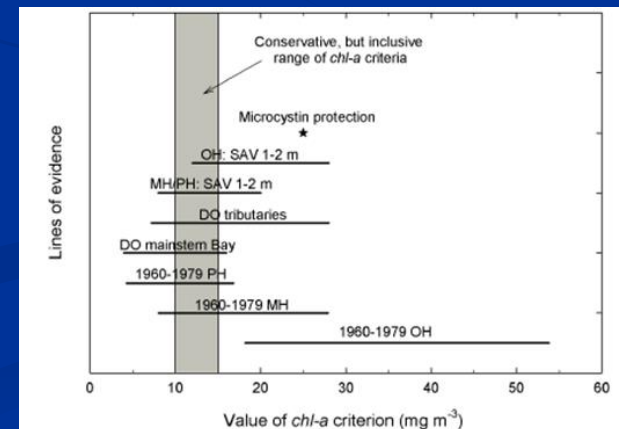


Chesapeake Bay Water Quality Criteria and their Assessment: The Monitoring and Assessment Framework Supporting the Chesapeake Bay TMDL

Peter Tango, USGS@CBPO
ELPR Symposium
William and Mary School of Law
March 29, 2015



Law: Clean Water Act (1972)

- The Clean Water Act (CWA) establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating **quality standards** for surface waters.



To understand the importance of criteria
we need to ask:

What are Water Quality Standards?

Standards are the foundation of the water quality-based control program mandated by the Clean Water Act.

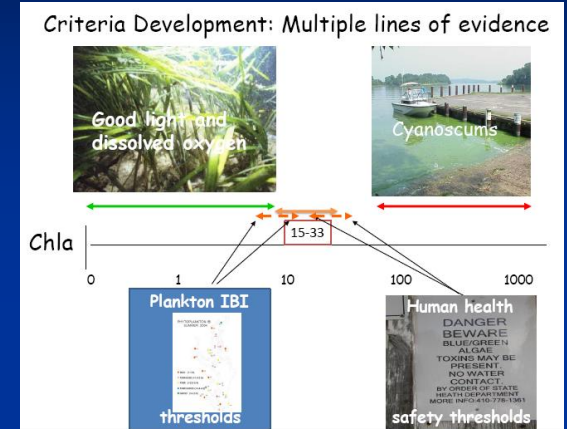
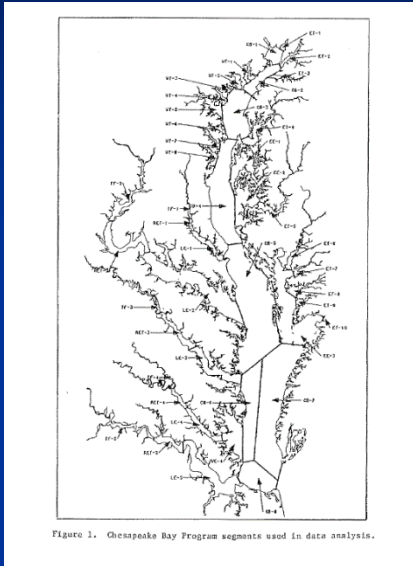
Water quality standards (WQS)

- legally binding
- describe the desired ambient condition (i.e., level of protection) for a waterbody and
- consist of the following three principle elements:
 - designated uses
 - criteria
 - antidegradation requirements

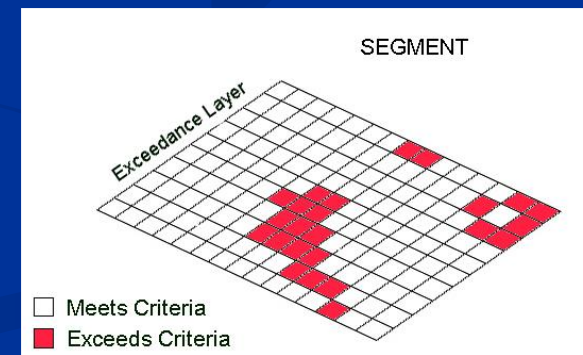
Criteria

- Criteria: specify the amounts of various pollutants, in either numeric or narrative form, that may be present in those waters without impairing the designated uses

Monitoring and Assessment Framework Supporting the Chesapeake Bay TMDL

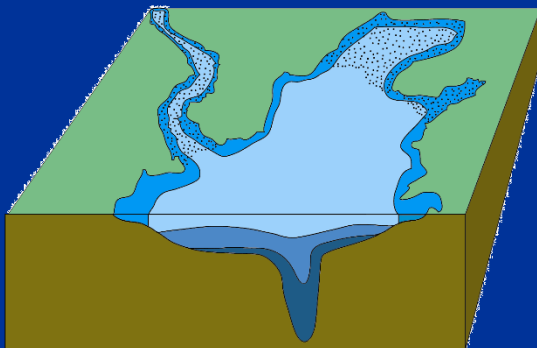


Water Quality Criteria Development



Water Quality Criteria Assessment

Management Segmentation



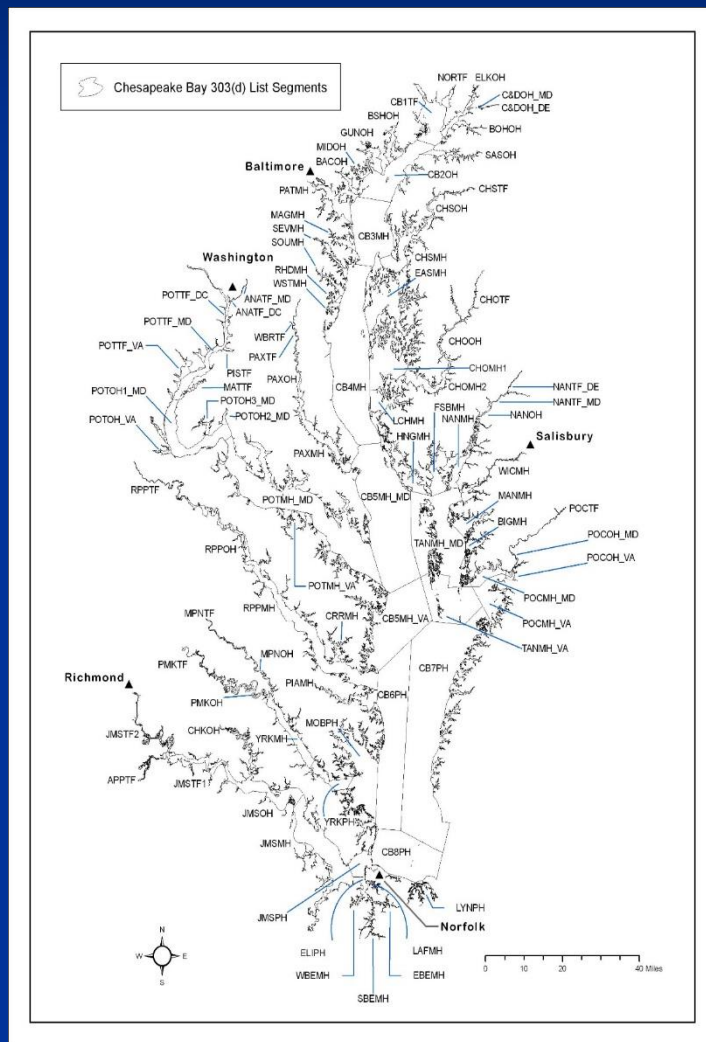
Designated Uses

Outline

Monitoring and Assessment Framework Supporting the Chesapeake Bay TMDL

- Chesapeake Bay Management Segmentation
- Designated Use Development
- Water Quality Criteria Development
- Water Quality Criteria Assessment

Chesapeake Bay Segmentation Scheme: Bay Segments

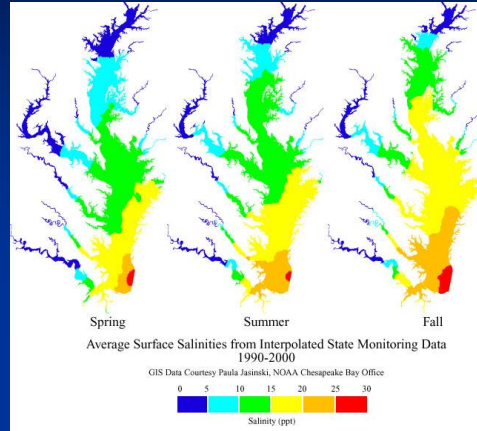


Chesapeake Bay Segmentation Scheme

TABLE 2. WATER AND SEDIMENT QUALITY DATA BASES

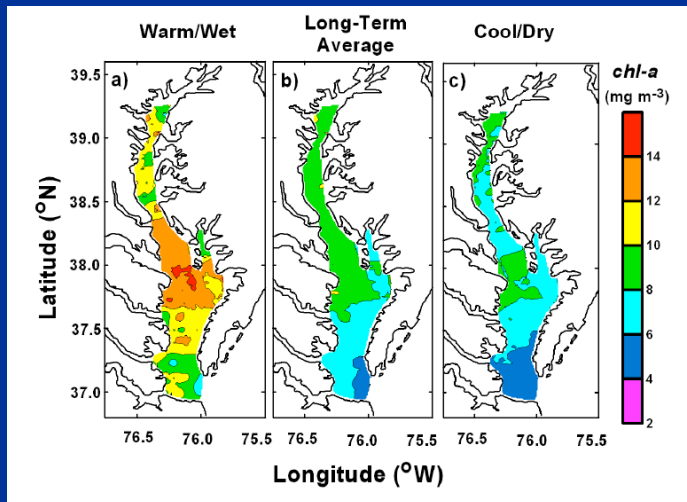
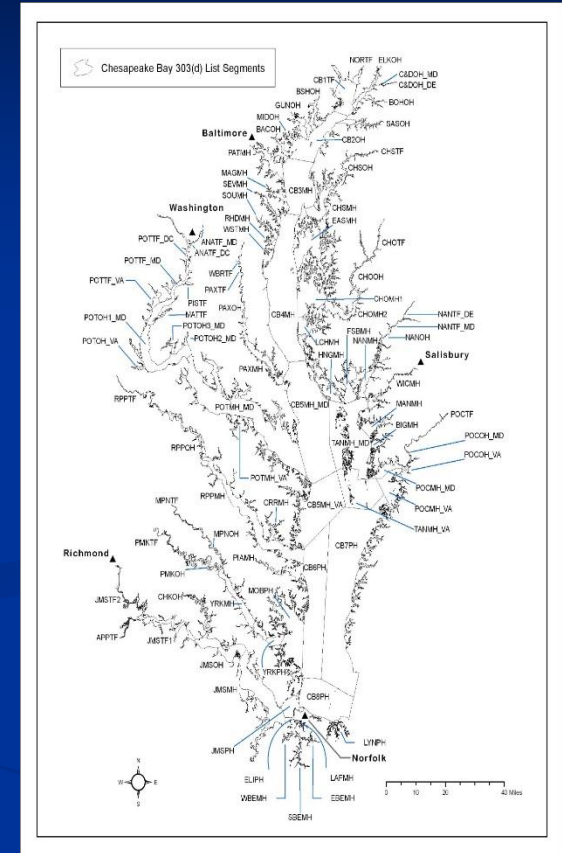
Physical Variables/Nutrients			
Agency	Temporal Coverage	Data Base Description	Parameters
Chesapeake Bay Institute	1949-1980	Bay, river, nutrient, AESOP, Special, Model, Whaley-Carpenter, Pro-Con	Temperature, salinity, D.O., pH, Chl-a, nutrients
Virginia Institute of Marine Science	1970-1980	Slackwater	Temp., sal., D.O., BOD, Secchi, Chl-a, nutrients
Maryland Office of Environmental Programs	1966-1972 1973-1980	STORET/MD 106	Temp., sal., D.O., Temp., D.O., BOD, pH, Chl-a, nutrients
Virginia State Water Control Board	1964, 1965-1980	STORET/VA 106	Temp., D.O., BOD, pH, turbidity, nutrients

Historical data sets
1949-1980s
+
Contemporary data
1984-present



Boundary
Characterization

- Biological
 - plankton, fish
- Chemical
 - Salinity
 - Turbidity max
 - D.O.
 - Nutrients
- Hydrodynamics
- Bathymetric
- Geographical



Year	Segments
1983	78
1997	89
2003	104
2008	92 (TMDL)
	USEPA CBPO 2008

Outline

Monitoring Applications supporting the Chesapeake Bay TMDL

- Chesapeake Bay Management Segmentation
- Designated Use Development
- Water Quality Criteria Development
- Water Quality Criteria Assessment

Designated Uses under the Clean Water Act

- Protection and propagation of fish, shellfish, and wildlife
- Recreation
- Public water supplies
- Agriculture
- Industry
- Navigation
- Coral reef preservation
- Marinas
- Groundwater recharge
- Aquifer protection
- Hydroelectric power

Designated Uses under the Clean Water Act

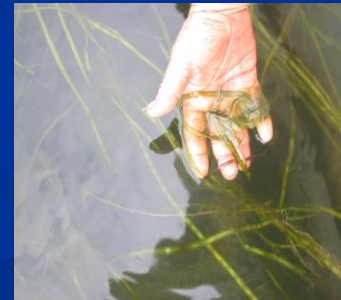
- Protection and propagation of fish, shellfish, and wildlife
- Recreation

Designated Uses under the Clean Water Act

- Protection and propagation of fish, shellfish, and wildlife

- coldwater fish, warmwater fish, and shellfish

- The use may also include protection of aquatic flora



- Recreation

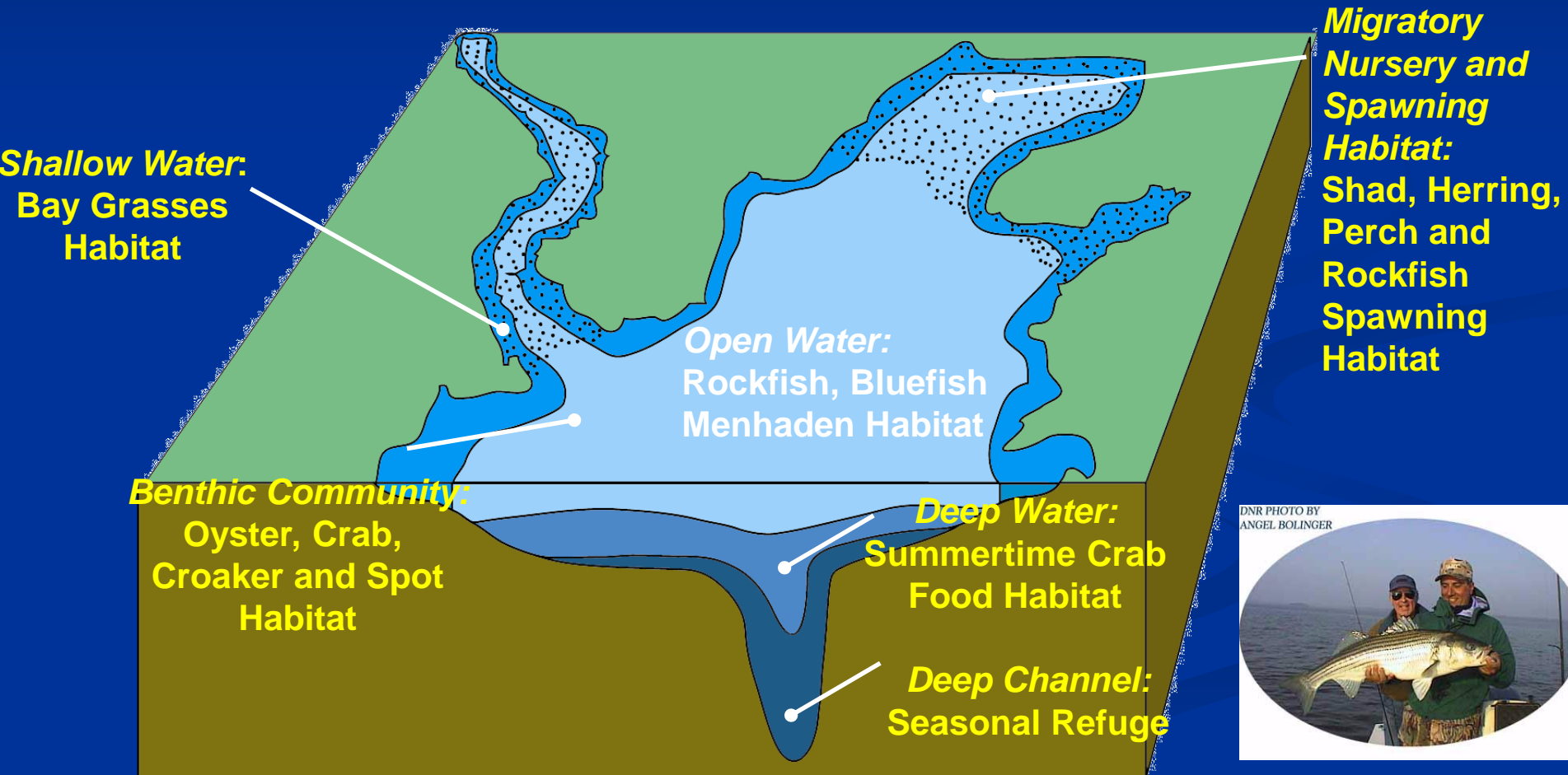
- primary contact



- secondary contact



Chesapeake Bay Designated Uses



DNR PHOTO BY
ANGEL BOLINGER



Translate Local Habitats Information for Designated Use Delineation

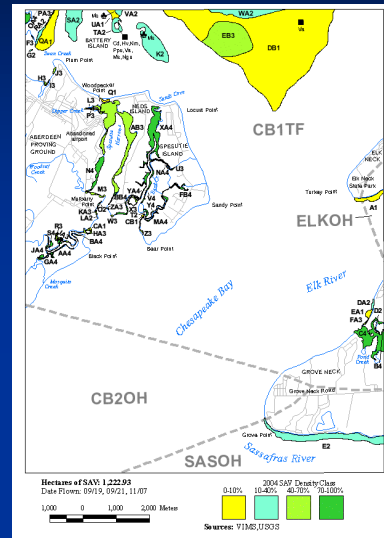
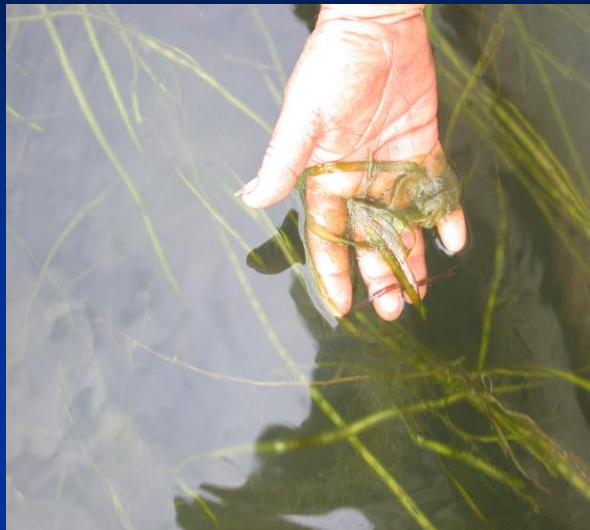


Photo courtesy of W. Boynton.

Field survey support

GIS coverage mapping of SAV beds

Mining our historical and recent aerial photographs



Bay Grasses Habitat

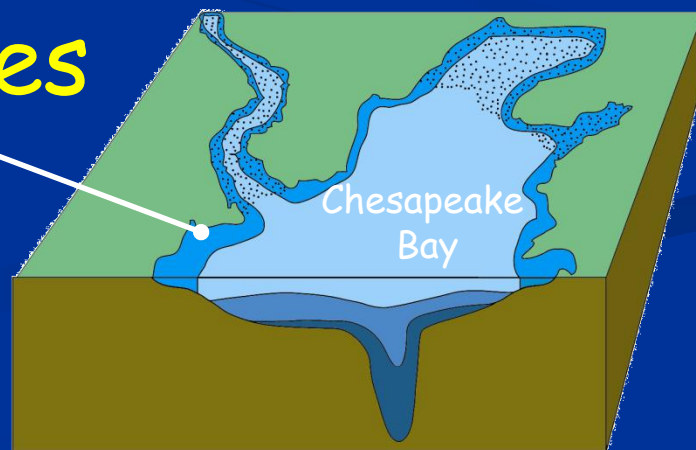
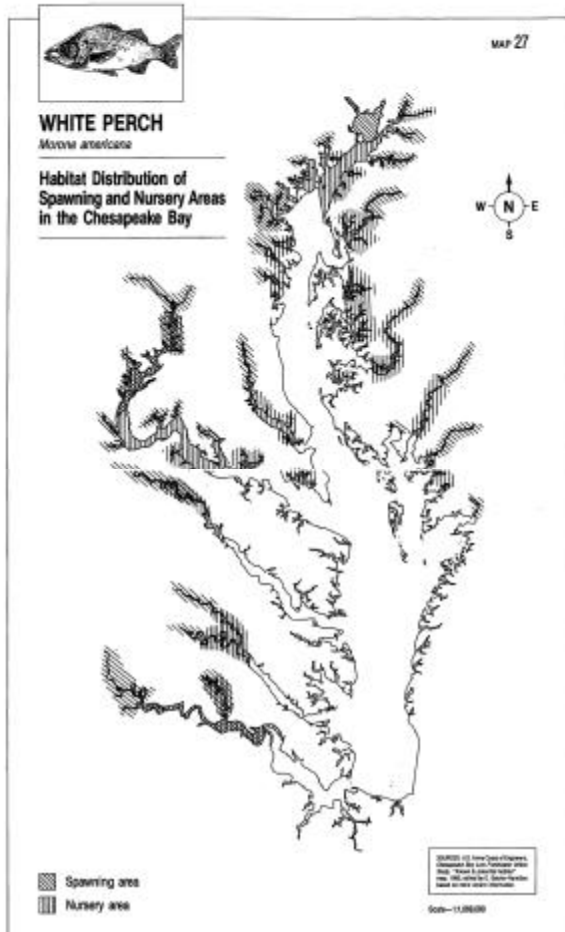


Photo courtesy of MD DNR/VIMS

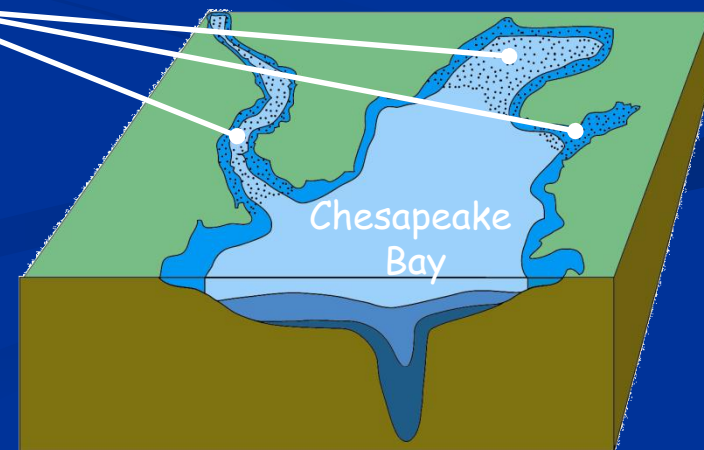
Translate the Best Scientific Information available for Designated Use Delineation



Funderburk et al. 1991



**Migratory
Nursery and
Spawning
Habitat:
Shad,
Herring,
Perch and
Rockfish
Spawning
Habitat**



Designated Uses

Space:

**Shallow Water:
Bay Grasses
Habitat**

**Open Water:
Rockfish, Bluefish
Menhaden Habitat**

**Migratory
Nursery and
Spawning
Habitat:
Shad, Herring,
Perch and
Rockfish
Spawning
Habitat**

**Benthic Community:
Oyster, Crab,
Croaker and Spot
Habitat**

**Deep Water:
Summertime Crab
Food Habitat**

**Deep Channel:
Seasonal Refuge**

Summer

DNR PHOTO BY
ANGEL BOLINGER



Source: EPA

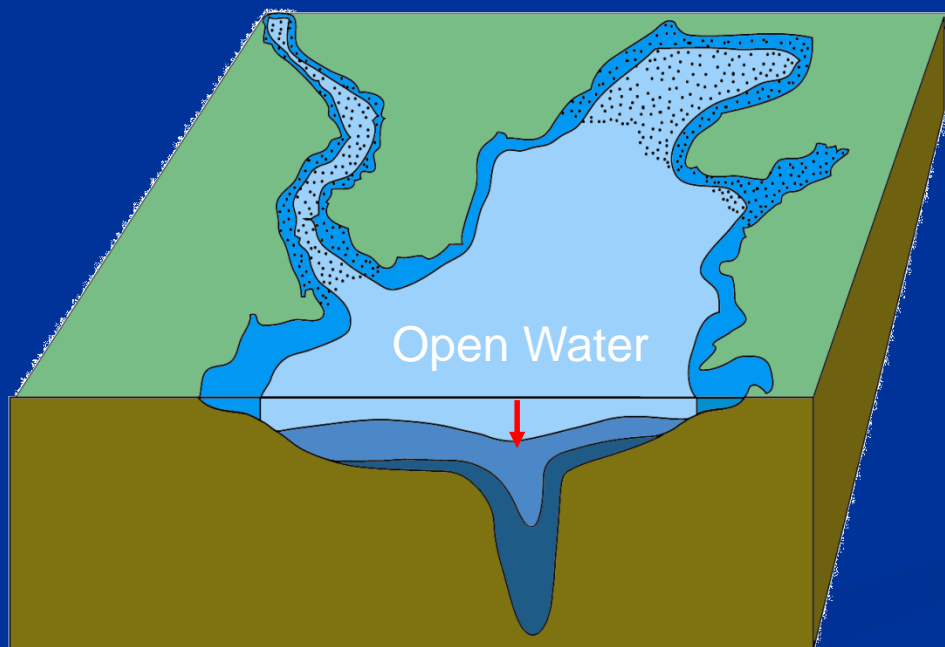
Designated Uses

Time: Seasonal

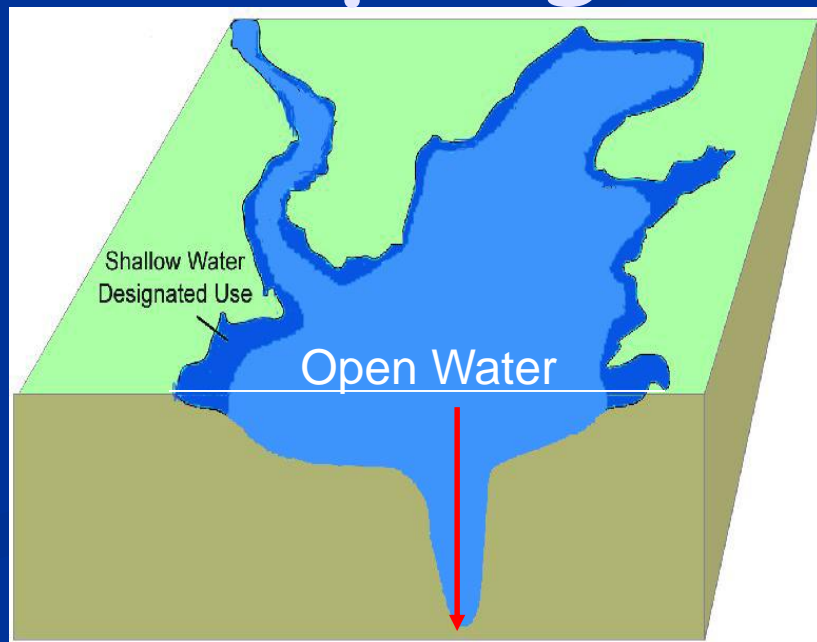


Space:

Summer



Fall, Winter
Spring

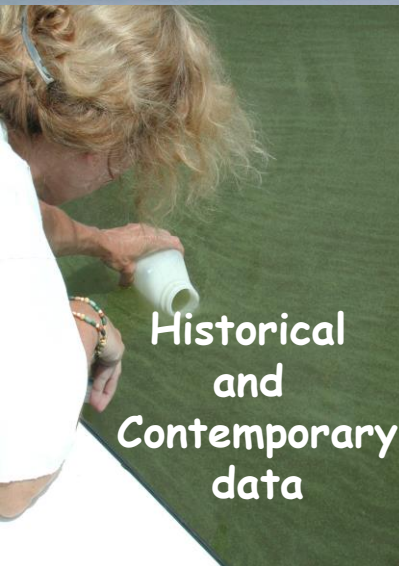


Outline

Monitoring and Assessment Framework Supporting the Chesapeake Bay TMDL

- Chesapeake Bay Management Segmentation
- Designated Use Development
- Water Quality Criteria Development
- Water Quality Criteria Assessment

Water Quality Criteria



Historical
and
Contemporary
data

United States
Environmental Protection
Agency

Region II
Chesapeake Bay
Program Office

Region III
Water Protection
Division

EPA 900-B-03-002
April 2003

In cooperation with the Office of Water/Office of Science and Technology, Washington, DC

**Ambient Water Quality
Criteria for Dissolved
Oxygen, Water Clarity and
Chlorophyll a for the
Chesapeake Bay and Its
Tidal Tributaries**

April 2003

DISSOLVED OXYGEN

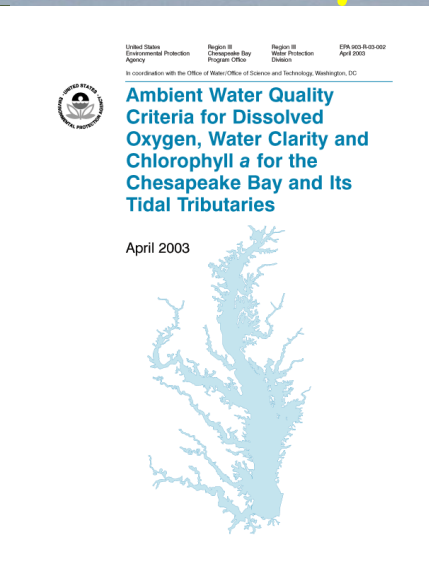
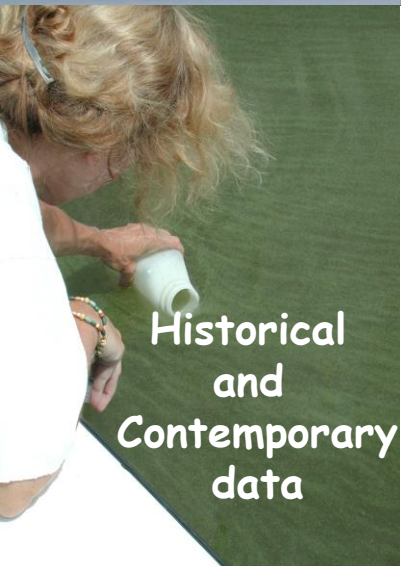
WATER CLARITY/SAV

CHLOROPHYLL CRITERIA

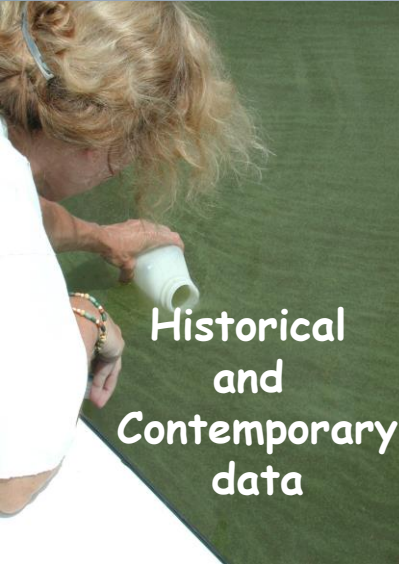


Water Quality Criteria (e.g. CHLA)

CHLOROPHYLL CRITERIA DEVELOPMENT



Water Quality Criteria (e.g. CHLA)



Historical
and
Contemporary
data



United States
Environmental Protection
Agency

Region II
Chesapeake Bay
Program Office

Region II
Water Protection
Division

EPA 903-R-03-002
April 2003

In coordination with the Office of Water, Office of Science and Technology, Washington, DC

Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll *a* for the Chesapeake Bay and Its Tidal Tributaries

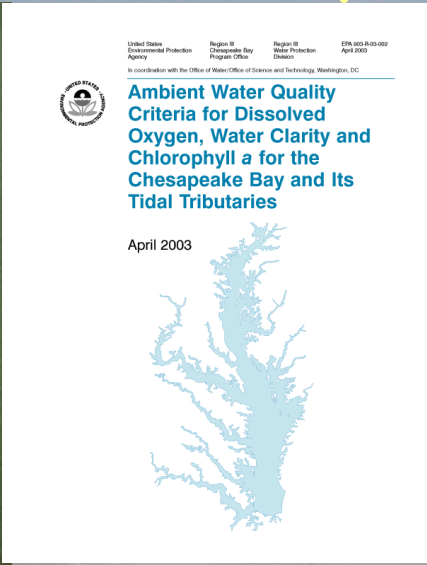
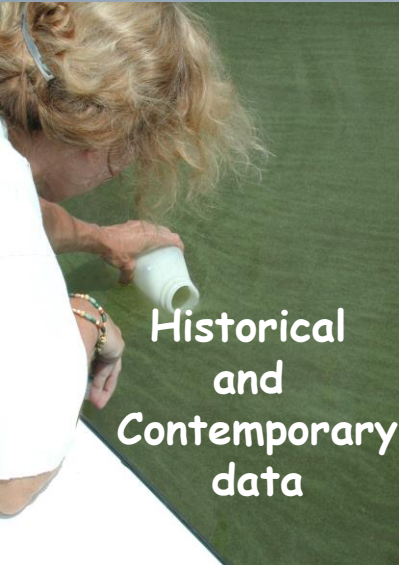
April 2003



NARRATIVE CHLOROPHYLL CRITERIA

Concentrations of chlorophyll *a* in free-floating microscopic aquatic plants (algae) shall not exceed levels that result in ecologically undesirable consequences — such as reduced water clarity, low dissolved oxygen, food supply imbalances, proliferation of species deemed potentially harmful to aquatic life or humans or aesthetically objectionable conditions — or otherwise render tidal waters unsuitable for designated uses (USEPA 2003).

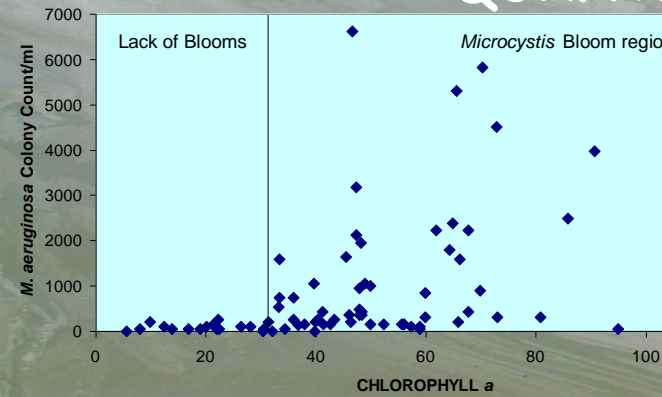
Water Quality Criteria (e.g. CHLA)



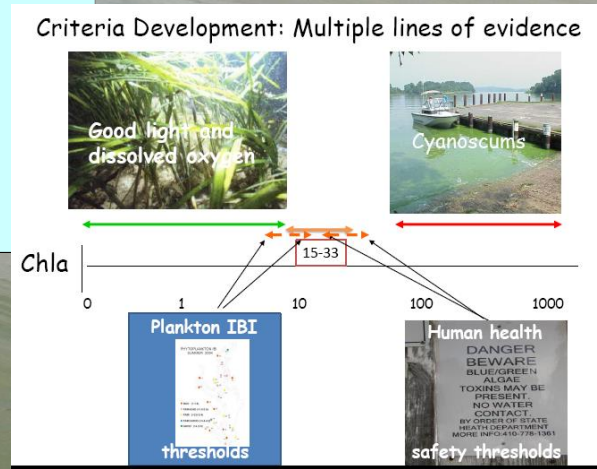
NARRATIVE CHLOROPHYLL CRITERIA

Concentrations of chlorophyll *a* in free-floating microscopic aquatic plants (algae) shall not exceed levels that result in ecologically undesirable consequences — such as reduced water clarity, low dissolved oxygen, food supply imbalances, proliferation of species deemed potentially harmful to aquatic life or humans or aesthetically objectionable conditions — or otherwise render tidal waters unsuitable for designated uses (USEPA 2003).

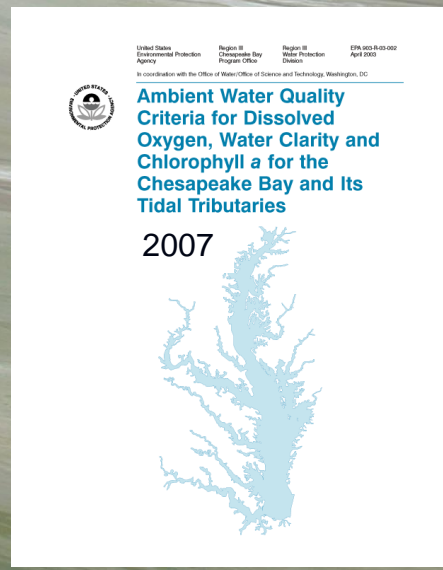
QUANTITATIVE CHLOROPHYLL CRITERIA



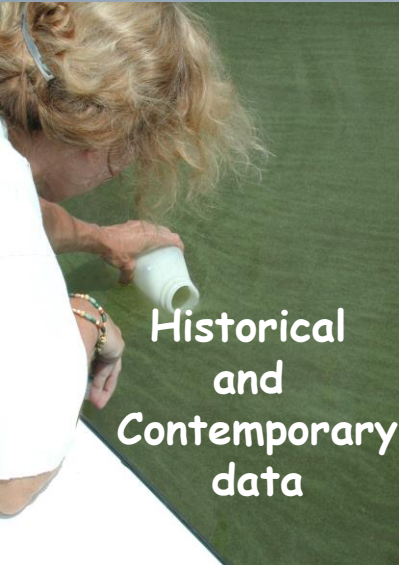
USEPA 2007



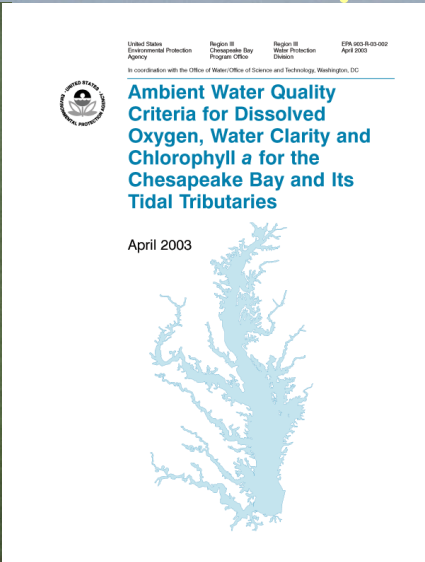
USEPA 2007



Water Quality Criteria (e.g. CHLA)



Historical
and
Contemporary
data



NARRATIVE CHLOROPHYLL CRITERIA

Concentrations of chlorophyll *a* in free-floating microscopic aquatic plants (algae) shall not exceed levels that result in ecologically undesirable consequences — such as reduced water clarity, low dissolved oxygen, food supply imbalances, proliferation of species deemed potentially harmful to aquatic life or humans or aesthetically objectionable conditions — or otherwise render tidal waters unsuitable for designated uses (USEPA 2003).

QUANTITATIVE CHLOROPHYLL CRITERIA



Applicable Criteria Seasons

Spring: March 1- May 31

Summer: June 1 – September 30

Outline

Monitoring and Assessment Framework Supporting the Chesapeake Bay TMDL

- Chesapeake Bay Management Segmentation
- Designated Use Development
- Water Quality Criteria Development
- Water Quality Criteria Assessment

Monitoring and Assessment - as easy as baking a cake!

Collect the ingredients



Follow the Recipe as the rules for Creating a cake



Create a layer, and then another, ...

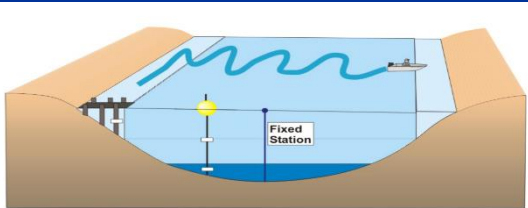
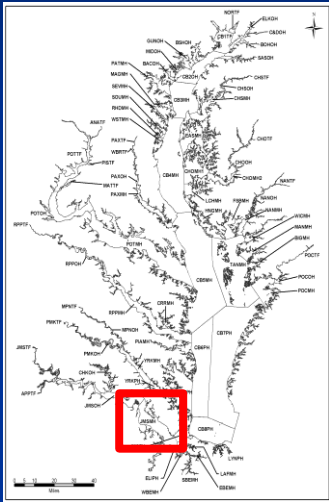


Voila! Assemble into the finished product!



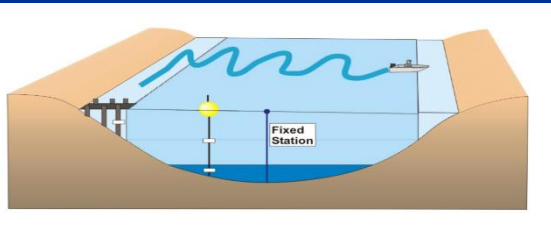
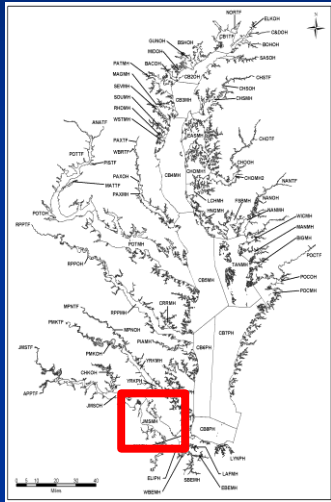
Water Quality Criteria Assessment

Water Quality Data Collection



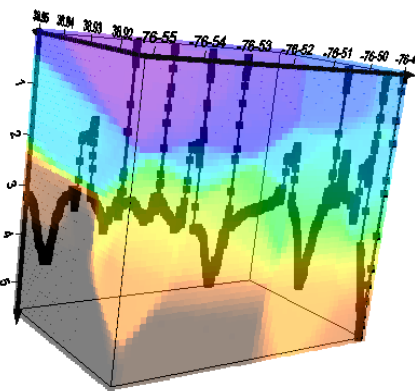
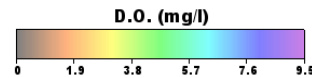
Water Quality Criteria Assessment

Water Quality Data Collection



Interpolation of Water Quality Monitoring Results

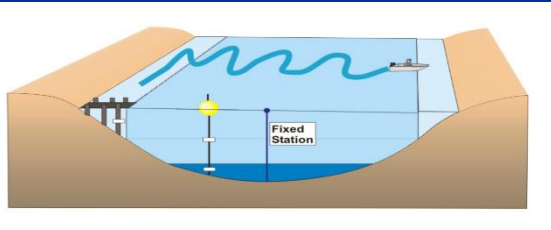
Dissolved Oxygen



Picture courtesy of A. Muller, USNA

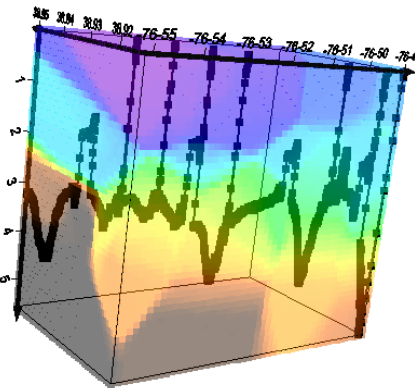
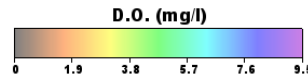
Water Quality Criteria Assessment

Water Quality Data Collection



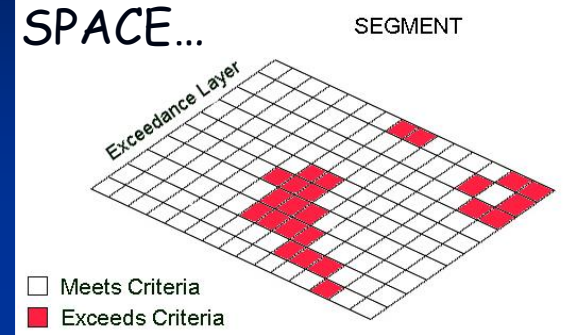
Interpolation of Water Quality Monitoring Results

Dissolved Oxygen

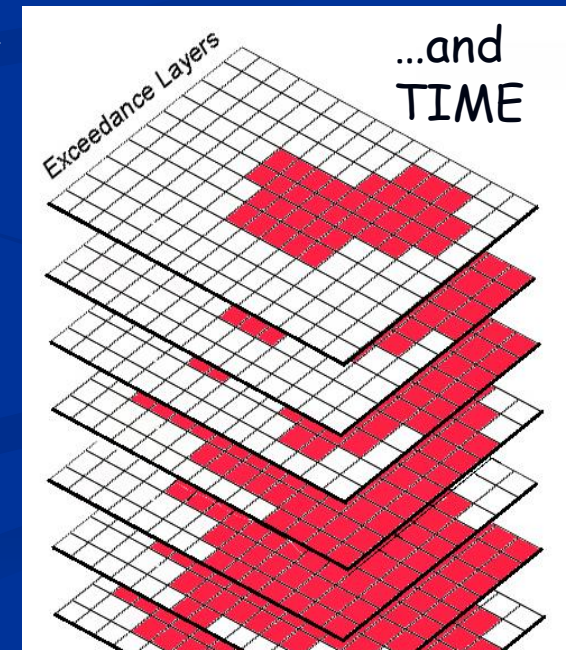


Picture courtesy of A. Muller, USNA

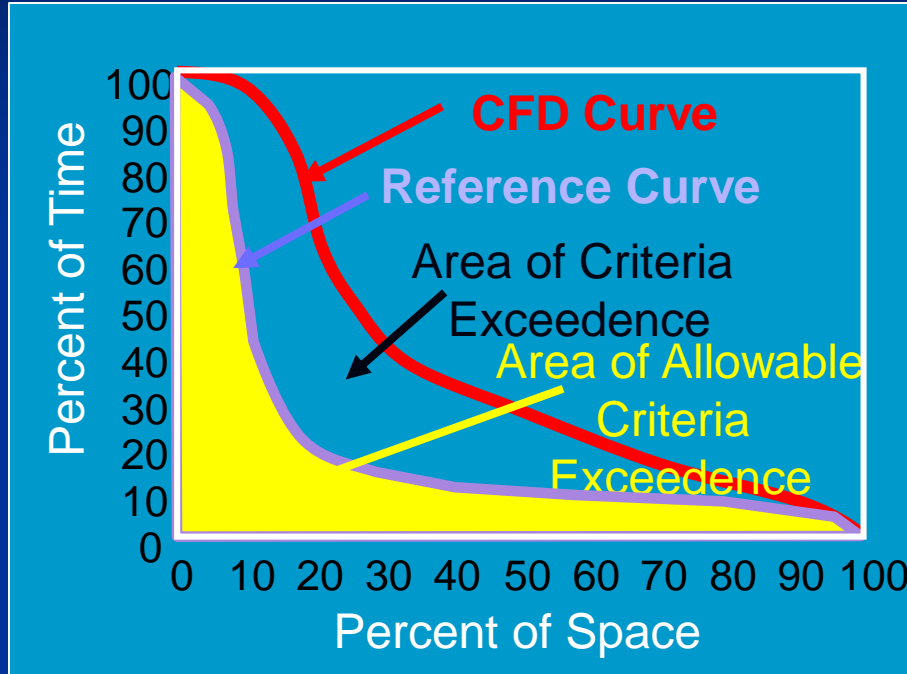
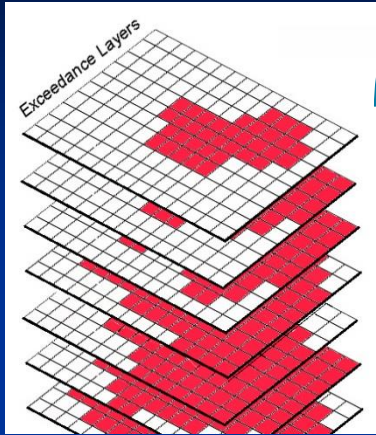
Single month Criteria assessment



Season x 3-year Criteria assessment



Water Quality Criteria Assessment

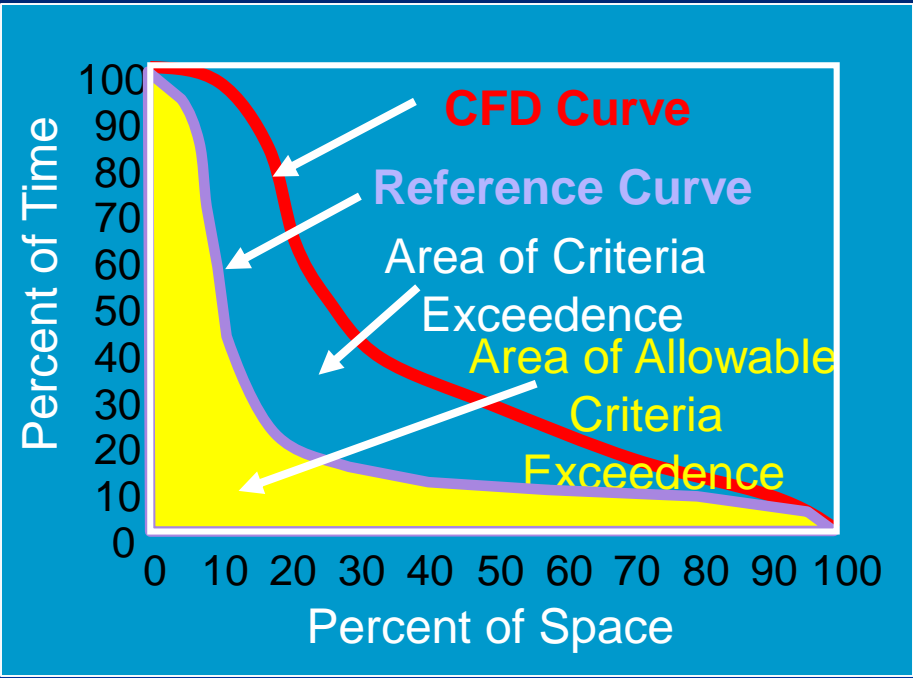
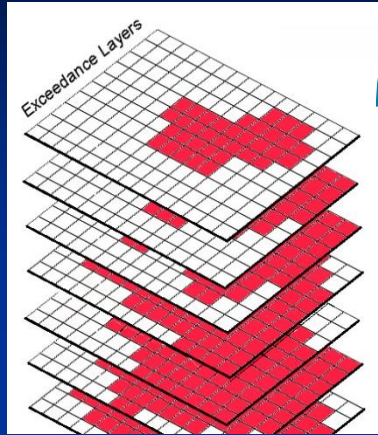


USEPA 2003

Pass or Fail Assessment
1 segment

Monitoring Data
1 segment
Over time

Water Quality Criteria Assessment



Monitoring Data
1 segment
Over time

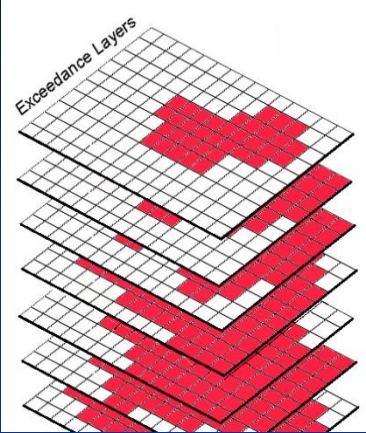
USEPA 2003

Pass or Fail Assessment
1 segment

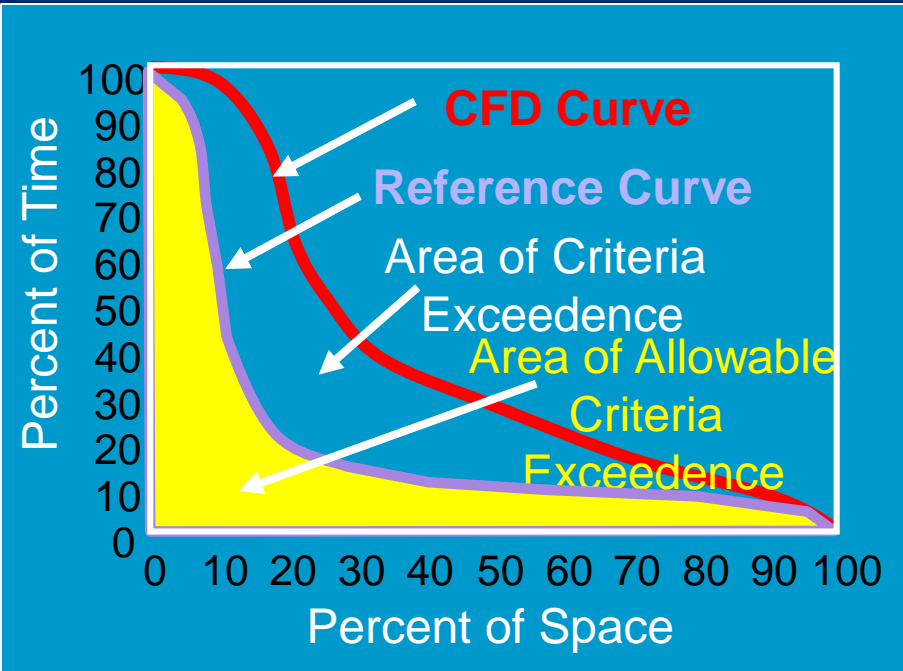
Water Quality Standards Attainment
"Either you're in or your out!"



Water Quality Criteria Assessment



Monitoring Data
1 segment
Over time

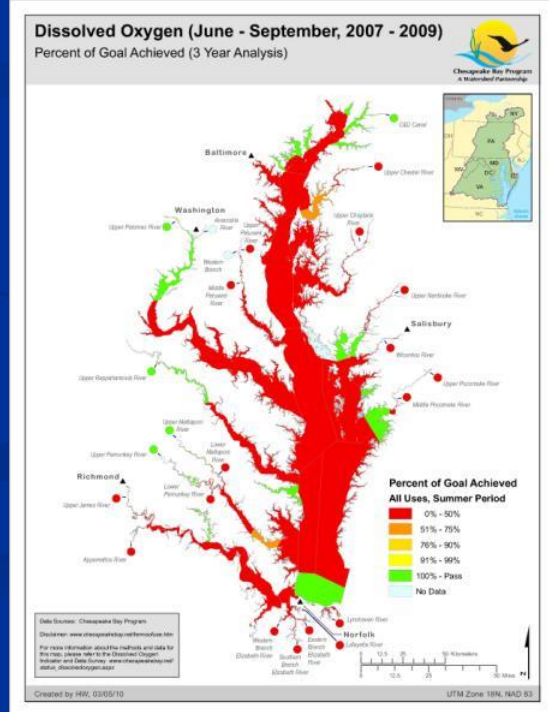


USEPA 2003

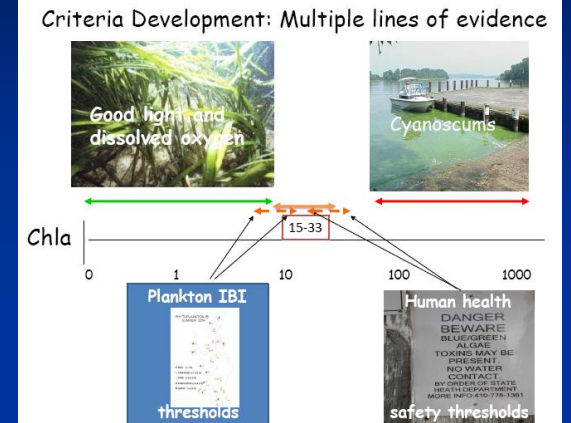
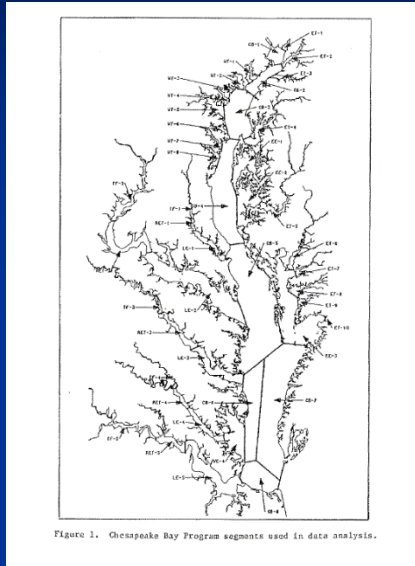
Pass or Fail Assessment
1 segment

Water Quality Standards Attainment

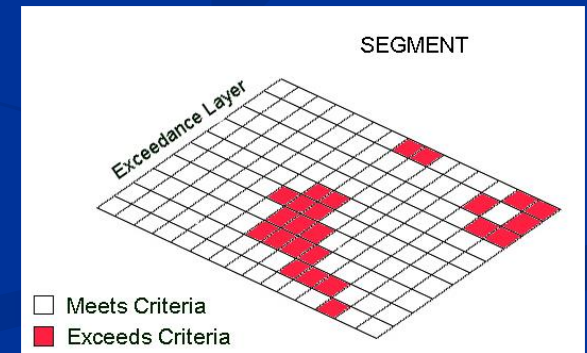
92 segment Baywide Assessment Summary



Thank you



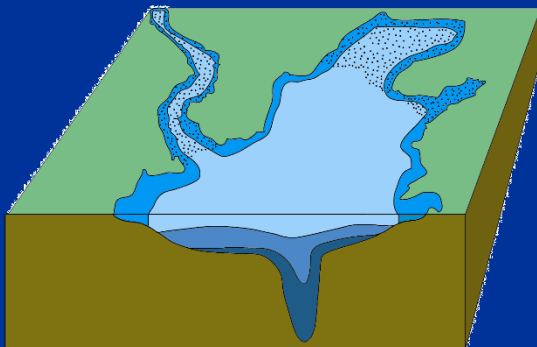
Water Quality Criteria Development



Water Quality Criteria Assessment



Management Segmentation



Designated Uses

5 Components of Chesapeake Bay Criteria Assessment

- Space
- Time
- Magnitude
- Duration
- Frequency

Law: Clean Water Act (1972)

- Objective: "restore and maintain the chemical, physical and biological integrity of the Nation's waters" (Clean Water Act 101(a))
- Interim goal: "water quality which provides for the protection and propagation of fish, shellfish and wildlife and provides for recreation in and on the water" wherever attainable by 1983 (Clean Water Act 101(a)(2))
- Implementation by States, Territories, and authorized Tribes