New York State & Stony Brook University Host

LONG ISLAND RESILIENCY & CLEAN WATER INFRASTRUCTURE MEETING

May 19, Noon - 4 p.m.
Charles B. Wang Center, Stony Brook University
100 Nicolls Road, Stony Brook, New York

Meeting Agenda

Welcome Noon – 1 p.m.

- **Samuel Leonard Stanley, Jr., M.D.**, President, Stony Brook University
- **Joseph Martens**, Commissioner, NYSDEC
- **U.S. Congressman Tim Bishop**
- **Steven Bellone**, Suffolk County Executive
- **Anna Throne-Holst**, Supervisor, Town of Southampton

Invited Speaker Presentations 1 p.m. – 2 p.m.

- **Matthew Driscoll**, President and CEO, NYS Environmental Facilities Corporation
- **Joan Matthews**, Director, US Environmental Protection Agency Clean Water Division
- **Carter H. Strickland, Jr.**, Vice President, Water & Natural Resources Program Manager at HDR
- **Sarah Landsale,** Director of Planning and Environment, and **Walter Dawydiak,** Acting Director of Environmental Quality, Suffolk County (Presenting for Steve Bellone)
- **Christopher J. Gobler, Ph.D.,** Professor, Stony Brook University, School of Marine and Atmospheric Sciences

Break 2:15 p.m. – 2:30 p.m.

Invited Speaker Presentations 2:30 p.m. – 4 p.m.

- **Dr. Harold Walker, P.E.**, Professor and Civil Engineering Program Director, Stony Brook University, Department of Mechanical Engineering
- **David Abecassis**, President, Biogard Inc.
- **Steven Zahn and Selvin Southwell**, Natural Resources Supervisor and Environmental Engineer, NSDEC
- **Dr. Anthony Dvarskas**, Assistant Professor, Stony Brook University, School of Marine and Atmospheric Sciences
- **Chris Clapp**, Marine Scientist, The Nature Conservancy

New York State
Environmental Facilities Corporation

LONG ISLAND RESILIENCY & CLEAN WATER INFRASTRUCTURE MEETING

May 19, 2014

Governor Andrew M. Cuomo

President Matthew J. Driscoll

Mission of the New York State Environmental Facilities Corporation

Promote environmental quality through low-cost financing and technical assistance for environmental and public health projects

EFC operates the largest and most innovative Clean Water State Revolving Loan Fund in the nation

EFC is the financing arm of Governor Cuomo's administration providing low-cost loans to local governments for water-quality infrastructure

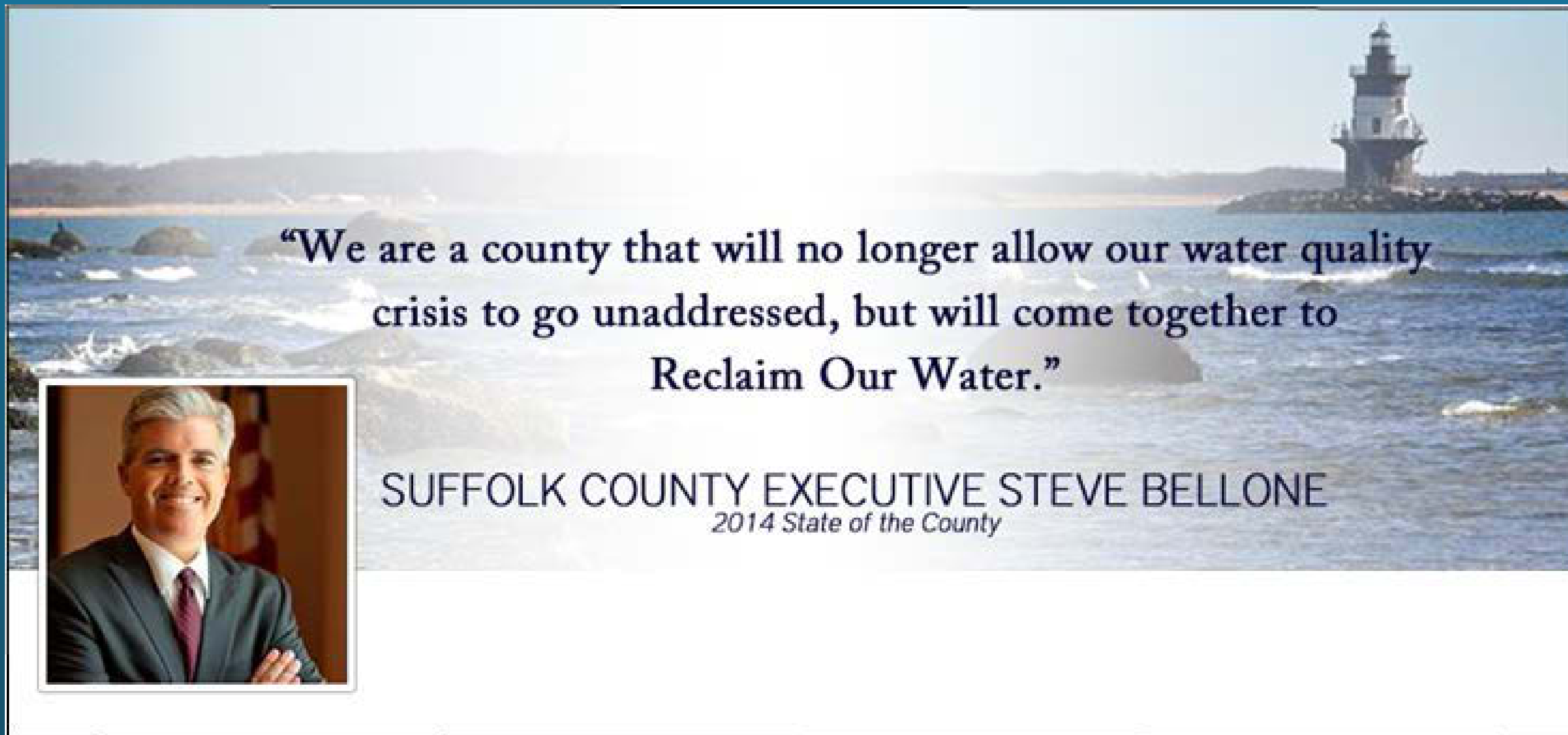
Largest, Most-Innovative Clean Water State Revolving Loan Fund in the Nation

- Since 1990, EFC has financed more than $17 B in low-cost loans to more than 2,000 water and sewer projects across New York State
- More than $6.5 B in financings and money-saving refinancing since 2010
- New EFC Business Model provides financing for virtually every infrastructure proposal

EFC's New Business Model:

Get Available Funds Out the Door Faster

- Higher-Scoring Projects Should Not Sit On Available SRF Dollars
- Begin Shovel-Ready Projects Now
- Protect Environmental and Public Health
- Spur Job Creation, Economic Growth

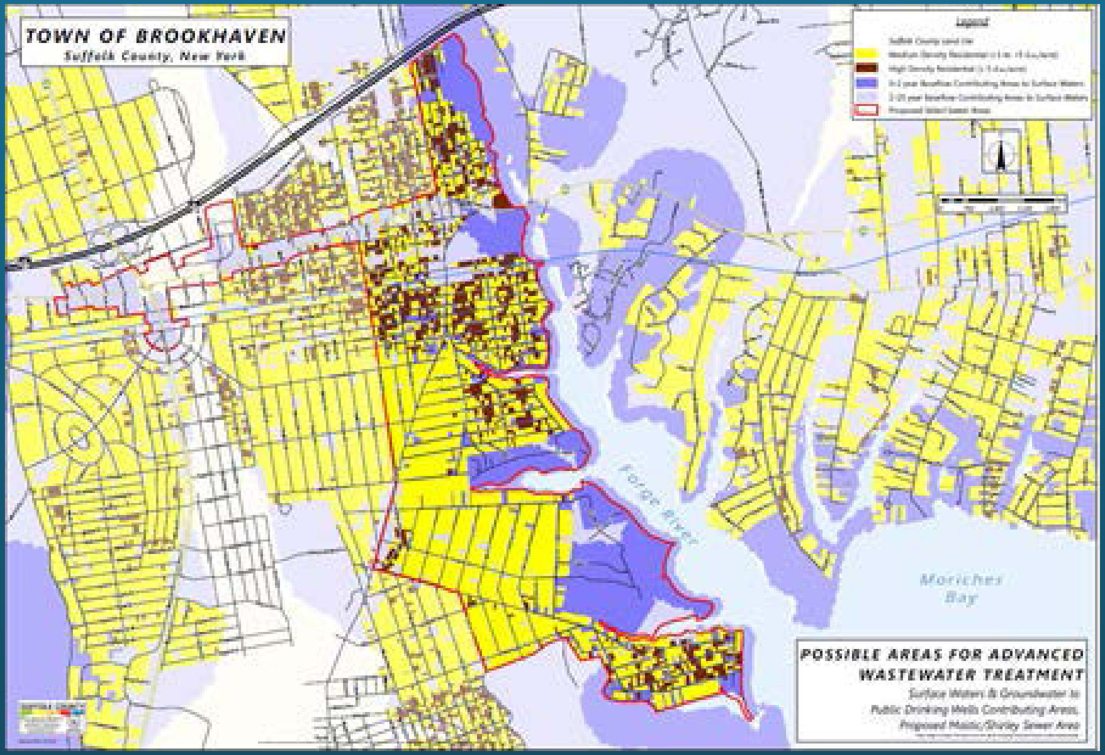

"We are a county that will no longer allow our water quality crisis to go unaddressed, but will come together to Reclaim Our Water."
SUFFOLK COUNTY EXECUTIVE STEVE BELLONE
2014 State of the County


Cornell Cooperative Extension
of Suffolk County

"Tidal wetlands can protect coastal communities from storm damage by reducing wave energy and amplitude, slowing water velocity, and stabilizing the shoreline through sediment deposition.

-- Governor Cuomo's 2100 Commission Report

Areas Proposed for New Sewer Collection/Treatment



- Forge River corridor
- Connetquot River: Oakdale/Sayville
- Carlls River: Deer Park, North Babylon & Wyandanch

Expanding Economic Opportunities Across NYS

"Over the past eight years, there has been over $150 million dollars worth of public and private investment in the Village of Patchogue, with another $150 million currently underway. This type of investment doesn't happen without a wastewater treatment plant."

-- Patchogue Village Mayor Paul Pontieri.

Failing septic systems

www.suffolkcountyny.gov

400,000 septic systems and cesspools in SC

*45,000 in areas of GW < 10 ft

*15,000 in areas of GW < 5 ft

NYS Environmental Facilities Corporation

NSF: National Sanitation Foundation

SERVICES BY INDUSTRY

Water and Wastewater

NSF International provides an extensive range of services for the water industry to help ensure the quality and safety of products in the marketplace. Our expertise in writing standards and testing and certifying products for drinking water, pools/spas, plumbing, plastics and wastewater is unmatched. Our global offices provide comprehensive services, quality support and superior knowledge to help you grow your business while saving time and money.

Choose NSF to certify your product.

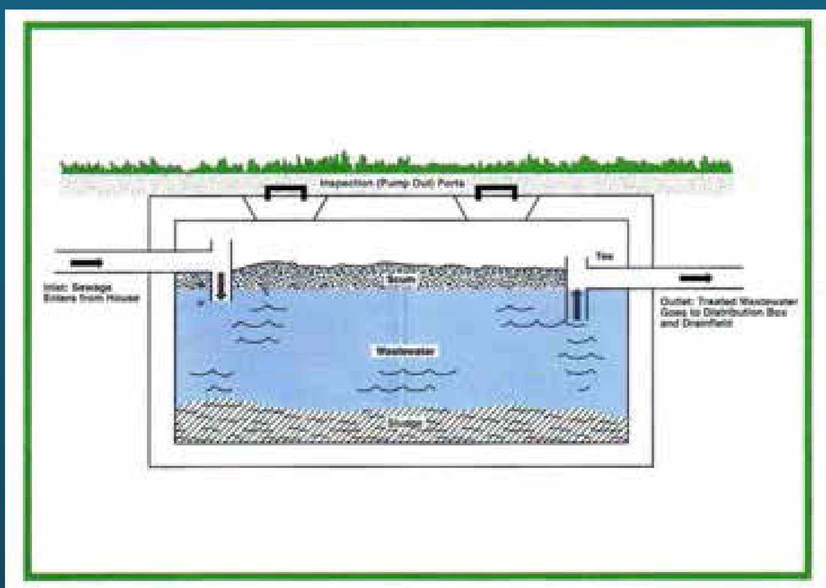
- International Approvals: NSF Passport Program
- Municipal Water Treatment
- Plastics
- Plumbing
- Recreational Water / Pools / Spas
- Residential Water Treatment
- Wastewater
- Water Treatment Chemicals
- Beverages and Bottled Water
- Ballast Water Testing
- Hotel Certification: NSF StaySafer Program
- HACCP for Building Water Systems

The Nature Conservancy
Protecting nature. Preserving life.

Current vs. Advanced On-Site

CURRENT

- No Nutrient reduction
- No moving parts



ADVANCED

- Reduces nutrients from 50% to >75%
- May have blowers, pumps or mixers

INVESTING FOR WATER QUALITY AND RESILIENCY

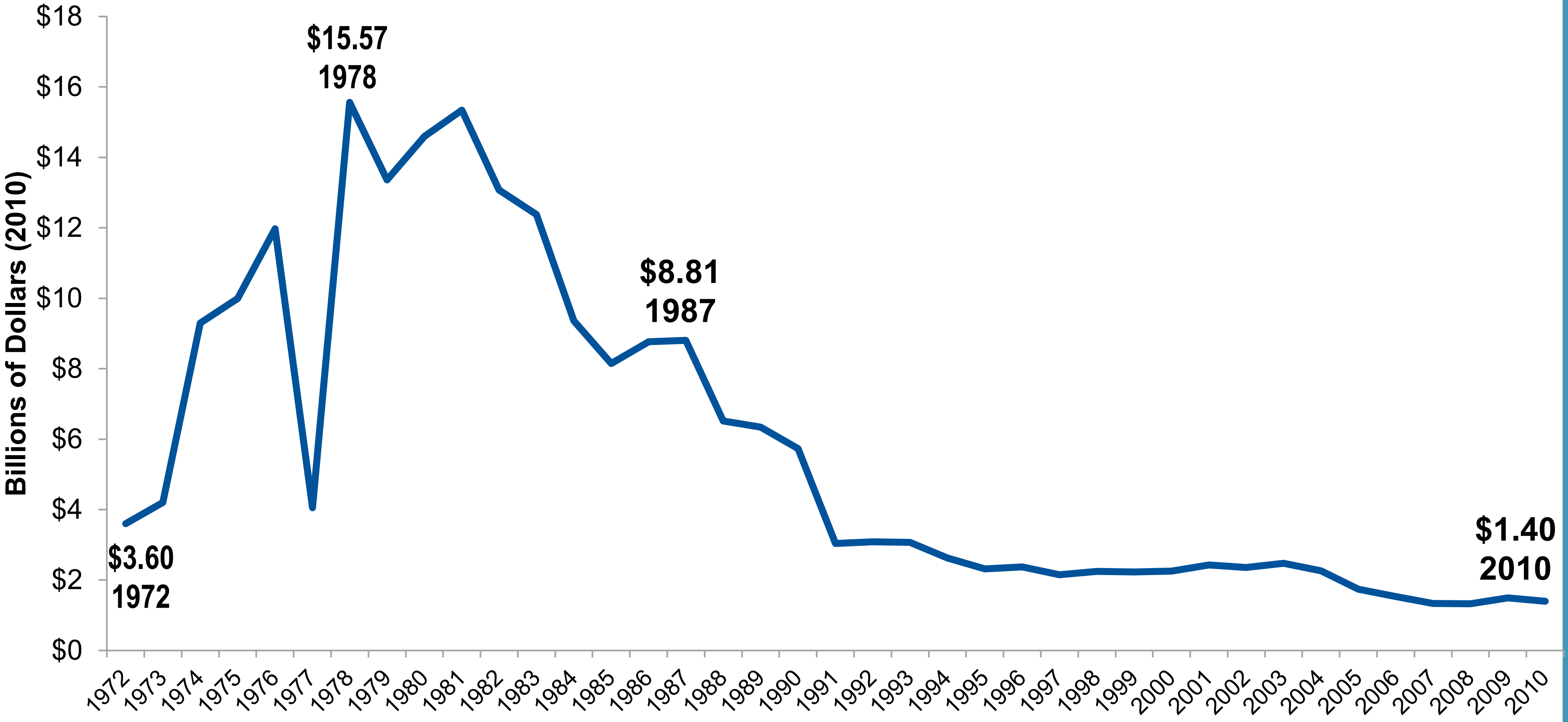
SUNY Stony Brook

Carter H. Strickland, Jr.
HDR
Vice President
Water & Natural Resources Program Manager

May 19, 2014

HDR

WATER QUALITY GRANTS ARE DECREASING



Source: *NACWA Money Matters - Two Sides of the Same Coin: Increased Investment & Regulatory Prioritization (2011)*

DISASTER RELIEF GRANTS ARE INCREASING

Fiscal year appropriations or supplementals	Estimated disaster-relief spending ($ billions)	Clean Water SRF Appropriations ($ billions)
FY 2011	$21.38	$1.52
FY 2012	$32.41	$1.47
FY 2012 Supp.	$8.17	--
FY 2013	$14.32*	$1.45*
FY 2013 Supp.	$60.21*	--
Total	$136.49	$4.44

*Before sequestration cuts

Source: *Center for American Progress, Daniel J. Weiss and Jackie Weidman, Disastrous Spending: Federal Disaster-Relief Expenditures Rise amid More Extreme Weather (Apr. 29, 2013); Congressional Research Service, Environmental Protection Agency (EPA): Appropriations for FY2013 (Sept. 6, 2012)*

$60B in Sandy funding includes:

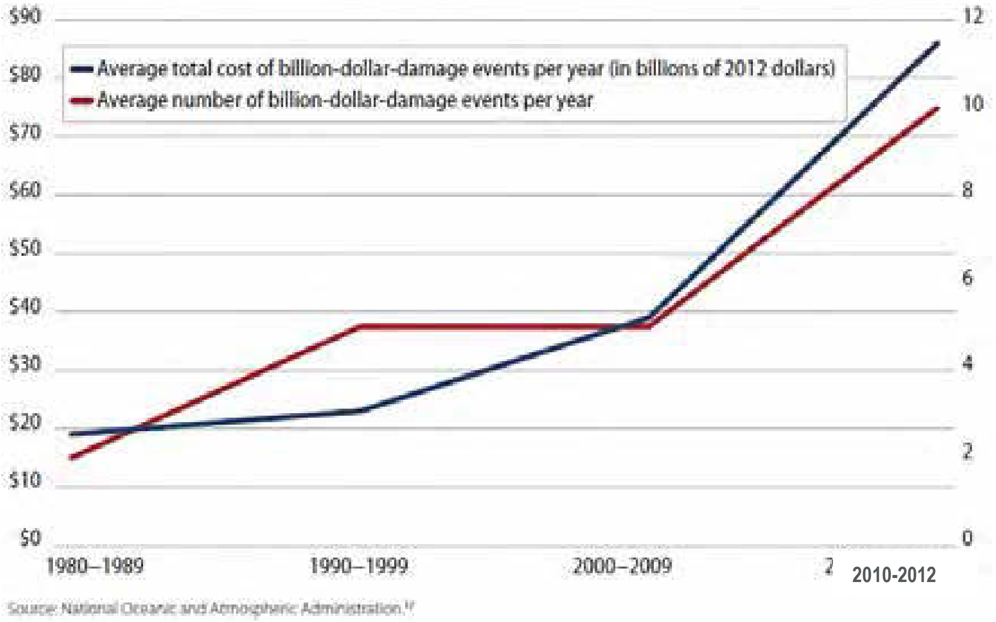
- $5.35B for Army Corps
- $0.83B for Interior
- $0.61B for EPA (SRF)
- $16B for CDBG funds
- CBO estimates Sandy funds will be spent through 2022

THE "NEW NORMAL"…

	Baseline (1971-2000)	2020s		2050s	
Scenario		Middle Range (25th-75th percentile)	High End (90th percentile)	Middle Range (25th-75th percentile)	High End (90th percentile)
Average Temperature	54°F	+ 2.0 to 3.0 F	+ 3.0 F	+ 4.0 to 5.5 F	+ 6.5 F
Precipitation	50.1 in.	+ 0 to 10%	+ 10%	+ 5 to 10%	+ 15%
Sea Level Rise	0	+ 4 to 8 in.	+ 11 in.	+ 11 to 24 in.	+ 31 in.

…MEANS MORE DISASTERS

Increasing Extreme Weather Events

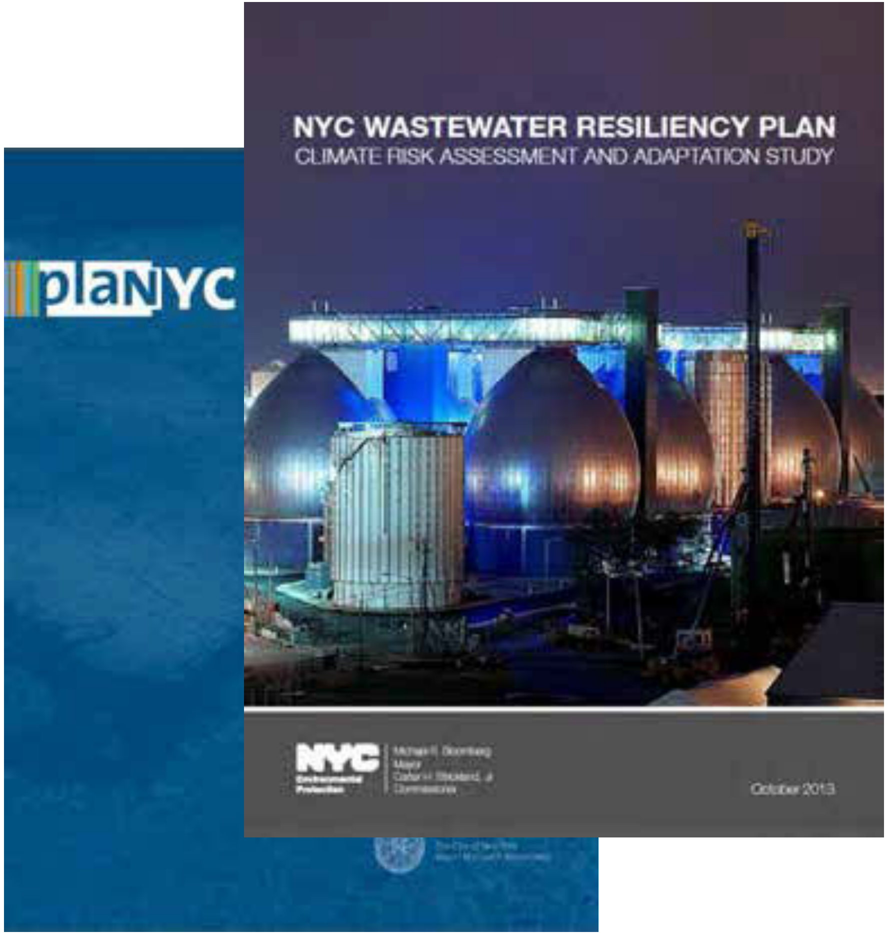


"Over the past 30 years, the location where tropical cyclones reach maximum intensity has been shifting toward the poles in both the northern and southern hemispheres at a rate of about 35 miles, or one-half a degree of latitude, per decade …coastal populations and infrastructure poleward of the tropics may experience increased risk… [and] endanger coastal cities not adequately prepared for them."

NOAA's website, discussing article published in Nature 509, 349–352 (May 15, 2014)

STANDARD OPERATING CONDITIONS?

PLANNING FOR RESILIENCY INVESTMENTS



- Facility-by-facility, asset-by-asset assessment of 14 wastewater treatment plants and 96 pump stations; all WWTPs and 58 PSs at risk of flood damage

- Over $1 billion at risk without protective measures, and over 50 years, cumulative damages could exceed $2 billion.

- Menu of mitigation measures costing $315 million, and phased in over time

- Design standards for new

REBUILDING WITH RESILIENCE

VA Hospital
Manhattan

LIRR Substation
Long Beach

Metro-North RR
NY and CT

PATH Station
NJ

NATURAL SYSTEMS ARE RESILIENT

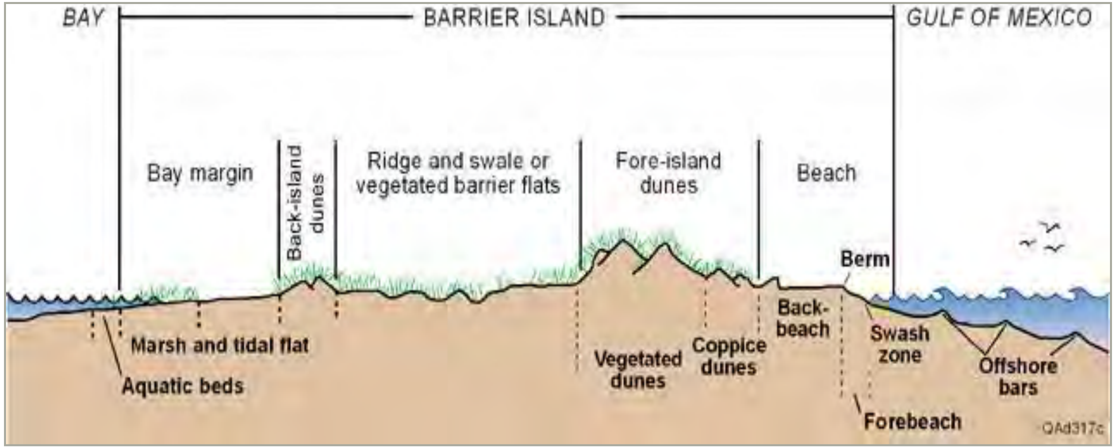
Gerritsen Creek,
Jamaica Bay

Before Restoration

After Restoration

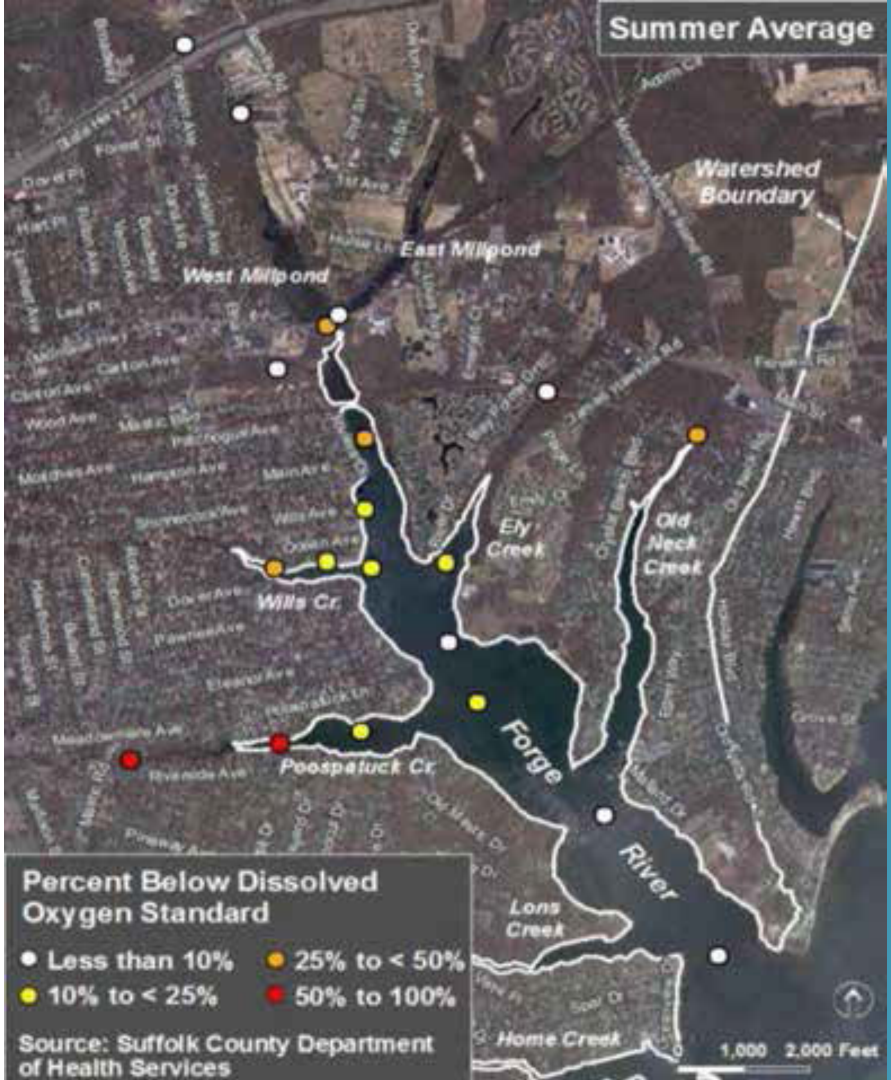
Day after Hurricane Sandy

ENGINEERED RESTORATION



FORGE RIVER, LI

- Unsewered watershed
- Low DO (Hypoxia/Anoxia) and High chlorophyll-a (>500 µg/L)
    - Phytoplankton and macro-algae (*Ulva*)
- High nitrogen load
    - Primarily from groundwater
    - Duck Farm at head of river
- Exacerbated by poor flushing in the river



RECLAIM OUR WATER

Steve Bellone (Presented by Sarah Landsale)
Suffolk County Executive
May 19, 2014

Why the Fuss?

- ~1.5 million people, >900 sq miles/600,000 acres
  - Mostly unsewered (~74% of population)

- Vulnerable sole source aquifer
  - Diffuse public water supply well network (>1,000 wells)
    - Often relatively shallow (upper glacial aquifer)
  - ~45,000 private wells

- Wetlands, surface waters, 3 major estuary systems
  - Groundwater and surface waters are connected
  - All Suffolk estuary systems impaired by NITROGEN
    - Peconics, South Shore Estuary Reserve, Long Island Sound
    - Eutrophication and low dissolved oxygen
    - Shellfish impacts
    - Mounting evidence showing linkages to harmful algal blooms
    - COASTAL RESILIENCY
      - Wetlands, eelgrass

COMP PLAN- THE "NUTSHELL"

- 704 Public Water Supply "Source Water Assessments"
  - *Enhanced modelling tools (sources, impacts)*
- Identified "sensitive areas" (open space, pollution control)
  - *Contributing to public supply wells and surface waters*
- Public water supply is safe
  - *Overall good-to-excellent quality*
    - *Manageable stresses (e.g., nitrogen in N/W Suffolk)*
  - *Ample quantity to meet demands (Pine Barrens may be used for East End)*
  - *Private wells still a concern*
  - *More action needed to protect surface waters from excess nitrogen*

SUFFOLK COUNTY'S WATER QUALITY CRISIS

Suffolk County Comprehensive Water Resources Management Plan Findings:

- Dramatic Decline in Health of Ground and Surface Waters

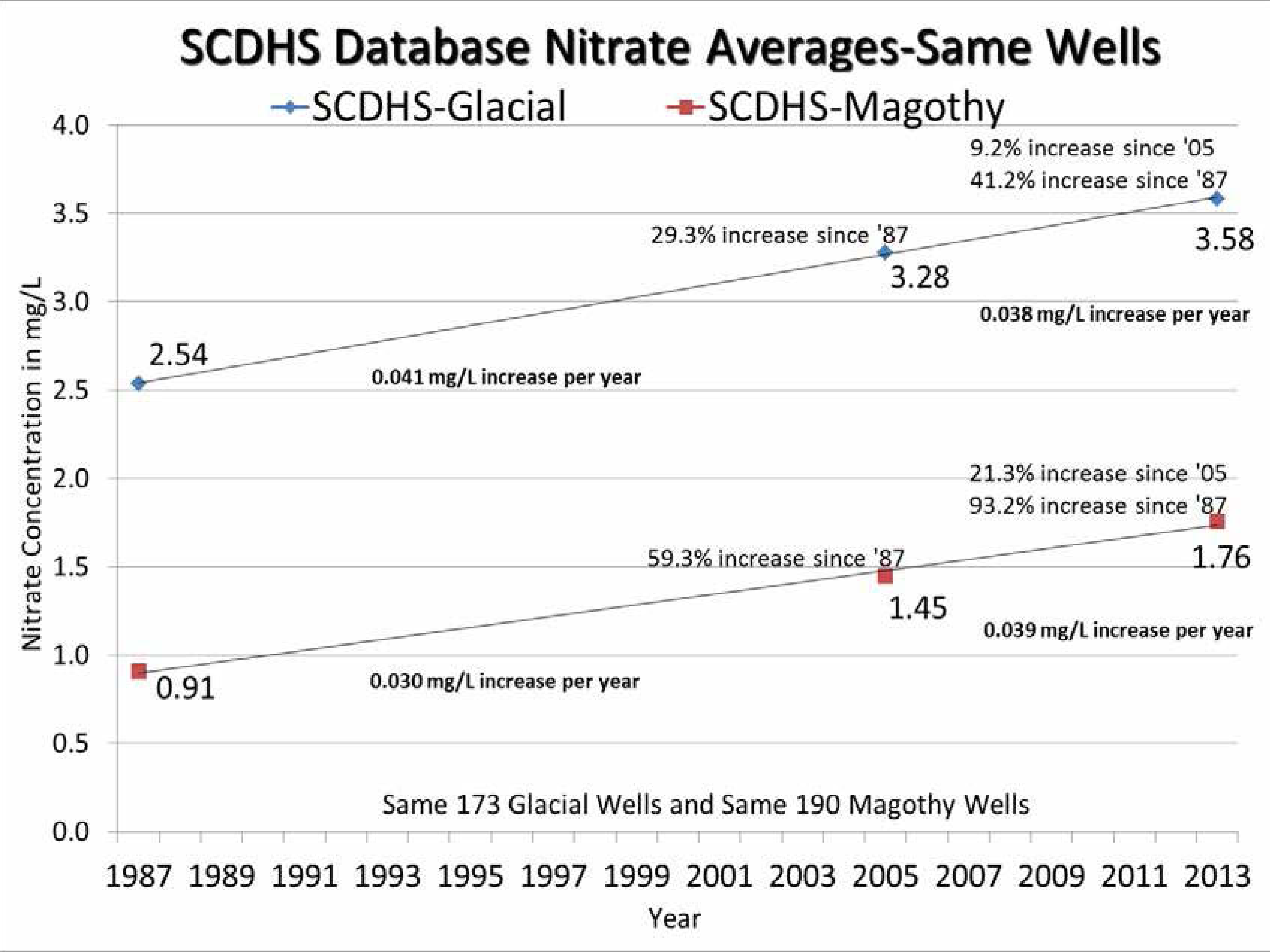
- Negative Trends in Quality of Drinking Water

- Pollution has caused harmful Algal Blooms, Brown Tide

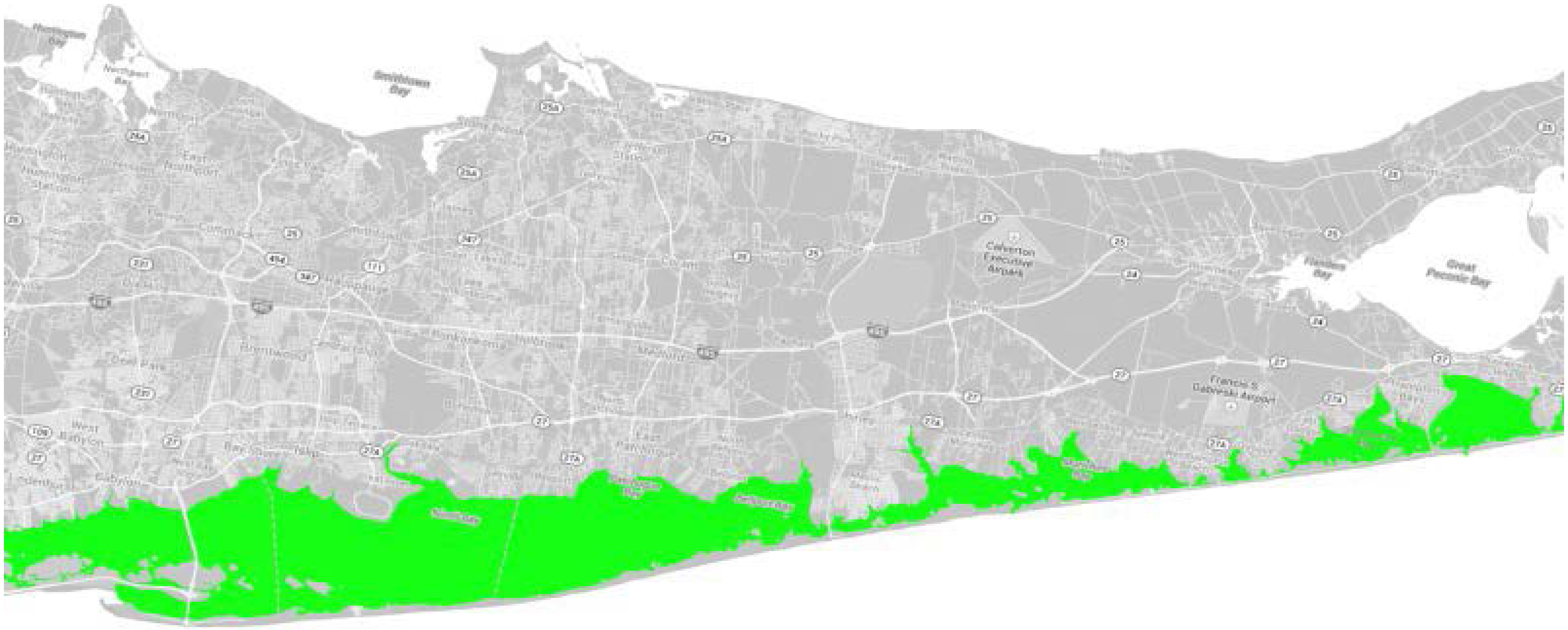
- Impacts include nitrification, impaired water bodies, impaired rivers, closed beaches and devastation of shellfish industry

In aftermath of Superstorm Sandy, it is clear that this significant decline in water quality is a major threat to our region.

Nitrogen is public enemy #1


SCDHS Database Nitrate Averages-Same Wells
SCDHS-Glacial
SCDHS-Magothy
Nitrate Concentration in mg/L
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
9.2% increase since '05
41.2% increase since '87
29.3% increase since '87
3.58
3.28
0.038 mg/L increase per year
2.54
0.041 mg/L increase per year
21.3% increase since '05
93.2% increase since '87
59.3% increase since '87
1.76
1.45
0.039 mg/L increase per year
0.91
0.030 mg/L increase per year
Same 173 Glacial Wells and Same 190 Magothy Wells
1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013
Year

Distribution of Coastal Vegetation: 1930

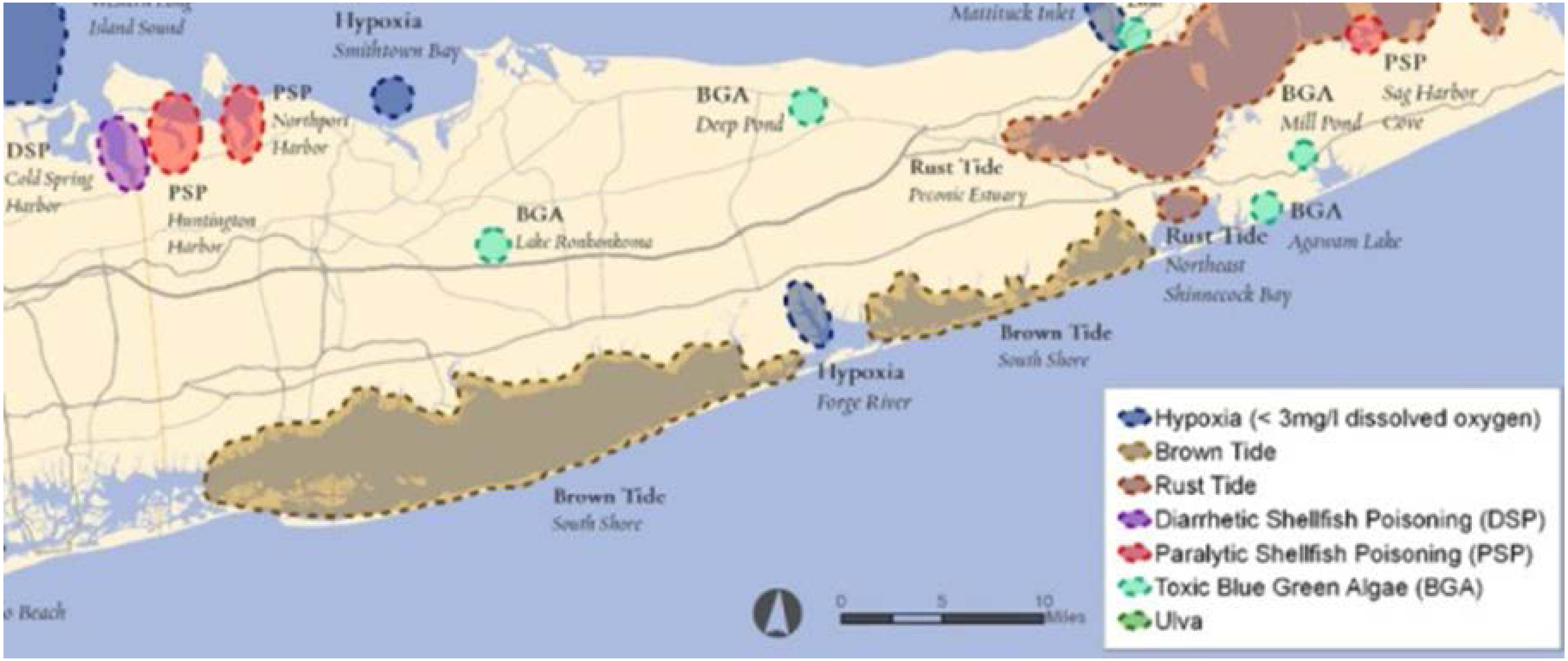


Estimated distribution of eelgrass beds in the South Shore Estuary in 1930 courtesy of Cornell Cooperative Extension of Suffolk County.

Distribution of Coastal Vegetation: 2012

Estimated distribution of eelgrass beds in the South Shore Estuary in 2012 courtesy of Cornell Cooperative Extension of Suffolk County.

Harmful Algal Blooms

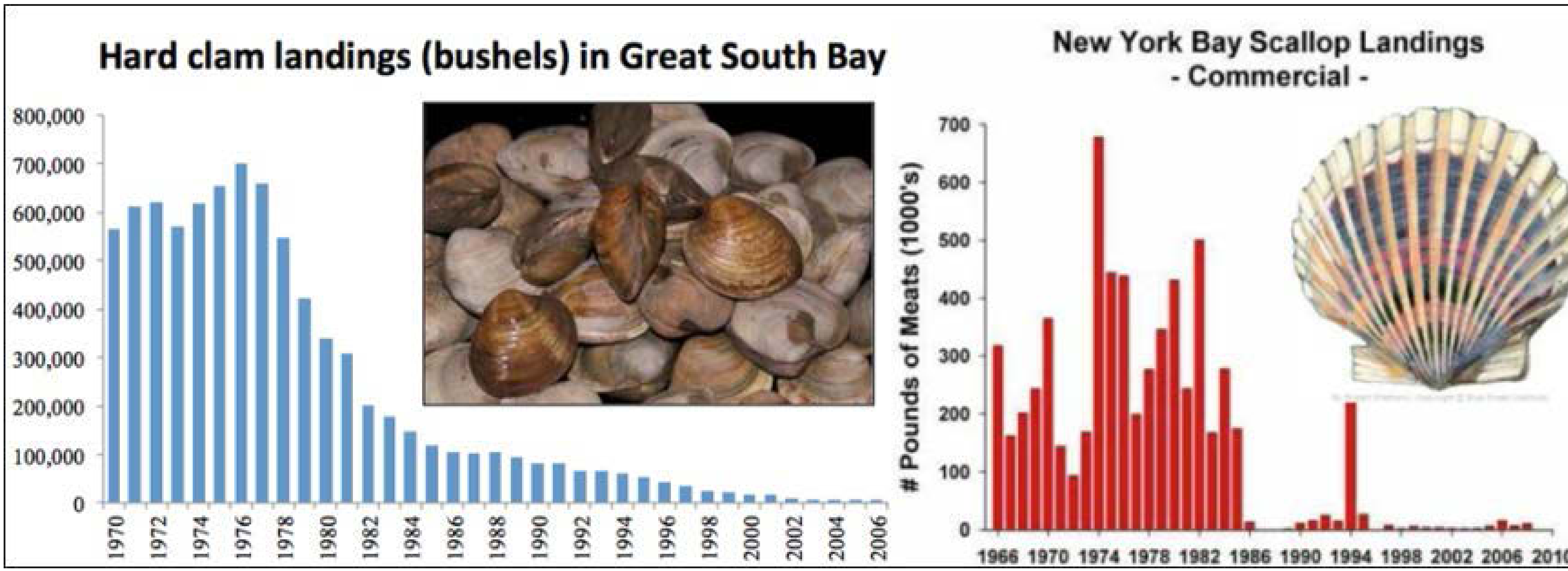


"While we had hoped we could simply plant seagrass and clams to bring back our bays," said Carl LoBue, Senior Scientist for the Nature Conservancy, "2013 has taught us that these efforts will only be successful if we can get nitrogen loads under control."

Harmful Algal Blooms

Photo credit: Doug Kuntz | Brown tide clouding the waters in the eastern end of Moriches

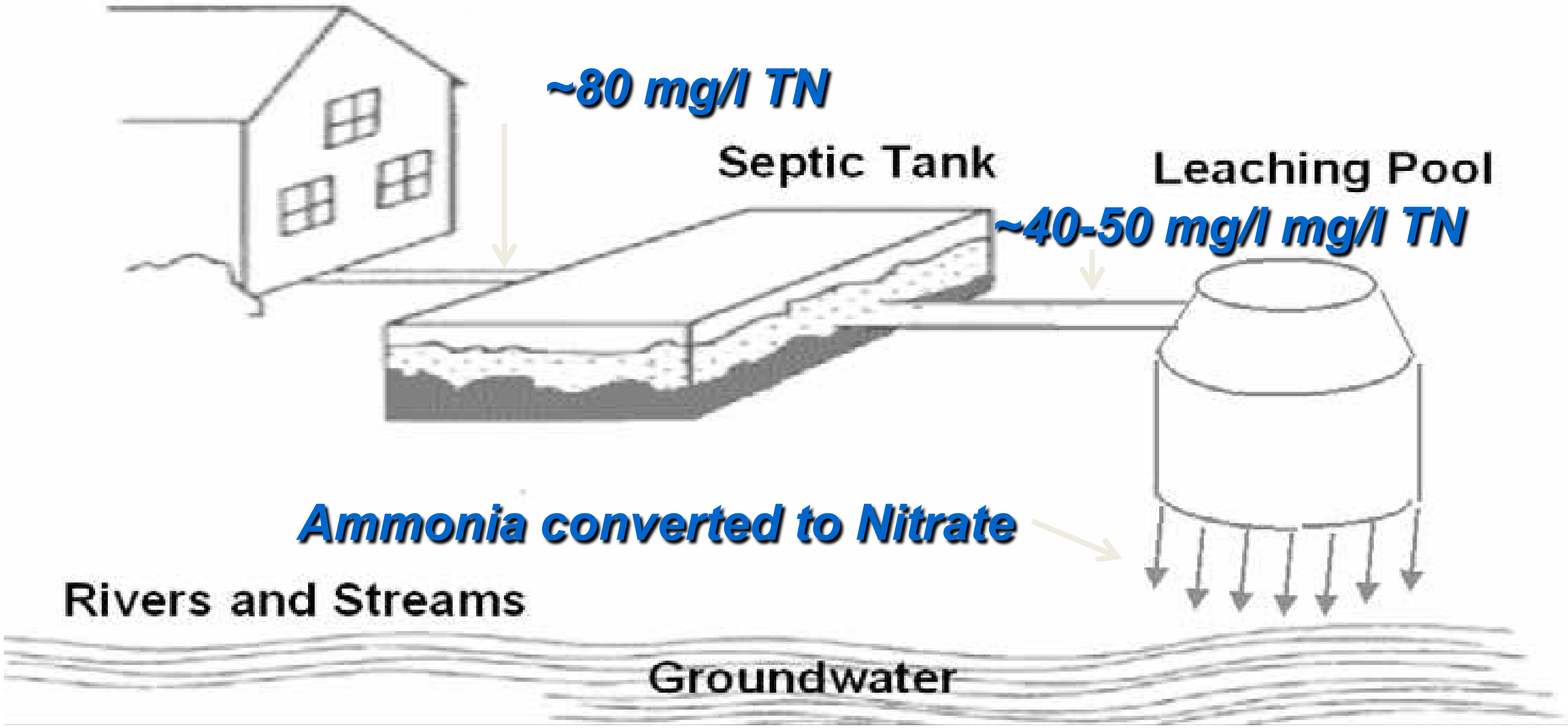
COLLAPSE OF FISHING INDUSTRY, ECONOMIC IMPACT



360,000 UNSEWERED HOMES IN SUFFOLK COUNTY

- 74% of all homes in Suffolk County are unsewered
- The National Environmental Services Center's historic reference information indicates that Suffolk County leads the State (and Tri-State region) in the number of individual septic systems, followed by Dutchess County [51,480] and Ulster County [41,927]

Septic Tanks/Leaching Pools in Suffolk County



Advanced Treatment (Sewage Treatment Plants, or STPs)

* Secondary (remove additional BOD and TSS)
  - -O2 and bacteria
* Tertiary (remove nitrogen)
  - -anoxic bacteria

Sewage Treatment Plants -

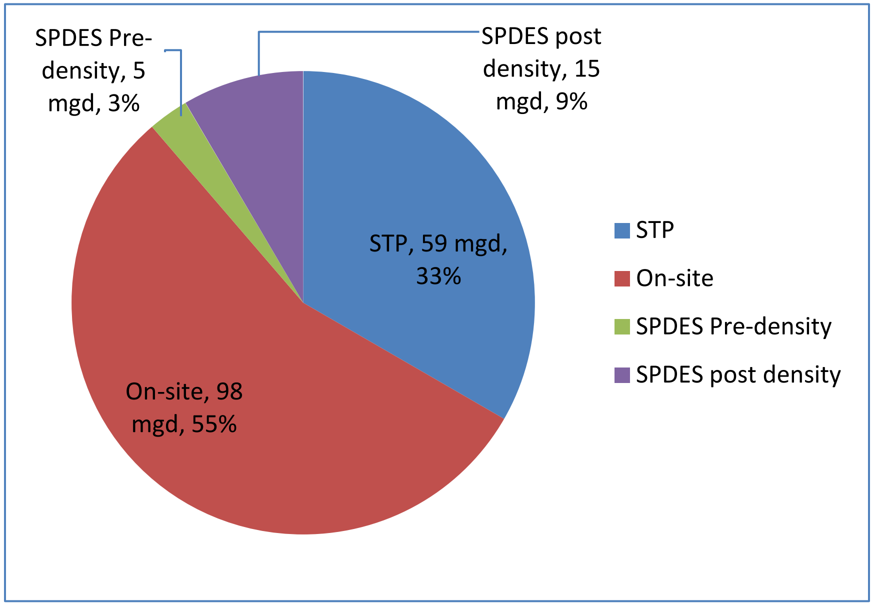
- **195 sewage treatment plants currently**

Performance Improved

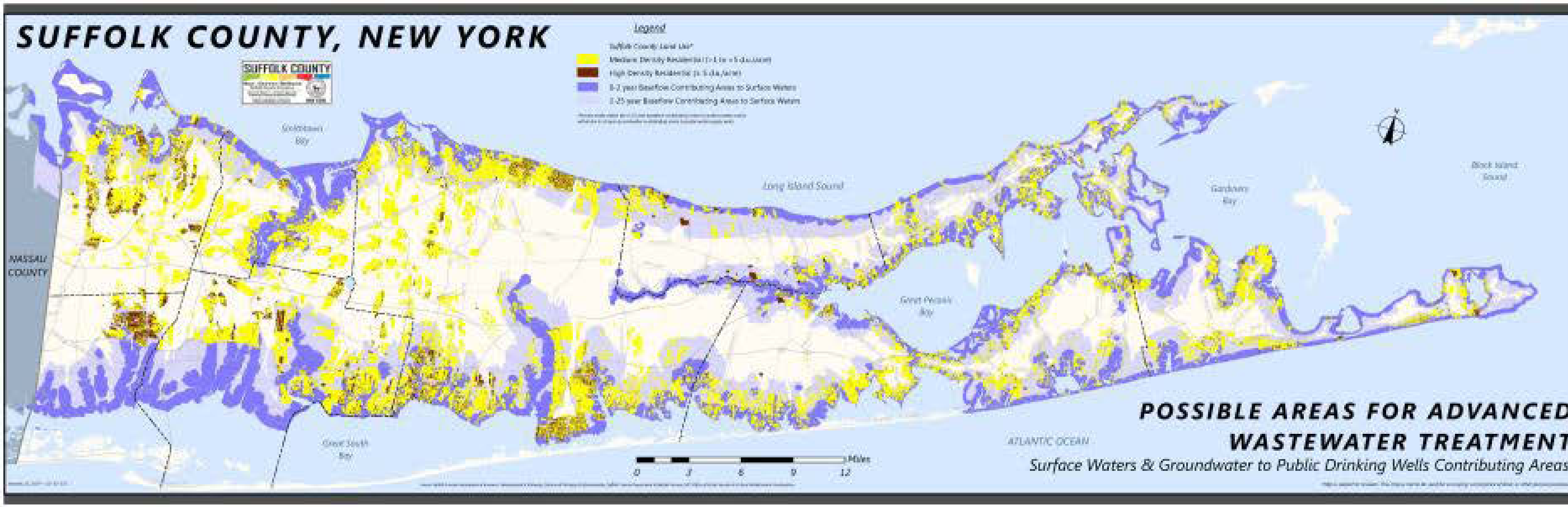
- **From average 10 mg/l discharge to 7 mg/l**

Approximate Flow

- Total STP discharge 59 million gallons per day
  - 43 mgd surface water
  - 16 mgd groundwater
- Total individual homes 108 million gallons per day
  - 360,000 x 300 gpd per home
- Total comm (inc. class 02) 20 million gallons per day
  - 8000 sites x 2500 gpd per site
  - SPDES program ~40 years old
  - SCSC Article 6 is ~30 years old
  - Permits issued since Article 6 consider density restrictions



209,000 Priority Areas for Advanced Wastewater Treatment



Governor Cuomo's NYS 2100 Commission Report

- Governor Cuomo's recently released New York State 2100 Commission report defines the challenges facing Suffolk County and New York State:
  1. Protect coastal communities;
  2. Reduce inland vulnerability to extreme weather events;
  3. Strengthen wastewater infrastructure.

> ***"tidal wetlands can protect coastal communities from storm damage by reducing wave energy and amplitude, slowing water velocity, and stabilizing the shoreline through sediment deposition. More than half of normal wave energy is dissipated within the first three meters of marsh vegetation such as cord grass. In addition, given sufficient sediment deposition, wetlands are able to build elevation in response to sea-level rise, providing a buffer against climate change and coastal submergence."***
>
> ***~ Governor Cuomo's 2100 Commission Report***

- Researchers support the report and have concluded that coastal vegetation (wetlands, marshlands and the sea grass that surrounds it) serves as a natural defense system against storm surges and waves along coastal regions, reducing wave height by 80% over short distances. Waves lose energy as they travel through vegetation.

NYS DEPT. OF ENVIRONMENTAL CONSERVATION

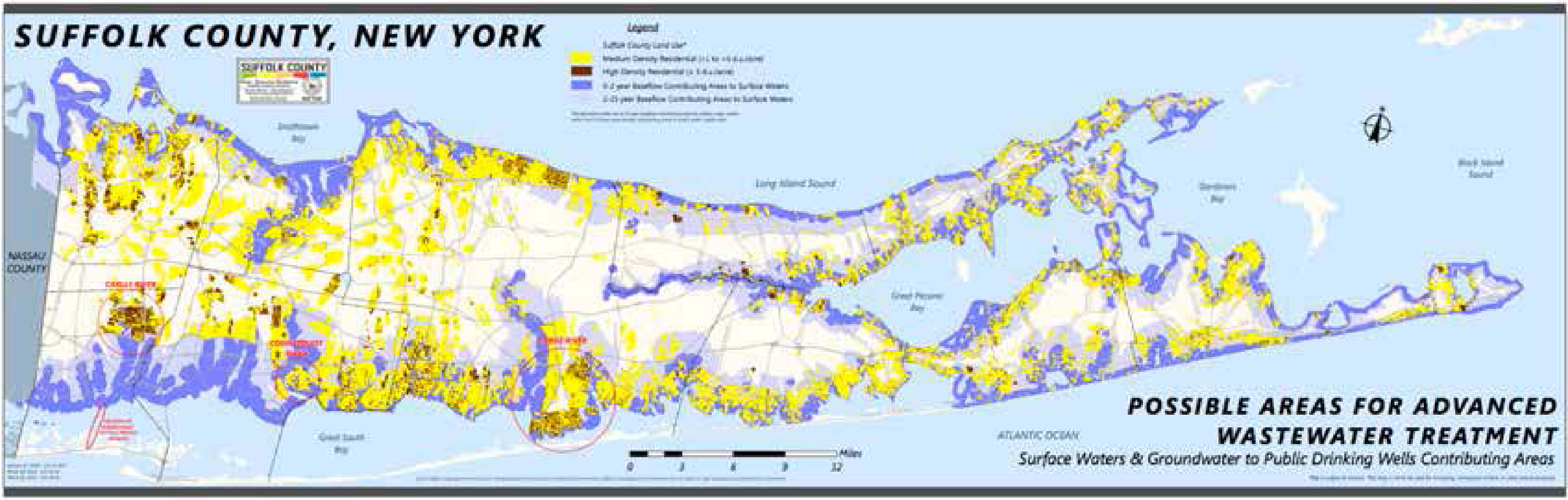
Given the nexus between nitrogen enrichment, the long-term sustainability of salt marshes along the south shore of Long Island, and the ability of the marshes to provide protection against coastal flooding, **New York State should consider supporting an array of programs to reduce nitrogen loadings into Long Island's south shore embayments**, including Jamaica Bay. Actions to restore marshes so as to increase coastal resiliency may be unsuccessful unless accompanied by actions to reduce overall nitrogen loadings. Projects that have the potential to remove significant concentrations of nitrogen (e.g., upgrading of the Bay Park Wastewater Treatment Plant with an ocean outfall, expanded use of the Bergen Point wastewater treatment plant with a repaired ocean outfall, the extension of sewers to cover densely populated areas of southern Suffolk County, etc.) could be an appropriate focus of disaster recovery and coastal resiliency efforts.

Nitrogen Pollution and Adverse Impacts on Resilient Tidal Marshlands
NYS DEC Technical Briefing – April 22, 2014

PRIORITIES

- Suffolk County has identified three priorities for addressing the decline in water quality and the restoration of our coastal wetlands:
  1. <u>Fortify our existing wastewater infrastructure:</u>
     - ✓ Suffolk County's largest sewage treatment plant, Bergen Point, was close to being comprised during Superstore Sandy. Serving 80,000 households, it is a critical facility.
     - ✓ Suffolk County has requested $242 million to replace the plant's ocean outfall pipe that runs beneath the Great South Bay. Request currently before FEMA.
  2. <u>Sewer targeted areas:</u>
     - ✓ Removing 1,390 pounds of nitrogen discharged each day into major tributaries which flow directly into the Great South Bay, will prevent further decline of critical coastal vegetation and provide the foundation to restore estuary and bay marshlands.
     - ✓ Suffolk County has identified three priority sub-regions to target:
       - Deer Park, North Babylon & Wyandanch
       - Mastic/Shirley
       - Oakdale
  3. <u>Pilot alternative/innovative on-site wastewater treatment systems;</u>
     - ✓ Initiate projects for the installation of community-scale innovative/alternative wastewater treatment systems for clusters of 50-100 homes.
     - ✓ Initiate project to assist homeowners with improved on-site systems.

Coastal Resiliency, 25% reduction in Nitrogen



SEPTIC/CESSPOOL ACTION PLAN: NEAR TERM

- In 2014 Suffolk County will:
  - Up to the approximately 209,000 households we will need to upgrade, we must undertake a household by household analysis so we have the answers as to which areas do we need to sewer, which areas do we need clustered systems and which areas do we need individual systems.
  - Learn best practices and latest technological advances from other states

    Completed: 4-state Septic Tour with US EPA, NYS EFC, TNC, PGG, Stony Brook, and Legislator Hahn, report available online
  - Test and approve advanced small onsite systems this year—None currently approved in Suffolk

GOAL for 2014—Delineate the scope of the problem, initiate work to sewer critical areas, and develop a clear road map moving forward.

On-Site Sewage Disposal System Study (2013) Cluster Decentralized

- Commercial Findings (to 15,000 gpd)
  - 9 commercial systems were studied in depth
  - 4 new technologies were added to the list of Approvable technologies
    - ✓ Nitrex
    - ✓ BESST
    - ✓ Aqua Point – Bioclere
    - ✓ WesTech STM-Aerotor
  - Existing technologies of Cromaglass, SBR, and MBR are still acceptable
  - SCDHS will continue to evaluate new technologies as they are proposed and will update the list as appropriate
- Reduced Separation Distances (75’) under Appendix A

SEPTIC/CESSPOOL ACTION PLAN: MID TERM

While we are accomplishing those items in 2014, we must operate on parallel tracks to begin longer-term priorities to address this problem:

- Working with NYS EFC to develop creative financing to help individual homeowners finance on-site and cluster projects.
- Working with Stony Brook University and Southampton Town to develop a NYS Water and Environmental Testing Laboratory to research and commercialize the next generation of wastewater treatment technology in Suffolk County, which is also the biggest potential market for this product.

"Septic Tour" Report

- 4 States (Md, NJ, RI, Ma)
- >10,000 Individual I/A Onsite Systems
- Most successful at >50% N removal
- Independent NSF and ETV certifications
- Lessons Learned
  - O&M, Monitoring, Institutional and Data Management
- SCDHS-Approvable Systems
  - Demonstration in 2014
  - Approve provisionally in 2015
- Part of "toolbox"
  - Road map for sewering, cluster decentralized, individual onsite
  - Priority areas, funding strategies

NEXT STEPS

- Ongoing Analysis and Stakeholder Engagement:
  IBM Smart Cities Challenge: June 2 – 20

  Suffolk County one of only four municipalities chosen in the United States to receive $500,000 in in-kind consultation services

- Public Education and Awareness:

IN CONCLUSION….

"What Sandy brought home is that trying to draw a line and say, 'From here on back is human lands, and from here forward is the natural system,' isn't going to work," Deegan said.

Deegan cites that while fertilizer represents 10 percent of the problem, she believes the other 90 percent is tougher, saying, "And what we need to do there is just bite the bullet and deal with the nutrients that are coming from human waste via septic and sewage. We need to get the nitrogen out of that waste. People say this is an expensive thing to do, but I think in the long run we're going to find it would have been more cost effective to have taken the nutrients out than to try and rebuild coastal areas after we've lost the sea grass and the salt marsh."

-Linda Deegan, Senior Scientist, Woods Hole Marine Biological Laboratory

How does excessive nitrogen loading effect the health and resiliency of Long Island's coastal ecosystems?

Christopher J. Gobler

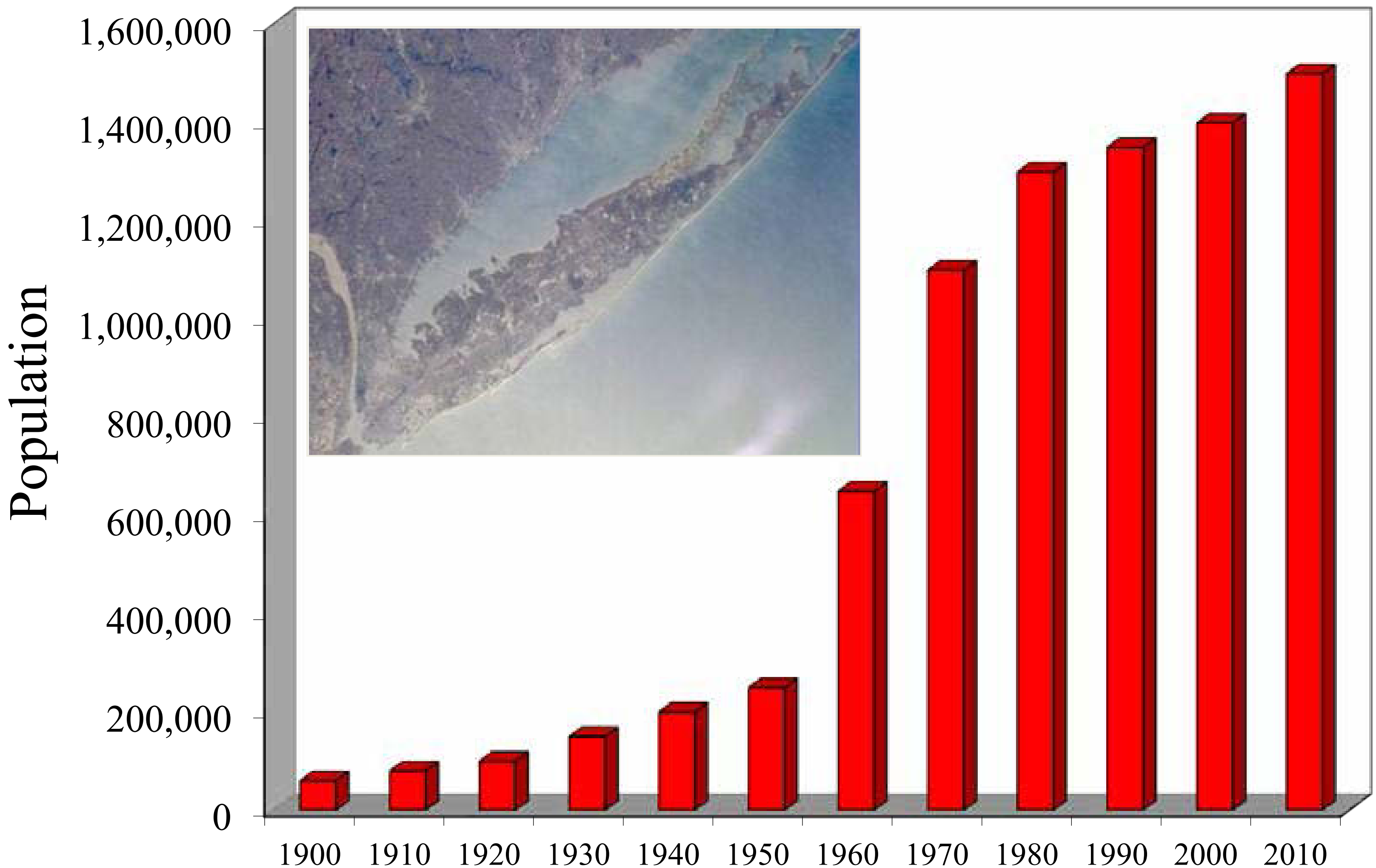
Stony Brook University
School *of* Marine and Atmospheric Sciences

"Nitrogen is the critical limiting factor to primary producers in Long Island coastal marine waters"

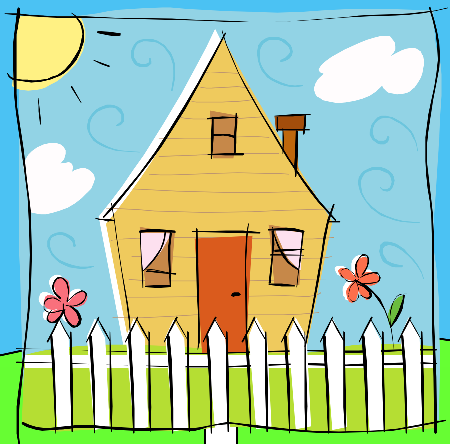
– Dr. John Ryther, Woods Hole Oceanographic Institute, Science Magazine, 1971

WOODS HOLE OCEANOGRAPHIC INSTITUTION
1930

Its getting crowded…Suffolk County

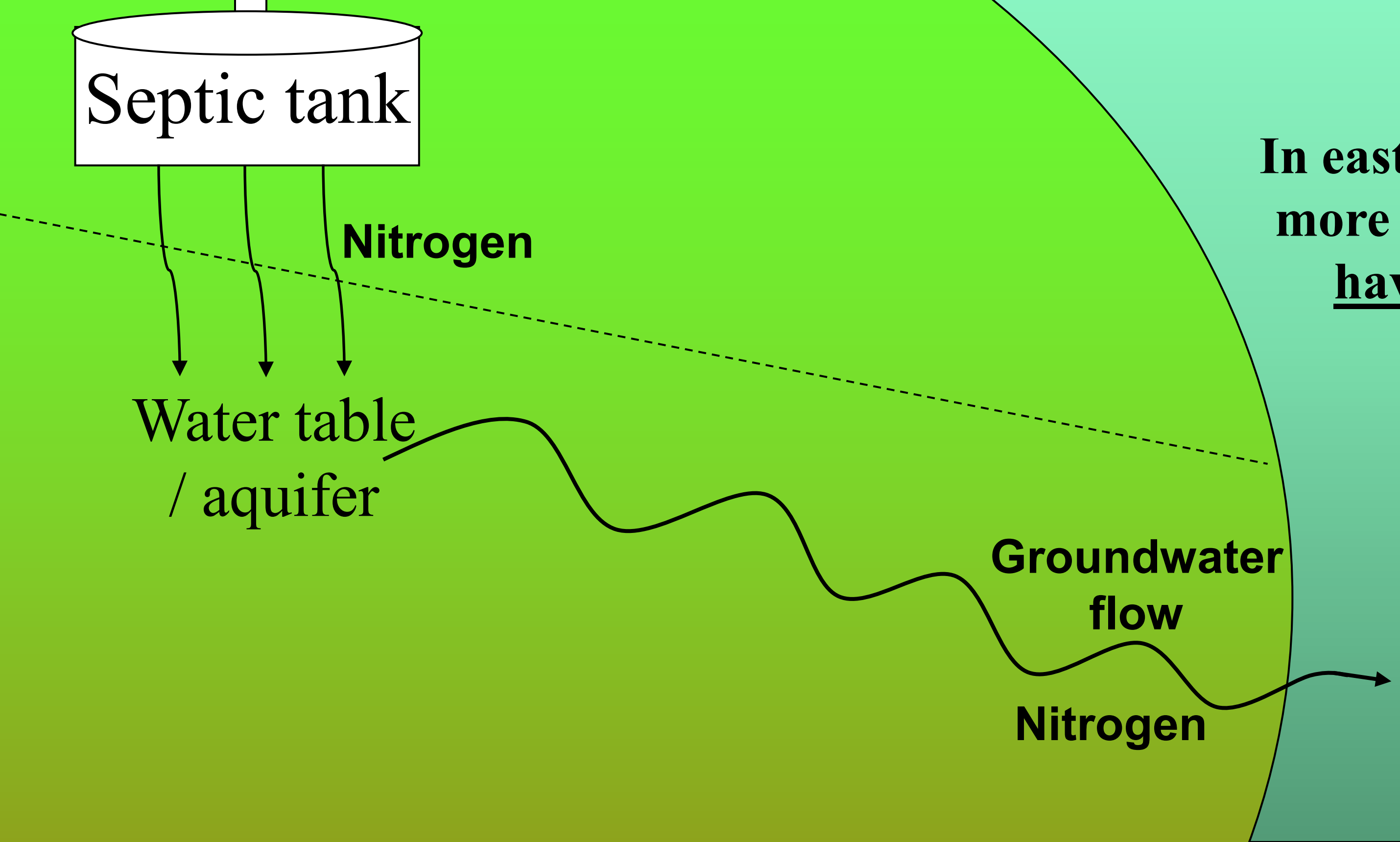


Long Island Legacy: wastewater

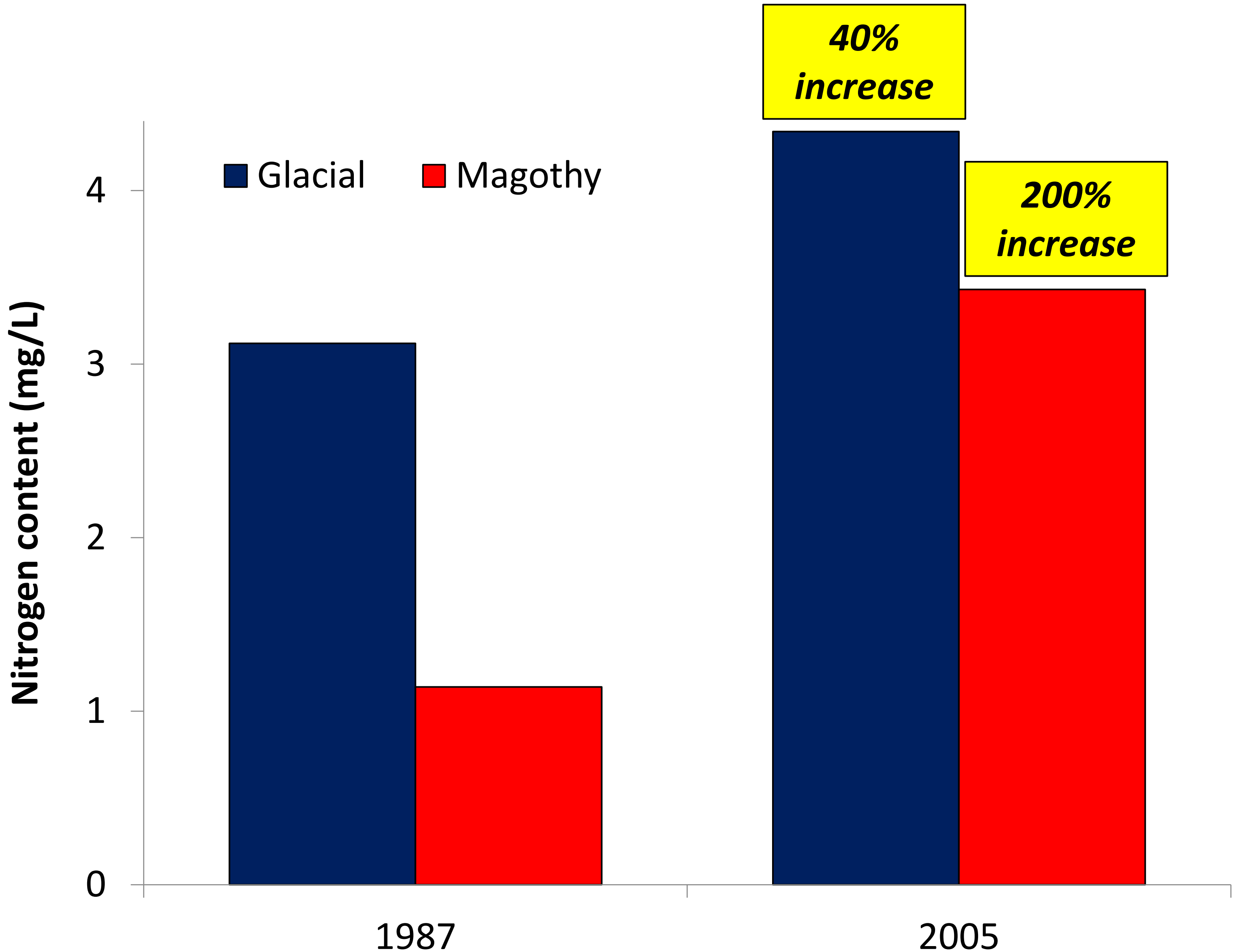


In Suffolk County, 70% of homes have septic tanks or cesspools.

In eastern Suffolk County, more than 90% of homes have septic tanks or cesspools.

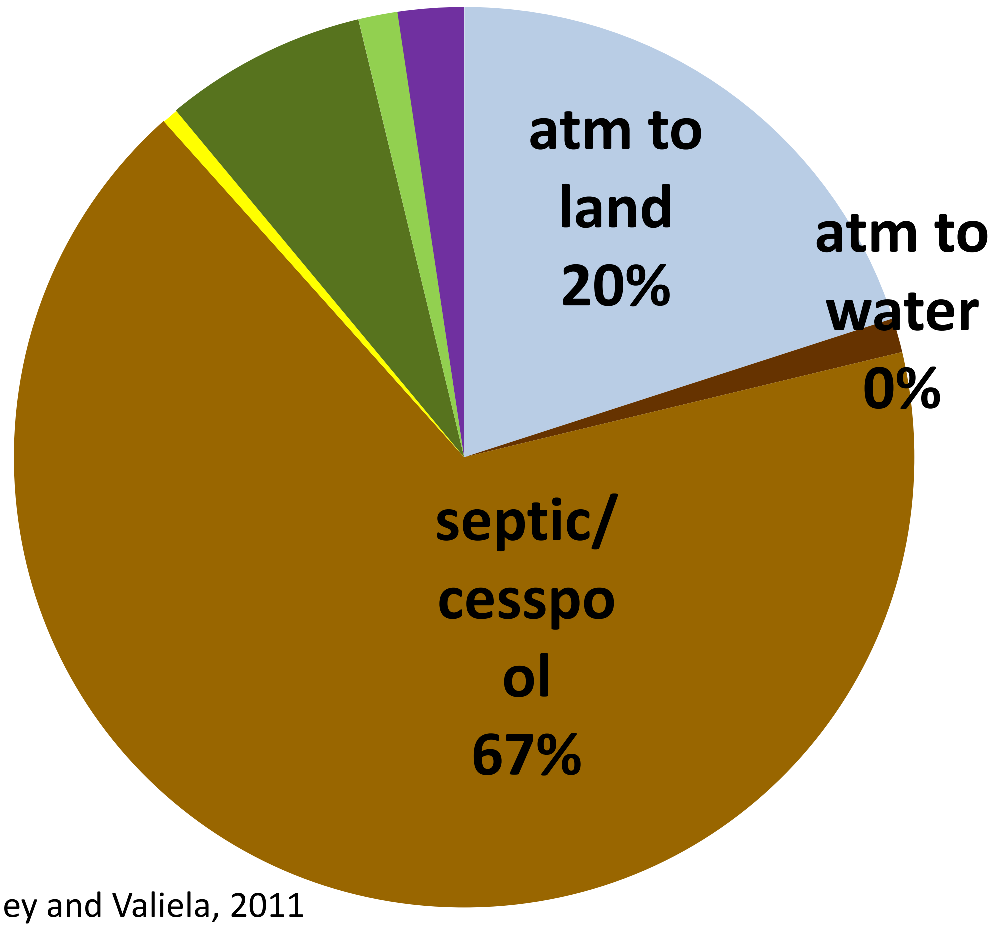


Changes in groundwater nitrogen levels in Suffolk County



Suffolk County Comprehensive Water Resources management plan, 2010

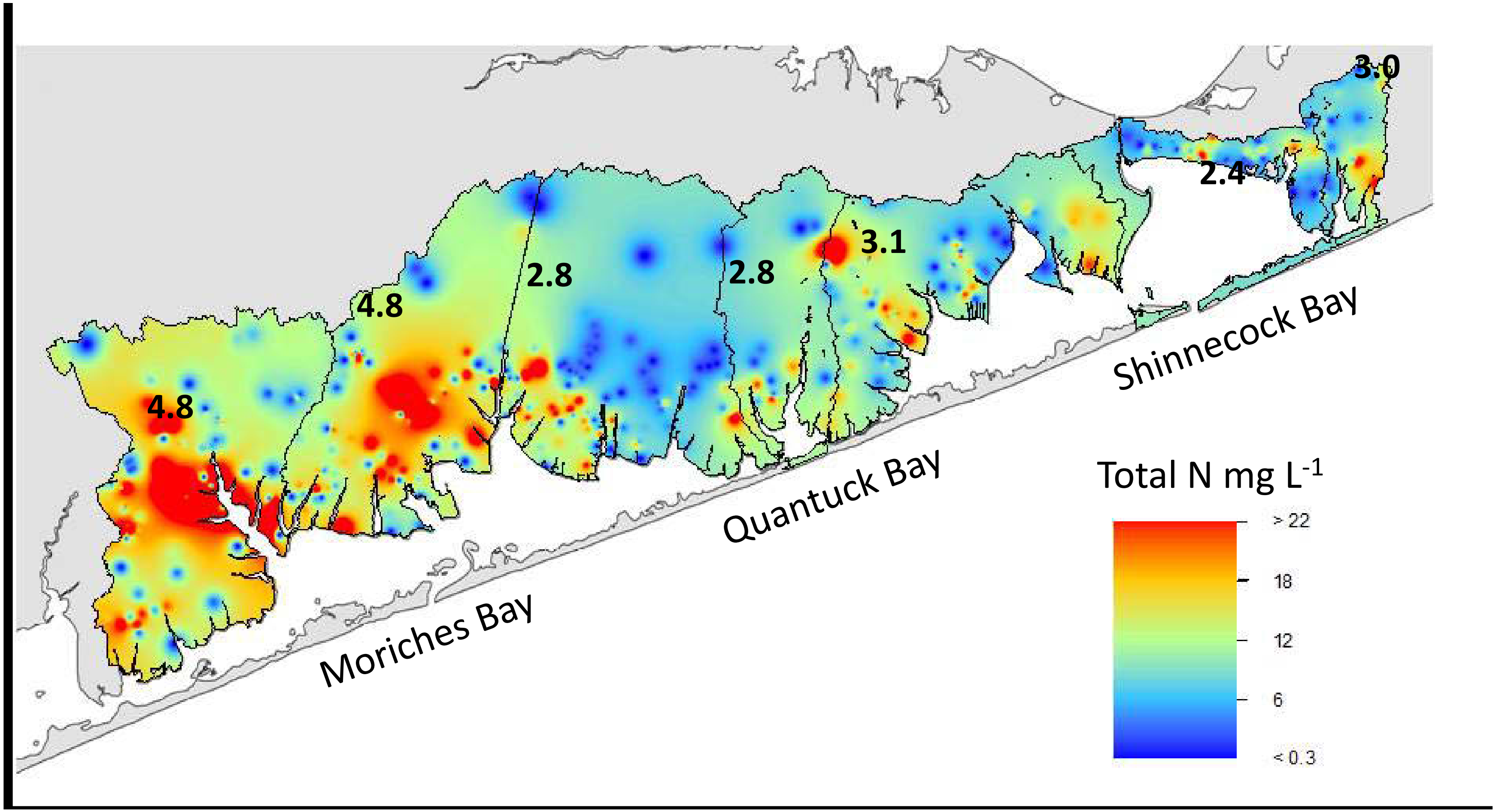
N loads to Great South Bay <u>from watershed</u>



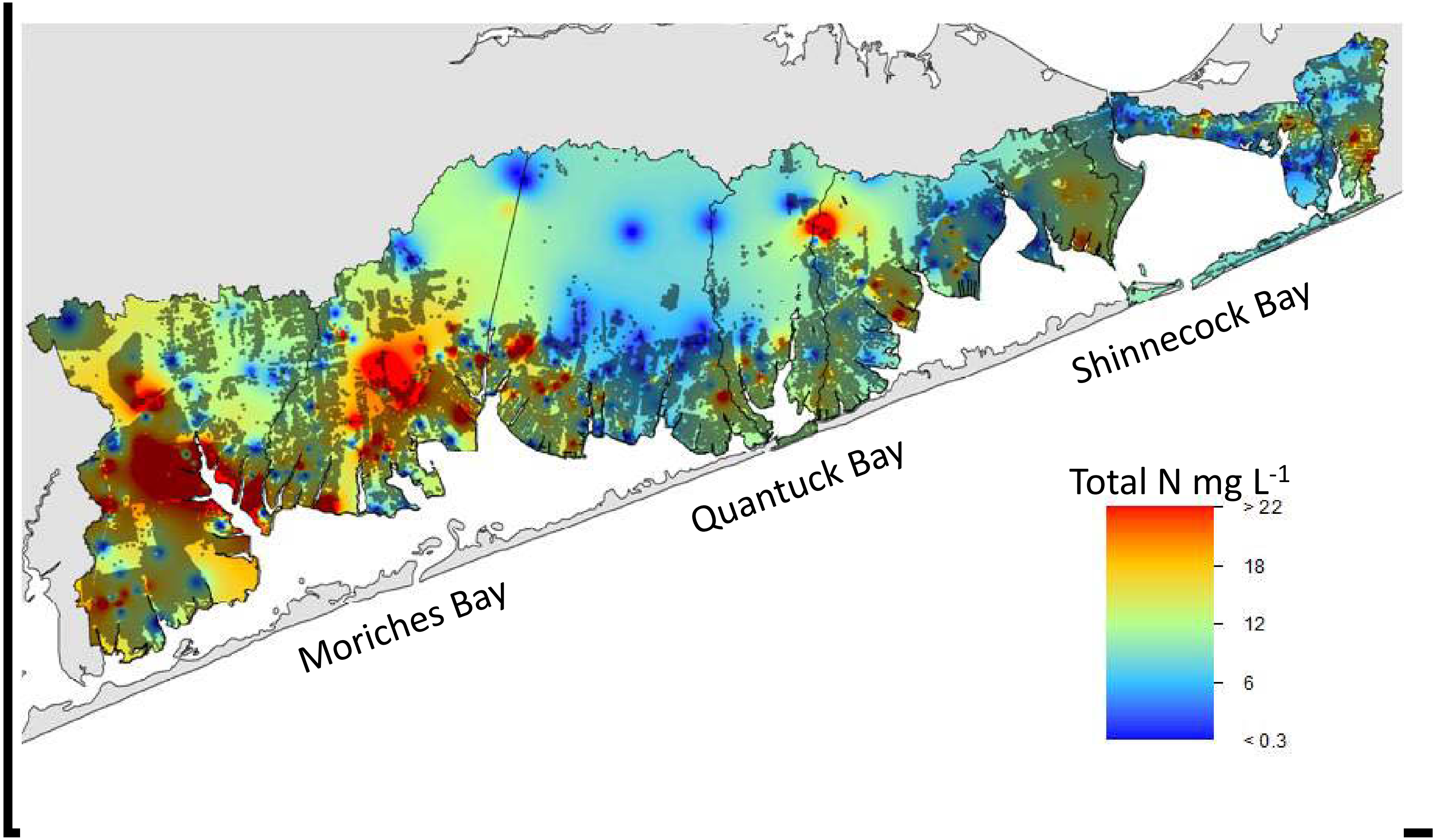
Kinney and Valiela, 2011

•~70% of N entering Moriches and Shinnecock Bay is from wastewater (Gobler et al, in progress for NYSDOS).

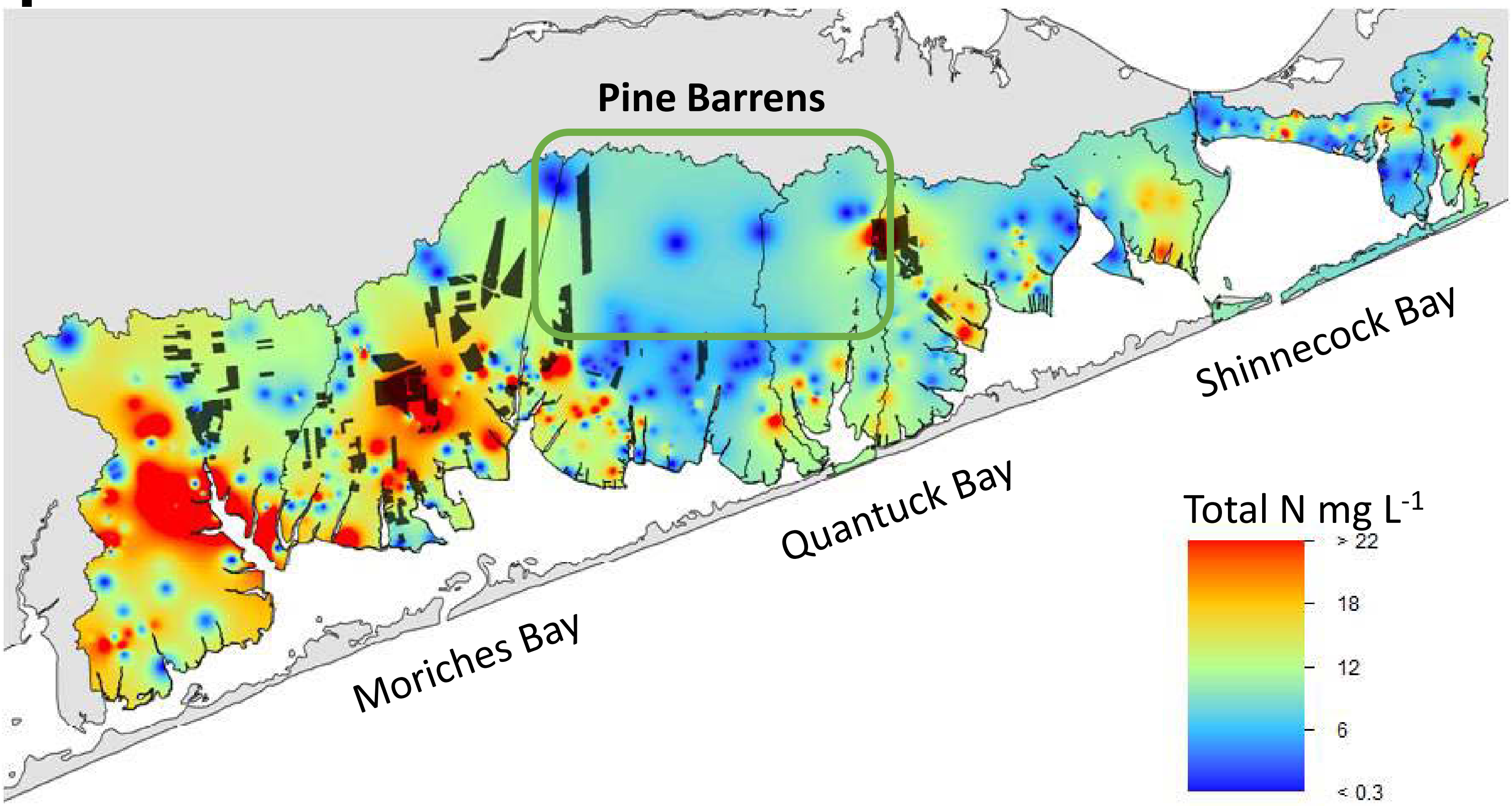
Groundwater nitrogen concentrations, Eastern Bays



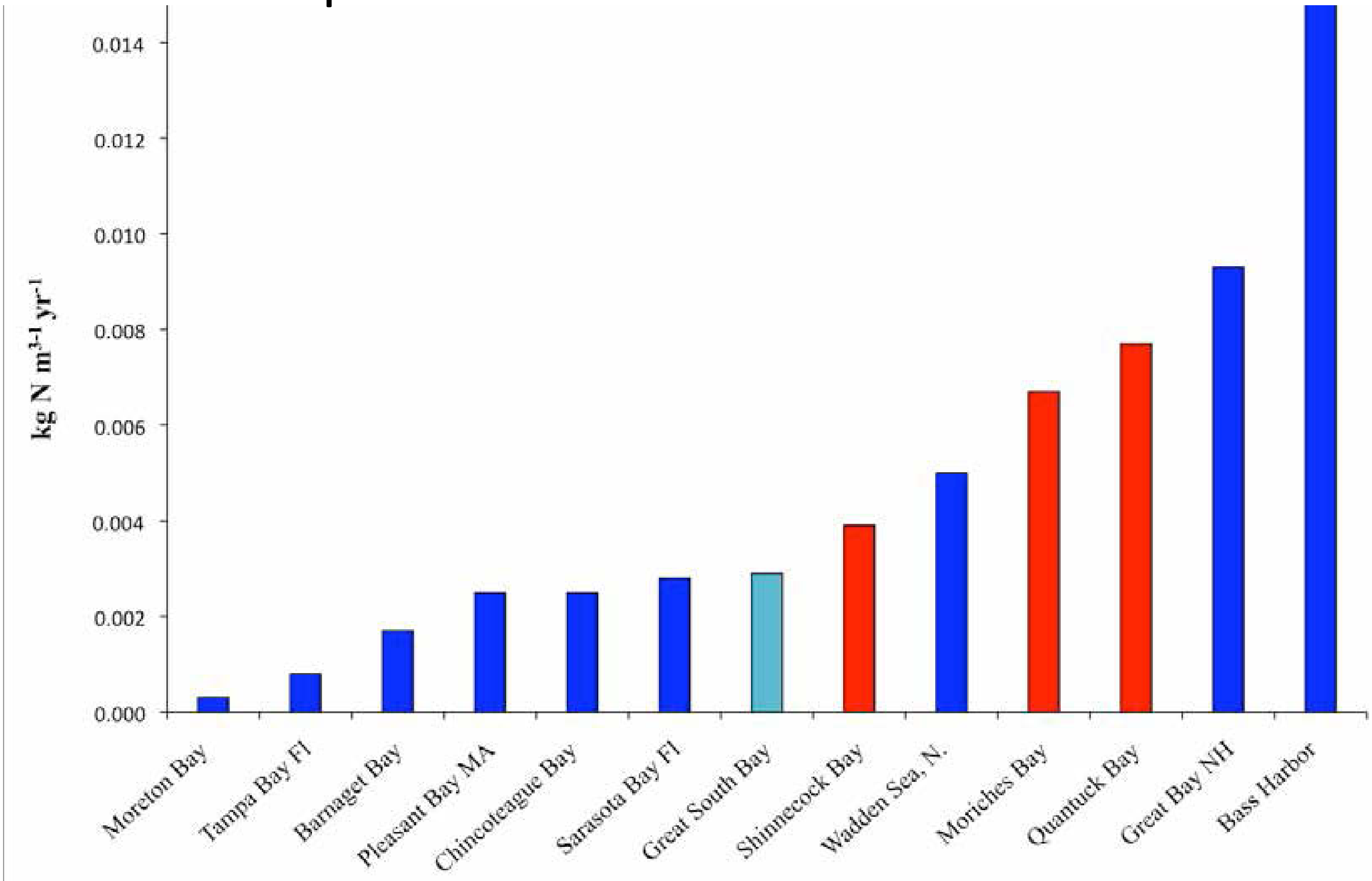
Groundwater N and buildings



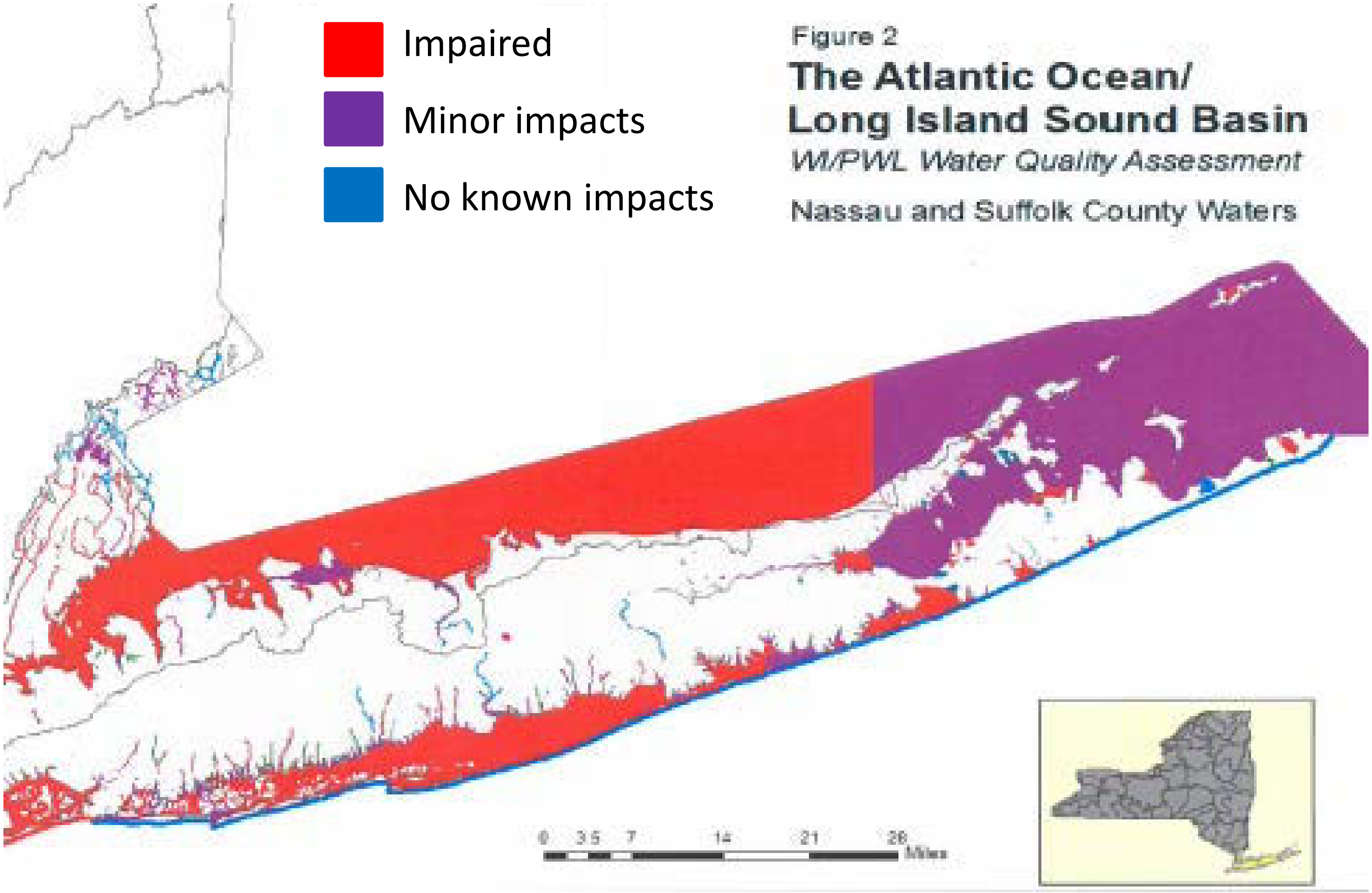
Groundwater N and agriculture



South shore bay nitrogen loads compared to other water bodies



NYSDEC assessment of Long Island coastal waters



What impairments are brought about by excessive nitrogen loading?

- **Loss of critical habitats**: Eelgrass, salt marshes
- **Low dissolved oxygen levels, hypoxia**
- **Acidification, low pH**
- **Macroalgal blooms**: Sea lettuce, *Ulva*
- **Toxic algal blooms**: Red, rust, brown tides
- **Loss or depletion of shellfisheries and finfisheries**

The vital role of salt marshes in coastal ecosystems and communities

Salt marsh ecosystems

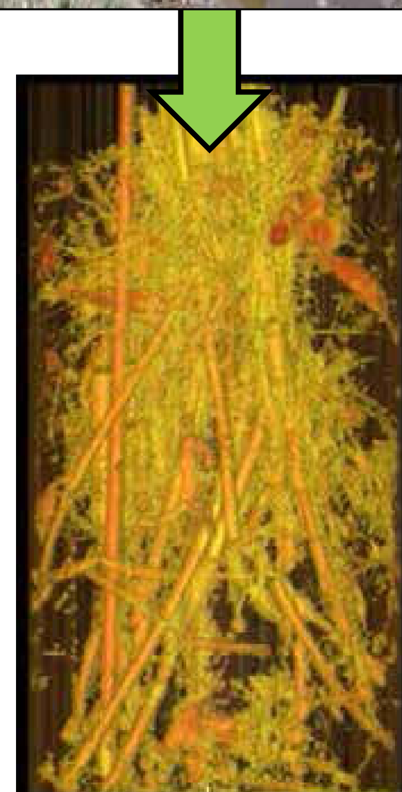
Salt marshes protect coastlines

Chris Bason, Delaware Center for the Inland Bays

Salt marshes protect coastlines

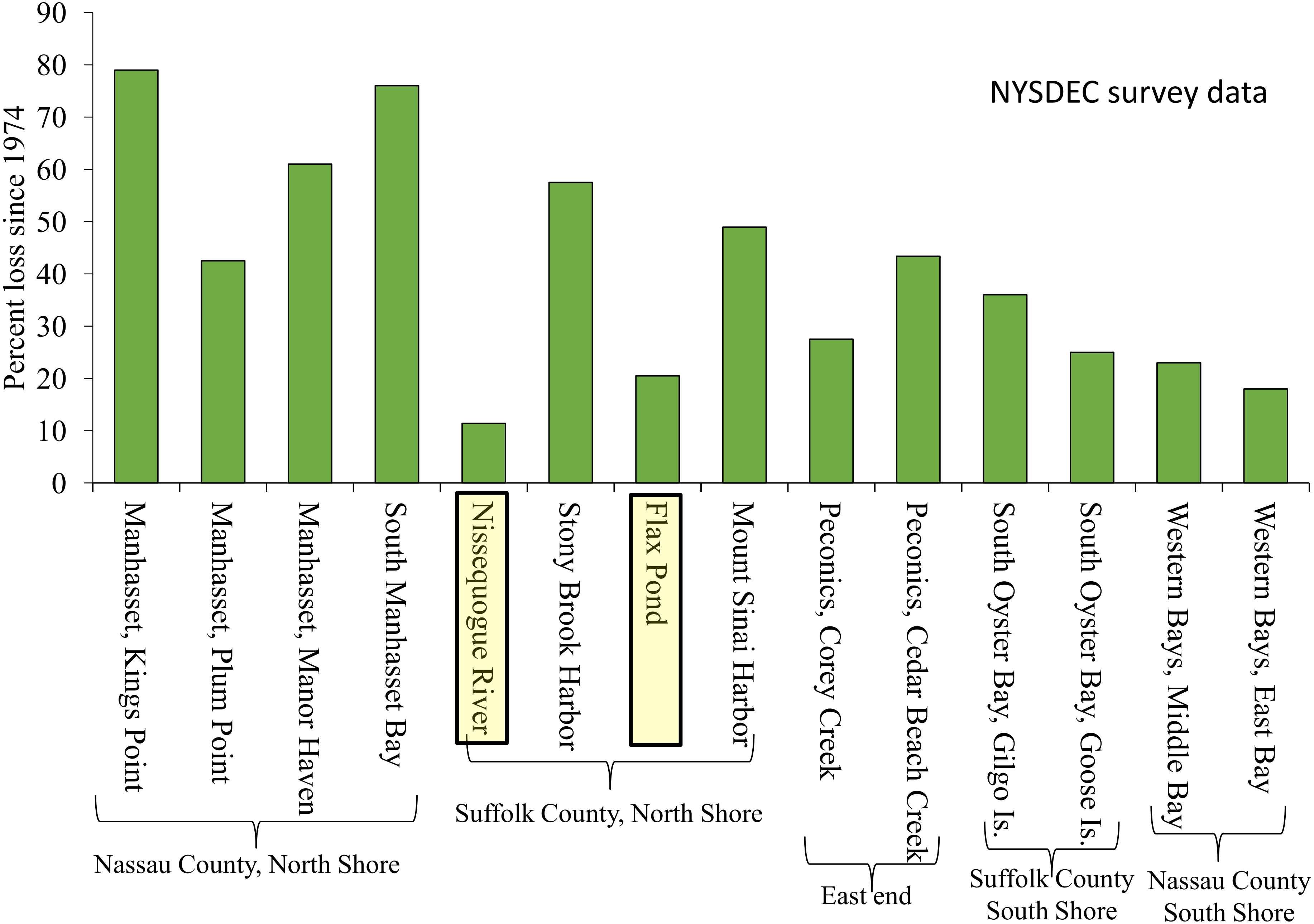
"Coastal eutrophication as a driver of salt marsh loss", Deegan et al 2012, Nature

Dense, strong roots



Nutrient weakened, roots

Loss of wetlands on Long Island, since 1974

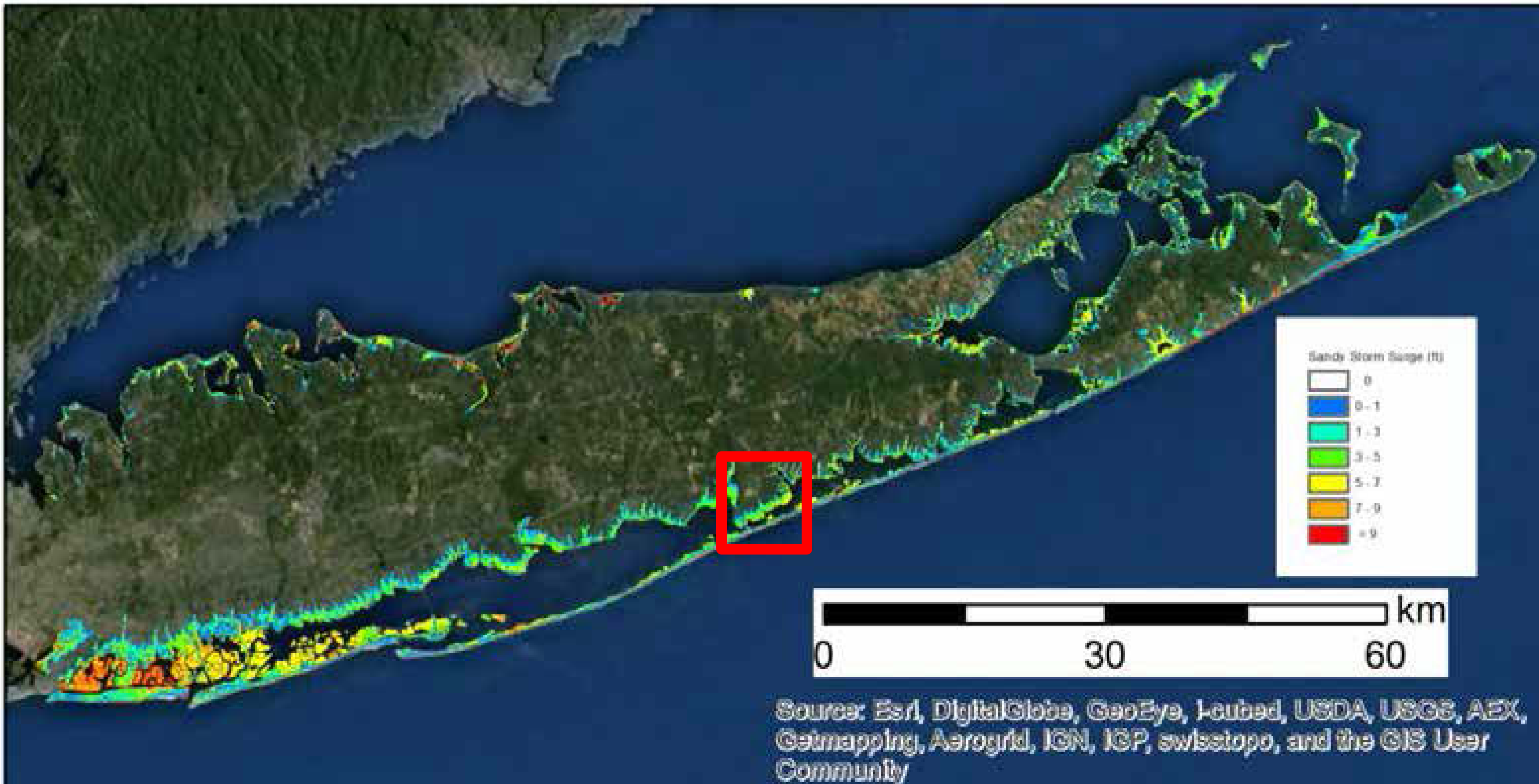


Salt marsh loss, Jamaica Bay

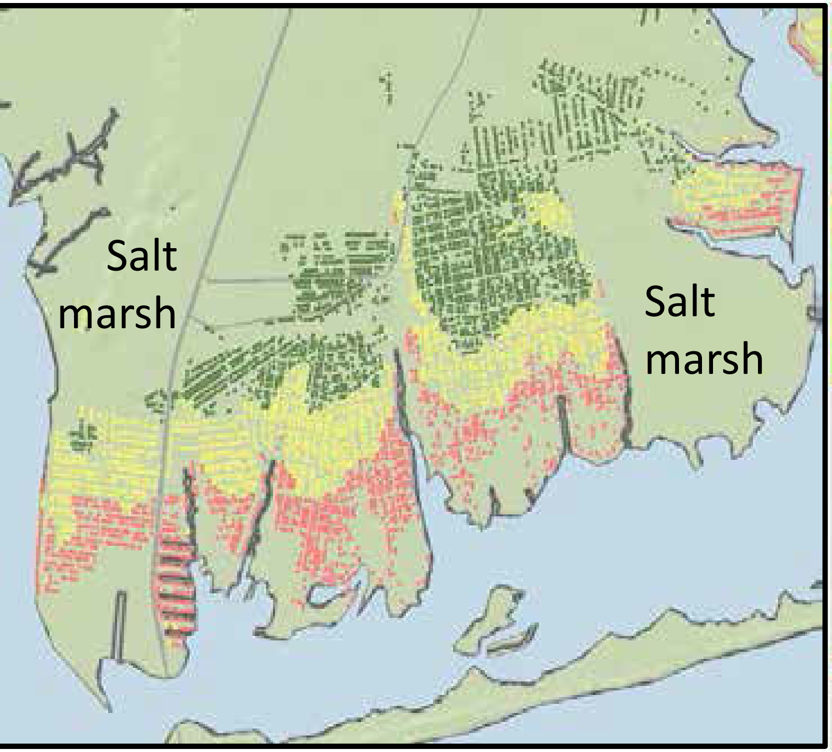
Flooding during Hurricane Sandy

NYS RISE

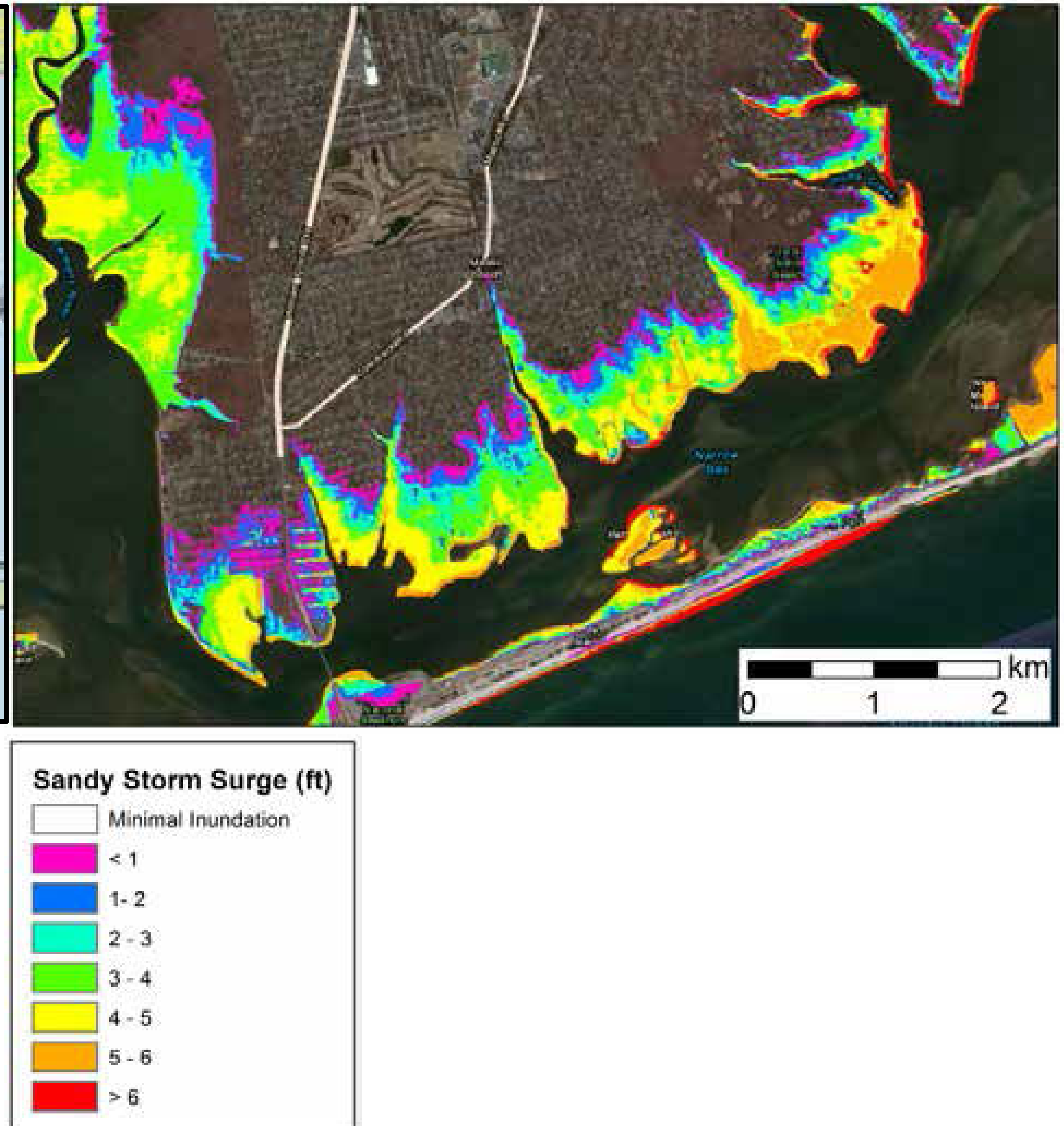
RESILIENCY INSTITUTE FOR STORMS & EMERGENCIES



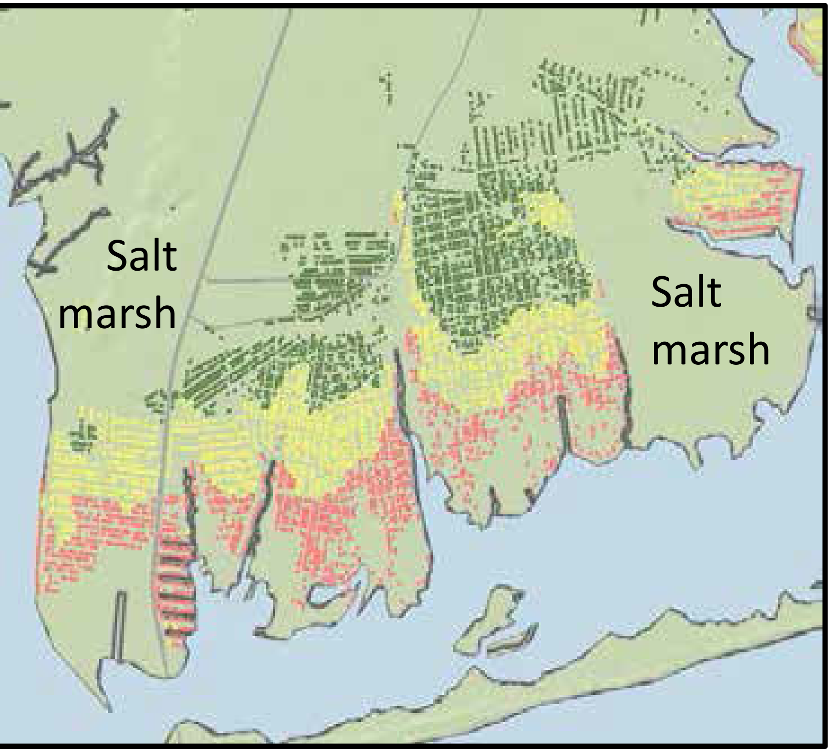
Flooding in Mastic – Shirley during Hurricane Sandy

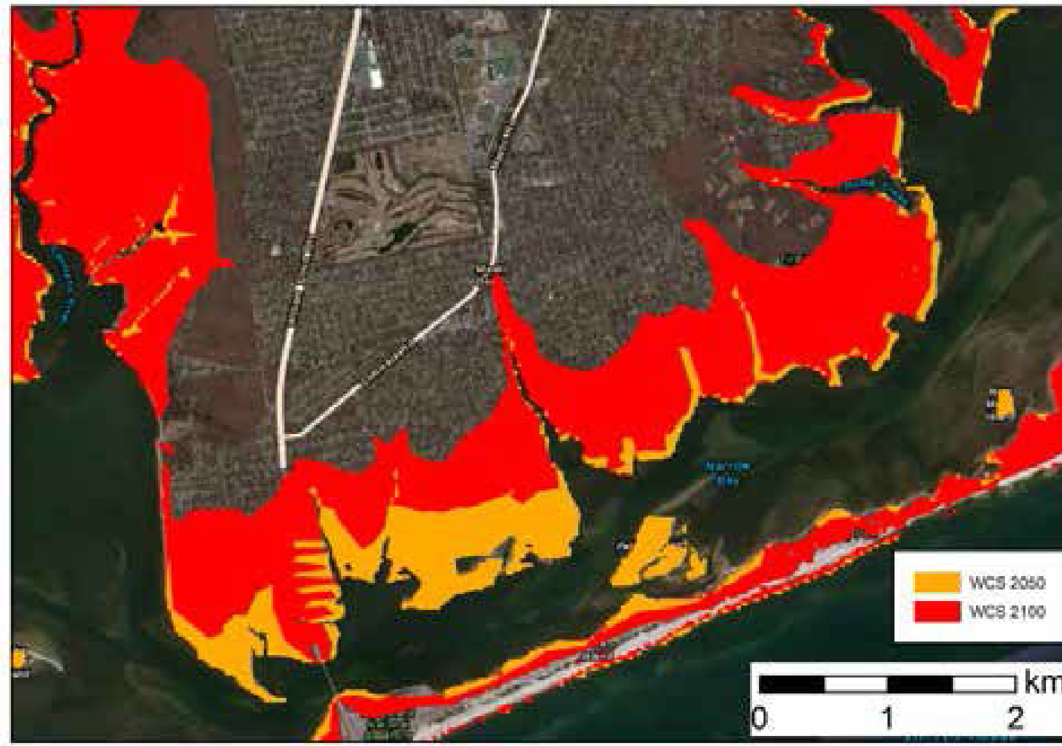


Each point is a home.



Flooding in Mastic – Shirley, sea level rise



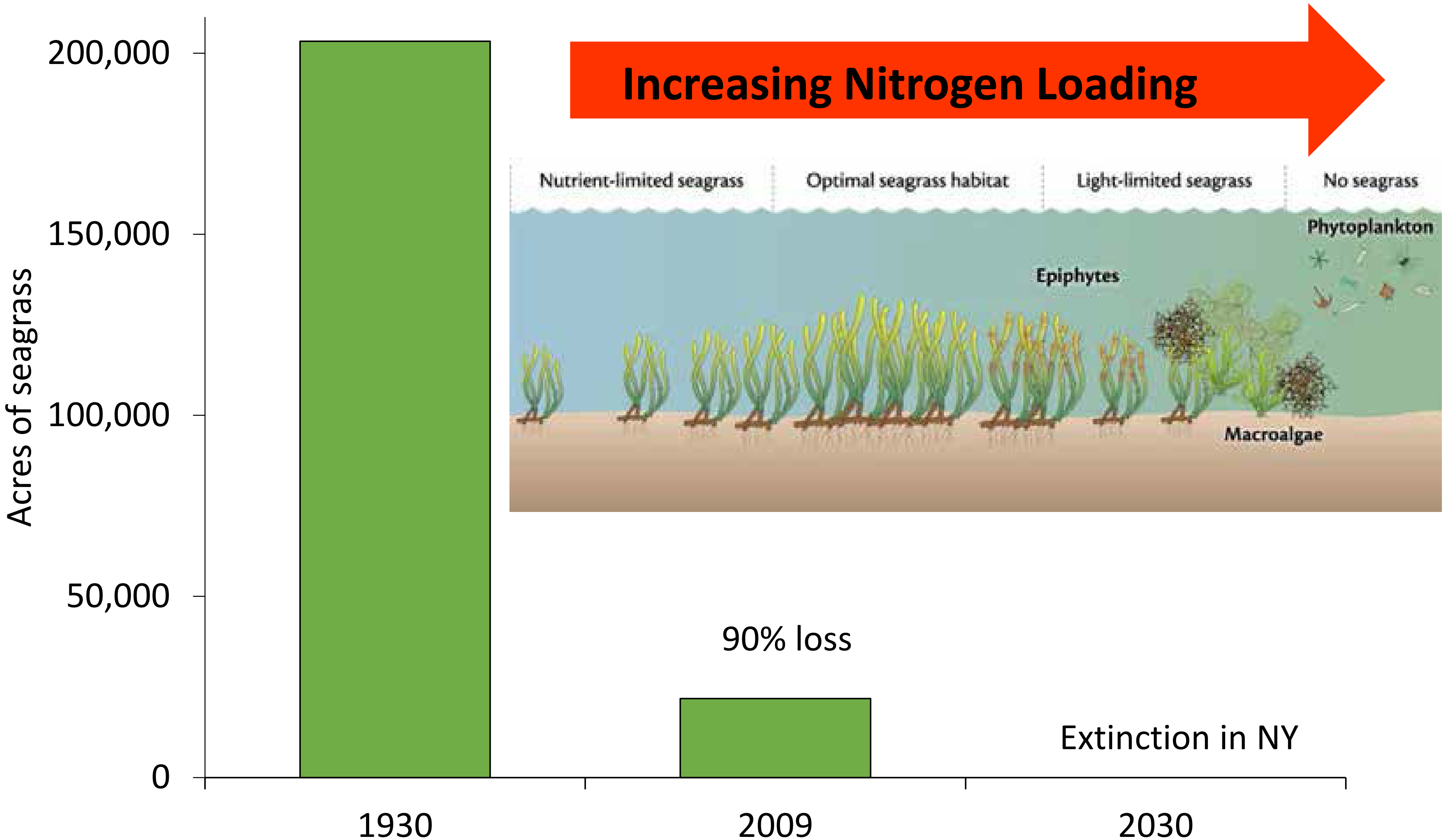


Each point is a home.

Flooding scenarios will worsen significantly with weakened or destroyed salt marshes.

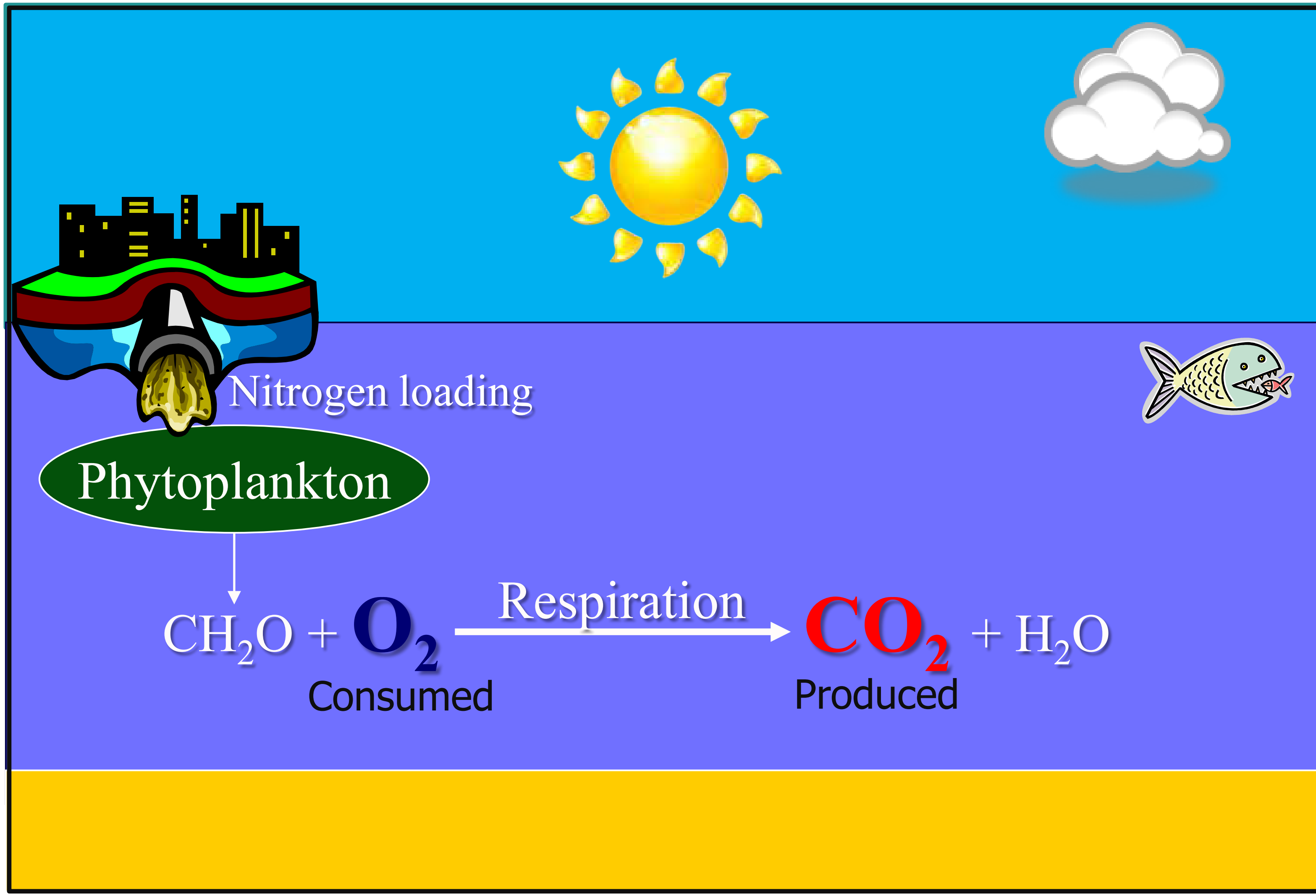
Eelgrass: Critical benthic habitat

NYS seagrass, 1930 - 2030

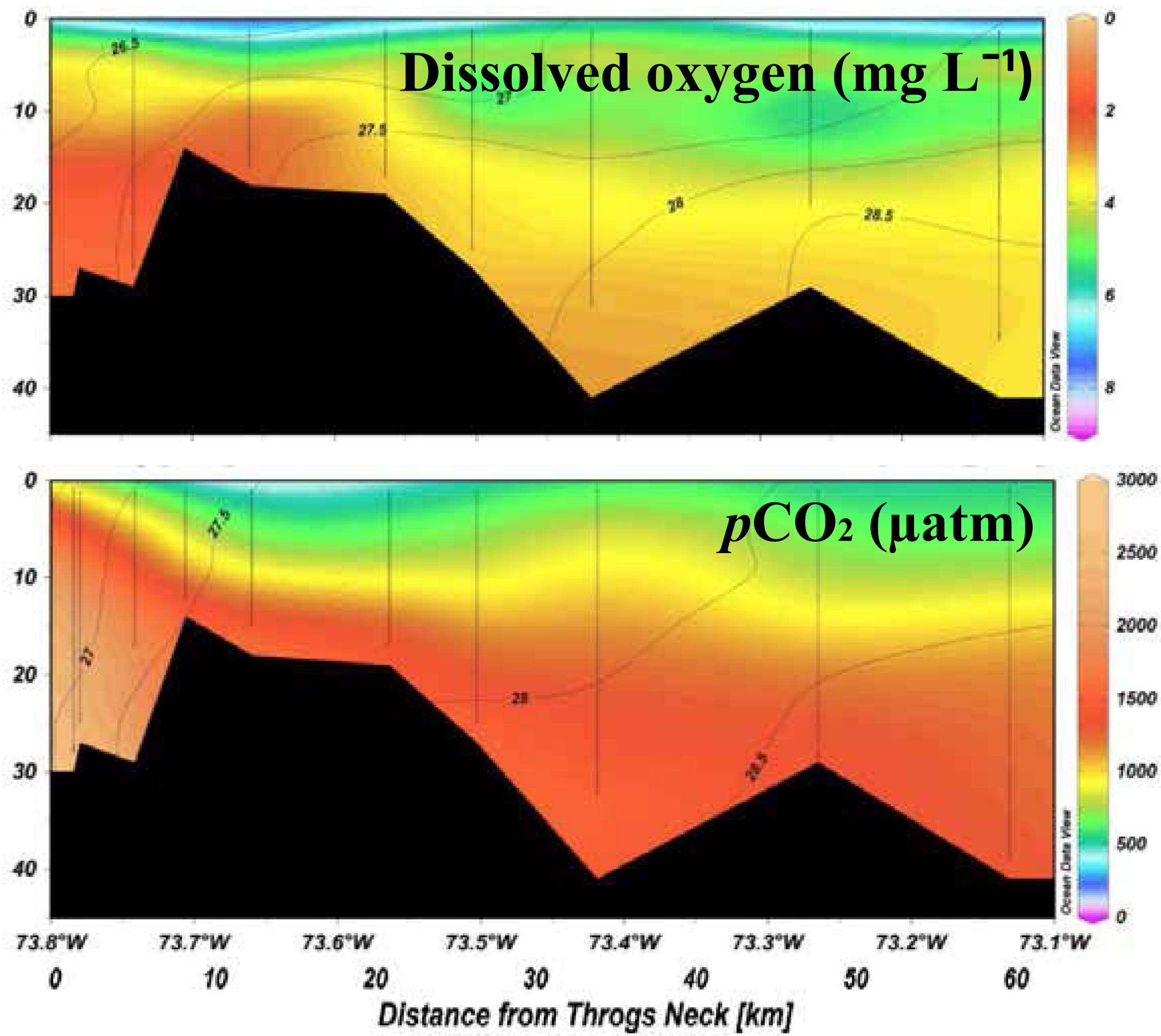


NYSDEC Seagrass Taskforce Final Report, 2010; Suffolk County assessment, 2014

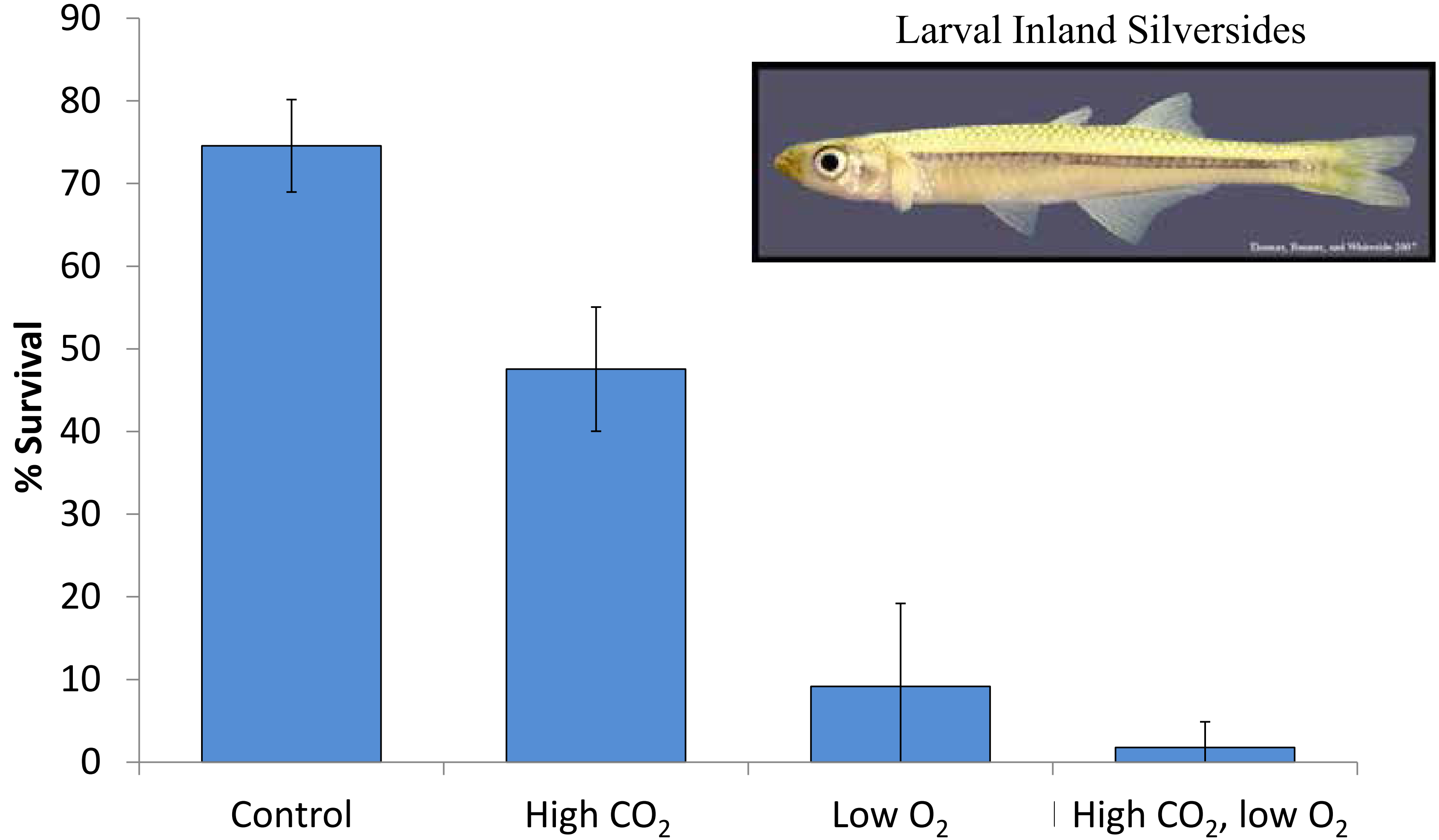
Nitrogen loading leads to low oxygen and high CO_2



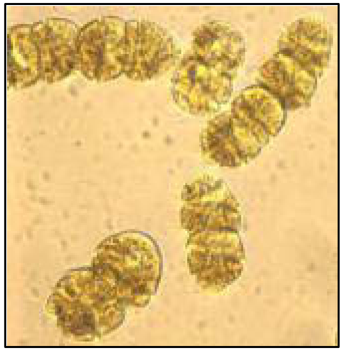
Long Island Sound, August 2013



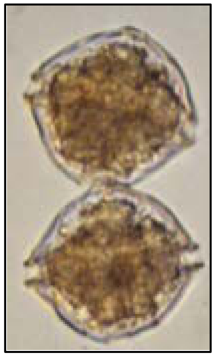
Effects of high CO_2 and low O_2 on fish survival



Harmful algal blooms across Long Island

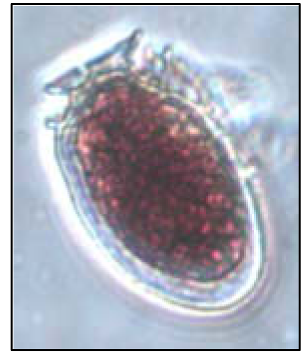


Cochlodinium

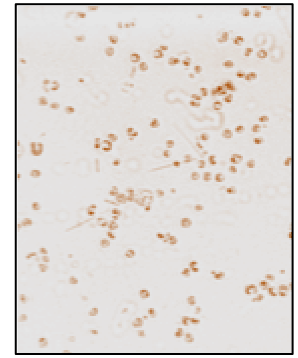


PSP, red tide

Toxic blue green algae

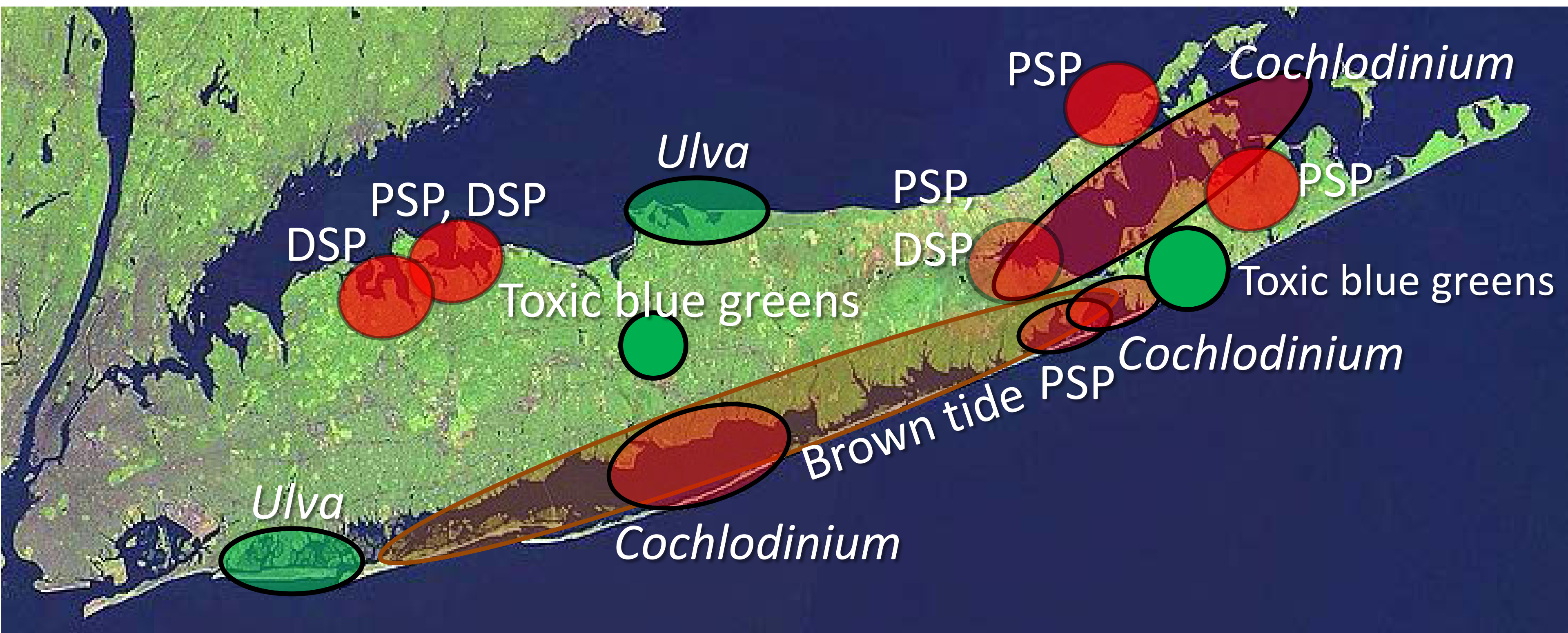


DSP, red tide



Brown tide

Ulva



Enhanced nutrient loading → more intense &/or toxic HABs

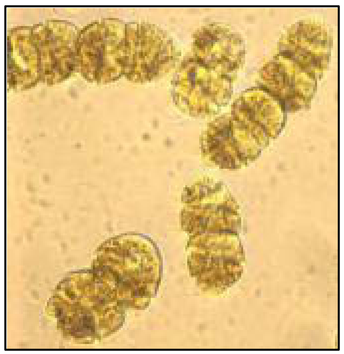
Gobler et al 2012

Harke and Gobler, 2013

Hattenrath et al 2010

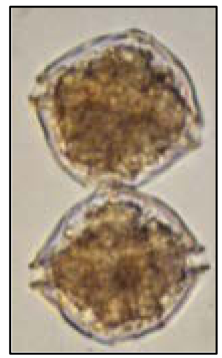
Hattenrath-Lehmann 2014

Gobler et al 2011; Gobler and Sunda 2012



Cochlodinium
'Rust tide'

Microcystis
'Blue green algae'

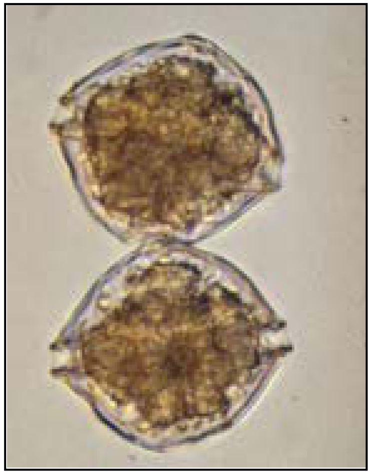


Alexandrium
'Red tide – PSP'

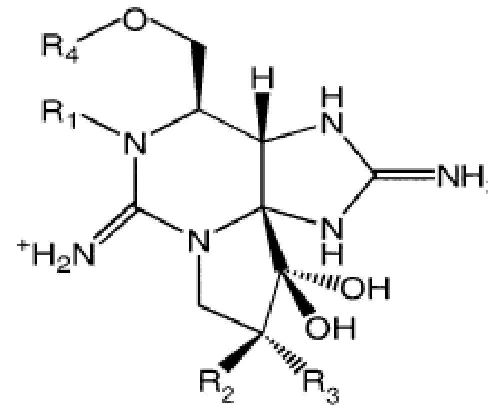
Dinophysis
'Red tide – DSP'

Aureococcus
'Brown tide'

Alexandrium red tides and paralytic shellfish poisoning (PSP)

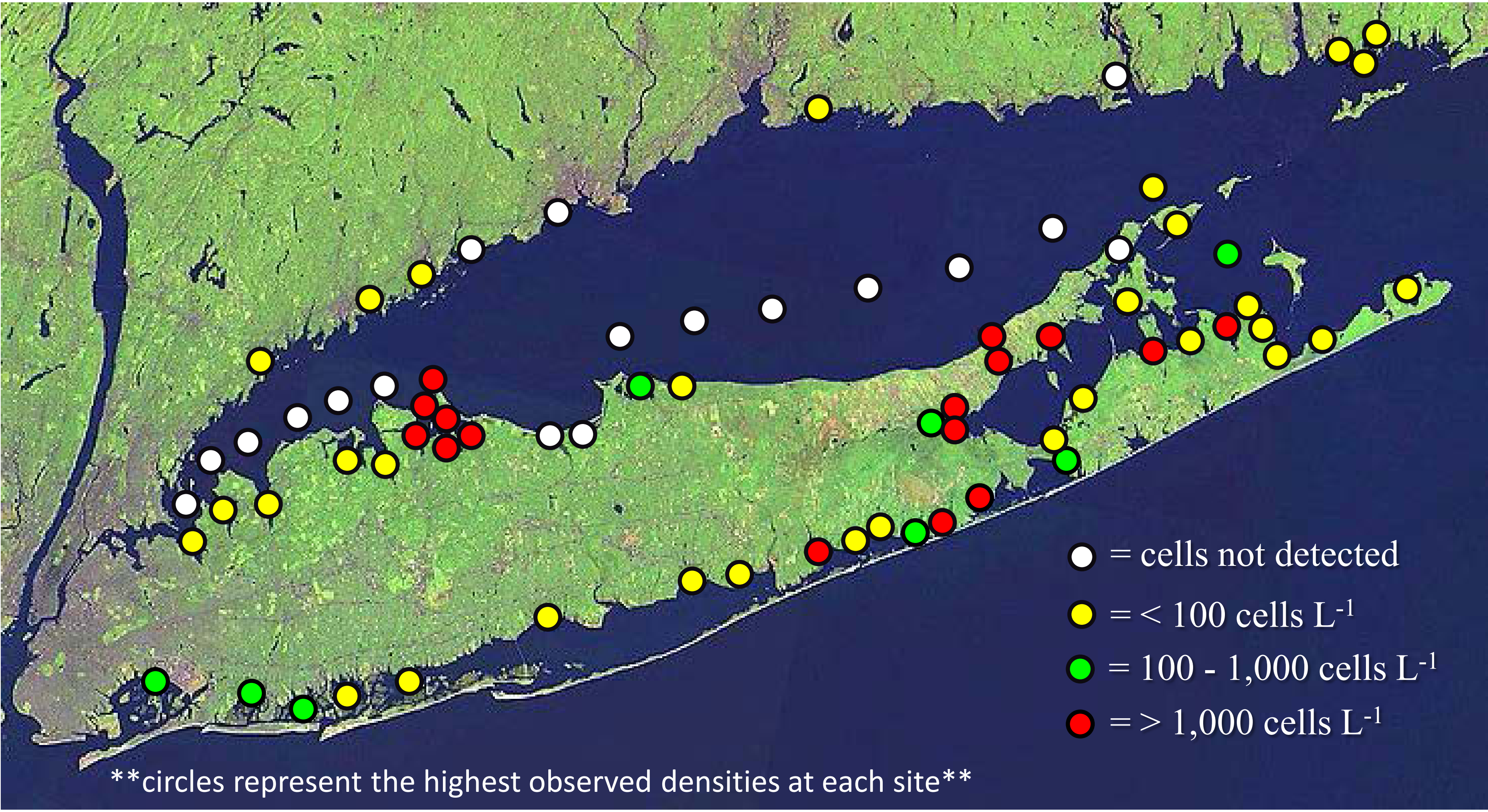


Alexandrium



Saxitoxin

Presence of PSP-producing *Alexandrium* in NY: 2007-2013



- *Alexandrium* found at 47 of 63 sites samples (75%)

Harmful Algae 9 (2010) 402–412

Contents lists available at ScienceDirect

Harmful Algae

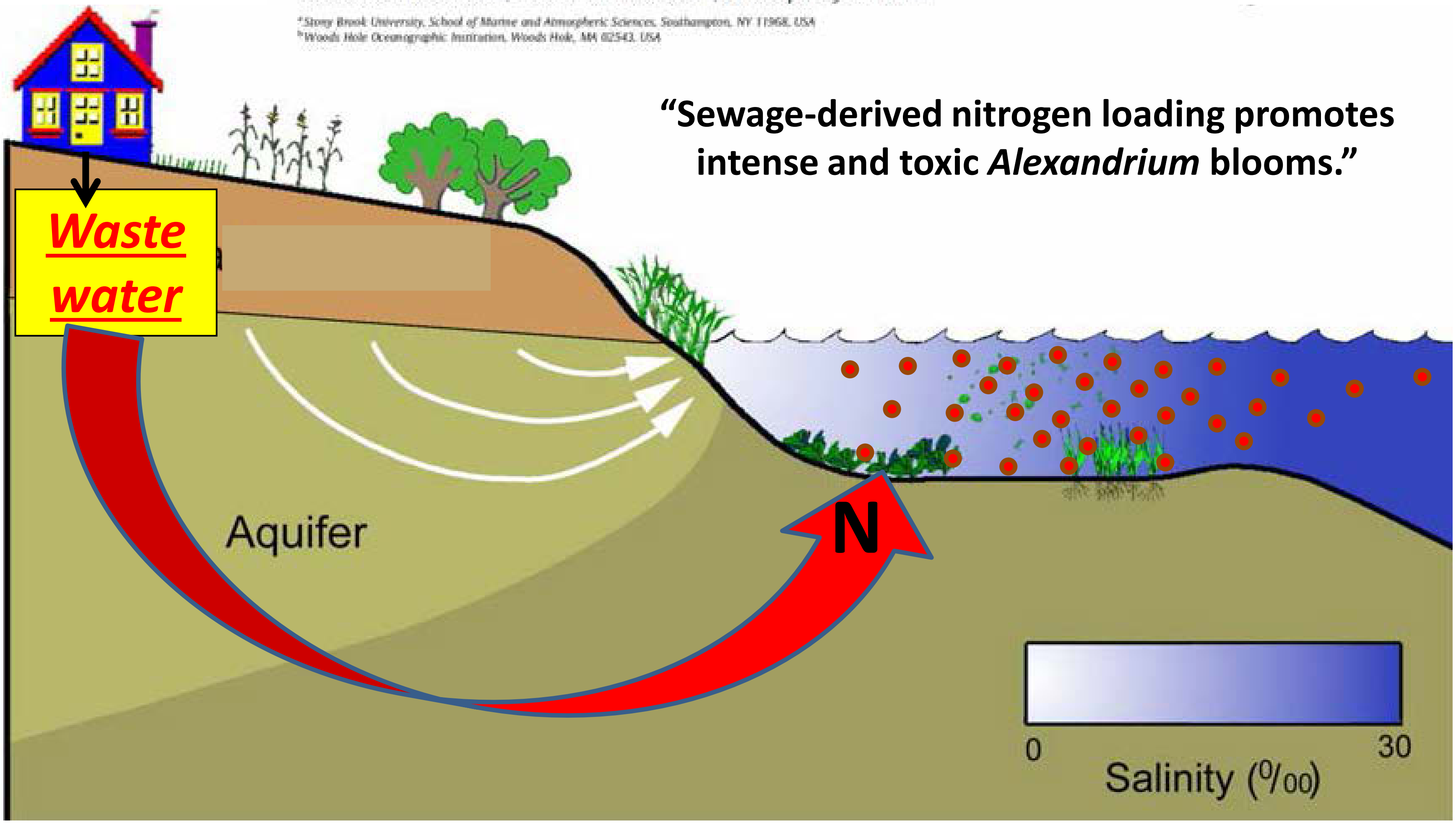
journal homepage: www.elsevier.com/locate/hal

The influence of anthropogenic nitrogen loading and meteorological conditions on the dynamics and toxicity of *Alexandrium fundyense* blooms in a New York (USA) estuary

Theresa K. Hattenrath[a], Donald M. Anderson[b], Christopher J. Gobler[a,*]

[a] Stony Brook University, School of Marine and Atmospheric Sciences, Southampton, NY 11968, USA
[b] Woods Hole Oceanographic Institution, Woods Hole, MA 02543, USA

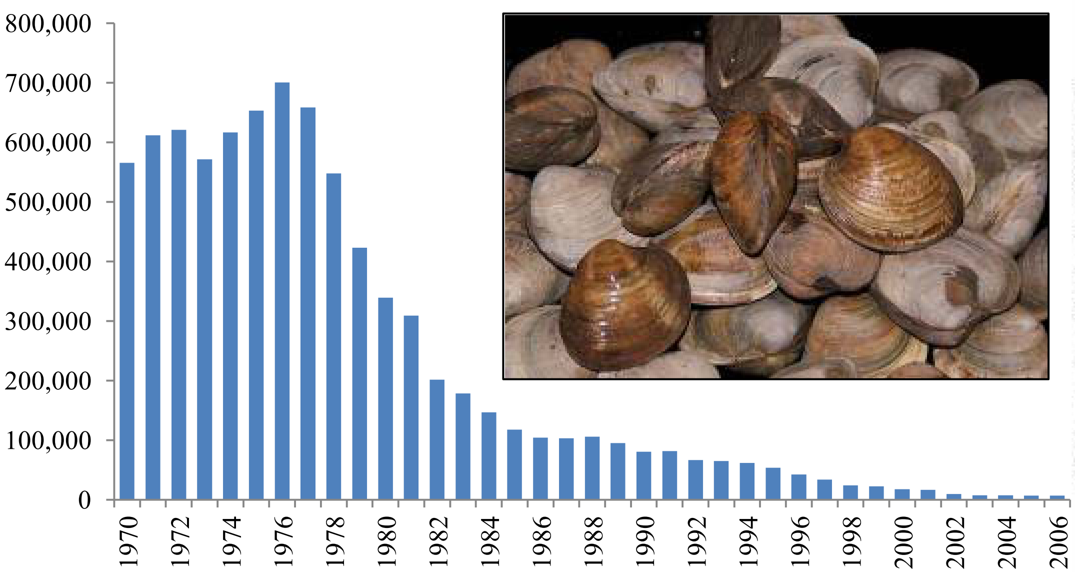
"Sewage-derived nitrogen loading promotes intense and toxic *Alexandrium* blooms."

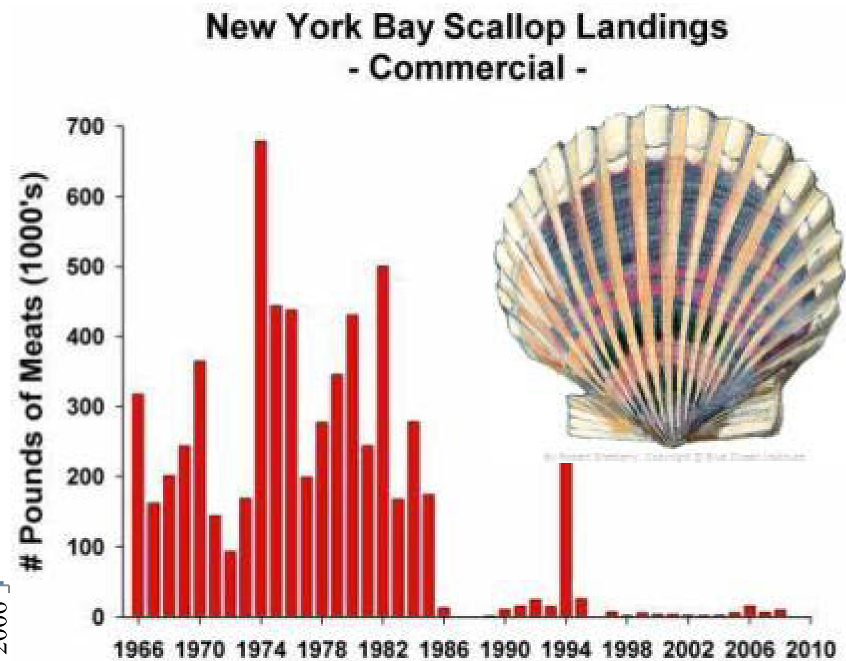


Nitrogen impacts on shellfish

- Landings of clams and scallops have declined 99% since 1980.
- Linkages to nitrogen driven HABs, habitat loss, and water quality degradation.

Hard clam landings (bushels) in Great South Bay





What impairments are brought about by excessive nitrogen loading?

- **Loss of critical habitats**: Salt marshes, eelgrass
- **Low dissolved oxygen levels, hypoxia**
- **Acidification, low pH**
- **Macroalgal blooms**: Sea lettuce, *Ulva*
- **Toxic algal blooms**: Red, rust, brown tides
- **Loss or depletion of shellfisheries and finfisheries**

On-Site Wastewater Treatment

Conventional Systems, Existing Alternatives, and Research Needs

Harold W. Walker, P.E., Ph.D.

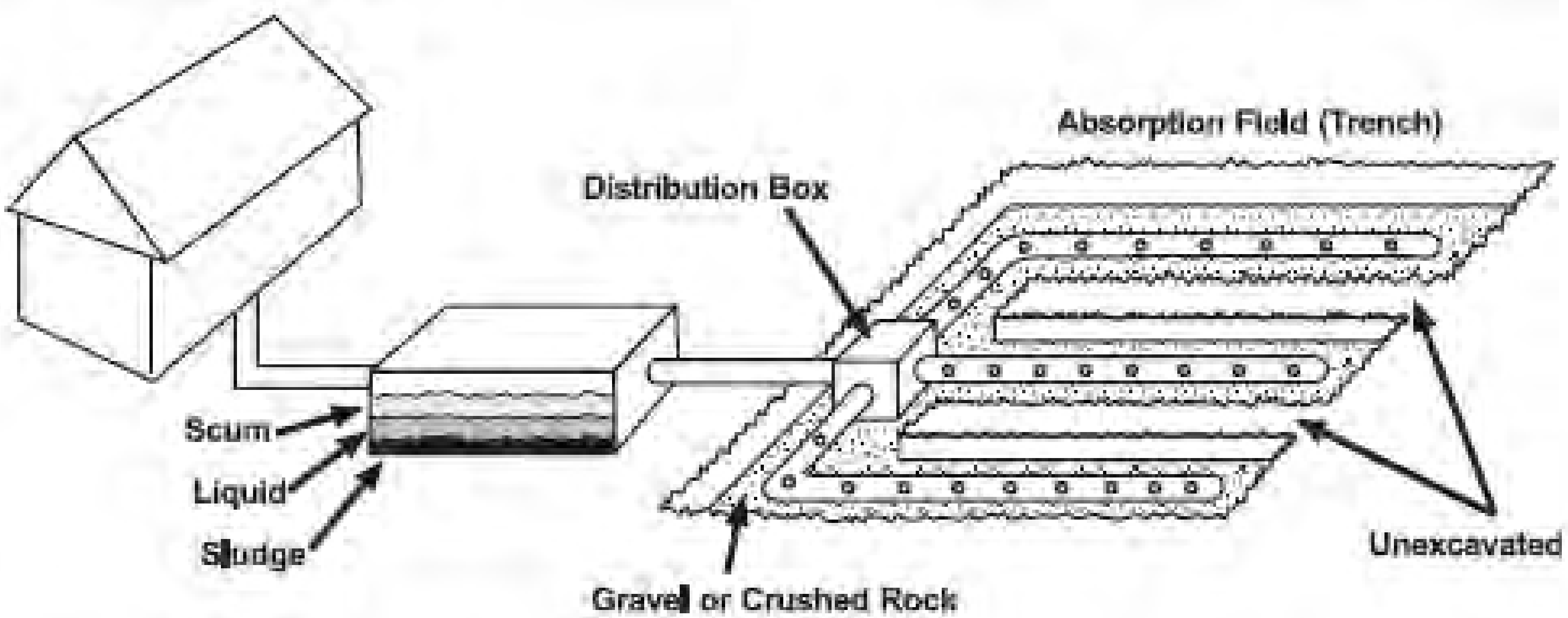
Professor and Director

Civil Engineering

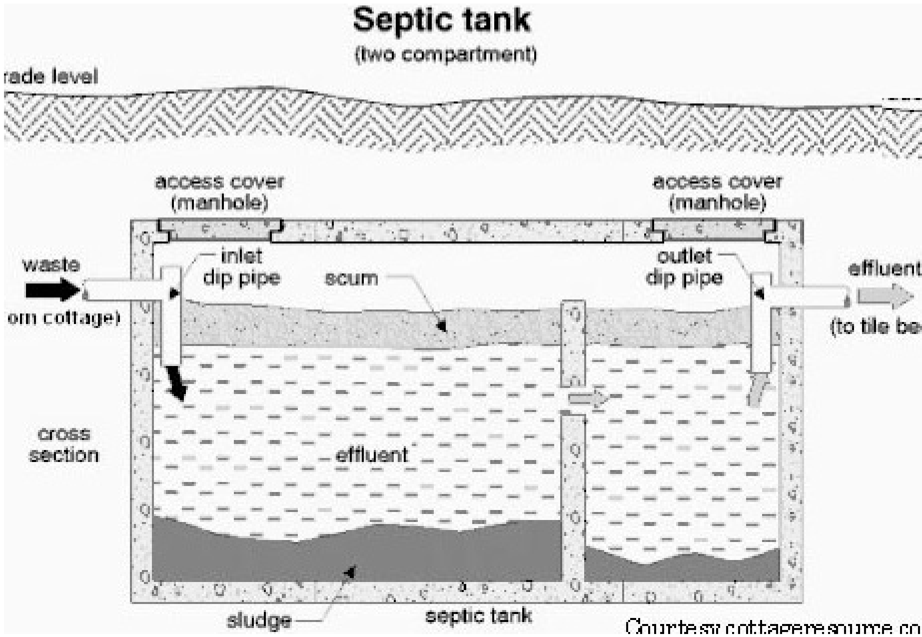
Stony Brook University

SUNY

Conventional Septic System



Conventional Septic System



Leaching Pit

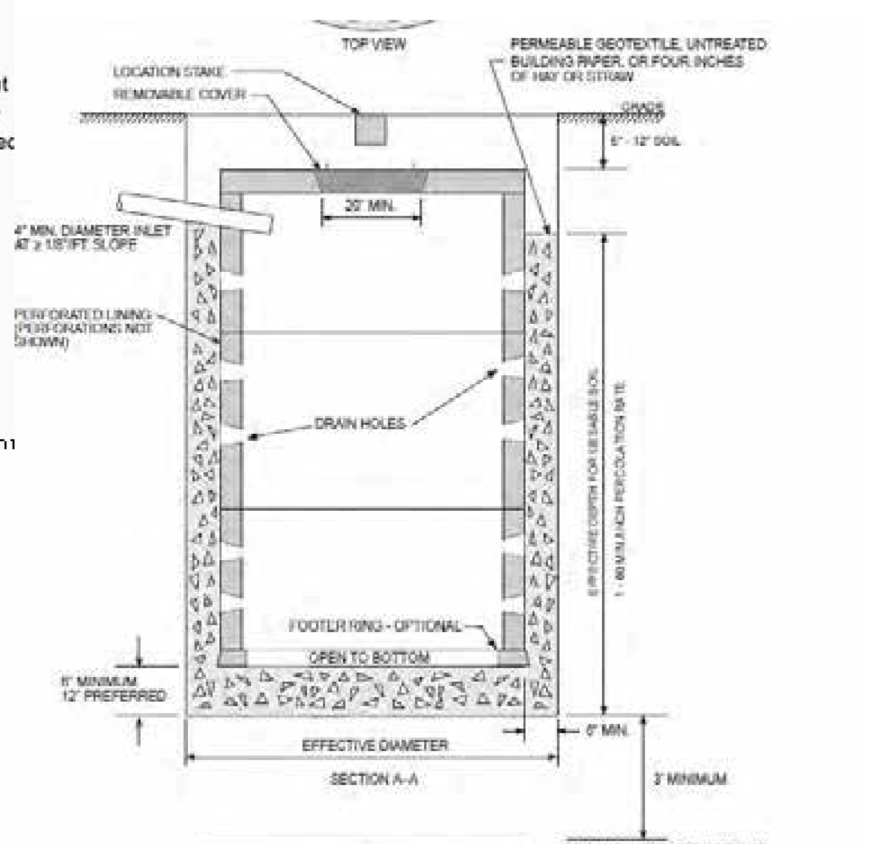
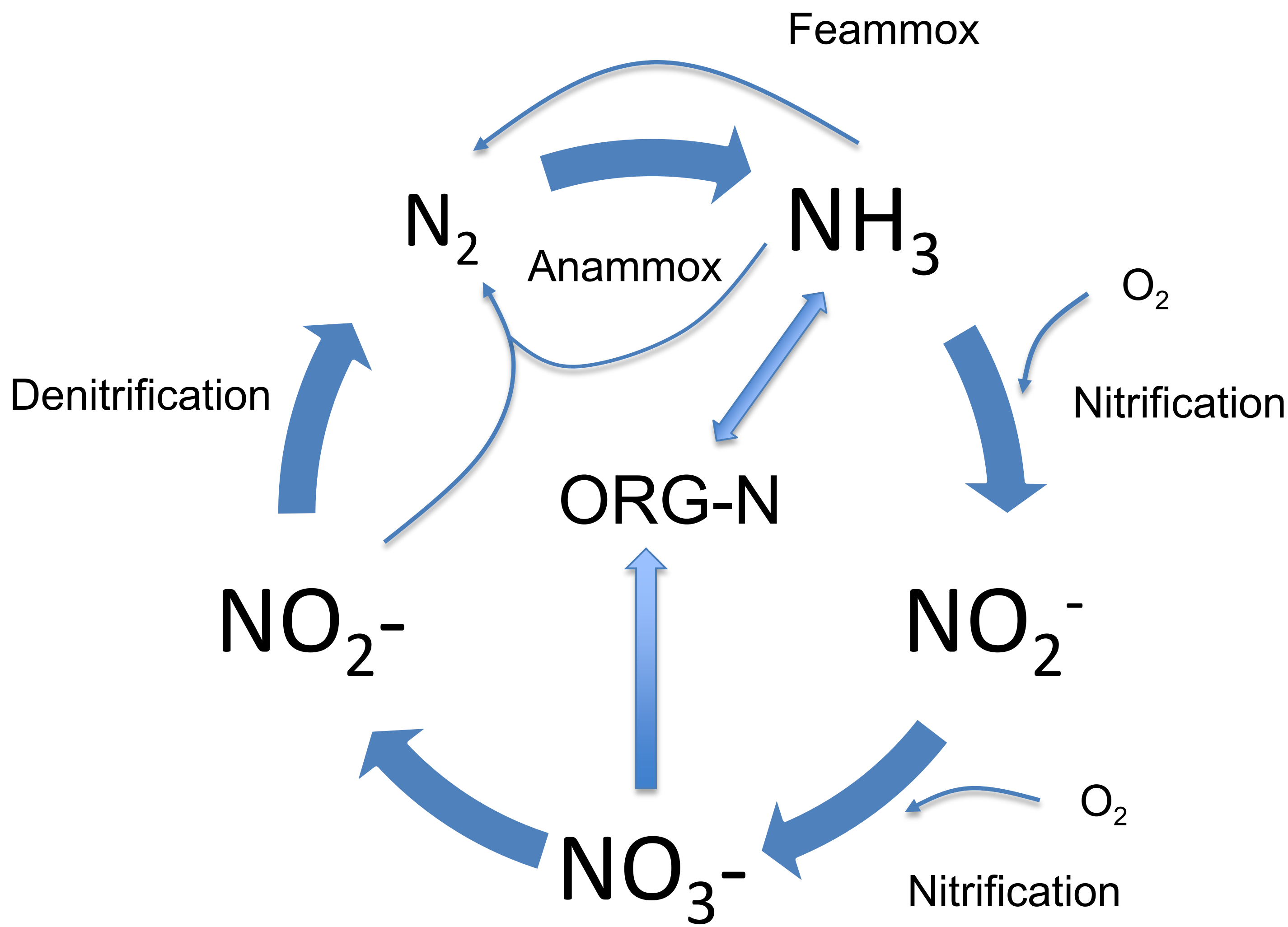


Figure 27: TYPICAL SEEPAGE PIT

Stony Brook University

Nitrogen Cycle



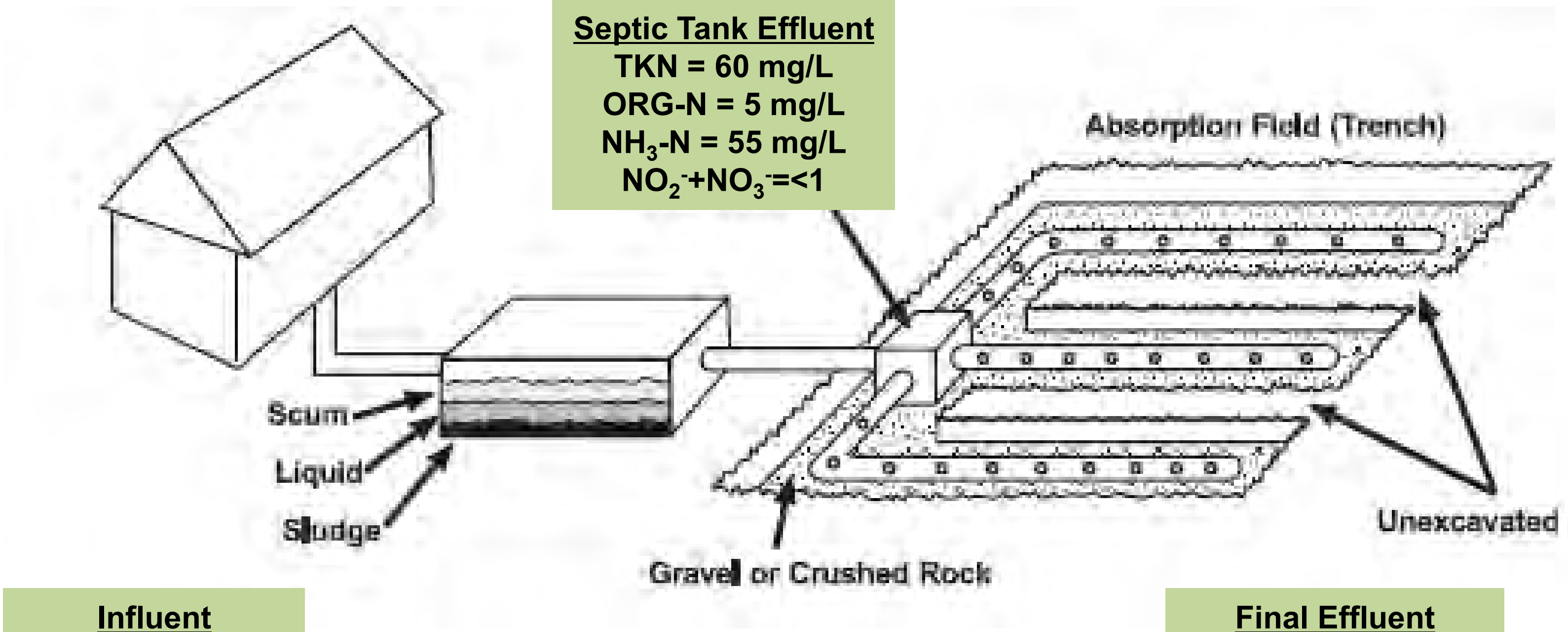
Survey of N Reduction Studies

Scientific consensus: Little nitrogen removal occurs in septic systems with a traditional drainfield or leaching pit

- USEPA Design Manual (2002) states 10-40% removal of N in soil infiltration systems based on studies in the 1970s (p.3-23).
- Beal et al. (2005) reviewed the literature and found very little N removal in soil absorption systems, though depended on redox state, microbial composition, and labile carbon.
- Wastewater Treatment Workgroup, Chesapeake Bay Partnership (2012) established a 20% reduction credit TN in a conventional septic system based largely on earlier studies by Jennson (1990) and Long (1995).
- George Loomis (University of Rhode Island, Extension Service) estimates 10-15% removal of nitrogen in septic systems and cesspools, as quoted in Newsday.

Conventional Septic System Performance – Nitrogen

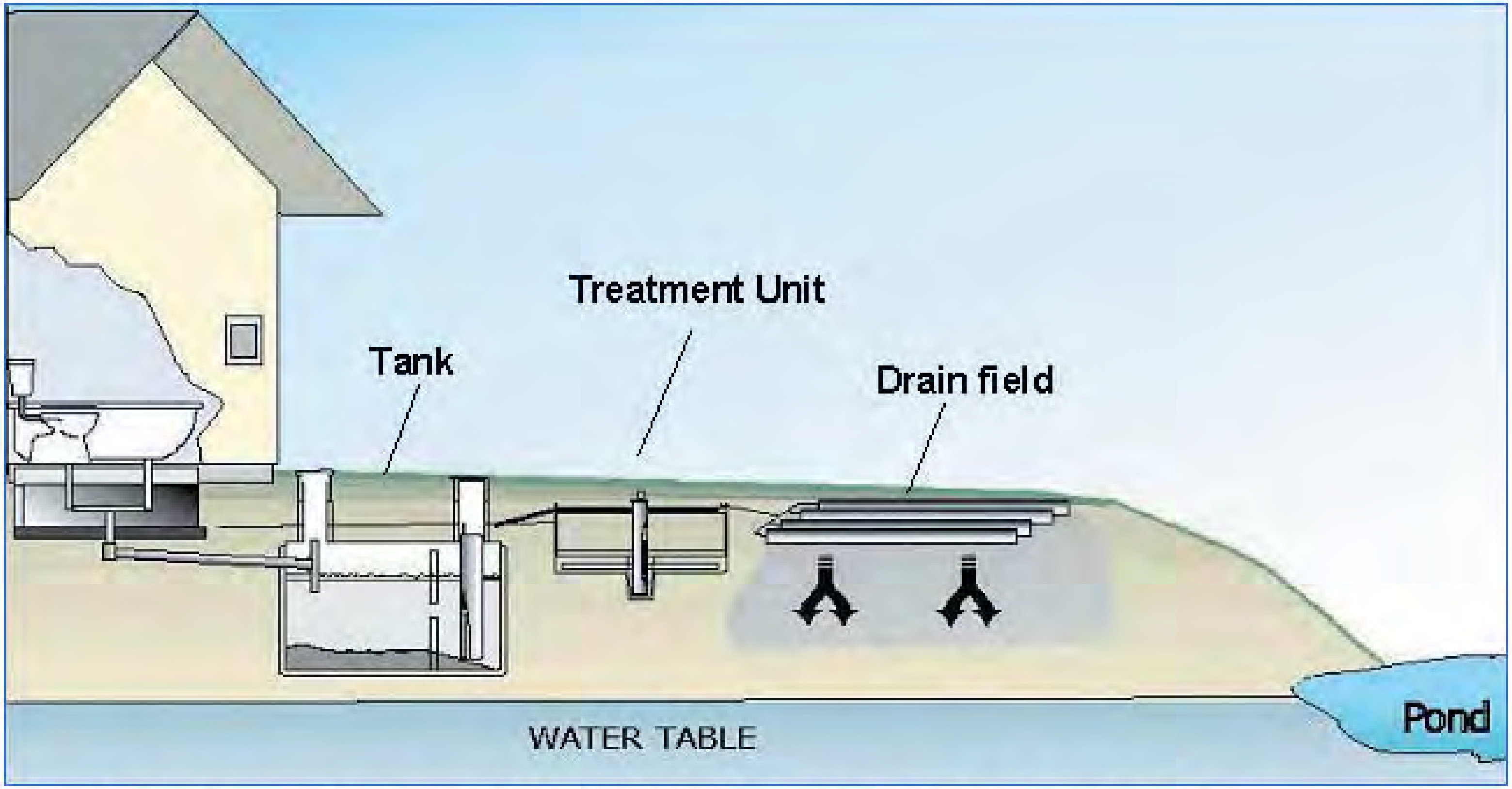
Septic Tank Effluent
TKN = 60 mg/L
ORG-N = 5 mg/L
NH_3-N = 55 mg/L
NO_2^-+NO_3^-=<1



Influent
TKN = 60 mg/L
ORG-N = 45 mg/L
NH_3-N = 15 mg/L
NO_2^-+NO_3^-=<1

Final Effluent
TKN = 50 mg/L
ORG-N = 0 mg/L
NH_3-N = 0 mg/L
NO_2^-+NO_3^-= 50 mg/L

Alternative Treatment Systems



Alternative and innovative systems add a component between the septic tank and drainfield.

Alternative On-Site Systems

- Mixed Biomass
  - Activated Sludge Systems
  - Fixed Film Systems
  - Sequencing Batch Reactors (SBRs)
- Two Phase Biomass
  - Heterotrophic denitrification
  - Autotrophic denitrification
- Soil Infiltration/Uptake
- Constructed Wetlands

Alternative On-Site Systems

	TN Removal	Capital Cost	O&M Cost	Reliability	Complexity	Footprint	Stage of Develop-ment
Mixed Biomass							
Suspended Growth	Yellow	Yellow	Green	Yellow	Yellow	Yellow	Green
Fixed Film with Recycle	Yellow	Yellow	Yellow	Red	Yellow	Yellow	Green
Fixed Film without Recycle	Red	Yellow	Yellow	Red	Yellow	Yellow	Green
Integrated Fixed Film Activated Sludge	Red	Yellow	Red	Yellow	Red	Yellow	Green
Two Stage							
Heterotrophic Denitrification	Green	Yellow	Yellow	Green	Green	Yellow	Yellow
Autotrophic Denitrification	Green	Yellow	Yellow	Green	Green	Yellow	Yellow
Anammox	Not enough data						
Feammox	Not enough data						

Alternative On-Site Systems

	TN Removal	Capital Cost	O&M Cost	Reliability	Complexity	Footprint	Stage of Develop-ment
Soil Systems							
Soil Infiltration with dosing							
Soil Infiltration with drip dispersal							
Permeable Reactive Barriers							
Anammox	Not enough data						
Feammox	Not enough data						
Constructed Wetlands							
Subsurface flow with prenitrification							
Surface flow							

Concluding Remarks

- Existing cesspools and septic systems (with leach pits) remove little nitrogen.
- Currently available, alternative systems can remove >50% TN in some cases, but may not be widely adopted due to cost, reliability, or other factors.
- Demonstrating and installing currently available alternative technology is a good start, but better technology is needed.
- Significant advances in technology will be made if R&D funding available

BIOGARD, INC

Green Solutions to Business, environmental, and agricultural sustainability

David Abecassis

Nitro-Cess™

Cost Effective Nitrogen Removal for Non-Sewer Systems

Biogard, Inc.

- Founded in 2010
- Green Technology Solutions Company
- Focus on Sustainable Agriculture, Food, Environmental Stewardship Technologies.
- 10 Core Patented Technologies and Growing
- Safe Cost Effective Solutions

Nitro-Cess™

- Patent Pending-Non Currently Published
- Uses safe low-cost proprietary media
- Selectively removes Nitrogen
- Developed and Tested with SCDH oversight and input.
- Currently in Proposal for Validation of Prototypes for field tests.

Simplicity

- Several versions of the invention are being developed. The patent has many embodiments.
- Version 1 will be inserted into the leaching overflow tank of 2 tank systems and will use passive in tank flow to contact the Nitrogen and remove it..
- Version 2 will sit outside the septic system disguised as a rock or shrub and recirculate Nitrogen-Reduced-Septic Water back into the tank using active pumping.
- Nitrogen is easily removed to renew our proprietary media and concentrated for re-sale on the chemical market.

Cost Effective

- Nitro-Cess Media is inexpensive.
- Nitro-Cess Media is highly selective for N
- Removal Target is 15-30lbs N per home of 3 inhabitants or more as a minimum goal.

Easy to Manufacture

- Potential to create LI jobs related to manufacturing.
- Product creates both engineering and entry level manufacturing jobs
- Low Set-Up Capital Requirements to Mfg.

Business Model

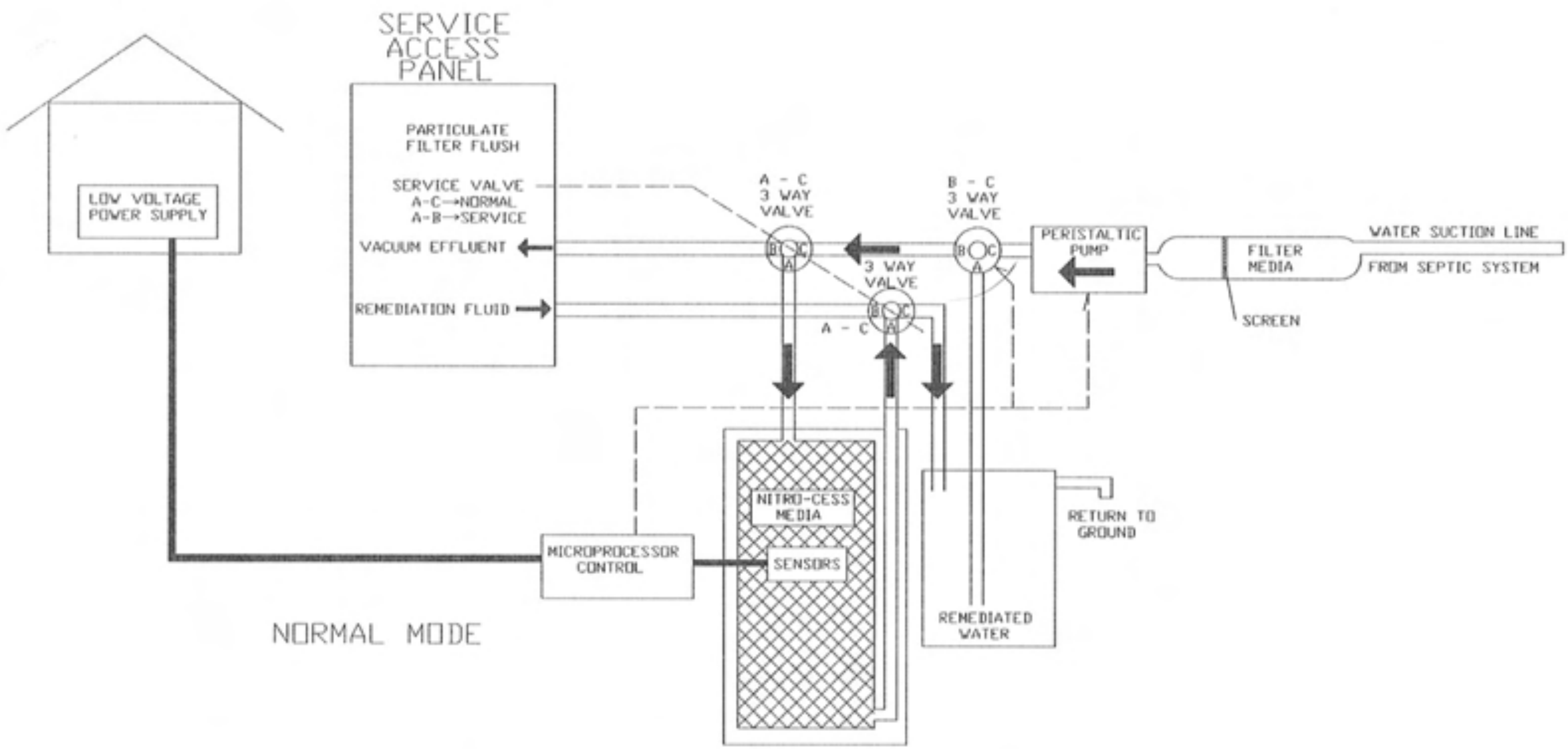
- License, train, and certify service providers.
- License manufacturing to third parties.
- Manufacture Nitro-Cess in house.
- Create Value from the Concentrated Nitrogen.

Initial Market

- Nassau 20%, Suffolk 80%
- New England
- Coastal States
- Caribbean

Acknowledgements

- Suffolk County Dept of Health: Walter Dawydiak and his team.
- Town of Southampton: Anna Throne Holst, Jennifer Garvey.
- NYIT: Sarah Meyland


SERVICE ACCESS PANEL
PARTICULATE FILTER FLUSH
SERVICE VALVE
A-C→NORMAL
A-B→SERVICE
VACUUM EFFLUENT
REMEDIATION FLUID
LOW VOLTAGE POWER SUPPLY
A - C 3 WAY VALVE
B - C 3 WAY VALVE
3 WAY VALVE A - C
PERISTALTIC PUMP
FILTER MEDIA
SCREEN
WATER SUCTION LINE
FROM SEPTIC SYSTEM
NITRO-CESS MEDIA
SENSORS
MICROPROCESSOR CONTROL
REMEDIATED WATER
RETURN TO GROUND

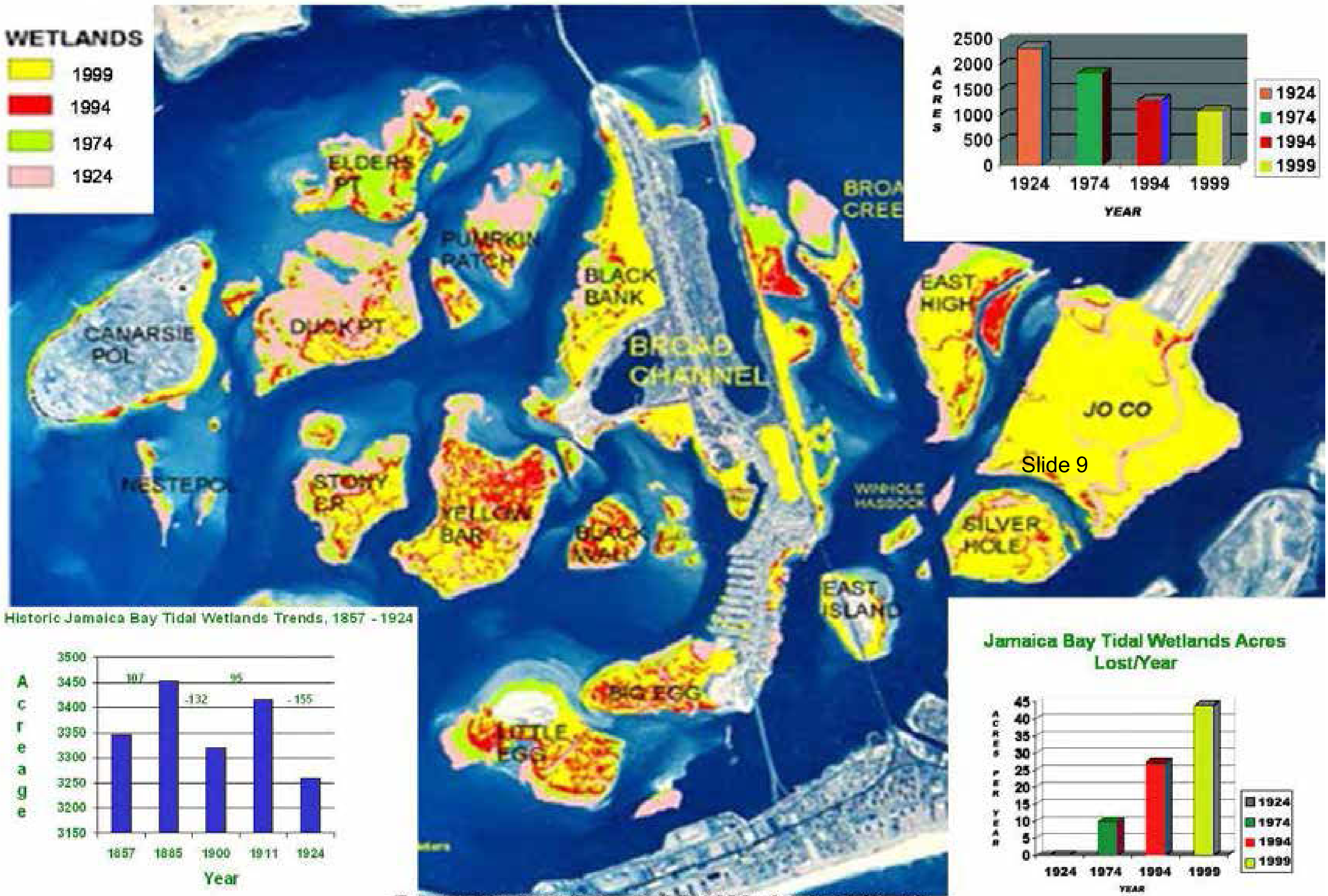
NORMAL MODE

Jamaica Bay
Marshlands & Spring Creek

Stephen Zahn
Deputy Regional Director
NYSDEC Region 2

Public Meeting on Coastal Resiliency
& Clean Water Infrastructure
May 19, 2014

Tidal Wetlands Lost 1924 - 1999



Prepared by Dave Fallon and Fred Mushacke, NYSDEC

Elders Marsh

Potential Causes of Vegetative Loss

Sediment budget disruption

Sea level rise

Eutrophication

Wave and wind erosion

Ice scour

Root knot nematode

Fusarium

Drought

Grazing by geese, snails, crabs and other herbivores

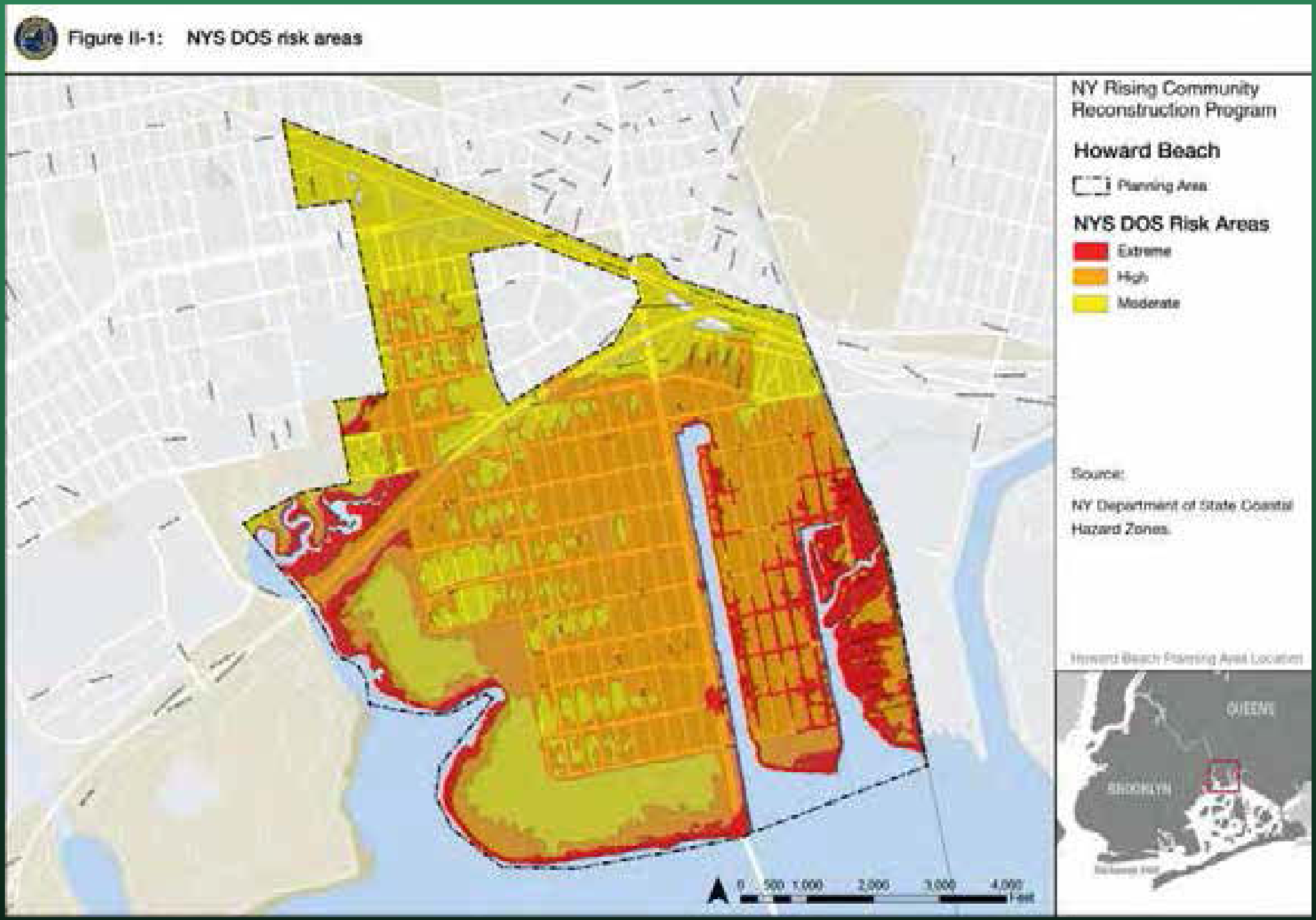
Marsh Island Construction Process

NYS Department of Environmental Conservation

NYS Department of Environmental Conservation


Spring Creek Hazard Mitigation Project
Elders West
249,000 CY/40 acres
Elders East
302,000 CY/40 acres
Yellow Bar
375,000 CY/44 acres
Rulers Bar
92,000 CY/8 acres
Black Wall
155,000 CY/16 acres
Jamaica Bay Marsh Island Restoratio
TOTAL: 148 Acres

Risk Area: Howard Beach



NYS Department of Environmental Conservation

Project Area: Spring Creek Park

NYS Department of Environmental Conservation

N
W
E
S
0
0.3
0.6 Miles
0
500
1000 Meters
Concept Plan
dune
tidal creek
forest
low marsh
high marsh

NY Rising

NYS Department of Environmental Conservation

Nature-Based Protective Features

Jamaica Bay Nitrogen Reduction

Long Island Coastal Resiliency and Clean Water Infrastructure Stakeholders Meeting – May 19, 2014

Selvin T. Southwell, P.E., NYSDEC


JA
26th
CI
RK
Coney Island WWTP
26th Ward WWTP
Jamaica WWTP
Rockaway WWTP

First Amended Nitrogen Consent Judgment

- High Level Biological Nitrogen Removal (BNR) upgrade of the 26th Ward WWTP

  Permanent Carbon Addition Facilities (6/2016)

- Mid-high Level BNR upgrade of the Jamaica WWTP

  BNR operation (12/2014)

  Permanent Carbon Addition Facilities (12/2016)

- Low Level BNR Upgrade of the Rockaway WWTP (12/2019)

- Low Level BNR Upgrade of the Coney Island WWTP (12/2020)

Jamaica Bay WWTPs Nitrogen Discharges

Total Nitrogen Discharge from all four WWTPs to Jamaica Bay:

2010 - 40,000 lbs/day

2014 - 34,000 lbs/day

Economics of Nitrogen and Water Quality

Anthony Dvarskas

Stony Brook University

May 19, 2014

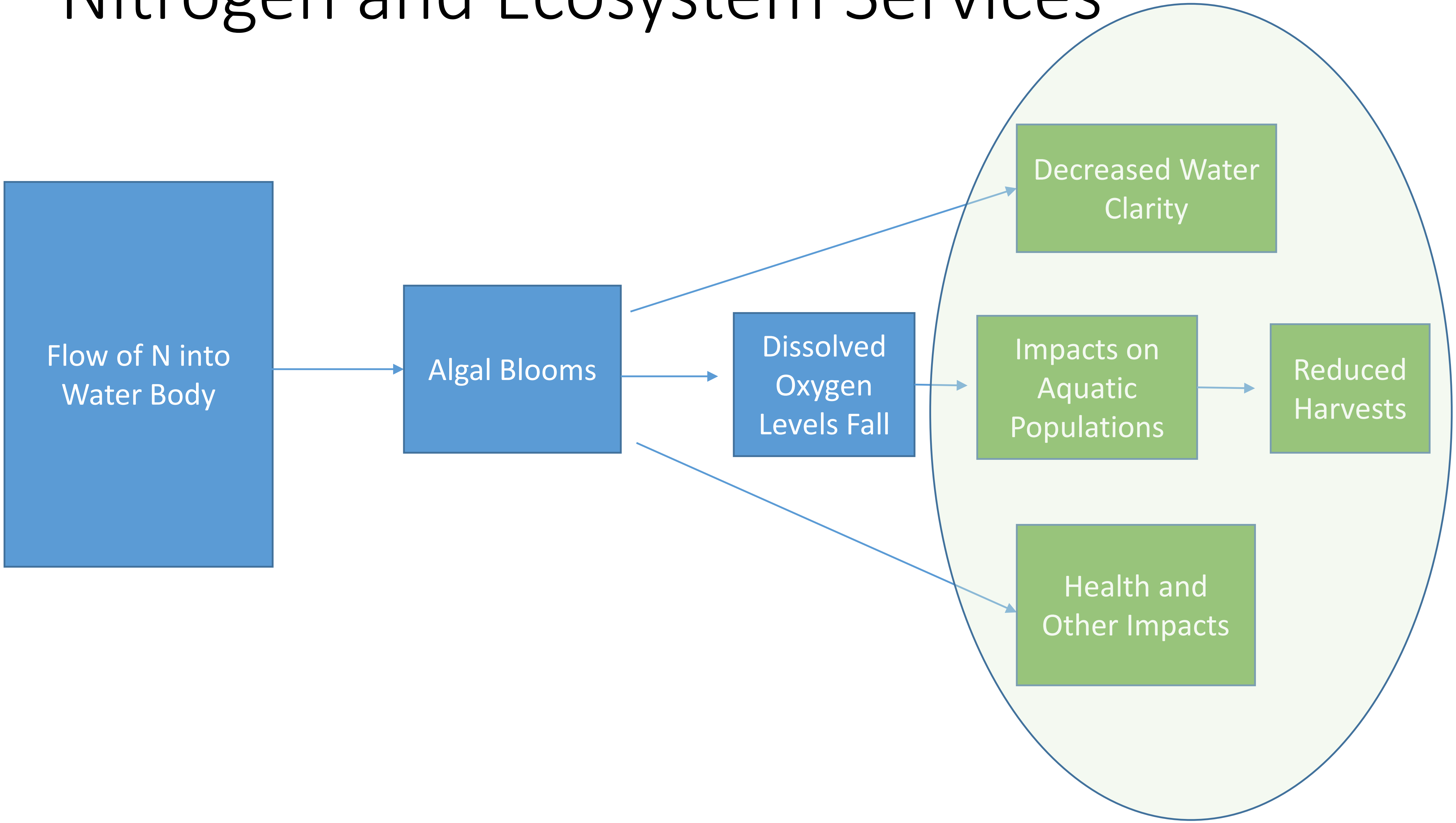
Overview of Comments

- Ecosystem Services and Water Quality
- Role for Economic Valuation
- Valuation Examples
- Concluding Remarks

Ecosystem Services

- One definition: Direct contributions of ecosystems to human well-being
- Ecosystem inputs into production of goods and services humans value
- Track how ability of ecosystem to produce valued goods and services changes with human influences on system
- What might this look like for water quality impacts related to nitrogen discharge?

Nitrogen and Ecosystem Services



Linking Water Quality Measures to Values

- Challenge:
  - How to link changes in nitrogen loadings to an ecological endpoint that is valued by humans?
  - Ecological production function is intermediary
  - By necessity, interdisciplinary work
- Some reassurance
  - Humans value TVs, computers, etc. without full information on how these goods are produced
  - Assessing targeted benefits people already value can simplify approach (e.g., people do not need to specify a value for nutrient cycling)

Role for Economic Valuation

- Market costs of increased nitrogen removal (e.g., new infrastructure, infrastructure improvements, abatement practices) generally available
- Potential benefits of changes in supply of environmental goods and services more difficult to quantify monetarily
  - May not be traded in market (like computers, TVs, legal services)
  - Lack of familiarity with purchasing the good/service
  - Complex relationships involved in provision of good or service
- Need approaches that take advantage of what people show/tell us

Economic Valuation Approaches

- Market-based
- Revealed preference
  - Analyze demonstrated behavior of people to estimate value
  - Travel cost (how much am I willing to spend to visit recreation sites of different "quality"?)
  - Hedonic analysis (how much am I willing to pay for a house that has access to environmental assets of a given "quality"?)
- Stated preference
  - Directly ask people how much resource is worth to them

Valuation Examples: Chesapeake Bay Hypoxia

- Bioeconomic model of summer flounder (Massey et al, 2006)
  - 50 % reduction in occurrences of hypoxia
  - In 4 coastal bays - $85,000 annually
  - In all bays and estuaries in species range - $556,000 annually
- Striped bass fishery (Lipton and Hicks, 2003)
  - Evaluated hypoxia impact on recreational anglers and their value for a fishing trip
  - Expected catch as function of water quality
  - Annual loss of $52,000 if DO < 3 mg/l in Patuxent
  - Annual loss of $7.3 million if all of Bay
- Blue crab fishery (Mistiaen et al, 2003)
  - Restricted to trotline commercial crabbers
  - < 4 mg/l results in 49% decrease in market revenue*
  - Upper bound since assumes crabbers will not move

*Revenue is not equivalent to value

Valuation Examples: North Carolina Hypoxia

- Brown shrimp (Huang et al, 2010)
  - Evaluated impact of hypoxia on commercial brown shrimp catch
  - Used lagged approach and bioeconomic model
  - Estimated revenue* loss of $32,000/yr in Neuse River, $1,240,000 in Pamlico Sound
- Brown shrimp (Huang et al, 2012)
  - Sought to specifically isolate economic surplus (rather than revenue) loss
  - Results indicated surplus lost in fishery attributed solely to producers
  - $261,372 average annual loss between 1999 and 2005

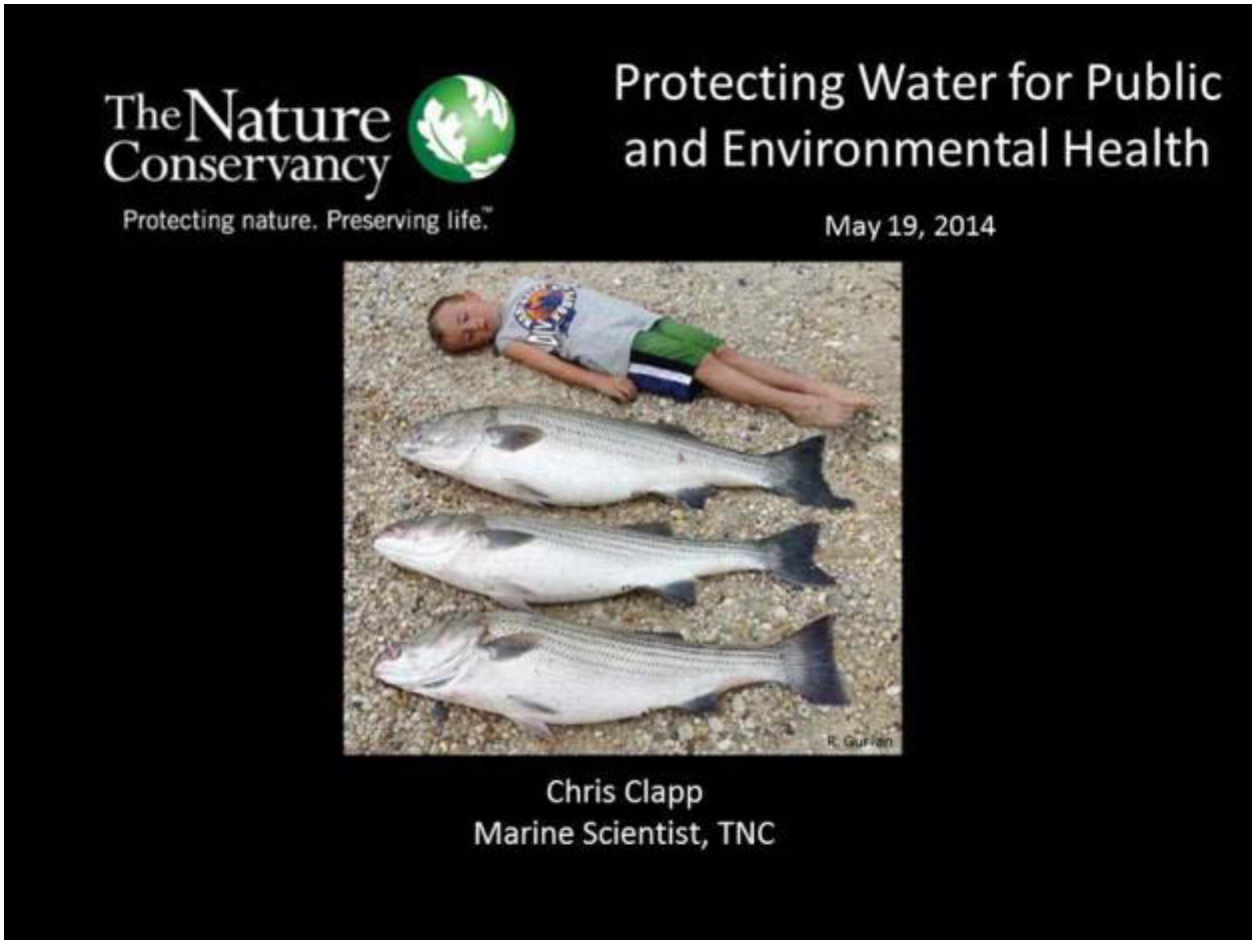
*Revenue is not equivalent to value

Valuation Examples: Water clarity and DIN

- Peconic Estuary (Johnston et al, 2002)
  - Multiple bays in Peconic Estuary System
  - Secchi disk depth as measure of water clarity
  - Annual benefits of $752,000 for 10% improvement
- Chesapeake Bay (Poor et al, 2007)
  - St. Mary's County on Chesapeake Bay
  - Evaluated impact of ambient water quality on housing values
  - Increase in 1 mg/L of DIN results in housing price decrease of $17,462

Concluding Remarks

- Approaches available to value ecosystem service benefits of nitrogen removal
- Including these benefits important for accurate benefit-cost analysis of options and improved decision-making
- Existing studies mainly focus on goods traded in market – only portion of potential benefits from nitrogen removal
  - Water quality monitoring data, harvest and population estimates essential
- More work is needed in this area, particular on Long Island
  - Existing literature may provide initial guidance
- Interdisciplinary work critical as need to connect changes in nitrogen to final ecosystem goods and services valued by people



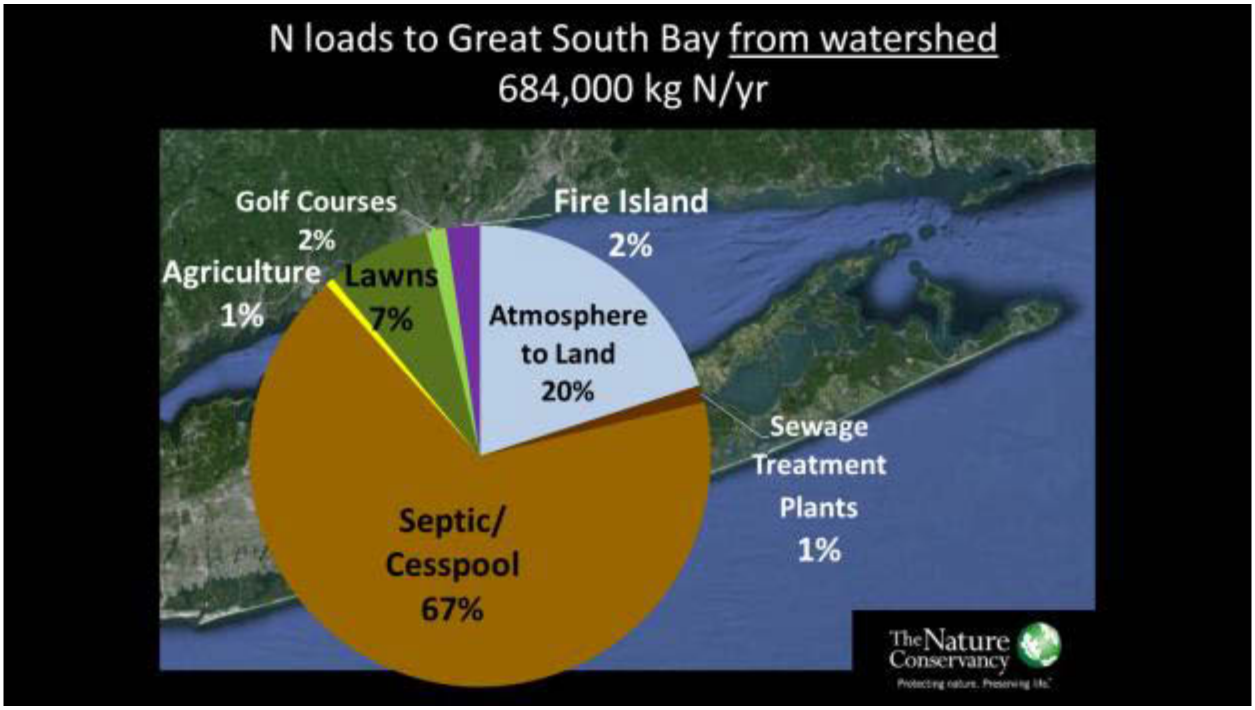
Thank you for inviting me today to speak on behalf of The Nature Conservancy.

You have had a lot of experts present today who have provided information on water quality and the need for clean water in order to have healthy estuaries and resilient coasts.

I will focus on how investing in advanced sewage treatment could set the stage for a much brighter, resilient future – for Long Islander's health, environment and economy.

To put things in context it really all began for TNC in 2004 when we launched our hard clam restoration.

We always knew there was a problem with the incoming water quality and the conventional wisdom of the time was that runoff was a major problem. What we learned through intense monitoring and targeted research was eye opening.



Wastewater derived nitrogen is the predominant pollutant entering our bays and harbors

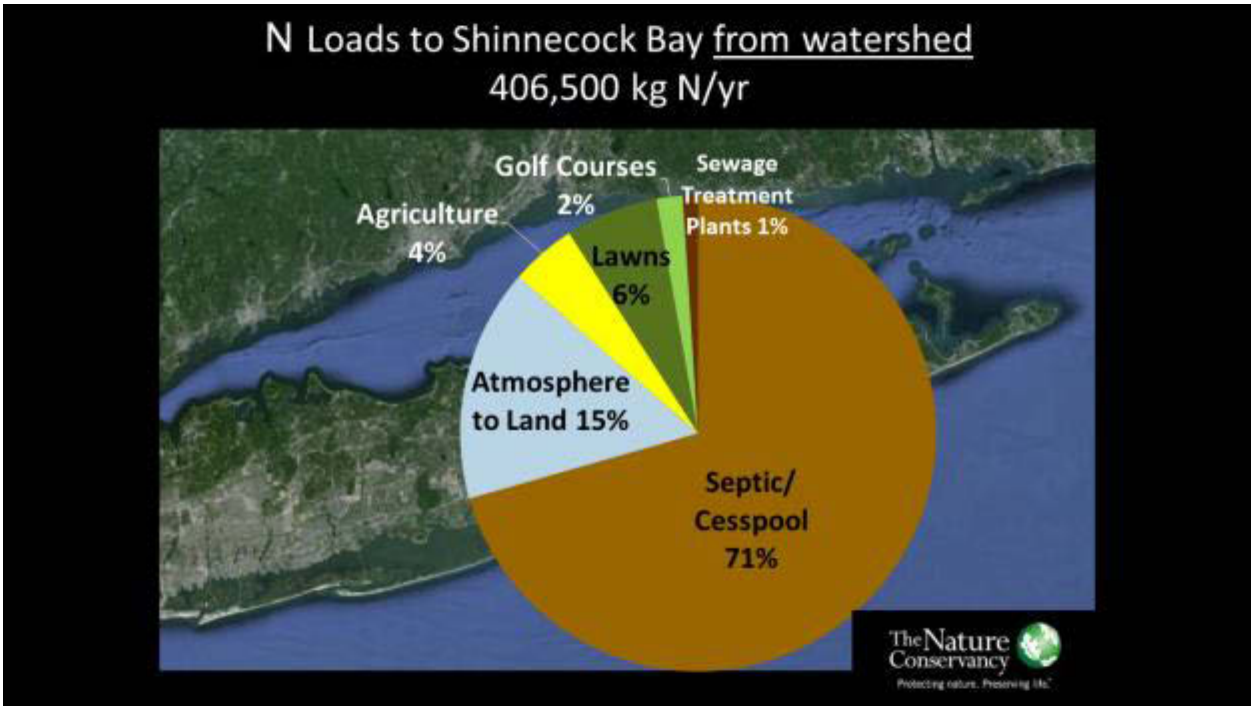
We now know this because as part of our shellfish restoration work, To improve success and pinpoint sources of pollution in Great South Bay, we hired Drs. Ivan Valiella and Erin Kinney from Woods Hole to identify sources of nitrogen – and they found that 67% of the nitrogen in the Great South Bay watershed is coming from septic systems and cesspools.

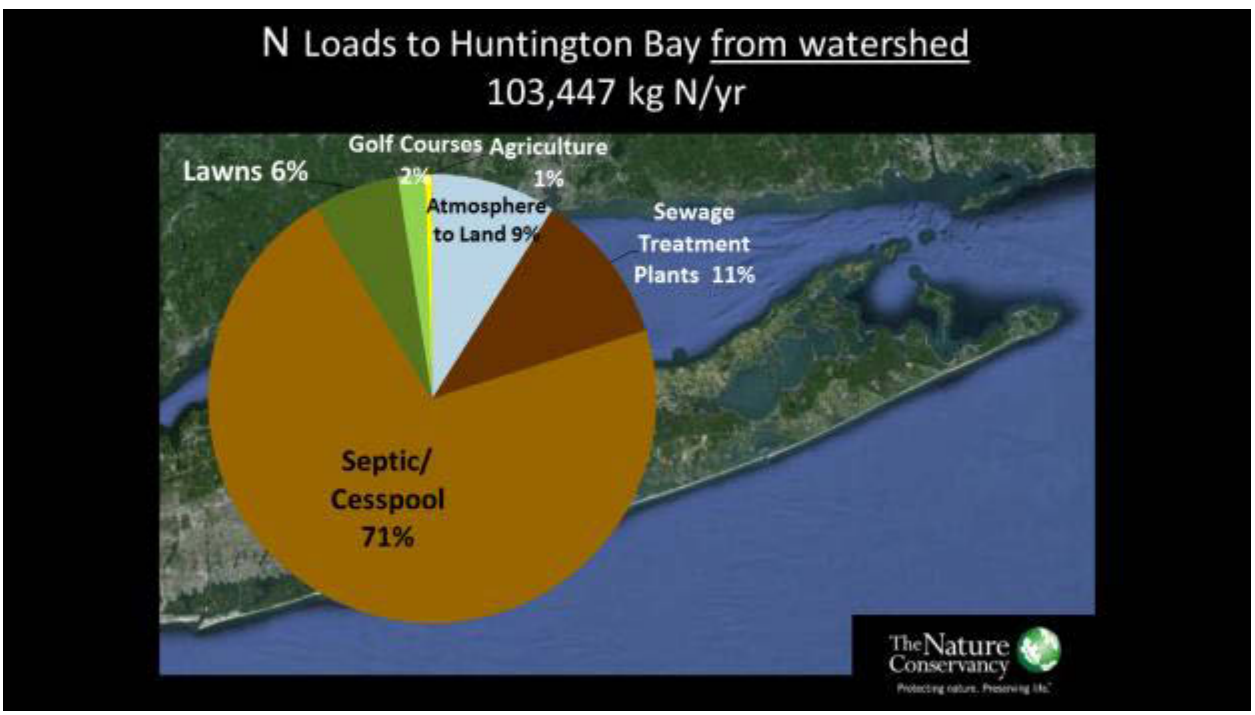
We had no idea – we assumed that because almost 1/3 of the population is connected to a sewage treatment plant with an ocean outfall, we did not expect septic systems and cesspools to be such a significant source of N.

We used the same model for the Peconic Estuary and Dr. Gobler's lab used Valiela's model for Shinnecock and the Woods Hole group used the model for the Northport Harbor/Huntington Bay complex (following two slides)

Again, cesspools and septics consistently dominated the N load coming from land in Suffolk County

Which is not surprising, considering that 75% of households in Suffolk rely on septics or cesspools


N Loads to Shinnecock Bay from watershed
406,500 kg N/yr
Golf Courses 2%
Sewage Treatment Plants 1%
Agriculture 4%
Lawns 6%
Atmosphere to Land 15%
Septic/ Cesspool 71%
The Nature Conservancy
Protecting nature. Preserving life.


N Loads to Huntington Bay from watershed
103,447 kg N/yr
Golf Courses 2%
Agriculture 1%
Lawns 6%
Atmosphere to Land 9%
Sewage Treatment Plants 11%
Septic/ Cesspool 71%
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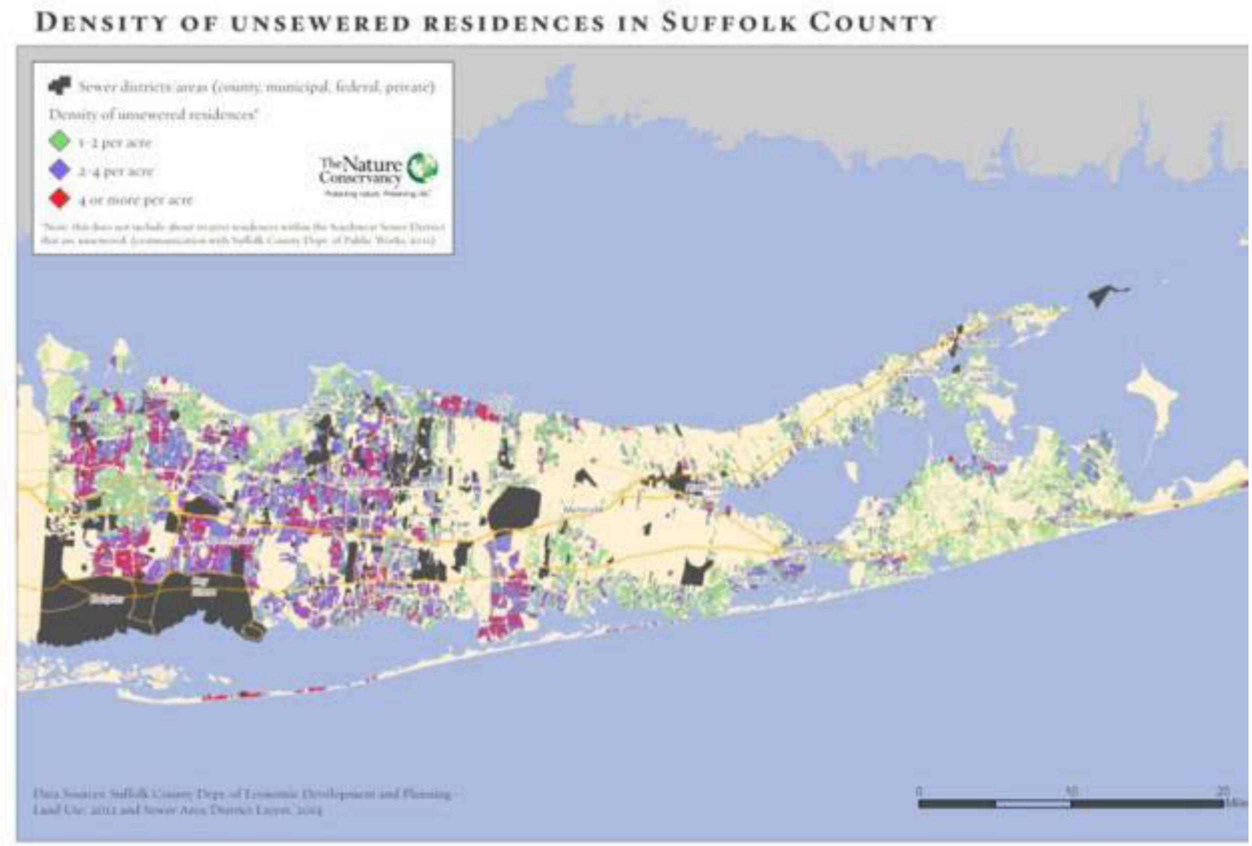
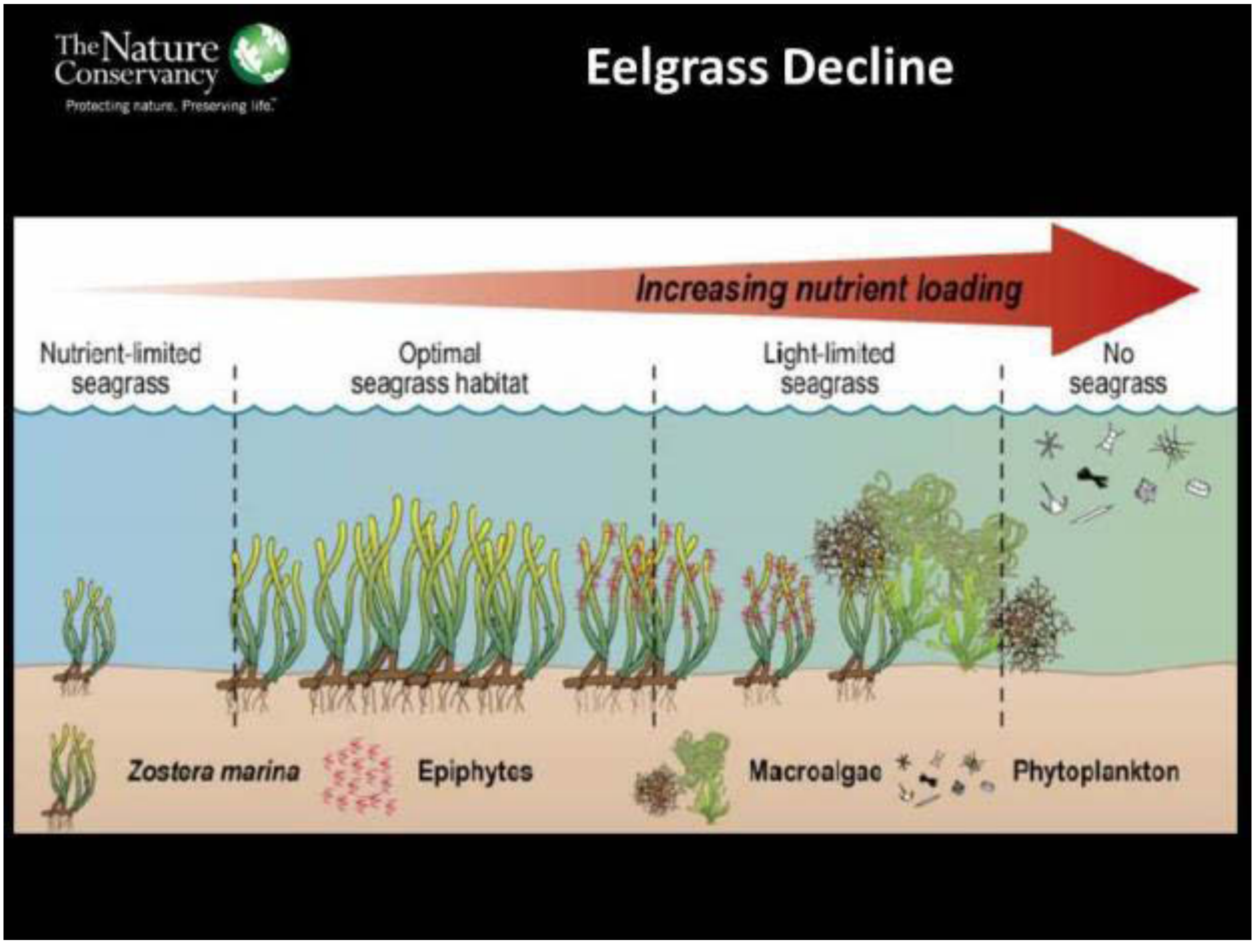


In great contrast to the testimony given In Nassau County last week where 90% of Nassau County's population is hooked up to municipal waste water treatment 70% of Suffolk County's population relies upon antiquated on-site cesspools and septic systems. That is approximately 360,000 homes, 100,000 commercial properties and 1 million people discharging their waste almost directly into the groundwater we drink the same water that leaches into our bays.

This has led to Harmful algal blooms that are getting stronger, more widespread and more persistent



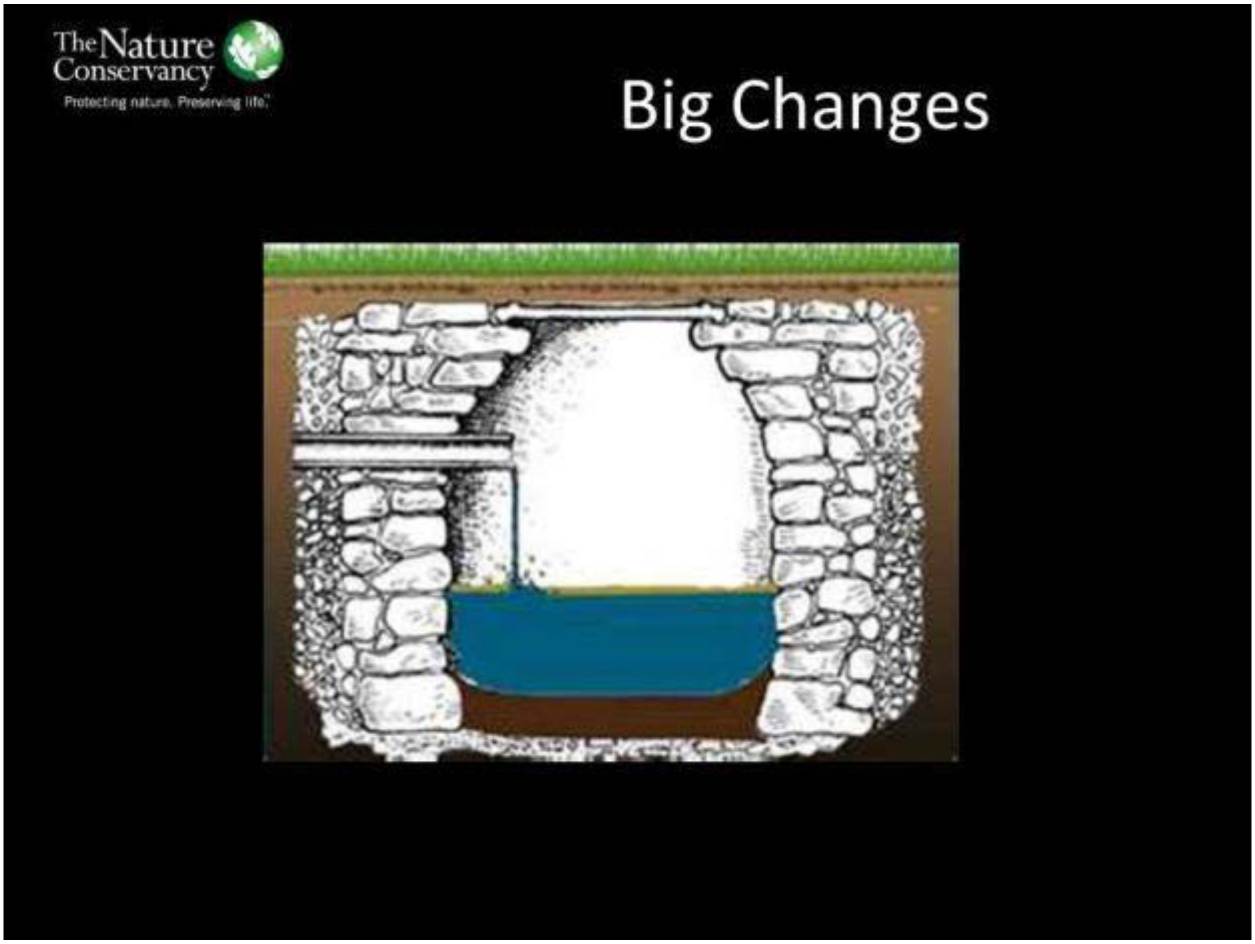
Eelgrass Loss as illustrated by the is cartoon is driven by the increase in nitrogen in to a system that begins as a shading problem and ultimately results in complete loss and a dominance by plankton or macro-algae which more readily take up the excess nitrogen

And the loss of Salt Marshes which has recently been shown to lose root biomass when loaded with excess nitrogen leading to a loss of the stability of the marsh.

The problem is everywhere

Human and environmental health is at risk

Now that we know the source and magnitude of the problem how do we change course



How do we go from this to this a hand laid cesspopol which belive it or not are still common on Lon Island to something more advanced

There will need to be big changes particularly culturally as we have a created and enabled a culture where one can dig a hole to dispose of their waste and forget about it.

A comprehensive plan is needed that will set standards for treatment that are protective of public and environmental health. Balanced against what is practical and implementable right now. Waiting for the magic system is currently not an option but by setting a high bar and sending a signal that the county and state are ready to move forward the industry will continue to make advances.

Current tested and implemented technology can get between a 50 and 75% reduction within the unit

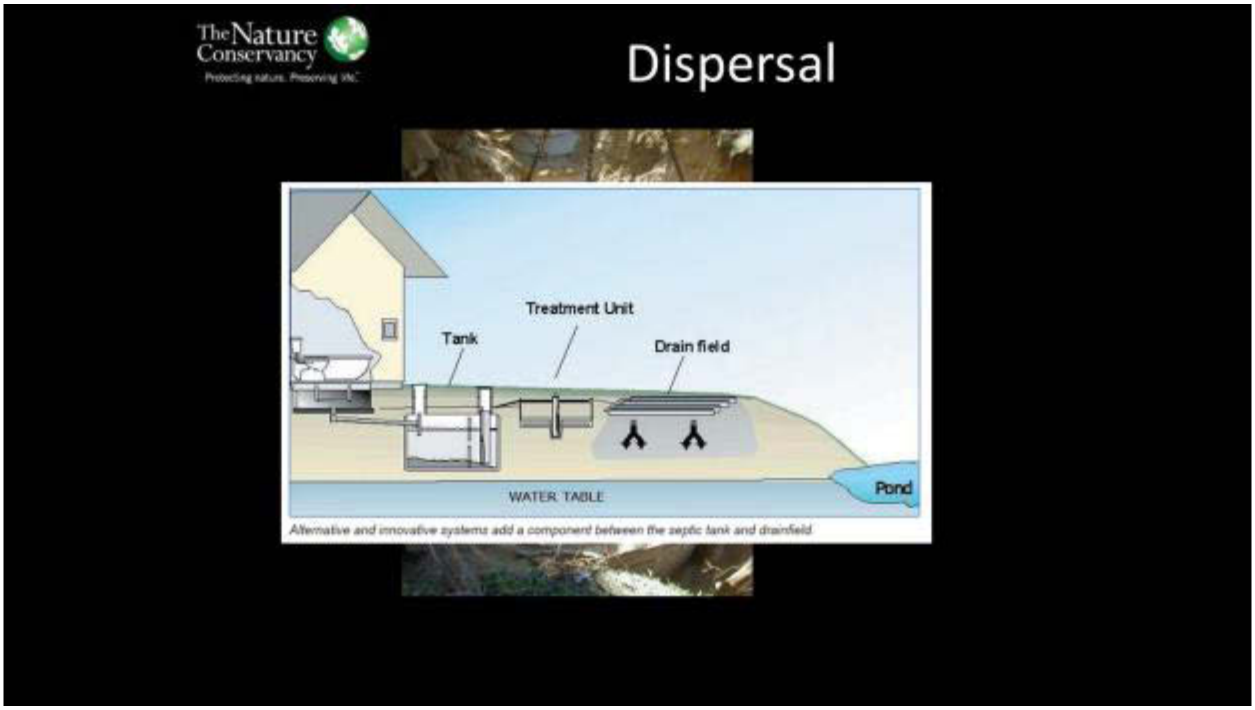
These units do require maintenance but the reality is that conventional systems were also designed to be maintained inspected and pumped on an as needed schedule. We've done a huge disservice to the our neighbors by allowing them to think that their wastewater utility can be ignored until it has a catastrophic failure putting themselves and their neighbor's health at risk

Changes need to be made not only to how we “treat” our waste but also how we dispose, or better still, disperse our waste.

These septic rings have been characterized by experts outside of Long Island as injection wells directing the nitrogen-rich effluent more quickly to groundwater

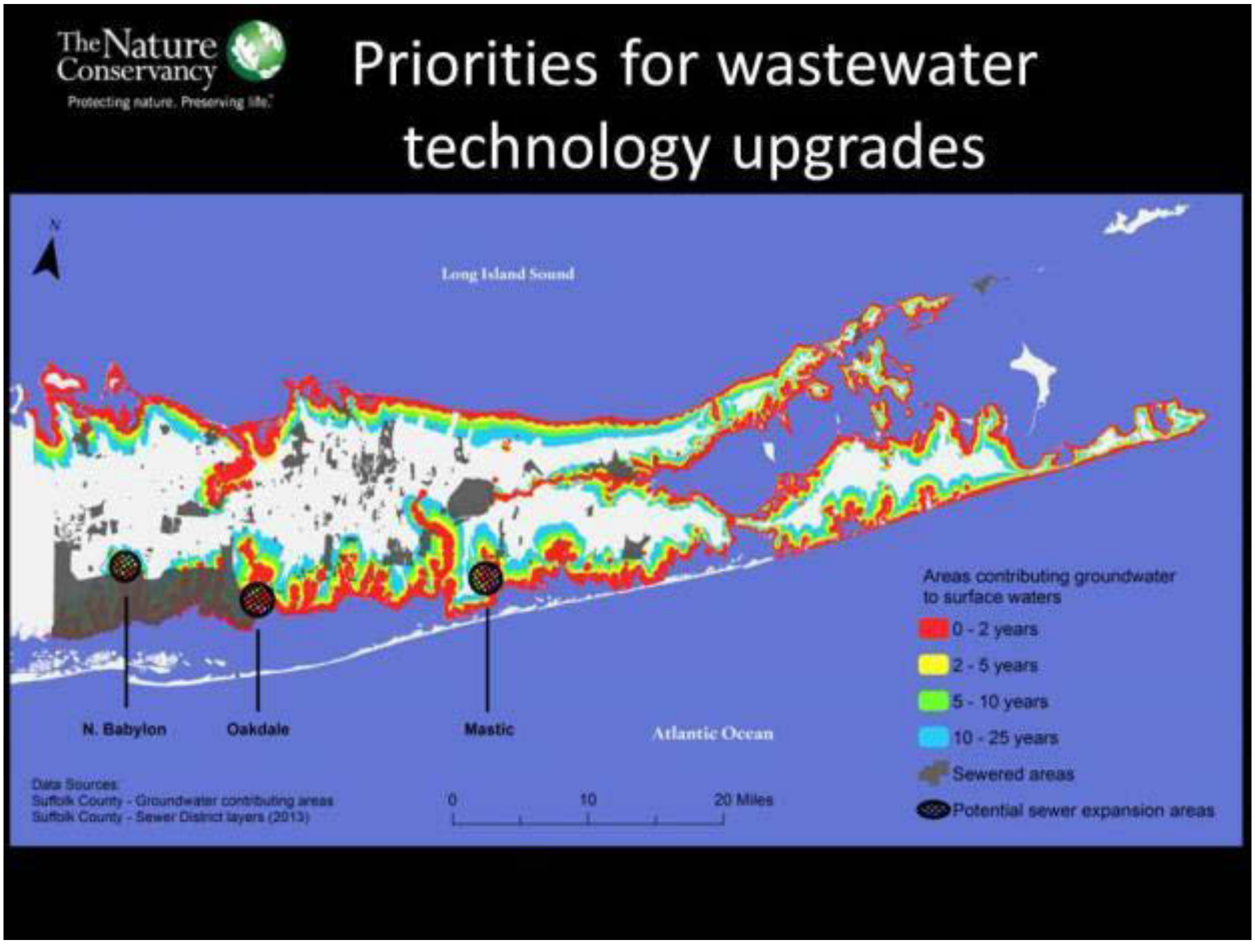
While it is reasonable to think the original intent was to protect public health by getting the effluent and the pathogens as far away from human contact as possible we’ve created a situation where we are “injecting” the effluent into the ground far below any area where microbes and plants can naturally recycle, re-mineralize, and uptake nutrients.

In fact in coastal areas this can be a very burdensome way to develop a site. Making advanced treatment the more affordable option.



Here is a cartoon of what a modern on-site waste water treatment system would look like with a solid separation tank a treatment unit and a shallow dispersal field. This is not new or cutting edge and has become the norm in many parts of the country and around the world.

This slide from the University of Rhode Island shows the installation and implementation of shallow narrow drain fields which time dose the treated effluent closer to the surface where microbial activity and the turf grass above continues to treat the effluent as it recharges the groundwater. You can clearly see in the image to the left where the dispersal lines are from the characteristic “tiger stripes” of the turf that is utilizing the remaining nutrients in the effluent. Rhode Island has since changed their guidelines so that the dispersal lines are closer together eliminating the tiger stripe effect and leaving a continuous green turf area.



Solutions will need to be phased in over time this is not a one or even five year deal this is a generational problem with solutions that have to be considered on that same scale.

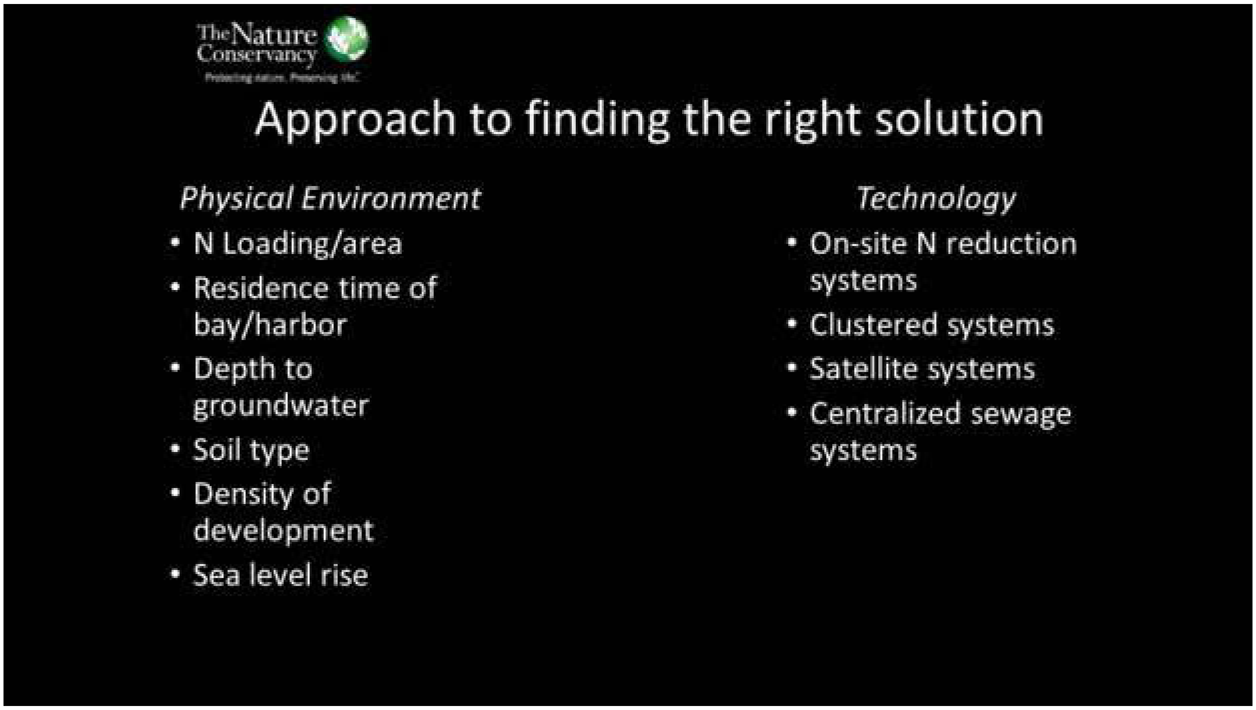
360,000- cesspools and septics in SC

210,000 are in the 0-25 travel time high priority area. (colored areas)

12,000 of those are being hooked up to sewers via the county's sewer expansion plans

That leaves approx 190,000 residential units that need to be addressed immediately through one means or another

The remaining 150,000 will still need to be addressed over time as well.



Suffolk County is at a point now where we can start to develop scenarios for options that consider a variety of factors.

For example, we need to consider all the technology options (right side) –

There are systems you can put in your backyard that are advanced on-site or septic systems that can reduce nitrogen

There are clustered systems where a number of homes can hook into 1 very large advance septic system

Or there are satellite systems that collect a lot of sewage or wastewater and convey it to some other larger centralized sewage treatment system.

An example of this is there are plans in the works to turn the Long Beach sewage treatment plant into a satellite system, where some treatment takes place, but rather than it being the last stop it gets sent to a more centralized sewage treatment plant for the rest of its needed treatment and ultimate disposal

The next step is to consider the physical environment – (left side)

How much nitrogen loading is occurring in a watershed or subwatershed,

What are the flushing rates of the receiving water. Remember, all the groundwater enriched nitrogen eventually makes its way to the closest bay or harbor. The nitrogen will pack a bigger punch if it ends up in a bay that is not well-flushed

Other factors include the depth of groundwater. Areas close to shore can have high water tables with ground water depths less than 3ft!

A lot of the technology under consideration will not work sitting in ground water

And of course, density of development. If there is quarter acre parcels or less, it limits the options because of space and other considerations.

And then of course there are economic and social considerations that need to be factored into finding the right wastewater technology for a community. (Center second slide above)

For example. How much are the capital costs? And the Annual operation and maintenance costs?

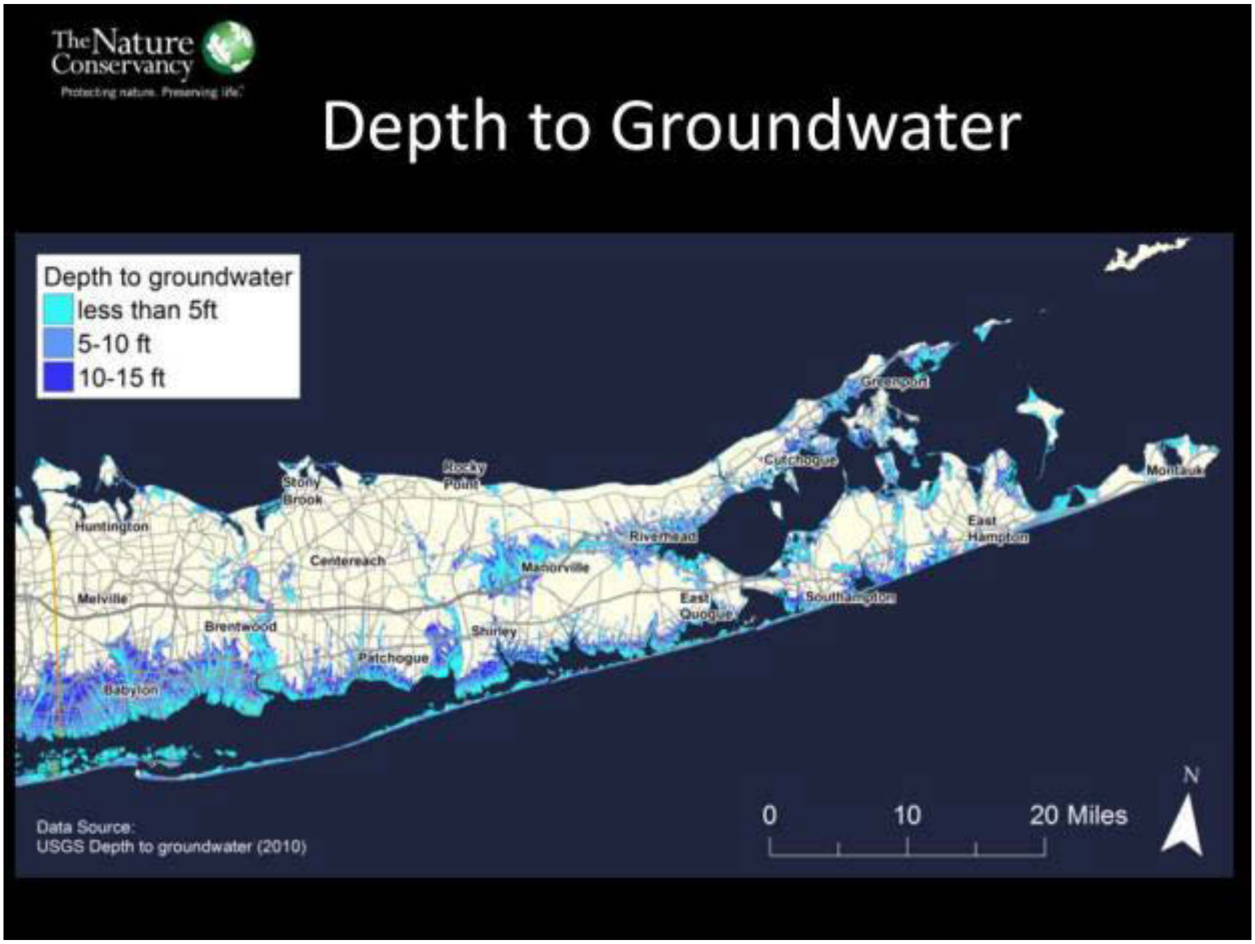
Given the goal of nitrogen removal, what is the per pound removal of cost of nitrogen?

And of course there are societal costs – for brevity I only listed 2 here

All of the disruption that will occur as new infrastructure is put in – whether it is roads or in some cases people's back yards

And the concern that once new technology is put in, making sure it doesn't open the door for the potential of over-development of an area – we don't want to see the character of a place change because of sewage treatment

And what are the socio-economic considerations – different households can afford different costs–really important considerations



With sea level rise, nitrogen loading becomes further exacerbated

Along the coast, there is a one-to-one ratio whereby for every foot of sea level rise, there is a corresponding one foot rise in ground water

There are roughly 360,000 septic systems and cesspools in Suffolk County –

45,000 septic systems are in areas of groundwater less than 10 ft from the surface – which is represented by the medium blue region

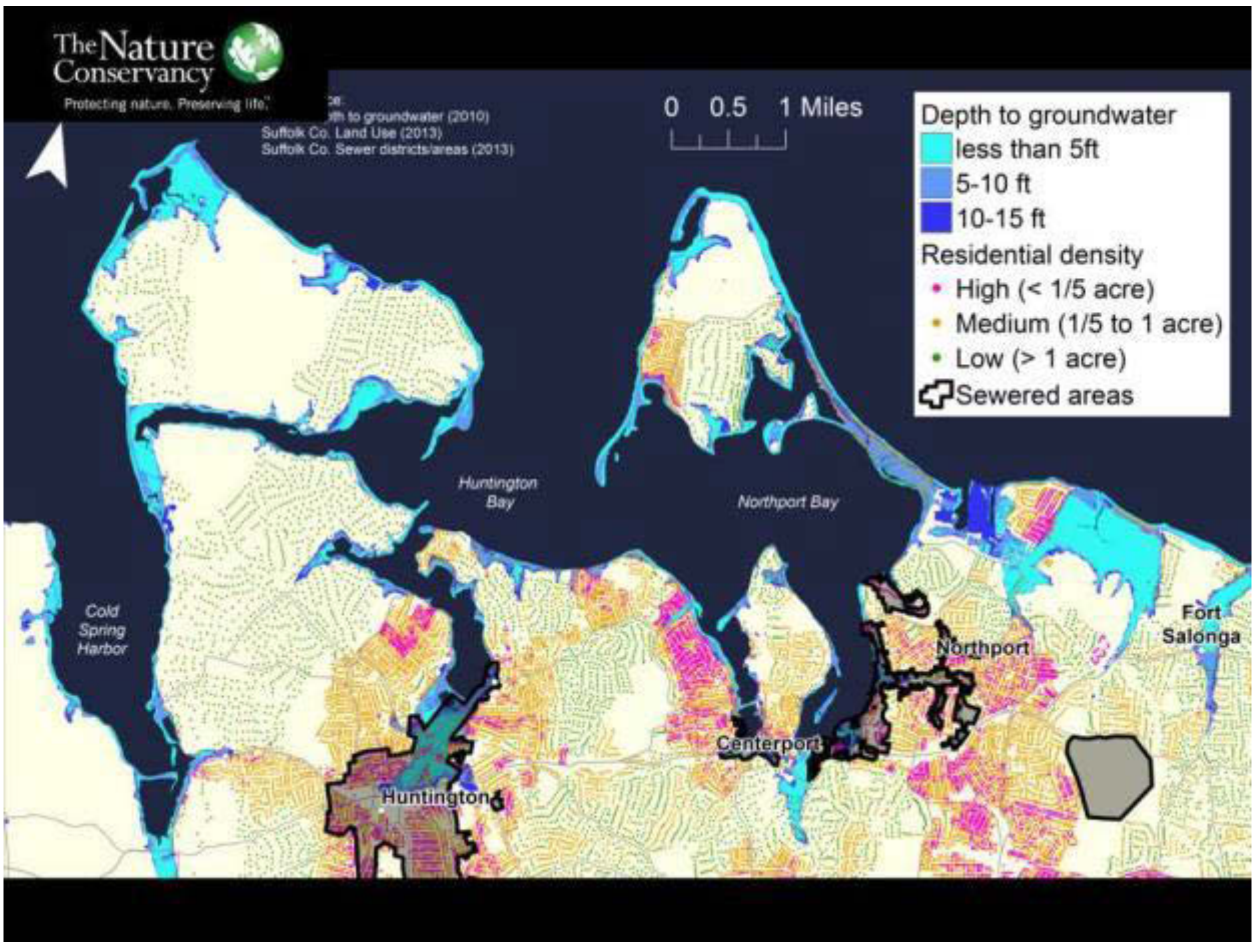
About 15,000 septic systems are in areas where the groundwater is less than 5 ft – which is represented by the light blue areas.

An average current septic system is between 5 to 10 ft in size not watertight

So while some of these systems may be mounded, we clearly have many septic systems currently sitting in ground water that are seeping into the bays

And this is not accounting for future sea level rise

And we heard this firsthand from some of the residents who participated in the Community reconstruction Program meetings

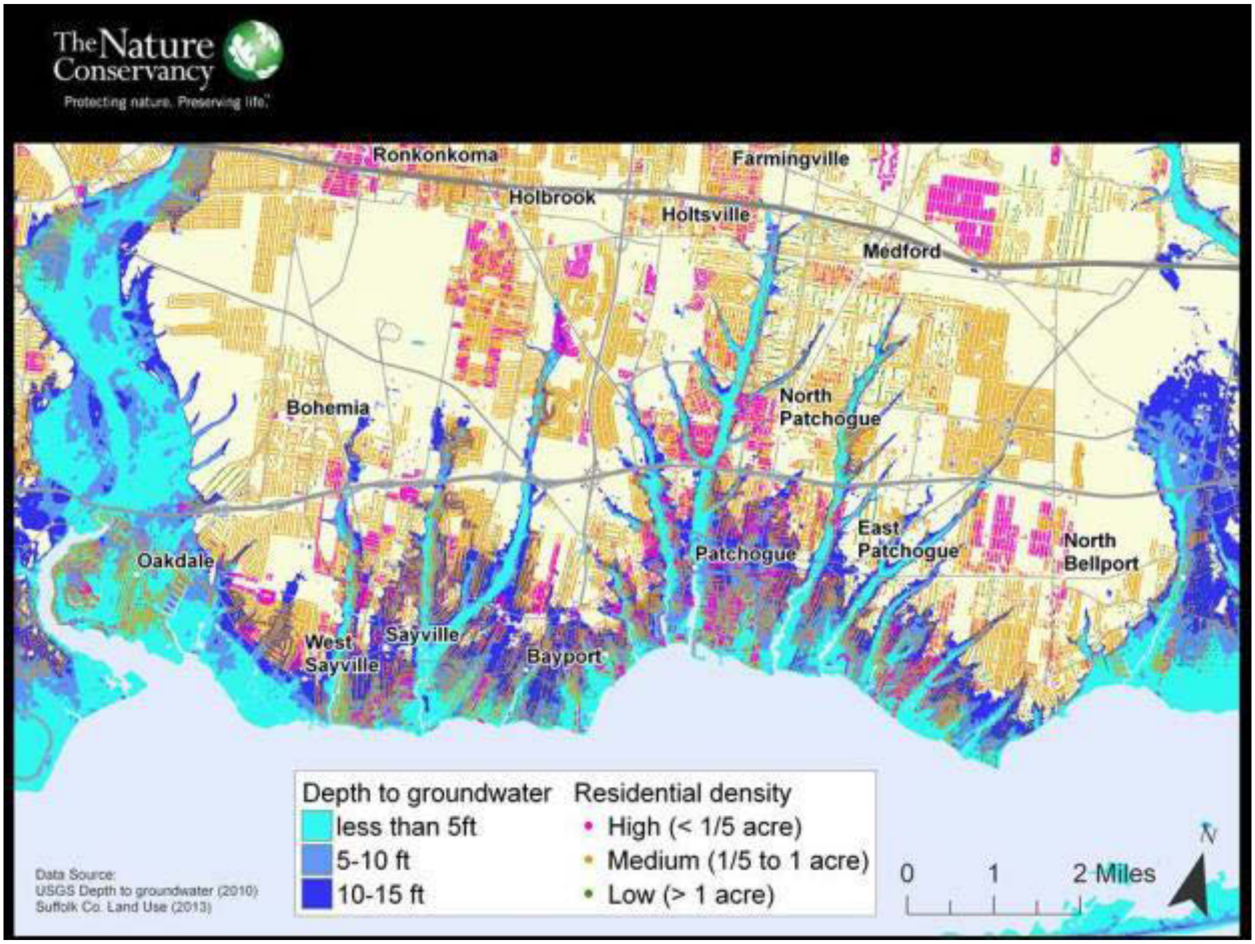


When all of these factors are considered simultaneously, some options immediately drop out, while others make more sense.

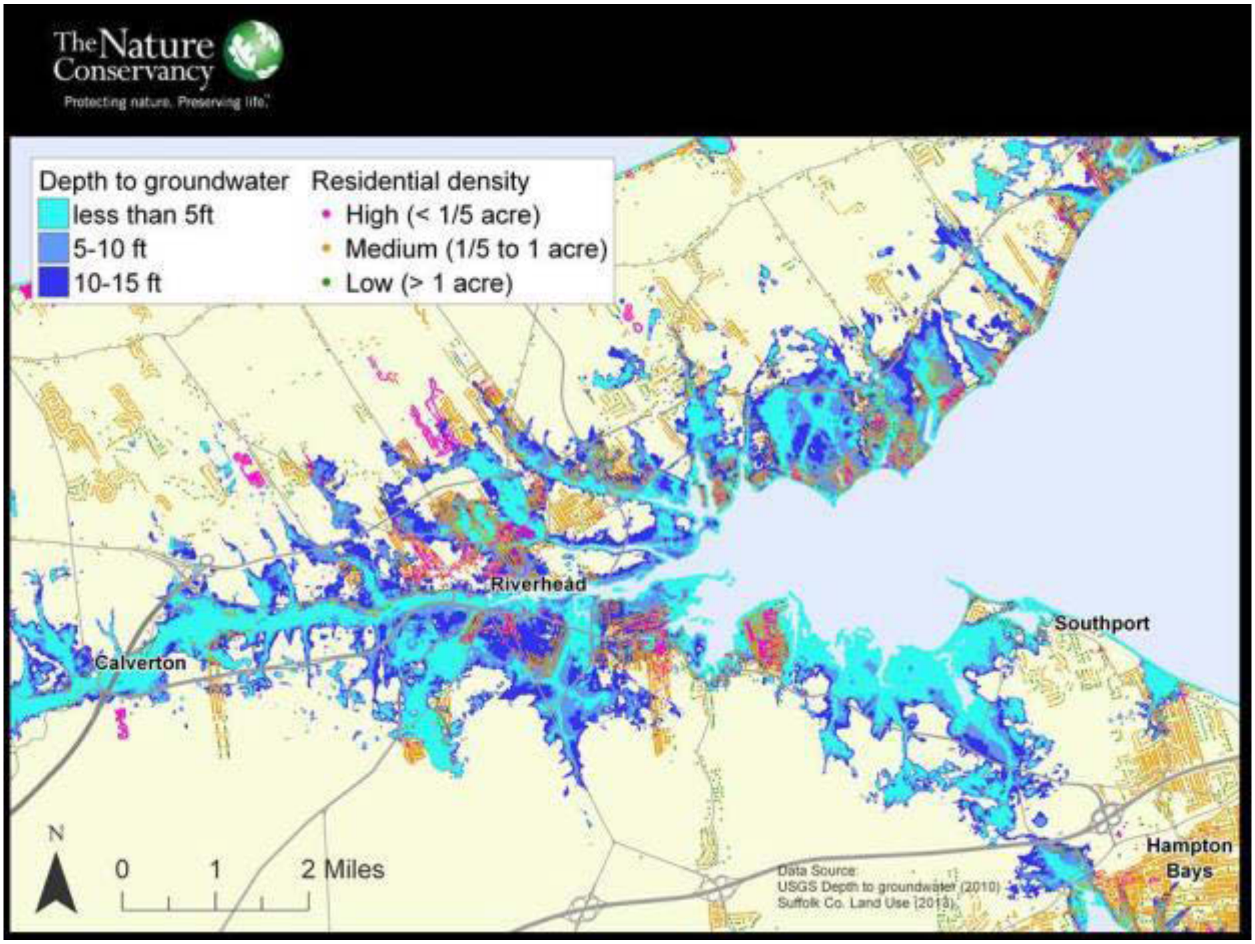
This is just an example of the kinds of analyses that are the next step in the process and what needs to be considered as we as a community move forward on this issue – whether it is for a pilot or all of Long Island.

The light blue is groundwater less than 5ft deep, the medium blue is groundwater between 5-10 ft deep, and the darker blue is groundwater 10-15 feet deep. The warmer colors are more dense development and the green dots are over an acre. The shaded areas are sewage treatment districts.

You can see from this example of Northport and Huntington where some places may have an option of being included in a district expansion if the plant has the capacity and the less dense areas where running pipelines is simply not an option. You can also see areas pop that are isolated high density areas which may require their own new district or a cluster system such as on the western edge of Centerport or even the community on the southwestern edge of Eatons Neck

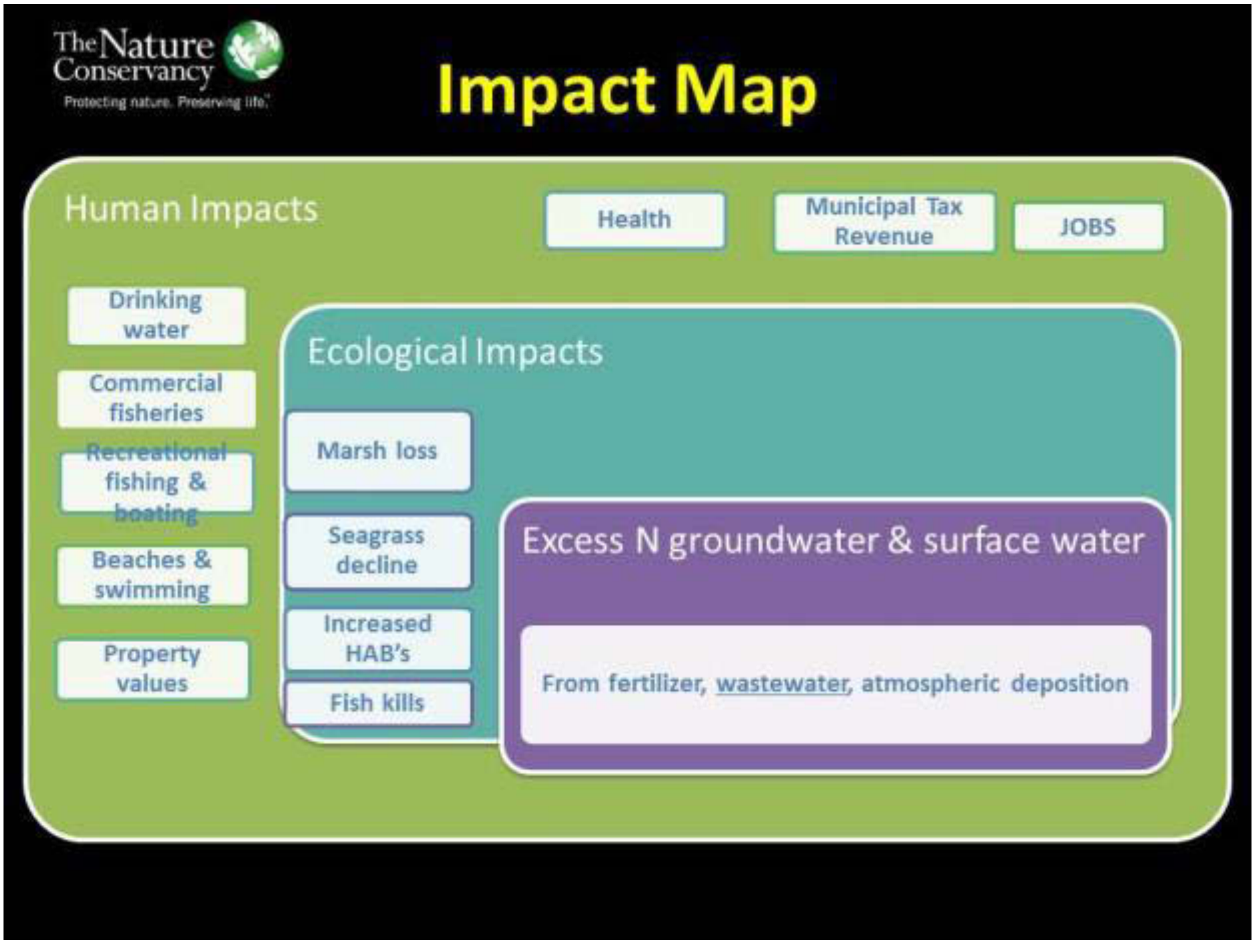


We can run these scenarios for all of Long Island or for distinct areas such as the unsewered communities along the Great South Bay from Oakdale to Bellport above



And here is the western Peconic Bay area showing Riverhead, Flanders, Riverside and Aquebogue.

While Riverhead has a treatment district the Flanders and Riverside areas are densely populated on the water and rely on cesspools and septic systems. Each area will require its own set of solutions that best match the parameters outlined earlier.



You can see here how the costs relate to what is at stake

Cost of doing nothing will have negative impacts on public and environmental health and ultimately the economy

We will lose the resources which we rely on for protection such as seagrasses and saltmarshes

We will lose the ability to swim and fish in our bays and harbors,

And ultimately we will pay more for it all in the long run

We will pay more for our water to be treated, for more wells etc

We will lose all of the economic benefits that rely on the health of our coasts.