305(b) Methodology

Presentation Prepared by Joe Hand, Donna Tterlikkis, and Tom Singleton

305(b) - *purpose*

Clean Water Act requires each state to conduct water quality surveys to determine if its waterways are:

- healthy
- sufficient quality to meet their designated uses

305(b) - *report*

- submitted every two years
- uses chemical data from STORET database, biology data from the Statewide Biological database, and fish consumption advisory data
- prepared by the Basin Planning and Management Section

305(b) Methodology- *activities*

12 steps to complete assessment

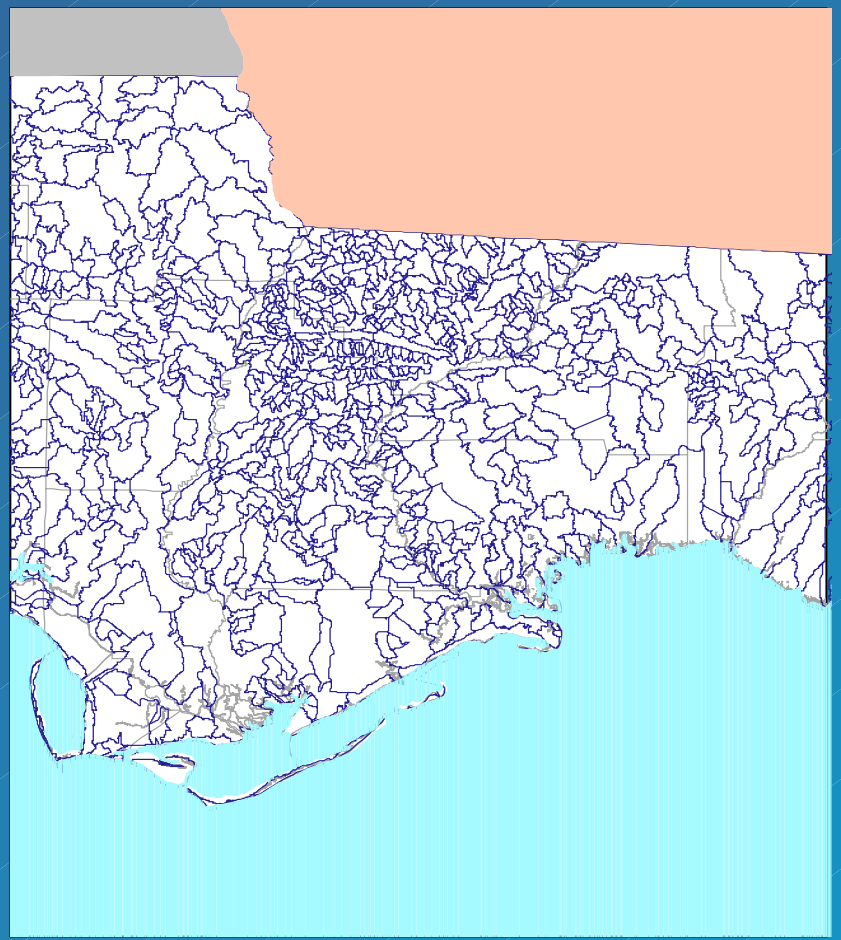
1. subdivide State into watersheds
2. identify waterbody type
3. identify waterbody classification and designated use
4. inventory chemical data - STORET
5. inventory biological data - Statewide Biologic Database
6. inventory fish consumption advisory data - Mercury Project

305(b) Methodology - *activities*

12 steps to complete assessment (cont'd)

7. calculate Index - WQI or TSI
8. identify exceedances of water quality standards
9. status determination
10. apply confidence filters
11. use determination status
12. other EPA reporting requirements -
    - screen for poor water quality values (causes)
    - nonpoint source survey (sources)
    - analyze trends

305(b) Methodology - *watershed assignment and classification*



1. *Subdivide state into watersheds*

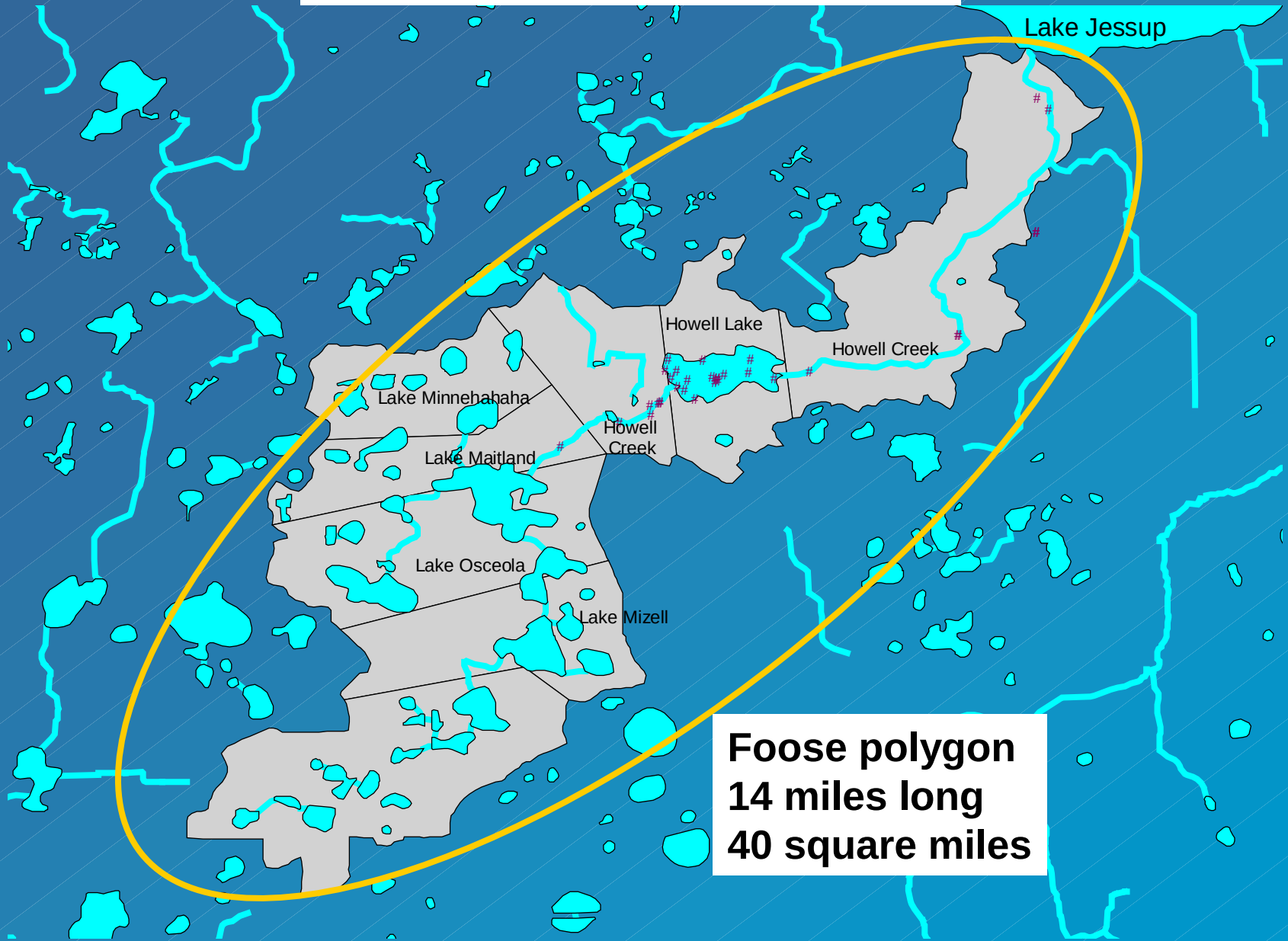
- 52 major river basins
- 4,934 watersheds

305(b) Methodology - *watershed assignment and classification*

Watershed:

- a waterbody and feeder streams that flow to it
- analytic unit for assessing surface water quality
- named for the major waterbody located within it
- water quality stations located within a given watershed are used to assess that watershed

Winter Park Chain of Lakes



305(b) Methodology - *watershed assignment and classification*

2. Identify waterbody type

- watershed identified by the predominant type of waterbody located within it
  - , *i.e.*, stream, black water stream, lake, estuary or spring
- watershed determined by visual inspection of data or GIS mapping
- water quality assumed to be homogeneous in each waterbody

305(b) Methodology - *watershed assignment and classification*

Waterbody type	Number of waterbodies	Characteristics	Assessment technique
Stream	3,359		Water Quality Index
Stream-black water	73	Color > 275 platinum color units, pH< 6	Water Quality Index
Lake	556		Trophic State Index
Spring	88	Low dissolved oxygen	Water Quality Index
Estuary	458	Conductivity > 5000 uhmos, chloride > 1500 ppm	Trophic State Index

305(b) Methodology - *watershed assignment and classification*

3. Identify water body classifications and designated use for each waterbody

- functional classifications are applied to all Florida surface waters (Class I through V)
- standards and water quality criteria have been established for each class of waterbody under Chapter 62-302

305(b) Methodology - *watershed assignment and classification*

Class	Function	Number of watersheds	Characteristics
I	Drinking Water	46	Usually lakes or reservoirs
II	Shellfish harvesting	124	Estuarine
III - Freshwater	Wildlife and recreation	3989	
III - Marine	Wildlife and recreation	374	Chlorides > 1500 ppm
IV	Agriculture	1	Everglades area
V	Industrial	0*	

* Fenholloway River changed to Class III in 1997

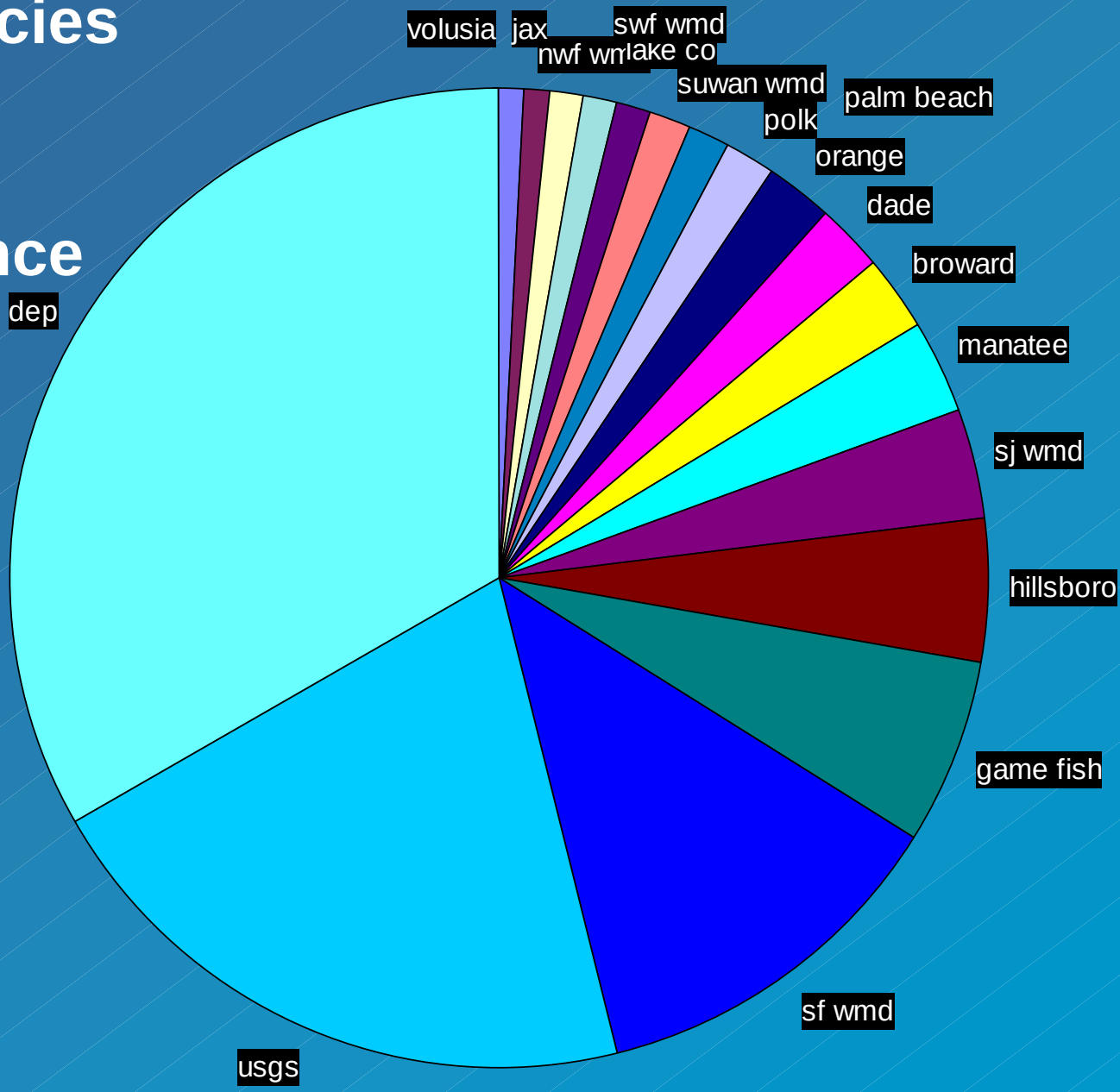
305(b) Methodology - *database development*

4. Inventory chemical data

STORET

- 9,200 STORET stations sampled since 1980
- in 1,900 of the 4,934 watersheds in Florida
- by 33 agencies
- current data defined as 1993-1997
- historic data defined as 1980 - 1992

Major agencies collecting STORET stations since 1970



305(b) Methodology - *database development*

5. Inventory biological data

Statewide Biological database

- SCI - Stream condition index
- uses 7 different indices based on types and numbers of macroinvertebrates present
  - if less than 20th percentile, then poor
  - if greater than 70th percentile, then good
- have other historical and new bioassessment data that needs to be integrated into assessment

Biological Index

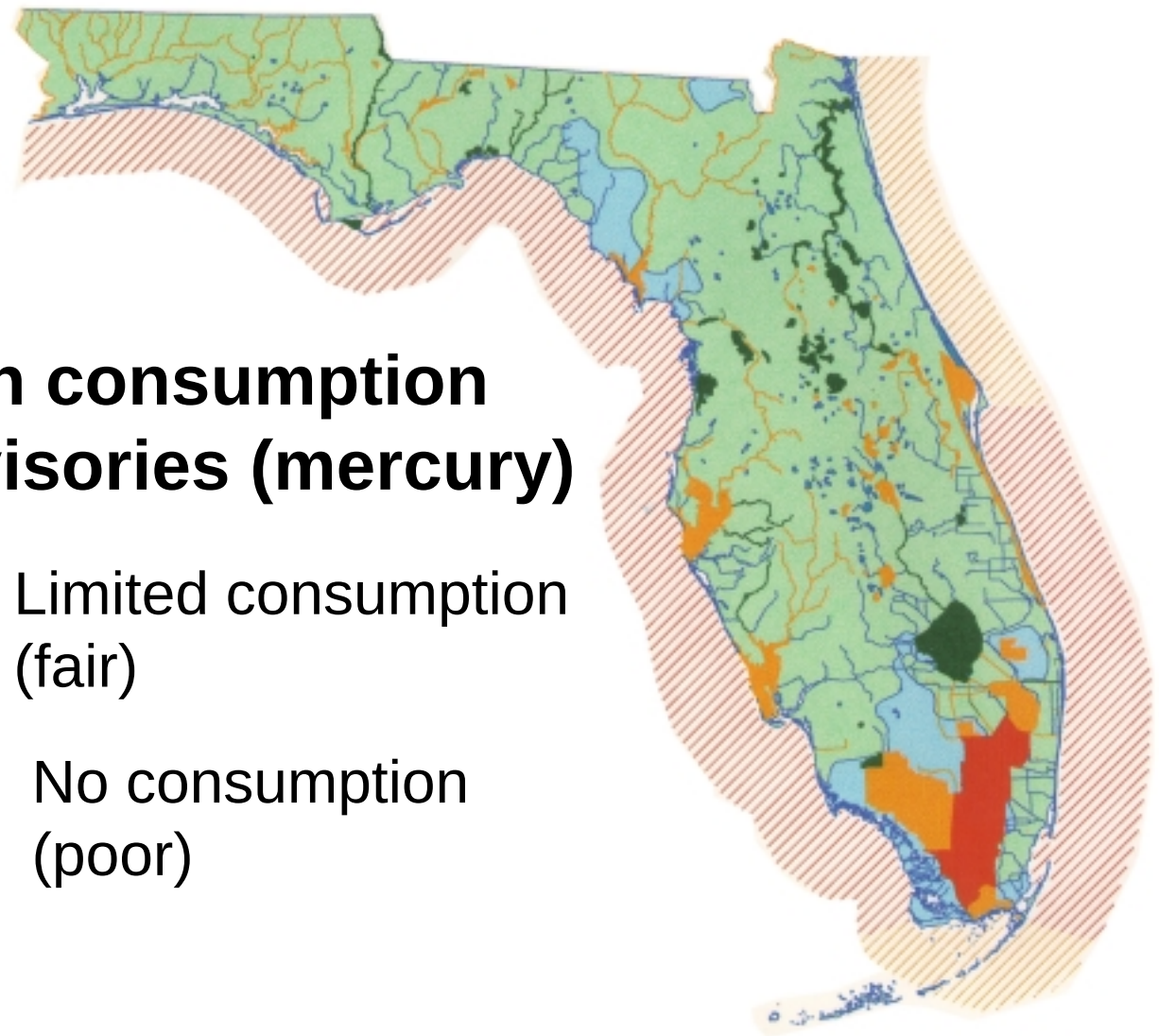
METRIC Lookup	METRIC	REGION	SEASON	5	3	1
No. of Total Taxa	TOTAXA	Panhandle	Summer	>=31	30.0-16.0	<16
No. of EPT Taxa	EPTTAXA	Panhandle	Summer	>=7	6.0-4.0	<4
No. of Chironomidae Taxa	CHIRTAXA	Panhandle	Summer	>=9	8.0-5.0	<5
% Dominant Taxon	PERDOM	Panhandle	Summer	<=22	23-61	>61
% Diptera	PERDIP	Panhandle	Summer	.	<=50	>50
Florida Index	FLAIND	Panhandle	Summer	>=16	15-8	<8
% Filters	PERFIL	Panhandle	Summer	>=12	11.0-6.0	<6
				meets	partially	does not meet

305(b) Methodology - *database development*

6. Inventory fish consumption advisory data

Mercury Survey

- in 1989, FGFFC, FDHRS, and FDEP initiated a project to sample fish tissue for mercury concentration
- approximately one million acres of fresh water are “no consumption” areas (do not support their designated use)
- approximately one million acres of fresh water have “limited consumption” advisories (partially support their designated use)



Fish consumption advisories (mercury)

- Limited consumption (fair)
- No consumption (poor)

Fish Consumption Advisory

	Good	Fair	Poor
Mercury in fish tissue	<0.5 mg/kg	0.5-1.5 mg/kg (limited consumption)	>1.5 mg/kg (no consumption)
	meets	partially	does not meet

305(b) Methodology - *data analysis*

7. Calculate index

a. Water Quality Index (WQI)

- developed and used in 1988 305(b) report
- a single numeric value condensed from several water quality parameters
- applies to streams, black waters, and springs
- annual median water quality values derived from STORET chemical data
- includes five (5) categories of measurements:

305(b) Methodology - *data analysis*

7. Calculate index - indices are primarily designed to address impacts from nutrients given narrative nutrient criteria

a. Water Quality Index (WQI)

Five Categories:

- **Water Clarity**
  - Turbidity and Total suspended solids
- **Dissolved Oxygen**
- **Oxygen demanding substances**
  - BOD, COD, and TOC
- **Nutrients**
  - Total N, Nitrate, and Total P
- **Bacteria**
  - Total Coliform and Fecal Coliform

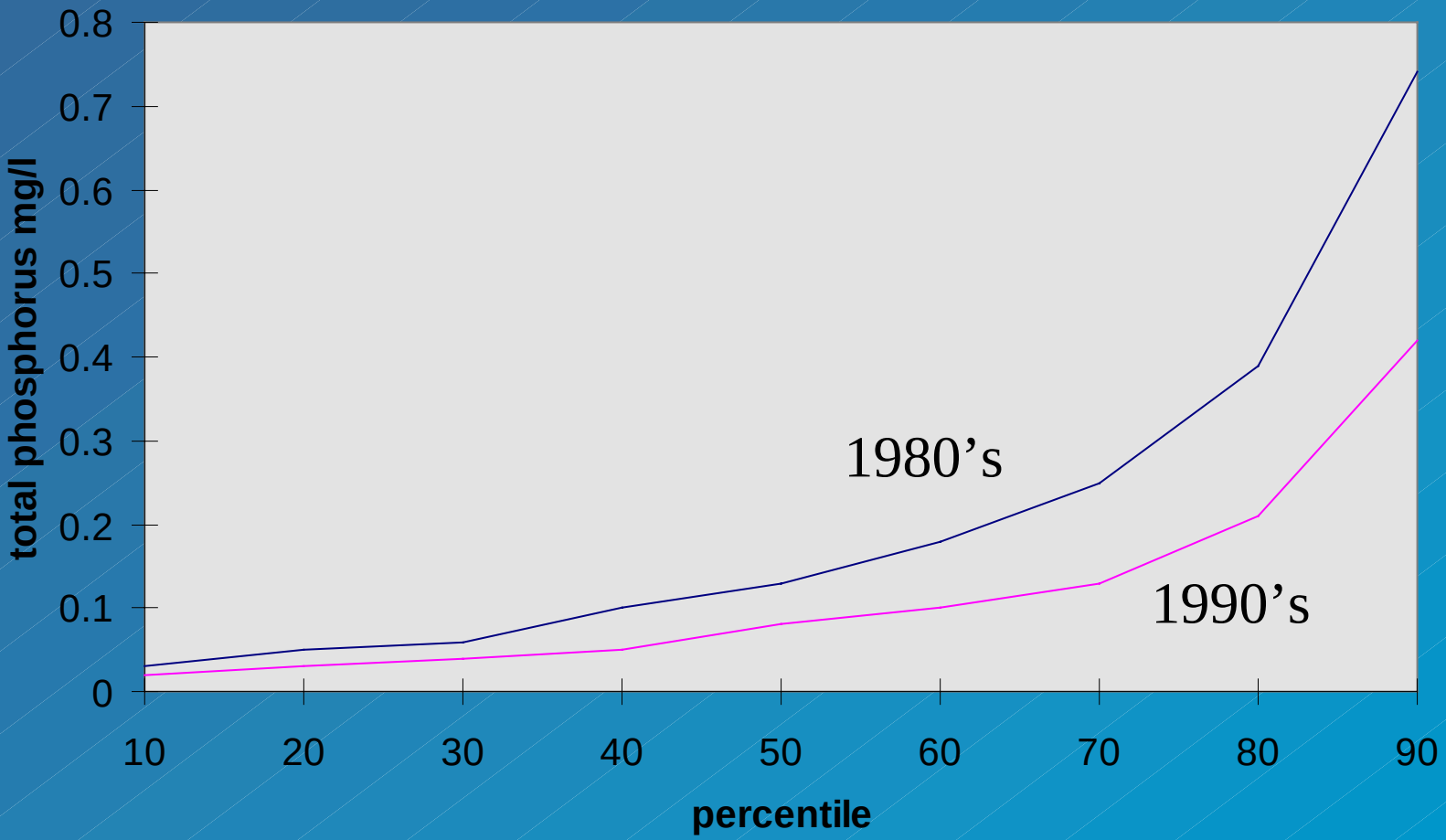
305(b) Methodology - *data analysis*

7. Calculate index

a. Water Quality Index (WQI)

- each parameter assigned a value between 0 and 99 based on the percentile distribution of stream water quality (Typical Water Quality Values, from 1989)
- values averaged to obtain an overall index value for each category
- each category are averaged to obtain a final WQI rating (good = 0-44, fair = 45-59, or poor = 60-99)

Stream phosphorus percentiles for 1980 and 1990



Chemistry Index
Water Quality Index Values

Parameter	Best quality								Worst quality
WQI	Unit	10	20	30	40	50	60	70	80	90
Category: Water clarity										
Turbidity	JTU	1.50	3.00	4.00	4.50	5.20	8.80	12.20	16.50	21.00
Total suspended solids	milligrams per liter (mg/l)	2.00	3.00	4.00	5.50	6.50	9.50	12.50	18.00	26.50
Category: Dissolved oxygen										
Dissolved oxygen	mg/l	8.00	7.30	6.70	6.30	5.80	5.30	4.80	4.00	3.10
Category: Oxygen demand										
Biochemical oxygen demand	mg/l	0.80	1.00	1.10	1.30	1.50	1.90	2.30	3.30	5.10
Chemical oxygen demand	mg/l	16.00	24.00	32.00	38.00	46.00	58.00	72.00	102.00	146.00
Total organic carbon	mg/l	5.00	7.00	9.50	12.00	14.00	17.50	21.00	27.50	37.00
Category: Nutrients										
Total nitrogen	mg/l as N	0.55	0.75	0.90	1.00	1.20	1.40	1.60	2.00	2.70
Nitrate plus nitrite	mg/l as N	0.01	0.03	0.05	0.07	0.10	0.14	0.20	0.32	0.64
Total phosphorus	mg/l as P	0.02	0.03	0.05	0.07	0.09	0.16	0.24	0.46	0.89
Category: Bacteria										
Total coliform	#/100 milliliters (ml)	100.00	150.00	250.00	425.00	600.00	1100.00	1600.00	3700.00	7600.00
Fecal coliform	#/100 ml	10.00	20.00	35.00	55.00	75.00	135.00	190.00	470.00	960.00

meets partially does not meet

305(b) Methodology - *data analysis*

7. Calculate index

b. Trophic State Index (TSI)

- applies to lakes and estuaries
- measures the potential for algal or aquatic weed growth - total nitrogen, total phosphorus, chlorophyll
- a ten (10) unit change in the index represents a halving or doubling of algal biomass
- overall TSI is an average of chlorophyll and nutrient indices

305(b) Methodology - *data analysis*

7. Calculate index

b. Trophic State Index (TSI)

- Trophic State Index for lakes based on:
  - Chlorophyll - Florida lake index value
    - developed from a regression analysis of data collected from 313 Florida lakes
  - Nutrients - Nutrient Trophic State Index Value
    - based on phosphorus and nitrogen concentrations and the limiting nutrient concept

305(b) Methodology - *data analysis*

7. Calculate index

b. Trophic State Index (TSI)

Limiting Nutrient Concept

Identifies a lake as phosphorus limited if the nitrogen-to phosphorous concentration ratio is greater than 30, nitrogen limited if the ratio is less than 10, and balanced if the ratio is between 10 and 30.

305(b) Methodology - *data analysis*

7. Calculate index

b. Trophic State Index (TSI)

- Trophic State Index for Estuaries
  - Rating scale is lower for each category
  - Reflects a lower desirable upper limit for chlorophyll

305(b) Methodology - *data analysis*

7. Calculate index

b. Trophic State Index (TSI)

- Trophic State Index

Rating	Lake	Estuary
Good	0 - 59	0 - 49
Fair	60 - 69	50 - 59
Poor	70 - 100	60 - 100

Chemistry Index

Lake Trophic State Index Values

Tsi	0	10	20	30	40	50	60	70	80	90	100
Chlorophyll ug/l	.3	.6	1.3	2.5	5	10	20	40	80	160	320
Total phosphorus mgP/l	.003	.005	.009	.01	.02	.04	.07	.12	.2	.34	.58
Total nitrogen mg N/l	.06	.10	.16	.27	.45	.7	1.2	2.0	3.4	5.6	9.3

meets partially does not meet

305(b) Methodology - *data analysis*

8. Identify exceedances of water quality criteria

- Florida's surface water quality criteria are used to assess whether a pollutant concentration in a watershed is high enough to preclude the designated use of the waterbody
- exceedances of metal's and conventional pollutants are determined using chemical water quality data from STORET
- based on the number of violations in last 3 years

305(b) Methodology - *data analysis*

8. Identify exceedances of water-quality standards

- parameters evaluated:
  - **Conventional pollutants**
    - Dissolved oxygen
    - Chlorides
    - Ammonium
    - Total/fecal Coliform
    - Fluoride
  - **Metals**
    - Arsenic
    - Aluminum
    - Cadmium
    - Chromium
    - Iron
    - Lead
    - Mercury
    - Nickel
    - Selenium
    - Silver
    - Thallium
    - Zinc

Determining water quality

(based on exceeded standards over a three-year period)

	Good	Fair	Poor
Conventional pollutants	< 10%	11 - 25 %	> 25%
Metals, unionized ammonia, chloride, cyanide, pesticides	< = 1 sample	10%	> 10%
Bacteria	0	10%	> 10%

305(b) Methodology - *conclusions*

9. Status determination

- a single, simple averaging, over-all water quality rating for a watershed
- each assessment value is given a score
  - Good quality - 1
  - Fair quality - 3
  - Poor quality - 5
- Score chemistry, biology and fish consumption

305(b) Methodology - *conclusions*

9. Status determination

- overall average is calculated
  - Good - 1 to 2
  - Fair - 2 to 4
  - Poor - 4 to 5
- result is a status rating representing the present status for each watershed with sufficient data for assessment
- does not address data sufficiency, simply assesses whatever data are present
- not used for Use determination, which is basis for 303(d) list

305(b) Methodology - *conclusions*

10. Apply confidence filters

- A minimum of three “samples” (a sample is defined as two sampling events: one summer and one winter) is required for each watershed instead of only one sample. (Note the 3 samples could be taken in 1 year from 3 different stations or from 1 station sampled over 3 years.)
- Data from three or more Water Quality Index (WQI) categories (water clarity, DO, oxygen demanding substances, nutrients, and bacteria) are required to determine a WQI.
- For the oxygen demanding substances category of the WQI, if BOD data are available, COD and/or TOC will not be used.

305(b) Methodology - *conclusions*

11. Use designation determination

- results reported as
  - Meets Designated Use
  - Partially Meets Designated Use
  - Does Not Meet Designated Use
- result is a rating representing the present use designation for each watershed with sufficient data for assessment
- Note - *EPA requires if biology and chemistry indicate poor quality, then the index is set to does not meet.*

305(b) Methodology - *conclusions*

11. Use designation determination

- **Assessment Components**

  Chemistry Index

  Stream WQI or Lake/estuary TSI

  Chemistry Violations

  conventionals

  metals

  Biology Index

  Fish Contamination

The Assessment Calculation for Chemistry Passing Confidence Filter

overall average is calculated
Good - 1 to 2
Fair - 2 to 4
Poor - 4 to 5

- **Chemistry Index** good 1
  - Stream WQI
  - Lake/estuary TSI
- **Chemistry Violations**
  - conventionals fair 3
  - metals good 1
- **Biology Index** good 1
- **Fish Contamination** fair 3

Status = (1 + (3 +1) /2 + 1 + 3)/4 = 7/4 = 1.75 = good

305(b) Use designation = Meets

The Assessment Calculation for Chemistry Not Passing Confidence Filter

overall average is calculated
Good - 1 to 2
Fair - 2 to 4
Poor - 4 to 5

- **Chemistry Index***
  - Stream WQI — good 1
  - Lake/estuary TSI
- **Chemistry Violations**
  - conventionals — fair 3
  - metals — good 1
- **Biology Index** — poor 5
- **Fish Contamination** — fair 3

305(b) Use designation = Does not Meet Use (because Biology is poor)

*** Not used because not enough samples were collected to pass confidence filter.**

The Assessment Calculation

overall average is calculated

Good - 1 to 2
Fair - 2 to 4
Poor - 4 to 5

- Chemistry Index
  - Stream WQI — good 1
  - Lake/estuary TSI
- Chemistry Violations
  - conventionals — fair 3
  - metals — good 1
- Biology Index — good 1
- Fish Contamination — fair 3

Overall call = (1 + (3+1/2)+ 1 + 3)/4 = 7/4 = 1.75 = good

305(b) Use designation = Meets

305(b) Methodology - *conclusions*

12. Other EPA reporting requirements - Screen for poor water quality (causes)

- used to identify poor water quality
- compare water quality value to index criteria
  - used in eBASE to color code individual water quality measurements

305(b) Methodology - *source determination*

12. Other EPA reporting requirements - nonpoint source pollution data (sources)

1994 update of 1988 Survey

- in 1988, FDEP qualitatively assessed the effect of nonpoint pollution on Florida's waters via a questionnaire sent to all major state agencies
- received 300-400 respondents from 150 agencies
- identified: nonpoint sources of pollution
- pollutants, symptoms (fish kills & algal blooms)
- updated survey in 1994
- ***1998 305(b) - used the pollution source information to identify sources (e.g. agriculture or urban runoff)***

305(b) Methodology - *trend analysis*

13. Other EPA reporting requirements - analyze trends

- trends determined by utilizing:
  - water quality measurements for individual parameters and
    - overall Stream Water Quality Index (streams, black water streams and springs) **or**
    - overall Trophic State Index (lakes and estuaries) for watersheds.
- determined for watersheds with at least 5 years of data between 1988 and 1997; total of 945 statewide

305(b) Methodology - *trend analysis*

13. Other EPA reporting requirements - analyze trends

- uses Spearman Ranked Correlation Coefficient
- determined by comparing improved and degraded water quality measurements
- annual median values for sampling stations are analyzed for changes
- if a waterbody shows no trend, or if just one indicator shows a trend, then the trend is classified as “no change”

305(b) Methodology - acknowledged weaknesses

- TSI for Estuaries based on Lakes
  - need estuarine-specific index
  - doesn’t differentiate between different types of estuaries
- Lake TSI not regionally based and doesn’t address nuisance aquatic vegetation
- WQI for streams not regionally based and criteria for good, fair, and poor (particularly fair) are questionable

305(b) Methodology - acknowledged weaknesses

(continued)

- Need to incorporate historical bioassessment data and data from BioRecons
- Uses mean Dissolved Oxygen (DO) values
  - doesn't adequately address low DO at depth
  - high DO from algal blooms skew data
    - could use percent DO saturation
- Doesn't address some designated uses
  - shellfish and beach closing

305(b) Methodology - Other Key Issues

- Confidence in assessment
  - frequency and number of samples
- Should we composite metrics or have independent applicability
- How to address natural perturbations and variability