. These systems have a tendency to last a long time. Lifecycle costs are included in the matrix, which includes the cost per pound of nitrogen. Trenching and wells can also be used in conjunction with each other to make a more effective system.
- *Brewster is looking at installing these systems, but the depth to groundwater makes a large cost difference.*
- *The depth of a PRB clearly matters; what about the width of a PRB?* PRBs can pretty much extend as far as you want.
- *There has been work done looking at roadways that are on long estuaries and installing PRBs on the shoulders of these roads.*

Inlet and culvert widening: Re-engineering and reconstruction of bridge or culvert openings to increase the tidal flux through the culvert or inlet. This solution generally works better with a larger tidal range but could be feasible on both the Cape Cod Bay side (approximately nine feet tidal range) and Nantucket Sound side (approximately 3 feet of tidal range).

Salt marsh habitat restoration: Salt marsh is one of the most productive ecosystems in the world, surpassing rainforest in productivity per acre. Approximately sixty-five percent of historic salt marsh has been lost in Massachusetts. Salt marshes cycle and remove nitrogen as well as provide critical habitat and spawning sanctuary for a wide variety of birds, mammals, and marine life in addition to hosting a range of plant species and important biogeochemical processes. The capacity of salt marsh to intercept nitrogen is significant and well researched worldwide. Substantial areas of former salt marsh on the Cape are either under consideration for restoration or could be restored, providing storm surge and coastal flooding protection in addition to water quality benefits in certain watersheds.

Shellfish habitat restoration: Oyster reefs were historically one of the main consumers and recyclers of nitrogen in the coastal environment on Cape Cod. According to the Nature Conservancy, populations have declined by ninety-five percent. In conjunction with the natural transition from land to sea in estuaries, bays, inlets, salt marsh, oyster reef, and eel grass function as critical buffer that can reduce eutrophication. Restoring Oyster populations leads to increased shellfish productivity as well as improved commercial and recreational fisheries for other species, increased protection from shoreline erosion and flooding, and buffering from ocean acidification. (Case example, Wellfleet, MA).

- *While nitrogen uptake only occurs during the growing season, this corresponds to the visitor season, when the Cape most needs it.*

Aquaculture / shellfish farming: Oyster beds have been proposed as a potential method for reducing nitrogen levels and eutrophication in estuaries. Nitrogen removal rates from oyster beds have been well documented, and the harvest of oysters physically removes the nitrogen sequestered by the oysters. In addition, oysters remove nitrogen through their biological cycling, which puts nitrogen back into the atmosphere. Aquaculture can use both man-made structures (e.g. cages, floating bags) or natural reefs.

Surface water remediation wetlands: Constructed to aid in water quality improvements to surface water bodies, usually streams or rivers. Water is pumped or allowed to flow naturally through treatment cells containing wetlands. Surface water remediation wetlands are often used in combination with groundwater recharge or potable water reuse systems. Surface water remediation wetlands are generally used with Free-Water Surface wetlands due to their larger size and lower capital and O+M Costs. (Case example, China).

Pond and estuary dredging: Lakes, ponds, streams, and estuaries store nutrients within their sediments. These sediments tend to accumulate over time. Subsequently, these nutrients can be released into the overlying water column and can become a major source of nitrogen and phosphorus. Dredging and removing these sediments and accumulated nutrients removes the nutrients from the water body and potentially from the watershed. (Case example, Dennis, MA).

- *Aren't spoils from dredging highly regulated at the moment? This will have to be addressed. The county has a dredge and should pursue this. The disposal of dredge spoils* is highly regulated. Maintenance dredging can help reduce nitrogen loads.
- *Harwich just dealt with a dredging project, and it was a major hassle.*
- *The state does not have a great way to regulate dredging solely related to nutrient removal.* Yes, Barnstable's recent dredging project at Mill Pond to increase freshwater involved dealing with complex regulations.

Cape-wide level regulatory approaches

Compact development: Both Compact Development and Open Space Residential Development (OSRD) of subdivisions result in smaller lots and less maintained lawn acres. The higher density development reduces wastewater collection costs while providing a common disposal area. Compact development is also referred to as "Smart Growth."

Fertilizer management: Managing fertilizer application rates to lawns, golf courses, athletic facilities, and cranberry bogs. Residential lawn loading rates could be reduced on existing developed parcels through an intensive public education/outreach program. This could include a "Cape Cod Lawn" branding program, replacing some turf areas with native vegetation, establishing naturally-vegetated buffer strips on waterfront lots, and reducing application rates. Fertilizer loading rates for new development could be accomplished by reducing lot sizes (cluster development), by restricting lawn sizes, and by incorporating more naturally vegetated open space areas. Municipalities could directly reduce fertilizer applications on athletic fields and other properties. Golf courses can significantly reduce nitrogen loading rates by using slow-release fertilizers and reducing application rates in rough areas. Cranberry bog fertilizer exports from the bogs can be reduced using tail water recovery systems. Site-specific assessments are needed to estimate load reductions.

- *For home fertilizer use, there are garden services that do not introduce nitrogen, and we should consider promoting this kind of service.*

Remediation of existing development: Existing developments or schools with excess wastewater treatment capacity allow existing nearby developments to connect to their underutilized wastewater treatment infrastructure. A town can operate the wastewater treatment facility if the existing owner prefers to not take the responsibility for treating the off-site wastewater. An example of this is the Kingman Marina in Bourne, which was permitted to expand its development footprint in exchange for hooking up adjacent, existing homes to its wastewater treatment facility. Mark Owen, Consultant from AECOM, noted there is a school in the area that has a treatment plant that would benefit from getting more wastewater, and there may be more of these opportunities.

- *What about the use of military base's treatment system; how does that play into this?* Yes, there is excess treatment and disposal capacity at the base. The Commission is working with base command to develop a master plan to decide what might happen at the base going forward. A host of potential solutions are under discussion, including bringing in the surrounding community's waste or having the towns around the base form a sewer district to take advantage of the base's extra capacity.

Transfer of development rights: A regulatory strategy that transfers development and development rights from one property (sending area) to another (receiving area) to direct growth and associated nutrient loading away from sensitive receiving watersheds or water bodies. The protected parcels (sending areas) receive a deed restriction that limits the level of future development. The deed restriction can limit the number of homes or tie development to the availability to future wastewater treatment facility infrastructure.

- *Do we have successful examples of developmental transfer in the area?* Not on Cape Cod specifically.
- *Shaws Market gave a transfer development right.* Yes, a good example of a single project offset.
- *In regard to the transfer of rights, Title V already has a provision that allows you to buy more land to make up for additional nitrogen loads on your on property. This is done in Harwich.*

Stormwater best management practices (BMP): Non-Structural Stormwater strategies include: street sweeping, maintenance of stormwater utilities, education and public outreach programs, land use planning, and impervious cover reduction and control.

Ms. Daley concluded by reviewing the technologies in use and under consideration in towns on the Cape. The Working Group suggested several revisions to this overview, including noting that the Muddy Creek Project is a two-town venture and the existence of a demo subsurface project in Falmouth. Ms. Perry responded that the Cape Cod Commission would check their information.

General questions and comments about technologies:

- *For clarity, the factsheets should state the source of nitrogen that the technology addresses, and the percentage that source is of the total nitrogen problem (*i.e. technology A removes 46% percent of nitrogen from a source that contains 60% of the total nitrogen load).
- *Not all of the recommendations from the Technology Panel are included in the fact sheets. The Technology Panel recommended starting with solutions that begin in the watershed*.
- *Huefelder, Kreissel and EPA have stated that high levels of nitrogen removal (down to less than 3 mg/l) are achievable at any scale from enhanced on-site (single home), cluster or satellite treatment or centralized treatment facilities.*

- *We need to clarify growth rate scenarios to estimate future waste loads. Towns have the ability to alter this future rate – Brewster has worked with zoning laws and acquired land to affect this.* This a good point and should be included.
- *Is the information that talks about finance on the CCC website?* Yes, it is[4].

IV. PROBLEM SOLVING PROCESS AND PRINCIPLES

Overview of 7-steps for Problem-Solving Process

Ms. Daley reiterated that the goal the Working Groups is to develop remediation options that would achieve water quality targets with a focus on first targeting low cost, low barrier options to reduce nitrogen and then considering more costly and traditional options later (e.g. sewering). She then described the alternatives screening process the group will apply. The process is as follows:

1) Establish targets and articulate project goals.
2) Identify priority geographic areas (e.g. high nitrogen reduction areas, Title V problem areas, and pond recharge areas).
3) Determine which management activities should definitely be implemented. These might be the easiest and least costly management activities that should be undertaken regardless of other management actions (e.g. fertilizer management and stormwater mitigation – two approaches that Cape Cod towns are already actively pursuing). In response to a question, Ms. Daley agreed that growth management solutions would also fit under this category.
4) Assess alternative options to implement at the watershed or embayment scale (e.g. innovative and lower-cost solutions)
5) Assess options to implement at the site-level
6) Examine priority collection/high density areas
7) Consider traditional sewering or other grey infrastructure management options

She further explained that the Working Groups will focus on total controllable nitrogen load. The technologies and approaches selected should aim to reduce the total controllable nitrogen load by identifying options that reduce the portion of *septic* load that needs to be reduced. For example, the portion of septic load that needs to be reduced could be made smaller if Cape Cod takes on fertilizer and stormwater solutions first. In addition, the percentages of controllable nitrogen that needs to be removed to meet TMDLs change depending on the characteristics of the watershed. She noted that in many instances, one of the solutions may not achieve the TMDL, but if you pair multiple solutions, you may be able to reach the goal.

Ms. Daley responded to questions from the Working Group about how to document and deal with regulations for different technologies. She explained this involves adaptive management and discussion with the Department of Environmental Protection (DEP). Another participant asked about the needed measurements for obtaining baseline data. Other Working Group

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[4] Cape Cod Commission topic page: http://www.capecodcommission.org/index.php?id=62&a=topic

members responded by listing existing monitoring programs, and Ms. Daley acknowledged the participant's concern about measuring success and its importance in demonstrating compliance, but emphasized that the goal of the meeting was discussing potentially successful technologies and outcomes.

Categories of Solutions and their Impacts on the Environment, Economy, and Community and Overview of Guiding Principles and Processes

Ms. Daley commented that evaluation of the technologies and approaches would be informed by their impacts (positive and negative) on the environment, economy, and community (Triple Bottom Line)

Ms. Daley highlighted some of the principles the Cape Cod Commission hopes will guide the technology/approaches selection and expressed her optimism that a wide-ranging discussion with the Working Group would be able to clarify role of these principles. These process and principles include:

- *100% septic removal sub-watershed*: Combinations of technologies can be used to reduce the septic and other controllable load that needs to be removed.
- *Scale: On-Site vs. Collection System vs. Natural System*: There will be tradeoffs between the scale of systems that can be used. On-site, collection, and natural systems all have their pros and cons and all require different levels of investment and infrastructure. These tradeoffs will be important from an implementation and public acceptance point of view.
- *Nutrient intervention and time of travel*: Some technologies/approaches intercept nutrients at their point of entry into the system, while others deal with it later on (e.g. once it is in the watershed). There are pros/cons to each approach that need to be considered.
- *Permitting Status*: The level of effort required to permit technologies will be a consideration.
- *Land use and Impacts of Growth*: Unintended consequences and opportunities for planned growth are important to consider.

Discussion – Identify Considerations and Priorities for Application

Before starting the discussion, Ms. Smith reiterated the themes she had captured during the discussion from the first part of the meeting. These themes included:

- Scale:
  - At the homeowner level, how can the Working Group clarify the best technologies for variable conditions; how can these technologies be enforced and homeowners be made accountable; and how do you incentivize people to use these better systems?
  - What are the costs and benefits as these technologies scale up, and what is the right place to implement technologies on this scale?
  - Systems with small pipes have potential benefits, but there are also concerns about their effectiveness and social impacts.
- Seasonality: What is the understanding and effect of different kinds of seasonality; how does this impact the success of different technologies; and considering this, how should technologies be tailored to specific properties?
- Compliance and documentation: how can this best be done, and how should success be measured going forward?

The Working Group members brought up a number of questions and comments about the discussed technologies.

Discussion of Potential Efficiencies in the Process:
Several members of the Working Group mentioned ideas and existing programs that could take advantage of efficiencies to simplify the adoption of future technologies. A participant noted that, as this process is both town and watershed based, the 208 Process could be aligned with the Towns' process. Ms. Smith agreed that this coordination is important for the next phase of the planning process.

Another participant brought up the idea of taking one town's effluent and sending it to another town within the watershed, and emphasized the importance of considering the economics of regional solutions, noting there are multiple opportunities for inter-municipal solutions. Others agreed that the Working Group should think in terms of watersheds instead of towns to find efficiencies. A discussant also suggested comparing the alternative technologies at both the local and watershed scales. A Working Group member noted that Brewster is considering a PRB as an alternative, and it might make sense to include adjacent towns in the project. Another group member pointed out that there can be timing issues in planning among municipalities if they are in different stages of the assessment process as it makes it more difficult to know the needs of the entire watershed and a common understanding has yet to be developed. Others acknowledged this, and felt that collaboration was still possible in meeting each town where they are. While Brewster is behind the other towns, it has made a point to keep an open dialogue and discuss solutions, even though it is not ready to commit to specific approaches yet. Other members brought up the Pleasant Bay Alliance, which includes all four towns, and holds monthly watershed workgroup meetings in which wastewater, stormwater, and fertilizer management plans have all been discussed. The Alliance could serve as a model for other towns that share a watershed. Ms. Daley noted that it would be the Commission's job to look at these collaborations after the third meeting and integrate them into Cape-wide options where shared infrastructure might make sense and present these findings to stakeholders.

Cost and Affordability:

The issues of cost and affordability were also recurrent themes in the discussion. In response to a Working Group question about the absence of cost from the fact sheets and matrix, Ms. Smith told the group that there is a huge range in the cost projections for the different projects depending on local conditions, and while funding is clearly a fundamental piece of this, there are other economic and environmental considerations on the fact sheets. Ms. Daley added that the Commission also did not include costs, as people might focus solely on the financial issue, which is a conversation for a later time. A Working Group member thanked the group for addressing the funding issue and acknowledged that, while this is not the forum to discuss cost, it is an important consideration as there is not an excess of money at the moment. In response to further comments about municipal funding of nitrogen reduction projects, Ms. Daley informed the Working Group that the Commission seeks to obtain fifty percent of the funding from state and federal sources.

Another participant noted that due to the lack of immediate deadlines, people do not have their feet to the fire and will want to wait for better and cheaper approaches to arise, but this does not usually happen. For example, every fire station project in the Cape that has been pushed back to save costs has cost more and been smaller than the original proposal. Other members expressed a shared concern that this problem has only gotten worse in the last fifteen years, creating a host of water quality issues; the towns on the Cape cannot wait anymore and let conditions further deteriorate.

The Working Group discussed the issue of incentives for homeowners making improvements. A participant noted that tax breaks could be problematic as those who can afford to make an immediate investment in new technologies are more likely to be the more financially stable residents of the Cape, so granting this group a tax break on their expensive properties would hurt town revenues. Others noted that costs are a huge area to be explored, and whole-town funding options could be one potential set of solutions. Ms. Daley added that new systems could also bolster the local pumping industry and emphasized the benefit of looking at nutrients as a value instead of a cost. Another participant brought up the difference in costs between new construction projects and retrofitting, stating that it may be more financially feasible to install systems such as eco-toilets in houses under future construction. Others noted that the Working Group needs to recognize the importance of resale in cost calculations. The cost of installing new system should be offset by the increase in a house's value in the long term. A Working Group member also asked about the effect of these additional costs on affordable housing projects on the Cape. Ms. Daley responded that there are many land use approaches for dealing with this type of issue, and wastewater infrastructure planning could be changed for future developments.

Regulatory:

The Working Group brought up several issues that involved the regulation of potential projects and technologies. A discussant stated that, while pilot programs can document the benefit of new technologies and demonstrate their feasibility, there are remaining regulatory and legal challenges and asked if the Cape Cod Commission envisions itself as a champion to the DEP in overcoming these obstacles where stakeholder have identified particular technologies as valuable. Ms. Daley responded that hearing stakeholders opinions about the proposed technologies will help the Commission in its discussions with state regulators.

The Working Group posed several questions about the technical and regulatory timeline of the process. Ms. Daley explained that the CWMPs look at the issue from a twenty to forty year build out perspective, and the time for fixing the nitrogen problem relates to its travel time in different areas, noting that a newly sewered area may still require a PRB to capture nitrogen already in the ground. From a regulatory standpoint, the towns need to meet the requirements set forth in their TMDLs, lest the DEP or a judge enforce these regulations, potentially in a less efficient and more expensive manner. Ms. Daley clarified that, while the state has not acted on a number of regulatory actions that it could take , it could if it wants to do so, but noted that it is in the Cape's best interest to come up with its own solutions as its economy is dependent on the quality of its environment.

A Working Group member proposed that the best regulatory course of action was promoting self-accountability and installing I/A systems, on an individual level. Ms. Smith noted previous comments about proper enforcement, and Ms. Daley added that, according to George Heufelder, I/A systems could not be used alone if more than fifty percent of nitrogen needs to be removed from a watershed system. Others group members encouraged thinking about a package of solutions with I/A systems as one of many potential options. Ms. Daley added that the Commission is using GIS layers to screen different areas to determine which technologies are most appropriate for specific sets of conditions.

In response to a participant request to individually review each technology, another discussant responded that in most cases the more local the response the higher the tolerance for risk because local responses require less capital, but these local proposals are more dependent on local conditions, and as there is high local variability, these will be finite discussions, noting that the Working Group had selected a good group of technologies and might not need to discuss the specifics yet. Another group member suggested that a reasonable principle would be not committing to any initial plans that would preclude other options later on in the process. Ms. Smith affirmed that looking at the extent to which any option allowed other options to stay on the table could be a possible evaluative criterion. A participant added that the nutrient issue should not be the sole focus of the Working Group, stating that there are other issues, including water supply considerations, that are important to residents of the Cape.

<u>General Questions and Concerns</u>:
A Working Group member asked for clarification about the 7-step process. Ms. Daley explained that it is not a temporal approach, but rather an evaluation method for considering alternatives. A Working Group member noted the recommendations of the Tech Panel to restore the natural functioning of systems and maximize in-situ solutions. Participants noted the value of considering other environmental and economic benefits of technology choices. Another discussant asked if it was possible to include a representative from the Tri-Town Septic

Treatment Facility. Ms. Smith explained that the group can talk about the plant and treatment facilities in general, but the Tri-Town plant is expected to be decommissioned.

V. PLANNING FOR THE NEXT MEETING

Meeting Three will be held:
Monday, December 9th, 2013
8:30AM -12:30PM
Orleans Town Hall, 19 School Road, Orleans, MA 02653

During this meeting the Working Groups will examine various scenarios (i.e. combinations of solutions) and their potential impacts (e.g. nutrient reduction, economic impacts, environmental impacts, social impacts, etc.). During the meeting, the Cape Cod Commission will use tools to calculate ideas/options and their impacts. Working Group participants should come prepared to offer their ideas about what solutions they would like to explore further given their understanding of the baseline conditions, issues, and priorities in this watershed.

VI. PUBLIC COMMENTS

- *This process should be broadened beyond nutrients alone to other issues, such as public health and not foreclose on other options and problems. I work with young scientists on social and technology issues, and remind the group that in addition to technological complexity, we need to consider the complexity of human behavior and the likelihood of citizens all fulfilling their parts. For example, use of seat belts, and replacing batteries on smoke alarms. I urge caution in underestimating the human regulatory component.*
- *I want to second the agenda for broadening the scope of this process and looking at other contaminants, such as hormones. Also, the more water you have to treat the less easy it is to clean that water. Given today's regulations, we should be able to implement I/A systems and save costs without having to raise taxes.*
- *Has anyone interacted with the online GIS data? IF so what was your experience?*
    - *I wasn't able to use it on my computer.* Ms. Daley responded that the site was having some issues that the GIS technicians would soon fix. Ms. Smith asked the Working Group to retry the GIS site as homework before the next meeting.

APPENDIX ONE: MEETING PARTICIPANTS

Primary Members:

Category	Name	Title
Local Elected Official	Linda Cebula	Harwich Board of Selectmen
	Florence Seldin	Chatham Board of Selectmen
	Sims McGrath	Orleans Selectman
Appointed/Committee	Russell Schell	Brewster Wastewater Committee
	Heinz Proft	Harwich, Natural Resources Director
Town Staff	George Meservey	Orleans Planning Director
	Sue Leven	Brewster Town Planner
	Robert Duncanson	Chatham, Program manger of CWMP
Environmental and Civic Group	Jeff Eagles	Orleans Citizens Peer Review Group
	Fran McClennen	Orleans Pond Coalition
	Joy Cuming	Orleans Community Partnership Advisory Council member
	Carole Ridley	Coordinator, Pleasant Bay Alliance
Business	David Bennett	Brewster Chamber of Commerce
	Jim McCauley	Orleans
	John Payson	Chatham Concerned Taxpayers
	Ben Buck	Orleans

Alternates and Members of the Public:

Jim Bast
Paul Davis
Steve Kleinberg
Dan Milz
Ed Nash
Peter Sivco
Gordon Smith

Cape Cod 208 Area Water Quality Planning
Provincetown Harbor Watershed Working Group
Provincetown Town Hall
Second Meeting

260 Commercial St, Provincetown, MA 02657
October 31, 2013
8:30 a.m.-12:30 p.m.

Agenda

8:30 Welcome, Review 208 goals and Process and the Goals of today's meeting – *Cape Cod Commission*

8:40 Introductions, Agenda Overview, Updates and Action Items– *Facilitator and Working Group*

9:00 Range of Possible Solutions – *Cape Cod Commission and Working Group*

- Technology Matrix
- Technologies Overview
- Survey Questions and Comments
- Additional Questions and Discussion

10:30 Break

10:45 Problem Solving Process and Principles – *Cape Cod Commission and Working Group*

- Overview of 7-steps for Problem-Solving Process
- Examination of Categories of Solutions and their impacts on the Environment, Economy, and Community (triple bottom line)
- Discussion – Identify Considerations and Priorities for Application

12:00 Preparing for Meeting 3 and Beyond – *Cape Cod Commission*

- Review Tools, Alternatives Analysis Approach
- Evaluating Scenarios for Meeting Nitrogen Goals
- Other Process Next Steps

12:15 Public Comments

12:30 Adjourn

Provincetown Harbor Group

Technologies and Approaches

What is the stakeholder process?

Public Meetings

Watershed Working Groups

Goals, Work Plan & Roles

Affordability, Financing

Baseline Conditions

Technology Options Review

Watershed Scenarios

July

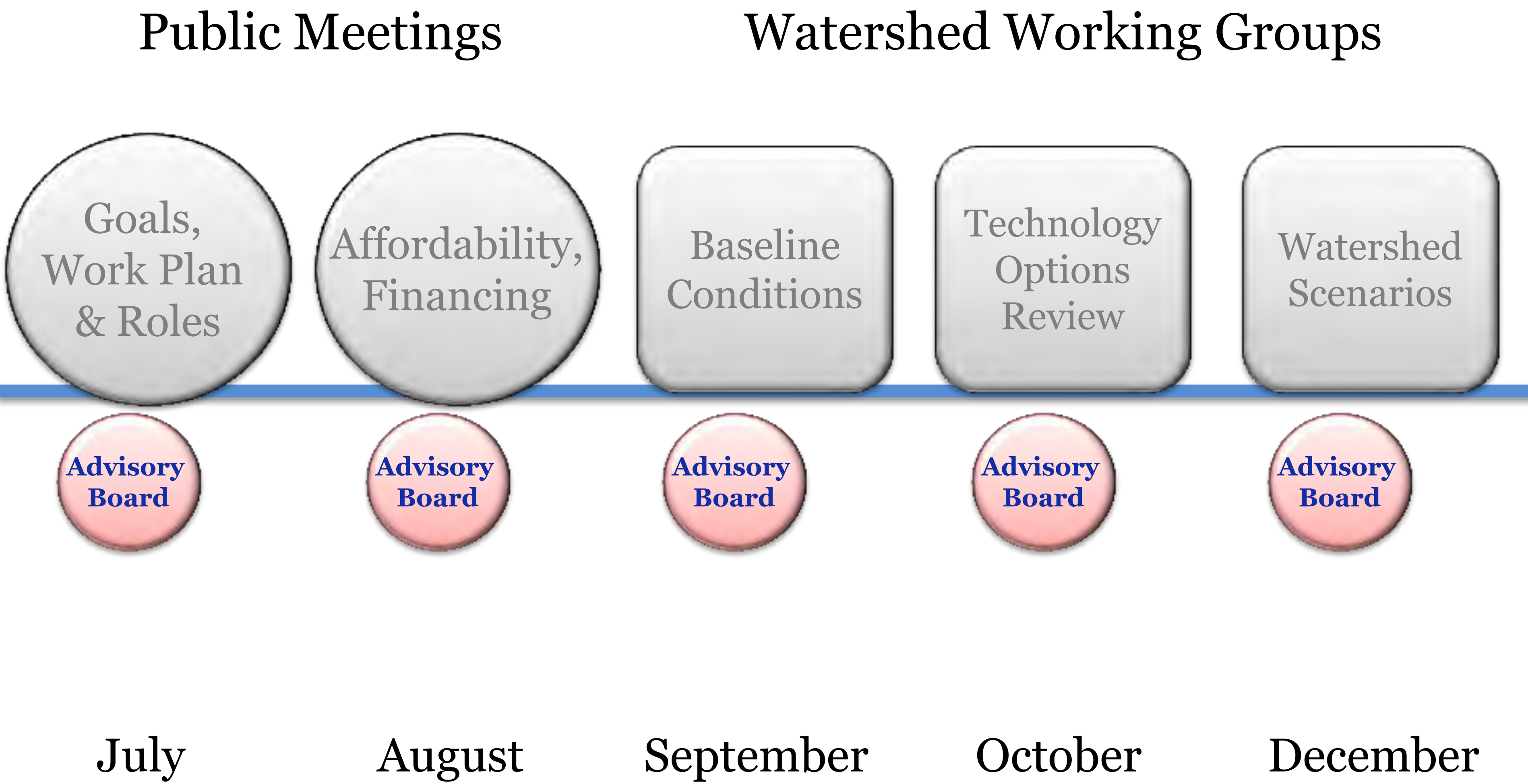
August

September

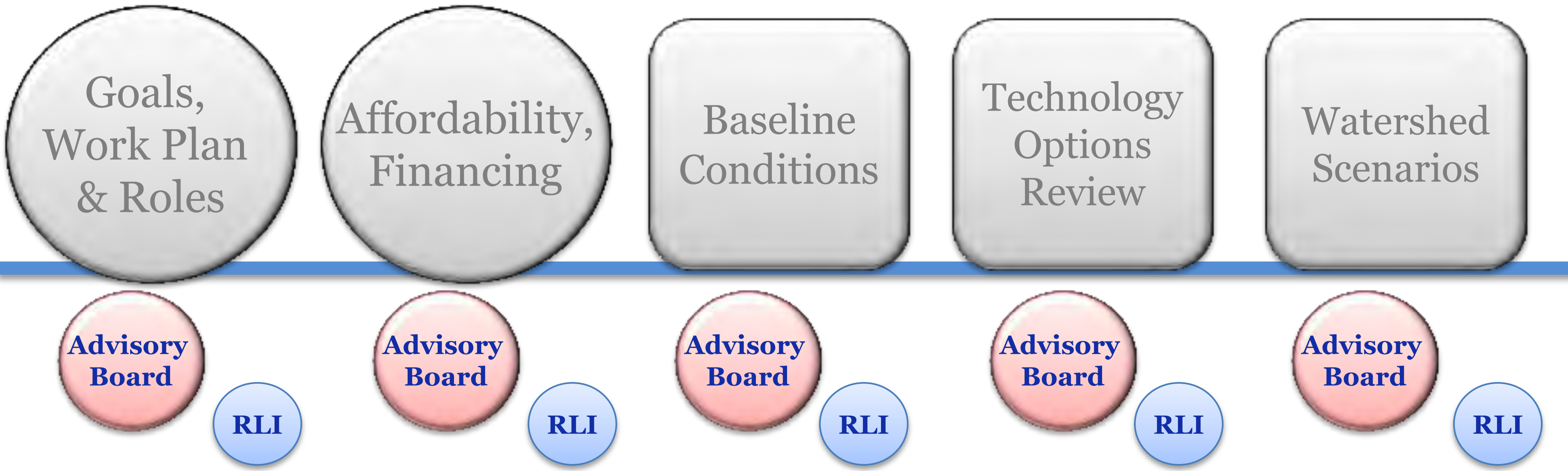
October

December

208 Planning Process


Public Meetings
Watershed Working Groups
Goals, Work Plan & Roles
Affordability, Financing
Baseline Conditions
Technology Options Review
Watershed Scenarios
Advisory Board
Advisory Board
Advisory Board
Advisory Board
Advisory Board
July
August
September
October
December

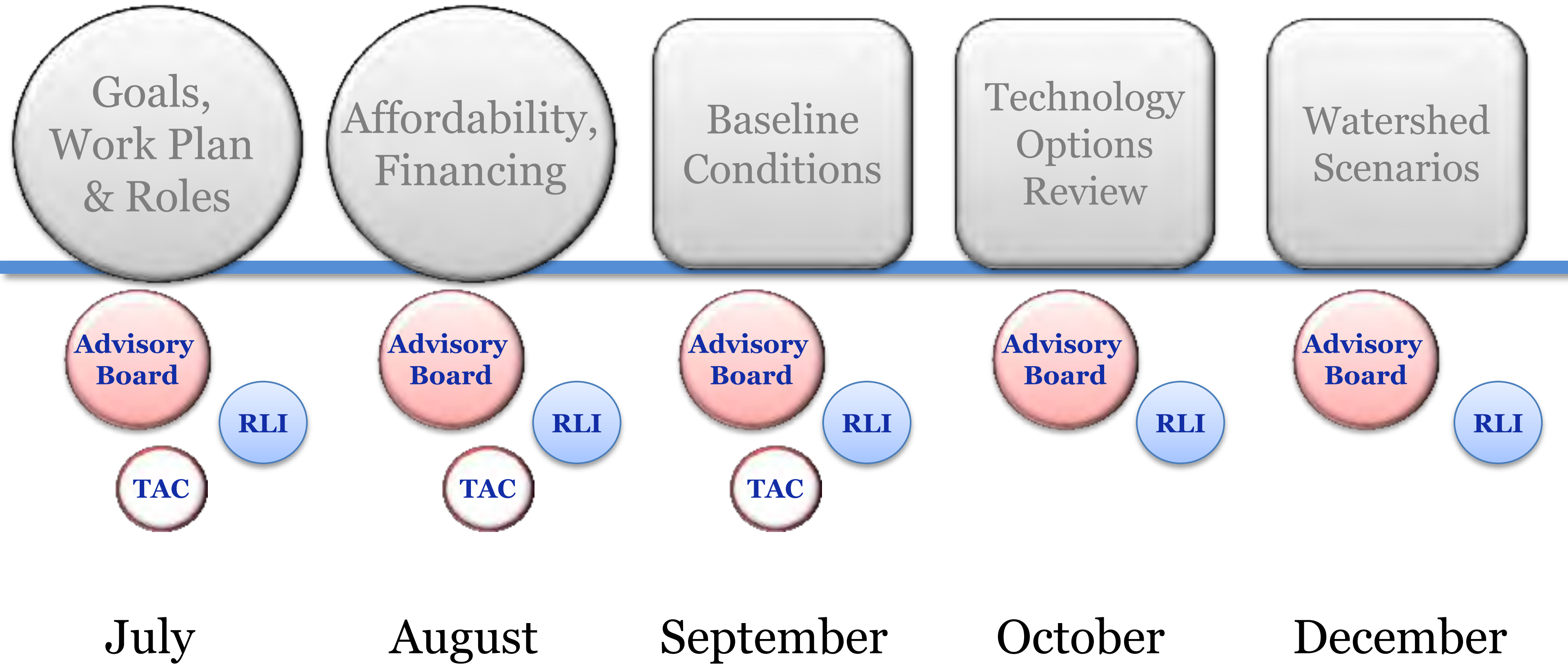
Public Meetings Watershed Working Groups



July August September October December

RLI Regulatory, Legal & Institutional Work Group

Public Meetings Watershed Working Groups



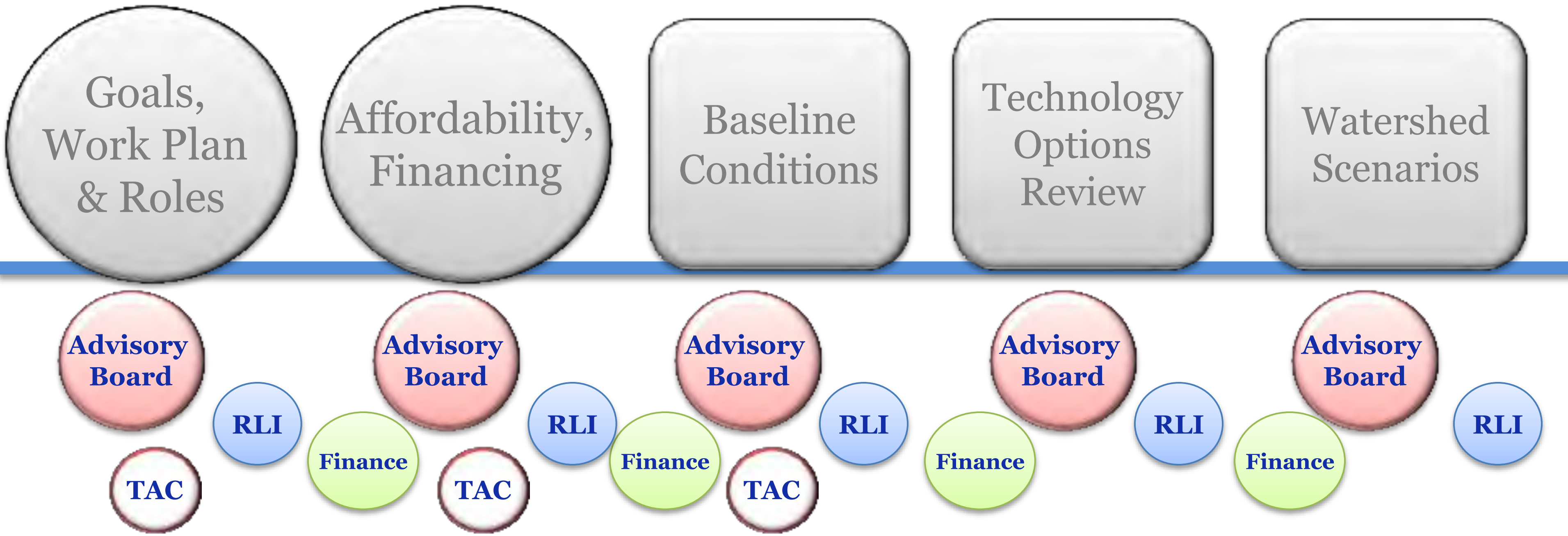
RLI Regulatory, Legal & Institutional Work Group

TAC Technical Advisory Committee of Cape Cod Water Protection Collaborative

208 Planning Process

Public Meetings

Watershed Working Groups



July August September October December

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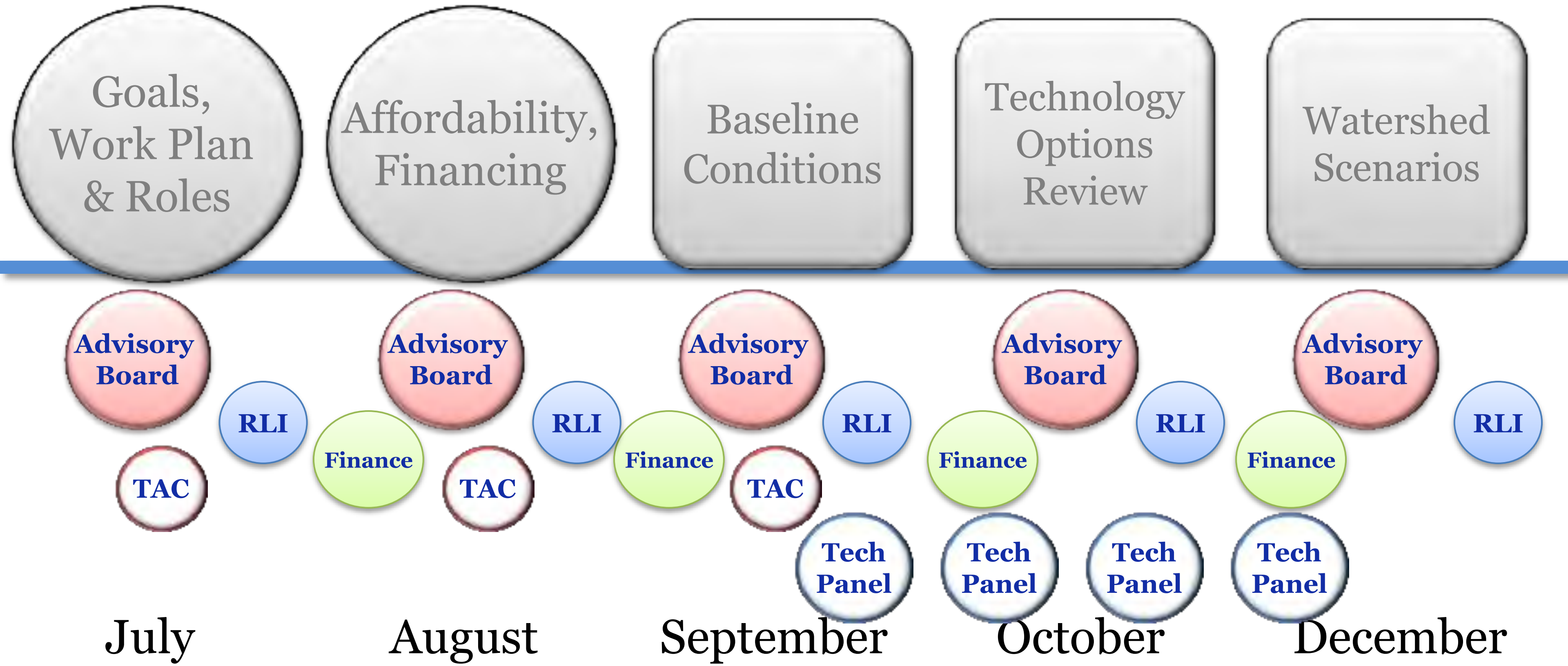
TAC Technical Advisory Committee of Cape Cod Water Protection Collaborative

Public Meetings Watershed Working Groups



RLI Regulatory, Legal & Institutional Work Group

TAC Technical Advisory Committee of Cape Cod Water Protection Collaborative

Baseline Conditions

11 Working Group Meetings: Sept 18-27

Goal of the First Meeting:

To review and develop shared understanding of the characteristics of these watersheds, the work done to date, existing data and information available, and how to apply all of this to planning for water quality improvements for these watersheds moving forward.

Progress since last meeting

- ❑ Meeting materials

Progress since last meeting

- ❑ Meeting materials
- ❑ GIS data layers

Progress since last meeting

- ❑ Meeting materials
- ❑ GIS data layers
- ❑ Chronologies

Baseline Conditions

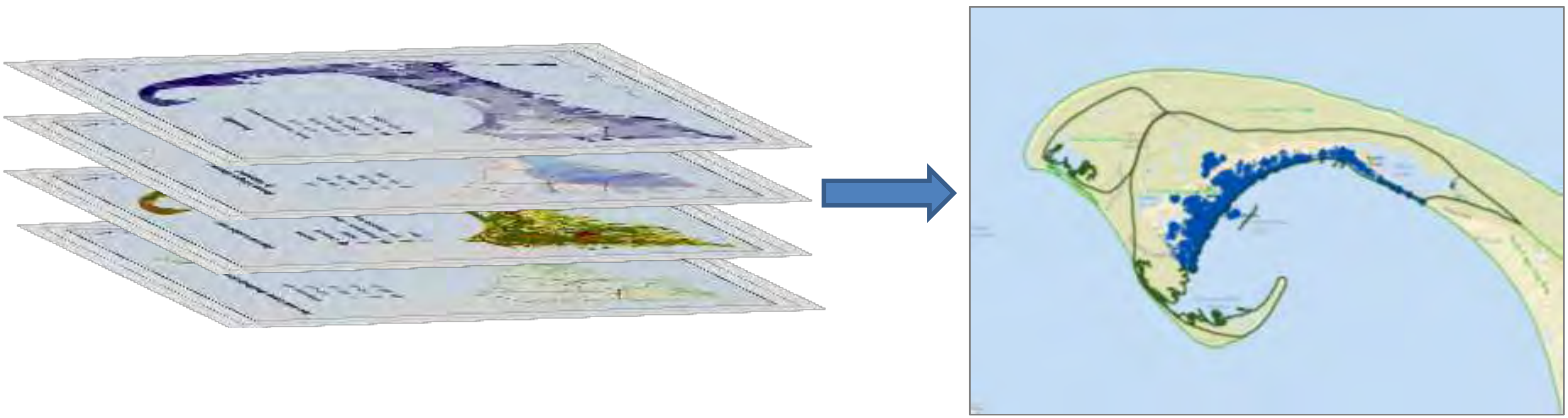
11 Working Group Meetings: Sept 18-27

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

208 Planning Process

Baseline Conditions	Technology Options Review	Watershed Scenarios
11 Working Group Meetings: Sept 18-27	11 Working Group Meetings: Oct 21-Nov 5	11 Working Group Meetings: Dec 2-11



Baseline Conditions

11 Working Group Meetings: Sept 18-27

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Watershed Scenarios

11 Working Group Meetings: Dec 2-11

Watershed Event

November 13

Center for the Arts Dennis

Wrap up of Cape2O: ur in charge!

Summary of planning process to date

Outline of second 6 months of the 208 planning process

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Goal of Today's Meeting:

To develop a shared understanding of the potential technologies and approaches identified to date, and the benefits and limitations of each; to explore the environmental, economic, and community impacts of a range of categories of solutions; and to identify priorities and considerations for applying technologies and approaches to remediate water quality impairments in your watershed.

Technologies and Approaches for Improving Water Quality

Technologies and Approaches for Improving Water Quality

- The Fact Sheets present various information on the technologies being considered.
- Additional information is contained on the Technology Matrix including the following:
  - Site Requirements
  - Construction, Project and Operation and Maintenance Costs
  - Reference Information
  - Regulatory Comments
- Input from the Stakeholders is requested regarding a technology's Public Acceptance

Technologies and Approaches for Improving Water Quality

- Comprehensive analysis of nutrient control technologies and approaches.

Technologies and Approaches for Improving Water Quality

- ❑ Comprehensive analysis of nutrient control technologies and approaches.
- ❑ Not all of the technologies and approaches will be applicable to Cape Cod.

Technologies and Approaches for Improving Water Quality

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- Not all of the technologies and approaches will be applicable to Cape Cod.
- Some technologies are so promising that we should identify them for demonstration and pilot projects.

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- Workshop 3 will embark on hands on problem solving in each watershed to meet target load reductions.

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- Workshop 3 will embark on hands on problem solving in each watershed to meet target load reductions.
- Certain technologies or approaches will be effective at **preventing** nutrients from entering the water body. Others will be effective at **reducing** or **remediating** nutrients that are already in the groundwater or water body.

Technologies and Approaches for Improving Water Quality

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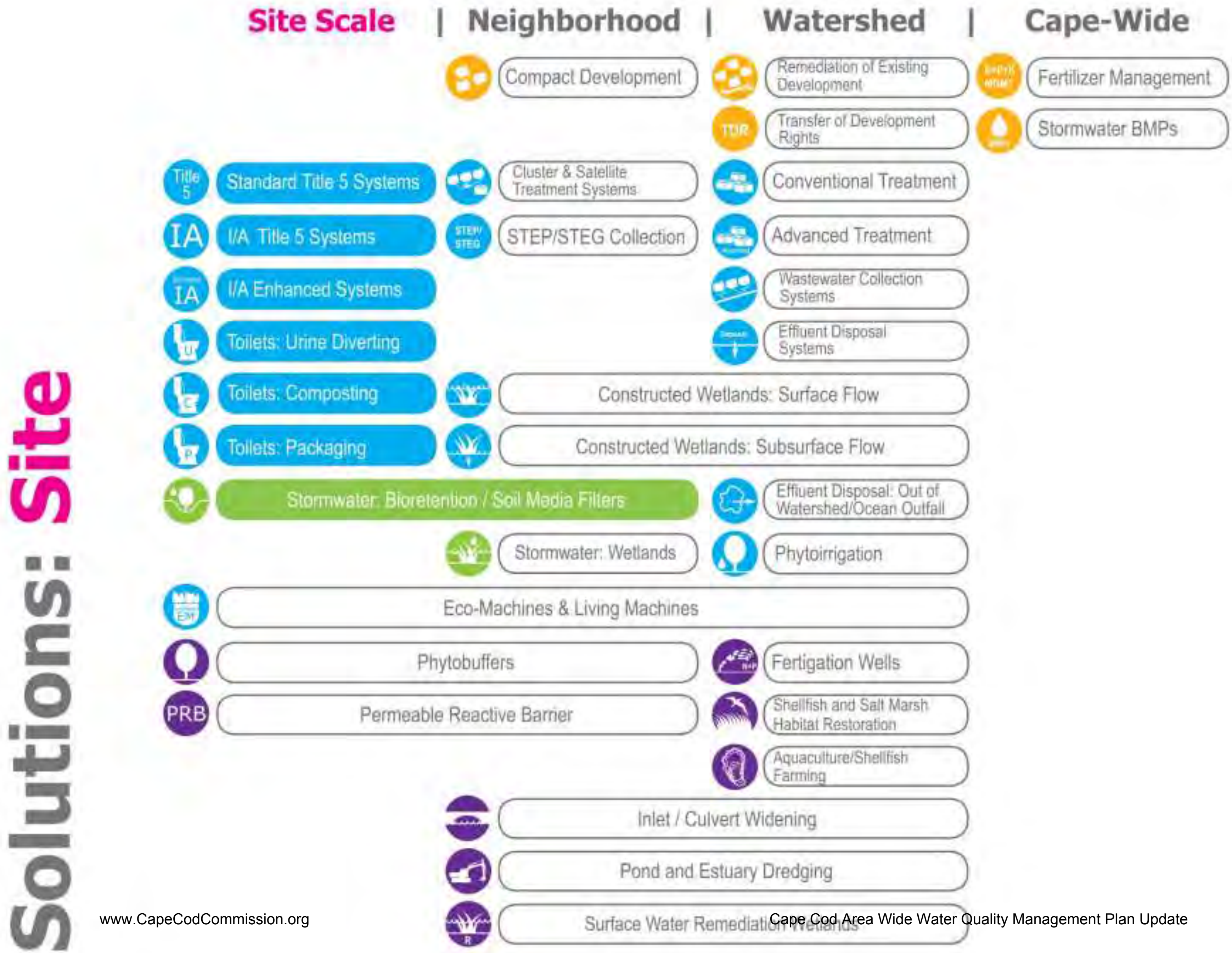
- Workshop 3 will embark on hands on problem solving in each watershed to meet target load reductions.
- Certain technologies or approaches will be effective at **preventing** nutrients from entering the water body. Others will be effective at **reducing** or **remediating** nutrients that are already in the groundwater or water body.
- Regulatory programs can address nutrient controls for both existing development and future development.


Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
IA
I/A Title 5 Systems
STEP/STEG
STEP/STEG Collection
Advanced Treatment
IA
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
EM
Eco-Machines & Living Machines
Phytobuffers
Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands
Solutions


Solutions: Site
Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
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Toilets: Urine Diverting
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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
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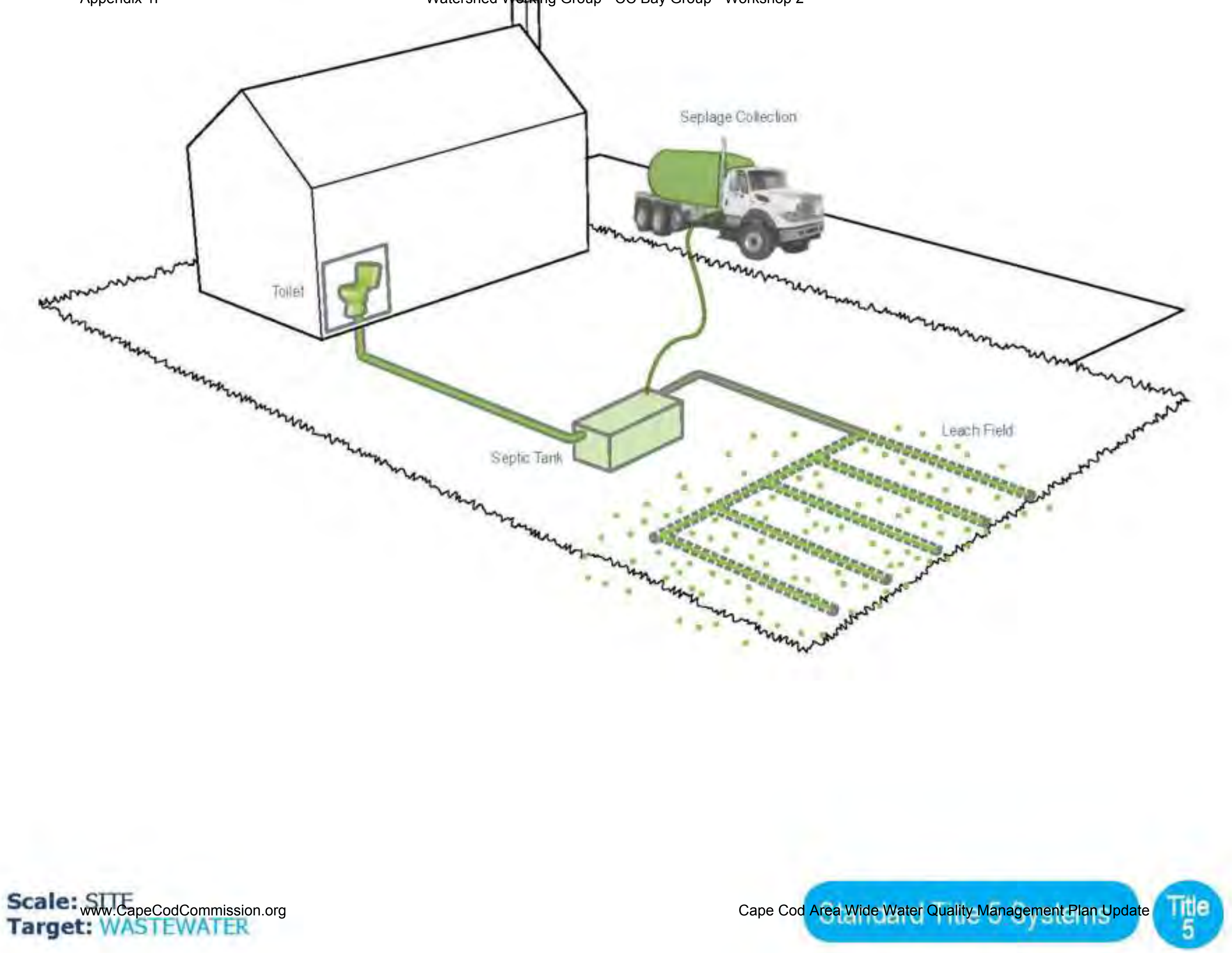
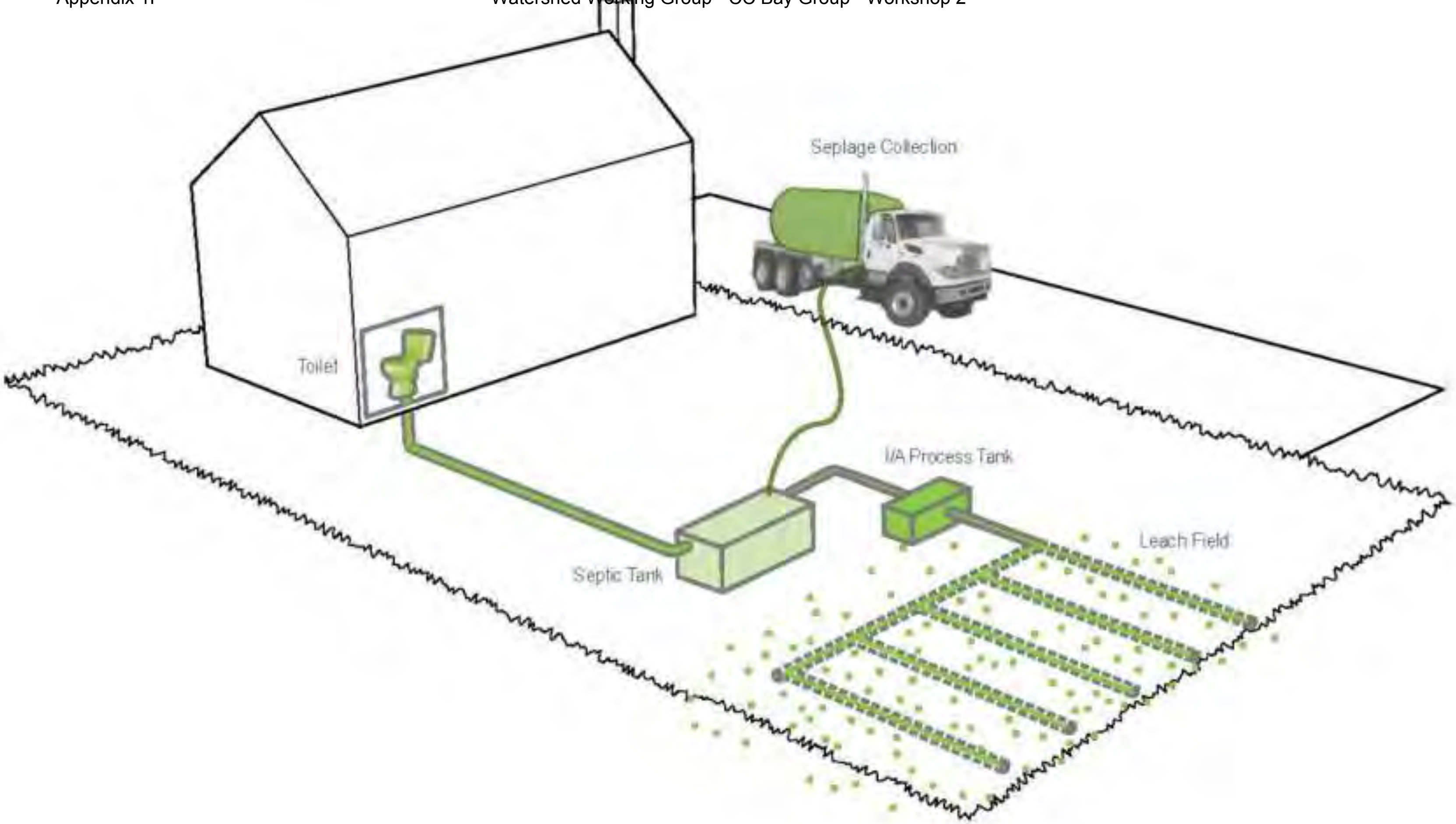
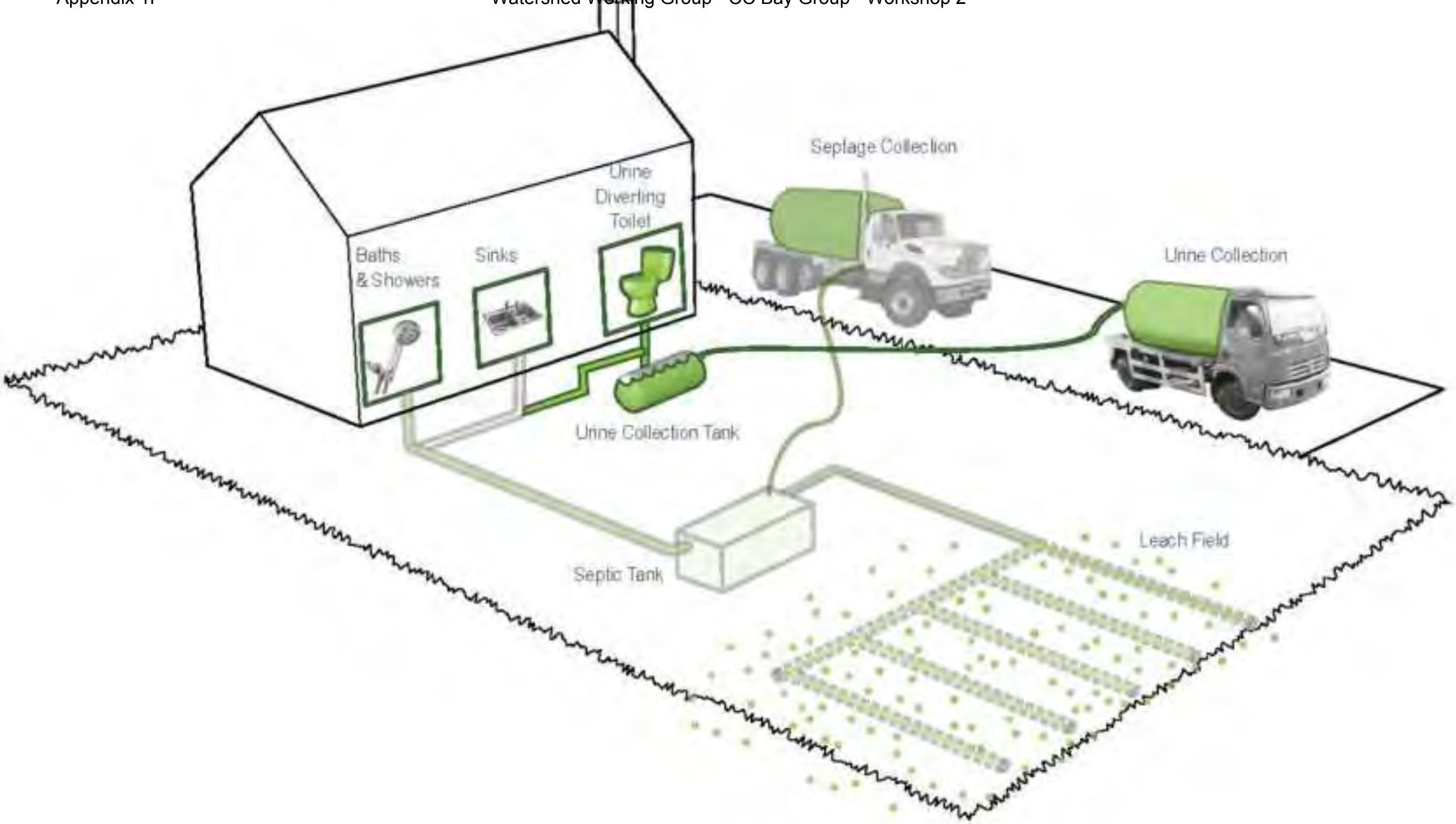
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands


Septage Collection
Toilet
Septic Tank
Leach Field
Scale: SITE
Target: WASTEWATER
Standard Title 5 Systems
Title 5



Scale: SITE
Target: WASTEWATER

I/A Title 5 Systems



Scale: SITE
Target: WASTEWATER

Toilets: Urine Diverting

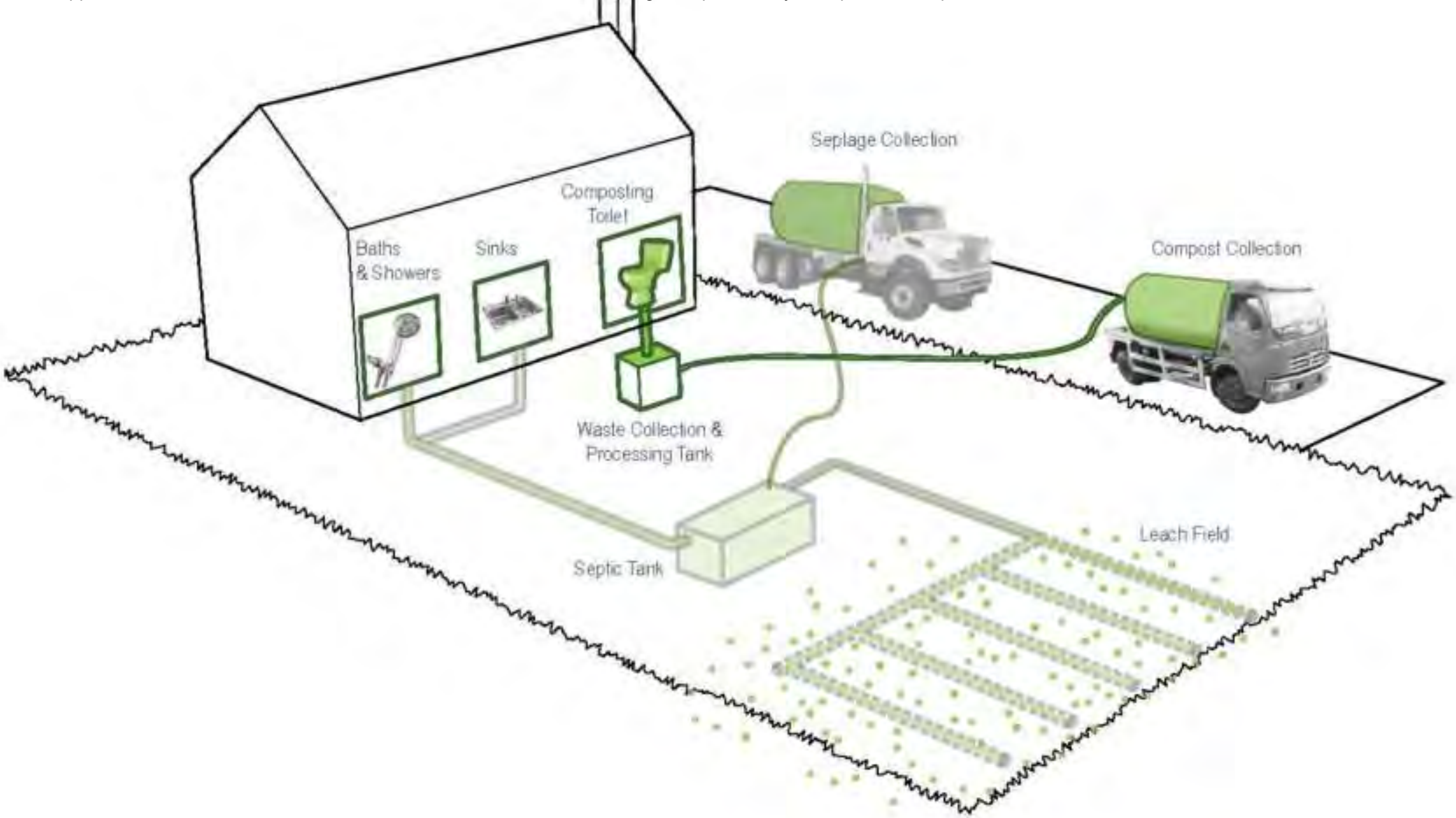
Waterless
Urinal

IBC container
(220 gallons)

40" x 40" x48"

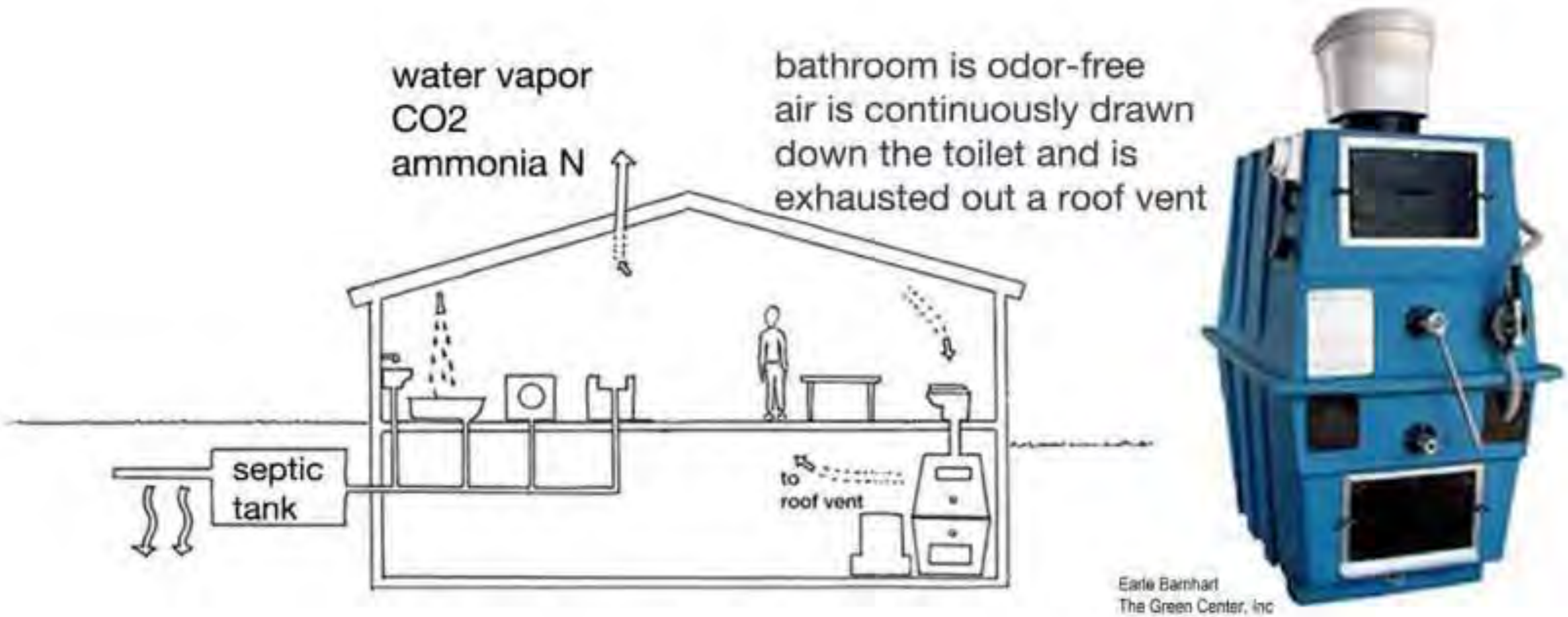
Source: Earle Barnhart, The Green Center Inc. and Horsley-Witten Group Inc.

Toilets: Urine Diverting



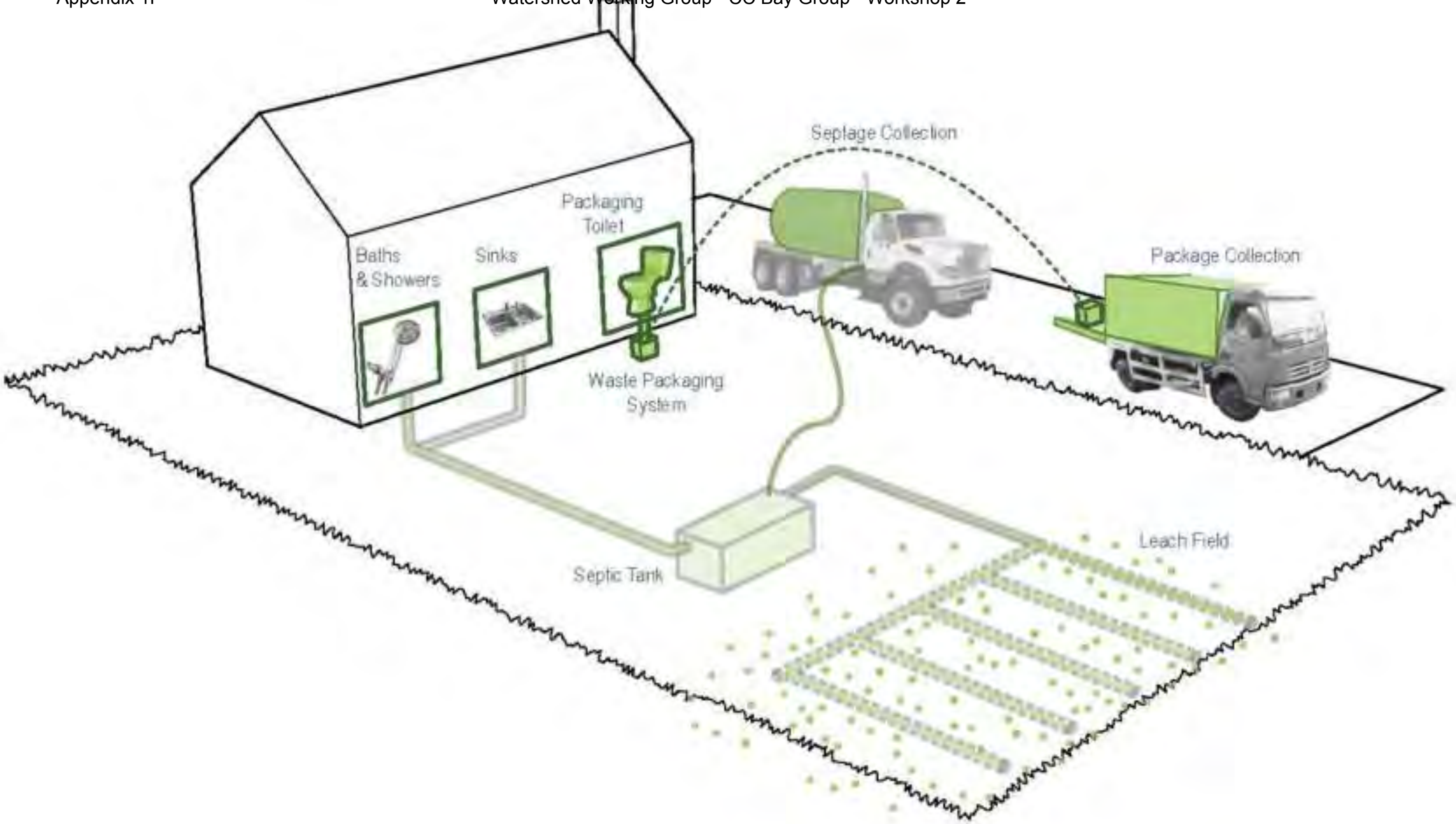
Scale: SITE
Target: WASTEWATER

Toilets: Composting



Source: Earle Barnhart, The Green Center Inc.

Toilets: Composting



Scale: SITE
Target: WASTEWATER

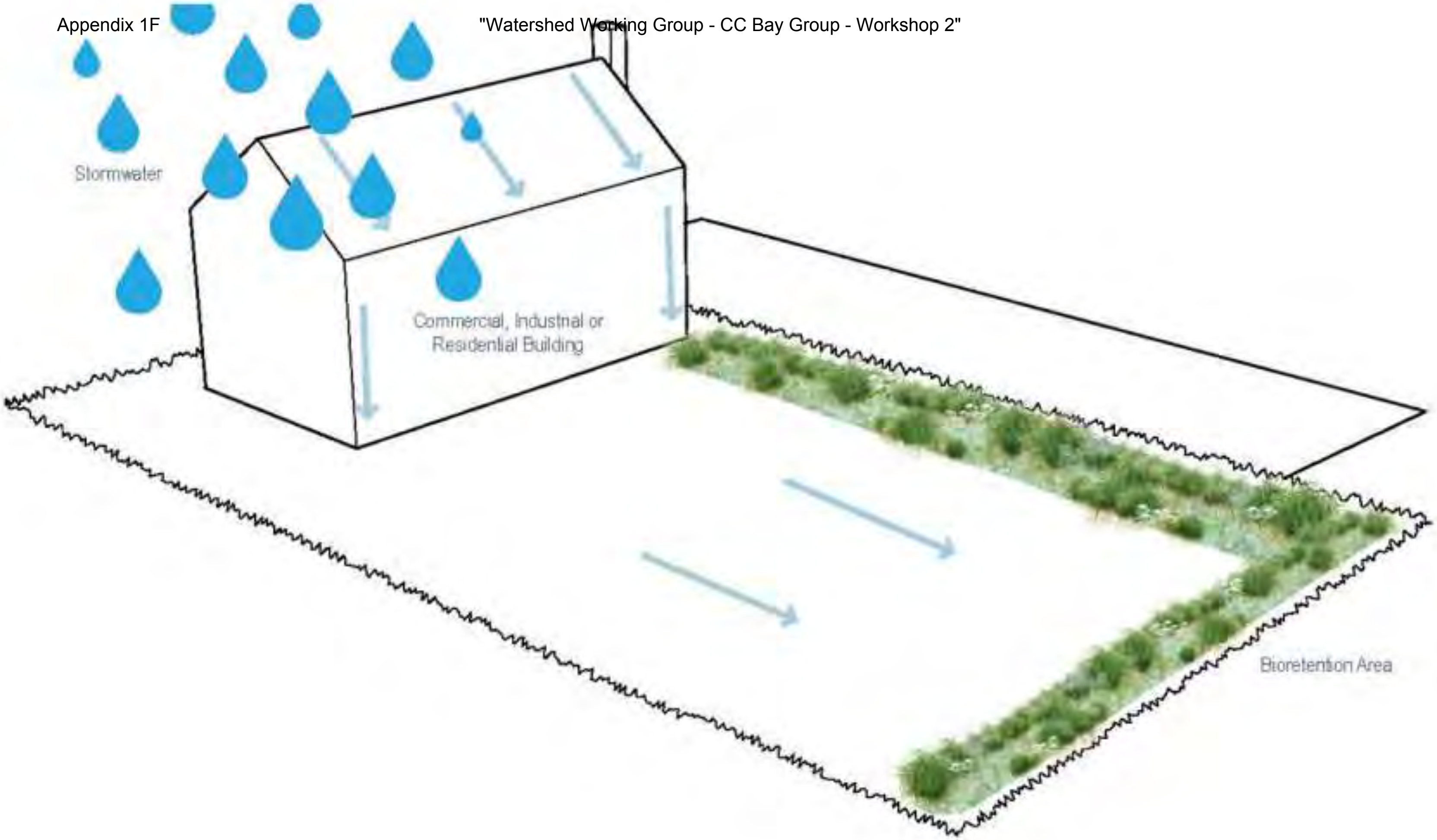
Toilets: Packaging

PACTO®

LOOWATT

Source: Earle Barnhart, The Green Center Inc.

Toilets: Packaging



Scale: SITE
Target: STORMWATER

Stormwater Bioretention / Soil Media Filters

Precedent: 12th Ave. Stormwater Project, Portland, OR
Source: City of Portland

Stormwater: Bioretention / Soil Media Filters

Rain Gardens


Site Scale | Neighborhood | Watershed | Cape-Wide
Solutions: Neighborhood
Compact Development
Remediation of Existing Development
Fertilizer Management
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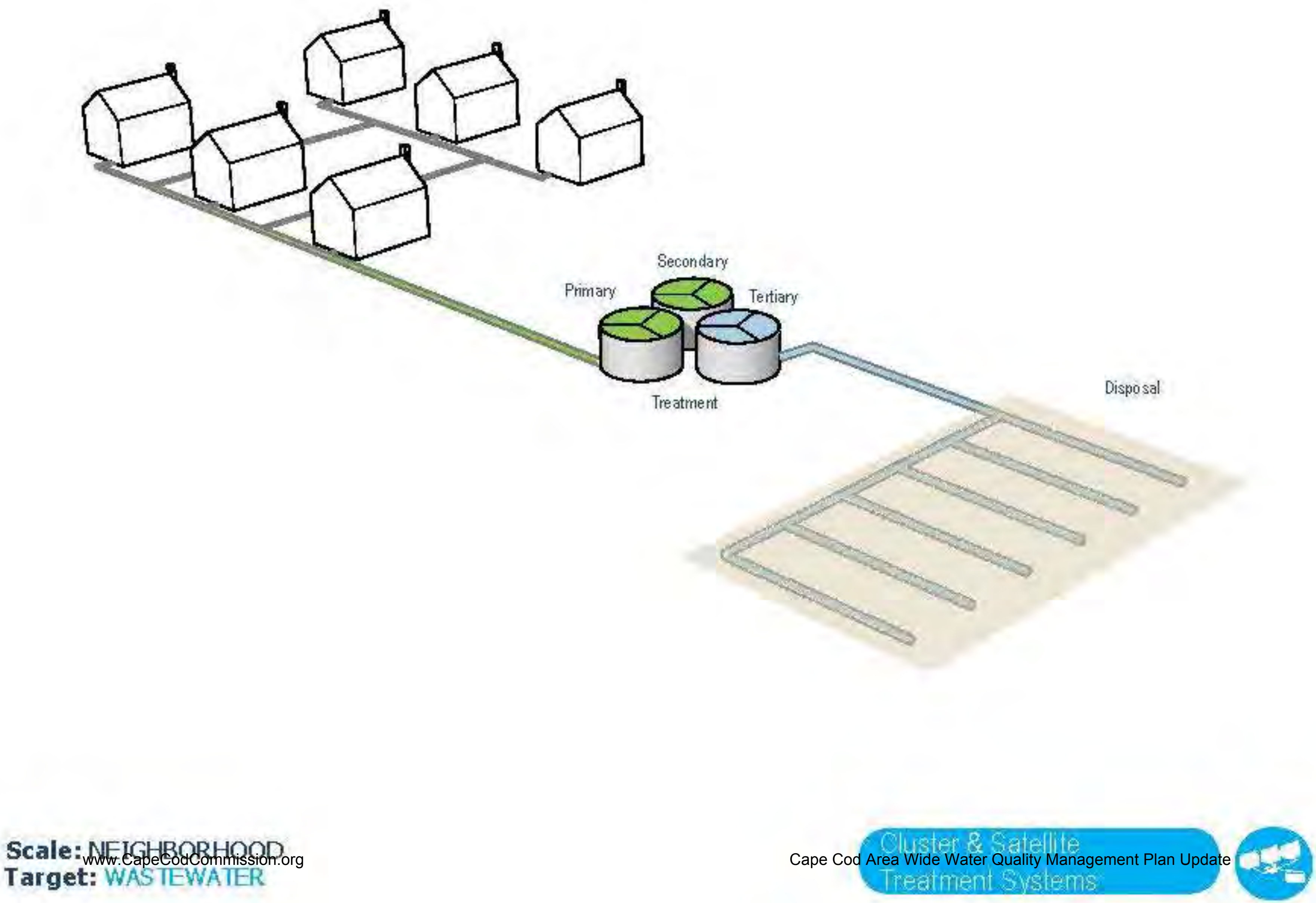
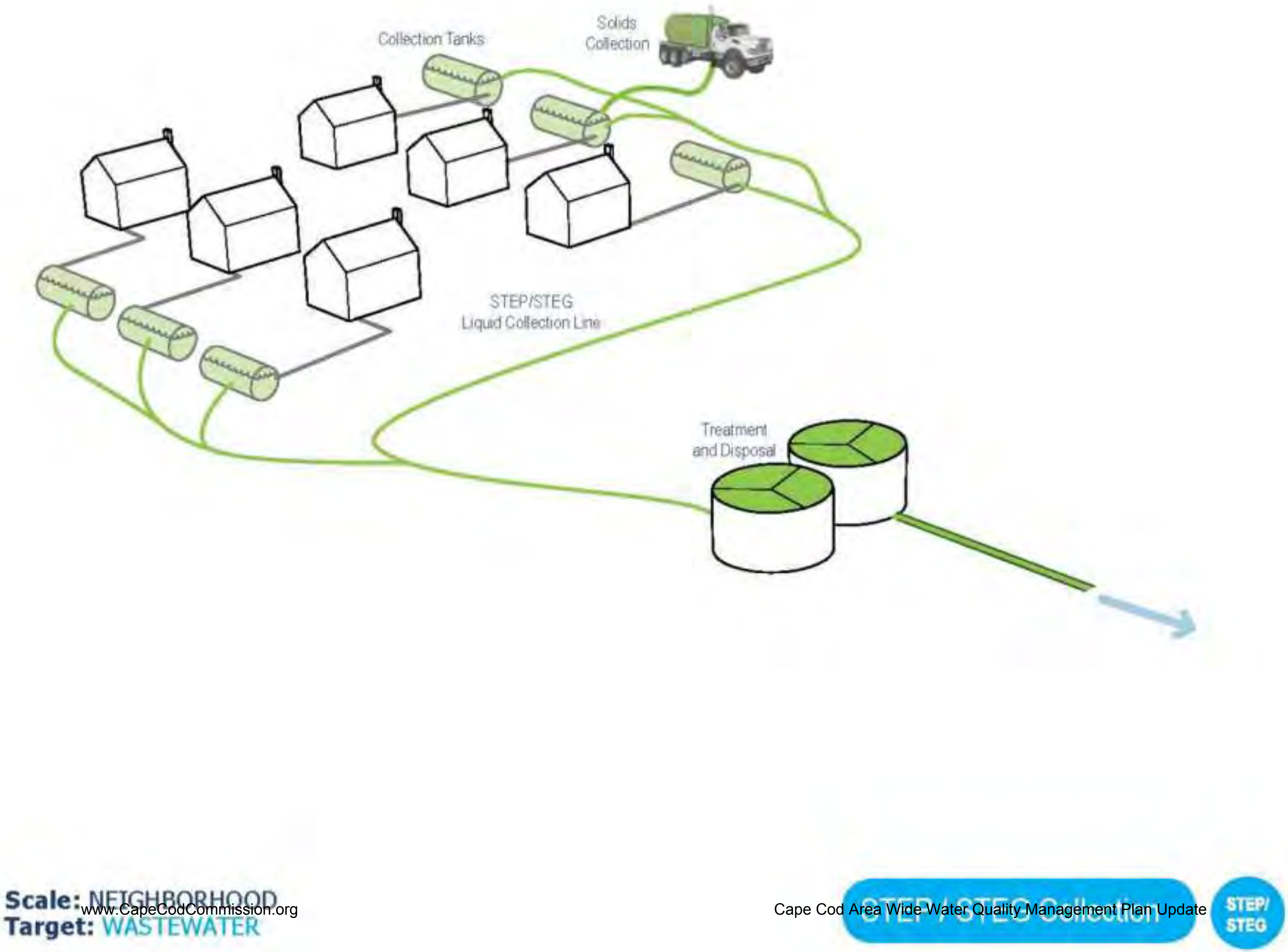
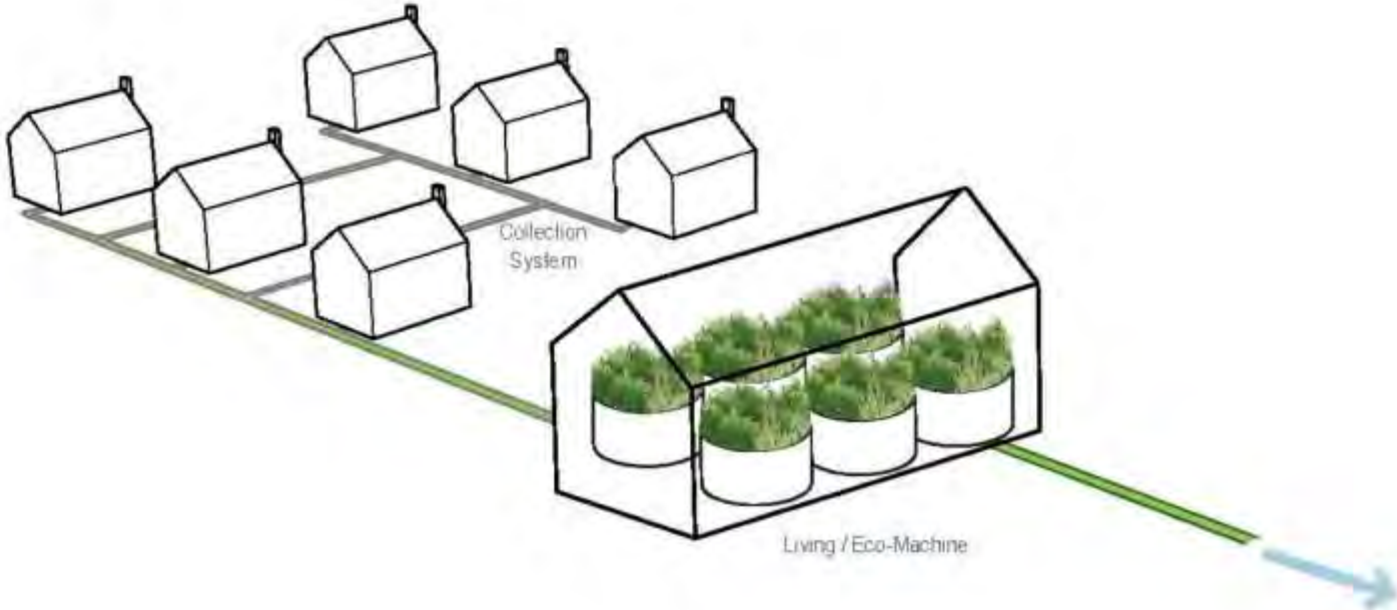
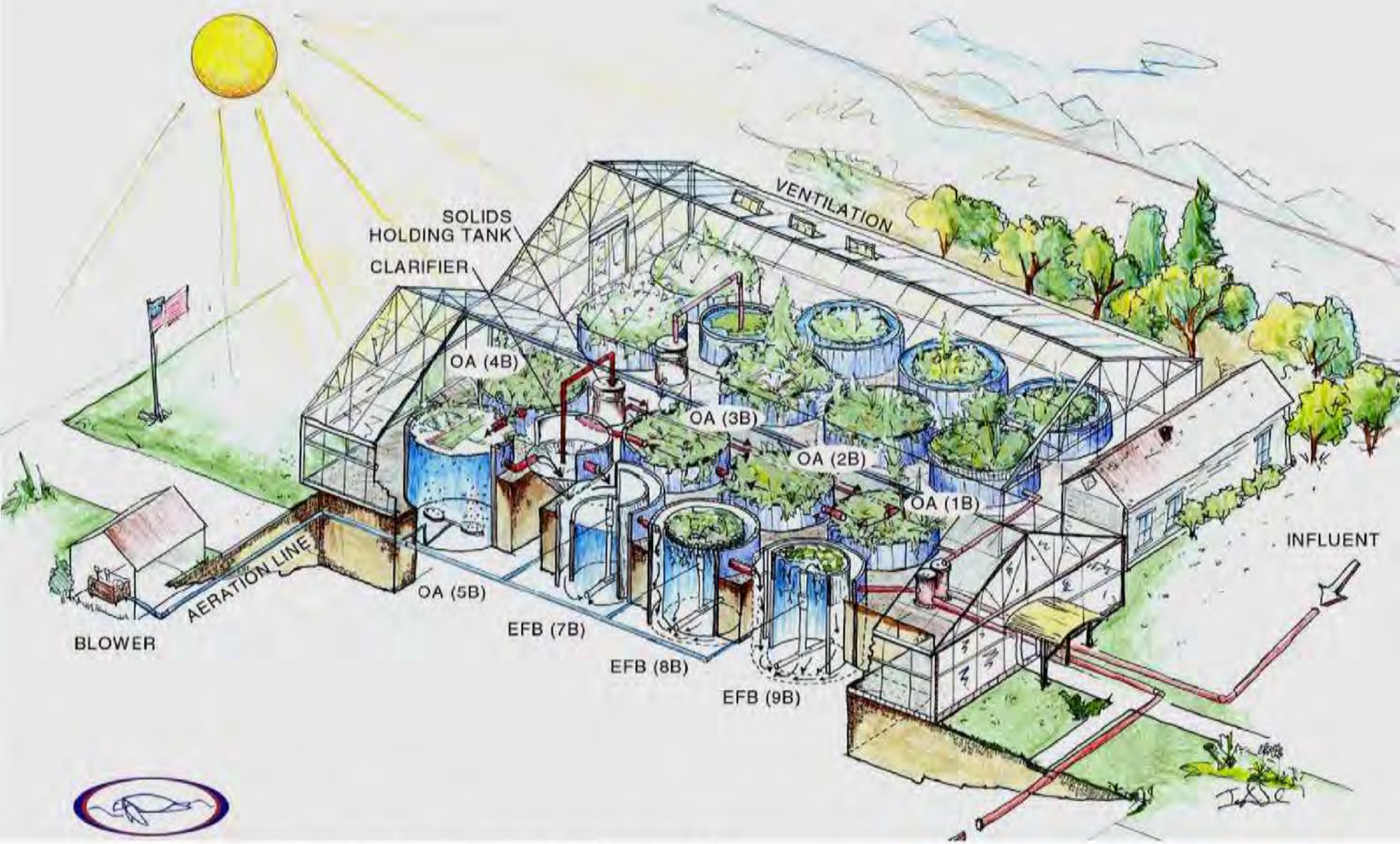

Secondary
Primary
Tertiary
Treatment
Disposal
Scale: NEIGHBORHOOD
Target: WASTEWATER
Cluster & Satellite
Treatment Systems


Collection Tanks
Solids
Collection
STEP/STEG
Liquid Collection Line
Treatment
and Disposal
Scale: NEIGHBORHOOD
Target: WASTEWATER
STEP / STEG Collection
STEP/
STEG



Scale: NEIGHBORHOOD
Target: WASTEWATER

Eco-Machines and Living Machines



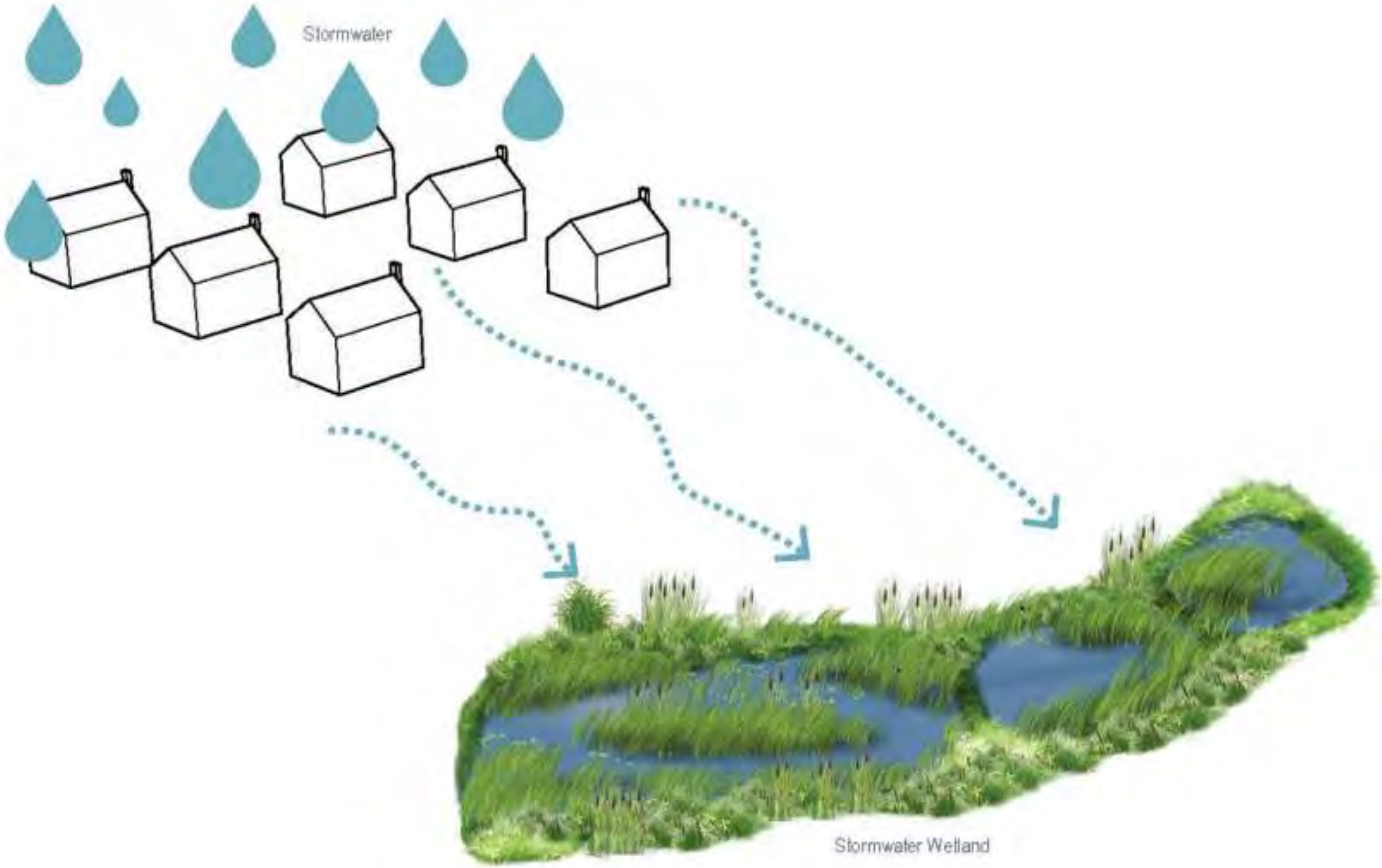
Precedent: Living Machine, South Burlington, VT

Source: Todd Ecological

Eco-Machines and Living Machines

Precedent: Living Machine - South Burlington, VT + Photobioreactors - Falmouth, MA
Source: Todd Ecological and Tom Cambareri

Eco-Machines and Living Machines

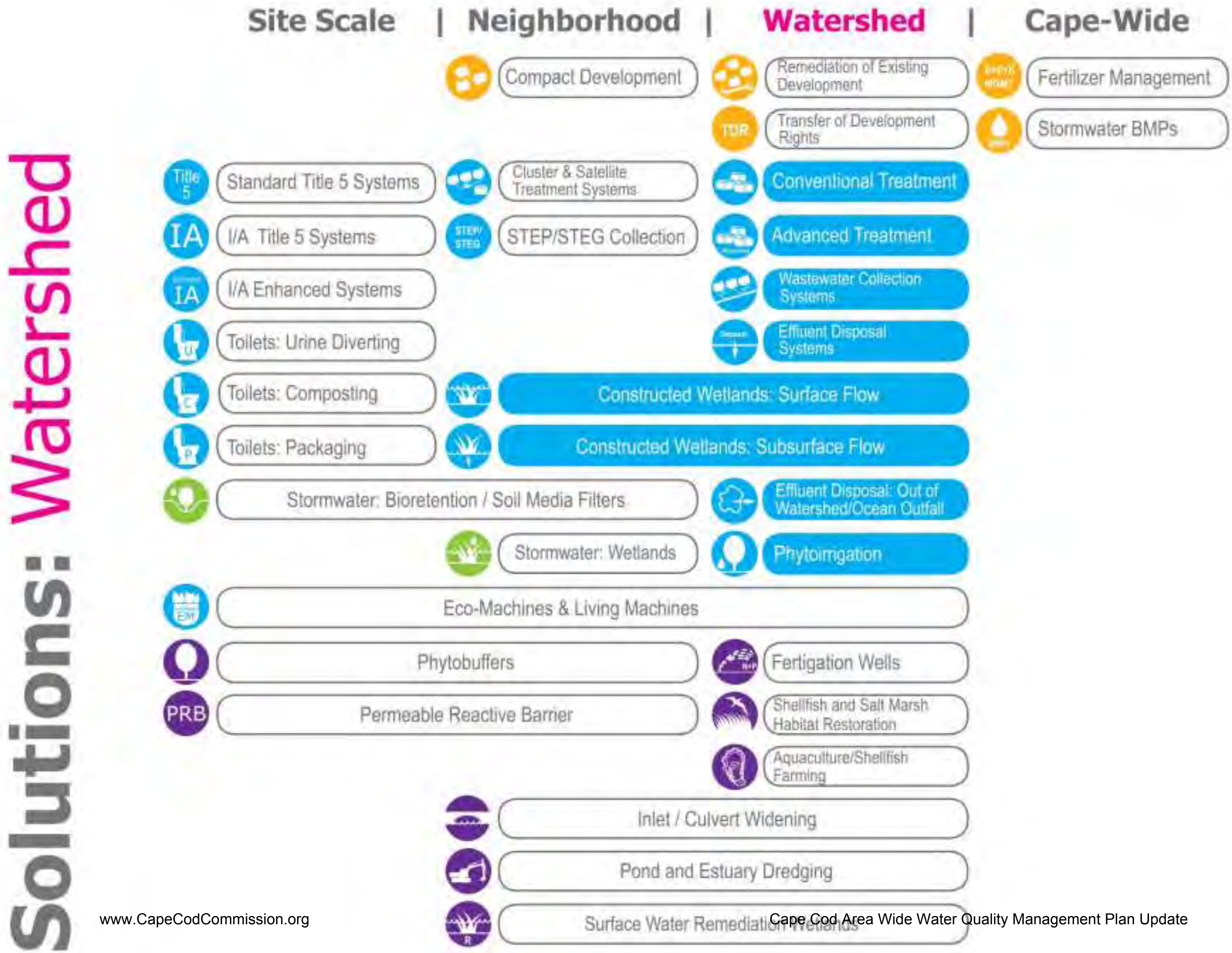


Scale: NEIGHBORHOOD
Target: STORMWATER

Stormwater Wetlands

Precedent: Missouri
Source: AECOM

Stormwater Wetlands


Solutions: Watershed
Site Scale | Neighborhood | Watershed | Cape-Wide
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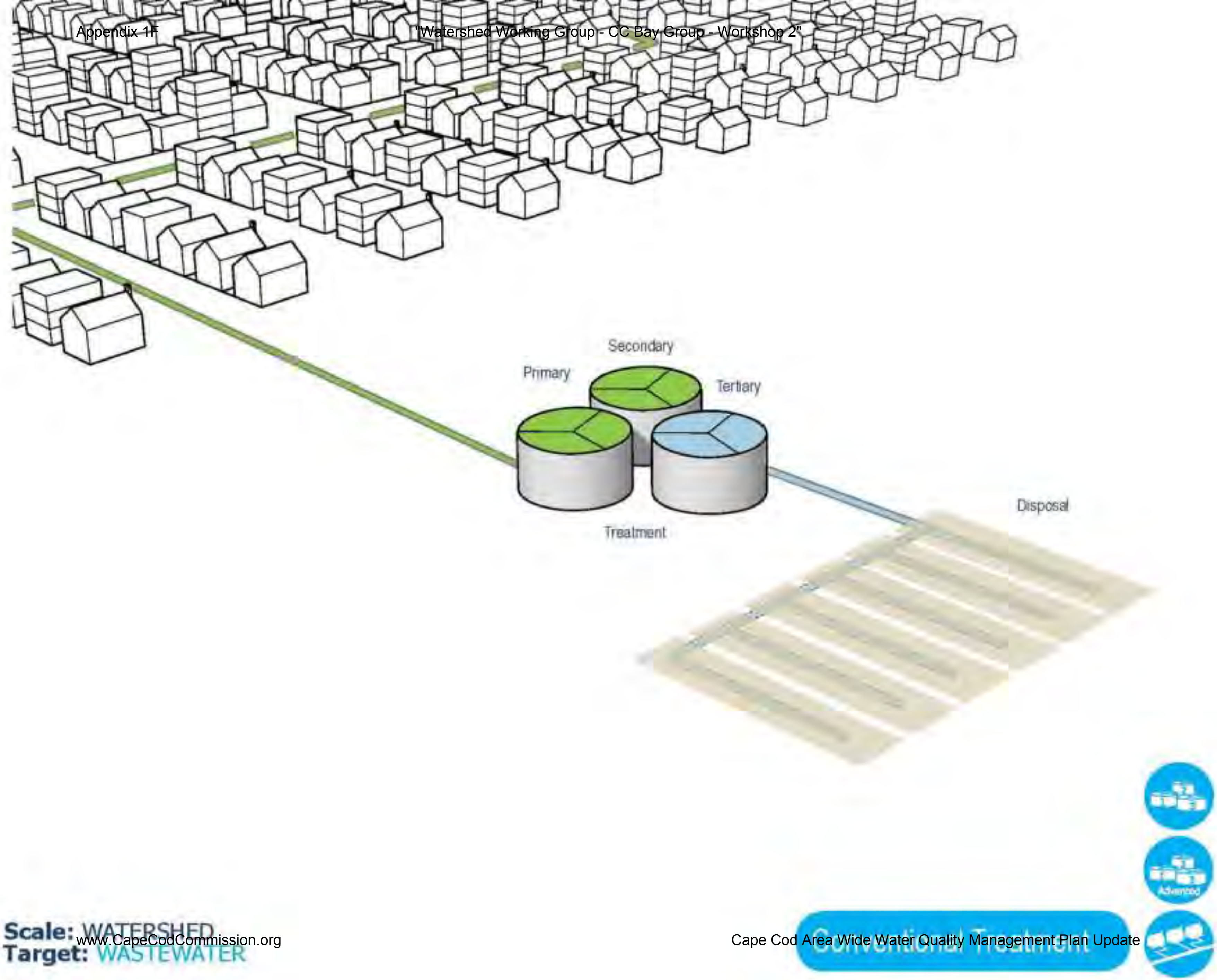
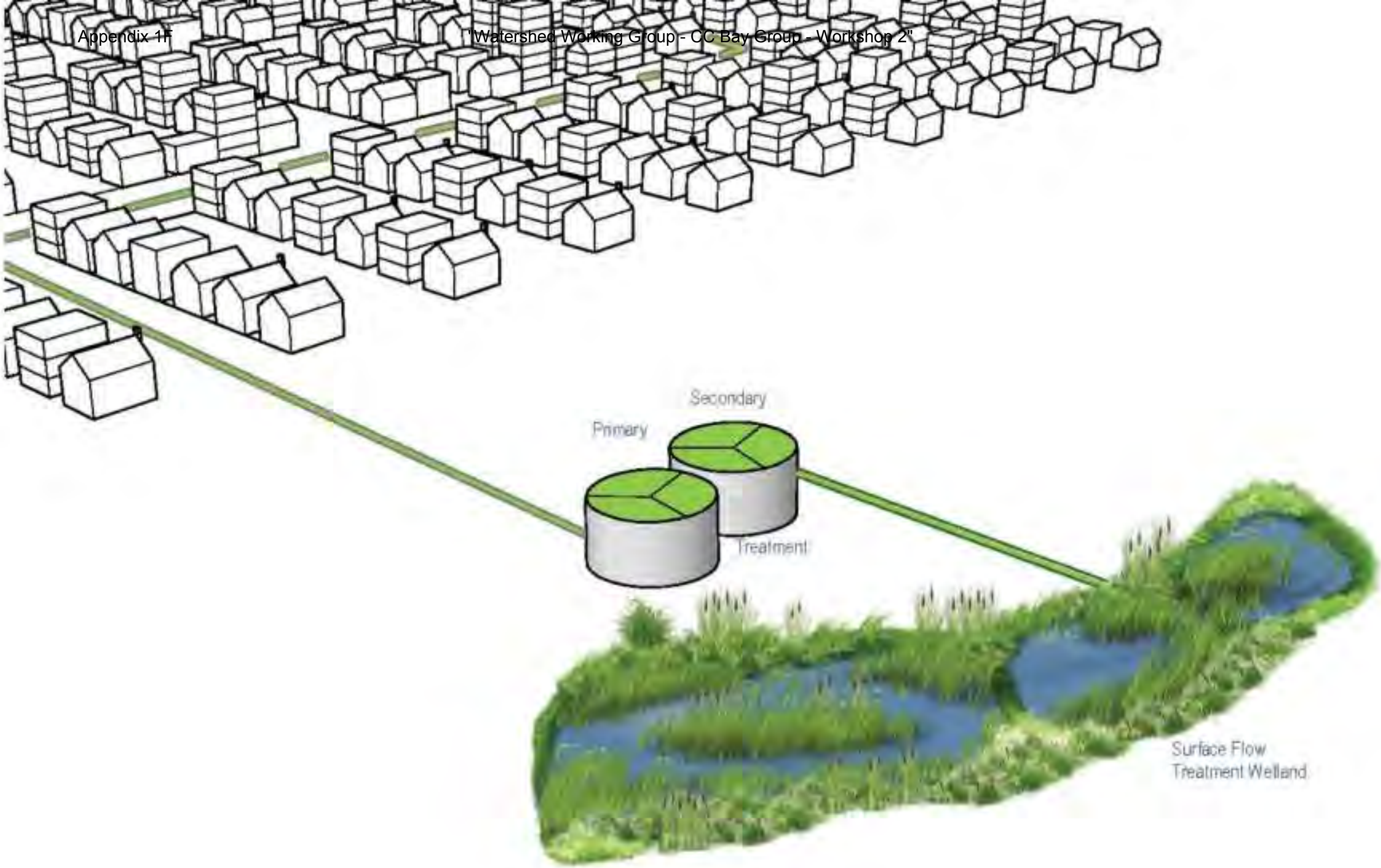
Constructed Wetlands: Subsurface Flow
Stormwater: Bioretention / Soil Media Filters
Effluent Disposal: Out of Watershed/Ocean Outfall
Stormwater: Wetlands
Phytoirrigation
EM
Eco-Machines & Living Machines
Phytobuffers
Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands


Secondary
Primary
Tertiary
Treatment
Disposal
Advanced
Conventional Treatment
Scale: WATERSHED
Target: WASTEWATER

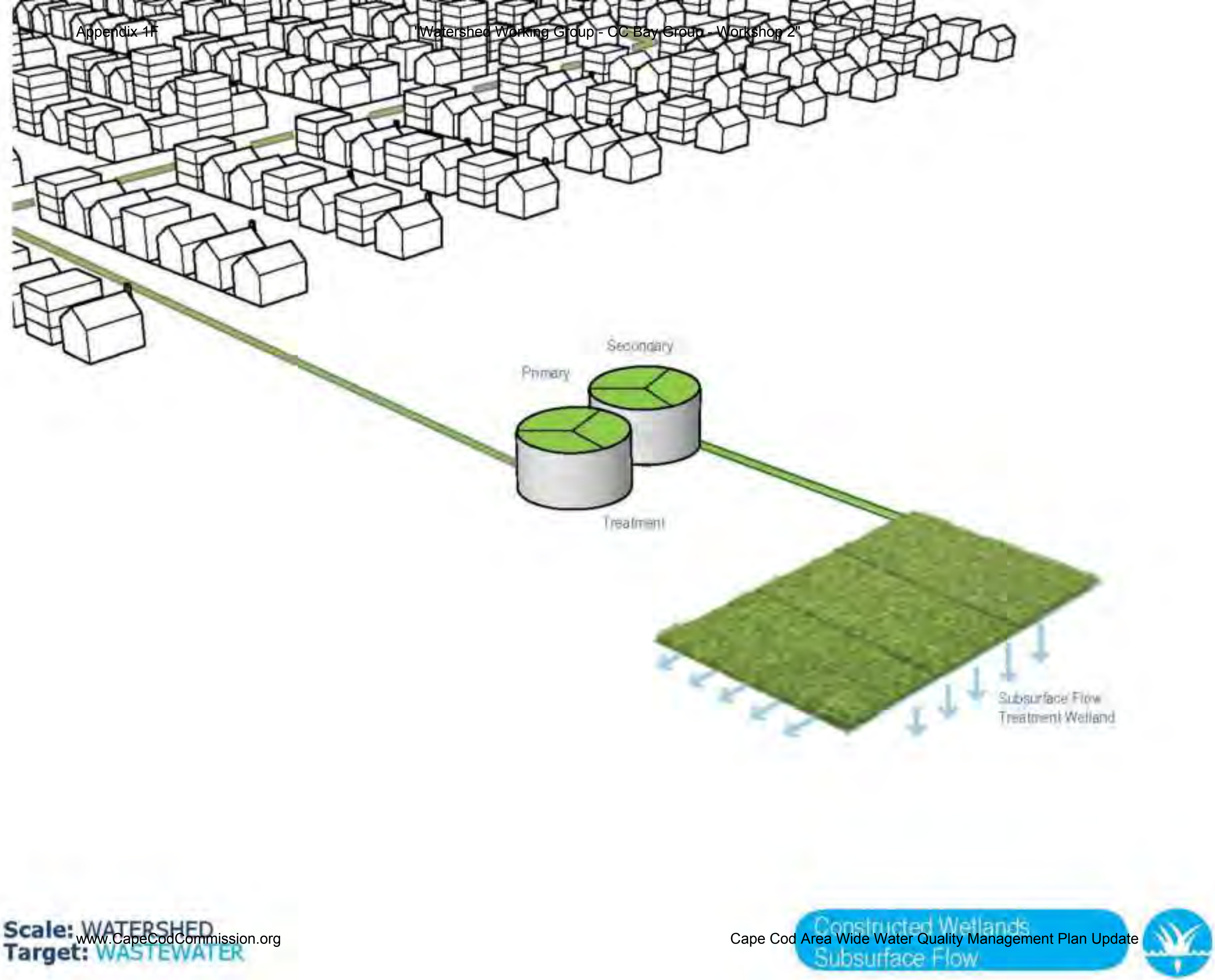


Scale: WATERSHED
Target: WASTEWATER

Constructed Wetlands
Surface Flow

Precedent: Talking Waters Garden - Albany, OR
Source: Kate Kennen

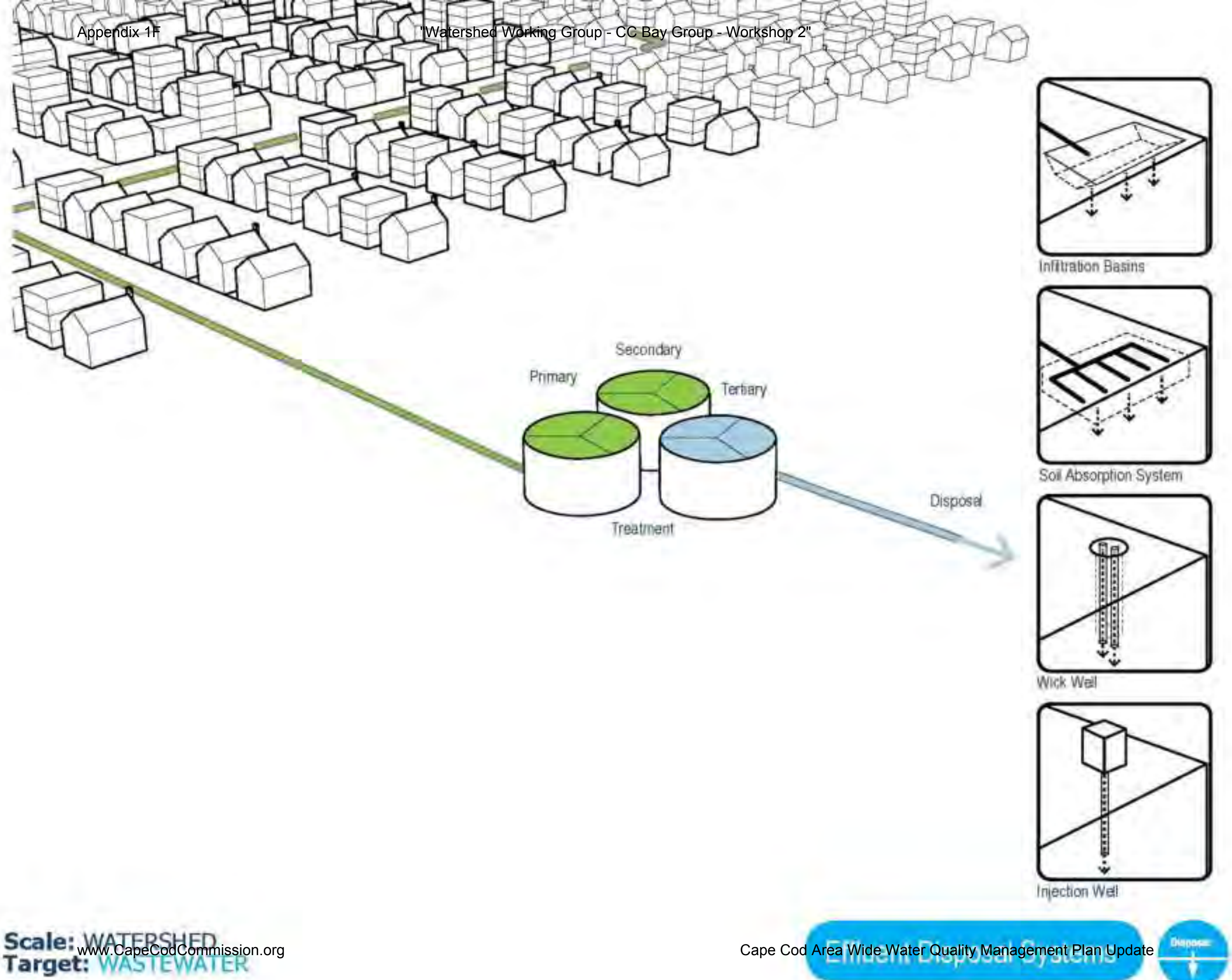
Constructed Wetlands: Surface Flow

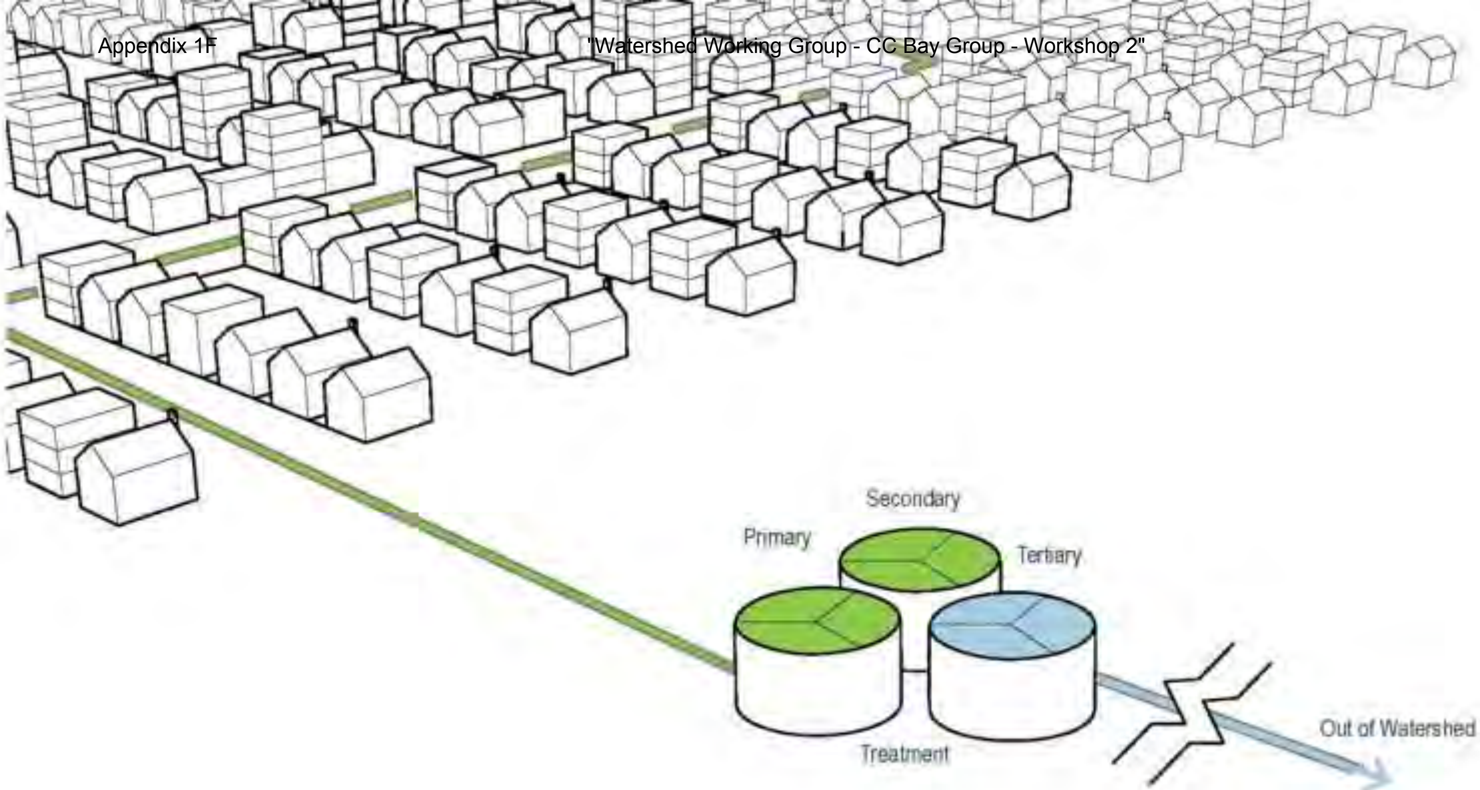

Secondary
Primary
Treatment
Subsurface Flow
Treatment Wetland
Scale: WATERSHED
Target: WASTEWATER
Constructed Wetlands
Subsurface Flow

Precedent: Koh Phi Phi Treatment Wetland, Thailand

Source: Hans Brix

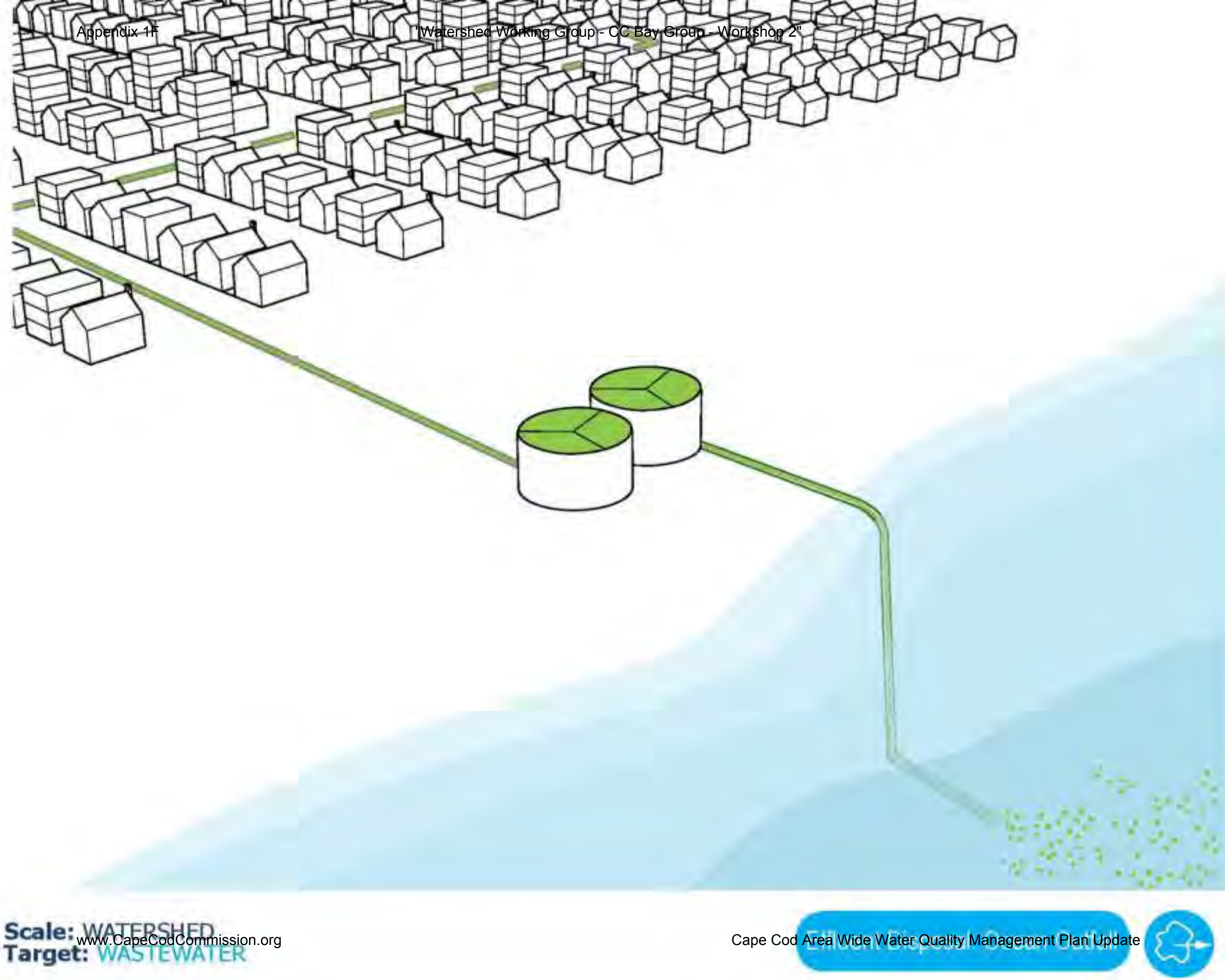
Constructed Wetlands: Subsurface Flow

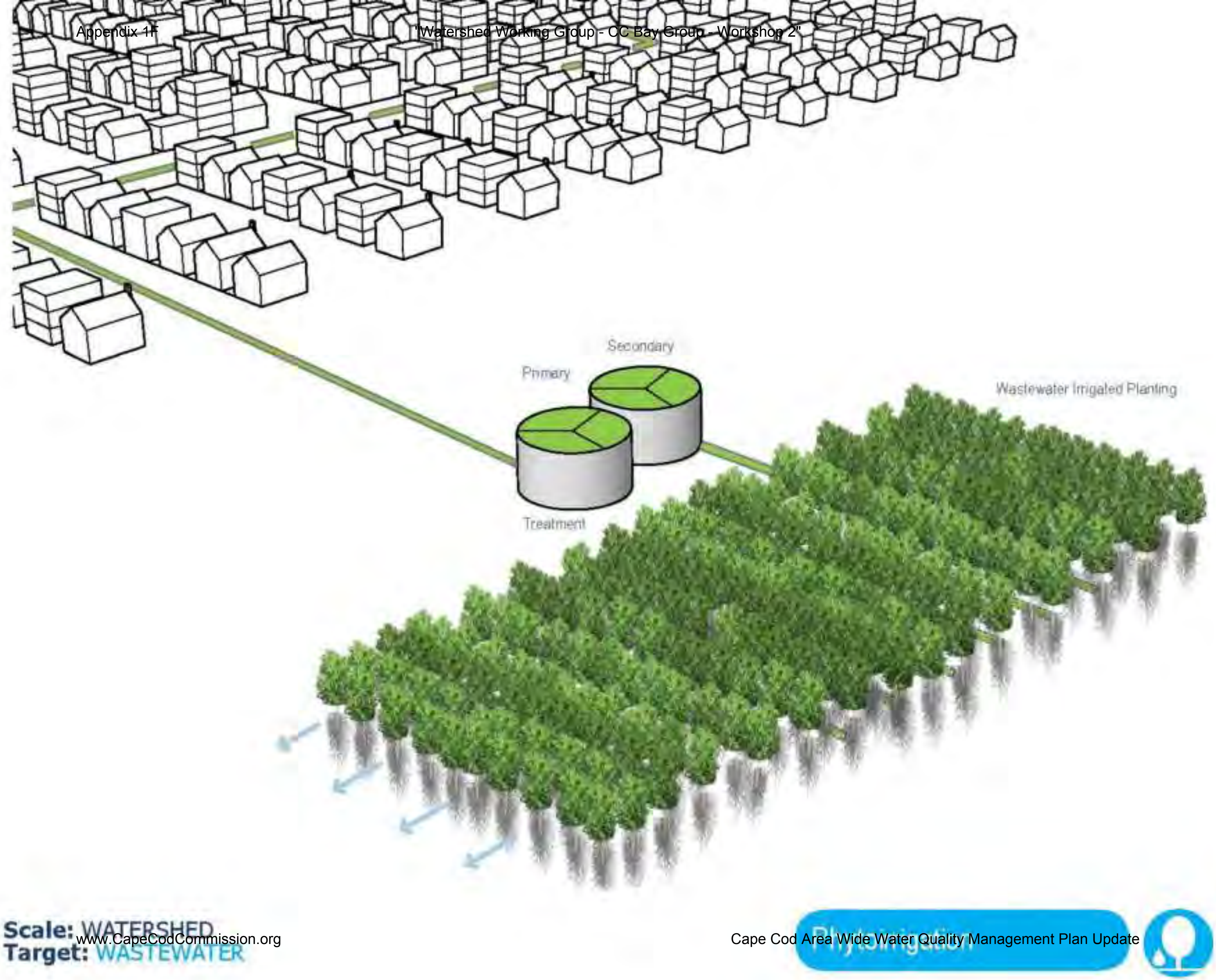

Secondary
Primary
Tertiary
Treatment
Disposal
Infiltration Basins
Soil Absorption System
Wick Well
Injection Well
Scale: WATERSHED
Target: WASTEWATER



Scale: WATERSHED
Target: WASTEWATER

Effluent Disposal: Out of Watershed


Scale: WATERSHED
Target: WASTEWATER


Secondary
Primary
Treatment
Wastewater Irrigated Planting
Scale: WATERSHED
Target: WASTEWATER

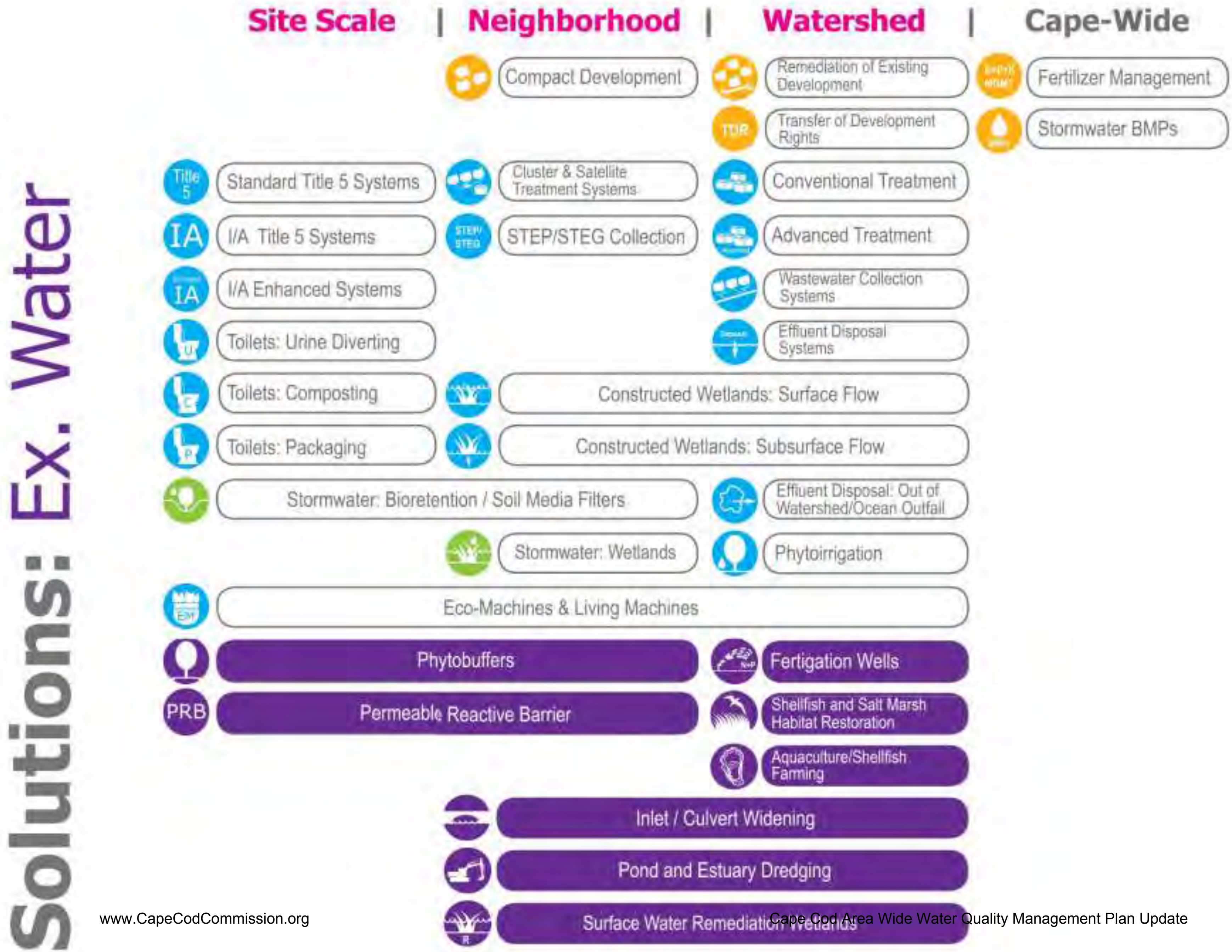
Precedent: Woodburn OR, Wastewater Treatment Facility

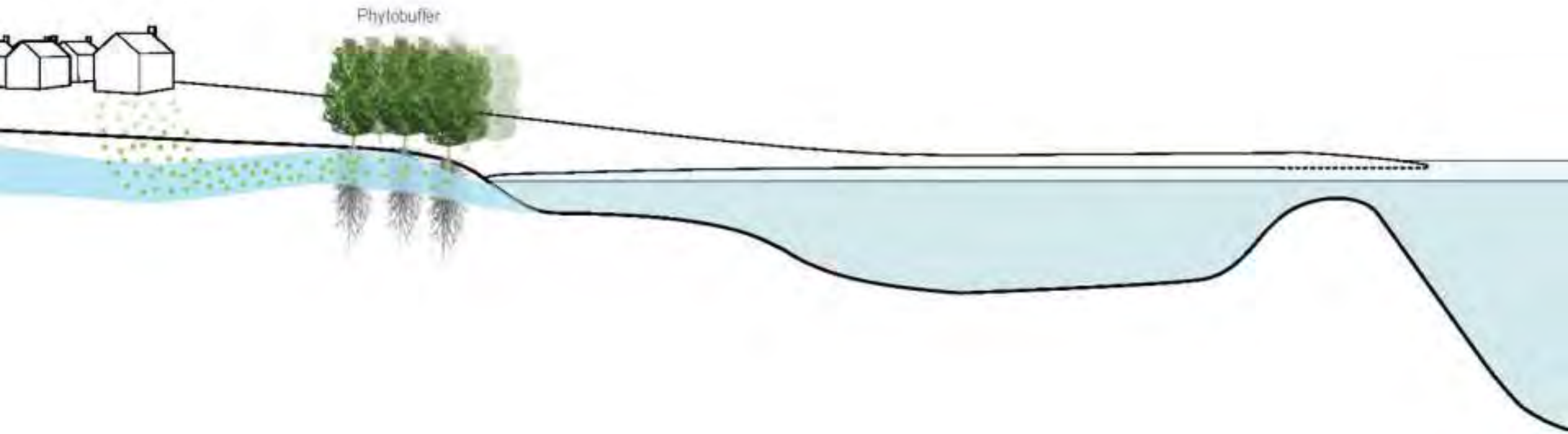
Source: CH2MHill

Phytoirrigation

Precedent: Woodburn OR, Wastewater Treatment Facility
Source: CH2MHill

Phytoirrigation


Site Scale | Neighborhood | Watershed | Cape-Wide
Solutions: Ex. Water
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
IA
I/A Title 5 Systems
STEP/STEG
STEP/STEG Collection
Advanced Treatment
IA
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
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands

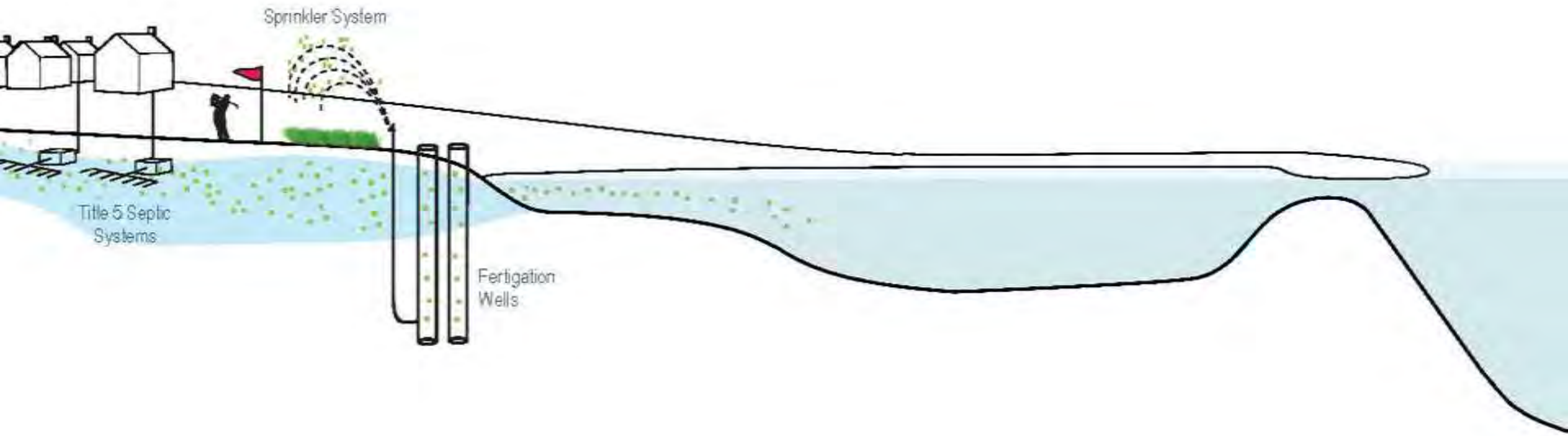


Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Phytobuffers

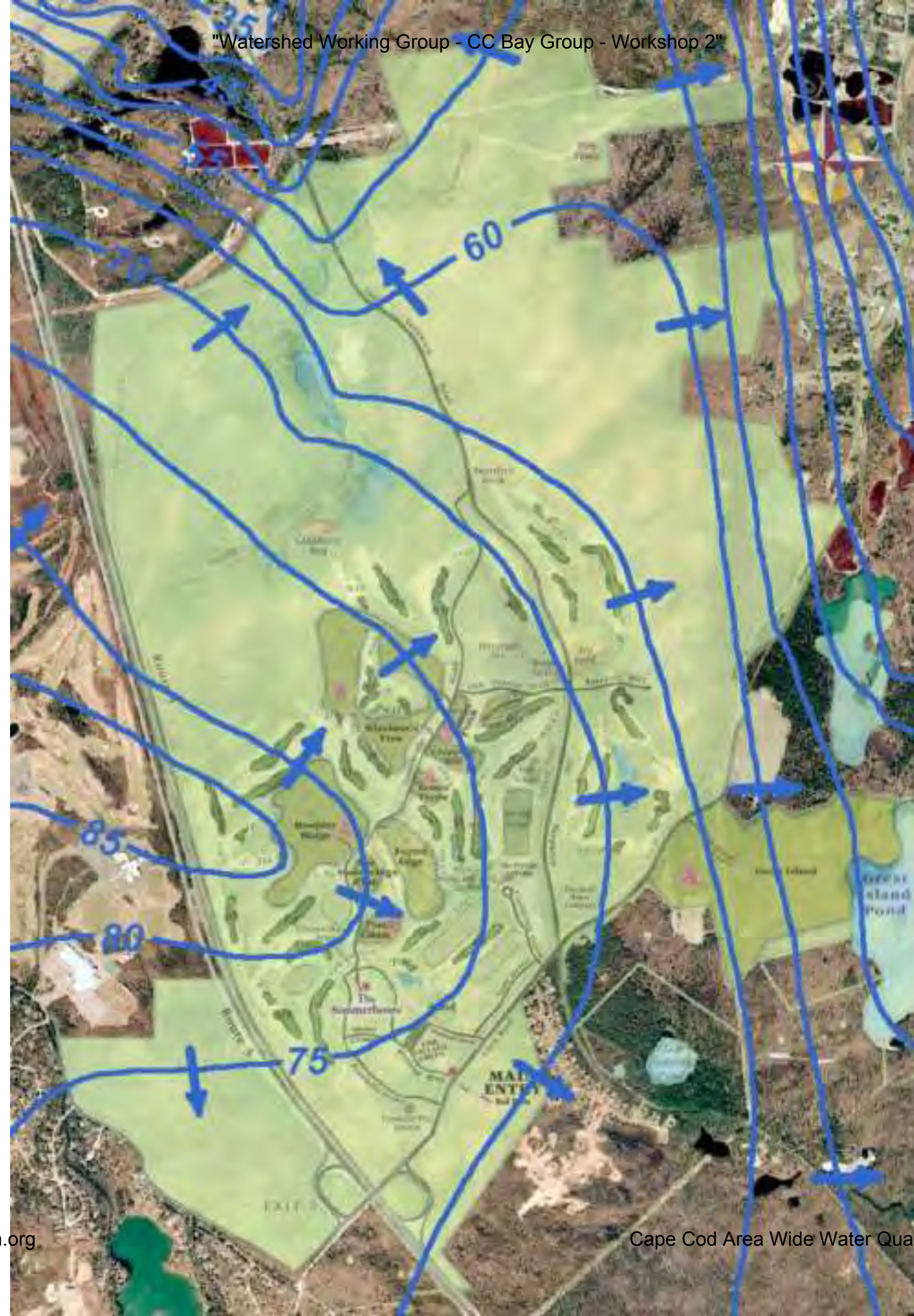
Precedent: Phytobuffer - Kavcee, WY
Source: Sand Creek Consultants

Phytobuffers

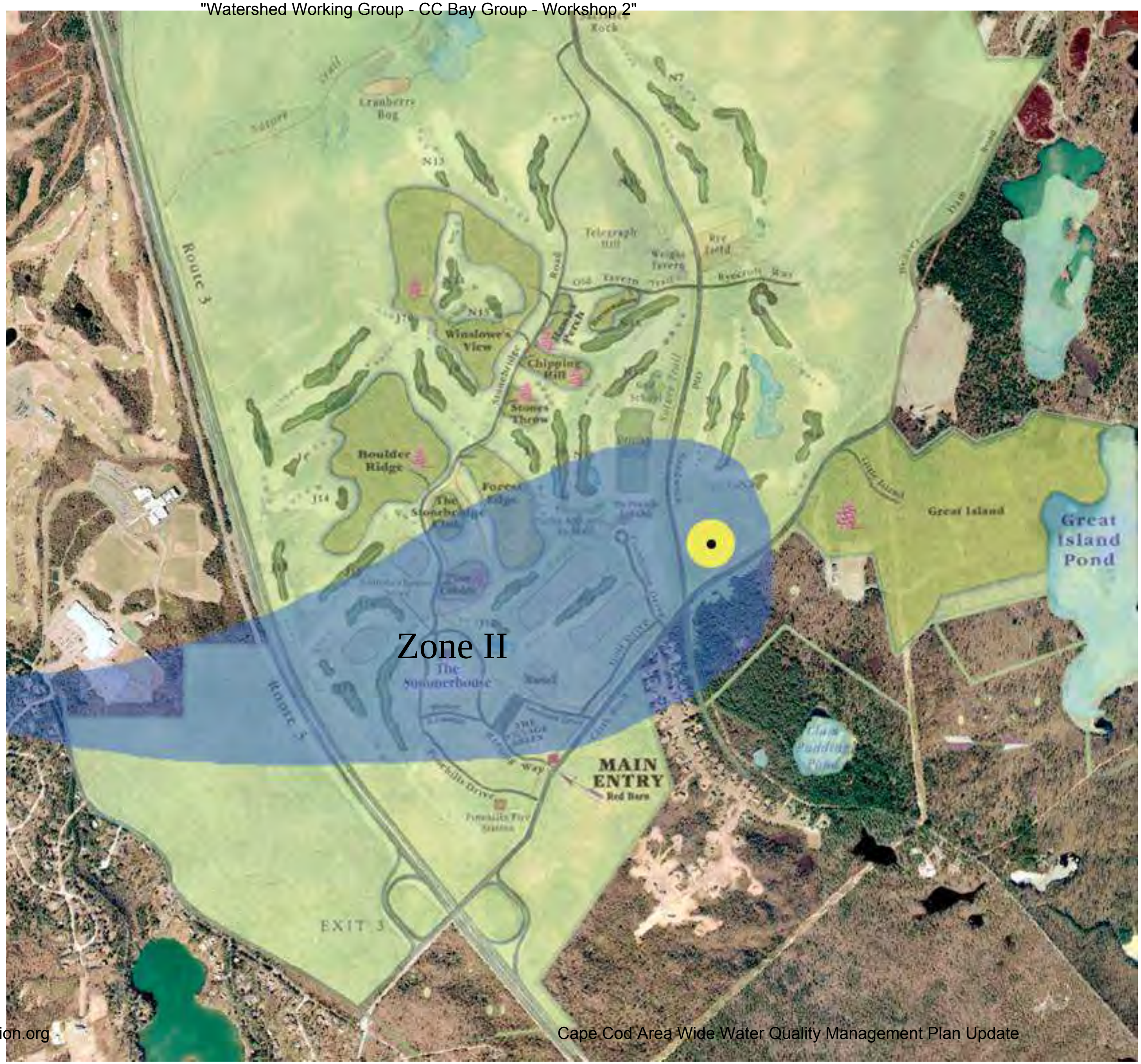


Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

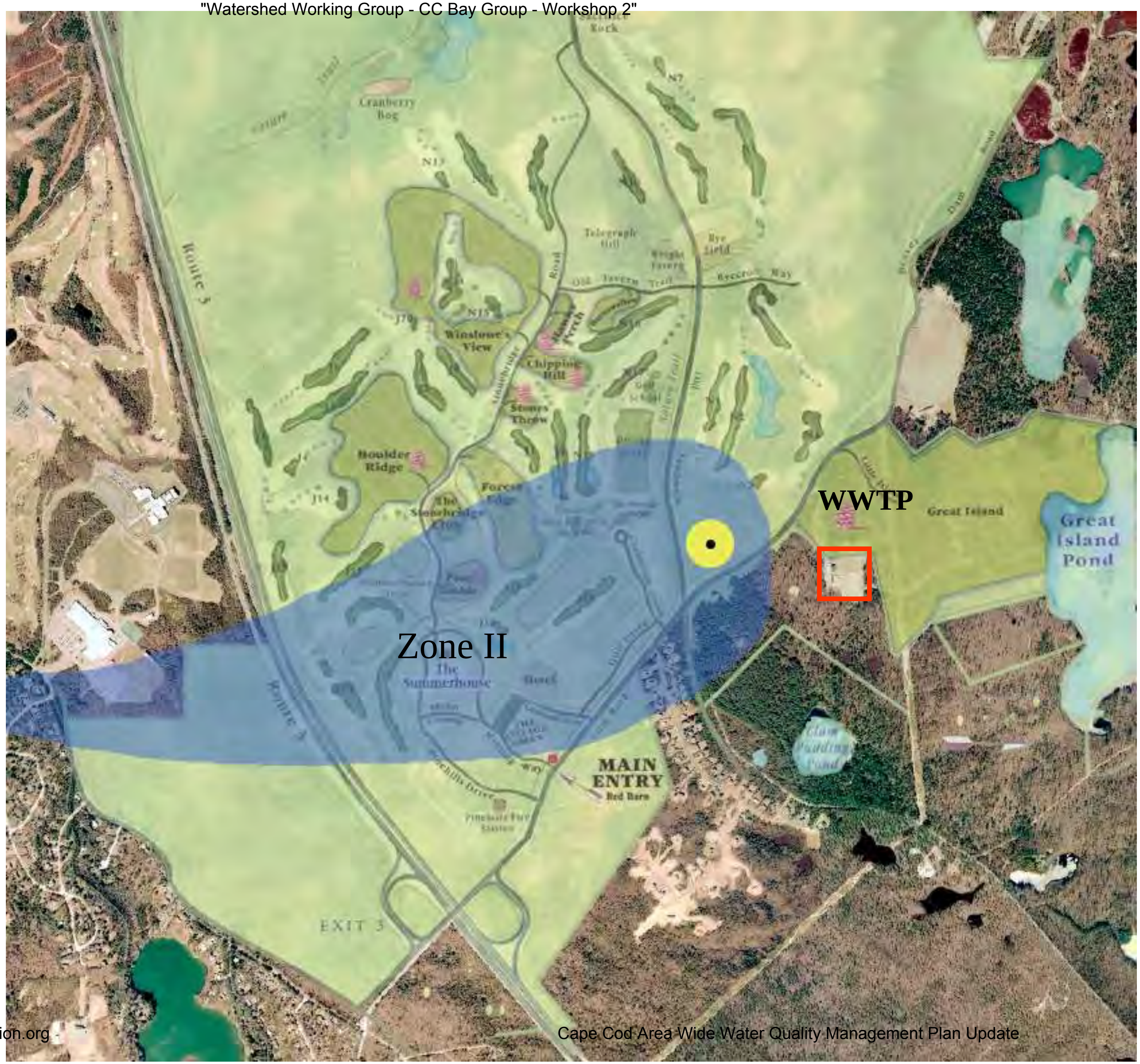
Fertigation Wells



Precedent:
Pine Hills
Plymouth, MA

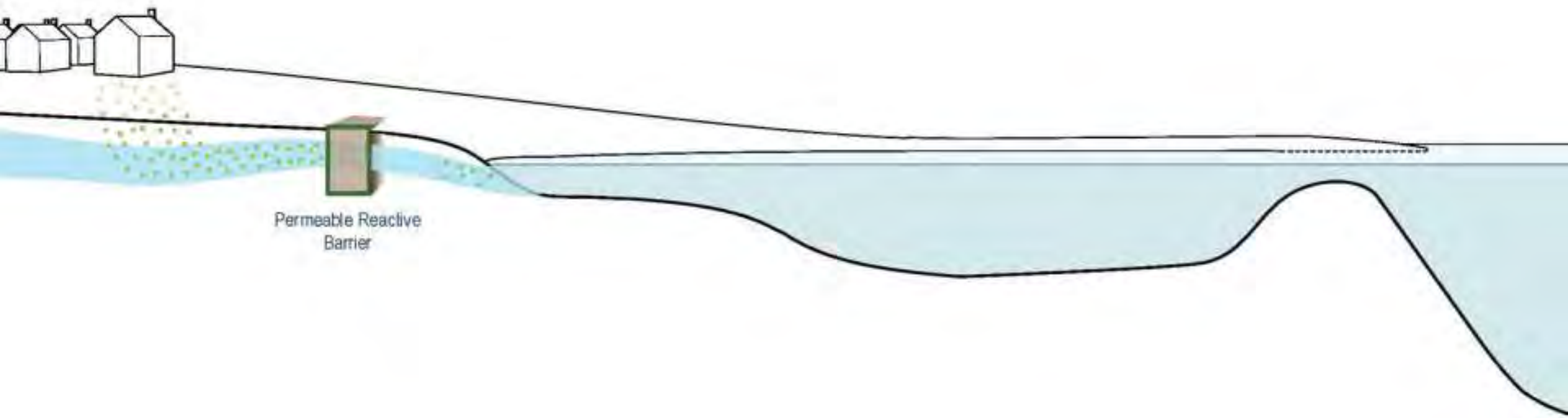


Precedent:
Pine Hills
Plymouth, MA



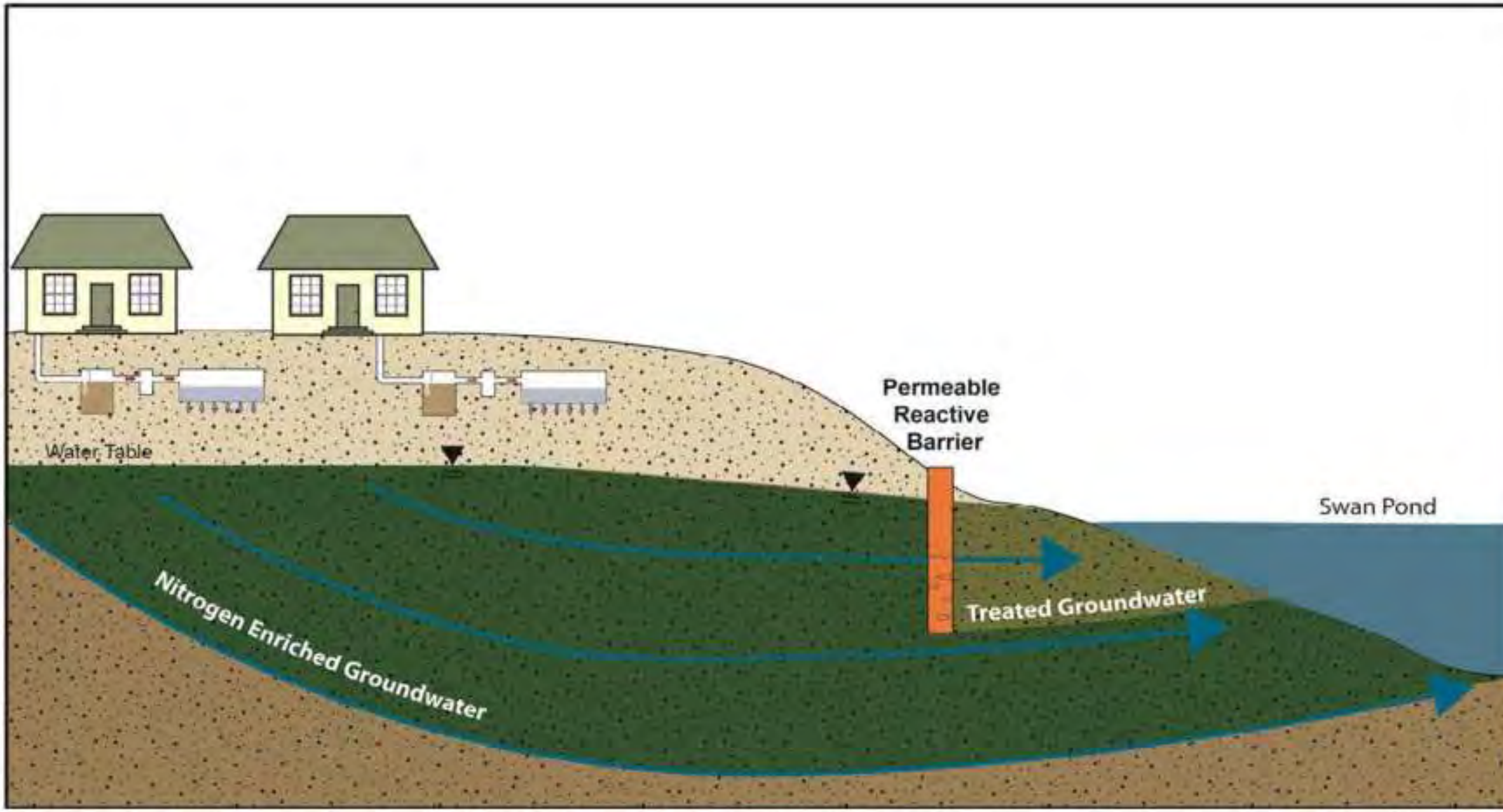
Precedent:
Pine Hills
Plymouth, MA

Precedent:
Pine Hills
Plymouth, MA



Scale: SITE / NEIGHBORHOOD / WATERSHED
Target: EXISTING WATER BODIES

PRB



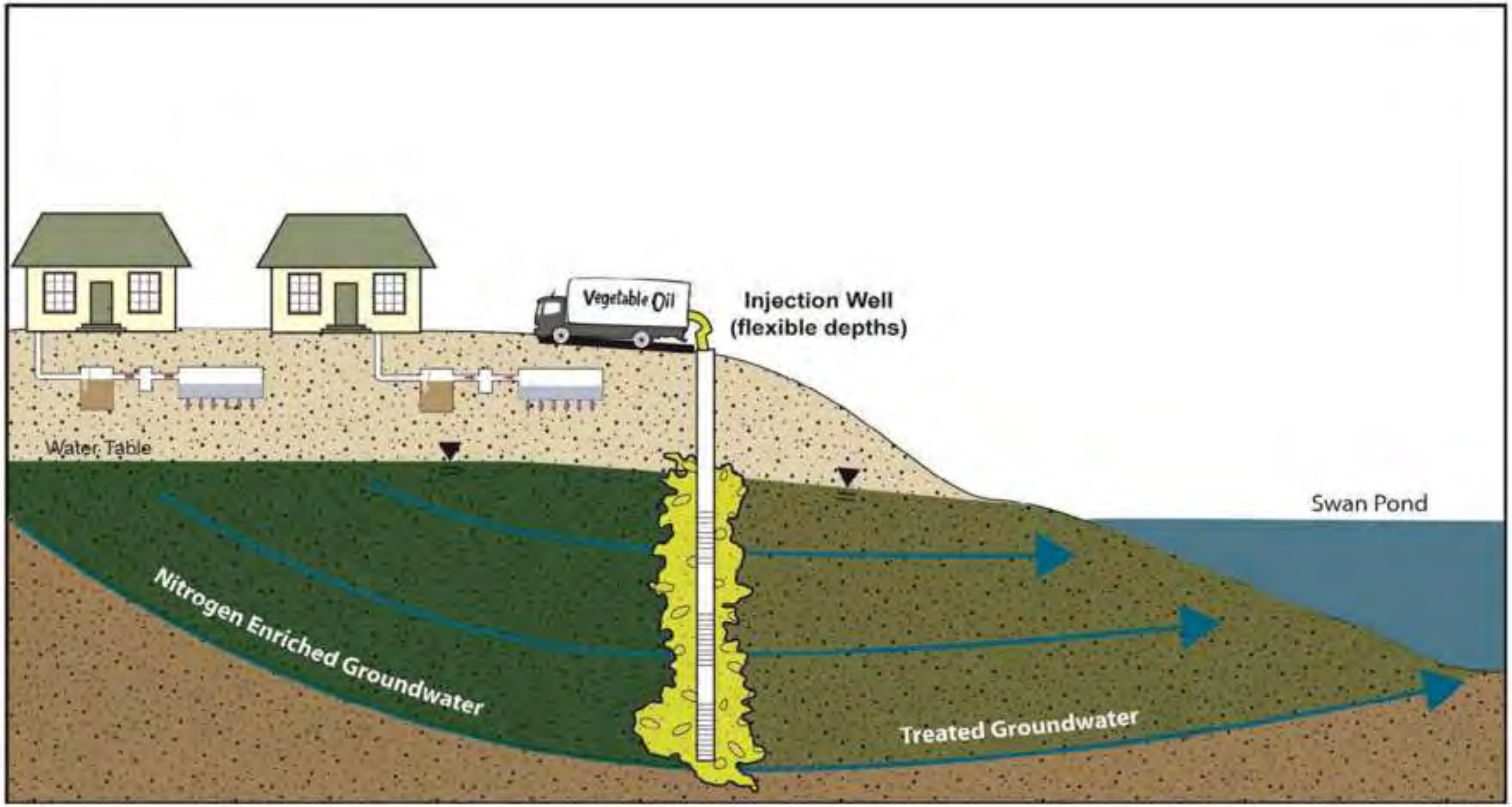
Precedent: PRB
Source: Horsley Witten Group Inc.

Permeable Reactive Barrier PRB

Precedent: Falmouth PRB

Source: Mike Domenica

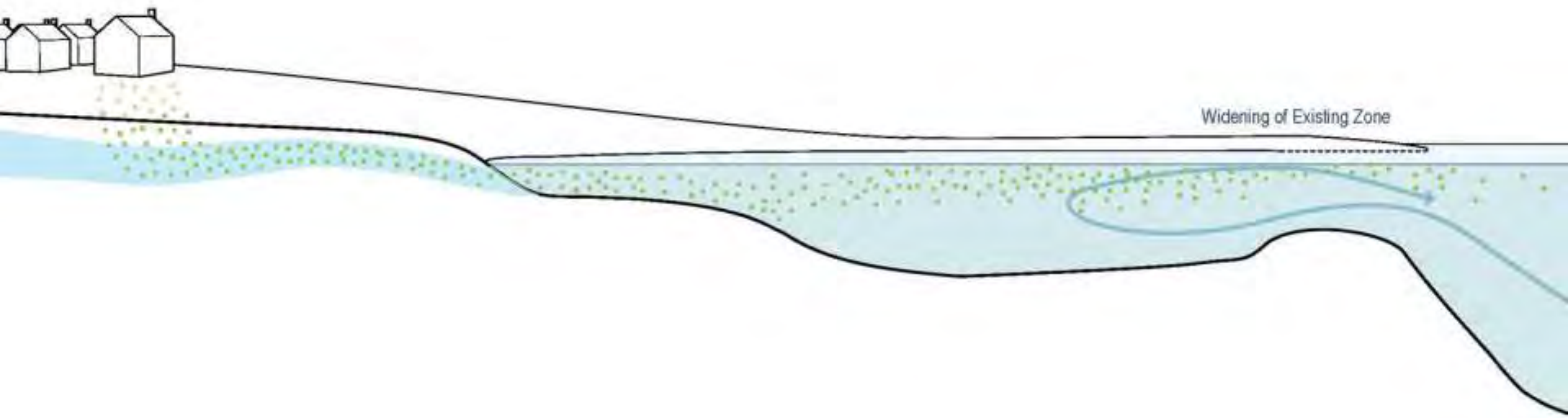
Permeable Reactive Barrier PRB



Precedent: PRB

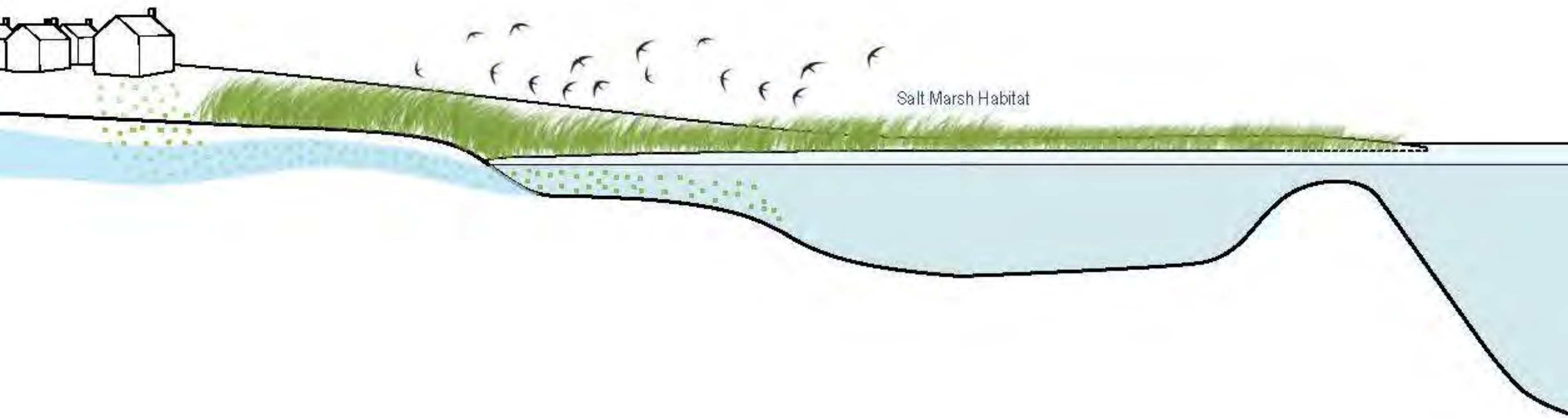
Source: Horsley Witten Group Inc.

Permeable Reactive Barrier PRB



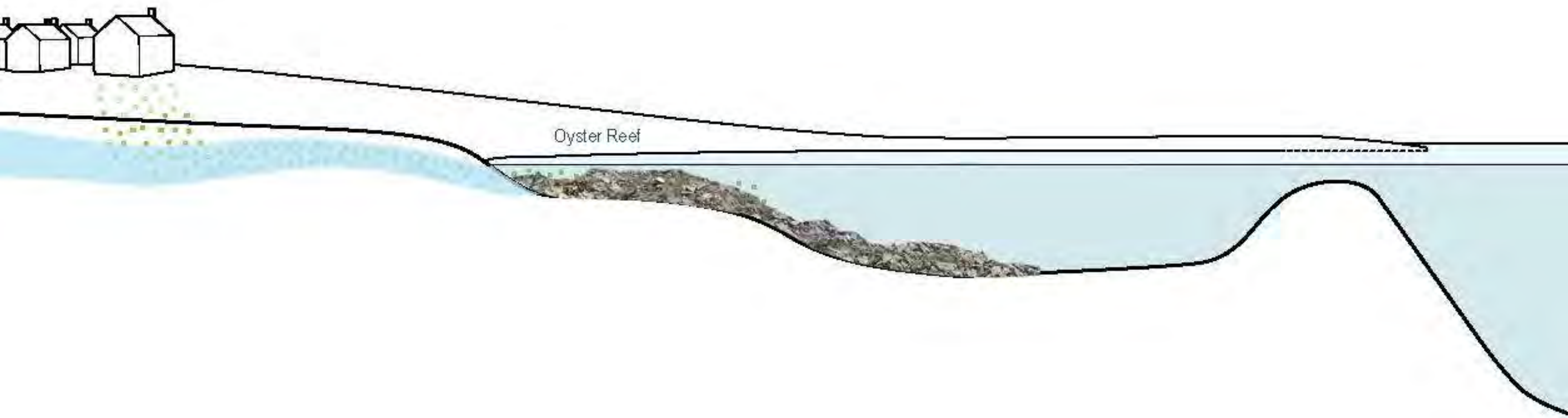
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Inlet and Culvert Widening



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Salt Marsh Habitat Restoration



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Shellfish Habitat Restoration

Precedent: Wellfleet Oyster Restoration Project

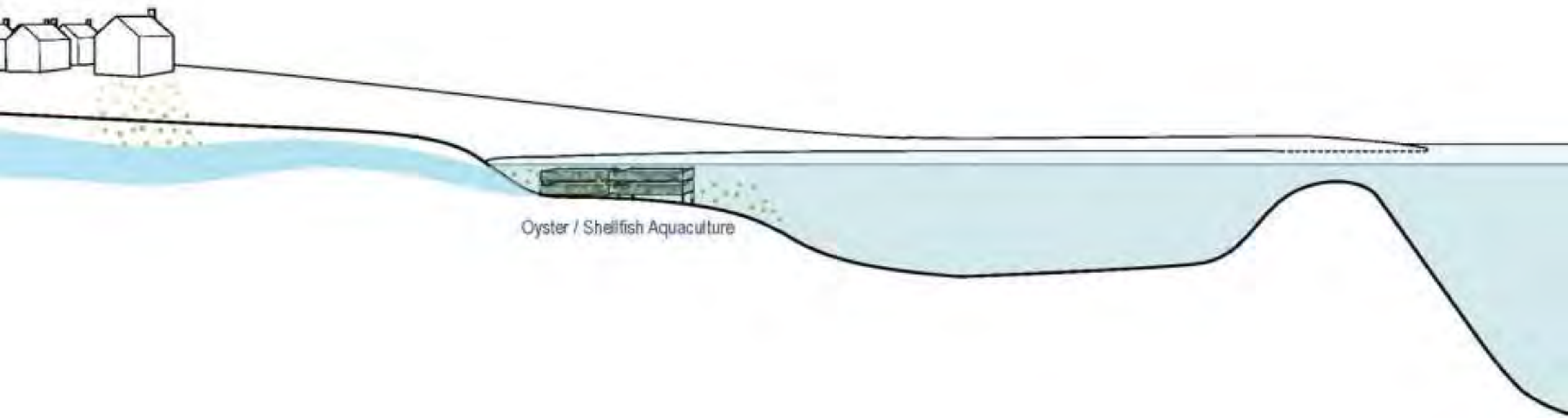
Source:

Shellfish Habitat Restoration

Precedent: Wellfleet Oyster Restoration Project

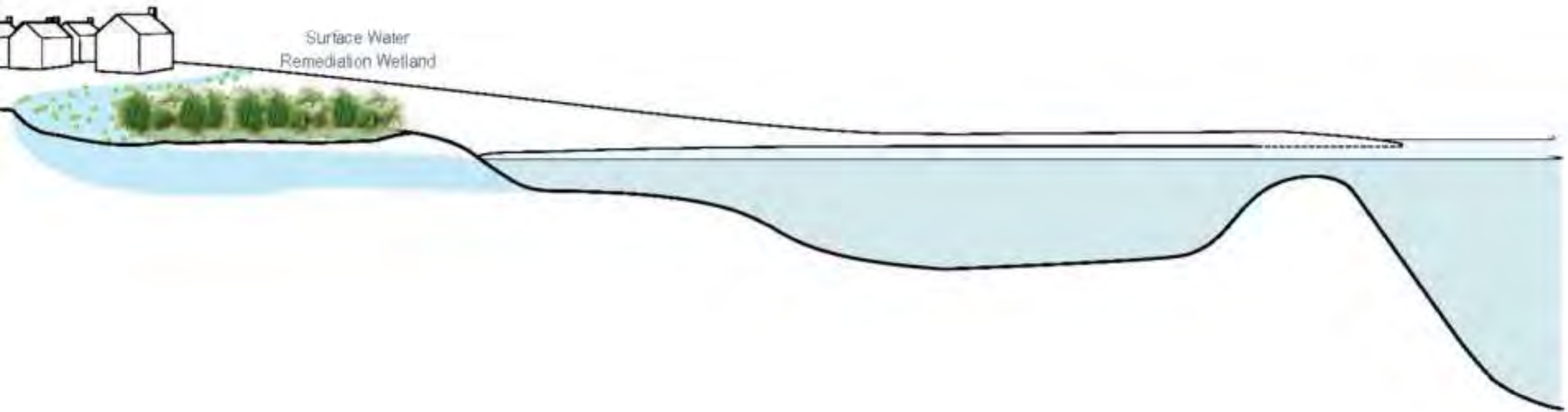
Source: Anamarija Francik

Shellfish Habitat Restoration



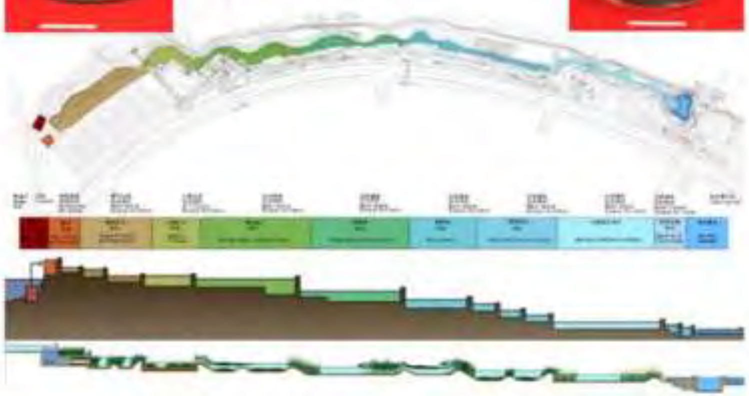
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Aquaculture / Shellfish Farming



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

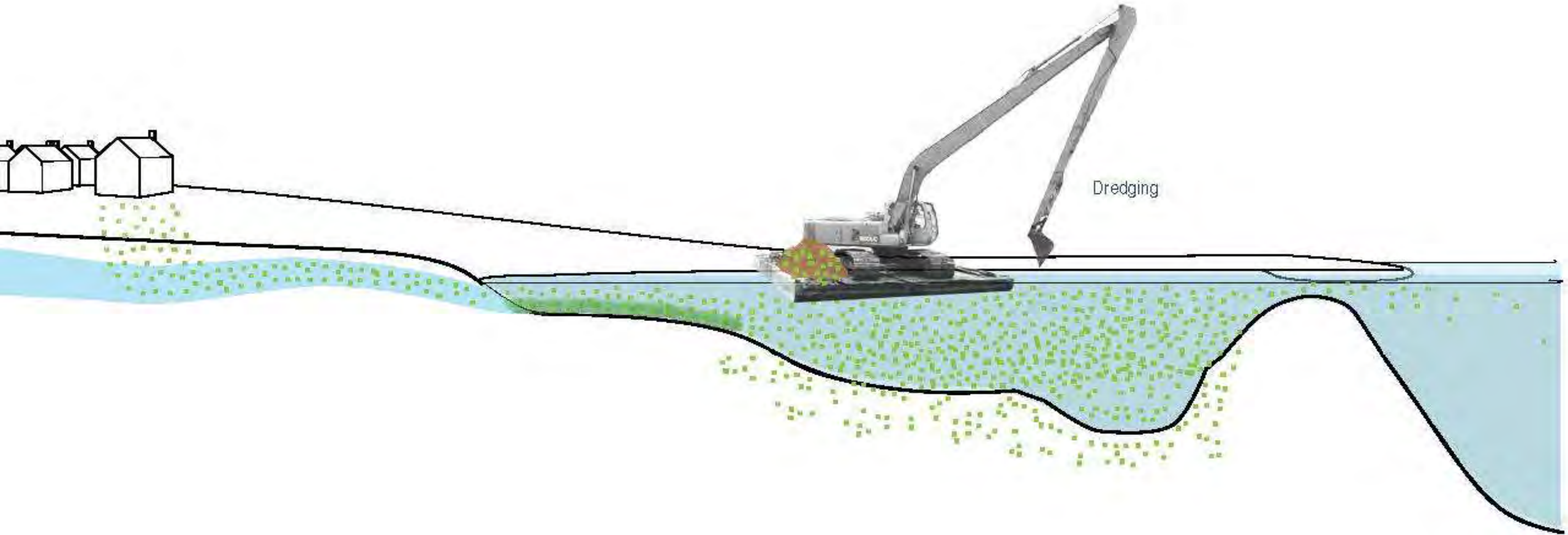
Surface Water
Remediation Wetlands



Precedent: Shanghai Houton Park

Source: Turenscape

Surface Water Remediation Wetlands

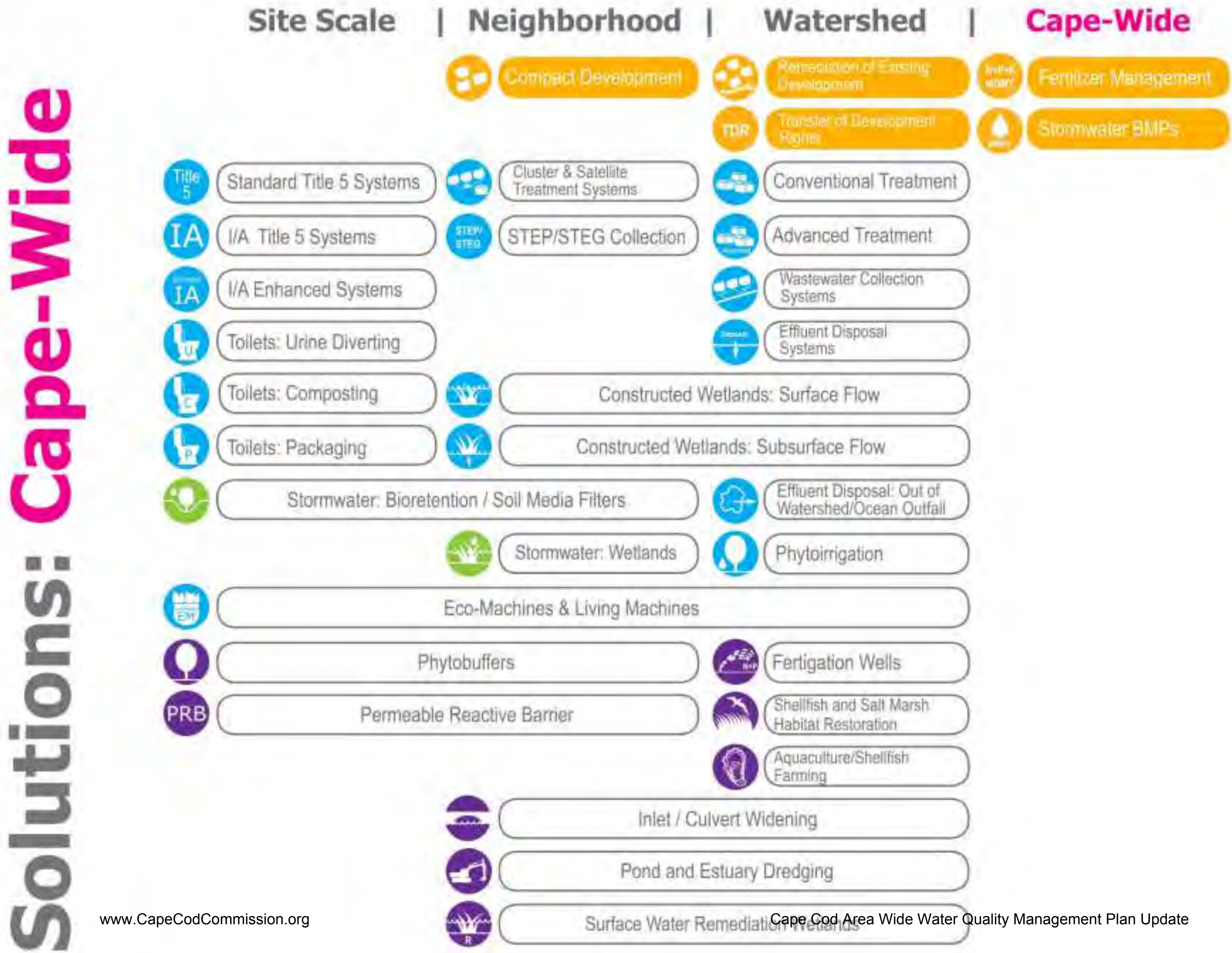


Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Pond and Estuary Dredging

Precedent: Pond and Estuary Dredging - Dennis, MA

Source: Cape Cod Times


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

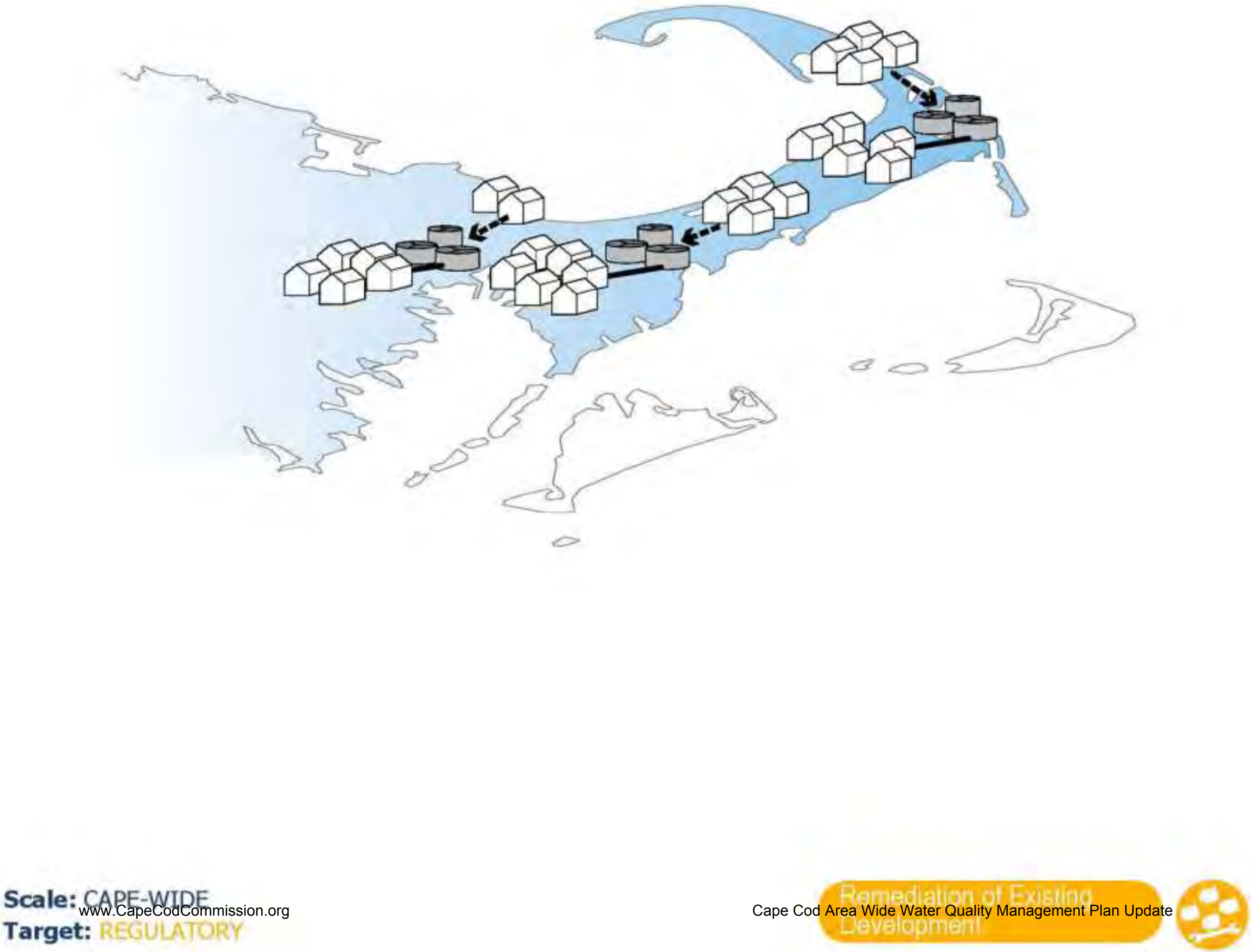
Scale: CAPE-WIDE
Target: REGULATORY

Compact Development

Scale: CAPE-WIDE
Target: REGULATORY

Fertilizer Management

N+P+K MGMT



Scale: CAPE-WIDE
Target: REGULATORY
Remediation of Existing Development

Scale: CAPE-WIDE
Target: REGULATORY

Transfer of Development Rights
TDR

Transfer of Developments Rights
The Concept

Owner of "sending" parcel sells development rights in exchange for permanent conservation easement.

Owner of "receiving" parcel buys development rights to build at densities higher than allowed under base zoning.

Source: Massachusetts Smart Growth Toolkit

Scale: CAPE-WIDE
Target: REGULATORY

Stormwater BMPs

Town Consideration of Alternative Technologies & Approaches

Wellfleet-	*Coastal habitat restoration & aquaculture*
Mashpee-	*Aquaculture & Expanding Existing Systems*
Brewster-	*PRB & Bioswales*
Orleans-	*Fertilizer Control By-Law*
Harwich &- Chatham	*Muddy Creek & Cold Brook Natural Attenuation*
Falmouth-	*Aquaculture* *Inlet Widening* *Eco-Toilet Demonstration Project* *PRBs* *Stormwater Management (Little Pond Watershed)* *Fertilizer Control By-Law* *Subsurface Nitrogen Removal Septic Systems*


Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
IA
I/A Title 5 Systems
STEP/STEG
STEP/STEG Collection
Advanced Treatment
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I/A Enhanced Systems
Wastewater Collection Systems
Toilets: Urine Diverting
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Toilets: Packaging
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Stormwater: Bioretention / Soil Media Filters
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Phytoirrigation
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Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediati
Solutions

Wastewater | Existing Water Bodies | Regulatory

Problem Solving Approach

1 Targets/Reduction Goals

Present Load: X kg/day − **Target:** Y kg/day = **Reduction Required:** N kg/day

2 Other Wastewater Management Needs

A. Title 5 Problem Areas
B. Pond Recharge Areas
C. Growth Management

3 Low Barrier to Implementation

A. Fertilizer Management
B. Stormwater Mitigation

4 Watershed/Embayment Options

A. Permeable Reactive Barriers
B. Inlet/Culvert Openings
C. Constructed Wetlands
D. Aquaculture

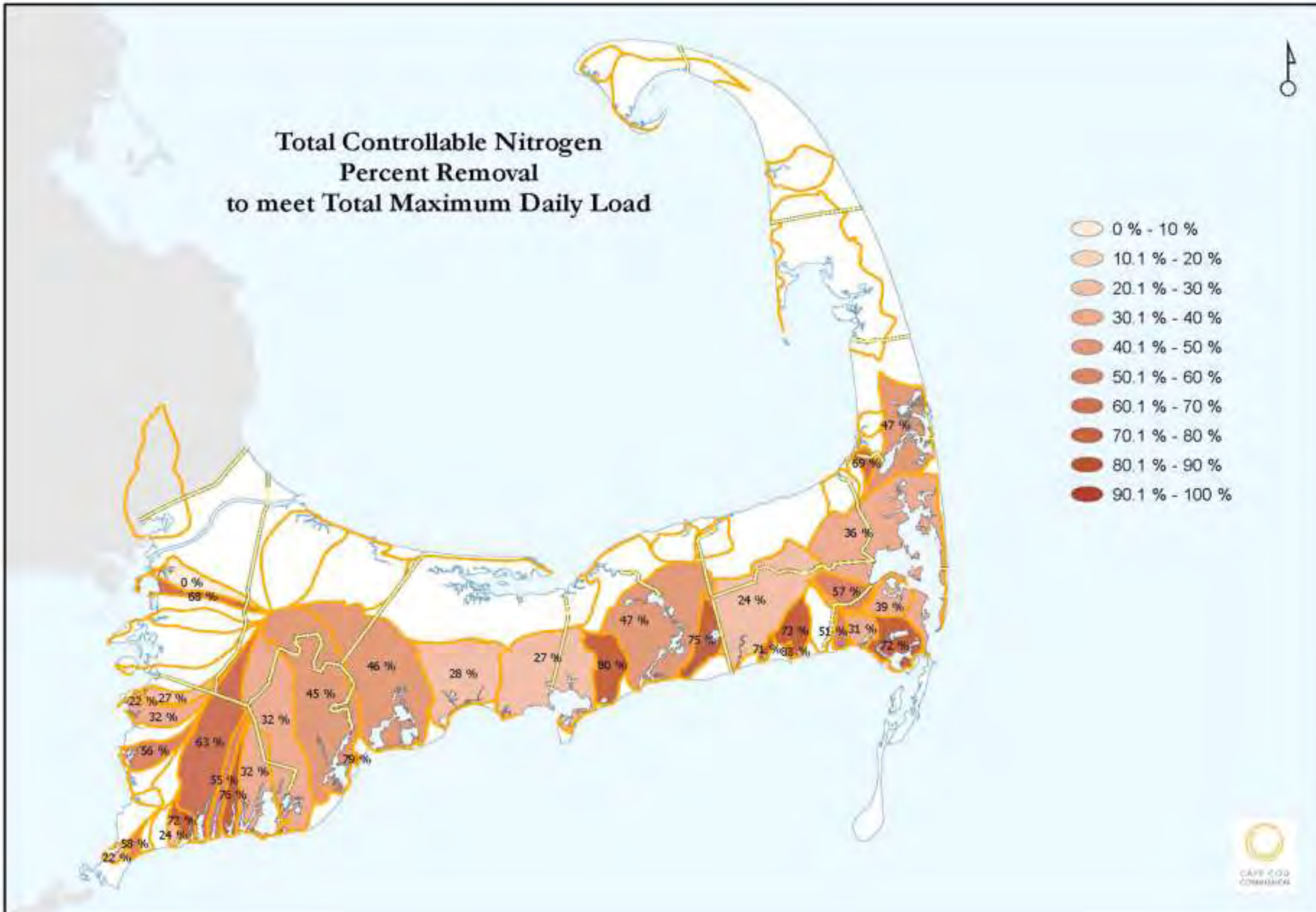
5 Alternative On-Site Options

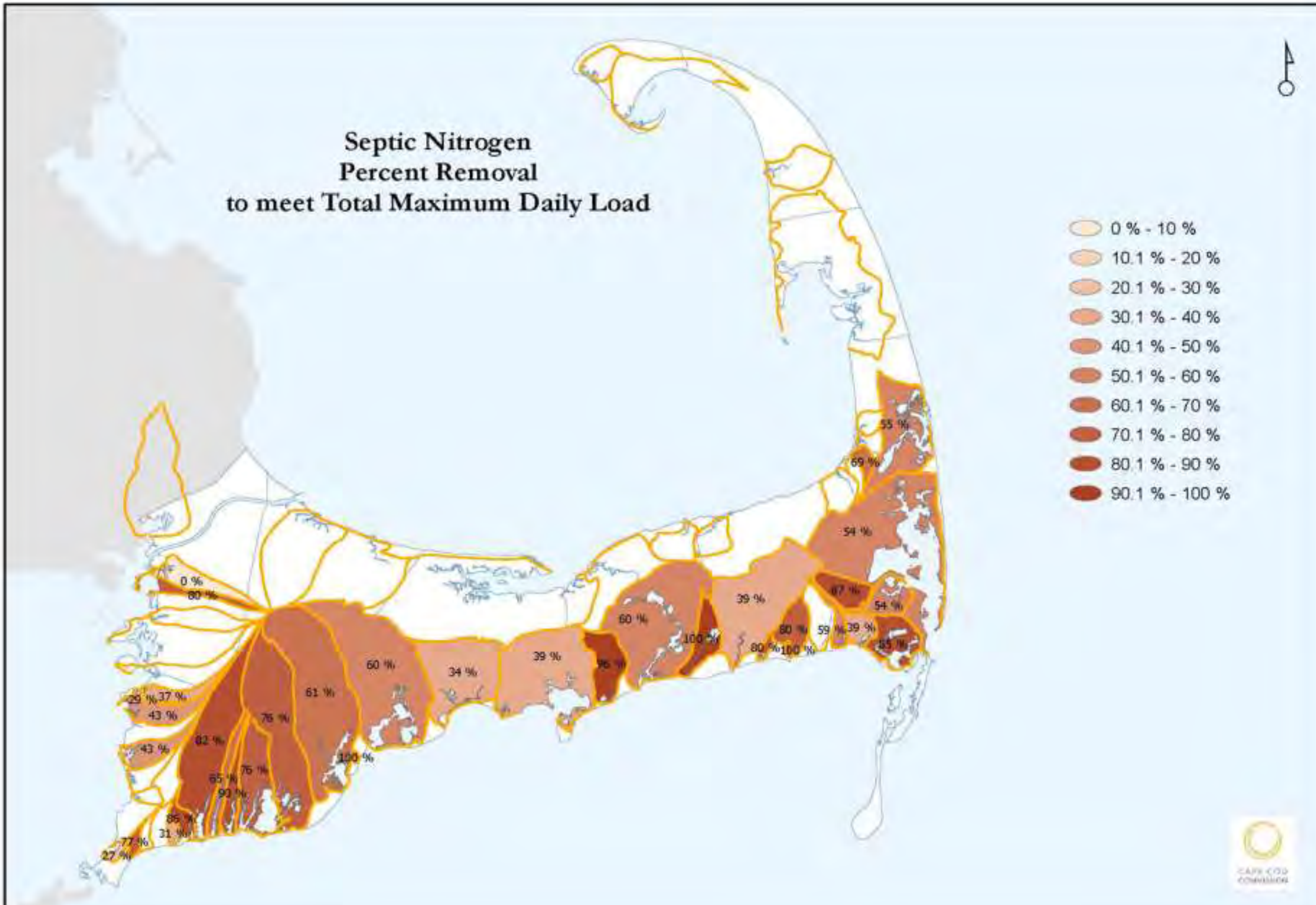
A. Eco-toilets (UD & Compost)
B. I/A Technologies
C. Enhanced I/A Technologies
D. Shared Systems

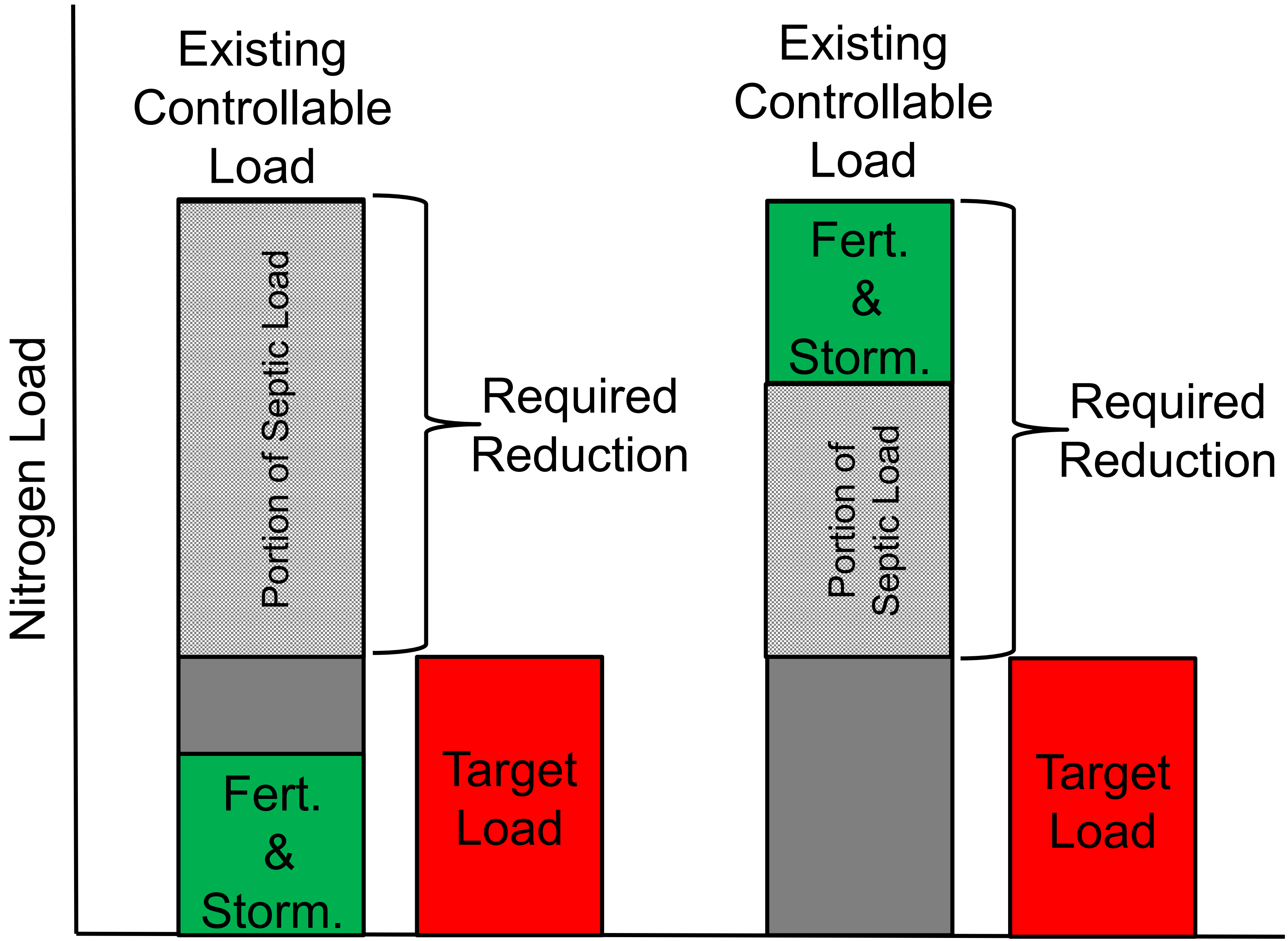
6 Priority Collection/High-Density Areas

A. Greater Than 1 Dwelling Unit/acre
B. Village Centers
C. Economic Centers
D. Growth Incentive Zones

7 Supplemental Sewering


Total Controllable Nitrogen
Percent Removal
to meet Total Maximum Daily Load
0 % - 10 %
10.1 % - 20 %
20.1 % - 30 %
30.1 % - 40 %
40.1 % - 50 %
50.1 % - 60 %
60.1 % - 70 %
70.1 % - 80 %
80.1 % - 90 %
90.1 % - 100 %
47 %
69 %
36 %
57 %
39 %
24 %
73 %
51 %
31 %
72 %
71 %
83 %
75 %
47 %
80 %
27 %
28 %
46 %
45 %
32 %
79 %
0 %
68 %
22 %
27 %
32 %
56 %
63 %
55 %
32 %
76 %
72 %
24 %
58 %
22 %


Septic Nitrogen
Percent Removal
to meet Total Maximum Daily Load
0 % - 10 %
10.1 % - 20 %
20.1 % - 30 %
30.1 % - 40 %
40.1 % - 50 %
50.1 % - 60 %
60.1 % - 70 %
70.1 % - 80 %
80.1 % - 90 %
90.1 % - 100 %


Nitrogen Load
Existing Controllable Load
Portion of Septic Load
Fert. & Storm.
Required Reduction
Target Load
Existing Controllable Load
Fert. & Storm.
Portion of Septic Load
Required Reduction
Target Load

Wastewater Existing Water Bodies Regulatory

Problem Solving Approach

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Present Load: X kg/day − **Target:** Y kg/day = **Reduction Required:** N kg/day

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A. Eco-toilets (UD & Compost)
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C. Enhanced I/A Technologies
D. Shared Systems

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A. Greater Than 1 Dwelling Unit/acre
B. Village Centers
C. Economic Centers
D. Growth Incentive Zones

7 Supplemental Sewering

Triple Bottom Line

Impacts of Technologies and Approaches

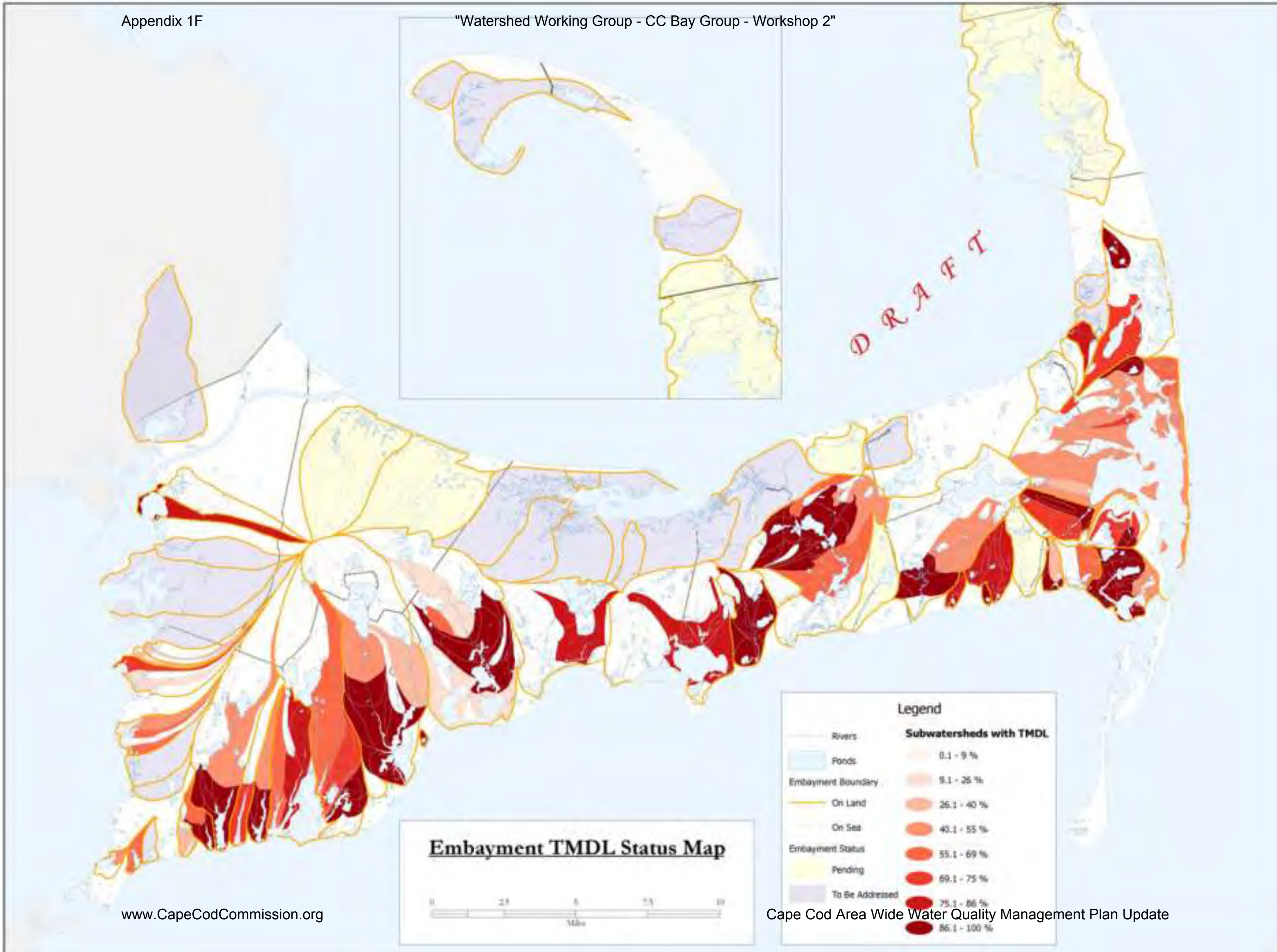
Environmental

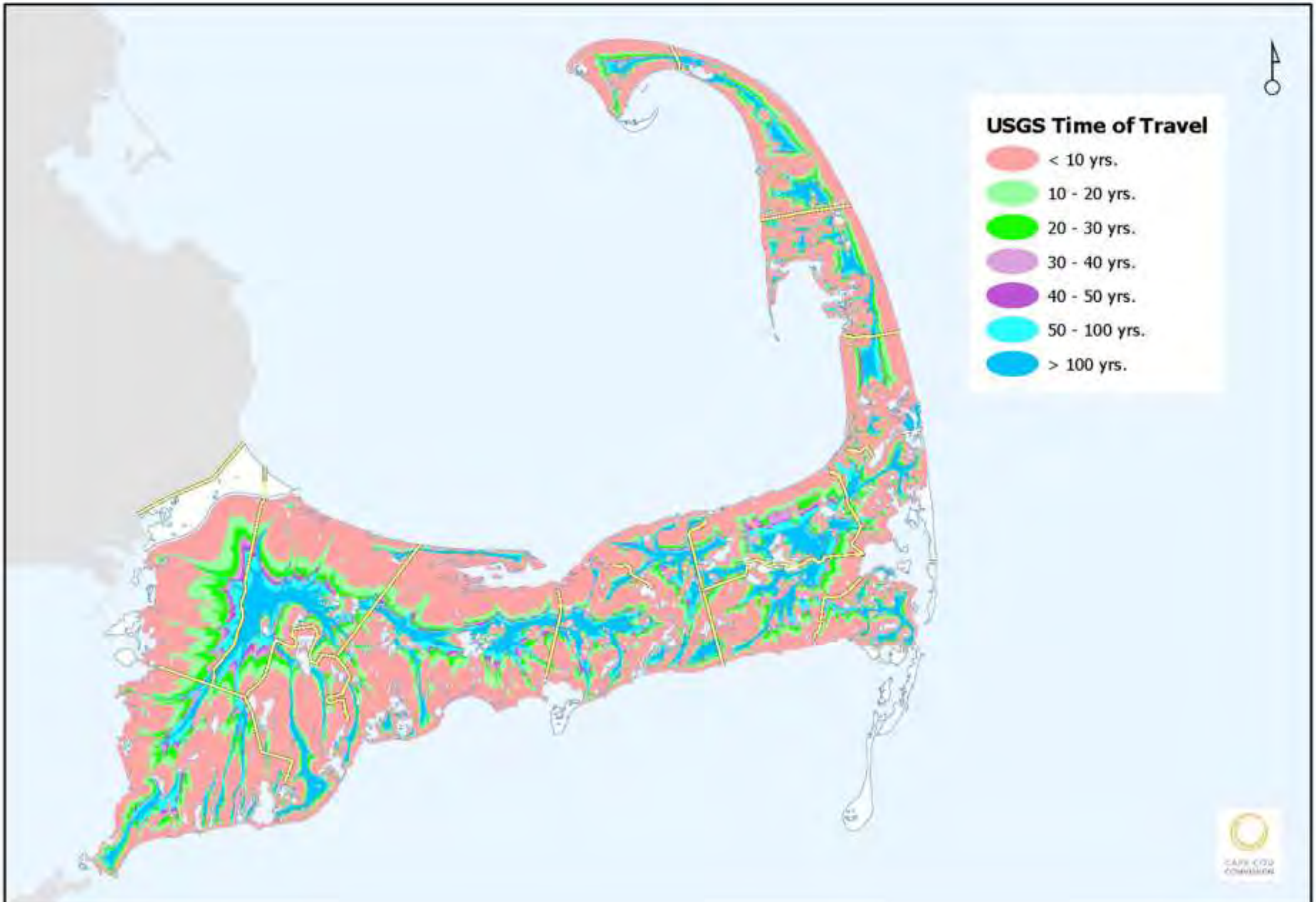
Economic

Social

Technology Selection: Process and Principles

- 100% septic removal subwatershed
- Scale: On-Site vs. Collection System vs. Natural System
- Nutrient intervention and time of travel
- Permitting Status
- Land use and Impacts of Growth


DRAFT
Embayment TMDL Status Map
0
2.5
5
7.5
10
Miles
Legend
Rivers
Ponds
Embayment Boundary
On Land
On Sea
Embayment Status
Pending
To Be Addressed
Subwatersheds with TMDL
0.1 - 9 %
9.1 - 26 %
26.1 - 40 %
40.1 - 55 %
55.1 - 69 %
69.1 - 75 %
75.1 - 86 %
86.1 - 100 %


USGS Time of Travel
< 10 yrs.
10 - 20 yrs.
20 - 30 yrs.
30 - 40 yrs.
40 - 50 yrs.
50 - 100 yrs.
> 100 yrs.

Preparing for Meeting 3 and Beyond

- Review tools and alternatives analysis approach
- Evaluating scenarios for meeting water quality goals
- Attend the November 13th meeting:

6:00
Cape Cod Museum of Art
Dennis, MA

Cape Cod 208 Area Water Quality Planning
Provincetown Harbor Working Group

Meeting Two
Thursday, October 31, 2013
8:30 am- 12:30 pm
Provincetown Town Hall

Meeting Summary Prepared by the Consensus Building Institute

I. ACTION ITEMS

Working Group

- Next meeting: Meeting Three
  Tuesday, December 3, 2013
  8:30AM -12:30PM
  Provincetown Town Hall, 260 Commercial Street, Provincetown, MA 02657
- Send Kate any additional comments on Meeting One Summary
- Continue to prepare thoughts about which technologies and approaches they would like to learn more about for application in the Provincetown Harbor watershed. Different scenarios and options will be discussed during Meeting Three

Consensus Building Institute

- Send link with presentation to participants
- Finalize Meeting One summary
- Draft and solicit feedback from Working Group on Meeting Two summary

Cape Cod Commission

- Share Technology Matrix with Working Groups
- Share updated chronologies with Working Groups
- Culvert needs to be replaced at East Harbor and Pilgrim Lake, add this to the Commission's list of plans
- Collect all studies and analyses that have been done for the Provincetown Harbor area

II. WELCOME, REVIEW 208 GOALS AND PROCESS AND THE GOALS OF MEETING

Ms. Erin Perry, special projects manager for the Cape Cod Commission (the Commission), welcomed participants and offered an overview of the 208 Update stakeholder process.[1] In July, public meetings were held across the Cape to present the 208 Plan Update goals, work plan, and participant roles. Public meetings were also held in August to present information on the affordability and financing of the updated comprehensive 208 Plan. The first meetings of

[1] The PowerPoint presentation is available at: http://watersheds.capecodcommission.org/index.php/watersheds/outer-cape/provincetown-harbor

the eleven Watershed Working Groups were held in September and focused on baseline conditions in each of the watersheds. The second meetings of the Watershed Working Groups, which are being held in October and early November, are focused on exploring technology options and approaches. The third meetings of the Watershed Working Groups will be held in December and will focus on evaluating watershed scenarios, which will be informed by Working Groups' discussions about baseline conditions, priority areas, and technology options and approaches. This conversation will also be informed by information shared in the Technology Matrix, which was developed by the Cape Cod Commission with technical input from the Technical Advisory Committee of the Cape Cod Water Protection Collaborative and the Technology Panel. The Technology Matrix builds on the information presented in the Technology Fact Sheets, which Working Group members reviewed in advance of the meeting.[2] Once it is finalized by the Commission, the Technology Matrix will be shared with Working Group members.

Ms. Perry shared the progress made by the 208 Plan team since Meeting One, which includes:

- Meeting materials were distributed to stakeholders and made available online at: http://watersheds.capecodcommission.org
- GIS data layers were made accessible online at: http://watersheds.capecodcommission.org
- Chronologies are being updated and will be made available soon. Commission staff members have been tracking down the things that were mentioned during the previous meeting and are in the process of incorporating these points into the chronologies.

Ms. Perry invited participants to attend the Cape Cod-wide event on November 13, which will be held at the Cape Cod Center for the Arts in Dennis. Participants from across the eleven Watershed Working Groups and the public are invited to attend the event, which will include: a wrap up of the "Cape2O: ur in charge!" game; a summary of the planning process to date; and a discussion of how the Commission can continue to engage stakeholders after the third meeting in December.

Ms. Perry then reviewed the goal of this meeting, which is:

- To develop a shared understanding of the potential technologies and approaches identified to date, and the benefits and limitations of each; to explore the environmental, economic, and community impacts of a range of categories of solutions; and to identify priorities and considerations for applying technologies and approaches to remediate water quality impairments in your watershed.

Ms. Kate Harvey, the facilitator from the Consensus Building Institute, reviewed the agenda and led introductions. A participant list is found in Appendix A. She also thanked participants who

[2] Technology Fact Sheets are available at: http://watersheds.capecodcommission.org/index.php/watersheds/outer-cape/provincetown-harbor

provided feedback on the chronology. She mentioned that, in light of the concern participants had at the last meeting about engaging the National Seashore, the Consensus Building Institute has reached out to them and National Parks Service representatives will be contributing input and attending some of the meetings. One participant added, in regards to the Seashore, that the Seashore is on the Herring Cove sewer and that they need to be involved in this process.

- Ms. Harvey responded that the Seashore does see itself as an important stakeholder, and they are committed to participating as much as they can given their budget and time limitations.

III. RANGE OF POSSIBLE SOLUTIONS

Mr. Scott Horsley, Area Manager for the Provincetown Harbor Watershed Working Group, led a discussion of the range of possible solutions.

Before he began, a participant asked for clarification on whether the goal of the Working Group is to agree on a viable technology that will then become mandated by law.

- Mr. Horsley explained that the Commission is not trying to get Working Groups to pick a particular technology. The Commission is trying to get the Working Groups' help in coming up with a couple of approaches that can be pursued in different places throughout the Cape. The Commission is very open minded about the technologies being considered.
- Additionally, Mr. Horsley reminded the Working Group that the goal is to consider pathogens as well as nitrogen and phosphorus. He said the group should to be mindful of drinking and surface water issues, since bathing and shellfish are affected by pathogens as well as nutrient-related problems.
- In response to concerns about how this process is going to lead into regulation, Mr. Horsley said the Commission going to develop a plan from this process. The plan is going to have alternatives that all 57 watersheds can consider. It will include a couple alternative approaches that emerge from these Working Group meetings; these approaches will reflect what the Working Groups think are most appropriate and acceptable for communities on the Cape. The plan produced through this 208 planning process will feed into local comprehensive plans, which will then have to be approved by the Department of Environmental Protection (DEP). There will not be one general plan or one recommended technology for the entire Cape. This process is designed to be targeted and to support locally appropriate planning. The Commission hopes that towns and communities throughout the Cape will learn from each other throughout the process.
- Ms. Perry added that one of the goals of this process is to create a more flexible approach that can be used for reviewing local plans.
- Mr. Horsley said that during the upcoming November 13 meeting there will be more emphasis on where this process is going.

Mr. Horsley encouraged Working Group participants to keep in mind the following points as they learn more about and consider the pros and cons of each of the technologies and approaches:

- The Commission has engaged in a comprehensive analysis of nutrient control technologies and approaches. This analysis is distilled into: the Technology Fact Sheets, which present various information on the technologies being considered; and the Technology Matrix, which includes additional information on site requirements, construction, project costs, operation and maintenance costs, reference information, and regulatory comments.
  - Mr. Horsley said that the Commission is asking for ongoing input from stakeholders on the public acceptability of technology options and approaches. He asked participants to provide feedback on the public acceptability of these different options during this meeting. This is an importance consideration and the Commission values stakeholders' perspectives on this.
- Not all of the technologies and approaches discussed will be applicable to Cape Cod.
- Some technologies are so promising that they may merit demonstration and pilot projects.
- Certain technologies or approaches will be effective at preventing nutrients from entering water bodies. Others will be effective at reducing or remediating nutrients that are already in the groundwater or water bodies.
- Regulatory programs can address nutrient controls for both existing development and future development.
  - Mr. Horsley encouraged participants to think about how addressing future development will either make the problem better or worse.
- Meeting Three will embark on hands on problem solving in each watershed to meet target load reductions. This meeting, Meeting Two, is intended to explore the possible solutions, their pros and cons, and the public acceptability of these options.

Technologies and Approaches for Improving Water Quality

Mr. Horsley began by discussing technologies and approaches for improving water quality. He offered a brief overview of the technologies and approaches. The following section briefly describes each technology, categorized by the scale of intervention. Participants' questions and comments about the technologies are also discussed below (in *italics*).

Site level technologies/approaches

Standard Title V System*:* This is a standard septic system that consists of a septic tank and soil adsorption system (leaching field). The system was primarily designed to address public health concerns related to waste in drinking water (e.g., coliform bacteria); they were not designed to remove nutrients (e.g., nitrogen).

Innovative/Alternative (I/A) Title V System: Innovative/Alternative on-site nutrient reducing systems typically consist of standard septic system components augmented to remove more nutrients than a standard Title V system. I/A systems refer to a class of systems designed to be recirculating sand filter (RSF) equivalents by meeting the same treatment limits in a smaller footprint. These systems are expensive, costing somewhere around twice as much as a regular Title V system. Mr. Horsley explained that these systems are usually geared toward reducing nitrogen, and often require the use of a carbon source, such as wood chips, that allow for denitrofication.

- *Is Bioclear is an I/A system*? Mr. Horsley responded that it is a separate system but along the same lines as an I/A system.
- *How much maintenance do these systems require?* Mr. Horsley replied that, like everything on the Technology Matrix including Title V systems, these systems require a significant amount of maintenance. He said that I/A systems require more maintenance than Title V, noting that there are instances in which Title V systems haven't required any maintenance at all and some instances in which they have been an ongoing problem.
- *Lint from washing machines is a big problem in Title V systems, and that putting a filter on your washer can really help.*
- *What happens when you the wood chips in an I/A system break down?* Mr. Horsley said you have to replace wood chips in your system, but not every year. They need to be replaced on a scale more like every decade or two. Methane pumps, in contrast to wood chips, provide an ongoing input of carbon and don't need to be replaced. The downside of methane pumps is that they require electricity and can be unplugged or can fail.
- Mr. Horsley explained that there are 20 or so technologies within the I/A system category. He said people who are interested in this approach can learn more about it from Massachusetts DEP (http://www.mass.gov/eea/agencies/massdep/water/wastewater/septic-systems-title-5.html) or the Barnstable County Health (http://www.barnstablecountyhealth.org/ia-systems).
- Mr. Horsley asked participants whether there are any I/A systems in Provincetown. A couple participants indicated that there are Bioclear systems in the area.

Urine Diverting Toilets: Urine diversion systems send urine into a holding tank where the urine is stored and periodically collected by a servicing company. The servicing company empties the tank for disposal or recycling, such as for conversion to fertilizer. The remainder of human waste and water from all other household uses, such as grey water from sinks and showers, continue to go to the septic system. Urine diverting toilets can remove significant quantities of nitrogen from the watershed. (Example case: Falmouth, MA).Mr. Horsley explained that in Europe, they take urine from urine-diverting toilets to an off-site facility and use it to manufacture fertilizer. It can also be used for fertilizer on-site.

- *A participant commented that people visiting a home with a urine diverting toilet won't know how to use the toilet, so some urine will likely go into the regular septic tank*. Mr.

Horsley said that is probably correct. This is not a problem, it just decreases the effectiveness of this system at removing nitrogen

- Mr. Horsley said that Falmouth has a test program that is offering $5000 to home owners to try this technology

Composting Toilets: Composting toilet systems separate human waste from shower, sink, and other household water uses. Composting toilets use minimal water or no water. The human waste captured by composting toilets is decomposed and turned into compost. The compost generated through these systems is removed from the site; nutrients in the compost can be recycled. Composting toilets require the replacement of existing toilets as well as sufficient space in the basement for a container to capture and compost human waste. Other household wastewater (such as from sink and shower uses) continues to flow into the septic system. (Example case: Falmouth, MA).

- *One participant said that the costs of things like composting toilets is going to be a key deterring factor for much of the public.* Mr. Horsley said that the cost of a composting toilet retrofit is about $5000 to $10,000. This approach might be a cost effective way for people, such as those in Provincetown, who can't get on sewer but want to.
- *Participants asked whether Provincetown officials can require that people who can't hook into sewer put in composting toilets?* Mr. Horsley replied that this shouldn't be required, but that the town could give people the option of putting in a composting toilet.
- *Participants noted that dry toilets and composting toilets are allowed in Massachusetts and that rain gardens are required by the Conservation Commission.*

Packaging Toilets: A packaging toilet encapsulates human waste in a durable material for removal from the site. The package is stored beneath the toilet and removed and taken away by a service company when full. The servicing company that picks up the packages can recycle the nutrients in the human waste. This is a waterless system.

Stormwater Bioretention: Bioretention systems utilize natural plant and soil functions to capture and treat stormwater runoff for a variety of contaminants including nutrients. A typical system consists of an under-drain/gravel layer, a layer of bioretention soil mix (a mix of sand, compost, woodchips, and loam), and a surface layer containing appropriate plantings. The treated water can be discharged into a water body or used for open space irrigation after treatment. The reclaimed water can also be discharged into a subsurface infiltration system for discharge to the groundwater. (Example case: Portland, OR).

Participants were asked for questions and comments on these site level technologies and approaches.

- *A participant said that nitrogen is a natural nutrient; therefore she wants to know what the natural level of this nutrient is in the environment and why it is a concern.* Mr. Horsley explained that when there is too much nitrogen in water systems, it drives problematic biological processes, such as algal blooms and loss of eel grass. We don't know to what extent nitrogen is a problem here in Provincetown, since there is no completed Massachusetts Estuaries Project (MEP) study for this area. It is possible that the nitrogen issue may not be as significant in the Provincetown area as it is throughout the rest of the Cape due to tidal floods. In light of this, the Provincetown Harbor Working Group may want to focus on other water quality issues.

- *A participant asked whether treating the ponds, such as with herbicide, is being considered as an approach*. Mr. Horsley said the goal is to prevent the problem, not just treat the symptoms.

- *A participant asked why there is no mention of pharmaceuticals and whether they can be removed from water systems*. Mr. Horsley said that the Commission is talking about the pharmaceutical and emerging contaminant issue. He said that a group called Silent Spring did a study on emerging contaminants and found that they are in water systems. However, studies on the impacts of the emerging contaminants haven't been done and we don't know what the effects of these chemicals are. Mr. Horsley acknowledged that there is the question of whether, as the Cape is addressing other water quality issues, we should think about addressing these emerging contaminants. He said the natural and biological technologies and approaches being discuss in this meeting appear to be the best way for removing these kinds of chemicals.

- *One participant said that some of the technologies being discussed involve waste removal by trucks, which is an involved process requiring trucks, people, and other infrastructure. The challenges associated with this should be considered.*

- *A participant said that people often don't do what they're supposed to. For example, they throw out plastic bottles rather than recycling them. He asked how we can get people to respond rather than react and to implement approaches that require individual compliance*. Mr. Horsley replied that behavior change can take 10 to 30 years, and that a significant public education campaign is needed. He said the Cape needs to be thinking decades ahead and be realistic that this process won't just involve one meeting, but will be ongoing. *The participant replied that he thinks approaches that involve the least amount of voluntary action or individual choices are likely to be most successful.*

- Mr. Horsley said the Cape needs to be thinking about climate change and sea level rise. He said that, due to these environmental changes, existing systems that are in compliance with Title V could fall out of compliance. This may make some of these new technologies and approaches look more appealing and more acceptable to the public.

Neighborhood level technologies/approaches

Cluster and Satellite Treatment Systems: A cluster or satellite system is a collection and treatment system treating wastewater flows from multiple properties. In most areas, the collection system is the most expensive part of wastewater treatment systems because houses are so far apart. Provincetown is an exception to this.

- *One participant said these cluster systems take up a lot of space. He asked how much space they realistically require.* Mr. Horsley replied that the drain field is the main use of space and that the collection system itself isn't that large.

STEP/STEG Collection: Septic Tank Effluent Pumping (STEP) and Septic Tank Effluent Gravity (STEG) systems convey liquid wastewater from on-site septic tanks to sewer systems. Only the liquid component of the wastewater may be conveyed by pumps or by gravity.

Eco Machines and Living Machines: Living or eco machines are natural systems that treat septic tank effluent or primarily treated wastewater. In these systems, aeration and clarification chambers are combined with constructed wetlands to treat the effluent. The wetlands are a series of chambers allowing for microbial communities to engage with and treat the wastewater. Plants are often suspended on racks with their roots systems doing the work. Solids removal is generally onsite, after which water is pumped through the gravel filled cells (similar to subsurface wetlands.) This process transfers more oxygen to the wastewater and completes the pollutant removal process. (Example cases: South Burlington, VT, and West Yarmouth, MA). Mr. Horsley explained that eco machines can be used to make fertilizer. So, instead of buying fertilizer from off the Cape, this process can be used to create fertilizer on the Cape. He added that these machines can be used at a variety of scales (e.g., at the municipal scale as well as the neighborhood scale).

- *How much wastewater this system can process?* Mr. Horsley said these systems can process a lot of water and can be scaled up. For example, in Hawaii, this technology is used a lot. He noted that in New England, this process would require greenhouses.
- *Does this system remove viruses and pharmaceuticals?* Mr. Horsley said there is not a lot of research on this, but that this might be an effective approach for removing viruses and pharmaceuticals.

Stormwater Wetlands: Constructed wetlands provide aerobic chambers followed by subsurface anaerobic chambers that facilitate nitrification followed by denitrification, respectively. This process mimics the process of natural systems coupled with an engineering design that guarantees sufficient residence time within a chamber containing anaerobic conditions. (Example case: Missouri. Also look at Alewife in Cambridge, MA). Mr. Horsley asked participants to explain how the stormwater wetland on Commercial Street in Provincetown is working.

- *One participant said that, historically, the town had 20 or so beach closures in the area. This summer there were none, which they think was in part due to the stormwater wetland.* Mr. Horsley asked what this project cost. *A participant said the completed section cost about $1.8 million and that the plan is to eventually do this throughout the town.* Mr. Horsley asked whether there have been any maintenance problems or degradation. *Participants replied that there hasn't really been any major maintenance or issues thus far.*

- *Is this technology something that could be applied to individual driveways?* Mr. Horsley and other participants said the maintenance of this would probably be an issue and that this kind of approach makes more sense for something like a shopping mall or larger.

Watershed level technologies/approaches

Conventional Treatment: A conventional wastewater treatment facility typically treats wastewater collected from homes and businesses. A groundwater discharge permit is required. Treatment generally results in nitrogen concentrations of less than 10 mg/L of water.

Constructed Wetlands—surface flow: After primary treatment in a septic tank or wastewater treatment facility, or secondary treatment at a wastewater treatment facility, water is fed into a surface flow constructed wetland. Surface flow constructed wetlands closely mimic the ecosystem of a natural wetland by utilizing water-loving plants to filter wastewater through their root zone, a planted medium, and open water zones. Surface flow wetlands are systems where open water is exposed, much like in a natural marsh. The reclaimed water from the wetland can be discharged into a water body or used for open space irrigation after treatment as well as discharged into a leach field. (Example case: Albany, OR).

- *A participant said he ran into planning problems while doing a constructed wetland project in Brewster. He said he is concerned about people getting caught between towns and Commission and asked to what extent the 208 Plan will be coordinated with the towns.* Mr. Horsley said that the towns should look to the 208 Plan as a guidance document; it will be an official plan that is adopted by the county and approved by the state and the Environmental Protection Agency (EPA). Ms. Harvey said the stakeholder process is designed to get the towns on board and to support coordination between the towns and the Commission. Ms. Perry added that the towns have had a lot of input throughout the process.
- *A participant said this "communication breakdown" point is important, and that if the Commission is going to implement a plan, communication has got to be loud and clear.*
- Mr. Horsley said that private developers sometimes want to do something innovative, but steer clear of doing it because it is too hard to get it permitted and accepted. The goal of this planning process is to make using innovative technology easier and to streamline permitting.
- *A participant commented that the Fact Sheet says the constructed wetland—surface flow approach hasn't been approved.* Mr. Horsley said that this technology has been routinely approved by the Massachusetts DEP, and there is a lot of evidence to indicate that it works.
- *Does this approach refer to existing as well as created wetlands?* Mr. Horsley replied that the wetlands used for this treatment are constructed, typically upstream of

natural wetlands. The goal is to protect existing wetlands, not to overload them with wastewater. That said, he added, the MEP process gives credit for water that moves through existing wetlands.

Constructed Wetlands—subsurface flow: After primary treatment in a septic tank or wastewater treatment facility, or secondary treatment at a wastewater treatment facility, wastewater is treated by pumping water slowly through subsurface gravel beds, where it is filtered through plant root zones and soil media. Water flows 3 to 8 inches under the surface to prevent public exposure to wastewater and mosquito breeding. A combination of horizontal and vertical flow subsurface systems must be utilized to provide total nitrogen removal. This solution can also offer opportunities for recreation activities on land above the subsurface system. (Example case: Thailand). Mr. Horsley said that data show these systems are even more effective than surface wetlands. This is a very powerful treatment system.

Effluent Disposal—out of watershed: Effluent disposal can take a variety of forms, including infiltration basins, a soil absorption system, injection wells, or wick wells. These disposal methods place highly treated effluent back into groundwater. Transporting and disposing of effluent out of the watershed has the advantage of removing the nitrogen load to another watershed. Transport to another watershed requires the receiving watershed to be able to accommodate the additional nitrogen load.

- *One participant commented that Provincetown's leach fields are soccer fields.*
- Mr. Horsley noted that one concern is keeping the water balance within the hydrologic system. You can deplete the water table if you inject water into deeper aquifer.

Effluent Disposal—ocean outfall: Similar to out of watershed effluent disposal, ocean outfall effluent disposal involves removing highly treated effluent from watershed, but in this option, the effluent is released into the ocean. This solution is not currently permitted, and would require a high level of regulatory oversight. The solution is being considered as part of the 208 planning process due to limited land availability for disposal on Cape Cod.

Phytoirrigation: In phytoirrigation, wastewater treatment facility effluent goes through secondary treatment and then is irrigated onto plants that can remove nutrients and other contaminates. Fast growing poplar and willow trees are typically used for this process. (Example case: Woodburn, OR).There is currently a proposed phytoirrigation project in Sandwich that would be run through rhododendrons. This project is in design phase.

Participants were asked for questions and comments on these watershed level technologies and approaches.

- *To what extent cost will be incorporated into the planning process?* Mr. Horsley said that cost will be added to matrix, along with other indicators, such as maintenance requirements.
- *To what extent is the 208 Process going to deal with financial limitations?* Mr. Horsley said this will be discussed more later in the presentation. He encouraged participants

to think about co-benefits of approaches. For example, if you use oyster reefs, the cost of implementation may be offset by the benefits this approach can provide. The Technology Matrix will incorporate a lot of this information.

- *What is the longevity of the approaches being considered? Are there things that can extend the lifecycle of these options (e.g., introducing beneficial insects) are being considered?* Mr. Horsley said the Commission is going to analyze technologies and approaches on a lifecycle basis and that longevity will be considered.
- *Has anyone has thought about reusing treated wastewater? Centralized tanks could be used to capture reuse water for fertilizer irrigation. In other areas of the country, he said, it is common practice for golf courses to use treated wastewater. This kind of "co-benefits" thinking is what the Cape needs to be doing.*
- *Water needs to be carefully tested before we put it on land, since it can kill crops, grass, and potentially wildlife if there are high concentrations of certain things (such as pharmaceuticals or other chemicals) in the water.*

Neighborhood or watershed level technologies/approaches

Phytobuffers: This approach involves using trees with deep root systems, particularly willows and poplars, to capture nutrients in the soil. Green plants with deep taproots are planted as a buffer to intercept existing groundwater. The plants and their associated microorganisms reduce contamination in soils and ground water. Often phytohydraulics causes the groundwater plume to be redirected and pulled towards the plants. (Example case: Kavcee, WY).

Fertigation Wells: Fertigation wells can capture nutrient enriched groundwater, such as from a wastewater treatment facility discharge, and recycle it back to be used to fertilize and irrigate turf grass areas, such as golf courses, athletic fields, and lawns. Fertigation can significantly reduce nutrient loads to down-gradient surface waters while reducing fertilizer costs to the irrigated areas. (Example case: Plymouth, MA). Mr. Horsley said that wastewater treatment plants don't remove all nutrients. Fertigation can be used to remove more nutrients from treated wastewater.

- *A participant commented that there is only sandy soil in this area and asked whether this will work for fertigation.* Mr. Horsley said yes, sand is a good filter. He said you need 50 feet of sand to remove bacteria, and more like 200 feet to remove viruses.

Permeable Reactive Barriers (PRB): A permeable reactive barrier (PRB) is an in-situ (installed within the aquifer) treatment zone designed to intercept nitrogen-enriched groundwater. Through use of a carbon source, microbes in the groundwater uptake the nitrogen, thereby denitrifying the groundwater. PRB systems typically use vertical trenches, sequences of bored columns, or injection methods to introduce a carbon source into the groundwater. PRBs would be sited perpendicular to groundwater flow and aligned with roadways and power lines. Use of PRBs can remove nitrogen from water flowing through the watershed, thereby reducing the nitrogen load flowing into estuaries. (Example case: Falmouth, MA). Mr. Horsley said a PRB has been installed in Waquoit Bay and has been successful in removing nitrogen.

- *One participant mentioned that it takes seven years for nitrogen to travel from the Provincetown leach field to Cape Cod Bay*.

<u>Inlet and Culvert Widening</u>: Re-engineering and reconstruction of bridge or culvert openings to increase the tidal flux through the culvert or inlet can help reduce the nitrogen levels in coastal waters. This solution generally works better with a larger tidal range, but could be feasible on both the Cape Cod Bay side (approximately nine feet tidal range) and Nantucket Sound side (approximately three feet of tidal range) of the Cape.

<u>Salt Marsh Habitat Restoration</u>: Salt marsh is one of the most productive ecosystems in the world, surpassing rainforest in productivity per acre. Approximately 65% of historic salt marsh has been lost in Massachusetts. Salt marshes cycle and remove nitrogen as well as provide critical habitat and spawning sanctuary for a wide variety of birds, mammals, and marine life in addition to hosting a range of plant species and important biogeochemical processes. The capacity of salt marsh to intercept nitrogen is significant and well researched worldwide. Substantial areas of former salt marsh on the Cape are either under consideration for restoration or could be restored, which would provide storm surge and coastal flooding protection in addition to water quality benefits in certain watersheds.

<u>Shellfish Habitat Restoration</u>: Oyster reefs were historically one of the main consumers and recyclers of nitrogen in the coastal environment on Cape Cod. However, according to the Nature Conservancy, oyster populations have declined by 95%. Restoring oyster populations may greatly reduce eutrophication in estuarine environments. It may also increase shellfish productivity, improve commercial and recreational fisheries for other species, increase protection from shoreline erosion and flooding, and provide buffering from ocean acidification. (Example case: Wellfleet, MA).

<u>Aquaculture / Shellfish Farming</u>: Farming oysters and other shellfish has been proposed as a potential method for reducing nitrogen levels and eutrophication in estuaries. Nitrogen removal rates from oysters have been well documented, and the harvest of oysters physically removes the nitrogen they sequester. Oysters also remove nitrogen through their biological cycle, which puts nitrogen directly back into the atmosphere. Aquaculture can be done on man-made structures (e.g., cages or floating bags) or natural reefs.

<u>Surface Water Remediation Wetlands</u>: Surface water remediation wetlands can be constructed to aid in water quality improvements to surface water bodies, usually streams or rivers. Water is pumped or allowed to flow naturally through treatment cells containing wetlands. Surface water remediation wetlands are often used in combination with groundwater recharge or potable water reuse systems. Surface water remediation wetlands are generally used with free-water surface wetlands due to their larger size as well as their lower capital and operation and maintenance costs. (Example case: Shanghai, China).

Pond and estuary dredging: Lakes, ponds, streams, and estuaries store nutrients within their sediments. These sediments tend to accumulate over time. Subsequently, these nutrients can be release into the overlying water column and can become a major source of nitrogen and phosphorus. Dredging and removing these sediments and accumulated nutrients removes the nutrients from the water body and potentially the watershed. (Example case: Dennis, MA).

- *A participant noted that the byproduct of dredging could be valuable and asked whether there are restrictions on what can be done with this sediment*. Mr. Horsley said that yes, there are restrictions on what can be done with this sediment and that is a big part of why dredging has such a lengthy permitting process. When dredging, you have to do extensive testing. Often there are a lot of toxins in this material. Depending on what is in the soil, it can be used for different purposes. If it is contaminated, it often has to be disposed of, which is expensive. This testing is time consuming and expensive.

Cape-wide level technologies/approaches

Compact Development: Both compact development and open space residential development (OSRD) of subdivisions result in smaller lots and less maintained-lawn acres. The higher density development reduces wastewater collection costs while also providing a common disposal area. Compact development is also referred to as "Smart Growth". Mr. Horsley noted that the Provincetown sewer system is affordable due to development not being so spread out.

Fertilizer Management: Managing fertilizer application rates to lawns, golf courses, athletic facilities, and cranberry bogs can reduce nutrient input into the watershed. Residential lawn loading rates could be reduced on existing developed parcels through an intensive public education and outreach program. This could include a "Cape Cod Lawn" branding program, replacing some turf areas with native vegetation, establishing naturally-vegetated buffer strips on waterfront lots, and reducing application rates. Fertilizer loading rates for new development could be accomplished by reducing lot sizes (cluster development), restricting lawn sizes, and/or by incorporating more naturally-vegetated open space areas. Municipalities could directly reduce fertilizer applications on athletic fields and other properties. Golf courses can significantly reduce nitrogen loading rates by using slow-release fertilizers and reducing application rates in rough areas. Cranberry bog fertilizer exports from the bogs can be reduced using tail water recovery systems. Site-specific assessments are needed to estimate load reductions. The Commission designated a cape-wide Fertilizer Management District of Critical Planning Concern (DCPC), which authorizes the towns to adopt local fertilizer management regulations (state law prohibits local fertilizer management except under the DCPC). The DCPC does not require towns to adopt fertilizer regulations, but paves the way for their adoption. Barnstable County will be conducting a public education process around fertilizer use. More information about this on the Commission website.

Remediation of Existing Development: Existing developments or schools with excess wastewater treatment capacity can allow existing nearby developments to connect to their underutilized wastewater treatment infrastructure. A town can operate the wastewater treatment facility if the existing owner prefers to not take the responsibility for treating the off-site wastewater. An example of this is the Kingman Marina in Bourne, which was permitted to expand its development footprint in exchange for hooking up adjacent, existing homes to its wastewater treatment facility. This is a good private-public partnership.

Transfer of Development Rights (TDR): Transfer of development rights is a regulatory strategy that transfers development rights from one property (known as the sending area) to another property (known as the receiving area). This strategy is used to direct growth and associated nutrient loading away from sensitive receiving watersheds or water bodies. When they sell their development rights, the protected parcels in the sending receive a deed restriction that limits future development on these properties. The deed restriction can limit the number of homes or tie development to the availability to future wastewater treatment facility infrastructure.

- *Is it is possible to do TDR across town boundaries?* Mr. Horsley replied that doing so would require a legal change, but it is something that we can and should consider. You can't do it today under current regulations, but it is possible to change the rules on this. Also, we don't have to create anything new in undertaking TDR—this is something other places have done and created a good template for.
- *In Provincetown there is a "checkerboard" system for sewer. There are a lot of properties that want to sign up, but it isn't always cost effective to hook these properties up to the sewer. What could be done for these properties?* Mr. Horsley said that a shared Title V system is one option for these properties.
- *Is having developers be required to put funding into a "sewer fund" or something like that is a possibility for generating funds?* Mr. Horsley said that it would be possible to trade development rights (e.g., increase density) in exchange for payment for infrastructure costs.
    - *Another participant said that economic development is one way to do this. Also, he mentioned that stakeholders in the towns have changed over time. For example, one hotel didn't want to be on sewer until the owners wanted to sell and then they "attended every meeting" and really wanted to get put on sewer.*

Stormwater best management practices (BMP): There are a number of non-structural best management practices stormwater strategies that can be used to reduce nutrient runoff, including: street sweeping, maintenance of stormwater utilities, education and public outreach programs, land use planning, and impervious cover reduction and control. Many towns map existing stormwater utilities. The Commission will try to add those data to the 208 Plan Reference Map.

Existing efforts on the Cape

Mr. Horsley noted that many towns on the Cape are already using some of these technology options and approaches. He gave an overview of some of the alternative technologies and approaches Cape towns are currently considering or have in place. These include:

- Wellfleet: Coastal habitat restoration & aquaculture
- Mashpee: Aquaculture & Expanding Existing Systems
- Brewster: PRB & Bioswales
- Orleans: Fertilizer Control By-Law
- Harwich: Muddy Creek & Cold Brook Natural Attenuation
- Falmouth: Aquaculture, Inlet Widening, Eco-Toilet Demonstration Project, PRBs, Stormwater Management (Little Pond Watershed), Fertilizer Control By-Law, Subsurface Nitrogen Removal Septic System

IV. PROBLEM SOLVING PROCESS AND PRINCIPLES

Mr. Horsley provided an overview of the problem solving process and principles. He reiterated that the goal the Working Groups is to develop remediation options that would achieve water quality targets with a focus on first targeting low cost, low barrier options to reduce nitrogen and then considering more costly and traditional options later (e.g. sewering). He noted that Provincetown has already sewered and thus is in a slightly different position than many other Cape communities.

Working Groups will focus on total controllable nitrogen load. The technologies and approaches selected should aim to reduce the total controllable nitrogen load by identifying options that reduce the portion of *septic* load that needs to be reduced. For example, the portion of septic load that needs to be reduced could be made smaller if Cape Cod takes on fertilizer and stormwater solutions first. Additionally, the percentages of controllable nitrogen that need to be removed to meet total maximum daily loads (TMDLs) change depending on the characteristics of the watershed.

Overview of 7-steps for Problem-Solving Process

Mr. Horsley described the 7-step alternatives screening process the group will apply. The process is as follows:

1) Targets/Reduction Goals: Establish targets and articulate project goals. Mr. Horsley noted that some study areas have MEP reports that tell them what the TMDL targets have to be. In Provincetown and a couple areas, we don’t have MEP studies, so we have to figure out what our targets and goals are going to be.
2) Other Wastewater Management Needs: Identify priority geographic areas (e.g. high nitrogen reduction areas, Title V problem areas, pond recharge areas).
3) Low Barriers to Implementation: Determine which management activities have low barriers to implementation and should definitely be implemented. These might be the easiest and least costly management activities that should be undertaken regardless of other management actions (e.g. fertilizer management and stormwater mitigation – two approaches that Cape Cod towns are already actively pursuing).

- *One participant indicated the East Harbor area needs to be targeted, Mr. Horsley agreed*.

4) Watershed/Embayment Options: Assess alternative options to implement at the watershed or embayment scale (e.g. innovative and lower-cost solutions).
    - *A participant said that there was a recent meeting about East Harbor and Pilgrim Lake, and that they know they need to at least replace the culvert. This should be added to the Commission's list of plans.*
5) Alternative On-Site Options: Assess options to implement at the site-level.
6) Priority Collection/High Density Areas: Examine priority collection/high density areas.
7) Supplemental Sewering: Consider traditional sewering or other grey infrastructure management options.

Ms. Harvey asked the Working Group to reflect on the goals and priorities of this process.

- *One participant commented that there is a presumption that Provincetown knows what its goals are as a town. If the goal is clear, then the challenge is to figure out how to get people to do what needs to be done, such as through incentivizing them to do things that will improve water quality.*

Mr. Horsley asked the group to articulate what they think the goals of the 208 planning process are for this area. Goals and priority concerns expressed by participants include:

- *Improve our environment*
- *Address nutrients in ponds*
- *Prevent beach closures*
- *Get more people hooked up to our sewer*
- *Stormwater continues to be a problem*. This is more of a pathogen concern than a nutrient concern, according to participants.
- *Beach Point is a priority*, this is a problem area. There were Title V problems at Beach Point associated with the condo complex and have been some beach closures due to contamination. Also, the bunkered systems in the area have affected aesthetics and property values.
- *Technical analyses and studies needed*. The MEP has done a study on Provincetown and Truro. This was not a technical analysis, but it does have some information that can help Provincetown figure out its goals. The town does have a good idea of what the problems are.
- *Parking and other impermeable surfaces are an issue*. Currently, the requirements are 1.5 parking spaces for unit. The pavement used for parking is impermeable, which creates runoff. You can't manage that kind of runoff with vegetation (it's too much). At some point in the past, the town was talking about putting scrubbers in storm drains in Provincetown.
- *Provincetown could become an eco-destination resort town.* Provincetown could become a demonstration community for sustainability and stormwater solutions. Mr. Horsley said there has been talk about making the Cape an environmental laboratory.

Provincetown could be a demonstration site for innovative water quality technologies. This could bring in money and be a source of economic development.

Ms. Harvey asked the group whether any of the technologies discussed are of particular interest to people in the Working Group.

- *Many participants expressed interest in the ecological solutions, such as phytobuffers and on-site vegetative solutions.*
- *One participant said that wood chips seem like a simple solution to the problem.*
- *A participant said stormwater is a particular concern. The town has talked about treating stormwater for biological contaminants, but currently doesn't*. Mr. Horsley said that permeable pavement will help with this.
- *One participant mentioned that the Cape brings in food from outside, and the nutrients from this food ultimately get deposited here. Therefore, she said, there is a nutrient imbalance that should be considered*.
- *One participant thinks that the urine diversion toilets are unlikely to be acceptable and realistic on the Cape. He's concerned about the infrastructure that would be involved in this*. Mr. Horsley replied that urinals in public bathrooms would be an easy way to try this approach. Perhaps Provincetown could put urine diverting urinals in new public restrooms, with signage about these toilets that indicate they are part of a larger eco-destination approach. *You would have to have a place to put in the tank, which could be challenging given the location of public restrooms. Also, finding locations for the restrooms themselves is challenging. Participants said this approach is likely to get pushback from the public.*
- *A participant suggested that one of the byproducts of this 208 planning process could be to create a guide for restaurants and businesses to give them tools and guidelines for implementing these kinds of innovative technologies. Good guidelines could help businesses make good investments that could be environmentally beneficial and cost-effective.*
- *One participant pointed out that people have complained about paying for water twice—one through their water bill and once through their sewer bill. The combined cost of sewer is somewhere around $800; the Commission has updated costs for this. Reducing wastewater could be cost-effective for people and businesses.*
- *A participant said that if the town is going to try something or pilot something, it has to have a good reasons for what it is doing and why*. Mr. Horsley suggested the town could meter urinals at the main public restaurants or restrooms, and get a sense of how much nitrogen could be diverted, and then this could be translated into effectiveness and cost savings.

Ms. Harvey asked whether there are any technologies or concerns that are particularly of interest to Truro.

- *A participant suggested that composting toilets and dry toilets are likely to be a hard sell in Truro. Installing these might decrease property value and they also won't fix Title*

V problems where they exist.
- *Another indicated that the big problem for the area is stormwater*.
- *A participant added that at Beach Point, they didn't size the pipe properly to address future water needs due to cost and legal issues.*

Ms. Harvey summarized the main priorities and concerns that participants thought should be considered in choosing approaches, according to the categories of Environmental, Economic, and Social concerns:

Environmental
- Climate change impacts
- Impact on ponds
- Co-benefits for the environment (e.g., habitat)
- Addressing contaminants of emerging concern

Economic
- Co-benefits and return economic benefits (e.g., cost savings and business development)
- Cost of implementation and maintenance
- Longevity of systems
- Effect on property values

Social
- Options with less homeowner involvement
- Things that are more easy to get public buy-in for
- Space requirements: things that take up less space are better
- Making the area a eco-resort destination and demonstration community
- Cost-effectiveness and co-benefits of approaches

Ms. Harvey summarized the technologies and approaches that participants expressed particular interest in:

Technologies and approaches of particular interest
- Composting toilets for public restrooms
- Ecological and vegetative solutions
- TDRs
- Woodchips as carbon additions to I/A systems
- Stormwater controls
- Aquaculture

Ms. Harvey then summarized the goals participants expressed during the meeting.

Goals for the 208 planning process
- Conduct studies and get a sense of the sources and extent of water quality issues

- Meet Title V requirements in areas where there isn't sewer
- Maintain bathing beach water quality
- Address stormwater runoff issues, particularly pathogen problems
- Address nutrient problems in ponds
- Deal with overuse of standard systems
- Increase the capacity of the Beach Point system or otherwise address this problem area

V. PLANNING FOR THE NEXT MEETING

Ms. Harvey gave an overview of the next meeting, Meeting Three. She said that scenarios will be formed using the input that was generated today and during the first meeting. At the next meeting, the group will be able to discuss these scenarios, evaluate them, and think about alternative tools and approaches.

Meeting Three will be held:
Tuesday, December 3, 2013
8:30AM -12:30PM
Provincetown Town Hall, 260 Commercial Street, Provincetown, MA 02657

Working Group participants should come the Meeting Three prepared to offer their ideas about what solutions they'd like to explore further given their understanding of the baseline conditions, issues, and priorities in this watershed.

Mr. Horsley encouraged participants to come to the November 13 meting for all stakeholders from all eleven working groups. This meeting will be a chance to think about and identify ways for the Commission to continue to engage stakeholders after the third meeting in December.

VI. GENERAL QUESTIONS AND COMMENTS

Ms. Harvey asked for any final questions or comments.

- *A participant suggested that treatment and sludge removal should be looked at as part of any studies or analysis that are done*.
- *A participant commented that, due to fertilizer regulations, fertilizer is going to be required to not have phosphorus in it. Getting rid of phosphorus in fertilizer will have significant benefits for ponds in the area. Golf courses support these fertilizer regulations. Additionally, the participant said, about $80,000 have been set aside for public education and engagement to make sure people understand the regulations and how to lower phosphorus and nitrogen use.*

Ms. Harvey asked whether any participants have tried using or looking at the GIS layers put online by the Commission.

- *One participant said she gave it a cursory look and thought the data was very impressive.*

APPENDIX ONE: MEETING PARTICIPANTS

Appendix A
Attendance

Name	Affiliation
Elaine Anderson	Provincetown Board of Selectmen
Brian Carlson	Conservation Agent, Provincetown
Laurie Demolino	Board of Health, Provincetown
Paul DeRuyter	Whaler's Wharf
Charleen Greenhalgh	Town Planner, Truro
Jerry Irmer	Provincetown Harbor Committee
Gloria McPherson	Planner, Provincetown
Sharon Lynn	Town Manager, Provincetown
Laura Kelly	Owner, Littlefield Landscapes, North Eastham
Pat Pajaron	Health Agent, Truro
Jonathan Sinaiko	Water and Sewer Board Chairman
Staff and Consultants	
Scott Horsely	Area Manager, Cape Cod Commission
Erin Perry	Special Projects Coordinator, Cape Cod Commission
Anne McGuire	Cape Cod Commission
Kate Harvey	Facilitator, Consensus Building Institute
Danya Rumore	Facilitator, Consensus Building Institute
Dan Milz	PhD Candidate, University of Chicago
Public	
Ed Nash	Golf Course Superintendents of Cape Cod

Cape Cod 208 Area Water Quality Planning
Three Bays Watershed Working Group
Second Meeting

COMM Fire Station
1875 Falmouth Rd, Centerville, MA 02632
October 29, 2013
8:30 a.m.-12:30 p.m.

Agenda

8:30 Welcome, Review 208 goals and Process and the Goals of today's meeting – *Cape Cod Commission*

8:40 Introductions, Agenda Overview, Updates and Action Items– *Facilitator and Working Group*

9:00 Range of Possible Solutions – *Cape Cod Commission and Working Group*

- Technology Matrix
- Technologies Overview
- Survey Questions and Comments
- Additional Questions and Discussion

10:30 Break

10:45 Problem Solving Process and Principles – *Cape Cod Commission and Working Group*

- Overview of 7-steps for Problem-Solving Process
- Examination of Categories of Solutions and their impacts on the Environment, Economy, and Community (triple bottom line)
- Discussion – Identify Considerations and Priorities for Application

12:00 Preparing for Meeting 3 and Beyond – *Cape Cod Commission*

- Review Tools, Alternatives Analysis Approach
- Evaluating Scenarios for Meeting Nitrogen Goals
- Other Process Next Steps

12:15 Public Comments

12:30 Adjourn

Three Bays & Centerville River

Technologies and Approaches

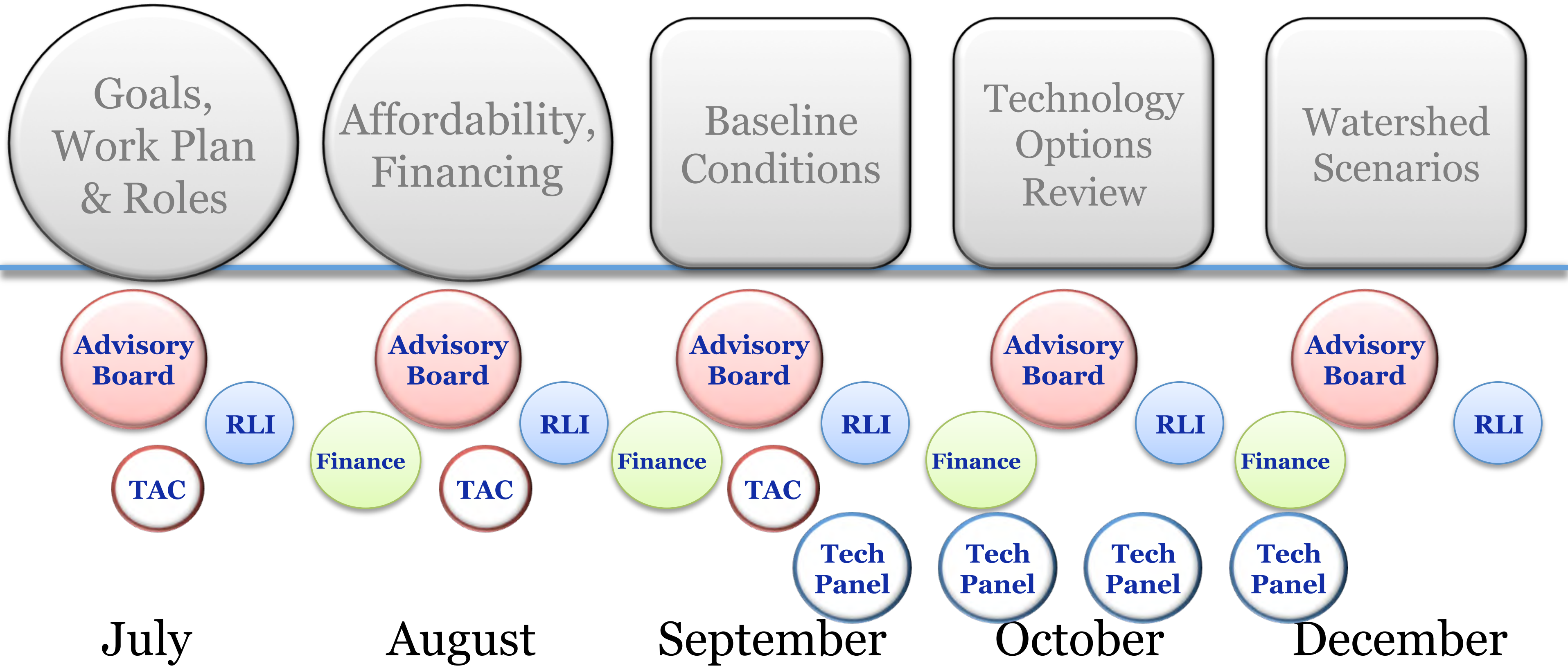
What is the stakeholder process?

Public Meetings

Watershed Working Groups

July	August	September	October	December
Goals, Work Plan & Roles	Affordability, Financing	Baseline Conditions	Technology Options Review	Watershed Scenarios

Public Meetings Watershed Working Groups



RLI Regulatory, Legal & Institutional Work Group

TAC Technical Advisory Committee of Cape Cod Water Protection Collaborative

Baseline Conditions

11 Working Group Meetings: Sept 18-27

Goal of the First Meeting:

To review and develop shared understanding of the characteristics of these watersheds, the work done to date, existing data and information available, and how to apply all of this to planning for water quality improvements for these watersheds moving forward.

Progress since last meeting

- Meeting materials

Progress since last meeting

- ❑ Meeting materials
- ❑ GIS data layers

Progress since last meeting

- ❑ Meeting materials
- ❑ GIS data layers
- ❑ Chronologies

Baseline Conditions

11 Working Group Meetings: Sept 18-27

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

208 Planning Process

Baseline Conditions

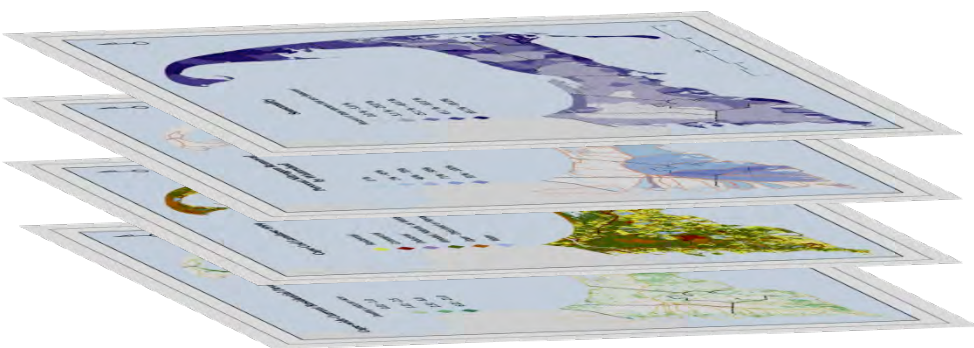
11 Working Group Meetings: Sept 18-27

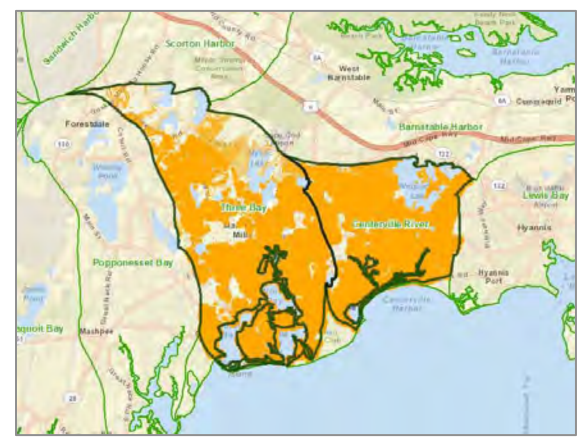
Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Watershed Scenarios

11 Working Group Meetings: Dec 2-11





Baseline Conditions

11 Working Group Meetings: Sept 18-27

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Watershed Scenarios

11 Working Group Meetings: Dec 2-11

Watershed Event

November 13

Center for the Arts Dennis

Wrap up of Cape2O: ur in charge!

Summary of planning process to date

Outline of second 6 months of the 208 planning process

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Goal of Today's Meeting:

To develop a shared understanding of the potential technologies and approaches identified to date, and the benefits and limitations of each; to explore the environmental, economic, and community impacts of a range of categories of solutions; and to identify priorities and considerations for applying technologies and approaches to remediate water quality impairments in your watershed.

Technologies and Approaches for Improving Water Quality

Technologies and Approaches for Improving Water Quality

- The Fact Sheets present various information on the technologies being considered.
- Additional information is contained on the Technology Matrix including the following:
  - Site Requirements
  - Construction, Project and Operation and Maintenance Costs
  - Reference Information
  - Regulatory Comments
- Input from the Stakeholders is requested regarding a technology's Public Acceptance

Technologies and Approaches for Improving Water Quality

- Comprehensive analysis of nutrient control technologies and approaches.

Technologies and Approaches for Improving Water Quality

- ❑ Comprehensive analysis of nutrient control technologies and approaches.
- ❑ Not all of the technologies and approaches will be applicable to Cape Cod.

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- ❑ Workshop 3 will embark on hands on problem solving in each watershed to meet target load reductions.
- ❑ Certain technologies or approaches will be effective at **preventing** nutrients from entering the water body. Others will be effective at **reducing** or **remediating** nutrients that are already in the groundwater or water body.

Technologies and Approaches for Improving Water Quality

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- Certain technologies or approaches will be effective at **preventing** nutrients from entering the water body. Others will be effective at **reducing** or **remediating** nutrients that are already in the groundwater or water body.
- Regulatory programs can address nutrient controls for both existing development and future development.

Solutions

Site Scale | Neighborhood | Watershed | Cape-Wide

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

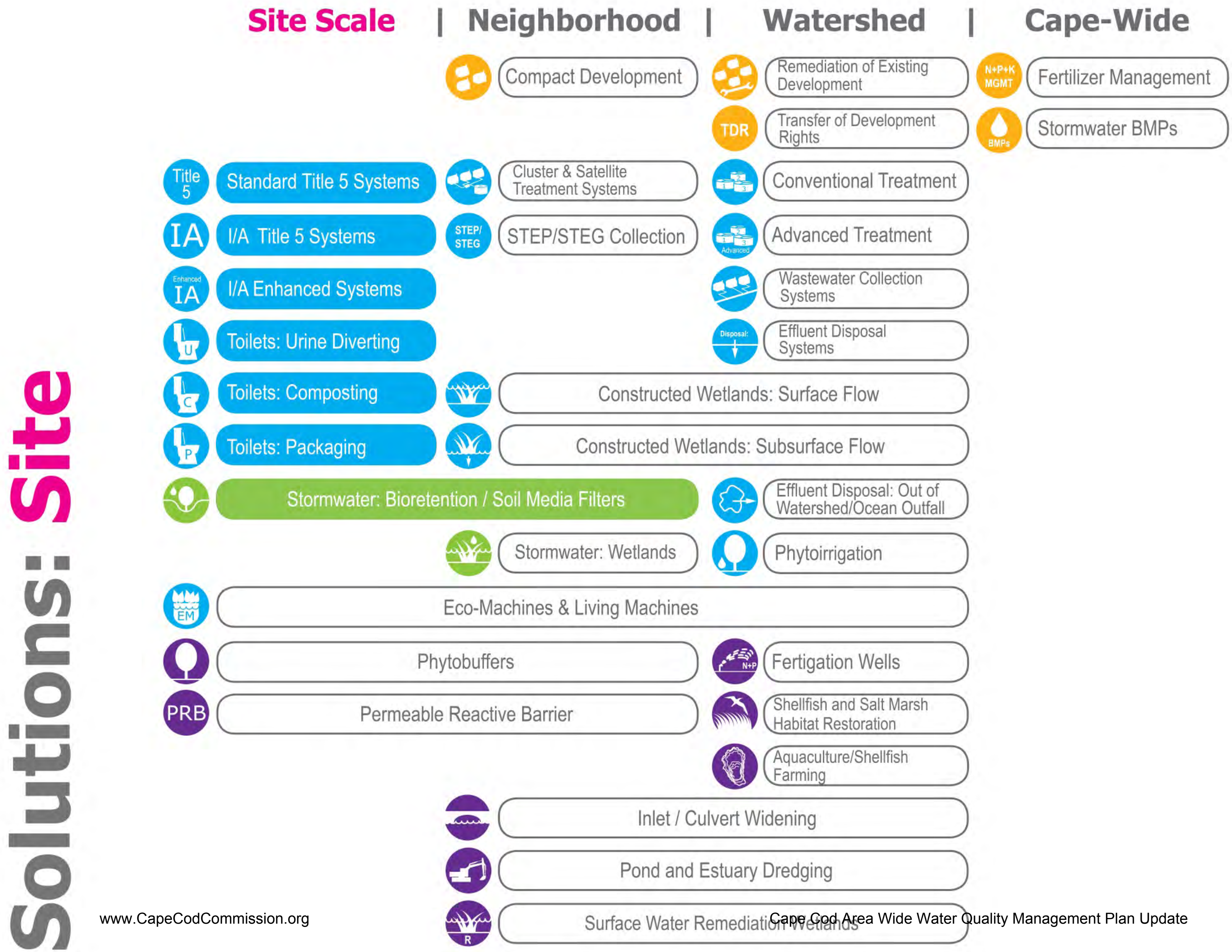
Shellfish and Salt Marsh Habitat Restoration

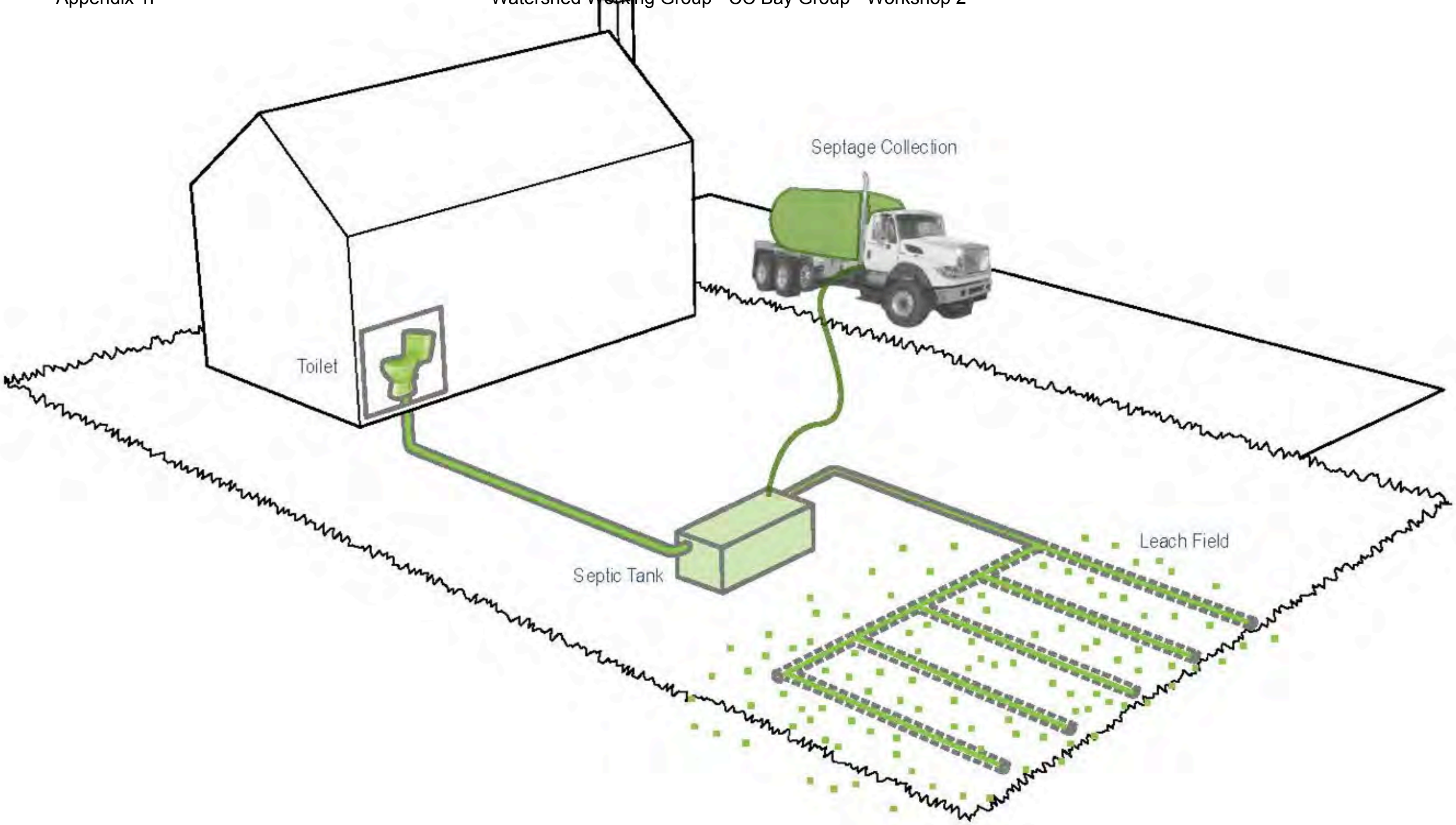
Aquaculture/Shellfish Farming

Inlet / Culvert Widening

Pond and Estuary Dredging

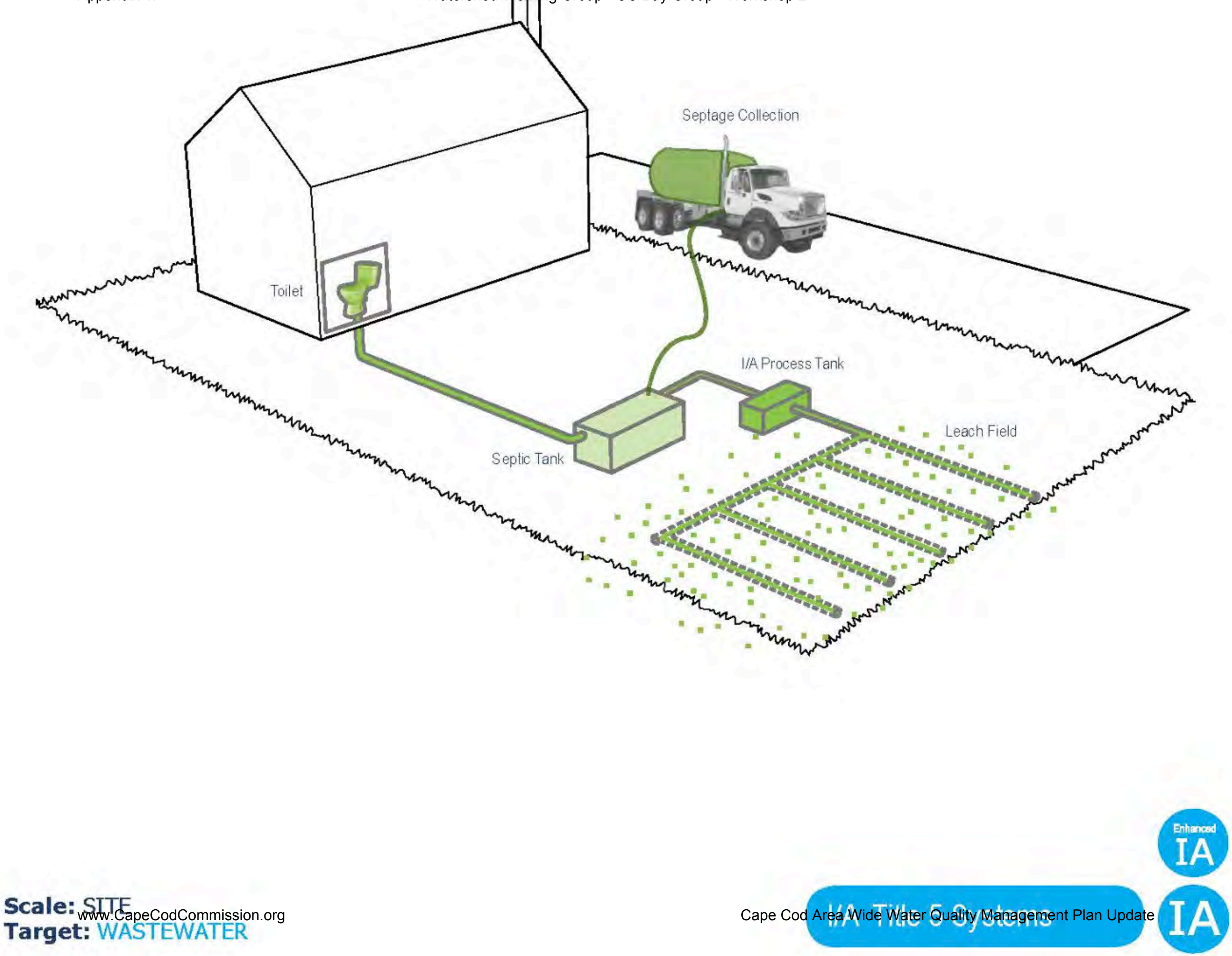
Surface Water Remediation Wetlands

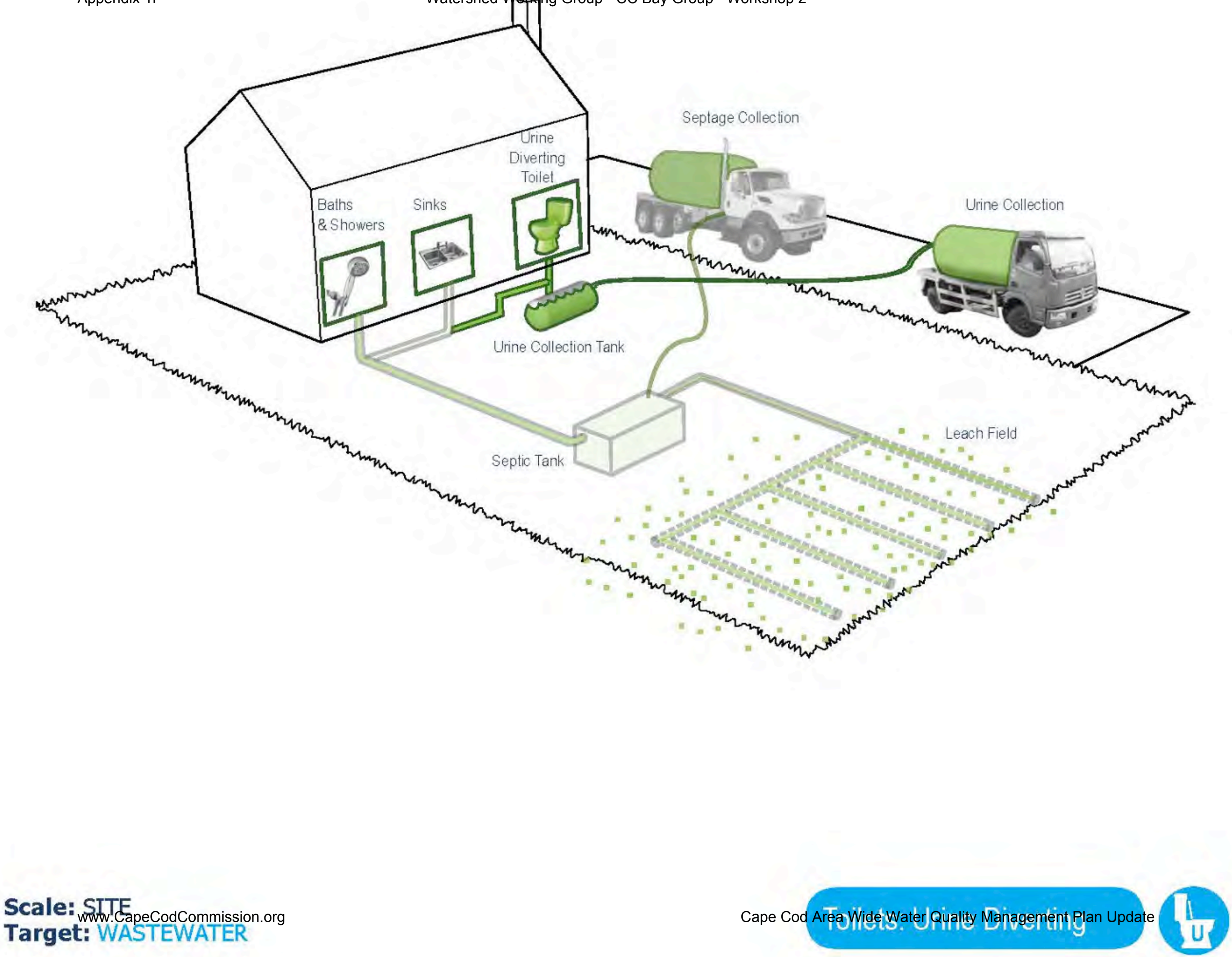

Site Scale | Neighborhood | Watershed | Cape-Wide
Solutions: Site
Compact Development
Remediation of Existing Development
N+P+K MGMT
Fertilizer Management
TDR
Transfer of Development Rights
BMPs
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
IA
I/A Title 5 Systems
STEP/ STEG
STEP/STEG Collection
Advanced
Advanced Treatment
Enhanced IA
I/A Enhanced Systems
Wastewater Collection Systems
Toilets: Urine Diverting
Disposal:
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
EM
Eco-Machines & Living Machines
Phytobuffers
N+P
Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
R
Surface Water Remediation Wetlands

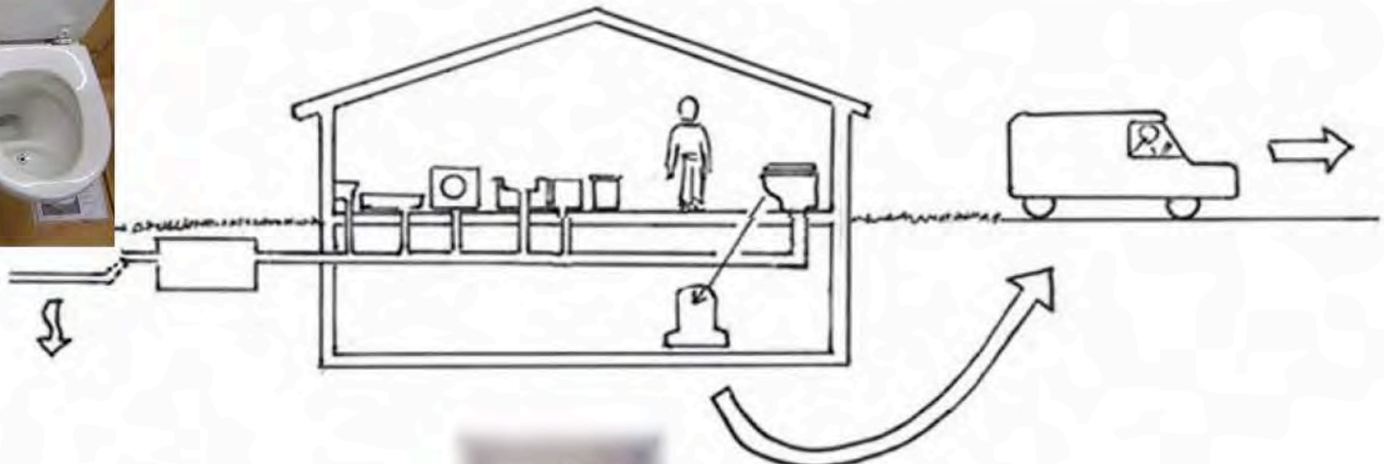


Scale: SITE
Target: WASTEWATER

Standard Title 5 Systems
Title 5


Septage Collection
Toilet
I/A Process Tank
Leach Field
Septic Tank
Enhanced IA
IA
Scale: SITE
Target: WASTEWATER
I/A Title 5 Systems


Septage Collection
Urine
Diverting
Toilet
Baths
& Showers
Sinks
Urine Collection
Urine Collection Tank
Leach Field
Septic Tank
Scale: SITE
Target: WASTEWATER
Toilets: Urine Diverting



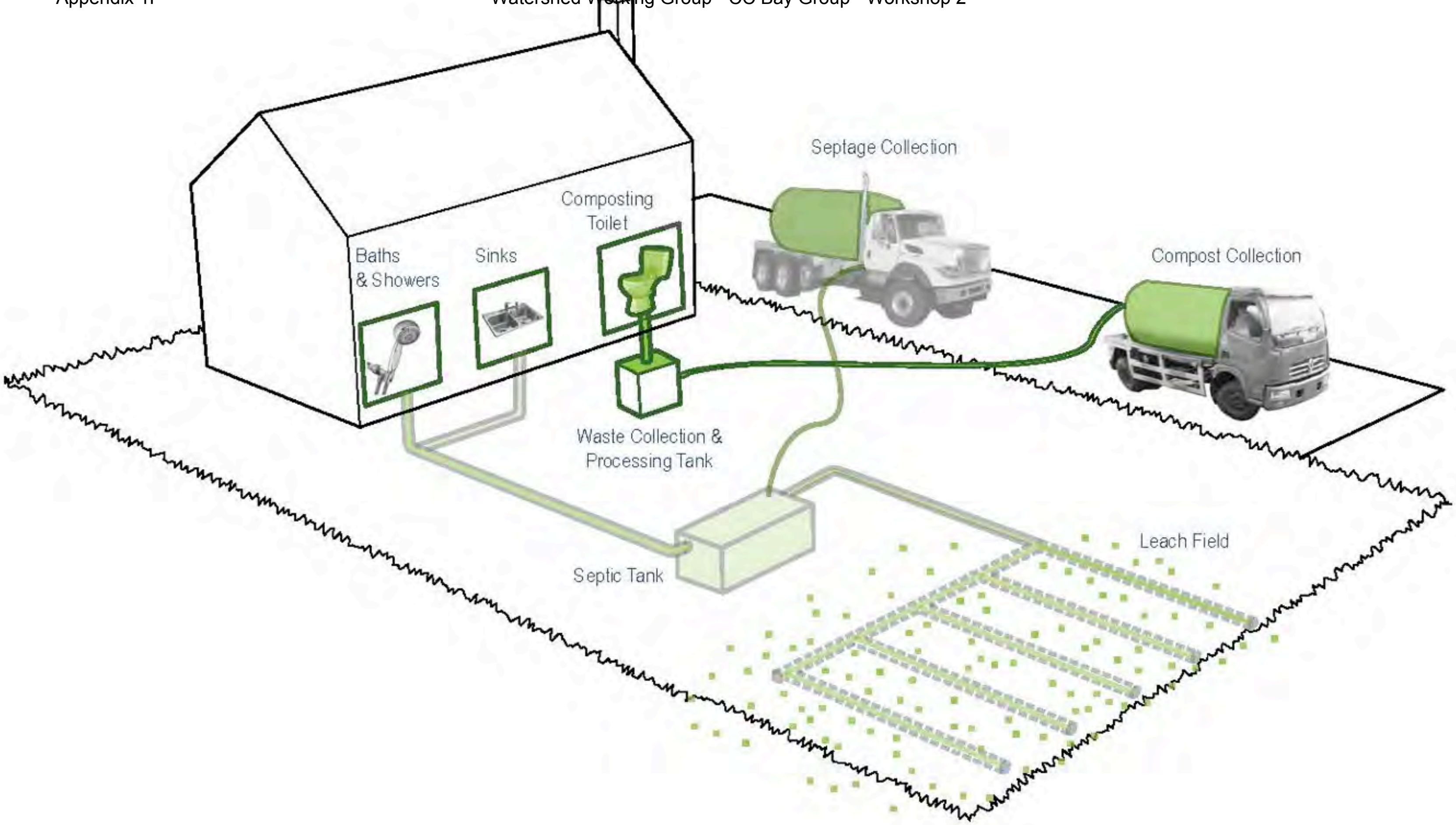
Waterless Urinal

IBC container (220 gallons)

40" x 40" x48"

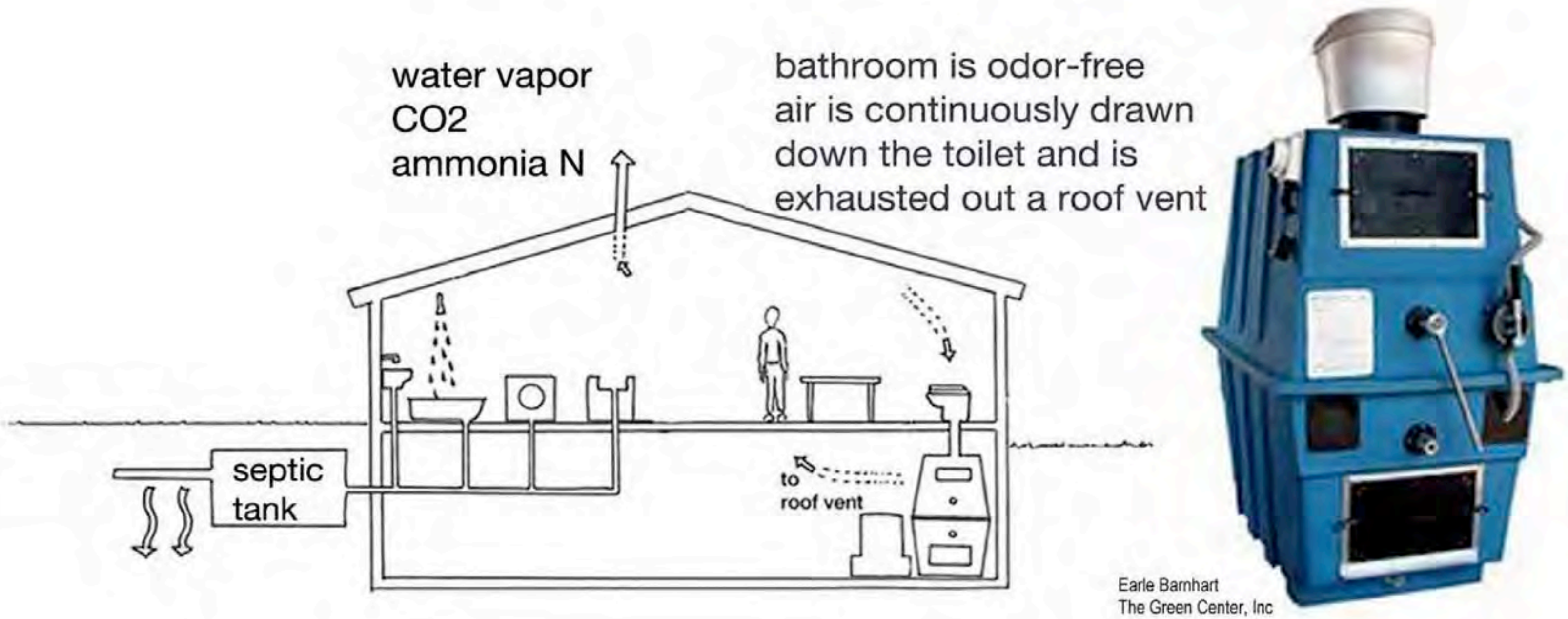
Source: Earle Barnhart, The Green Center Inc. and Horsley-Witten Group Inc.

Toilets: Urine Diverting



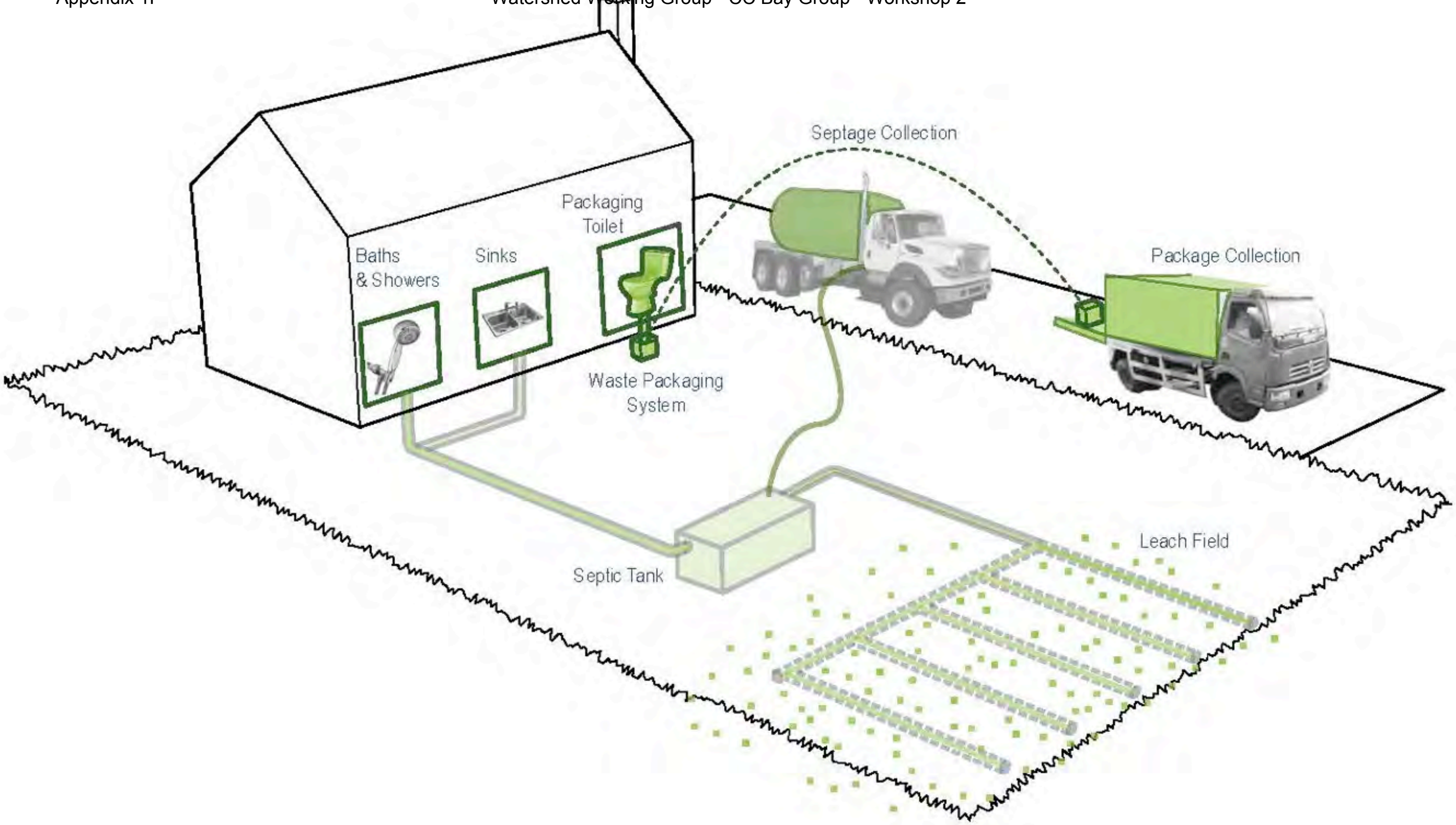
Scale: SITE
Target: WASTEWATER

Toilets: Composting



Source: Earle Barnhart, The Green Center Inc.

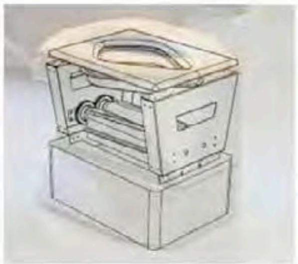
Toilets: Composting



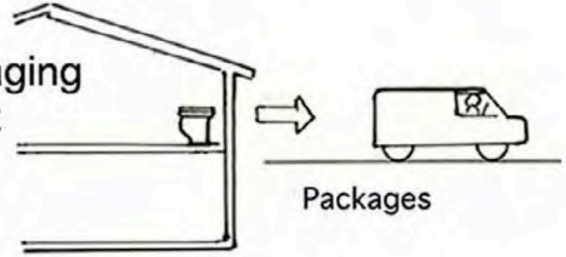
Scale: SITE
Target: WASTEWATER

Toilets: Packaging

PACTO®

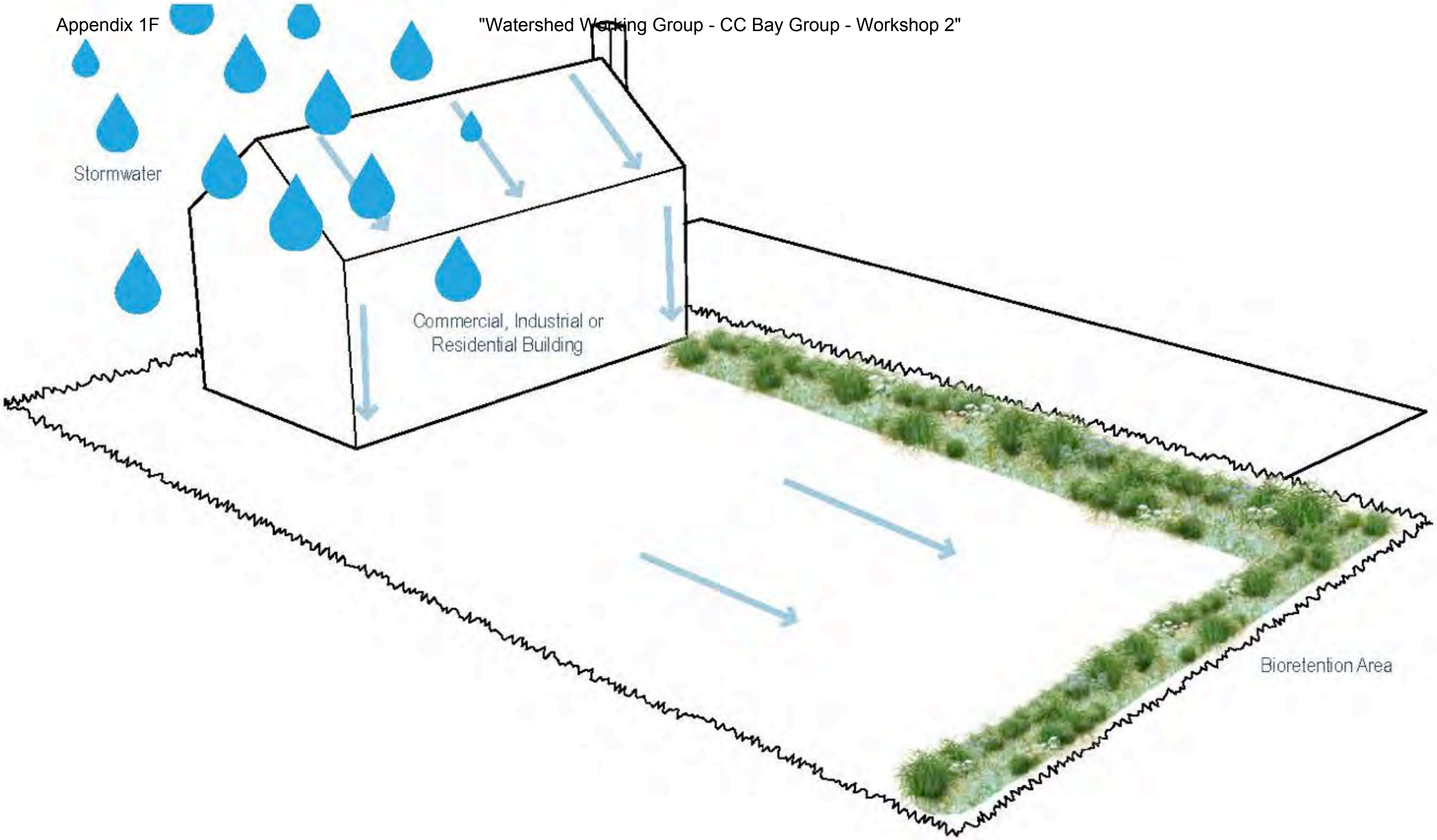


LOOWATT



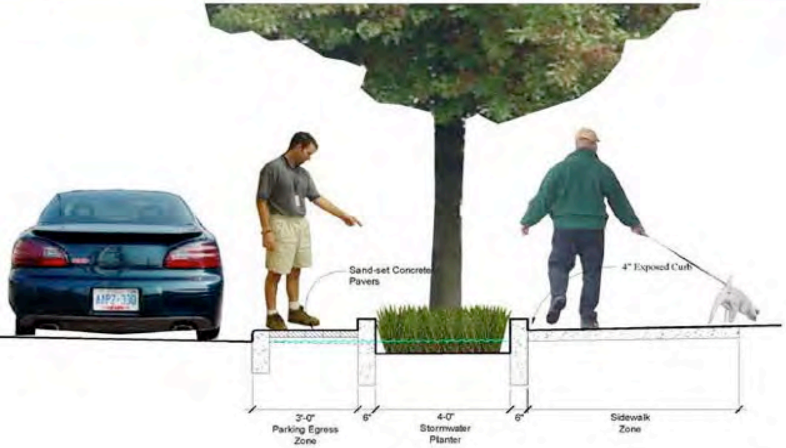
Source: Earle Barnhart, The Green Center Inc.

Toilets: Packaging



Scale: SITE
Target: STORMWATER

Stormwater: Bioretention / Soil Media Filters



Precedent: 12th Ave. Stormwater Project, Portland, OR

Source: City of Portland

Stormwater: Bioretention / Soil Media Filters

Rain Gardens


Solutions: Neighborhood
Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
Remediation of Existing Development
N+P+K MGMT
Fertilizer Management
TDR
Transfer of Development Rights
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Constructed Wetlands: Subsurface Flow
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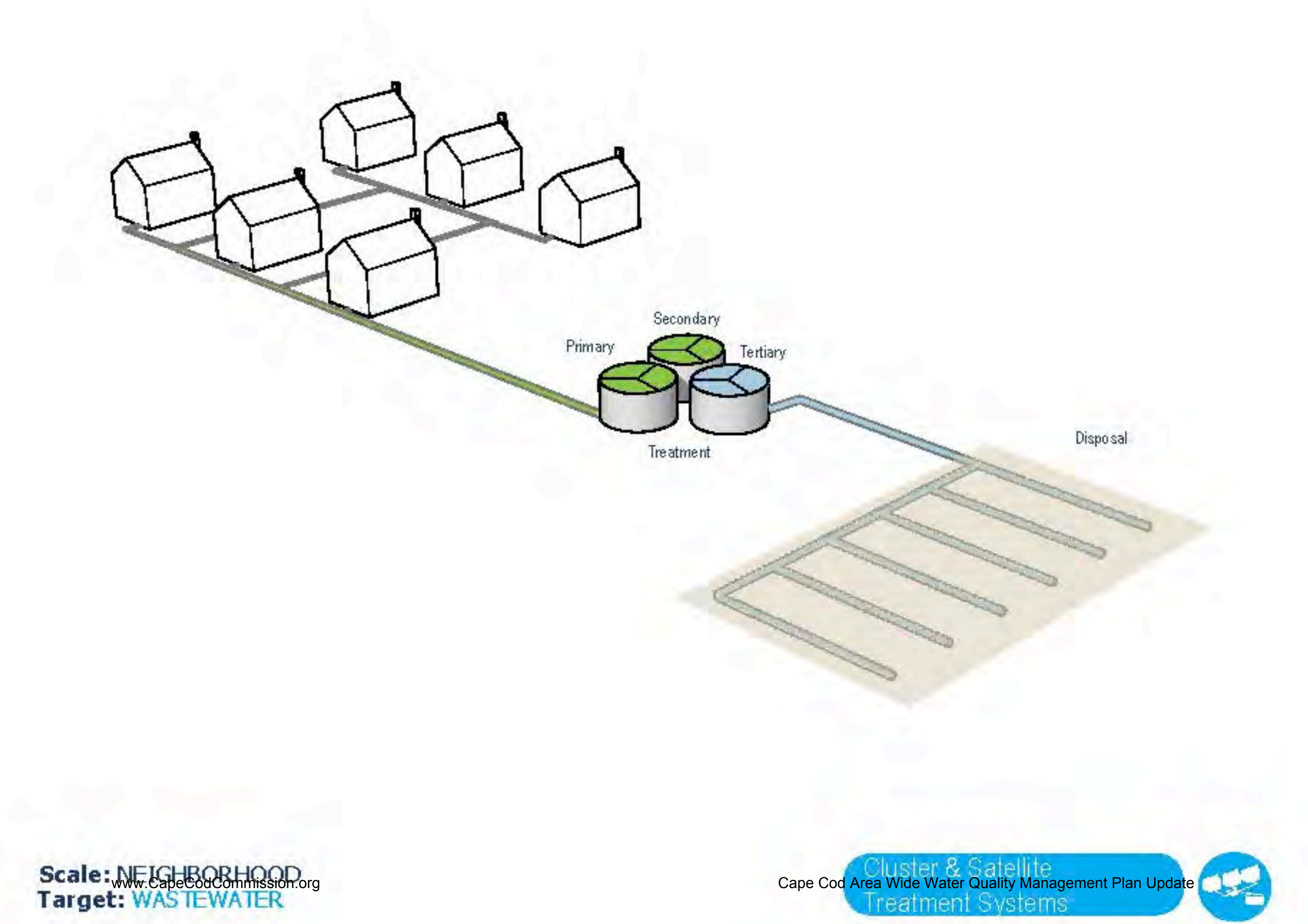
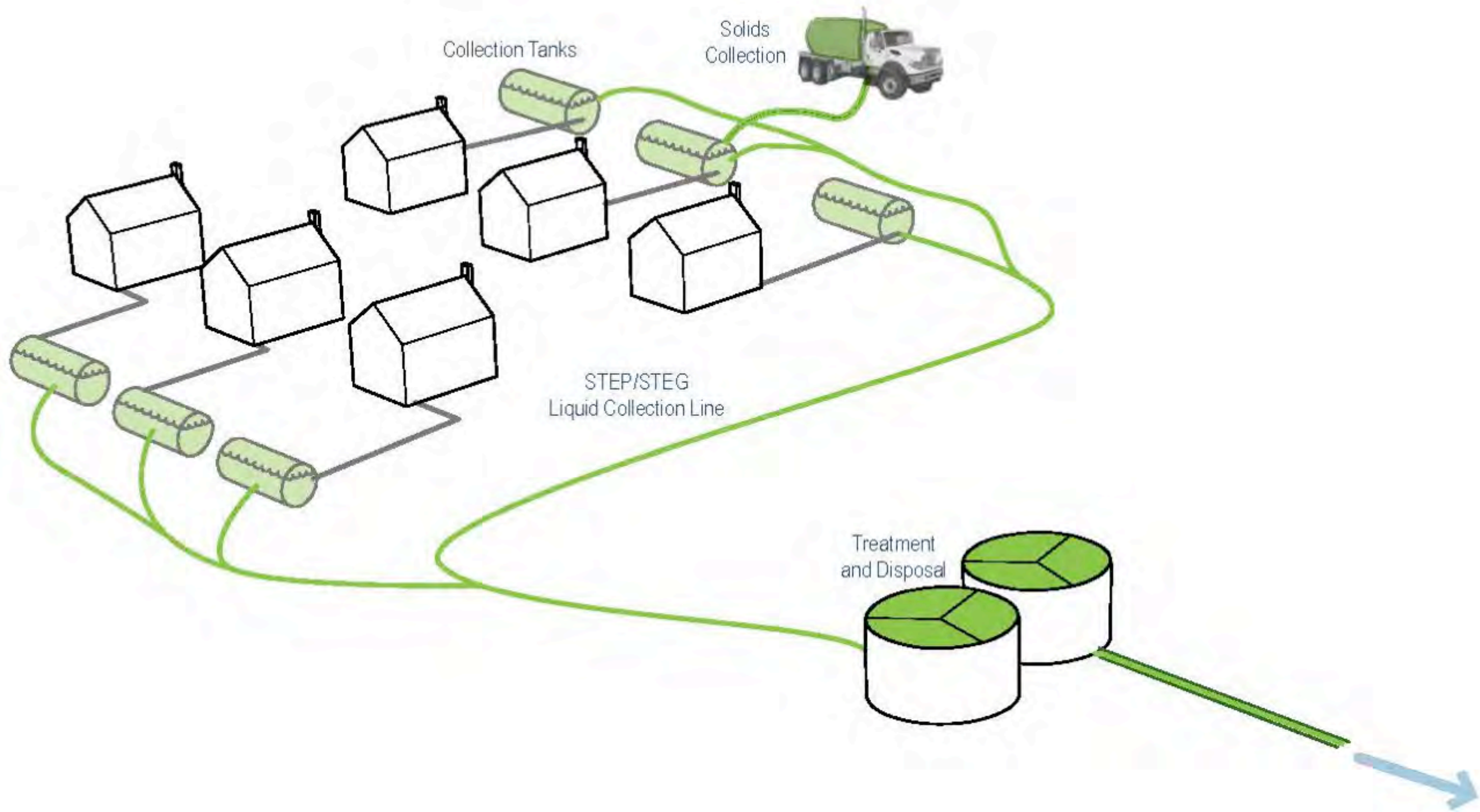
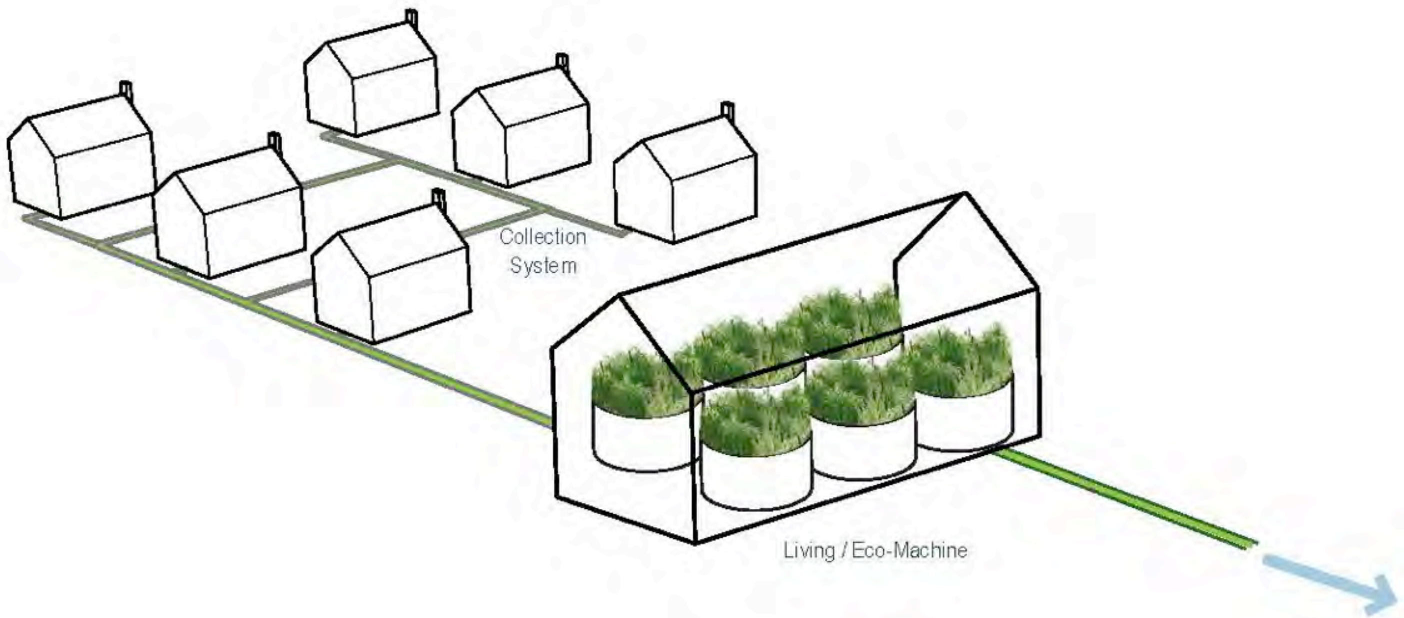

Secondary
Primary
Tertiary
Treatment
Disposal
Scale: NEIGHBORHOOD
Target: WASTEWATER
Cluster & Satellite
Treatment Systems



Scale: NEIGHBORHOOD
Target: WASTEWATER

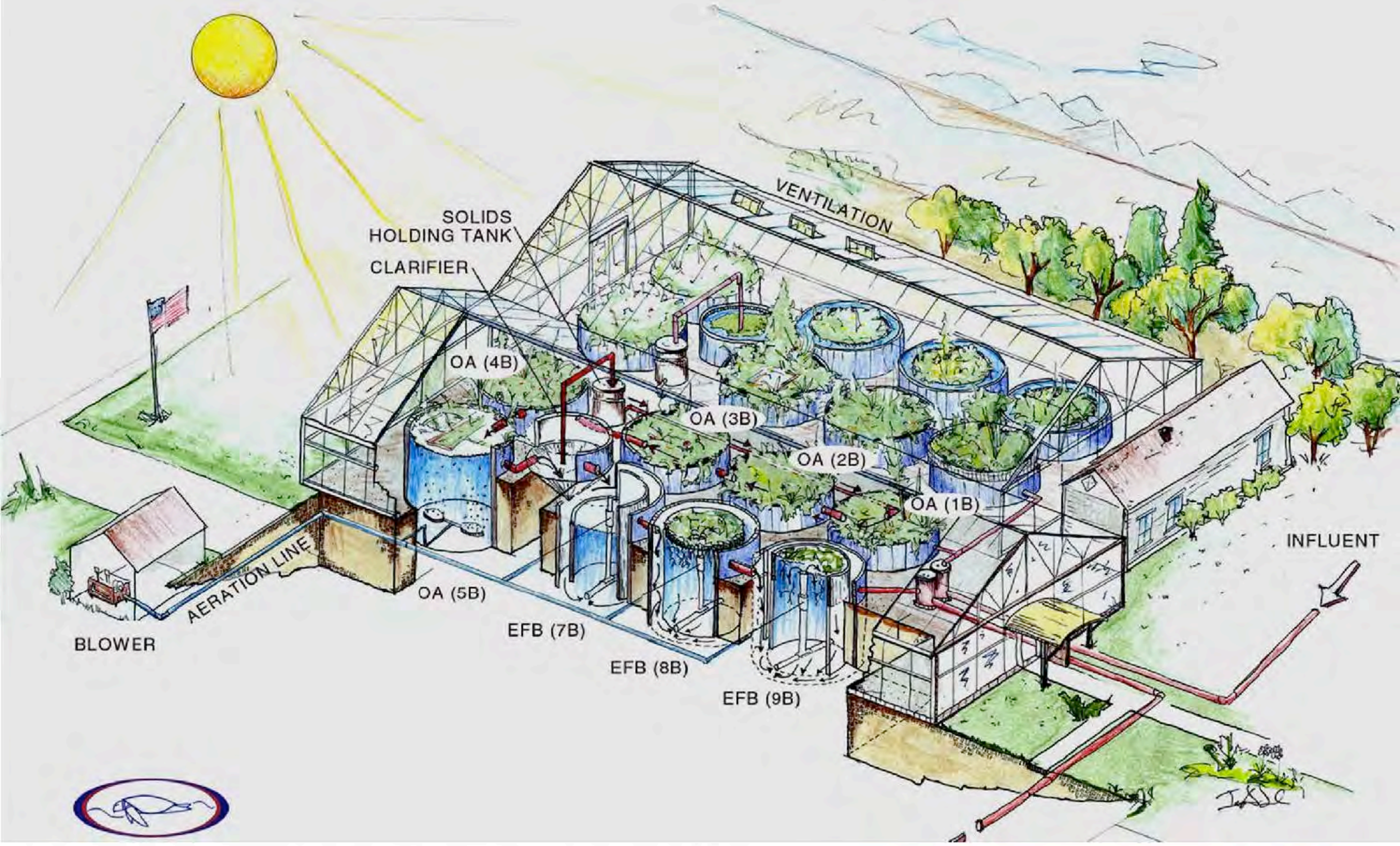
STEP / STEG Collection

STEP/
STEG



Scale: NEIGHBORHOOD
Target: WASTEWATER

Eco-Machines and
Living Machines



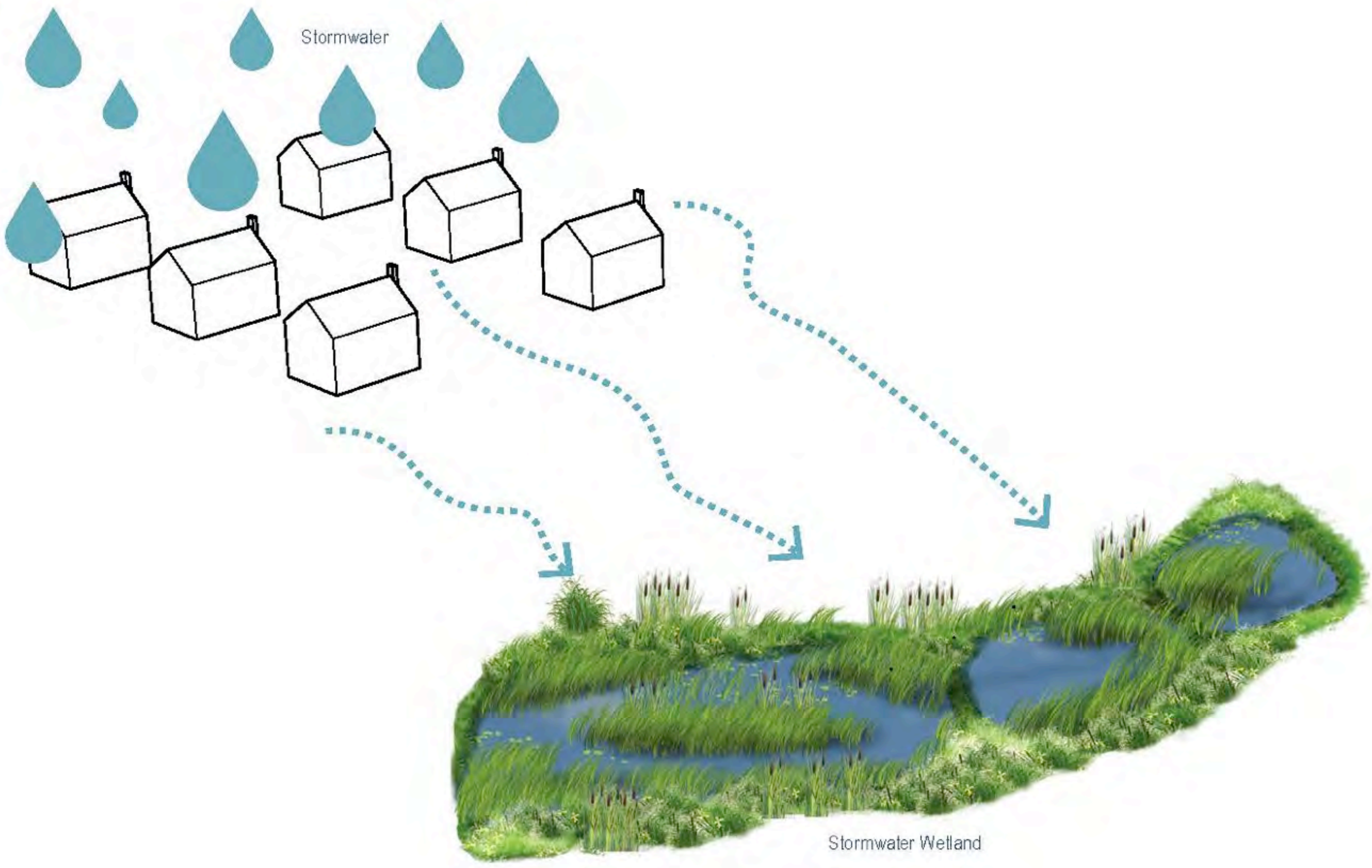
Precedent: Living Machine, South Burlington, VT
Source: Todd Ecological

Eco-Machines and Living Machines

Precedent: Living Machine - South Burlington, VT + Photobioreactors - Falmouth, MA
Source: Todd Ecological and Tom Cambareri

Eco-Machines and Living Machines

EM

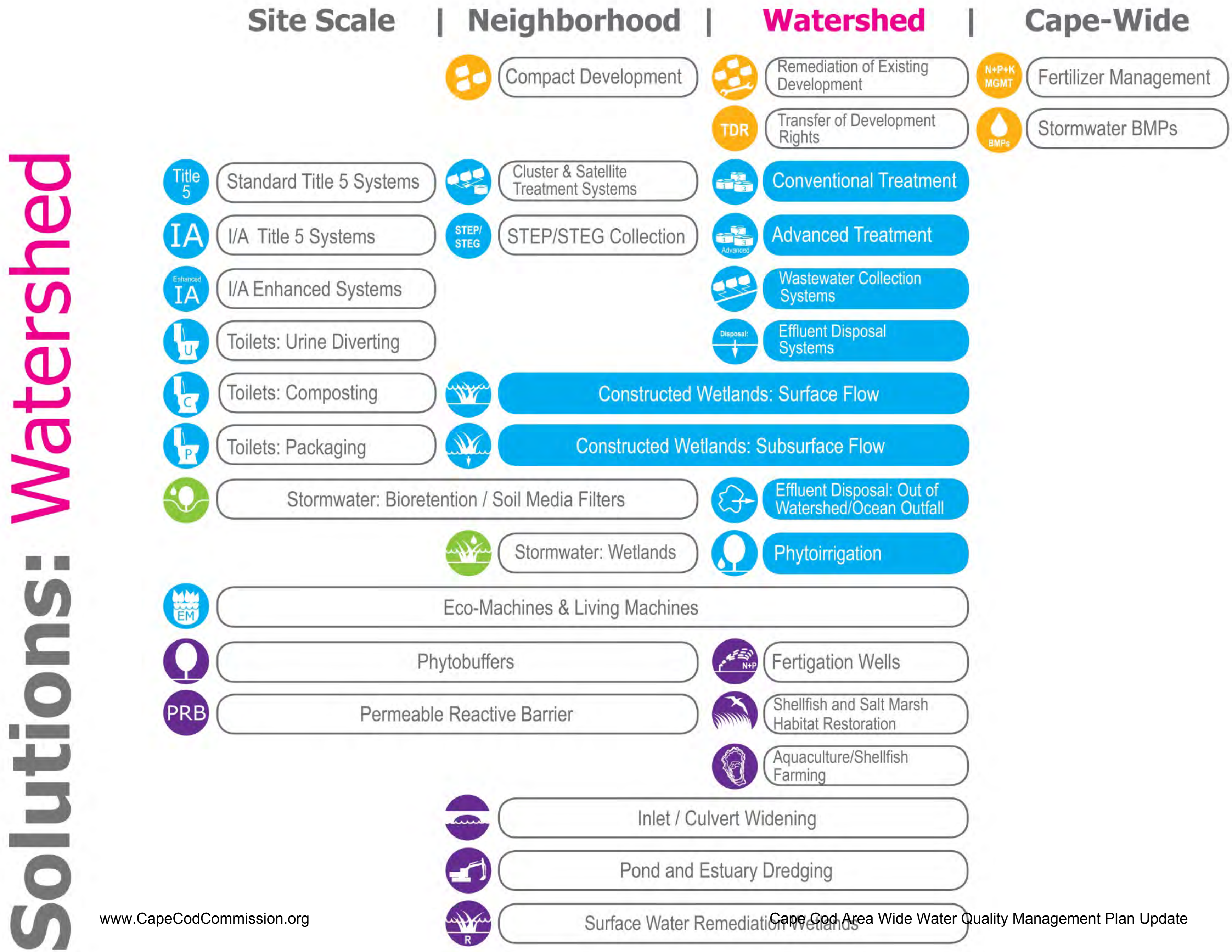


Scale: NEIGHBORHOOD
Target: STORMWATER

Stormwater Wetlands

Precedent: Missouri
Source: AECOM

Stormwater Wetlands


Solutions: Watershed
Site Scale | Neighborhood | Watershed | Cape-Wide
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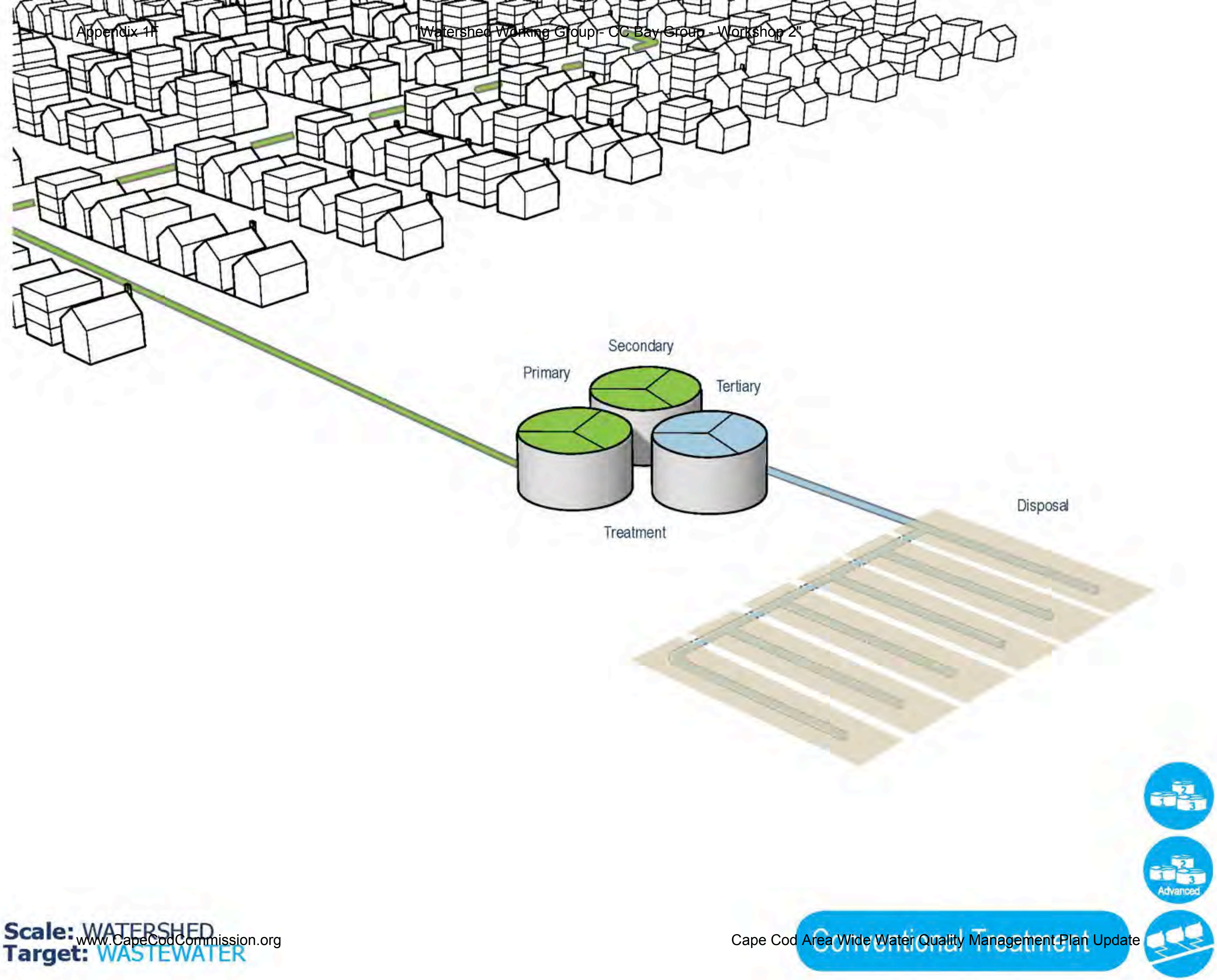
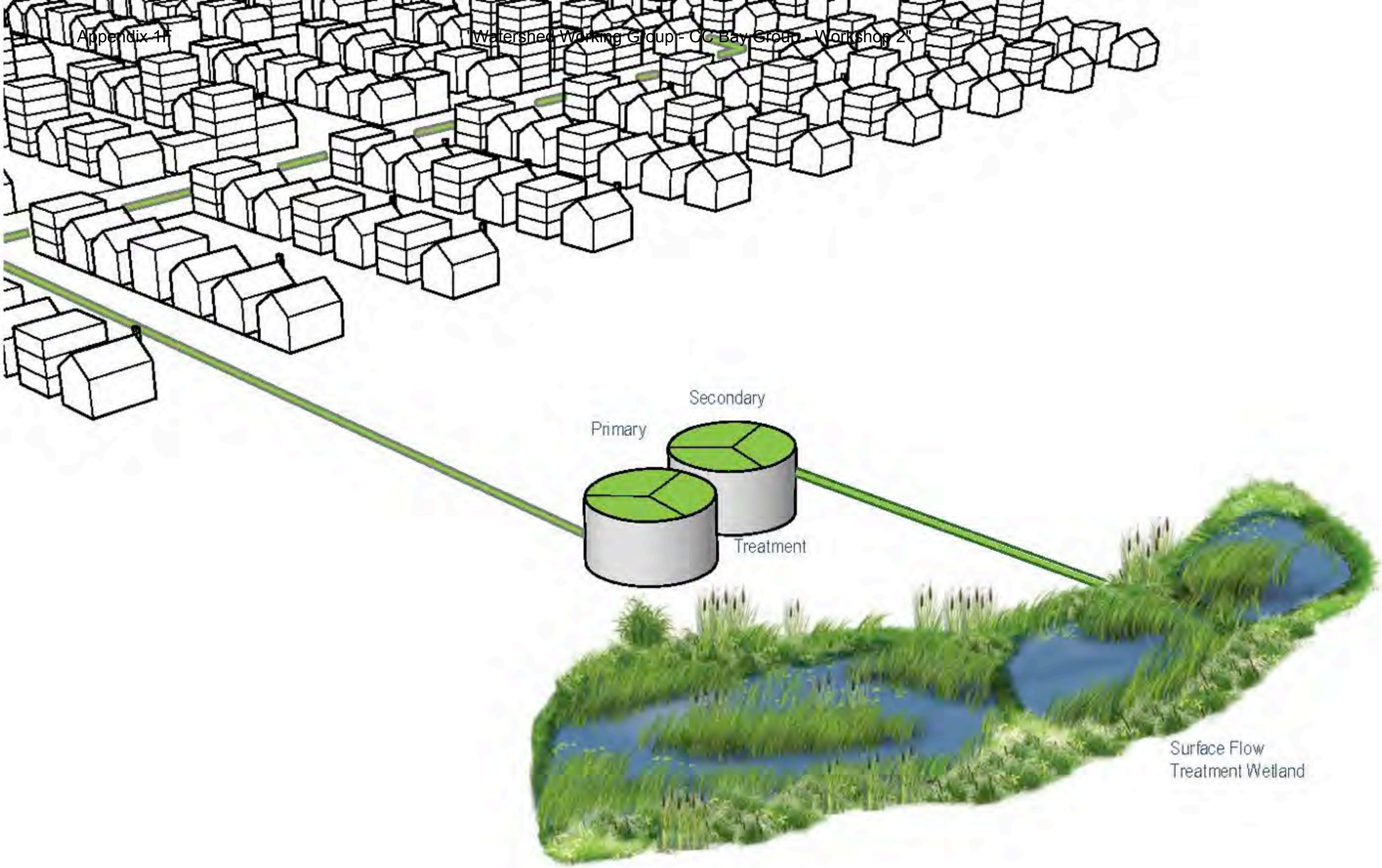
Surface Water Remediation Wetlands


Secondary
Primary
Tertiary
Treatment
Disposal
Advanced
Scale: WATERSHED
Target: WASTEWATER
Conventional Treatment

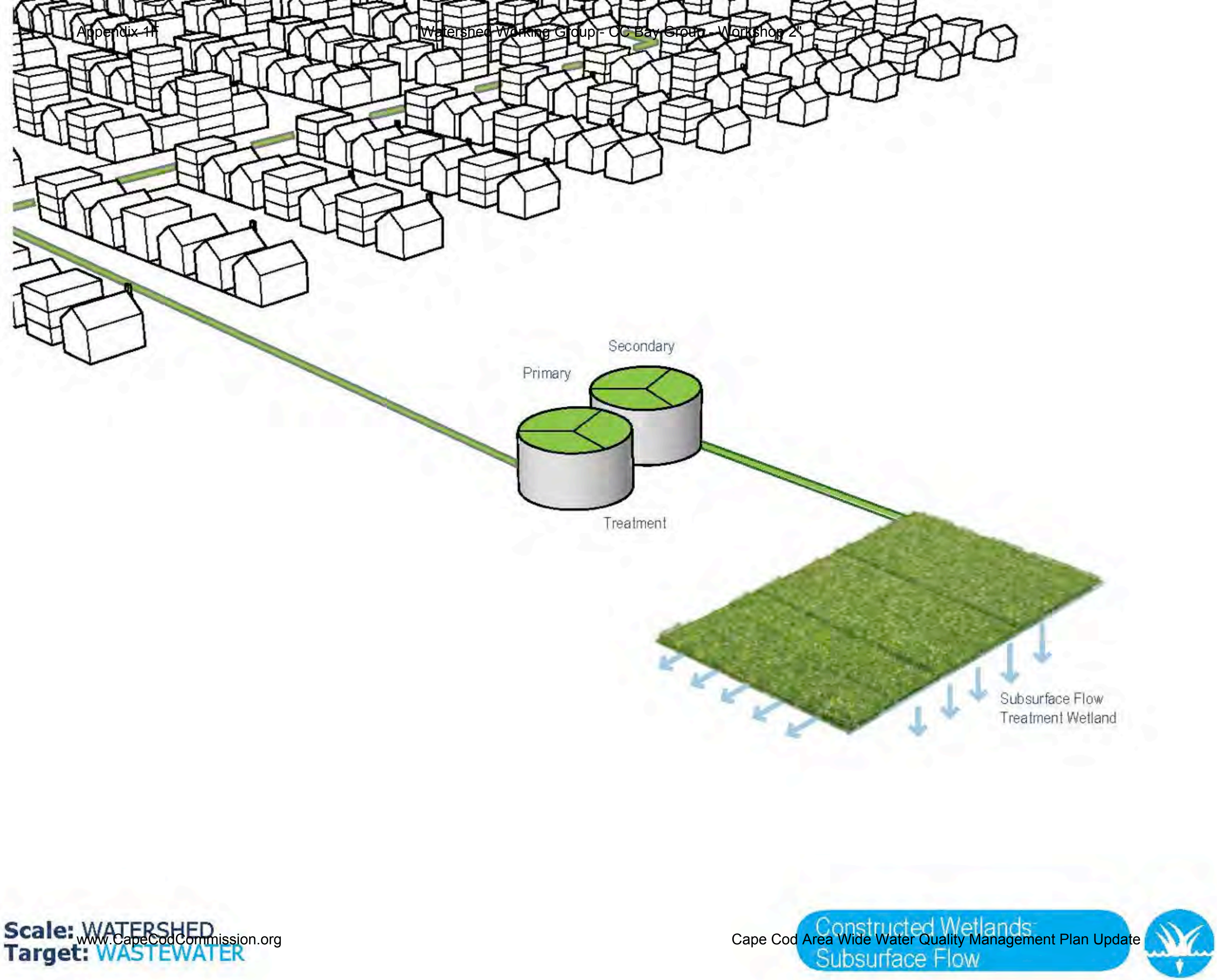


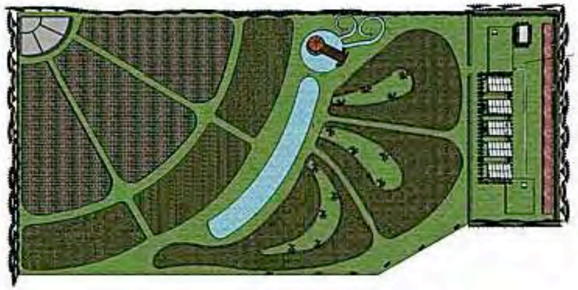
Scale: WATERSHED
Target: WASTEWATER

Constructed Wetlands:
Surface Flow

Precedent: Talking Waters Garden - Albany, OR
Source: Kate Kennen

Constructed Wetlands: Surface Flow

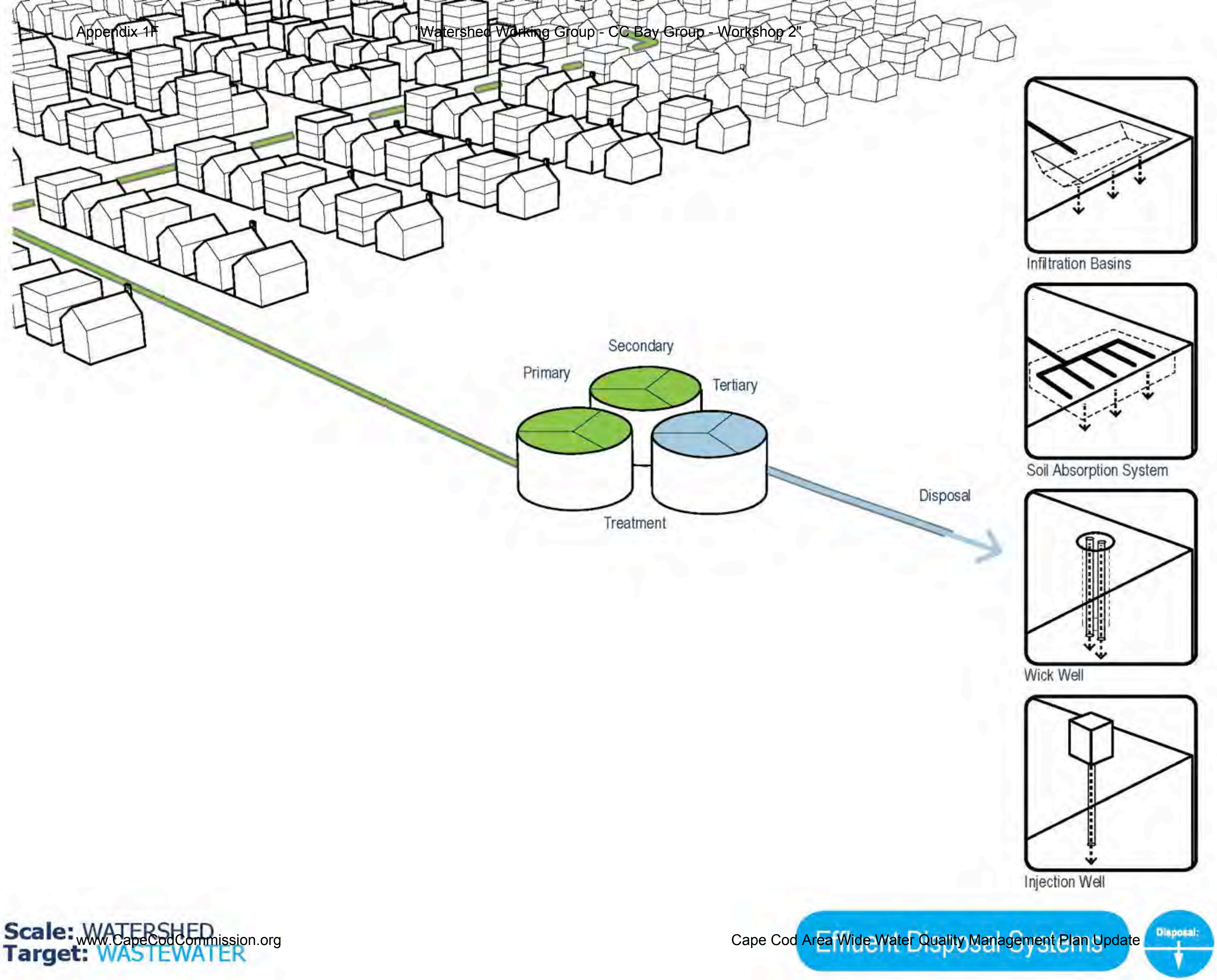

Secondary
Primary
Treatment
Subsurface Flow
Treatment Wetland
Scale: WATERSHED
Target: WASTEWATER
Constructed Wetlands:
Subsurface Flow

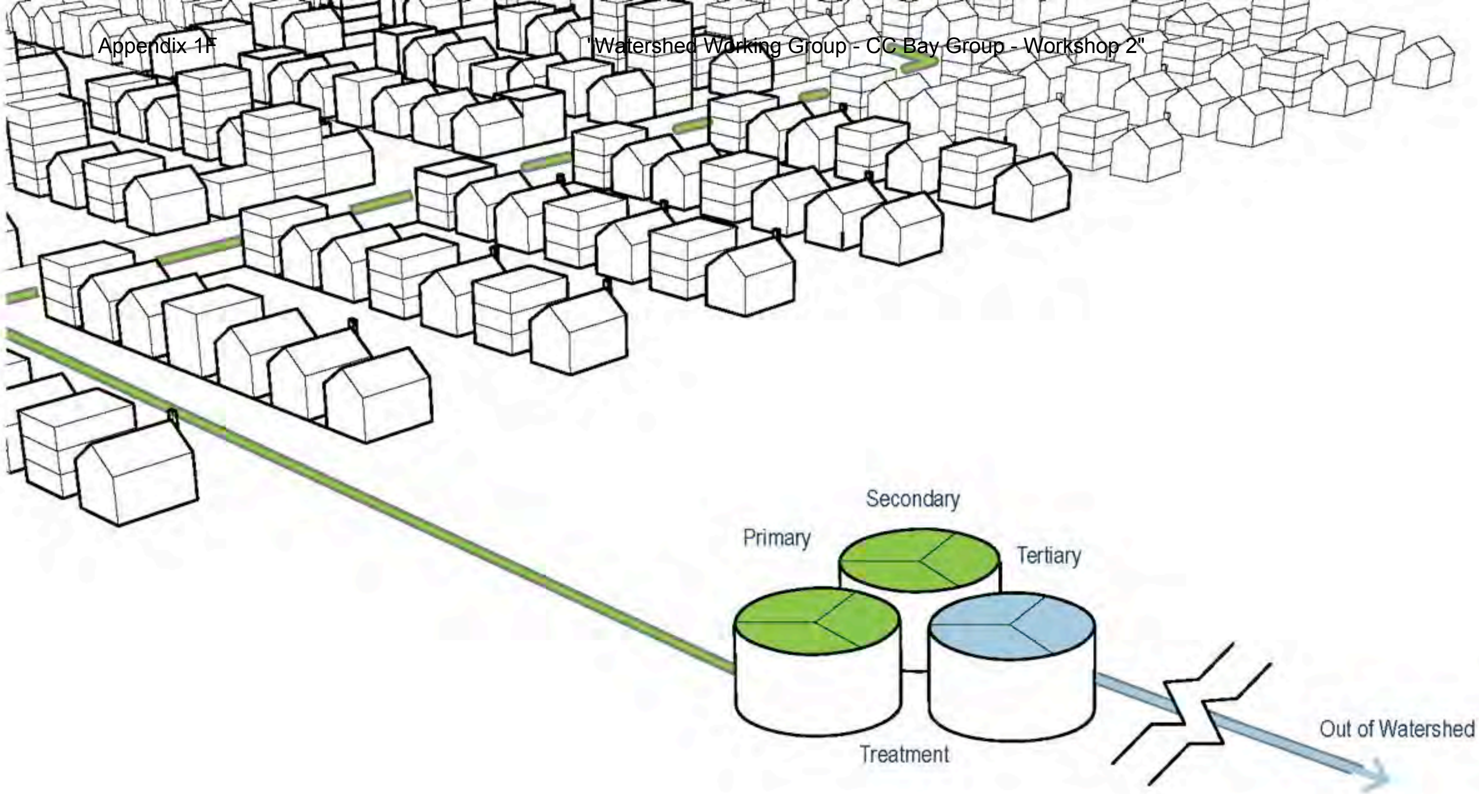


Precedent: Koh Phi Phi Treatment Wetland, Thailand

Source: Hans Brix

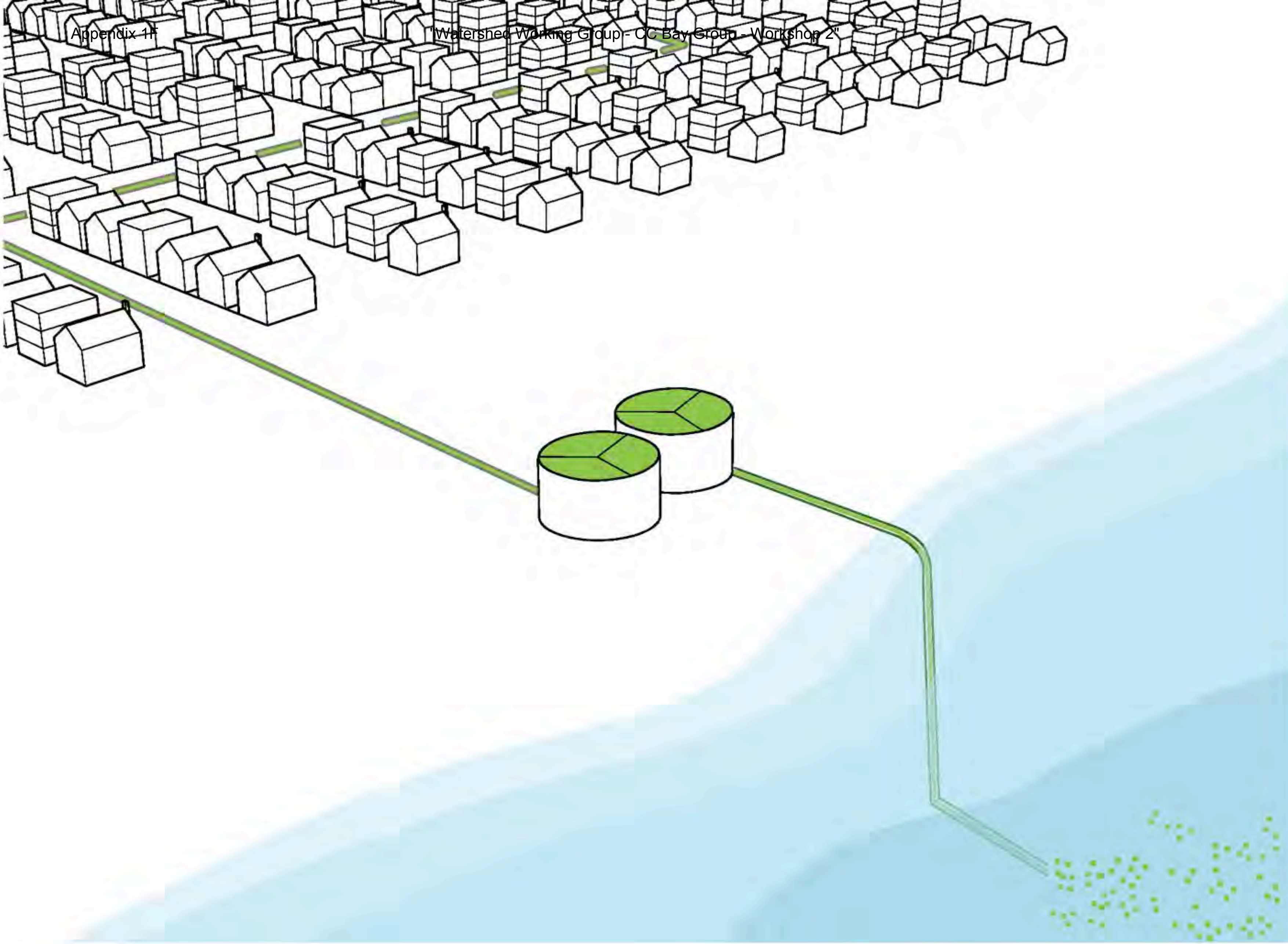
Constructed Wetlands: Subsurface Flow


Primary
Secondary
Tertiary
Treatment
Disposal
Infiltration Basins
Soil Absorption System
Wick Well
Injection Well
Scale: WATERSHED
Target: WASTEWATER
Effluent Disposal Systems
Disposal:



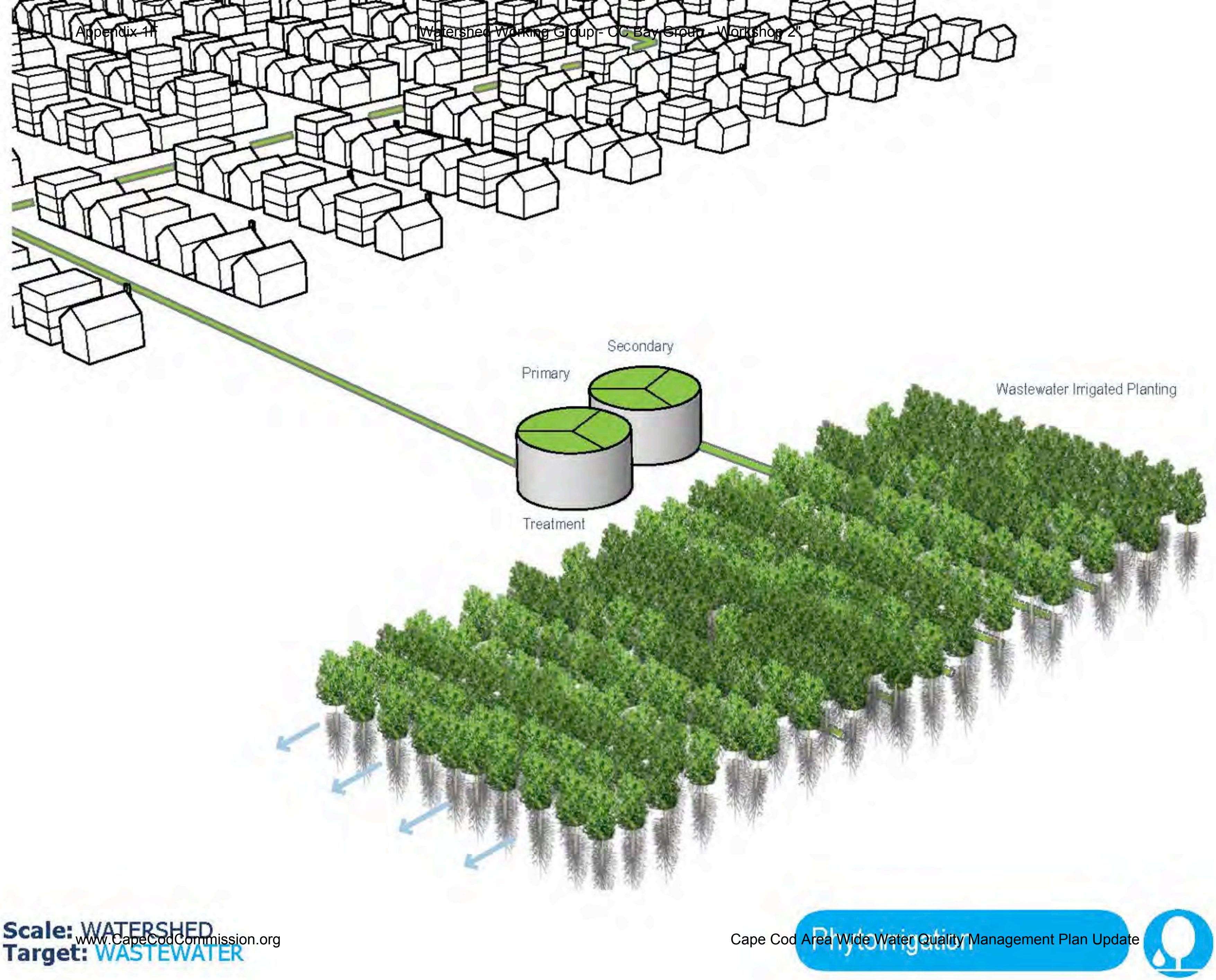
Scale: WATERSHED
Target: WASTEWATER

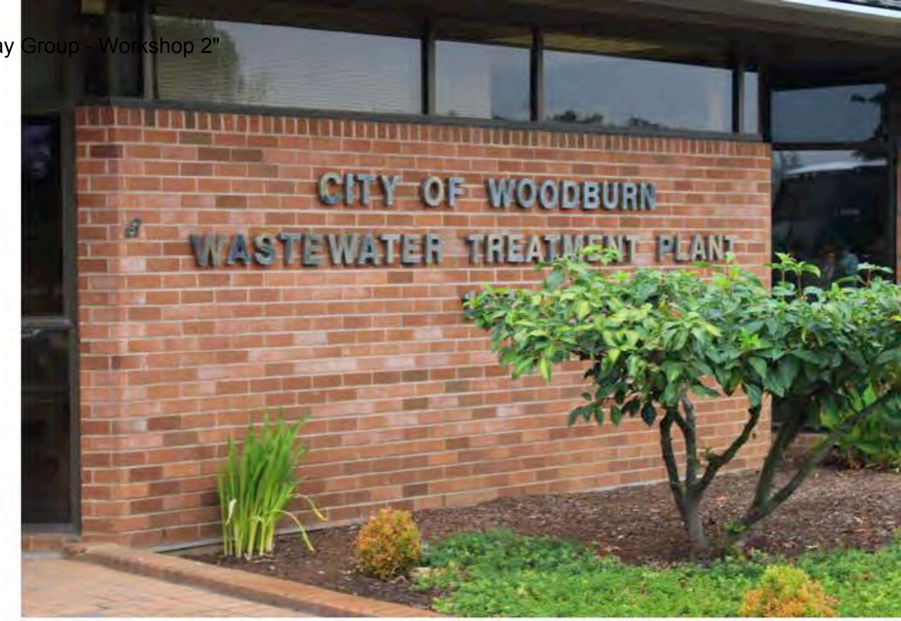
Effluent Disposal: Out of Watershed



Scale: WATERSHED
Target: WASTEWATER

Effluent Disposal: Ocean Outfall


Secondary
Primary
Wastewater Irrigated Planting
Treatment
Scale: WATERSHED
Target: WASTEWATER
Phytoirrigation



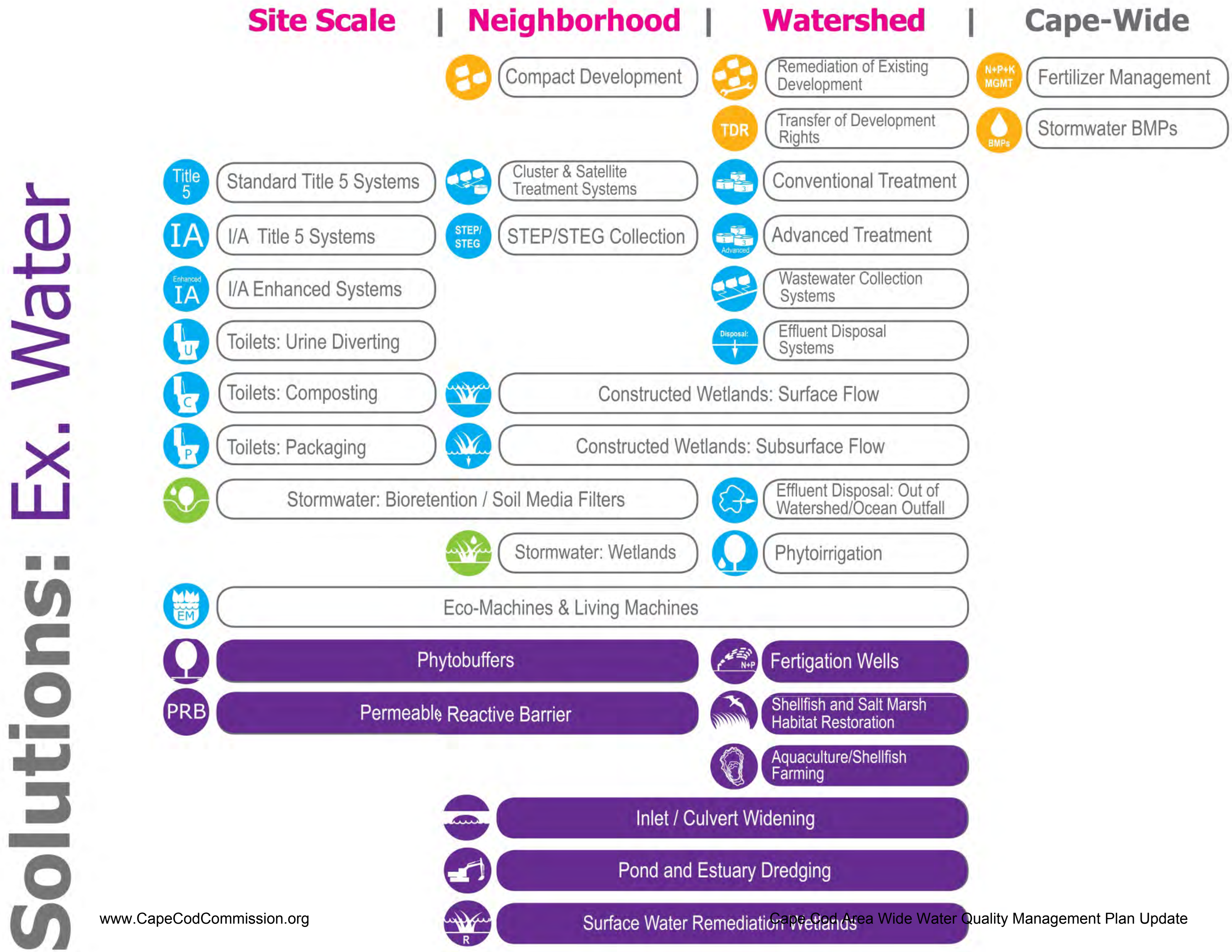
Precedent: Woodburn OR, Wastewater Treatment Facility
Source: CH2MHill

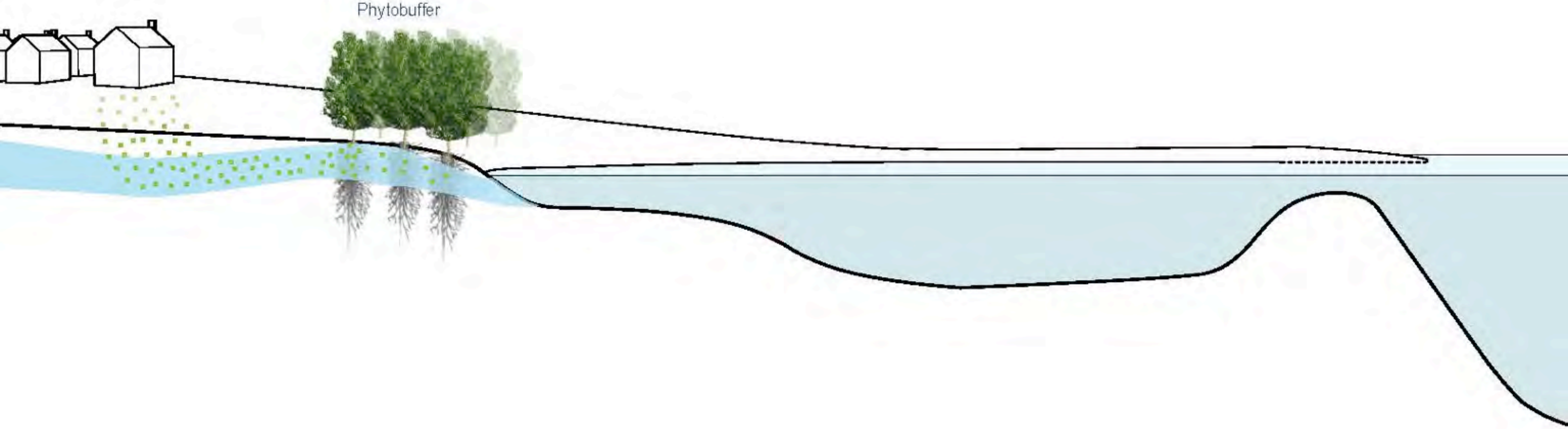
Phytoirrigation

Precedent: Woodburn OR, Wastewater Treatment Facility

Source: CH2MHill

Phytoirrigation


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



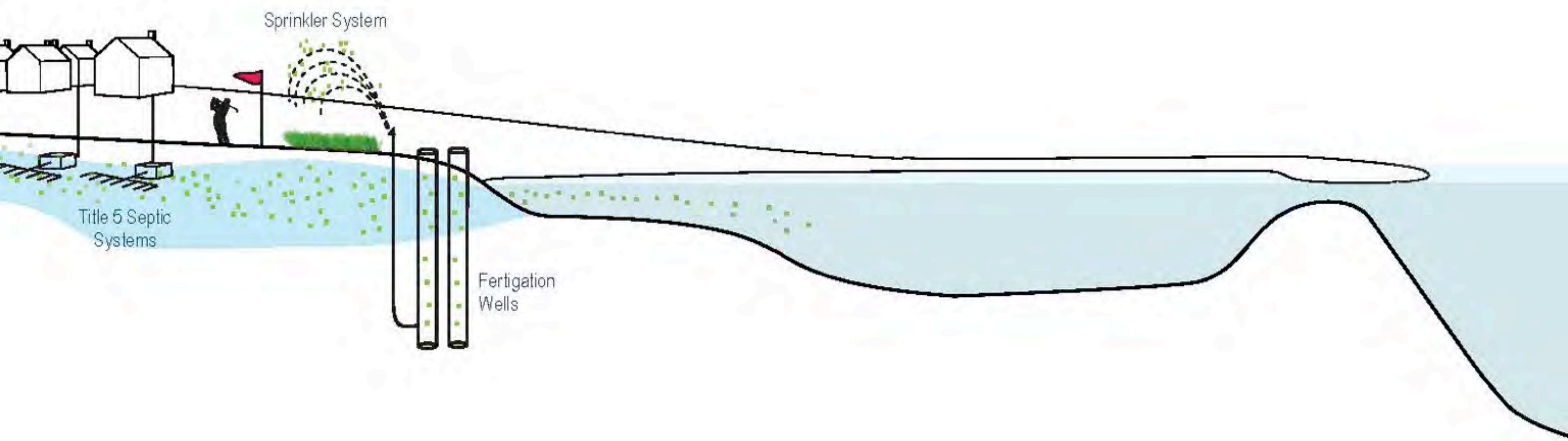
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Phytobuffers

Precedent: Phytobuffer - Kavcee, WY

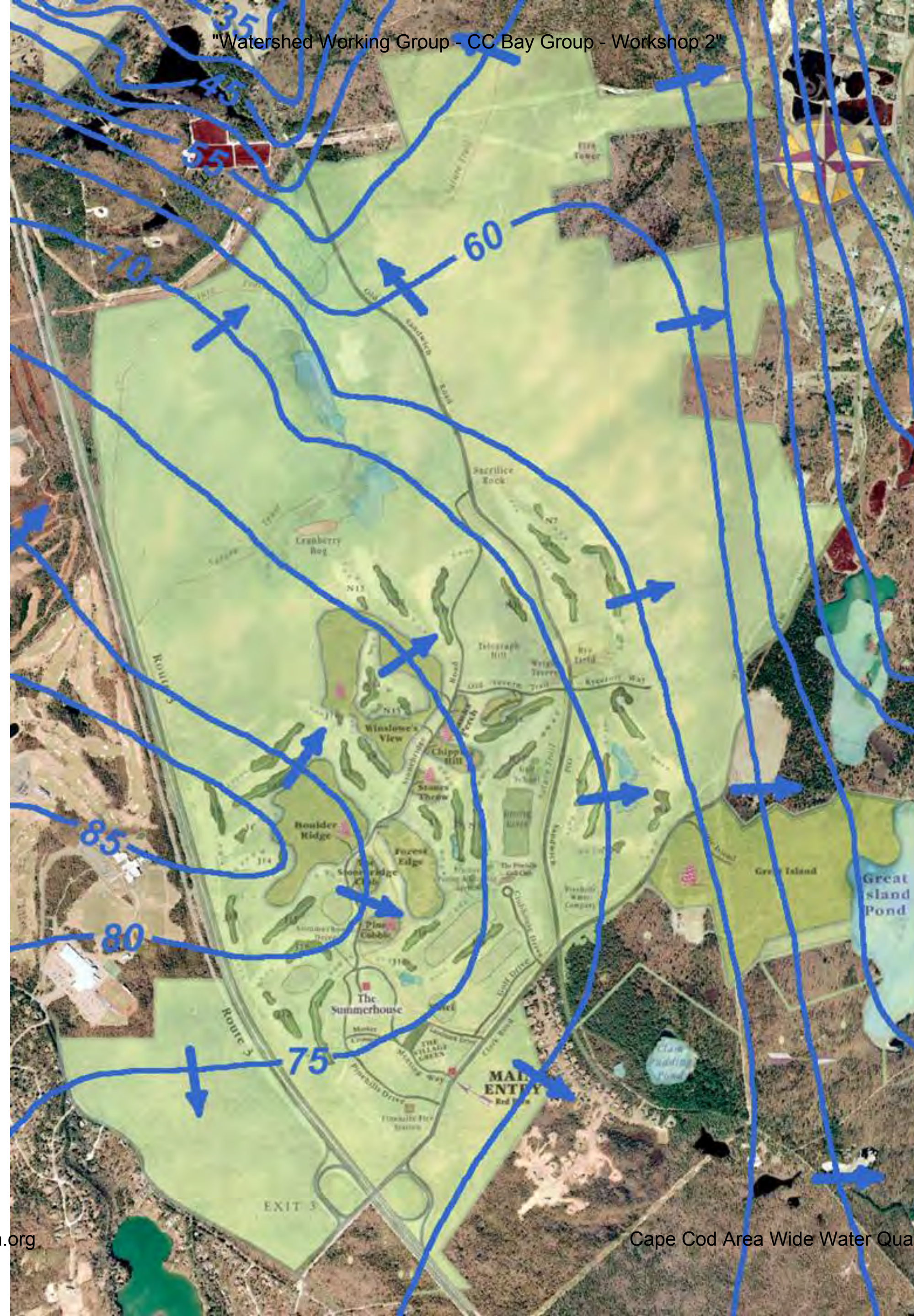
Source: Sand Creek Consultants

Phytobuffers

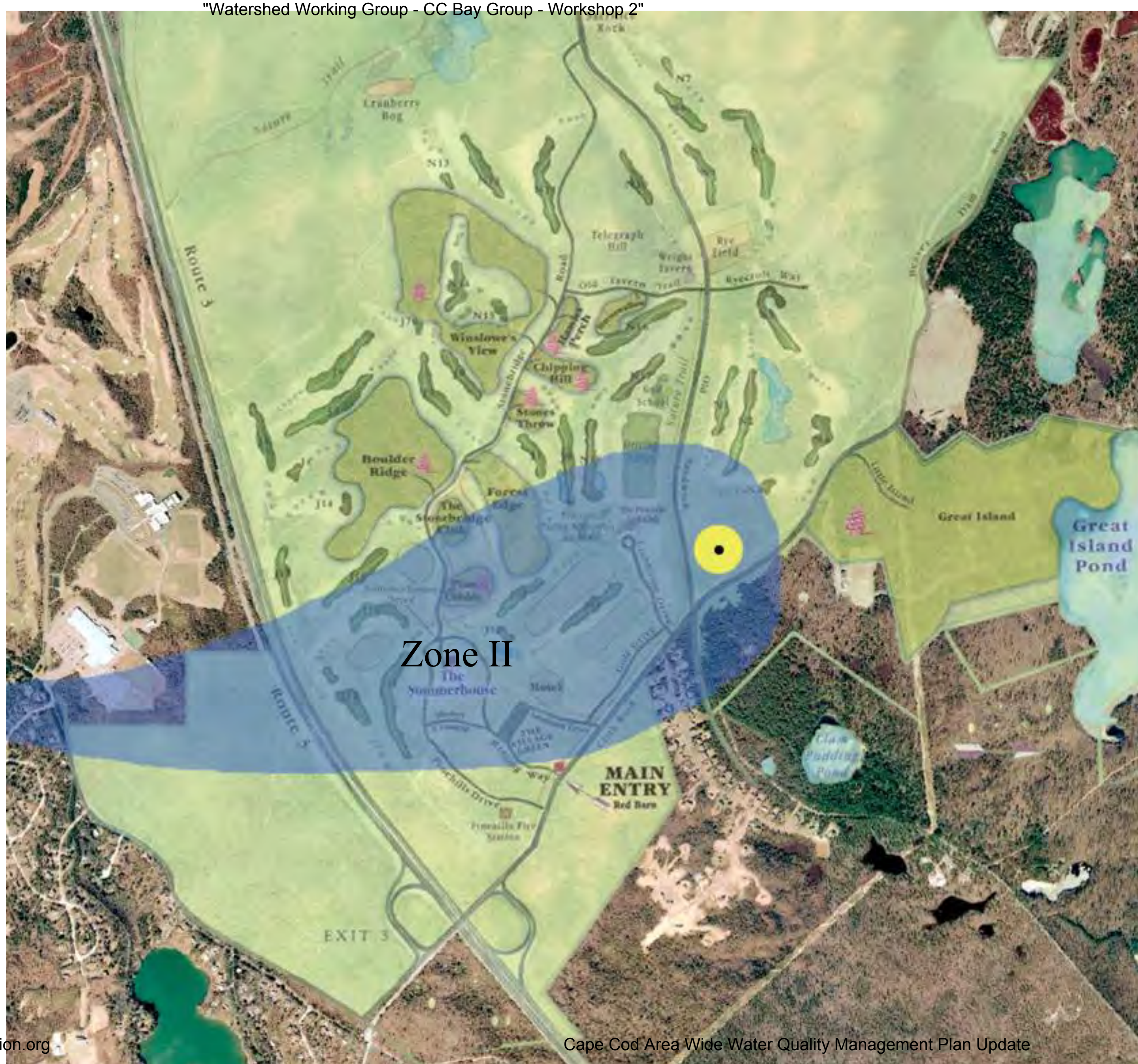


Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

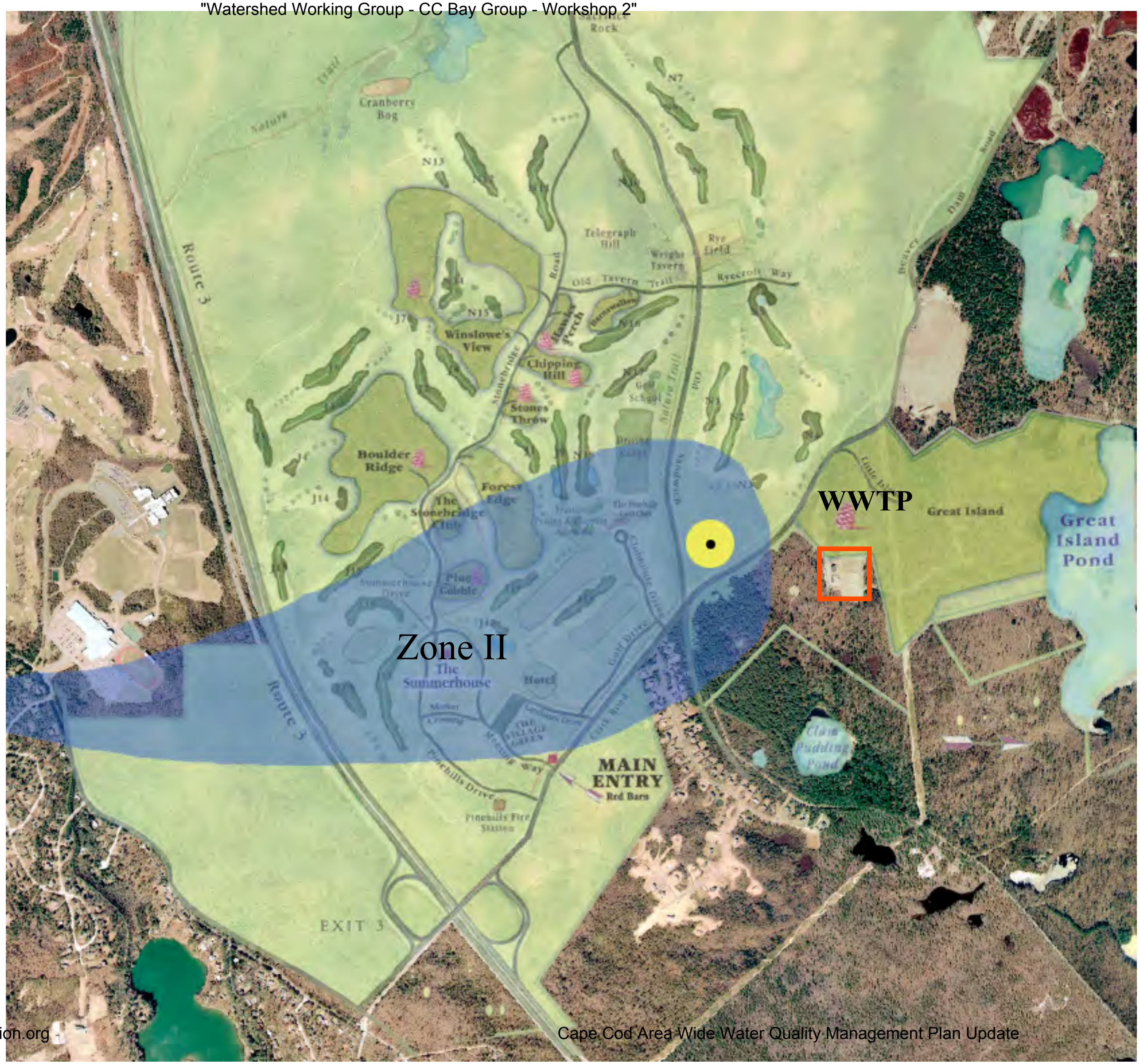
Fertigation Wells



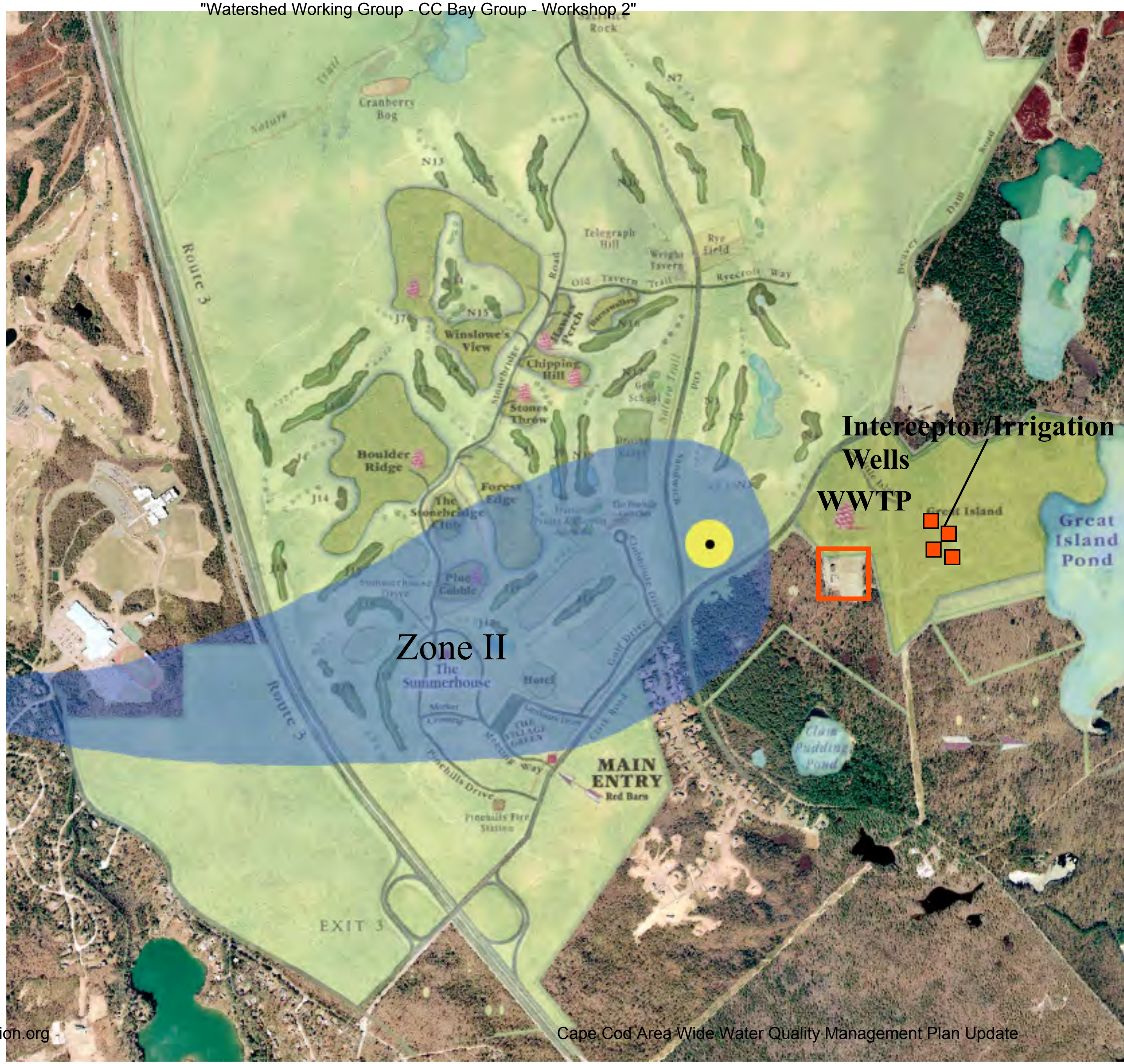
Precedent:
Pine Hills
Plymouth, MA



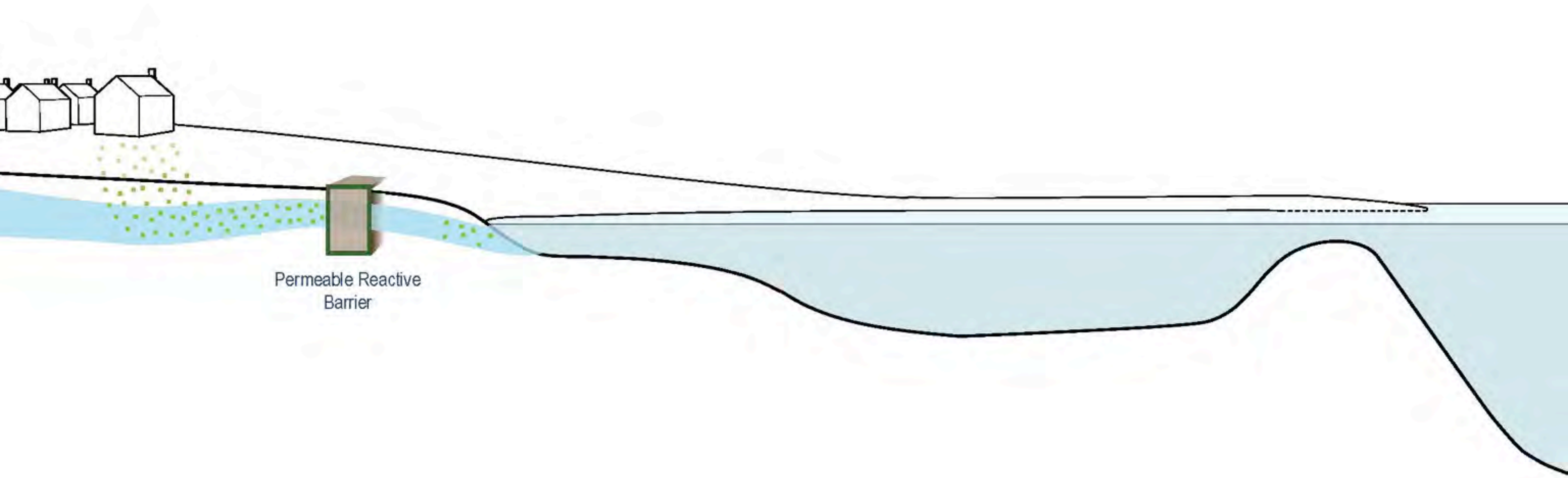
Precedent:
Pine Hills
Plymouth, MA



Precedent:
Pine Hills
Plymouth, MA

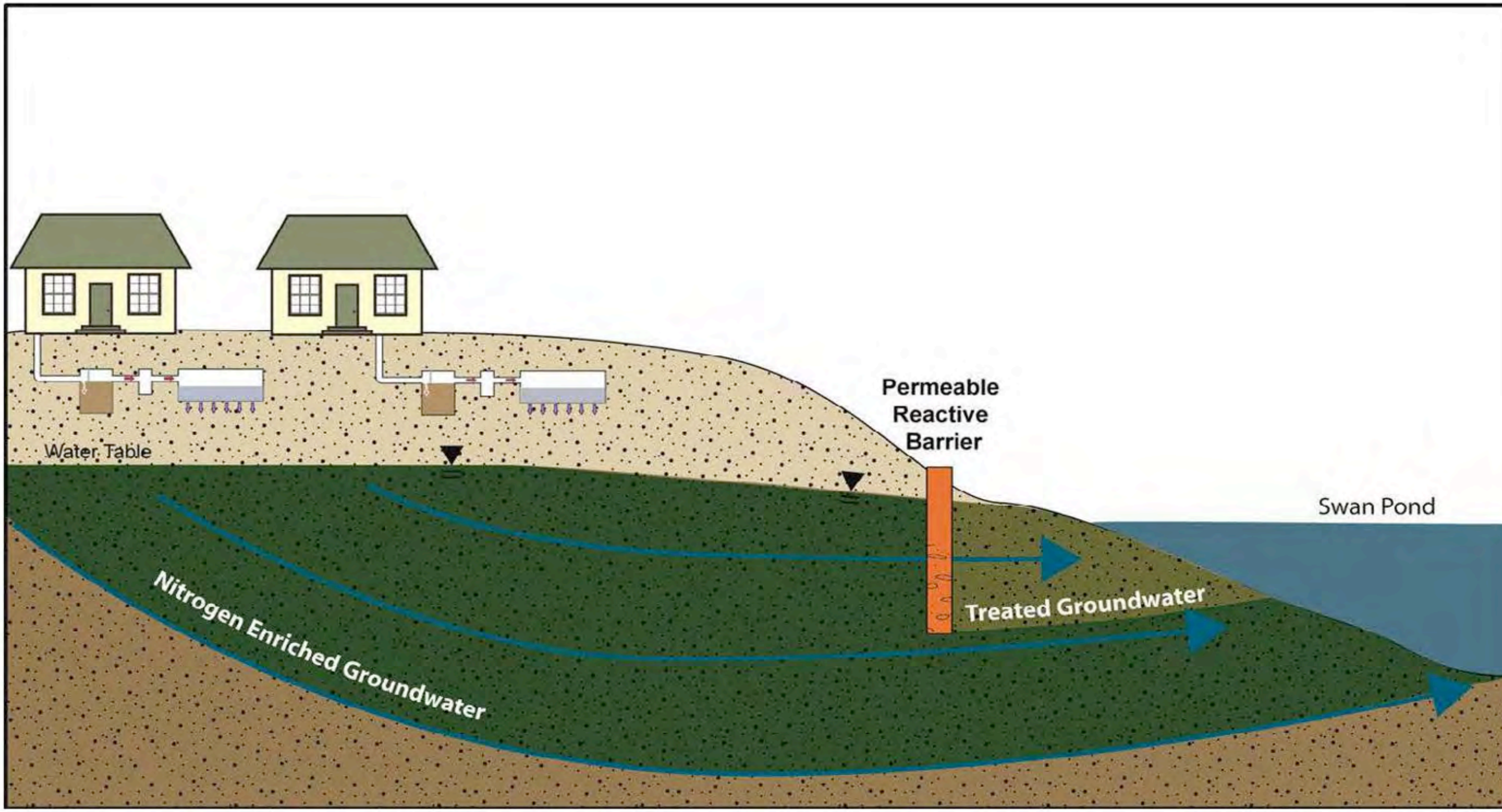


Precedent:
Pine Hills
Plymouth, MA



Scale: SITE / NEIGHBORHOOD / WATERSHED
Target: EXISTING WATER BODIES

Permeable Reactive Barrier PRB



Precedent: PRB

Source: Horsley Witten Group Inc.

Permeable Reactive Barrier

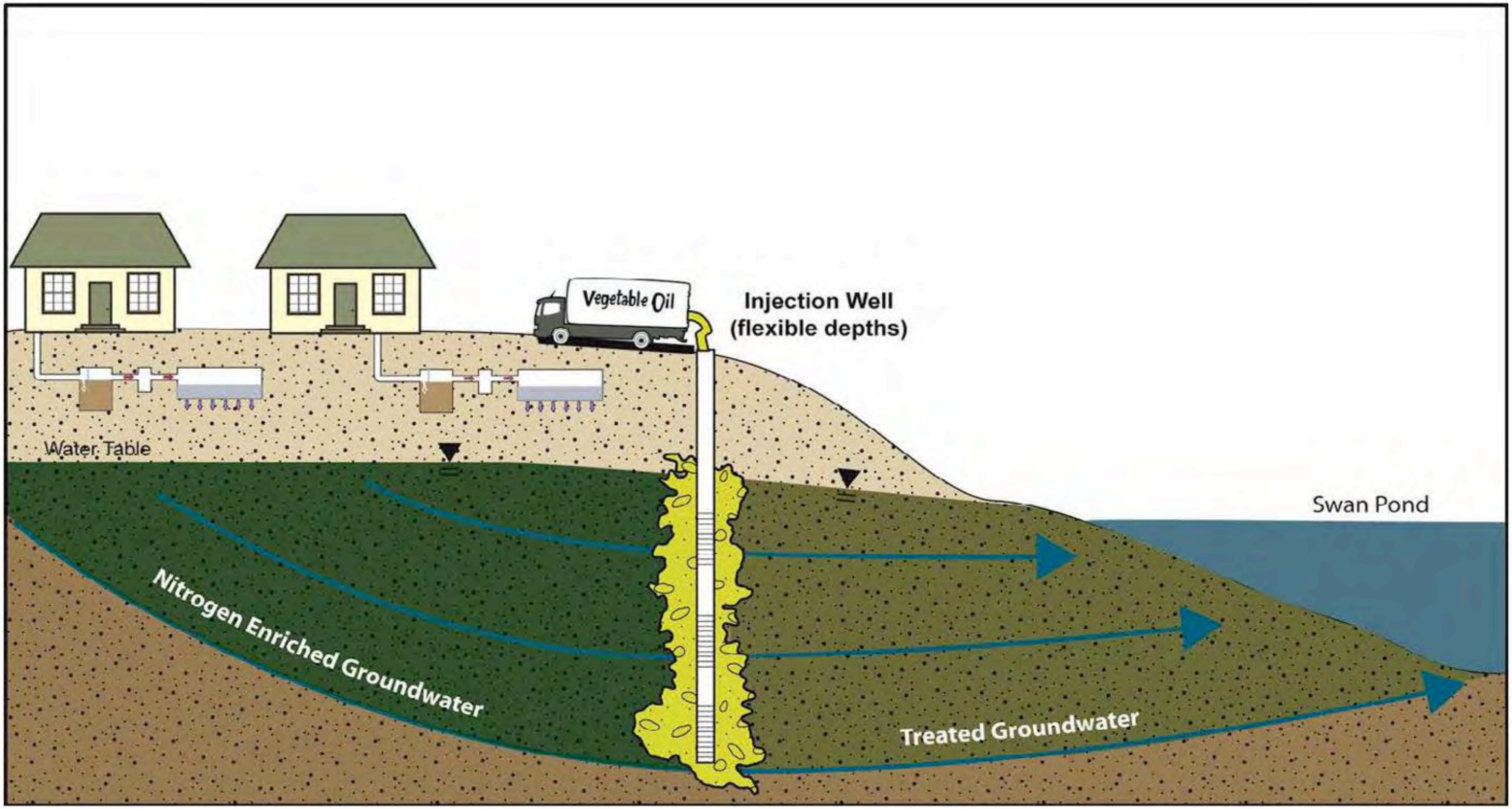
PRB

Precedent: Falmouth PRB

Source: Mike Domenica

Permeable Reactive Barrier

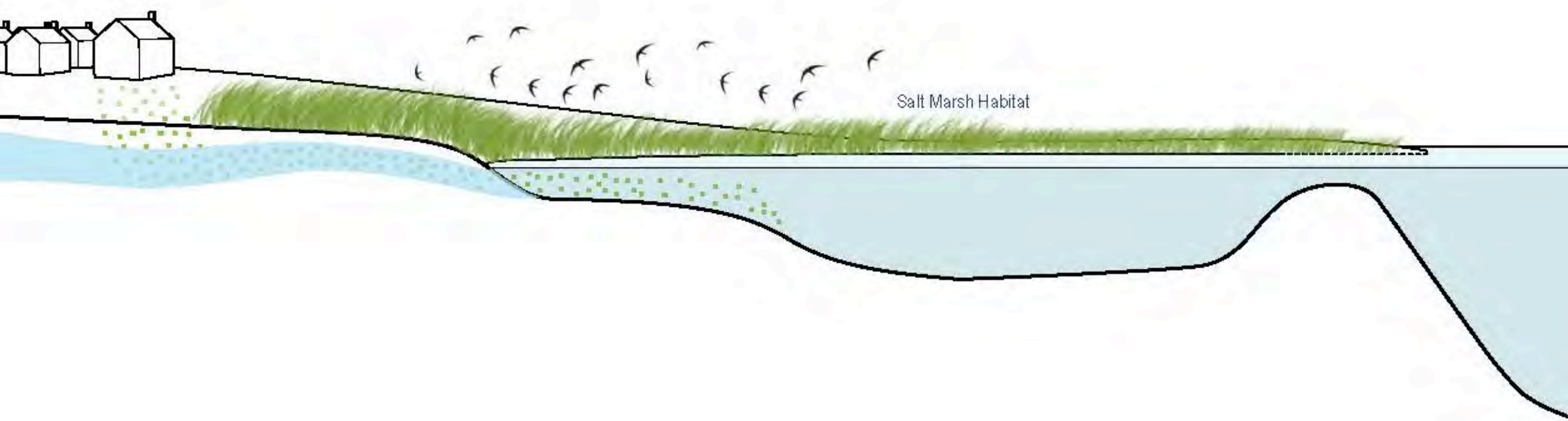
PRB



Precedent: PRB
Source: Horsley Witten Group Inc.

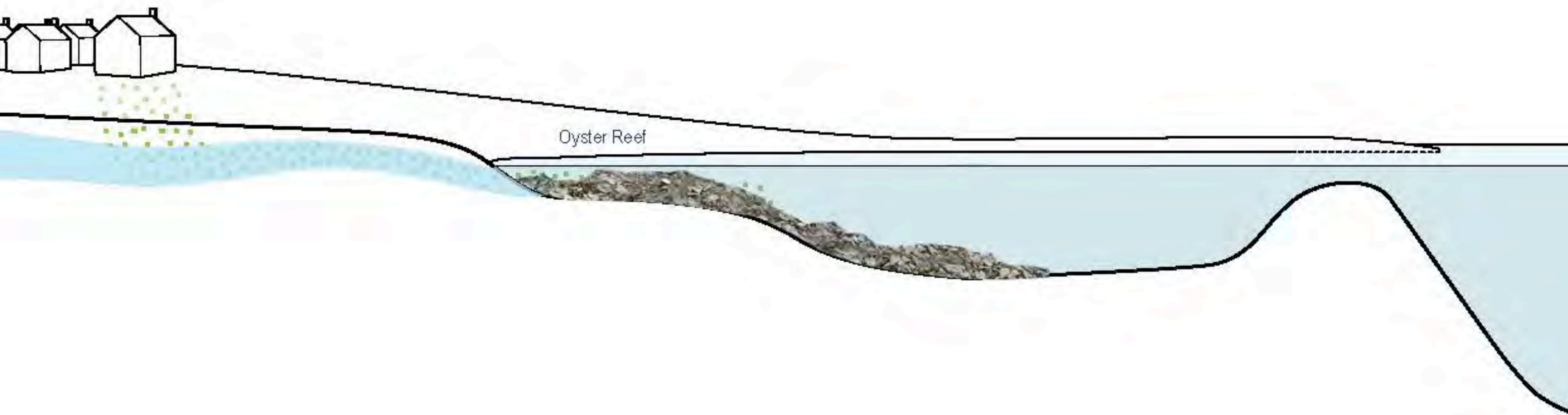
Permeable Reactive Barrier
PRB


Widening of Existing Zone
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES
Inlet and Culvert Widening



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Salt Marsh Habitat Restoration



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Shellfish Habitat Restoration

Precedent: Wellfleet Oyster Restoration Project

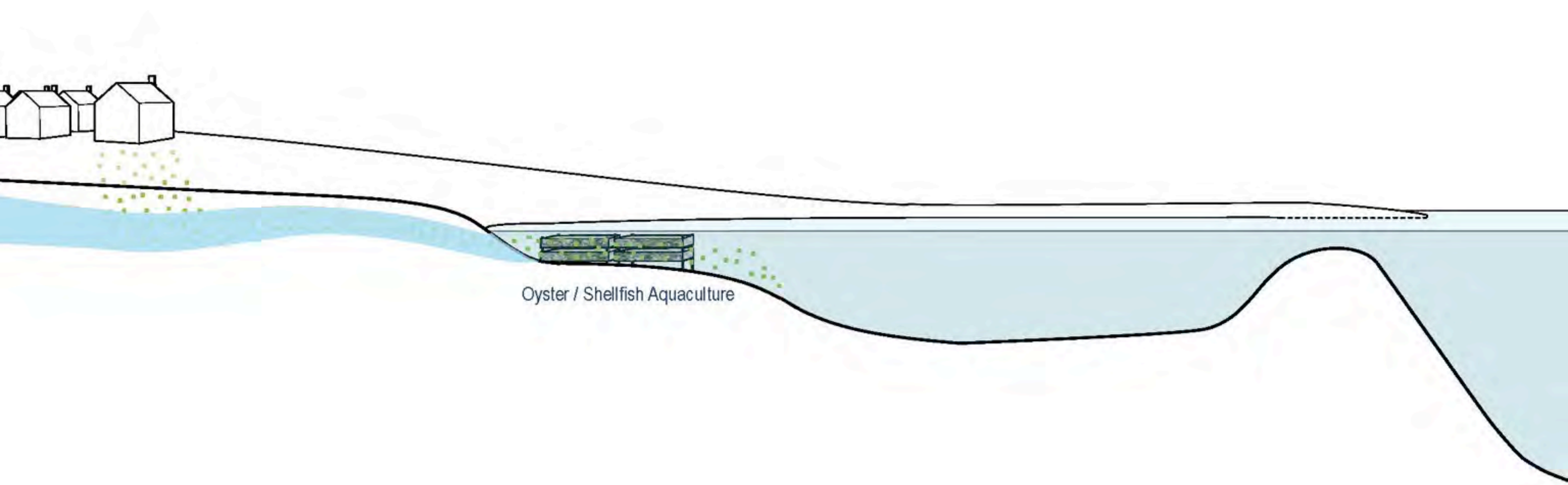
Source: Anamarija Frankic

Shellfish Habitat Restoration

Precedent: Wellfleet Oyster Restoration Project

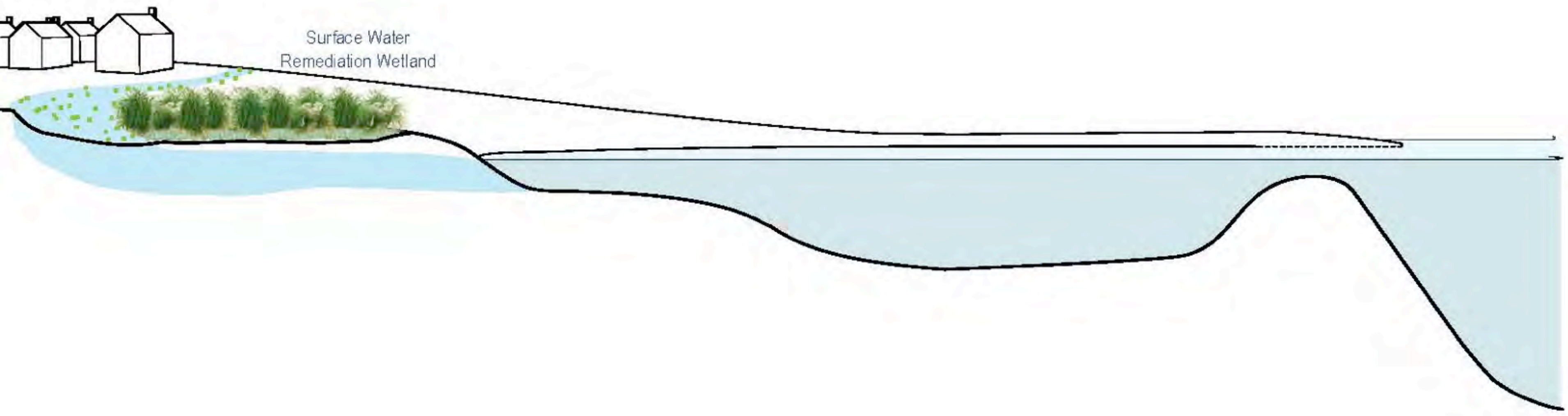
Source: Anamanja Francik

Shellfish Habitat Restoration



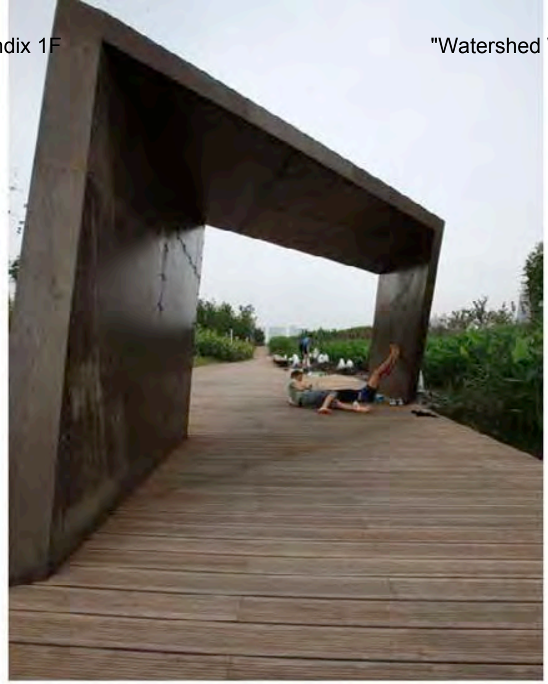
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

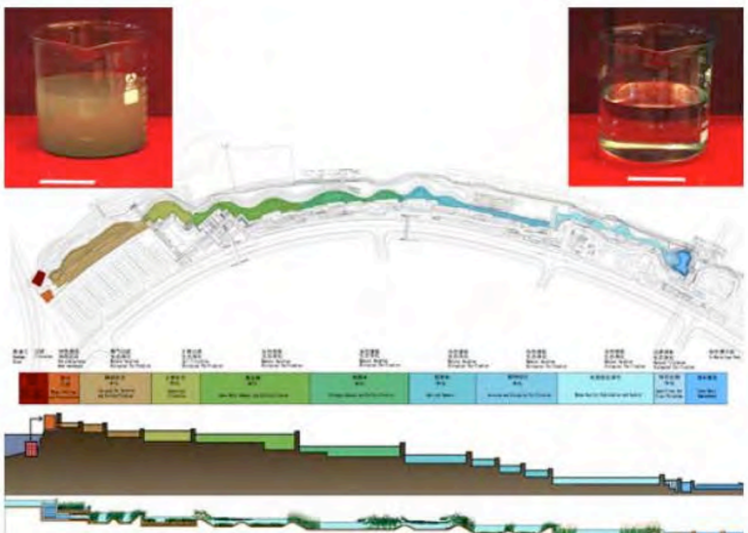
Aquaculture / Shellfish Farming



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Surface Water
Remediation Wetlands

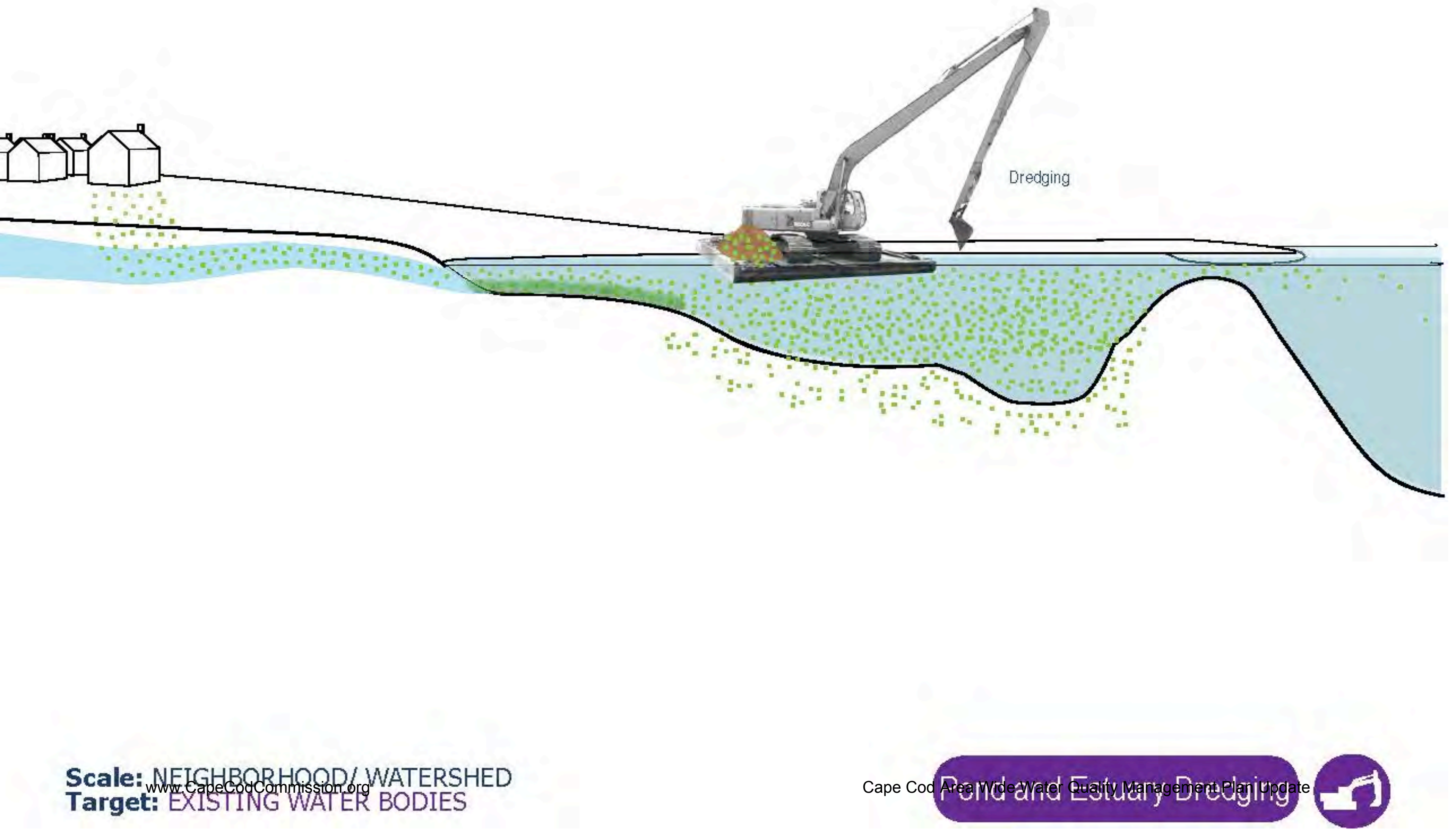




Precedent: Shanghai Houton Park

Source: Turenscape

Surface Water Remediation Wetlands


Dredging
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES
Pond and Estuary Dredging

Precedent: Pond and Estuary Dredging - Dennis, MA

Source: Cape Cod Times

Solutions: Cape-Wide

Site Scale | Neighborhood | Watershed | Cape-Wide

Compact Development

Remediation of Existing Development

Fertilizer Management

TDR

Transfer of Development Rights

Stormwater BMPs

Title 5

Standard Title 5 Systems

Cluster & Satellite Treatment Systems

Conventional Treatment

IA

I/A Title 5 Systems

STEP/ STEG

STEP/STEG Collection

Advanced Treatment

Enhanced IA

I/A Enhanced Systems

Wastewater Collection Systems

Disposal:

Effluent Disposal Systems

Toilets: Urine Diverting

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

EM

Eco-Machines & Living Machines

Phytobuffers

Fertigation Wells

PRB

Permeable Reactive Barrier

Shellfish and Salt Marsh Habitat Restoration

Aquaculture/Shellfish Farming

Inlet / Culvert Widening

Pond and Estuary Dredging

Surface Water Remediation Wetlands

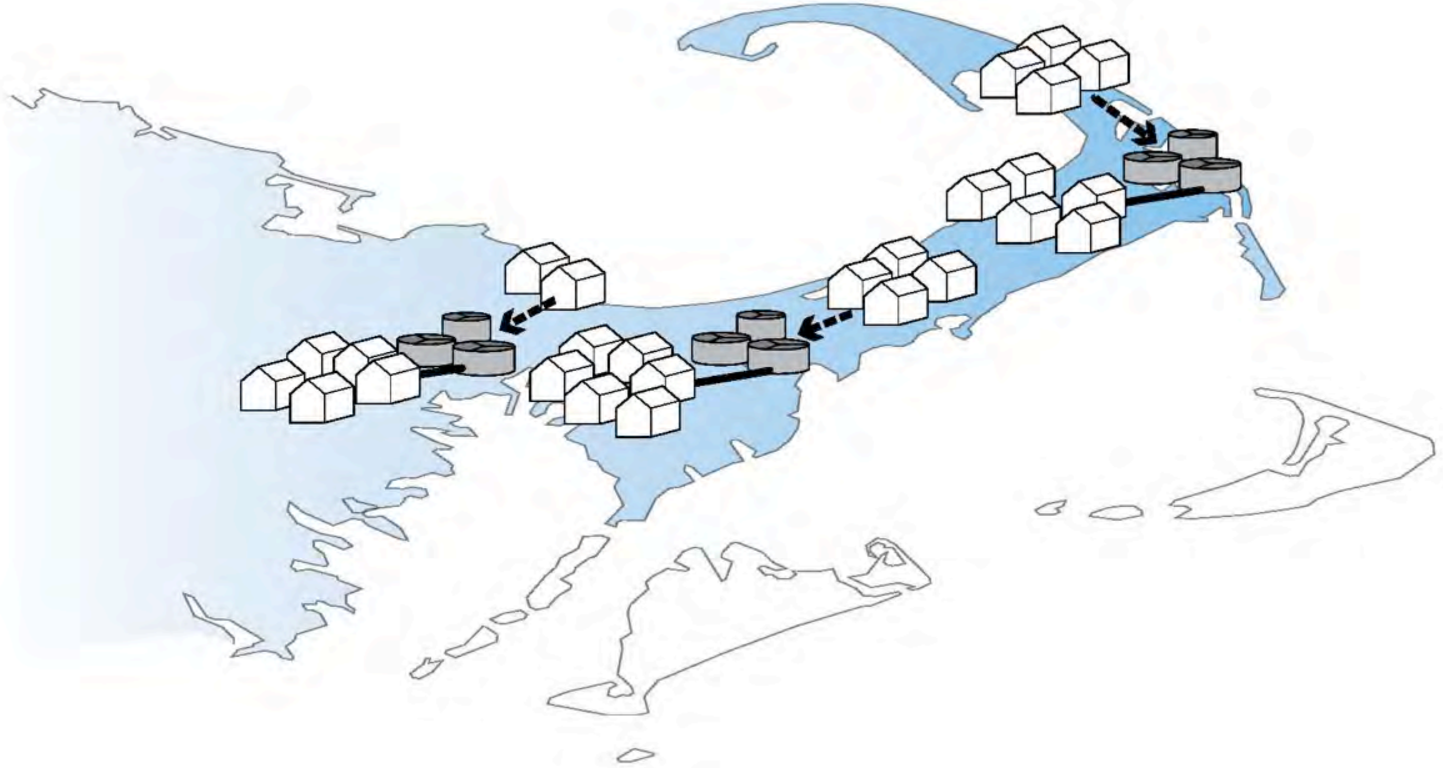
Scale: CAPE-WIDE
Target: REGULATORY

Compact Development

Scale: CAPE-WIDE
Target: REGULATORY

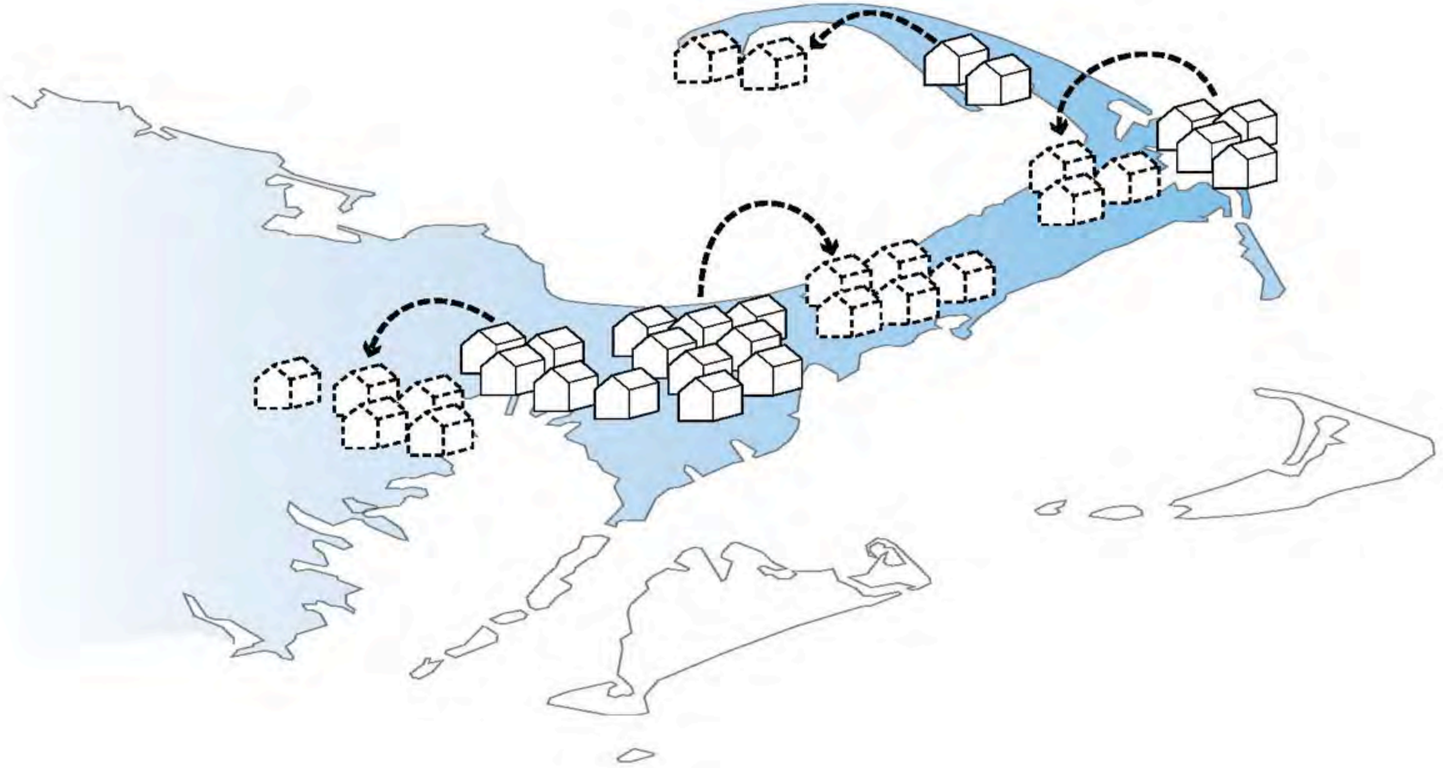
Fertilizer Management

N+P+K MGMT



Scale: CAPE-WIDE
Target: REGULATORY

Remediation of Existing Development



Scale: CAPE-WIDE
Target: REGULATORY

Transfer of Development Rights

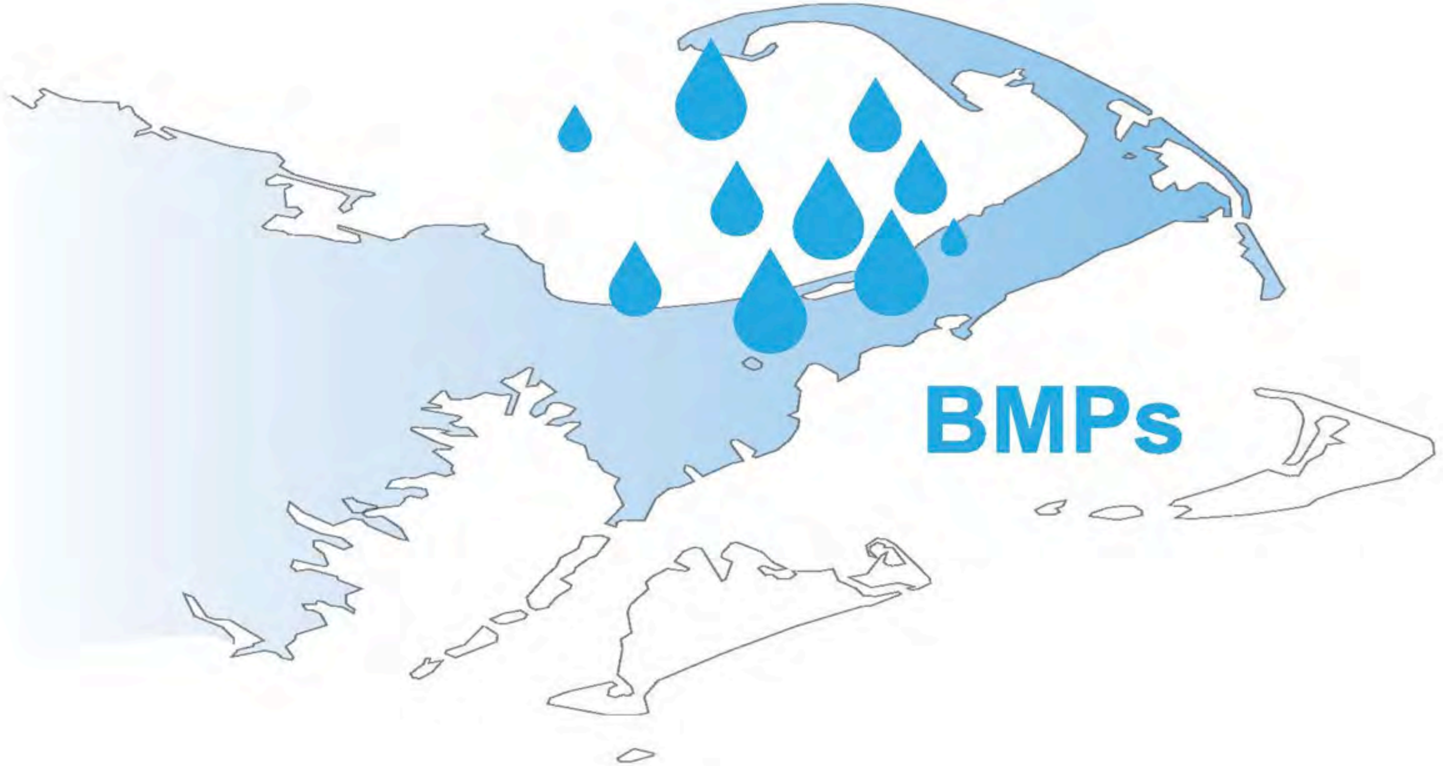
TDR

Transfer of Developments Rights
The Concept

Owner of “sending” parcel sells development rights in exchange for permanent conservation easement.

Owner of “receiving” parcel buys development rights to build at densities higher than allowed under base zoning.

Source: Massachusetts Smart Growth Toolkit

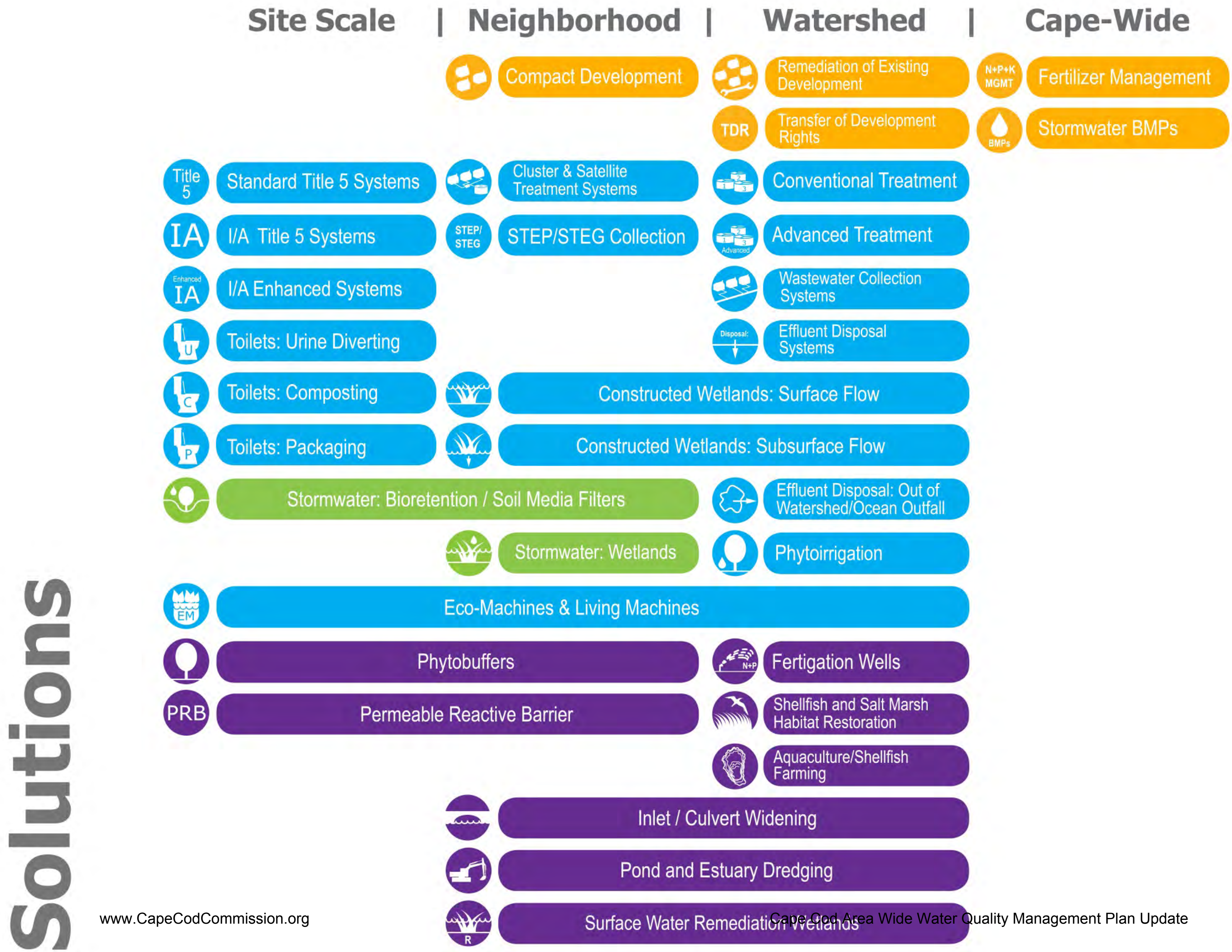


Scale: CAPE-WIDE
Target: REGULATORY

Stormwater BMPs

Town Consideration of Alternative Technologies & Approaches

Wellfleet-	*Coastal habitat restoration & aquaculture*
Mashpee-	*Aquaculture & Expanding Existing Systems*
Brewster-	*PRB & Bioswales*
Orleans-	*Fertilizer Control By-Law*
Harwich &- Chatham	*Muddy Creek & Cold Brook Natural Attenuation*
Falmouth-	*Aquaculture* *Inlet Widening* *Eco-Toilet Demonstration Project* *PRBs* *Stormwater Management (Little Pond Watershed)* *Fertilizer Control By-Law* *Subsurface Nitrogen Removal Septic Systems*


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

Wastewater Existing Water Bodies Regulatory

Problem Solving Approach

1
Targets/Reduction Goals

Present Load: X kg/day − Target: Y kg/day = Reduction Required: N kg/day

2
Other Wastewater Management Needs

A. Title 5 Problem Areas
B. Pond Recharge Areas
C. Growth Management

3
Low Barrier to Implementation

A. Fertilizer Management
B. Stormwater Mitigation

N+P+K MGMT
BMPs

4
Watershed/Embayment Options

A. Permeable Reactive Barriers
B. Inlet/Culvert Openings
C. Constructed Wetlands
D. Aquaculture

PRB
R

5
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
C
IA
U
P

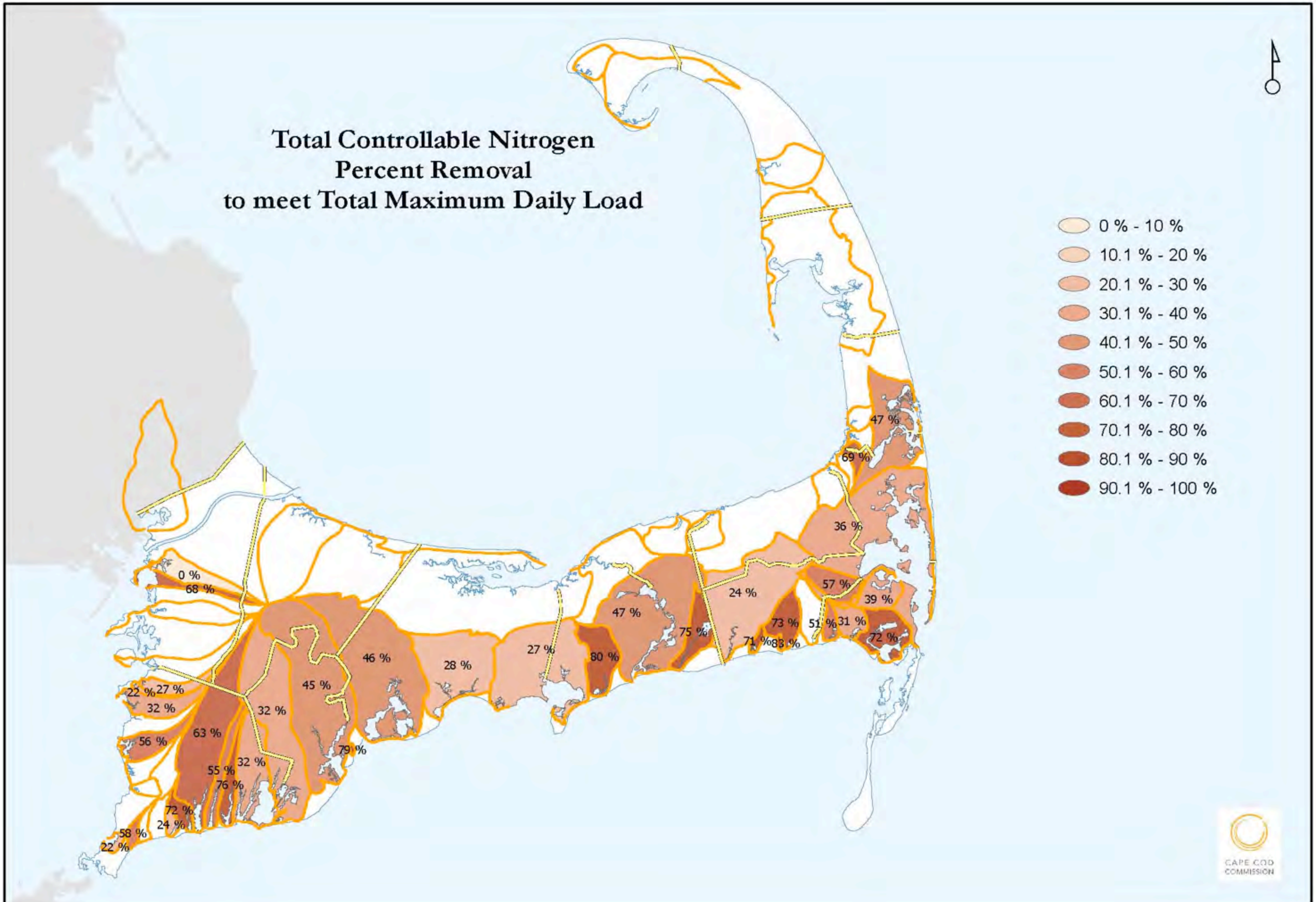
6
Priority Collection/High-Density Areas

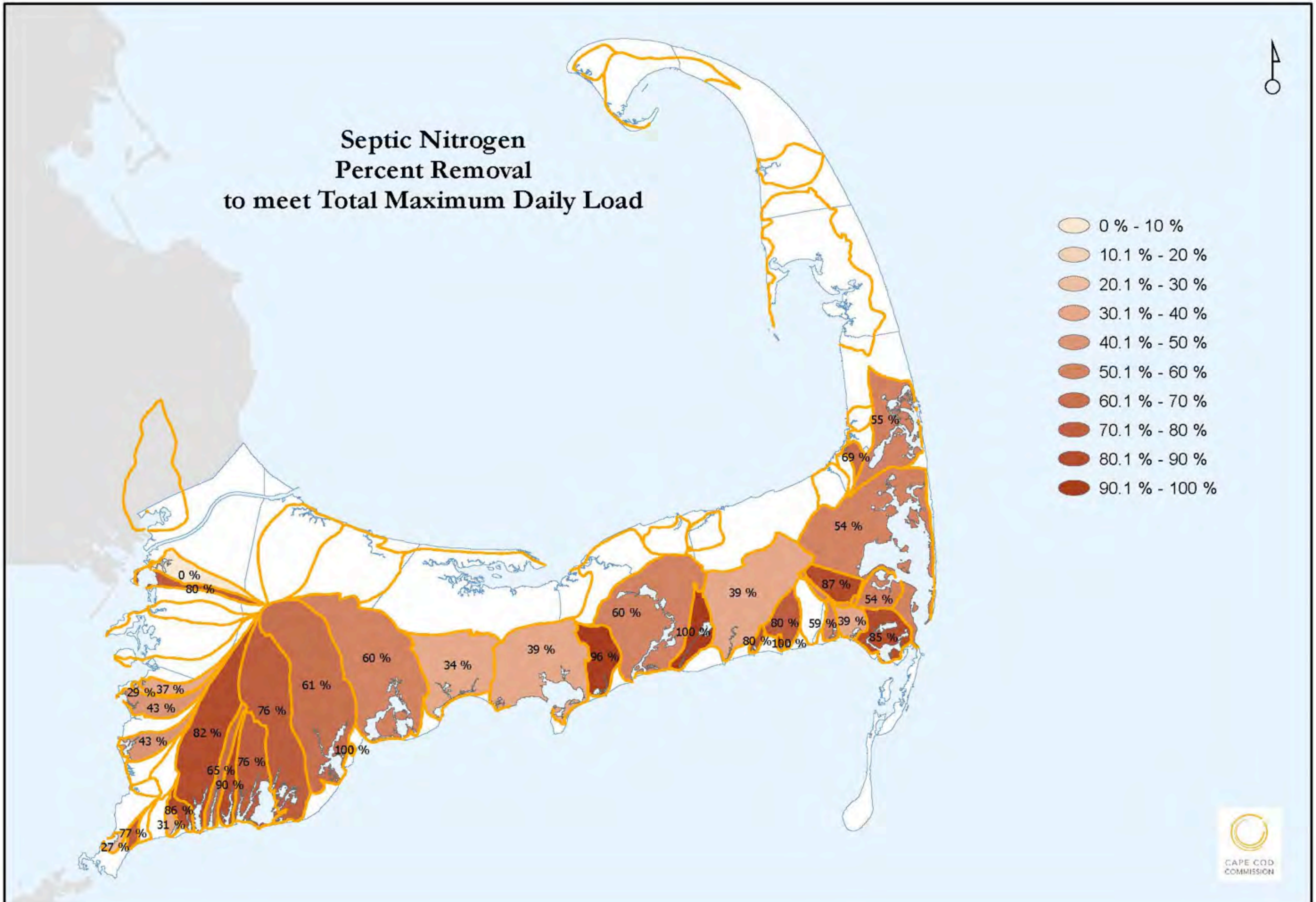
A. Greater Than 1 Dwelling Unit/acre
B. Village Centers
C. Economic Centers
D. Growth Incentive Zones

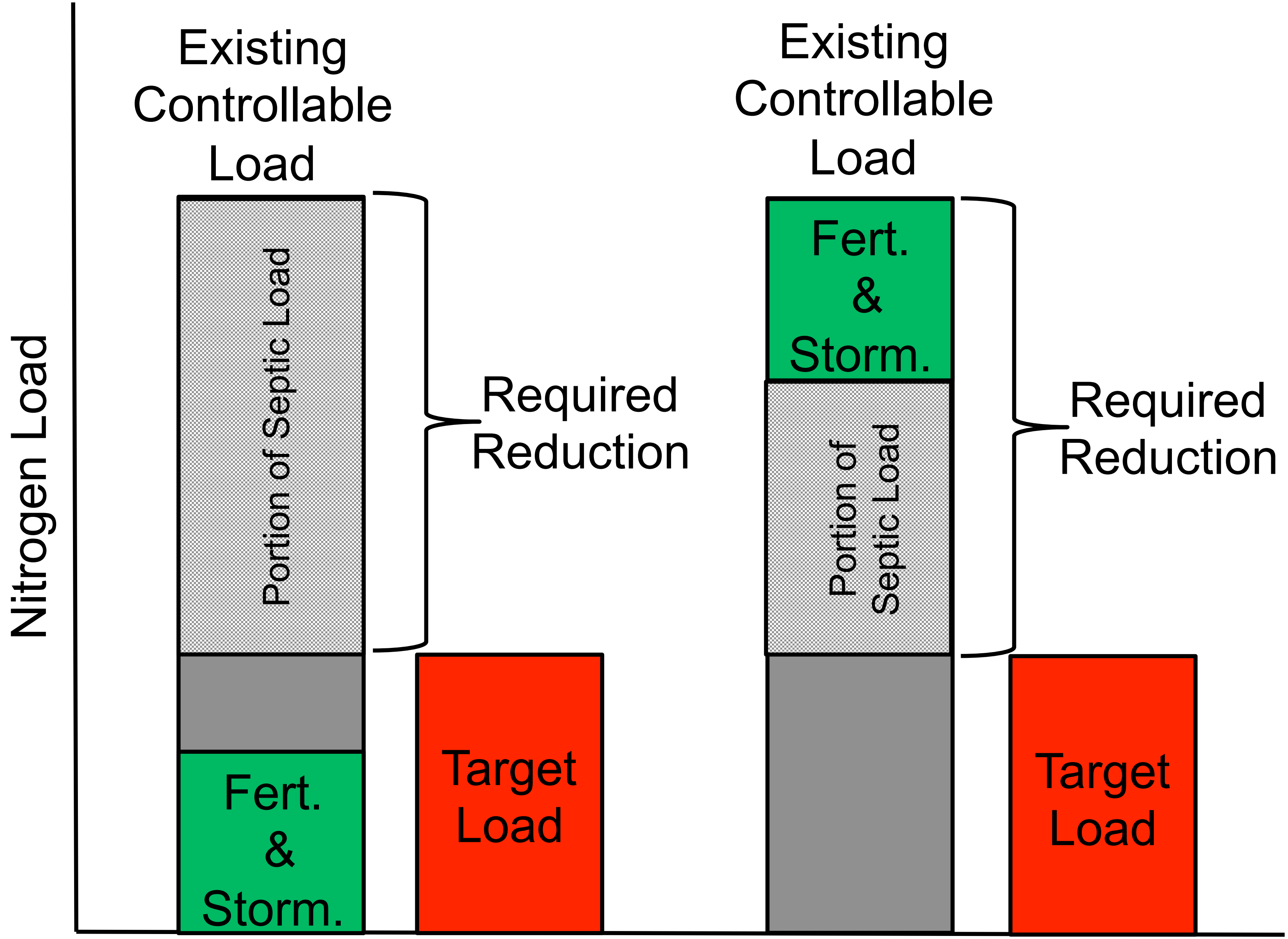
Advanced
Disposal
STEP/STEG

7
Supplemental Sewering

Advanced


Total Controllable Nitrogen
Percent Removal
to meet Total Maximum Daily Load
0 % - 10 %
10.1 % - 20 %
20.1 % - 30 %
30.1 % - 40 %
40.1 % - 50 %
50.1 % - 60 %
60.1 % - 70 %
70.1 % - 80 %
80.1 % - 90 %
90.1 % - 100 %
47 %
69 %
36 %
57 %
39 %
24 %
73 %
51 %
31 %
72 %
71 %
83 %
75 %
47 %
80 %
27 %
28 %
46 %
45 %
32 %
79 %
0 %
68 %
22 %
27 %
32 %
56 %
63 %
55 %
32 %
76 %
72 %
24 %
58 %
22 %
CAPE COD COMMISSION


Septic Nitrogen
Percent Removal
to meet Total Maximum Daily Load
0 % - 10 %
10.1 % - 20 %
20.1 % - 30 %
30.1 % - 40 %
40.1 % - 50 %
50.1 % - 60 %
60.1 % - 70 %
70.1 % - 80 %
80.1 % - 90 %
90.1 % - 100 %
55 %
69 %
54 %
87 %
54 %
39 %
60 %
100 %
80 %
59 %
39 %
85 %
80 %
100 %
96 %
39 %
34 %
60 %
61 %
76 %
82 %
0 %
80 %
29 %
37 %
43 %
43 %
100 %
76 %
65 %
90 %
86 %
31 %
77 %
27 %
CAPE COD COMMISSION


Nitrogen Load
Existing Controllable Load
Portion of Septic Load
Fert. & Storm.
Required Reduction
Target Load
Existing Controllable Load
Fert. & Storm.
Portion of Septic Load
Required Reduction
Target Load

Problem Solving Approach

Wastewater | Existing Water Bodies | Regulatory

1 Targets/Reduction Goals

Present Load: X kg/day − **Target**: Y kg/day = **Reduction Required**: N kg/day

2 Other Wastewater Management Needs

A. Title 5 Problem Areas
B. Pond Recharge Areas
C. Growth Management

3 Low Barrier to Implementation

A. Fertilizer Management
B. Stormwater Mitigation

4 Watershed/Embayment Options

A. Permeable Reactive Barriers
B. Inlet/Culvert Openings
C. Constructed Wetlands
D. Aquaculture

5 Alternative On-Site Options

A. Eco-toilets (UD & Compost)
B. I/A Technologies
C. Enhanced I/A Technologies
D. Shared Systems

6 Priority Collection/High-Density Areas

A. Greater Than 1 Dwelling Unit/acre
B. Village Centers
C. Economic Centers
D. Growth Incentive Zones

7 Supplemental Sewering

Triple Bottom Line

Impacts of Technologies and Approaches

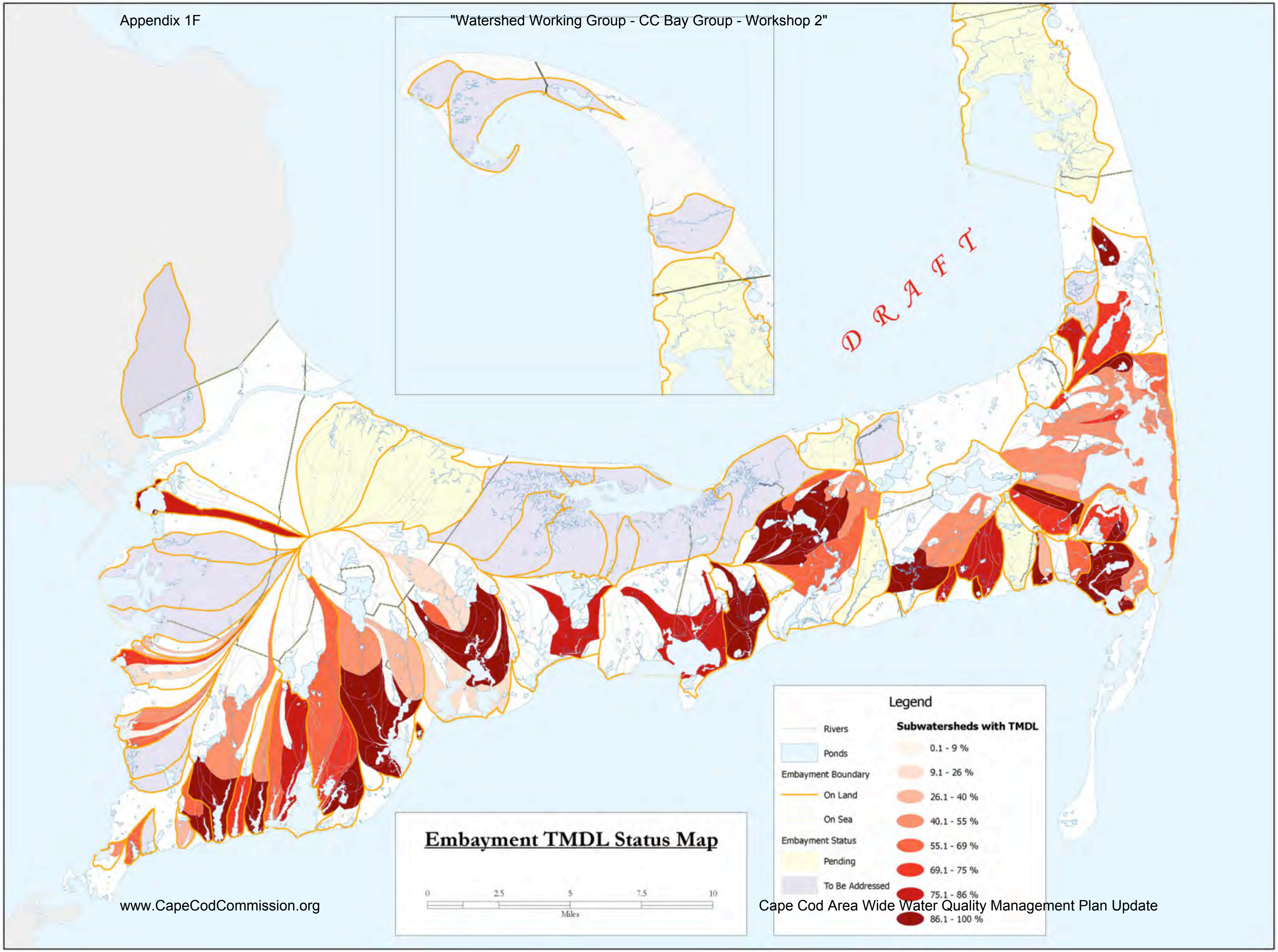
Environmental

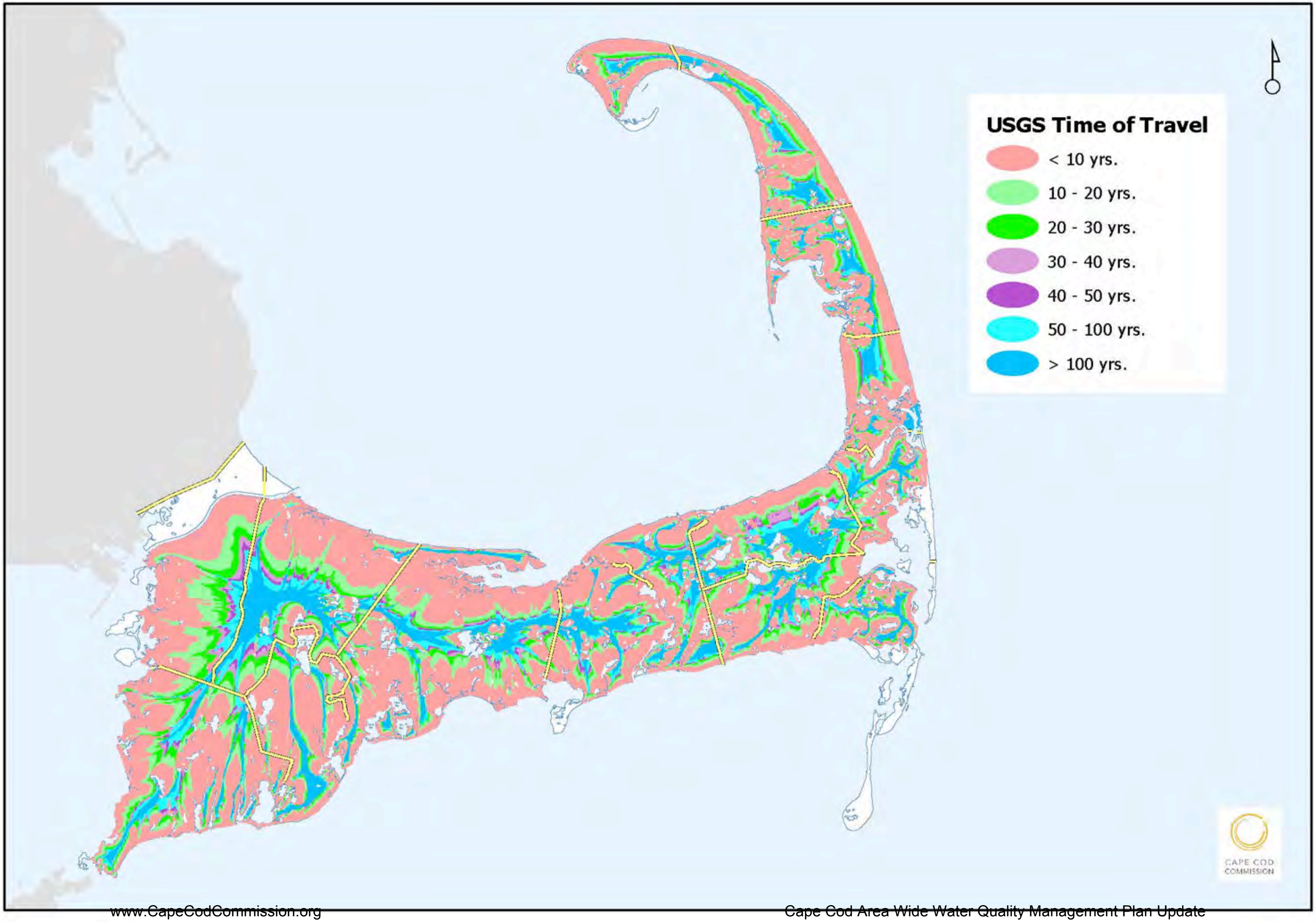
Economic

Social

Technology Selection: Process and Principles

- 100% septic removal subwatershed
- Scale: On-Site vs. Collection System vs. Natural System
- Nutrient intervention and time of travel
- Permitting Status
- Land use and Impacts of Growth


D R A F T
Embayment TMDL Status Map
0
2.5
5
7.5
10
Miles
Legend
Rivers
Ponds
Embayment Boundary
On Land
On Sea
Embayment Status
Pending
To Be Addressed
Subwatersheds with TMDL
0.1 - 9 %
9.1 - 26 %
26.1 - 40 %
40.1 - 55 %
55.1 - 69 %
69.1 - 75 %
75.1 - 86 %
86.1 - 100 %


USGS Time of Travel
< 10 yrs.
10 - 20 yrs.
20 - 30 yrs.
30 - 40 yrs.
40 - 50 yrs.
50 - 100 yrs.
> 100 yrs.
CAPE COD COMMISSION

Preparing for Meeting 3 and Beyond

- ❑ Review tools and alternatives analysis approach
- ❑ Evaluating scenarios for meeting water quality goals
- ❑ Attend the November 13th meeting:

6:00
Cape Cod Museum of Art
Dennis, MA

Cape Cod 208 Area Water Quality Planning
Three Bays & Centerville River Watershed Working Group

Meeting Two
Tuesday, October 29, 2013
8:30 am- 12:30 pm
COMM Fire Station, Centerville, MA

Meeting Summary Prepared by the Consensus Building Institute

I. ACTION ITEMS

Working Group

- Next meeting: Meeting Three
  Wednesday, December 4, 2013
  8:30AM -12:30PM
  COMM Fire Station, 1875 Falmouth Road, Centerville, MA 02632
- Send Ms. Carri Hulet any additional comments on Meeting One summary (by Oct 31)
- Continue to prepare thoughts about which technologies/approaches you would like to learn more about for application in the Three Bays Watershed. Different scenarios and options will be discussed during Meeting Three.

Consensus Building Institute

- Send link with presentation to participants
- Finalize Meeting One summary
- Draft and solicit feedback from Working Group on Meeting Two summary

Cape Cod Commission

- Share Technology Matrix with Working Groups
- Share updated Chronologies with Working Groups

II. WELCOME, REVIEW 208 GOALS AND PROCESS AND THE GOALS OF MEETING

Erin Perry, Special Projects Coordinator at the Cape Cod Commission, welcomed participants and offered an overview of the 208 Update stakeholder process.[1] In July, public meetings were held across the Cape to present the 208 Plan Update goals, work plan, and participant roles. Public meetings were also held in August to present information on the affordability and financing of the updated comprehensive 208 Plan. The first meetings of the eleven Watershed Working Groups were held in September and focused on baseline conditions in each of the watersheds. The second meetings of the Watershed Working Groups will be held in October and early November and are

[1] The PowerPoint Presentation made at this meeting is available at: http://watersheds.capecodcommission.org/index.php/watersheds/mid-cape/three-bays-centerville-river.

focused on exploring technology options and approaches. The third meetings of the Watershed Working Groups will be held in December and focus on evaluating watershed scenarios which will be informed by Working Groups' discussions about baseline conditions, priority areas, and technology options/approaches. This conversation will also be informed by information shared in the Technology Matrix, which was developed by the Cape Cod Commission with technical input from the Technology Panel. The Technology Matrix builds on the information presented in the Technology Fact Sheets, which Working Group members reviewed in advance of the meeting[2]. Once it is finalized by the Cape Cod Commission, the Technology Matrix will be shared with Working Group Members.

Ms. Perry shared the 208 Plan team's progress since Meeting One which includes:

- Meeting materials distributed to stakeholders and available at http://watersheds.capecodcommission.org
- GIS data layers accessible at: http://watersheds.capecodcommission.org
- Chronologies are being updated and will be made available soon

Ms. Perry also shared that the second round of the Cape-2-O game launched on October 22. She noted that over 400 people registered for the first round of the Cape-2-O game and encouraged Working Group members to participate in the interactive, online game which provides valuable education and input to the Cape Cod Commission.

Ms. Perry announced that there will also be a Cape Cod wide event on November 13 at the Cape Cod Center for the Arts in Dennis. Participants from across the eleven Watershed Working Groups and the public are invited to attend the event which will include: Wrap up of Cape-2-O: ur in charge!; a summary of planning process to date; discussion of the stakeholder role in the second 6 months of the 208 planning process.

Dan Milz, a doctoral candidate at the University of Illinois at Chicago, introduced himself and explained that he would like to videotape the meeting for purposes of his dissertation research. He indicated that, although the meeting is public, the recording would be kept private and that he would withhold names and affiliations in his work. Ms. Hulet asked if anyone had a concern with Dan filming the meeting. No one objected.

Ms. Perry reviewed the goal of the meeting:

- To develop a shared understanding of the potential technologies and approaches identified to date , and the benefits and limitations of each; to explore the environmental, economic, and community impacts of a range of categories of solutions; and to identify priorities and considerations for applying technologies and approaches to remediate water quality impairments in your watershed.

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[2] Technology Fact Sheets are available at: http://watersheds.capecodcommission.org/index.php/watersheds/mid-cape/three-bays-centerville-river.

Working Group members asked the following questions about the context and goals of the meeting and the 208 planning process:

- *To what extent is the 208 process supposed to involve freshwater resources? Freshwater resources can be a resource to capture nitrogen, but we do not seem to be dealing with these as much as the estuaries, embayments, and other salt water areas.* Ms. Perry responded by explaining that, while the 208 process is driven by nitrogen loads, the Working Group should not ignore the presence and effects of phosphorus in freshwater resources. The Commission is also looking at ponds for their capacity to attenuate nitrogen.
- *Is the Working Group's task in this meeting to look at the different remediation options and technologies strictly from a technological perspective or should the Working Group also look at the different options from political and sociological perspectives?*
    - Ms. Perry responded that the Cape Cod Commission would definitely like to hear from Working Group members about the political and sociological perspectives. The Commission would like to hear about which options are palatable and which ones are not.
    - Carri Hulet, the facilitator from the Consensus Building Institute, added that gaining political and sociological perspectives is precisely the value of convening Working Groups. Input from informed residents is exactly what the Commission is interested in receiving and these Working Group meetings also allow for residents to share their perspectives with one another. If remediation plans were going to be created on purely technical grounds, then the Commission would not need to create a stakeholder process involving Working Groups.

Ms. Hulet reviewed the agenda and led introductions. A participant list can be found in Appendix A. She also requested that anybody with additional comments or edits to the Meeting 1 meeting summary send them to her within the next two days.

III. RANGE OF POSSIBLE SOLUTIONS

Scott Horsely, Area Manager for the Outer Cape, led the discussion of the range of possible solutions. As Working Groups learn more and consider the pros and cons of the technologies and approaches, he encouraged participants to keep in mind that:

- The Cape Cod Commission has engaged in a comprehensive analysis of nutrient control technologies and approaches. This analysis is distilled into: the Technology Fact Sheets, which present various information on the technologies being considered; the Technology Matrix, which includes additional information on site requirements, construction, project and operation and maintenance costs, reference information, and regulatory comments; and ongoing input from stakeholders on the public acceptance of technology options and approaches.
- Not all of the technologies and approaches will be applicable to Cape Cod.
- Some technologies are so promising that we should identify them for demonstration and pilot projects.
- Workshop 3 will focus on hands-on problem solving in each watershed to meet target load

reductions.

- Certain technologies or approaches will be effective at preventing nutrients from entering the water body. Others will be effective at reducing or remediating nutrients that are already in the groundwater or water body.
- Regulatory programs can address nutrient controls for both existing development and future development.

Mr. Horsely offered a brief overview of the technologies and approaches. The following section briefly describes each technology. Participants' questions and comments about the technologies are also discussed below *(in italics)*:

Site level technologies/approaches

Standard Title V System*:* This is a standard septic system that consists of a septic tank and soil adsorption system (leaching field). The system was primarily designed to address public health concerns related to waste in drinking water (e.g. coliform bacteria); they were not designed to remove nutrients (e.g. nitrogen).

I/A title V System: Innovative/Alternative (I/A) on-site nutrient reducing systems typically consist of standard septic system components augmented to remove more nutrients than a standard Title 5. I/A systems refer to a class of systems intended to be designed as recirculating sand filter (RSF) equivalents by meeting the same treatment limits in a smaller footprint.

- *Could some information about costs of different systems be provided, both for these I/A Title V systems and for the other technologies?*
    - Mr. Horsely responded that the Commission is working to develop cost estimates but that these are still in progress.
    - Dr. Dale Saad, Senior Project Manager for Water, Sewer, and Green Energy at Barnstable DPW, added that an I/A system is roughly $30,000, generally about twice the cost of a standard Title V system.

Urine Diverting Toilets: Urine diversion systems send urine into a holding tank where the urine is stored and periodically utilized on-site as a fertilizer or is collected by a servicing company. The servicing company empties the tank for either treatment and disposal or recycling such as conversion to a fertilizer. Through these means, the nitrogen may be removed from the watershed. With urine diverting toilets, the remainder of the human waste and all other water uses (sink and shower) continue to go to the septic system. (Case example, Falmouth, MA).

- *Do nitrogen levels vary by people's diets?* Mr. Horsely responded that diet is unlikely to cause significant variation in the nitrogen content of urine. He added, however, that current estimates of 85% of nitrogen in septic system coming from urine may be too high due to organic food wastes in kitchen water.

Composting toilets: A toilet system which separates human waste from shower, sink and other household water uses. The composting toilets use no or minimal water. The human waste captured by the composting toilets is decomposed and turned into compost. The compost generated is removed from the site and nutrients can be recycled. Composting toilets require the replacement of existing toilet(s) and room in the basement for a container to capture and compost the human waste. Household water use (sink and shower uses) continue to flow to the septic system. (Case example, Falmouth, MA).

- *How has public reception to these been?*
  - A Working Group member explained that reception has been mixed. While toilets have been installed successfully in some cases, there remain some issues to be resolved relating to loads, insects, etc.
  - Mr. Horsely added that the toilets also require space underneath, such as in the basement, to install a composter.

<u>Packaging toilets</u>: A packaging toilet encapsulates human waste in a durable material for removal from the site. The package is stored beneath the toilet and removed and taken away when full. The nutrients can be recycled by the servicing company that picks up the packages.

<u>Stormwater bioretention</u>: Bioretention systems utilize natural plant and soil functions to capture and treat stormwater runoff for a variety of contaminants including nutrients. A typical system consists of an underdrain/gravel layer, a layer of bioretention soil mix (a mix of sand, compost, woodchips and loam), and a surface layer containing appropriate plantings. The treated water can be discharged into a water body or used for open space irrigation after treatment. The reclaimed water can also be discharged into a subsurface infiltration system for discharge to the groundwater. (Case example, Portland, OR).

- *What are the key sources of nitrogen when considering the individual home or business?* Most nitrogen is coming from people's lawns and parking lots.
- *It is somewhat deceiving to say that regulatory agencies would be able to monitor nitrogen runoff effectively at the lot-level. In order to implement stormwater bioretention systems and receive credit from DEP and EPA for these, the regulatory agencies would have to basically say that simply installing a system will trigger a credit for, say, a 15% reduction in nitrogen load. Otherwise, the regulatory agencies do not have the resources to monitor the effects of bioretention systems at the site-specific level.* Mr. Horsely responded that monitoring would likely take place at the watershed level. In general, and not only in relation to stormwater bioretention, it will be difficult to identify exactly which sites, and even which technologies, are effectively capturing or mitigating nitrogen flows.

General Comments about Site level technologies/approaches:

- *Some of these technologies may not work under all environmental conditions. For example, some (specifically septic systems) may not work if the water table is too high.*
- *The difference in nitrogen-removal efficiency between urine-diversion and composting toilets needs further investigation.*
- *As we look into these different options, it is tempting to look at traditional Title V Systems as "the problem." But it is important to remember that, since Title V has already been implemented, policy and procedures for this regime are already in place. With other systems, that process of policy creation and implementation would still be ahead of us. We need to*

think about the likelihood of successful implementation and the timeframe that would require. Mr. Horsely responded that implementation of other technologies may also occur over the course of decades. Title V took many years to implement, and any new solutions may similarly require a longer timeframe to develop policies and procedures.

- *Could regulatory trade-offs be instituted to entice people to install these sorts of technologies? For example, allowing 3 bedrooms instead of 2 bedrooms, or allowing additional construction on the coast, could entice residents and developers to adopt some of these technologies.*
    - *A working group member stated that a homeowner had approached the Barnstable Land Trust to ask if he could use the Land Trust's development rights to expand his property. These sorts of considerations ultimately come down to money.*
    - Mr. Horsely added that it does come down to money, and some people will prefer to pay more to install sewering and others will prefer to save money and install an eco-toilet. He noted that Barnstable has already instituted some provisions to entice residents to install nitrogen-remediation technologies and that this approach could be explored further.
    - *A working group member responded that the cost of an eco-toilet may be cheaper from a public perspective but a homeowner who has to retrofit her house with new plumbing to accommodate an eco-toilet may end up paying more.*
    - *A working group member suggested that denser growth may not be preferable everywhere on the Cape. Policies to encourage density and adoption of other remediation technologies would need to be placed in the context of how residents want to see the Cape develop and in terms of environmental impacts.*
- *A working group member commented that Title V systems are an appropriate technology in non-sensitive areas. For example, if nitrogen discharges are flowing directly to the ocean, then Title V systems do not present an issue. Nitrogen flows only present an issue in ecologically-sensitive areas.*
    - Mr. Horsely responded that, while that is true, there are not many non-sensitive areas present on the Cape.
- *It is important to document the comments and pros and cons about each technology option that working group members are contributing so that members of the general public, who will look at this information later, can follow our thinking and do not worry about ulterior motives and other issues.*
- *A working group member suggested that, with regard to site-level technologies, not all homeowners will follow recommendations for installing technologies to mitigate nitrogen loads. In that case, would it be up to municipalities to enforce provisions and pay for improvements?*
    - Mr. Horsely responded that, currently, contractors are responsible for enforcing provisions of this nature, but that this system rates at a C or C- grade in terms of efficacy. Ultimately, the costs of any system will be shared between the municipality and individual homeowners. Upgrading existing Title V to I/A Title V systems is an expense that is difficult for many residents to bear.

Neighborhood level technologies/approaches

Cluster and satellite treatment systems: A cluster or satellite system is a collection and treatment system treating wastewater flows from multiple properties.

STEP/STEG collection: Septic Tank Effluent Pumping (STEP) and Septic Tank Effluent Gravity (STEG) systems convey liquid wastewater from on-site septic tanks to sewer systems; Only the liquid component of the wastewater may be conveyed by pumps or by gravity.

Eco machines and living machines: Living or Eco-Machines are natural systems that treat septic tank effluent or primarily treated wastewater. In these systems, aeration and clarification chambers are combined with constructed wetlands to treat the influent. The wetlands are a series of chambers allowing for microbial communities to engage with and treat the wastewater. Plants are often suspended on racks with their roots systems doing the work. Solids removal is generally onsite, after which water is pumped through the gravel filled cells (similar to subsurface wetlands.) This process transfers more oxygen to the wastewater and completes the pollutant removal process. (Case example, South Burlington, VT).

- *There is an Eco Machine-type wastewater treatment plant in Weston Massachusetts, and dozens elsewhere outside of Massachusetts. Harwich had one as a pilot system but it is no longer in operation.*

Stormwater wetlands: Constructed wetlands provide aerobic chambers followed by subsurface anaerobic chambers that facilitate nitrification followed by denitrification, respectively. This process mimics that of natural systems coupled with engineering design guaranteeing residence time within a chamber containing anaerobic conditions. (Case example, China).

- *The slide should clearly state that this would involve constructed, not natural, wetlands.*
- *Has research been conducted on how stormwater runoff affects the wetlands?*
    - Mr. Horsely responded that, while he was not sure about research findings, Massachusetts state regulations state that water must be treated before it can be discharged to wetlands.
    - James Sherrard, hydrologist with the Cape Cod Commission, added that, in New Hampshire, the water flowing into wetlands is required to be of higher quality than the existing water in the wetlands.
- *The fact sheet on stormwater wetlands says "does not allow for year round nutrient removal efficiencies." Do these wetlands systems work year-round?*
    - Mr. Horseley explained that wetlands systems do work year-round, as most nutrient treatment occurs in the root zones of plants, where the temperature is much warmer than air temperature during the winter. Removal efficiencies may decrease during the winter, but the system does keep working.

General Comments about Neighborhood-level technologies/approaches:

- *Are there space requirements and limitations for each of these different options?*
    - Mr. Horsely answered that yes, these options require different amounts of space and that a stormwater wetland, for example, may require a significant amount of

open space. In areas with new construction, municipalities can require developers to include different remediation technologies, but finding space can present a larger challenge when retrofitting in built-out areas. That being said, approaches such as bioretention gardens are being installed in portions of sidewalk in Manhattan, so not all of these options require significant open space.

Watershed level technologies/approaches

Conventional treatment: A conventional wastewater treatment facility typically treats wastewater collected from homes and businesses. A groundwater discharge permit is required. Treatment generally results in less than 10 mg/L Nitrogen.

- *Does the $34,000 per household figure that Mr. Horsely quoted for sewer installation in Falmouth apply to the entire town or just to a limited area of Falmouth.* Mr. Horsely and a working group member answered that that figure likely applied to just a subset of the town. They added that the cost of sewering in Provincetown would likely be much cheaper, but that Provincetown is much more densely developed than are most other areas on the Cape.

Constructed wetlands: surface flow: Constructed wetlands can be utilized to intercept ambient groundwater or to treat partially processed wastewater. They can be built in targeted areas downgradient of high-density septic systems to intercept and treat nitrogen-enriched groundwater. After secondary treatment at a wastewater treatment facility, water can also be fed into a surface flow constructed wetland. Surface flow constructed wetlands closely mimic the ecosystem of a natural wetland by utilizing water loving plants to filter wastewater through their root zone, a planted medium, and open water zones. Surface flow wetlands are systems where open water is exposed much like in a natural marsh. The reclaimed water from the wetland can be discharged into a water body or used for open space irrigation after treatment as well as discharged into a leach field. (Case example, Albany, OR).

- *How much space is required for constructed wetlands?* Mr. Horsely responded that the size can be variable, with some being an acre large and some being 3 or 4 acres large.
- *We would not want to turn the entire Cape into wetlands just to deal with nitrogen loads, so some sort of guidelines should be developed in terms of what the size of the wetlands should be or their locations.*
- *Is hydrologic balance a consideration? Would some of these approaches take water out of certain watersheds?* Mr. Horsely said that, yes, this could be a concern. Additionally, a participant in the Technology Panel the previous day pointed out that freshwater resource stress may be exacerbated by climate change.

Constructed wetlands: subsurface flow: Constructed wetlands can be utilized to intercept ambient groundwater or to treat partially processed wastewater. They can be built in targeted areas downgradient of high-density septic systems to intercept and treat nitrogen-enriched groundwater. They can also be used to process partially treated wastewater from a septic system or treatment plant by pumping the effluent water slowly through subsurface gravel beds where it is filtered through plant root zones and soil media. Water flows 3-8” under the surface to prevent public exposure to wastewater and mosquito breeding. A combination of horizontal and vertical flow subsurface systems must be utilized to provide total nitrogen removal. This solution can also offer opportunities for recreation activities on land above the subsurface system. (Case example, Thailand).

Effluent disposal: out of watershed: Effluent disposal can take a variety of forms, including infiltration basins, a Soil Absorption System, Injection Wells or Wick Wells. These disposal methods place highly treated effluent back into groundwater. Effluent Transport out of the watershed has the advantage of removing the nitrogen load to another watershed. Transport to another watershed requires the receiving watershed to be able to accommodate the additional nitrogen load.

- *These different effluent disposal systems each have pros and cons, with some being better for more densely-developed areas. Some systems may be good for recharging groundwater and could even hold back saltwater infiltration of freshwater aquifers.*
- *There are a number of areas where groundwater levels are dropping due to use. For example, the Marsten Mills River is being depleted and water is being redistributed to other areas. We need to be aware of these sorts of issues and have to be careful that water is redistributed in a way that does not harm the environment.*
    - Mr. Horsely responded that it is very important to keep that in mind and that it can be important to remediate water withdrawals from certain areas. It is also important to take into account how much water is being withdrawn in relation to the size of the entire watershed.

Effluent disposal: ocean outfall: Similar to out of watershed effluent disposal, highly treated effluent is transported out of the watershed and into the ocean. This solution requires a high level of regulatory oversight, but is being considered because there is limited land availability for disposal on Cape Cod.

Phytoirrigation: After secondary treatment, wastewater treatment facility effluent is irrigated onto plants to remove nutrients and other contaminates. Fast growing poplar and willow trees are typically used. (Case example, Woodburn, OR).

- *Could crops be grown using this methodology?*
    - Mr. Horsely said that the second largest crop in the United States is lawn. The example that was shown from Oregon involves harvesting of the trees that are grown. A rhododendron nursery in Sandwich also uses phytoirrigation. These could all be revenue streams and co-benefits that are important to consider.
    - *In other words, we could think about wastewater as a resource, not as a problem or a waste to be disposed of.*

General Comments about Watershed-level technologies/approaches:

- *The notes for a number of these options indicate that they are only viable for six months of the year, not year-round. What happens during the rest of the year?*

- Mr. Horsely responded that some of the technologies, such as wetlands, do work year-round, but sometimes at slower rates in the winter. The incoming load is also slower in the winter, however.

Neighborhood or Watershed level technologies/approaches

Phytobuffers: Using trees with a deep root system to capture nutrients in the groundwater, particularly willows and poplars. Green plants with deep tap roots are planted as a buffer to intercept existing groundwater. The plants and their associated microorganisms reduce contamination in soils and ground water. Often phytohydraulics cause the groundwater plume to be redirected and pulled towards the plants. (Case example, Kavcee, WY).

- *Harvesting bio-phragmites could also be a means of reducing nitrogen loads. This would be a type of phytobuffering.*

Fertigation wells: Fertigation wells can capture nutrient enriched groundwater, typically from a wastewater treatment facility discharge, and recycle it back to irrigated and fertilized turf grass areas. These irrigated areas include golf courses, athletic fields and lawns. Fertigation can significantly reduce nutrient loads to downgradient surface waters while reducing fertilizer costs to the irrigated areas. (Case example, Plymouth, MA).

- *Is micro-fertigation, such as a residence picking up leachings from its own lawn and using this as fertilizer, an option?*
    - Mr. Horsely noted that Eastham is basically doing this already, since they use wells.

Permeable reactive barrier (PRB): A permeable reactive barrier (PRB) is an in-situ (installed within the aquifer) treatment zone designed to intercept nitrogen enriched groundwater. Through use of a carbon source, microbes in the groundwater uptake the nitrogen, denitrifying the groundwater. PRB systems typically use vertical trenches, sequences of bored columns or injection methods to introduce the carbon source into the groundwater to reduce the nitrogen load to an estuary, removing it from the watershed. (Case example, Falmouth, MA).

- *Could PRBs be dovetailed with an approach to sequester carbon dioxide from the atmosphere?*
    - Mr. Horsely suggested that this sort of approach could be explored, as a variety of materials could be installed to serve as a carbon source. For example, the Massachusetts Military Reservation (MMR) used iron filings.

Inlet and culvert widening: Re-engineering and reconstruction of bridge or culvert openings to increase the tidal flux through the culvert or inlet. This solution generally works better with a larger tidal range but could be feasible on both the Cape Cod Bay side (approximately nine feet tidal range) and Nantucket Sound side (approximately 3 feet of tidal range).

- *This method may only have a marginal effect on nitrogen concentrations, such as 3-5%.*
- *While the impact may be small, if the widening project is happening for other reasons, we might as well take advantage of it to account for the co-benefits in terms of nitrogen load reductions.*

Salt marsh habitat restoration: Salt marsh is one of the most productive ecosystems in the world, surpassing rainforest in productivity per acre. Approximately 65% of historic salt marsh has been lost in MA. Salt marshes cycle and remove nitrogen as well as provide critical habitat and spawning sanctuary for a wide variety of birds, mammals and marine life in addition to hosting a range of plant species and important biogeochemical processes. The capacity of salt marsh to intercept nitrogen is significant and well researched worldwide. Substantial areas of former salt marsh on the Cape are either under consideration for restoration or could be restored providing storm surge and coastal flooding protection in addition to water quality benefits in certain watersheds.

Shellfish habitat restoration: Oyster reefs were historically one of the main consumers and recyclers of nitrogen in the coastal environment on Cape Cod. According to the Nature Conservancy, populations have declined by 95%. In conjunction with the natural transition from land to sea in estuaries, bays and inlets; salt marsh, oyster reef and eel grass function as critical buffer that can reduce eutrophication. Restoring Oyster populations leads to increased shellfish productivity as well as improved commercial and recreational fisheries for other species, increased protection from shoreline erosion and flooding, and buffering from ocean acidification. (Case example, Wellfleet, MA).

- *Work around shellfish habitat restoration has been done in a number of places, including the Southeast Coast, Chesapeake Bay, and in southern Georgia. In all of these places, oyster populations undergo large population swings and humans have not been able to understand why this is the case. Seeing this, it may not make sense to rely on this technology by itself.*
    - Mr. Horsely said that this is an excellent point and, because shellfish populations are highly-variable, this technology could not be implemented on its own.
- *Salt march and shellfish habitat restoration both seem to be very promising approaches but we need to keep in mind that, with climate change, coastlines and marshes will move inland.*
- *Shellfish populations declined over time due to the types of environmental problems that we are currently trying to address. How would it be possible to restore shellfish populations to deal with nitrogen loads if the environmental challenges that caused population declines are still currently in place?*
    - Mr. Horsely responded that this is a valid question that needs further exploration, perhaps by the Technology Panel. He added that, while the question is valid, shellfish populations do seem to have been successfully reintroduced in Wellfleet. Shellfish restoration is really premised on shellfish habitat restoration, not simply reintroducing the shellfish.
    - *A working group member added that today's environmental conditions may not be identical to those that caused a die-off in shellfish populations in earlier decades, as clear-cutting was a major issue and environmental driver in the past.*

Aquaculture / shellfish farming: Oysters have been proposed as a potential method for reducing nitrogen levels and eutrophication in estuaries. Nitrogen removal rates from oysters have been well documented and the harvest of oysters physically removes the nitrogen they sequester in addition to the nitrogen removed by their biological cycling which puts nitrogen directly back into the atmosphere. Aquaculture can be done on man-made structures (e.g. cages, floating bags) or natural reefs.

- *The type of oyster or shellfish operation that is implemented would also make a difference. For example, a put-and-take operation would work differently than an aquaculture operation.*
    - Working group members and Commission staff members discussed the facets of different types of oystering operations. They noted that caged-aquaculture is more manageable and predictable, but that this also limits the size and scope of the oyster industry.
    - *A working group member added that aquaculture is likely to change the nature of the waterfront, including reducing public access, and that this is likely to provoke some public pushback.*

Surface water remediation wetlands: Constructed to aid in water quality improvements to surface water bodies, usually streams or rivers. Water is pumped or allowed to flow naturally through treatment cells containing wetlands. Surface water remediation wetlands are often used in combination with groundwater recharge or potable water reuse systems. Surface water remediation wetlands are generally used with Free-Water Surface wetlands due to their larger size, and lower capital and operation and maintenance costs. (Case example, China).

Pond and estuary dredging: Lakes, ponds, streams and estuaries store nutrients within their sediments. These sediments tend to accumulate over time. Subsequently, these nutrients can be release into the overlying water column and can become a major source of nitrogen and phosphorus. Dredging and removing these sediments and accumulated nutrients removes the nutrients from the water body and potentially the watershed. (Case example, Dennis, MA).

Cape-wide level technologies/approaches

Compact development: Both Compact Development and Open Space Residential Development (OSRD) of subdivisions result in smaller lots and less maintained lawn acres. The higher density development reduces wastewater collection costs while providing a common disposal area. Compact development is also referred to as “Smart Growth”.

Fertilizer management: Managing fertilizer application rates to lawns, golf courses, athletic facilities and cranberry bogs. Residential lawn loading rates could be reduced on existing developed parcels through an intensive public education/outreach program. This could include a “Cape Cod Lawn” branding program, replacing some turf areas with native vegetation, establishing naturally-vegetated buffer strips on waterfront lots, and reducing application rates. Fertilizer loading rates for new development could be accomplished by reducing lot sizes (cluster development), by restricting lawn sizes and/or by incorporating more naturally-vegetated open space areas. Municipalities could directly reduce fertilizer applications on athletic fields and other properties. Golf courses can significantly reduce nitrogen loading rates by using slow-release fertilizers and reducing application rates in rough areas. Cranberry bog fertilizer exports from the bogs can be reduced using tail water recovery systems. Site-specific assessments are needed to estimate load reductions. The Cape Cod

Commission designated a cape-wide Fertilizer Management District of Critical Planning Concern (DCPC) which authorizes the towns to adopt local fertilizer management regulations (state law prohibits local fertilizer management except under the DCPC). The DCPC does not require towns to adopt fertilizer regulations, but paves the way for their adoption. Barnstable County will be conducting a public education process around fertilizer use.

Remediation of existing development: Existing developments or schools with excess wastewater treatment capacity allow existing nearby developments to connect to their underutilized wastewater treatment infrastructure. A town can operate the wastewater treatment facility if the existing owner prefers to not take the responsibility for treating the off-site wastewater. An example of this is the Kingman Marina in Bourne, which was permitted to expand its development footprint in exchange for hooking up adjacent, existing homes to its wastewater treatment facility.

Transfer of development rights: A regulatory strategy that transfers development and development rights from one property (sending area) to another (receiving area) to direct growth and associated nutrient loading away from sensitive receiving watersheds or water bodies. The protected parcels (sending areas) receive a deed restriction that limits the level of future development. The deed restriction can limit the number of homes or tie development to the availability to future wastewater treatment facility infrastructure.

- *The water suppliers occasionally talk about selling their land, and there should be a provision that they can only sell for the purposes of transferrable development rights. It is important to preserve these open spaces.*

Stormwater best management practices (BMP): Non-Structural Stormwater strategies include: street sweeping, maintenance of stormwater utilities, education and public outreach programs, land use planning, and impervious cover reduction and control.

General questions and comments:

- *Are there any interactive models available that would be able to tell us how effective different approaches and technologies would be in different places? In Meeting 1, the Commission showed a map that identified different areas as having different nitrogen removal targets, such as "100% removal", "80% removal", etc. Are there models that would show how effective different mitigation technologies would be in specific geographies?*
    - Representatives from the Cape Cod Commission answered that there are two models of this sort. One is the Multi-Variable Planning (MVP) scenario planning tool, but this model largely focuses on traditional approaches, such as sewering. A second tool, which will be used in Meeting 3, is a spreadsheet calculator for the alternative and innovative approaches.

- *We should remember that MA DEP must approve of any remediation plan and sign off on it. Either DEP would need to agree to simply award credits for installing certain systems that cannot be monitored after installation, such as various site-scale systems, or Cape communities will have to present a reasonable and defensible model and estimate of likely* *reduction rate(s) from different technologies and approaches.*

- *It would be helpful to think about the actions that individuals and individual homeowners can take. For example, if a homeowner plants a tree on the downgrade-side of the leach field, how much of a nitrogen-reduction impact would it have? This is the sort of action that an individual could take.*

- *What was the importance of the historical timelines (chronologies) for different towns that the working group reviewed in the previous meeting?*
    - Ms. Hulet and Mr. Horsely explained that the Commission wanted to demonstrate transparency and clarity that it understands the history of wastewater management in each town. The timelines will also be included in the Section 208 update plans.
    - *A working group member suggested that looking at what actions have been proposed in the past and whether those actions have received public support, or not, and how well implementation worked could inform the working group's current work.*

IV. PROBLEM SOLVING PROCESS AND PRINCIPLES

Overview of 7-steps for Problem-Solving Process
Mr. Horsely reiterated that the goal the Working Groups is to develop remediation options that would achieve water quality targets with a focus on first targeting low cost, low barrier options to reduce nitrogen and then considering more costly and traditional options later (e.g. sewering). He then described the alternatives screening process the group will apply:

1) Establish targets and articulate project goals.
2) Identify priority geographic areas (e.g. high nitrogen reduction areas, Title V problem areas, pond recharge areas).
3) Determine which management activities should definitely be implemented. These might be the easiest and least costly management activities that should be undertaken regardless of other management actions (e.g. fertilizer management and stormwater mitigation – two approaches that Cape Cod towns are already actively pursuing).
4) Assess alternative options to implement at the watershed or embayment scale (e.g. innovative and lower-cost solutions)
5) Assess options to implement at the site-level
6) Examine priority collection/high density areas
7) Consider traditional sewering or other grey infrastructure management options

He further explained that the Working Groups will focus on total controllable nitrogen load. The technologies and approaches selected should aim to reduce the total controllable nitrogen load by identifying options that reduce the portion of *septic* load that needs to be reduced. For example, the portion of septic load that needs to be reduced could be made smaller if Cape Cod takes on fertilizer and stormwater solutions first. Additionally, the percentages of controllable nitrogen that need to be removed to meet TMDLs change depending on the characteristics of the watershed.

He noted that in many instances, one of the solutions may not achieve the TMDL, but if you pair multiple solutions you may be able to reach the goal. For example, many towns are already using and pairing some of the technology options and approaches:

- Wellfleet- *Coastal habitat restoration & aquaculture*
- Mashpee- *Aquaculture & Expanding Existing Systems*
- Brewster- *PRB & Bioswales*
- Orleans- *Fertilizer Control By-Law*
- Harwich- *Muddy Creek & Cold Brook Natural Attenuation*
- Falmouth- *Aquaculture, Inlet Widening, Eco-Toilet Demonstration Project, PRBs, Stormwater Management (Little Pond Watershed), Fertilizer Control By-Law, Subsurface Nitrogen Removal Septic System*

Categories of Solutions and their Impacts on the Environment, Economy, and Community

Mr. Horsely commented that evaluation of the technologies and approaches would be informed by their impacts (positive and negative) on the environment, economy, and community (Triple Bottom Line). He asked participants to consider the environmental, economic, and community impacts of the possible technologies and approaches and asked them what evaluation criteria/factors they might consider in guiding evaluation of the range of possible solutions. Working Group members offered the following suggestions:

<u>Environmental</u>

- *Time of travel:* Some options address the problem before it enters the groundwater. These might be preferable in many circumstances.
  - *A working group member added that time of travel is also important to consider because current impacts on estuaries result from the nitrogen loads of 20 or 50 years ago (whatever the relevant time of travel is). Water with today's nitrogen loads, which may be much higher, will not even hit the estuaries for a few years yet.*
  - *Since most existing development tends to be near the shoreline, the time of travel estimates will not be as long as those that are assumed to be coming from the spine of the Cape.*
- *Possibility of catastrophic impacts*: Considering the potential that nutrient-rich water that is already moving towards the estuaries could catastrophically impact the estuaries before a "tried-and-tested" remedy such as sewering could be implemented and sufficiently mitigate nutrient flows at the source, it may be more attractive to the permitting agencies that some alternative, in-situ technologies be implemented now, before it is too late.

<u>Economic</u>

- *Costs:*
  - Costs will always be important. In considering the different options that are contained in the fact sheets, it would be helpful to have more information about costs and also to have information about which options have previously been rejected as too costly or as socially undesirable for some reason.

  - Each option should be considered in terms of a 20-year lifecycle cost analysis.
  - Mr. Horsely explained that the financial analysis accompanying different scenarios that is presented in Meeting 3 will be pretty detailed and will include different financing options.
    - A working group member added that it would be important to include co-benefits in these financial calculations.

<u>Social</u>

- *Opportunity to shift social perceptions:* This process provides an opportunity to shift social perceptions. For example, while people may prefer their current toilet system over installing a urine-diversion toilet, they may also change their mind when the trade-off of $12,000 to install urine-diversion toilets is set against the $60,000 that it may cost to implement another type of solution, or the estimated $43,000 per household cost of sewering in Falmouth.
- *Education:* Each homeowner sees his or her situation as only his or her own and does not recognize that costs are necessarily going to be shared. We need to engage in an educational process to try to help people understand that costs are going to be shared between households in one form or another.
- *Factors for Successful Implementation:* Thinking about successful implementation of any of the remedies will require that we look at policy and the social sciences in addition to technology. We need to think about how to motivate people and what factors are present and necessary in any technology adoption.
  - More valuable than concepts like “the public interest” or “the long-term good” is probably a process of emphasizing regulatory trade-offs and alternatives as well as cost-benefit analyses.

Priorities for this Watershed

Ms. Hulet asked participants to hone in on the specific environmental, economic, and social trade-offs or consequences that they felt would be important to consider for this watershed. Working Group members offered the following suggestions:

- *Local Planning:* Land Use Vision Maps that have been developed by local communities should be taken into consideration when considering remediation options. Infrastructure should be concentrated in areas that have been targeted for growth by the local communities.

- *Keep Longer-term Options Open:* Promising options for longer-term remediation should be identified and taken into account now. For example, if open spaces are developed now, it would take certain longer-term options off the table. This process should operate according to the “do no harm” principle.

- *Be Realistic:* In some areas, it is not really practical or feasible to achieve a condition of true restoration, as defined by the geology of each embayment. For example, not all areas are going to see the return of eelgrass. For some areas, avoiding algae blooms would be a measure of success. For example, it would be much too expensive and infeasible to restore Warren's Cove to a pristine state. This process should be honest about these circumstances and set realistic expectations. It is important to set the parameters of what you are trying to achieve, similar to the methodology employed when remediating hazardous waste sites.

- *Focus on the Achievable:* The "A" in the SMART acronym stands for "achievable." If a remedy is not achievable in a political or economic sense, it will not work. We should be able to rank the different approaches in terms of what is achievable.

- *All Politics are Local:* While an area such as Lawrence Cove may be harder to remediate than some other areas, the residents there are also wealthier than in some other areas. Local residents have more of an investment and sense of buy-in to the health and condition of their local environment and, in the case of Lawrence Cove, there may be a greater capacity for taxation and other mechanisms to pay for remediation. Particularly since a lot of high-value property is located along the coast, if local residents are willing to pay more for a more comprehensive remediation approach, those approaches may take higher priority.
    - Another working group member commented that the implication of this principle seems to be that residents who do not live adjacent to the watershed would not have any incentive to pay for remediation.
    - A working group member added that there has to be something in the solution for everybody and it has to be relatively immediate.

- *Alternative Financial Models:* Non-taxation financial models, such as gift accounts, could be considered to support remediation.

- *Who pays*: Cost-sharing is both important and necessary, but it can be a difficult political sell. A few years ago, a tax increase to cover maintenance of private roads was proposed and was voted down even though it would have benefited almost all residents.

- *Economic Costs versus Political Costs*: While land use regulations could be seen as "low cost" in a public sense, they can be politically very costly and difficult to implement.

Concrete Suggestions for this Watershed

Ms. Hulet asked participants to provide feedback about specific technologies and remediation approaches. Working Group members offered the following suggestions:

- Could widening the outflow from Rushing Marsh help reduce nitrogen concentrations?
    - A working group member responded by saying that this was tried previously using "soft" approaches, but not with "hard" engineering. It did not work at the time.

- Natural approaches to remediation would be preferable.

- Controlling the development that has not yet occurred would address 40% of the nutrient issue. That seems like the biggest bang for the buck.

- Shared systems work in many neighborhoods. For example, although a shared septic system in Craigville has not completely eliminated nitrogen, and the nitrogen will still eventually flow to the estuary, it has made houses livable because sewage is routed further away. In many places where houses are closer together and the septic systems are older, this can be a good option.
    - A working group member responded that, while these sorts of shared septic systems may work in certain remote places, if they are implemented en masse, the operations and maintenance burden would be quite significant and may become difficult to maintain by the group of people that they serve. As a result, the operations and maintenance responsibilities would likely fall to the municipalities.

- Permeable reactive barriers seem very promising. The challenge seems to be whether the water flows through the barrier or around it, but this seems like a surmountable challenge. It seems cost effective and unobtrusive.

- Aquaculture seems very promising.

- Title V systems are already widely installed and adding I/A systems to these existing systems seems straightforward. If there is a concern about people switching off their systems to save electricity, these I/A systems could be connected with solar photovoltaic panels in order to provide constant, minimal-cost electricity.

- Framing nitrogen as a resource is a smarter approach than framing it as a pollutant. For example, dry toilets can produce a fertilizer resource .

- In response to a question from the Cape Cod Commission about whether participants and their neighbors would choose to pay $12,000 for an alternative toilet or $36,000 towards the cost of installing sewer infrastructure, working group participants provided the following responses:
    - The structure and options for financing those costs would be significant in making a decision. For example, people will pay more to lease a car than to pay cash to buy one outright because of cash-flow considerations.
    - People will go with what they know.
    - Part of the consideration is the age of the system on the property. If someone would have to replace the system soon anyways, he or she may be more willing to switch to an alternative toilet.

- How we, as a society, think about this challenge is key: currently, we pollute the water and then clean it. How do we get to a point where we do not pollute the water?

- What is the actual cost of polluting water? If people had to write checks for their own pollution, they would be much less likely to pollute.

  - A Cape Cod Commission representative noted that the Commission is working on a study about this issue.
  - Another participant said if someone does not want to adopt one of these alternatives, he or she can pay for the cost of dealing with their own nitrogen waste.

- Citizens may expect that, once they pay $35,000 to install sewering or implement some other technology, that the issue has been addressed for the foreseeable future. They may be very resistant about being asked to pay again in five years time if, for example, regulations evolve and become more stringent or if the initial solution does not work as expected.
  - A working group member noted that the Barnstable Board of Health did not recommend the adoption of alternative systems because they were concerned about the unfairness of imposing a future cost down the line if the system did not perform as expected.

Technology Selection: Process and Principles
Mr. Horsely noted that the Working Group had identified many of the principles that the Cape Cod Commission hoped would guide technology/approaches selection. These process and principles include:

- *100% septic removal subwatershed*: Combinations of technologies can be used to reduce septic load that needs to be removed.
- *Scale: On-Site vs. Collection System vs. Natural System*: There will be tradeoffs between the scale of systems that can be used. On-site, collection, and natural systems all have their pros and cons and all require different levels of investment and infrastructure. These tradeoffs will be important from an implementation and public acceptance point of view.
- *Nutrient intervention and time of travel*: Some technologies/approaches intercept nutrients at their point of entry into the system, while others deal with it later on (e.g. once it is in the watershed). There are pros/cons to each approach which need to be considered.
- *Permitting Status*: The level of effort required to permit technologies will be a consideration.
- *Land use and Impacts of Growth*: Unintended consequences and opportunities for planned growth are important to consider.

V. PLANNING FOR THE NEXT MEETING

Meeting Three will be held:
Wednesday, December 4, 2013
8:30AM -12:30PM
COMM Fire Station, 1875 Falmouth Road, Centerville, MA 02632

During this meeting the Working Groups will examine various scenarios (i.e. combinations of solutions) and their potential impacts (e.g. nutrient reduction, economic impacts, environmental impacts, social impacts, etc.). During the meeting, the Cape Cod Commission will use tools to calculate ideas/options and their impacts. Working Group participants should come prepared to offer their ideas about what solutions they'd like to explore further given their understanding of the baseline conditions, issues, and priorities in this watershed.

VI. PUBLIC COMMENTS

- Ed Nash, Golf Course Superintendents Association of Cape Cod. I have not seen any discussion of pond aerators as a way of de-nitrifying water bodies, which is done in a lot of places. In addition, another option could be purchasing properties in low-lying areas. It may be cheaper to deconstruct properties in these areas than it is to install mitigation technologies to deal with their nutrient flows.

- Fred Dempsey, Barnstable Association for Recreational Shellfishing. As a first time observer, I am impressed with the thoughtful consideration that is being taken for these issues.

APPENDIX ONE: MEETING PARTICIPANTS

Name	Affiliation
Representatives	
Mary Barry	Resident of Barnstable
Jaci Barton	Barnstable Land Trust
Steve Brown	Red Lily Pond Project, Inc.
JoAnne Miller Buntich	Town of Barnstable
Fred Chirigotis	Barnstable Town Councilor
Tom Colombo	Hyannisport Club
Lindsey Counsell	Three Bays Preservation
Beth Ferranti	Citizen
Conrad Geyser	Cotuit Solar / Cotuit Dry Toilet
Tamar Haspel	Indian Ponds Association
Holly Hobart	Indian Ponds Association
Tom Klein	Citizen
Darren Meyer	Sandwich Health Department
Mark Robinson	Director of Compact of Cape Cod Conservation Trusts
Rob Steen	Barnstable Public Works
Public Attendees	
Fred Dempsey	Barnstable Association for Recreational Shellfishing
Monica Mejia	Tufts University
Ed Nash	Golf Course Superintendents Association of Cape Cod
Dale Saad	Barnstable Department of Public Works
Staff	
Scott Horsley	Area Manager, Cape Cod Commission
Erin Perry	Special Projects Coordinator, Cape Cod Commission
Scott Michaud	Hydrologist, Cape Cod Commission
Anne McGuire	Community Relations Specialist, Cape Cod Commission
James Sherrard	Hydrologist, Cape Cod Commission
Carri Hulet	Consensus Building Institute
Tushar Kansal	Consensus Building Institute

Cape Cod 208 Area Water Quality Planning
Waquoit Bay & Popponesset Bay Watershed Working Group
Second Meeting

Mashpee Town Hall
16 Great Neck Road North, Mashpee, MA 02649
October 30, 2013, 1:00-5:00 p.m.

<u>Agenda</u>

1:00 Welcome, Review 208 goals and Process and the Goals of today's meeting – *Cape Cod Commission*

1:10 Introductions, Agenda Overview, Updates and Action Items– *Facilitator and Working Group*

1:30 Range of Possible Solutions – *Cape Cod Commission and Working Group*
- Technology Matrix
- Technologies Overview
- Survey Questions and Comments
- Additional Questions and Discussion

3:00 Break

3:15 Problem Solving Process and Principles – *Cape Cod Commission and Working Group*
- Overview of 7-steps for Problem-Solving Process
- Examination of Categories of Solutions and their impacts on the Environment, Economy, and Community (triple bottom line)
- Discussion – Identify Considerations and Priorities for Application

4:30 Preparing for Meeting 3 and Beyond – *Cape Cod Commission*
- Review Tools, Alternatives Analysis Approach
- Evaluating Scenarios for Meeting Nitrogen Goals
- Other Process Next Steps

4:45 Public Comments

5:00 Adjourn

Popponesset Bay & Waquoit Bay Group

Technologies and Approaches

What is the stakeholder process?

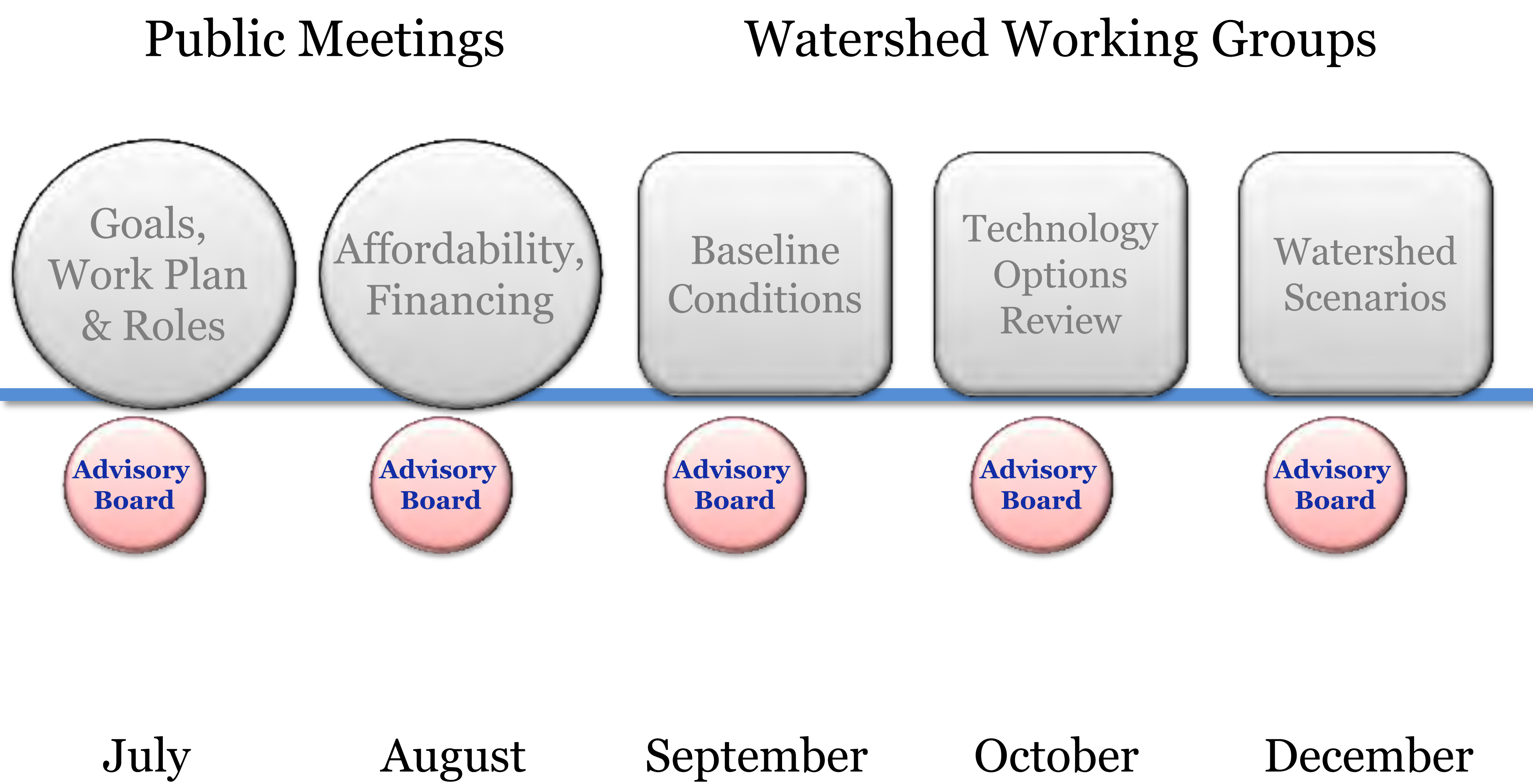
Public Meetings

- Goals, Work Plan & Roles — July
- Affordability, Financing — August

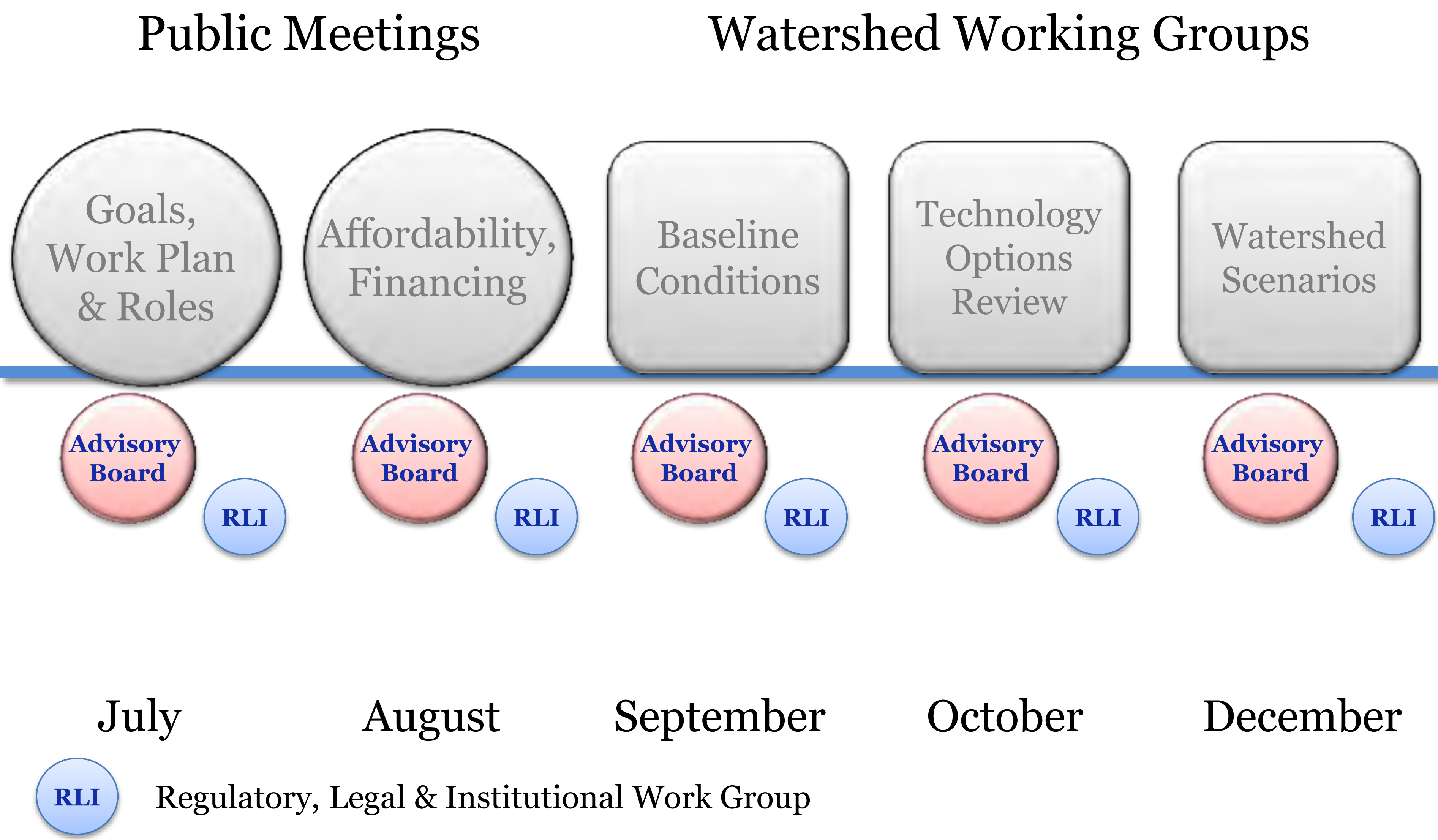
Watershed Working Groups

- Baseline Conditions — September
- Technology Options Review — October
- Watershed Scenarios — December

208 Planning Process



208 Planning Process


Public Meetings
Watershed Working Groups
Goals, Work Plan & Roles
Affordability, Financing
Baseline Conditions
Technology Options Review
Watershed Scenarios
Advisory Board
RLI
Advisory Board
RLI
Advisory Board
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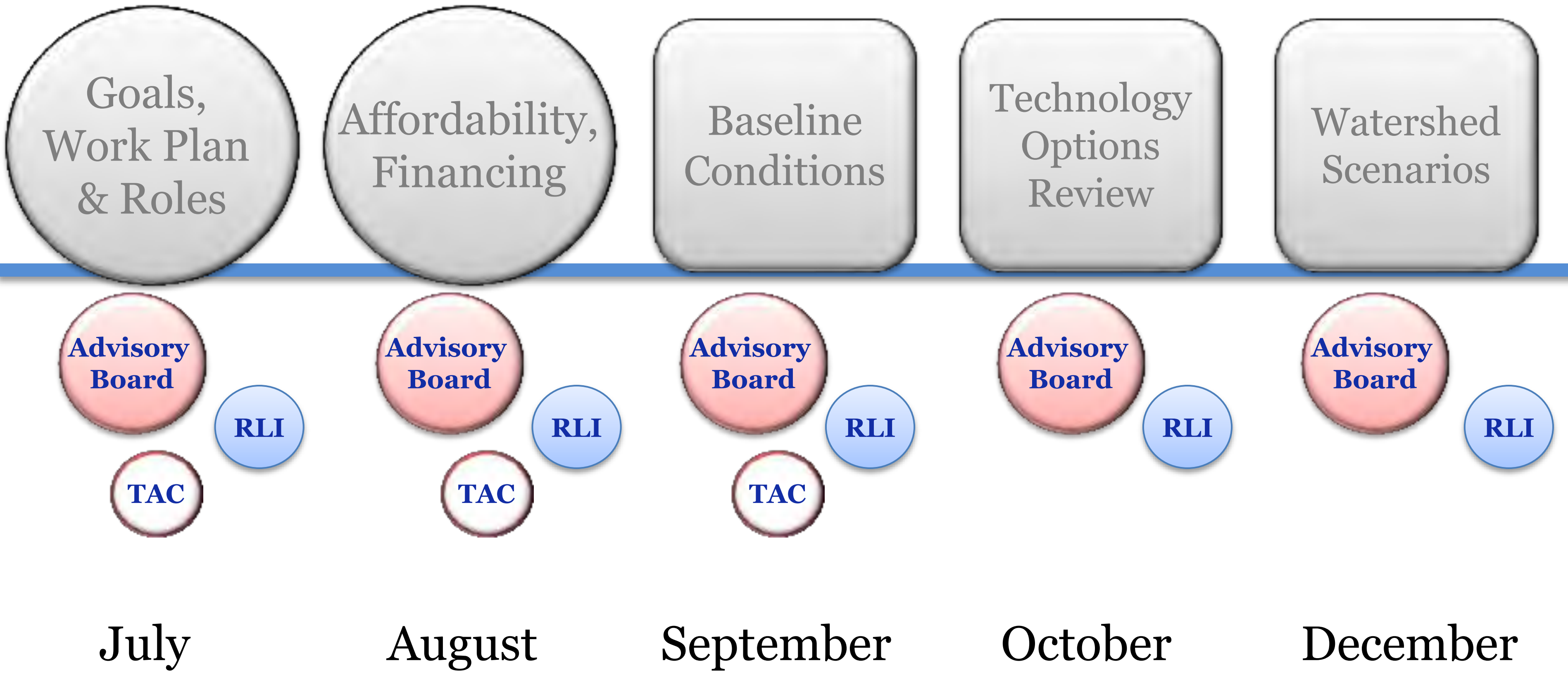
July
August
September
October
December
RLI
Regulatory, Legal & Institutional Work Group

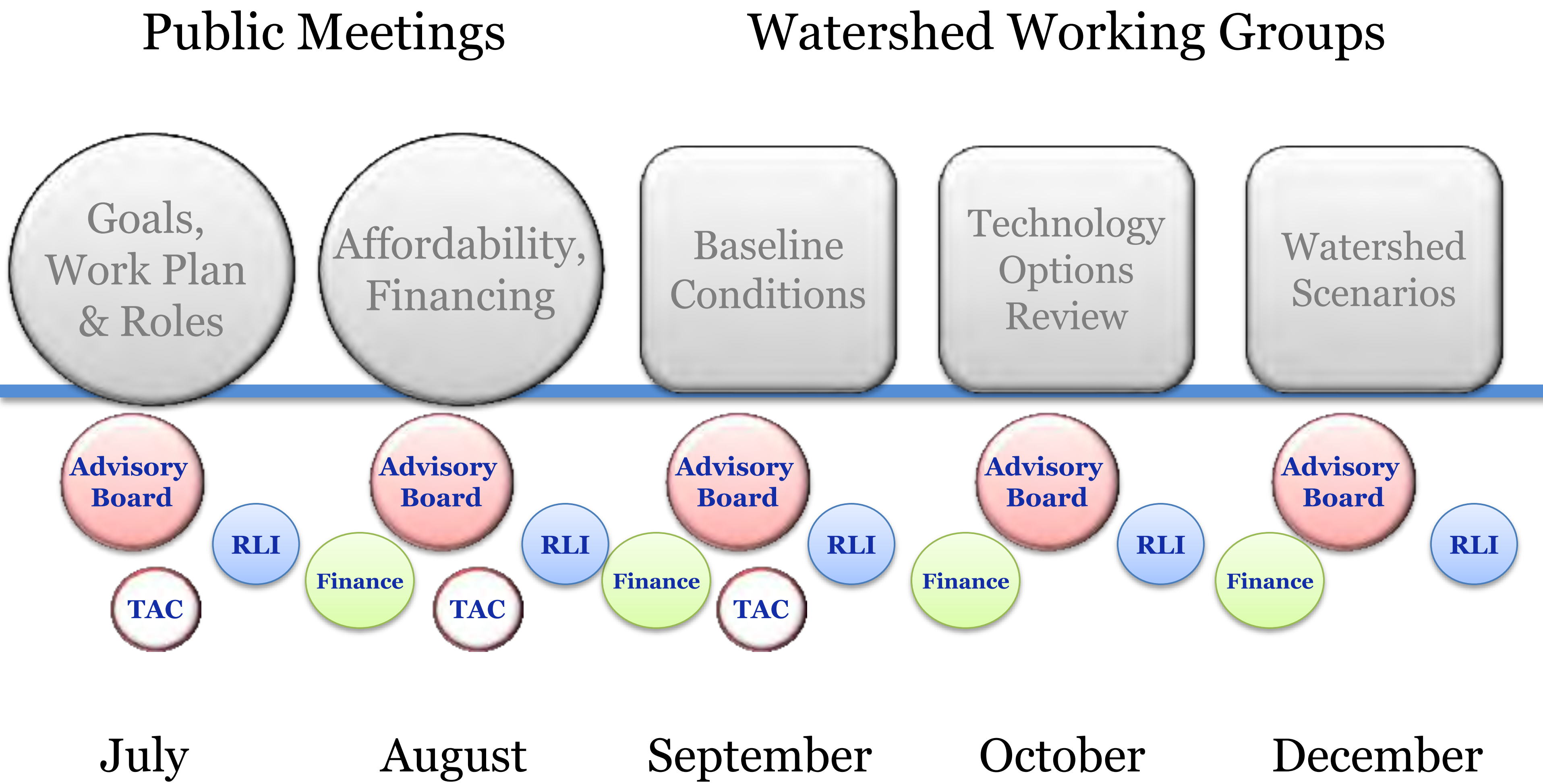
Public Meetings

Watershed Working Groups



RLI Regulatory, Legal & Institutional Work Group

TAC Technical Advisory Committee of Cape Cod Water Protection Collaborative



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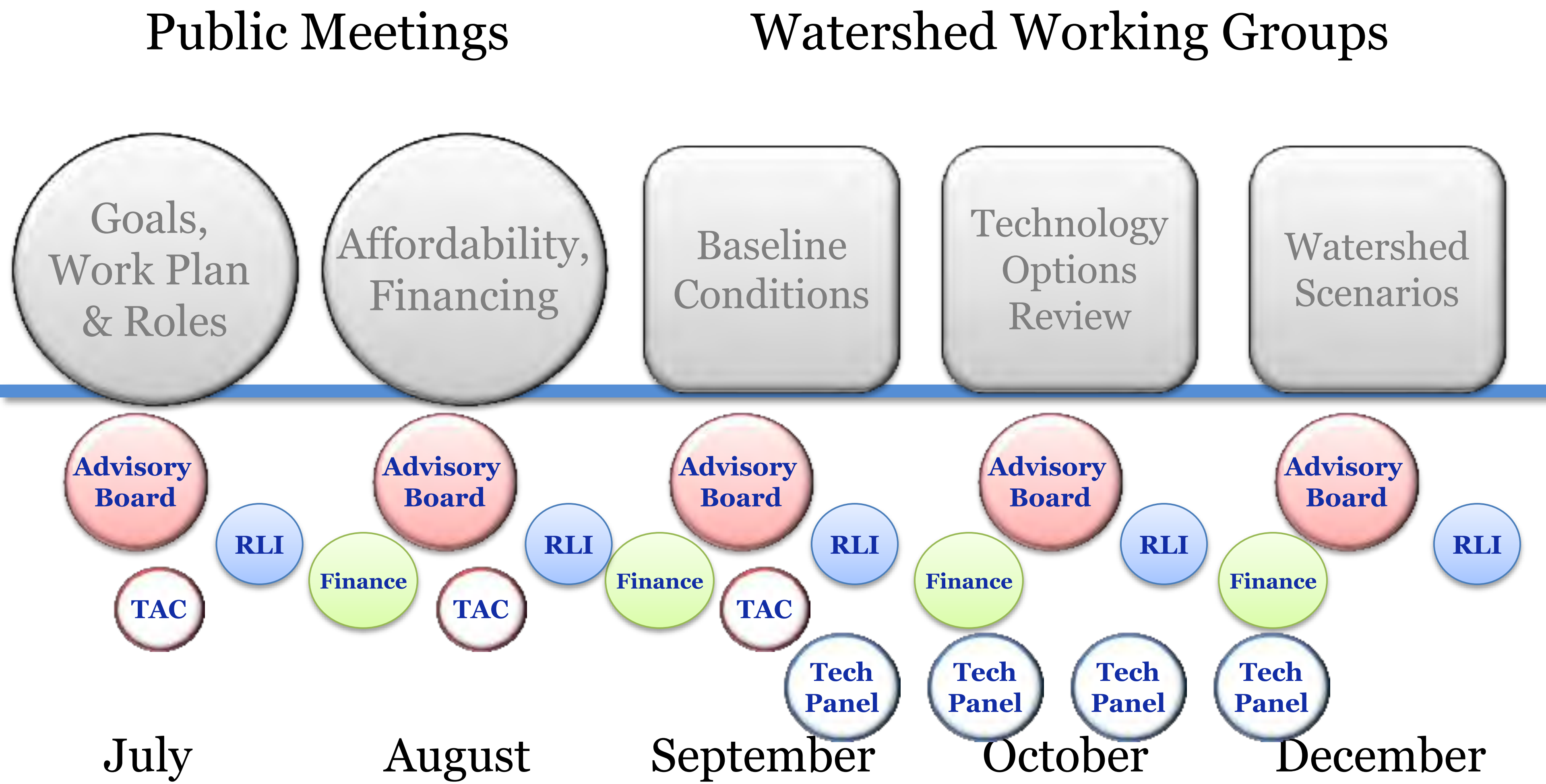

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TAC Technical Advisory Committee of Cape Cod Water Protection Collaborative

208 Planning Process

Baseline Conditions

11 Working Group Meetings: Sept 18-27

Goal of the First Meeting:

To review and develop shared understanding of the characteristics of these watersheds, the work done to date, existing data and information available, and how to apply all of this to planning for water quality improvements for these watersheds moving forward.

Progress since last meeting

- Meeting materials

Progress since last meeting

- ❑ Meeting materials
- ❑ GIS data layers

Progress since last meeting

- ❑ Meeting materials
- ❑ GIS data layers
- ❑ Chronologies

Baseline Conditions

11 Working Group Meetings: Sept 18-27

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

208 Planning Process

Baseline Conditions

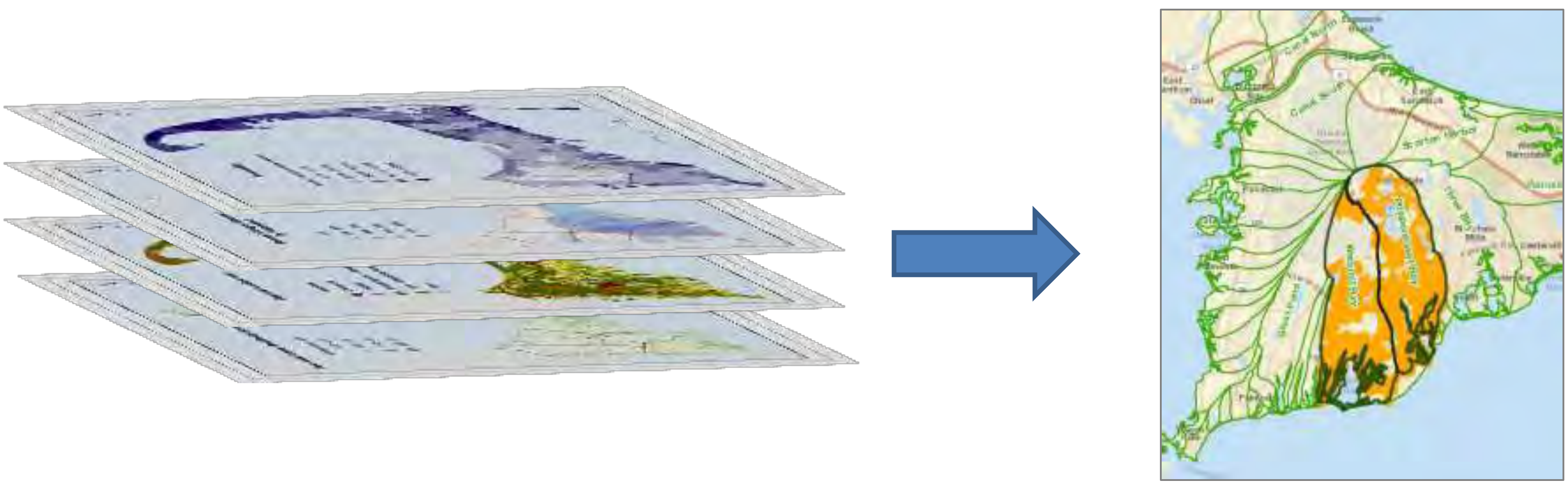
11 Working Group Meetings: Sept 18-27

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Watershed Scenarios

11 Working Group Meetings: Dec 2-11



Baseline Conditions

11 Working Group Meetings: Sept 18-27

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Watershed Scenarios

11 Working Group Meetings: Dec 2-11

Watershed Event

November 13

Center for the Arts Dennis

Wrap up of Cape2O: ur in charge!

Summary of planning process to date

Outline of second 6 months of the 208 planning process

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Goal of Today's Meeting:

To develop a shared understanding of the potential technologies and approaches identified to date, and the benefits and limitations of each; to explore the environmental, economic, and community impacts of a range of categories of solutions; and to identify priorities and considerations for applying technologies and approaches to remediate water quality impairments in your watershed.

Technologies and Approaches for Improving Water Quality

Technologies and Approaches for Improving Water Quality

- The Fact Sheets present various information on the technologies being considered.
- Additional information is contained on the Technology Matrix including the following:
  - Site Requirements
  - Construction, Project and Operation and Maintenance Costs
  - Reference Information
  - Regulatory Comments
- Input from the Stakeholders is requested regarding a technology's Public Acceptance

Technologies and Approaches for Improving Water Quality

- Comprehensive analysis of nutrient control technologies and approaches.

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- Certain technologies or approaches will be effective at **preventing** nutrients from entering the water body. Others will be effective at **reducing** or **remediating** nutrients that are already in the groundwater or water body.

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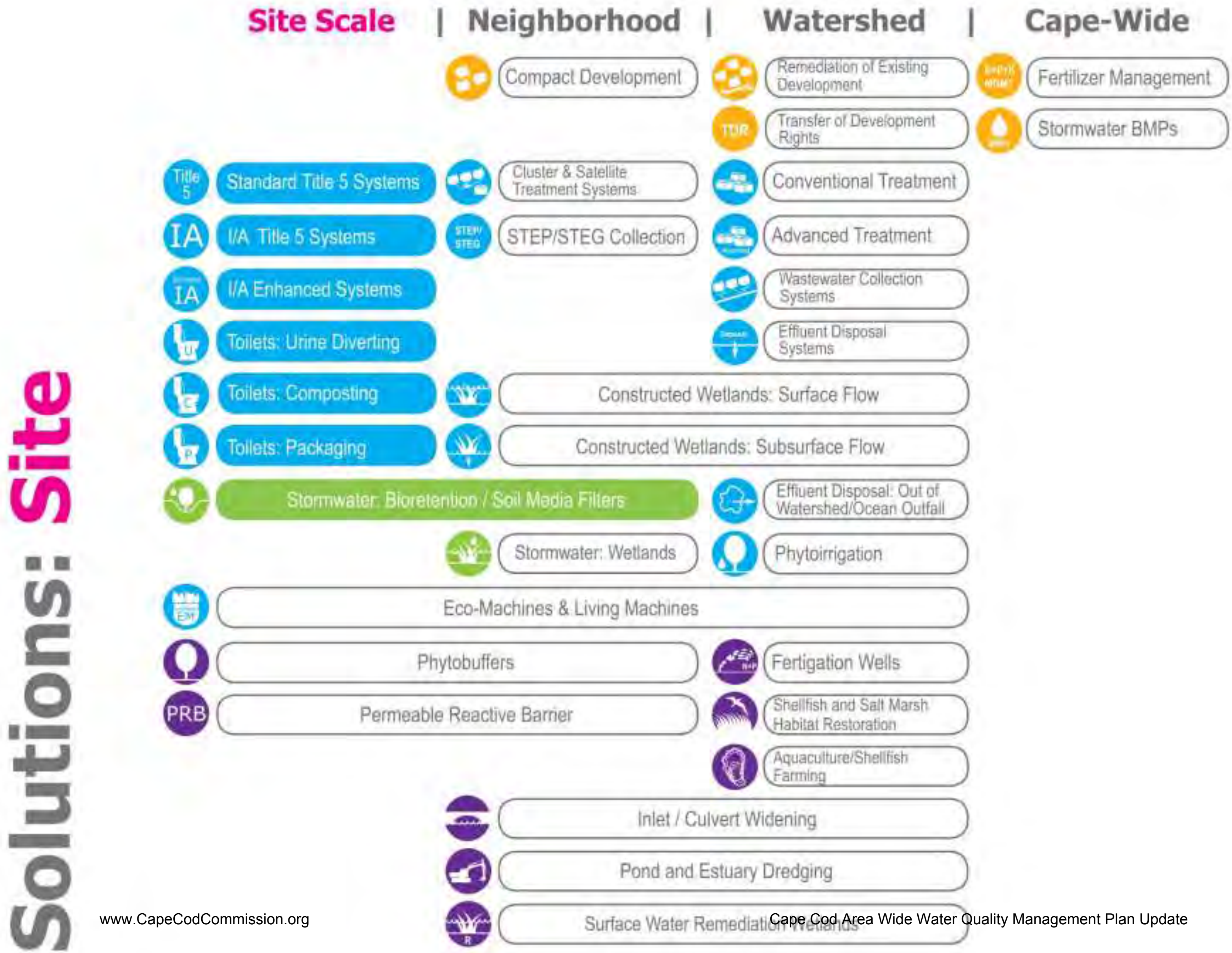
- Certain technologies or approaches will be effective at **preventing** nutrients from entering the water body. Others will be effective at **reducing** or **remediating** nutrients that are already in the groundwater or water body.
- Regulatory programs can address nutrient controls for both existing development and future development.


Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
IA
I/A Title 5 Systems
STEP/STEG
STEP/STEG Collection
Advanced Treatment
IA
I/A Enhanced Systems
Wastewater Collection Systems
Effluent Disposal Systems
Toilets: Urine Diverting
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
EM
Eco-Machines & Living Machines
Phytobuffers
Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands
Solutions


Solutions: Site
Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
Remediation of Existing Development
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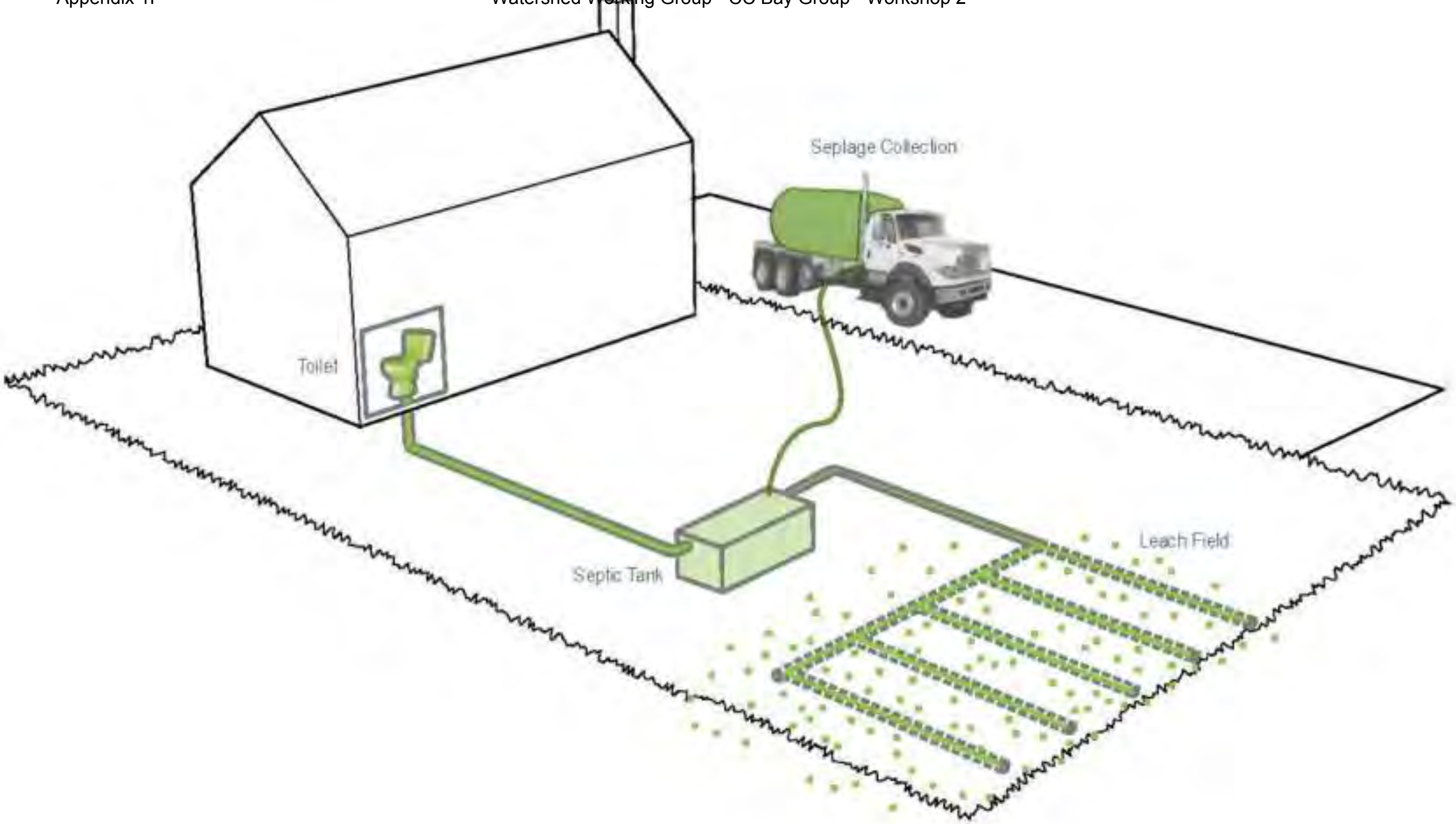
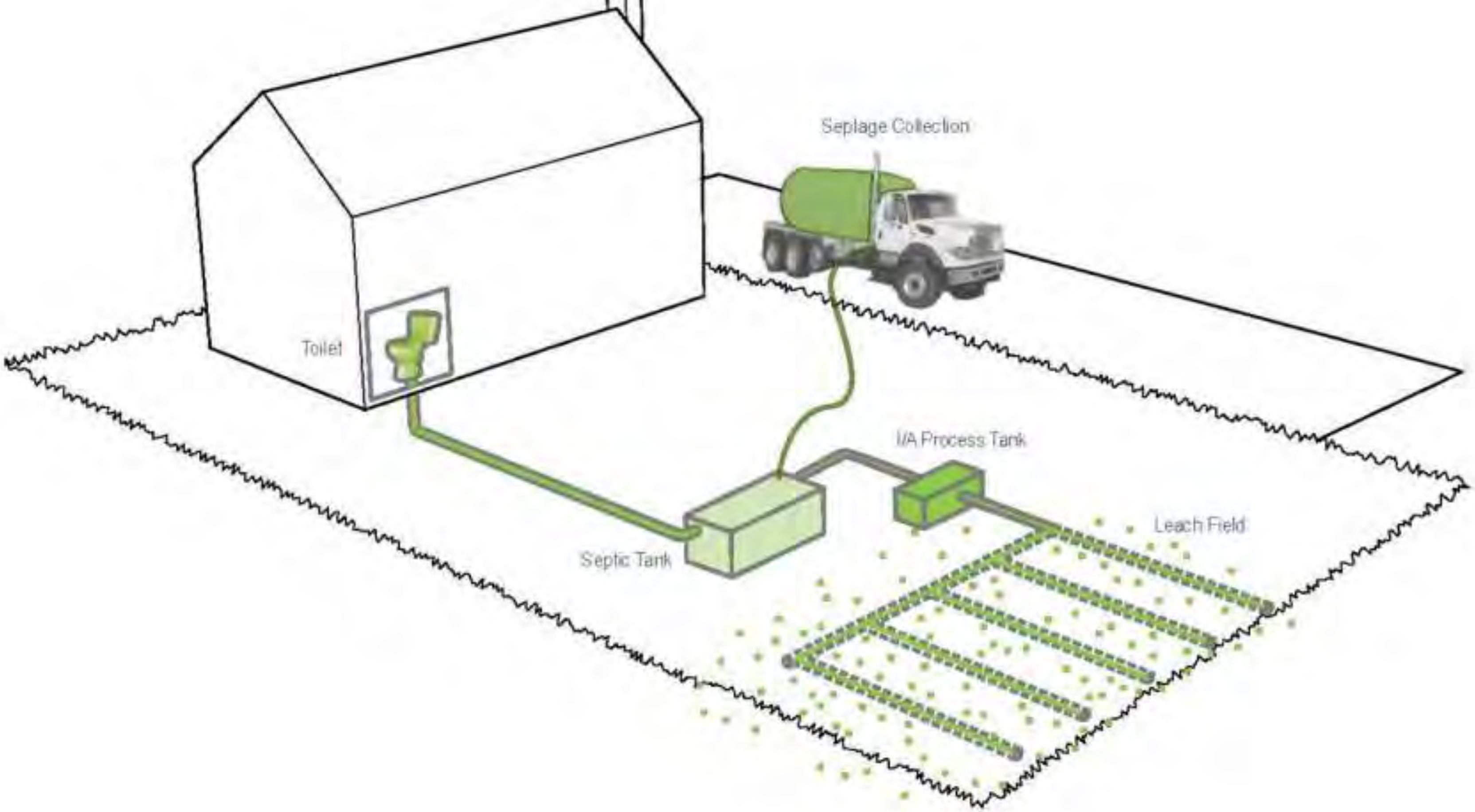


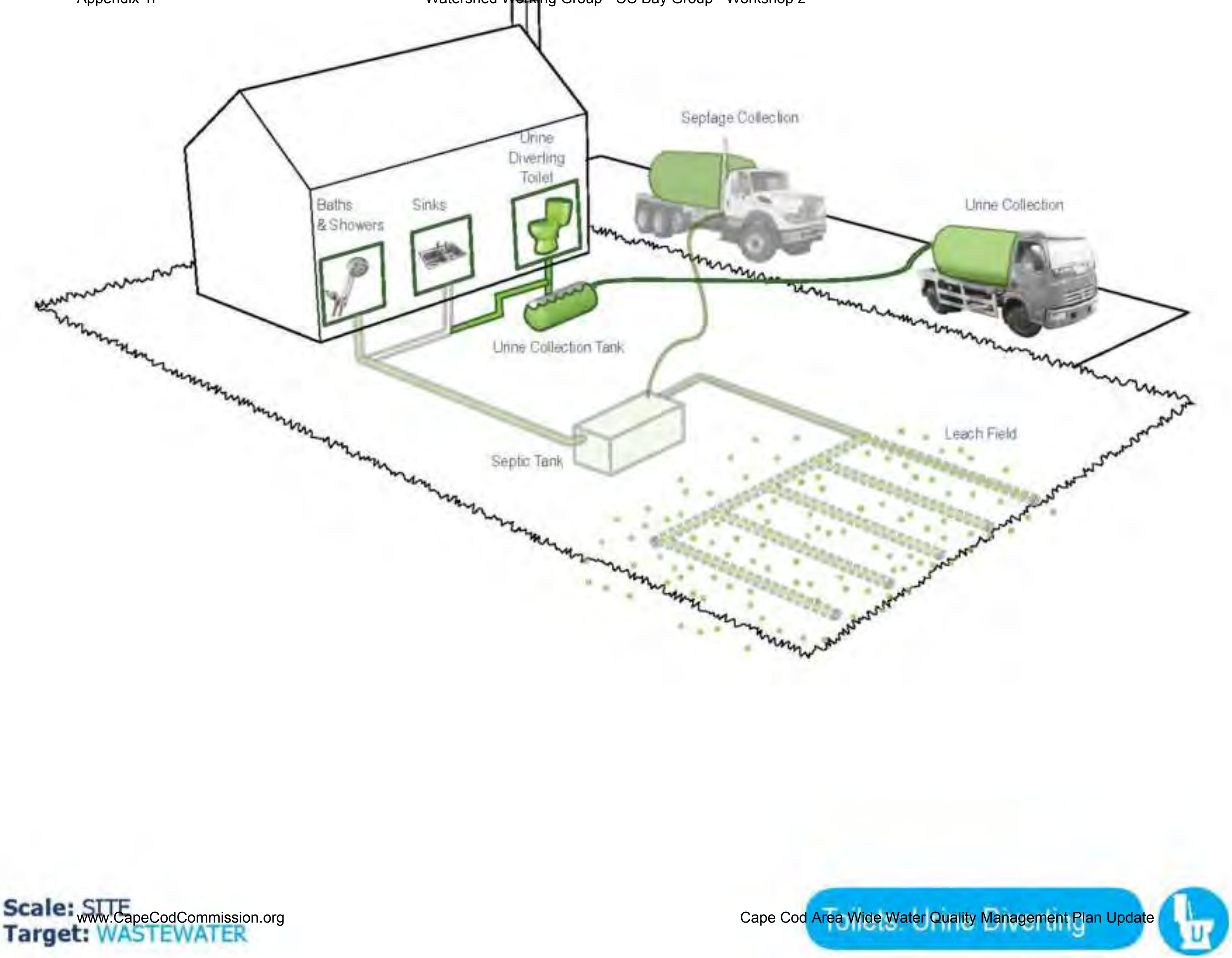
Scale: SITE
Target: WASTEWATER

Standard Title 5 Systems
Title 5



Scale: SITE
Target: WASTEWATER

I/A Title 5 Systems


Septage Collection
Urine Diverting Toilet
Baths & Showers
Sinks
Urine Collection
Urine Collection Tank
Leach Field
Septic Tank
Scale: SITE
Target: WASTEWATER
Toilets: Urine Diverting

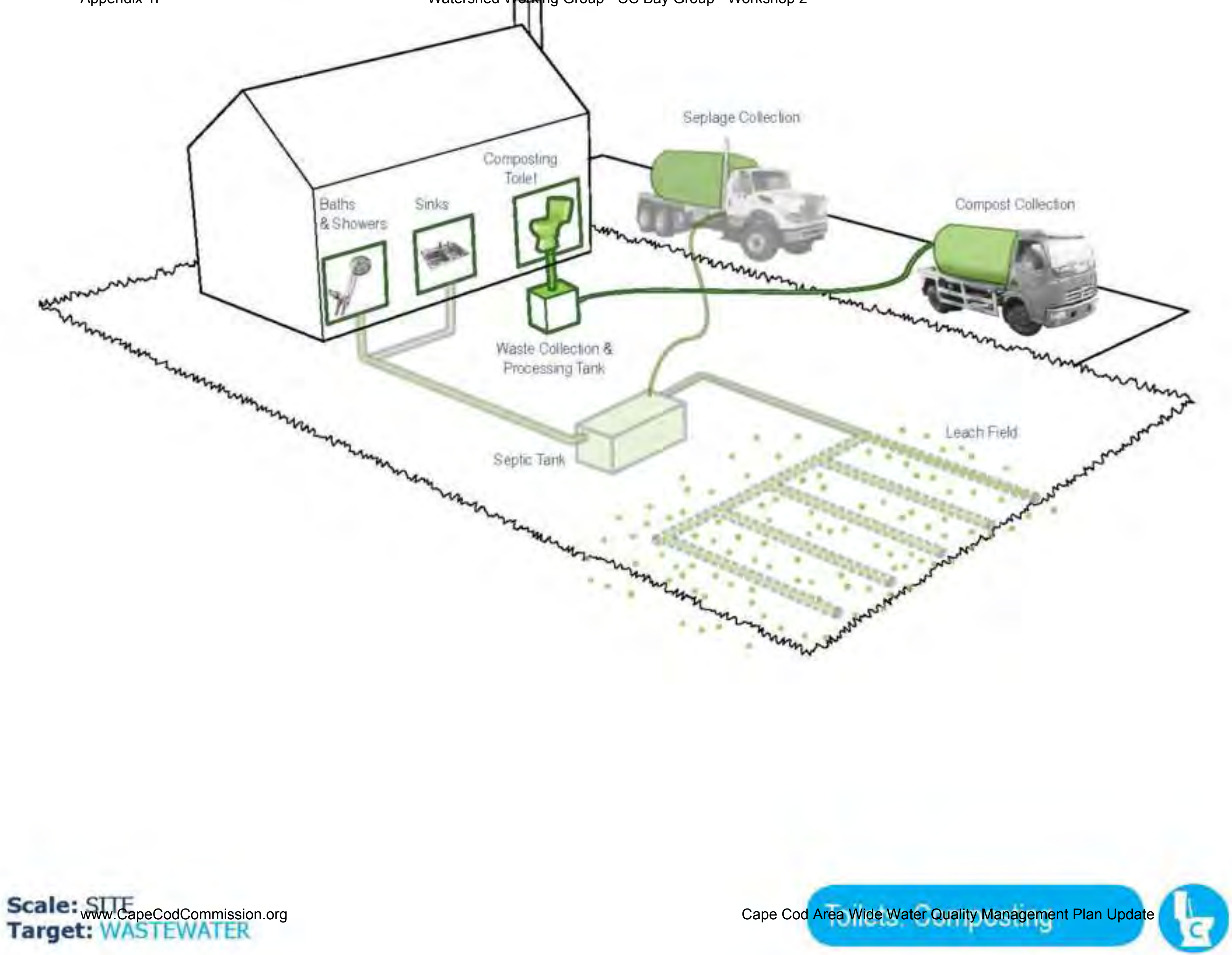
Waterless
Urinal

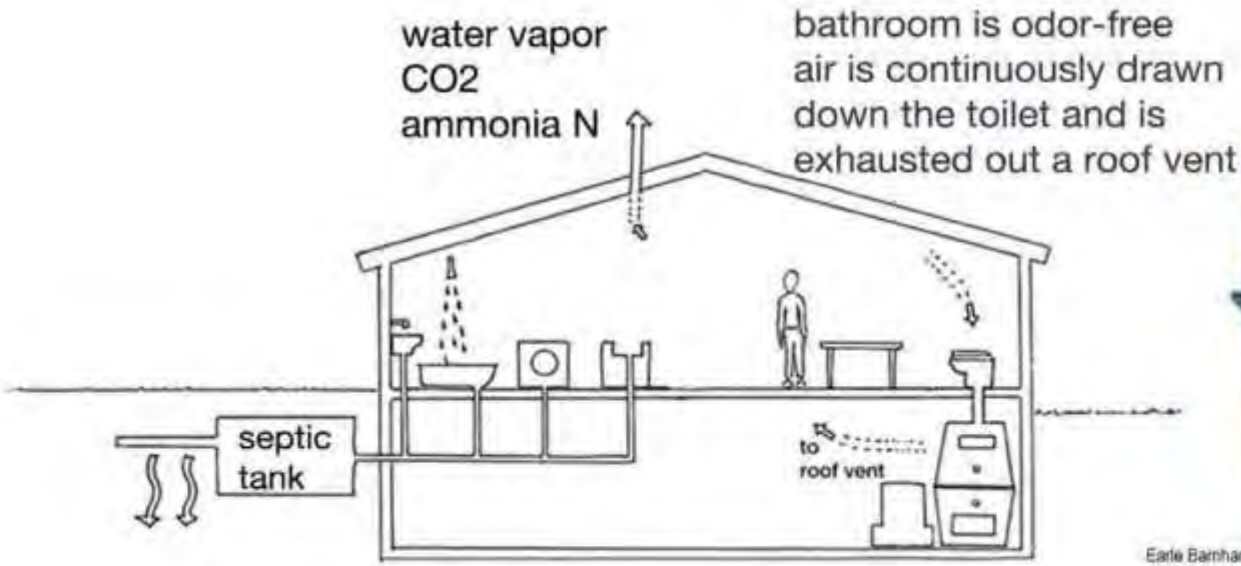
IBC container
(220 gallons)

40" x 40" x48"

Source: Earle Barnhart, The Green Center Inc. and Horsley-Witten Group Inc.

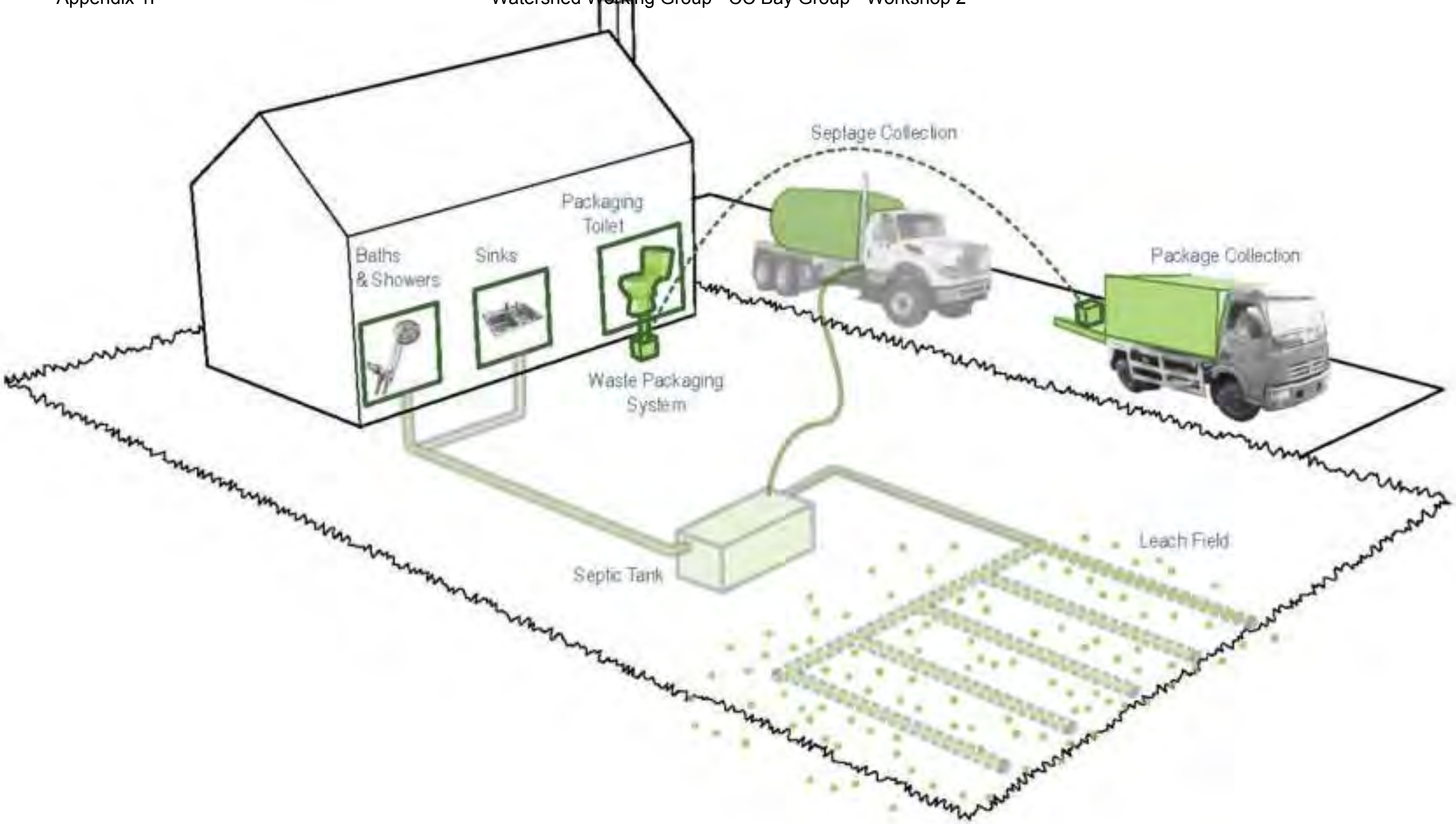
Toilets: Urine Diverting


Septage Collection
Composting Toilet
Baths & Showers
Sinks
Compost Collection
Waste Collection & Processing Tank
Leach Field
Septic Tank
Scale: SITE
Target: WASTEWATER
Toilets: Composting



Toilets: Composting

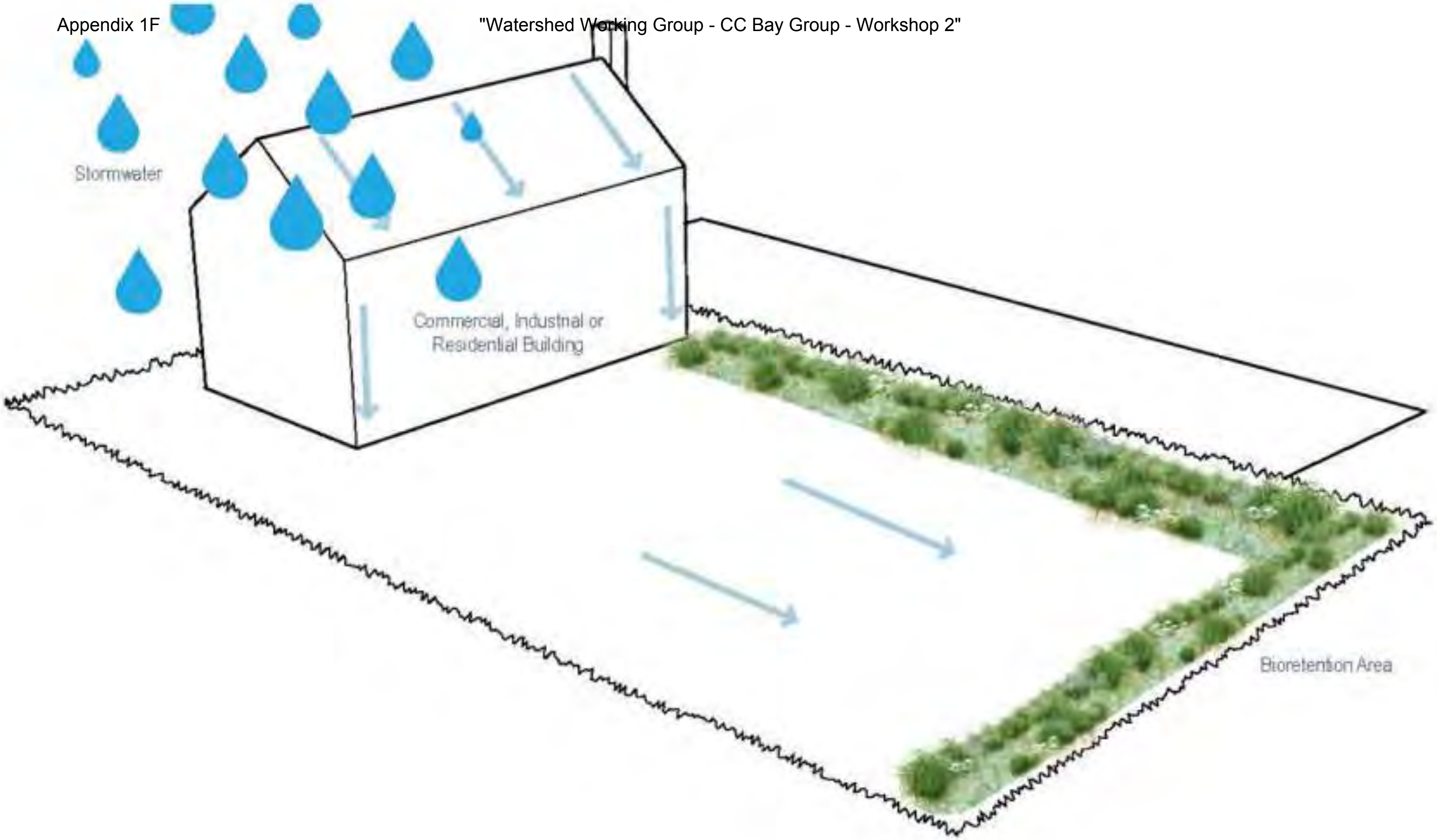
Source: Earle Barnhart, The Green Center Inc.


Septage Collection
Packaging Toilet
Baths & Showers
Sinks
Package Collection
Waste Packaging System
Leach Field
Septic Tank


Scale: SITE
Target: WASTEWATER
Toilets: Packaging

Source: Earle Barnhart, The Green Center Inc.

Toilets: Packaging



Scale: SITE
Target: STORMWATER

Stormwater Bioretention /
Soil Media Filters

Precedent: 12th Ave. Stormwater Project, Portland, OR

Source: City of Portland

Stormwater: Bioretention / Soil Media Filters

Rain Gardens


Site Scale | Neighborhood | Watershed | Cape-Wide
Solutions: Neighborhood
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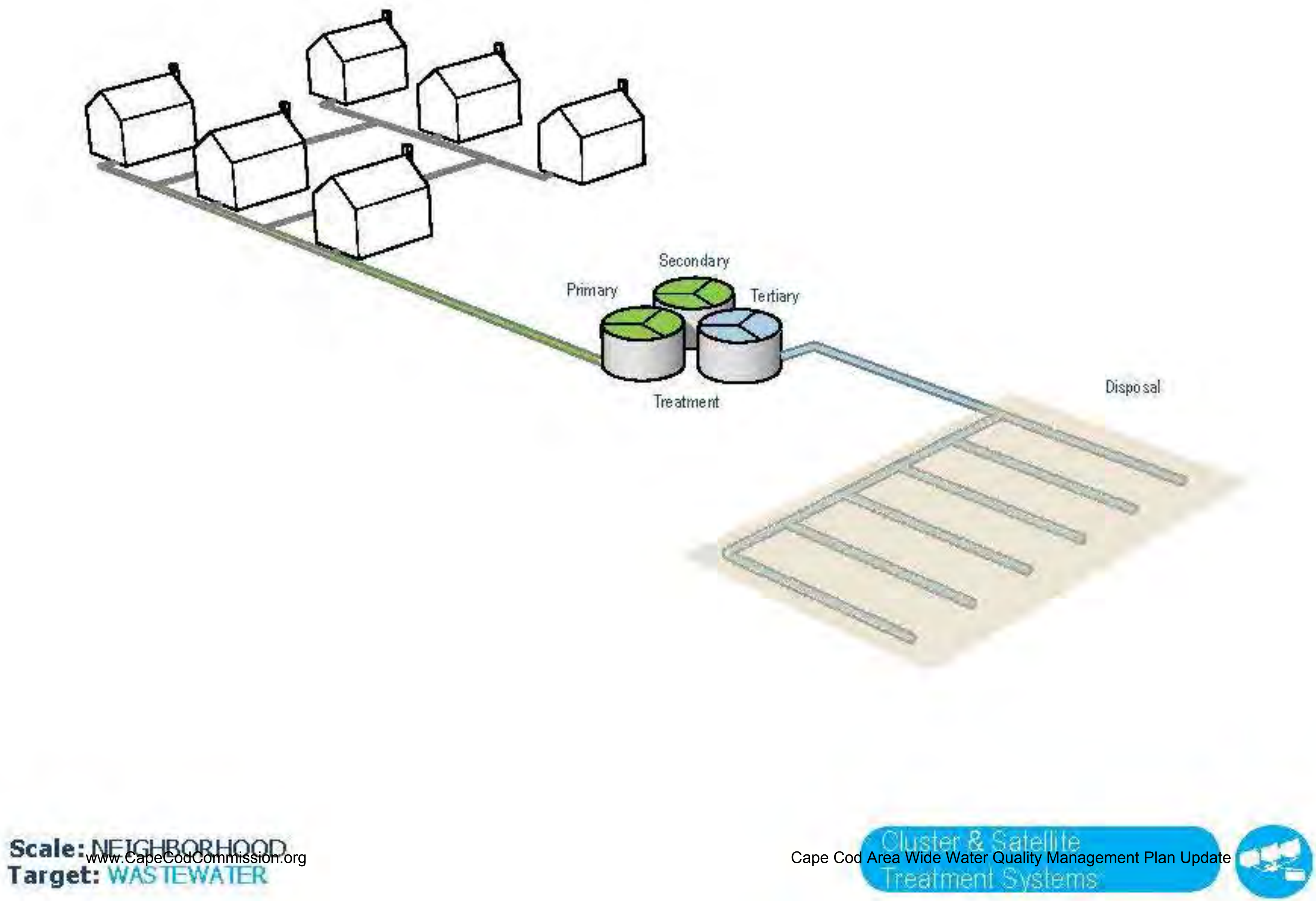
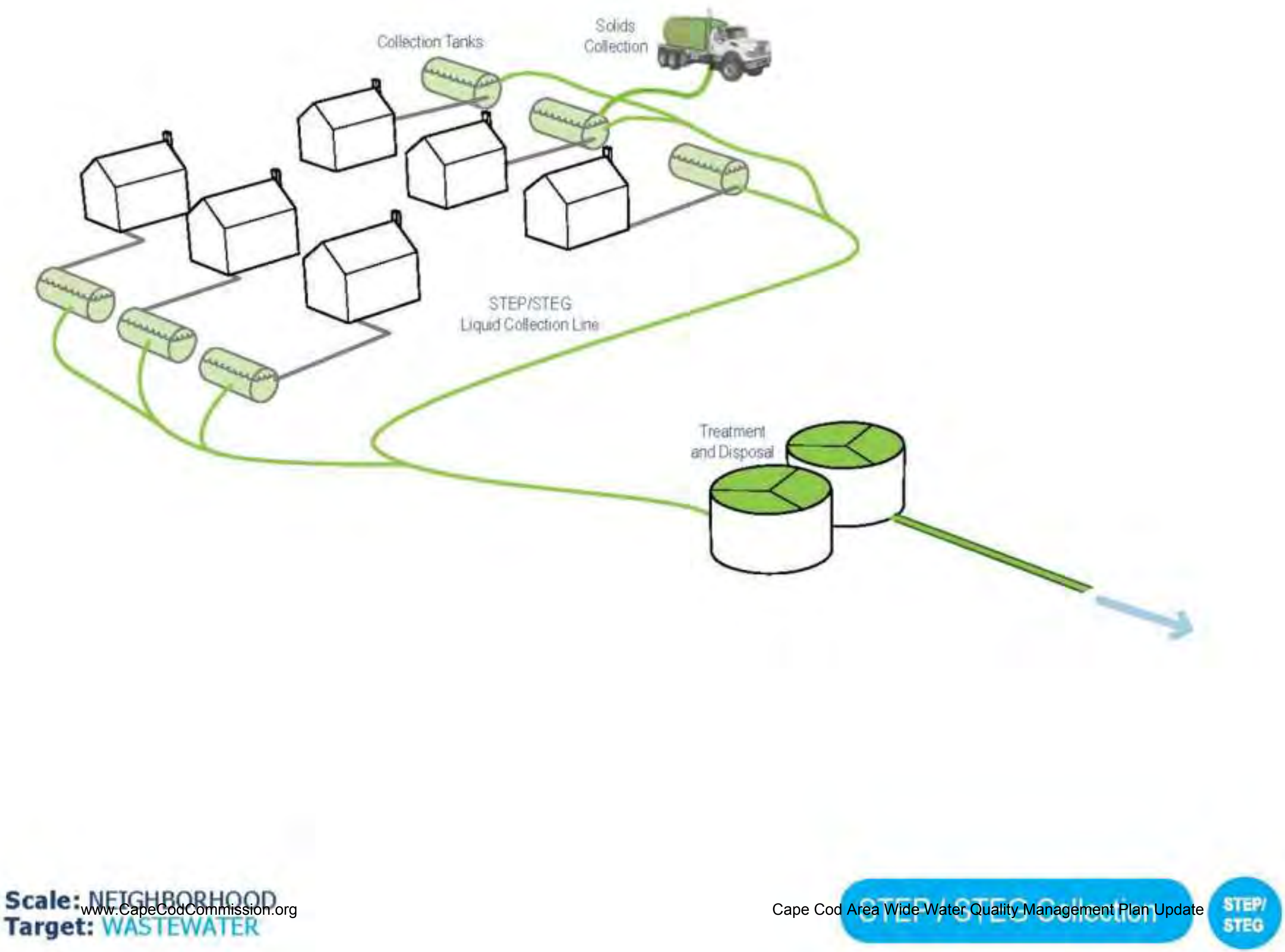
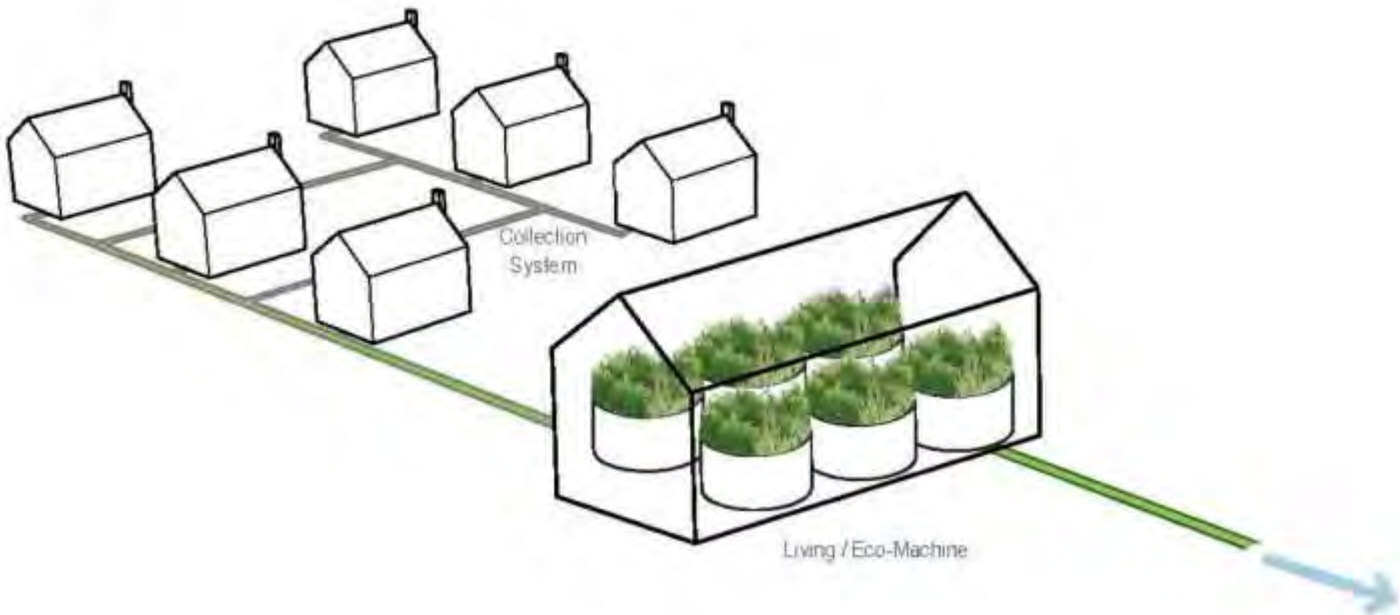
Surface Water Remediation Wetlands

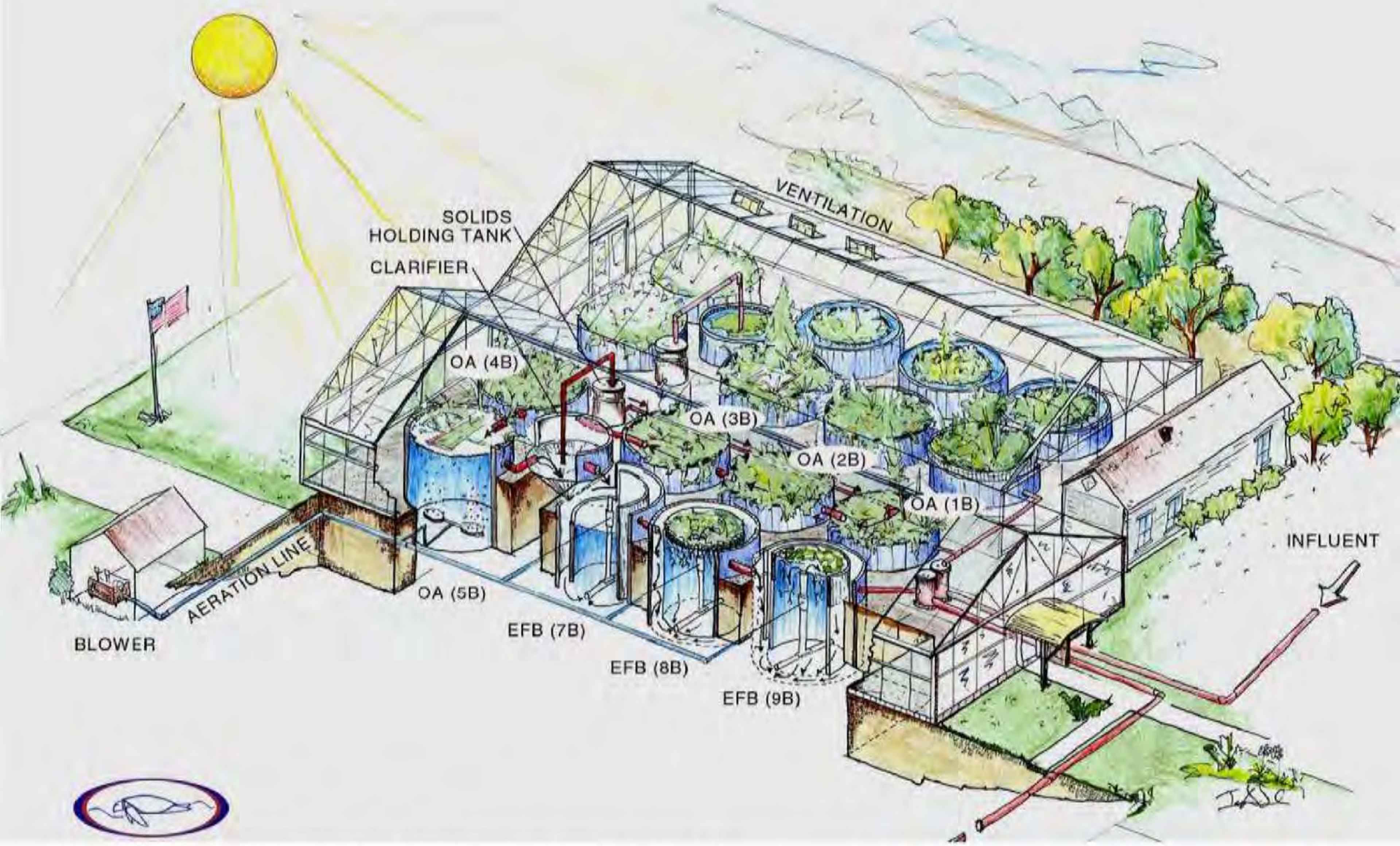

Secondary
Primary
Tertiary
Treatment
Disposal
Scale: NEIGHBORHOOD
Target: WASTEWATER
Cluster & Satellite
Treatment Systems


Collection Tanks
Solids Collection
STEP/STEG Liquid Collection Line
Treatment and Disposal
Scale: NEIGHBORHOOD
Target: WASTEWATER
STEP / STEG Collection
STEP/ STEG



Scale: NEIGHBORHOOD
Target: WASTEWATER

Eco-Machines and
Living Machines



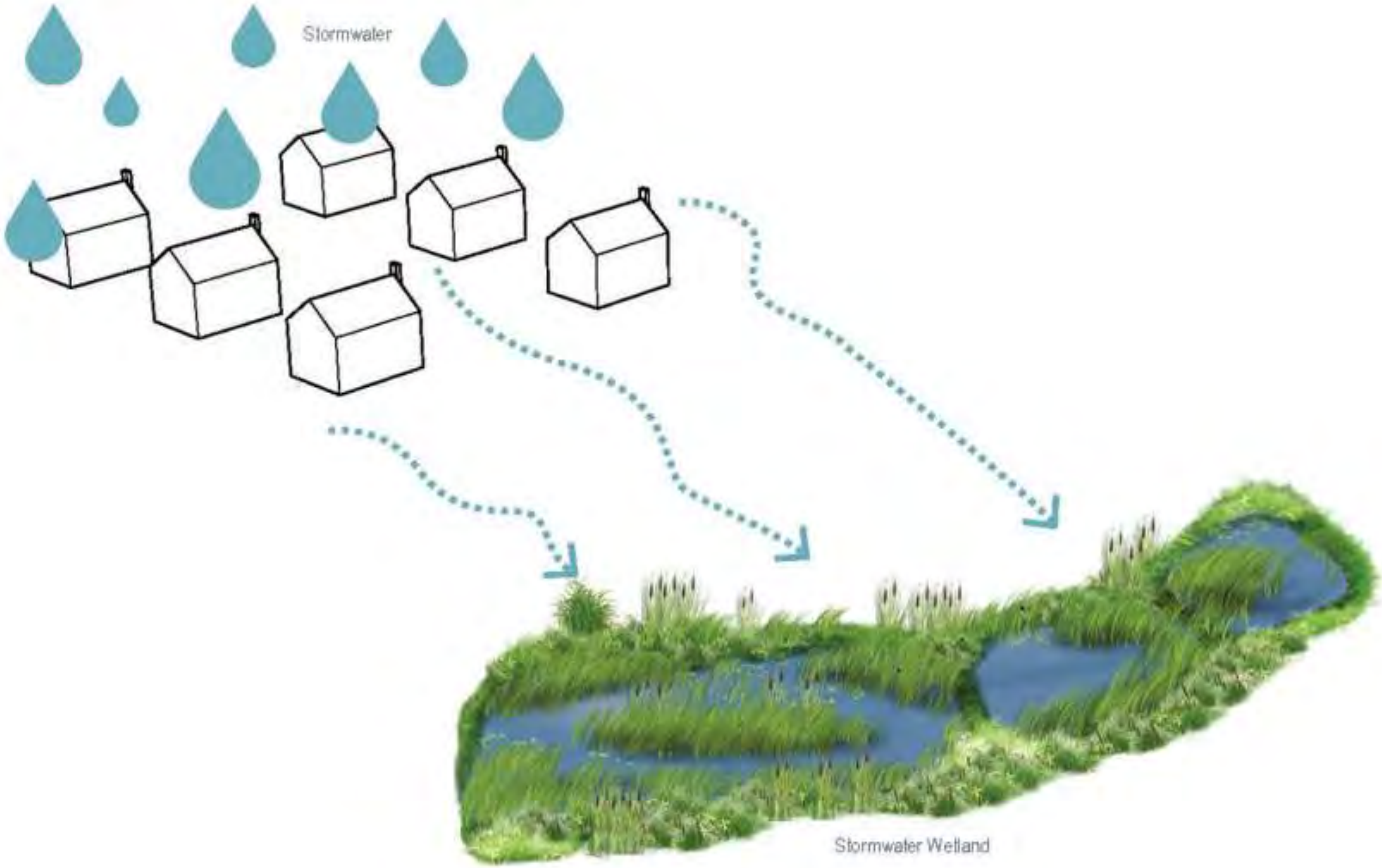
Precedent: Living Machine, South Burlington, VT

Source: Todd Ecological

Eco-Machines and Living Machines

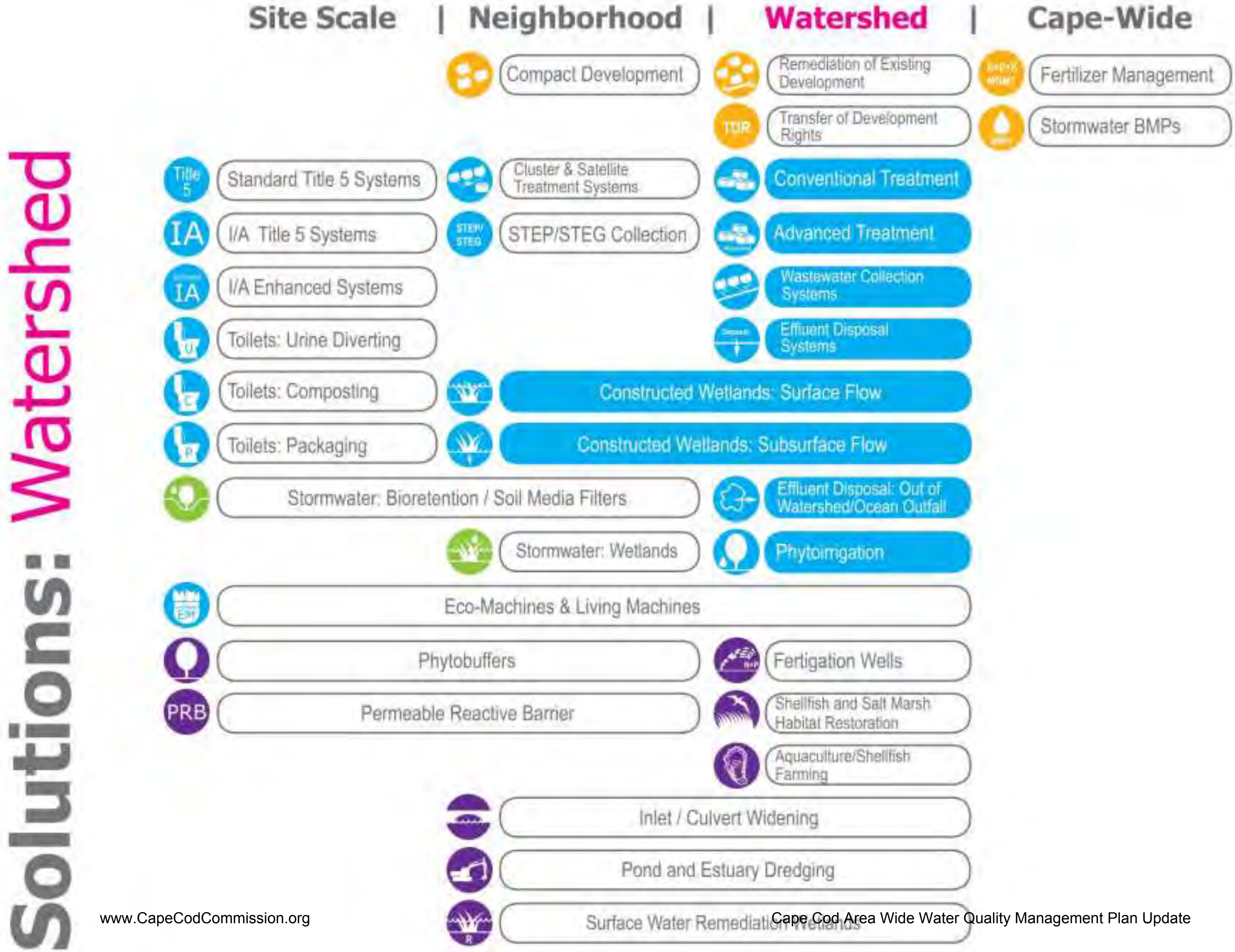
Precedent: Living Machine - South Burlington, VT + Photobioreactors - Falmouth, MA
Source: Todd Ecological and Tom Cambareri

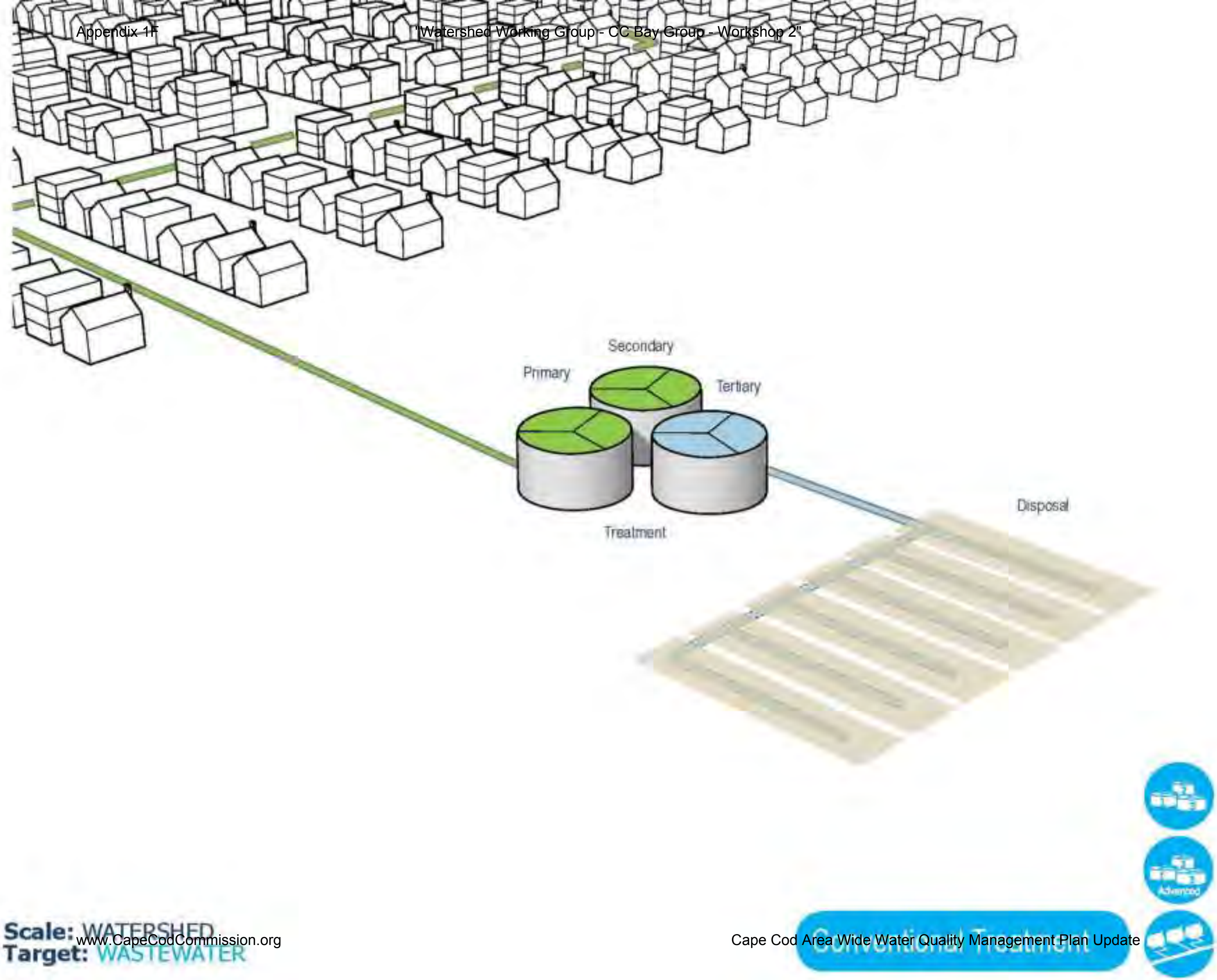
Eco-Machines and Living Machines

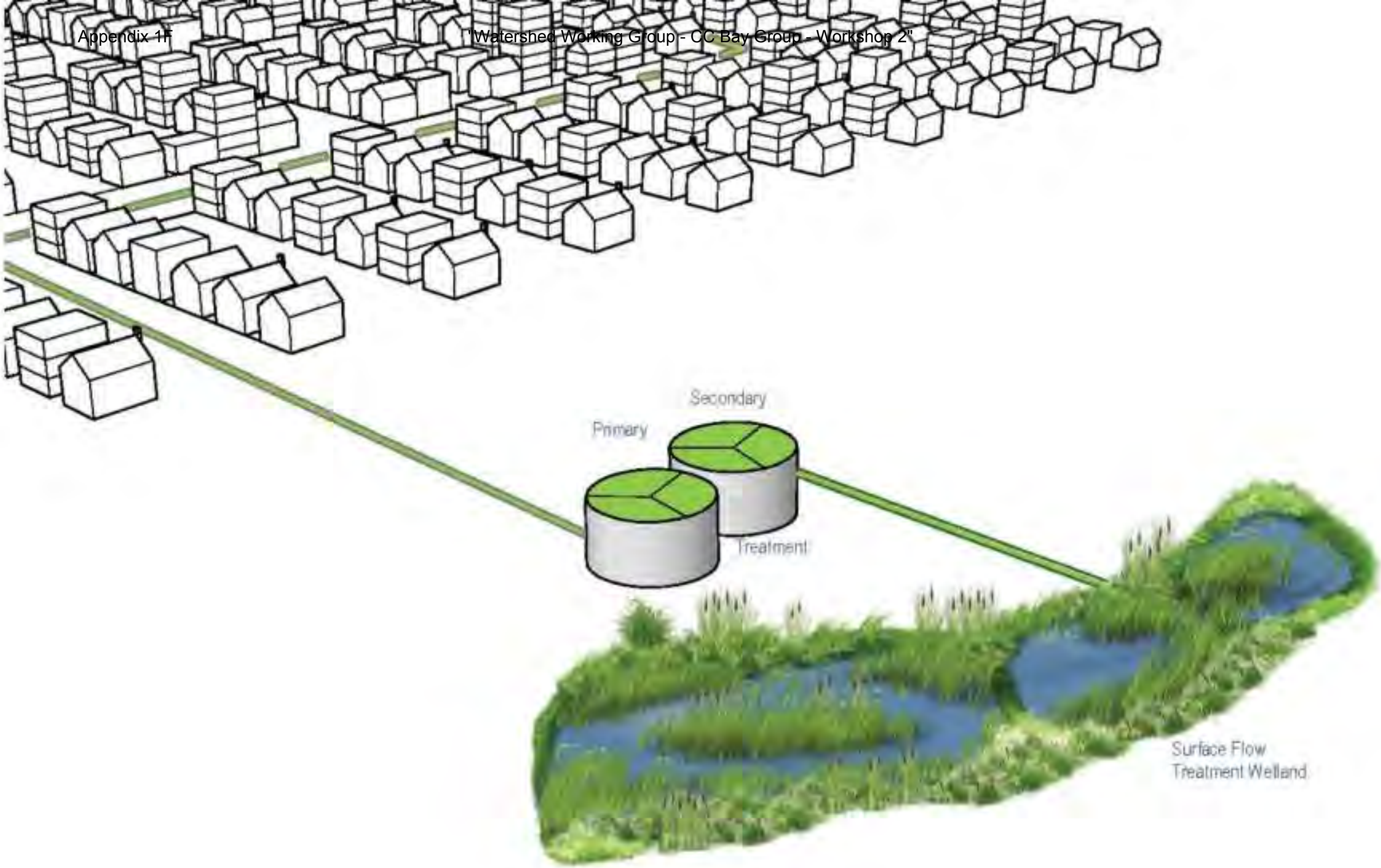


Scale: NEIGHBORHOOD
Target: STORMWATER

Stormwater Wetlands


Solutions: Watershed
Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
IA
I/A Title 5 Systems
STEP/STEG
STEP/STEG Collection
Advanced Treatment
IA
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
EM
Eco-Machines & Living Machines
Phytobuffers
Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands


Secondary
Primary
Tertiary
Treatment
Disposal
Scale: WATERSHED
Target: WASTEWATER
Conventional Treatment

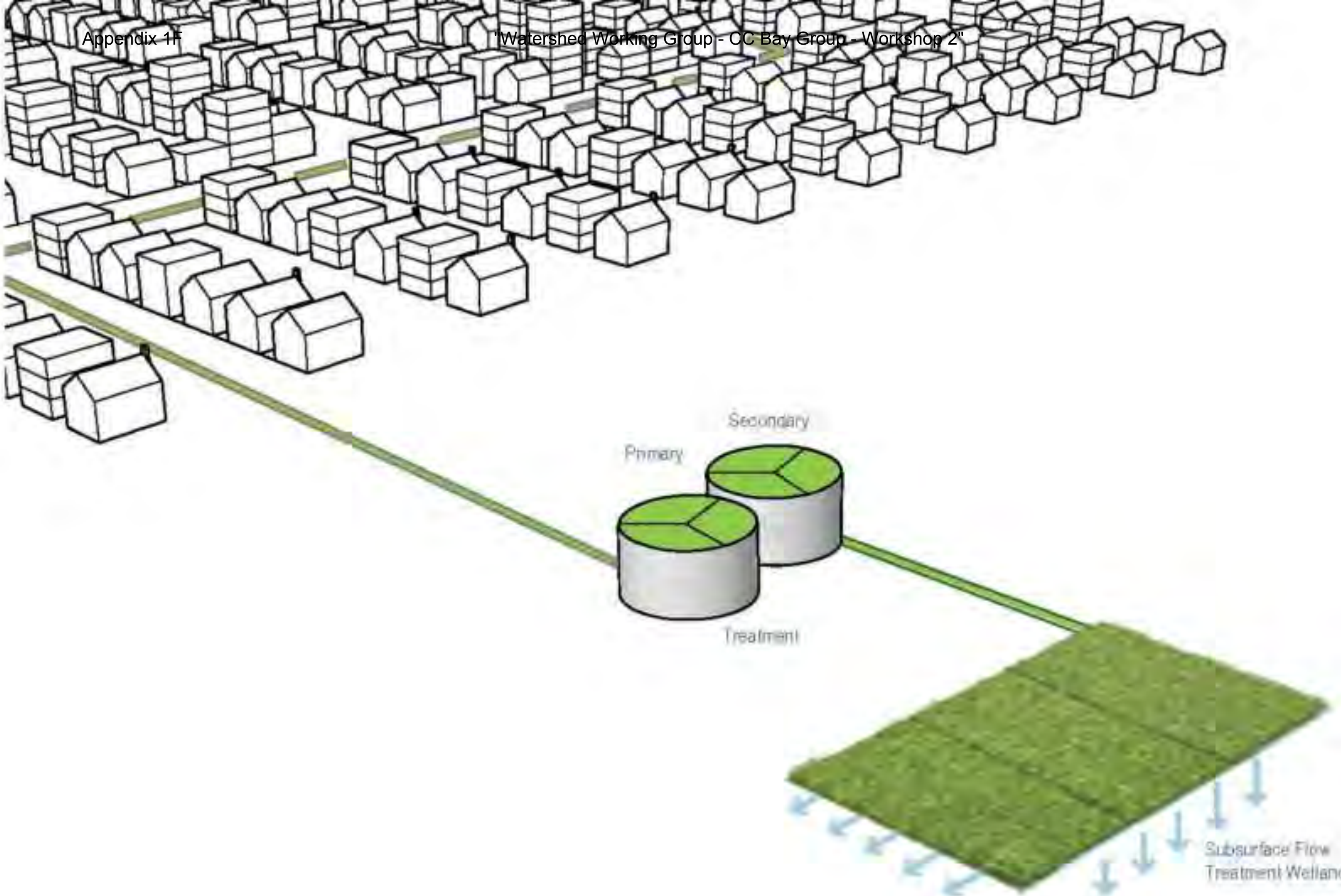


Scale: WATERSHED
Target: WASTEWATER

Constructed Wetlands
Surface Flow

Precedent: Talking Waters Garden - Albany, OR
Source: Kate Kennen

Constructed Wetlands: Surface Flow



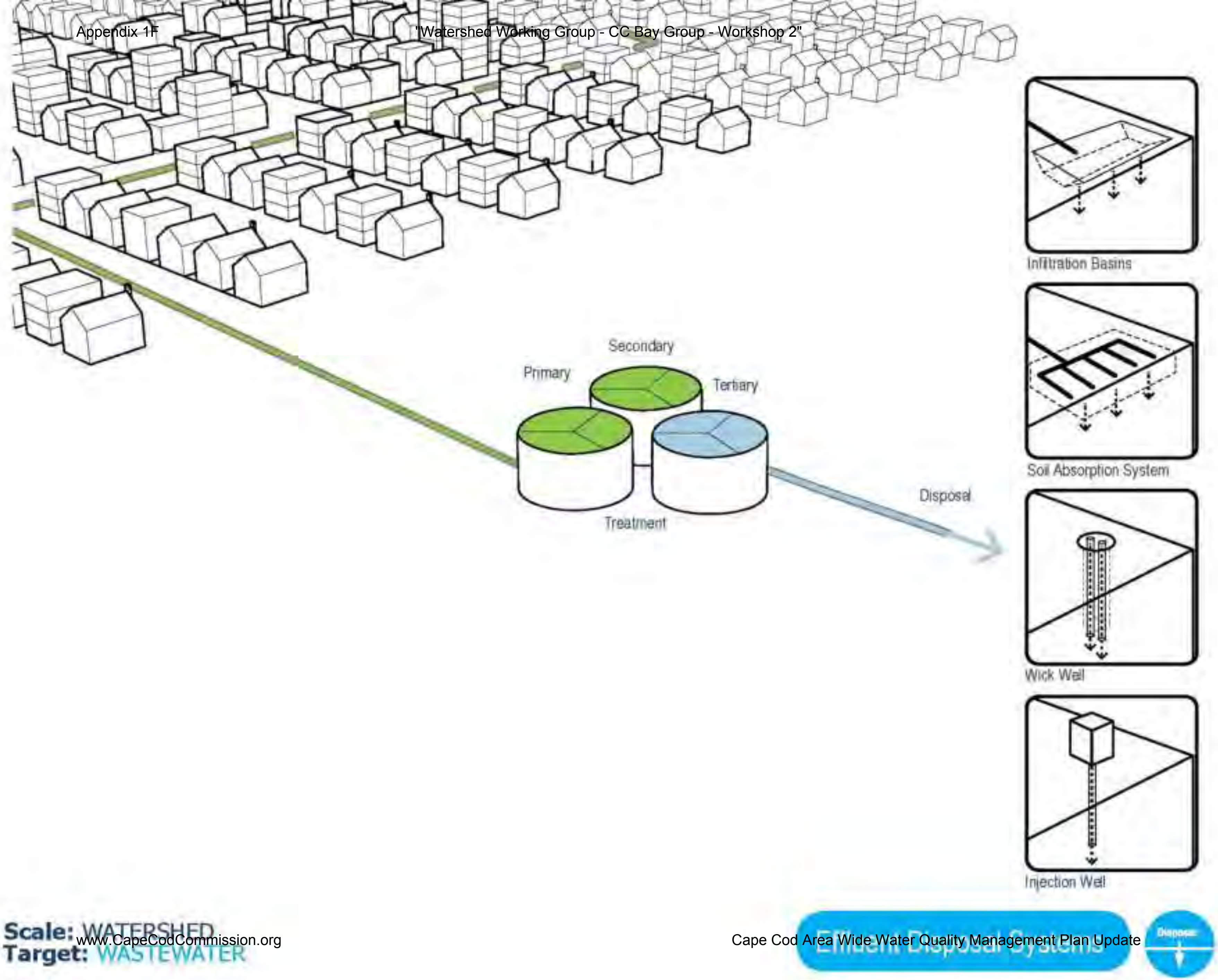
Scale: WATERSHED
Target: WASTEWATER

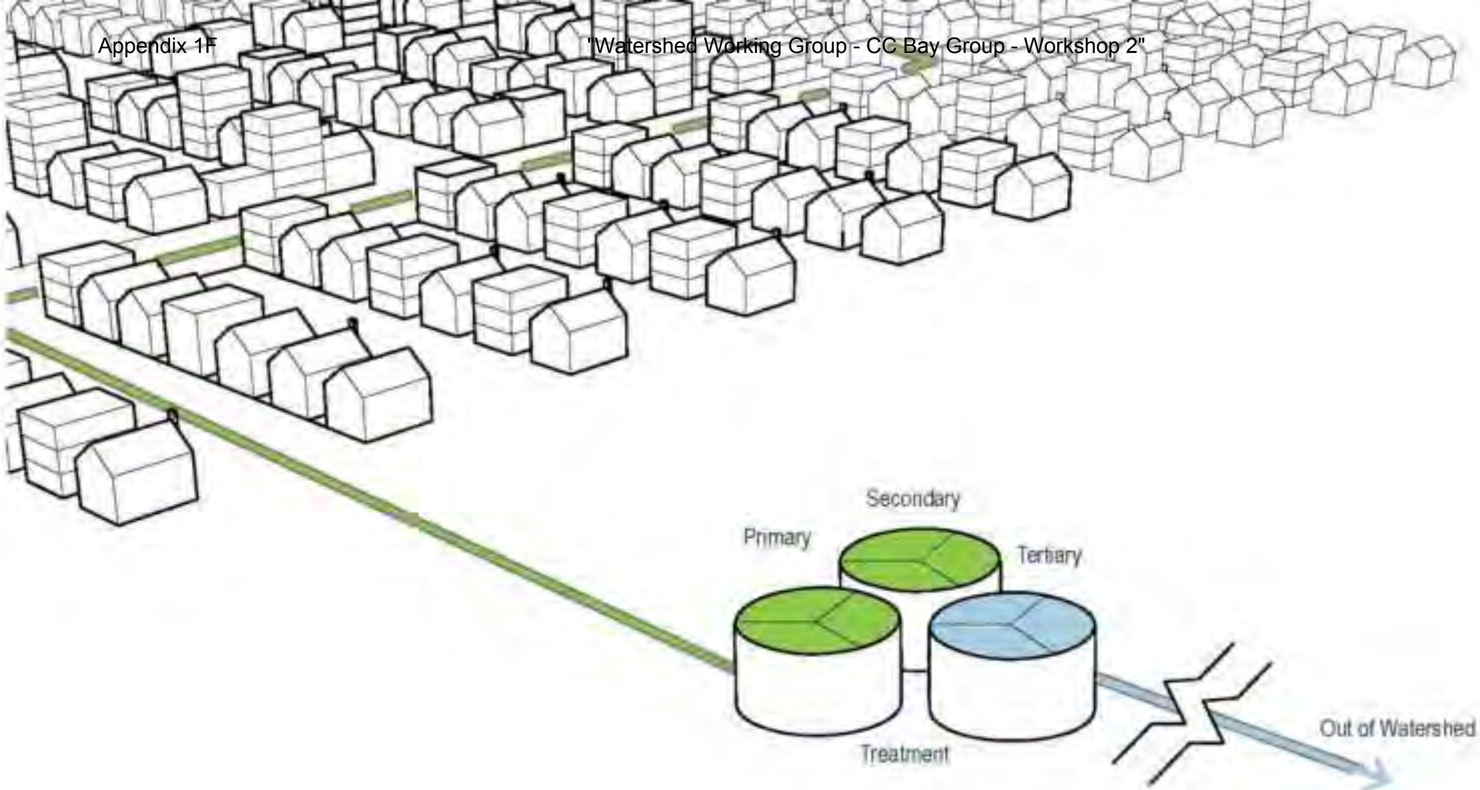
Constructed Wetlands
Subsurface Flow

Precedent: Koh Phi Phi Treatment Wetland, Thailand

Source: Hans Brix

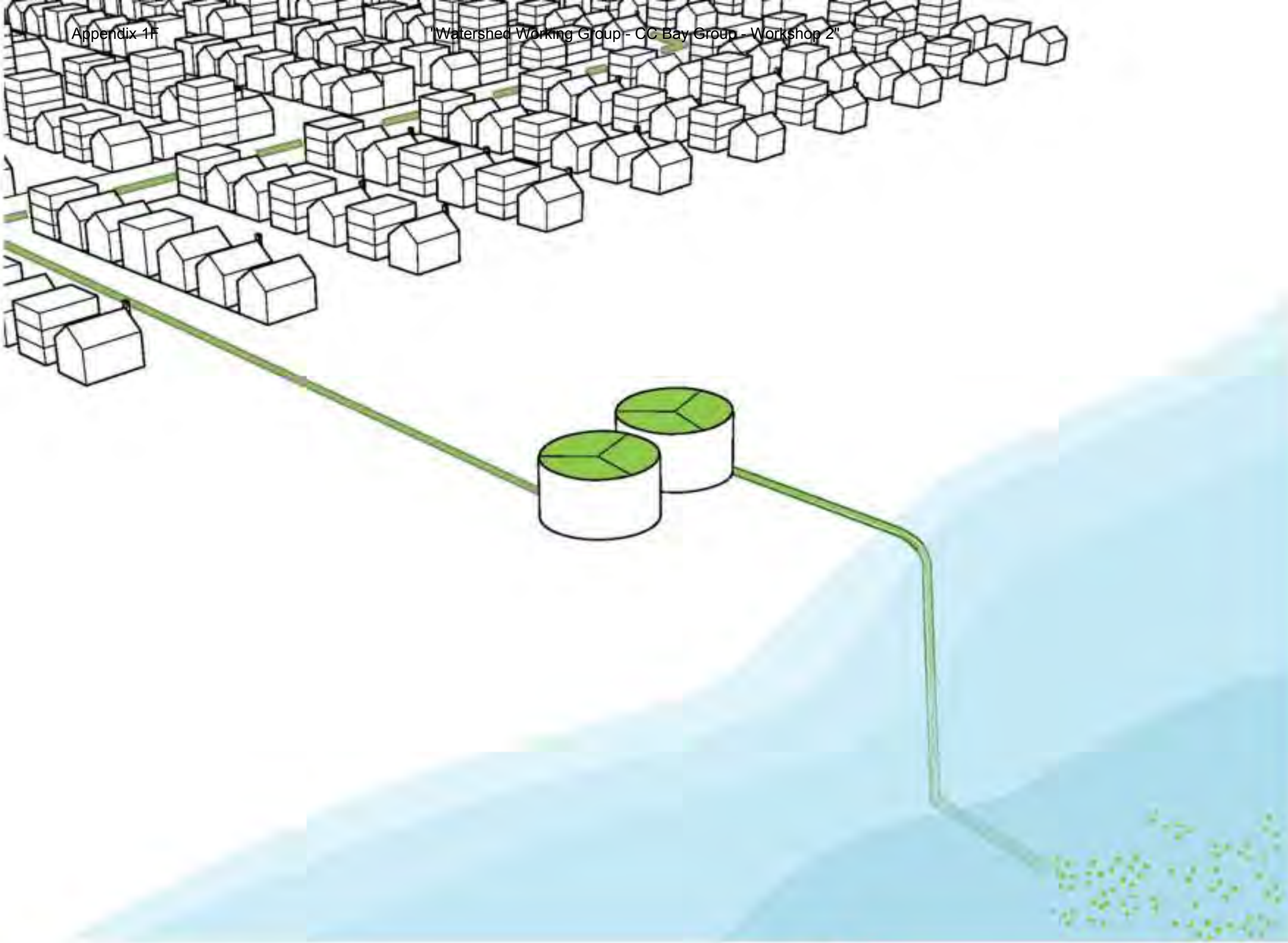
Constructed Wetlands:
Subsurface Flow


Secondary
Primary
Tertiary
Treatment
Disposal
Infiltration Basins
Soil Absorption System
Wick Well
Injection Well
Scale: WATERSHED
Target: WASTEWATER
Effluent Disposal Systems
Disposal

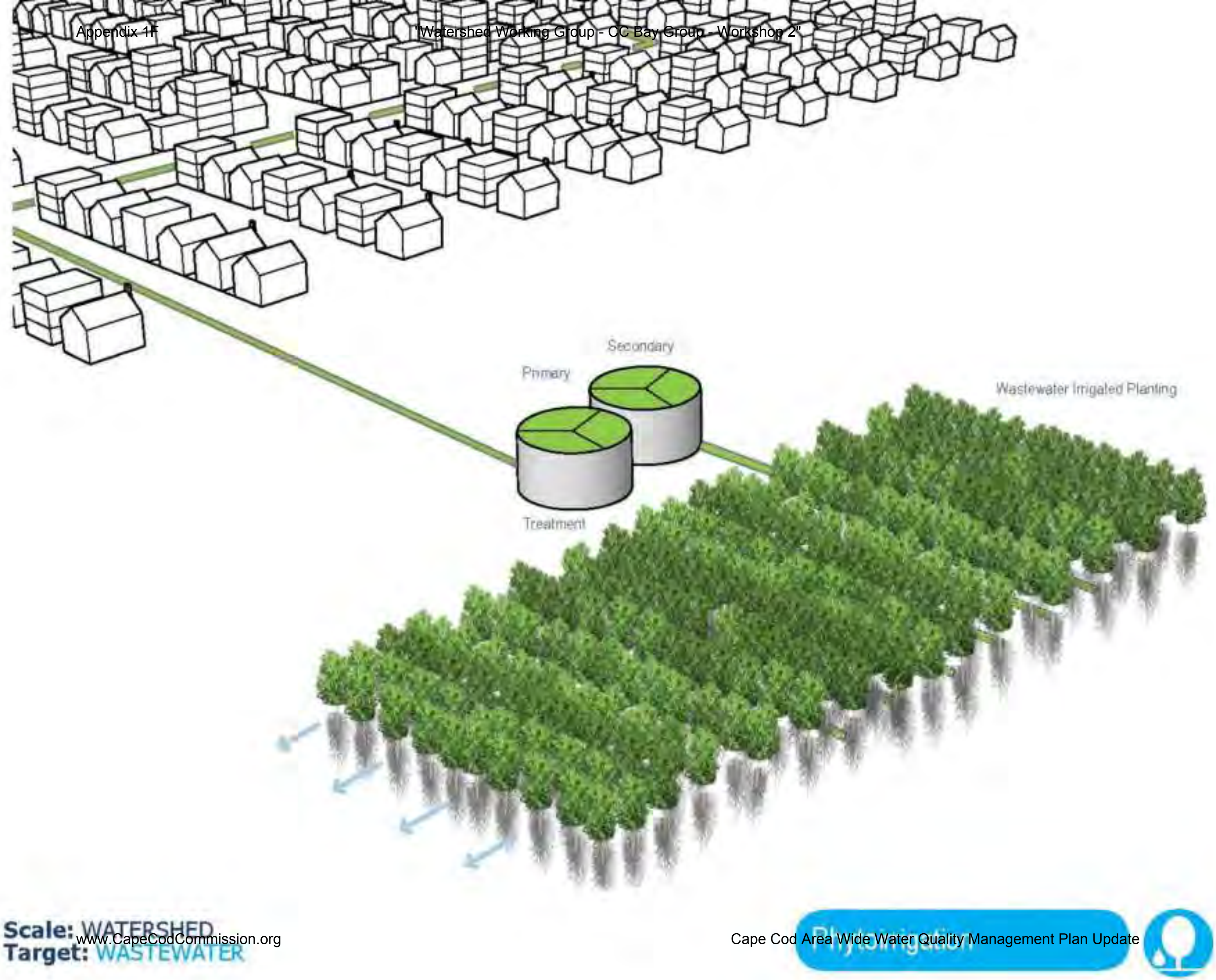


Scale: WATERSHED
Target: WASTEWATER

Effluent Disposal: Out of Watershed



Scale: WATERSHED
Target: WASTEWATER


Secondary
Primary
Wastewater Irrigated Planting
Treatment
Scale: WATERSHED
Target: WASTEWATER

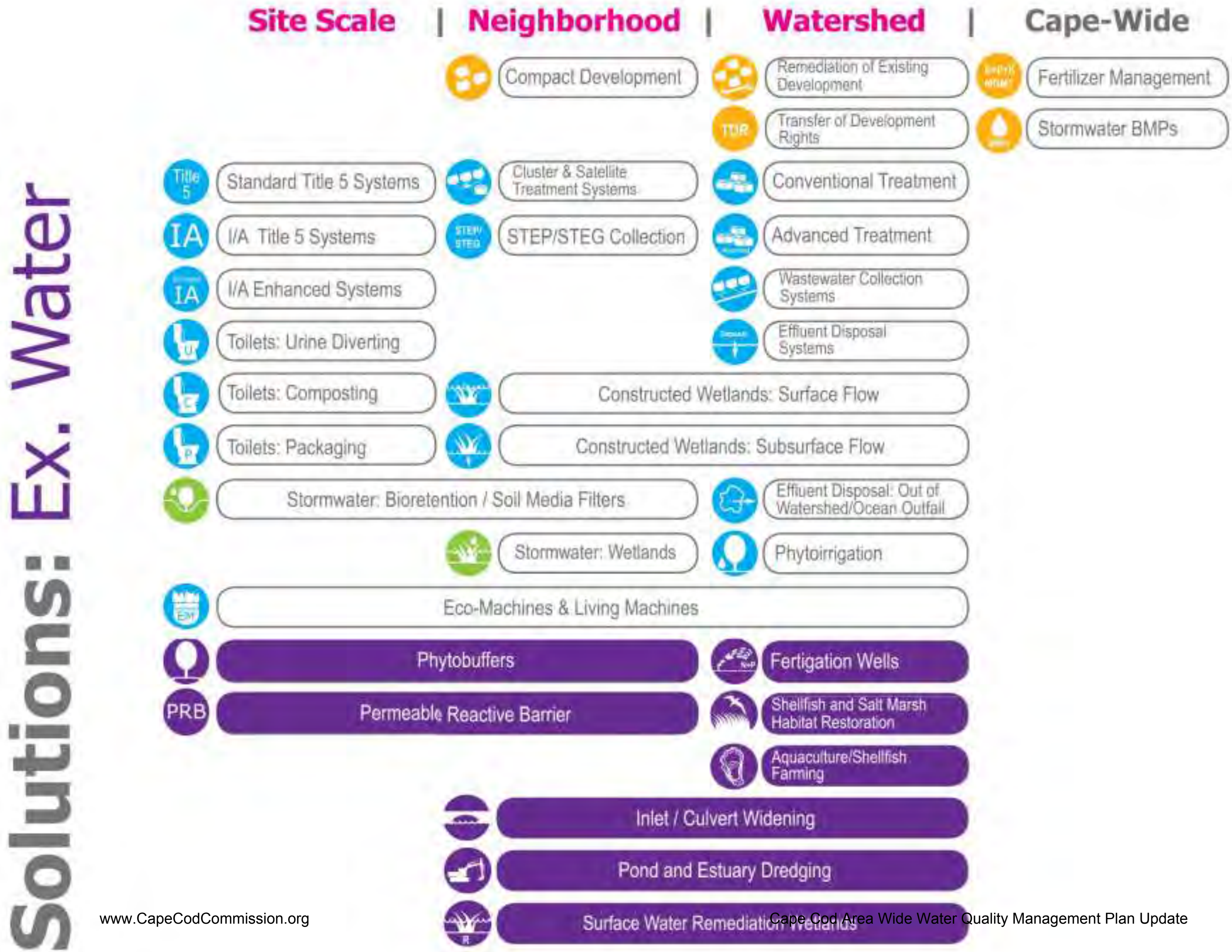
Precedent: Woodburn OR, Wastewater Treatment Facility

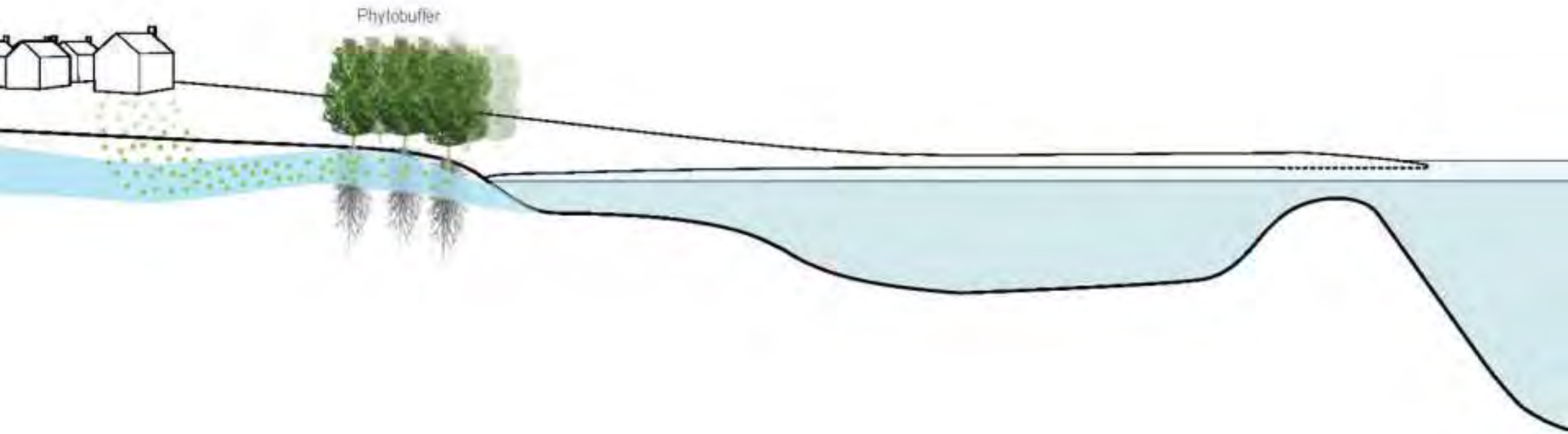
Source: CH2MHill

Phytoirrigation

Precedent: Woodburn OR, Wastewater Treatment Facility
Source: CH2MHill

Phytoirrigation


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



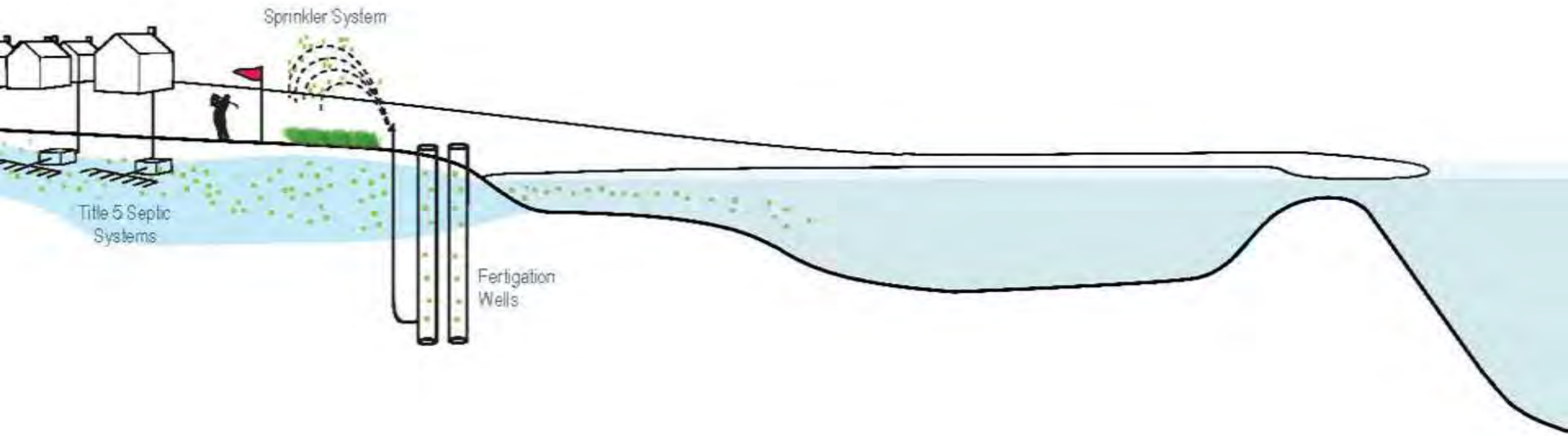
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Phytobuffers

Precedent: Phytobuffer - Kavcee, WY

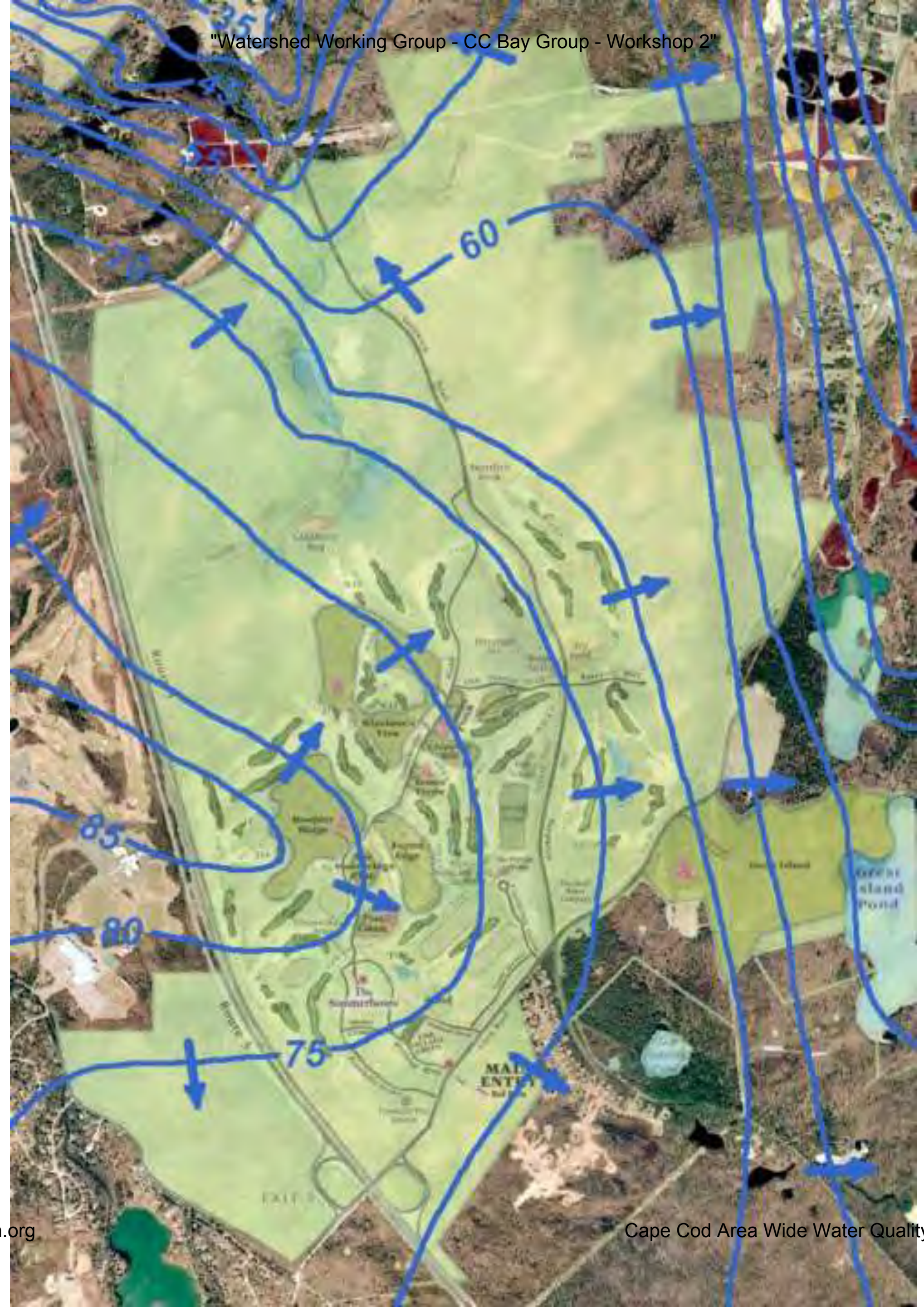
Source: Sand Creek Consultants

Phytobuffers

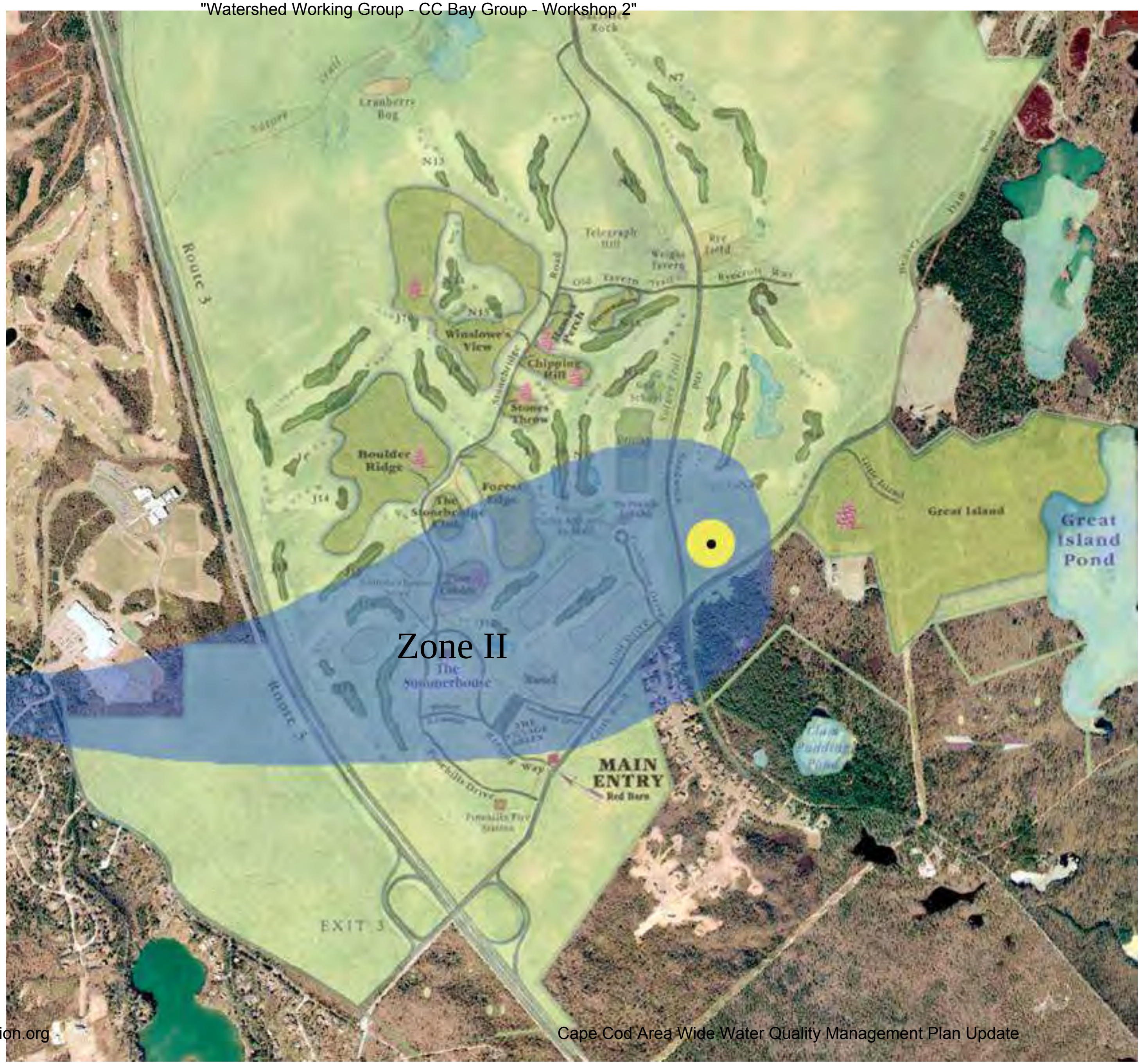


Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

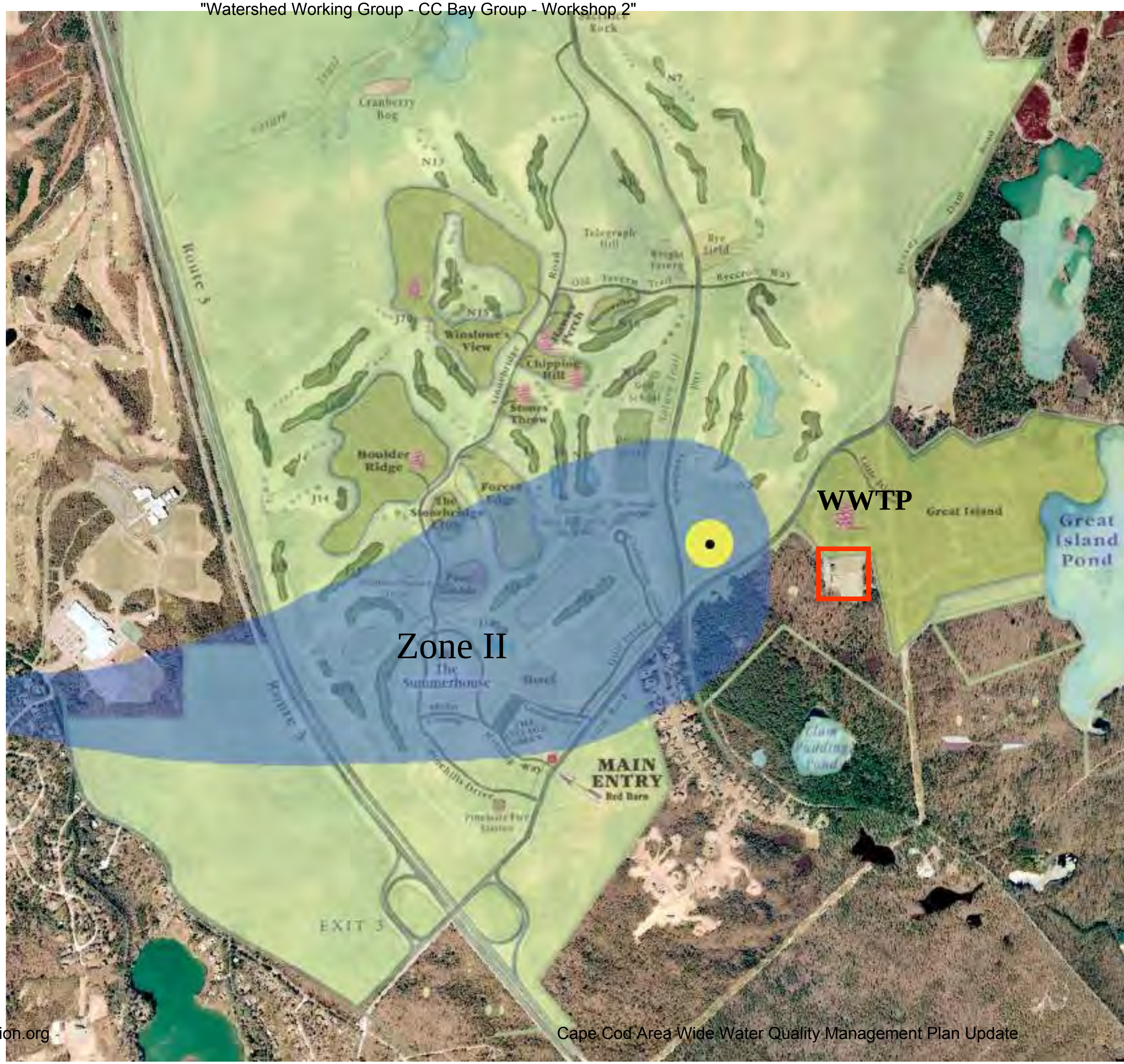
Fertigation Wells



Precedent:
Pine Hills
Plymouth, MA

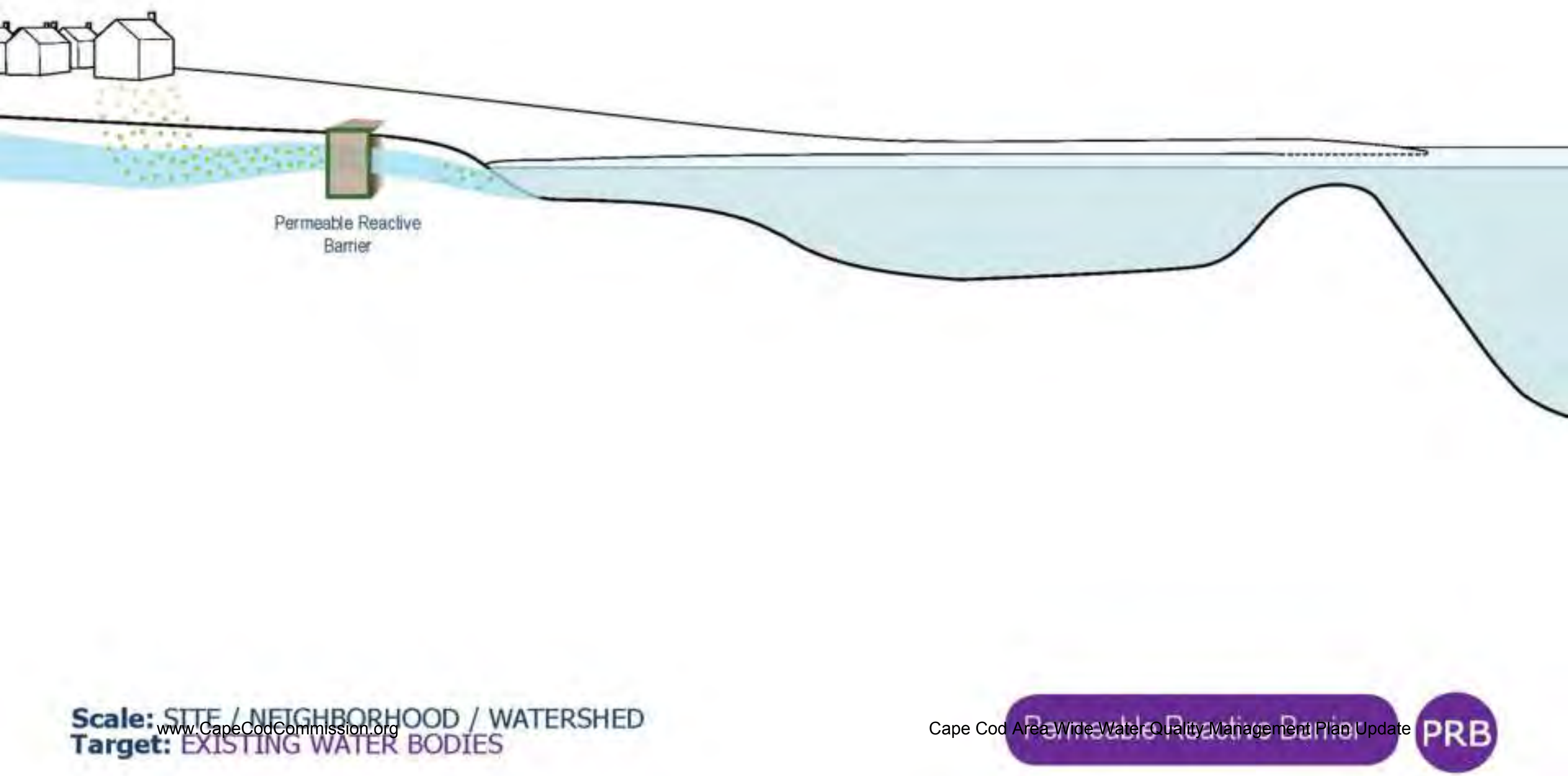


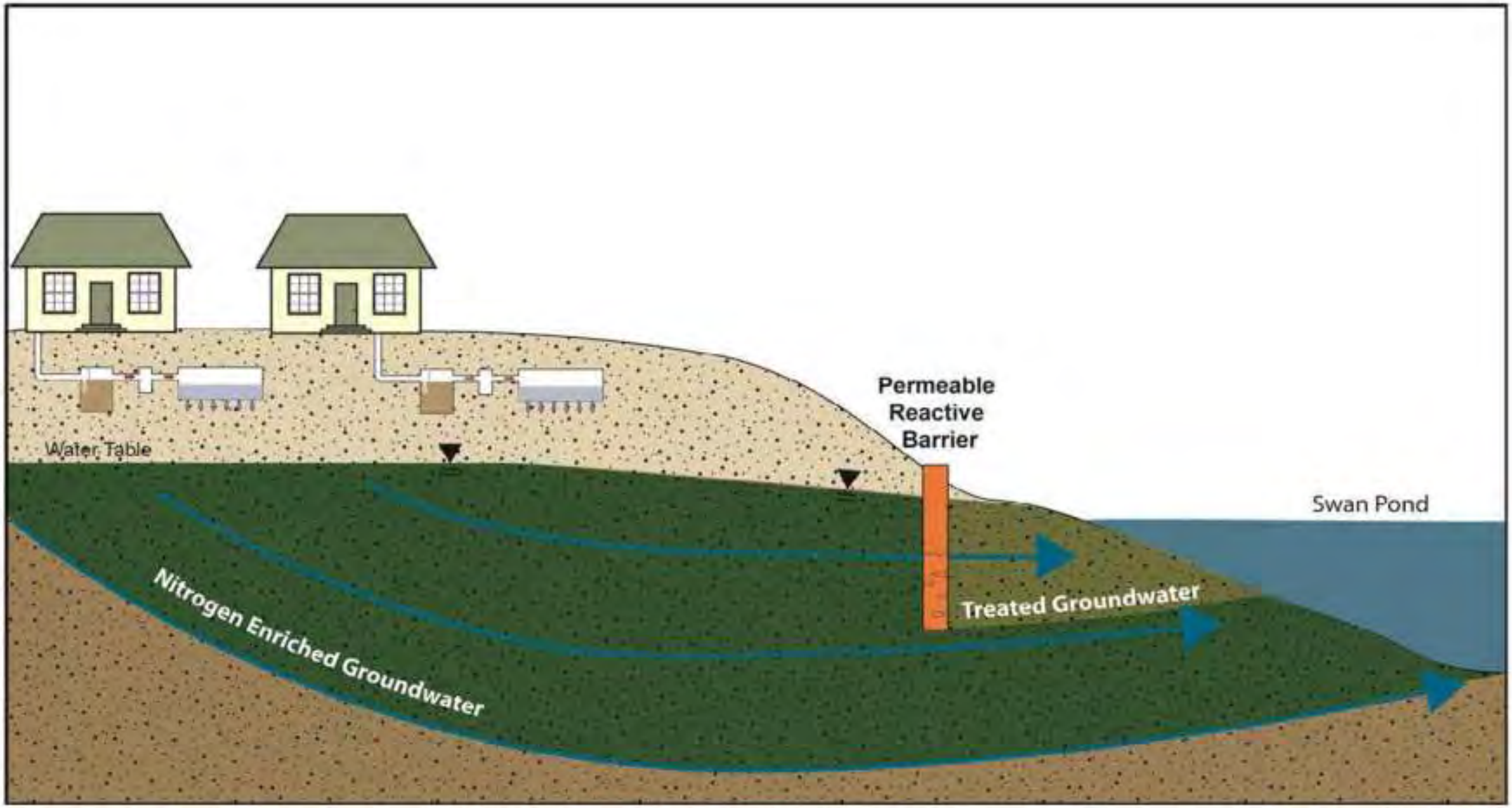
Precedent:
Pine Hills
Plymouth, MA



Precedent:
Pine Hills
Plymouth, MA

Precedent:
Pine Hills
Plymouth, MA


Permeable Reactive Barrier
Scale: SITE / NEIGHBORHOOD / WATERSHED
Target: EXISTING WATER BODIES
Permeable Reactive Barrier
PRB



Precedent: PRB

Source: Horsley Witten Group Inc.

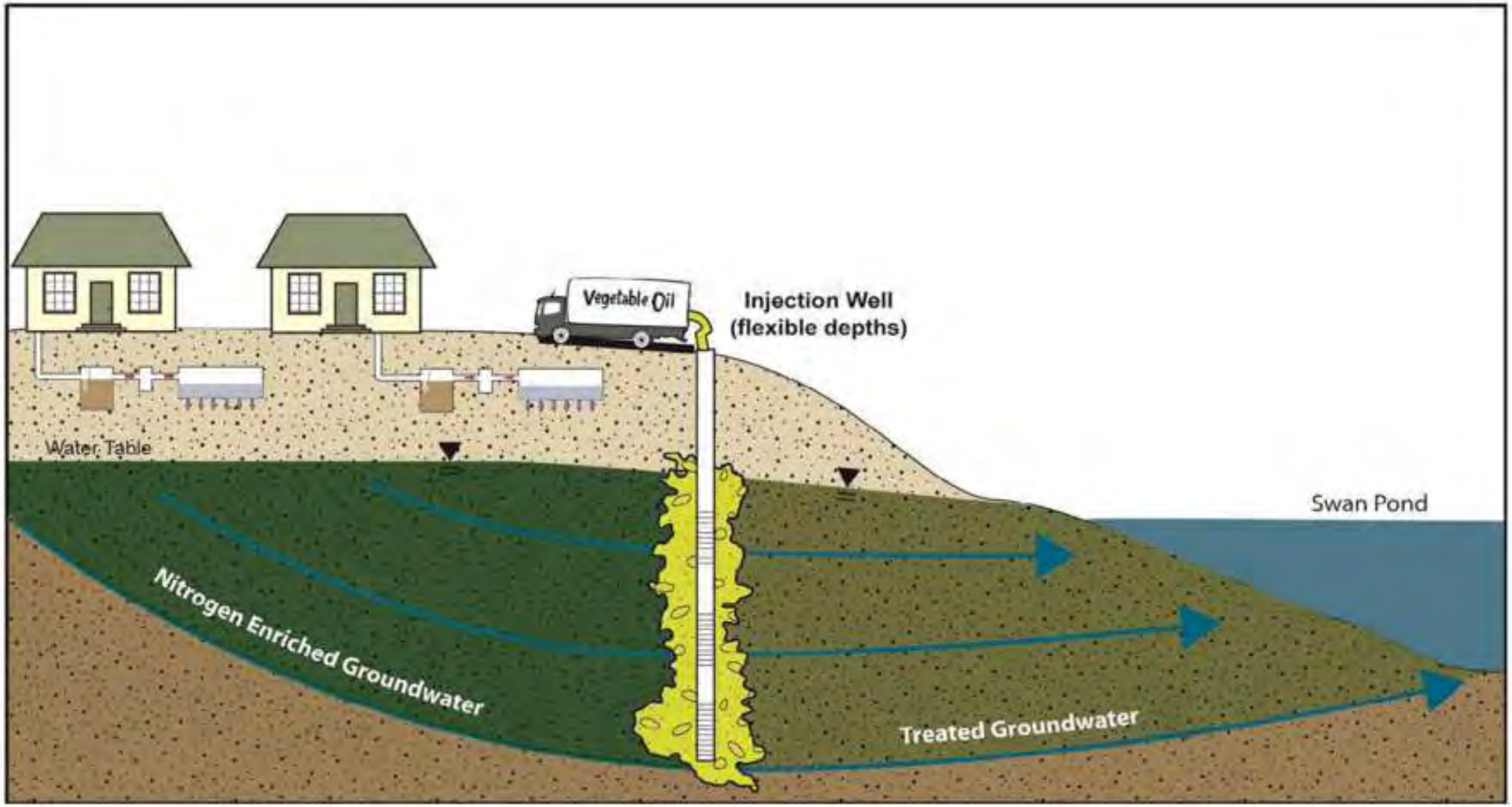
Permeable Reactive Barrier

PRB

Precedent: Falmouth PRB

Source: Mike Domenica

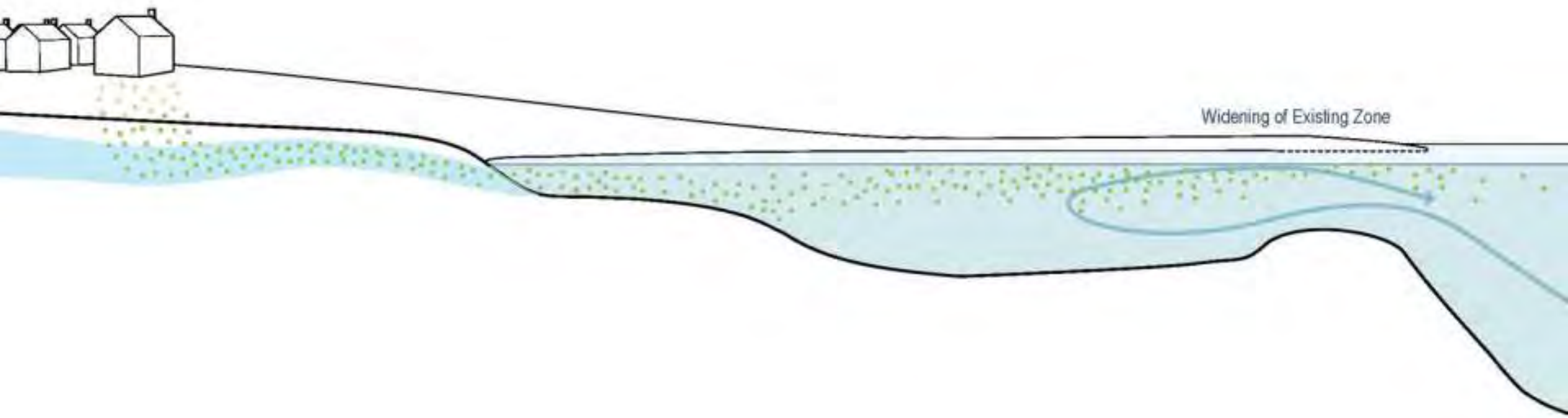
Permeable Reactive Barrier PRB



Precedent: PRB

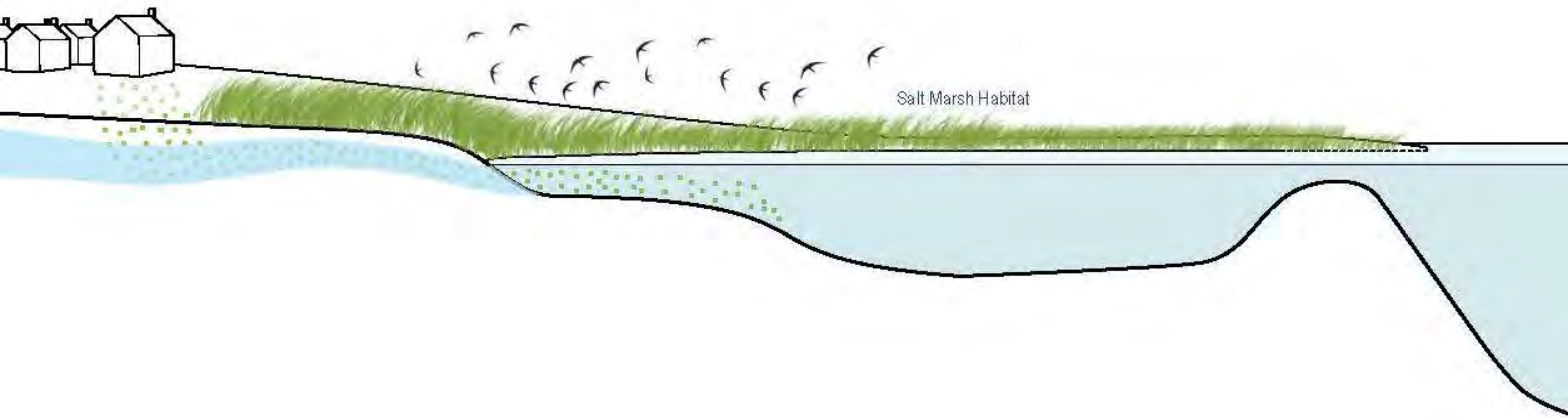
Source: Horsley Witten Group Inc.

PRB



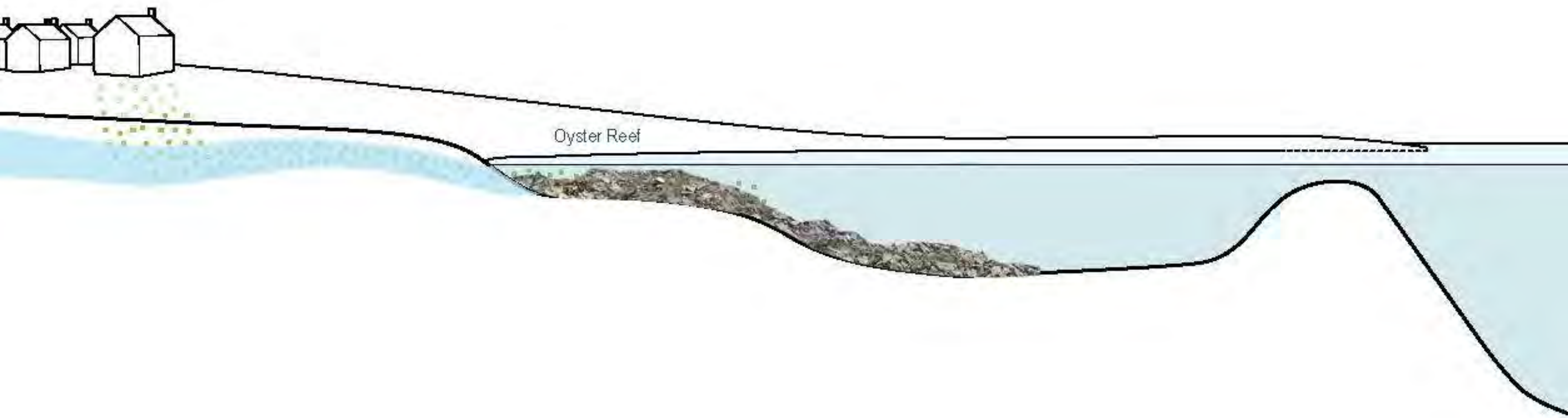
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Inlet and Culvert Widening



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Salt Marsh Habitat Restoration



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Shellfish Habitat Restoration

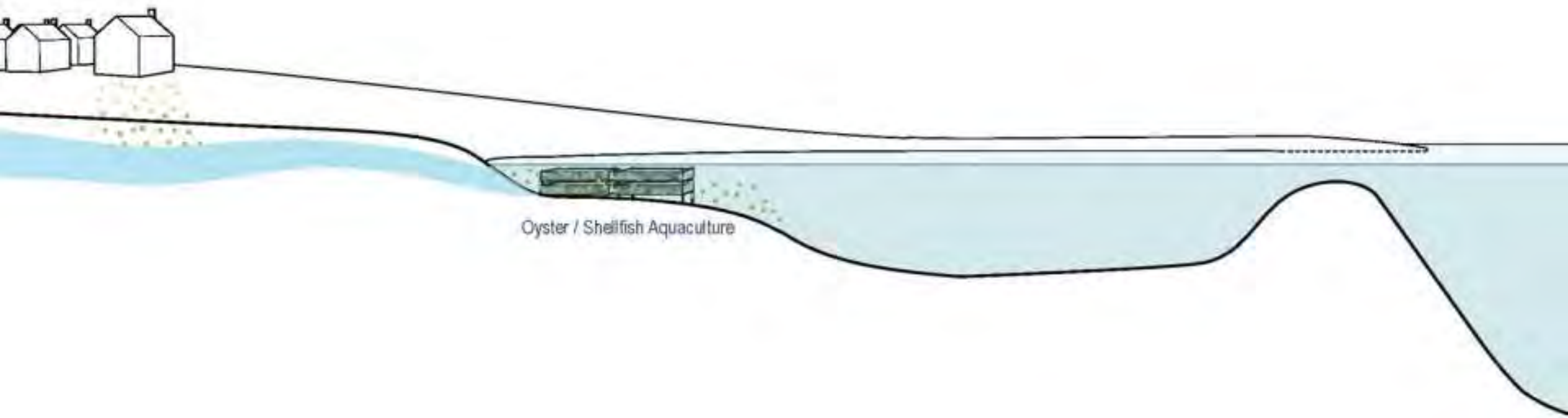
Precedent: Wellfleet Oyster Restoration Project

Shellfish Habitat Restoration

Precedent: Wellfleet Oyster Restoration Project

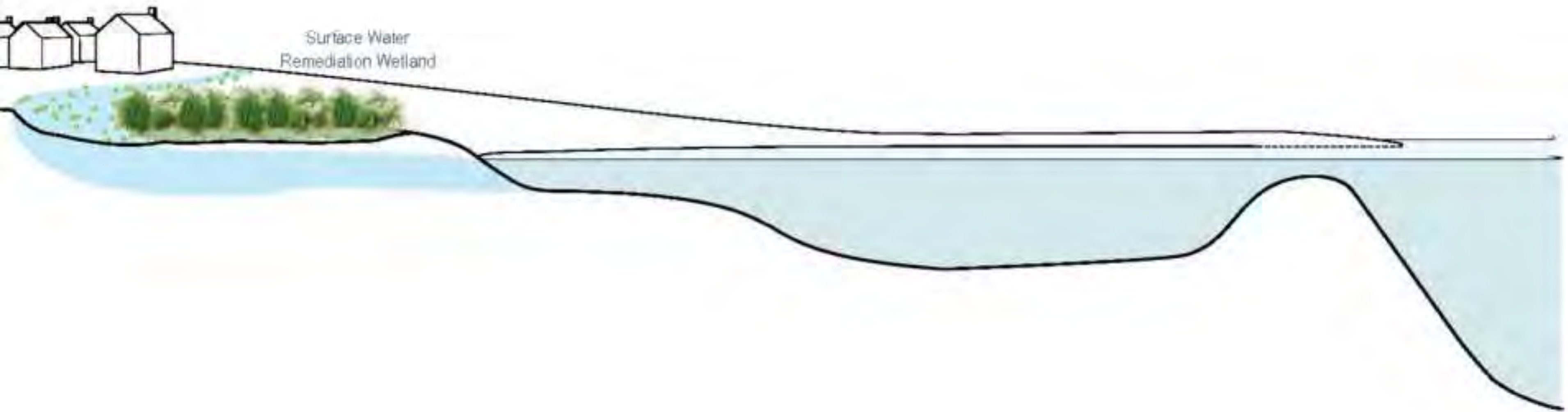
Source: Anamarija Frankic

Shellfish Habitat Restoration



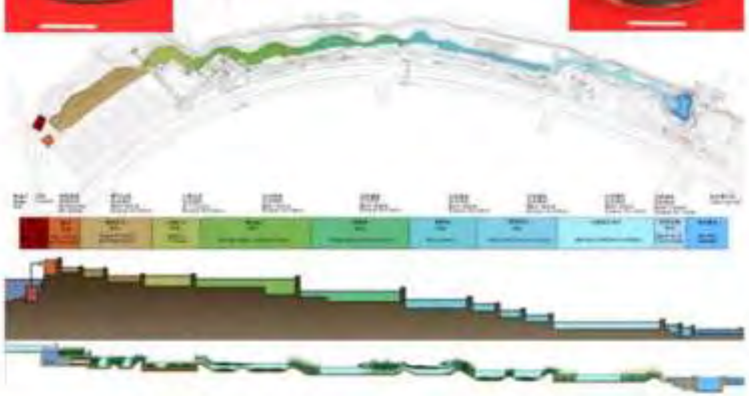
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Aquaculture / Shellfish Farming



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

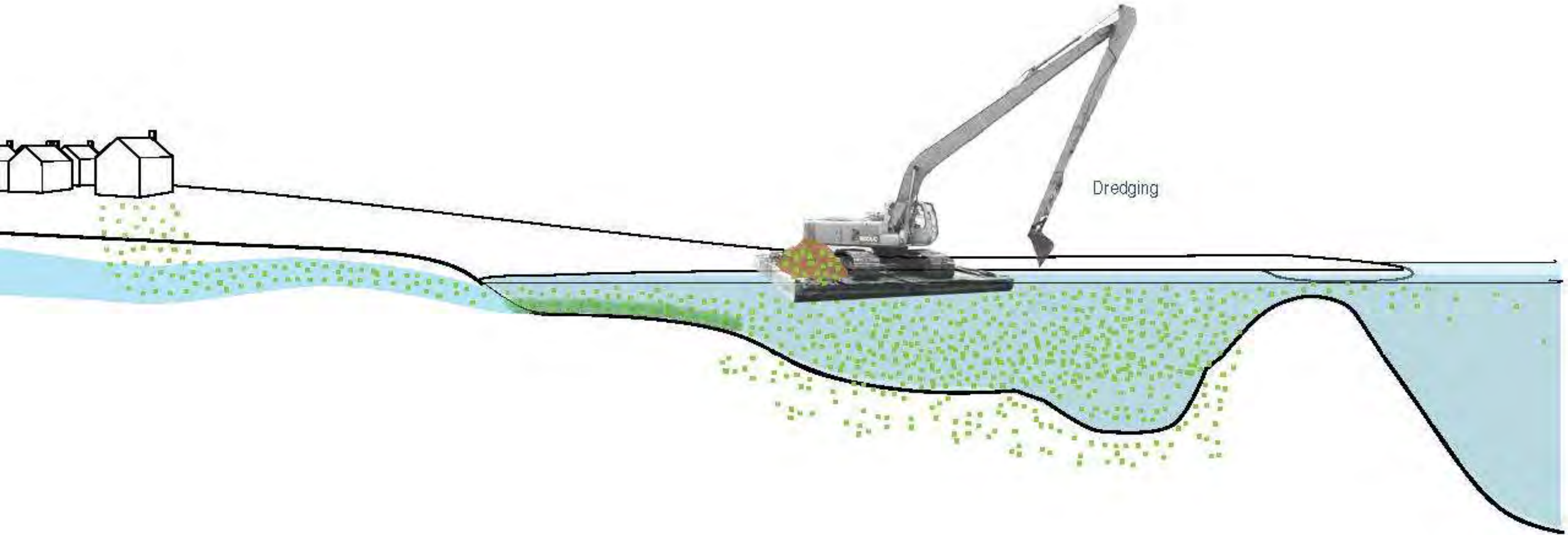
Surface Water
Remediation Wetlands



Precedent: Shanghai Houton Park

Source: Turenscape

Surface Water
Remediation Wetlands

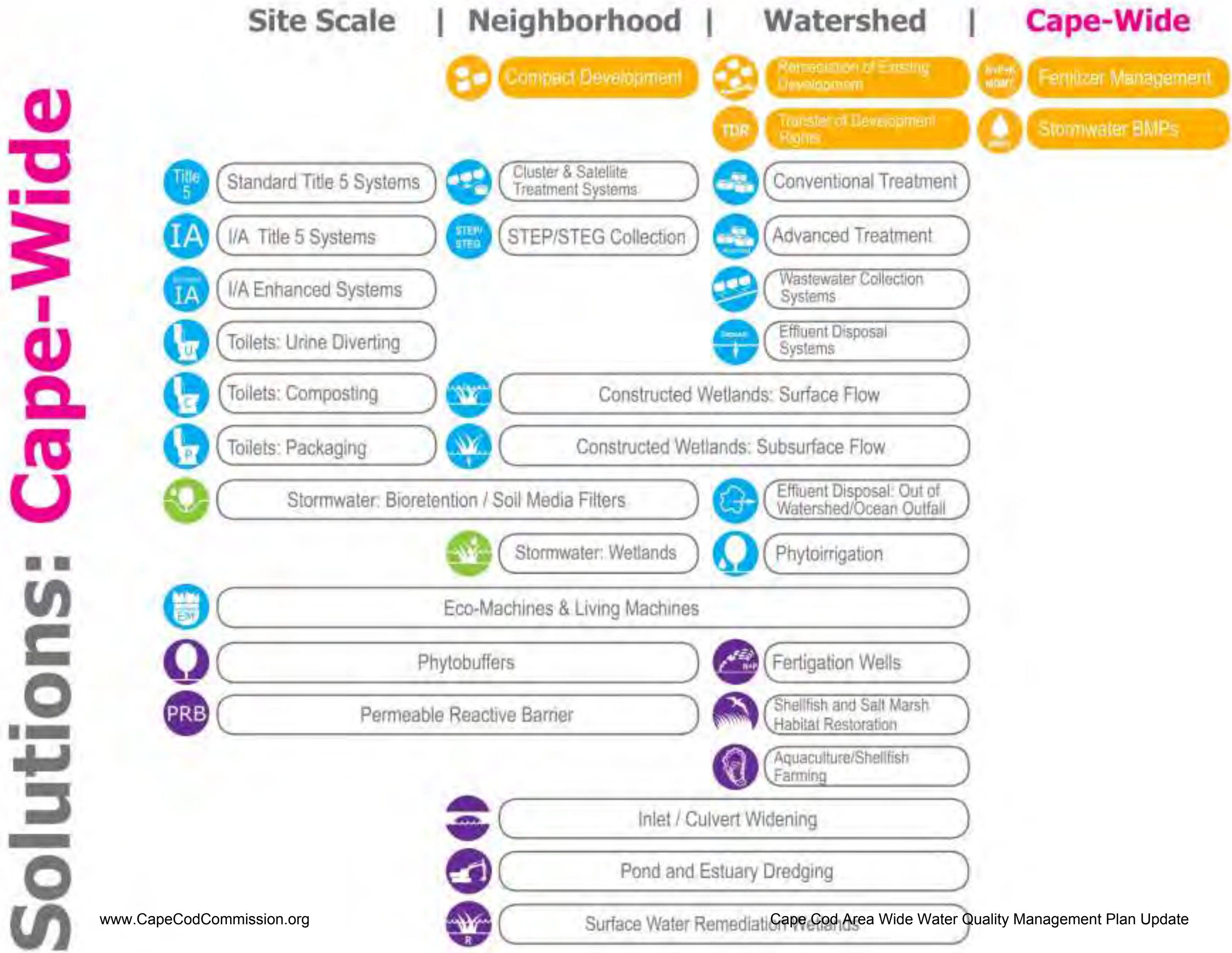


Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Pond and Estuary Dredging

Precedent: Pond and Estuary Dredging - Dennis, MA

Source: Cape Cod Times


Solutions: Cape-Wide
Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
IA
I/A Title 5 Systems
STEP/STEG
STEP/STEG Collection
Advanced Treatment
IA
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
EM
Eco-Machines & Living Machines
Phytobuffers
Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands

Scale: CAPE-WIDE
Target: REGULATORY

Compact Development

Scale: CAPE-WIDE
Target: REGULATORY

Fertilizer Management

N+P+K MGMT

Scale: CAPE-WIDE
Target: REGULATORY

Remediation of Existing Development

Scale: CAPE-WIDE
Target: REGULATORY

Transfer of Development Rights

TDR

Transfer of Developments Rights
The Concept

Owner of "sending" parcel sells development rights in exchange for permanent conservation easement.

Owner of "receiving" parcel buys development rights to build at densities higher than allowed under base zoning.

Source: Massachusetts Smart Growth Toolkit

Scale: CAPE-WIDE
Target: REGULATORY

Town Consideration of Alternative Technologies & Approaches

Wellfleet-	*Coastal habitat restoration & aquaculture*
Mashpee-	*Aquaculture & Expanding Existing Systems*
Brewster-	*PRB & Bioswales*
Orleans-	*Fertilizer Control By-Law*
Harwich &- Chatham	*Muddy Creek & Cold Brook Natural Attenuation*
Falmouth-	*Aquaculture* *Inlet Widening* *Eco-Toilet Demonstration Project* *PRBs* *Stormwater Management (Little Pond Watershed)* *Fertilizer Control By-Law* *Subsurface Nitrogen Removal Septic Systems*


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

Problem Solving Approach

Wastewater · Existing Water Bodies · Regulatory

1 Targets/Reduction Goals

Present Load: X kg/day − **Target:** Y kg/day = **Reduction Required:** N kg/day

2 Other Wastewater Management Needs

A. Title 5 Problem Areas
B. Pond Recharge Areas
C. Growth Management

3 Low Barrier to Implementation

A. Fertilizer Management
B. Stormwater Mitigation

4 Watershed/Embayment Options

A. Permeable Reactive Barriers
B. Inlet/Culvert Openings
C. Constructed Wetlands
D. Aquaculture

PRB

5 Alternative On-Site Options

A. Eco-toilets (UD & Compost)
B. I/A Technologies
C. Enhanced I/A Technologies
D. Shared Systems

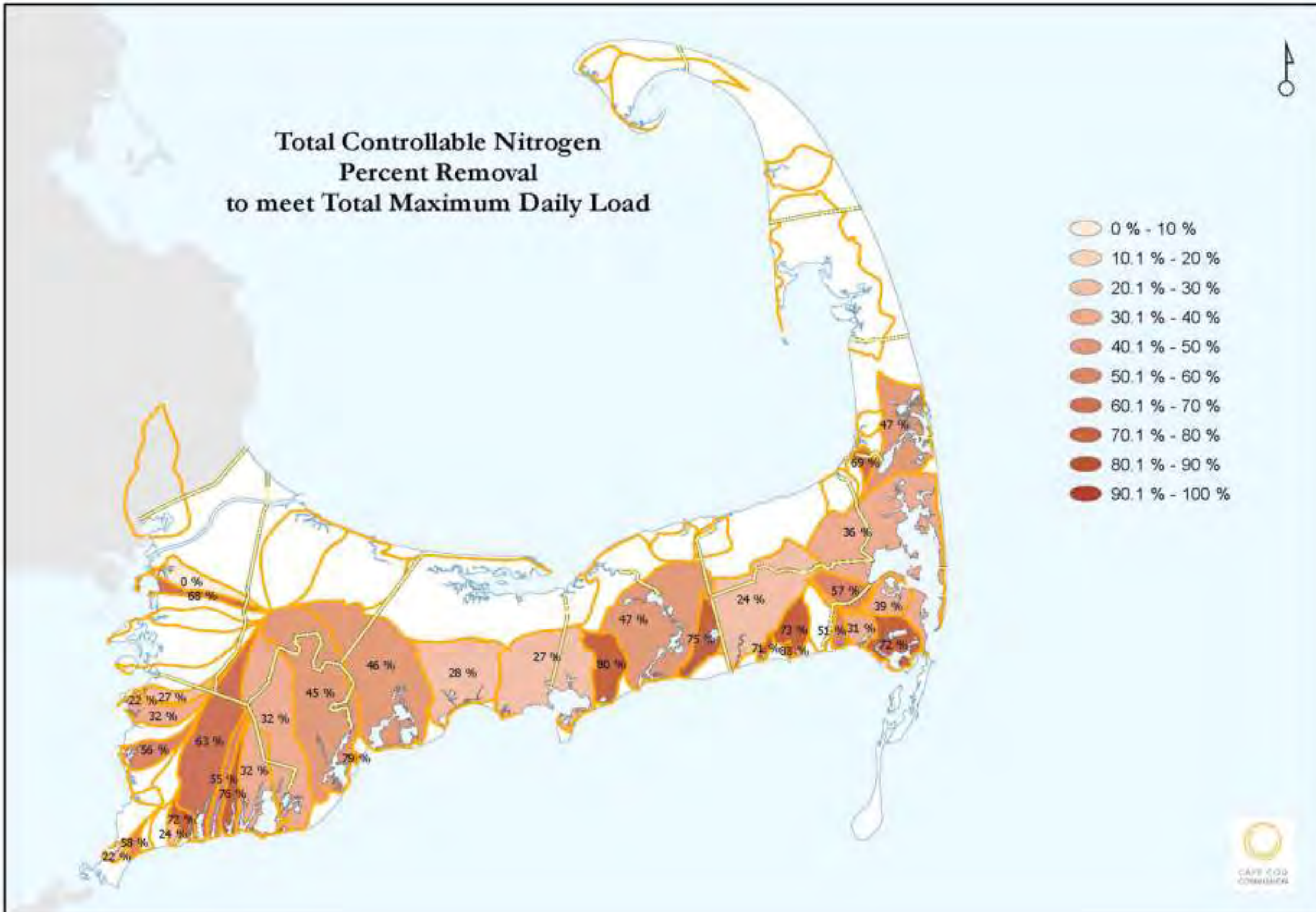
Title 5 · IA · IA

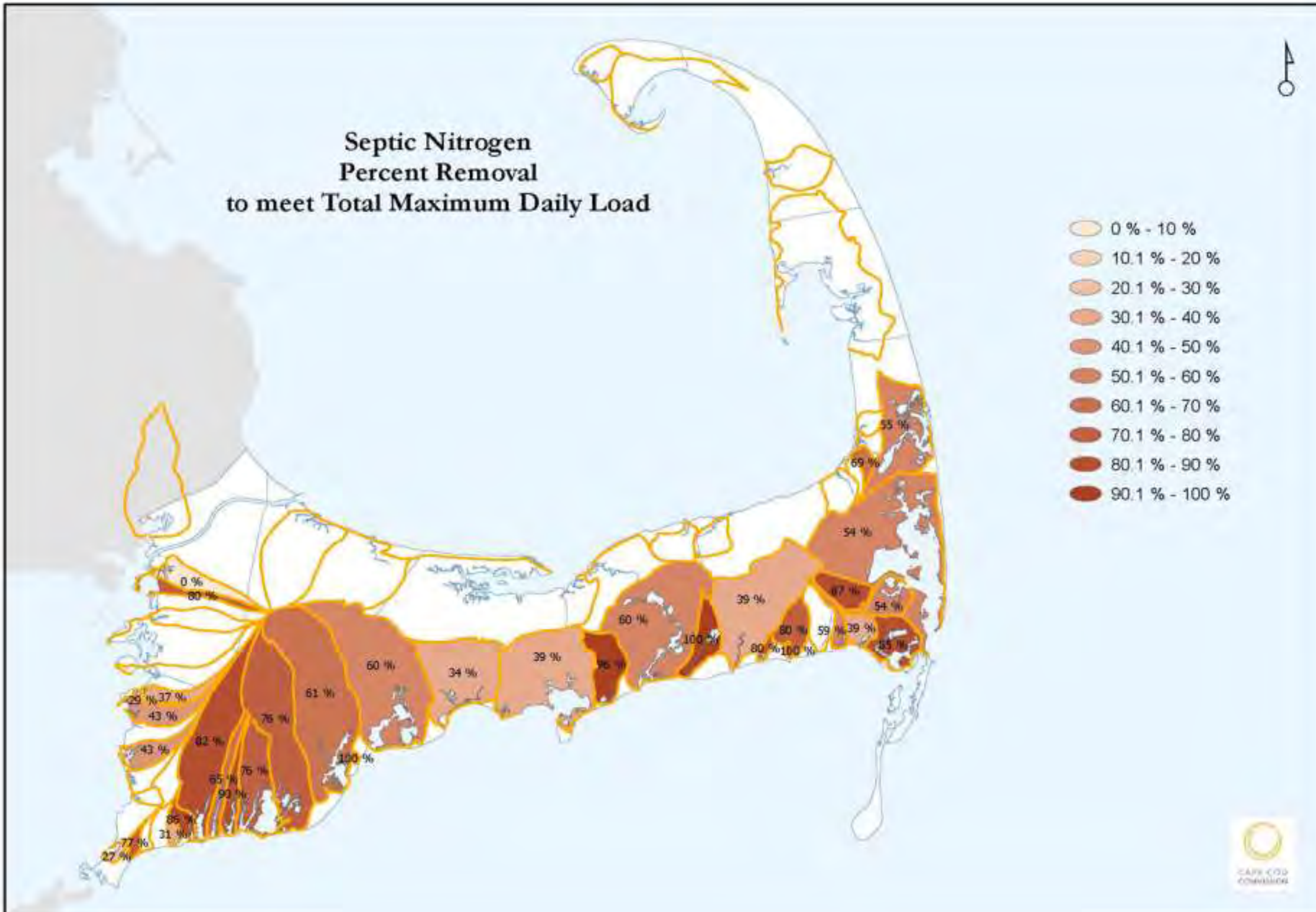
6 Priority Collection/High-Density Areas

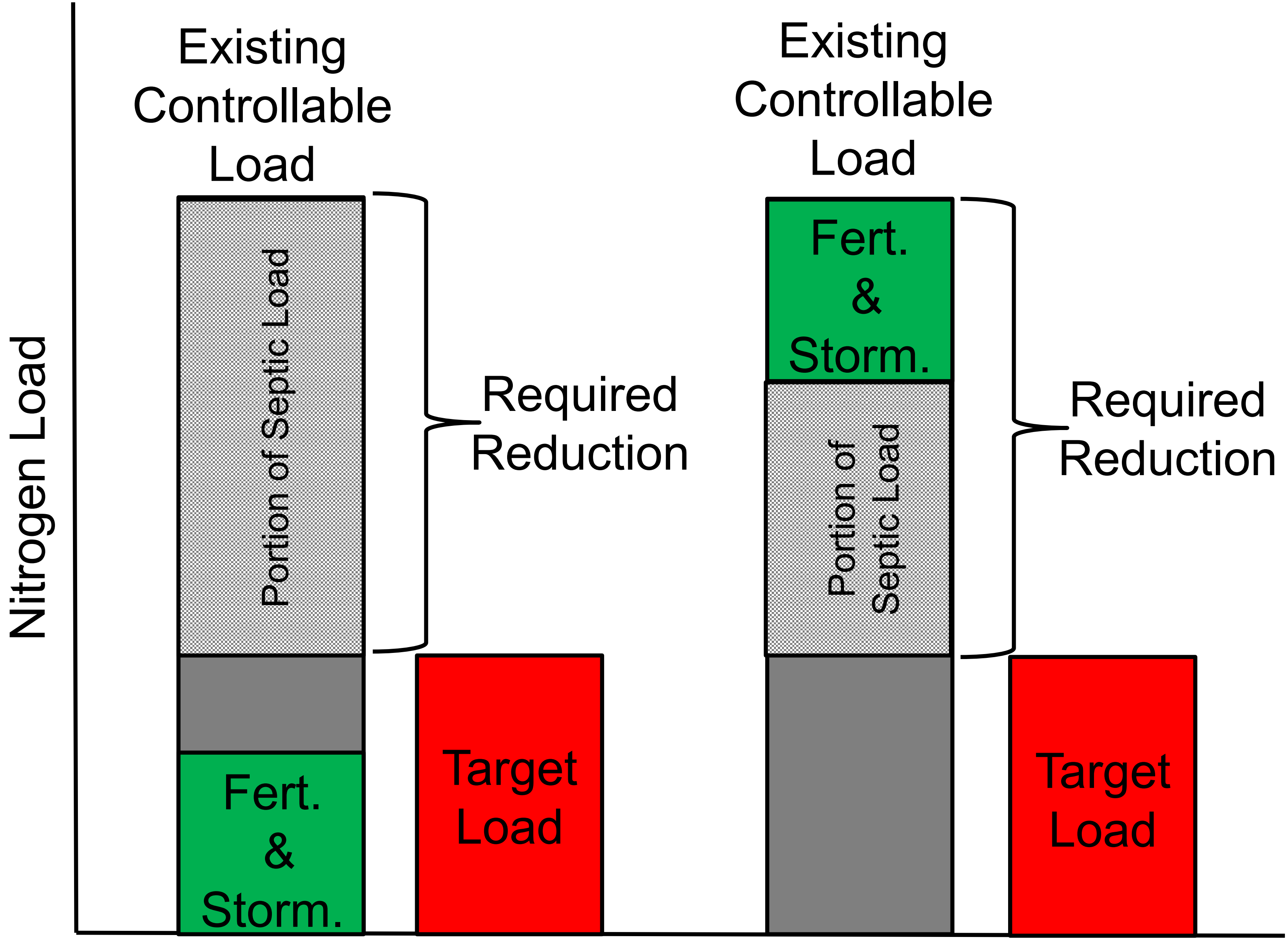
A. Greater Than 1 Dwelling Unit/acre
B. Village Centers
C. Economic Centers
D. Growth Incentive Zones

STEP/STEG

7 Supplemental Sewering


Total Controllable Nitrogen
Percent Removal
to meet Total Maximum Daily Load
0 % - 10 %
10.1 % - 20 %
20.1 % - 30 %
30.1 % - 40 %
40.1 % - 50 %
50.1 % - 60 %
60.1 % - 70 %
70.1 % - 80 %
80.1 % - 90 %
90.1 % - 100 %
47 %
69 %
36 %
57 %
39 %
24 %
73 %
51 %
31 %
72 %
71 %
47 %
75 %
80 %
27 %
28 %
46 %
45 %
32 %
79 %
0 %
68 %
22 %
27 %
32 %
56 %
63 %
32 %
55 %
76 %
72 %
24 %
58 %
22 %


Septic Nitrogen
Percent Removal
to meet Total Maximum Daily Load
0 % - 10 %
10.1 % - 20 %
20.1 % - 30 %
30.1 % - 40 %
40.1 % - 50 %
50.1 % - 60 %
60.1 % - 70 %
70.1 % - 80 %
80.1 % - 90 %
90.1 % - 100 %
55 %
69 %
54 %
87 %
54 %
39 %
59 %
39 %
85 %
80 %
100 %
80 %
100 %
60 %
96 %
39 %
34 %
60 %
61 %
76 %
82 %
100 %
76 %
65 %
90 %
85 %
31 %
77 %
27 %
29 %
37 %
43 %
43 %
0 %
80 %


Nitrogen Load
Existing Controllable Load
Portion of Septic Load
Fert. & Storm.
Required Reduction
Target Load
Existing Controllable Load
Fert. & Storm.
Portion of Septic Load
Required Reduction
Target Load


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

Triple Bottom Line

Impacts of Technologies and Approaches

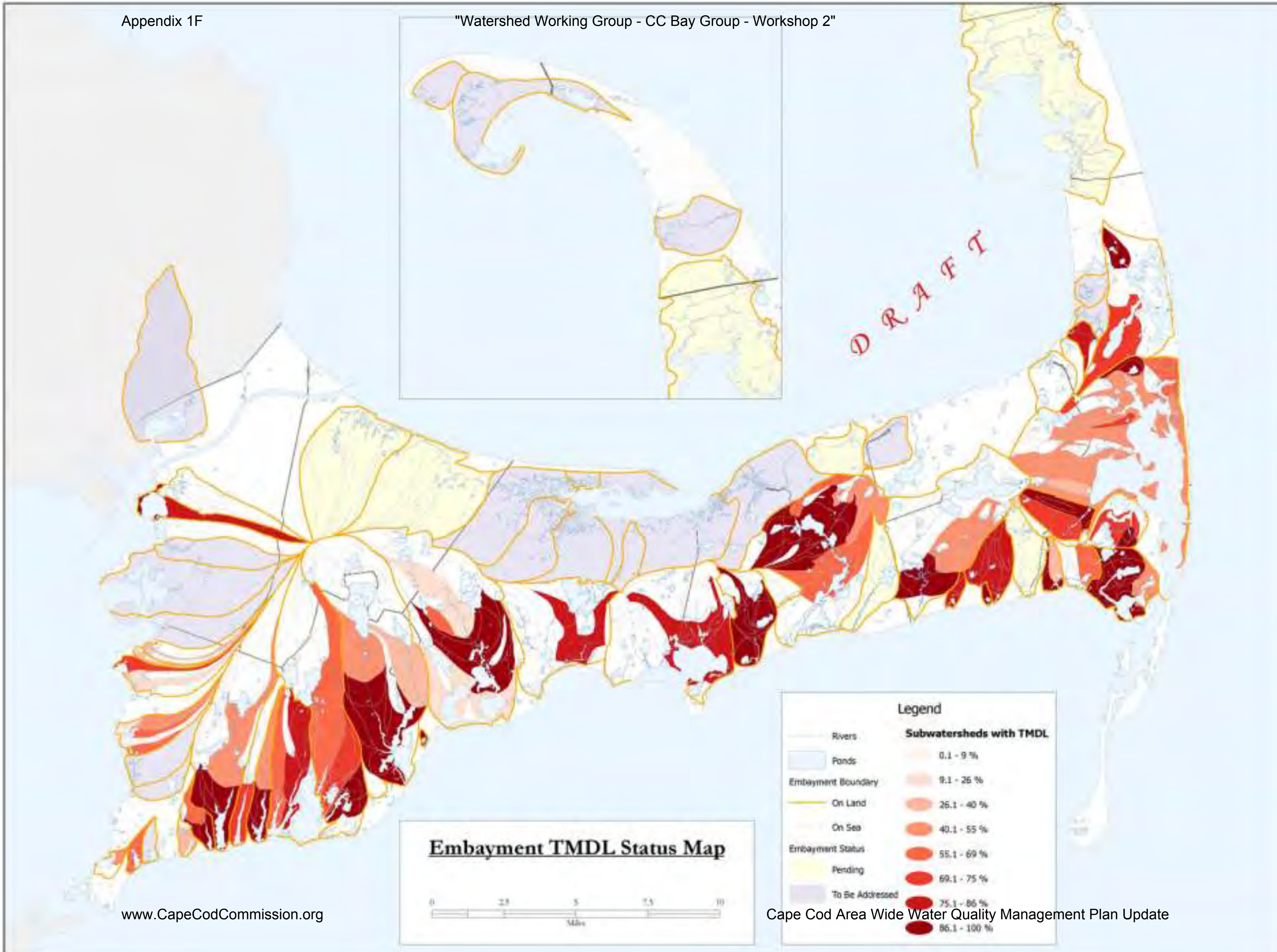
Environmental

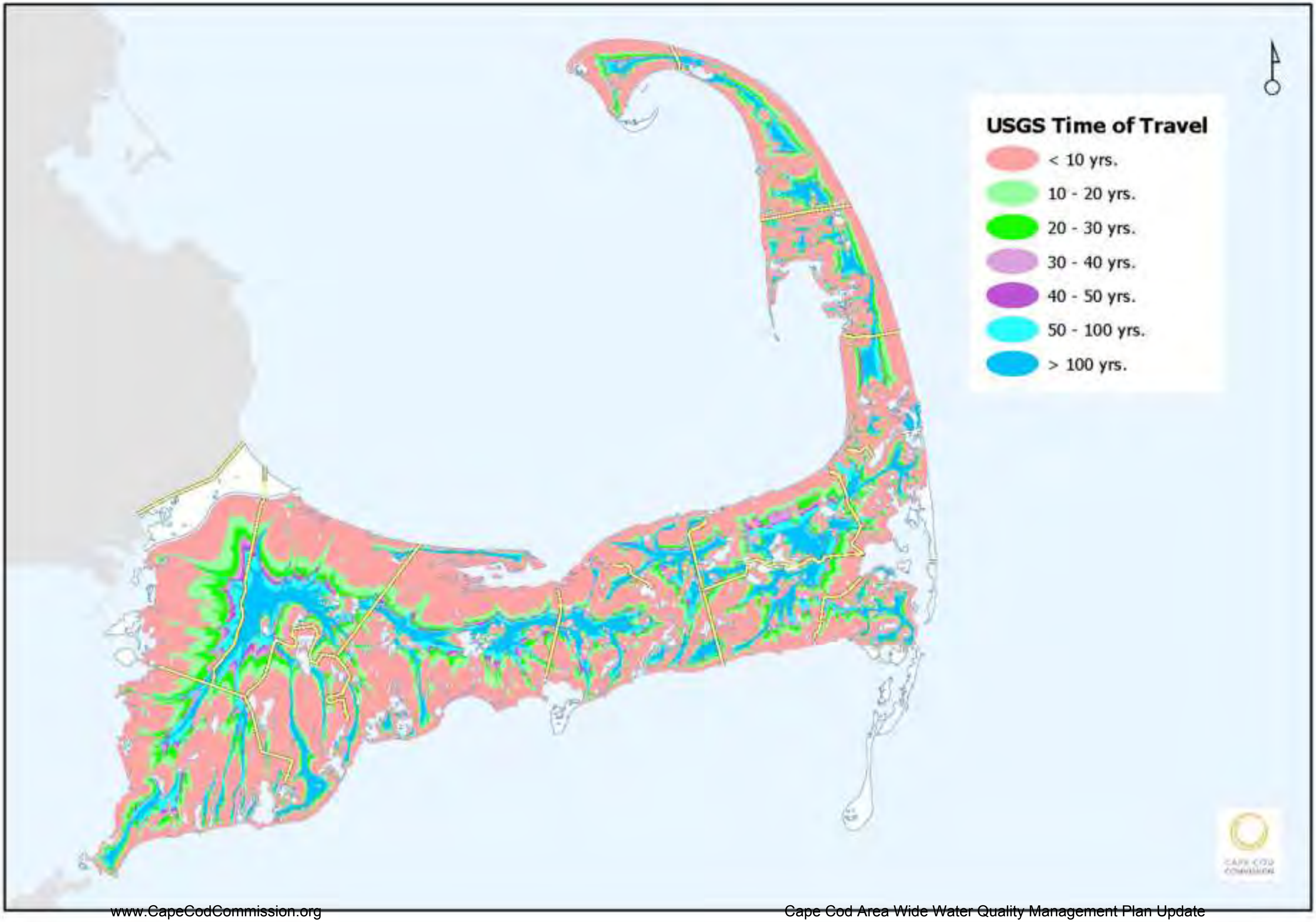
Economic

Social

Technology Selection: Process and Principles

- 100% septic removal subwatershed
- Scale: On-Site vs. Collection System vs. Natural System
- Nutrient intervention and time of travel
- Permitting Status
- Land use and Impacts of Growth


DRAFT
Embayment TMDL Status Map
0
2.5
5
7.5
10
Miles
Legend
Rivers
Ponds
Embayment Boundary
On Land
On Sea
Embayment Status
Pending
To Be Addressed
Subwatersheds with TMDL
0.1 - 9 %
9.1 - 26 %
26.1 - 40 %
40.1 - 55 %
55.1 - 69 %
69.1 - 75 %
75.1 - 86 %
86.1 - 100 %


USGS Time of Travel
< 10 yrs.
10 - 20 yrs.
20 - 30 yrs.
30 - 40 yrs.
40 - 50 yrs.
50 - 100 yrs.
> 100 yrs.

Preparing for Meeting 3 and Beyond

- ❑ Review tools and alternatives analysis approach
- ❑ Evaluating scenarios for meeting water quality goals
- ❑ Attend the November 13th meeting:

6:00
Cape Cod Museum of Art
Dennis, MA

Cape Cod 208 Area Water Quality Planning
Poppenesset Bay and Waquoit Bay Watershed Working Group

Meeting Two Summary
Wednesday, October 30, 2013
1:00-5:00 pm
Mashpee Town Hall, 16 Great Neck Road, Mashpee

I. ACTION ITEMS

Working Group

- Next meeting: Meeting Three
  Wednesday, December 11, 2013
  1:00PM – 5:00PM
  Mashpee Town Hall, 16 Great Neck Road North, Mashpee
- Send Doug any additional comments on Meeting One Summary within one week
- Continue to prepare thoughts about preferred technologies/approaches for application in the Poppenesset Bay and Waquoit Bay Watershed. Different scenarios and options will be discussed during the third meeting
- Review the information from the funding workshop that the commission ran earlier this year.

Consensus Building Institute

- Send link with presentation to participants
- Finalize Meeting One summary
- Draft and solicit feedback from Working Group on second meeting summary

Cape Cod Commission

- Share Technology Matrix with Working Groups
- Share updated chronologies with Working Groups
- Send invite for November 13th meeting, including whether there will be food and how long it is anticipated to go
- Send directions for accessing GIS layers to all participants
- Identify location of I/A Title V systems on a GIS layer
- Confirm where wood chips are placed in subsurface nitrogen removal septic systems and notify interested stakeholders
- Add existing stormwater utility map information to 208 Plan Reference Map
- On slide for effluent disposal, show that water receives tertiary treatment before it goes out to the ocean.
- Add sustainability concerns to the Technology Matrix.

Things for the Cape Cod Commission to Consider

- Consider preparing models and guidelines that municipalities can use when working with contractors to install and use technologies and approaches
- Consider educating town decision-makers about TMDLs and the process for ensuring compliance with water quality standards
- Consider vacuum collection systems along with STEP and STEG systems.
- Consider indicating effectiveness in dealing with chemicals of emerging concern on Technology Matrix.
- Consider modifying the 7-Step Problem-Solving Process diagram to clarify interventions of different types (such as conventional sewering and alternative technologies) should be considered and implemented simultaneously.

II. WELCOME, REVIEW 208 GOALS AND PROCESS AND THE GOALS OF MEETING

Ms. Kristy Senatori, Deputy Director at the Cape Cod Commission (the Commission), welcomed participants and offered an overview of the 208 Plan Update stakeholder process. In July, public meetings were held across the Cape to present the 208 Plan Update goals, work plan, and participant roles. Public meetings were also held in August to present information on the affordability and financing of the updated comprehensive 208 Plan. The first meetings of the eleven Watershed Working Groups were held in September and focused on baseline conditions in each of the watersheds. Second meetings of the Watershed Working Groups are underway and will focus on exploring technology options and approaches. The third meetings of the Watershed Working Groups will be held in December and focus on evaluating watershed scenarios, which will be informed by Working Groups' discussions about baseline conditions, priority areas, and technology options/approaches. This conversation will also be informed by information shared in the Technology Matrix, which was developed by the Cape Cod Commission with technical input from the Technical Advisory Committee of the Cape Cod Water Protection Collaborative and the Technology Panel. The Technology Matrix builds on the information presented in the Technology Fact Sheets, which Working Group members reviewed in advance of the meeting. Once it is finalized by the Cape Cod Commission, the Technology Matrix will be shared with Working Group Members.

Ms. Senatori shared the progress of the Commission's 208 Plan team since the first meeting which includes:

- Meeting materials were distributed to stakeholders and made available online at: http://watersheds.capecodcommission.org
- GIS data layers made available online at: http://watersheds.capecodcommission.org
- The chronologies are being updated and will be made available online soon

Ms. Senatori announced that there would also be a Cape Cod wide event on November 13 at the Cape Cod Center for the Arts in Dennis. Participants from across the eleven Watershed

Working Groups and the public are invited to attend the event which will include: a wrap up of the "Cape2O: ur in charge!" game; a summary of the planning process to date; and a discussion of the role of stakeholders in the second 6 months of the 208 planning process

Ms. Senatori then officially welcomed participants and reviewed the goal of the meeting:

To develop a shared understanding of the potential technologies and approaches identified to date, and the benefits and limitations of each; to explore the environmental, economic, and community impacts of a range of categories of solutions; and to identify priorities and considerations for applying technologies and approaches to remediate water quality impairments in your watershed.

Ms. Patty Daley, Deputy Director at the Cape Cod Commission and Area Manager for the Working Group, asked whether anyone had tried to access the online GIS layers.

- A couple participants indicated they have had trouble accessing the data layers.
- Ms. Daley, said that the Commission would be sending around directions for accessing GIS layers to all participants.

Mr. Thompson, the facilitator from the Consensus Building Institute, then reviewed the agenda and led participant introductions. A participant list is found in Appendix A. He also recapped what this meeting and upcoming meetings would be covering and reminded participants about the protocols that had been agreed upon during the previous Working Group meeting.

He also thanked participants for their feedback on the draft meeting notes from the first meeting, and reminded participants to look over these and provide feedback if they haven't already.

III. RANGE OF POSSIBLE SOLUTIONS

Ms. Daley led a discussion of the range of possible solutions that could be implemented as part of the 208 Plan. She encouraged Working Group participants to keep the following points in mind as they learn more about these possible solutions and consider the pros and cons of each technology and approach:

- The Commission has engaged in a comprehensive analysis of nutrient control technologies and approaches. This analysis is distilled into "Technology Fact Sheets," which present information on the various technologies being considered and the Technology Matrix, which includes additional information on site requirements, construction, project and operation and maintenance costs, reference information, and regulatory comments.
- The Commission will be soliciting ongoing input from stakeholders on the public acceptance of technology options and approaches.

- Not all of the technologies and approaches will be applicable to Cape Cod.
- Some technologies are so promising that we should identify them for demonstration and pilot projects.
- Certain technologies or approaches will be effective at preventing nutrients from entering the water body. Others will be effective at reducing or remediating nutrients that are already in the groundwater or water body.
- Regulatory programs can address nutrient controls for both existing development and future development.
- The third meeting will embark on hands on problem solving in each watershed to meet target load reductions. This current meeting is intended to explore the possible solutions, their pros and cons, and the public acceptability of these options.

Ms. Daly asked the stakeholders to identify promising approaches and to provide feedback on the public acceptability of each option during today's meeting.

Technologies and Approaches for Improving Water Quality

Ms. Daly began by discussing technologies and approaches for improving water quality.
Ms. Daley offered a brief overview of the technologies and approaches. The following section briefly describes each technology, categorized by the scale of intervention. Participants' questions and comments about the technologies are also discussed below (in *italics)*:

Site level technologies/approaches

Standard Title V System*:* This is a standard septic system that consists of a septic tank and soil adsorption system (leaching field). The system was primarily designed to address public health concerns related to waste in drinking water (e.g., coliform bacteria); they were not designed to remove nutrients (e.g., nitrogen).

- 85 percent of wastewater flow in Cape Cod is through backyard Title V systems.

I/A title V System: Innovative/Alternative (I/A) on-site nutrient reducing systems typically consist of standard septic system components augmented to remove more nutrients than a standard Title 5. I/A systems refer to a class of systems intended to be designed as recirculating sand filter (RSF) equivalents by meeting the same treatment limits in a smaller footprint.

- Ms. Daly noted that there are about 1500 of these systems throughout the Cape; the Commission is trying to identify the location of these and put them on a GIS layer.

Urine Diverting Toilets: Urine diversion systems send urine into a holding tank where the urine is stored and periodically collected by a servicing company. The servicing company empties the tank for disposal or recycling, such as for conversion to fertilizer. The remainder of human waste and water from all other household uses, such as grey water from sinks and showers, continue to go to the septic system. Urine diverting toilets can remove significant quantities of nitrogen from the watershed (Example case: Falmouth).

Composting toilets: Composting toilet systems separate human waste from shower, sink, and other household water uses. Composting toilets use no or minimal water. The human waste captured by the composting toilets is decomposed and turned into compost. The compost generated is removed from the site and nutrients can be recycled. Composting toilets require the replacement of existing toilets as well as sufficient space in the basement for a container to capture and compost human waste. Household water use (such as from sink and shower uses) continues to flow into the septic system. (Example case: Falmouth).

Packaging toilets: A packaging toilet encapsulates human waste in a durable material for removal from the site. The package is stored beneath the toilet and removed and taken away by a service company when full. The servicing company that picks up the packages can recycle the nutrients in the human waste. This is a waterless system

Stormwater bioretention: Bioretention systems utilize natural plant and soil functions to capture and treat stormwater runoff for a variety of contaminants including nutrients. A typical system consists of an under-drain/gravel layer, a layer of bioretention soil mix (a mix of sand, compost, woodchips, and loam), and a surface layer containing appropriate plantings. The treated water can be discharged into a water body or used for open space irrigation after treatment. The reclaimed water can also be discharged into a subsurface infiltration system for discharge to the groundwater. (Example case: Portland, OR).

Ms. Daly noted that all of urine-diverting toilets, composting toilets, and packaging toilets require some input and effort on the behalf of homeowners.

Participants were then asked to ask questions and share comments on these technologies.

- *One participant asked whether "eco-toilets" are waterless or if they use water.*
  - The technical experts from the Commission said that it depends. These toilets can be either waterless or use water. Either way, homeowners will still need a septic system for all other gray water, such as water from sinks, dishwashers, and clothes washers.
- *Another participant asked whether the Commission has nitrogen removal numbers for certain technologies.*
  - Ms. Daly noted that there is a column in the technology matrix that lists nitrogen removal and also encouraged him to look at the references for the technology matrix, suggesting these may be helpful for this.
- *One participant asked whether bioretention-like approaches could be used at a larger scale (e.g., neighborhood)*
  - Ms. Daly explained that they can be and that such approaches will be discussed later in the presentation.

- *A participant said he would like to see reuse of gray water included in the technologies and approaches considered. He also said he would like there to be more discussion about what is being done with solid waste throughout the Cape and to explore opportunities for connecting wastewater solutions to solid waste work going on throughout the Cape.*
    - Mr. Mark Owen from AECOM said there has been some discussion around how biosolids can be reused, such as how urine from diverting toilets can be used as fertilizer on the Cape. Some information about this is on the technology matrix.
- *A participant said the Cape needs to think about the sustainability of these technologies and approaches, such as their greenhouse gas emissions and energy use.*
    - Ms. Daly said those issues have been raised during technology panel discussions, and the technology panel has agreed that columns about sustainability concerns should be added to the technology matrix.
- *One participant asked how timescale and feasibility of these technology and approach options would be addressed. He also said that there is still confusion about the Total Maximum Daily Limit (TMDL), which needs to be addressed.*
    - Ms. Daly said that the second part of this meeting would be spent talking about the approach to applying these solutions, the time of nutrient travel and how these solutions intervene in the nutrient cycle. She also said that the controllable nitrogen discussion would be revisited.
    - *The participant responded that he thinks the group needs to define the problem before they start talking about solutions. He would like to put the discussion of the problem before talking about the solutions.*
- *One participant said she feels like she wants some sort of weighting system for the pros and cons of the technology options being considered.*
    - The technical expert responded by saying that since all watershed and neighborhoods are so different, it is not really possible to create a weighting system that will work for all. What is a deal breaker in one area may not be a deal breaker in another area. The Commission hopes that feedback from all of the Working Groups will help figure out what is most appropriate for each site.
- *A participant said that he is very happy to hear this talk about the difference between watersheds. He asked whether this site-specificity could somehow be incorporated into the information about the different technologies and approaches, since a lot of aspects about these technologies (such as their cost and effectiveness) will depend on where they are put. He feels this should be included in the materials about the technology options.*

Neighborhood level technologies/approaches

<u>Cluster and satellite treatment systems</u>: A cluster or satellite system is a collection and treatment system treating wastewater flows from multiple properties.

STEP/STEG collection: Septic Tank Effluent Pumping (STEP) and Septic Tank Effluent Gravity (STEG) systems convey liquid wastewater from on-site septic tanks to sewer systems. Only the liquid component of the wastewater may be conveyed by pumps or by gravity.

Eco machines and living machines: Living or Eco-Machines are natural systems that treat septic tank effluent or primarily treated wastewater. In these systems, aeration and clarification chambers are combined with constructed wetlands to treat the effluent. The wetlands are a series of chambers allowing for microbial communities to engage with and treat the wastewater. Plants are often suspended on racks with their roots systems doing the work. Solids removal is generally onsite, after which water is pumped through the gravel filled cells (similar to subsurface wetlands.) This process transfers more oxygen to the wastewater and completes the pollutant removal process. (Example cases: South Burlington, VT, and West Yarmouth, MA).

Stormwater wetlands: Constructed wetlands provide aerobic chambers followed by subsurface anaerobic chambers that facilitate nitrification followed by denitrification, respectively. This process mimics the process of natural systems coupled with an engineering design that guarantees sufficient residence time within a chamber containing anaerobic conditions. (Example case: Missouri).

Participants were asked for questions and comments on these technologies:

- *One participant asked what "tertiary treatment" means and whether it can be used to treat chemicals of emerging concern?*
  - Mr. Owen said that tertiary treatment is the level above secondary treatment, and it usually involves some level of nitrogen and phosphorus removal. Removing additional nutrients and chemicals is usually more costly.
  - The participant replied that it is possible to use activated carbon to remove some of these chemicals of emerging concern.
  - Ms. Daly replied that some of the natural approaches on the technology matrix can also help address some of the chemicals of emerging concern.
- *One participant said that an issue that has come up in Falmouth is the question of where to discharge treated effluent.*
  - Mr. Owen said that the ideal discharge location is somewhere that is not an embayment. Falmouth is ringed by embayments, which makes discharge particularly challenging. Another option is to discharge a little bit into each watershed, spreading out whatever nitrogen and phosphorus is left across the nearby watersheds.
- *One participant said he is curious why STEP and STEG collection systems are being considered while other collection systems, such as vacuum collection, are not.*
  - Mr. Owen said that central collection is also considered, and that the technical committee should perhaps also consider vacuum collection systems.
  - Mr. Scott Michaud of the Cape Cod Commission said that STEP and STEG systems

limit the amount of trenching that has to be done and are an alternative to conventional wastewater collection systems.

Watershed level technologies/approaches

Conventional treatment: A conventional wastewater treatment facility typically treats wastewater collected from homes and businesses. A groundwater discharge permit is required. Treatment generally results in nitrogen concentrations of less than 10mg/L of water.

Constructed wetlands—surface flow: After primary treatment in a septic tank or wastewater treatment facility, or secondary treatment at a wastewater treatment facility, water is fed into a surface flow constructed wetland. Surface flow constructed wetlands closely mimic the ecosystem of a natural wetland by utilizing water-loving plants to filter wastewater through the root zone, a planted medium, and open water zones. Surface flow wetlands are systems where open water is exposed, much like in a natural marsh. The reclaimed water from the wetland can be discharged into a water body or used for open space irrigation after treatment as well as discharged into a leach field. (Example case: Albany, OR).

Constructed wetlands—subsurface flow: After primary treatment in a septic tank or wastewater treatment facility, or secondary treatment at a wastewater treatment facility, wastewater is treated by pumping water slowly through subsurface gravel beds, where it is filtered through plant root zones and soil media. Water flows 3-8 inches under the surface to prevent public exposure to wastewater and mosquito breeding. A combination of horizontal and vertical flow subsurface systems must be utilized to provide total nitrogen removal. This solution can also offer opportunities for recreation activities on land above the subsurface system. (Example case: Thailand).

Effluent disposal—out of watershed: Effluent disposal can take a variety of forms, including infiltration basins, a soil absorption system, injection wells, or wick wells. These disposal methods place highly treated effluent back into groundwater. Transporting and disposing of effluent out of the watershed has the advantage of removing the nitrogen load to another watershed. Transport to another watershed requires the receiving watershed to be able to accommodate the additional nitrogen load.

Effluent disposal—ocean outfall: Similar to out of watershed effluent disposal, ocean outfall effluent disposal involves removing highly treated effluent from watershed, but in this option, the effluent is released into the ocean. This solution is not currently permitted, and would require a high level of regulatory oversight. The solution is being considered as part of the 208 planning process due to limited land availability for disposal on Cape Cod.

- *One participant pointed out that the slide for this option should show tertiary treatment before the water goes out to the ocean.*

Phytoirrigation: In phytoirrigation, wastewater treatment facility effluent goes through secondary treatment and then is irrigated onto plants that can remove nutrients and other contaminates. Fast growing poplar and willow trees are typically used for this process. (Example case: Woodburn, OR).

Participants were asked for questions and comments on these technologies.

- *One participant mentioned since one issue is the lack of areas for effluent disposal, perhaps the Cape should consider using power line right of ways.*
    - Ms. Daly said this has been brought up by a number of people and that this should be a discussion with the utilities. She said the group could also look at road right of ways.

Neighborhood or watershed level technologies/approaches

Phytobuffers: This approach involves using trees with a deep root system, particularly willows and poplars, to capture nutrients in the soil. Green plants with deep tap roots are planted as a buffer to intercept existing groundwater. The plants and their associated microorganisms reduce contamination in soils and ground water. Often phytohydraulics causes the groundwater plume to be redirected and pulled towards the plants. (Example case: Kavcee, WY).

Fertigation wells: Fertigation wells can capture nutrient enriched groundwater, such as from a wastewater treatment facility discharge, and recycle it back to be used to fertilize and irrigate turf grass areas, such as golf courses, athletic fields, and lawns. Fertigation can significantly reduce nutrient loads to down-gradient surface waters while reducing fertilizer costs to the irrigated areas. (Example case: Plymouth, MA).

Permeable reactive barriers (PRB): A permeable reactive barrier (PRB) is an *in-situ* (installed within the aquifer) treatment zone designed to intercept nitrogen-enriched groundwater. Through use of a carbon source, microbes in the groundwater uptake the nitrogen, thereby denitrifying the groundwater. PRB systems typically use vertical trenches, sequences of bored columns, or injection methods to introduce a carbon source into the groundwater. PRBs would be sited perpendicular to groundwater flow and aligned with roadways and power lines. Use of PRBs can remove nitrogen from water flowing through the watershed, thereby reducing the nitrogen load flowing into estuaries. (Example case: Falmouth, MA).

Inlet and culvert widening: Re-engineering and reconstruction of bridge or culvert openings to increase the tidal flux through the culvert or inlet can help reduce the nitrogen levels in coastal waters. This solution generally works better with a larger tidal range, but could be feasible on both the Cape Cod Bay side (approximately nine feet tidal range) and Nantucket Sound side (approximately three feet of tidal range) of the Cape.

Salt marsh habitat restoration: Salt marsh, one of the most productive ecosystems in the world, surpasses rainforest in productivity per acre. Approximately 65% of historic salt marsh has been lost in Massachusetts. Salt marshes cycle and remove nitrogen as well as provide critical habitat and spawning sanctuary for a wide variety of birds, mammals, and marine life. They also support a range of plant species and important biogeochemical processes. The capacity of salt marsh to intercept nitrogen is significant and well researched worldwide. Substantial areas of former salt marsh on the Cape are either under consideration for restoration or could be restored, thereby providing storm surge and coastal flooding protection in addition to water quality benefits in certain watersheds.

Shellfish habitat restoration: Oyster reefs were historically one of the main consumers and recyclers of nitrogen in the coastal environment on Cape Cod. However, according to the Nature Conservancy, oyster populations have declined by 95%. Restoring oyster populations may greatly reduce eutrophication in estuarine environments. It may also increase shellfish productivity, improve commercial and recreational fisheries for other species, increase protection from shoreline erosion and flooding, and provide buffering from ocean acidification. (Example case: Wellfleet, MA).

Aquaculture / shellfish farming: Farming oysters and other shellfish has been proposed as a potential method for reducing nitrogen levels and eutrophication in estuaries. Nitrogen removal rates from oysters have been well documented, and the harvest of oysters physically removes the nitrogen they sequester. Oysters also remove nitrogen through their biological cycle, which puts nitrogen directly back into the atmosphere. Aquaculture can be done on man-made structures (e.g., cages or floating bags) or natural reefs.

Surface water remediation wetlands: Constructed to aid in water quality improvements to surface water bodies, usually streams or rivers. Water is pumped or allowed to flow naturally through treatment cells containing wetlands. Surface water remediation wetlands are often used in combination with groundwater recharge or potable water reuse systems. Surface water remediation wetlands are generally used with free-water surface wetlands due to their larger size as well as their lower capital and operation and maintenance costs. (Example case: Shanghai, China).

Pond and estuary dredging: Lakes, ponds, streams, and estuaries store nutrients within their sediments. These sediments tend to accumulate over time. Subsequently, these nutrients can be release into the overlying water column and can become a major source of nitrogen and phosphorus. Dredging and removing these sediments and accumulated nutrients removes the nutrients from the water body and potentially the watershed. (Example case: Dennis, MA).

Participants were asked for questions and comments on these technologies and approaches:

- *One participant said there are a couple approaches that aren't on this list:*
    1. *Well fences that collect and treat the plumes: collecting groundwater, treating it, and re-injecting it may be less invasive than PRB.*

2. *Injecting carbon into groundwater to uptake nitrogen is another approach. Mike McGrath is exploring this option*
   - Mr. Michaud from the Commission said that a lot of the options being explored combine a couple approaches.
   - Mr. Owen said that PRB provides a carbon source, but that people tend to only think of digging a ditch, putting in a substrate, and letting water flow through it. Another option is to remove water, treat it, and then re-inject it. Injection wells could be put in between utilities, he said.

- *Another participant said that the effectiveness of barriers varies with water levels, using Ashumet Pond as an example. Also, he said, leaching from uncapped landfills has caused anaerobic conditions in streams, which has in turn broken down some of the complex molecules.*
- *One participant said that listing the full array of what is being done on the Cape would be helpful.*
  - Ms. Daly explained that this would be covered later in the presentation.
- *The participant followed up and said that it would be good to put to put together some information for the communities that can help them work with contractors to install and use these technologies and approaches. It would be helpful to provide models that the towns can use.*
- *One participant said that it is important to keep in mind that there is a lot more detail on the technology matrix.*

Cape-wide level technologies/approaches

Compact development: Both compact development and open space residential development (OSRD) of subdivisions result in smaller lots and less maintained-lawn acres. The higher density development reduces wastewater collection costs while also providing a common disposal area. Compact development is also referred to as “Smart Growth.”

Fertilizer management: Managing fertilizer application rates to lawns, golf courses, athletic facilities and cranberry bogs can reduce nutrient input into the watershed. Residential lawn loading rates could be reduced on existing developed parcels through an intensive public education and outreach program. This could include a “Cape Cod Lawn” branding program, replacing some turf areas with native vegetation, establishing naturally-vegetated buffer strips on waterfront lots, and reducing application rates. Fertilizer loading rates for new development could be accomplished by reducing lot sizes (cluster development), restricting lawn sizes, and/or by incorporating more naturally-vegetated open space areas. Municipalities could directly reduce fertilizer applications on athletic fields and other properties. Golf courses can significantly reduce nitrogen loading rates by using slow-release fertilizers and reducing application rates in rough areas. Cranberry bog fertilizer exports from the bogs can be reduced using tail water recovery systems. Site-specific assessments are needed to estimate load reductions.

- The Cape Cod Commission designated a cape-wide Fertilizer Management District of Critical Planning Concern (DCPC), which authorizes the towns to adopt local fertilizer management regulations (state law prohibits local fertilizer management except under the DCPC). The DCPC does not require towns to adopt fertilizer regulations, but paves the way for their adoption. Barnstable County will be conducting a public education process around fertilizer use. More information about this on the Commission website.

<u>Remediation of existing development</u>: Existing developments or schools with excess wastewater treatment capacity can allow existing nearby developments to connect to their underutilized wastewater treatment infrastructure. A town can operate the wastewater treatment facility if the existing owner prefers to not take the responsibility for treating the off-site wastewater. An example of this is the Kingman Marina in Bourne, which was permitted to expand its development footprint in exchange for hooking up adjacent, existing homes to its wastewater treatment facility. This is a good private-public partnership.

<u>Transfer of development rights (TDR)</u>: Transfer of development rights is a regulatory strategy that transfers development rights from one property (known as the sending area) to another property (known as the receiving area). This strategy is used to direct growth and associated nutrient loading away from sensitive receiving watersheds or water bodies. When development rights are sold, the protected parcels receive a deed restriction that limits future development on these properties. The deed restriction can limit the number of homes or tie development to the availability to future wastewater treatment facility infrastructure.

<u>Stormwater best management practices (BMP)</u>: There are a number of non-structural best management practices stormwater strategies that can be used to reduce nutrient runoff, including: street sweeping, maintenance of stormwater utilities, education and public outreach programs, land use planning, and impervious cover reduction and control. Many towns map existing stormwater utilities. The Commission will try to add those data to the 208 Plan Reference Map.

Participants were asked for questions and comments about these technologies.

- *One participant asked whether anyone knows how much fertilizer contributes to the nutrient load in the watershed and how much could be removed through proper fertilizer management —he wants information for the Mashpee Health Board.*
  - Ms. Daly said that, assuming a 50% reduction, which the Commission thinks is realistic for good management based upon its recent study, this could have significant impacts. In some areas, it could even prevent the need for sewering or other major technologies.
- *Another participant said many things can be done to raise the public's awareness of fertilizer problems. For example, it is possible to sell slow-release fertilizer in stores. This may be an advertising problem and there is potential, long term, of getting the*

message across. He doesn't feel fertilizer management will result effectively by regulation but rather through education and engagement.
    - Ms. Daly replied that she sees this as an opportunity to have a widespread effect. She also mentioned that the golf courses are doing a great job of reducing and managing fertilizer use.
- *One participant said he thinks people undervalue the role of public education and engagement. He said he recently attended a workshop where he learned that if people properly maintained their septic systems, this could remove more emerging chemical contaminants than a standard wastewater system. Since this work will need to be done by individuals, he feels that education is key.*
- *One participant said that the turf industry should have information on how much nitrogen is really necessary for fertilizing.*
    - He wasn't sure this would be public information. He said he would look into it.

Town Consideration of Alternative Technologies and Approaches

Ms. Daly gave an overview of some of the alternative technologies and approaches Cape towns are currently considering or have in place. These include:
- Wellfleet: Coastal habitat restoration & aquaculture
- Mashpee: Aquaculture & Expanding Existing Systems
- Brewster: PRB & Bioswales
- Orleans: Fertilizer Control By-Law
- Harwich/Chatham: Muddy Creek & Cold Brook Natural Attenuation
- Falmouth: Aquaculture, Inlet Widening, Eco-Toilet Demonstration Project, PRBs, Stormwater Management (Little Pond Watershed), Fertilizer Control By-Law, Subsurface Nitrogen Removal Septic System.

Ms. Daly asked participants for any general questions or comments about technologies and approaches.
- *One participant asked where wood chips are placed in the subsurface nitrogen removal septic systems?*
    - Mr. Michaud said he thinks they are below the septic system, but he will confirm this.
- *A participant asked: "What is the relationship between TMDLs, future build out, control technologies, and funding?"*
    - Ms. Daly responded that the scenarios to be discussed in the next meeting will focus mostly on existing development, but that the Cape will have to think about future development.
- *One participant asked about funding.*
    - Ms. Daly encouraged stakeholders to go to the Commission website and look at the Funding workshop the Commission convened.

    - She said there are a whole series of financing approaches that are being considered by the financing advisory committee, and that the Commission knows that the bottom line is that it has to be affordable or people won't do it.
- *A participant asked for more information about the stormwater management effort at in the Little Pond Watershed in Falmouth*.
    - Another participant explained that the group is measuring stormwater in the area, identifying problem sites, and trying to address these concerns as much as money allows.
- *One participant encouraged the Commission to think about dealing with the entire water cycle, saying people tend to focus on the wastewater side of things. He said people need to think about evapotransporation and filtration, and that these processes will be affected by climate change and other environmental changes. Hence, he added, the planning effort should take these environmental changes into account.*

Survey Monkey Results

Ms. Daly quickly reviewed some of the key findings from the survey monkey poll and thanked participants for contributing to this.

After a short break the meeting resume

IV. PROBLEM SOLVING PROCESS AND PRINCIPLES

Review of TMDLs and nitrogen targets

Ms. Daly began the discussion of the problem solving process and principles with a review of TMDLs and nitrogen. She explained that the Working Groups will focus on total controllable nitrogen load. The technologies and approaches selected should aim to reduce the total controllable nitrogen load by identifying options that reduce the portion of septic load that needs to be reduced. For example, the portion of septic load that needs to be reduced could be made smaller if Cape Cod takes on fertilizer and stormwater solutions first. Additionally, the percentages of controllable nitrogen that need to be removed to meet TMDLs change depending on the characteristics of the watershed.

- *One participant pointed out that the numbers on slides are from 2001, so the actual numbers of what needs to be removed are probably too low.*
    - He expressed concern about using percentages for removal targets for this reason, since the baseline is changing.
- *Another participant asked what it means ecologically if the TMDL is achieved. He asked whether the target load is designed to allow for remediation of compromised ecosystems and to restore them to the state they were in before degradation. He also asked how long it would take to restore these ecosystems.*
    - Mr. Michaud said the TMDL is designed to sustain a healthy ecosystem and to return

the ecosystem back to a healthy state, but how long it takes to restore the system isn't known.
- Another participant said that we don't scientifically know how much we can restore the system or how long it will take.
- Another participant said the path to recovery isn't the inverse of the path to degradation. She added that simply reducing the nutrient loads to the level they were at when the region still had eelgrass wouldn't mean there would suddenly be eelgrass again.

Overview of 7-steps for Problem-Solving Process

Ms. Daley reiterated that the ultimate goal the Working Groups is to develop remediation options that would achieve water quality targets with a focus on first targeting low cost, low barrier options to reduce nitrogen and then considering more costly and traditional options later (e.g., sewering). She then described the alternatives screening process the group will apply. The process is as follows:

1) Targets/Reduction Goals: Establish targets and reduction goals; articulate project goals.
2) Other Wastewater Management Needs: Identify priority geographic areas (e.g., high nitrogen reduction areas, Title V problem areas, pond recharge areas).
3) Low Barriers to Implementation: Determine which management activities should definitely be implemented. These might be the easiest and least costly management activities that should be undertaken regardless of other management actions (e.g., fertilizer management and stormwater mitigation – two approaches that Cape Cod towns are already actively pursuing).
4) Watershed/Embayment Options: Assess alternative options to implement at the watershed or embayment scale (e.g., innovative and lower-cost solutions)
5) Alternative On-Site Options: Assess options to implement at the site-level
6) Priority Collection/High Density Areas: Examine priority/high density areas for wastewater collection
7) Supplemental Sewer: Consider traditional sewering or other grey infrastructure management options

Ms. Daly noted that through mixing and matching technologies and addressing key issues, such as fertilizer in certain areas, it might be possible to totally avoid sewering in certain areas.

Technology Selection: Process and Principles

Ms. Daley noted that the Working Group had identified many of the principles that the Cape Cod Commission hoped would guide technology/approaches selection. These process and principles include:

- *100% septic removal subwatershed*: Combinations of technologies can be used to reduce septic load that needs to be removed.
- *Scale: On-Site vs. Collection System vs. Natural System*: There will be tradeoffs between

the scale of systems that can be used. On-site, collection, and natural systems all have their pros and cons and all require different levels of investment and infrastructure. These tradeoffs will be important from an implementation and public acceptance point of view.

- *Nutrient intervention and time of travel*: Some technologies/approaches intercept nutrients at their point of entry into the system, while others deal with it later on (e.g., once it is in the watershed). There are pros/cons to each approach that need to be considered.
- *Permitting Status*: The level of effort required to permit technologies will be a consideration.
- *Land use and Impacts of Growth*: Unintended consequences and opportunities for planned growth are important to consider.

General Questions and Comments

Participants were asked for general questions and comments about the problem-solving process and principles.

- *One participant mentioned that plumes rise to the surface when close to ponds and wetlands and that, therefore, biosolutions around these areas can be more effective.*
    - Mr. Michaud replied that this point brings up the important fact that natural systems already do a good job of removing these nutrients.
    - Mr. Owen agreed and said that enhanced treatment within streams entering estuaries, may be able to enhance the positive effect.
- *Talking about the Embayment TMDL Map, one participant said she "can see the mental block around TMDLs." She asked whether the Department of Environmental Protection (DEP) needs empirical evidence that areas have met their TMDL goals or whether modeled evidence is sufficient.*
    - A participant who is knowledgeable about the DEP process said that communities will put forward their comprehensive wastewater plans, which should include stormwater management. In their plans, they will indicate what they think are their best options for removing nitrogen, and will ask DEP "what money are you going to give us to make progress toward doing these things?" DEP may issue them credits toward removal. Then, towns and communities are going to have to monitor ponds and water bodies. The participant said that communities will have to monitor not just treatment areas but also around sentinel stations to make sure that water quality objectives are being met. They will also want to monitor the interventions they have put in place (such as oyster reefs or PRBs) to see what effect these approaches are having on nutrient loads. He said this is going to have to be adaptive management, there is going to have to be some experimentation and learning as we go. He said this will need to be a partnership between DEP and towns to see what works and what doesn't.
    - One participant replied that the TMDL obligation is to meet applicable water

quality standards; if you remove all of the nutrients you commit to removing but still don't hit target, you have to do more. Towns and cities aren't removed from the list until they comply with water quality standards. They are given the flexibility to try lots of things and take time to achieve goals, but they still have to hit water quality targets.

  - One participant said that towns are anxious about TMDLs but that they might be less so if they fully understood how this process works.
- *A participant pointed out that having sufficient time to monitor before implementation in order to provide a sound baseline is challenging. Having a good baseline can help sort out the effect of interventions from natural fluctuations. He said that monitoring needs to begin now to build up this baseline data.*
  - Another participant said that monitoring has been underway in Waquoit Bay and Poppenesset Bay for about 17 years, since the mid-1990s.

Mr. Thompson, the facilitator, asked whether this proposed 7-Step Problem Solving Process makes sense and what the participants think about it.

- *One participant said he has doubts about the things that are listed as having low barriers to implementation. He said that, while these options may not cost a lot, it may be challenging to ensure their implementation. Effectively implementing voluntary efforts, he said, is not "low barrier"—it is really challenge.*
- *Another participant said that she thinks the 7-step concept makes sense, but is concerned about managing public expectations. She fears that some might use this diagram to say "we're going to save costs by doing all of these things" only to come back in 10 years and say "it's not working", leading to frustration. She's concerned that those desperate for a low cost solution will therefore grab onto these low cost alternative solutions and assume they will solve the nutrient-loading problem. Her worry is that this might lead to problems down the road and not adequately address the nutrient problem.*
  - Another participant added to this point and said that the Cape is going to continue to grow and that unless we get to the growth part of this—managing future growth—we may just have future problems
  - Mr. Owen explained that if a PRB was put in place with the expectation that it would reduce something like 1000 pounds of nitrogen, it would be monitored over a time period and the actual reduction might be higher or lower than the expectation, but it would almost certainly not be zero. Doing these kinds of demonstration projects on the Cape would give everyone a better idea of how effective these interventions actually are. Then, going forward, everyone would have a better idea of what particular technologies cost and how effective they are at removing nutrients. He said that, with treatment plants as well as alternative technologies, it is still necessary to do a lot of monitoring.
  - A participant replied to the above discussion that, in light of the cost of interventions, no one is going to overshoot and try to reduce more than they have to. Therefore, if interventions perform less well than anticipated, towns

and cities are going to fall short of their TMDL goals.

- *Another participant said that he doesn't like the 7-step problem solving process. He is concerned that it will be used to stall action and may be used as a reason for towns and cities to put off what actually needs to be done to deal with the problems. He suggested that the Working Group might need to prioritize what areas and things in terms of greater and lesser urgency and importance.*
- *A participant also said that leadership is needed. He said if we are going to turn Cape Cod into an experiment, there needs be progress on the issue at the same time. He feels that leadership requires being firm about what needs to be done today to reach TMDLs. He also feels that taking leadership on the issue means putting in place regulations on future development to prevent the issue from getting worse.*
    - Mr. Thompson asked for clarification on this point, asking whether the participant is concerned that the 7-step process will be misused or whether he thinks that it is just not helpful.
    - The participant explained he thinks it will be misused, since people tend to have a "follow the money" mentality. He said that people who own summer homes and aren't year-round residents won't want to pay for interventions. The alternative technology experiments are going to take at least 5 to 10 years before we know how well they're working, he thinks, and he is concerned about where the Cape will be at by then in terms of water quality and wastewater issues.
    - A number of other participants agreed with this concern.
    - One participant added that in town after town, plans to sewer haven't been acted on. He is concerned that this is going to happen in Falmouth next spring. He said that 5 to 10 years ago, the Commission was saying "let's sewer," and now it's saying something different because sewering hasn't been implemented. He asked, " How do you get around this?"
    - Ms. Daly clarified that the Commission knows that sewering is going to be necessary in some watersheds, and that it will make public statements to this effect.
- *Another participant said that water clarity is an easy way to evaluate water quality. He likes the 7-step approach put forward by the commission. He thinks that people can figure out pretty quickly whether approaches are working, and then the goal is to move through the steps to keep implementing solutions until you meet water quality goals.*
    - Mr. Owen clarified that some of the monitoring that will take place will require 5 or more years to know whether or not an intervention removes a certain amount of nitrogen. However, with other interventions, it will be easy to detect whether it is having a beneficial effect. And some of these other interventions could result in impacts a lot more quickly than sewering, which can take years to have an effect due to nutrient travel time. Also, he reminded the group, towns may not pass sewering, in which case, nothing happens.
- *Another participant said that we already know where we're going to need sewering regardless. She suggested that the Cape should target those obvious areas for*

sewering. She said that if the selectmen decided "we have to do this" and they worked with finance people to figure out how to present it, then it likely would pass and would get implemented. Simultaneously, she said, we can be putting in place interventions that will have more immediate effects. Therefore, she thinks the problem solving approach will require parallel tracks of intervention.

  - Another participant followed up on this point and said that his problem with the 7-step approach is that it is numbered 1 to 7 as a sequential process, rather than indicating these activities may be simultaneous.
  - Ms. Daly clarified that the Commission is looking at both conventional and alternative approaches at the same time.
  - A participant said the diagram should convey that certain areas need to go directly to sewer, whereas other areas should move through these steps.
- *One participant explained that the DEP is going to review local comprehensive plans. The DEP will push back on towns and cities if they don't think their plans are sufficient to address the problem.*
- Mr. Owen said he sees this 7-step approach as a planning framework to help towns and cities think through how they can deal with the problem. He thinks going through the 7-step planning process should take only about 3 months.
- *One participant said she feels addressing this issue and the associated cost has to be shared across the Cape. She said this may not be "politically correct," but necessary nonetheless. Also, she thinks the problem isn't just about wastewater, but that it is also about drinking water and swimming areas.*
  - Some participants agreed that cost-sharing is important.
  - They also think that focusing more on drinking water and not just on the nutrients that are being put into the watershed would be helpful.
  - One participant suggested that is important to find a way to get people who are coming over the bridge and using facilities on the Cape to pay into the solution.
- *A participant pointed out that environmental justice issues are a concern, citing unequal ability to pay and suggesting that some form of graduated payment scheme might be necessary.*
- *One participant commented that he feels the burden for paying for addressing the water quality problem has to be put on the property tax base. He thinks this best reflects people's ability to pay. He doesn't feel interventions should be paid for through betterments, since this doesn't distribute the cost.*
- *Another participant said that public private partnerships, TDRs, and other similar approaches can innovatively deal with the issue. He also said that if towns do a lot of this work locally, it will create jobs and direct and indirect economic benefits. He said people should think about balancing costs versus the benefits of creating jobs and keeping work locally. There are ways to reduce the impact on local people and prevent this from all being a drag on local taxpayers.*
- *A participant said that ecotoilets can be used to capture and reuse resources such as nitrogen and phosphorus, and that the Cape could take advantage of this. He is*

skeptical that stormwater and fertilizer management are going to be as effective in reducing nutrient loads as the Commission thinks. However, he likes this framework and thinks it is helpful.

- *One participant commented that the states and federal government are looking at issues associated with climate change, particularly in areas that are vulnerable to sea level rise. He thinks the group should add climate change as a consideration for all technologies and approaches. He also said that states have started to buy out vulnerable coastal areas in certain regions. The Environmental Protection Agency (EPA) is spending quite a bit of its resources on these kinds of issues, he said. He thinks climate change impacts and vulnerability will be considered by DEP when they review comprehensive plans.*
    - A participant replied to this that oyster beds may not be able to survive ocean acidification, and that this could be a problem if they are being used to mitigate nitrogen.
    - Another participant pointed out that there could be some co-benefits between resilience-building efforts, such as oyster reefs to protect from storms, and wastewater remediation.
- *A participant suggested that crossing town lines has been an ongoing issue, and that there needs to be better communication between towns. She suggested and MOU that could be easily implemented.*

Following questions and comments, Mr. Thompson provided an overview of some of the key considerations and concepts brought up throughout the meeting. The points he captured were:

- Think about and try to emphasize co-benefits of certain approaches, such as the possibility of increasing resilience to climate change while mitigating nutrient loads.
- Focus on getting the most out of approaches and technologies. For example, PRBs may be most effective where plumes come to the surface.
- Enforceability can be challenging and needs to be considered.
- Expectation management is important. We need to convey that doing the easiest things along is unlikely to achieve targets, while also conveying that there are many approaches towns and cities can take to address the problem.
- Leadership is necessary. This can help with identifying priorities and addressing funding concerns.
- People are reluctant to put funds into something that isn't highly visible. It is important to make a compelling case to people who have to support interventions.
- There is a tension between experimentation and implementation of techniques we know will be effective.
- How long will it take to see measurable results? We need to keep this in mind.
- Who bears the cost? We need to think about cost-sharing, as well as Environmental Justice and ability to pay concerns.

V. PLANNING FOR THE NEXT MEETING

Mr. Thompson reminded participants that the next and third meeting will be held:
Wednesday, December 11, 2013; 1:00PM – 5:00PM
Mashpee Town Hall, 16 Great Neck Road North, Mashpee

Ms. Daly said that during the third meeting, Working Groups will examine various scenarios (i.e., combinations of solutions) and potential impacts (e.g., nutrient reduction, economic impacts, environmental impacts, social impacts, etc.) of each. During the meeting, the Cape Cod Commission will use analytic tools to calculate the impact of particular ideas and options. Working Group participants should come prepared to offer their ideas about what solutions they'd like to explore further given their understanding of the baseline conditions, issues, and priorities in this watershed.

Ms. Daly encouraged participants to attend the November 13th meeting for all stakeholders from all 11 working groups. This meeting will be an opportunity to talk about how the Commission can engage stakeholders in continued efforts during the January to June timeframe. The meeting will be held at 6:00pm in the Cape Cod Museum of Art, Dennis, MA.

APPENDIX ONE: MEETING PARTICIPANTS

Name	**Affiliation**
Working Group Members	
Tom Fudala	Mashpee Planning, Sewer & Water District
Andrew Gottlieb	CCWPC
Jessica Rapp Grassetti	Town of Barnstable, Town Councilor
Peter Hargraves	FACES
Alison Leschen	WBNERR
Win Munro	Wastewater Committee, Falmouth
Dale Saad	Barnstable DPW
Art Traczyk	Town of Barnstable
Public	
David Dow	Sierra Club
Scott Nickerson	GCSACC
Jon Ford	MBD
Jayne Abbott	COWB LWV
Rob Adler	US EPA
Staff and Consultants	
Patty Daley	Cape Cod Commission
Kristy Senatori	Cape Cod Commission
Scott Michaud	Cape Cod Commission
Maria McCauley	Cape Cod Commission
Doug Thompson	Facilitator, Consensus Building Institute
Danya Rumore	Associate, Consensus Building Institute
Betsey Shreve	AECOM
Mark Owen	AECOM

Cape Cod 208 Area Water Quality Planning
Wellfleet Harbor & Pamet River Watershed Working Group
Wellfleet Council on Aging
Second Meeting

715 Old King's Hwy, Wellfleet, MA 02667
October 30, 2013
1:00-5:00 p.m.

Agenda

1:00 Welcome, Review 208 goals and Process and the Goals of today's meeting – *Cape Cod Commission*

1:10 Introductions, Agenda Overview, Updates and Action Items– *Facilitator and Working Group*

1:30 Range of Possible Solutions – *Cape Cod Commission and Working Group*

- Technology Matrix
- Technologies Overview
- Survey Questions and Comments
- Additional Questions and Discussion

3:00 Break

3:15 Problem Solving Process and Principles – *Cape Cod Commission and Working Group*

- Overview of 7-steps for Problem-Solving Process
- Examination of Categories of Solutions and their impacts on the Environment, Economy, and Community (triple bottom line)
- Discussion – Identify Considerations and Priorities for Application

4:30 Preparing for Meeting 3 and Beyond – *Cape Cod Commission*

- Review Tools, Alternatives Analysis Approach
- Evaluating Scenarios for Meeting Nitrogen Goals
- Other Process Next Steps

4:45 Public Comments

5:00 Adjourn

Wellfleet Harbor & Pamet River Group

Technologies and Approaches

What is the stakeholder process?

Public Meetings

Watershed Working Groups

Goals, Work Plan & Roles

Affordability, Financing

Baseline Conditions

Technology Options Review

Watershed Scenarios

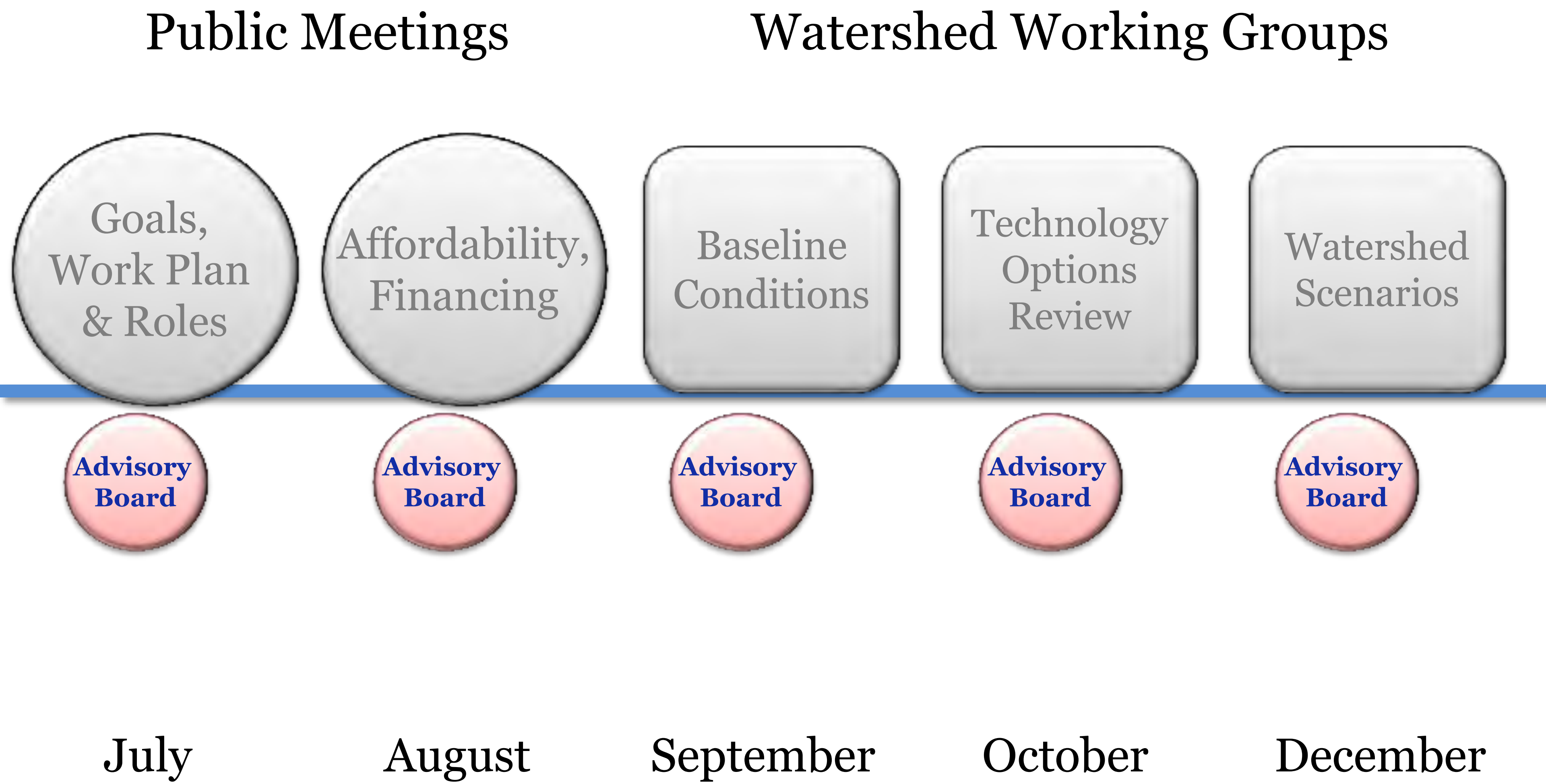
July

August

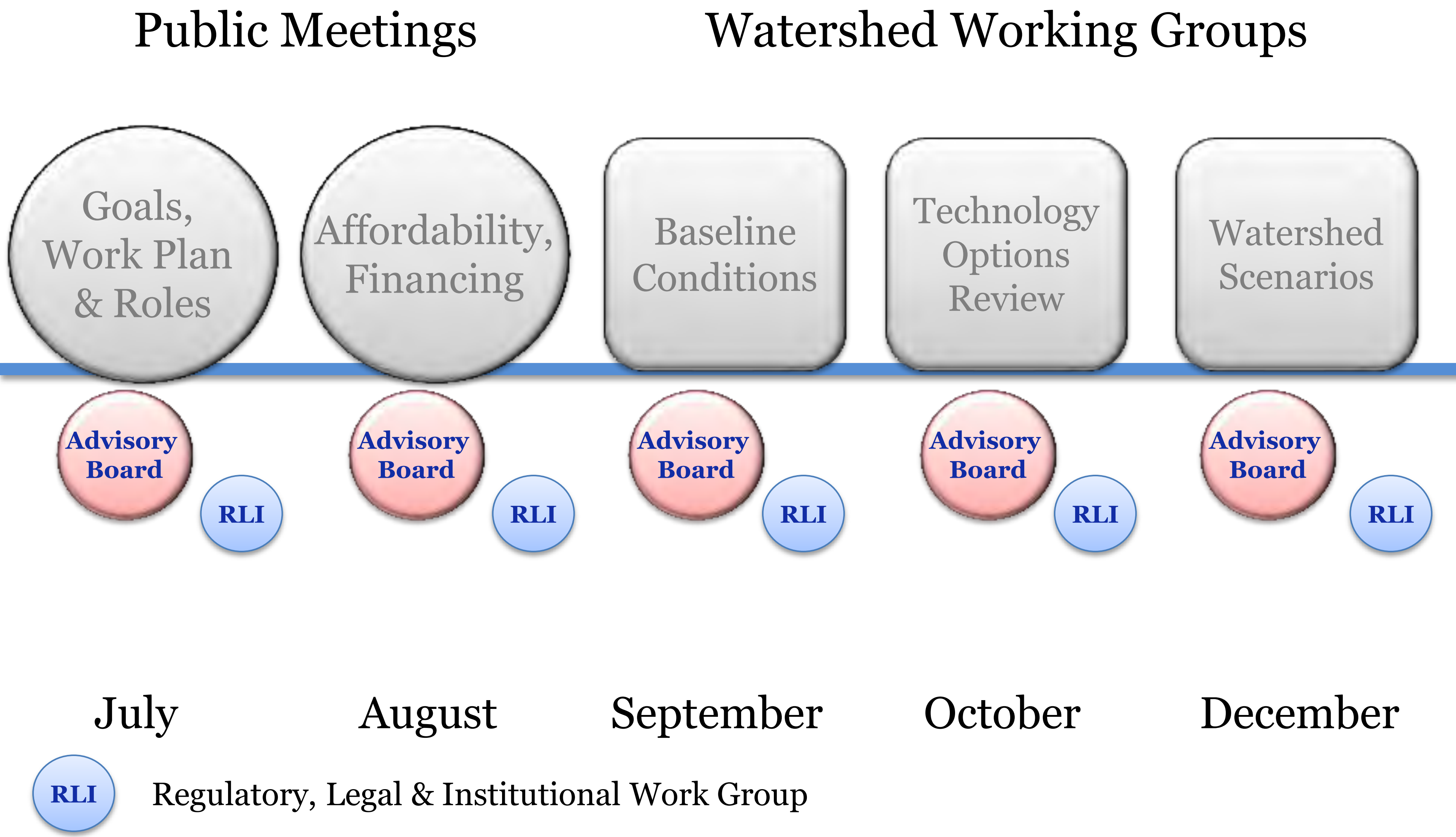
September

October

December



208 Planning Process


Public Meetings
Watershed Working Groups
Goals, Work Plan & Roles
Affordability, Financing
Baseline Conditions
Technology Options Review
Watershed Scenarios
Advisory Board
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July
August
September
October
December
RLI
Regulatory, Legal & Institutional Work Group

Public Meetings

Watershed Working Groups

Goals, Work Plan & Roles

Affordability, Financing

Baseline Conditions

Technology Options Review

Watershed Scenarios

Advisory Board
RLI
TAC

Advisory Board
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Advisory Board
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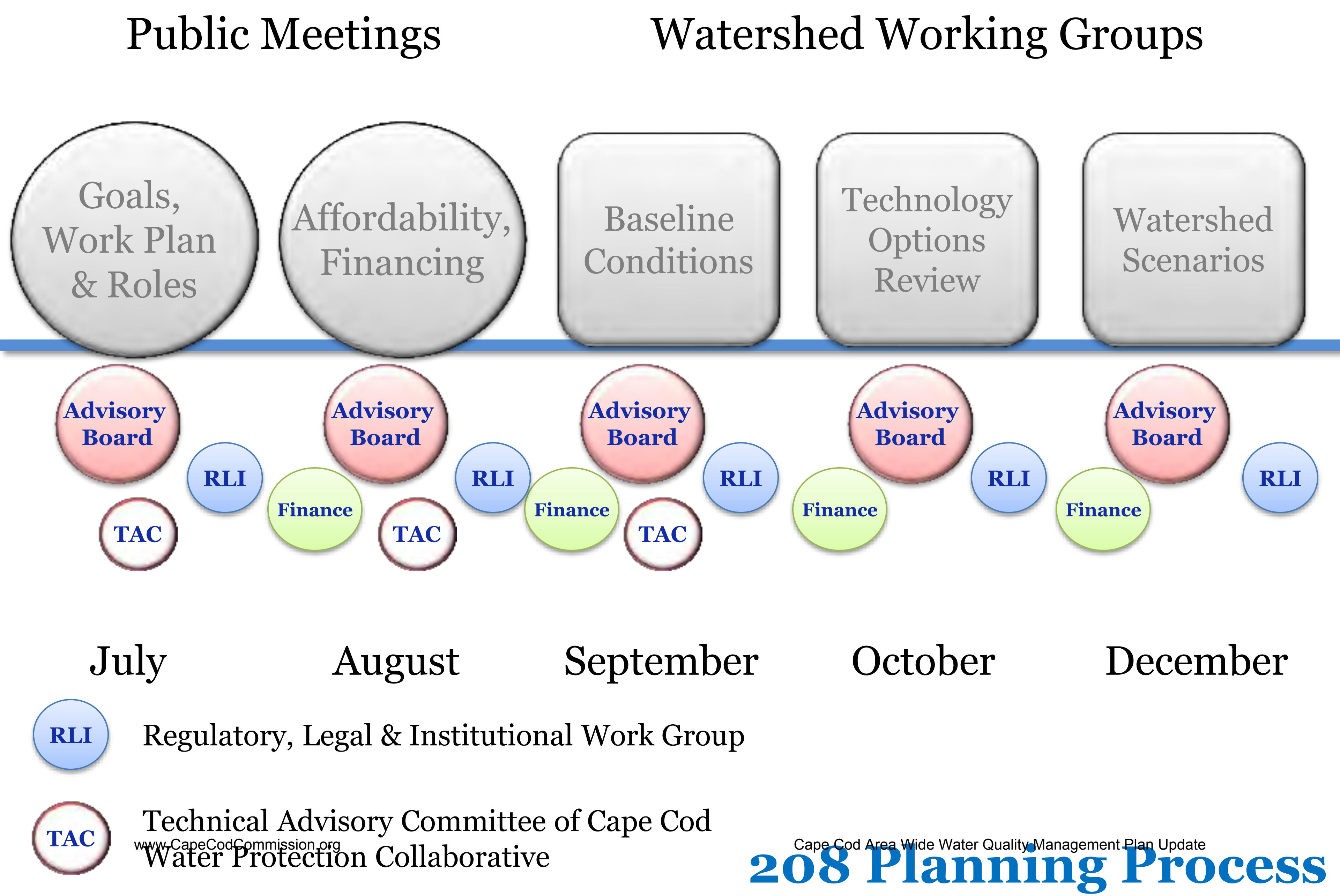
July August September October December

RLI Regulatory, Legal & Institutional Work Group

TAC Technical Advisory Committee of Cape Cod Water Protection Collaborative

208 Planning Process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Regulatory, Legal & Institutional Work Group
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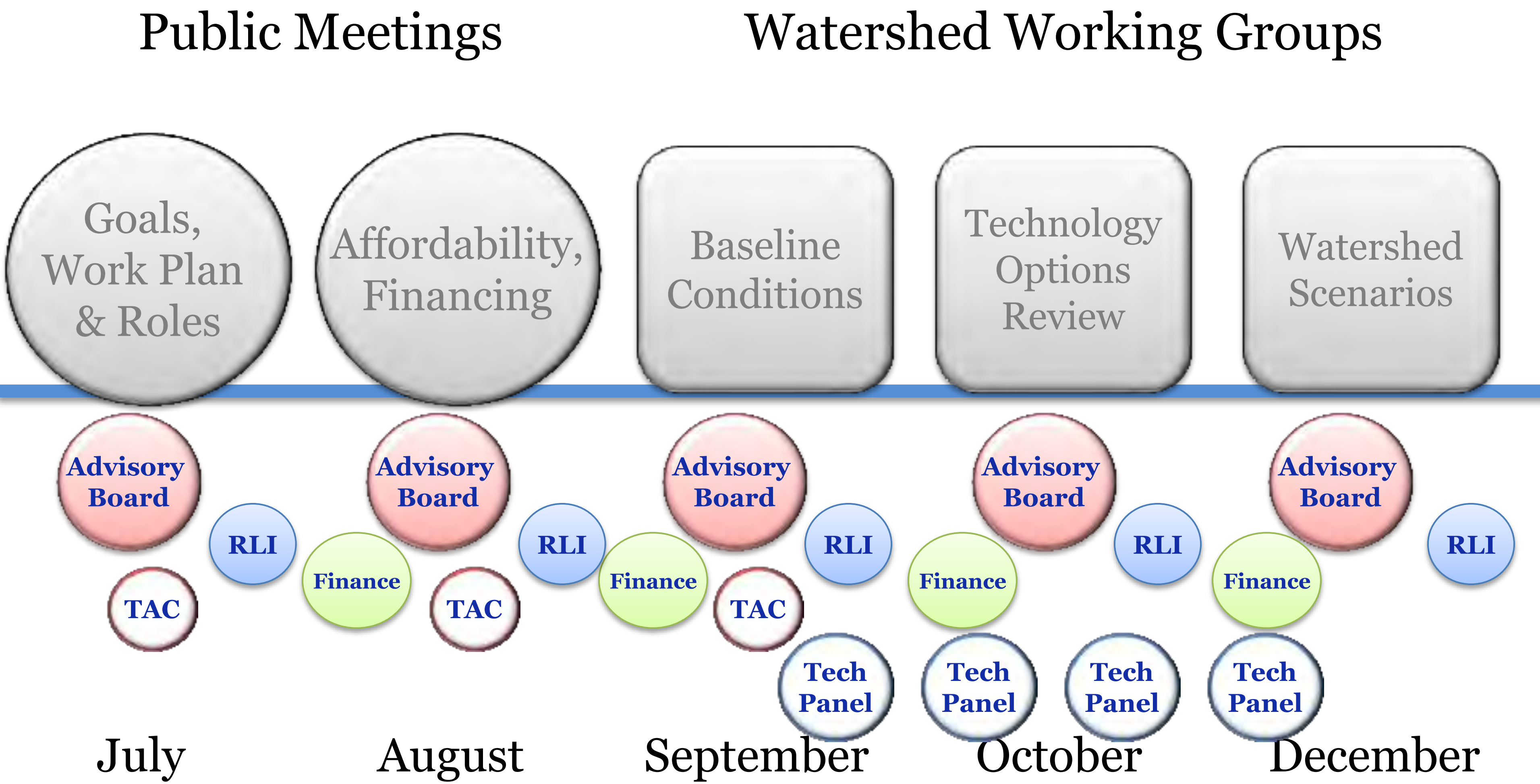
Technical Advisory Committee of Cape Cod Water Protection Collaborative
208 Planning Process



RLI Regulatory, Legal & Institutional Work Group

TAC Technical Advisory Committee of Cape Cod Water Protection Collaborative

Baseline Conditions

11 Working Group Meetings: Sept 18-27

Goal of the First Meeting:

To review and develop shared understanding of the characteristics of these watersheds, the work done to date, existing data and information available, and how to apply all of this to planning for water quality improvements for these watersheds moving forward.

Progress since last meeting

- Meeting materials

Progress since last meeting

- ❑ Meeting materials
- ❑ GIS data layers

Progress since last meeting

- ❑ Meeting materials
- ❑ GIS data layers
- ❑ Chronologies

Baseline Conditions

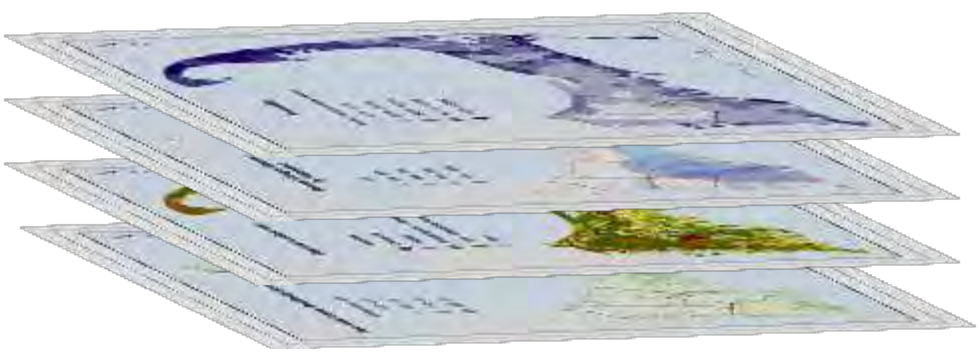
11 Working Group Meetings: Sept 18-27

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

208 Planning Process

Baseline Conditions	Technology Options Review	Watershed Scenarios
11 Working Group Meetings: Sept 18-27	11 Working Group Meetings: Oct 21-Nov 5	11 Working Group Meetings: Dec 2-11



208 Planning Process

Baseline Conditions

11 Working Group Meetings: Sept 18-27

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Watershed Scenarios

11 Working Group Meetings: Dec 2-11

Watershed Event

November 13

Center for the Arts Dennis

Wrap up of Cape2O: ur in charge!

Summary of planning process to date

Outline of second 6 months of the 208 planning process

208 Planning Process

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Goal of Today's Meeting:

To develop a shared understanding of the potential technologies and approaches identified to date, and the benefits and limitations of each; to explore the environmental, economic, and community impacts of a range of categories of solutions; and to identify priorities and considerations for applying technologies and approaches to remediate water quality impairments in your watershed.

Technologies and Approaches for Improving Water Quality

Technologies and Approaches for Improving Water Quality

- The Fact Sheets present various information on the technologies being considered.
- Additional information is contained on the Technology Matrix including the following:
  - Site Requirements
  - Construction, Project and Operation and Maintenance Costs
  - Reference Information
  - Regulatory Comments
- Input from the Stakeholders is requested regarding a technology's Public Acceptance

Technologies and Approaches for Improving Water Quality

- Comprehensive analysis of nutrient control technologies and approaches.

Technologies and Approaches for Improving Water Quality

- ❑ Comprehensive analysis of nutrient control technologies and approaches.
- ❑ Not all of the technologies and approaches will be applicable to Cape Cod.

Technologies and Approaches for Improving Water Quality

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- Certain technologies or approaches will be effective at **preventing** nutrients from entering the water body. Others will be effective at **reducing** or **remediating** nutrients that are already in the groundwater or water body.

Technologies and Approaches for Improving Water Quality

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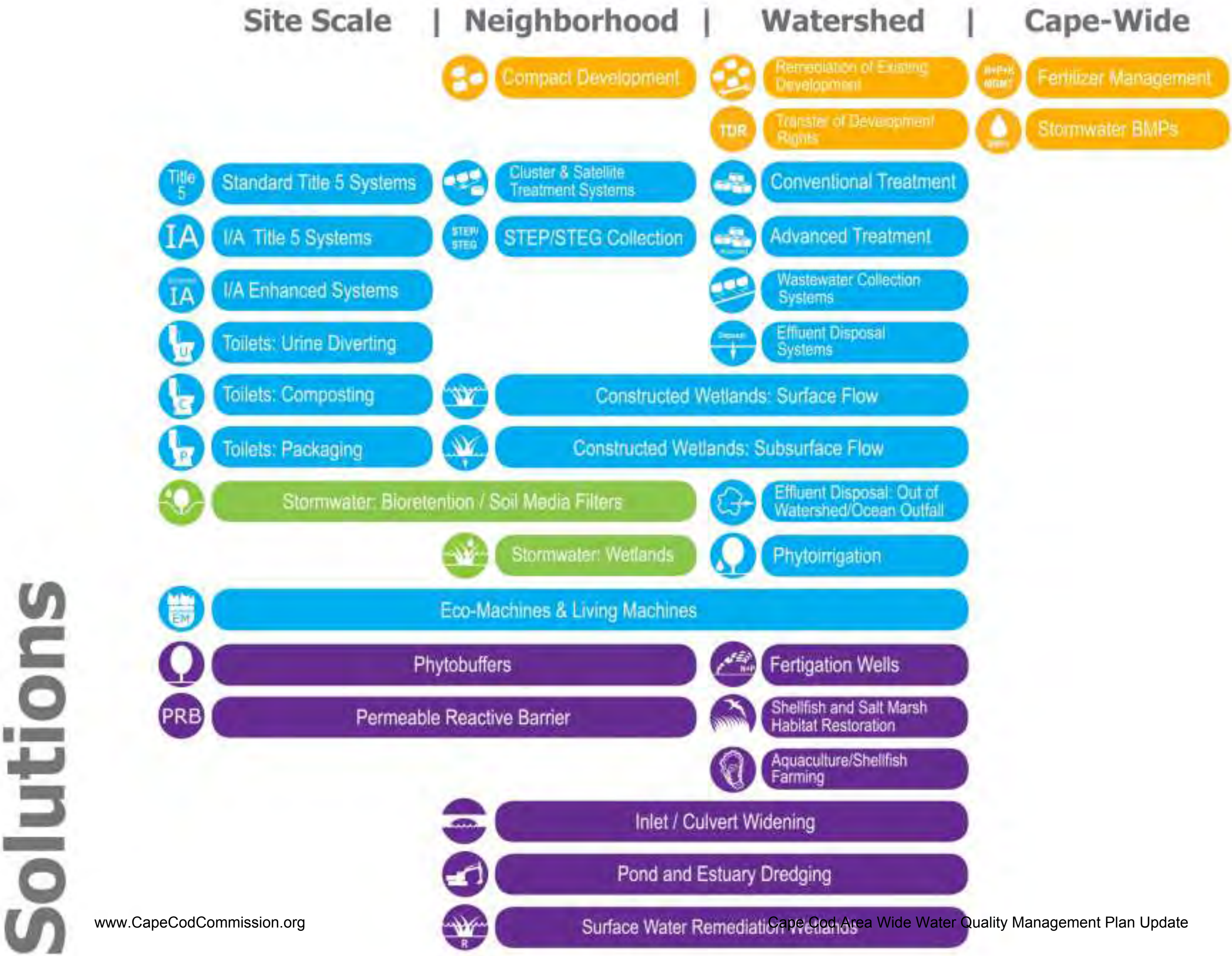
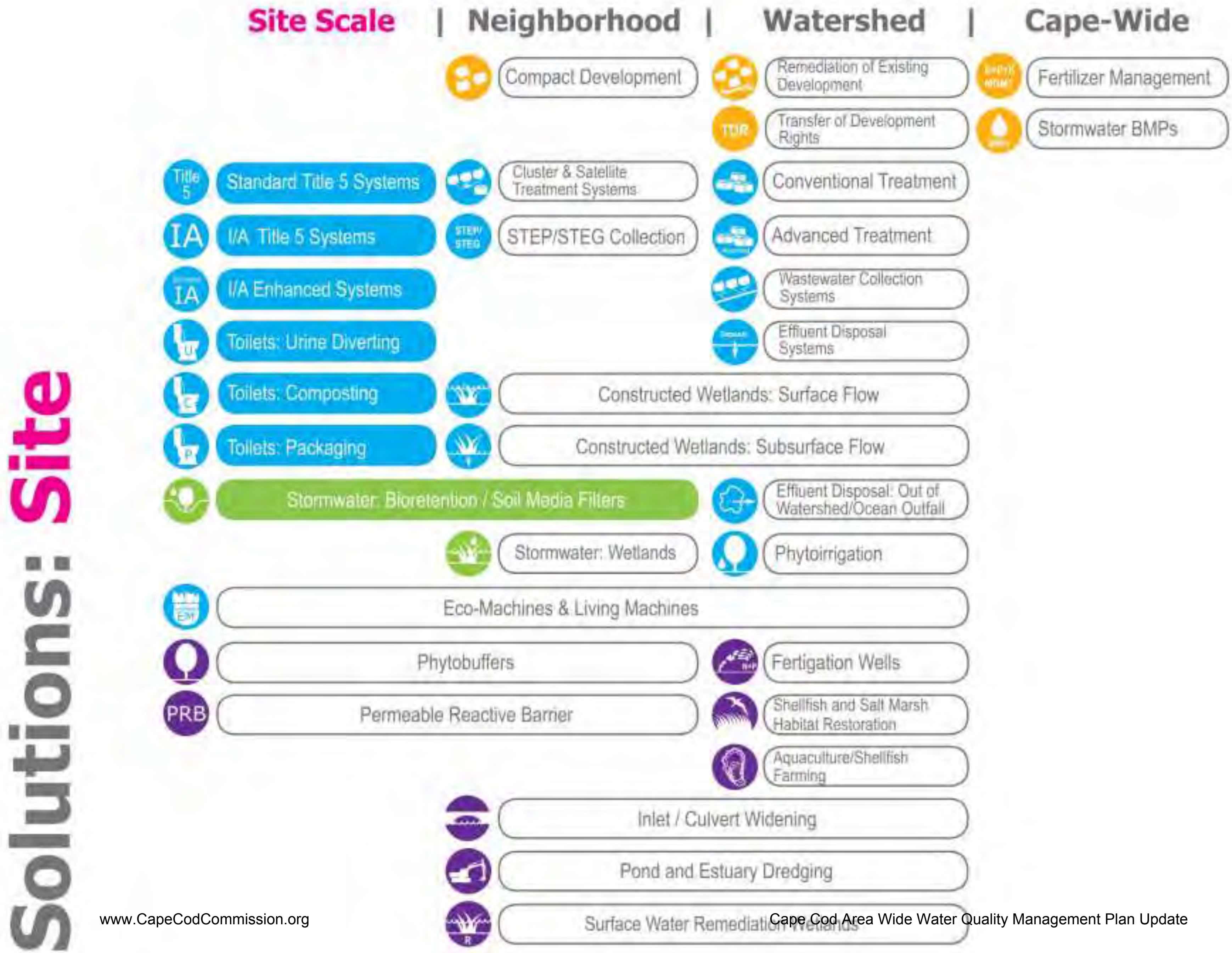
- Certain technologies or approaches will be effective at **preventing** nutrients from entering the water body. Others will be effective at **reducing** or **remediating** nutrients that are already in the groundwater or water body.
- Regulatory programs can address nutrient controls for both existing development and future development.


Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
IA
I/A Title 5 Systems
STEP/STEG
STEP/STEG Collection
Advanced Treatment
IA
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
EM
Eco-Machines & Living Machines
Phytobuffers
Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands
Solutions


Solutions: Site
Site Scale | Neighborhood | Watershed | Cape-Wide
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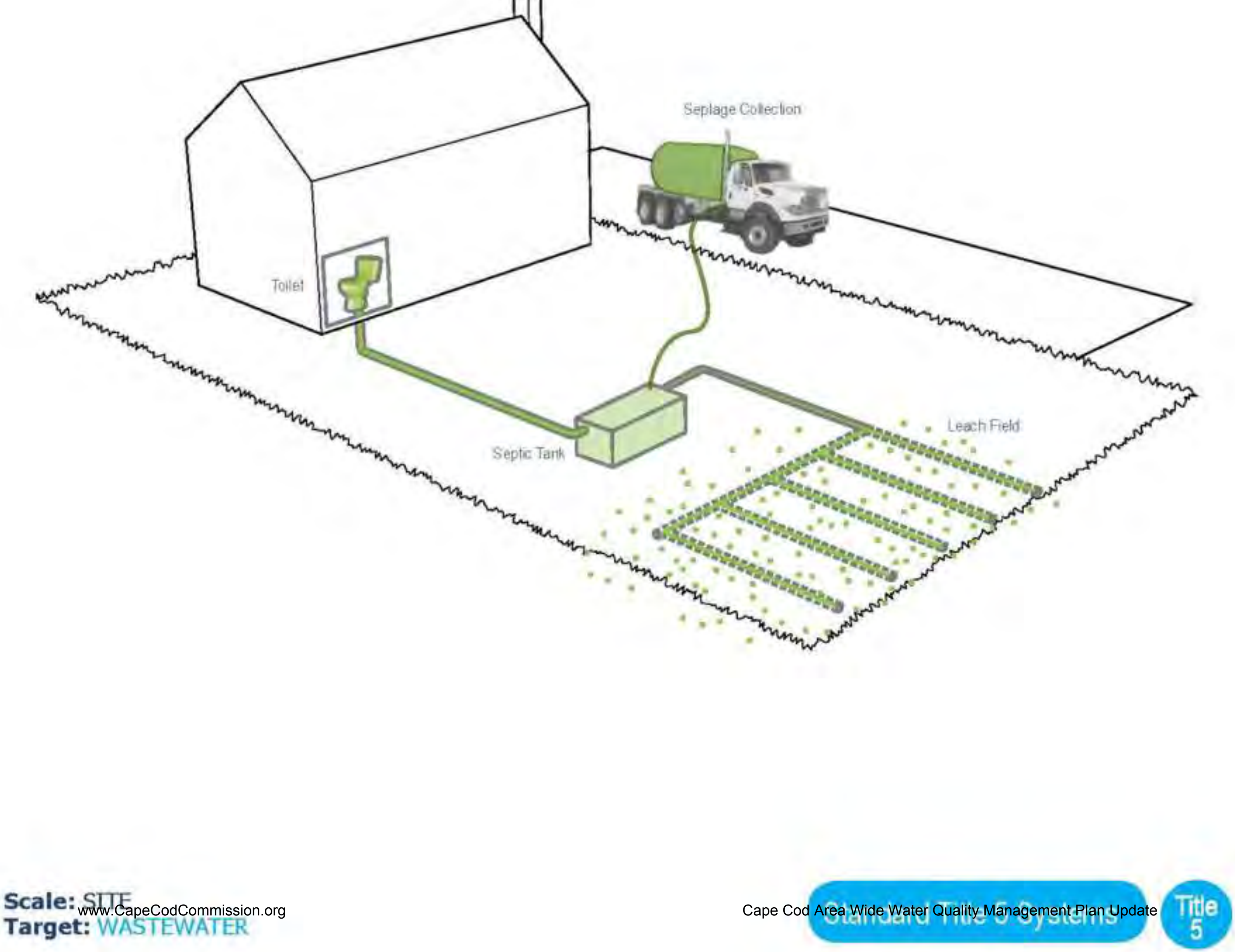
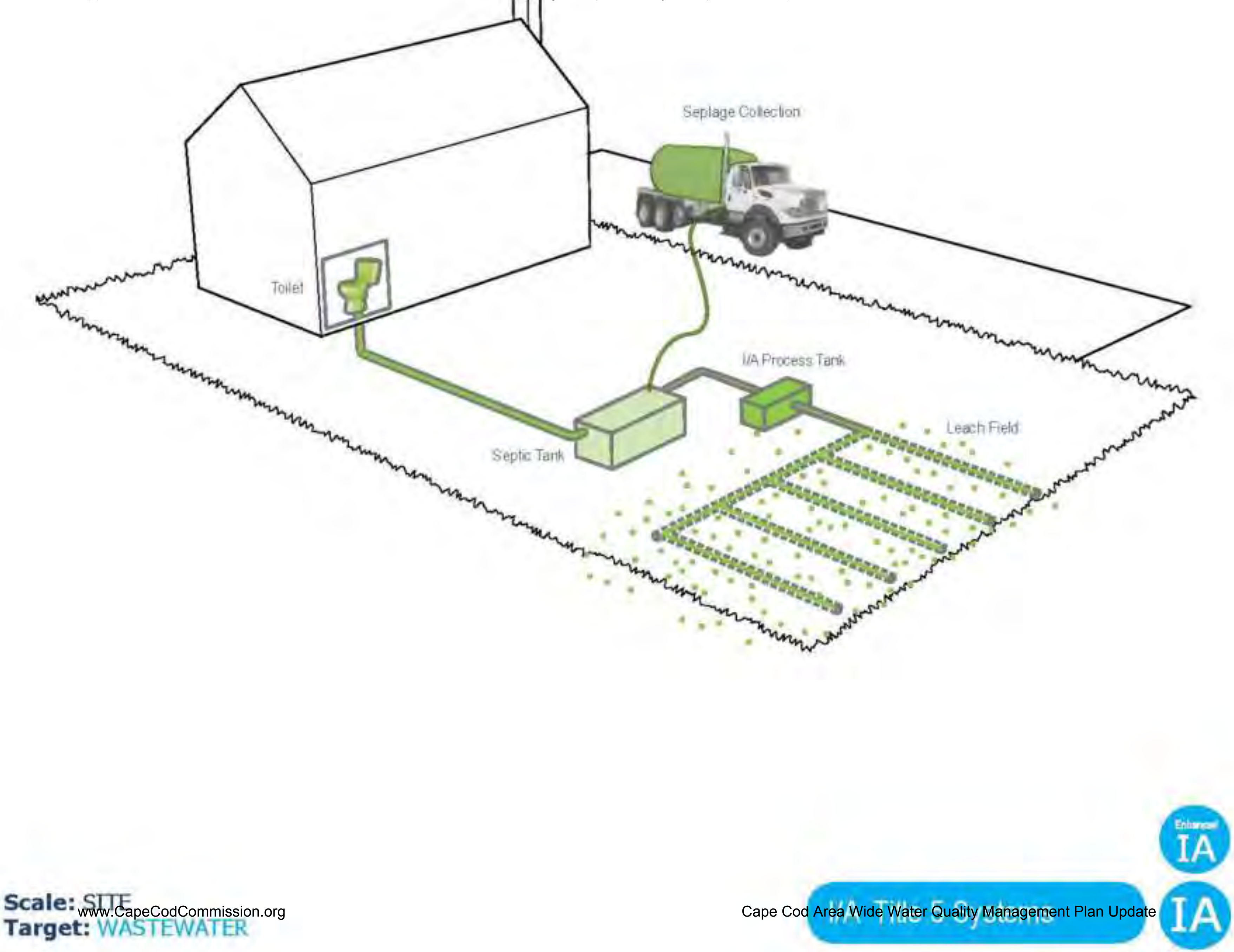
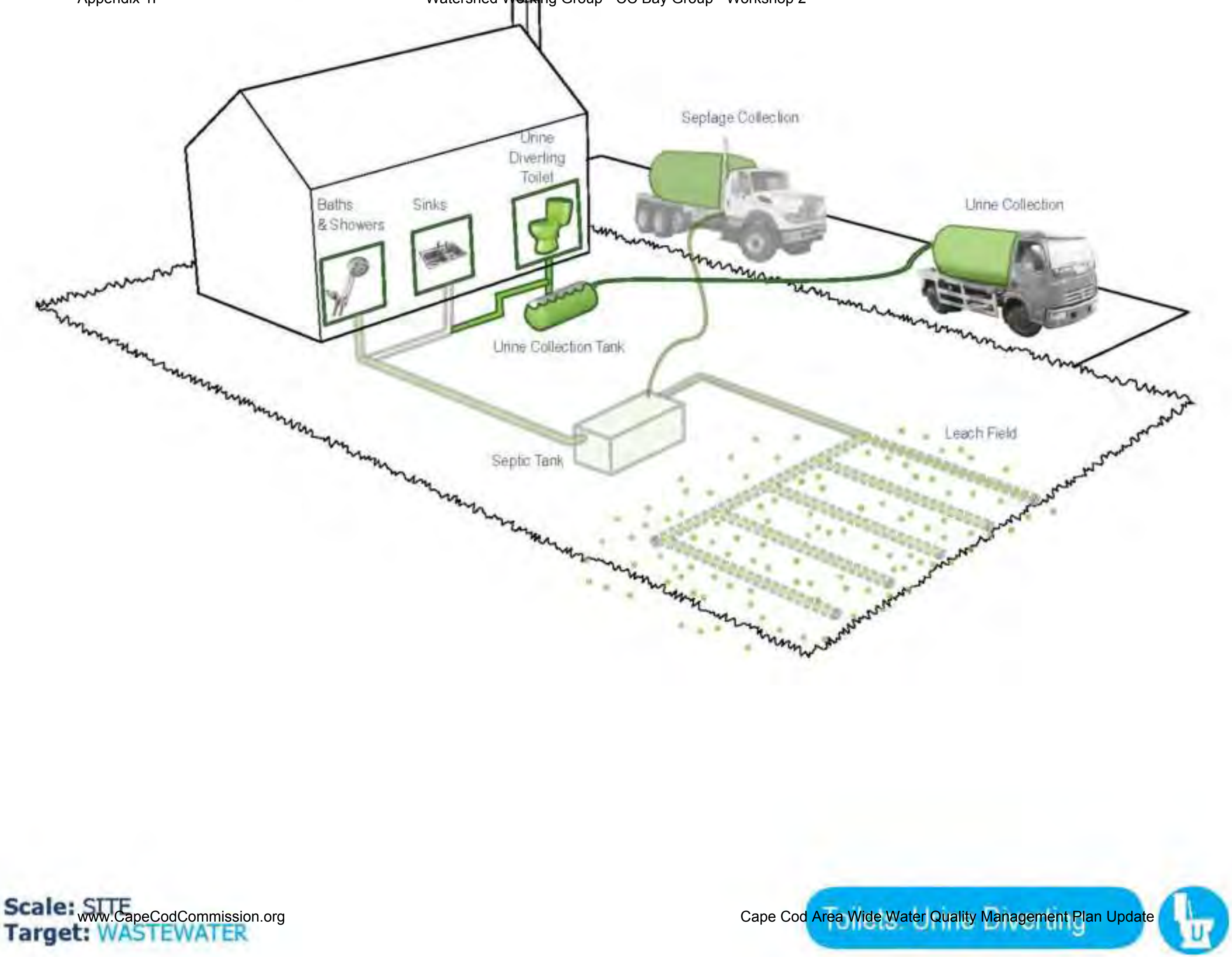
Wetlands


Septage Collection
Toilet
Septic Tank
Leach Field
Scale: SITE
Target: WASTEWATER
Standard Title 5 Systems
Title 5


Septage Collection
Toilet
I/A Process Tank
Leach Field
Septic Tank
Scale: SITE
Target: WASTEWATER
I/A Title 5 Systems
IA
IA


Septage Collection
Urine Diverting Toilet
Baths & Showers
Sinks
Urine Collection
Urine Collection Tank
Leach Field
Septic Tank
Scale: SITE
Target: WASTEWATER
Toilets: Urine Diverting

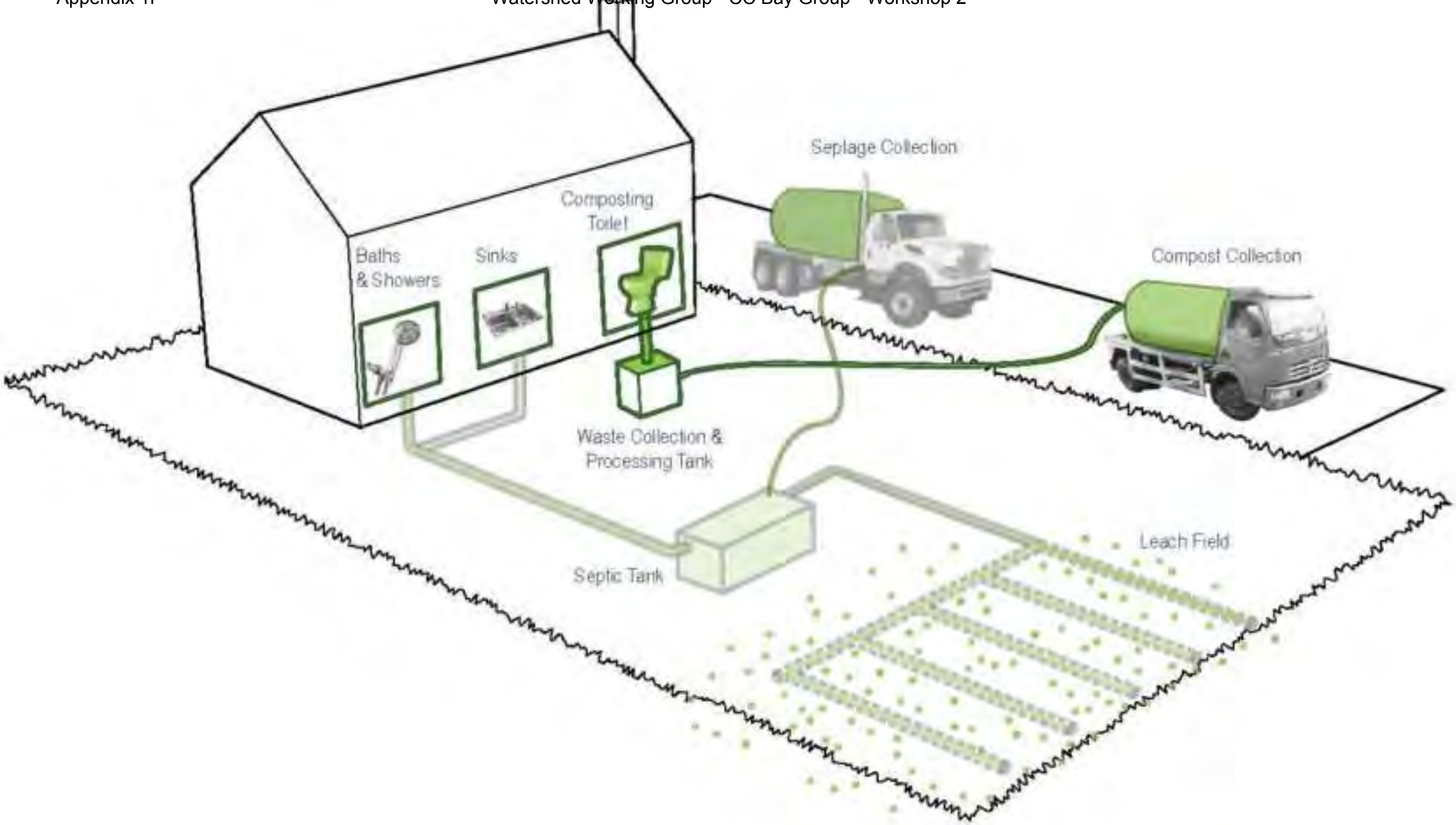
Waterless Urinal

IBC container (220 gallons)

40" x 40" x48"

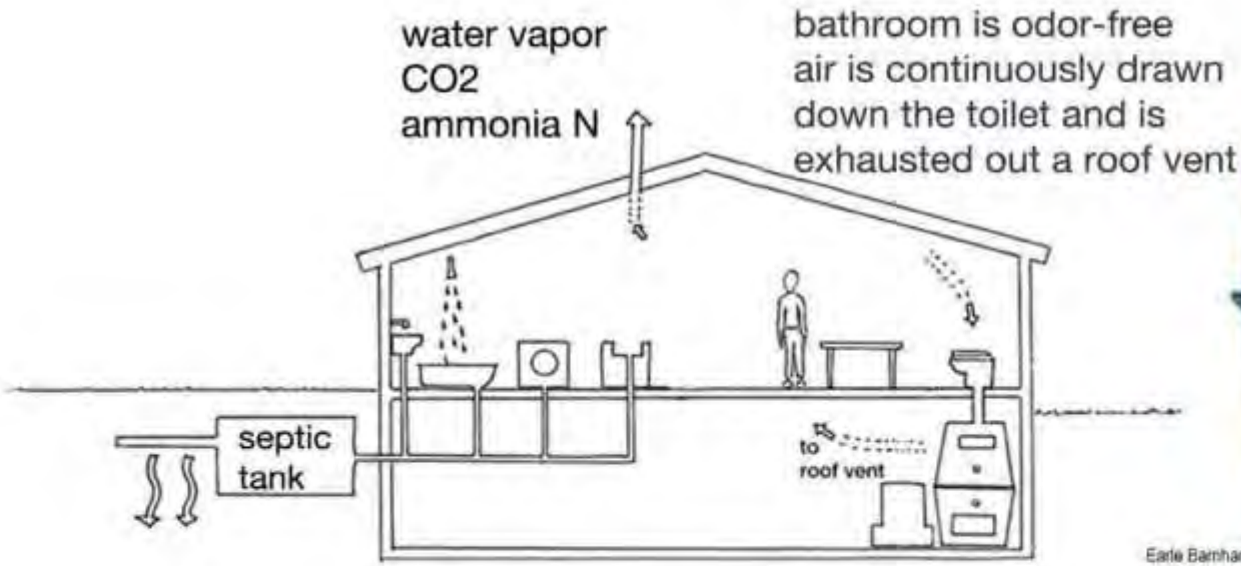
Source: Earle Barnhart, The Green Center Inc. and Horsley-Witten Group Inc.

Toilets: Urine Diverting



Scale: SITE
Target: WASTEWATER

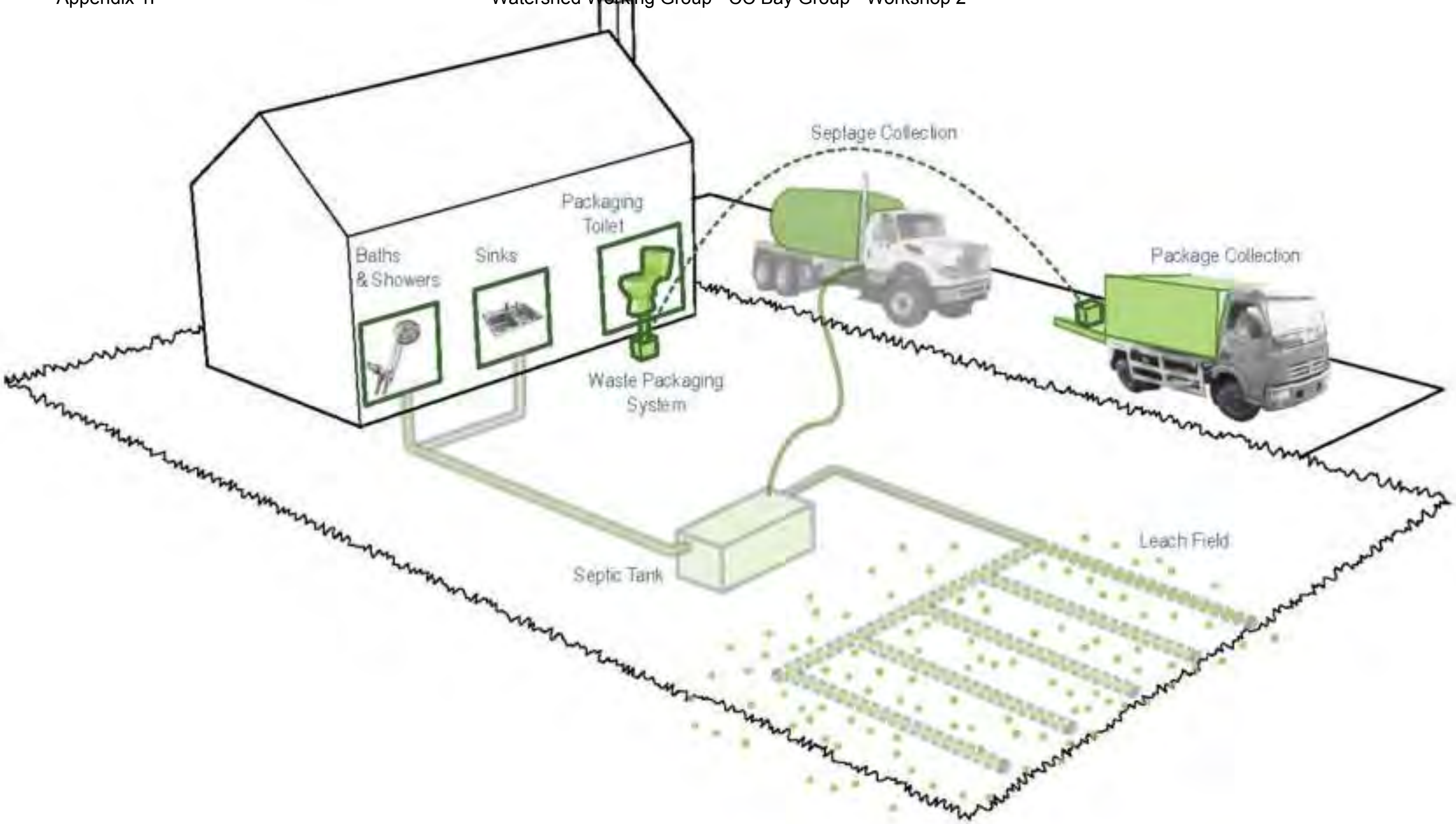
Toilets: Composting



Earle Barnhart
The Green Center, Inc

Source: Earle Barnhart, The Green Center Inc.

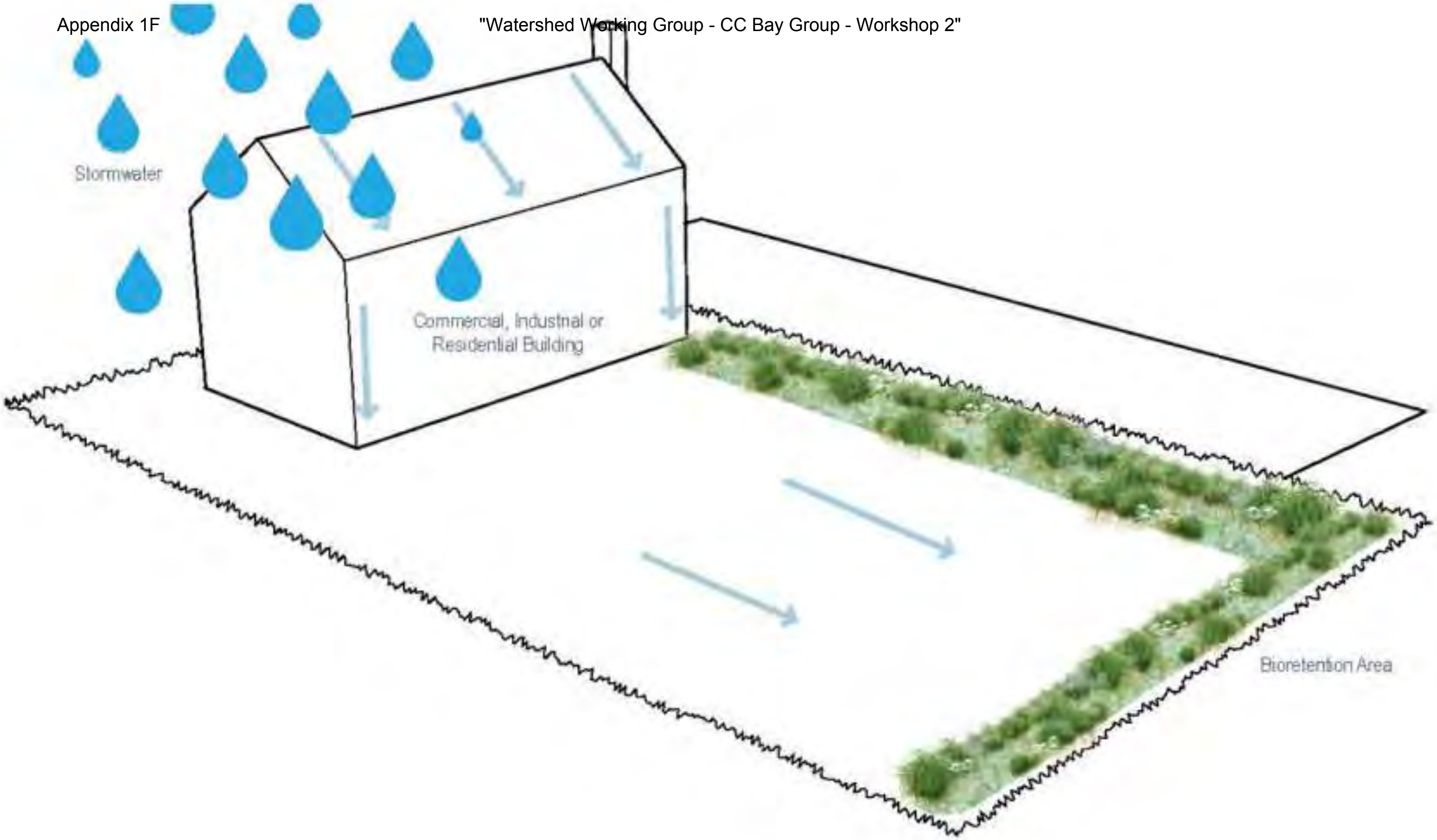
Toilets: Composting



Scale: SITE
Target: WASTEWATER

Toilets: Packaging


PACTO®
LOOWATT
Packaging Toilet
Packages
Source: Earle Barnhart, The Green Center Inc.
Toilets: Packaging



Scale: SITE
Target: STORMWATER

Stormwater Bioretention / Soil Media Filters

Precedent: 12th Ave. Stormwater Project, Portland, OR

Source: City of Portland

Stormwater: Bioretention / Soil Media Filters

Rain Gardens


Solutions: Neighborhood
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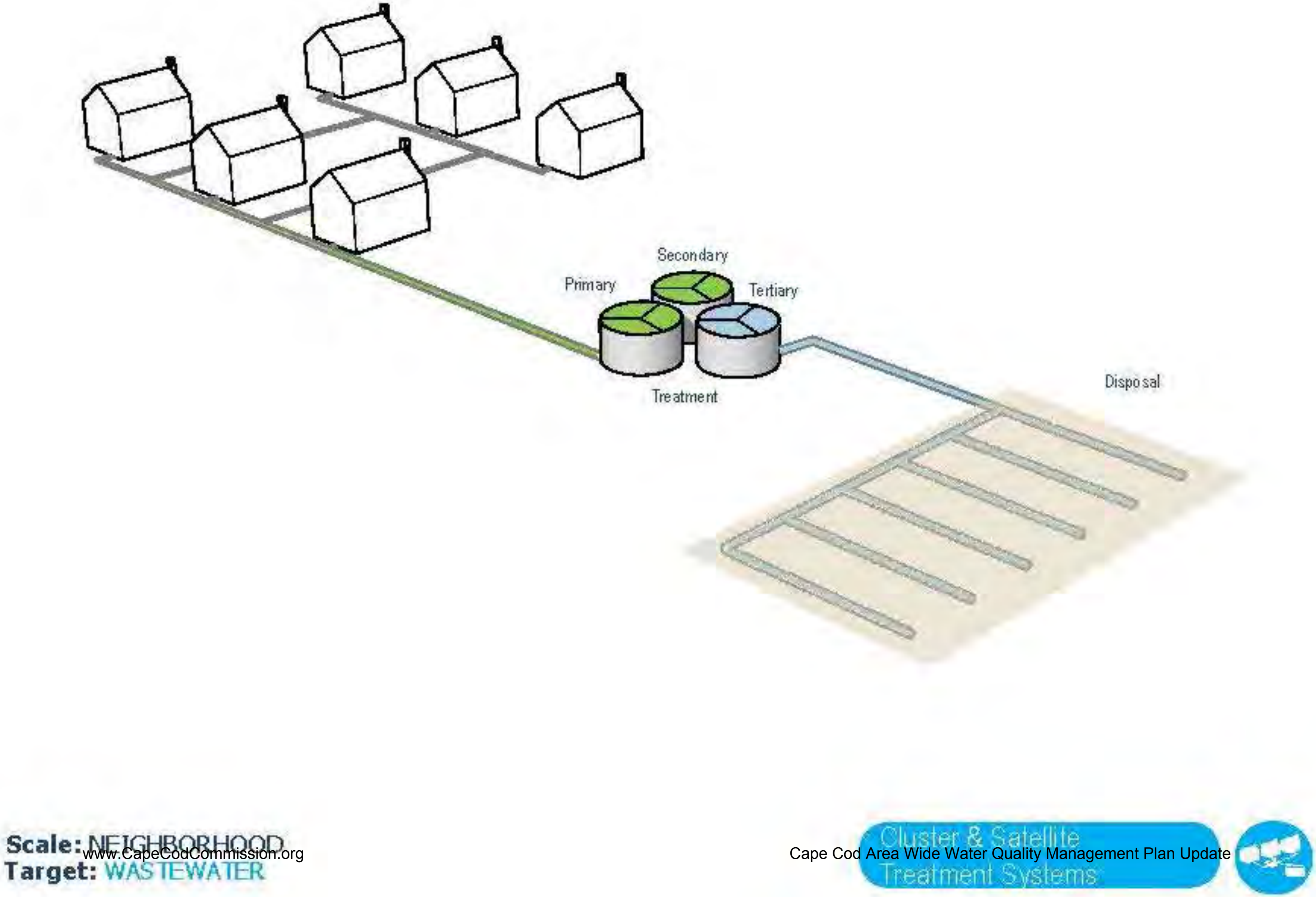
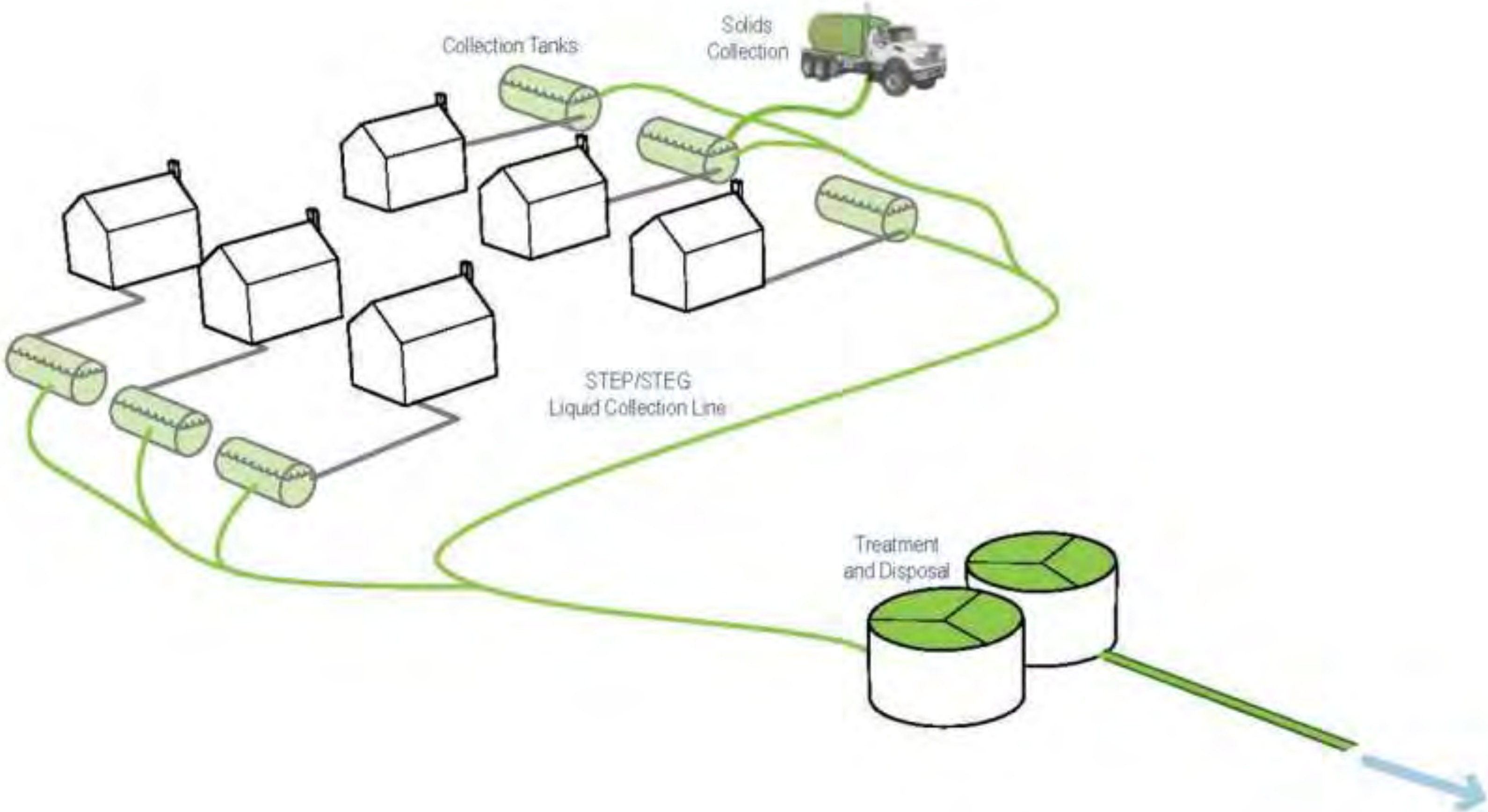
R
Surface Water Remediation Wetlands

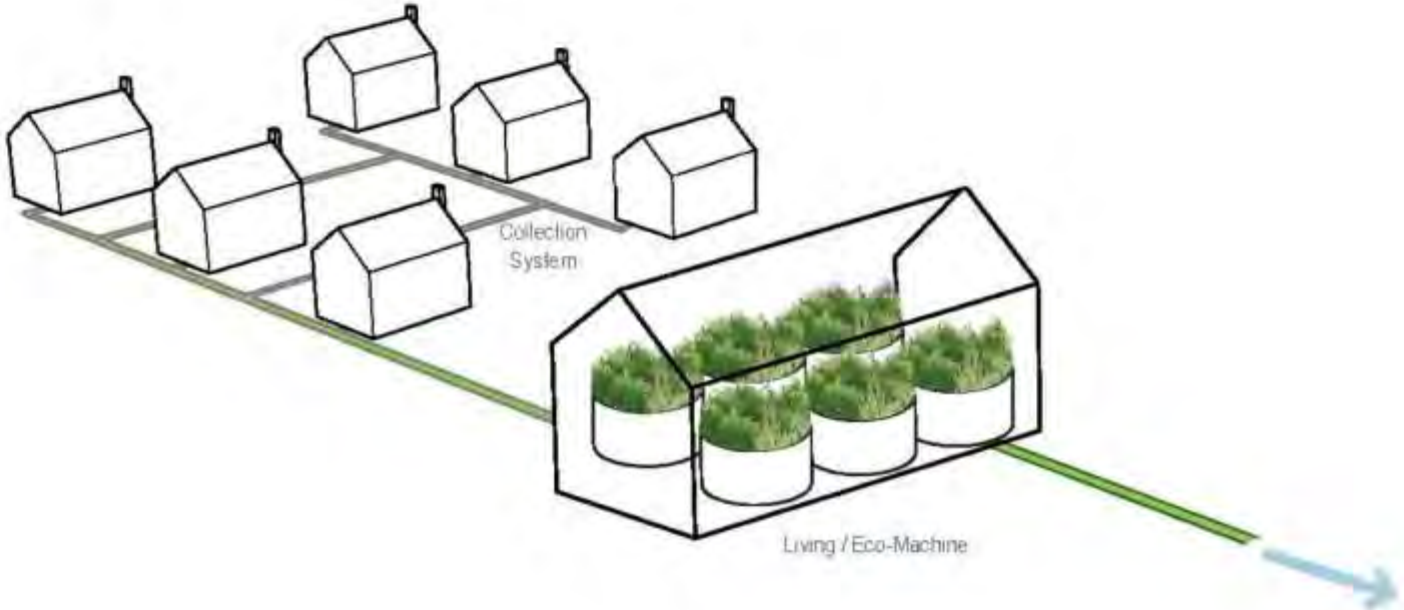

Secondary
Primary
Tertiary
Treatment
Disposal
Scale: NEIGHBORHOOD
Target: WASTEWATER
Cluster & Satellite
Treatment Systems



Scale: NEIGHBORHOOD
Target: WASTEWATER

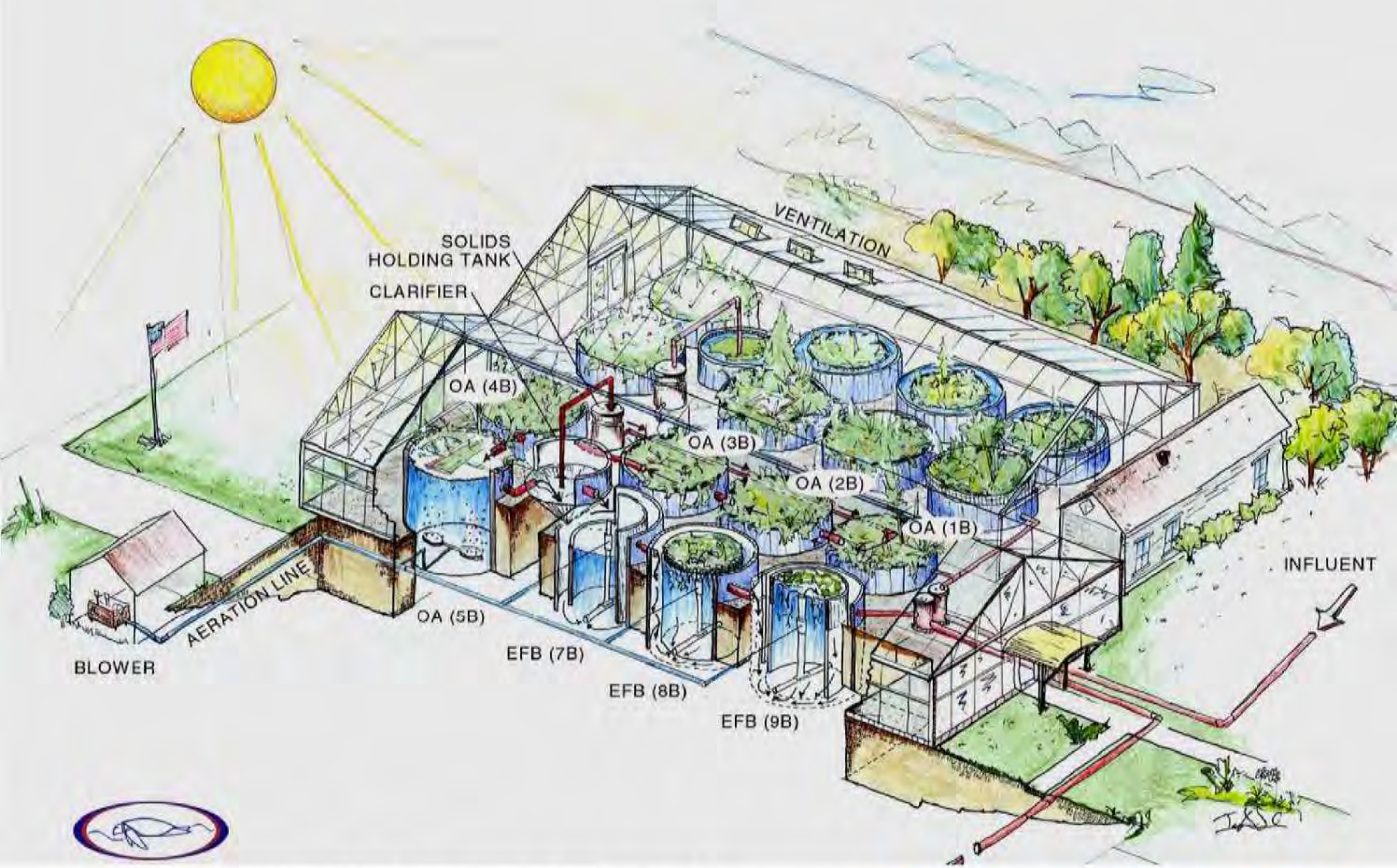
STEP / STEG Collection

STEP/
STEG



Scale: NEIGHBORHOOD
Target: WASTEWATER

Eco-Machines and Living Machines



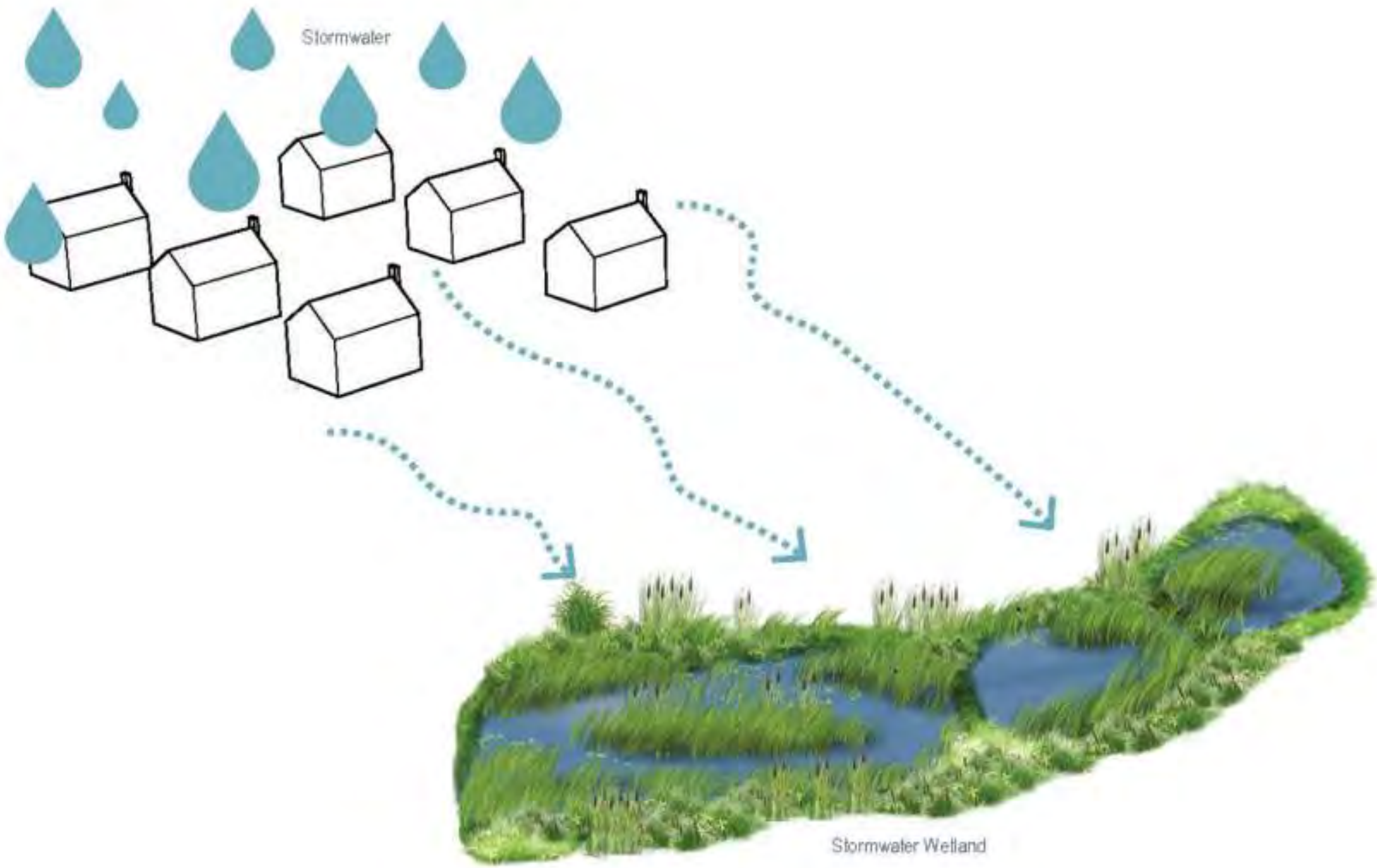
Precedent: Living Machine, South Burlington, VT

Source: Todd Ecological

Eco-Machines and Living Machines

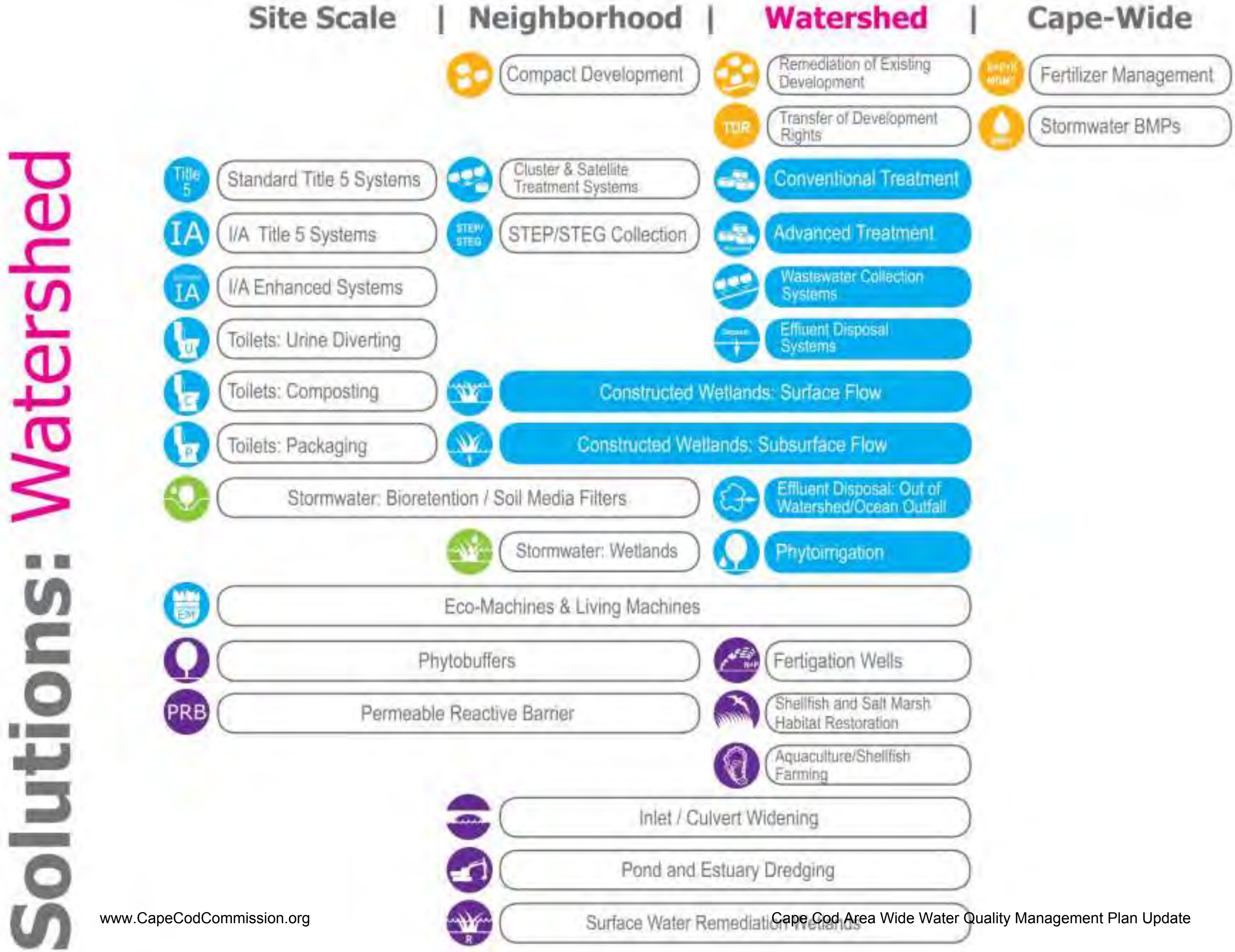
Precedent: Living Machine - South Burlington, VT + Photobioreactors - Falmouth, MA
Source: Todd Ecological and Tom Cambareri

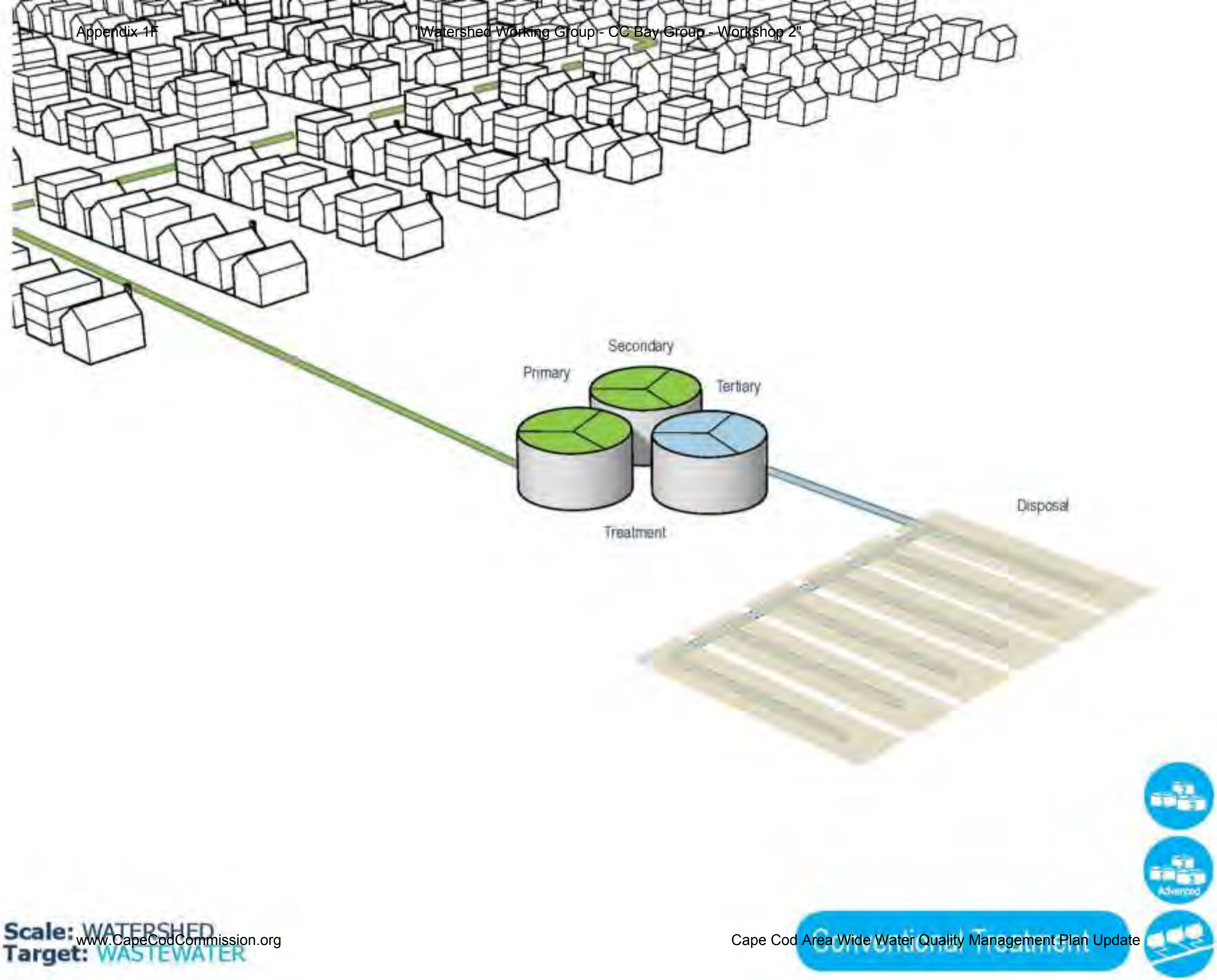
Eco-Machines and Living Machines

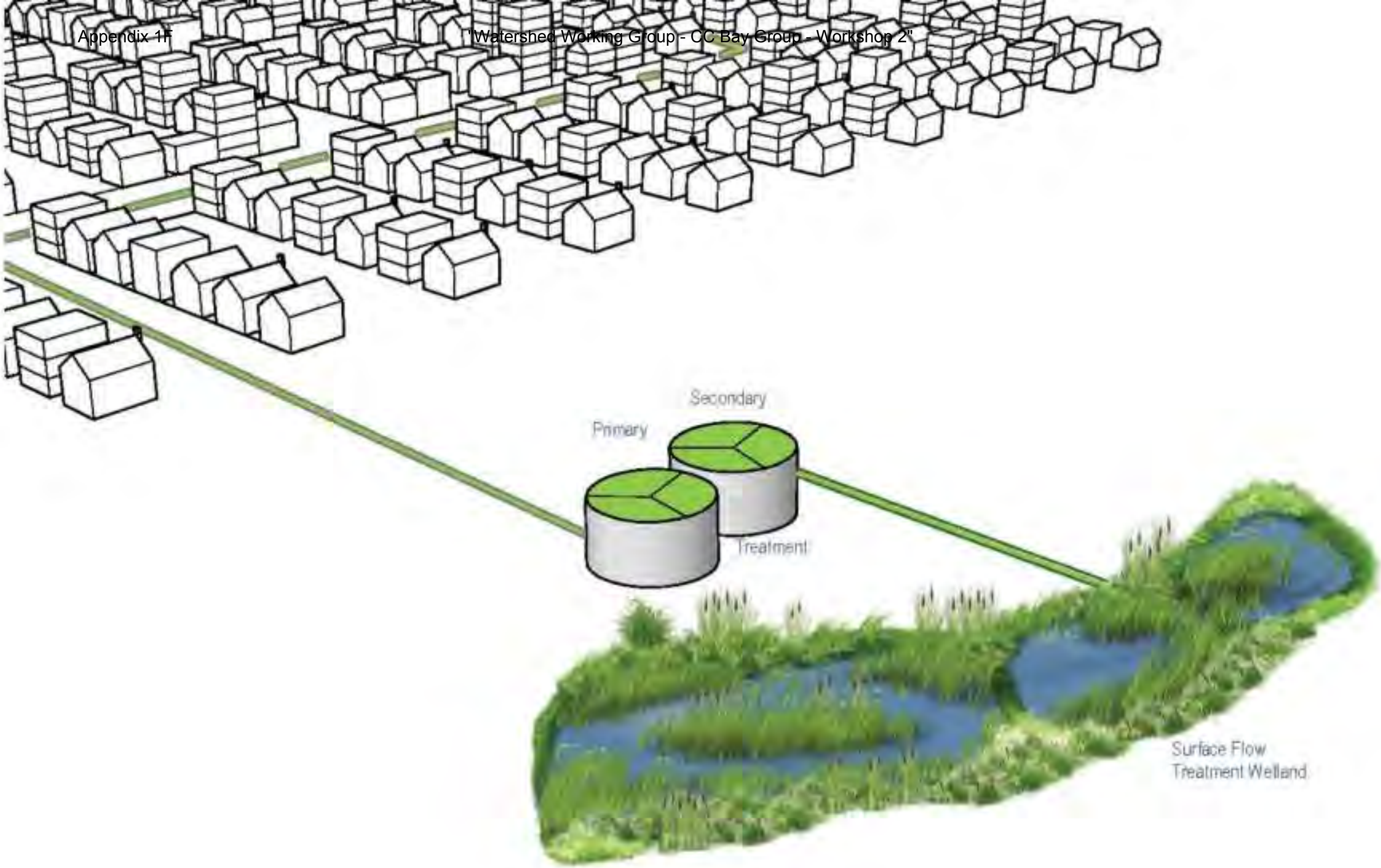


Scale: NEIGHBORHOOD
Target: STORMWATER

Stormwater Wetlands


Solutions: Watershed
Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
IA
I/A Title 5 Systems
STEP/STEG
STEP/STEG Collection
Advanced Treatment
IA
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
EM
Eco-Machines & Living Machines
Phytobuffers
Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands


Secondary
Primary
Tertiary
Treatment
Disposal
Advanced
Conventional Treatment
Scale: WATERSHED
Target: WASTEWATER



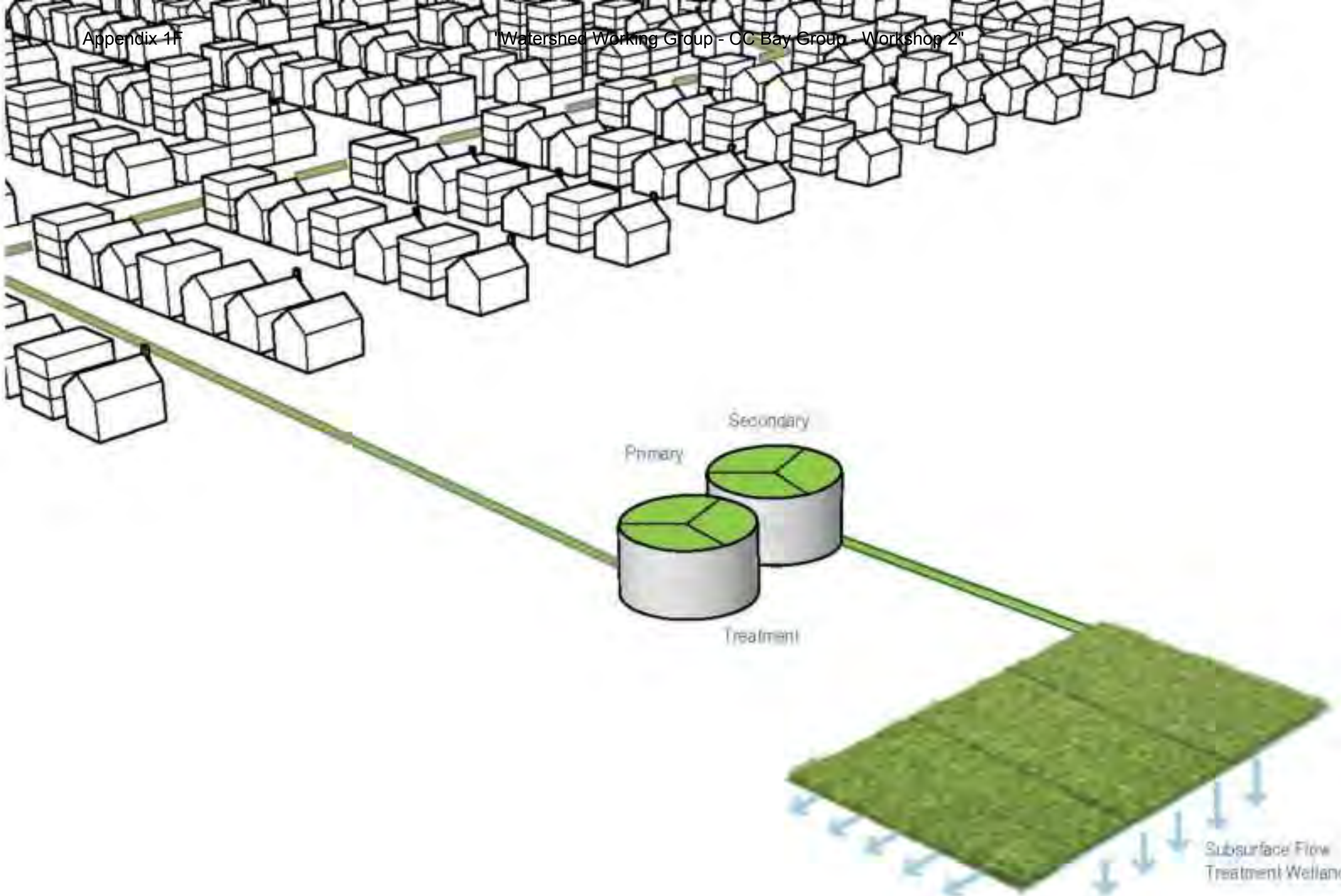
Scale: WATERSHED
Target: WASTEWATER

Constructed Wetlands
Surface Flow

Precedent: Talking Waters Garden - Albany, OR

Source: Kate Kennen

Constructed Wetlands: Surface Flow



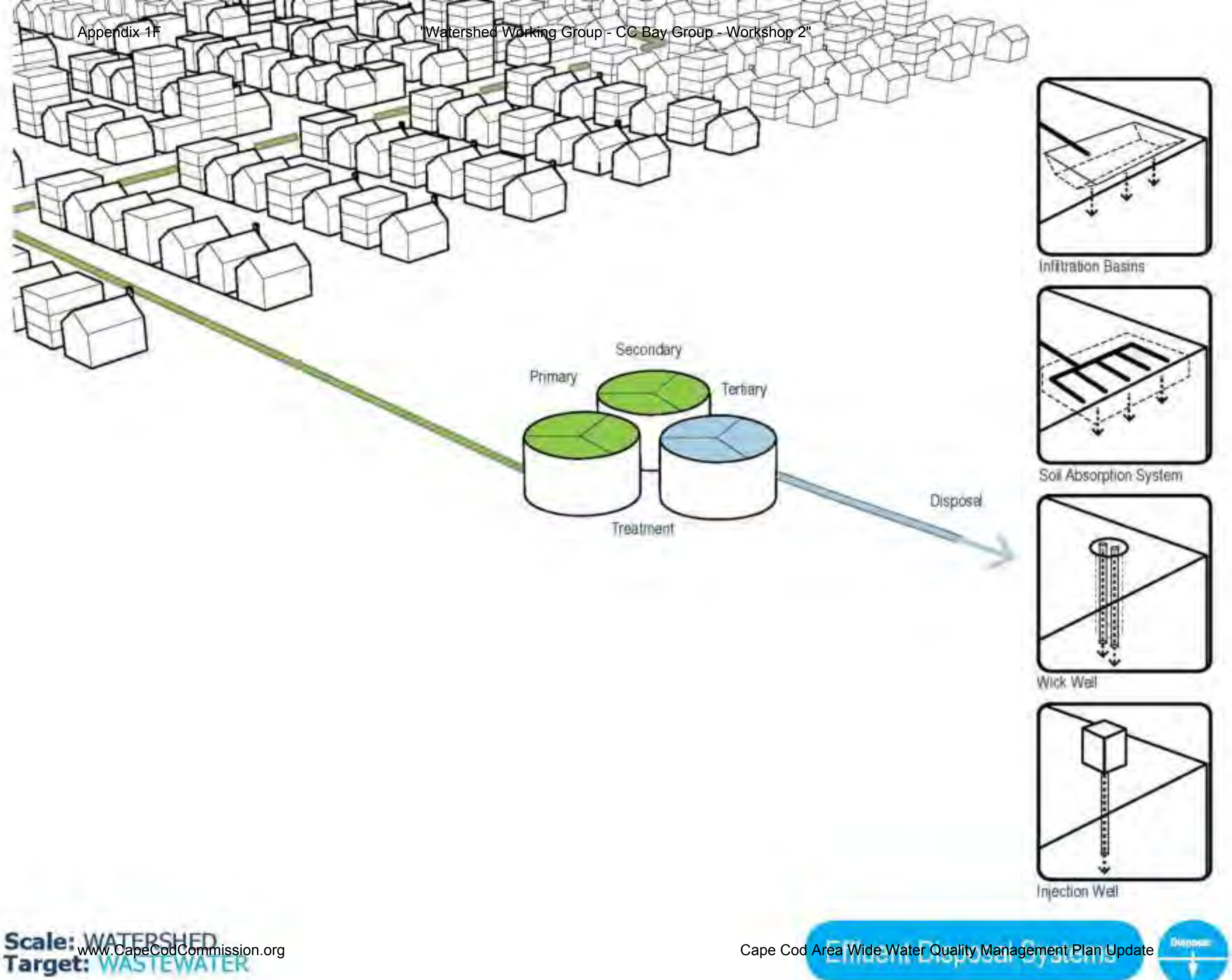
Scale: WATERSHED
Target: WASTEWATER

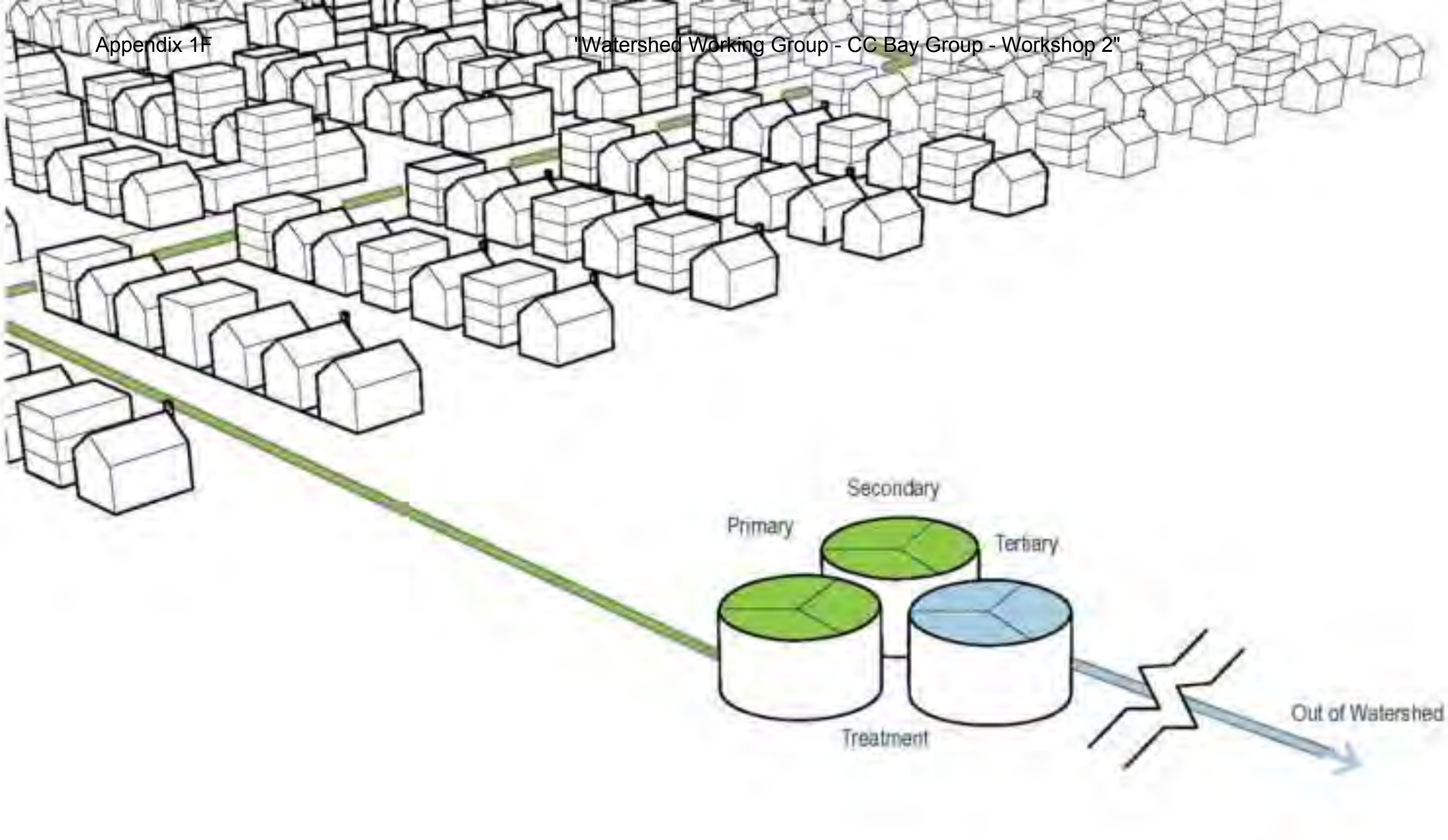
Constructed Wetlands
Subsurface Flow

Precedent: Koh Phi Phi Treatment Wetland, Thailand

Source: Hans Brix

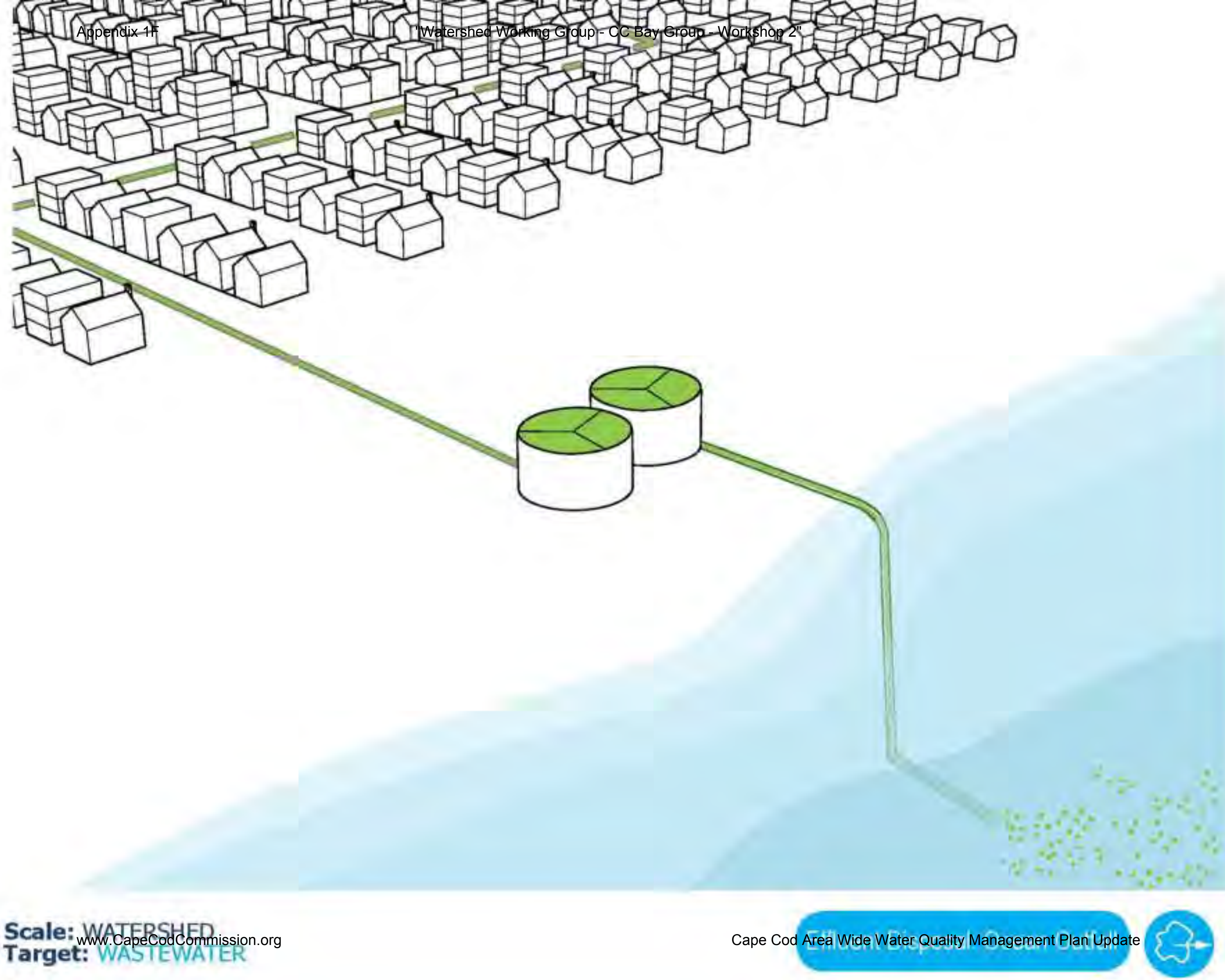
Constructed Wetlands: Subsurface Flow

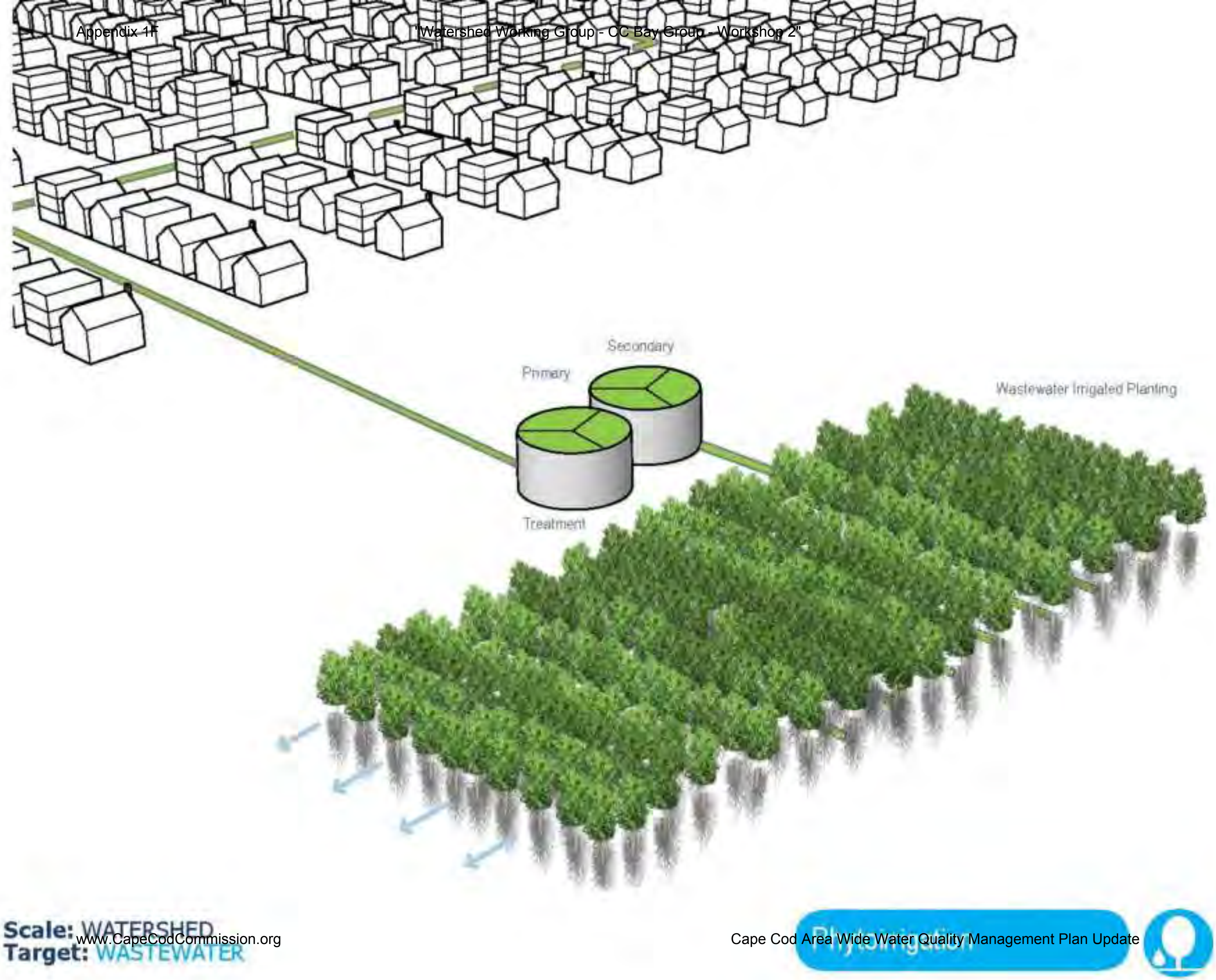

Secondary
Primary
Tertiary
Treatment
Disposal
Infiltration Basins
Soil Absorption System
Wick Well
Injection Well
Scale: WATERSHED
Target: WASTEWATER
Efficient Disposal Systems



Scale: WATERSHED
Target: WASTEWATER

Effluent Disposal: Out of Watershed


Scale: WATERSHED
Target: WASTEWATER

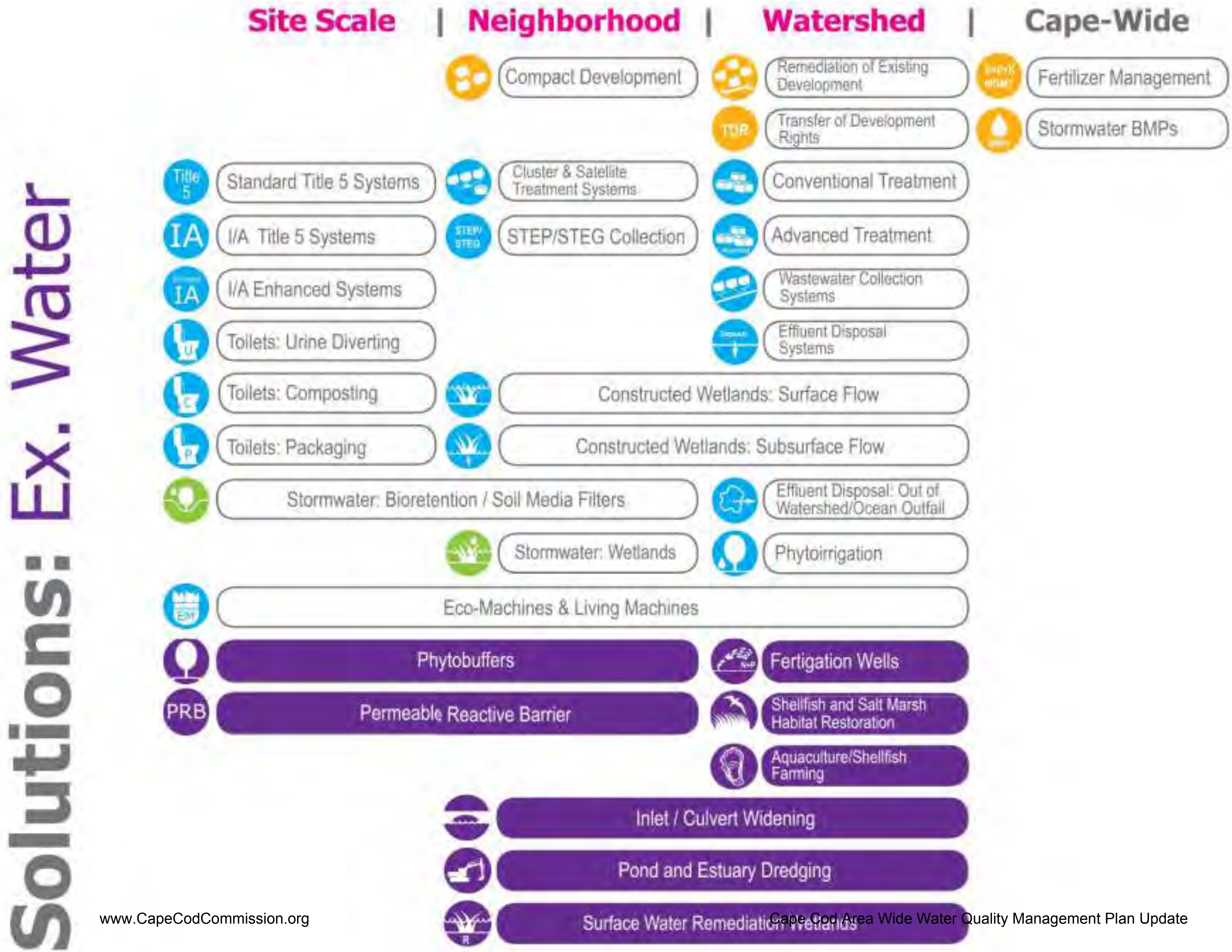

Secondary
Primary
Treatment
Wastewater Irrigated Planting
Scale: WATERSHED
Target: WASTEWATER

Precedent: Woodburn OR, Wastewater Treatment Facility
Source: CH2MHill

Phytoirrigation

Precedent: Woodburn OR, Wastewater Treatment Facility
Source: CH2MHill

Phytoirrigation


Solutions: Ex. Water
Site Scale
Neighborhood
Watershed
Cape-Wide
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
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STEP/STEG Collection
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Toilets: Urine Diverting
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C
Toilets: Composting
Constructed Wetlands: Surface Flow
P
Toilets: Packaging
Constructed Wetlands: Subsurface Flow
Stormwater: Bioretention / Soil Media Filters
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Stormwater: Wetlands
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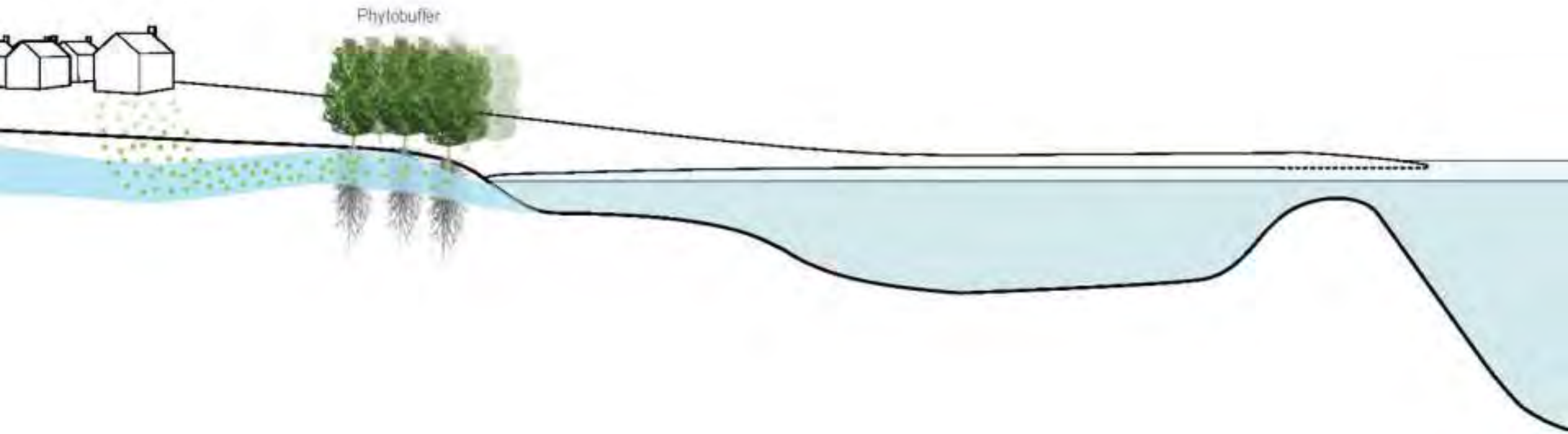
Eco-Machines & Living Machines
Phytobuffers
Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
R
Surface Water Remediation Wetlands



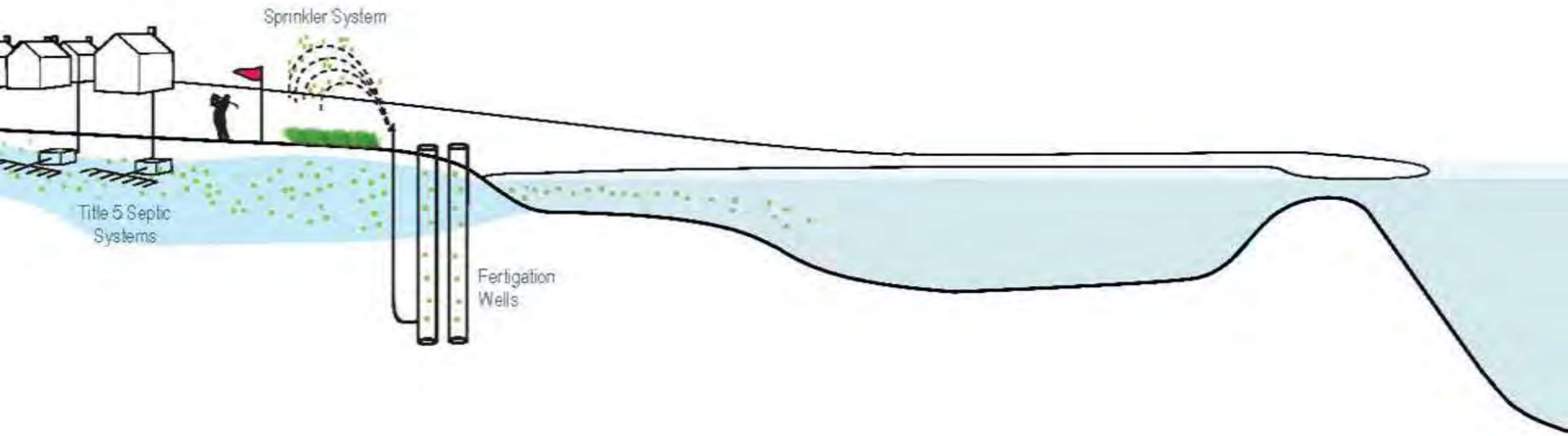
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Phytobuffers

Precedent: Phytobuffer - Kavcee, WY

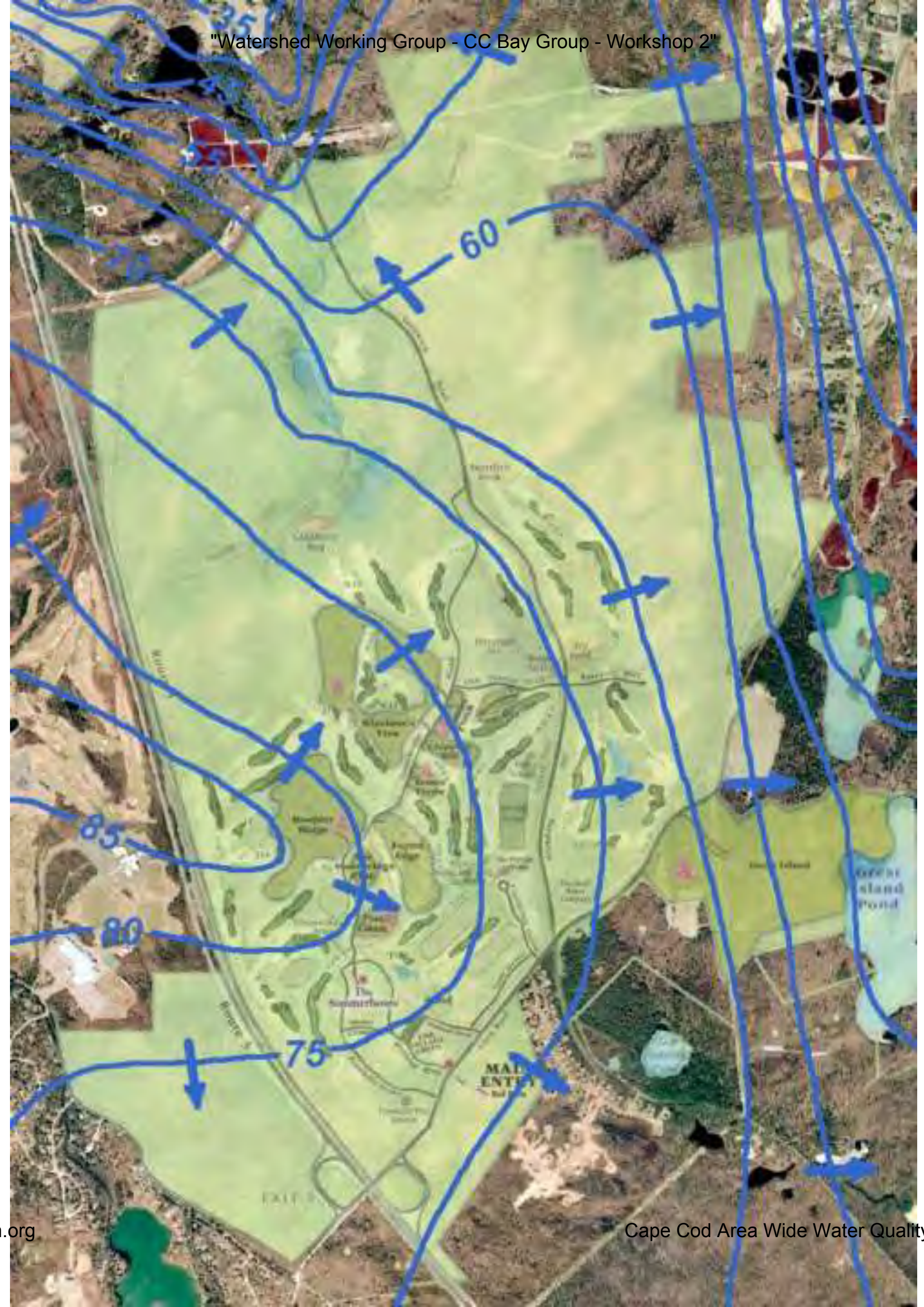
Source: Sand Creek Consultants

Phytobuffers

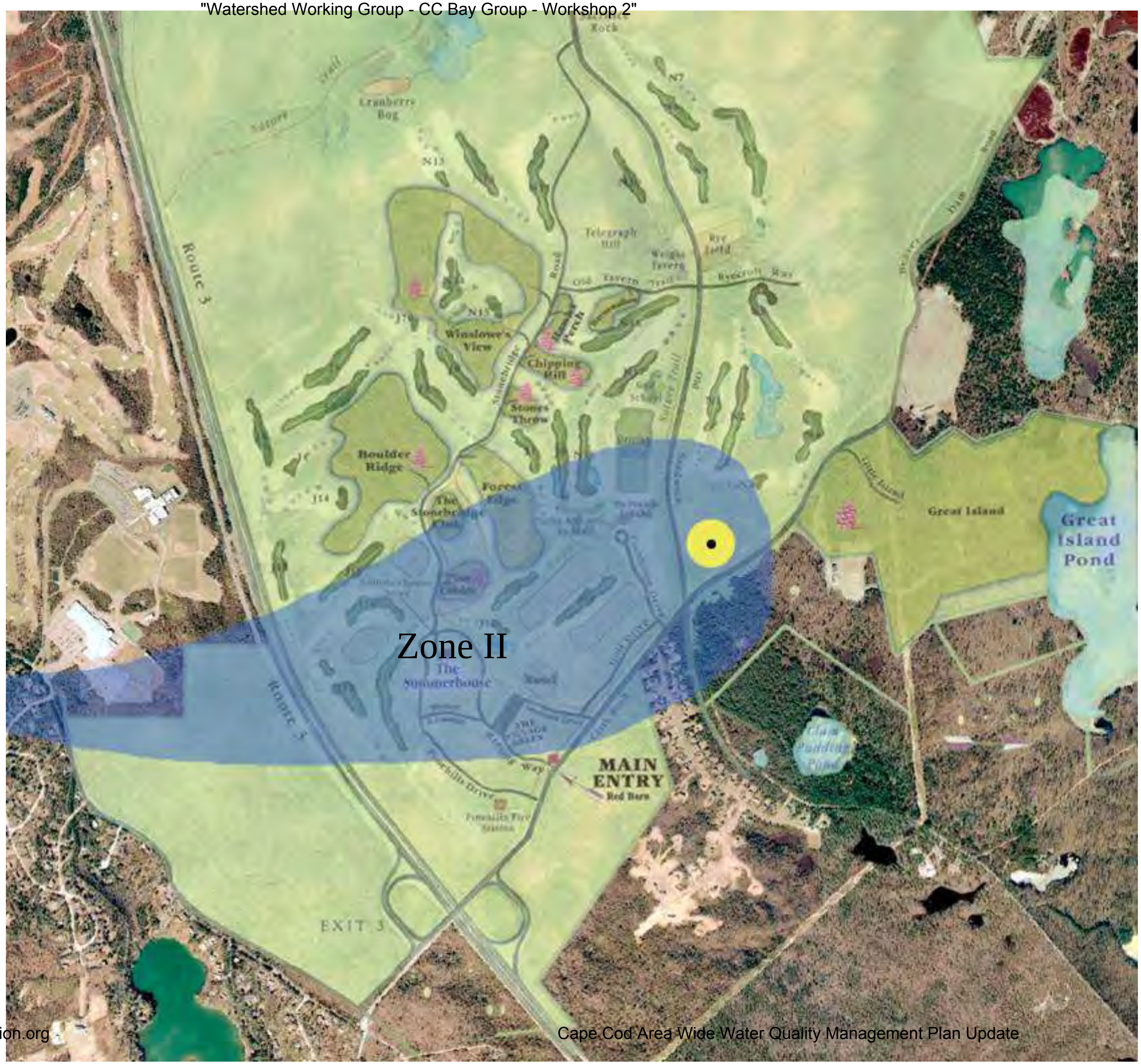


Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

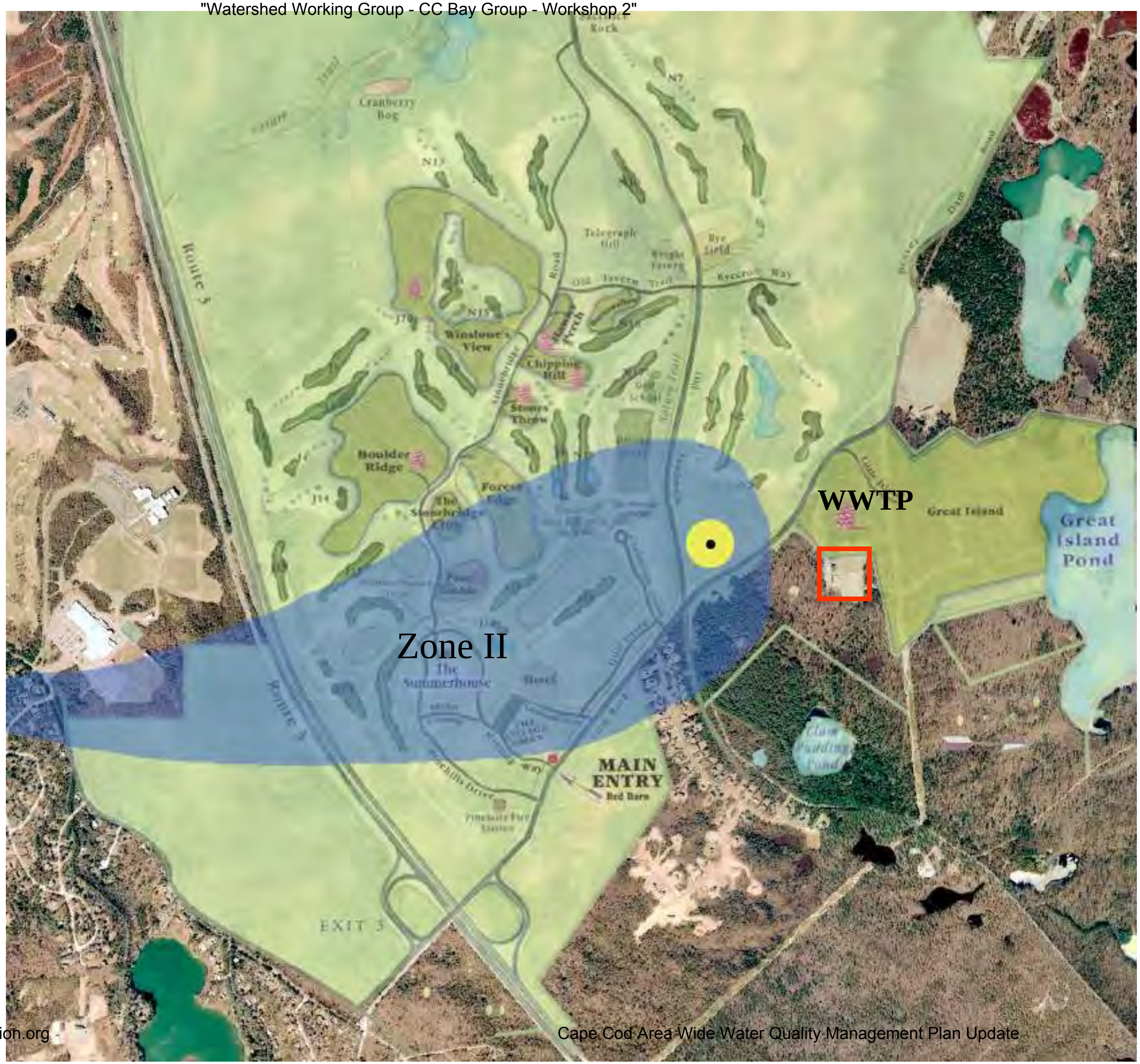
Fertigation Wells



Precedent:
Pine Hills
Plymouth, MA

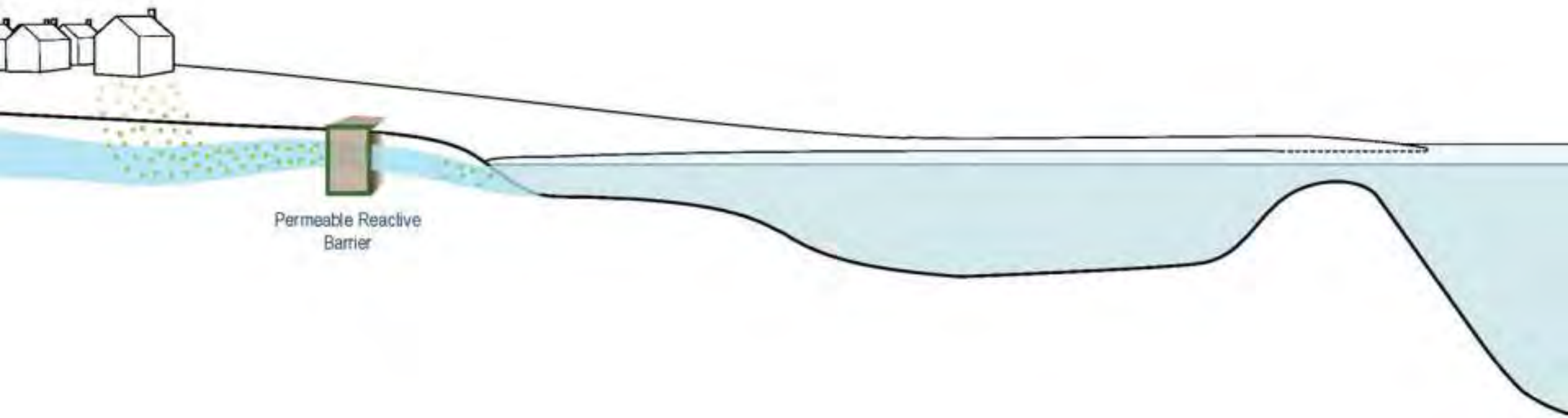


Precedent:
Pine Hills
Plymouth, MA



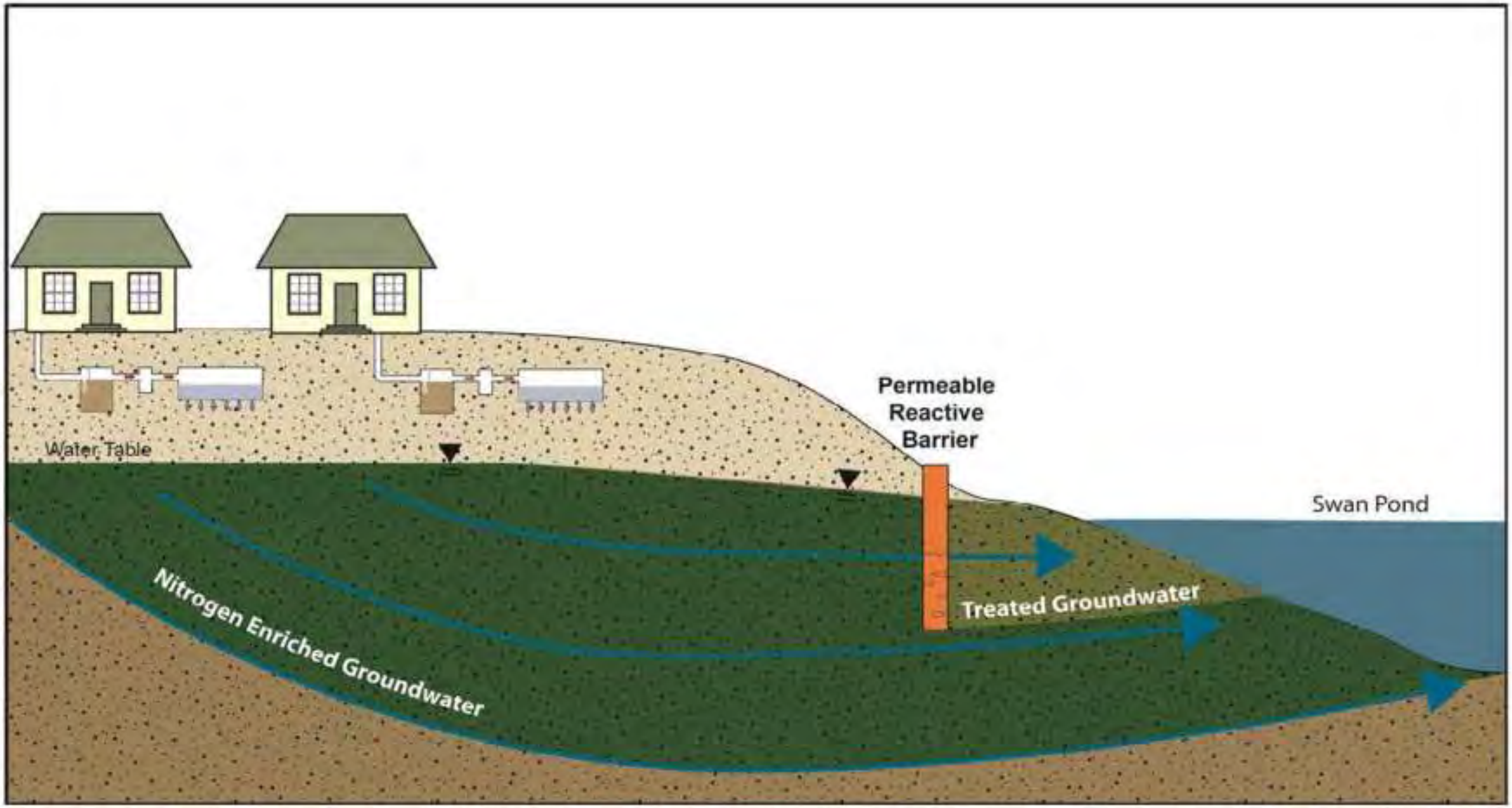
Precedent:
Pine Hills
Plymouth, MA

Precedent:
Pine Hills
Plymouth, MA



Scale: SITE / NEIGHBORHOOD / WATERSHED
Target: EXISTING WATER BODIES

Permeable Reactive Barrier PRB



Precedent: PRB

Source: Horsley Witten Group Inc.

Permeable Reactive Barrier

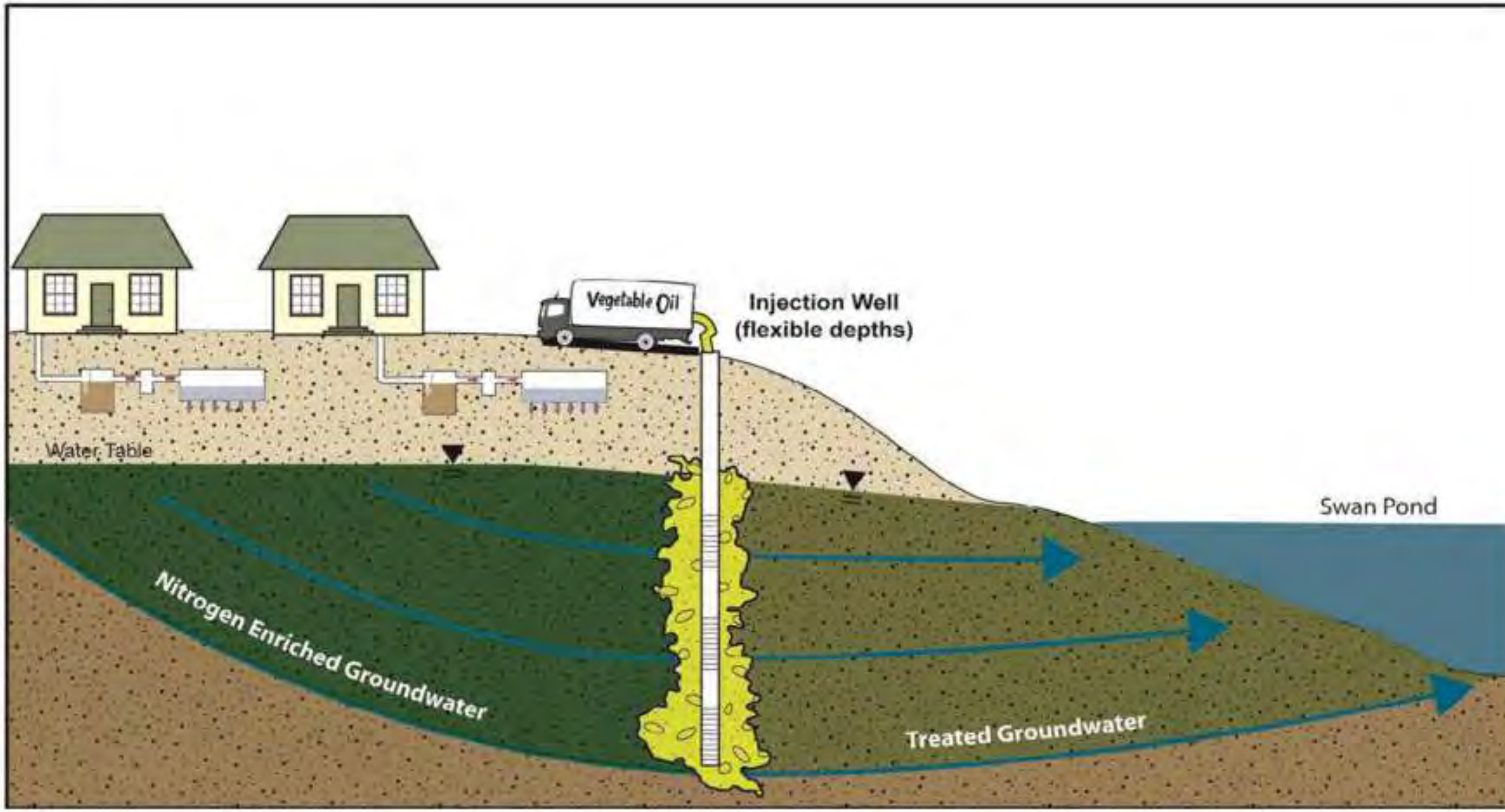
PRB



Precedent: Falmouth PRB

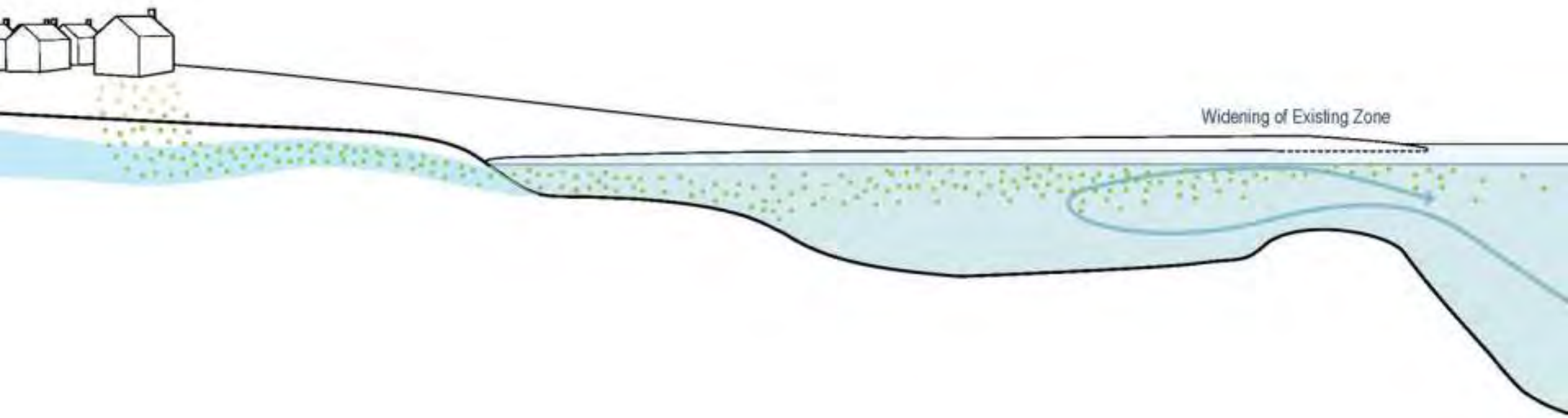
Source: Mike Domenica

Permeable Reactive Barrier PRB



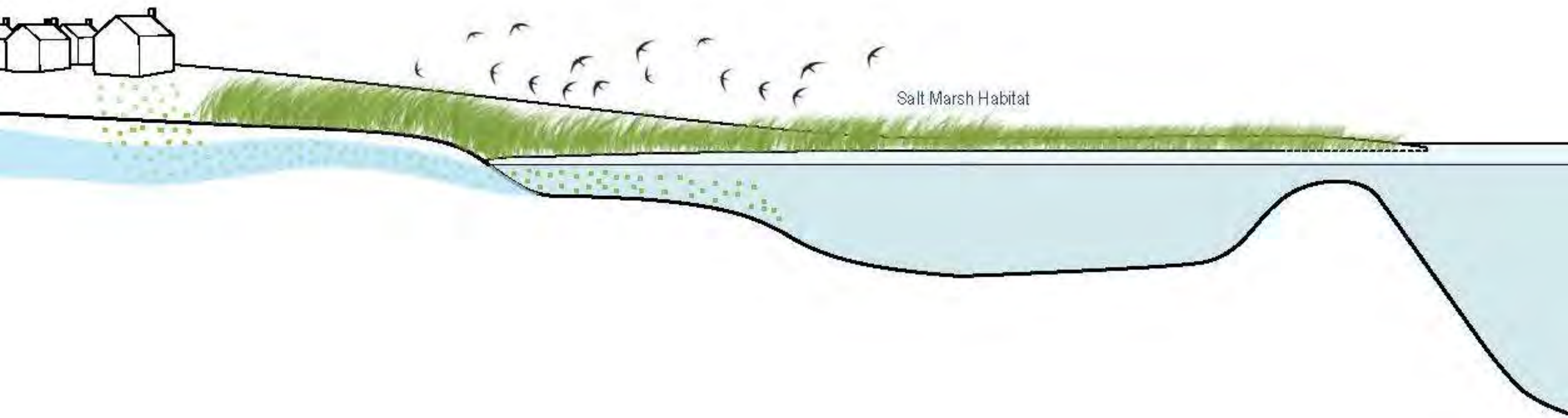
Precedent: PRB
Source: Horsley Witten Group Inc.

Permeable Reactive Barrier PRB



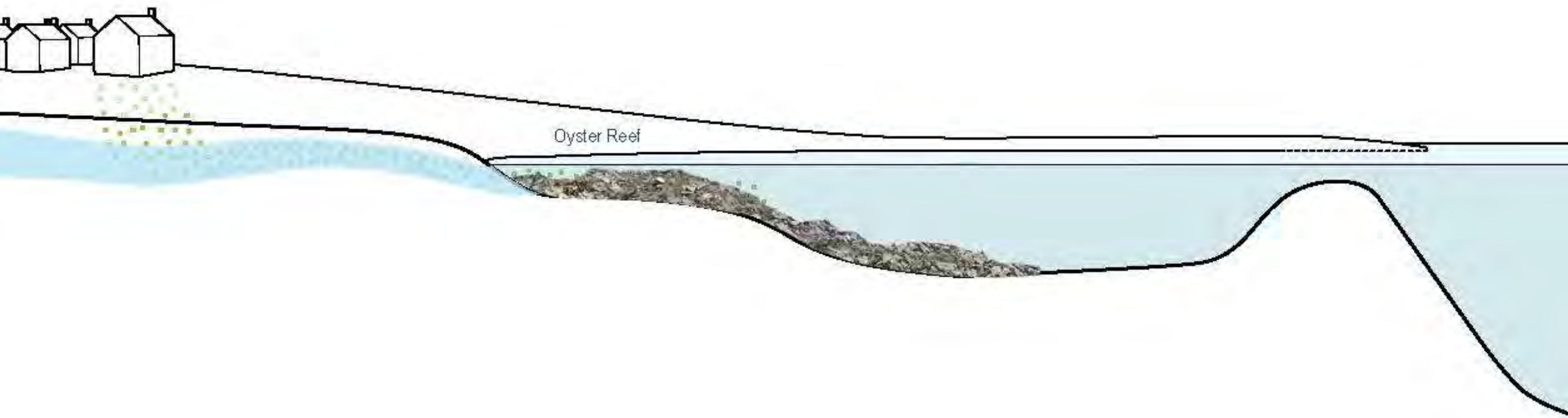
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Inlet and Culvert Widening



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Salt Marsh Habitat Restoration



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Shellfish Habitat Restoration

Precedent: Wellfleet Oyster Restoration Project

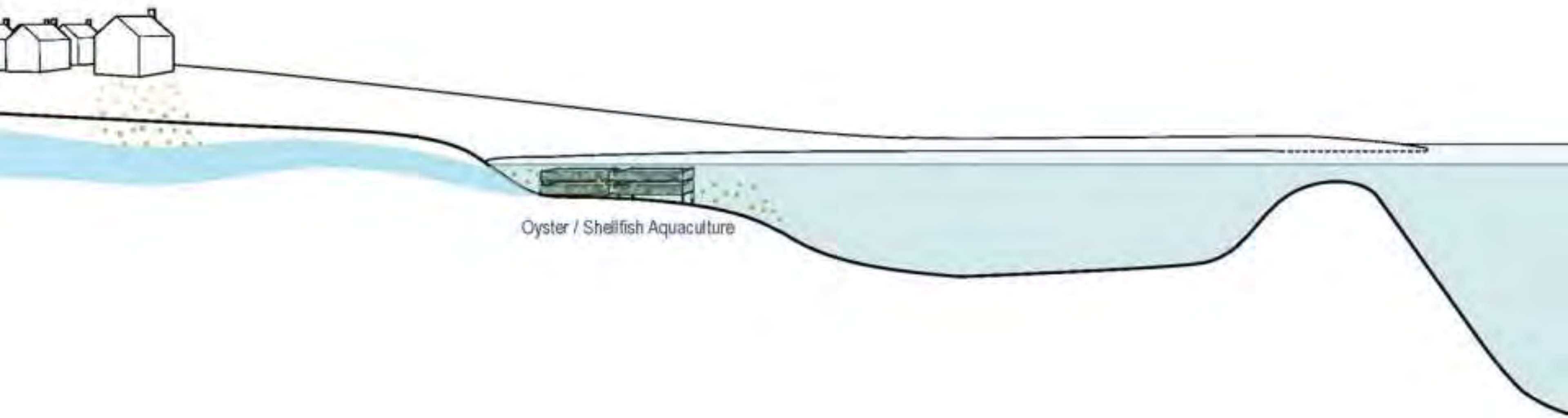
Source: A[illegible]

Shellfish Habitat Restoration

Precedent: Wellfleet Oyster Restoration Project

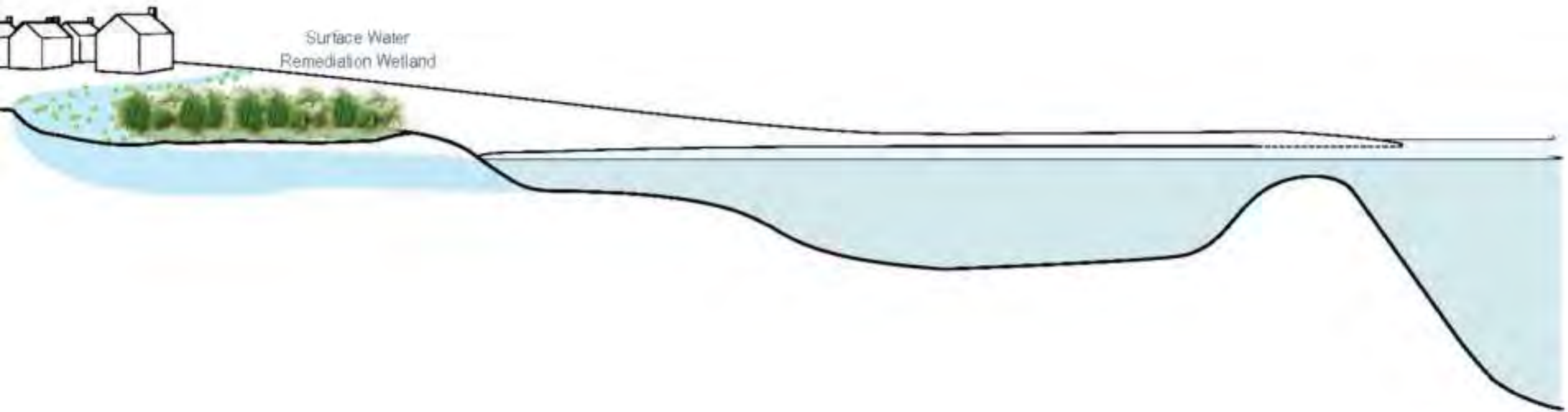
Source:

Shellfish Habitat Restoration



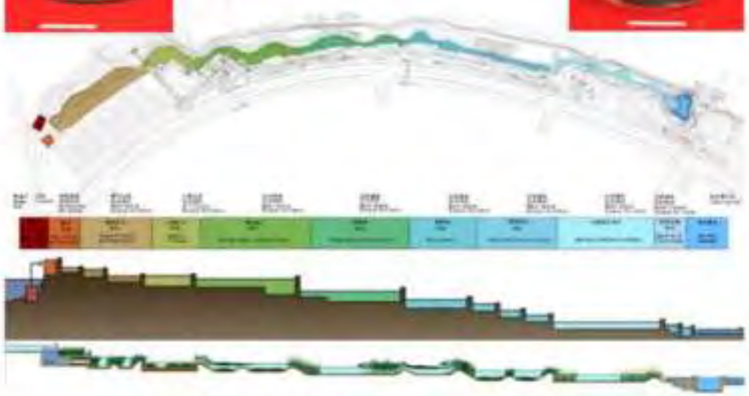
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Aquaculture / Shellfish Farming



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

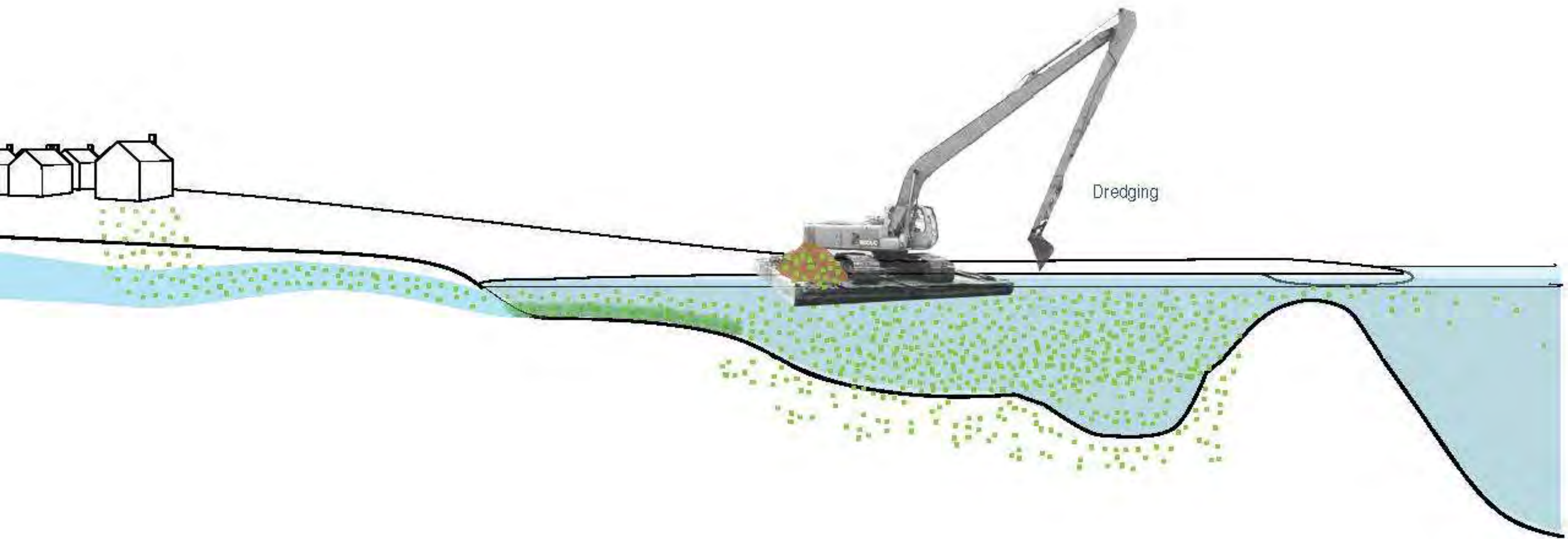
Surface Water
Remediation Wetlands



Precedent: Shanghai Houton Park

Source: Turenscape

Surface Water Remediation Wetlands

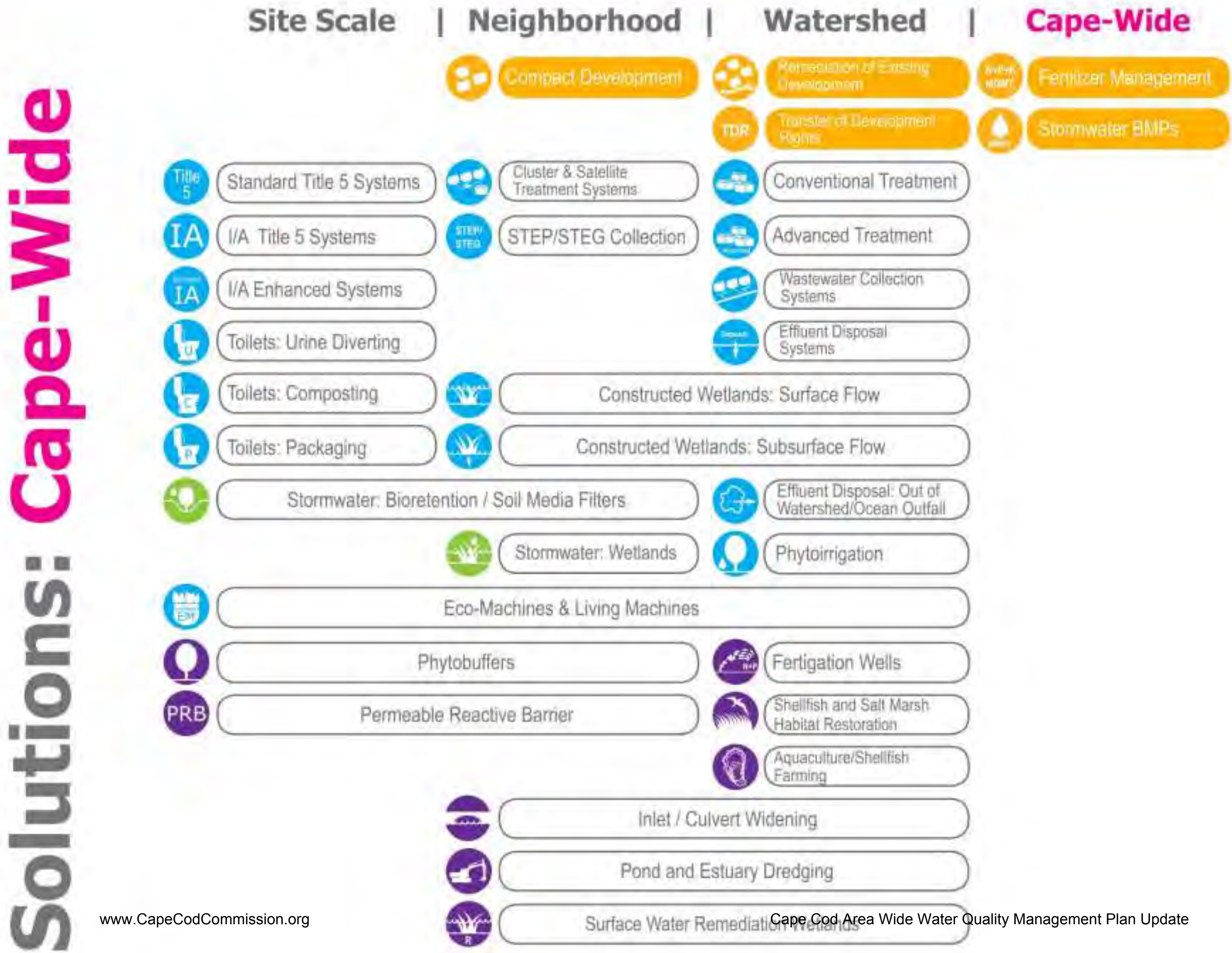


Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Pond and Estuary Dredging

Precedent: Pond and Estuary Dredging - Dennis, MA

Source: Cape Cod Times


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

Scale: CAPE-WIDE
Target: REGULATORY

Compact Development

Scale: CAPE-WIDE
Target: REGULATORY

Fertilizer Management

N+P+K MGMT

Scale: CAPE-WIDE
Target: REGULATORY

Remediation of Existing Development

Scale: CAPE-WIDE
Target: REGULATORY

Transfer of Development Rights

TDR

Transfer of Developments Rights
The Concept

Owner of "sending" parcel sells development rights in exchange for permanent conservation easement.

Owner of "receiving" parcel buys development rights to build at densities higher than allowed under base zoning.

Source: Massachusetts Smart Growth Toolkit

Scale: CAPE-WIDE
Target: REGULATORY

Stormwater BMPs

Town Consideration of Alternative Technologies & Approaches

Wellfleet-	*Coastal habitat restoration & aquaculture*
Mashpee-	*Aquaculture & Expanding Existing Systems*
Brewster-	*PRB & Bioswales*
Orleans-	*Fertilizer Control By-Law*
Harwich &- Chatham	*Muddy Creek & Cold Brook Natural Attenuation*
Falmouth-	*Aquaculture* *Inlet Widening* *Eco-Toilet Demonstration Project* *PRBs* *Stormwater Management (Little Pond Watershed)* *Fertilizer Control By-Law* *Subsurface Nitrogen Removal Septic Systems*


Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
Remediation of Existing Development
Fertilizer Management
TDR
Transfer of Development Rights
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
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Toilets: Urine Diverting
Effluent Disposal Systems
Toilets: Composting
Constructed Wetlands: Surface Flow
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Stormwater: Bioretention / Soil Media Filters
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Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediati
Solutions

Problem Solving Approach

Wastewater | Existing Water Bodies | Regulatory

1 Targets/Reduction Goals

Present Load: X kg/day − **Target:** Y kg/day = **Reduction Required:** N kg/day

2 Other Wastewater Management Needs

A. Title 5 Problem Areas
B. Pond Recharge Areas
C. Growth Management

3 Low Barrier to Implementation

A. Fertilizer Management
B. Stormwater Mitigation

4 Watershed/Embayment Options

A. Permeable Reactive Barriers
B. Inlet/Culvert Openings
C. Constructed Wetlands
D. Aquaculture

PRB

5 Alternative On-Site Options

A. Eco-toilets (UD & Compost)
B. I/A Technologies
C. Enhanced I/A Technologies
D. Shared Systems

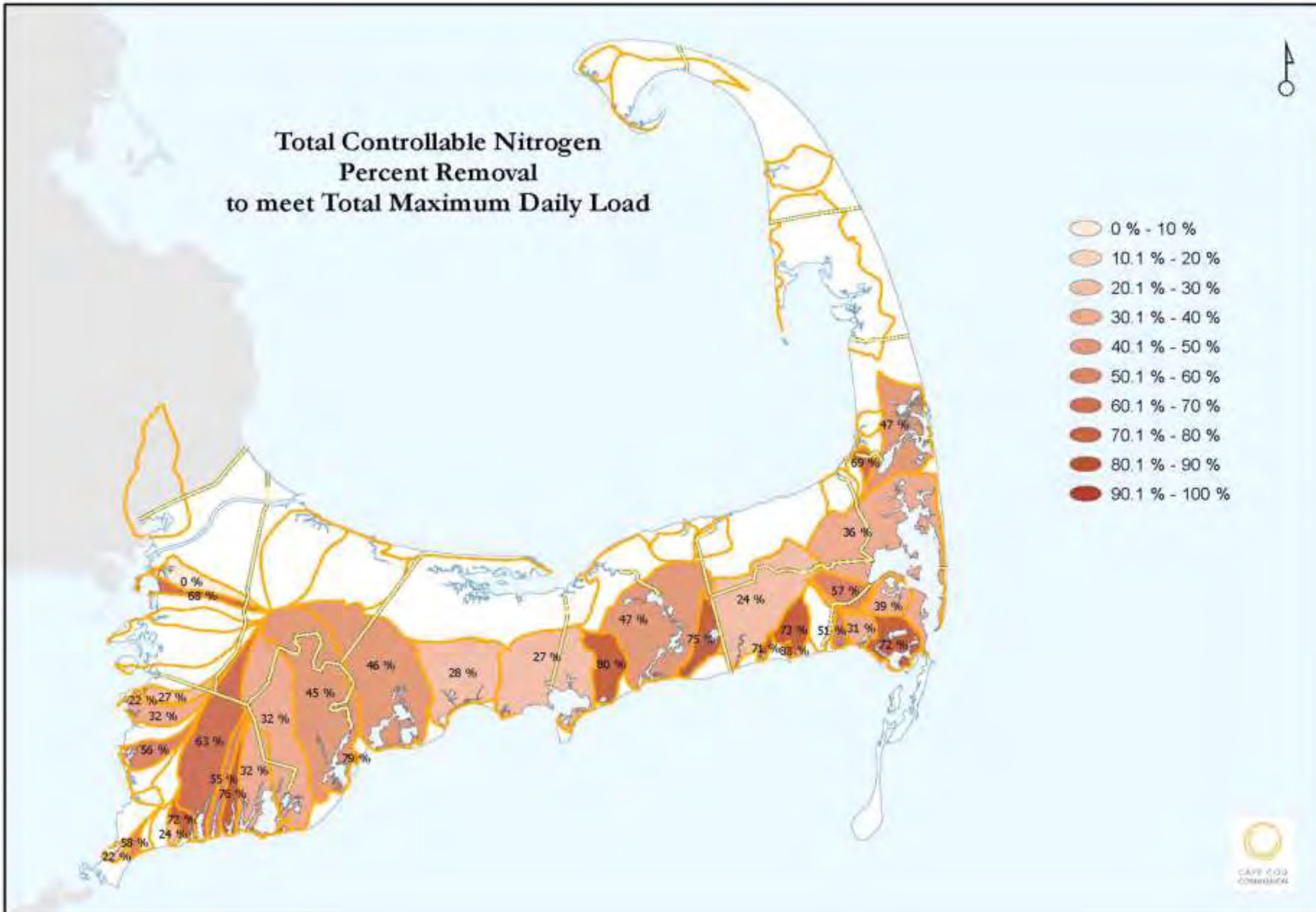
Title 5 | IA | IA

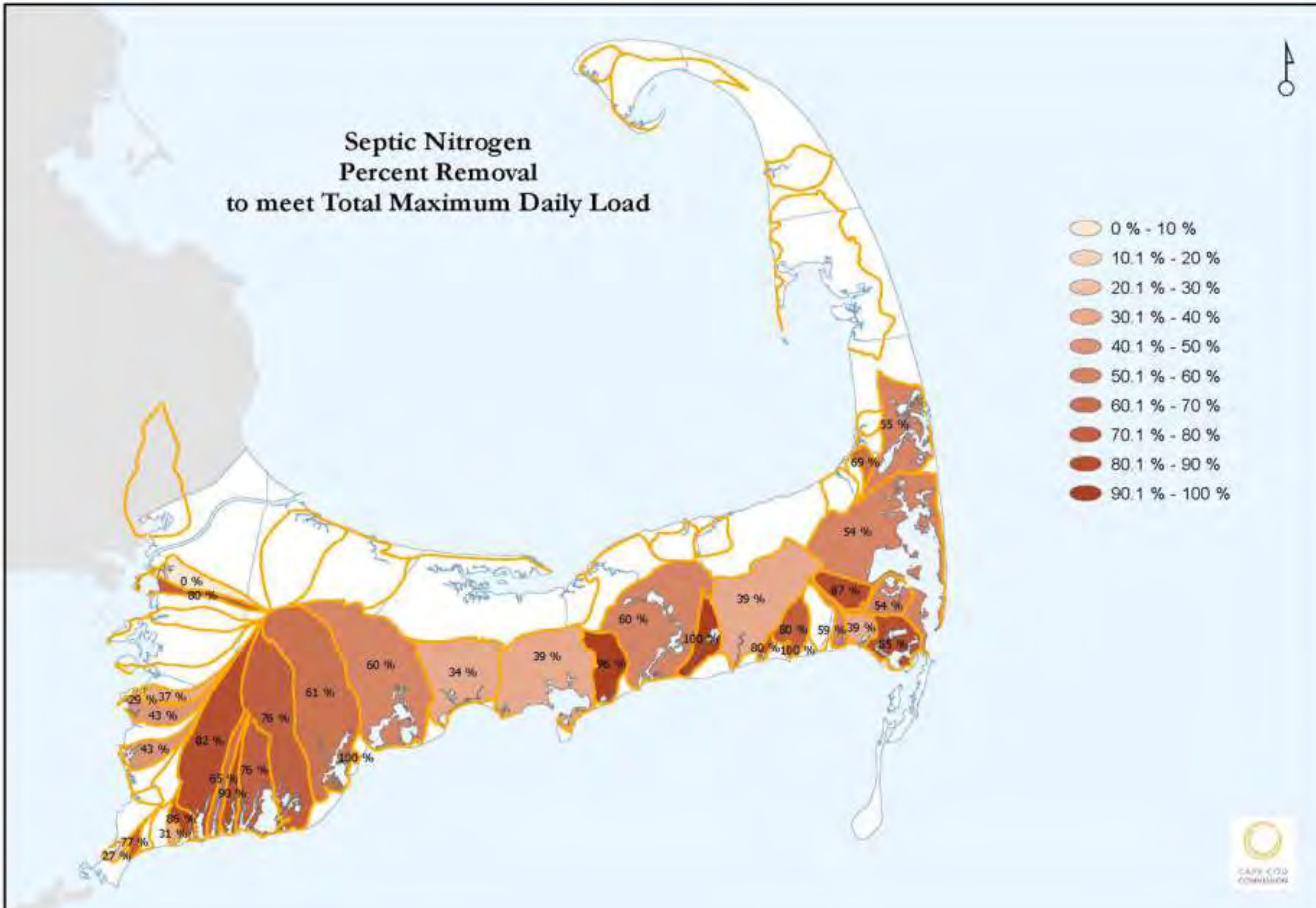
6 Priority Collection/High-Density Areas

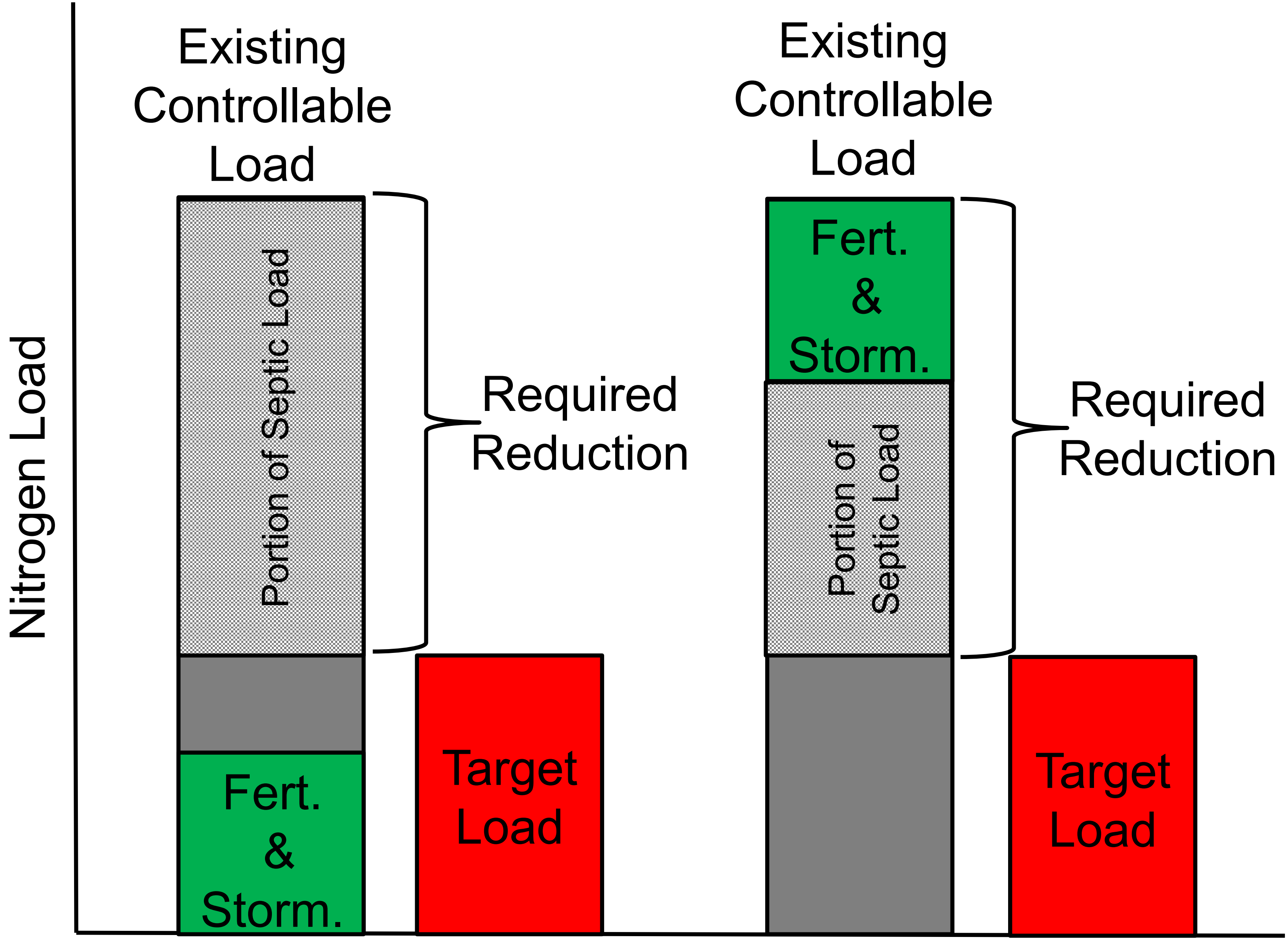
A. Greater Than 1 Dwelling Unit/acre
B. Village Centers
C. Economic Centers
D. Growth Incentive Zones

STEP/STEG

7 Supplemental Sewering


Total Controllable Nitrogen
Percent Removal
to meet Total Maximum Daily Load
0 % - 10 %
10.1 % - 20 %
20.1 % - 30 %
30.1 % - 40 %
40.1 % - 50 %
50.1 % - 60 %
60.1 % - 70 %
70.1 % - 80 %
80.1 % - 90 %
90.1 % - 100 %
47 %
69 %
36 %
24 %
57 %
39 %
47 %
75 %
73 %
51 %
31 %
72 %
71 %
80 %
27 %
28 %
46 %
45 %
32 %
63 %
0 %
68 %
22 %
27 %
32 %
56 %
79 %
32 %
55 %
76 %
72 %
24 %
58 %
22 %


Septic Nitrogen
Percent Removal
to meet Total Maximum Daily Load
0 % - 10 %
10.1 % - 20 %
20.1 % - 30 %
30.1 % - 40 %
40.1 % - 50 %
50.1 % - 60 %
60.1 % - 70 %
70.1 % - 80 %
80.1 % - 90 %
90.1 % - 100 %
55 %
69 %
54 %
87 %
54 %
39 %
60 %
100 %
80 %
59 %
39 %
85 %
80 %
100 %
60 %
34 %
39 %
96 %
61 %
76 %
82 %
100 %
76 %
65 %
90 %
0 %
80 %
29 %
37 %
43 %
43 %
85 %
31 %
77 %
27 %


Nitrogen Load
Existing Controllable Load
Portion of Septic Load
Fert. & Storm.
Required Reduction
Target Load
Existing Controllable Load
Fert. & Storm.
Portion of Septic Load
Required Reduction
Target Load

Problem Solving Approach

Wastewater | Existing Water Bodies | Regulatory

1 Targets/Reduction Goals

Present Load: X kg/day − **Target:** Y kg/day = **Reduction Required:** N kg/day

2 Other Wastewater Management Needs

A. Title 5 Problem Areas
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C. Growth Management

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A. Fertilizer Management
B. Stormwater Mitigation

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A. Permeable Reactive Barriers
B. Inlet/Culvert Openings
C. Constructed Wetlands
D. Aquaculture

5 Alternative On-Site Options

A. Eco-toilets (UD & Compost)
B. I/A Technologies
C. Enhanced I/A Technologies
D. Shared Systems

6 Priority Collection/High-Density Areas

A. Greater Than 1 Dwelling Unit/acre
B. Village Centers
C. Economic Centers
D. Growth Incentive Zones

7 Supplemental Sewering

Triple Bottom Line

Impacts of Technologies and Approaches

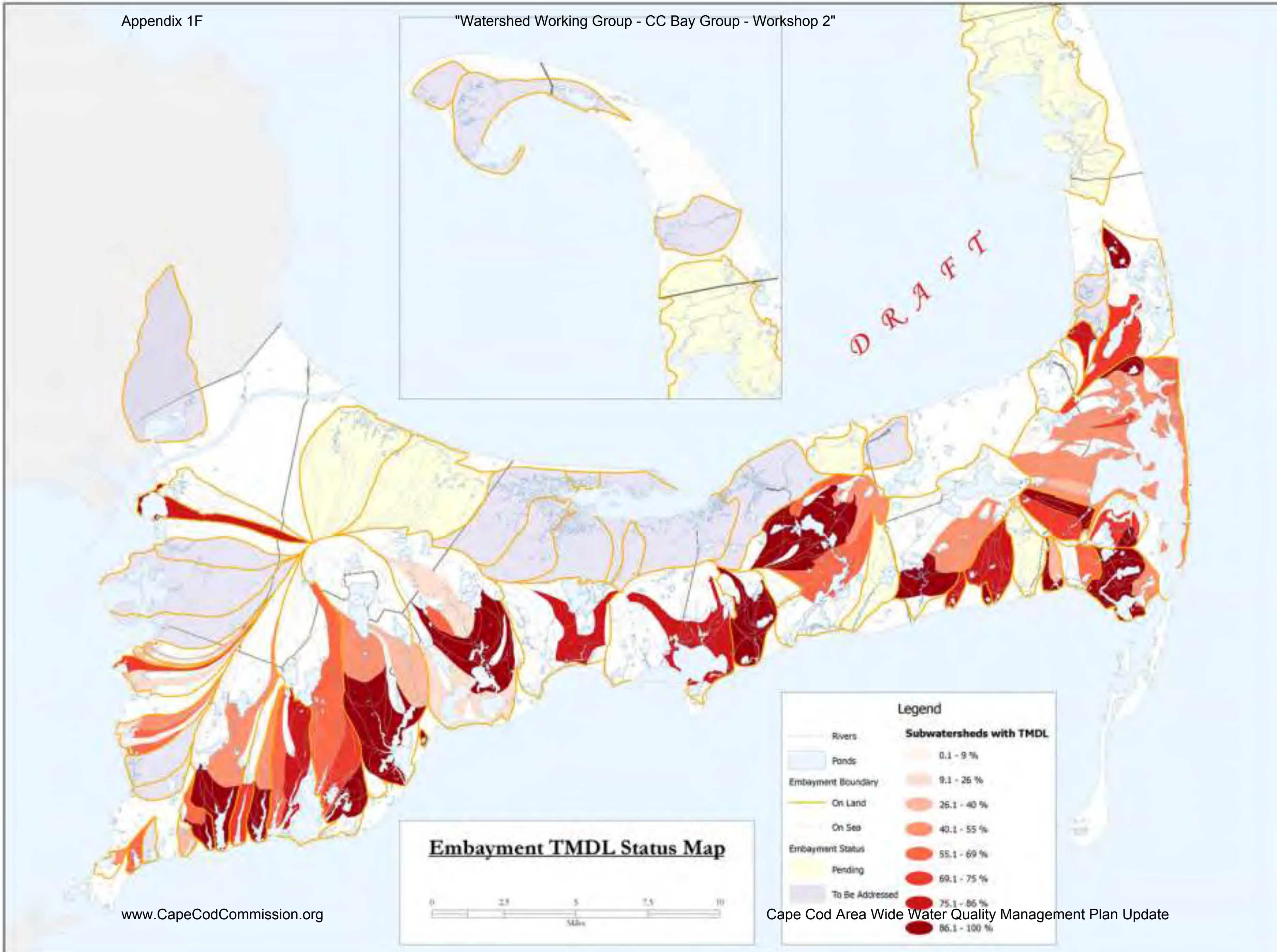
Environmental

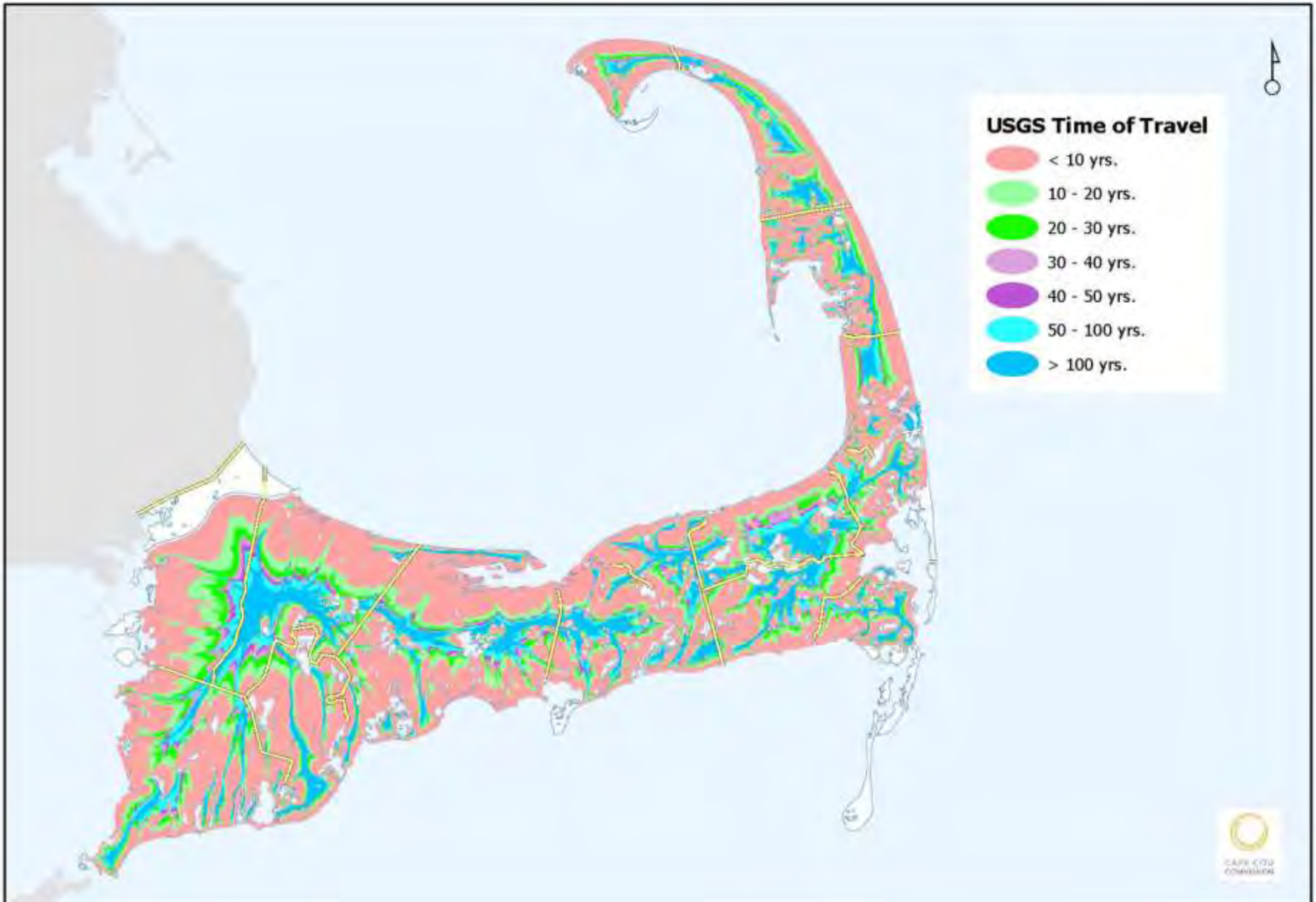
Economic

Social

Technology Selection: Process and Principles

- 100% septic removal subwatershed
- Scale: On-Site vs. Collection System vs. Natural System
- Nutrient intervention and time of travel
- Permitting Status
- Land use and Impacts of Growth


DRAFT
Embayment TMDL Status Map
0
2.5
5
7.5
10
Miles
Legend
Rivers
Ponds
Embayment Boundary
On Land
On Sea
Embayment Status
Pending
To Be Addressed
Subwatersheds with TMDL
0.1 - 9 %
9.1 - 26 %
26.1 - 40 %
40.1 - 55 %
55.1 - 69 %
69.1 - 75 %
75.1 - 86 %
86.1 - 100 %


USGS Time of Travel
< 10 yrs.
10 - 20 yrs.
20 - 30 yrs.
30 - 40 yrs.
40 - 50 yrs.
50 - 100 yrs.
> 100 yrs.

Preparing for Meeting 3 and Beyond

- Review tools and alternatives analysis approach
- Evaluating scenarios for meeting water quality goals
- Attend the November 13th meeting:

6:00
Cape Cod Museum of Art
Dennis, MA

Cape Cod 208 Area Water Quality Planning
Wellfleet Harbor and Pamet River Watershed Working Group

Meeting Two
Wednesday, October 30, 2013
1:00 – 5:00 pm
Wellfleet Council on Aging

Meeting Summary Prepared by the Consensus Building Institute

I. ACTION ITEMS

Working Group

- Next meeting: Meeting Three
  Monday, December 2, 2013
  1:00 – 5:00 pm
  Wellfleet Council on Aging, 715 Old King's Highway, Wellfleet, MA 02667
- Send Kate any additional comments on Meeting One Summary
- Continue to prepare thoughts about which technologies/approaches they would like to learn more about for application in the Wellfleet Harbor and Pamet River Watershed. Different scenarios and options will be discussed during Meeting Three.

Consensus Building Institute

- Send link with presentation to participants
- Finalize Meeting One summary
- Draft and solicit feedback from Working Group on Meeting Two summary.

Cape Cod Commission

- Share Technology Matrix with Working Groups
- Share updated Chronologies with Working Groups
- Compile information about I/A systems from EPA's and MA DEP's websites.

II. WELCOME, REVIEW 208 GOALS AND PROCESS AND THE GOALS OF MEETING

Erin Perry, Special Projects Coordinator at the Cape Cod Commission, welcomed participants and offered an overview of the 208 Update stakeholder process.[1] In July, public meetings were held across the Cape to present the 208 Plan Update goals, work plan, and participant roles. Public meetings were also held in August to present information on the affordability and financing of the updated comprehensive 208 Plan. The first meetings of the eleven Watershed Working Groups were held in September and focused on baseline conditions in each of the

[1] The PowerPoint Presentation made at this meeting is available at: http://watersheds.capecodcommission.org/index.php/watersheds/outer-cape/wellfleet-harbor-pamet-river

watersheds. The second meetings of the Watershed Working Groups will be held in October and early November and are focused on exploring technology options and approaches. The third meetings of the Watershed Working Groups will be held in December and focus on evaluating watershed scenarios which will be informed by Working Groups' discussions about baseline conditions, priority areas, and technology options/approaches. This conversation will also be informed by information shared in the Technology Matrix, which was developed by the Cape Cod Commission with technical input from the Technology Panel. The Technology Matrix builds on the information presented in the Technology Fact Sheets, which Working Group members reviewed in advance of the meeting[2]. Once it is finalized by the Cape Cod Commission, the Technology Matrix will be shared with Working Group Members.

Ms. Perry, shared 208 Plan team's progress since Meeting One which includes:

- Meeting materials distributed to stakeholders and available at http://watersheds.capecodcommission.org
- GIS data layers accessible at: http://watersheds.capecodcommission.org
- Chronologies are being updated and will be made available soon

Ms. Perry also shared that the second round of Cape2O game is launching on October 22. She noted that over 400 people registered for the first round of the Cape2O game and encouraged Working Group members to participate in the interactive, online game which provides valuable education and input to the Cape Cod Commission.

Ms. Perry announced that there will also be a Cape Cod wide event on November 13 at the Cape Cod Center for the Arts in Dennis. Participants from across the eleven Watershed Working Groups and the public are invited to attend the event which will include: Wrap up of Cape2O: ur in charge!; a summary of planning process to date; discussion of the stakeholder role in the second 6 months of the 208 planning process.

Dan Milz, a doctoral candidate at the University of Illinois at Chicago, introduced himself and explained that he would like to videotape the meeting for purposes of his dissertation research. He indicated that, although the meeting is public, the recording would be kept private and that he would withhold names and affiliations in his work.

Ms. Perry reviewed the goal of the meeting:

- To develop a shared understanding of the potential technologies and approaches identified to date, and the benefits and limitations of each; to explore the environmental, economic, and community impacts of a range of categories of solutions; and to identify priorities and considerations for applying technologies and approaches to remediate water quality impairments in your watershed.

[2] Technology Fact Sheets are available at: http://watersheds.capecodcommission.org/index.php/watersheds/outer-cape/wellfleet-harbor-pamet-river

Kate Harvey, the facilitator from the Consensus Building Institute, reviewed the agenda and led introductions. A participant list can be found in Appendix A. She also requested that, if anybody has any additional comments or edits to the Round 1 meeting summary, they send them to her.

III. RANGE OF POSSIBLE SOLUTIONS

Scott Horsley, Area Manager for the Wellfleet and Pamet River Working Group, led the discussion of the range of possible solutions. As Working Groups learn more and consider the pros and cons of the technologies and approaches, he encouraged participants keep in mind that:

- The Cape Cod Commission has engaged in a comprehensive analysis of nutrient control technologies and approaches. This analysis is distilled into: the Technology Fact Sheets, which present various information on the technologies being considered; the Technology Matrix, which includes additional information on site requirements, construction, project and operation and maintenance costs, reference information, and regulatory comments; and ongoing input from stakeholders on the public acceptance of technology options and approaches.
- Not all of the technologies and approaches will be applicable to Cape Cod.
- Some technologies are so promising that we should identify them for demonstration and pilot projects.
- Workshop 3 will embark on hands on problem solving in each watershed to meet target load reductions.
- Certain technologies or approaches will be effective at preventing nutrients from entering the water body. Others will be effective at reducing or remediating nutrients that are already in the groundwater or water body.
- Regulatory programs can address nutrient controls for both existing development and future development.

Mr. Horsley offered a brief overview of the technologies and approaches. The following section briefly describes each technology. Participants' questions and comments about the technologies are also discussed below *(in italics)*:

Site level technologies/approaches

<u>Standard Title V System</u>*:* This is a standard septic system that consists of a septic tank and soil adsorption system (leaching field). The system was primarily designed to address public health concerns related to waste in drinking water (e.g. coliform bacteria); they were not designed to remove nutrients (e.g. nitrogen).

<u>I/A title V System:</u> Innovative/Alternative (I/A) on-site nutrient reducing systems typically consist of standard septic system components augmented to remove more nutrients than a

standard Title 5. I/A systems refer to a class of systems intended to be designed as recirculating sand filter (RSF) equivalents by meeting the same treatment limits in a smaller footprint.

- *Responding to a statement from Mr. Horsley that I/A systems can capture up to 80% of controllable nitrogen, a working group member emphasized that the 80% figure refers to controllable nitrogen, not the entire nitrogen load. It misses what the environment can actually absorb. In Orleans recently, the harbor basin was removed from TMDL requirements because 95% of nitrogen was coming in on the tide. When you're looking at costs and start looking at trade-offs, 60-95% of the problem comes from birds and other natural sources. We need to be very clear about the messaging around this.*
- *A working group member noted that Title V requirements, which were written in the 1970s, were not good enough to capture the nitrate building up in the groundwater. Title V was a good rule for Massachusetts as a whole, but it was not a good rule for the Cape because our soils are so sandy. On the Cape, you also need to put carbon into the ground to encourage bacterial growth in the ground. Back in the 1970s, Title V was very contentious, with people saying that they could not afford to install a system that cost so much money. The state implemented Title V anyways. It is important that MA DEP and EPA recognize that some of today's problem stem from these old regulations.*
    - Mr. Horsley responded that Title V was designed to remove pathogens and control public health, but it was not written to control nutrients. With regards to the carbon source: a lot of I/A systems work to introduce carbon sources into the ground to encourage bacterial growth under the ground. There is more information available about I/A systems on EPA's and MA DEP's websites, and the Cape Cod Commission will compile some information for all of you. The performance data on I/A systems is very variable, and a key factor in how well these systems perform is how well the homeowner maintains these technologies. For example, a common challenge that we have seen is that homeowners will unplug a methane pump in order to save on electricity and, without a functioning methane pump, the I/A system does not work very well.

<u>Urine Diverting Toilets</u>: Urine diversion systems send urine into a holding tank where the urine is stored and periodically collected by a servicing company. The servicing company empties the tank for disposal or recycling such as conversion to a fertilizer. Through these means, the nitrogen may be removed from the watershed. With urine diverting toilets, the remainder of the human waste and all other water uses (sink and shower) continue to go to the septic system. (Case example, Falmouth, MA).

<u>Composting toilets</u>: A toilet system which separates human waste from shower, sink and other household water uses. The composting toilets use no or minimal water. The human waste captured by the composting toilets is decomposed and turned into compost. The compost generated is removed from the site and nutrients can be recycled. Composting toilets require the replacement of existing toilet(s) and room in the basement for a container to capture and compost the human waste. Household water use (sink and shower uses) continue to flow to the septic system. (Case example, Falmouth, MA).

- *Why is there such a large difference in nitrogen-removal efficiency between urine-diversion and composting toilets?*
  - Mr. Horsley said that this issue needs further investigation.
- *With a composting toilet, you would need to pump the septic system much less frequently. There would still be some food waste going into it, but not sewage waste.*

Packaging toilets: A packaging toilet encapsulates human waste in a durable material for removal from the site. The package is stored beneath the toilet and removed and taken away when full. The nutrients can be recycled by the servicing company that picks up the packages.

Stormwater bioretention: Bioretention systems utilize natural plant and soil functions to capture and treat stormwater runoff for a variety of contaminants including nutrients. A typical system consists of an underdrain/gravel layer, a layer of bioretention soil mix (a mix of sand, compost, woodchips and loam), and a surface layer containing appropriate plantings. The treated water can be discharged into a water body or used for open space irrigation after treatment. The reclaimed water can also be discharged into a subsurface infiltration system for discharge to the groundwater. (Case example, Portland, OR).

- *Chatham has installed some of these systems, correct?*
  - Mr. Horsley responded that every town on the Cape has implemented quite a few of these systems. Towns have been retrofitting parking lots. These systems remove pathogens and also remove nitrogen and phosphorus.

Neighborhood level technologies/approaches

Cluster and satellite treatment systems: A cluster or satellite system is a collection and treatment system treating wastewater flows from multiple properties.

STEP/STEG collection: Septic Tank Effluent Pumping (STEP) and Septic Tank Effluent Gravity (STEG) systems convey liquid wastewater from on-site septic tanks to sewer systems. Only the liquid component of the wastewater may be conveyed by pumps or by gravity.

- *Why does the nitrogen removal for this system say "NA" on the fact sheet?*
  - Mr. Horsley explained that STEP/STEG collection is basically a cost-saving measure that collects waste from Title V systems. It does not add any additional treatment to the septic treatment technology.

Eco machines and living machines: Living or Eco-Machines are natural systems that treat septic tank effluent or primarily treated wastewater. In these systems, aeration and clarification chambers are combined with constructed wetlands to treat the influent. The wetlands are a series of chambers allowing for microbial communities to engage with and treat the wastewater. Plants are often suspended on racks with their roots systems doing the work. Solids removal is generally onsite, after which water is pumped through the gravel filled cells (similar to subsurface wetlands.) This process transfers more oxygen to the wastewater and completes the pollutant removal process. (Case example, South Burlington, VT).

<u>Stormwater wetlands</u>: Constructed wetlands provide aerobic chambers followed by subsurface anaerobic chambers that facilitate nitrification followed by denitrification, respectively. This process mimics that of natural systems coupled with engineering design guaranteeing residence time within a chamber containing anaerobic conditions. (Case example, China).

- *Do the constructed wetlands have concrete at the bottom?*
    - The can have many different designs. They can be large or small, and they can be constructed in the water table, in which case they would not need to be lined, or they can be higher than the water table, in which case they would need to be built with some sort of lining material to retain water. Wetlands are very flexible in how they work.
- *Has there been any conversation about changing the MA DEP regulations around natural wetlands? In some places in the South, some people are running stormwater directly to natural wetlands and monitoring the health of the wetlands to make sure that this is not causing any adverse effects.*
    - Mr. Horsley noted that Massachusetts' wetlands regulations were enacted in 1995. He added that he has not heard any discussion about the state changing those regulations. The current policy says that "no untreated discharge" can be sent to wetlands, meaning that stormwater would have to undergo some primary treatment before it is sent to natural wetlands. This regulation would be difficult to change in Massachusetts as the wetlands-protection constituency is pretty satisfied with the current system.

Watershed level technologies/approaches

<u>Conventional treatment</u>: A conventional wastewater treatment facility typically treats wastewater collected from homes and businesses. A groundwater discharge permit is required. Treatment generally results in less than 10 mg/L Nitrogen.

<u>Constructed wetlands: surface flow</u>: After primary treatment in a septic tank or wastewater treatment facility or secondary treatment at a wastewater treatment facility, water is fed into a surface flow constructed wetland. Surface flow constructed wetlands closely mimic the ecosystem of a natural wetland by utilizing water loving plants to filter wastewater through their root zone, a planted medium, and open water zones. Surface flow wetlands are systems where open water is exposed much like in a natural marsh. The reclaimed water from the wetland can be discharged into a water body or used for open space irrigation after treatment as well as discharged into a leach field. (Case example, Albany, OR).

<u>Constructed wetlands: subsurface flow</u>: After primary treatment in a septic tank or wastewater treatment facility or secondary treatment at a wastewater treatment facility, wastewater is treated by pumping water slowly through subsurface gravel beds where it is filtered through plant root zones and soil media. Water flows 3-8" under the surface to prevent public exposure to wastewater and mosquito breeding. A combination of horizontal and vertical flow

subsurface systems must be utilized to provide total nitrogen removal. This solution can also offer opportunities for recreation activities on land above the subsurface system. (Case example, Thailand).

- *Due to Cape Cod's very sandy soils, we do not have a whole lot of soil that holds water. Particularly in Eastham, but also other places on the Cape, I cannot think of many places where there is standing water that is not part of the natural water table. I understand that MA DEP and EPA want us to look at all of these options, but I hope that they are not thinking that we will have the resources to build a watertight wetland.*
  - Mr. Horsley responded that wetlands can be constructed in the water table, in which case they would not need to be lined, or they can be higher than the water table, in which case they would need to be built with some sort of lining material to retain water. The unlined wetlands would be cheaper to construct.
- *I like that we are looking at a number of different options as having this many options before us presents a "Chinese menu" of various options that we could be looking at in terms of best management practices.*

<u>Effluent disposal: out of watershed</u>: Effluent disposal can take a variety of forms, including infiltration basins, a Soil Absorption System, Injection Wells or Wick Wells. These disposal methods place highly treated effluent back into groundwater. Effluent Transport out of the watershed has the advantage of removing the nitrogen load to another watershed. Transport to another watershed requires the receiving watershed to be able to accommodate the additional nitrogen load.

<u>Effluent disposal: ocean outfall:</u> Similar to out of watershed effluent disposal, highly treated effluent is transported out of the watershed and into the ocean. This solution requires a high level of regulatory oversight. The solution is considered due to limited land availability for disposal on Cape Cod.

<u>Phytoirrigation:</u> After secondary treatment, wastewater treatment facility effluent is irrigated onto plants to remove nutrients and other contaminates. Fast growing poplar and willow trees are typically used. (Case example, Woodburn, OR).

- *How far below the surface is the groundwater in the Woodburn example?*
  - Mr. Horsley responded that, in this case, the depth of the groundwater would not matter since the trees are being watered with enriched water, but that in some cases groundwater depth would have to be taken into consideration.

Neighborhood or Watershed level technologies/approaches

<u>Phytobuffers</u>: Using trees with a deep root system to capture nutrients in the soil, particularly willows and poplars. Green plants with deep tap roots are planted as a buffer to intercept existing groundwater. The plants and their associated microorganisms reduce contamination in soils and ground water. Often phytohydraulics causes the groundwater plume to be redirected and pulled towards the plants. (Case example, Kavcee, WY).

Fertigation wells: Fertigation wells can capture nutrient enriched groundwater, typically from a wastewater treatment facility discharge, and recycle it back to irrigated and fertilized turf grass areas. These irrigated areas include golf courses, athletic fields and lawns. Fertigation can significantly reduce nutrient loads to downgradient surface waters while reducing fertilizer costs to the irrigated areas. (Case example, Plymouth, MA).

- *There is a plume near Truro that could be captured using this sort of technology.*
  - Mr. Horsley noted that one would have to be careful about the source of the plume because it would be dangerous to return metals and other wastes if the plume comes from a landfill.
- *How does this technology work during the winter?*
  - Mr. Horsley responded that the wells would be shut off during the winter, but noted that groundwater flows about a foot per year on the Cape, and when the wells are turned back on during the spring, they capture all of the water that flowed past during the winter.
  - *A member of the public added that, for untreated water flows, fertigation wells must be placed at a sufficient distance from the source to allow water to flow for two years underground so that pathogens are killed before they are picked up by the wells.*

Permeable reactive barrier (PRB): A permeable reactive barrier (PRB) is an in-situ (installed within the aquifer) treatment zone designed to intercept nitrogen enriched groundwater. Through use of a carbon source, microbes in the groundwater uptake the nitrogen, denitrifying the groundwater. PRB systems typically use vertical trenches, sequences of bored columns or injection methods to introduce the carbon source into the groundwater to reduce the nitrogen load to an estuary, removing it from the watershed. (Case example, Falmouth, MA).

- *What are some examples of carbon-containing fluids besides gasoline?*
  - Waste oils, cooking oil, and beer-brewery by-products are all examples. Any substance that has carbon but does not have contaminants would work.
- *PRBs do not sound like a good idea to me. It sounds like you are introducing something unnatural into the ground.*
  - Mr. Horsley responded by thanking the commenter and saying that those are the types of reactions that the Commission is looking for from these working group meetings. PRBs would definitely need to be explained to the public to win public acceptance. PRBs would not be installed upstream of a drinking water source in case something goes awry.
- *This technology leads me to wonder whether anyone use woodchips to enhance Title V systems?*
  - Yes, that practice is definitely done. For example, you could install a layer of wood chips to enhance the nitrogen-processing ability of a leach field.

Inlet and culvert widening: Re-engineering and reconstruction of bridge or culvert openings to increase the tidal flux through the culvert or inlet. This solution generally works better with a larger tidal range but could be feasible on both the Cape Cod Bay side (approximately nine feet tidal range) and Nantucket Sound side (approximately 3 feet of tidal range).

Salt marsh habitat restoration: Salt marsh is one of the most productive ecosystems in the world, surpassing rainforest in productivity per acre. Approximately 65% of historic salt marsh has been lost in MA. Salt marshes cycle and remove nitrogen as well as provide critical habitat and spawning sanctuary for a wide variety of birds, mammals and marine life in addition to hosting a range of plant species and important biogeochemical processes. The capacity of salt marsh to intercept nitrogen is significant and well researched worldwide. Substantial areas of former salt marsh on the Cape are either under consideration for restoration or could be restored providing storm surge and coastal flooding protection in addition to water quality benefits in certain watersheds.

Shellfish habitat restoration: Oyster reefs were historically one of the main consumers and recyclers of nitrogen in the coastal environment on Cape Cod. According to the Nature Conservancy, populations have declined by 95%. In conjunction with the natural transition from land to sea in estuaries, bays and inlets; salt marsh, oyster reef and eel grass function as critical buffer that can reduce eutrophication. Restoring Oyster populations leads to increased shellfish productivity as well as improved commercial and recreational fisheries for other species, increased protection from shoreline erosion and flooding, and buffering from ocean acidification. (Case example, Wellfleet, MA).

Aquaculture / shellfish farming: Oysters, has been proposed as a potential method for reducing nitrogen levels and eutrophication in estuaries. Nitrogen removal rates from Oysters have been well documented and the harvest of oysters physically removes the nitrogen they sequester in addition to the nitrogen removed by their biological cycling which puts nitrogen directly back into the atmosphere. Aquaculture can be done on man-made structures (e.g. cages, floating bags) or natural reefs.

- *The Board of Selectmen in Wellfleet just signed a Sanctuary provision for the harbor. As a result, the shellfish population in Wellfleet Harbor is protected from harvesting.*
- *A big part of the reason for the Board's decision for Wellfleet Harbor is that some residents and tourists do not like the aesthetic effects of an active shellfishing industry due to the cages that are placed in the water and the restrictions on access and use, etc.*
- *Even without a shellfish farming industry, a healthy shellfish bed can still significantly reduce nitrogen loads. Nitrogen is sequestered in the shells of shellfish, and this stays sequestered even when the shellfish die. Microbiota eat the dead body mass, and so in a sanctuary area, nitrogen removal can be 2 or 3 times as significant as in an area without shellfish, largely because of the ecosystem that a healthy shellfish bed supports.*
- *It is important to think beyond oysters since they are not suitable for all habitats. Clam beds have almost as much nitrogen-removal impact as oyster beds.*

Surface water remediation wetlands: Constructed to aid in water quality improvements to surface water bodies, usually streams or rivers. Water is pumped or allowed to flow naturally through treatment cells containing wetlands Surface water remediation wetlands are often used in combination with groundwater recharge or potable water reuse systems. Surface water remediation wetlands are generally used with Free-Water Surface wetlands due to their larger size, and lower capital and O+M Costs. (Case example, China).

Pond and estuary dredging: Lakes, ponds, streams and estuaries store nutrients within their sediments. These sediments tend to accumulate over time. Subsequently, these nutrients can be release into the overlying water column and can become a major source of nitrogen and phosphorus. Dredging and removing these sediments and accumulated nutrients removes the nutrients from the water body and potentially the watershed. (Case example, Dennis, MA).

- *Time of year restrictions on dredging would present a challenge to using this technology.*
    - Mr. Horsley noted that, of all of the approaches that are being presented to the working groups, dredging is likely the most highly-regulated approach. The Commission's rule of thumb is to pursue dredging only when absolutely necessary. That being said, dredging can work.

Cape-wide level technologies/approaches

Compact development: Both Compact Development and Open Space Residential Development (OSRD) of subdivisions result in smaller lots and less maintained lawn acres. The higher density development reduces wastewater collection costs while providing a common disposal area. Compact development is also referred to as "Smart Growth".

Fertilizer management: Managing fertilizer application rates to lawns, golf courses, athletic facilities and cranberry bogs. Residential lawn loading rates could be reduced on existing developed parcels through an intensive public education/outreach program. This could include a "Cape Cod Lawn" branding program, replacing some turf areas with native vegetation, establishing naturally-vegetated buffer strips on waterfront lots, and reducing application rates. Fertilizer loading rates for new development could be accomplished by reducing lot sizes (cluster development), by restricting lawn sizes and/or by incorporating more naturally-vegetated open space areas. Municipalities could directly reduce fertilizer applications on athletic fields and other properties. Golf courses can significantly reduce nitrogen loading rates by using slow-release fertilizers and reducing application rates in rough areas. Cranberry bog fertilizer exports from the bogs can be reduced using tail water recovery systems. Site-specific assessments are needed to estimate load reductions. The Cape Cod Commission designated a cape-wide Fertilizer Management District of Critical Planning Concern (DCPC) which authorizes the towns to adopt local fertilizer management regulations (state law prohibits local fertilizer management except under the DCPC). The DCPC does not require towns to adopt fertilizer regulations, but paves the way for their adoption. Barnstable County will be conducting a public education process around fertilizer use.

Remediation of existing development: Existing developments or schools with excess wastewater treatment capacity allow existing nearby developments to connect to their underutilized wastewater treatment infrastructure. A town can operate the wastewater treatment facility if the existing owner prefers to not take the responsibility for treating the off-site wastewater. An example of this is the Kingman Marina in Bourne, which was permitted to expand its development footprint in exchange for hooking up adjacent, existing homes to its wastewater treatment facility.

Transfer of development rights: A regulatory strategy that transfers development and development rights from one property (sending area) to another (receiving area) to direct growth and associated nutrient loading away from sensitive receiving watersheds or water bodies. The protected parcels (sending areas) receive a deed restriction that limits the level of future development. The deed restriction can limit the number of homes or tie development to the availability to future wastewater treatment facility infrastructure.

- *Responding to Mr. Horsley's comment that this mechanism would not require zoning changes, a working group member said that there would have to be zoning changes in the receiving area to accept the additional growth.*
    - Mr. Horsley agreed and acknowledged that the receiving area would have to agree to accept additional density. He added that there would not have to be zoning changes made in the sending area, where downzoning is usually the really difficult thing to do.
- *The growth-receiving areas would need to have sufficient infrastructure, or would need to invest in infrastructure, to handle the additional growth.*
- *In Truro and Wellfleet, we are land-poor. A lot of our land is in the National Seashore area. We have very little developable land here because any open land is part of the National Seashore.*
- *In Wellfleet and in many other towns, one of the big challenges would be that people think of their town as a "traditional fishing village" and would be opposed to three-story buildings.*
    - Mr. Horsley responded that many people think of density as a negative thing or have an image in their minds of what density would look like. For example, increased density in Wellfleet would not necessarily need to include any three-story buildings. But the Association to Preserve Cape Cod created visuals of what greater density, sensitively done, could look like on the Cape and people liked the visuals more than the status quo. The Urban Land Institute came out with a coffee table book called Visualizing Density that shows what ½-acre density could look like, 1-acre density could look like, what a village center can actually look like, and visuals of this sort help to allay a lot of concerns that people have about greater density.

Stormwater best management practices (BMP): Non-Structural Stormwater strategies include: street sweeping, maintenance of stormwater utilities, education and public outreach programs, land use planning, and impervious cover reduction and control.

General questions and comments:

- *When trying to protect a freshwater system, year-round protection is important. Eutrophication is more of an issue during the summer, however, so you nitrogen uptake is not as much of a concern during the winter. Seasonality can work in our favor, depending on the watershed.*

- *A number of working group members expressed appreciation for the slideshow, presentation, and fact sheets, as they really helped to explain the different technologies.*

- *Developers could be incentivized to include features such as bioswales, rainwater collection, stormwater management, nitrogen mitigation technologies, etc., and also to site develop more efficiently, such as in clusters.*

- *We seem to be going through a regulatory cycle in which EPA is putting greater emphasis on stormwater runoff. Some of this has to do with a new computer modeling program that makes it easier for towns to evaluate runoff levels. Will EPA's focus on stormwater runoff intersect with our effort to deal with nutrients?*
    - Mr. Horsley responded that EPA does have new regulations in place for stormwater runoff in urban areas and the next iteration of EPA's program is likely to cover all areas, including the Wellfleet Harbor and Pamet River Watershed. Correcting stormwater problems, as some of the proposals would do, and simultaneously reducing nutrient loads, would address both issues simultaneously.
    - *A working group member added that many of the stormwater issues in Cape communities actually come from state highways.*
        - Cape Cod Commission staff members discussed their efforts to communicate with the Massachusetts Department of Transportation around this issue and possibilities for the Commission and Cape communities to address these concerns during the Section 208 process.

- *Downtown Wellfleet is installing infrastructure to address excess nitrogen from underground drinking water sources. This issue should not be constrained to coastal waters.*
    - Mr. Horsley responded that, while the regulations for coastal waters with regards to allowable nitrogen levels are much more stringent than they are for subsurface freshwater, the interventions should not ignore freshwater resources.

IV. PROBLEM SOLVING PROCESS AND PRINCIPLES

Overview of 7-steps for Problem-Solving Process

Mr. Horsley reiterated that the goal the Working Groups is to develop remediation options that would achieve water quality targets with a focus on first targeting low cost, low barrier options to reduce nitrogen and then considering more costly and traditional options later (e.g. sewering). He then described the alternatives screening process the group will apply. The process is as follows:

1) Establish targets and articulate project goals.
2) Identify priority geographic areas (e.g. high nitrogen reduction areas, Title V problem areas, pond recharge areas).
3) Determine which management activities should definitely be implemented. These might be the easiest and least costly management activities that should be undertaken regardless of other management actions (e.g. fertilizer management and stormwater mitigation – two approaches that Cape Cod towns are already actively pursuing).
4) Assess alternative options to implement at the watershed or embayment scale (e.g. innovative and lower-cost solutions)
5) Assess options to implement at the site-level
6) Examine priority collection/high density areas
7) Consider traditional sewering or other grey infrastructure management options

He further explained that the Working Groups will focus on total controllable nitrogen load. The technologies and approaches selected should aim to reduce the total controllable nitrogen load by identifying options that reduce the portion of *septic* load that needs to be reduced. For example, the portion of septic load that needs to be reduced could be made smaller if Cape Cod takes on fertilizer and stormwater solutions first. Additionally, the percentages of controllable nitrogen that need to be removed to meet TMDLs change depending on the characteristics of the watershed.

He noted that in many instances, one of the solutions may not achieve the TMDL, but if you pair multiple solutions you may be able to reach the goal. For example, many towns are already using and pairing some of the technology options and approaches:

- Wellfleet- *Coastal habitat restoration & aquaculture*
- Mashpee- *Aquaculture & Expanding Existing Systems*
- Brewster- *PRB & Bioswales*
- Orleans- *Fertilizer Control By-Law*
- Harwich- *Muddy Creek & Cold Brook Natural Attenuation*
- Falmouth- *Aquaculture, Inlet Widening, Eco-Toilet Demonstration Project, PRBs, Stormwater Management (Little Pond Watershed), Fertilizer Control By-Law, Subsurface Nitrogen Removal Septic System*

- *Wellfleet also has a huge stormwater management system and has the highest number* *of I/A systems per capita in the entire Cape.*

- *Truro also has two restoration projects going on near Eagle Nut Creek.*
    - Mr. Horsley noted that the presented technologies in the towns are only examples and that all of the towns also have other projects in place.

Categories of Solutions and their Impacts on the Environment, Economy, and Community

Mr. Horsley commented that evaluation of the technologies and approaches would be informed by their impacts (positive and negative) on the environment, economy, and community (Triple Bottom Line). Ms. Harvey asked participants to consider the environmental, economic, and community impacts of the possible technologies and approaches and asked them what evaluation criteria/factors they might consider in guiding evaluation of the range of possible solutions. Working Group members offered the following suggestions:

<u>Environmental</u>

- *Secondary impacts, including to wildlife:* Different approaches will have various secondary impacts on the environment (beyond the primary nutrient-mitigation effects), and these should be taken into account.
- *Environmental co-benefits:* Potential environmental co-benefits, such as reducing or capturing greenhouse gas emissions, restoring wetlands and estuaries, enhancing hazard resilience, etc. should be taken into account when considering different approaches.
- *Contaminants of emerging concern (CECs)*: Will additional measures have to be taken in the future to deal with contaminants other than nitrogen? Is there some way to plan for these proactive? Technologies that address CECs might be worth considering.
- *Timeframe of impact:* Different approaches address the problem in different ways and at different sites, with some addressing nutrients before they enter the groundwater and others reducing the impact of nutrients that are already present in the embayments. It may be important to implement a mixture of these approaches. In addition, current challenges really need to be dealt with quickly. Mucky fishing areas and smelly areas impact people directly.

<u>Economic</u>

- *Return revenue opportunities & co-benefits:* Some of the technologies and approaches have the potential to generate revenue and provide other economic benefits, such as providing business opportunities. These factors should definitely be factored into the process of evaluating different approaches.
- *Costs:* Costs will always be important. It might be worth pursing options with the least cost first. Or exploring options that have a lower cost per unit of nitrogen removed. The value of the infrastructure over time, and the payback period, should also be considered. Cape Codders may also be particularly cost sensitive at present because they are also facing higher insurance costs as a result of revised FEMA flood-risk maps.

- *Allocation of costs:* How will costs and benefits of different approaches be allocated? Can these be allocated fairly? Will costs be shared across a community, a set of communities, or across the entire Cape?
- *Alignment with priorities of other actors:* If a particular approach or proposal for nitrogen mitigation aligns with the interests or priorities of bodies such as federal or state agencies, they may be willing to pay for a portion of the cost. Participants suggested looking beyond EPA to include USDA, US Army Corps of Engineers, NOAA, etc.
- *Job opportunities:* Different remediation approaches may create job opportunities for local residents in terms of the implementation of the technology, operations and maintenance, and from co-benefits and related industries.
- *Operations and maintenance (O&M)*: In addition to installation costs, the long term costs for O&M should be considered because towns might not be able to support costly O&M.
- *Efficiency*: Stakeholders noted that technologies should be efficient in terms of cost, impact, and resources used. Towns will not support options that are not efficient over the long and short term.
- *Impact on homeowners and purchasers*: Infrastructure investments and requirements for homeowners may have a number of impacts on homeowners and the real estate business. For example, they may impact home maintenance costs, may increase costs for real estate sellers as they prepare to sell, may discourage purchasers who shy away from new regulations, and may make it harder for people to bear the costs of homeownership due to higher maintenance costs and taxes.
- *Boating conflicts*: Some approaches, such as aquaculture, may cause conflicts with boaters.
- *Unintended consequences*: There may be unintended consequences to residents and businesses, such as disruption to tourism from construction, which should be anticipated, to the extent possible.

<u>Social</u>

- *Secondary benefits/opportunities*: It might be valuable to explore options that create useful secondary benefits for communities, such as additional recreational space or conservation area, that can be beneficial both for local residents and for the tourism industry.
- *Personal responsibility*: Maintaining personal responsibility, for example, for the maintenance of Title V I/A systems, is important.
- *Aesthetic impacts*: The aesthetic impacts, both positive and negative, of different approaches should be considered. For example, aesthetics of installing infrastructure. For example, some residents may be opposed to infrastructure related to aquaculture such as cages, trucking, etc.
- *Heart and soul characteristics of communities*: Maintaining the key community characteristics that residents value, with regards to issues such as greater density of development, is important.

- *Leadership by example*: Public buildings could implement alternative technologies, such as I/A systems, to help expose residents to promising approaches and help them understand how they work.
- *Education and public buy-in:* Ensuring public buy-in to whatever approaches are pursued is critical. Public messaging cannot be top-down. Buy-in has to come from the bottom-up and from community members themselves. The press can be an ally in communicating with the public, but they need to cover the process fairly and not only focus on controversy.

Implementation

- *Retrofit or New Requirements*: To what extent will technologies be retrofits or be required for new construction? At what cost and what are the mechanisms for implementation?
- *Seasonal variability*: How do the technologies work with seasonal variability (e.g. I/A systems don't work as well if they are not run regularly).
- *Regulatory considerations*: The difficulty of regulatory approval for different approaches should be taken into consideration.
- *Self-sustainability:* Approaches that require ongoing upkeep and maintenance, whether by municipalities or individuals, require more resources and effort than approaches that are more self-sustaining.
- *Unintended consequences*: Unintended and negative impacts on other priorities, such as drinking water quality, should be avoided.

Siting

- *Environmental Factors:* Some of these technologies may not work under all environmental conditions. For example, some may not work if the soils are of inappropriate chemistry, the water table is either too high or too low, etc..
- *Impact on property values:* The potential positive and negative impacts of different approaches on property values should be considered.
- *Abutters*: The potential impacts and reactions of abutters to specific technologies should be considered. Some may be opposed to land clearing or hard infrastructure.
- *Long-term buildout and land use*: The impact of technologies on land use and build out should be considered. There may be unintended consequences (positive and negative) that could result from certain technologies (e.g. smart growth, sprawl, growth neutral, etc.). Future growth should be managed in line with community desires and vision.

Priorities for this Watershed

Ms. Harvey asked participants to hone in on the specific environmental, economic, and social trade-offs or consequences that they felt would be important to consider for this watershed? Working Group members offered the following suggestions:

- *Framing of the issue:* This issue seems to be overly-focused on reducing nutrients as the goal. The focus should really be on environmental quality and water quality. One of the reasons that this issue has been so difficult to deal with is because the public does not see, feel, or smell nitrogen. On the other hand, the public does have a connection to their watersheds and the embayments, and so the issue could be framed around "observable water quality." People really care about habitat quality and, particularly, the aesthetic value of the environment. For example, are the beaches nice? These broad environmental concerns should be the focus of this process.

- *Costs:* Costs will always be important. It might be worth pursing options with the least cost first. Or exploring options that have a lower cost per unit of nitrogen removed. The value of the infrastructure over time, and the payback period, should also be considered. Cape Codders may also be particularly cost sensitive at present because they are also facing higher insurance costs as a result of revised FEMA flood-risk maps.

- *Timeframe of impact:* Different approaches address the problem in different ways and at different sites, with some addressing nutrients before they enter the groundwater and others reducing the impact of nutrients that are already present in the embayments. It may be important to implement a mixture of these approaches. In addition, current challenges really need to be dealt with quickly. Mucky fishing areas and smelly areas impact people directly.

- *Environmental co-benefits:* Potential environmental co-benefits, such as reducing or capturing greenhouse gas emissions, restoring wetlands and estuaries, enhancing hazard resilience, etc. should be taken into account when considering different approaches.

- *Long-term buildout and land use*: The impact of technologies on land use and build out should be considered. There may be unintended consequences (positive and negative) that could result from certain technologies (e.g. smart growth, sprawl, growth neutral, etc.). Future growth should be managed in line with community desires and vision.

- *Managing change:* Change is difficult for communities to go through. They must be managed gently throughout this process.

Technology Selection: Process and Principles

Mr. Horsley noted that the Working Group had identified many of the principles that the Cape Cod Commission hoped would guide technology/approaches selection. These process and principles include:

- *100% septic removal subwatershed*: Combinations of technologies can be used to reduce septic load that needs to be removed.
- *Scale: On-Site vs. Collection System vs. Natural System*: There will be tradeoffs between

the scale of systems that can be used. On-site, collection, and natural systems all have their pros and cons and all require different levels of investment and infrastructure. These tradeoffs will be important from an implementation and public acceptance point of view.

- *Nutrient intervention and time of travel*: Some technologies/approaches intercept nutrients at their point of entry into the system, while others deal with it later on (e.g. once it is in the watershed). There are pros/cons to each approach which need to be considered.
- *Permitting Status*: The level of effort required to permit technologies will be a consideration.
- *Land use and Impacts of Growth*: Unintended consequences and opportunities for planned growth are important to consider.

Additional Questions and Comments from Working Group Members

Responding to a suggestion from Mr. Horsley that the Commission is considering proposing "Plan A / Plan B" approaches to the regulatory agencies (in which Plan A would be more innovative and Plan B would be a proven fallback option, such as sewering), a working group member asked why the Commission believed that a Plan A / Plan B approach is more likely to win approval from MA DEP.

- In response, Mr. Horsley explained that, generally, this is consistent with how MA DEP has operated in the past. For example, in order to receive permission to install a composting toilet, the applicant would also have to show DEP that he or she has the space to install a full Title 5 system if the toilet does not work. The plan has to be adaptive and has to have some fallback positions that DEP has confidence in. For example, DEP knows that sewering works but the agency does not have the same level of confidence in aquaculture.
- *A working group member added that, last fall, EPA and DEP said for the first time that they would consider shellfish as part of a permitting proposal. Until then, that idea was not on the table. This Section 208 process is the first time that there has been an opening for these sorts of alternative and innovative approaches from the permitting agencies.*
- Mr. Horsley added that the robustness of Cape Cod's Section 208 process, which includes public participation of various kinds, the Technology Panel, and the various other resources being dedicated to the process, is compelling EPA and DEP to consider alternatives that they have never before considered.

Are Martha's Vinyard and Nantucket engaged in a similar process as the Cape is and are they considering similar solutions?

- Ms. Erin Perry said that, generally, the nutrient challenges faced in those communities are not as severe as those facing the Cape and that they have less data about the health of their water bodies, meaning that they do not have goals that are as stringent as those on the Cape. Martha's Vinyard has a commission that works similarly to the Cape Cod

Commission and that has expressed interest in coordinating and collaborating with the Cape Cod Commission on the Section 208 process. The Commissions will be coordinating more closely in Years 2 and 3 of the Section 208 process.

V. PLANNING FOR THE NEXT MEETING

Meeting Three will be held:
Monday, December 2, 2013
1:00 – 5:00 pm
Wellfleet Council on Aging, 715 Old King's Highway, Wellfleet, MA 02667

During this meeting the Working Groups will examine various scenarios (i.e. combinations of solutions) and their potential impacts (e.g. nutrient reduction, economic impacts, environmental impacts, social impacts, etc.). During the meeting, the Cape Cod Commission will use tools to calculate ideas/options and their impacts. Working Group participants should come prepared to offer their ideas about what solutions they'd like to explore further given their understanding of the baseline conditions, issues, and priorities in this watershed.

VI. PUBLIC COMMENTS
No public comments were made.

APPENDIX ONE: MEETING PARTICIPANTS

Name	**Affiliation**
Working Group Members	
Joanna Buffington	Eastham Board of Health
Aimee Eckman	Eastham Selectman
Curt Felix	Comprehensive Wastewater Planning Committee, Wellfleet
Deborah Freeman	Wellfleet Conservation Trust
Charleen Greenhalgh	Town Planner, Truro
Mike Guzowski	Water Management Committee, Eastham
Charles Harris	Water Management Committee, Eastham
Ned Hitchcock	Wastewater Committee, Wellfleet
Sheila Lyons	Wellfleet
Lauren McKean	National Parks Service
John Morrissey	Selectman, Wellfleet
Patricia Pajaron	Health Agent, Truro
Tracey Rose	Real Estate Agent, Thomas D. Brown Real Estate Agency
May Ruth Seidel	Wellfleet Non-Resident Taxpayer Association
Robert Weinstein	Planning Board, Truro
Bill Worthington	Planning Board, Truro
Staff	
Kate Harvey	Consensus Building Institute
Tushar Kansal	Consensus Building Institute
Scott Horsley	Cape Cod Commission
Anne McGuire	Cape Cod Commission
Erin Perry	Cape Cod Commission
James Sherrard	Cape Cod Commission
Observers	
Elizabeth Migliore	CCNS Americorps
Dan Milz	PhD Candidate, University of Chicago
Ed Nash	Golf Course Superintendents Association of Cape Cod
Jean Schaefer	Wellfleet Non-Resident Taxpayer Association
Joseph Bateau	Truro Energy Committee (Provincetown WG member)