Possible Remediation Measures for New York Coastal Waters

A Presentation to the New York State Ocean Acidification Task Force

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Current Strategies Associated with Acidification Observed in Lakes

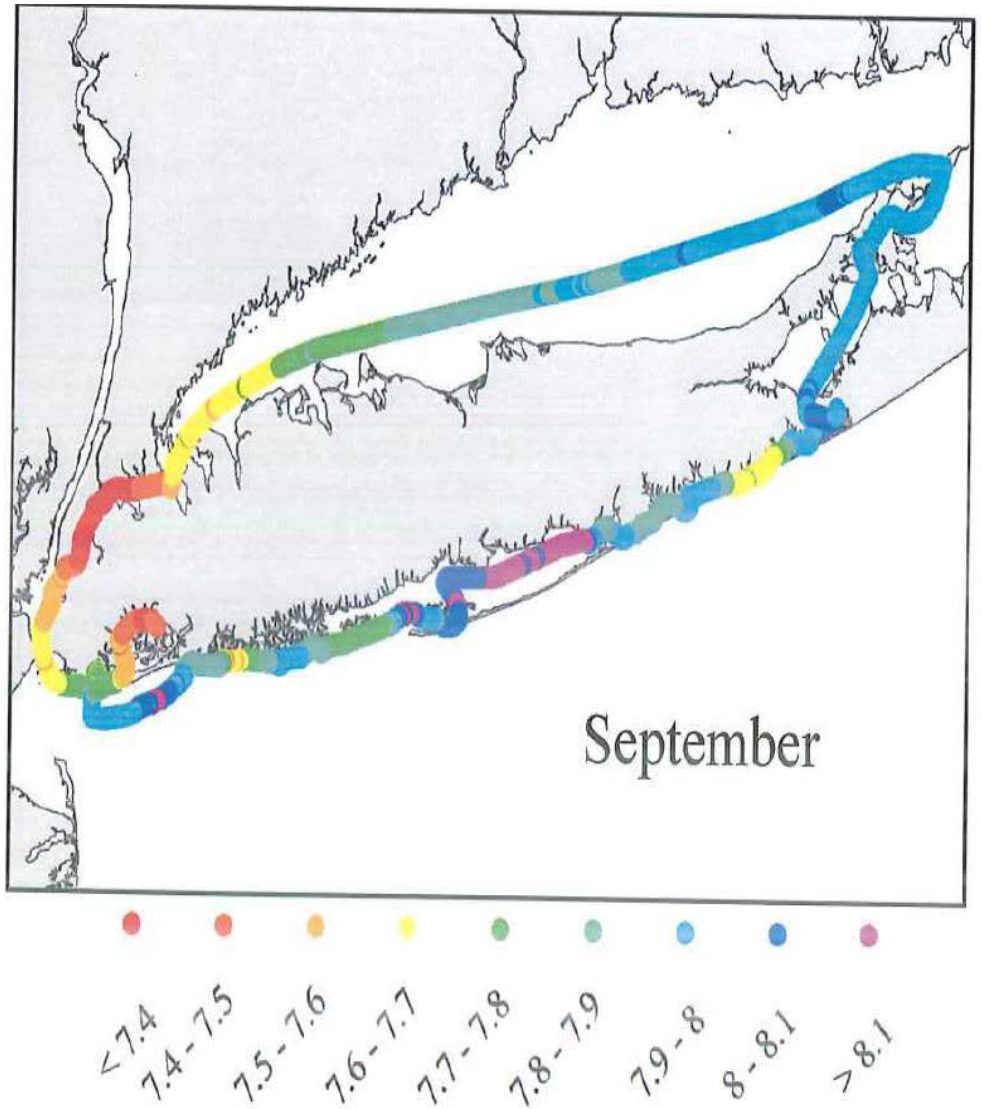
What Can We Learn From Previous Studies

- Numerous Publications in the Literature
- Benefits of Liming Lakes
  - Inexpensive
  - Available
  - Non-toxic
  - Natural Mineral
  - Easy to Distribute
  - Dissolves in Water
- Very Few Publications Addressing Mitigation Strategies in Marine Systems

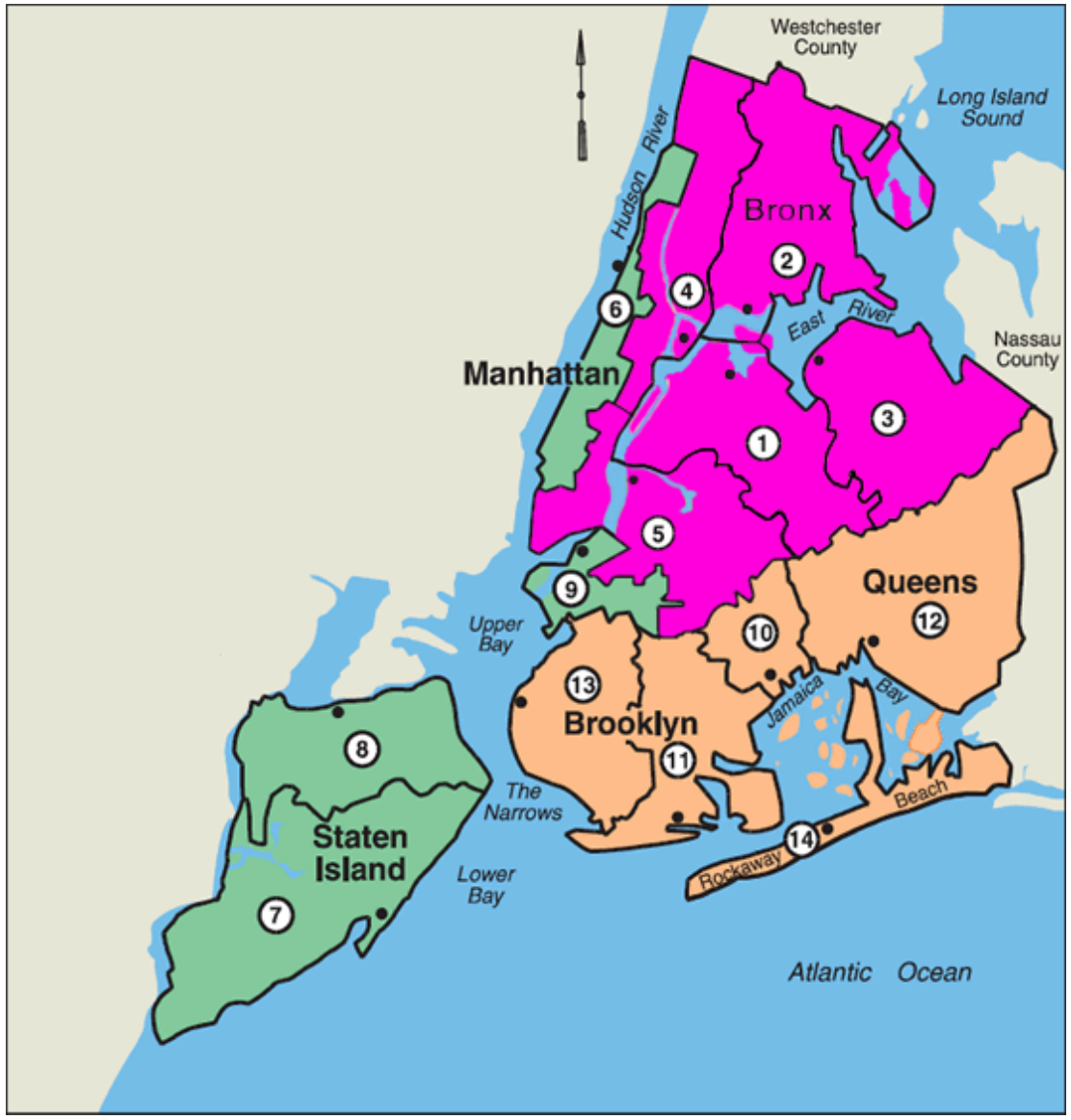
Potential Distribution Option

- Sewage Treatment Outfalls
  - Fourteen Facilities in NYC
- Power Plants
  - Con-Ed Facilities
  - LIPA Facilities
- New Commercial Construction in NYC
  - Storm Water Management Designs

Impacted Areas



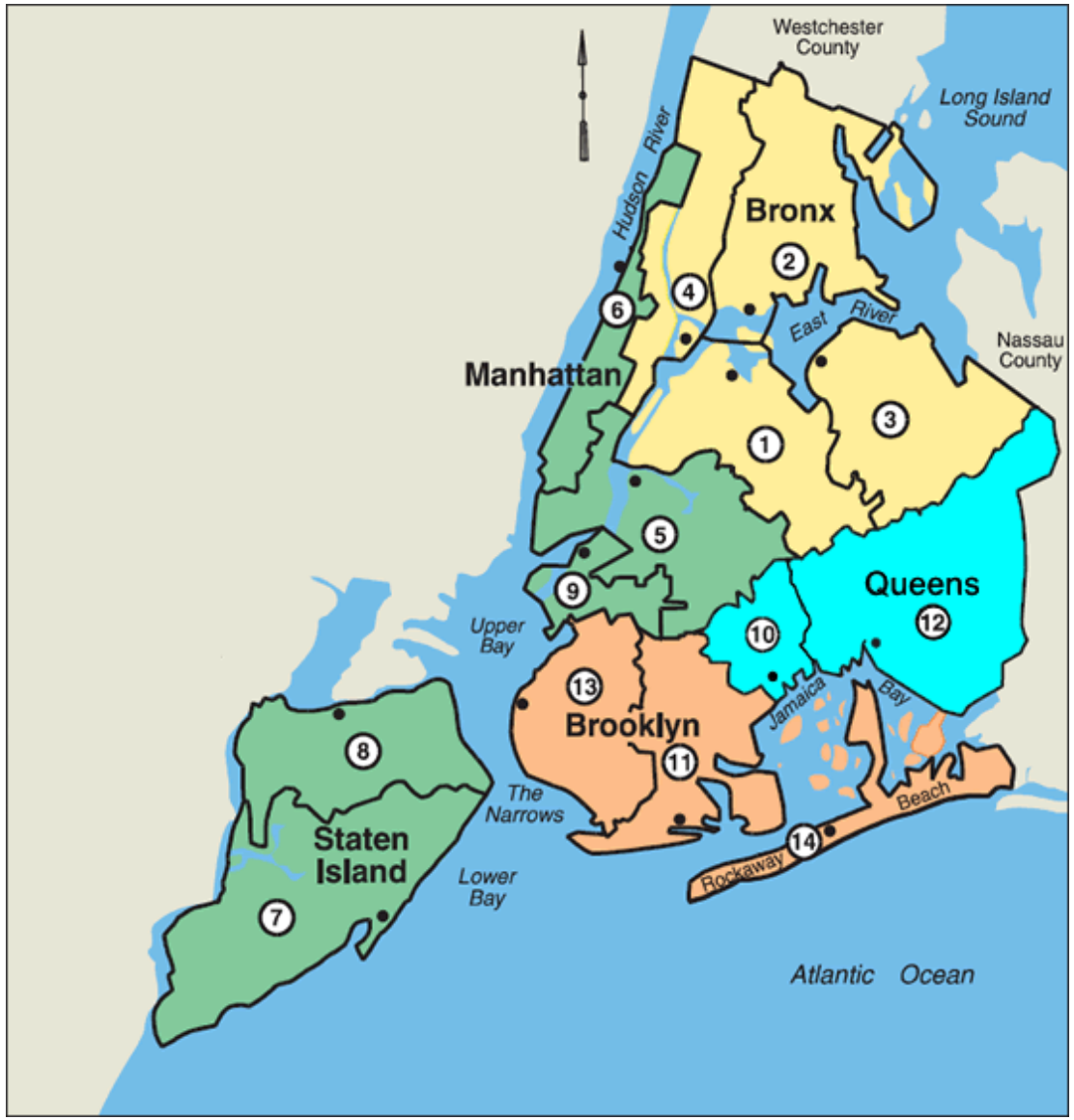
Courtesy of Gobler Lab, Stony Brook University



Area No.	Location	Capacity (MGD)
1	Bowery Bay	150
2	Hunts Point	200
3	Tallman Island	80
4	Wards Island	275
5	Newtown Creek	300

Total = 1 Billion Gallons per Day

Sewage effluent is ~15% of the freshwater in the Hudson River Estuary (Hydroqual, 1991)



Area No.	Location	Capacity (MGD)
10	26th Ward	85
12	Jamaica	100

Total = 185 Million Gallons per Day

Potential Alkaline Reagents

Highly Alkaline Liquid

- Sodium Hydroxide
  - Readily Available
  - Easy to Integrate into Existing Systems
  - Highly Corrosive

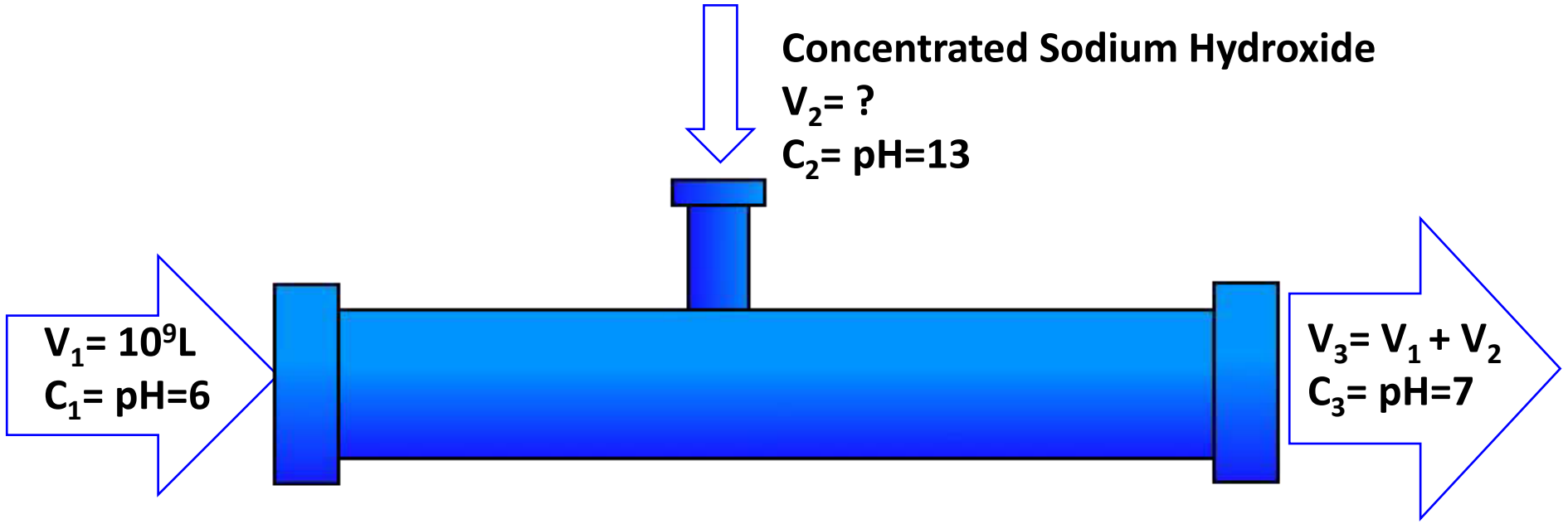
Highly Alkaline Solid

- Lime
  - Available as a Waste Product
    - Scrubber Residual
    - Waste to Energy Facilities and Coal Fired Power Plants
      - currently disposal costs on Long Island = $60/ton

Potential Environmental Policy Objectives

- Reduce the rate of acidification
  - Achievable and potentially financially viable
- Halt increase in acidification
  - Requires new technology and investment
- Reverse the trend in acidification
  - Laudable goal

Estimate of Amount of NaOH Needed to Affect pH



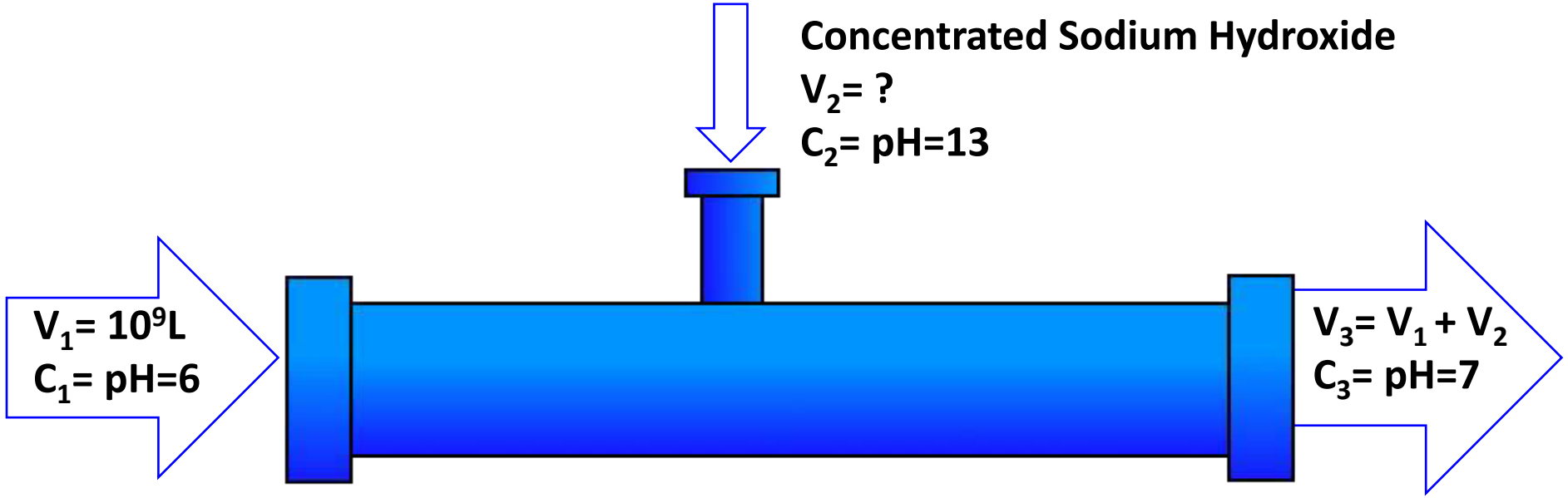
Assumptions:

Effluent - 260 MG/d, ($1x10^9$L) pH = 6

NaOH – pH=13

Discharge – pH=7

Estimate of Amount of NaOH Needed to Affect pH



$$(V_1 \cdot C_1) + (V_2 \cdot C_2) = V_3 \cdot C_3$$

$$(V_1 \cdot C_1) + (V_2 \cdot C_2) = (V_1 + V_2) \cdot C_3$$

$$V_2 = \frac{V_1(C_3 - C_1)}{(C_2 - C_3)} \rightarrow V_2 = 900\ L, \sim 240\ Gallons$$

1 Billion Gallons/d = ~900 Gallons NaOH/d

Other Potential Strategies

- Portland Cement Manufacturing
- Shell Grinding
- Reduce use of chlorine as a STP disinfectant
  - Ozone, UV, potential alternatives
  - Dechlorination prior to discharge
- Sediment Modification
- Enhancing marine vegetation

Portland Cement Manufacturing

- Major Contributor of CO_2 emissions in the US and Worldwide
  - 7% of worldwide CO_2 emissions come from cement production
    - New York Times (December, 2018)
  - 90 million tons produced in the US/yr
  - 3 million tons used in NY State/yr
  - 1 ton of Portland cement produces 1 ton of CO_2

Pulverized Post Consumer Glass

- Pozzolanic properties – Urban Mining Co.
- Supports glass recycling, a major problem for most municipalities
- Saves landfill space
- Replacement of a percentage of Portland cement can result in CO_2 reduction
- Encourages sustainable construction

Considerations for Using Recycled Glass in the Cement Industry

- Construction companies tend to be hesitant with new materials
- More research is needed to demonstrate durability of material
- Research financial viability
  - Can it be supported out of the nickel deposit law?
- Legislation promoting/requiring use of recycled glass in municipal construction projects

Can Clam Shells Mitigate OA?

- Cost effective
- No adverse effects
- Whole shells promote regrowth
- Dissolution is a function of particle size
  - 1400-1500 year old oyster middens in Chesapeake Bay (Jansen, 2018)
- Optimal grain size would be a function of local conditions

Conclusions

- Moving Forward
  - There exists several financially-viable, regional mitigation strategies.
  - Research, demonstration projects, and legislation
  - Partnerships with industry