

Comments of the EPA Science Advisory Board on the Draft Report: Hypoxia in the Gulf of Mexico

(October 2, 2007)

1. Dr. James Galloway

- a) Does the draft report adequately address the original charge questions asked by EPA?
Noting that there were no specific 'charge questions', but rather a listing of things to address under three general topics, it is my assessment that the panel did address the things there were asked to address. It would be helpful however if the Executive Summary was organized in such a way as to put specific findings/conclusions/recommendations to specific items in the charge.
- b) Is the report clear and logical?
The report is clear and logical, and very detailed—the authors are to be commended. It does stress however the need for a well organized Executive Summary and a letter to the Administrator that identifies the most important recommendations. Specifically, the letter to the Administrator should specify the top 3-4 conclusions of the panel. This will not only be useful to the Administrator but will give the panel members the opportunity to work these through in their own minds. In this regard, the letter directs the Administrator to the Executive Summary of the Advisory for specific findings and recommendations. However, it appears that the Summary lists things that need to be done (all important) but does not indicate what the most important actions are. It would be very helpful if the panel could identify the top 3-4 things that need to be done and the order that they should be done in. Then identify the next top 3-4 things, etc.
- c) Are the conclusions drawn, and/or recommendations made in the report, supported by information in the body of the draft SAB report? The conclusions/recommendations are supported by information in the report, and in the documents that the report references.
- d) Are there technical errors in, or omissions from the report?
There do not appear to be major errors of statement or omission in the report. I do have the following comments:

Page 3, line 17: I would encourage the panel to choose a word other than 'ballpark' when saying what specific percentages of the N and P fluxes come from point sources.

Page 6, line 12: I would avoid using the word 'reduced' when discussing chemicals unless the exchange of electrons is involved.

Section 4.4, Cost-Effective Approaches for Non-point Source Control: For each approach in this section it is important to ask the following question: Is the N that is not being released to the waters, being lost to other systems with the consequence of not removing reactive N from environmental systems but rather just re-distributing it.

2. Dr. Rogene Henderson:

The report is on a topic outside my field, so I only reviewed the Executive Summary and the front material. I briefly scanned the comments of the outside reviewers. I thought the executive summary was a clearly written document that I enjoyed reading. I appreciated the extensive glossary of terms and acronyms in the front material. The conclusions and recommendations of

the group appeared to be reasonable and logical. The charge questions as described in the submittal letter were addressed. This report may turn out to be one of the classic reports from the SAB.

3. Dr. Tom Theis:

This is a comprehensive report on the causes, impacts, and potential remedies available for the hypoxic zone in the Gulf of Mexico. The report itself is embedded within, and is a logical product of, EPA's classical approach to environmental management, which favors chemical-by-chemical, media-by-media, and problem-by-problem assessments. This approach is engendered by most of the Agency's enabling legislation, and is the classical way in which its regulatory functions are carried out. Still, to its credit, the report goes considerably further than this by examining the hypoxia problem as a series of processes in which a suite of interrelated physical and chemical factors, and several chemical species, are involved.

The Panel may wish to consider the following thoughts as they prepare the final draft:

- The report is organized around 43 “key findings” and 91 “recommendations”, a large number as befits its comprehensive nature. But not all of the recommendations are of equal importance, and a great many are better directed at other agencies (in particular the USDA, but also many State agricultural agencies). The usefulness of the document could be improved considerably by prioritizing the recommendations, and identifying those that might be implemented by the Agency in the short term through its regulatory authority, and those that will take longer either because the knowledge base is insufficient, societal management institutions are not yet mature enough, or cooperative actions are the best way to proceed.
- As best I can determine all but one of the charge questions is answered. That one (III.C.iii.), requests that the Panel address the most effective technologies for point source controls on nutrients. The Panel's answer refers to the need to further analyze the costs and feasibility of tightened limits, and mentions only biological nutrient removal, and “enhanced nutrient removal” technologies (section 4.5.8). Given that several findings and recommendations are made regarding the need for better point source controls, the level of the analysis in the report that this charge question requests is modest and lacks the detail that is prevalent throughout most other sections in support of other charge questions.
- Given the scope of the report, and the significant role of non-point nutrient sources, it is surprising that it makes no mention of one of the Agency's main tools for controlling them, the Total Maximum Daily Load (TMDL) program, an approach that is mandated by the Clean Water Act. This is especially odd since the report reviews very thoroughly the components that comprise the TMDL process: monitoring, water quality modeling, computation of loads, and implementation of Best Management Practices (BMPs), many of which are also reviewed in the report. It is true that the TMDL process has a distinctly local focus (on watersheds), and as far as I know the Gulf hypoxic zone is not a listed impaired water body (although other oceanic waters are listed). TMDL was not specifically designed to manage a water body the impairment of which is the result of the combined effects of many smaller watersheds. However the methodology is certainly applicable, the regulatory authority is present, and the goals of the program are consistent with the needs identified in the report. TMDL alone is probably not sufficient to address

the hypoxia problem, but together with other approaches suggested (for example market-based tools), it may be an important part of a collection of tools for achieving desired reductions in nutrient loads to the Gulf. In any case its absence from such a comprehensive report would seem to be a significant omission.

- The report contains quite a bit of information, and in general presents it in a very organized way. It reading it, though, one oddity is the inconsistent use of mathematical notation. There are two very complex PDEs (in that their application is complex) on page 21, but not a single chemical reaction anywhere in the report in spite of the fact that transformations among chemical forms and species are central to understanding the complexity of the hypoxia problem. This omission is especially hard to understand in light of the great pains that are taken to explain the complexities of hypoxia in the MARB. For instance the glossary explains that the atmosphere contains 78.09% N₂ and 20.95% O₂, rather elementary facts for a science-based report, but glosses over the subtleties of nitrification, denitrification, and phosphate cycling to name a few.
- The report, in at least two places (p. 7, p. 224), refers to the application of market-based trading programs as a means of reducing compliance costs of nutrient controls. While this may be the end result, since presumably technical and organizational innovation will be spurred, it is not guaranteed (for instance if water quality “caps” are inadequate or lowered too rapidly). In any market-based scheme there will be some “winners” and some “losers”, with the aimed for result that the overall costs are spread out in a more efficient way than other approaches (e.g. command-and-control methods). I believe a more accurate depiction of trading schemes is that they “levelize” costs.
- Ultimately, upsets of the order of those that have occurred for the earth’s nutrient cycles, especially for nitrogen, presents society with many, often unpalatable, conundrums and trade-offs. The somewhat hidden assumption of the Panel is that all that it is possible to do to reverse the extent of the hypoxia problem must be done, and hence concludes that specific reduction goals should be set and means taken to reach them. As suggested above, one consequence of the problem-specific focus is that well-meaning recommendations for improvement may exacerbate other problems that have not been comprehensively considered. Most of the recommendations in the report for reducing the severity of the hypoxia problem are aimed at either reducing nutrient loads to the MARB, or increasing rates of denitrification. The consequences for related environmental, social, or economic systems have, in general, not been adequately addressed by the Panel. A few examples. (1) One suite of recommendations is aimed at reducing loads of fertilizer on agricultural lands, and planting alternative, less N-demanding crops, but consideration of potential parallel impacts on national and global dietary needs is not considered. (2) The report spends less than a page on the well-known production of nitrous oxide from denitrification, yet makes several recommendations to increase rates of denitrification (e.g. through restoration or development of wetlands), noting that the amounts of N₂O are anticipated to be a small percentage of total nitrate reduced. No analysis of the impact of increased amounts (not rates) of N₂O on global warming appears to have been considered (i.e. small yields, but the potential for overall increased production of a powerful greenhouse gas). (3) The report does consider the consequences of national energy policies, in the form of biofuels, on hypoxia and recommends that cellulosic crops (such as switchgrass) be cultivated. Yet there is no wider, life cycle based, analysis of the impacts of the processing of such feedstocks into biofuels, most of which rely on chemically-intensive methods. Further, the short and long term consequences on the agricultural community of widespread and rapid transition from traditional row crops to a

“new” crop such as switchgrass may be considerable, with consequences ranging from the creation of new markets to as yet unknown responses of farmers to its cultivation (e.g. they may add fertilizer anyway if even modest improvements in yield result).

4. Dr. Jana Milford

This is an impressive report that responds well to the charge questions asked by EPA. The report is very well written and the conclusions are generally well supported.

I have a few comments for consideration by the Hypoxia review panel.

p. 6. I wish the panel would explain in the executive summary about what it means by “the system moves to a point of no return.” Although it’s explained better later in the report, at this point this is a vague, if dire-sounding phrase.

p. 8. The panel recommends “incentives for conversion to cellulosic perennials ... as a cellulosic source for biofuels.” This recommendation seems to put the cart in front of the horse, since as yet, cellulosic biofuels are not thought to be commercially viable on a wide scale. Perhaps the recommendation could be modified to suggest that further development of the technology to produce cellulosic biofuels be encouraged, and point out that even when cellulosic biofuels are commercially viable, incentives may be needed to encourage production of ceullosic perennials.

pp. 196-198. I wish the panel would include some additional discussion of NH_x emissions to air and not just omit this discussion because these emissions represent only “a recycling of nitrogen within the basin.” I would argue that if followed by conversion to ammonium nitrate or sulfate, emissions to air can lead to significant long-distance transport and contributions to reactive nitrogen deposition in other sensitive areas besides the Gulf. At the least, reductions in air emissions of NH_x should be mentioned as co-benefits of reducing agricultural inputs of nitrogen, and the panel should flag any strategies it recommends for reducing N discharges to water that might increase discharges to air.

pp. 197-198. The discussion of NO_x emissions from electricity generation seems somewhat dated, because it doesn’t acknowledge the additional emissions reductions from this sector that will be required under the Clean Air Interstate Rule, which include year-round reductions in 23 states and the District of Columbia.

p. 201. Given the rapid pace of change in the biofuel industry, the report should consider updating references to projections for increased ethanol production and corn acreage. At the least, the report needs to say when the 263% rise in ethanol production is expected to occur by, and likewise when the 7.3 million ha increase in corn acreage is expected to occur by.

p. 215. Table 18. I believe more of the listed agricultural management options have benefits for air quality than are indicated in this table. Reductions in NH_x or N₂O emissions associated with many of these options should be identified as having air quality benefits.

5. Dr. Kristin Shrader-Frechette

9-23-07 Comments by Kristin Shrader-Frechette on EPA Hypoxia Study

While the hypoxia study, overall, is very well done and very readable, four amendments would probably make it a stronger study.

Proposed amendment 1: Because the definition of “biosolids” in the glossary on p. xv contains a major value judgment and begs a controversial scientific question about harms associated with biosolids, the word “harmless” should be removed from line 3 of the definition. See rationale below.

Proposed amendment 2: Because the definition of “biosolids” in the glossary on p. xv contains a second value judgment and begs a second controversial scientific question about whether they should be used as fertilizer, the third sentence of the definition should be cut because it claims that when treated, such biosolids can be applied as fertilizer.

Rationale for amendments 1-2:

(A) Using the word “harmless” in the glossary, to describe biosolids, is inconsistent, given that EPA itself says the sludge is not harmless. EPA says dioxins in the treated biosolids, for example, cause a small, but measurable, increase in cancers among farm families. (<http://yosemite.epa.gov/opaOpenDocument/admpress.nsf/b1ab9f485b098972852562e7004dc686/209dab87e1b0a8b785256dc20050c977?>).

(B) Because the document affirms (p. 3) that most (54%) non-point sources of N are from fertilizer, and (p. 3) that hypoxia reduction is at odds with many current agricultural and energy policies, the glossary and document probably should not beg any related value or policy questions (such as that the sludge is harmless, or that it can be safely applied as fertilizer), especially when the questions are matters of scientific controversy.

(C) Although in 2003, the EPA concluded that using sewage sludge as fertilizer caused few adverse health effects and declined to impose regulations on the practice, researchers have complained both about undesirable chemicals and about pathogens in the waste. University of Georgia microbiologist David Lewis showed in 2002, in a British medical journal, that 25 percent of individuals surveyed (who lived within a half mile of sewage sludge used as fertilizer) experienced eye, lung, skin and other irritations, including Staphylococcus aureus infections. The study showed that although modern treatment can eliminate 95 percent of pathogens, enough pathogens remained in class B sludge to pose a health risk. In 2002, the National Research Council also concluded that there may be public health risks from using processed sewage sludge – biosolids -- as commercial fertilizers.

Proposed amendment 3: Since the document affirms (p. 3) that most (54%) non-point sources of N are from fertilizer, it might be good if the 5 significant opportunities for N reduction, mentioned on p. 6 mentioned fertilizer specifically.

Proposed amendment 4: Although the report warns (p. 8) that action on hypoxia lags behind the science; (p. 52) that there is evidence of a dangerous regime shift in the Gulf; (p. 16) that the ultimate goal of the study is mitigation and control to reduce hypoxia; (p. 8) that scientists and policymakers must confront the conflicts causing hypoxia – nevertheless the vagueness and generality of the recommendations on pp. 5-8 of the executive summary do not encourage action as much as they ought. To be more effective, in achieving the admitted goals of the study and in

addressing the severity of the hypoxia problem, the report might benefit from 5 organizational improvements. These include (i) giving a full list of bulleted or numbered recommendations, either in the executive summary, or in an entire chapter at the end, as most National Academy reports do; (ii) organizing the recommendations, so that action proposals and research proposals are listed together; (iii) rewriting the recommendations so that they are more specific, empirical, and action oriented; (iv) rewriting them so that they include who or what group might be responsible for implementing or initiating the actions; (v) rewriting the recommendations so that there is more emphasis on the adaptive management discussed on pp. 121 ff. Otherwise, the recommendations might not be as clear as possible and might not promote needed action.

This bulleting, gathering, and rewriting of specific, empirical recommendations could build on the recommendations already given, e.g., on pp. 52, 55, 98, 107-108, 119-120, 124-5, 133-4, 143-144, 152-4, 157, 162, 175-6, 195-6, 199, 201, 209-10.

6. **Dr. Granger Morgan:**

The report is clear and well written. It is directly responsive to all the charge questions. My congratulations and thanks to all who are responsible for this impressive effort.

Many issues are identified for which scientific understanding is still not complete and various recommendations are made for research to make that understanding more complete. However, EPA's ultimate concern should be managing the problem of hypoxia. In that regard, it is not always clear to me which of the recommended research efforts, if satisfactorily undertaken, have a high probability of supporting improved management activities, and which do not. If some differentiation is possible that would be good – otherwise there is the risk that research might become a substitute for action. The recommendation (pg 120) that "model selection should depend on the question(s) being asked," is very good. The same philosophy should be applied to the prioritization of research.

The report talks of a "state change" in the Northern Gulf, but does not articulate very clearly what exactly has changed. Some more concrete explanation of what has changed would help. The report suggests that there will likely be hysteresis in the system. It is clear to me why this is important but as a non-expert reader it is not clear to me what the mechanisms causing hysteresis are likely to be.

The recommendations supporting an adaptive approach are very sensible, especially if it is undertaken with adequate instrumentation and observation of the system that allows ongoing improvement in models and understanding – this because it is unlikely that all of the uncertainties will be resolved through research on the time scale over which the management problem must be addressed. It is not clear to me that the need for adequate instrumentation and measurement as a corollary to successful adaptive management is sufficiently emphasized.

The two bulleted recommendations on page 131 which state needed reductions should take the form "a reduction of at least X is needed in order to meet the established target of Y." Otherwise they read like the SAB is making a policy recommendation which is not its appropriate role.

I don't understand why *shallower* tile depth *reduces* drainage flow in tile systems (pp 155-157). Is this because spacing is taken as constant and becomes too wide to collect all surface input as depth gets shallower? An explanatory sentence would be nice.

Add "are needed" in the final recommendation on bioenergy. More fundamentally, bio-energy production can reduce volume but in general it does not eliminate, indeed it concentrates, N and P in the residual.

Page 199 the recommendation is missing the word "should".

On page 223 I am troubled by the response to IIIA that the "...goal will need to be extended beyond 2015...". I would think it better to say "...that either a much more aggressive set of control strategies will need to be adopted or the goal will need to be extended beyond 2015..." I am concerned about the SAB straying too far into policy making.

Top of page 224 "...recommends a minimum target of 45% reduction..." Don't you need some language about an adaptive approach in that recommendation? I don't think you are saying get - 45% and the problem will be solved but rather, aim for a big cut and then start adjusting policy on the basis of what one sees as the process proceeds.

Given the various public comments about "voluntary approaches" and the fact that there is now a small literature on the effectiveness of such approaches (including the recent RFF study), should the panel consider saying something about this?

Several of the comments above, if adopted, should also be reflected into the summary material at the start of the report.

While it gets mentioned a few times, there is very little discussion of how climate change may impact this problem. The time scale on which the hypoxia problem is being addressed is comparable to the time scale on which significant climate change will occur. A bit more focus on the implications of climate change (frequency, intensity and distribution of precipitation, soil moisture, etc.) would be well advised. Also, when the SAB visited region 6 and received briefings on the work on coastal wetland restoration it appeared that EPA was not factoring potentially large climate-induced sea-level rise into their thinking. The committee might consider whether this is an issue that could also be important for this problem.

7. Dr. Valerie Thomas:

Here are my comments on the Draft Hypoxia Report.

Overall a truly strong report. There are some inconsistencies, as detailed below:

p. 138. The summary statement on the potential to protect social welfare while reducing Hypoxia isn't completely consistent with the detailed discussion. The detailed discussion, on p. 137 lines 31-40, and before, says that the Integrated Assessment remains the most complete coverage and suggests that benefits exceed costs, even with only some of the co-benefits included. So it is surprising to read, on p. 138 lines 12-13 that that "there is great uncertainty of whether the goal can be achieved while protecting social welfare in the Basin." The paragraph that follows is consistent with the detailed discussion, that is "while we cannot definitively say that we can achieve the 5000 km² goal while maintaining social welfare, there is evidence to suggest that it is feasible to do so." I suggest that lines 12-13 on p. 138 be cut; that removes the inconsistency.

p. 143. Key findings. "Due to inadequate research funding... there is currently inadequate scientific basis to know with assurance whether the goal of a 5-year running average of 5000 km² for the hypoxic zone can be achieved while maintaining social welfare in the Basin." Again, this

statement is more negative than the evidence reviewed in the body of the report. Moreover, this statement and much of the preceding section could be interpreted to suggest that the panel's interest in more research funding is resulting in an exaggeration of the social welfare issue. None of the evidence presented in the body of the report suggests that maintaining social welfare will be impossible. A better sentence would be something like this: "The evidence strongly suggests that social welfare in the basin can be maintained while achieving the goal of a 5-year running average of 5000 km² for the hypoxic zone." See also the response to the charge question on page p. 223, lines 36-39, where there is an excellent statement; the body of the report needs to be brought into conformity with the response to the charge question.

pp. 145-146. Very nice discussion of voluntary measures.

pp. 168-169. Key Findings. Perennials. The draft states that use of perennials would result in significant N and P reductions. However, the preceding text, while mentioning that perennials are more efficient users of N, doesn't mention the P implications of a switch to perennials. More importantly, the text does not seem to include any references that directly support the N or P benefits of perennials. I don't doubt that the benefits are real. But since a switch to perennials would be a major change for the Basin, the recommendation should be strongly supported by references to the peer-reviewed literature.

p. 172 line 3. Remove the word "are"

p. 175. Line 4. Change "affect" to "effect". Line 44: change "in" to "is".

p. 176. Key Findings. The key findings section says that "co-siting with biofuel production facilities... will likely create the economies of scale and alternative technologies for manure management more feasible." This finding is not supported in the text; the text says the opposite: on p. 173 lines 23-30 the text says that co-locating AFOs with corn production "may exacerbate the accumulation of manure-based nutrient." The finding is also inconsistent with the finding on p. 210. (Also, note that the quoted sentence from the findings is not a grammatically correct, and that "sighting" should be changed to "siting." Further, the last bullet point isn't a complete sentence; something like "should be provided" needs to be added.) Overall, this section is not as well written as others; it is not tightly argued; the conclusions are not well-supported by the text.

p. 199. Atmospheric Deposition. Excellent section. (Also, the recommendation needs the word "should" before "be incorporated".)

p. 201. Excellent section on sewage treatment plants.

p. 223, lines 36-39: "social welfare can be protected by choosing policies that incorporate targeting." This statement in the charge question responses is an accurate reflection of the evidence discussed in the body of the report; it is a more accurate reflection than the statements on this topic on pp. 138 and 143.