NOAA's Coastal Assessment and Data Synthesis System

Estuarine Eutrophication

Dataset Description

This dataset provides information for assessing the scale and severity of the symptoms of eutrophication based on expert review of the 1991-1992 National Estuarine Eutrophication Survey. Estuarine eutrophication experts reviewed the results of the survey during the National Estuarine Eutrophication Assessment Workshop (August 6-7, 1998, Silver Spring, MD). The dataset also includes information about estuarine resources likely to be impacted by eutrophication, sources of nutrient inputs that could be targeted for management purposes, gaps within the dataset itself, and future outlooks.

The data are available for one distinct spatial aggregation as outlined below. To view the data dictionary of the dataset, click on the link below or refer to NOAA's Coastal Assessment and Data Synthesis System (http://coastalgeospatial.nos.noaa.gov).

1) Coastal Watersheds (from NOAA's Coastal Assessment Framework), (http://spo.nos.noaa.gov/projects/cads/data_references/eutro/eutro_eda_h_dict.html)

Source(s) of Information

Coastal Assessment and Data Synthesis (CA&DS)
Special Projects Office
NOS, NOAA
1305 East West Highway, SSMC4 9th Floor
Silver Spring, Maryland 20910
310-713-3000

Reports:

Bricker, S.B., C.G. Clement, D.E. Pirhalla, S.P. Orlando, and D.R.G. Farrow. 1999. National Estuarine Eutrophication Assessment: Effects of Nutrient Enrichment in the Nation's Estuaries. NOAA, National Ocean Service, Special Projects Office and the National Centers for Coastal Ocean Science. Silver Spring, MD: 71 pp.

NOAA. 1998. NOAA's estuarine eutrophication survey, vol. 5: Pacific Coast region. Silver Spring, MD: Office of Ocean Resources Conservation and Assessment. 75 pp.

NOAA. 1997. NOAA's estuarine eutrophication survey, vol. 4: Gulf of Mexico region. Silver Spring, MD: Office of Ocean Resources Conservation and Assessment. 77 pp.

NOAA. 1997. NOAA's estuarine eutrophication survey, volume 3: North Atlantic region. Silver Spring, MD: Office of Ocean Resources Conservation and Assessment. 46 pp.

NOAA. 1997. NOAA's estuarine eutrophication survey, vol. 2: Mid-Atlantic region. Silver Spring, MD: Office of Ocean Resources Conservation and Assessment. 51 pp.

NOAA. 1996. NOAA's estuarine eutrophication survey, vol. 1: South Atlantic region. Silver Spring, MD: Office of Ocean Resources Conservation and Assessment. 50 pp.

National Assessment Workshop Participants (*denotes core group member):

Richard Alexander*	U.S. Geological Survey
Walter Boynton*	University of Maryland
David Brock*	Texas Water Development Board
Darell Brown*	U.S. Environmental Protection Agency
David Chestnut*	South Carolina Dep. of Health and Environmental Control
David Flemer*	U.S. Environmental Protection Agency
Holly Greening*	Tampa Bay National Estuary Program
Thomas Malone*	University of Maryland
Gregory McMurray*	Oregon Department of Environmental Quality
Jan Newton*	Washington Department of Ecology
Jonathan Pennock*	University of Alabama/Dauphin Island Sea Lab
Andrew Robertson*	National Oceanic and Atmospheric Administration
Donald Stanley*	East Carolina University
J. Kevin Summers*	U.S. Environmental Protection Agency
Terry Whitledge*	University of Alaska
Merryl Alber	University of Georgia
Donald Boesch	University of Maryland
Thomas Brosnan	National Oceanic and Atmospheric Administration
Brian Cole	U.S. Geological Survey
Elizabeth Cosper	Cosper Environmental Services, Inc.
Christopher D'Elia	State University of New York at Albany
Ernest Estevez	Mote Marine Laboratory
Peggy Fong	University of California
Fred Holland	South Carolina Department of Wildlife and Marine Resources
Renee Karrh	Maryland Department of Natural Resources
Jack Kelly	U.S. Environmental Protection Agency
Peter Larsen	Bigelow Laboratory for Ocean Science
Theodore Loder	University of New Hampshire
Robert Magnien	Maryland Department of Natural Resources
Michael Mallin	University of North Carolina
Hank McKellar	University of South Carolina
Gary Powell	Texas Water Development Board
Randy Shuman	Metropolitan King County, Washington
Richard Smith	U.S. Geological Survey
Ronald Thom	Battelle Marine Science Laboratory
David Tomasko	Southwest Florida Water Management District
Richard Valigura	National Oceanic and Atmospheric Administration
Peter Verity	Skidaway Institute of Oceanography
Richard Wetzel	Virginia Institute of Marine Science

National Survey: Data Collection and Synthesis. Given limited resources and the methodological difficulties in consolidating existing records, NOAA elected to acquire a consistent and detailed set of categorical data from an existing expert knowledge base with a series of surveys, interviews, and regional workshops.

NOAA conducted three workshops in 1991-92 with local and regional estuarine scientists and coastal resource managers. The purpose of the first two workshops was to facilitate an exchange of ideas about how to best characterize eutrophication in U.S. estuaries and to consider suggestions for NOAA's proposed data collection survey. The first two workshops were held in January 1991 and included presentations by invited speakers and a series of discussions about nutrient problems. A third workshop held in April 1992 focused specifically on recommendations for conducting a nationwide survey.

Based on the workshops and additional meetings with experts, NOAA identified a set of parameters for identifying symptoms of eutrophication. A parameter had to be (1) useful for an accurate characterization of nutrient enrichment; (2) generally available for most estuaries; (3) comparable among estuaries; and (4)

based upon existing data and knowledge, in other words, not requiring new monitoring or analysis. A categorical range of values for each parameter was determined by reviewing nationwide data and through discussions with eutrophication experts. For example, the survey asked whether total dissolved nitrogen in the water column was high, medium, or low based upon predetermined thresholds ("High" ≥ 1 mg/l, 1 mg/l>"Medium" ≥ 0.1, 0.1 mg/l>"Low">0 mg/l, or unknown).

Data Collection Framework. Information was collected to represent both existing conditions and recent trends (circa 1970-1995). Existing conditions include the maximum value observed over a typical annual cycle (e.g., normal freshwater inflow and average temperatures). For instance, in the case of nutrients, the information includes peak concentrations during spring runoff and turnover. For chlorophyll *a*, information includes the peak concentrations during a bloom period. In all, the eutrophication survey provides over 40,000 data values (120-1,200/estuary). See Table 1 for details on parameters.

NOAA's National Estuarine Inventory (NEI) was used as a spatial framework to collect and organize information. Each parameter was characterized for three salinity zones as defined in the NEI (tidal fresh 0-0.5 ppt, mixing 0.5-25 ppt, and seawater >25 ppt), providing a consistent basis for comparisons among the estuarine systems.

The Eutrophication Model. NOAA worked with a "core group" of 15 scientists and managers who had participated in the original survey to develop a model for symptoms of eutrophication. The model isolated three primary and three secondary symptoms. Overabundance of algae using chlorophyll *a*, epiphytes, and macroalgae as indicators represent the first symptoms of degradation in water quality associated with eutrophication. Nitrogen and phosphorus concentrations in the water column are difficult to interpret and were not included as primary symptoms in the model.

In many estuaries, primary symptoms of eutrophication lead to the development of secondary symptoms such as a loss of submerged aquatic vegetation (SAV), nuisance and toxic algae blooms, and low dissolved oxygen (anoxia and hypoxia). However in some cases, secondary symptoms can arise independently of primary symptoms. For instance, toxic algae blooms are transported into many North Atlantic estuaries from the ocean.

Data Processing

Determining the Overall Eutrophication Condition. NOAA worked with the core group to develop a scoring system to rank the overall status of eutrophication. The three primary (chlorophyll *a*, epiphytes, macroalgae) and three secondary (SAV, nuisance and toxic algae, anoxia and hypoxia) symptoms of eutrophication were combined in the following way:

Table 1. Survey parameters and characteristics.

	PARAMETERS	EXISTING CONDITIONS (maximum values observed over a typical annual cycle)	TRENDS (1970 - 1995)
ALGAL CONDITIONS	**CHLOROPHYLL *A***	• Surface concentrations: Hypereutrophic (>60 µg chl-a/l) High (>20, ≤60 µg chl-a/l) Medium (>5, ≤20 µg chl-a/l) Low (>0, ≤5 µg chl-a/l) • Limiting factors to algal biomass (N, P, Si, light, other) • Spatial coverage[1], Months of occurrence, Frequency of occurrence[2]	• Concentrations[3,4] • Limiting factors • Contributing factors[5]
	TURBIDITY	• Secchi disk depths: High (<1m), Medium (1≥m, ≤3m), Low (>3m), Blackwater area • Spatial coverage[1], Months of occurrence, Frequency of occurrence[2]	• Concentrations[3,4] • Contributing factors[5]
	SUSPENDED SOLIDS	• Concentrations: Problem (significant impact upon biological resources) No Problem (no significant impact) • Months of occurrence, Frequency of occurrence[2]	(no trends information collected)
	NUISANCE ALGAE **TOXIC ALGAE**	• Occurrence Problem (significant impact upon biological resources) No Problem (no significant impact) • Dominant species • Event duration (Hours, Days, Weeks, Seasonal, Other) • Months of occurrence, Frequency of occurrence[2]	• Event duration[3,4] • Frequency of occurrence[3,4] • Contributing factors[5]
	MACROALGAE **EPIPHYTES**	• Abundance Problem (significant impact upon biological resources) No Problem (no significant impact) • Months of occurrence, Frequency of occurrence[2]	• Abundance[3,4] • Contributing factors[5]
NUTRIENTS	**NITROGEN**	• Maximum dissolved surface concentration: High (≥1 mg/l), Medium (≥0.1, <1 mg/l), Low (≥0, < 0.1 mg/l) • Spatial coverage[1], Months of occurrence	• Concentrations[3,4] • Contributing factors[5]
	PHOSPHORUS	• Maximum dissolved surface concentration: High (≥0.1 mg/l), Medium (≥0.01, <0.1 mg/l), Low (≥0, < 0.01 mg/l) • Spatial coverage[1], Months of occurrence	• Concentrations[3,4] • Contributing factors[5]
DISSOLVED OXYGEN	**ANOXIA (0 mg/l)** **HYPOXIA (>0mg/l ≤ 2mg/l)** **BIOL. STRESS (>2mg/l ≤ 5mg/l)**	• Dissolved oxygen condition Observed No Occurrence • Stratification (degree of influence): (High, Medium, Low, Not a factor) • Water column depth: (Surface, Bottom, Throughout water column) • Spatial coverage[1], Months of occurrence, Frequency of occurrence[2]	• Min. avg. monthly bottom dissolved oxygen conc.[3,4] • Frequency of occurrence[3,4] • Event duration[3,4] • Spatial coverage[3,4] • Contributing factors[5]
ECOSYSTEM / COMMUNITY RESPONSE	**PRIMARY PRODUCTIVITY**	• Dominant primary producer: Pelagic, Benthic, Other	• Temporal shift • Contributing factors[5]
	PLANKTONIC COMMUNITY	• Dominant taxonomic group (number of cells): Diatoms, Flagellates, Blue-green algae, Diverse mixture, Other	• Temporal shift • Contributing factors[5]
	BENTHIC COMMUNITY	• Dominant taxonomic group (number of organisms): Crustaceans, Molluscs, Annelids, Diverse mixture, Other	• Temporal shift • Contributing factors[5]
	SUBMERGED AQUATIC VEG. **INTERTIDAL WETLANDS**	• Spatial coverage[1]	• Spatial coverage[3,4] • Contributing factors[5]

NOTES

(1) SPATIAL COVERAGE (% of salinity zone): High (>50, ≤100%), Medium (>25, ≤50%), Low (>10, ≤25%), Very Low (>0, ≤10%), No SAV / Wetlands in system

(2) FREQUENCY OF OCCURRENCE: Episodic (conditions occur randomly), Periodic (conditions occur annually or predictably), Persistent (conditions occur continually throughout the year)

(3) DIRECTION OF CHANGE: Increase, Decrease, No trend

(4) MAGNITUDE OF CHANGE: High (>50%, ≤100%), Medium (>25%, ≤50%), Low (>0%, ≤25%)

(5) POINT SOURCE(S), NONPOINT SOURCE(S), OTHER

First, the average value of the three primary symptoms was calculated.

Second, the highest value of the three secondary symptoms was taken. The highest value was taken because, as a general rule, an estuary showing only one secondary symptom of eutrophication may be just as impacted as an estuary showing all three secondary symptoms.

Finally, numeric variables used to gauge primary and secondary symptoms of eutrophication were converted into categorical variables of high, moderate, and low using methods developed by the "core group." A description of the methodology in included in the tables below.

Data Completeness and Reliability. The results of the Eutrophication Survey were affected by two factors: data gaps and data based on speculative inference. Respondents were given the option of calling the information they provided a speculative inference. Data gaps occurred whenever information was either unavailable or insufficient. To understand the limitations of the estuarine eutrophication survey data set, a simple rating of data completeness and reliability (DCR) was calculated.

A DCR score was assigned to thirteen parameters and for the estuary as a whole. DCR was calculated based on the percent of the total area of the estuary about which information was considered certain. For example, if information about the concentration of chlorophyll *a* were available for the entire estuary, then the chlorophyll-a DCR index would be 100%. If there was missing data for twenty percent of the estuary, then the DCR would be 20%.

The DCR rating scheme was as follows:

High (3) = 75 – 100%
Medium (2) = 50 – 74%
Low (1) = 0 – 49%

Interpretation and Review

Interpretation and Review. At the National Assessment Workshop, experts reviewed the primary and secondary symptoms of eutrophication for all 138 estuaries in the survey. Some changes were made. For instance, borderline estuaries with values near 0.3 or 0.6 were sometimes moved up or down a category level based on expert knowledge, such as better information not in the original survey data.

Nutrient Inputs. Nitrogen and phosphorus loads from point, non-point, and atmospheric sources were estimated for each estuarine watershed. The USGS SPARROW (spatially referenced regressions of contaminant transport on watershed attributes) model was the primary indicator of nitrogen pressure. Estimates of total nitrogen loads were made for five major nutrient source types: point, fertilizer, livestock, atmospheric deposition, and non-point/nonagricultural. The estimates provide a snapshot of conditions during the early-1980s. Data are available for all USGS 8-digit hydrologic catalog units and are based on measurements from a national network of stream gauge stations (NASQAN) operating between 1970 and 1988. For the purposes of the national workshop, NOAA aggregated data for the 8-digit units to the watershed scale. An overestimation of actual loads in some estuaries is possible. Other trend data sets including EPA county level estimates of fertilizer sales, USGS county level estimates of fertilizer use, USGS Land Use/Land Cover, U.S. Census Bureau Population Census and U.S. Department of Agriculture Census of Agriculture (livestock and cropland) were used to substantiate nitrogen load estimates and account for phosphorus.

Chlorophyll Level of Expression Determina

Spatial coverage and frequency of occurrence are used to determine the level of expression for each salinity zone and are then aggregated up to the estuary level (See Estuary Aggregation Rules).

IF	*AND*	*AND*	*THEN*	
Concentration	Spatial Coverage	Frequency	Expression	Value
Hypereutrophic *or* High	High	Periodic	High	1
	Moderate	Periodic	High	1
	Low	Periodic	Moderate	0.5
	Very Low	Periodic	Moderate	0.5
	High	Episodic	High	1
	Moderate	Episodic	Moderate	0.5
	Low/Very Low	Episodic	Low	0.25
	Any Spatial Coverage	Unknown	Flag A	0.5
	Unknown	Any Frequency	Flag A	0.5
Concentration	Spatial Coverage	Frequency	Expression	
Medium	High	Periodic	High	1
	Moderate	Periodic	Moderate	0.5
	Low/Very Low	Periodic	Low	0.25
	High	Episodic	Moderate	0.5
	Mod/Low/Very Low	Episodic	Low	0.25
	Any Spatial Coverage	Unknown	Flag A	0.5
	Unknown	Any Frequency	Flag A	0.5
Concentration	Spatial Coverage	Frequency	Expression	
Low	Any Spatial Coverage	Any Frequency	Low	0.25
Concentration	Spatial Coverage	Frequency	Not included in calculation at zone level	
Unknown	Unknown	Unknown		

Submerged Aquatic Vegetation (SAV) Loss Level of Expression Det

The magnitude of loss of the decline is used to determine the level of expression at the zone level and is then aggregated up to the estuary level (See Estuary Aggregation Rules).

IF	AND	THEN	
SAV Loss	Magnitude of Loss	Expression	Value
Observed	High	High	1
	Moderate	Moderate	0.5
	Low	Low	0.25
	Unknown	Flag D	0.25

Nuisance and Toxic Blooms Level of Expression Determination

Flags A through F are used to identify impacts for which not enough data was available. Assumptions were based on a conservative estimate that an unknown spatial coverage represented at least 10 percent of the zone, an unknown duration was at least one or more days, and an unknown frequency was episodic.

The duration of bloom events and frequency of occurrence is used to determine impact severity at the salinity zone level, and are then aggregated up to the estuary level (See Estuary Aggregation Rules).

IF	AND	AND	THEN	
Nuisance Blooms	Duration	Frequency	Expression	Value
Problem	M, WM, WS, S, PR	Periodic	High	1
	DW, V, W	Periodic	Moderate	0.5
	D	Periodic	Low	0.25
	M, WM, WS, S, PR	Episodic	Moderate	0.5
	DW, V, W	Episodic	Low	0.25
	D	Episodic	Low	0.25
	Unknown	Any Frequency	Flag E	0.25
Toxic Blooms	Duration	Frequency	Expression	Value
Problem	M, WM, WS, S, PR	Periodic	High	1
	DW, W, V	Periodic	Moderate	0.5
	D	Periodic	Low	0.25
	M, WM, WS, S, PR	Episodic	Moderate	0.5
	DW, W, V	Episodic	Low	0.25
	D	Episodic	Low	0.25
	Unknown	Any frequency	Flag F	0.25

S = seasonal, M = months, V = variable, W = weeks, D = days, WS = weeks to seasonal, WM = weeks to months, DW = days to weeks

Low Dissolved Oxygen Level of Expression Determ

Spatial coverage and frequency of occurrence are used to determine level of expression at the zone level and are then aggregated up to the estuary level (See Estuary Aggregation Rules).

IF	AND	AND	THEN	
Anoxia	Spatial Coverage	Frequency	Expression	Value
	High	Periodic	High	1
	Moderate	Periodic	High	1
Observed	Low	Periodic	Moderate	0.5
	Very Low	Periodic	Low	0.25
	High	Episodic	Moderate	0.5
	Moderate/Low/Very Low	Episodic	Low	0.25
	Unknown	Any frequency	Flag A	0.25
Hypoxia	Spatial Coverage	Frequency	Expression	Value
	High	Periodic	High	1
	Mod	Periodic	Moderate	0.5
Observed	Low/Very Low	Periodic	Low	0.25
	High	Episodic	Moderate	0.5
	Moderate/Low/Very Low	Episodic	Low	0.25
	Unknown	Any frequency	Flag B	0.25
Biological Stress	Spatial Coverage	Frequency	Expression	Value
	High	Periodic	Moderate	0.5
Observed	Moderate/Low /Very Low	Periodic	Low	0.25
	Any Spatial Coverage	Episodic	Low	0.25
	Unknown	Any frequency	Flag C	0.25

Epiphyte Problem Level of Expression Determ

The frequency of problematic epiphytic growth is used to determine level of expression at the salinity zone level and is then aggregated up to the estuary level (See Estuary Aggregation Rules).

IF	AND	THEN	
Epiphyte Problems	Frequency	Expression	Value
Observed	Periodic	High	1
	Episodic	Moderate	0.5
	Unknown	Flag B	0.5
Unknown	Unknown	Not included in calculation at zone level	

Estuary Aggregation Rules

1. For each symptom, an area weighted expression value for each zone is determined. First the surface area of the salinity zone is multiplied by the symptom expression value for the zone and then divided by the surface area of the entire estuary to obtain an area weighted value for the zone. The area weighted values are then summed to obtain the estuary level of expression value for the symptom.

$$\overset{n}{\underset{i=1}{?}} \left(\frac{A_z}{A_t} \right) \cdot \left(\text{Expression Value} \right) = \text{symptom level of expression value for estuary}$$

Symbols:

A_z= surface area of a single zone

A_t= total surface area of estuary

n= total number of zones in estuary

2. The level of expression of the primary symptoms for the estuary is determined by calculating the ***average*** of the three estuary level of expression values. The level of expression of the secondary symptoms for the estuary is determined by taking the ***highest*** of the three estuary level of expression values.

3. The estuary is then assigned a category for Primary Symptoms as follows:

Estuary Expression Value	Level of Expression Category Assigned
? 0 to S 0.3	Low
>0.3 to S 0.6	Moderate
>0.6 to S 1	High

Susceptibility: Determining the Estuarine Export Potential (EXP). Susceptibility to nutrient input

depends on the amount of time that nutrients remain in an estuary before exiting. An estuary with a high flushing potential and a high dilution potential is less susceptible to nutrient-related eutrophication. In contrast, an estuary with a low flushing and low dilution potential is more susceptible to nutrient-related eutrophication. An estuarine export potential (EXP), being developed as part of NOAA's Coastal Assessment and Data Synthesis system, gauges an estuary's capacity to dilute and flush dissolved nutrient loads. The higher the EXP, the greater the ability of an estuary to dilute and flush dissolved nutrients.

Dilution potential is an estimate of an estuary's ability to dilute nutrient inputs. In general, the larger the estuary volume the greater the dilution potential. For stratified estuaries, nutrients are retained in the upper portion of the water column and less of the total water column is available for dilution purposes. Flushing potential is an estimate of an estuary's ability to flush an incoming nutrient source based on its tide range, daily freshwater inflow and estuary volume. In general, the greater the freshwater and tidal flow the greater the flushing potential.

Determining Overall Human Influence. An attempt was made to determine the degree to which human activities have contributed to symptoms of eutrophication. Nutrient input alone is usually not sufficient to determine overall human influence. A relatively small nutrient input from human sources may have a profound effect if an estuary has a high inherent susceptibility. On the other hand, a relatively large nutrient input from human sources may have a negligible effect if an estuary has a low inherent susceptibility. Inherent susceptibility and nutrient input were combined to estimate overall human influence on eutrophic conditions. Experts at the National Assessment Workshop reviewed and when appropriate modified susceptibility or nutrient pressure assessments.

Identifying Impaired Uses and Potential Management Concerns. Experts at the National Assessment Workshop identified the kinds of uses that would be impaired by estuarine eutrophication including recreational and commercial fishing, fish consumption, shellfish, swimming, boating, aesthetics, tourism, SAV and habitat loss, and loss of assimilative capacity. The information about impaired use provides a rough estimate of how eutrophic conditions affect use of estuarine resources.

In addition, experts at the workshop identified important point and non-point sources that could be targeted to manage nutrient inputs, including wastewater treatment plants, combined sewer overflow, on-site waste disposal such as septic systems, industrial discharge, large animal operations, urban runoff, agriculture, forestry practice, rangeland use, atmospheric inputs and aquaculture.

Determining Future Outlook. Given estuarine susceptibility and projected changes coastal population density, it was possible to estimate the likelihood that conditions might worsen, improve, or stay the same in any given estuary over the next twenty years. Experts at the National Assessment Workshop were asked to make modifications to initial estimates of future nutrient pressure based upon their own knowledge of planned or likely changes in the future.

For more complete details of methods, see Appendix A of the National Estuarine Eutrophication Assessment report at http://coastalgeospatial.nos.noaa.gov/documentation/eutro/eutro_report.pdf

Contact(s) on Data Processing

Percy A. Pacheco
Environmental Engineer
NCA Branch, Special Projects Office (SPO), NOS/NOAA
1305 East West Highway, SSMC4, 9th Floor
Silver Spring, Maryland 20910
Tel: 301-713-3000 x 155
Fax: 301-713-4384
Email: mailto:percy.pacheco@noaa.gov

Quality Control

Survey data was reviewed by all of the participants of the regional assessment workshops. Participants at the National Assessment Workshop reviewed aggregate data. A professional team in NOAA's Special Projects Office also reviewed data. The Special Projects team incorporated corrections, comments and observations into the final 1999 eutrophication (existent, trend and ecosystem) dataset. All data processing was done using the Statistical Analysis System (SAS) software. Further data management and analysis was done using FileMaker Pro database software.

Citation:

Estuarine Eutrophication. Coastal Assessment and Data Synthesis (CA&DS) System, 1999. National Coastal Assessments (NCA) Branch, Special Projects Office (SPO), National Ocean Service (NOS), National Oceanic and Atmospheric Administration (NOAA). Silver Spring, Maryland.

Applicable Digital Geography

The data are associated to distinct spatial aggregations. Geographic Information System (GIS) digital geographies are available for associating these data to their appropriate spatial aggregations. The following GIS files apply to and should be used with these data during GIS processing. To download the data or an applicable digital geography, click on the links below.

Dataset Spatial Aggregation	Applicable GIS file(s)
Coastal Watersheds	

For Additional Information:

For additional information, refer to NOAA's Coastal Assessment and Data Synthesis (CA&DS) System, or contact:

The CA&DS team.
National Coastal Assessments Branch
Special Projects Office (SPO), NOS/NOAA
1305 East West Highway, SSMC4, 9th Floor
Silver Spring, Maryland 20910
Tel: 301-713-3000
Fax: 301-713-4384