

MEMORANDUM

TO: Mr. Andrew Puffer, EPA Gulf of Mexico Program

FROM: Ms. Corey Wisneski, and Dr. Carlton D. Hunt, Ph.D, Battelle

DATE: January 30, 2008

SUBJECT: Gulf of Mexico Estuarine Prioritization Update (Contract 68-C-03-041, WA4-01)

Introduction

In January 2007 and under Work Assignment (WA) 3-01 of EPA Contract 68-C-03-041, Battelle developed a draft of “A Report on the Prioritization of Candidate Estuaries under Consideration for Nutrient Criteria Analysis in the Northern Gulf of Mexico” (Battelle, 2007). This report provided guidance on which northern Gulf of Mexico estuaries should be chosen for further study on nutrient criteria development. The recommendations were based on water quality data (encompassing the time period from 1905 through 2003) that had been collected under WA 1-01 of the EPA Contract 68-C-03-041. Eight coastal systems¹ (identified by the Northern Gulf of Mexico Nutrient Criteria Pilot Study Technical Steering Committee) were originally included in the review. Battelle used the data availability of specific nutrient-related parameters as the primary rationale to narrow the list of eight to a list of four estuarine systems most appropriate for further nutrient criteria development. The systems recommended were:

- Mobile Bay, AL
- Bon Secour Bay, AL
- Bay St. Louis, MS
- Biloxi Back Bay, MS

Battelle (2007) evaluated each of these water bodies by assigning a qualitative metric “to describe the relative ability for supporting data to reasonably and sufficiently characterize cause and effect of nutrient enrichment”. Five evaluation criteria were used to assess the key attributes of each water body’s data:

- (1) Are data sufficient to characterize nutrient loads from terrestrial, atmospheric, and offshore sources?
- (2) Are data sufficient to characterize the physics of the system?
- (3) Are data sufficient to characterize negatively influenced ecosystem attributes associated with (a) total system metabolism (dissolved oxygen, sediment oxygen demand, and productivity), (b) light attenuation, and (c) benthic habitat?
- (4) Are data sufficient to support the comparison to reference conditions?
- (5) Are data sufficient to characterize system variability?

The key attributes represented by these five criteria were subdivided into individual components for evaluation purposes. This allowed a more detailed examination of the data sufficiency for each water body. Table 5 at the end of this technical memorandum shows the complete set of

¹ Lake Borgne complex, AL; Pearl River, LA; Bay St. Louis, MS; Biloxi Back Bay, MS; Pascagoula, MS; Mississippi Sound, AL; Mobile Bay, AL; and Bon Secour Bay, AL

components as well as how each of the four water bodies scored. The metrics used in Battelle (2007) were: Poor, Good, and Unknown. *Poor* (P) involves cases where data are either nonexistent or limited. The *Good* (G) classification is associated with cases where it is believed that data are either sufficient or close to sufficient to characterize a given ecosystem or physical attribute. *Unknown* (U) is applied where there is currently no information to prove data availability or limitation. For the purposes of this technical memorandum, the ‘U’ scores are considered ‘P’ because the two classifications are very similar.

In the time since Battelle (2007) was completed, additional nutrient and water quality data have been identified and acquired for the original study region under EPA Contract 68-C-03-041, WA 4-54, specifically for the time period from 2004 to 2007. Understanding that these data may help further refine water bodies to use for pilot nutrient criteria development in the Northern Gulf of Mexico, the Gulf of Mexico Program Office requested an additional evaluation of the four recommended coastal systems. This technical memorandum summarizes the activities that were conducted and narrows the list to one estuarine system that, based on its temporal and topical data richness, is likely the best candidate for nutrient criteria development.

Each of the four estuaries is examined separately below. The five evaluation criteria and the qualitative metrics that were used in Battelle (2007) were used for this evaluation, but incorporate the additional 2004-2007 data. A caveat to this process is necessary: because the new data were collected with different objectives and requirements than the data that were evaluated in Battelle (2007), some parameters that may be valuable to nutrient criteria development were not collected as part of the 2004-2007 data. For example, the effort to acquire the 2004-2007 data did not collect information on physics of the estuarine systems; therefore, the assessment of physics-related data richness described in Battelle (2007) cannot be augmented in this technical memorandum because no new data have been identified.

Mobile Bay, AL

The nutrient criteria database that was created for the 1905-2003 data contains a variety of water quality data for Mobile Bay. Additional 2004-2007 data for Mobile Bay have been identified and acquired (although not yet fully processed). Figure 1 shows the water body and data collection locations. The different station colors indicate whether the data at those stations were collected from 1905-2003 or from 2004-2007.

Battelle (2007) found that Mobile Bay’s data availability for the key attributes described in the five evaluation criteria was Good (G) across the board (Table 1), meaning that the available data were sufficient to characterize the cause and effect of nutrient enrichment in the system. While no overall system attribute was rated as ‘P’ for Mobile Bay in Battelle (2007) two attribute components were rated ‘P’ (Table 5).

The additional post-2003 data adds to the data availability for this system, but remains insufficient to change the two poor attribute scores; hence the overall scores in Table 1 have not changed. Given that Mobile Bay had already been evaluated as ‘G’ based on the ‘old’ data, the addition of the ‘new’ data improves the already ‘Good’ data availability for this water body.

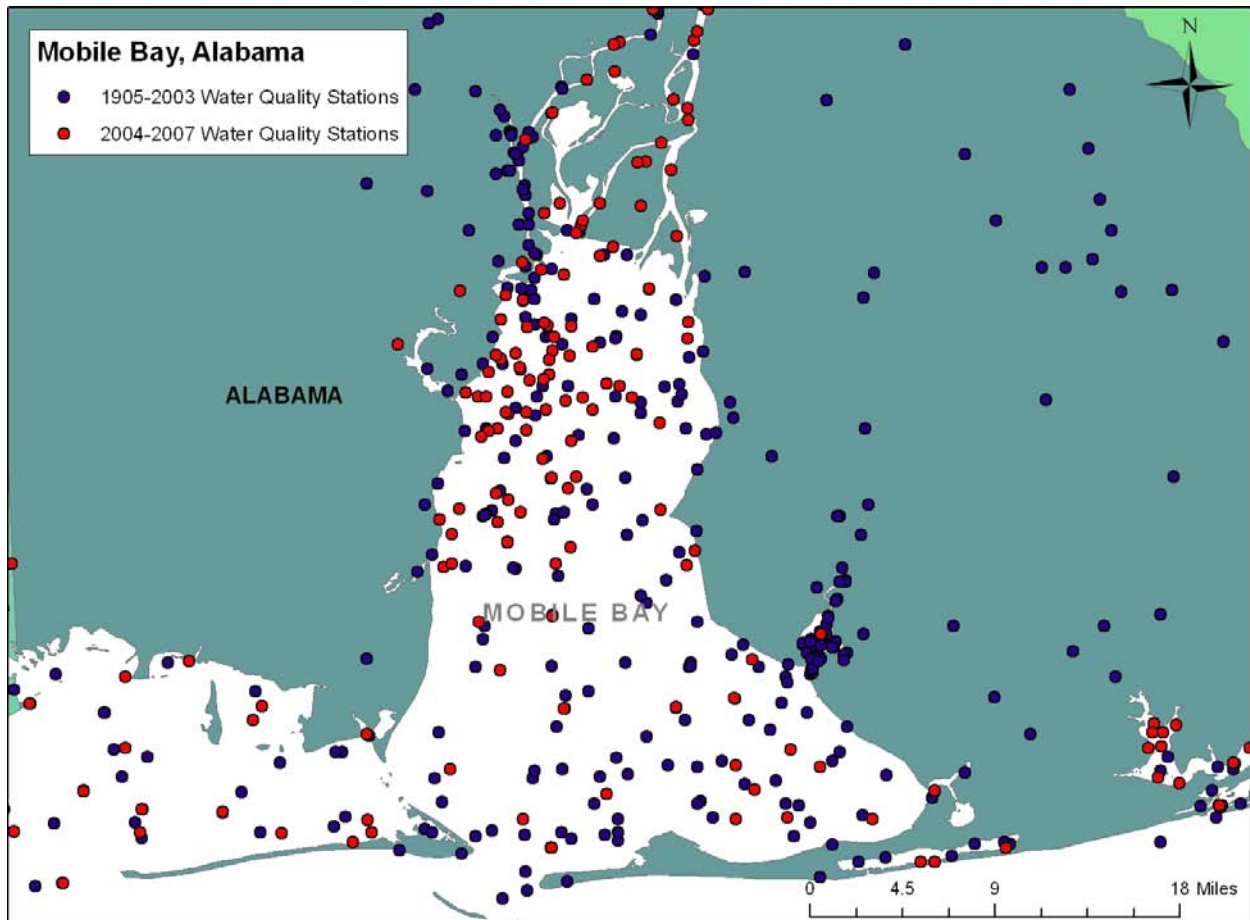


Figure 1. Mobile Bay, AL Station Locations Showing Data Collected from 1905-2003 and from 2004-2007.

Table 1. Summary of key system attributes and data availability for Mobile Bay, AL (Battelle, 2007).

| | Nutrient Loads | Physics | TSM* | Light Attenuation | Reference Conditions | Nutrient Concentrations | System Variability |
|-----------------|----------------|---------|------|-------------------|----------------------|-------------------------|--------------------|
| Mobile Bay (AL) | G | G | G | G | G | G | G |

*TSM = total system metabolism

Bon Secour Bay, AL

Data collected in Bon Secour Bay for nutrient-related and other water quality parameters were collected and processed for WA 1-01. These data are augmented by additional data that have been collected (although not yet fully processed) under WA 4-54. Figure 2 shows the water body and point locations for the ‘old’ and ‘new’ data.

Similarly to Mobile Bay, Battelle (2007) found that Bon Secour Bay’s data availability for key attributes was Good (G) overall (Table 2), meaning that the available data were sufficient to characterize the cause and effect of nutrient enrichment in the system. While no overall system attribute was rated as ‘P’ for this water body two components of these attributes were rated ‘P’ (Table 5). However, the newly gathered data are not enough to alter the individual component scores (Table 5).

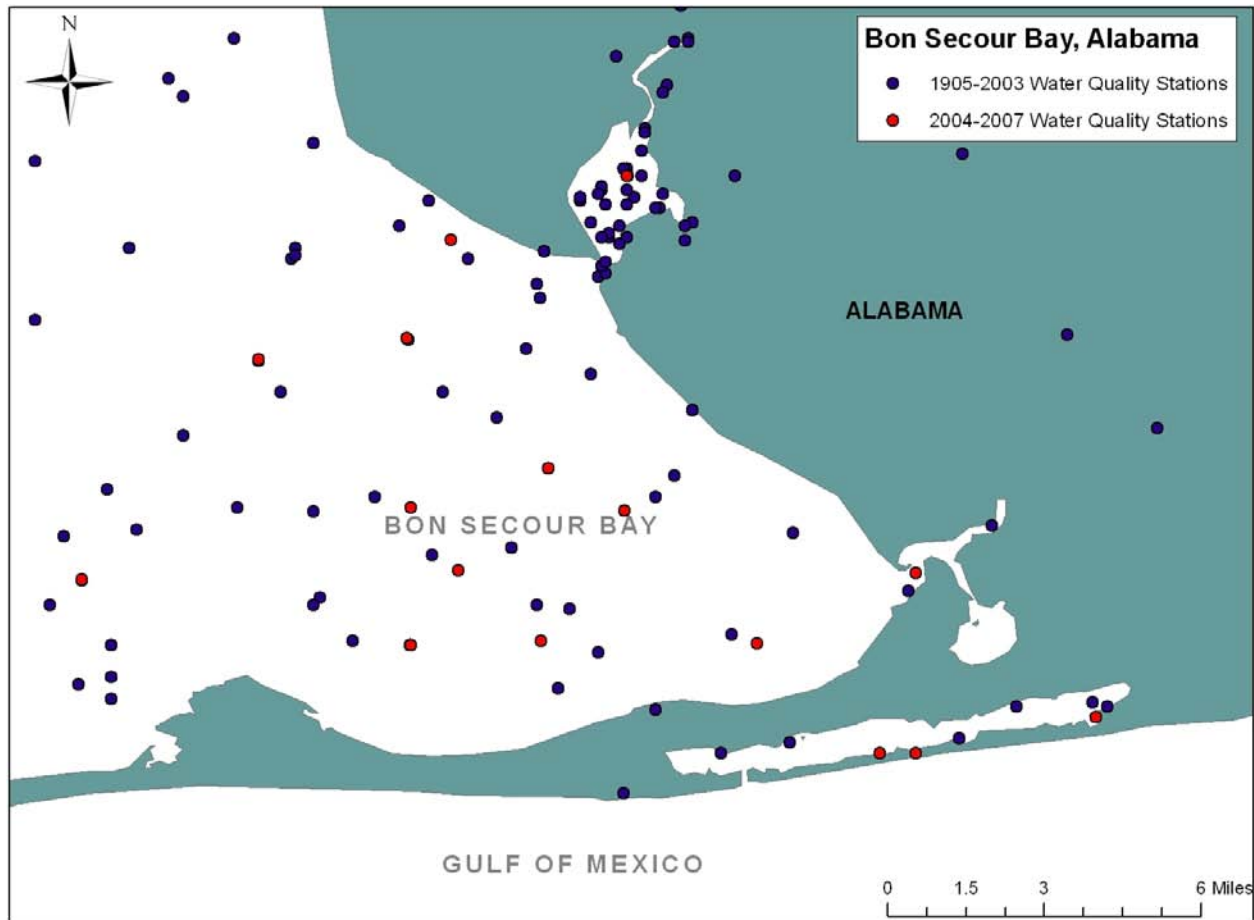


Figure 2. Bon Secour Bay, AL Station Locations Showing Data Collected from 1905-2003 and from 2004-2007.

Table 2. Summary of key system attributes and data availability for Bon Secour Bay, AL (Battelle, 2007).

| | Nutrient Loads | Physics | TSM | Light Attenuation | Reference Conditions | Nutrient Concentrations | System Variability |
|----------------------------|----------------|---------|-----|-------------------|----------------------|-------------------------|--------------------|
| Bon Secour Bay (AL) | G | G | G | G | G | G | G |

Bay St. Louis, MS

The evaluation of key attributes for Bay St. Louis in Battelle (2007) indicated that the available data was sufficient to characterize the Bay as largely ‘Good’ (Table 3). Figure 3 shows the water body with the ‘old’ data locations (new data are not yet available). In addition, the attributes rated as ‘G’ in Table 3 possessed some components that were scored as ‘P’ (Table 5) and indicate where data may be lacking, even for attributes rated ‘G’ overall (Table 3).

Data collected under WA 4-54 for Bay St. Louis were not yet available as of the writing of this technical memorandum. Multiple data requests were made to the Mississippi Department of Environmental Quality (MDEQ) in the fall of 2007 and, although the requested data are now being compiled for Battelle by MDEQ, they have not yet been made available. It is therefore not possible to further assess the data availability for the purposes of this exercise. Hence, it is as yet

unknown if the ‘new’ data would augment the ‘old’ data and improve the overall scoring of attributes in Table 3.

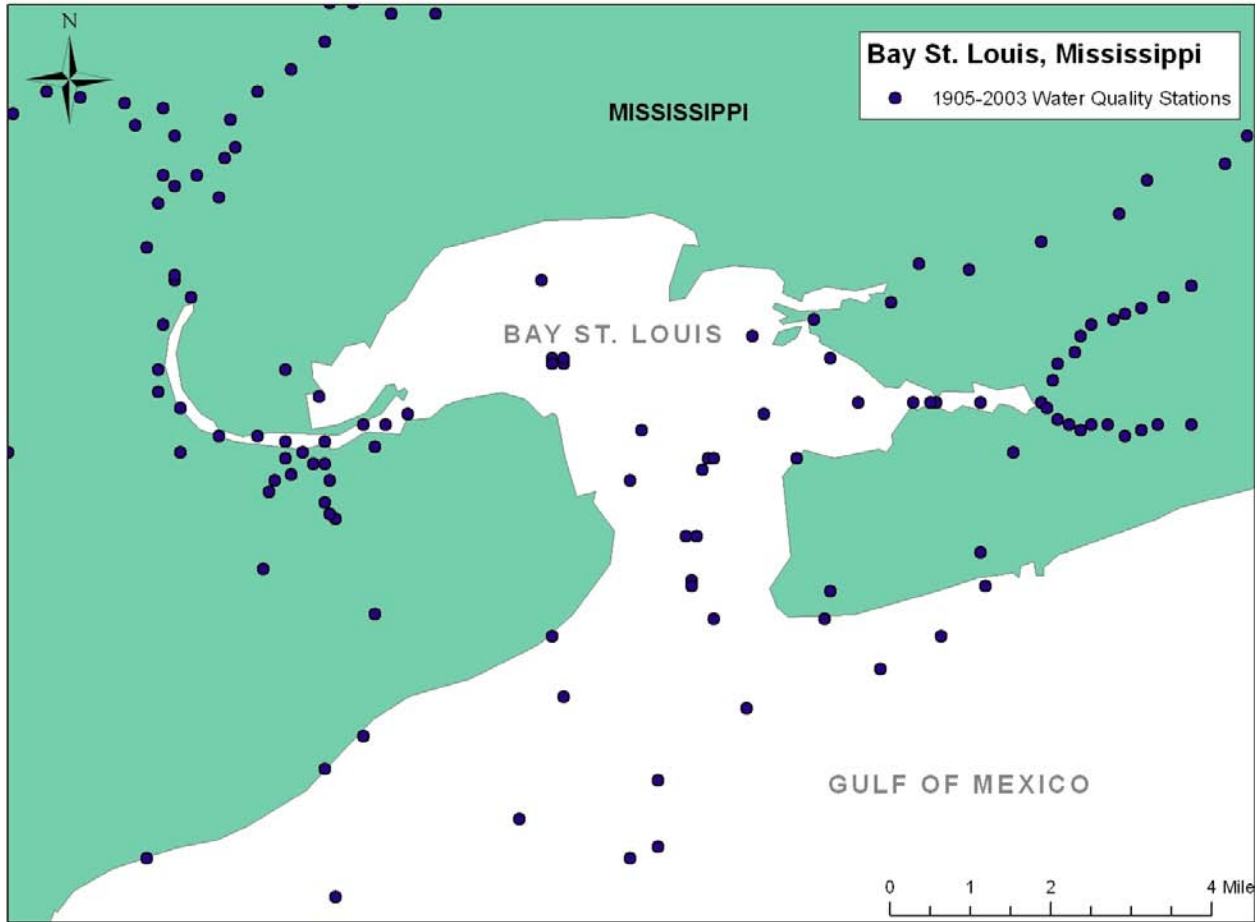


Figure 3. Bay St. Louis Station Locations Showing Data Collected from 1905-2003.

Note: Data collected from 2004-2007 are not yet available.

Table 3. Summary of key system attributes and data availability for Bay St. Louis, MS (Battelle, 2007).

| | Nutrient Loads | Physics | TSM | Light Attenuation | Reference Conditions | Nutrient Concentrations | System Variability |
|--------------------|----------------|---------|-----|-------------------|----------------------|-------------------------|--------------------|
| Bay St. Louis (MS) | P | P | G | G | G | G | G |

Biloxi Back Bay, MS

The amount of data available for Biloxi Back Bay, MS was much less than that available for the Alabama estuaries (Figure 4). In addition, the 1905-2003 data indicate that the same overall attributes that were lacking in data sufficiency for Bay St. Louis (Table 5) were also lacking for Biloxi Back Bay, although light attenuation is available in Biloxi Bay (Table 4).

Data collected under WA 4-54 for Biloxi Back Bay were not yet available as of the writing of this technical memorandum. Multiple data requests were made to the Mississippi Department of Environmental Quality (MDEQ) in the fall of 2007 and, although the requested data are now being compiled for Battelle by MDEQ, they have not yet been made available and, therefore,

cannot be further assessed for the purposes of this exercise. Hence, it is as yet unknown if the ‘new’ data would augment the ‘old’ data and improve the overall scoring of attributes in Table 3.

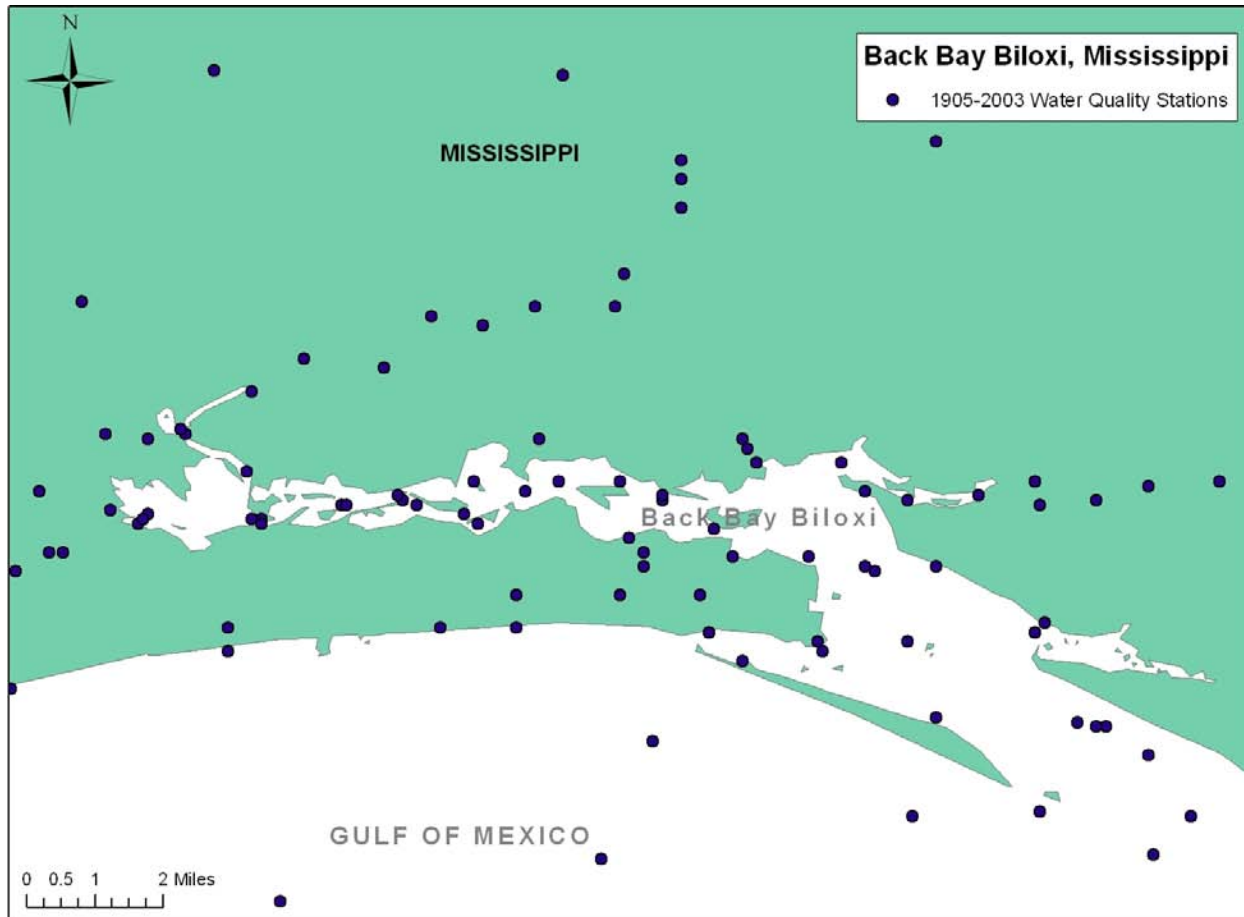


Figure 4. Back Bay Biloxi Station Locations Showing Data Collected from 1905-2003.

Note: Data collected from 2004-2007 are not yet available.

Table 4. Summary of key system attributes and data availability for Biloxi Back Bay, MS (Battelle, 2007).

| | Nutrient Loads | Physics | TSM | Light Attenuation | Reference Conditions | Nutrient Concentrations | System Variability |
|-----------------------------|----------------|---------|-----|-------------------|----------------------|-------------------------|--------------------|
| Biloxi Back Bay (MS) | P | P | G | P | G | G | G |

Conclusions

Given that ‘new’ data from Mississippi are not yet available to evaluate against the ‘old’ data, and that the addition of ‘new’ Alabama data does not change the overall scoring of the systems’ key attributes, Mobile Bay or Bon Secour Bay remain logical water bodies for continued nutrient criteria development. Of those two estuaries, Bon Secour Bay may be better suited to criteria development than Mobile Bay, if only because of the size differences between the water bodies. Mobile Bay is a far larger system than Bon Secour Bay and, as pointed out in Battelle (2007), will possess multiple salinity zones and multiple subsystems that will require further boundary definitions. Therefore, by nature of its more manageable size and associated characteristics, and

potential to use subareas in Mobil Bay as reference areas, Bon Secour Bay is the best choice at this time for the next phase of nutrient criteria development in the Northern Gulf of Mexico.

Recommendations

Based on the available data, we recommend that the next phase of nutrient criteria development be focused on Bon Secour Bay. However, given the data richness for Mobile Bay and that Bon Secour Bay is a sub embayment to the bay, we recommend that the subsequent phase should expand to include all of Mobile Bay. The lessons learned in Bon Secour Bay can be applied to the larger Mobile Bay and make that task more manageable. In turn, the Mobile Bay approach should provide a comprehensive example on how to develop nutrient criteria throughout the rest of the Northern Gulf of Mexico.

Battelle (2007) made recommendations for additional research that could be conducted to more thoroughly characterize the four water bodies discussed above. Given that both Mobile and Bon Secour Bays received a “P” score for offshore nutrient load data sufficiency, the nutrient load and mass balance studies recommended in Battelle (2007) may help fill in the gaps in understanding how much offshore upwelling contributes to nutrient concentrations detected in Mobile and Bon Secour Bays. These studies (Cowan et al. (1996), Harned (1999), Harned et al. (2004), and Lehrter et al. (2005)) may provide data useful for determining offshore nutrient loads.

References

Battelle. 2007. A Report on the Prioritization of Candidate Estuaries under Consideration for Nutrient Criteria Analysis in the Northern Gulf of Mexico. EPA Contract No. 68-C-03-041. Work Assignment 3-01. Duxbury, MA.

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Table 5. Full Scoring Results for the Data Availability of Key Attributes.

| | Nutrient Load Information | | | | System Physics | | | Total System Metabolism | | | | Light Attenuation | | Reference Conditions | | Nutrient Concentrations | | System Variability | | | | | |
|-----------------|---------------------------|------------------|---------------------|------------------|----------------------|--------------|------------------|-------------------------|--------------------------------|-------------------------|-------------|-------------------|------------------|-----------------------|------------------|-------------------------|------------|--------------------|------------|---------------|--------------|-------------|----------|
| | Watershed Sources | Riverine Sources | Atmospheric Sources | Offshore Sources | Water Residence Time | Tidal Regime | Wind/Meteorology | Productivity | Standing Stock (Chlorophyll a) | Dissolved Oxygen Trends | Temperature | Secchi Depth | Light Extinction | Historical Conditions | Alternate System | Nitrogen | Phosphorus | Nitrogen | Phosphorus | Chlorophyll a | Secchi Depth | Temperature | Salinity |
| Mobile Bay | G | G | G | P | G | G | G | G | G | G | G | G | G | G | P | G | G | G | G | G | G | G | G |
| Bon Secour Bay | G | G | G | P | G | G | G | G | G | G | G | G | G | G | P | G | G | G | G | G | G | G | G |
| Bay St. Louis | P | G | P | P | P | P | G | P | P | G | G | G | P | G | P | G | G | G | G | P | G | G | G |
| Biloxi Back Bay | P | P | P | P | P | P | G | P | P | G | G | P | P | G | P | G | G | G | G | P | P | G | G |