Hurricane Irene and Tropical Storm Lee: Impacts to the Chesapeake Bay

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Maryland Department of Natural Resources

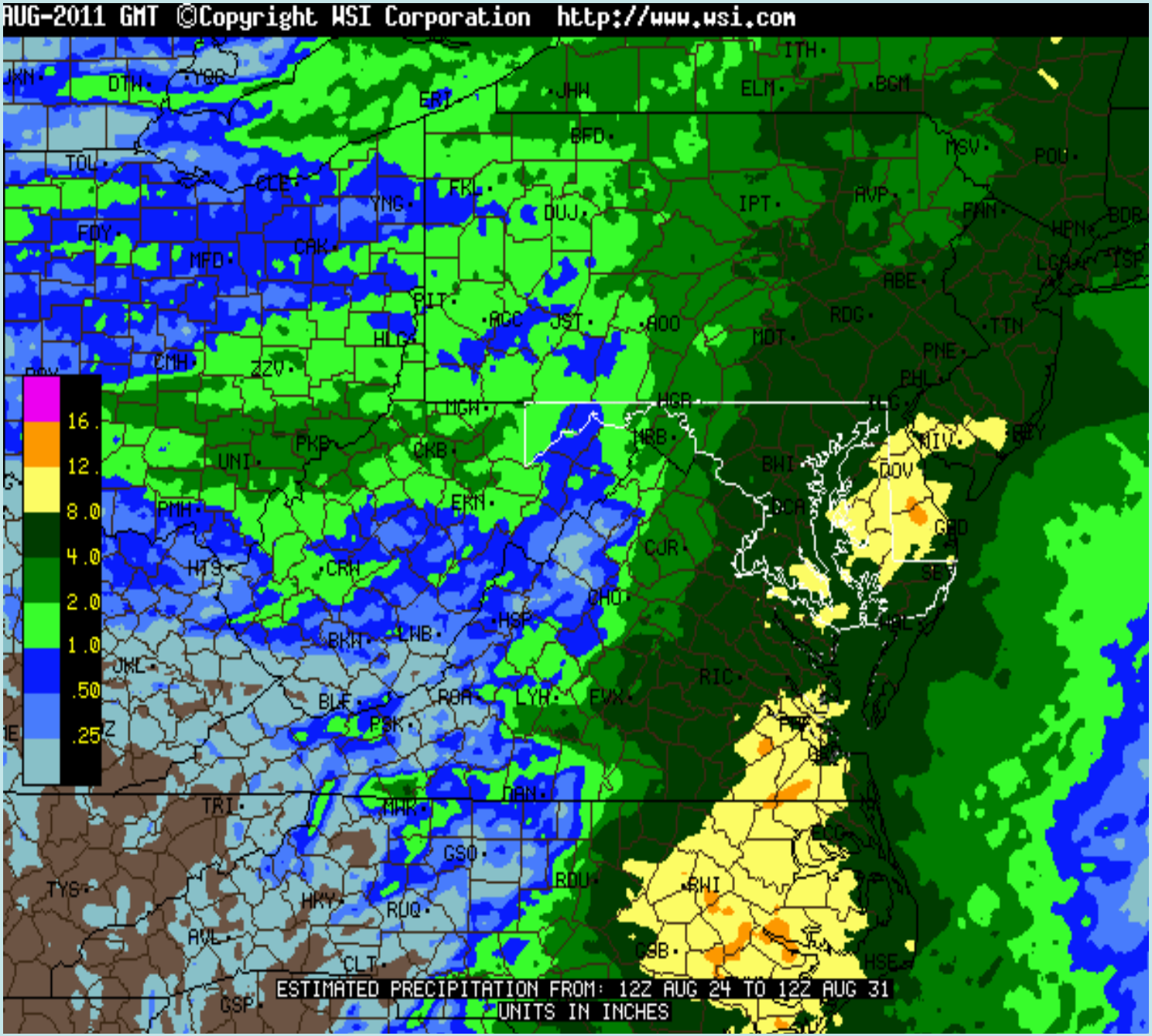
October 20th, 2011

www.eyesonthebay.net

Hurricane Irene departing the Delmarva Peninsula – August 28, 2011
Image courtesy of MODIS Rapid Response Project at NASA/GSFS (250m resolution, True color)

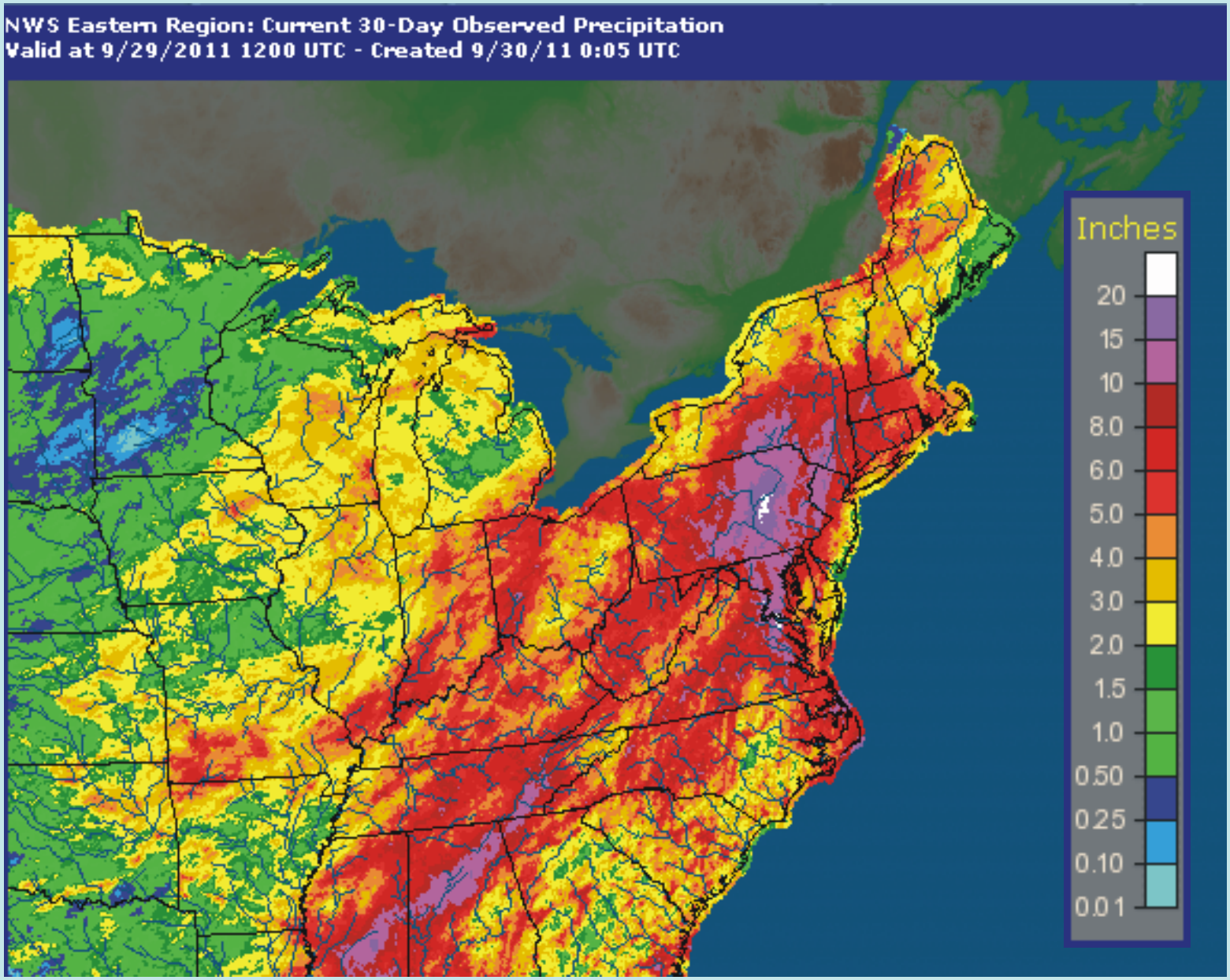
Hurricane Irene

- August 27-28, 2011
- Precipitation centered on Eastern Shore, Delaware River Basin & NJ.
- High flows on some areas of Eastern shore (Choptank River)
- High north/northwest winds

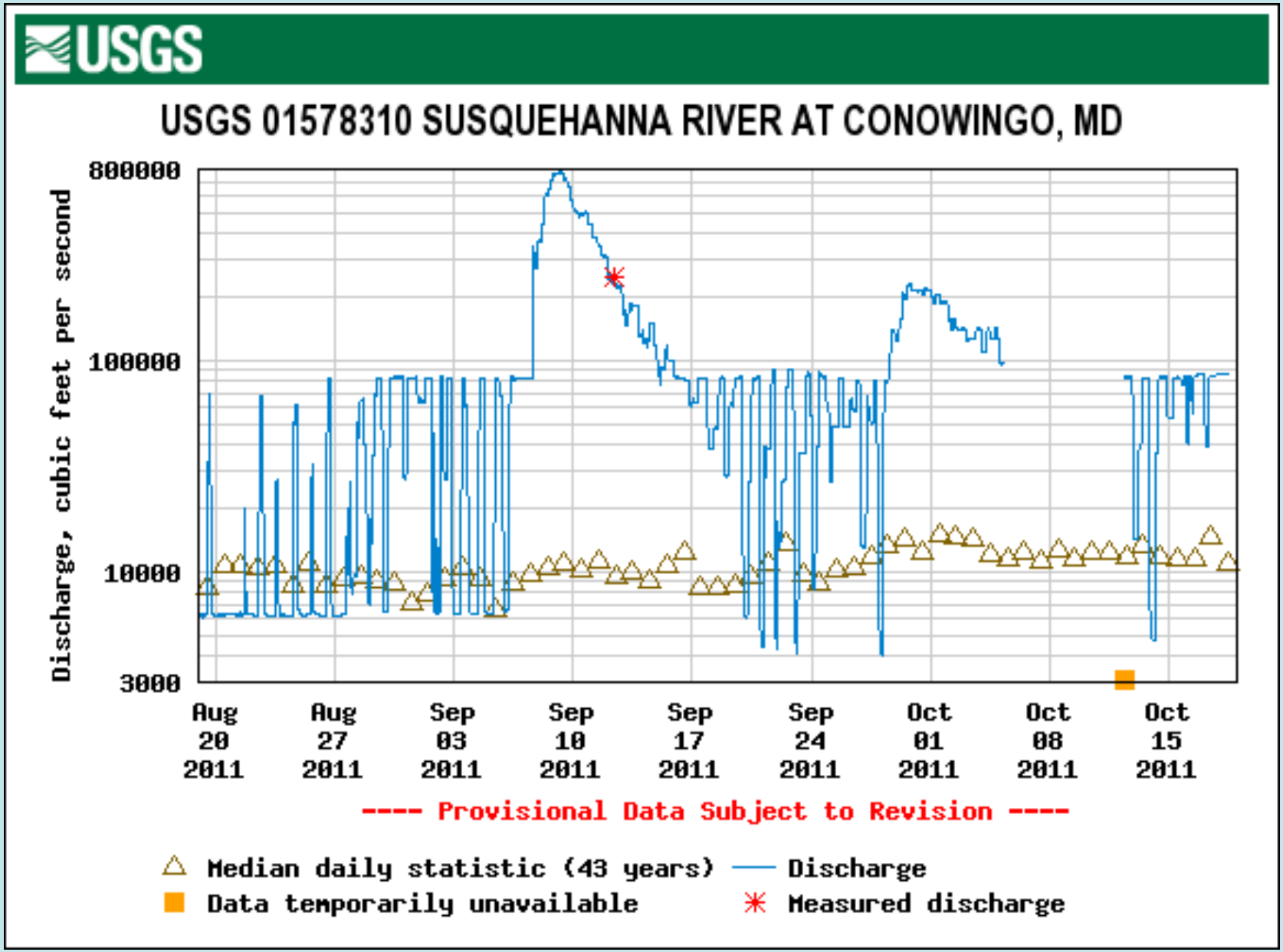

AUG-2011 GMT ©Copyright WSI Corporation http://www.wsi.com
16.
12.
8.0
4.0
2.0
1.0
.50
.25
ESTIMATED PRECIPITATION FROM: 12Z AUG 24 TO 12Z AUG 31
UNITS IN INCHES

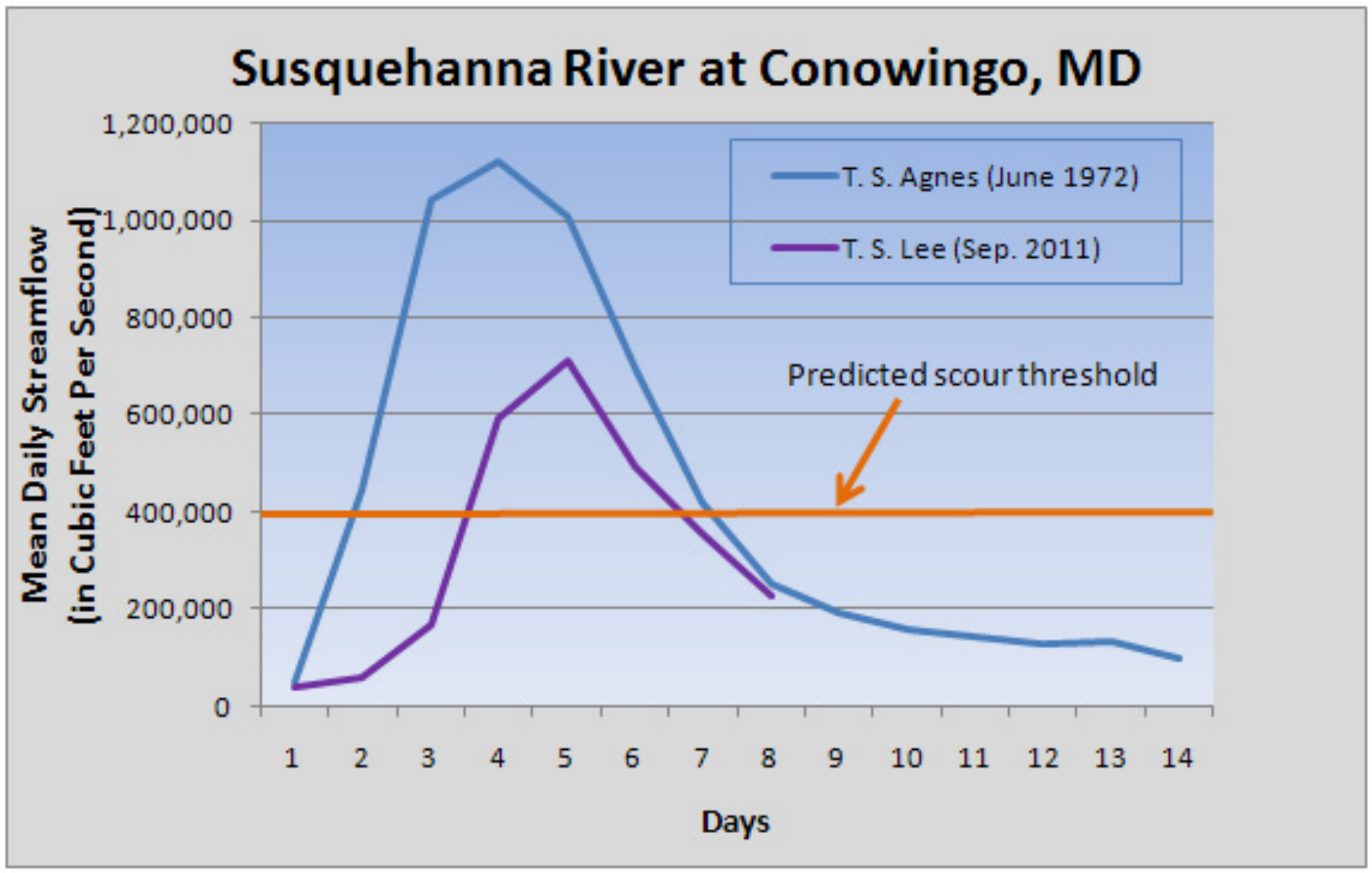
Tropical Storm Lee

- Precipitation centered on upper western shore north to New York
- Freshwater flow from Tropical Storm Lee ranks 2nd all-time in recorded freshwater flow behind Tropical Storm Agnes (1972)
- Heavy scouring of sediment behind Conowingo Dam



September 2011 rainfall estimate (including Tropical Storm Lee but not Hurricane Irene) http://water.weather.gov/precip/


USGS
USGS 01578310 SUSQUEHANNA RIVER AT CONOWINGO, MD
Discharge, cubic feet per second
800000
100000
10000
3000
Aug 20 2011
Aug 27 2011
Sep 03 2011
Sep 10 2011
Sep 17 2011
Sep 24 2011
Oct 01 2011
Oct 08 2011
Oct 15 2011
---- Provisional Data Subject to Revision ----
Median daily statistic (43 years)
Discharge
Data temporarily unavailable
Measured discharge

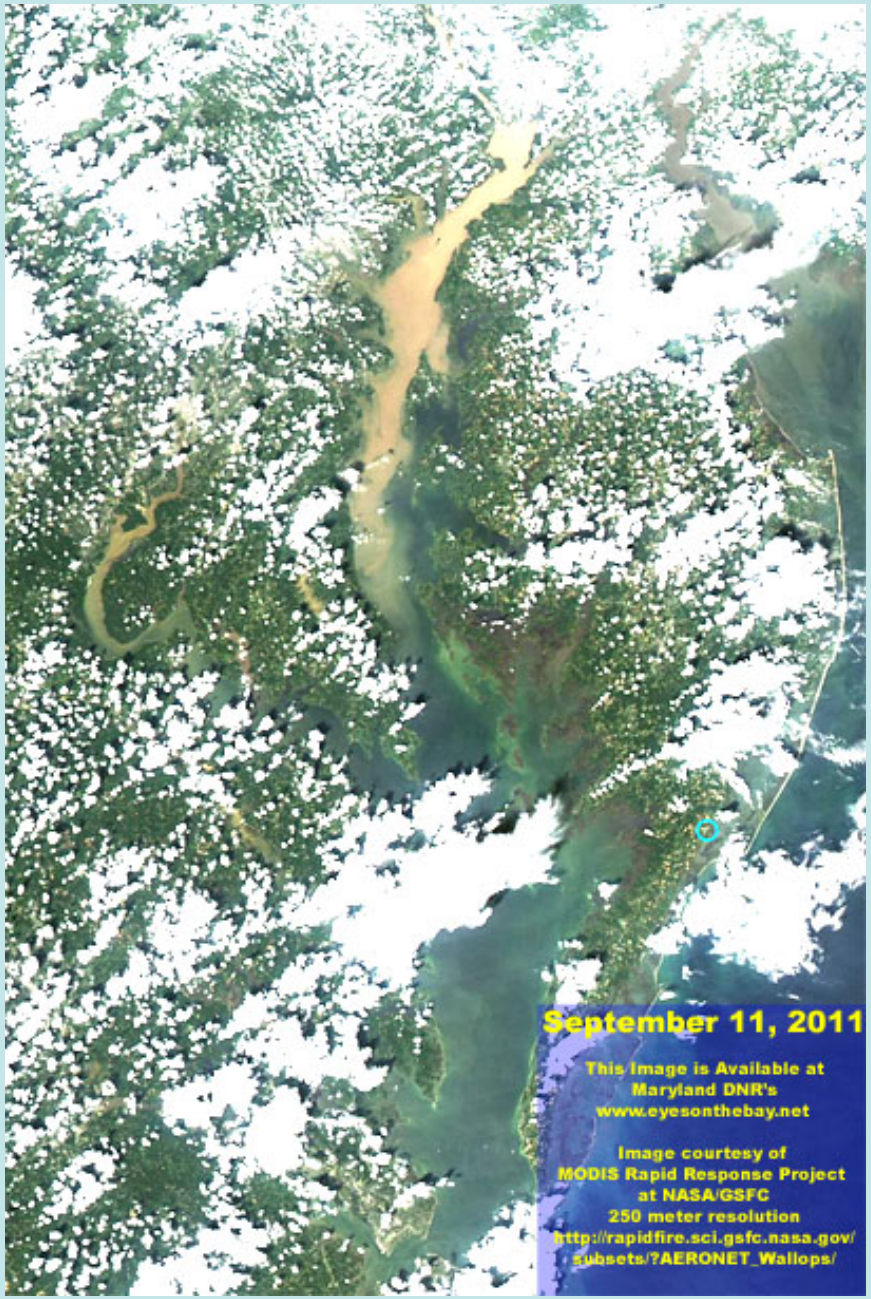


Graph from USGS, http://chesapeake.usgs.gov/featuresedimentscourconowingo.html

USGS Streamflow

http://waterwatch.usgs.gov/new/index.php?m=wwmaps

September 10-14th



October 5-9th
October 15th

Maryland DNR Water Quality Monitoring Programs

Intensive / Shallow Water Monitoring Component

Continuous *In Situ* Monitoring

- **39 Monitors in 2010**
- **Includes 1 Vertical Profiler and 1 buoy with associated bottom monitors.**
- **Data collected every 15 minutes**
- **Parameters: D.O., Turbidity, Chlorophyll W.Temp, Salinity, pH, Depth**
- **Calibration Data Every 2 weeks**

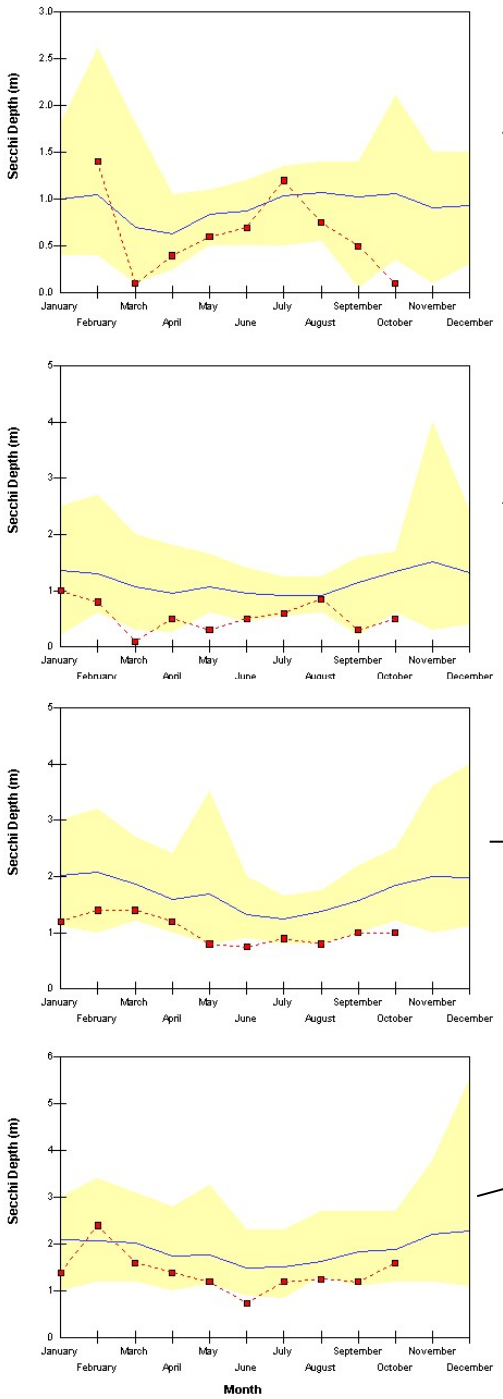
Water Quality Mapping

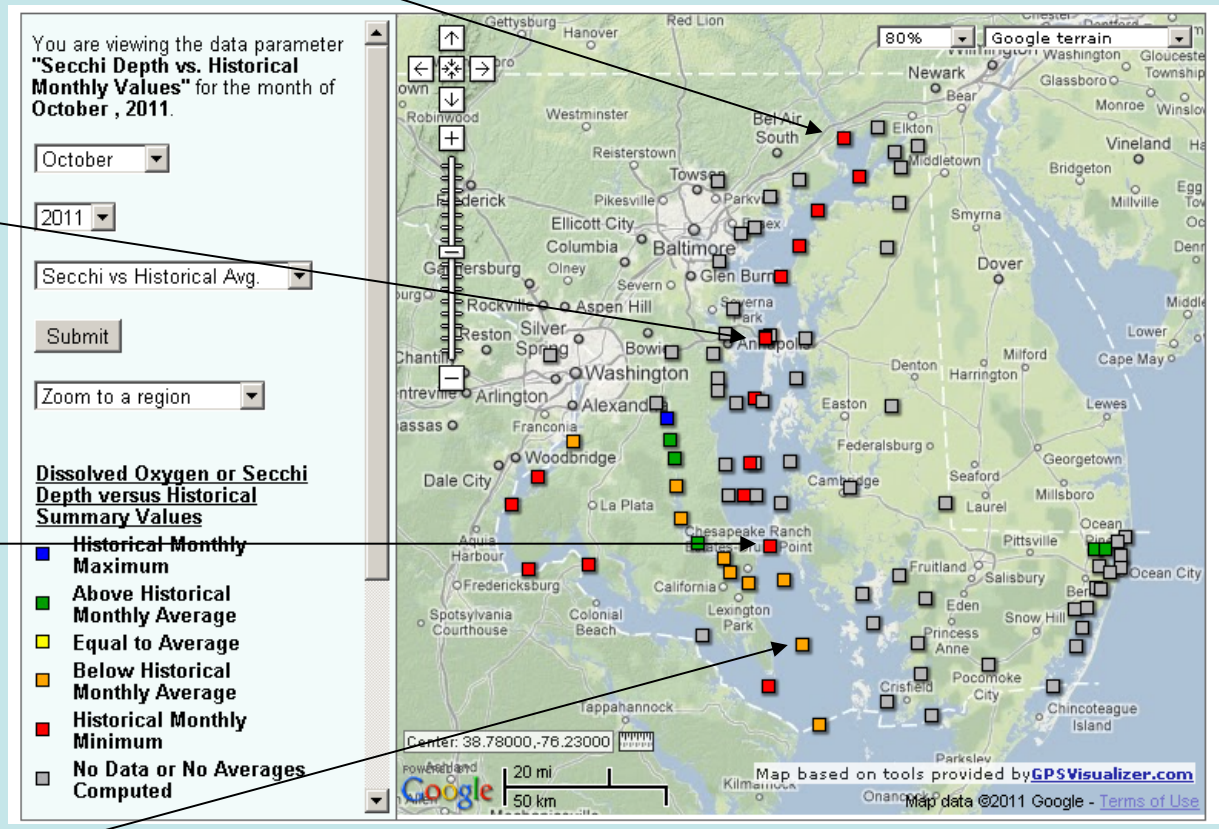
- **6 Monthly cruises Apr.-Oct in 2010 over large areas.**
- **Data collected every 4 seconds in transit**
- **Parameters: D.O., Turbidity, Chlorophyll W.Temp, Salinity, pH, Water Depth**
- **Calibration Data at ~5 Sites each Cruise**

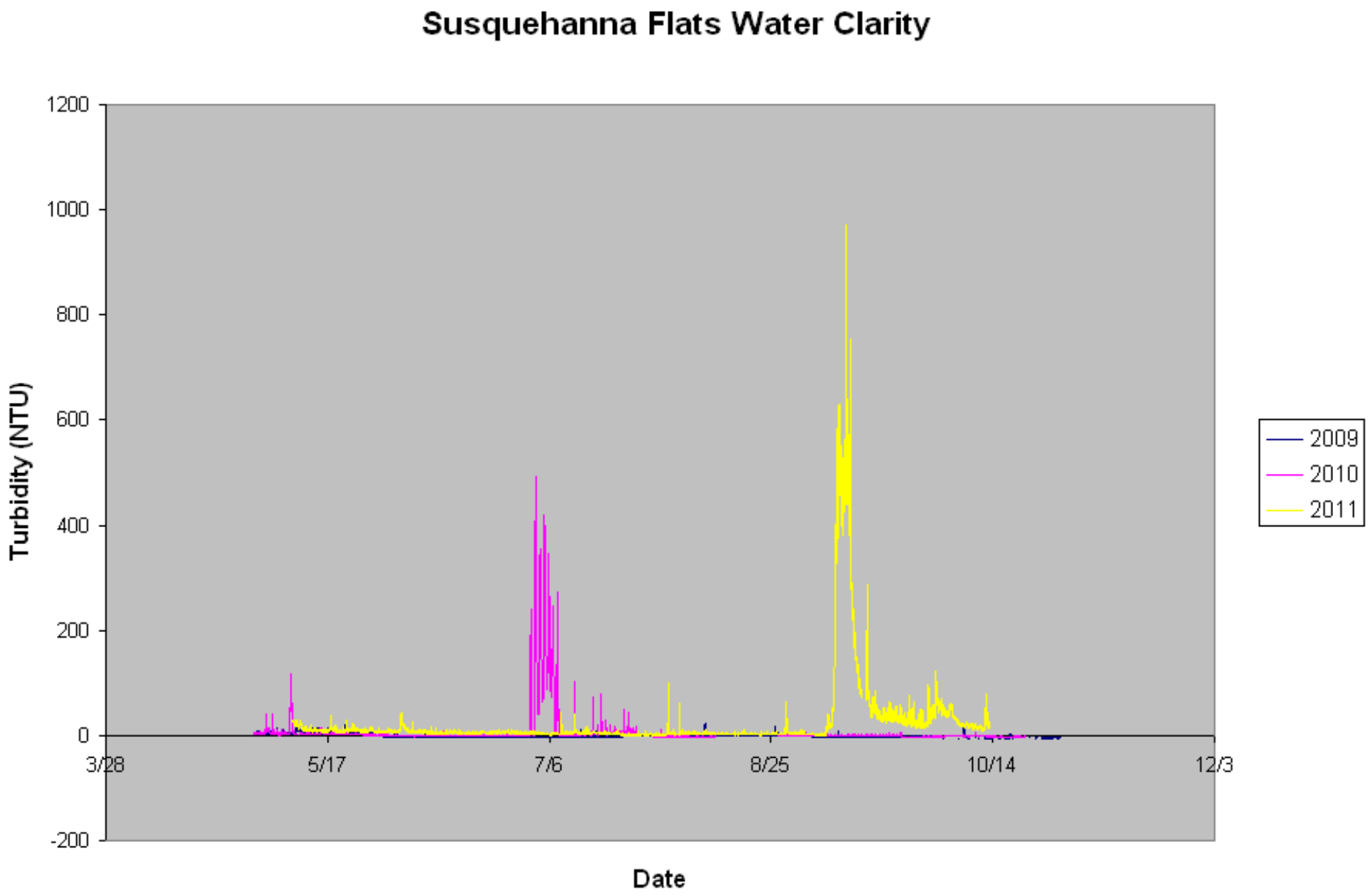
Long-Term Fixed Station Monitoring

- **Monthly/Twice Monthly cruises year round**
- **Collected Since 1985**
- **80+ Stations**
- **Full suite of parameters and depth profiles**

Record Low Water Clarity Throughout Year

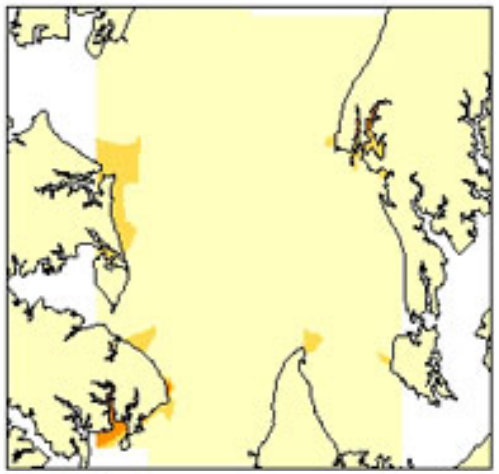




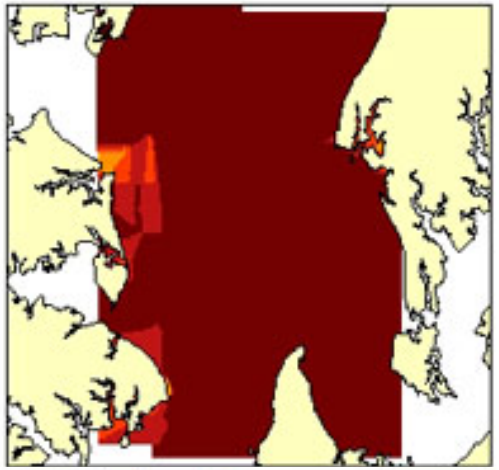

Susquehanna Flats Water Clarity
Turbidity (NTU)
1200
1000
800
600
400
200
0
-200
3/28
5/17
7/6
8/25
10/14
12/3
Date
2009
2010
2011

Water Quality Mapping
Turbidity

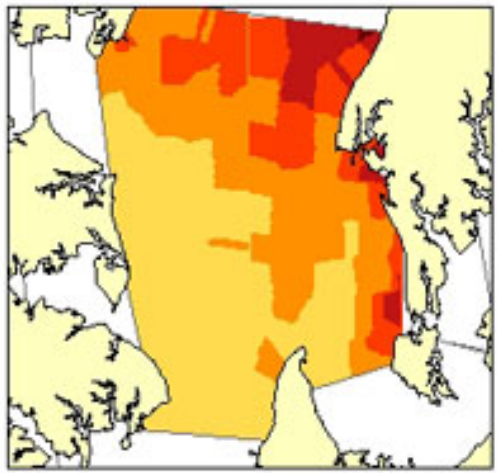
Chesapeake Bay
Segment 3
(North of Bay Bridge to Above Patapsco River)



8/17/2011



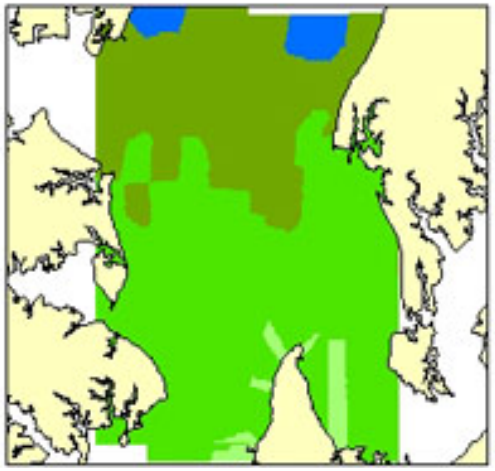
9/14/2011



10/3/2011

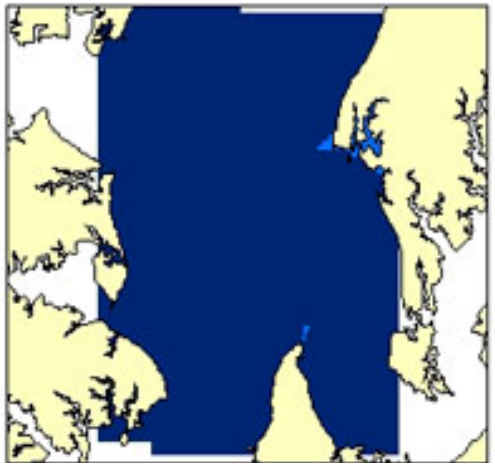
Water Quality Mapping
Salinity

Chesapeake Bay
Segment 3
(North of Bay Bridge to Above Patapsco River)



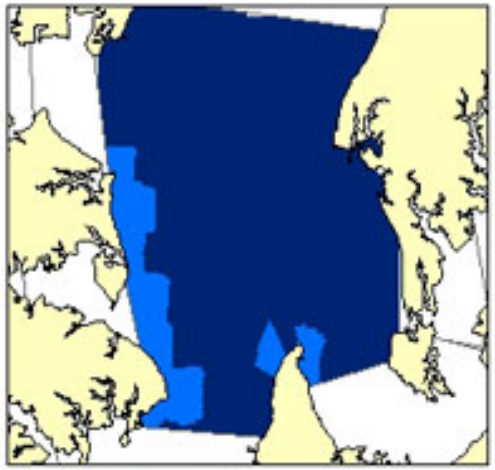
Salinity (ppt)
0 - 2.5
2.5 - 5
5 - 7.5
7.5 - 10
10 - 12.5
12.5 - 15
15 - 17.5
17.5 - 20

8/17/2011



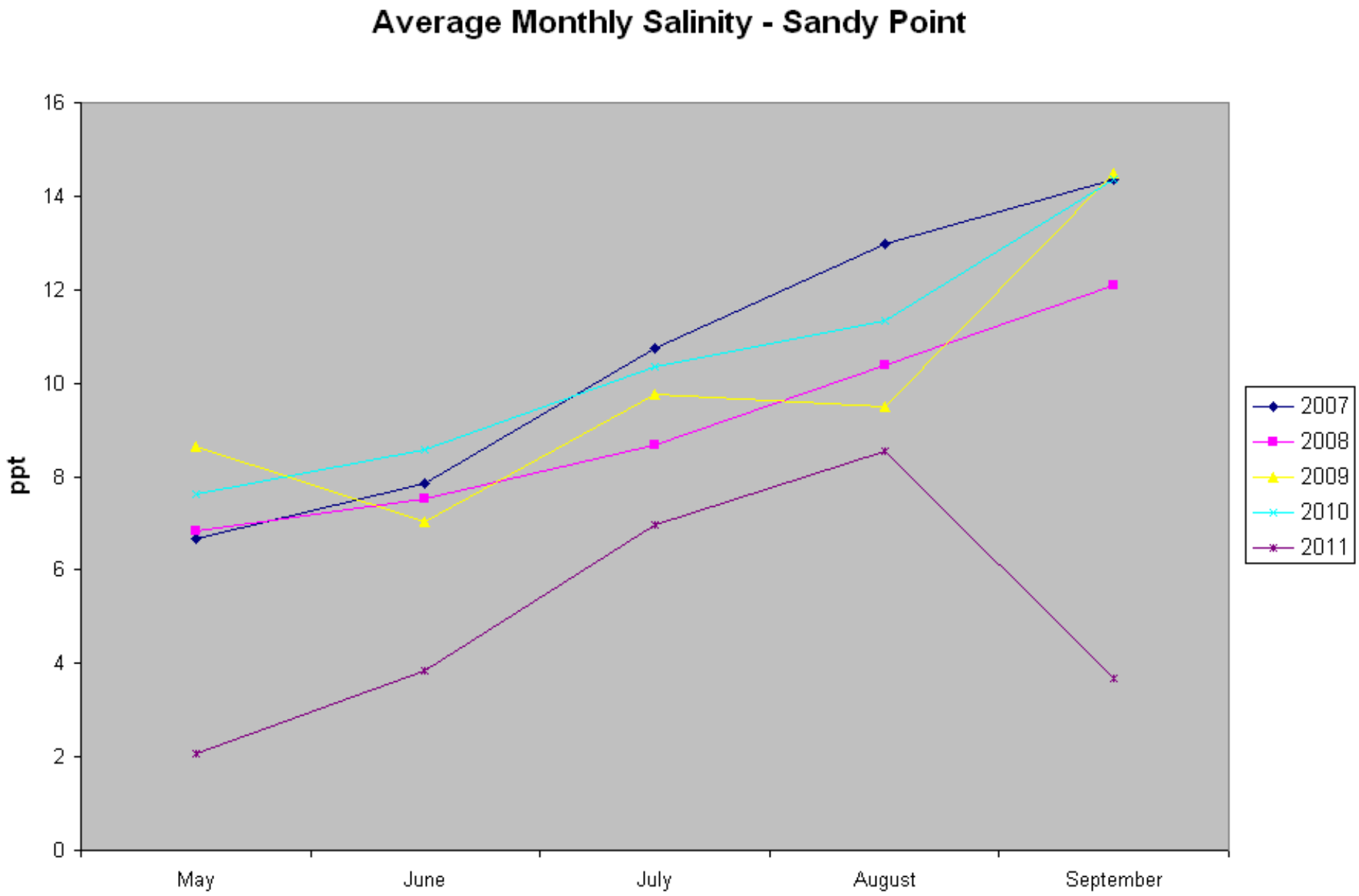
Salinity (ppt)
0 - 2.5
2.5 - 5
5 - 7.5
7.5 - 10
10 - 12.5
12.5 - 15
15 - 17.5
17.5 - 20

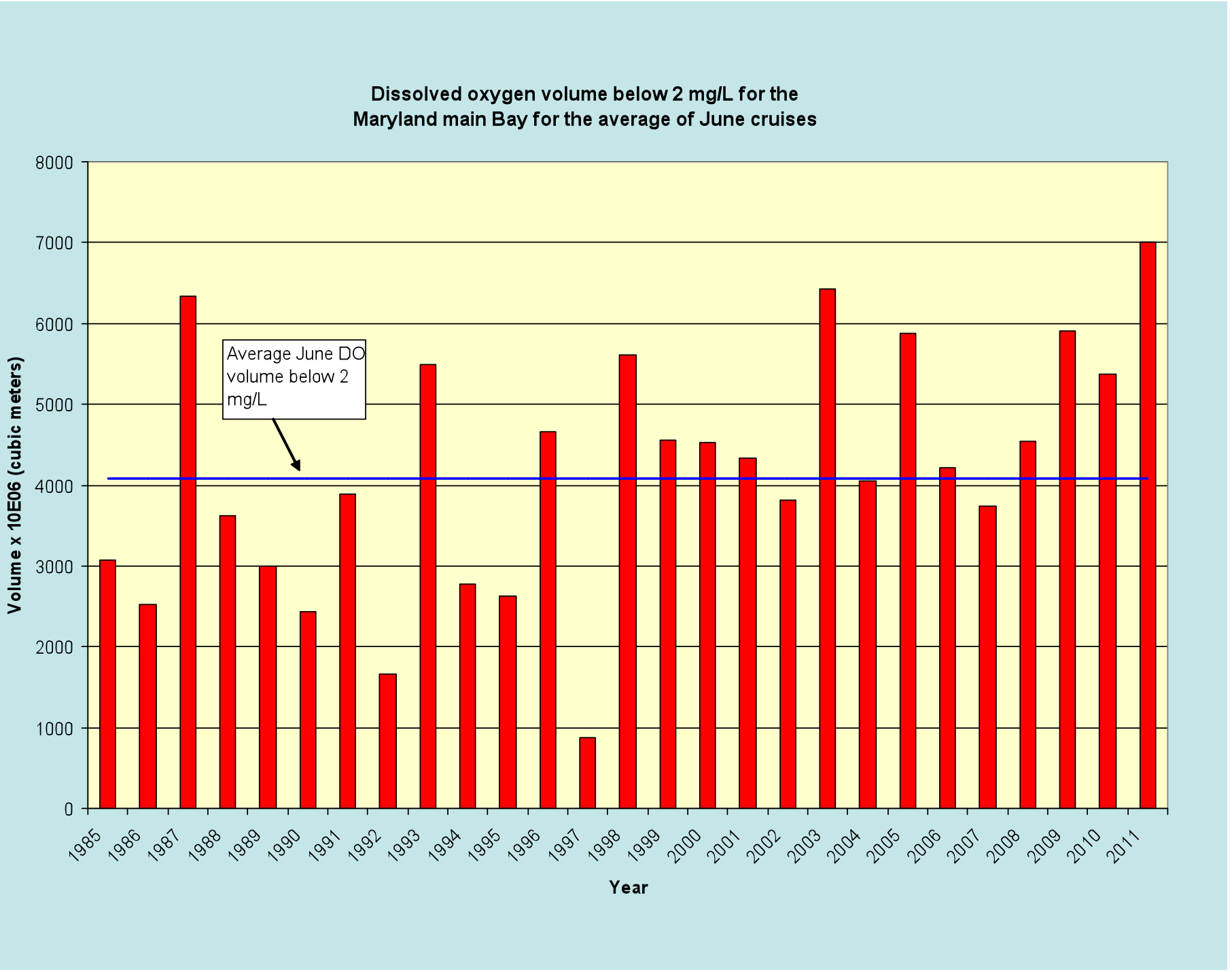
9/14/2011



Salinity (ppt)
0 - 2.5
2.5 - 5
5 - 7.5
7.5 - 10
10 - 12.5
12.5 - 15
15 - 17.5
17.5 - 20

10/3/2011

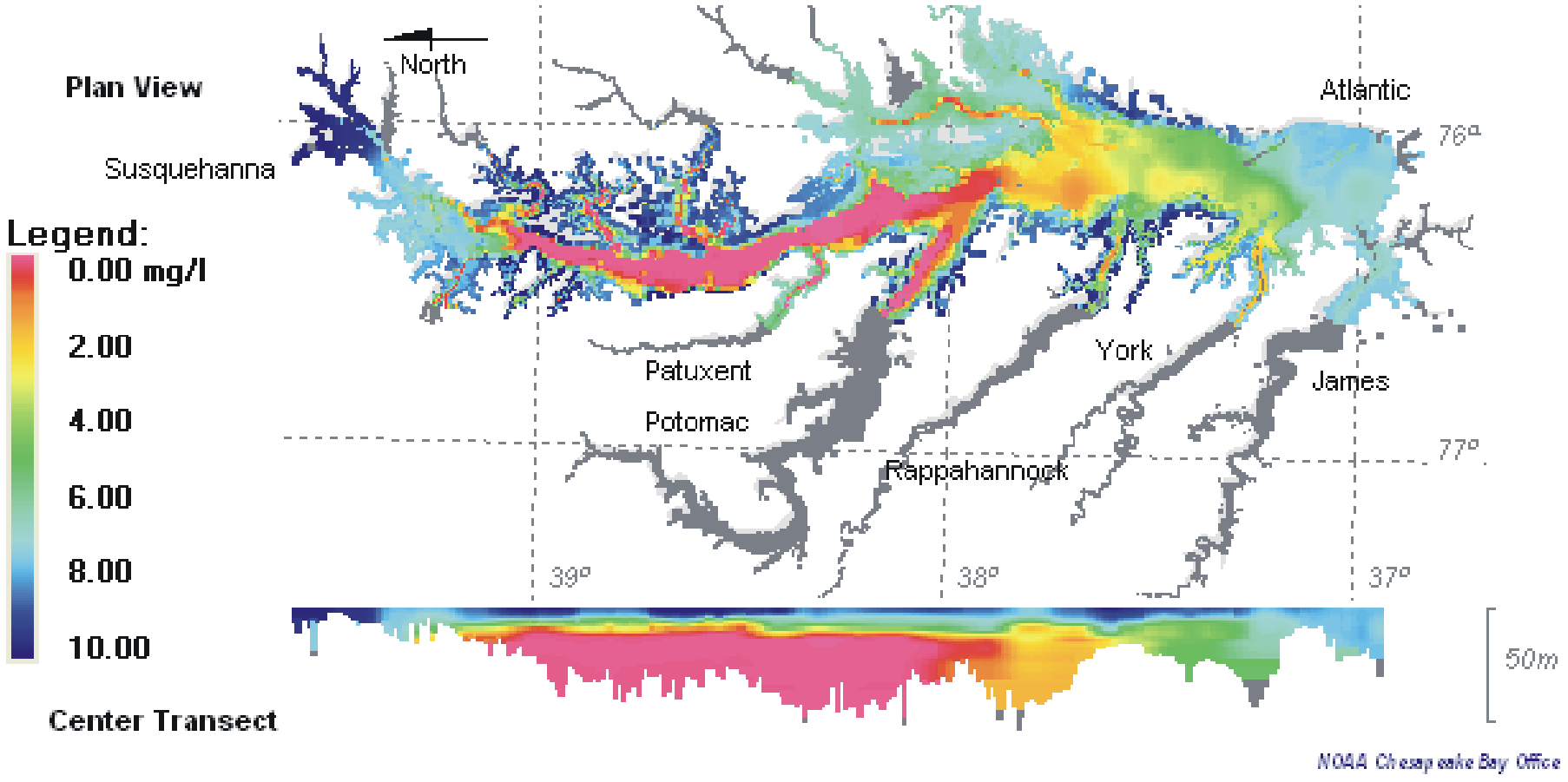

Average Monthly Salinity - Sandy Point
ppt
16
14
12
10
8
6
4
2
0
May
June
July
August
September
2007
2008
2009
2010
2011

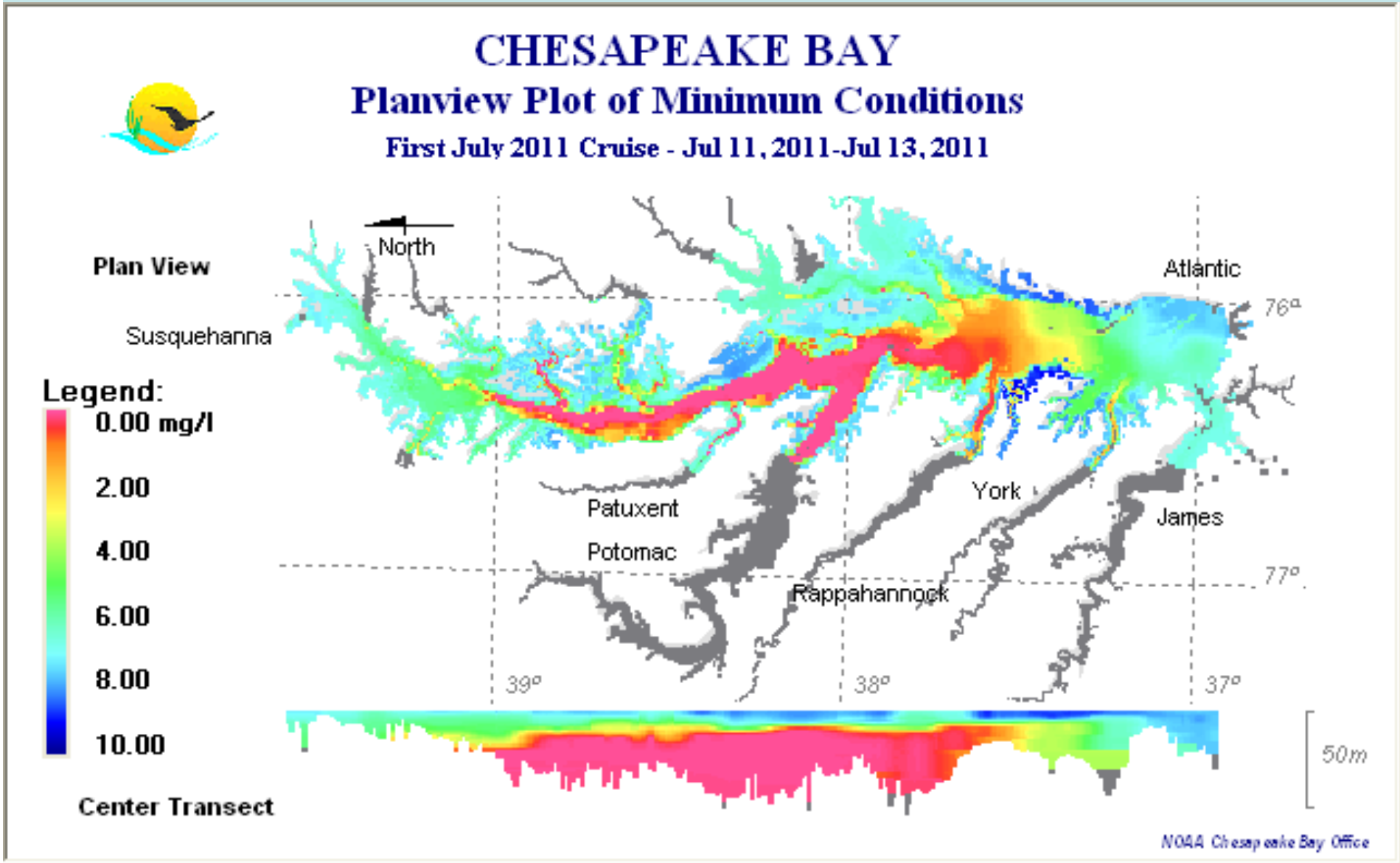

Dissolved oxygen volume below 2 mg/L for the
Maryland main Bay for the average of June cruises
Volume x 10E06 (cubic meters)
8000
7000
6000
5000
4000
3000
2000
1000
0
Average June DO volume below 2 mg/L
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Year

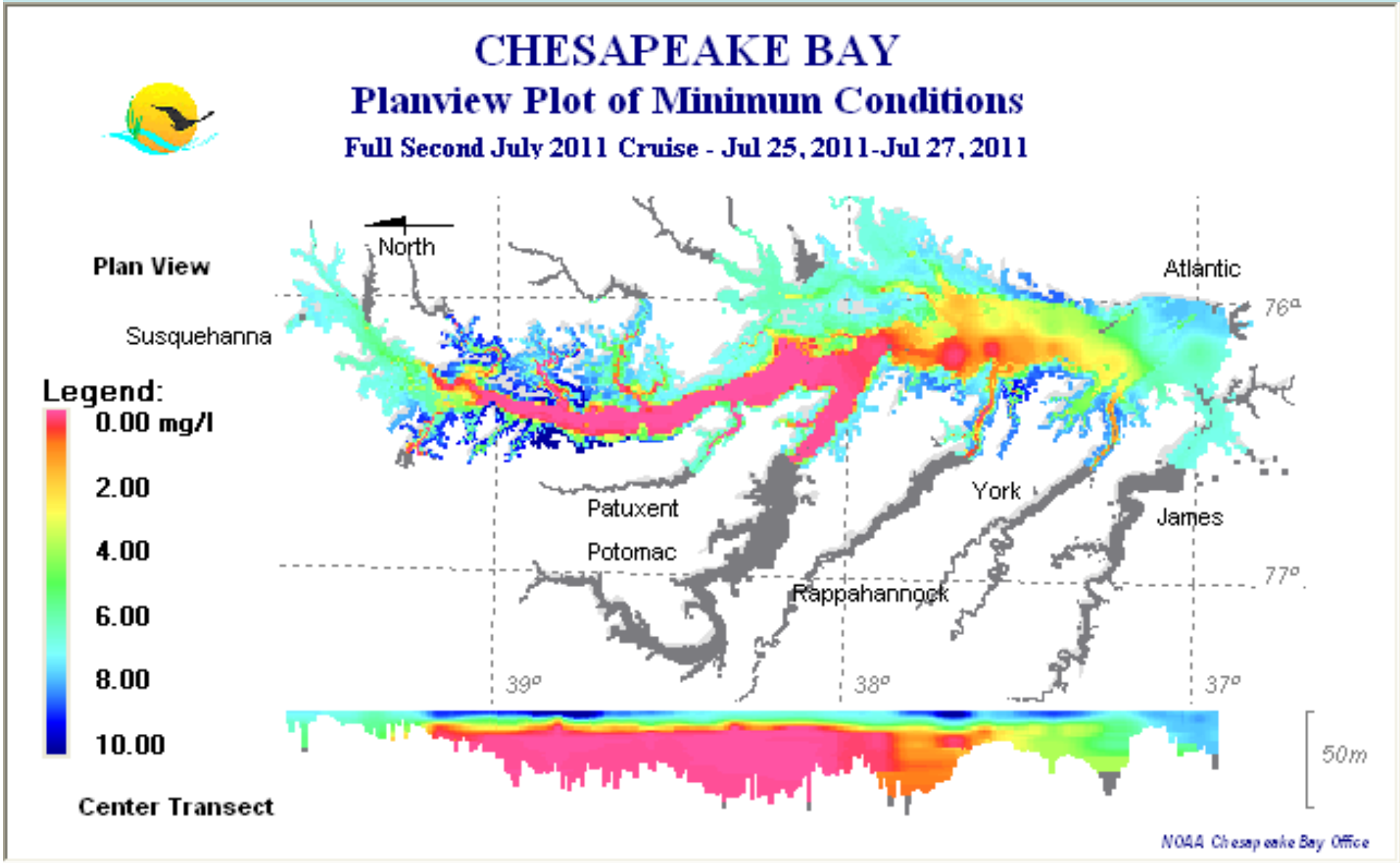
CHESAPEAKE BAY

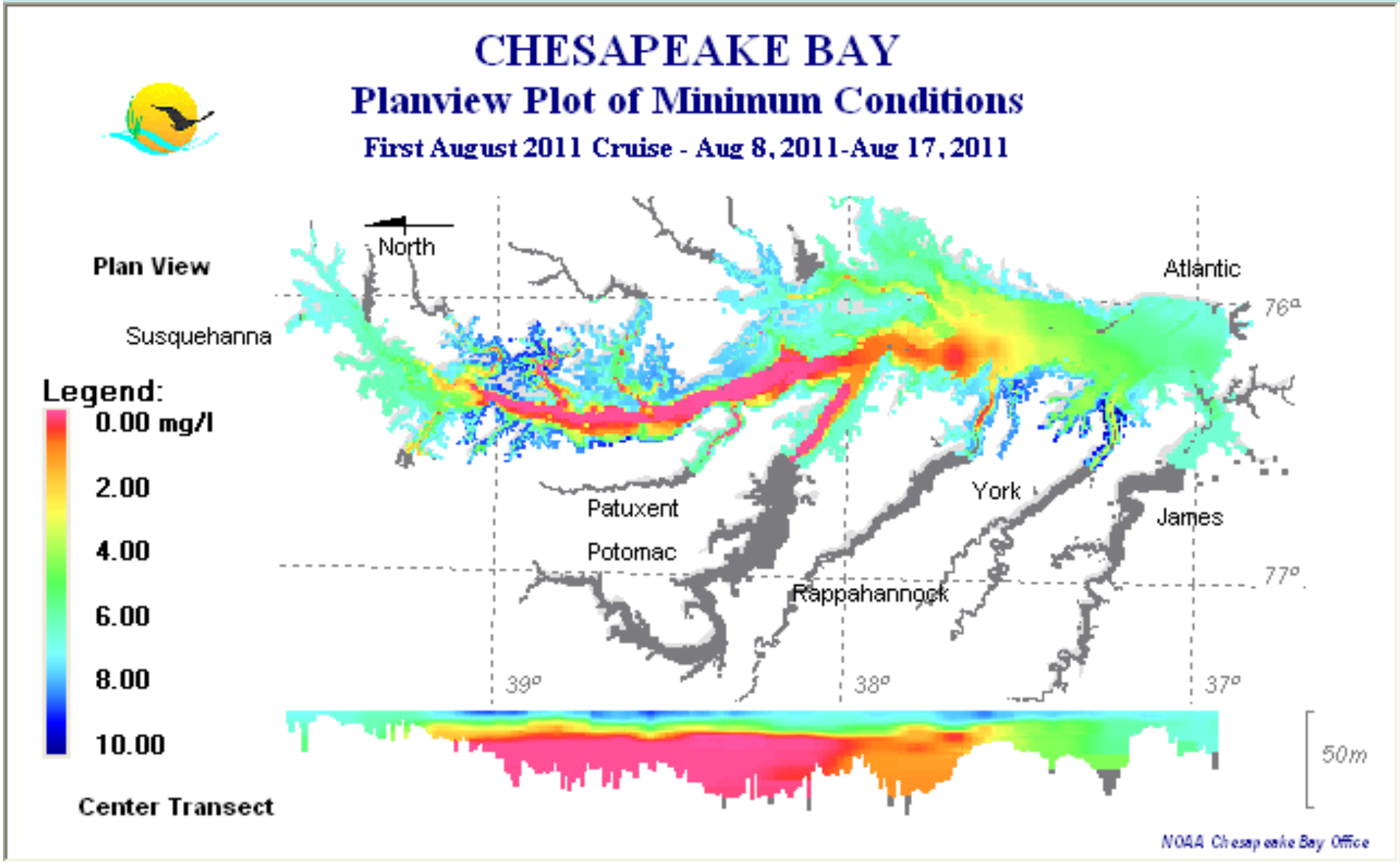
Planview Plot of Minimum Conditions

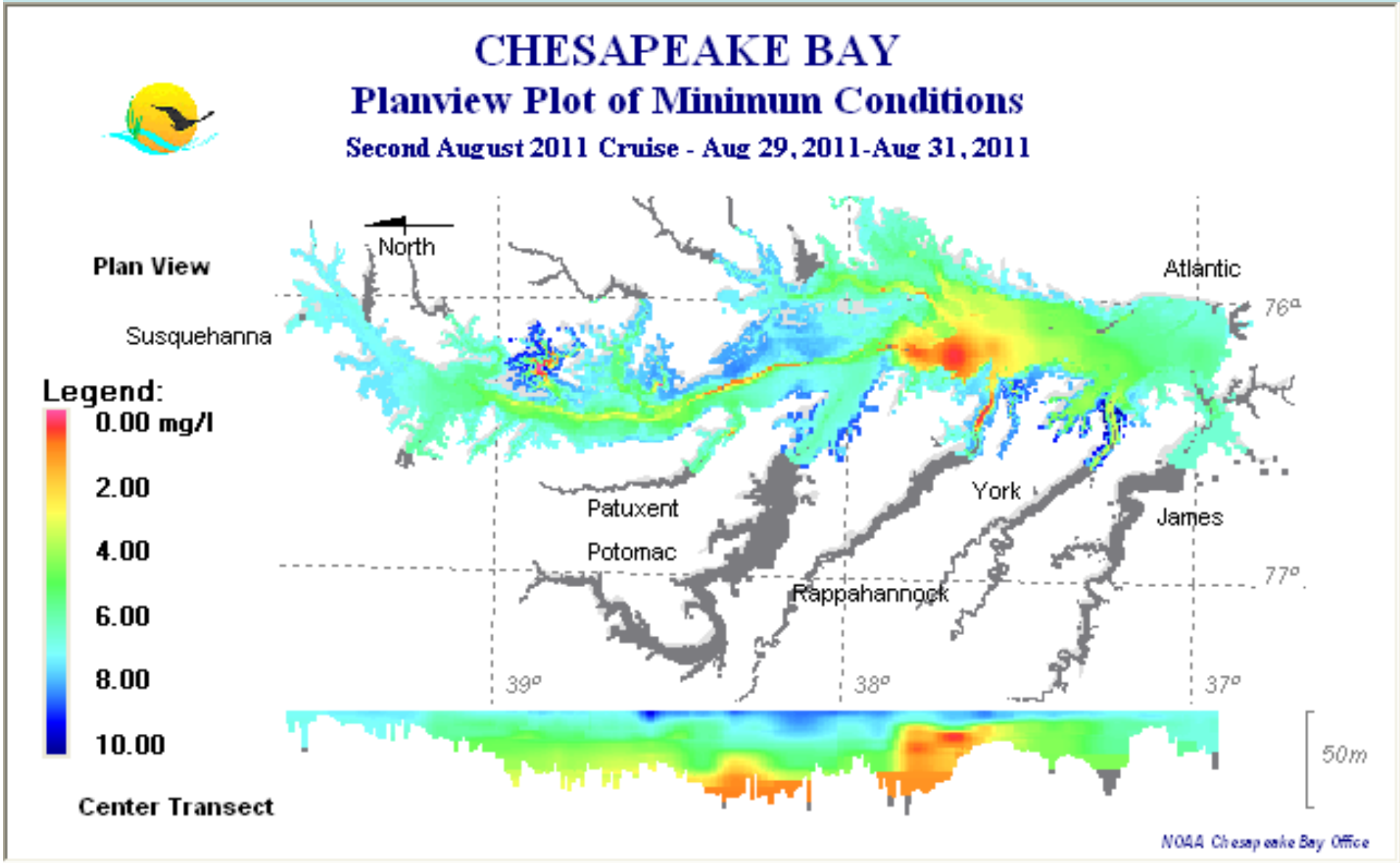
First June 2011 Cruise - Jun 6, 2011-Jun 8, 2011

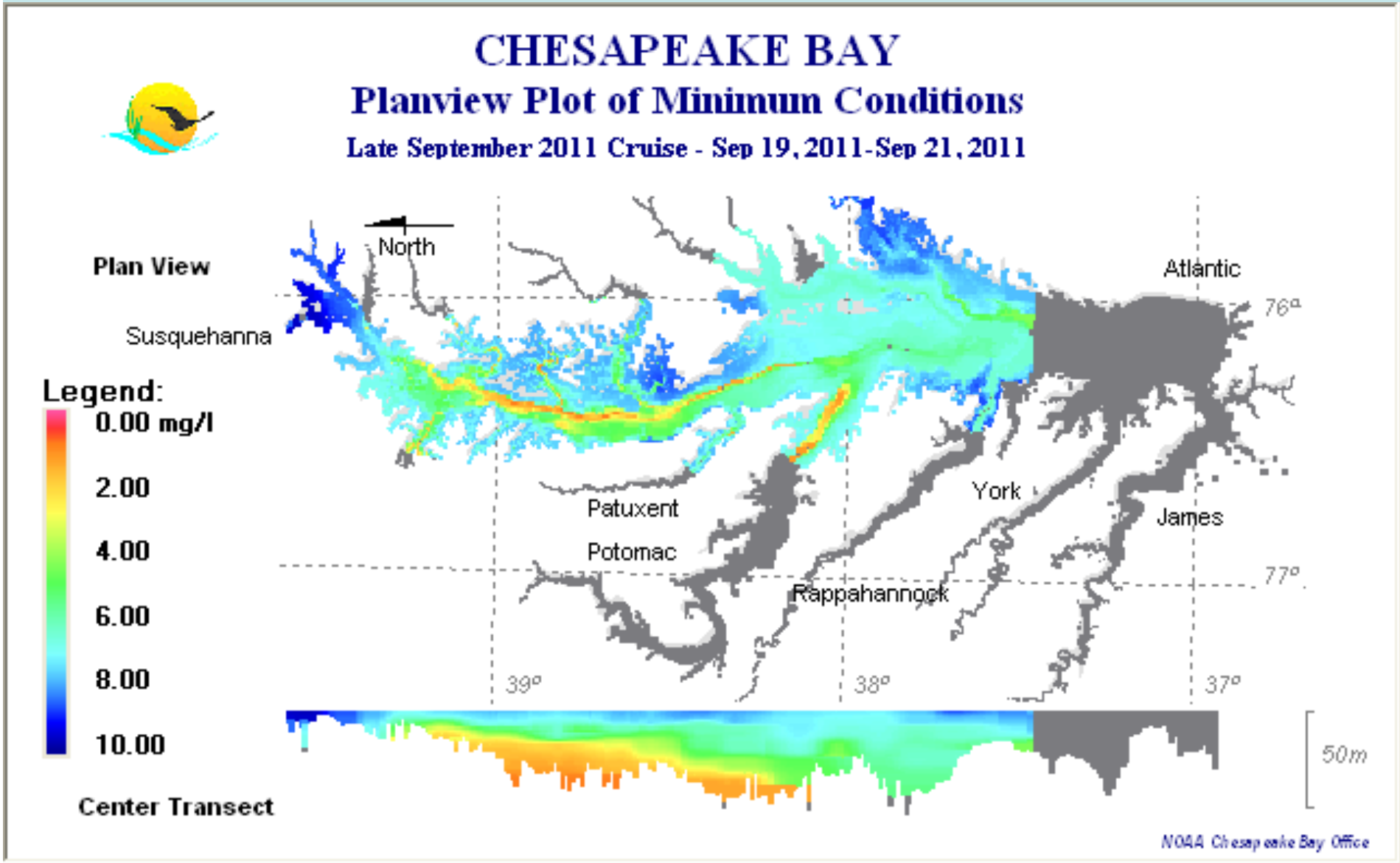


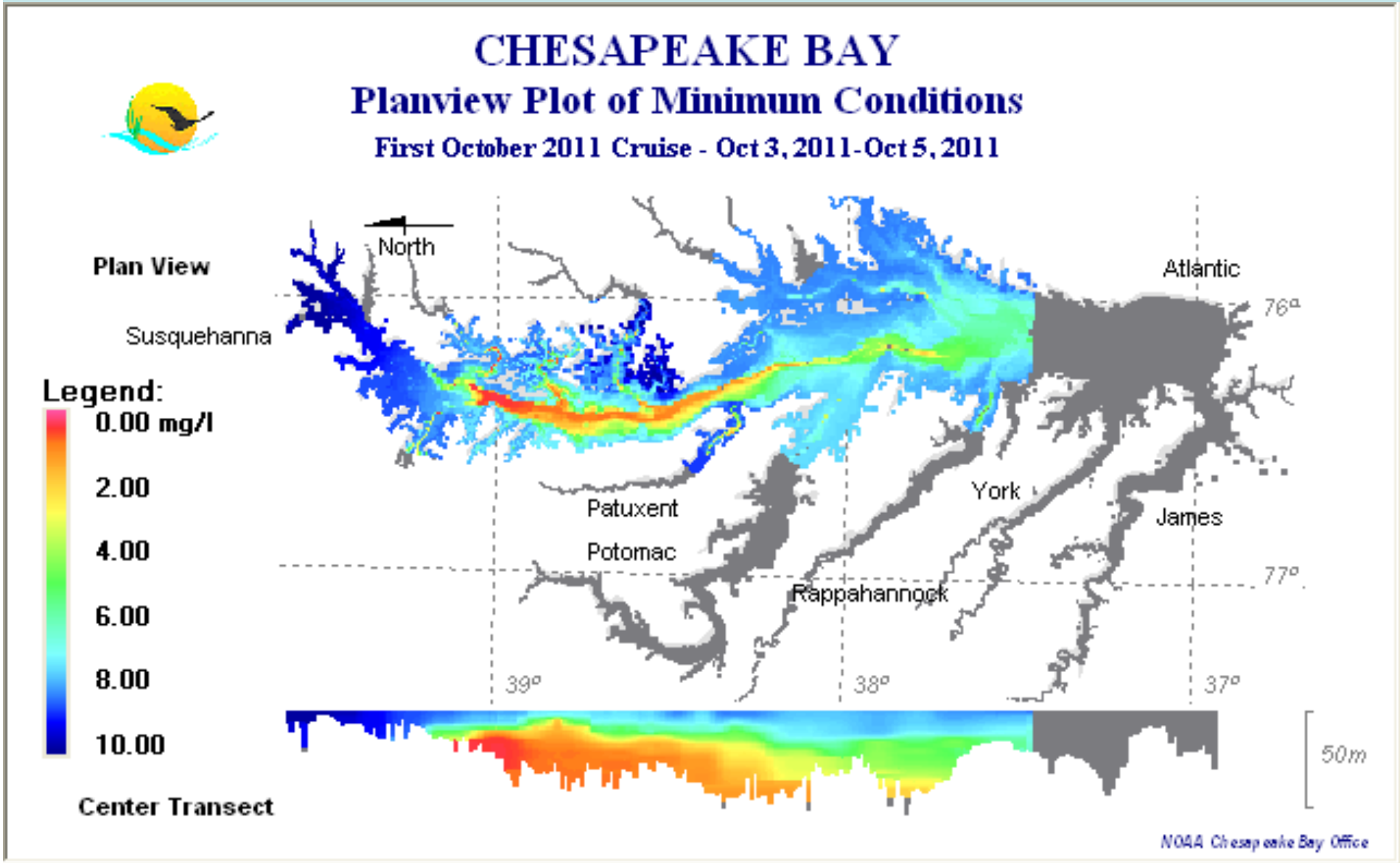

CHESAPEAKE BAY
Planview Plot of Minimum Conditions
First July 2011 Cruise - Jul 11, 2011-Jul 13, 2011
Plan View
North
Susquehanna
Patuxent
Potomac
Rappahannock
York
James
Atlantic
76°
77°
39°
38°
37°
Legend:
0.00 mg/l
2.00
4.00
6.00
8.00
10.00
Center Transect
50m
NOAA Chesapeake Bay Office


CHESAPEAKE BAY
Planview Plot of Minimum Conditions
Full Second July 2011 Cruise - Jul 25, 2011-Jul 27, 2011
Plan View
North
Susquehanna
Atlantic
76°
Legend:
0.00 mg/l
2.00
4.00
6.00
8.00
10.00
Patuxent
Potomac
Rappahannock
York
James
77°
39°
38°
37°
50m
Center Transect
NOAA Chesapeake Bay Office


CHESAPEAKE BAY
Planview Plot of Minimum Conditions
First August 2011 Cruise - Aug 8, 2011-Aug 17, 2011
Plan View
North
Susquehanna
Patuxent
Potomac
Rappahannock
York
James
Atlantic
76°
77°
39°
38°
37°
Legend:
0.00 mg/l
2.00
4.00
6.00
8.00
10.00
Center Transect
50m
NOAA Chesapeake Bay Office

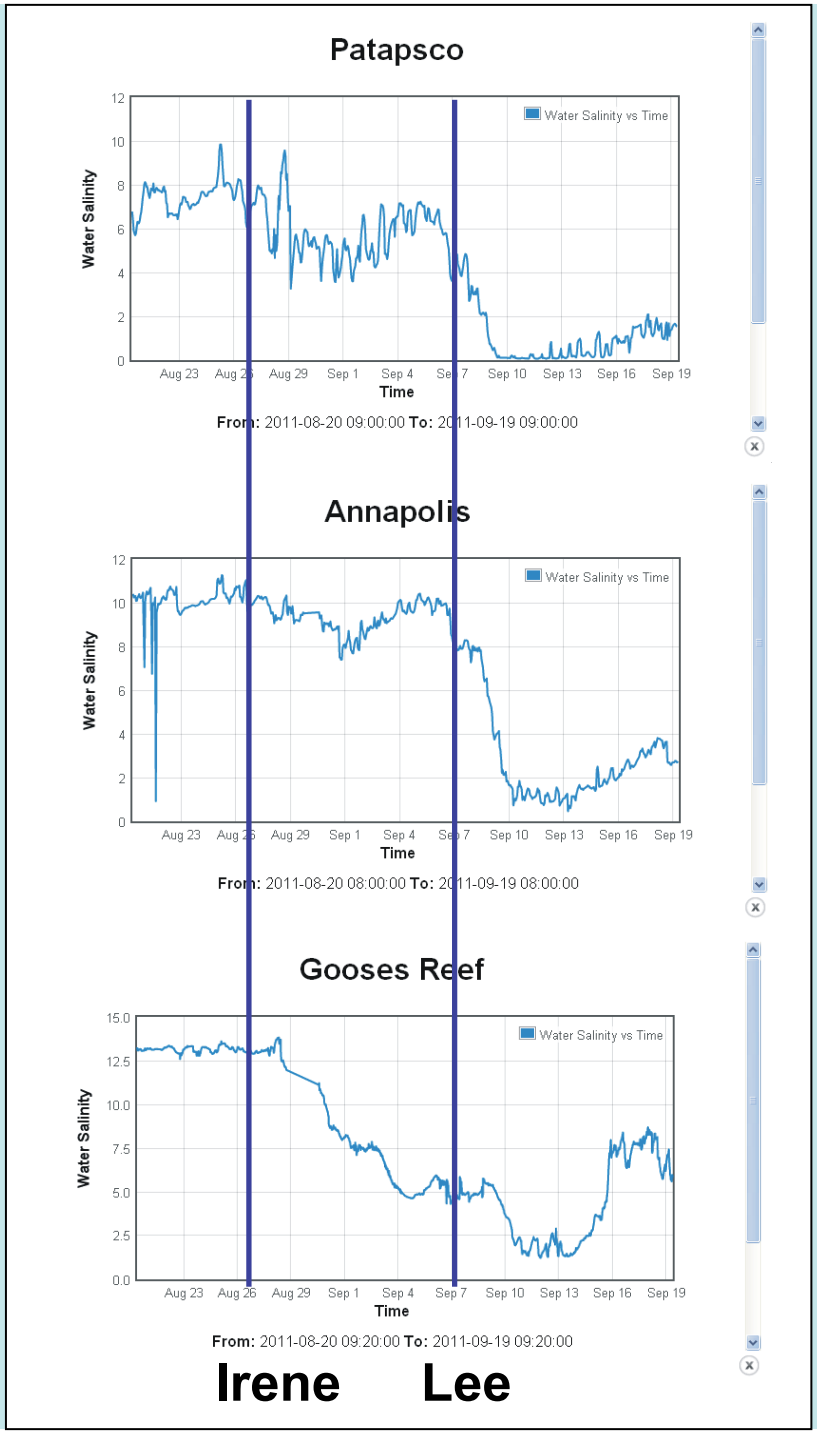

CHESAPEAKE BAY
Planview Plot of Minimum Conditions
Second August 2011 Cruise - Aug 29, 2011-Aug 31, 2011
Plan View
North
Susquehanna
Atlantic
76°
Patuxent
Potomac
Rappahannock
York
James
77°
39°
38°
37°
Legend:
0.00 mg/l
2.00
4.00
6.00
8.00
10.00
Center Transect
50m
NOAA Chesapeake Bay Office


CHESAPEAKE BAY
Planview Plot of Minimum Conditions
Late September 2011 Cruise - Sep 19, 2011-Sep 21, 2011
Plan View
North
Susquehanna
Atlantic
76°
Patuxent
Potomac
Rappahannock
York
James
77°
39°
38°
37°
Legend:
0.00 mg/l
2.00
4.00
6.00
8.00
10.00
Center Transect
50m
NOAA Chesapeake Bay Office


CHESAPEAKE BAY
Planview Plot of Minimum Conditions
First October 2011 Cruise - Oct 3, 2011-Oct 5, 2011
Plan View
North
Susquehanna
Patuxent
Potomac
Rappahannock
York
James
Atlantic
76°
77°
39°
38°
37°
Legend:
0.00 mg/l
2.00
4.00
6.00
8.00
10.00
Center Transect
50m
NOAA Chesapeake Bay Office

Salinity from NOAA Buoys

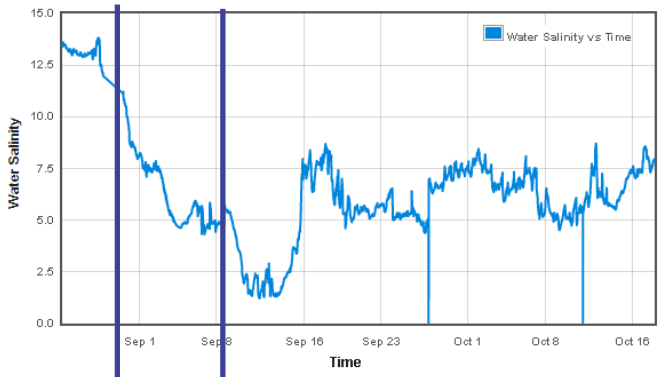
(www.buoybay.org)



NOAA/DNR
Dominion Gooses Reef Buoy

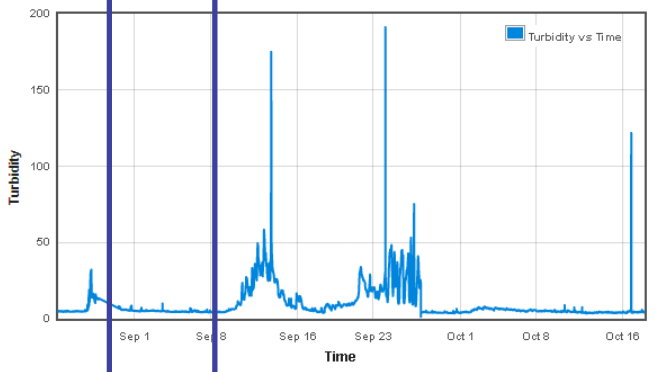
(www.buoybay.org)

Irene **Lee** Gooses Reef



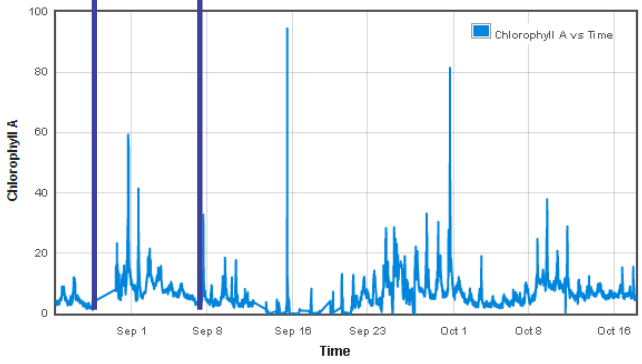
From: 2011-08-25 00:00 **To:** 2011-10-17 23:59

Salinity



From: 2011-08-25 00:00 **To:** 2011-10-17 23:59

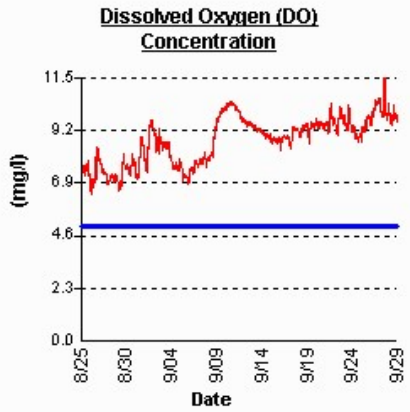
Turbidity

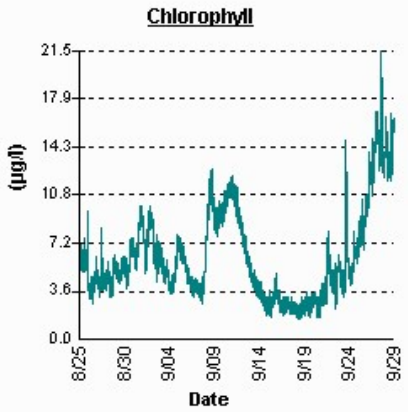


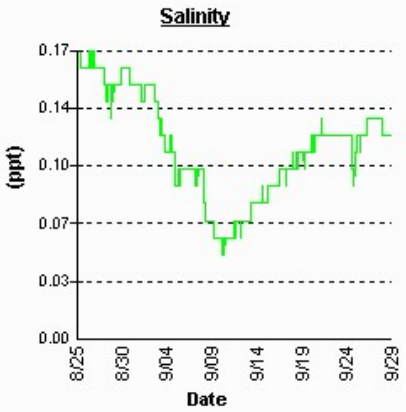
From: 2011-08-25 00:00 **To:** 2011-10-17 23:59

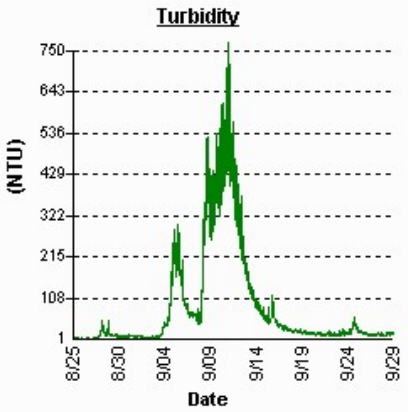
Algae

Havre de Grace

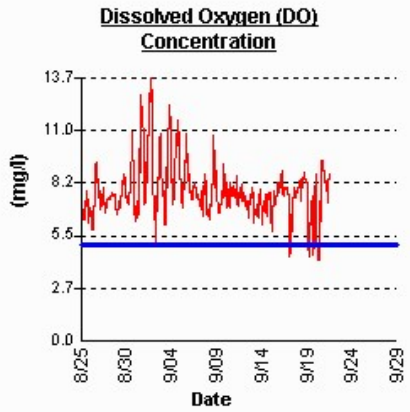


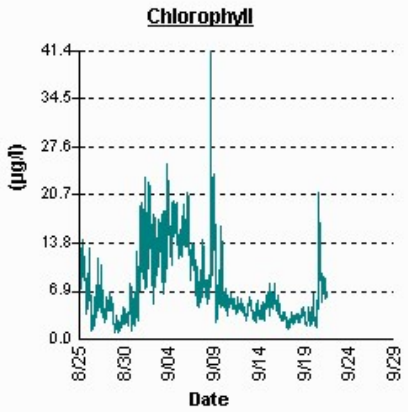


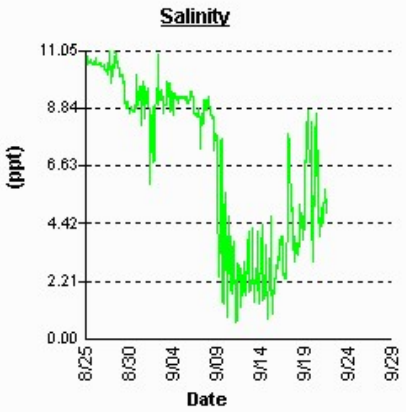


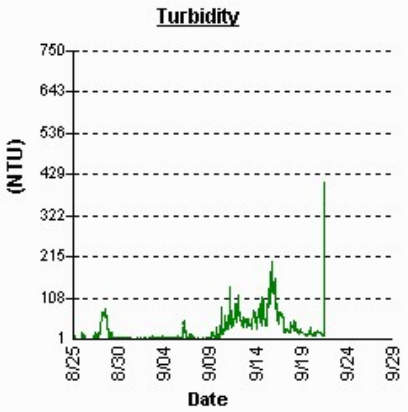


Love Point

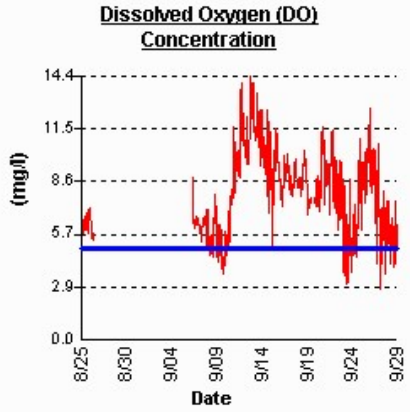


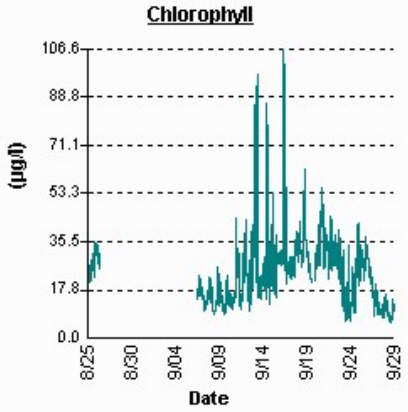


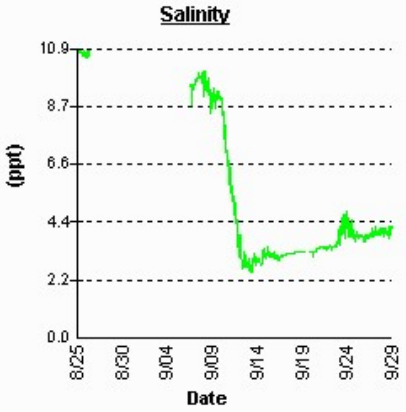


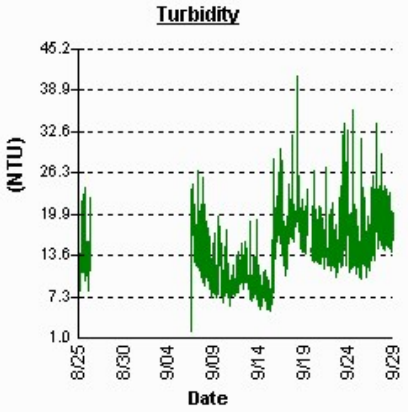


West River









Summary

- Elevated turbidity in Susquehanna River from September 7th, 2011 to present
- Dead zone temporarily eliminated by Hurricane Irene
- Anoxic conditions reset after Tropical Storm Lee
- This muddy water contained large amounts of nutrients capable of fueling large algal blooms which could rob the waters of dissolved oxygen when the algae would die and settle to the bottom to decompose.
- This large discolored freshwater plume could have major impacts to the Bay's fish, shellfish and underwater grass communities by smothering habitat, blocking light and decreasing salinity levels for an extended time.

For more current water quality conditions of Maryland's tidal waters,

- *visit us on the web: eyesonthebay.net*
- *On Twitter: @eyesonthebay*
- *On Facebook: Eyes on the bay*