

Outline dated 2-8-07 to assist SAB Hypoxia Advisory Panel in deliberations. Do Not Cite or Quote. This draft outline is a work in progress, does not reflect consensus advice or recommendations, has not been reviewed or approved by the chartered SAB, and does not represent EPA policy.

Hypoxia Advisory Panel Table of Contents

Executive Summary (5 pages)	
Background on Hypoxia Panel and its discovery process	
Key findings.....	
1. Introduction (6 pages).....	
1.1. Hypoxia in Gulf – brief history.....	
1.2. SAB report is product of specially convened panel.....	
1.3. Process of gathering information for report.....	
1.4. Charge questions.....	
2. Findings (95 pages total).....	
2.1. Response to charge question I – Characterization of hypoxia (30 pages total)....	
2.1.1. Address the state of the science and the importance of various processes in the formation of hypoxia in the Gulf of Mexico.....	
2.1.1.1. Historical patterns and evidence for hypoxia on the shelf.....	
Consistency with increased nutrient loading over the past 50 years	
Proxies used for hypoxic conditions: agreement and disagreement	
2.1.1.2. Role of N and P and potential for seasonal limitation in controlling primary production.....	
Nitrogen and phosphorus fluxes to the NGOM	
N and P limitation in different shelf zones	
Relative importance of each of the Rowe and Chapman (2002) zones to the onset and continuation of hypoxia	
The linkages between high primary production inshore and the hypoxic regions further offshore	
2.1.1.3. Other limiting factors.....	
2.1.1.4. Role of Si in phytoplankton species composition and subsequent alterations of C transport and utilization:.....	
2.1.1.5. The physical context	
Changes in discharge volumes and/or hydrologic processes.....	
Use of the Rowe and Chapman (2002) zonal boundaries.....	
Local vs. regional drivers of circulation	
Gaps in understanding.....	
2.1.1.6. Carbon fluxes from the Mississippi River Basin: sources, sinks, and changes through time	
Terrestrial (including eroded wetlands) vs. autochthonously produced carbon ..	
2.1.1.7. Transport, loss and transformation of terrestrial and autochthonously-produced carbon in different shelf zones	
2.1.1.8. Denitrification, P burial, and nutrient (especially N and P) recycling and removal and their impacts on primary production	
2.1.1.9. Single vs. dual nutrient removal strategies	
New and existing evidence of the role of P in hypoxia	

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- Action Plan targets N but explicitly encourages strategies that will remove P along with N.....
- Joint removal strategies.....
- 2.1.2. Comment on the state of the science for characterizing the onset, volume, extent and duration of the hypoxic zone.
- 2.1.2.1. Current state of forecast models
- 2.1.2.2. Advantages and disadvantages, and reconciling different model types
- 2.2. Response to charge question II – Characterization of nutrient fate, transport, and sources (20 pages total).....
- 2.2.1. Evaluate data and models on loads, fate, and transport of nutrients and importance of various processes
- 2.2.1.1. Temporal characteristics of nutrient loads and fluxes
- Research needs identified in CENR.....
- Findings since CENR report
- Change in load estimation technique
- Temporal patterns in streamflow and nutrients
- Annual.....
- Seasonal
- Sub-basin annual and seasonal loads (waiting for data, should be soon)
- Contributions from tile drained watersheds (will discuss after getting sub-basin data).....
- Research needs.....
- 2.2.1.2. Mass balance of nutrients.....
- Research needs identified in CENR: improve mass balance calculations.....
- Findings since CENR report
- Cropping Patterns.....
- Nitrogen
- Atmospheric deposition
- Phosphorus.....
- Research need
- 2.2.1.3. Nutrient transport and transformation processes
- In-stream processes
- Nitrogen
- Phosphorus.....
- Conclusions/Recommendations
- Freshwater wetlands.....
- Coastal wetlands
- Research Needs.....
- Conclusions and Suggested Recommendations.....
- 2.2.2. Ability to route nutrients and predict their delivery to the Gulf
- 2.2.2.1. Research needs identified in CENR:.....
- 2.2.2.2. Findings since CENR report
- Overview of models used.....
- SWAT
- SPARROW

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- Others
- Uncertainties in model predictions
- Current ability to model nutrient routing (from initial outline)
- 2.2.2.3. Research needs.....
- 2.3. Response to charge question III – Scientific basis for goals and management options (45 pages total).....
- 2.3.1. Scientific Basis for Goals and Management Option.....
- 2.3.1.1. Goal setting (5 pgs.).....
 - Technical feasibility
 - Economic feasibility
 - Benefits versus costs – importance of being directionally correct
- 2.3.1.2. Upstream Costs and Benefits of Hypoxia Reduction Actions
- CENR Topic 6 report:.....
 - Summary of key points
 - What findings are still valid, what may not be?.....
 - New integrated modeling studies since Task 6 report (4 pgs.).....
 - Basinwide scale integrated economic-biophysical modeling
 - Smaller watershed scale integrated economics-biophysical modeling
 - Basinwide co-benefits, carbon sequestration, local water quality, biodiversity, etc.....
 - Research Assessing Policy Design and Effectiveness (7 pgs.).....
 - Purely voluntary (no incentives).....
 - Incentive programs, ag. Conservation programs and trading
 - Targeting and other issues in cost-effective design
 - Taxes
 - Mandatory: regulations, conservation compliance
 - Landscape Design
 - Adaptive Management
- 2.3.1.3. Downstream Effects and Benefits (3 pgs.)
- CENR Topic 2 report.....
 - Summary of key points
 - What findings are still valid, what may not be?.....
 - New literature since Task 2 report.....
 - Quantifying biological effects of hypoxia is very difficult.....
 - Many species can avoid hypoxic areas
 - Potential impacts on a particular species will depend strongly on species-specific factors
 - Shrimp is key species.....
 - Loss of habitat.....
 - Block migratory corridors.....
 - Potential for fisheries collapse, as observed elsewhere
 - “Jubilee” effect.....
 - May make bottom dwelling organisms move vertically in the water column, which may also make them more vulnerable to predators.....
 - May kill benthic invertebrates (e.g., annelid worms) off which shrimp feed...

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Lipids in a shrimp's body tends to be 20 to 25 percent lower in animals caught in low-oxygen areas than in those caught in fully oxygenated water ...
 Ecosystem change create habitat that favors jellyfish over the commercially valuable finfish, crabs, and oysters, as observed elsewhere.
 Irreversibilities. It might take many years or decades for ecosystems to recover after nutrient inputs are stopped.....

2.3.2. Based on the current state of the science, what level of reduction in causal agents will be needed to achieve the current reduction goal for the size of the hypoxic zone?

2.3.2.1. Basis for the current reduction goal

2.3.2.2. (now covered under IIIAi)

2.3.2.3. Advantages, disadvantages, and limitations of the current forecast models to predict NGOM response to reduced nutrient loadings.....
 N.....
 P

Discharge patterns.....

2.3.2.4. Confidence estimates around model results and areas for further research

2.3.3. Options for managing nutrients, co-benefits, and consequences.....

2.3.3.1. Agricultural drainage

Current extent and patterns of agricultural drainage, including cropland “benefiting” from field drainage as well as cropland contributing to drainage networks.....
 Effects of agricultural drainage on N and P transport from cropland.....
 Research Needs Identified in CERN:

Findings since CERN report

Conclusions.....

Tile drainage and N leaching

Potential effects of alternative drainage system design and management on N and P transport from cropland (including controlled drainage and bioreactors), and their technical feasibility

2.3.3.2. Wetlands and deepwater habitats: upland, riverine, and floodplain
 Current extent, distribution and effects of wetlands and deepwater habitats on N and P transport

Effects of current wetland treatment practices on nitrate removal and P transport

Nitrate

Phosphorous.....

Effects of potential treatment wetland practices on nitrate removal and P transport

Potential effects of creation and management of wetland and deepwater habitats on N and P transport

Find what off-field practices are available; i.e., channel / river mitigation practices that retard N and P losses.....

2.3.3.3. Conservation buffers.....

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- How have conservation buffers been applied and are there any estimates of N and P reduction benefits and the mechanisms involved?.....
- How can conservation buffers be integrated into tile-drained landscapes, specifically where changes in drainage management has the potential to increase surface runoff?
- What new information on hydrogeologic settings can be used to better design conservation buffers within the basin?
- 2.3.3.4. Cropping systems.....
 - Row crops, perennials, cover crops, living mulches, relay crops
 - Current extent, distribution, and effects of major cropping systems on N and P export
 - Potential effects of alternative cropping systems on N and P export
 - Effects of changes in cropping practices and rotations for bio-fuel production on N and P transport)
- 2.3.3.5. Animal production systems.....
 - System evolution and nutrient flows.....
 - Remedial Strategies
 - Recommendations.....
- 2.3.3.6. In field nutrient management.....
 - Current Practices.....
 - Nutrient Management Planning Strategies
 - High-P feed byproducts from ethanol industry.....
 - Manure treatment.....
 - Best Management Practices
 - Potential effects of changes in rate and timing of fertilizer application on N and P export
 - Rate
 - Timing.....
 - Effects of N and P management on soil resource sustainability.....
 - Effects of manure management and proper accounting of manure N and P
 - Newer technologies for reduction in nitrate-N and P discharges
 - Precision agriculture management tools
 - Controlled release or enhanced efficiency fertilizers.....
 - Need for more properly replicated on-farm research, using farmer equipment, to better define site-specific N rates?.....
 - New technologies related to control of N and P from manure
 - Older technologies that could receive greater implementation for improved effectiveness of applied N and reduced losses from farm fields
 - Soil N tests and basal corn stalk nitrate test.....
 - Targeted tissue sampling in-season (e.g. petioles: cotton, potatoes)
 - Nitrification inhibitors, urease inhibitors (beyond Minnesota) to enhance N use efficiency (potentially reducing applied N rates)
 - Appropriate N timing and rates.....
 - Other BMPs- as outlined by NCSU
- 2.3.3.7. Most Effective Actions for Other Non-Point Sources

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- Atmospheric Deposition
- Residential and Urban Sources
- 2.3.3.8. Most Effective Actions for Industrial and Municipal Sources
- 2.3.3.9. Consequenses of Increased Production of Ethanol.....
- 3. Key Conclusions and Recommendations (5 pages).....
- 3.1. Major advancements since the CERN report.....
- 3.2. Gaps and research needs
- 3.3. Implications of scientific advancements and science gaps for management of hypoxia in the Gulf of Mexico and Mississippi River Basin and co-benefits
- References.....
- Appendices.....
- Acronyms.....