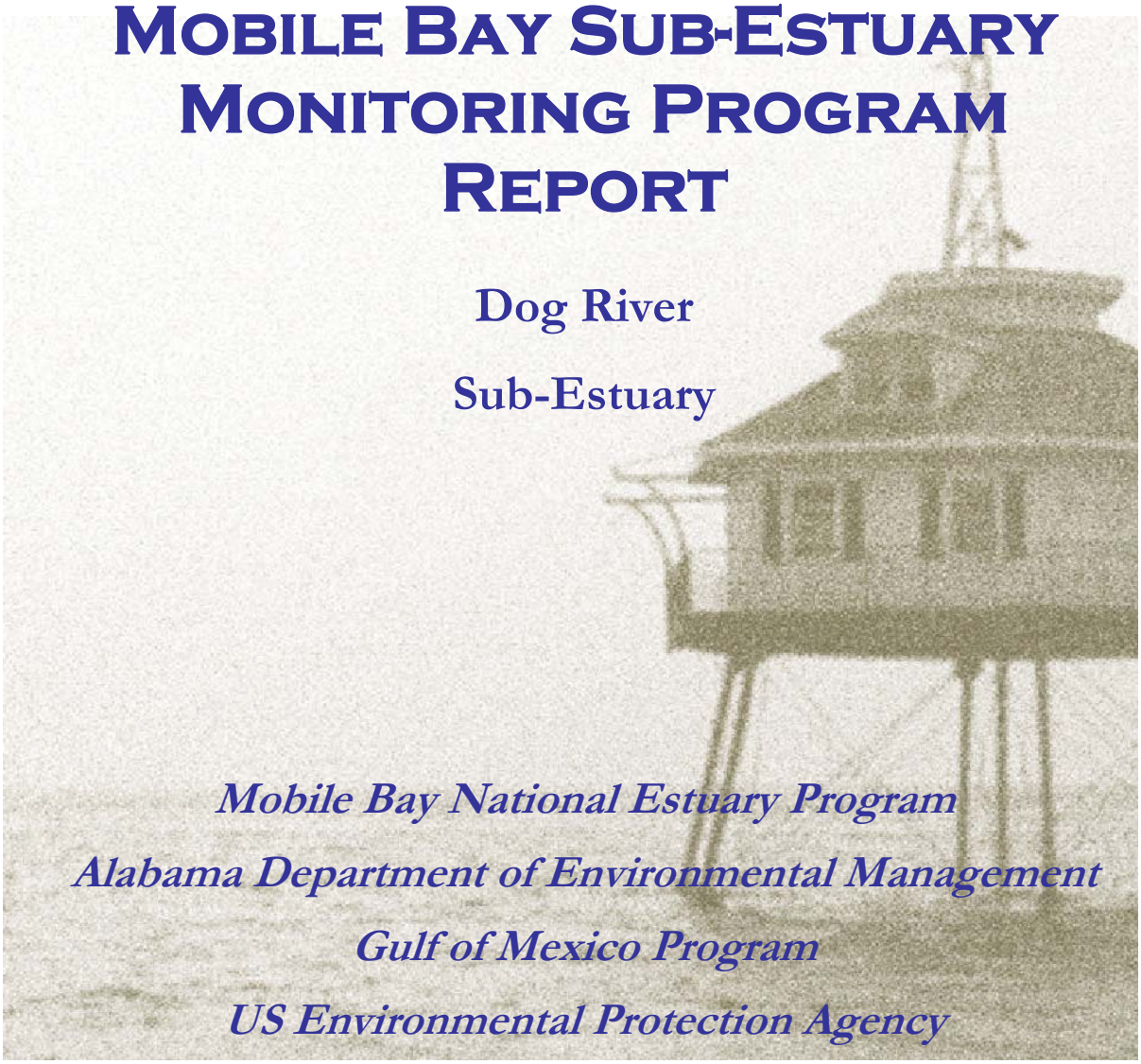
Mobile Bay Sub-Estuary Monitoring Program Report

Dog River

Sub-Estuary



Mobile Bay National Estuary Program

Alabama Department of Environmental Management

Gulf of Mexico Program

US Environmental Protection Agency

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Acknowledgments

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Acronyms

ADEM	Alabama Department of Environmental Management
ADCP	Acoustic Doppler Current Profiler
ADPH	Alabama Department of Public Health
BMP	Best Management Practice
CCMP	Comprehensive Conservation Management Plan
DISL	Dauphin Island Sea Lab
DO	Dissolved Oxygen
EPA(USEPA)	Environmental Protection Agency
GPS (DGPS)	(Differential) Global Positioning System
GSA	Geological Survey of Alabama
HAB	Harmful Algal Bloom
HUC	Hydrologic Unit Code
MBNEP	Mobile Bay National Estuary Program
MCHD	Mobile County Health Department
NCA	National Coastal Assessment (Coastal 2000)
MDN	Mercury Deposition Network
NEP	National Estuary Program
NOAA	National Oceanic and Atmospheric Administration
NADP	National Atmospheric Deposition Program
NPDES	National Pollution Discharge Elimination System
NPS	Non-Point Source
NRCS	National Resource Conservation Service
NTU	Nephelometric Turbidity Units
PAHs	Polycyclic Aromatic Hydrocarbons
QAQC	Quality Assurance Quality Control
SAV	Submerged Aquatic Vegetation
TMDL	Total Maximum Daily Load
USACE	US Army Corps of Engineers
USFDA	US Food and Drug Administration
USFWS	US Fish and Wildlife Service
USGS	US Geological Survey
WQ	Water Quality
WWTP	Waste Water Treatment Plant

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Executive Summary

In 2005 the Mobile Bay National Estuary Program (MBNEP) initiated a monitoring program within the Sub-Estuaries of Mobile Bay. The project area consisted of portions of Mobile Bay and adjoining waterbodies in coastal Alabama. This report covers actions initiated by the MBNEP in an agreement between the Alabama Department of Environmental Management (ADEM) and the Dauphin Island Sea Lab pursuant to an appropriation by the Environmental Protection Agency (EPA) and on behalf of the MBNEP.

This report describes the findings of the third of several sub-estuaries that were evaluated for the monitoring program, Dog River. The Bon Secour River / Intracoastal Waterway / Oyster Bay Sub-Estuary in southwestern Baldwin County (Southeastern Mobile Bay) and the Bayou la Batre sub-estuaries were also evaluated under this program.

With the exception of the mouth of Dog River and Halls Mill Creek it was observed that Bolton Branch, Eslava Creek, and Moore Creek had values that failed to meet Alabama Department of Environmental Management (ADEM) water quality criteria. Based on National Coastal Assessment (NCA) water quality index, the Dog River Sub-Estuary rated as “Fair” to “Good”. NCA Sediment Index rated the sub-estuary as “Fair” to “Good” with one location rated as “Poor” for sediment Mercury.

Of the 5 ADEM stations, 3 were “Non-Supporting” of their use classification: ESCM-3, BOLM-3, and MCM-1. Two stations were “Supporting” their use classification: DGRM-1A and HMCM-1. Conventional water quality parameters (i.e. dissolved oxygen, temperature and pH), were within ADEM water quality criteria.

Based on nitrogen and chlorophyll-a data, nutrient loadings to the sub-estuary appears to be moderate to high. Phosphorous does not appear to be a factor. Of the 13 sampling stations, 11 exceeded the NCA “Poor” threshold for nitrogen for a poor rating of 76.9% (based on number of stations). All 13 stations rated as “Fair” for chlorophyll. All of the stations rated “Good” for phosphorus.

One location exceeded the <5 ERL criterion, RBTM-1 for Mercury in Sediment 0.714 ppm which resulted in a “Poor” rating and was also an ERM exceedance. Three stations rated as “Fair” (BOLM-3, DR-1, and MCM-1). All other stations were rated as “Good”. Also, no location had an exceedance of PAHs or Pesticides.

Introduction

In 2005 the Mobile Bay National Estuary Program (MBNEP) initiated a monitoring program within the Sub-Estuaries of Mobile Bay. The project area consisted of portions of Mobile Bay and adjoining waterbodies in coastal Alabama. This report covers actions initiated by the MBNEP in an agreement between the Alabama Department of Environmental Management (ADEM) and the Dauphin Island Sea Lab pursuant to an appropriation by the Environmental Protection Agency (EPA) and on behalf of the MBNEP.

This report describes the findings of the third of three sub-estuaries that were evaluated for the monitoring program. The Bon Secour River / Intracoastal Waterway / Oyster Bay Sub-Estuary in southwestern Baldwin County was the first sub-estuary to be evaluated under this program. Subsequent studies were conducted in the Bayou la Batre and Dog River sub-estuaries.

The program also provided support for components of the Mobile Bay National Estuary Program Plan (August 2000) and was consistent with the MBNEP Comprehensive Conservation and Management Plan (CCMP). Further, it was designed to fulfill the needs of the ADEM by using departmental personnel and procedures. In this way, data generated by the MBNEP will supplement ADEM monitoring. Thus, both agencies benefit from the collaborative effort.

To be consistent with ADEM procedures, the data was analyzed using the standard operating procedures of the department. The data was compared to use criteria for differing waterbody classifications as set forth by the ADEM. Sections 305(b) and 303(d) of the federal Clean Water Act direct states to monitor and report the condition of their water resources. Alabama's Final Methodology for Use Support Determinations (Applicable Prior to 2006 Integrated Report), established a process to assess the status of surface waters in Alabama relative to the beneficial uses assigned to each waterbody.

Data collected for the MBNEP by Federal, State, and/or Local agencies have the same goal of measuring estuarine conditions. While data cannot be directly compared due to differing methodologies, NEPs are able to choose data and methods that best fit their environmental concerns. Both State and Federal methodologies were used in the assessment of the sub-estuary, ADEM water quality standards (assessment and listing methodology) and EPA's National Coastal Assessment (NCA).

Methods

Water Quality Monitoring

Standardized methods were used in this project, to assure consistency, quality, and reliability of data and results generated by this program. These methods were developed for use by the ADEM as the Standard Operating Procedures (SOPs) and are specified in the Quality Assurance Management Plan (QAMP, 2005).

The Bon Secour River/ Intracoastal Waterway/Oyster Bay sub-estuary monitoring program was conducted with the previous QAMP (2003). A major difference between the 2003 and 2005 QAMP was that for the 2005QAMP, a geometric mean for bacteria was calculated from no less than five samples collected at a given station over a 30-day period at intervals not less than 24 hours.

The MBNEP coordinated the Sub-Estuary monitoring effort with ADEM's ambient monitoring program. The ADEM conducted water quality monitoring within the aforementioned sub-estuaries by agreement with the MBNEP and simultaneously through the ADEM Ambient monitoring program. The total effort involved the following:

ADEM established 4 judgmentally located sampling locations within the sub-estuary and 9 judgmentally located sampling locations near major tributaries for a total of 13 locations sampled quarterly. The ADEM Water Quality Branch also requested that 7 of the 13 stations be sampled on a monthly basis in 2007 in addition to the quarterly sampling for the MBNEP. Additionally, 1 site on Eslava Creek and 2 sites on Bolton Branch, all upstream of the sampling area were sampled as part of the 303d sampling for 2007.

In-situ measurements made at each site included: Dissolved Oxygen (mg/l), Temperature (C), pH, Salinity (ppt), Specific Conductance (mS/cm) and Depth (m). These measurements were made with a YSI® 650MDS and 600QS multiparameter water quality datasondes. Light penetration was measured using a photometer and a standard Secchi disk. Water samples were a composite of the Photic zone using a submersible pump (Except for the bacteria sample from the sub-surface). The photic zone was calculated by lowering the photometer until a depth of 1% of the sub-surface was reached.

Water Flow data was collected using a vessel mounted Acoustic Doppler Current Profiler (ADCP) flow meter. 72 hour diurnal *in situ* water quality data were collected at 3 locations using a YSI® 600XLM water quality data logger: DRSND 1 (Dog River Bridge), DRSND 2 (Pier near DGRM-4 with permission of the Alba Club), and DRSND 3 (the pipeline adjacent to the Interstate 10 bridge).

Laboratory parameters analyzed at each monitoring location included:

- Turbidity
- Total Suspended Solids
- Total Dissolved Solids
- Ammonia
- Total Nitrogen (TN)
- Total Phosphorus (TP)
- Dissolved Reactive Phosphorus, (ortho-phosphate)
- Total Kjeldahl Nitrogen (TKN)
- Chlorophyll-a
- 5-day Carbonaceous Biochemical Oxygen Demand (CBOD5)
- Hardness
- Pathogens

Sediment was collected once at each monitoring location and analyzed for the following:

- Aluminum
- Arsenic
- Cadmium
- Chromium
- Copper
- Lead
- Mercury
- Nickel
- Silver
- Tin
- Zinc
- Antimony
- Iron
- Manganese
- Selenium
- Polynuclear Aromatic Hydrocarbons (PAHs)
- Pesticides (DDD, DDE, DDT, Dieldrin, Heptachlor, BHC)

Sediment samples were collected at each station from subsamples of composited surficial sediment collected with a 0.052m² modified stainless steel Ponar sampler.

The upper reaches of Dog River have tributaries that are listed separately on the 2006 and 2008 303(d) list for pathogens: Eslava Creek (Urban runoff/storm sewers) from Dog River to it's source, and Bolton Branch is listed twice. It is listed once for Urban runoff/storm sewers from Dog River to it's source and is listed again for Urban runoff/storm sewers and Collection System failures from Moor Creek to it's source.

ADEM Water Quality Criteria Used

Alabama's assessment and listing methodology establishes a process, consistent with EPA guidance, to assess the status of surface waters in Alabama relative to the designated uses assigned to each. This methodology is not intended to limit the data or information that the State considers as it prepares an integrated water quality assessment report. Rather, it is intended to establish a rational and consistent process for reporting the status of Alabama's surface waters relative to their designated uses.

The EPA guidelines for preparation of the §305(b) Water Quality Report to Congress offer the following guidance regarding use support determinations using conventional water quality parameters (i.e. dissolved oxygen, temperature, pH).

- Fully Supporting – For any one pollutant or stressor the criteria is exceeded in $\leq$ 10 percent of the measurements.
- Partially Supporting – For any one pollutant or stressor the criteria is exceeded in 11 to 25 percent of the measurements.
- Not Supporting – For any one pollutant or stressor the criteria is exceeded in > 25 percent of the measurements.

Water quality standards consist of three components: designated uses, numeric and narrative criteria, and an antidegradation policy. Data collected for the MBNEP (by Federal, State, and/or Local agencies), have the same goal of measuring estuarine conditions. While data cannot be directly compared due to differing methodologies, NEPs are able to choose data and methods that best fit their environmental concerns.

NCA Criteria Used

The National Coastal Assessment relies on 5 water quality indicators to estimate an estuarine Water Quality Index: Dissolved Inorganic nitrogen (DIN), Dissolved Inorganic Phosphorous (DIP), Chlorophyll a, water clarity, and bottom dissolved oxygen. During discussions with the EPA Gulf Ecology Division it was recommended that the criteria set for DIN and DIP was inappropriate for sub-estuary sampling due to lower salinity. It should be noted that although high salinity was recorded near the bottom (salt wedge), water quality samples were collected in the photic zone above the salt wedge. Therefore, TN & TP were substituted and criteria was amended from USEPA Recommended Values of TN & TP for Alabama Ecoregion 75 (USEPA 2000).

*National Coastal Assessment's (NCA) *Water Quality Criteria*

GOOD	FAIR	POOR
-Total nitrogen (TN) Good = < 0.02 mg/L Fair = 0.02 – 0.04 mg/L Poor = >0.04 mg/L	-Chlorophyll-a Good = < 5 µg/L Fair = 5 – 20µ g/L Poor = >20µg/L	-*Water Clarity Good = > 10% Fair =5 – 10% Poor = <5% *Comparison of percent light penetration at a depth of 1.0 meter
-Total phosphorus (TP) Good = < 0.4 mg/L Fair = 0.4 – 0.8 mg/L Poor = >0.9 mg/L	-Bottom dissolved oxygen Good = > 5 mg/L Fair = 2 – 5mg/L Poor = >2 mg/L	

*Amended to correspond to EPA recommended values of TN & TP for Alabama Ecoregion 75 (USEPA 2000).

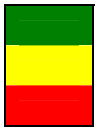
NCA Water Quality Index

A water quality index, developed for the Gulf Coast by the U.S. EPA, was used to determine the condition of Alabama's coastal waters for the National Coastal Condition Report. At each sampling location, these indicators were ranked good, fair, or poor. For the water quality index, each of these rankings was used to determine an index ranking for the specific sampling point. For a site to be ranked as good, it could have no more than one indicator rated as fair. For a site to be ranked as fair, it would have one indicator rated as poor or two or more indicators rated as fair. A site would be ranked as poor if it had two or more indicators rated as poor.

NCA Sediment Contaminants

Sediments were examined in Alabama's coastal waters for a total of 15 trace metals, 25 polynuclear aromatic hydrocarbons (PAHs), 21 polychlorinated biphenyls (PCBs), and 22 pesticides. Effects Range Median (ERM) and Effects Range Low (ERL) values were published for many of these contaminants by Long *et al* (1995), and are used as guidelines for contamination by the EPA (NCA) as well as Alabama. These values are shown in Table 3. ERM is the concentration which would result in adverse effects in 50 percent of the studies examined. ERL is the concentration which would result in adverse effects in 10 percent of the studies examined. These ERM and ERL values are used to assess sediment contamination. The Sub-Estuary Monitoring Program has adopted criteria similar to that of the EPA National Coastal Assessment (See Table 1).

National Coastal Assessment's (NCA) Sediment Contaminants Criteria



Good = No ERM exceeded and < 5 ERL concentrations exceeded
Fair = 5 or more ERL concentrations exceeded
Poor = An ERM concentrations exceeded

**Criteria for Assessing Sediment Contaminants by NEP Estuary or Region*

Good = <5% of estuary is in poor condition
Fair = 5-15% of estuary is in poor condition
Poor = >15% of estuary is in poor condition

*Adopted from National Estuary Program Coastal Condition Report (USEPA) 2006

Table 1. Guidance Values for ERM and ERL Long et al, 1995

Metals ug/g (ppm)	**ERL**	**ERM**
Arsenic (As)	8.2	70
Cadmium (Cd)	1.2	9.6
Chromium (Cr)	81	370
Copper (Cu)	34	270
Lead (Pb)	46.7	218
Mercury (Hg)	0.15	0.71
Nickel (Ni)	20.9	51.6
Silver (Ag)	1	3.7
Zinc (Zn)	150	410
Analyte ng/g (ppb)	**ERL**	**ERM**
Acenaphthene	16	500
Acenaphthylene	44	640
Anthracene	85.3	1100
Flourene	19	540
2-Methyl naphthalene	70	670
Napthalene	160	2100
Phenanthrene	240	1500
Benz(a)anthracene	261	1600
Benzo(a)pyrene	430	1600
Chrysene	384	2800
Dibenzo(a,h)anthracene	63.4	260
Flouranthene	600	5100
Pyrene	665	2600
Low molecular weight PAH	552	3160
High molecular weight PAH	1700	9600
Total PAHs	4020	44800
4,4'-DDE	2.2	27
Total DDT	1.6	46.1
Total PCBs	22.7	180

Table 1. Guidance Values for ERM and ERL (Long et al,1995).

Atmospheric Input Criteria

ADEM operates several Particulate monitors throughout the state and 2 wet deposition monitors in Mobile and Baldwin Counties that are partially funded by the MBNEP. These monitors are part of the National Atmospheric Deposition Program (NADP). Data was evaluated on a regional basis, as opposed to individual monitors and are evaluations from NADP regional data.

Atmospheric inputs are pollutant emissions to the atmosphere that are either anthropogenic (human activities), natural, or re-emitted (transferred to the atmosphere from previously deposited pollutants).

Atmospheric loading to waterbodies can happen via dry or wet deposition of a pollutant either by direct or indirect deposition. Spatial and temporal limitations of monitoring networks as well as uncertainties and data gaps for specific pollutants make it difficult to report loading to waterbodies (See Figure 2).

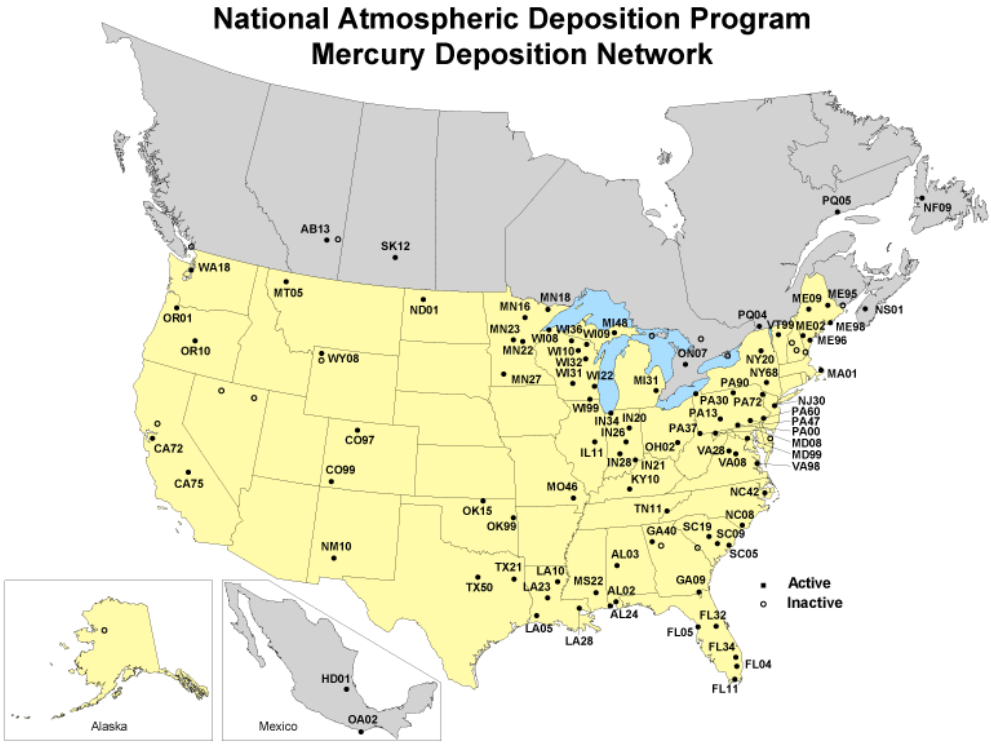


Figure 1. National Atmospheric Deposition Program.

Fish Tissue Monitoring

The ADEM Fish Tissue Monitoring Program (FTMP) provides statewide screening of bioaccumulative contaminants in fish tissue, and provides the Alabama Department of Public Health (ADPH) with data needed for issuance, modification, or removal of fish consumption advisories in accordance with US Environmental Protection Agency (EPA) guidance levels. It should be noted that the ADPH began using the EPA guidance in 2005. Formerly, ADPH used Food and Drug Administration (FDA) guidance. The data was made available for this report by the FTMP.

ADEM collected fish in the ship channel south of and into the mouth of Bayou la Batre. Fish were also collected for the NCA program however analyses for contamination were done using the whole body of the fish which differs from ADEM procedures. ADEM procedures call for the removal and analysis of the left and right fillets rather than whole body. Neither EPA nor FDA guidance criteria exist for whole body contaminants, therefore no comparison to consumption advisories can be made with NCA results.

National Coastal Assessment's (NCA) Summarization of Indices for Overall Condition

The overall condition of the sub-estuary is calculated by summing the scores for the available indices and dividing by the number of available indices. Good =5, Fair =4, 3, or 2 and Poor = 1. The NCA summarization is based on the following indices: Water Quality, Sediment Quality, Benthic Index, and Fish Tissue Contaminants. Enough data exists to calculate overall condition based on Water and Sediment Quality; however, Benthic samples were not included in the program. Also, ADEM fish tissue collection methods differ from NCA methods and a direct comparison cannot be made.

Sampling Platform

A twenty -two foot gasoline powered research vessel (*R/V Tensaw*) with crew was provided by ADEM. Stations were located using Differential Global Positioning System (DGPS) receiver with accuracies of better than 10 meters. A 10 foot tender was also used in narrower creeks where the main vessel could not maneuver.

Analytical Requirements

The ADEM gathered data collected from sub-estuary sample locations and compare it to ADEM's Specific Water Quality Criteria as set forth in ADEM Administrative Code R. 335-6. As a part of its water quality assessment program, ADEM has created a use support methodology. The purpose of this protocol is to assess if a waterbody is supporting its use classification.

Data Management

Measurements and observations were entered directly onto ADEM Field Sheets or in a bound Field Book. Field records were then transferred into the appropriate electronic format as required by the Mobile Bay NEP.

All raw data, field records, and laboratory reports were provided to the MBNEP. Request for data should be submitted to the MBNEP or to ADEM Public Records Officer, P.O. Box 301463, Montgomery, AL 36130-1463.

Monitoring Locations

ADEM established 4 judgmentally located sampling locations within the sub-estuary and 9 judgmentally located sampling locations near major tributaries for a total of 13 locations sampled quarterly. The ADEM Water Quality Branch also requested that 7 of the 13 stations be sampled on a monthly basis in 2007 in addition to the quarterly sampling for the MBNEP. Figure 3 is a map of sampling locations. Table 1 shows latitude and longitude coordinates for sampling locations.

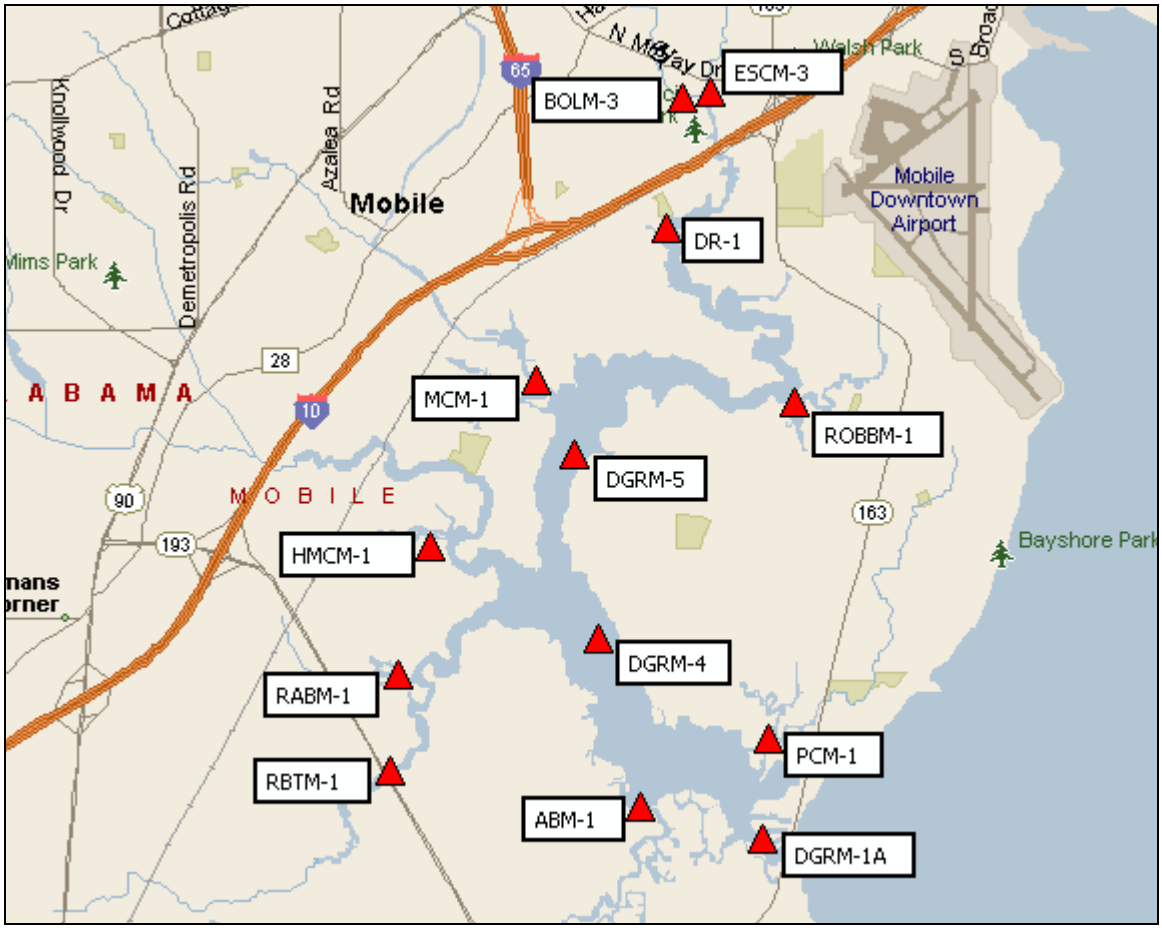


Figure 2. Map of sampling locations.

Station	Latitude	Longitude
BOLM-3	30.6416	-88.0999
ESCM-3	30.6422	-88.0966
DR-1	30.6285	-88.1017
DGRM-4	30.5700	-88.095
PCM-1	30.5767	-88.0897
ABM-1	30.5699	-88.1049
DGRM-1A	30.5868	-88.1098
RBTM-1	30.5734	-88.1343
RABM-1	30.5832	-88.1333
HMCM-1	30.5962	-88.1296
MCM-1	30.6130	-88.1172
DGRM-5	30.6056	-88.1127
ROBBM-1	30.6108	-88.0867

Table 2. Dog River Sampling Stations.

Hydrologic Flow and Modeling

Hydrologic flow data was collected at select sites to determine fresh water input and tidal exchange. A boat-mounted Acoustic Doppler Current Profiler (ADCP) was used to collect flow data during the study (see Figures 6 & 7). The flow data, along with in-situ data and samples collected from various media will be entered into a water quality model developed by the USEPA and a hydrologic model developed by Tetra Tech.

Figure 3. Boat mounted ADCP.

Figure 4. ADCP with custom mount.

Tetra Tech, Inc. was contracted in 2001 to develop a system of models for the entire Mobile Bay System in collaboration with USEPA. The models include a hydrologic and water quality model of the watershed that projects the flows and nutrient loads to the lower estuarine portion of the system, and a receiving water and water quality model for Mobile Bay.

Tetra Tech and EPA have utilized the Hydrologic Simulation Program in Fortran (HSPF) based watershed model, Loading Simulation Program in C++ (LSPC) for watershed simulation and the Environmental Fluid Dynamics Code (EFDC) and the Water Quality Analysis and Simulation Program (WASP) for three-dimensional dynamic flow and water quality simulations of Mobile Bay, respectively (See Figure 15). Once completed, the bay model can be employed to develop TMDLs and wasteload allocations for Mobile Bay. The model considers the effects of wind-driven residual transport, salinity intrusion, loadings and oxygen uptake from adjacent salt marshes, sediment oxygen demand, primary productivity, and point source discharge from municipal and industrial permits.

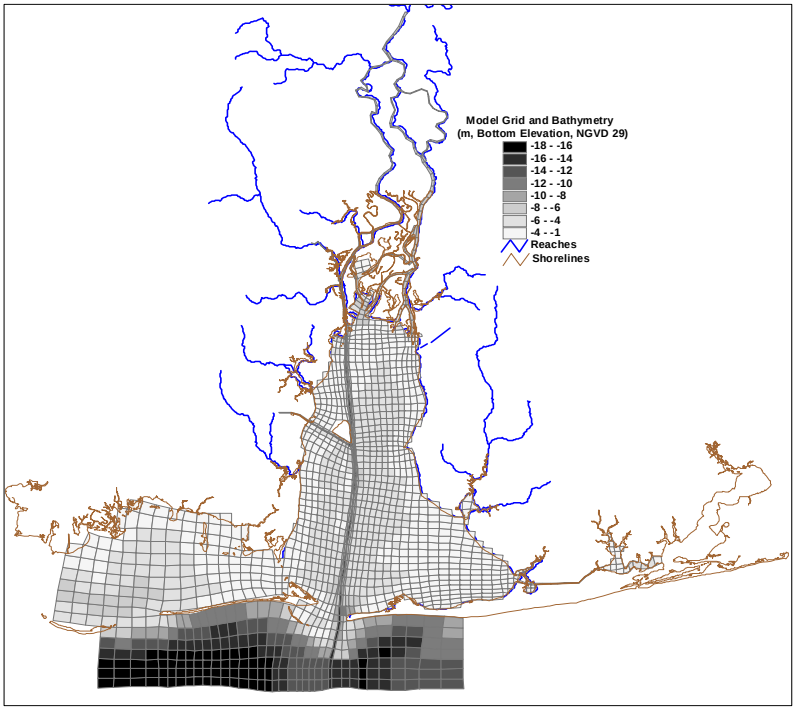


Figure 5. Tetra Tech Mobile Bay Model Grid.

Geographical Information

The Mobile Bay and its estuaries are connected to the Gulf of Mexico and Mississippi Sound. The Mobile Bay watershed covers approximately 43,630 square miles including fresh water inputs. Mobile Bay experiences daily tidal exchanges with the Gulf of Mexico and Mississippi Sound. Waterbodies that have an open connection to the Mobile Bay estuary and meet the definition of an estuary are called sub-estuaries.

Hydrologic Modifications

The existing ship channel from the Mobile Ship Channel to Dog River was authorized in1969 by the River and Harbor Act and dredging was initiated and completed in 1986. See Figure 9.

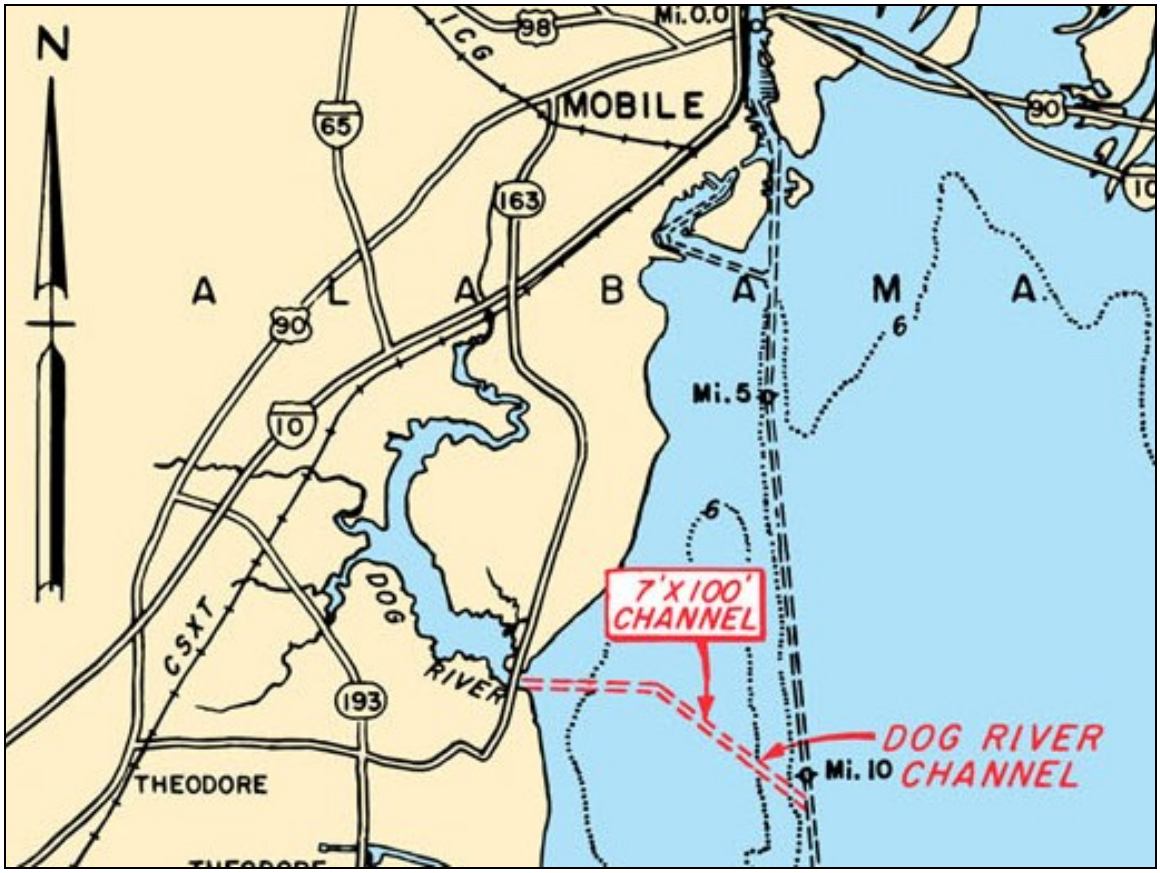


Figure 6. Hydrologic Modification through Channel Dredging (USACE 2008).

Climate

The coastal region of Alabama is characterized by a humid subtropical climate with mild winters and warm summers. Average annual precipitation is 68.1 inches. Tropical cyclones or hurricanes are frequent in the Gulf of Mexico and landfall areas can experience wind damage and flooding that can alter shoreline and bathymetry.

Land Use
Development in the Dog River Sub-Estuary was historically centered in the upper reaches of Eslava Creek and Bolton Branch and was residential and light industry. In the mid 1950s, the wetland area known as Wragg Swamp was drained via the newly created Montlimar Canal (tributary to Moore Creek), and Interstate 65 along with a vast system of storm water drains were constructed for a large area of impervious surfaces that enter the Dog River Sub-Estuary during storm events. Other tributaries such as Halls Mill Creek and its tributaries now receive storm water from the westward expansion of the city/county of Mobile.

Tidal Discharge
Mobile Bay has a diurnal tidal cycle with one high and one low tide in a 24 hour period and two high and two low tides during neap tides and spring tides. Dog River receives tidal in flow from Mobile Bay.

Point Source Discharges
ADEM regulates point source discharges with 2 program types: National Pollution Discharge Elimination System (NPDES) and State Indirect Discharge (SID). Facilities with these permits must provide their own monitoring records or Discharge Monitoring Reports (DMRs) and are subject to ADEM Compliance Sampling Inspections (CSIs).

Results

ADEM Water Quality Criteria

Two geometric means were calculated with no less than 5 stations over a 30 day period at intervals not less than 24 hours per event (A & B). Enterocci was the indicator species for the intensive study. Of the 5 stations, 3 were "Non-Supporting" of their use classification: ESCM-1, BOLM-3, and MCM-1. Two stations were "Supporting" their use classification. See Table 3. Conventional water quality parameters (i.e. dissolved oxygen, temperature and pH), were within ADEM water quality criteria.

Station	Single Sample Exceedance Rate (%)	Geomean Limit	Geomean Value Event A	Geomean Value Event B	Use Support Result
ESCM-3	28.6%	**35**	**180**	**17**	Non-Supporting
BOLM-3	30.8%	**35**	**164**	**14**	Non-Supporting
DGRM1A	7.7%	**35**	**6**	**6**	Supporting
HMCM-1	23.1%	**35**	**11**	**19**	Supporting
MCM-1	15.4%	**35**	**213**	**7**	Non-Supporting

Table 3. Geometric Mean for Bacteria.

NCA Water Quality Criteria

Bottom Dissolved Oxygen Bottom Dissolved Oxygen (DO) concentrations were rated as "Good" for all stations except ESCM-3, DR-1, and HMCM-1 which were rated as "Fair". Bottom DO is usually lower than surface and mid-depth DO in coastal waters. Deployed data sonds (suspended at the expected mid-depth) at times recorded DO consecrations <5mg/l. These observations were made in conjunction with low water level and the datasond's temporary submersion into bottom substrate.

Total Nitrogen Total nitrogen concentrations "Poor" at 76.9% of the 13 stations with 15.4% of the sites rated as "Fair" (PCM-1 and DGRM-5) and 7.7% and of the sites rated as "Good" (RBTM-1).

Total Phosphorus Total Phosphorous concentrations were rated as "Good" at each sampling location.

Chlorophyll-a Chlorophyll-a concentrations were rated as "Good" at every sampling location. Concentrations were higher than expected but upon review, high chlorophyll-a results were observed in Dog River by John Lehrter in his study of nutrient loads to tidal river estuarine systems. High chlorophyll-a concentrations were observed in conjunction with relatively low nitrogen and phosphorus concentrations. A possible explanation was longer than normal residence time and resuspension of phytoplankton. The measured tidal flows discussed earlier could provide insight into the aforementioned residence times and resuspension.

Water Clarity Water Clarity was rated as "Good" at all sampling locations and is an indication that chlorophyll-a is not significantly reducing water clarity.

Water Quality Index
Based on National Coastal Assessment water quality index, all stations were "Fair" except for 2 stations (DGRM-4 and RBTM-1) which were "Good". (See Figure 7).

NCA Sediment Contaminants

One location exceeded the <5 ERL criterion, RBTM-1 for Mercury in Sediment 0.714 ppm which resulted in a "Poor" rating and was also an ERM exceedance. Three stations rated as "Fair" (BOLM-3, DR-1, and MCM-1). All other stations were rated as "Good". Also, no location had an exceedance of PAHs or Pesticides. See Table 3. Figures 7 and 8 are a graphic representation of the findings.

Station	Bottom DO	Assessment	TN	Assessment	TP	Assessment	Chlor-a	Assessment	H2O Clarity	Assessment	WQ Index	Sediment Index
BOLM-3	6.61	Good	0.157	Poor	0.099	Good	18.7	Fair	1.75	Good	Fair	Fair
ESCM-3	3.54	Fair	0.186	Poor	0.100	Good	11.8	Fair	1.64	Good	Fair	Good
DR-1	3.3	Fair	0.102	Poor	0.149	Good	15.9	Fair	2.08	Good	Fair	Fair
DGRM-1A	7.16	Good	0.097	Poor	0.058	Good	11.7	Fair	1.64	Good	Fair	Good
PCM-1	7.19	Good	0.035	Fair	0.052	Good	9.13	Fair	1.96	Good	Fair	Good
ABM-1	7.67	Good	0.191	Poor	0.061	Good	8.78	Fair	1.59	Good	Fair	Good
DGRM-4	5.76	Good	0.065	Poor	0.068	Good	9.6	Fair	1.75	Good	Good	Good
RBTM-1	5.52	Good	0.006	Good	0.045	Good	11.6	Fair	1.37	Good	Good	Poor
RABM-1	7.16	Good	0.041	Poor	0.056	Good	15.5	Fair	1.1	Good	Fair	Good
HMCM-1	3.45	Fair	0.079	Poor	0.057	Good	13.5	Fair	1.75	Good	Fair	Good
MCM-1	6.33	Good	0.114	Poor	0.096	Good	15.4	Fair	1.61	Good	Fair	Fair
DGRM-5	5.72	Good	0.037	Fair	0.063	Good	14.1	Fair	1.82	Good	Fair	Good
ROBBM-1	7.08	Good	0.044	Poor	0.081	Good	13.2	Fair	1.85	Good	Fair	Good

Table 4. NCA Water Quality Index.

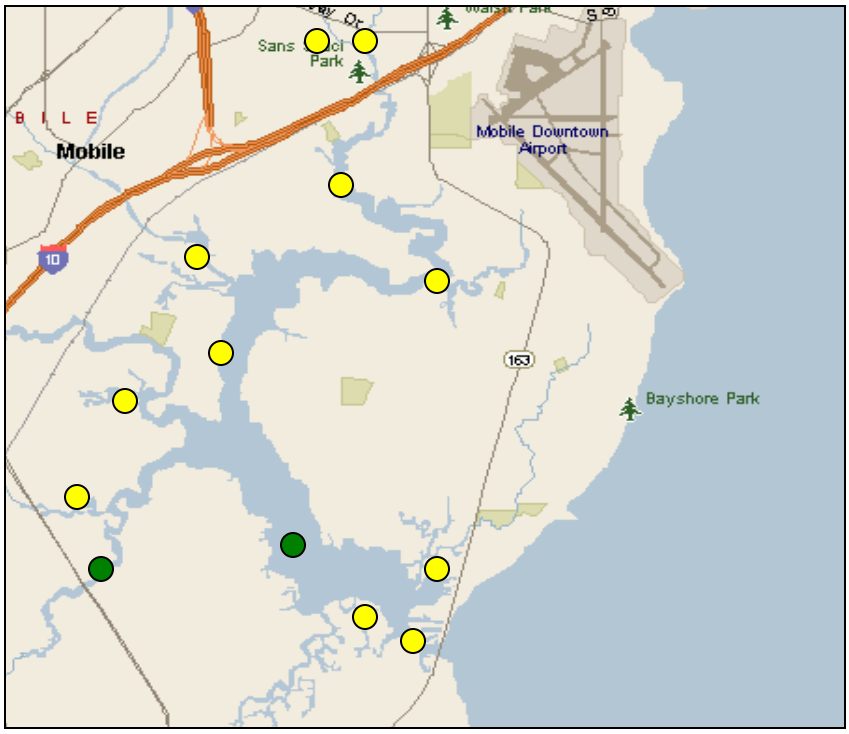


Figure 7. Water Quality Index.

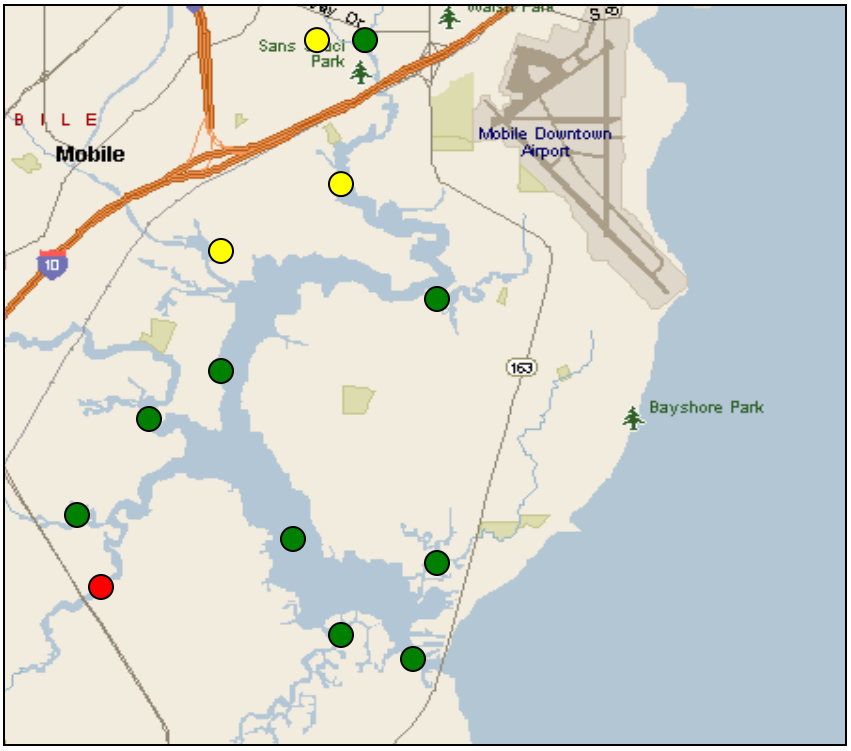


Figure 8. Sediment Quality Index

Atmospheric Input

Data compiled by the National Atmospheric Deposition Program and Mercury Deposition Network in 2007 supports the incidence of atmospheric deposition and loading of mercury (Hg) to the sub-estuary (see Figure 8). Atmospheric mercury deposition in the Mobile Bay area were among the highest values measured in the country.

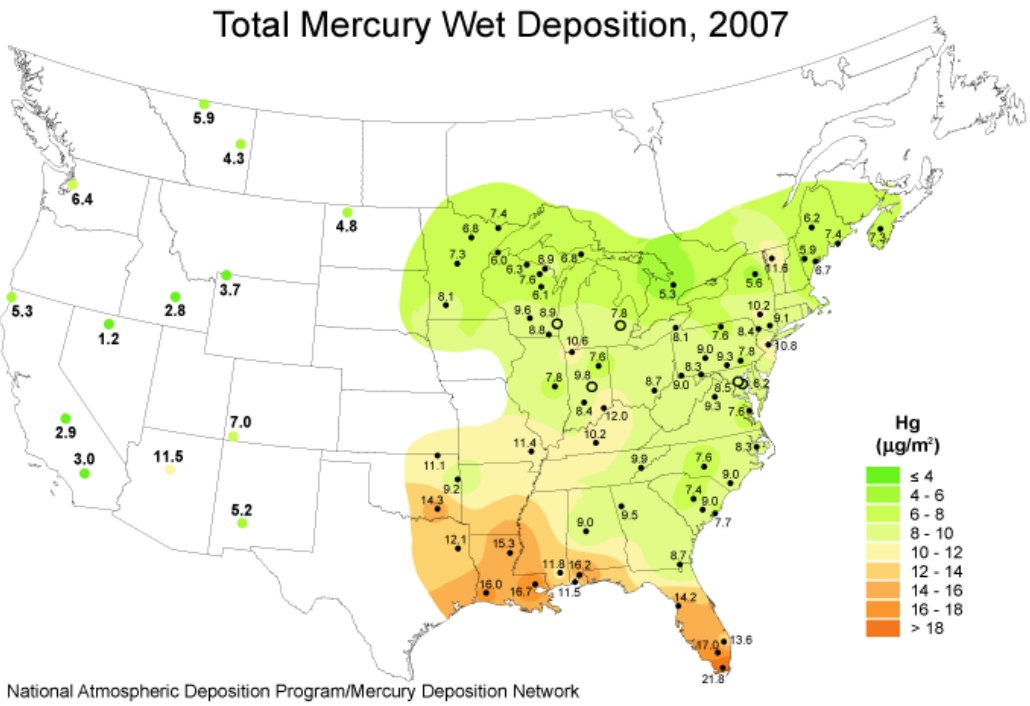


Figure 9. Total Mercury Wet Deposition for 2007.

Fish Tissue Monitoring

The Alabama Department of Public Health (ADPH) did not issue a No Consumption Advisory for any species in Dog River based on fish tissue collection and analysis by ADEM. However, on October 8, 2007, the Mobile County Health Department (MCHD) advised that people swimming in the area of the Alba Club (DGRM-4) faced an increased risk of illness and advised that all seafood harvested in the affected area should be thoroughly cooked before consumption and that individuals should wash their hands after cleaning any fish or other seafood, and also before preparing food.

ADEM and the Alabama Department of Public Health (ADPH) Mobile Laboratory, reported that a sample taken Wednesday, Oct. 8, at the Alba Club exceeded the Environmental Protection Agency's (EPA) threshold of 104 enterococcus organisms per 100 milliliters for marine water. The site was retested on Thursday, Oct. 9, and the enterococci count still exceeded the EPA threshold.

ADEM and the ADPH conduct the bacteriological water-quality monitoring and notification program under a grant from the Environmental Protection Agency (EPA) BEACH Act Program. This program involves the routine collection of water samples from a total of 25 high-use coastal recreational sites in Mobile and Baldwin counties. In the summer months, samples are taken once or twice a week at the most highly used sites and biweekly at the other sites. All sites are tested once a month in the cooler months.

Conclusion

With the exception of the mouth of Dog River and Halls Mill Creek it was observed that Bolton Branch, Eslava Creek, and Moore Creek had values that failed to meet Alabama Department of Environmental Management (ADEM) water quality criteria. Based on National Coastal Assessment (NCA) water quality index, the Dog River Sub-Estuary rated as “Fair” to “Good”. NCA Sediment Index rated the sub-estuary as “Fair” to “Good” with one location rated as “Poor” for sediment Mercury.

While the two criteria, ADEM and NCA, seem to differ on their statements of water quality, the ADEM criteria highlights a problem with bacteria yet does not evaluate nutrient loading. The NCA criterion highlights nutrient loading yet it does not evaluate bacteria. Therefore, both criteria were used to assess the sub-estuary.

Of the 5 ADEM stations, 3 were “Non-Supporting” of their use classification: ESCM-3, BOLM-3, and MCM-1. Two stations were “Supporting” their use classification: DGRM-1A and HMCM-1. Conventional water quality parameters (i.e. dissolved oxygen, temperature and pH), were within ADEM water quality criteria.

Based on nitrogen and chlorophyll data, nutrient loadings to the sub-estuary appears to be moderate to high. Phosphorous does not appear to be a factor. Of the 13 sampling stations, 11 exceeded the NCA “Poor” threshold for nitrogen for a poor rating of 76.9% (based on number of stations). All 13 stations rated as “Fair” for chlorophyll. All of the stations rated “Good” for phosphorus.

One location exceeded the <5 ERL criterion, RBTM-1 for Mercury in Sediment 0.714 ppm which resulted in a “Poor” rating and was also an ERM exceedance. Three stations rated as “Fair” (BOLM-3, DR-1, and MCM-1). All other stations were rated as “Good”. Also, no location had an exceedance of PAHs or Pesticides.

ADEM is continually monitoring Coastal Long-Term Trend Stations (see Figure 10). There are two long term trend stations in the Dog River Sub-Estuary, DGRM-1 and DR-1. ADEM and the MBNEP are also working together on other programs in the Mobile Bay area.

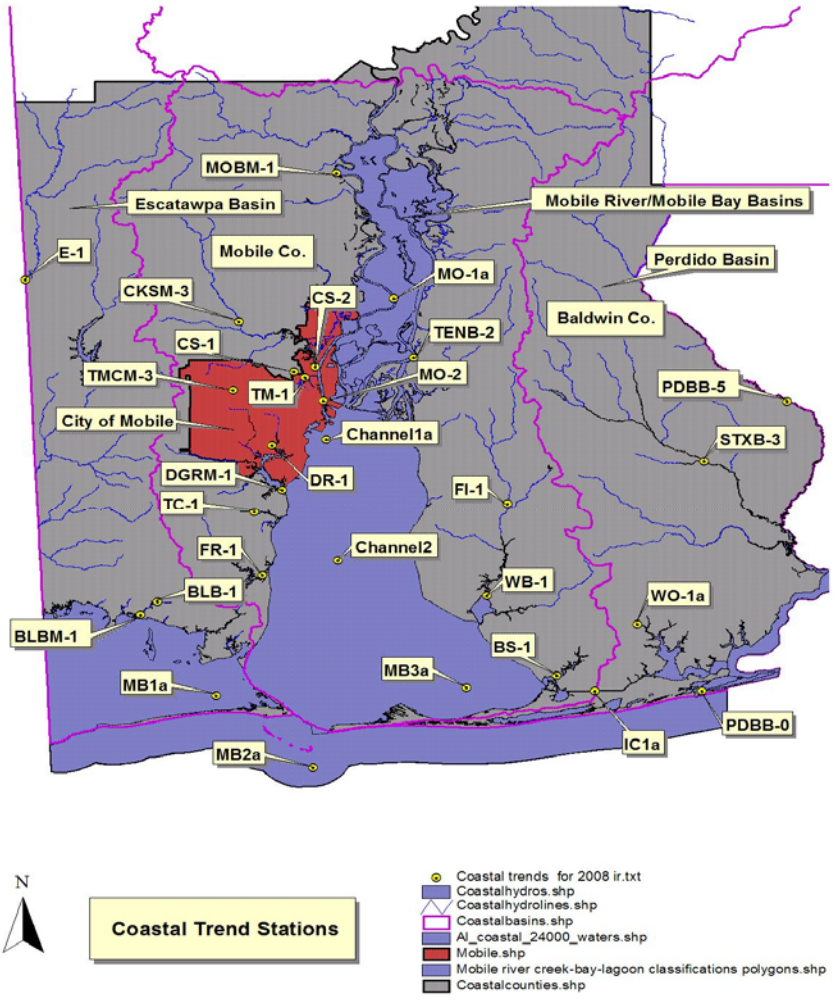


Figure 10. Coastal Long-Term Trend Stations.

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