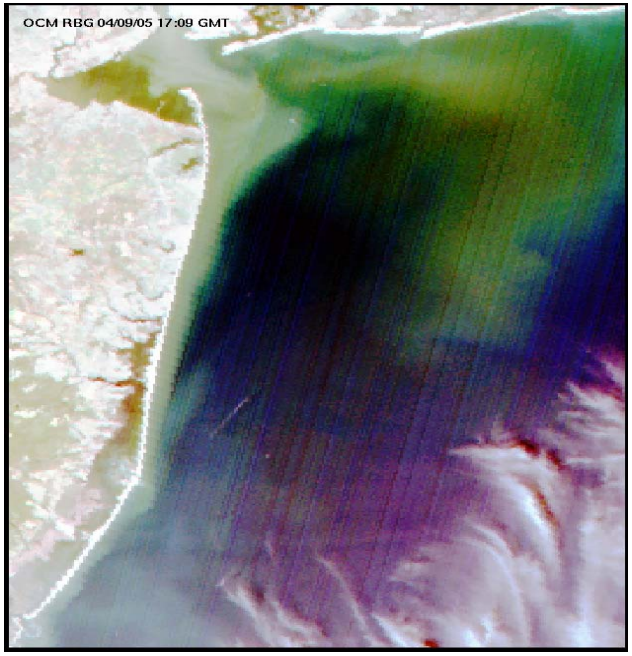
"A new paradigm of coordination is needed among public health departments and oceanographers to develop an Integrated Ocean Observation System that meets their collective needs."

From "Public Health Risks: Coastal Observations For Decision-making" Workshop. 1/23/2006
http://www.ocean.us/Ocean_US_Workshops

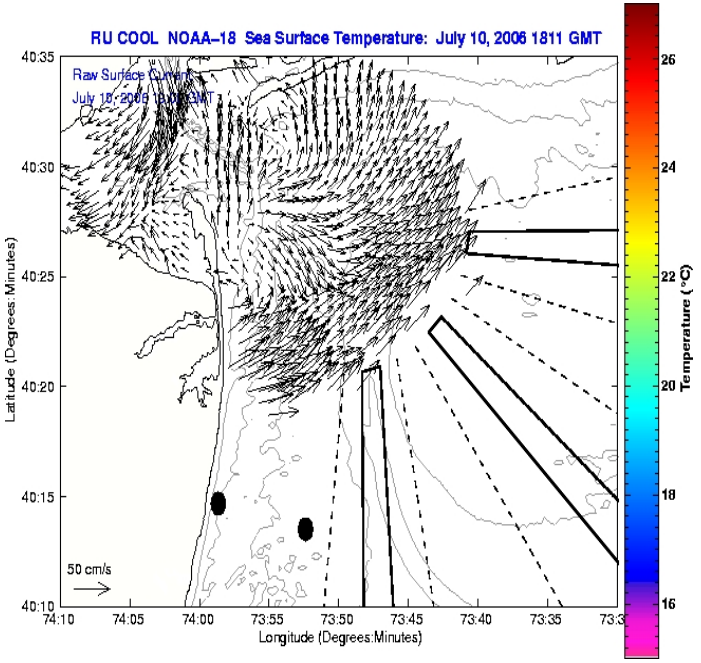
ALGAE AND BACTERIA

ARE MASSED



Downwelling

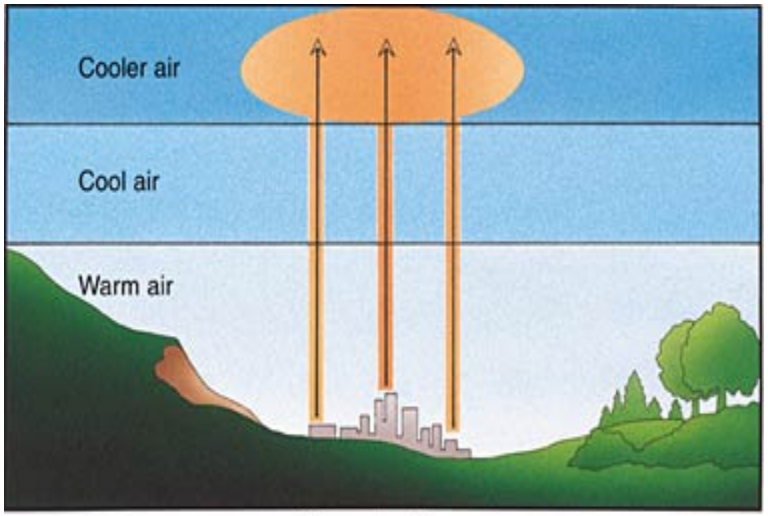
AND DISPERSED



Upwelling

BY HYDRODYNAMIC FORCES ALONG THE JERSEY SHORE

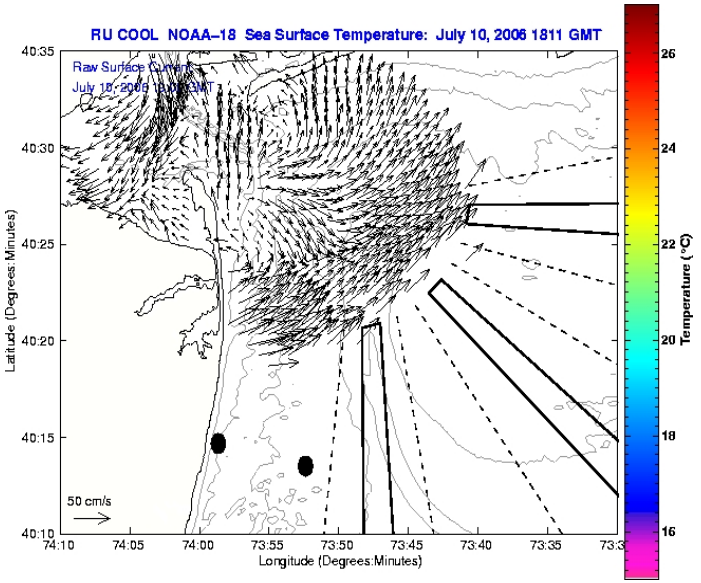
CURRENTS ARE THE “WEATHER OF THE OCEAN”

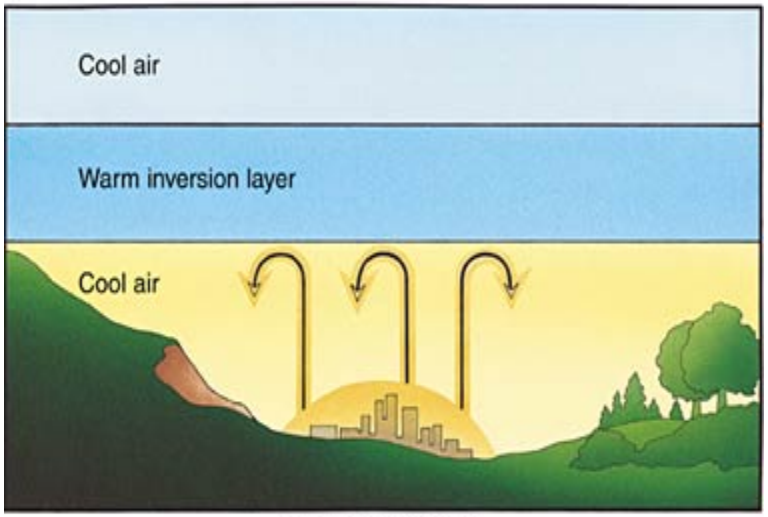


Normal pattern

~

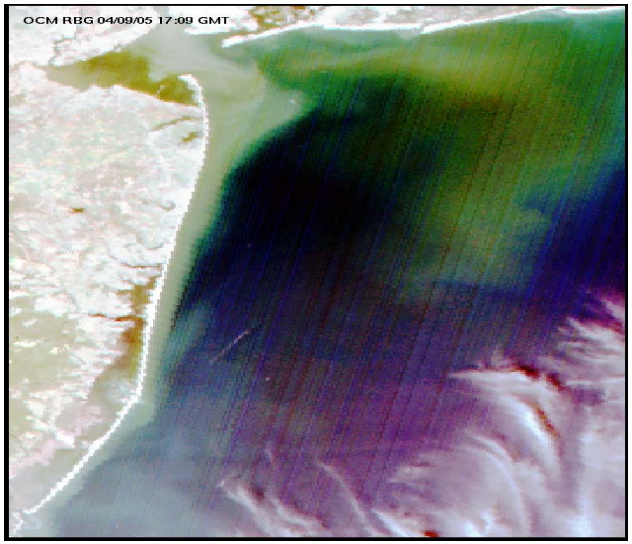
Upwelling





Thermal inversion

~



Downwelling

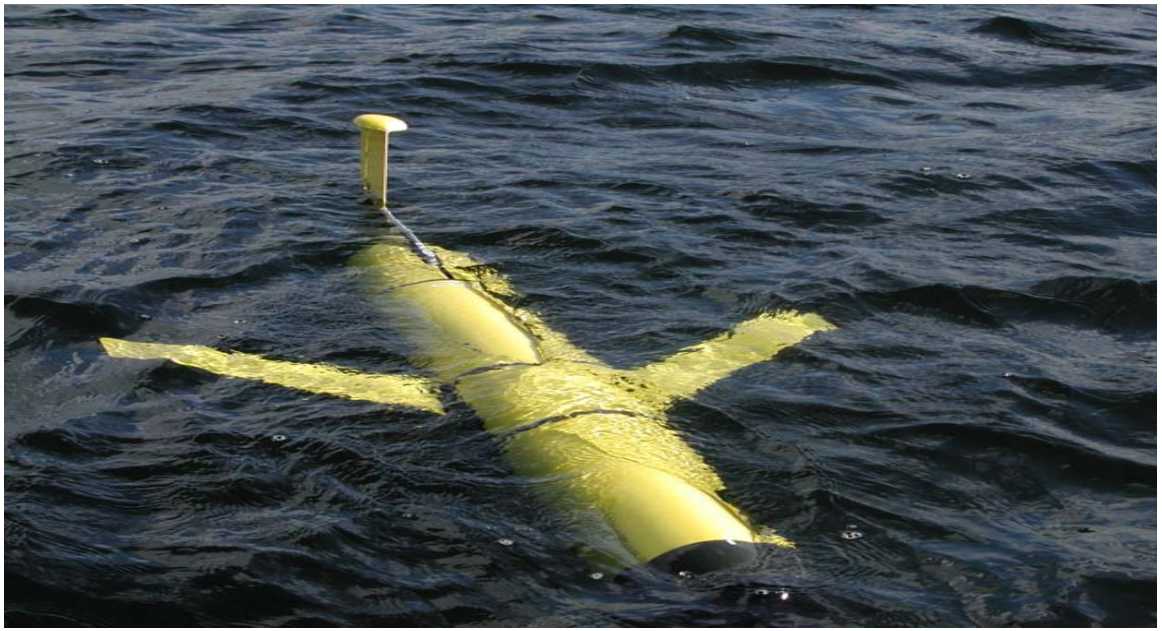
http://serc.carleton.edu/research_education/yellowstone/snowmobiles.html

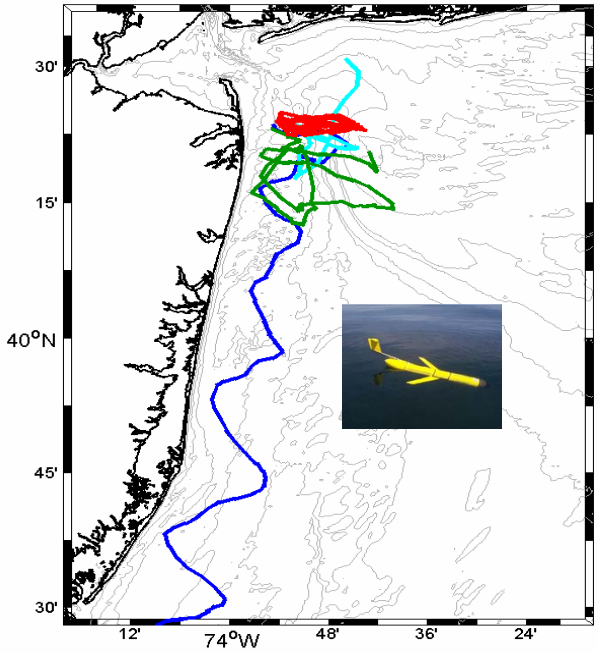
PART 1 – THE RESEARCH in NJ

Stevens Institute of Technology established their New York Harbor Observing and Prediction System (NYHOPS) to provide knowledge about hydrometeorological conditions both in real-time and forecasted out to 48 hours in the Hudson River, the East River, NY/NJ Estuary, Raritan Bay, Long Island Sound and the coastal waters of New Jersey.

In October 1992, the Rutgers' Coastal Ocean Observation Lab was established at its Institute of Marine and Coastal Sciences. Rutgers Lagrangian Transport and Transformation Experiment (LaTTE) was launched in 2002 (http://marine.rutgers.edu/mrs/latte/latte2006.htm). **This work is partially funded by agencies associated with the Department of Homeland Security**.

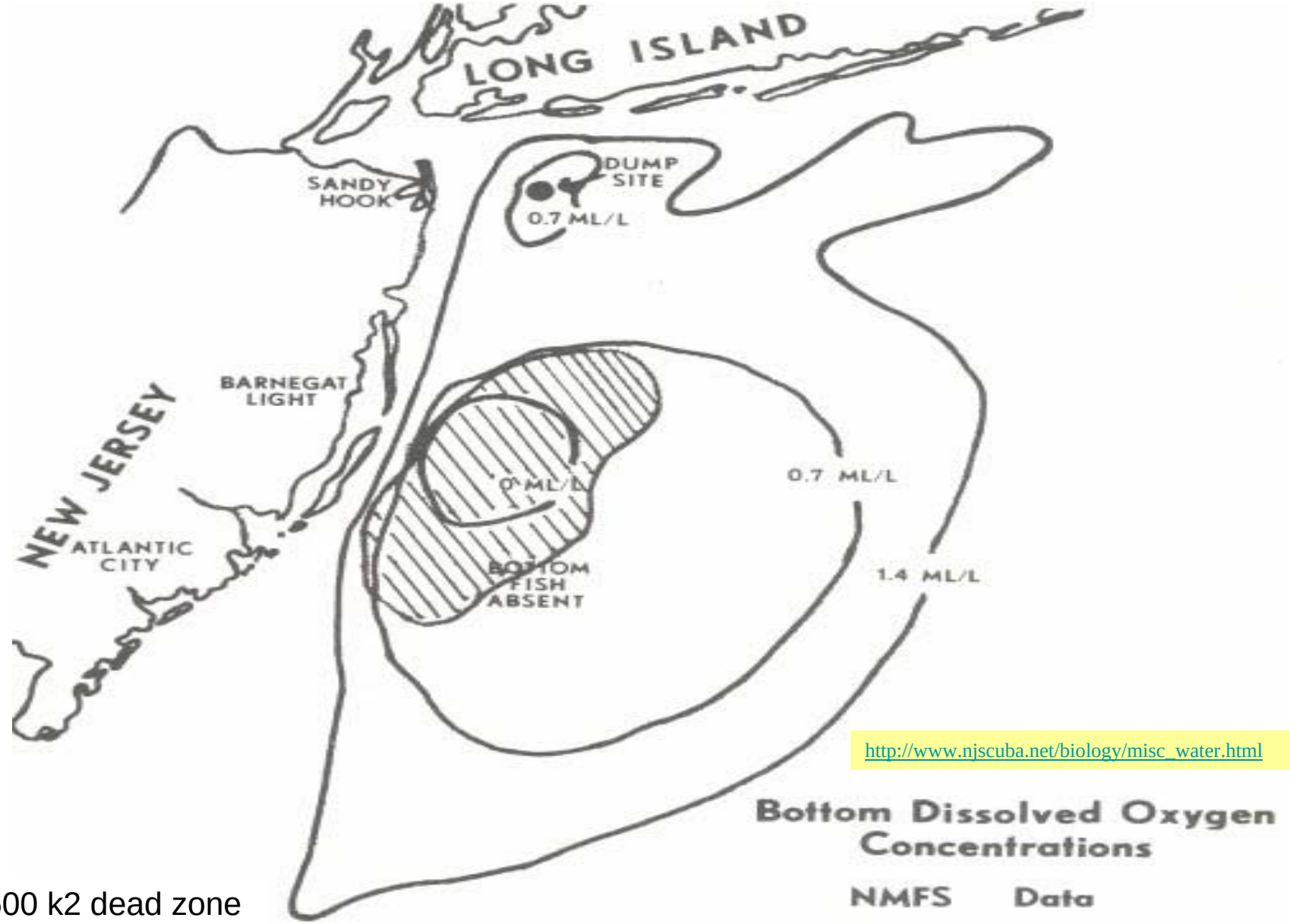
Coastal Ocean Dynamics Applications Radar (CODAR). Slocum Electric Glider.





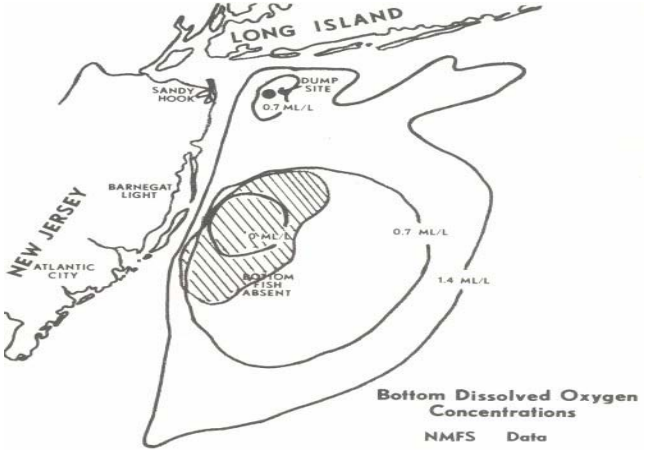
Oscar Schofield, Scott Glenn, Liz Creed, John Kerfoot, Hugh Roarty, Josh Kohut (Rutgers University)
Clayton Jones (Webb Research), Mike Twardowski (WetLabs). 2006. Riders in the storm: Benthic resuspension, storms, and transport.

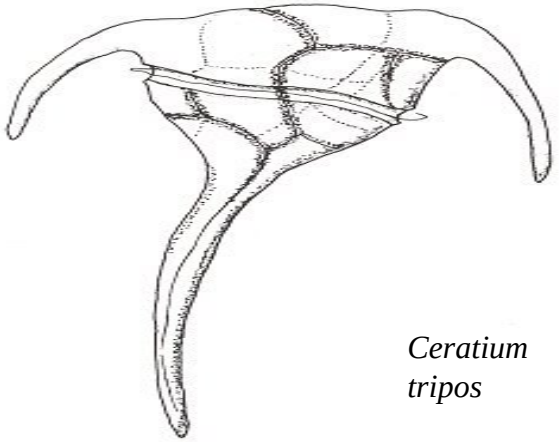
In 1976 a Massive Phytoplankton Bloom Advanced the Study of Hydrometeorology



http://www.njscuba.net/biology/misc_water.html

8600 k2 dead zone





Ceratium tripos

In 1976, the worst marine die-off in New Jersey's history happened as a result of unique meteorological conditions, including unusually persistent southwesterly winds that slowed and even reversed the normal southwestward flow of bottom currents on the shelf (Sinderman et al., 1979; Walsh, 1979). A massive bloom of the dinoflagellate Ceratium tripos concentrated in the cold bottom waters of an early thermocline – a species that prefers cooler waters but is usually found in small numbers (Malone et al., 1979; Sinderman et al., 1979; Swanson et al., 1979).

When the bloom ultimately depleted the dissolved oxygen, the phytoplankton rapidly suffocated and decomposed, creating an 8600 square kilometer dead zone of hydrogen sulfide in the bottom waters, 10 to 100 kilometers offshore from Sandy Hook to Cape May. This lasted until October 1976, when lower temperatures and vertical mixing finally broke up the thermocline (Malone et al., 1979; Reid, 2006; Sinderman et al., 1979; Swanson et al., 1979; Walsh, 1979).

Sindermann, C. and Swanson, L. 1979. Chapter 1. Historical and regional perspective. In Oxygen Depletion and Associated Benthic Mortalities in the New York Bight, 1976. NOAA Professional Paper 11. Rockville Md. December.

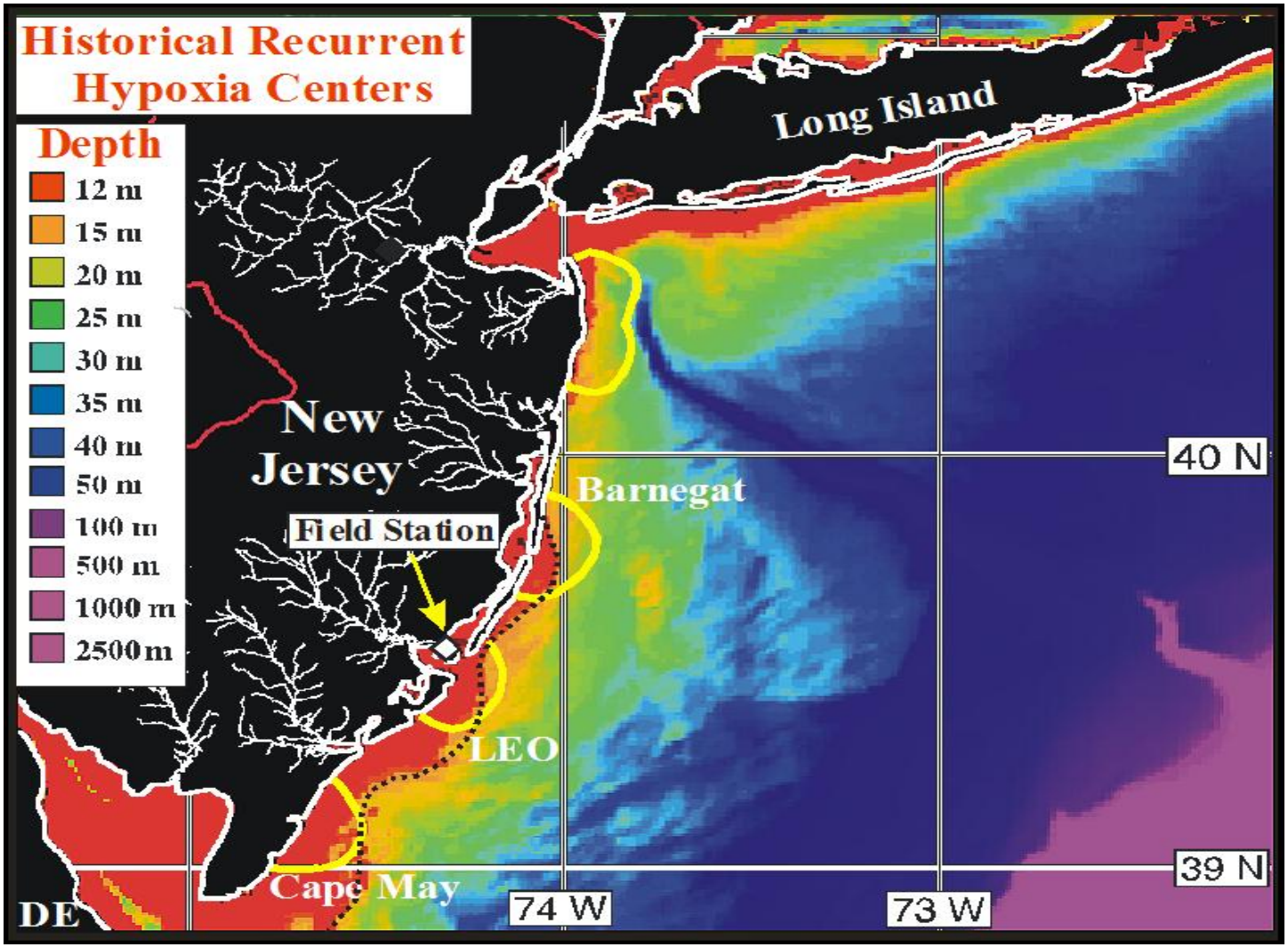
Malone, T., Esaias, W. and Falkowski, P. 1979. Chapter 9. Plankton dynamics and nutrient cycling. Part 1. Water column processes. In Oxygen Depletion and Associated Benthic Mortalities in the New York Bight, 1976. NOAA Professional Paper 11. Rockville Md. December.

Reid, R. 8/11/06. Email. National Oceanic and Atmospheric Administration. Sandy Hook NJ.

Swanson, L., Sindermann, C. and Han, G. 1979. Oxygen depletion and the future: an evaluation. In Oxygen Depletion and Associated Benthic Mortalities in the New York Bight, 1976. NOAA Professional Paper 11. Rockville Md. December.

Walsh, J. 1979. Forward – Oxygen Depletion and Associated Benthic Mortalities in the New York Bight, 1976. NOAA Professional Paper 11. Rockville Md. December.

PHYTOPLANKTON AND HYPOXIA



Glenn, S.; Arnone, R.; Bergmann, T.; Bissett, Q.; Crowley, M.; Cullen, J.; Gryzmski, J.; Haidvogel, D.; Kohut, J.; Moline, M.; Oliver, M.; Orrico, C.; Sherrell, R.; Song, T.; Weidemann, A.; Chant, R. and Schofield, O. 2004. Biogeochemical impact of summertime coastal upwelling on the New Jersey shelf. Journal of geophysical Research, Vol. 109, C12So2. http://marine.rutgers.edu/mrs/coolresults/papers/2003JC002265_Glenn_Biogeochemical.pdf

Oscar Schofield & Scott Glenn. 2004.Ocean Science in the New Millennium: The history and the potential for regional partnerships. Rutgers University. Coastal Ocean Observation Lab (COOL). http://www.marine.rutgers.edu/mrs/coolresults/2004/DEP_september04.ppt

EDDIES CAN CENTRIFUGE PHYTOPLANKTON INTO A BLOOM

Phytoplankton blooms rapidly deplete dissolved oxygen to hypoxic levels of 2 milliliters per liter or less in 4 centers off the NJ coast.

The upwelling center off Monmouth County forms where the Hudson Raritan plume rounds Sandy Hook. Southerly winds will blow the plume towards Long Island; northerly winds will deflect it back into the Monmouth shoreline, usually in the area from Long Branch north). (Pullen, 2006). (Chant et al. 2004b; Glenn et al., 2006; Kohut et al. 2004).

The 3 other recurrent "upwelling centers" are located in drowned river deltas off the Barnegat Inlet, the Mullica River Estuary, and the Townsend/Hereford Inlets (Chant et al. 2004b; Glenn et al., 2006; Kohut et al. 2004). Counterclockwise currents moving counter to the direction of the main current form on the downslope side of hilly areas of the seafloor associated with an ancient river delta (Glenn et al., 2004; Glenn et al., 2006; Chant et. al, 2004a).

When this cyclonic eddy forms over the upwelling center, it pulls phytoplankton and other organic matter from the wider shelf area down into a vortexing trap of cold, less oxygenated water (Glenn et al., 2004; Glenn et al., 2006).

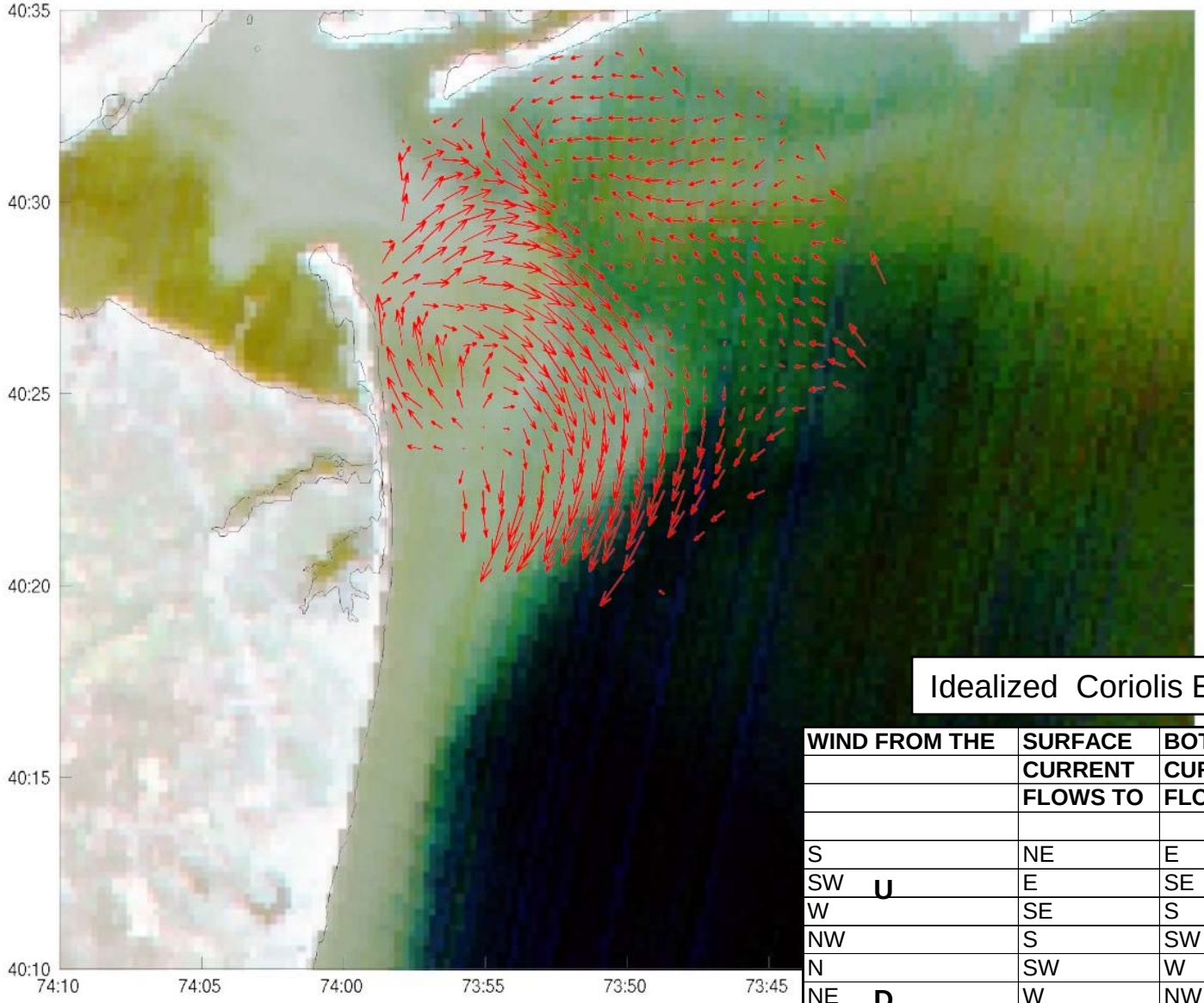
Chant, R.; Glenn, S.; and Kohut, J. 2004a. Flow reversal during upwelling conditions on the New Jersey inner shelf. Journal of Geophysical Research. Vol. 109, C12S03. http://marine.rutgers.edu/pubs/private/2004Chant_JGR.pdf

Chant, R.; Reinfedler, J.; Glenn, S.; Schofield, O.; Wilkin, J.; Houghton, R.; Chen, B; Zhou, M.; Bissett, P.; Moline, M. and Frazer, T. 2004b. Collaborative Research: Lagrangian studies of the transport, transformation, and biological impact of nutrients and contaminant metals in a buoyant plume: A process study in an operational ocean observatory. Grant proposal, The Center for Coastal Marine Sciences at California Polytechnic State University. San Louis Obispo, Ca. http://www.marine.calpoly.edu/researchprograms/latte/Latte_proposal.pdf

Glenn, S.; Arnone, R.; Bergmann, T.; Bissett, Q.; Crowley, M.; Cullen, J.; Gryzmski, J.; Haidvogel, D.; Kohut, J.; Moline, M.; Oliver, M.; Orrico, C.; Sherrell, R.; Song, T.; Weidemann, A.; Chant, R. and Schofield, O. 2004. Biogeochemical impact of summertime coastal upwelling on the New Jersey shelf. Journal of geophysical Research, Vol. 109, C12So2. http://marine.rutgers.edu/mrs/coolresults/papers/2003JC002265_Glenn_Biogeochemical.pdf
Glenn, S.; Crowley, M.; Haidvogel, D. and Song, D. Accessed 5/29/06. Underwater observatory captures coastal upwelling off New Jersey. American Geophysical Union (AGU) http://www.agu.org/sci_soc/eisglenn.html

Kohut, J.; Glenn, S.; and Chant, R. 2004. Seasonal current variability on the New Jersey inner shelf. Journal of Geophysical Research. Vol 109. C07S07. http://osec.rutgers.edu/mrs/coolresults/papers/kohut_jgr_2003JC001963.pdf

Pullen, J., Holt, T., Blumberg, A., and Bornstein, R. 2006. Atmospheric response to local upwelling in the vicinity of the NY/NJ Harbor. May4, 2006. http://www.theworldisyourocean.net/papers/2006jam.pdf



Idealized Coriolis Effect

WIND FROM THE	SURFACE CURRENT FLOWS TO	BOTTOM CURRENT FLOWS TO	CURRENT DIRECTION TO COAST
S	NE	E	OFFSHORE
SW **U**	E	SE	OFFSHORE
W	SE	S	OFFSHORE
NW	S	SW	?
N	SW	W	ONSHORE
NE **D**	W	NW	ONSHORE
E	NW	NW	ONSHORE
SE	N	NE	?

http://marine.rutgers.edu/cool/latte/pics/2005/sat_fullimage/050409_OCMCodarOverlay.jpg

(**U**pwelling – **D**ownwelling)

PHYTOPLANKTON BLOOMS and the ROLE of CHANNELS as CONDUITS

In San Francisco Bay, the larger interia:friction ratio in deep channels results in greater tidal excursions and higher residual velocities than in shallow regions.

“Deep regions were shown to be large-scale vehicles for mass transport within an estuary, due to the large tidal excursion and residual currents there.”

“… lateral sloshing of material out of a shallow region and into a deep channel region on ebb tide, and then back into the shoal during flood tide.”

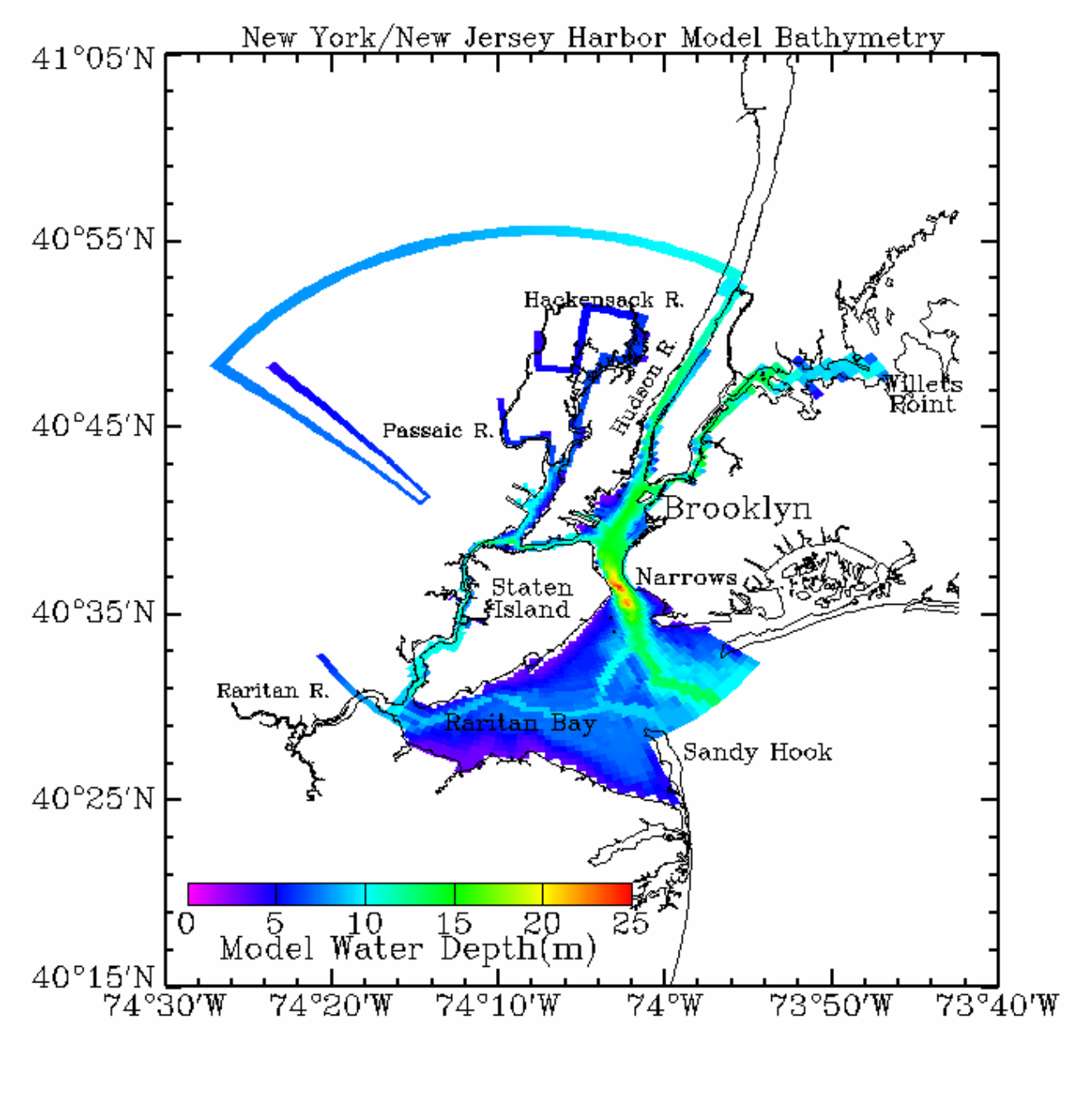
“… residual transport can result in significant phytoplankton biomass accumulation in regions where local conditions are not conducive to rapid population growth.”

If a highly productive shoal region supplies biomass to a channel that is also productive for phytoplankton, which then transports the algal biomass over large distances, “that biomass may then seed blooms in other shoal regions which have open communications with the channel.”

Lucas, L., Koseff, J., Monismith, S., Cloern, J., and Thompson, J. 1999. Processes governing phytoplankton blooms in estuaries. II: The role of horizontal transport. Marine Ecology Progress Series. Vol. 187:17-30. October 14, 1999.

http://sfbay.wr.usgs.gov/publications/pdf/lucas_1999_estuaries2.pdf

BOTTOM TOPOGRAPHY



Port of New York/New Jersey Nowcasting/Forecasting System

http://nauticalcharts.noaa.gov/csdl/op/nynj/ny_topo.html

Since 1986, the Coastal Cooperative Monitoring Program has limited its interpretation of bacterial dynamics in the environment almost exclusively to rainfall. Rutgers' Coastal Ocean Observation Lab was established in 1992.

In 2007, it is still not known if changes in the turbulence or the direction of currents might create localized shifts in bacterial communities, as they do on a wider scale for phytoplankton. One reason why not:

EPA Index (Indicator) Organisms Definition -

- Fecal contamination indicators should:
  - Occur consistently and exclusively in human and animal feces,
  - Be capable of detection using simple and reproducible methodology,
  - Should persist and be detectable when other gastrointestinal pathogens are present, and
  - **Should not multiply in the environment,**

It is now apparent that **Enterococcus fails as an ideal indicator,** since it is no longer believed to be solely associated with sewage discharges, or to perish quickly in the environment. Under the right conditions during the summer, it can survive and even reproduce for weeks to months in sediments, seaweed, zooplankton, etc (see Smith et al. for overview).

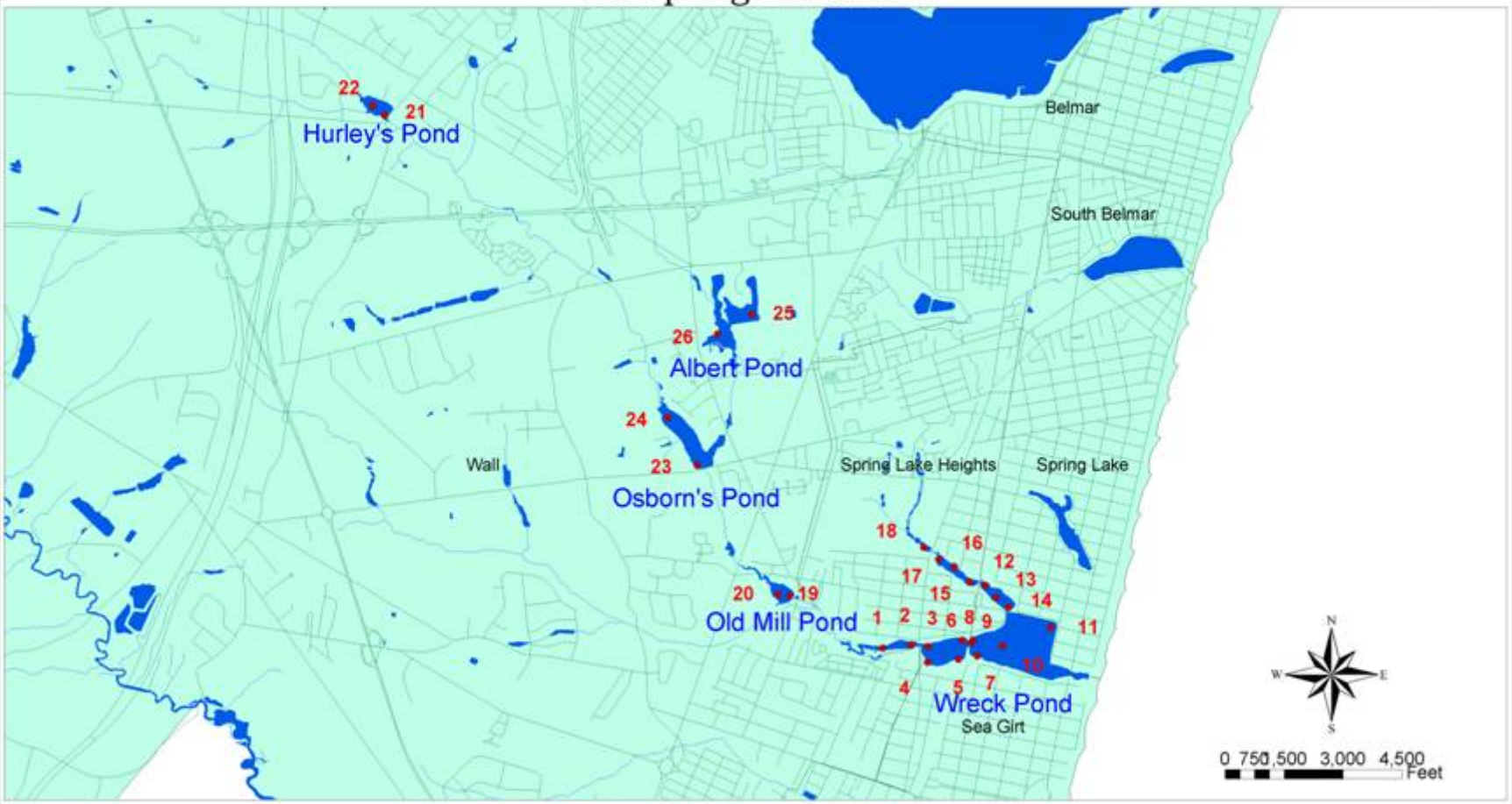
Atherholt, T. 2007. Water Quality: Using Bacterial Indicators. Powerpoint. NJDEP. Division of Science and Research.

Smith, Wendy, Meredith Nevers, and Richard Whitman. 2006. Advances in recreational water quality monitoring at Indiana Dunes National Lakeshore. Park Science 24(1): 19-23. http://www2.nature.nps.gov/ParkScience/index.cfm?ArticleID=49

Monmouth County Health Department

Wreck Pond

Fecal Coliform Colony Values
Sampling Locations



Legend

- Sample Sites
- Roads
- Streams
- Lakes
- Municipalities

Wreck Pond

1	340	17000	7	450	30000	13	220	3500
2	280	30000	8	350	5000	14	2800	1300
3	430	50000	9	140	17000	15	1700	8000
4	1060	17000	10	170	300	16	70	50000
5	100	1600000	11	70	300	17	670	500000
6	1300	2200	12	170	300	18	1600	5000

Old Mill Pond

19	670	5000
20	80	40

Osborn's Pond

23	1880	1700
24	850	17000

Hurley's Pond

21	40	11000
22	80	17000

(surface water colonies per 100mL / sediment colonies per 100grams wet weight)

This map was developed in part, using NJDEP digital data, in conjunction with the MCHDs work, but this secondary product, has not been verified by the NJDEP and is not state authorized.

This map was prepared to recognize public and environmental health trends. Data accuracy is limited by the accuracy and scales of the original data sources. Site specific conditions should be field verified.