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# Environmental Goals and Indicators for Delaware's Coastal Zone

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## Recommendations of the Environmental Indicators Technical Advisory Committee

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March 1999



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## **About this Document**

This document was produced as part of a partnership between the members of the Coastal Zone Environmental Indicators Technical Advisory Committee (EITAC) and the EITAC Support Staff. The document is introduced by an overview of the events leading up to the passage of the Coastal Zone Act (CZA) of 1971, the new Regulations Governing Delaware's Coastal Zone, and a description of the process used for development of the Coastal Zone Environmental Goals and Indicators associated with these regulations. It then outlines the recommended Environmental Goals and Indicators developed through the efforts of the EITAC over an intensive 6-month period. It then provides a summary of the EITAC recommendations and a plan of action to ensure the successful use of the Coastal Zone Environmental Goals and Indicators.

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## **The EITAC Recommendations to DNREC**

This document contains the recommendations of the Delaware Coastal Zone Environmental Indicators Technical Advisory Committee (EITAC) to the Delaware Department of Natural Resources and Environmental Control regarding the development of Environmental Goals and Indicators for Delaware's Coastal Zone. It represents the collective work of the many stakeholders from government agencies, non-governmental organizations, and the general public. It also reflects the collective input of a broad range of technical experts who participated in the Technical Workshop on January 29, 1999.

The EITAC fully recognizes that the Environmental Indicators recommended in this document will require additional development and refinement in order to be meaningful and useful in support of the new Regulations Governing the Use of the Delaware's Coastal Zone. They are intended to serve as the framework from which DNREC can build upon for the initial implementation and continuous refinement of Indicators. This document also includes recommendations for the next steps that should be taken in order to ensure successful implementation of the Coastal Zone Environmental Goals and continuous refinement of the Indicators.

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## **Purpose of the Coastal Zone Act Environmental Goals & Indicators**

The purpose of the Coastal Zone Environmental Goals & Indicators Project is to develop tools that will assist resource managers in measuring and monitoring the health of the Coastal Zone. These tools include a set of environmental goals specific to the Delaware Coastal Zone and a set of prioritized Environmental Indicators (EIs) that will be used to assess and track progress toward achieving these environmental goals. The project design to establishes a continuous process that will allow changes or updates to the initial set of Delaware Coastal Zone Environmental Indicators over time. This effort is a direct outgrowth of recommendations to the Delaware Department of Natural Resources and Environmental Control (DNREC) as outlined in the Memorandum of Understanding (MOU) developed and ratified by the Coastal Zone Regulatory Advisory Committee in 1998. These CZA goals and indicators will be an integral part of the Coastal Zone permit process in accordance with the Regulations Governing Delaware's Coastal Zone.

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## **For More Information**

For more information on this Recommendations Document or the Delaware Coastal Zone Environmental Goals & Indicators Project please contact:

Dave Carter or Carl Yetter  
Delaware Coastal Programs  
Department of Natural Resources & Environmental Control  
89 Kings Highway, Dover, DE 19901  
Tele: (302) 739-3451  
Fax: (302) 739-2048  
dcarter@dnrec.state.de.us  
cyetter@dnrec.state.de.us

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# **Environmental Goals and Indicators for Delaware's Coastal Zone**

## **Recommendations of the Environmental Indicators Technical Advisory Committee**

**March 1999**

**Authored by:**

**The Delaware Coastal Zone Environmental Indicators Technical  
Advisory Committee (EITAC), and the EITAC Support Team**

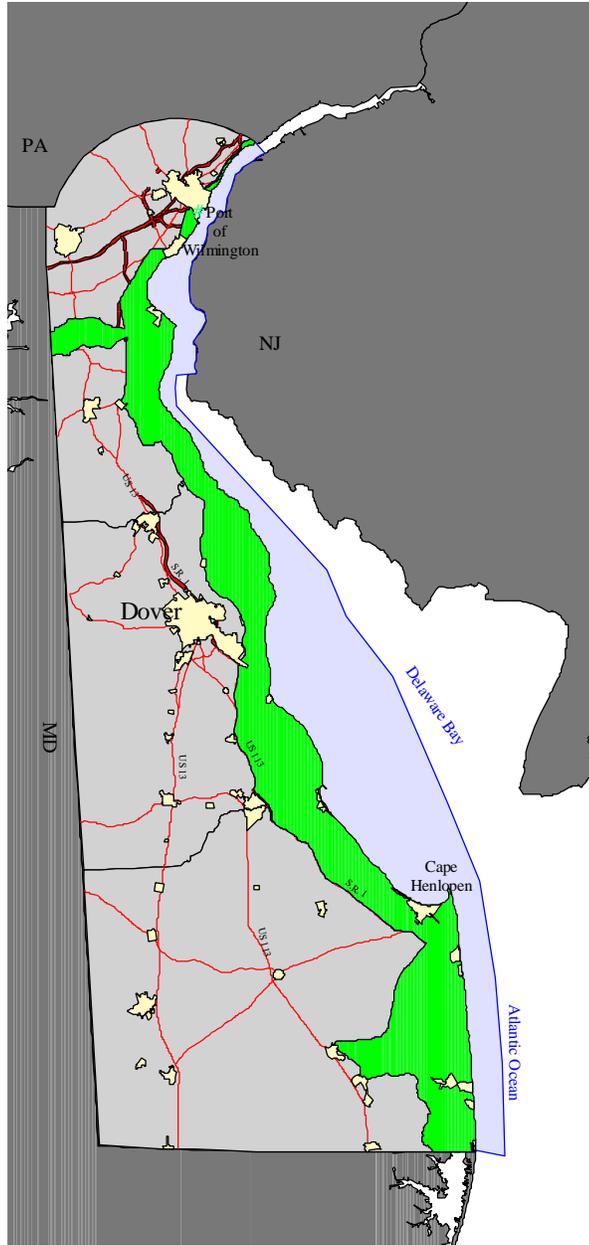
**Edited and Prepared by:**

**Delaware Coastal Programs  
Division of Soil & Water Conservation  
Delaware Department of Natural Resources and Environmental Control  
Dover, Delaware**

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# State of Delaware

## Coastal Strip with Port of Wilmington



### Regulated Area



## Executive Summary

This document contains the recommendations from the Delaware Coastal Zone Environmental Indicators Technical Advisory Committee (EITAC) to the Delaware Department of Natural Resources and Environmental Control (DNREC) regarding the development of Environmental Goals and Indicators for Delaware's Coastal Zone. It represents the collective work of many stakeholders from government agencies, non-governmental organizations, and the general public. It also reflects the collective input of a broad range of technical experts who participated in the January 29, 1999 Technical Workshop.

The purpose of the Coastal Zone Environmental Goals and Indicators Project is to develop several tools to measure and monitor the health of the Coastal Zone. These tools include a set of environmental goals specific to the Delaware Coastal Zone and a set of prioritized Environmental Indicators (EIs) to assess and track progress toward the environmental goals.

Delaware's General Assembly enacted the Delaware Coastal Zone Act of 1971 to control the location, extent, and type of industrial development in Delaware's environmentally sensitive Coastal Zone. The Act specifically states that the coastal areas of Delaware are the most critical areas for the future of the State in terms of the quality of life. The Act was specifically seeking to entirely prohibit the construction of new heavy industry in the state's Coastal Zone because it was considered, in most cases, incompatible with the protection of the natural environment of the coastal area.

The Act called for establishment of regulations within one year to assist in the implementation of the Act. However, the details of the Act's regulations have proven to be a continuing area of controversy. A lack of agreement regarding the content of the regulations has kept them from being promulgated for over 25 years. Ironically, the success of the Act now appears to have made promulgation of regulations possible.

After several unsuccessful attempts over the years to develop CZA Regulations, an Advisory Committee, composed of all major stakeholders in coastal activities, was established

in 1996 to once again undertake this effort. The group was facilitated for 18 months by the Consensus Building Institute, leading to the development and ratification of a Memorandum of Understanding (MOU) by the Coastal Zone Regulatory Advisory Committee. This MOU contains recommendations from the Advisory Committee to the DNREC. The recommendations advised DNREC on the content of the regulations that have been approved by the Coastal Zone Industrial Control Board. Once fully promulgated, these regulations will be used to implement the Coastal Zone Act.

This Project is a direct outgrowth of recommendations to DNREC as outlined in the MOU developed and ratified by the Coastal Zone Regulatory Advisory Committee. These Coastal Zone Act (CZA) Environmental Goals and Indicators will be an integral part of the Coastal Zone permit and offset decision-making process in accordance with the Regulations governing Delaware's Coastal Zone.

The recommendations of the EITAC are the result of an intensive six-month effort resulting in the development of four (4) broad environmental goals and fourteen (14) prioritized environmental indicators. The recommended Coastal Zone Environmental Indicators are composed of various combinations of forty-seven (47) parameters.

Development of a concise set of environmental goals provided a solid foundation for the Environmental Indicators project. Previously, goals had been developed for the entire state of Delaware. However, the specific charge to this group was to focus exclusively on issues affecting the health of the Coastal Zone region as defined by the 1972 Coastal Zone Act. Defining these goals enabled the EITAC to focus on issues affecting the health of the Coastal Zone and to determine how a subset of indicators and parameters could more fully measure progress toward those goals. The Memorandum of Understanding from the Delaware Coastal Zone Regulatory Advisory Committee to the Delaware DNREC (March 19, 1998) provided the following definition:

***“Environmental Goals are a collection of broad and strategic environmental priorities and objectives for a region.”***

The recommended Environmental Goals for Delaware's Coastal Zone are:

**Air Quality:** *Improve air quality, which directly or indirectly affects all forms of life within the Coastal Zone.*

**Water Quality:** *Improve water quality and quantity, which directly or indirectly affects all forms of life within the Coastal Zone.*

**Habitat/Land Cover:** *Protect the mosaic of land cover in the Coastal Zone, including upland, wetland, shoreline, and aquatic areas, to ensure a healthy ecosystem. Encourage appropriate land use and land cover.*

**Aesthetics:** *Ensure the protection of natural vistas in the Coastal Zone for public enjoyment. (This goal was combined with habitat/land cover during the indicator development phase.)*

**Living Resources:** *Preserve and maintain healthy native animal and plant populations, or biodiversity, in the Coastal Zone. Preserve and improve the ability of native populations to live and thrive in the Coastal Zone.*

To track progress towards these goals, a series of closely linked Environmental Indicators has been developed. These were developed by the EITAC from information derived at the January 29 workshop. They thematically grouped the draft Environmental Indicator worksheets into the fourteen recommended Indicators. In order to quantify each indicator, one or more parameters, each measuring a particular aspect of the indicator, has been identified. The indicators for each goal are listed below. Full descriptions of the indicators and their parameters, begins on page 19.

**Air Quality Indicators:**

- Ambient Air Quality Indicator
- Affected Populations Indicator
- Accidental Releases Indicator
- Atmospheric Deposition Indicator

**Water Quality Indicators:**

- Benthic Community Indicator
- Contaminants/Toxicity Indicator
- Ambient Water Quality Indicator
- Watershed Pollutant Load Indicator
- Affected Populations Indicator

- Accidental Releases Indicator
- Non-point Source Nutrient Mass Balance Indicator

**Habitat/Land Cover Indicators:**

- Habitat Change Indicator
- Wetland Inventory Indicator

**Living Resources Indicators:**

- Keystone Species Indicator
- Biodiversity Indicator
- Benthic Community Indicator

The EITAC fully recognizes that the Environmental Indicators recommended in this document require additional development and refinement to be meaningful and useful in support of the new Regulations Governing the Use of the Delaware's Coastal Zone. They are intended to serve as the framework from which DNREC can build upon for the initial implementation and continuous refinement of Indicators.

To help meet this challenge, this document also includes recommendations for the next steps to be taken to ensure the successful use of the Coastal Zone Environmental Goals, Indicators, and Parameters.

The six key recommendations of the Environmental Indicators Technical Advisory Committee to the Delaware Department of Natural Resources and Environmental Control include the following.

1. DNREC should accept the four Coastal Zone Environmental Goals as the guiding principles for protecting our coastal resources for uses addressed in the 1999 Regulations Governing Delaware's Coastal Zone, for the benefit of present and future generations.
2. DNREC should accept the Coastal Zone Environmental Indicators and their associated parameters as a starting point, and refine them in accordance with scientific knowledge.

3. DNREC should begin immediate development and implementation of an Environmental Indicator monitoring program, while recognizing that the initial set of Coastal Zone Environmental Indicators still requires refinements. DNREC should use a phased approach to the initial implementation of Environmental Indicators, focusing on those thirteen (13) parameters that have data available during year I. DNREC should address those eighteen (18) additional parameters with some data available by year II, and the remaining seventeen (17) parameters that require significant work and resources by year III. DNREC should also issue an annual progress report on the Environmental Indicators program.
4. The refinement of the Environmental Indicators should be accomplished using highly structured focus groups of scientific and technical experts and should include the continuation of direct stakeholder and public input. A new committee, "EITAC II", should be established with a modified membership from the original EITAC to provide oversight for the focus groups. The new committee will need a considerably higher percentage of scientifically and technically trained members than the original EITAC.
5. The partially implemented state of the current Environmental Indicators program is of limited value in carrying out the purposes outlined in the 1999 Regulations Governing Delaware's Coastal Zone. Adequate funding and support from State Government is critical for further development. Therefore, the EITAC recommends that work for phase II be fully funded and supported by DNREC, other State agencies, and the State Legislature.
6. DNREC should develop a fully integrated information management system linked to a geographic information system as an additional support tool to manage the Coastal Zone Environmental Indicators program. The effectiveness of the Coastal Zone Environmental Goals and Indicators will be measured not by the quality of the content of this recommendation document, but by the level of implementation of Environmental Indicators. It will also be measured by the extent to which they prove useful in pro-

viding industry flexibility while quantifying net improvements in the environmental quality of the coastal zone. It should be clear that many details of the Environmental Goals and Indicators program will be refined and revised over time, an important process of continuous management that will help ensure they improve over time.

The biggest challenge, that of implementation, still lies ahead. The recommendations in this document should provide the foundation necessary to ensure that the next 25 years of implementation of the Delaware Coastal Zone Act will be even more successful than the past 25 years since its enactment.



## Environmental Indicators Technical Advisory Committee

David	Baker	Council of Farm Organizations
Greg	Breese	USFWS/DBEP
Sarah	Cooksey	DNREC/Delaware Coastal Programs
Leonard	Fasullo	DuPont/Edgemoor
*Richard	Fleming	Private Citizen
Debbie	Heaton	Sierra Club
Jim	Lisa	Delaware Economic Development Office
Peter	Martin	Delaware Wild Lands
James R.	May	Widener Univ. School of Law
*Tom	Molin	United Steelworkers of America
Paul	Morrill	Delaware City - City Hall
Ed	O'Donnell	Private Citizen
Bill	Ritter	University of Delaware
Clyde	Roberts	Waterman
Mike	Sprague	Diamond State Port Corp.

\*denotes committee co-chairs

## EITAC Alternates

Barry	Bowers	United Steelworkers of America
Susan	Brenneman	DuPont/Edgemoor
Ed	Christoffers	USFWS/DBEP
Lorraine	Fleming	Delaware Nature Society
Rick	Greene	DNREC/DWR
Cheryl	Heiks	Delaware Economic Development Office
Jack	Klingmeyer	Mayor of New Castle
Wendy	Myers	Widener Univ. School of Law
Brian	Page	Office of Emergency Mgmt.
Grace	Pierce-Beck	Delaware Audobon Society

## EITAC Support Team

Dennis	Brown	DNREC/Office of the Secretary
Kathy	Stiller	DNREC/DAWM
John	Schneider	DNREC/DWR/WAS
Ron	Vickers	DNREC/DPR
Dave	Carter	DNREC/Delaware Coastal Programs
Carl	Yetter	DNREC/Delaware Coastal Programs
Charles	Schonder	DNREC/Delaware Coastal Programs
Robert	Scarborough	DNREC/Delaware Coastal Programs
Lonnie	Dye	DNREC/Delaware Coastal Programs
Betsy	Archer	DNREC/Delaware Coastal Programs
Jennifer	Reid	DNREC/Delaware Coastal Programs
Gerald	Llewellyn	DHSS/DPH

## Committee Activities

October 13, 1998

First EITAC Meeting, 9am-4pm, Grass Dale Conference Center, Delaware City

November 6, 1998

Second EITAC Meeting, 9am-4pm, Grass Dale Conference Center, Delaware City

December 2, 1998

Third EITAC Meeting, 9am-4pm, Grass Dale Conference Center, Delaware City

January 8, 1999

4th EITAC Meeting. 9am-4pm, Grass Dale Conference Center, Delaware City

January 29, 1999

Coastal Zone Environmental Indicators Workshop, at Clayton Hall, University of Delaware, Newark. 9:00am-4:00pm.

A large meeting of invited participants from various government agencies, academic research institutions, industry and the public to further characterize issues that face Delaware's Coastal Zone. Initial discussion will also begin on the selection of specific parameters to use in the creation of Environmental Indicators.

February 19, 1999

5th EITAC Meeting, 9am-4pm, Grass Dale Conference Center, Delaware City

March 12, 1999

6th EITAC Meeting, 9am-12pm, Grass Dale Conference Center, Delaware City

March 26, 1999

7th EITAC Meeting, 9am-4pm, Grass Dale Conference Center, Delaware City

In addition to time spent in meetings and workshops, the Committee and staff put in a considerable amount of time reviewing background information from other indicator projects and reviewing drafts of the intermediate documents that it has produced.

## Public Participation

One of the primary reasons for forming the EITAC was to gather input from a wide audience of interested stakeholders. The EITAC was also charged with collecting and encouraging comments from other members of the public. This effort was advanced on several fronts.

1. At the lunch break and close of every meeting, specific time was set aside for the general public.
2. A web site was hosted by DNREC to post events, meeting minutes, and project background.
3. A workshop was held January 29 at the University of Delaware to include the knowledge of a wide range of environmental, scientific, and technical professionals. Opportunities were provided for all to comment at this workshop.

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# Contents

	Page
Executive Summary .....	i
EITAC Membership Listing .....	v
EITAC Support Team .....	v
Committee Activities .....	vi
Public Participation .....	vi
Table of Contents .....	vii
List of Figures .....	viii
List of Tables .....	viii
Introduction .....	1
Some Perspective.....	1
The Legislative Origin .....	1
The Coastal Zone Environmental Goals & Indicators Process.....	5
The Structure of the Goals and Indicators .....	11
Delaware CZA Environmental Indicators .....	11
Environmental Goals .....	15
Definition and Development .....	15
Air Quality .....	16
Water Quality.....	16
Habitat/Land Cover/Aesthetics.....	17
Living Resources.....	18
Indicators and their Parameters.....	19
Air Quality .....	21
Water Quality.....	25
Habitat/Land Cover/Aesthetics.....	29
Living Resources.....	33
Supporting Tools .....	36
Recommendations to DNREC.....	37
Status of Recommended Coastal Zone Environmental Goals and Indicators .....	39
The Unfinished Agenda and Recommended Next Steps .....	46
Definition of Acronyms.....	51
Appendix	
A. Map Portfolio	
B. Participants in the January 29, 1999 Workshop	
C. Guidance Document for Focus Groups	

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## Figures

Page

1.	Aerial view of Blackbird Creek .....	2
2.	Key recommendations included in the CZRAC MOU.....	3
3.	Revised Coastal Zone environmental goals .....	6
4.	Schematic diagram of how work to date was incorporated into the Technical Workshop.....	7
5.	Diagram of the process.....	10
6.	Schematic diagram of goals and indicators.....	12
7.	Example of parameters that define indicators.....	13
8.	Air Quality indicators and parameter schematic.....	20
9.	Water Quality indicators and parameter schematic.....	24
10.	Habitat/Land Cover/Aesthetics indicators and parameter schematic.....	28
11.	Living Resources indicators and parameter schematic .....	32
12.	Percent attainment of EITAC recommended Coastal Zone environmental indicators.....	40
13.	Percent attainment of EITAC recommended Coastal Zone environmental indicators by priority.....	41
14.	Air Quality goal.....	42
15.	Water Quality goal.....	43
16.	Habitat/land Cover/Aesthetics goal.....	44
17.	Living Resources goal.....	45

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## Tables

1.	Summary implementation status for parameters that comprise the Coastal Zone Indicators.....	39
2.	Summary of implementation status for parameters that comprise environmental indicators by priority ranking.....	41

## Introduction

*This document contains the recommendations of the Delaware Coastal Zone Environmental Indicators Technical Advisory Committee (EITAC) to the Delaware Department of Natural Resources and Environmental Control on the development of Environmental Goals and Indicators for Delaware's Coastal Zone. It represents the collective work of many stakeholders from government agencies, non-governmental organizations, and the general public. It also reflects the collective input of a broad range of technical experts who participated in the Technical Workshop on January 29, 1999.*

*These recommendations are the result of an intensive six-month effort which resulted in the development of four (4) broad environmental goals and fourteen (14) prioritized environmental indicators. The recommended Coastal Zone Environmental Indicators are indices composed of various combinations of forty-seven (47) parameters.*

*The EITAC fully recognizes that the Environmental Indicators recommended in this document require additional development and refinement in order to be meaningful and useful in supporting the new Regulations Governing Delaware's Coastal Zone. They are intended to serve as a framework from which DNREC will be able to build upon for the initial implementation and continuous refinement of Indicators. This document also includes recommendations for the next steps that should be taken to ensure the successful use of the Coastal Zone Environmental Goals and Indicators.*

## Some Perspective

The purpose of the Coastal Zone Environmental Goals and Indicators Project is to develop tools that will assist resource managers in measuring and monitoring the health of the Coastal Zone. These tools include a set of environmental goals specific to the Delaware Coastal Zone and a set of prioritized Environmental Indicators (EIs) that will be used to assess and track progress toward achieving the environmental goals.

This document should be considered as the completion of the first phase of a continuous process. This process will allow improvements to the initial set of Delaware Coastal Zone Environmental Indicators over time.

This effort is a direct outgrowth of recommendations to the Delaware Department of Natural Resources and Environmental Control (DNREC) as outlined in the Memorandum of Understanding (MOU) developed and ratified by the Coastal Zone Regulatory Advisory Committee. These Coastal Zone Act (CZA) Environmental Goals and Indicators will be an integral part of the Coastal Zone permit and offset decision-making process in accordance with the Regulations Governing Delaware's Coastal Zone.

## The Legislative Origin

Delaware's General Assembly enacted the Delaware Coastal Zone Act of 1971 to control the location, extent, and type of industrial development in Delaware's environmentally sensitive Coastal Zone. The Act specifically states that the coastal areas of Delaware are the most critical areas for the future of the State in terms of the quality of life. The Act was specifically seeking to entirely prohibit the construction of new heavy industry in the state's Coastal Zone because it was considered, in most cases, incompatible with the protection of the natural environment of the coastal area.

The passage of this Act was the culmination of a decade-long public policy debate, triggered by the *Morning News of*



**Figure 1. Aerial View of Blackbird Creek**

*Wilmington* article in May 1961 that revealed that 3,500 acres of marsh and upland in Blackbird Hundred were being held under option by the Shell Oil Company. This news immediately aroused substantial public opposition. Shell Oil's goal was to eventually acquire 5,000 acres in order to "round out a site adequate for a long term development... including a refinery, a chemical plant or complex of chemical plants and research facilities." The site included what are currently the Cedar Swamp Wildlife Area, the Delaware Wild Lands' Blackbird Creek Preserve, and the Delaware National Estuarine Research Reserve's Blackbird Creek Component.

The wetlands and uplands of this proposed site were zoned for agriculture, requiring a change in zoning classification for industrial development. Despite the growing public opposition and lengthy petitions in opposition, the New Castle County Zoning Commission unanimously recommended the rezoning of this land for industrial use. The Commission found that 60 percent of the area was marsh and hence useless for any other purpose.

The New Castle County Levy Court, under the Commission's recommendation, subsequently rezoned the land for industrial use. At the peak of the public policy debate, the *Morning News* published an editorial maintaining a strong position that until the enactment of provisions for statewide planning, which Delaware lacked; no decision to rezone should be made. The *Evening Journal of Wilmington* called the decision of the Levy Court to re-zone this parcel "an error of the first magnitude."

The public policy debate carried on in the courts and was eventually extended beyond the realm of a local zoning issue to a national issue. The threat of the refinery just a few miles north of Bombay Hook National Wildlife Refuge and adjacent to the Woodland Beach State Wildlife Area, both considered major migratory bird stopover and wintering areas, became apparent. This threat along the Delaware Bay coast emerged as a dominant issue in the protection of the Atlantic Waterfowl Flyway.

After several years of litigation and public scrutiny, the Shell Oil Company began to

retreat from their development plans, largely due to the significant amount of public opposition. The State of Delaware, as part of the State Preliminary Comprehensive Development Plan, recommended that the marsh areas along Delaware Bay south of the Chesapeake and Delaware Canal be preserved for wildlife conservation purposes. This was the first statewide policy statement reflecting the public's overwhelming interest in preserving their natural coastal resources. The controversy had been an invaluable educational process with lasting effects upon the public viewpoint. This change in public opinion was narrowly codified, with one vote, by the passage of the Delaware Coastal Zone Act of 1971. The Act called for establishment of regulations within one year to assist in the administration of the act. However, the details of the Act's regulations have proven to be a continuing area of controversy. A lack of agreement regarding the content of the regulations has kept them from being promulgated for over 25 years. Ironically, the success of the Act now appears to have made promulgation of regulations possible.

After several unsuccessful attempts over the years to develop CZA Regulations, an Advisory Committee, composed of all major stakeholders in coastal activities, was established in 1996 to once again undertake this effort. The group was facilitated for 18 months by the Consensus Building Institute, leading to the development and ratification of a Memorandum of Understanding (MOU) by the Coastal Zone Regulatory Advisory Committee. This MOU contains recommendations from the Advisory Committee to the Delaware Department of Natural Resources and Environmental Control (DNREC). The recommendations advised DNREC on the content of the regulations that have been approved by the Coastal Zone Industrial Control Board. Once fully promulgated, these regulations will be used to implement the Coastal Zone Act.

**Figure 2. Key Recommendations included in the Coastal Zone Regulatory Advisory Committee MOU**

*Key Recommendations Included in the Coastal Zone Regulatory Advisory Committee Memorandum of Understanding*

*These recommendations are built around two linked goals. First, the regulations shall ensure environmental improvement in the Coastal Zone. Second, the regulations shall allow for industrial flexibility.*

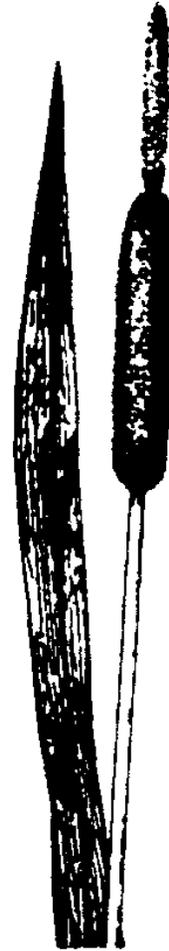
*In order to meet these goals, the regulatory process should be designed so that each heavy industry facility can obtain permits to add new products, change existing products, increase production capacity, add new processes and modify existing processes so long as these activities are: 1) undertaken in a way that assures environmental improvement in the Coastal Zone; and 2) undertaken in such a way that they meet the six criteria outlined in the Coastal Zone Act.*

*In addition, the regulatory process should be designed so that manufacturing, public sewage treatment, and public recycling facilities can obtain a permit either to initiate operations in the Coastal Zone or to modify its existing operations so long as these activities are: 1) undertaken in a way that assures environmental improvement in the Coastal Zone; and 2) undertaken in such a way that they meet the six criteria outlined in the Coastal Zone Act.*

Regulatory mechanisms developed by DNREC to meet the dual goals of environmental improvement and industry flexibility must be implemented simultaneously. In practice, this means that each grandfathered heavy industrial facility, manufacturing facility, public sewage treatment plant, and public recycling facility should be allowed increased flexibility in permitting and operations only after DNREC has developed a carefully defined procedure for assessing the applications. This procedure will ensure that proposed activities meet the environmental improvement standard, as well as the six criteria cited in the Act.

In particular, DNREC would need to develop tools that will be used to evaluate whether activities proposed for Coastal Zone permits will ensure an environmental improvement. First, a set of Environmental Goals specific to the Delaware Coastal Zone would have to be developed. Second, DNREC would develop a set of prioritized Environmental Indicators to assess and track progress towards these environmental goals.

Over the past 25 years, the issues and problems of Delaware's Coastal Zone have changed significantly, leading to new management approaches based on modern-day challenges, such as those proposed in the Regulations Governing the Use of the Coastal Zone. DNREC and the Environmental Indicators Technical Advisory Committee (EITAC) have a formidable challenge ahead in the future development and refinement of the Environmental Goals for the Delaware Coastal Zone and the implementation of a set of Environmental Indicators that will assess and track progress toward these Environmental Goals. The EITAC believes that the recommendations in this document are a solid base upon which to build, and hope to continue assisting DNREC in this effort by providing direct public input into the process through an evolving committee. This will require a modification to the membership that will be well suited for the new challenges arising with work ahead.



## The Coastal Zone Environmental Goals & Indicators Process

The process undertaken by the Environmental Indicators Technical Advisory Committee (EITAC) was a deliberate effort to overcome many of the obstacles of managing Delaware's Coastal Zone in a social environment of scientific uncertainty. Therefore, the committee used a highly structured approach to identify many of the pressing issues of the Coastal Zone and for the development of a set of key Environmental Indicators that will track environmental health over time. This process of goal setting and decision-making as part of environmental management included direct and active public participation, increasing the numbers of scoping meetings and public hearings. These Indicators will also enable CZA permit offset decisions to be made based on the best available scientific data.

The overall process included six distinct phases of work, each with a specific outcome. To date, the committee has completed the first five phases resulting in these recommendations for DNREC that will help guide them through phase six. The completion of the sixth phase will result in the refinement of these Environmental Indicators and the development of a supporting information management system. This system will use the information derived from the Environmental Indicators to enable the assessment of environmental health in the Coastal Zone and to make decisions regarding movement toward achieving environmental goals through Coastal Zone permit activities. A diagram of the process is included on page 10 (Figure 5).

## Establishing the Environmental Goals for the Coastal Zone

The first phase of the Coastal Zone Environmental Goals & Indicators process was completed with the selection and convening of the Environmental Indicators Technical Advisory Committee (EITAC) on October 13, 1998. The EITAC is comprised of representatives from the major stakeholder groups and includes a substantial proportion of technical experts. The participating stakeholder groups are listed below:

### *EITAC Stakeholder Groups*

*Academic Environmental Research  
Agriculture  
Delaware Development Office  
Delaware's Coastal Watermen  
Environmental Advocacy  
Federal Environmental Management Agencies  
Industry outside Delaware's Coastal Zone  
Industry within Delaware's Coastal Zone  
Labor Interests  
Legal Interests  
Local Government  
Port of Wilmington  
Private Citizens  
State Environmental Management Agencies*

Prior to convening this committee, the Coastal Programs staff compiled background information based on a comprehensive literature search of technical information related to the development of environmental indicator programs. This information was used to prepare a notebook of reference information for the committee members. The notebook also included a series of worksheets for EITAC members to complete and return prior to the first meeting. These worksheets were designed to organize thoughts and opinions on Environmental Goals for the Coastal Zone and to identify issues or challenges associated with each goal. This information was used to identify and select goals, based on thematic topics derived from the worksheets.

During the second EITAC meeting, a structured work session was conducted to identify and to begin to refine the first set of

CZA Goals. A total of eight preliminary Goals were identified.

These initial CZA Goals were further refined through a series of structured breakout group work sessions conducted on December 2, 1998. These sessions were designed to identify and characterize the issues or challenges associated with each Goal. The Goals were grouped as follows:

*Group 1: Habitat/Land Cover; Wetlands; Aesthetics*

*Group 2: Natural Resources/Biodiversity; Biological/Wildlife*

*Group 3: Air Quality; Water Quality; Human Health*

Three workgroups were charged with identifying the key issues associated with the Goals that were assigned to their group. They then drafted a preliminary characterization of each issue using a structured template format. This initial characterization identified information or data that would be required to address the issues as well the organizations that could provide technical input into the refinement of the characterization and the development of Environmental Indicators. During their deliberations, the workgroups further refined the Goals. This resulted in several Goals being combined. Group 1 found that wetlands were best addressed as an issue under the Habitat/Land Cover Goal. Group 2 combined the three initial Goals into a Living Resources Goal. Biodiversity was addressed as an underlying theme throughout a number of the Goals. The remaining group found that the Public Health Goal fit best as an important issue under both the Air Quality and Water Quality Goals. The result at the end of the day was five broad goals that are outlined in the following section.

The work of these groups was compiled, edited with minimal changes to content, and included as part of the “*Delaware Coastal Zone – Environmental Goals and Associated Issue Characterizations*” document. This document would be the basis for the Coastal Zone Environmental Goals & Indicators Technical Workshop held on January 29, 1999 at the University of Delaware’s Clayton Hall, in Newark, DE. It is at this meeting where the

initial sets of Environmental Indicators were developed.

**Figure 3.**

***Revised Coastal Zone Environmental Goals***

*Habitat/Land Cover:* "Protect the mosaic of land cover in the coastal zone, including upland, wetland, shoreline and aquatic areas, to ensure a healthy ecosystem. Encourage appropriate land use and land cover."

*Air Quality:* "Improve air quality which directly or indirectly affects all forms of life within the coastal zone."

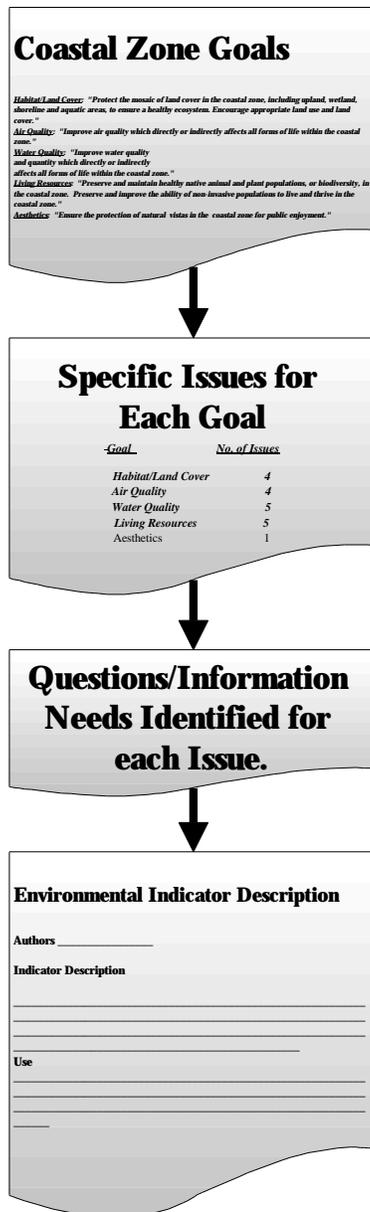
*Water Quality:* "Improve water quality and quantity which directly or indirectly affects all forms of life within the coastal zone."

*Living Resources:* "Preserve and maintain healthy native animal and plant populations, or biodiversity, in the coastal zone. Preserve and improve the ability of non-invasive populations to live and thrive in the coastal zone."

*Aesthetics:* "Ensure the protection of natural vistas in the coastal zone for public enjoyment."

The diagram below depicts the project flow leading up to crafting the initial Environmental Indicators. The EITAC first identified the key Environmental Goals for the Coastal Zone, then outlined a set of issues and information associated with each Goal. Each issue also had identified information needs. The workshop participants were then directed to refining the issues and identifying information needs. After this was completed they then crafted the draft set of Environmental Indicators.

**Figure 4. Schematic diagram of how work to date was incorporated into the Technical Workshop**



## The Technical Workshop

Upon completion of their work on the Goals and issues, the EITAC concluded that they needed input from a broad range of technical experts in order to begin crafting the first set of Environmental Indicators for Delaware’s Coastal Zone. It was decided that this would be best accomplished through an intensive technical workshop.

The DRAFT Coastal Zone Environmental Indicator Descriptions in this document focus on providing information directly related to the assessment of a specific issue and Coastal Zone Environmental Goal. They describe how a wide range of information may be useful as an Environmental Indicator (EI) or as a component for a more comprehensive EI. They provide critical background about the acceptable use of this information and its limitations for environmental policy decision-making. In addition, they provide descriptive information about the geographic scope for their use, the recommended methodology to be used to ensure scientific validity, prerequisites to their development and use, and potential contacts for existing information. However, much work remains to be done. This work will be completed through the efforts of the EITAC and selected focus groups, which will provide a forum for their improvement.

## The Workshop Process

Developing Coastal Zone Environmental Indicator descriptions requires a common understanding of the broad Environmental Goals for Delaware's Coastal Zone as well as the specific issues or problems associated with these Goals. It also requires technical expertise about how to scientifically evaluate the status of these issues. To meet the first requirement, this workshop relied on the information distributed prior to the workshop in the *Delaware Coastal Zone - Environmental Goals and Associated Issue Characterization* document. This document was developed to summarize the outcome of an intensive EITAC worksession held on December 2, 1998. It included the Draft Coastal Zone Goals, preliminary issues associated with the Goals, and an initial description of these issues. To meet the

second requirement, scientists, researchers, natural resource managers, and others with technical expertise related to the previously identified Coastal Zone Environmental Goals & Issues were invited to attend the workshop. The input of participants with different technical expertise, experience, and background was critical for identifying feasible and applicable Environmental Indicators for the Coastal Zone. Appendix A lists those who attended the workshop.

The process used at this workshop was straightforward, using an organized set of summary forms to refine the draft issues and a template to record information on potential Coastal Zone Environmental Indicators. This served to stimulate critical thinking about the details required to develop an Environmental Indicator that could be implemented and tracked over time. In addition, it provided a common foundation for comparing, evaluating, and selecting indicators. Specifically, participants were assigned to thematic work and asked to review and refine the draft issues provided, outline the information needed to address questions associated with these issues, and describe potential Coastal Zone Environmental Indicators derived from these issues and information needs.

It was accepted by the EITAC that the Workshop's output would have limitations. The meeting design sought maximum and broad input from the many experts who generously donated their time, background, experience, and judgement. They were urged to accept the design of the day's activities, move along quickly and ensure that their most important decisions and recommendations were recorded. Refinement was expected during follow-up and post-processing after the workshop's conclusion.

## **Technical Workshop Results**

The participants at the workshop revised fourteen (14) of the original eighteen (18) issues. They also identified or refined seventy-seven (77) information needs and completed descriptions for fifty-seven (57) potential Environmental Indicators derived from these information needs. The initial descriptions provided the basis for the parameters

recommended by the EITAC for their Environmental Indicators.

As expected, there is a wide range of level of detail presented in these Environmental Indicator descriptions. Some are very focused (e.g. Living Resources EI descriptions for individual species) and may be integrated into broader indicators as a weighted parameter. Others are much broader and already rely on a number of parameters to define the Indicator (e.g. Ambient Air Quality Data that uses a number of parameters to determine the Pollutant Standards Index).

Regardless of the level of detail, all of the Draft Environmental Indicator Descriptions were further evaluated for consideration in the Coastal Zone Goals and Environmental Indicator development process as described below.

## ***EITAC Follow-up to the Technical Workshop***

The EITAC reconvened on February 19, 1999 to review the workshop summary and to develop the first set of Environmental Indicators. These were derived by the EITAC from information developed at the January 29 workshop. They thematically grouped the draft environmental indicator worksheets into the fourteen recommended indicators. In order to quantify each indicator, one or more parameters, each measuring a particular aspect of the indicator, has been identified. At this meeting they also prioritized potential Environmental Indicators and began to identify EITAC & Support Staff that would champion focus group efforts to further refine the Indicators and their parameters.

The final result was the development of fourteen (14) prioritized Environmental Indicators directly linked to the four (4) broad Environmental Goals for the Coastal Zone. The Coastal Zone Environmental Indicators are derived as indices from various combinations of forty-seven (47) parameters.

Following the February 19 EITAC meeting, the support staff summarized the meeting results in diagrams. These are included in the Environmental Indicators sections of this document. In order to provide a clear work plan

for further refinement of these indicators, the support staff also developed a guidance document for future work by focus groups (see Appendix C).

The EITAC met again on March 8, 1999 to review this information and to identify the final content for this recommendation document. At this time, the group also realized that although additional work is needed, time would not permit the refinement of Environmental Indicators through focus groups before the deadline March 31, 1999. They also concluded that although some form of direct public input should be continued to assist DNREC with the refinement and implementation of Coastal Zone Environmental Indicators, the evolving needs of the project would be best met by a modification to the existing group.

At this point, the EITAC membership agreed that they had successfully completed the task assigned to them, and that any future work would be turned over to a new committee as described in the recommendation section of this document.

DNREC, with or without the assistance of a revised committee, will need to further develop and refine the recommended Environmental Indicators outlined in this document. They must also determine decision making threshold values and the relative weight of each parameter comprising the indices. This will require a considerable amount of technical expertise and work that may best be conducted through a series of focus groups.

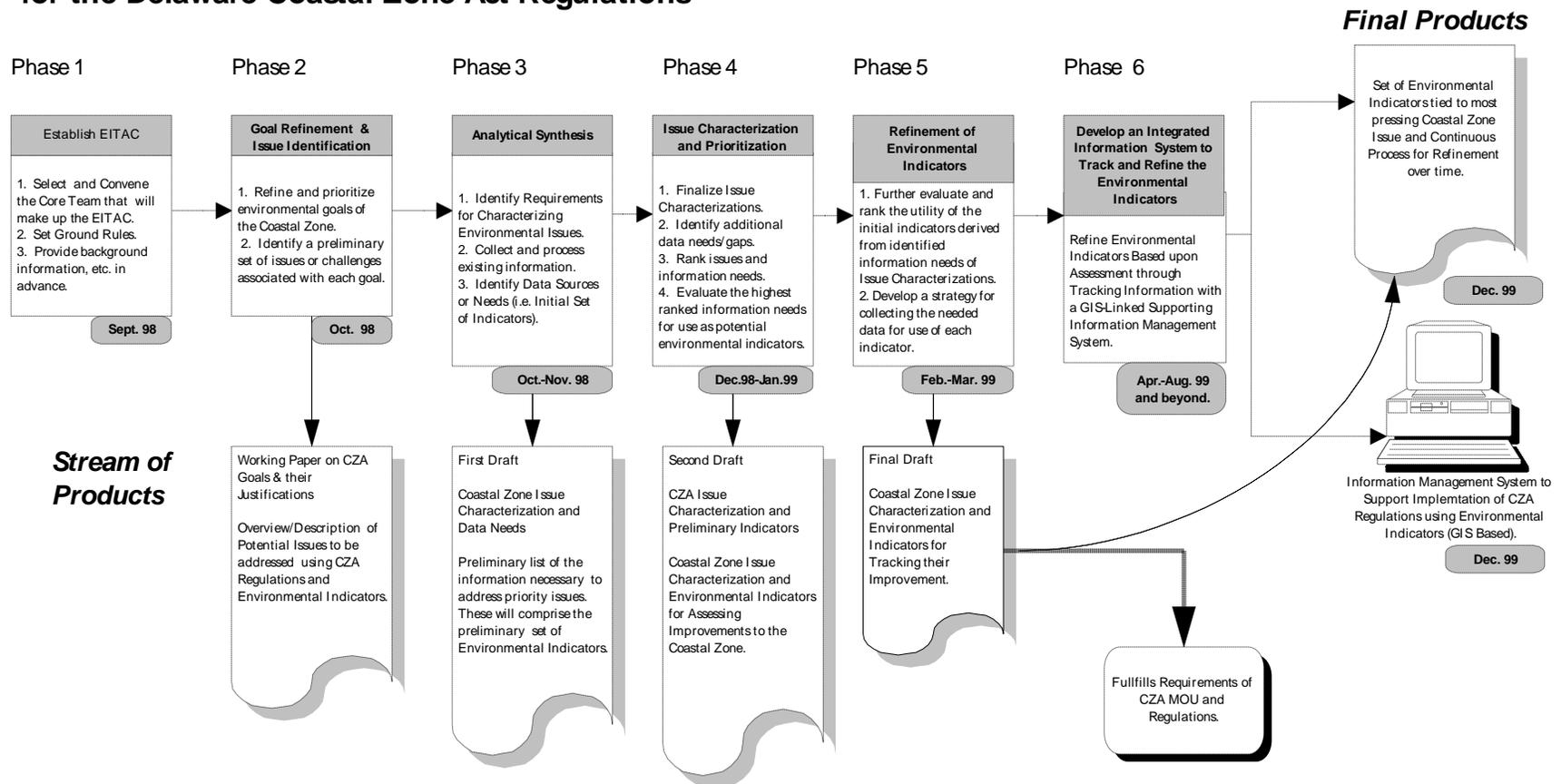
Focus groups would need to develop detailed strategies that outline implementation of each of the priority Coastal Zone Environmental Indicators. This would include data collection protocols, data management protocols, standard operating procedures, and quality assurance procedures. The strategies would identify the responsible party(s) for data collection and describe the media and digital file structure for the data. Annual cost estimates for monitoring of each Coastal Zone Indicator would also be developed. Finally, data reduction/analysis, the conversion of raw data into meaningful measurements of Coastal Zone Environmental Indicators, and information dissemination procedures would be described.

The implementation phase of this project should develop an information management system to track and conduct a detailed assessment of the regulatory program and to initiate monitoring of key Environmental Indicators that do not currently have monitoring programs in place. This information system would be designed to bring disparate Coastal Zone Environmental Indicator data into a single computer system for data comparisons, display, and analysis. It would enable managers to view relationships between Environmental Indicators and CZA permit offset proposals to identify both potential improvement actions and the expected impact of those actions. It would also allow the evaluation of the efficacy of the Environmental Indicators for decision-making. Thus, providing a critical tool for an iterative process for their refinement. The resulting system would enable an expedited comprehensive review of projects. It would be capable of queries with other spatially related information to help determine both cumulative impacts and potential opportunities for improvement in the Coastal Zone.

The Geographic Information System (GIS) based Information Management System would expedite project reviews and make environmental information generated by the review of CZA permit offsets available for use in other environmental initiatives. By putting the permit and Environmental Indicator information into a spatial data format in an integrated system where it can be organized, analyzed, and mapped, this tool would enable decision-makers to identify patterns and relationships previously unrecognized. The ease of interpreting and understanding information presented in a visual format would also yield more information and much less conjecture in the decision-making process.

# Diagram of the Process

## Overview of the Process for Developing the Environmental Indicators for the Delaware Coastal Zone Act Regulations



## The Structure of the Goals and Indicators

Environmental indicators are measures of environmental resource quality. They are used to show the current condition of a resource. Indicators can also be measured and recorded over time to illustrate the changing condition of a resource. Well-designed indicators are a useful tool for results-oriented environmental planning and management.

Indicators are used to:

1. Define and describe the magnitude of environmental problems.
2. Provide the basis for setting environmental goals.
3. Show progress (or lack of progress) towards achieving those goals.

Indicators can provide a visual graphic of the magnitude of an environmental problem. If the problem is a loss of open space, an indicator will identify the number of acres of open space that are currently available and show how the number of acres has declined over time.

Indicators provide a means for describing how current conditions do not meet the desired state for any given resource. That description is then used as the basis for goal setting and refinement. The indicator itself may not lead an individual to set a specific goal or guide a group towards a consensus goal; however, the indicator can provide the substance for the discussion.

Indicators measure progress toward attaining the goal. For the example above, the continuing loss of open space can be monitored and that loss reported as a measure of the effectiveness of actions taken to reduce the loss.

Additionally, indicators can provide information on the effects of recreational, commercial, and industrial uses of the resource. For example, indicators showing trends in land development and employment in the building industry will add further substance to the discussion of what options are plausible for land use policies.

By utilizing indicators, policymakers and the public can evaluate the success of strategies to attain their goals. However, many environmental planning efforts rely on broadly stated goals, such as the preservation of habitat or the protection of human health. These non-measurable goals are laudable, but they lack specificity and do not include any means for measuring success of policies enacted to attain them. Therefore, indicators must be directly linked back to these broader goals to provide a means of evaluation.

### Delaware Coastal Zone Act Environmental Indicators

The proposed Regulations Governing Delaware's Coastal Zone define an environmental indicator as:

*“A numerical parameter which provides scientifically-based information on important environmental issues, conditions, trends, influencing factors and their significance regarding ecosystem health.”*

The need to develop these indicators was specifically outlined in the Memorandum of Understanding ratified by the Coastal Zone Regulatory Advisory Committee in 1998. This committee identified Environmental Indicators as a tool necessary to implement the proposed new regulations for Delaware's Coastal Zone Act (CZA).

To be effective, the CZA environmental indicators must be linked back to a clearly defined goal with clearly defined issues associated with each of these goals. Development of these goals and each issue or challenge associated with them must be an integral part of indicator development.

In order to quantify each indicator, one or more parameter(s) that measure a particular aspect of the indicator will be identified. The parameter must be quantifiable, understandable, sensitive enough to characterize trends, and cost effective.

Below is a schematic diagram of the environmental indicators structure, with the goals for the Coastal Zone, environmental indicators related to these goals, the parameters associated with the indicators, and the quantitative index of environmental quality for the Coastal Zone.

This structure would enable the development of broad goals that may require one or more environmental indicators for the evaluation of progress toward these goals. For example, a goal could be set to characterize the

current condition of Delaware’s Coastal water, land, and air resources. This goal would require more than one indicator for its assessment, such as a water quality indicator, an air quality indicator, and a habitat quality indicator. Each of these indicators could be measured by a number of quantifiable parameters that have a varying level of importance or weight, toward the index or ranking of environmental quality associated with this indicator.

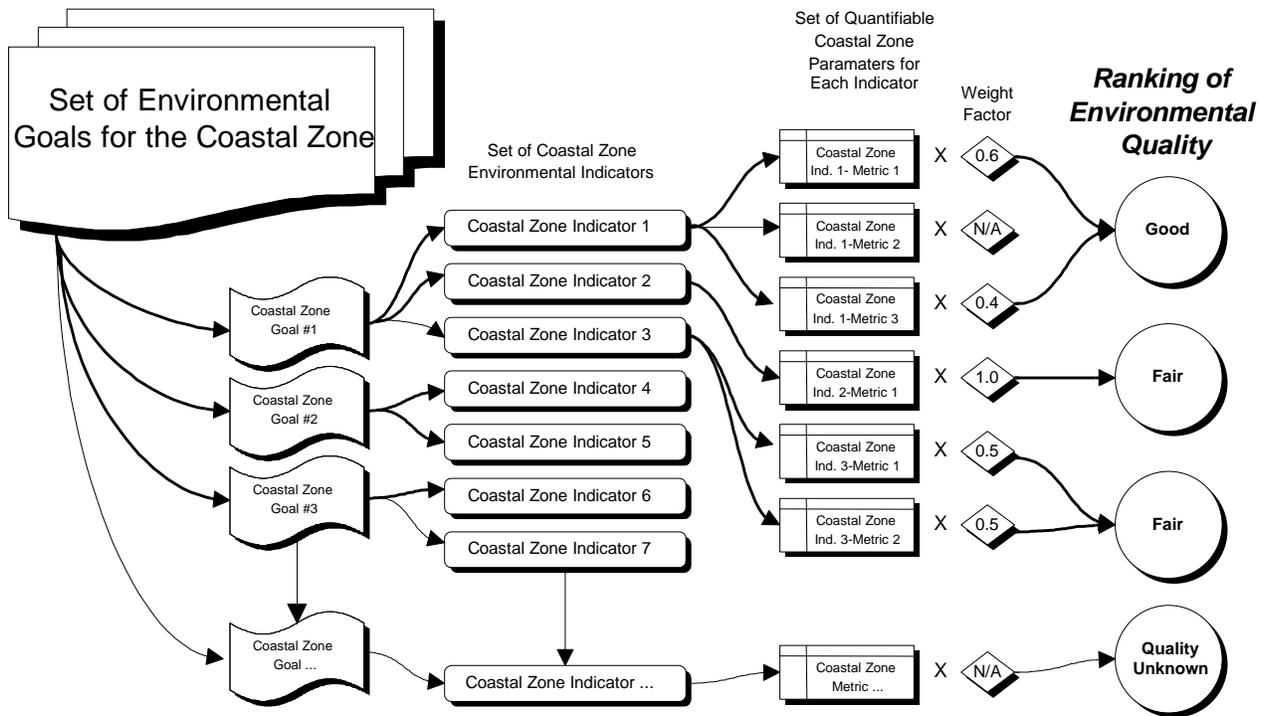


Figure 6. Schematic diagram of goals and indicators

Using this example, a theoretical diagram of how this could fit together is outlined below.

This method enables the use of existing information while identifying new or additional information that is needed. By using this type of approach, environmental indicators become a scalable tiered-level process for decision-makers. They can extract a simplistic environmental ranking of excellent to poor or extract the details

and specific numerical data used to derive these rankings.

This approach may also enable Delaware to move forward with the use of environmental indicators for other applications in the near future. Delaware intends build upon this foundation for improved evaluations, as additional parameter information becomes available over time.

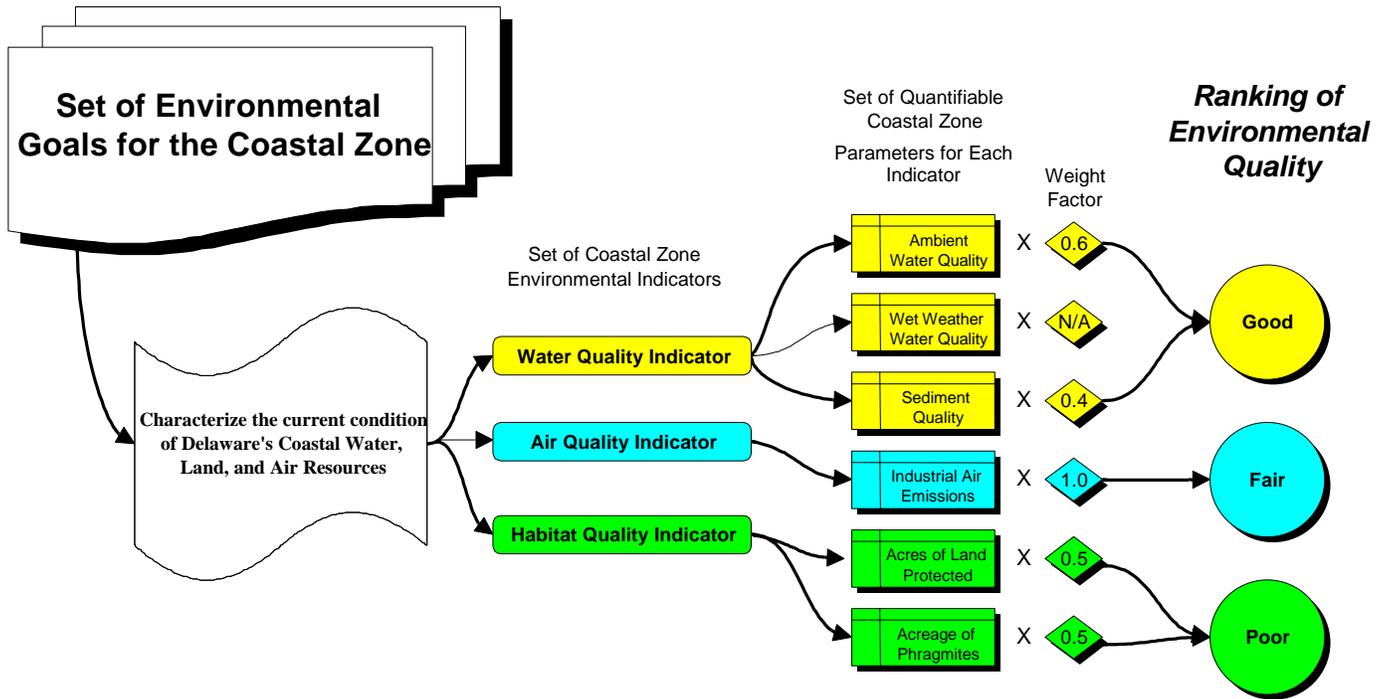


Figure 7. Example of parameters that define indicators



## Environmental Goals

### Definition and Development

The development of a concise set of environmental goals provided a solid foundation for the Environmental Indicators project. Previously, goals had been developed for the entire state of Delaware. However, the specific charge to the EITAC was to focus exclusively on issues affecting the health of the Coastal Zone region as defined by the 1972 Coastal Zone Act. Defining these goals enabled the EITAC to focus on issues affecting the health of the Coastal Zone and to determine how subset indicators and parameters could more fully measure progress toward those goals. The Memorandum of Understanding from the Delaware Coastal Zone Regulatory Advisory Committee to the Delaware DNREC (March 19, 1998) provided the following definition:

***“Environmental Goals are a collection of broad and strategic environmental priorities and objectives for a region.”***

The goal statements divide the project’s primary objective “determining the health of Delaware’s Coastal Zone” into manageable categories. While several issues and indicators crossed over the goal categories, the process was flexible enough to encourage cross-disciplinary analysis.

Prior to their first meeting, Environmental Indicators Technical advisory Committee (EITAC) members were asked to submit a preliminary list of issues that could frame measurements of Coastal Zone health. A total of 35 issue statements were submitted as a result of this request. At the initial meeting, the Committee compiled this information and used it to identify one goal for each of eight issue areas: Habitat/Land Cover, Air Quality, Water Quality, Biological/Wildlife, Natural Resources/Biodiversity, Human Health, Wetlands, and Aesthetics. However, as work progressed on linking issue descriptions and information needs to the goals, it became clear that these could be condensed into five broad

goal descriptions. The final characterization of these goals is as follows:

**Air Quality:** Improve air quality, which directly or indirectly affects all forms of life within the Coastal Zone.

**Water Quality:** Improve water quality and quantity, which directly or indirectly affects all forms of life within the Coastal Zone.

**Habitat/Land Cover:** Protect the mosaic of land cover in the Coastal Zone, including upland, wetland, shoreline, and aquatic areas, to ensure a healthy ecosystem. Encourage appropriate land use and land cover.

**Aesthetics\*:** Ensure the protection of natural vistas in the Coastal Zone for public enjoyment.

*\*This goal was combined with habitat/land cover during the indicator development phase.*

**Living Resources:** Preserve and maintain healthy native animal and plant populations, or biodiversity, in the Coastal Zone. Preserve and improve the ability of native populations to live and thrive in the Coastal Zone.

On the following pages, a description of each of these goals is presented. These descriptions have evolved throughout the process, as the supporting information for each was developed. Additionally, a list of the indicators related to each goal is presented, and the indicator descriptions will provide further information related to specific components of each goal area.

## Air Quality Goal

*"Improve air quality, which directly or indirectly affects all forms of life within the coastal zone."*

Air pollution, generated locally, regionally, or globally may cause health and environmental problems for the Delaware Coastal Zone. In humans and wildlife, air pollution causes a variety of ailments, the primary one being cardiovascular impairment. It can also harm trees and crops, reducing growth and crop yield and making plants more vulnerable to insects and disease. Ensuring air quality is vital to maintaining the quality of our coastal environment and the quality of life for Delawareans and others living in, or using, our Coastal Zone.

Ambient air quality standards have been set for automobiles, power plants, and industrial facilities to protect humans and forests from smog, the most visible air pollutant in Delaware's Coastal Zone. An accumulation of gases in the lower portion of the earth's atmosphere, called the troposphere, smog is composed mainly of ground-level ozone. Volatile organic compounds (VOCs) and nitrogen oxides (NOX) in the presence of sunlight and warm temperatures form ground-level ozone. VOCs (also called hydrocarbons) are found in oil and natural gas. They are released in vehicle emissions (fossil fuel combustion) and from the evaporation of gasoline and solvents from the petrochemical industry. NOX are mainly produced in the combustion of fossil fuels.

In order to understand the status of air quality within the Coastal Zone, the primary sources and relative contributions of remaining problems, and progress toward meeting the general goal of improved quality of air in Delaware's Coastal Zone; the following indicators are being developed.

### **Air Quality Indicators Identified to Date:**

- Ambient Air Quality Indicator
- Affected Populations Indicator
- Accidental Releases Indicator
- Atmospheric Deposition Indicator

## Water Quality Goal

*"Improve water quality & quantity, which directly or indirectly affects all forms of life within the Coastal Zone."*

Development in coastal areas places heavy demands on water resources for municipal water supplies, industrial and agricultural use, recreational use, and commercial fisheries. Ensuring continued high quality and sufficient quantities of water is vital to balancing concerns for the coastal environment while maintaining a high quality of life for Delawareans living in, or using, the resources of our Coastal Zone.

Many of the same activities that make our coastal waters valuable also create problems with their use and management. These issues or problems are the inevitable consequences when conflicting uses compete for limited resources. Swimming, surfing, boating, sport fishing, commercial fishing, maritime transportation, public and private water supply, sewage disposal, industrial processing, and aesthetic enjoyment may all be valid uses of coastal water resources, but they cannot all be accommodated in the same area at the same time.

In order to understand the status of water quality and quantity within the Coastal Zone, the primary sources and relative contributions of remaining problems, and progress toward meeting the general goal of improved water quality and quantity in Delaware's Coastal Zone, the following indicators are being developed.

### **Water Quality Indicators Identified to Date:**

- Benthic Community Indicator
- Contaminants/Toxicity Indicator
- Ambient Water Quality Indicator
- Watershed Pollutant Load Indicator
- Affected Populations Indicator
- Accidental Releases Indicator
- Non-point Source Nutrient Mass Balance Indicator

## Habitat/Land Cover/Aesthetics Goal

*"Protect (the mosaic of) land cover in the Coastal Zone, including upland, wetland, shoreline, and aquatic areas, to ensure a healthy ecosystem. Encourage appropriate land use and land cover. Ensure the protection of natural vistas in the Coastal Zone for public enjoyment."*

Habitat represents the availability of food, water, shelter or cover, and space suitable for organisms in the Coastal Zone to survive. These areas provide essential breeding, nesting, staging, and feeding grounds for many mammals, waterfowl, shorebirds, raptors, songbirds, reptiles, amphibians, and fishes. Delaware's Coastal Zone habitats support species from the lowest to the highest trophic levels. While some species are fairly adaptable and can flourish in a variety of habitats, many species are more sensitive to disturbances and have very specific habitat requirements. These sensitive plant and wildlife species will only thrive in the Coastal Zone if a diverse land cover mosaic exists where open and forested uplands, tidal wetlands, and shallow and deep-water areas are maintained. Loss of any one of these habitats can lead to a significant reduction in the biodiversity and health of the ecosystem.

Over the past three decades, since the passage of the Coastal Zone Act, the extent and quality of important habitats in the Coastal Zone has improved in some cases and grown worse in others. Many of the improvements are related to the numerous regulatory and management systems that have restricted the expansion of heavy industry, improved water quality, reduced the rate of tidal wetland loss, restored or enhanced wetland values and functions, and encouraged more environmentally sensitive development in coastal areas. However, upland habitats have not fared as well and are experiencing loss and fragmentation brought about by development and the lack of comprehensive programs to address the issue. Other areas, such as large tracts of tidal wetlands, still lie in a degraded state caused by damages incurred prior to the passage of Delaware's Wetlands Act in the 1970's. These areas are choked by invasive species, drained by

tidegates, and shut off to passage of spawning fishes. The exact extent of these problems is only partially understood, and much more information is needed to quantify their extent and impact.

The coastal area provides an endless array of activities and events, from nature walks and picnicking, to birding and recreational hunting. It is the natural beauty and tranquility it instills that draws people to the coast. It is the threats to the coastal region that give members of the public their conviction for protecting the area.

Natural vistas can be degraded rapidly by changing landscape due to development, rising smokestacks, construction of structures that do not blend in with the scenery, and other major activities such as road widening or new road construction. These types of development can detract from the natural beauty that draws Delawareans to these areas.

Fortunately, many attractive vistas do still exist throughout Delaware's Coastal Zone. However, past actions have already degraded the beauty of many unspoiled natural areas. Cutting down forests may expand vistas but the resulting view may be unsightly development or a loss of privacy. Billboards and signs have been placed in scenic areas, and litter and trash are often dumped, detracting from natural beauty. Fortunately, many ecological restoration activities can be planned to include improvements to the natural vista of areas in the coastal zone.

### Habitat/Land Cover Indicators Identified to Date:

- Habitat Change
- Wetland Inventory

## **Living Resources Goal**

*" Preserve and maintain healthy native animal and plant populations, or biodiversity, in the Coastal Zone. Preserve and improve the ability of non-invasive populations to live and thrive in the Coastal Zone. "*

Not only do diverse, robust populations strengthen the natural ecosystem, but they also provide enjoyment for individuals who enjoy birding, fishing, and other wildlife-related activities. Living resources of the Coastal Zone range from microscopic plankton, bacteria, oysters, crabs, minnows and sturgeon, to waterfowl and internationally migrating shorebirds. These and many other naturally occurring species are part of the complex food web. Due to these complex linkages, any disruption that affects a single species could have a domino effect throughout the entire ecosystem.

The species composition of communities residing in Delaware's Coastal Zone is critical to the ecological functioning of these systems. Although a few species are valued for commercial, recreational, or aesthetic reasons; all species are important as part of the food web which contributes to the survival and production of the entire system. Some species are referred to as keystone species in this regard, and the health of one particular population could indicate the more general health of a particular ecosystem. Often keystone species are found only in specialized habitats; therefore, measuring these keystone species can indicate the pressures on land cover and use in the Coastal Zone.

### **Living Resources Indicators Identified to Date:**

- Keystone Species Indicator
- Biodiversity Indicator
- Benthic Community Indicator

## Indicators and their Parameters

As stated earlier, Environmental Indicators must be linked back to clearly defined goals. In the previous section, the Environmental Goals for the Coastal Zone were enumerated. The issues associated with those goals provide the basis for the indicators that will be described in the following section. In order to quantify each indicator, one or more parameters, each measuring a particular aspect of the overall indicator, will be identified.

This chapter is divided by goal topic: Air Quality, Water Quality, Habitat/Land Cover/Aesthetics, and Living Resources. At the beginning of each goal section, a diagram outlines the structure of the indicators and the parameters that define them. Closing the chapter is a section that describes some Supporting Tools. These were items that did not fit as indicators but may provide useful information for successful implementation of many of the Environmental Indicators.

# Set of Environmental Goals for Delaware's Coastal Zone

**Habitat/Land Cover/Aesthetics:** "Protect the mosaic of land cover in the coastal zone, including upland, wetland, shoreline, and aquatic areas, to ensure a healthy ecosystem. Ensure the protection of natural vistas in the coastal zone for public enjoyment."

**Air Quality:** "Improve air quality which directly or indirectly affects all forms of life within the coastal zone."

**Water Quality:** "Improve water quality and quantity which directly or indirectly affects all forms of life within the coastal zone."

**Living Resources:** "Preserve and maintain healthy native animal and plant populations, or biodiversity, in the coastal zone. Preserve and improve the ability of non-invasive populations to live and thrive in the coastal zone."

## Set of Coastal Zone Environmental Indicators

- Habitat Change Indicator
- Keystone Species Indicator
- Biodiversity Indicator
- Ambient Air Quality Indicator
- Wetlands Indicator
- Benthic Community Indicator
- Contaminants/Toxicity Indicator
- Ambient Water Quality Indicator
- Watershed Pollutant Load Indicator
- Affected Populations Indicator
- Accidental Release/Spill Indicator
- Atmospheric Deposition Indicator
- Nonpoint Source Nutrient Mass Balance Indicator
- Trends in Quality of Contaminated Areas Indicator

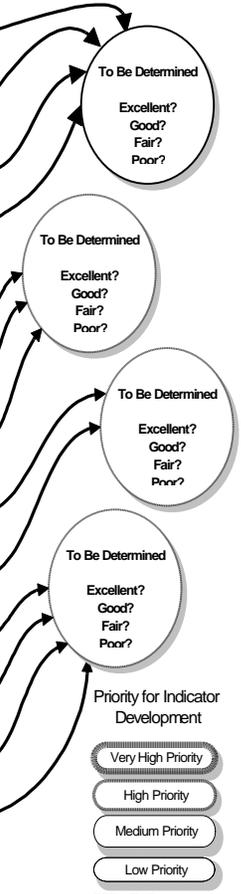
## Set of Quantifiable Coastal Zone Parameters Comprising Each Environmental Indicator

- Ambient Air Quality (Data Index)
- Air Emissions from Permitted Sources
- Air Emissions from Non-Permitted Sources
- Trends in Pollutant Loading Using Toxic Release Inventory (TRI) Data
- Affected Populations
- Human Health - Fish Consumption Advisories, Asthma, Beach Closures, etc.
- Plant Health
- Accidental Release Occurrences by Quantities and Substances Overtime
- Potential Impact of Accidental Releases
- Atmospheric Deposition of NO3
- Atmospheric Deposition of NH4
- Atmospheric Deposition of SO4
- Precipitation Ph

Weight Factor

- X TBD

## Ranking of Environmental Quality



## Air Quality Goal

*"Improve air quality, which directly or indirectly affects all forms of life within the Coastal Zone."*

### Ambient Air Quality Indicator *Very High Priority*

#### Ambient Air Quality (Data Index)

The ambient air quality parameter would be a database comprising all information on ambient air quality. Currently measured items include SO<sub>2</sub>, NO<sub>2</sub>, PM<sub>2.5</sub>/PM<sub>10</sub>, CO, O<sub>3</sub>, and VOC's. This database would be used to document trends, to assess spatial variability, and to generate exposure estimates. Data is currently available through DNREC/DAWM and the University of Delaware College of Marine Studies. More research would have to be done to develop a risk-based/hazard system to quantify critical levels of parameters.

#### Air Emissions from Permitted Sources

This parameter would provide baseline information on air emissions from permitted sources within and adjacent to the Coastal Zone. These emissions would include all industrial and some other related sources. The data should be coupled with USEPA and DNREC methodologies to develop air emission profiles. This would not only enable trend analysis over time but could also target areas heavily impacted by poor air quality. Air emissions information should also be coupled with meteorological data to determine the influence that these sources have on the Coastal Zone.

#### Air Emissions from Non-Permitted Sources

This parameter would provide baseline information on air emissions from a variety of non-permitted sources within and adjacent to the Coastal Zone. These emissions would include on- and off-road vehicle emissions, construction, farm and residential internal combustion engine equipment, and other sources such as pesticide use, open burning, etc. Data should be collected throughout the state and coupled with USEPA

and DNREC methodologies to develop air emission profiles. This would not only enable trend analysis over time but could target areas heavily impacted with poor air quality. Adequate science and technology exists to successfully identify and quantify these emission sources. This information should also be coupled with meteorological data to determine influences on the Coastal Zone from the sources.

#### Trends in Pollutant Loading using TRI data

Toxics Release Inventory (TRI) reports describe the quantity of toxic chemicals released to the air, water, and land from industrial facilities. The quantity of pollutants released to the air can be used to model risks to users. Decreases in the amount of reported releases could indicate the effectiveness of pollution prevention efforts at a facility. This parameter can look at local and regional contributions to pollutant loads.

### Affected Populations Indicator *High Priority*

#### Affected Populations

This parameter would identify the human population that is at risk from releases of airborne contaminants into the Coastal Zone. Density and proximity to sources or transport corridors would characterize the population in order to develop "affected population" profile maps of the Coastal Zone. Isolation of population centers away from high-risk centers would be an improvement to the Coastal Zone from a human risk perspective.

#### Human Health – Ozone Action Days, Respiratory illness rates, Etc.

The human health parameter would provide information on the human health impacts from exposure to contaminants, both directly and indirectly. Data from other indicators are used to make decisions in regard to human health. Ozone level warnings are examples of data trends indicating need for human health warnings. This parameter would track the number and extent of human health actions taken related to Coastal Zone activities. It would provide a measure of environmental effects that is easily interpreted.

Reductions in the number or extent of air advisories would indicate improvements, while the reverse would identify a need to determine the cause of increased hazards.

### **Plant Health**

The plant health parameter would provide information on the plant health and viability impacts from exposure to contaminants related to Coastal Zone activities, both directly and indirectly. For example, decreased crop yields or estuary eutrophication would signal imbalances in the system. To develop this parameter, sensitive indicator species would have to be identified. Additionally, in-depth statistical analysis would have to be performed to isolate the specific causes of the changes in plant health. Other factors that are known to affect plant health, such as acid rain or nutrient loadings, could be correlated with impacts identified in the plant indicator species. Another measure could be the viability and spatial distribution of native plants, with decreases indicating a stress on the environment. Increases in the geographic range of plants or the viability of native species would indicate an improvement to the Coastal Zone.

### **Accidental Air Releases Indicator** *Medium Priority*

#### **Accidental Release Occurrences by Quantity and Substance over Time**

This parameter would provide information to develop a database of accidental releases. The data would contain information on location, quantity, substance, time, and duration of each episode. From these data, trends of accidental releases can be developed including an interpretation of the severity of these releases. Periodic interpretation of the data will show improvement/degradation of the Coastal Zone by quantifying the number and severity of accidental releases.

#### **Potential Impact of Accidental Releases**

This parameter would quantify the potential impacts of an accidental release to human, animal, and plant life in the Coastal Zone. Based on known sources of materials that

could have potential accidental releases, vulnerability zones would be developed. By overlapping density profiles on human/animal/plant populations, a risk index would be developed. Much effort would be needed to rank the vulnerability zones based on the potential risk of the accidental release based on quantities, duration, and material that could be released. A decrease in the risk index for areas of the Coastal Zone would indicate improvement in those areas.

### **Atmospheric Deposition Indicator** *Medium Priority*

#### **Atmospheric Deposition of NO<sub>3</sub>**

The atmospheric deposition parameter will provide information on the concentration of NO<sub>3</sub>, a significant component of the rainfall in the region. This information is needed to quantify the relative contribution of atmospheric deposition to the total loads in the ecosystem. Preferably a network of samplers will be installed inside and outside the Coastal Zone to monitor the local influences of atmospheric deposition. The samplers should be installed in conjunction with meteorological monitoring equipment to be able to better understand the results and local influences. Currently two samplers are available in the Coastal Zone; one at the UD College of Marine Studies at Lewes and one at the Delaware National Estuarine Research Reserve near Kitts Hummock. There are some specific historical data available to perform some trend analysis from these sites.

#### **Atmospheric Deposition of NH<sub>4</sub>**

See description above.

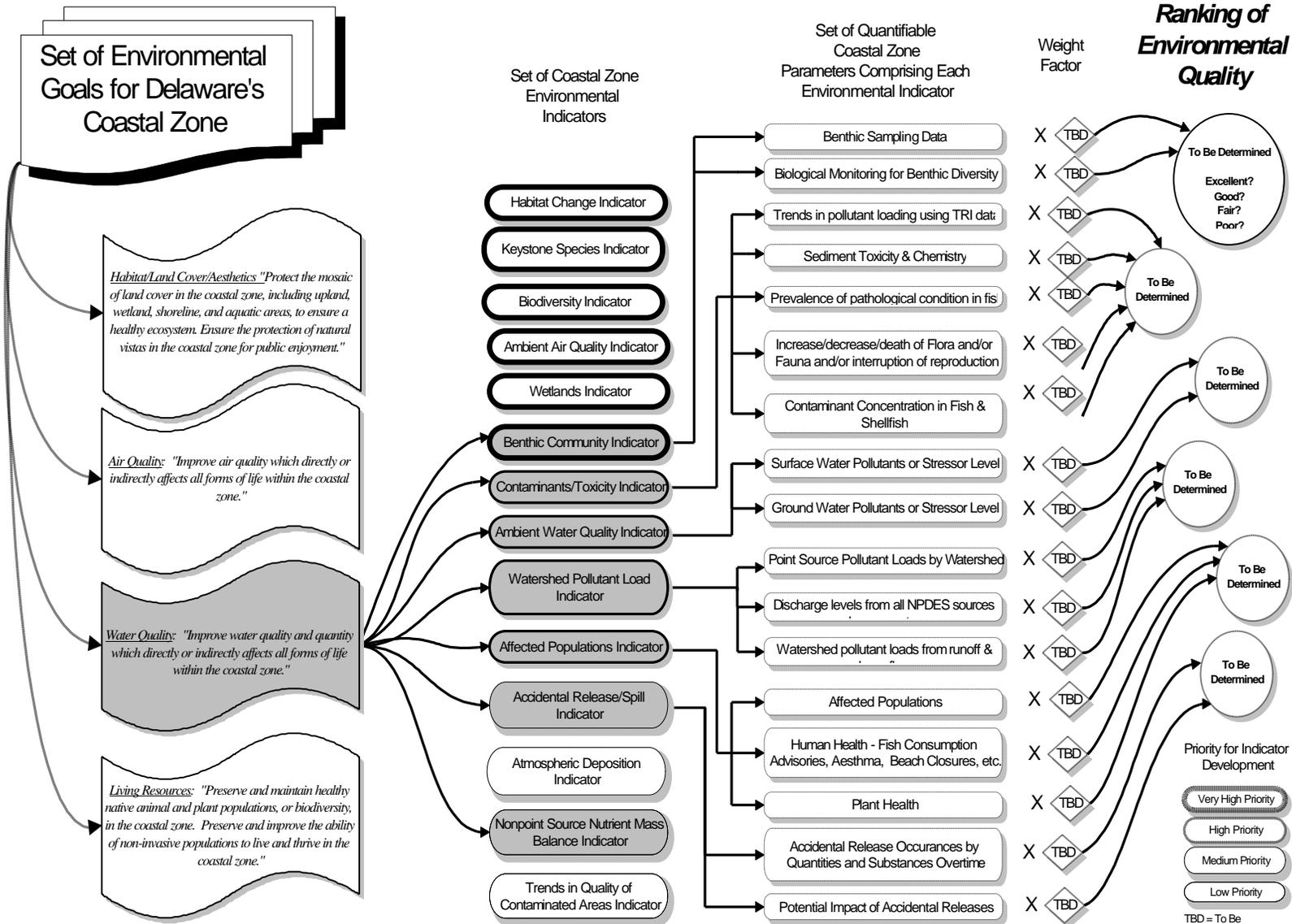
#### **Atmospheric Deposition of SO<sub>4</sub>**

See description above.

#### **Precipitation pH**

See description above.





## Water Quality Goal

*"Improve water quality & quantity, which directly or indirectly affects all forms of life within the Coastal Zone."*

### Benthic Community Indicator *Very High Priority*

#### Benthic Sampling Data

The benthic sampling parameter is intended to catalog the quantity and types of species of organisms in an area and also the extent and quality of the habitat. Indices would help determine whether these habitats are occupied by pollution tolerant or pollution intolerant organisms. Various indices of population and habitat health have been developed for piedmont and coastal plain streams. However, this is not the case for subaqueous habitats in ponds, lakes, reservoirs, and estuaries.

#### Biological Monitoring for Benthic Diversity

This parameter requires the characterization of reference sites for specific habitats. The measure of Coastal Zone health will be an index that compares the site of interest to a corresponding reference site. This parameter is a good way to communicate environmental information to the public because attainment of a desired outcome is inherent in the product.

### Contaminants / Toxicity Indicator *High Priority*

#### Trends in Pollutant Loading Using TRI Data

Toxic Release Inventory (TRI) reports describe the quantity of toxic chemicals released to the air, water, and land from large industrial facilities. The quantity of pollutants released to water can be used to model risks to users of that water. Decreases in the amount of reported releases could be used to measure pollution

prevention efforts at these facilities. This parameter can look at local and wide area contributions to the loading of pollutants.

#### Sediment Toxicity & Chemistry

This parameter uses different toxicity end points (i.e. mortality, impaired reproduction, physiological stress) to provide information on the quality of sediments. Concentrations of chemicals in sediments are compared against guidance values for known outcomes. Maps of the extent and severity of sediment toxicity and contamination can be developed to aid interpretation by resource managers. Difficulties remain in that many chemicals need to be profiled and not all effects can be measured by assays (i.e. carcinogenic, bioaccumulation).

#### Prevalence of Pathological Conditions in Fish

The trends in the presence of lesions (any abnormality in tissue that can be observed grossly or microscopically) would constitute this parameter. Morphological or histopathological observations in selected species of fish are made to determine the frequency of occurrence at specific sites. This data would then be compared to data from a reference site over time. Other data on water quality, sediment quality, and tissue concentration would need to be collected simultaneously.

#### Increase/Decrease Death of Flora and/or Fauna and/or Interruption of Reproduction

This parameter would track mortality and reproductive trends of flora and fauna with respect to specific releases of hazardous substances into the environment. Information would be gathered in order to detect changes from ambient or baseline conditions. New effort would be required for this indicator, especially in creating the baseline data and tracking reproductive rates.

#### Contaminant Concentration in Fish and Shellfish

This parameter tracks the concentration of chemical contaminants in edible tissues of fish and shellfish in order to protect human health. This information is used to determine the need for consumption advisories or restrictions. Trends in the contamination levels can be evaluated over time for improvements. Much

work has been done already in this area, and existing information can serve as a foundation for development and refinement of this parameter.

**Ambient Water Quality Indicator**  
*High Priority*

**Surface Water Pollutants or Stressor Level**

This parameter seeks to establish the current status and developing trends in the pollutant levels of surface water. The spatial distribution of waterbodies would be classified by watershed unit, where a significant amount of surface water quality and quantity monitoring has already occurred in these units. These monitoring programs are being continuously improved as additional funding is appropriated for the development of Total Maximum Daily Loads (TMDLs) and waters are more comprehensively monitored as part of DNREC's Whole Basin Management Program.

**Groundwater Pollutants or Stressor Level**

This parameter seeks to establish the current status and predict future trends for pollutant levels in ground water. Groundwater regions would be classified by aquifer units. Although there are many existing efforts upon which to build, groundwater data sets lack long term trends and rarely measure all the contaminants of concern.

**Watershed Pollutant Load Indicator**  
*High Priority*

**Point Source Pollutant Loads by Watershed**

Despite State and federal regulations, we continue to experience the degradation of water quality from some point sources that do not comply with permit limits and conditions. This indicator provides a quantitative analysis of pollutant loads from within a particular watershed. The indicator could be based on the increase/decrease in pollutant loads from a base (historical) year. This indicator would also determine compliance with load limits

established for individual watersheds (Total Maximum Daily Loads).

**Discharge Levels from all NPDES Sources by Parameter**

NPDES facilities are allowed to discharge pollutants up to certain limits on concentration, flow, and load established by the permit. The aggregate total of all permitted discharge levels represents the permitted point source (NPDES) levels. Reductions in these permitted levels will enable improvement in water quality.

**Watershed Pollutant Loads from Runoff and Base Flow**

This parameter would relate changes in land use to spatial and temporal trends in water quality. Information on the relative contributions to pollutant loading from different land uses would need to be determined. Improvements in water quality would be seen as the result of implementation of various local reduction strategies (e.g. stormwater controls, nutrient management, and controls on septic systems). Preliminary work would include: landscape characterization to identify relative contributions from different land uses; monitoring watershed outlets to determine loadings; and modeling to predict local reductions expected from BMP implementation.

**Affected Populations Indicator**  
*High Priority*

**Affected Populations**

This parameter would quantify the human population that is at risk from releases of contaminants into the Coastal Zone. The population would be categorized by density, proximity to sources and/or transport corridors to develop affected population profile maps of the Coastal Zone. Isolation of population centers away from high-risk centers would be an improvement to the Coastal Zone from a human risk perspective.

### **Human Health – Fish Consumption Advisories, Beach Closures, etc.**

The human health parameter would provide information on the human health impacts from exposure to contaminants, both directly and indirectly. Much of the monitoring from other indicators is used to make decisions in regard to human health. For example, contaminant levels in fish may prompt issuance of fish consumption advisories. Ozone level warnings are another example. This parameter would track the number and extent of human health actions taken related to Coastal Zone activities. It is a measure of the ecosystem that is easily interpreted. Reductions in the number or extent of advisories would indicate improvements, while the reverse would also be true.

### **Plant Health**

The plant health parameter would provide information on the plant health and viability impacts from exposure to contaminants related to Coastal Zone activities, both directly and indirectly. For example decreased crop yields or estuary eutrophication. To accomplish this parameter, sensitive indicator species would have to be identified. Additionally, in depth statistical analysis would have to be performed to isolate the specific causes in the change of the plant health. Other items that are known to effect plant health, such as acid rain or nutrient loadings could be interpreted as to their known impacts to plant health. Another measure could be the viability and extend of native plants, with decreases indicating a stressor on the environment. Improvements in the growing environment of plants and the viability of native species would indicate an improvement to the Coastal Zone.

### **Accidental Release/Spill Indicator** *Medium Priority*

#### **Accidental Release Occurrences (to water) by Quantity and Substance over Time**

This parameter would provide information to develop a database of accidental releases to water. The data would contain information on location, quantity, substance, time, and duration of the releases. From these

data, trends of accidental releases can be developed including an interpretation of the severity of these releases. Periodic interpretation of the data will show improvement/degradation of the Coastal Zone by quantifying the number and severity of accidental releases.

### **Potential Impact of Accidental Releases**

This parameter would quantify the potential impacts of an accidental release to human, animal and plant life in the Coastal Zone. Based on known sources of materials that could have potential accidental releases, vulnerability zones would be developed. By overlapping density profiles on human/animal/plant populations, a risk index would be developed. Much effort would be needed to rank the vulnerability zones based on the potential risk of the accidental release based on quantities, duration and material that could be released. A decrease in the risk index for areas of the Coastal Zone would indicate improvement in those areas.

### **Nonpoint Source Nutrient Mass Balance Indicator** *Low Priority*

This parameter provides information on the supply, utilization, location, and surplus/deficit of nutrients on cropland in Delaware. The indicator would show locations where either a surplus or deficit exists in utilization of nutrients. The base spatial unit would be watersheds that drain into and include the Coastal Zone.

Currently nutrient data is available at the county level, and this information would need to be recalculated at the watershed level. Additionally, data from soil analysis and fertilizer sales will supplement existing information in order to provide a comprehensive understanding of the status of nutrient quantities and spatial distribution.



## Habitat / Land Cover / Aesthetics Goal

*"Protect (the mosaic of) land cover in the Coastal Zone, including upland, wetland, shoreline, and aquatic areas, to ensure a healthy ecosystem. Ensure the protection of natural vistas in the Coastal Zone for public enjoyment."*

### Habitat Change Indicator Very High Priority

#### Forest Fragmentation/Loss in the Coastal Zone

This parameter can be used to assess the impacts of land cover change and the resulting forest fragmentation and loss in the Coastal Zone ecosystem. It will provide an inventory of current and historic habitat conditions from which effects of development projects on forest-dependent species can be inferred. Using Delaware Bay Estuary Project (DBEP) data on habitat requirements for specific species, it will be possible to model species distribution based on the land use classifications. Data required would be 30 m<sup>2</sup> resolution (existing) land cover data sets. Fragmentation analysis would be based on forest-non-forest mapping distinctions obtained from satellite image analysis.

This parameter will also provide information on degree and rate of forest fragmentation/loss in the Coastal Zone, specifically as it would be likely to affect populations of forest-interior dependent (FID) birds. Techniques developed by the USFWS, Delaware Bay Estuary Project (DBEP), provide parameters of forest fragmentation/loss specifically identified in local field studies to significantly ( $p < .05$ ) affect FID birds. The existing methodology can be applied to forest cover in existing or future land cover mapping efforts, rates of change over time or impacts from specific projects can be analyzed.

Forest parameters include the following: 1. Stand area (as determined by GRID's zonal thickness), 2. Forest isolation (% forest in 2 km radius, as determined by GRID's

focal mean), and 3. Riparian forest width (as determined by zonal thickness stratified to riparian zones).

#### Inventory and Trend Analysis of Land Use/Land Cover

This parameter provides a measurement of land conversion, which can be used to assess forest fragmentation, habitat availability, open space, farmland loss or gain, population/housing density, impervious cover, available buffering/filtering areas, and loss of coastal communities. Data will be collected from aerial photos, satellite images, GAP analysis studies, parcel zoning maps, National Wetlands Inventory (NWI) maps, DelDOT cartography, USGS maps, and state or county GIS data to determine acreage and distribution of each land cover type and the location of contiguous blocks within each classification.

Development of the parameter will require collection of all relevant land cover databases, both historical and recent. Trend analysis of acreage losses and gains in each category will provide temporal information that highlights the rate and direction of land conversions. Land use types can be linked to habitat benefits, and in this way land conversion can be correlated with changes in available habitat for living resources.

#### Inventory of Wetlands and Adjacent Land Use/Land Cover Impacts

This parameter would be based on the increase/decrease in wetland acreage from a base year as estimated from: a) acres of permitted loss (CWA 404); b) acres of non-permitted fill or development (citations); and c) acres in mitigation projects. National Wetlands Inventory (NWI) maps as well as DNREC wetlands maps will be used to identify location and acreage of wetlands. Permit records from the Corps of Engineers and DNREC will supplement information regarding permitted and non-permitted wetland losses.

#### Wetlands Inventory

This parameter will provide a hydrologic delineation (spot basis) of large or significant wetlands in the Coastal Zone. Information will be developed to assess the change in wetland boundaries and to track

movement and health of wetland systems. The targeted sites will be wetlands over 300 acres, identified through queries of National Wetlands Inventory (NWI) maps. Additionally the 1987 Federal wetlands delineation manual will be used for biannual spot testing.

### **Loss of Natural Habitat to Development in the Coastal Zone**

Information will be collected to assess development pressure (measured through non-point source pollution loads) on habitat in the Coastal Zone. DNREC well permits and septic permits as well as county government building permits will be catalogued and evaluated as a measurement for “development.” The evaluation procedure will be as follows: search permits and records, collect data from state and county governments, combine information for the Coastal Zone, and analyze and link the results to change in quantity of habitat areas.

### **Shoreline/Riparian Habitat Loss**

This parameter provides information on the degree and rate of shoreline/riparian habitat loss through physical, man-made, and natural disturbances. It would be based on the percentage of shoreline and riparian habitat lost or degraded since a pre-determined base year. Loss of such habitat may negatively impact flood control, storm surge protection, public recreation potential and access, water quality benefits, property, bank stabilization, and biological diversity.

The base spatial units for measurement would be each of the watersheds along the Coastal Zone. Land use data is available from national and state inventories based on similar classification systems and can be aggregated in a variety of ways without difficulty. Specific data sets include National Wetlands Inventory (NWI) maps, DNREC wetlands maps, aerial photography from NOAA, DNREC, and DelDOT, and permit records from the Corps of Engineers and DNREC. The methodology would use existing baseline maps to get acreage estimates, search permit records, find citations for illegal dredge and fill activities, combine acreage into target geographical units, and collect and analyze data and aerial imagery from local, state, and federal sources.

### **Undisturbed Perimeter to Wetland Areas**

Valuable wetland habitats are dependent in part upon the size of the actual tract and the nature of the surrounding parcels. To determine the quality of wetlands based on size and health, an inventory of wetlands and adjacent land use/land cover will be created. Using a historical perspective, the trend of disturbances to the systems would be tracked. NWI maps, historical aerial photos, and satellite imagery will be used to map the perimeters of wetland areas (width of buffers) and the types of land cover in the perimeter areas. This will allow DNREC to track changes in use and characteristics of uplands adjacent to wetlands.

### **Change in Habitat Types**

This parameter evaluates the amount of various types of habitat in the Coastal Zone. Acreage of forested, tidal marsh, beach and dune, and riparian areas will be catalogued at three-year intervals, and the change over time will be evaluated. 1997 GIS data from the University of Delaware will be used as the baseline and future trend analysis will provide information on the change in types of suitable habitat available for use by different species.

### **Amount of Vegetative Cover in the Coastal Zone**

A catalog of land use/cover will allow analysis of habitat quality based on several parameters. The areas will be classified from most to least valuable with regards to habitat quality. For forested areas, concerns will be the forest age, acreage, distribution, and size of intact parcels. Wetlands will be evaluated using the standard Cowardin (1974) classification system and transition trend interpretation. Beach and dune areas will be measured for both quantity and habitat quality. Measurements would be taken every 3 years at 30 m<sup>2</sup> resolution.

### **Percent Impervious Cover**

Information would be provided regarding the percentage of land use associated with impervious cover. This can be used to indicate water quality impacts associated with land development. Literature shows that as the net impervious surface increases, there is often observable environmental degradation, which

can lead to other downstream impacts. DNREC landuse coverages can be used, and experts in this area can develop an estimate of perviousness associated with landuse classifications as mapped. This approach may require ground-truthing to ensure accuracy. Additionally, DelDOT load coverages and historical New Castle County landuse data could supplement the information for this parameter.

### **Wetlands Indicator** *High Priority*

#### **Wetland Functions and Values**

The functional assessment of wetlands is a comparative tool to make better management decisions on the maintenance and improvement of wetland quality. The functional assessment would be based on existing and to-be-developed methodologies. This parameter will develop a quantitative and qualitative assessment of wetlands in Delaware, utilizing on-site characteristics and those that can be inferred from GIS technology. Its objective would be to provide managers with a tool for determining what is necessary to improve the protection and conservation of wetland functions. Mapping tools will be similar to those described above in “wetland quality.”

#### **Wetland Type**

Mapping wetlands by type (classification) will allow consideration of overall quality. Additionally, tracking changes over time will indicate temporal trends of acreage loss or gain and could guide the permitting process and offsets. Much of the same information as above (“wetland quality”) will be collected for this parameter.

#### **Wetland Quality: Invasive Species Monitoring by Aerial Photos, Fraction of Open Water**

Despite state and federal regulations, we continue to experience the loss of wetland acreage and degradation of wetland quality. The aggressive nature of invasive species further degrades our remaining wetlands. This parameter will provide an inventory of wetlands

and adjacent land use/land cover impacts. It will particularly highlight wetland quality, measured as abundance of particular species, especially invasive species. Information will be collected to measure the acreage and distribution of invasive plant species (which reduce wetland quality) and also to compile gross information regarding hydrologic changes in coastal wetlands. Tracking such changes in wetland quality can assist regulators when evaluating the permit process and offsets. Data collection will come from NWI maps, aerial and satellite imagery, and DNREC wetland maps, and analysis will be dependent upon establishing a wetland classification system to reflect quality (i.e. ranking 1-5).

### **Trends in Quality of Contaminated Areas Indicator** *Low Priority*

This parameter will present graphically the areas in the Coastal Zone known to be contaminated with hazardous substances. A “contaminated” site would be characterized as having contaminants above the practical quantitative limits (detection limits) as per EPA methods. This would include active waste management areas. The information will be used to track the density of contaminated sites in a particular area and the risks that these sites pose to human health and the environment. Risk assessment models would be run based on different exposure scenarios.

# Set of Environmental Goals for Delaware's Coastal Zone

**Habitat/Land Cover/Aesthetics:** "Protect the mosaic of land cover in the coastal zone, including upland, wetland, shoreline, and aquatic areas, to ensure a healthy ecosystem. Ensure the protection of natural vistas in the coastal zone for public enjoyment."

**Air Quality:** "Improve air quality which directly or indirectly affects all forms of life within the coastal zone."

**Water Quality:** "Improve water quality and quantity which directly or indirectly affects all forms of life within the coastal zone."

**Living Resources:** "Preserve and maintain healthy native animal and plant populations, or biodiversity, in the coastal zone. Preserve and improve the ability of non-invasive populations to live and thrive in the coastal zone."

## Set of Coastal Zone Environmental Indicators

- Habitat Change Indicator
- Keystone Species Indicator
- Biodiversity Indicator
- Ambient Air Quality Indicator
- Wetlands Indicator
- Benthic Community Indicator
- Contaminants/Toxicity Indicator
- Ambient Water Quality Indicator
- Watershed Pollutant Load Indicator
- Affected Populations Indicator
- Accidental Release/Spill Indicator
- Atmospheric Deposition Indicator
- Nonpoint Source Nutrient Mass Balance Indicator
- Trends in Quality of Contaminated Areas Indicator

## Set of Quantifiable Coastal Zone Parameters Comprising Each Environmental Indicator

- Indicator Species for health of Coastal Zone (TBD - E.g. ODONATA, Stone corals, Tube Worms, Tiger Beetle, Osprey, Herons, Migratory shorebirds, horseshoe crabs, Green Tree frog, Diadromous and Demersal Fish)
- Assessment of the impact of riparian buffers
- Forest age/stability
- Degradation of habitats by invasive/exotic
- Spatial quality of habitats
- Coastal Marsh zone selected bird
- Coastal Upland zone selected bird
- GAP Biodiversity Index
- Changes in populations of rare and uncommon species and natural communities of the Coastal Zone.
- Benthic Sampling Data
- Biological Monitoring for Benthic Diversity

Weight Factor

- X TBD

## Ranking of Environmental Quality

- To Be Determined
- Excellent? Good? Fair? Poor?
- To Be Determined
- Excellent? Good? Fair? Poor?
- To Be Determined
- Excellent? Good? Fair? Poor?

Priority for Indicator Development

- Very High Priority
- High Priority
- Medium Priority
- Low Priority

TBD = To Be

## Living Resources Goal

*"Preserve and maintain healthy native animal and plant populations, or biodiversity, in the Coastal Zone. Preserve and improve the ability of non-invasive populations to live and thrive in the Coastal Zone"*

### Keystone Species Indicator Very High Priority

#### Keystone and Indicator Species

The Living Resources workgroup agreed that in order to properly assess the living resources in the Coastal Zone; it was necessary to identify priority species that could serve as indicators of ecosystem health. Population abundance as well as quality factors can provide information on the status of each species and how it relates to Coastal Zone stability. Some species would be more amenable to quality measurements, and these are starred (\*) in the following list. This focus group came up with the following fauna as indicator species, and flora species can be acquired from the Delaware Heritage Program. In addition, the list provided can be supplemented and prioritized with reference to Delaware Estuary Program's *Living Resources of the Delaware Estuary* (July 1995) publication which provides a more comprehensive list with information on each species and the representative communities.

Diadromous Fish	Blue Crab
Bobwhite	Shortnose Sturgeon
Osprey *	Heron *
Black duck *	Migratory Shorebirds
Snapping Turtle	Black Rail
Least Bittern	Coastal Plain Swamp Sparrow
Yellow Warbler	Tiger Beetle
Dragonflies	Horseshoe Crabs
Damsel Flies	Otter *
Barred Owl *	Meadow Jumping Mouse
Green Tree Frog	Oyster

Hard Clams	Ribbed Mussel *
Muskrat *	Silversides
Mummichogs	Summer Flounder
Weakfish	Tube Worms
Stone Corals	Atlantic Croaker
Least Bittern	Clapper Rail
Swamp Sparrow	Seaside/ "Sharp-tailed" Sparrows
Eastern Meadowlark	Wood Thrush
Grasshopper Sparrow	

\* Species where quality would be measured as well as population abundance

quality factors:

year class strength	size
age structure	contaminants
reproductive success	deformities
disease status	tumor incidence

Ospreys and herons were identified as avian species that provide good indicators of the health of the Coastal Zone. Environmental contaminant exposures and effects should be monitored in ospreys, herons, and other shorebird species. Specific indicators include contaminant concentrations and sublethal responses that may point to the effects of coastal development, degradation, and restoration. Because bird species are migratory, it is necessary to select life stages (eggs and young) that reflect contamination of local origin. Some methodologies for measurement are as follows: "sample egg" technique; sublethal and lethal collection of matrices from nestlings; analytical chemistry including measurement of organochlorine pesticides, organophosphorus pesticides, PCBs, metals, and petroleum hydrocarbons; biochemical analyses including cytochrome P450 induction, oxidative stress, inhibition of cholinesterase and delta-aminoleulionic acid dehydratase; Teratogenesis and Histopathology; and study of reproductive success (nest and fledging). Several texts, databases, and a website are available (through USGS Patuxent Wildlife Reserve Center and others) to provide more specific information on the topic and specific methodologies.

Horseshoe crabs are also an indicator species as they directly affect the robustness of the migratory bird populations that feed on their eggs. Hence these two communities would need to be monitored in tandem, measuring population changes in each and the length of stay and weights of the birds, which in turn reflect the

condition of the benthic invertebrate community. The publications Birds of Delaware (G.K. Hess) and Delaware Non-game Program's international shorebird survey and horseshoe crab counts provide existing information on the species.

For diadromous fish (Striped bass, White perch, American shad, Alewife, Blueback Herring, American Eel) and demersal fish (Summer flounder, Weakfish, Atlantic croaker, Spot, Hogchoker, Channel Catfish, and Tautog), catch per unit effort and some fishery independent data will be centralized. Where possible, age distributions and year class strengths will more fully describe each species. Data sources include the following: Delaware commercial fisheries statistics, Delaware juvenile trawl survey, New Jersey beach seine survey, PSEG fisheries data, and Delaware recreational fish statistics. Additionally, a search of historical databases and literature review will provide baseline information and allow generation of abundance indices against which current distributions can be ranked.

The Green Tree Frog can provide indirect information on wetland quality in fresh and brackish marshes and freshwater impoundments. In general, amphibians have been found to be good indicators of environmental change (i.e. water quality, air quality, acid rain, and ozone), and they could also be used to monitor toxicity. Of the spectrum of amphibians available, the Green Tree Frog is particularly easy to monitor using breeding call surveys. Data do already exist on this species and are available through the Delaware Non-game Program, Delaware Heritage Program, and Delaware Nature Society.

The presence of a Tiger Beetle population indicates a high quality, relatively undisturbed beach or dune area. There are several species of tiger beetles, each preferring a slightly different habitat – Atlantic foredunes, Atlantic backdunes, and Atlantic and/or Bayshore beaches and dunes. The protocol for sampling involves a field biologist walking a pre-determined stretch of the beach or dune looking for flying Tiger Beetles. Specimens are collected and either identified in the field or brought back to a lab for identification. If population size is desired, a plot outline can be placed and tunnel entrances within that plot area can be counted.

Invasive plants and animals often threaten species diversity in an area and consume habitat normally utilized by native species. The species responsible vary by ecosystem type, and different measurement techniques are required based on the species of concern and region. In tidal marshes, one must measure percent of total marsh habitat and change over time of Phragmites-dominated marshes. The beach/dune region would have a similar protocol, and other regions would require additional technical expertise to develop protocol. The Living Resources workgroup identified the following species as potential invasives, which threaten native habitats in the Coastal Zone of Delaware. There are numerous other species that could be added.

Phragmites	Purple Loosestrife
Carp	Asian Tiger Mosquito
Asiatic Clam	Green Crab
Nutria	Brown-Headed Cowbird
[Pfisteria]	Multiflora Rose
Autumn Olive	Asiatic Bittersweet
Japanese Black Pine	Honeysuckle (Japanese)

#### **Assessment of the Impact of Riparian Buffers on the Coastal Zone Habitat/Land Cover**

Riparian buffers are strips of vegetation along the shoreline of a waterway designed to take up some of the nutrients from adjacent land uses that would otherwise run directly into a stream or river. An inventory of existing riparian buffers would provide information on their effectiveness and the level of participation in voluntary programs would be useful to encourage future or expanded planting. The base spatial unit would be each watershed along the Coastal Zone, and existing riparian buffers would be identified on aerial photographs scanned into a GIS. Additionally, areas that are good candidates for installation of riparian buffers could be identified using a methodology that has been developed in some USFWS pilot studies.

#### **Forest Age/Stability**

Data indicate that forest age and stability have direct impacts on habitat quality. This parameter would address this linkage in Delaware, aerial photographs and other coverages will be evaluated to identify and

quantify mature forests that existed in or before 1926 and still exist currently. 1997 will then be set as a base year, and changes in acreage of contiguous forest will be measured over time.

### **Spatial Quality of Habitats**

In many cases, it is not the total acreage of a particular habitat across the entire Coastal Zone that indicates suitability but instead the spatial distribution. Large areas are often preferred to small pockets since certain species are more vulnerable at the edge of their desired habitat and prefer to have a substantial area in which to forage and breed. In some cases, transitional areas surrounding forests are preferable to a forest that abuts directly upon high-density commercial development.

Forest size and distribution will be evaluated based on meeting minimum acreage requirements and buffer criteria to be developed (CGIS analysis in GRID). For beach/dune habitat, the size and distribution of intact, contiguous beach segments that meet length and width criteria will be identified and tracked. The approach for tidal marsh and riparian habitat areas will be similar to that for the other two.

### **Biodiversity Indicator** *Very High Priority*

#### **GAP Biodiversity Index**

This parameter provides information on the current status and future trends of high biodiversity areas (species-rich) as well as levels of habitat protection and/or management for biodiversity. It also provides modeled distribution of all terrestrial/amphibious vertebrates, actual distribution of sensitive, threatened, and endangered vertebrate species, and modeled distribution of exotic vertebrate species. The information collected would be used to evaluate the effects of land cover changes on identified biodiversity areas, and on individual species, to remodel exotics based on changes in land cover, and to evaluate changes in land management status for biodiversity land use. The relationship between species and habitat will be established and then used to protect species richness/ biodiversity. USFWS Land Stewardship and Biodiversity Analysis

data will be used in addition to standard measurements of land cover and species modeling.

### **Changes in Populations of Rare and Uncommon Species and Natural Communities of the Coastal Zone**

Delaware Natural Heritage Program data will be used to select rare and uncommon species occurring in the Coastal Zone, and GIS data layers of their locations will be created. An "element occurrence" (EO) rank will be determined for each species. Using a pre-determined baseline, species' EO rank should be tracked and upgraded or downgraded every five years. By measuring the distribution of these species over time, it will be possible to determine whether the native flora and fauna are more or less secure and therefore interpret one component of Coastal Zone health.

### **Benthic Community Indicator** *Very High Priority*

#### **Benthic Sampling Data**

The benthic sampling parameter is intended to catalog the quantity of organisms in an area and also the extent and quality of the habitat. Some background information on what constitutes healthy benthic habitat needs to be developed prior to implementing this parameter.

#### **Biological Monitoring for Benthic Diversity**

This parameter requires the characterization of reference sites for specific habitats. The measure of Coastal Zone health will be an index that compares the site of interest to the reference site. This parameter is a good way to communicate environmental information to the public because attainment of a desired outcome is inherent in the product.

## Supporting Tools for the Environmental Indicators

### Real-Time Meteorological Network

The availability of centrally accessible, real-time meteorological information for the State is key to supporting several other indicators and activities (i.e. emergency response, airshed modeling, atmospheric deposition). A real-time and an archived database will be developed. The ideal network would be comprised of 10 homogeneously distributed stations. Some of the stations are in existence today. The bulk of the work will involve standardizing data formats and communications to a central site.

### Results of Airshed Modeling

Computerized simulation modeling provides estimates of impact of various sources (point source, area, and mobile) on projected concentrations of pollutants in ambient air. For example, a disposition model can look at release from a source and where it would impact. Regional models, looking at a larger scale, can be used for control strategy development. Mobile source models give estimates of emissions from cars/highway sources. This information can be used to project or assess changes in air quality.

### Analysis of State/Regional and Local Comprehensive Plans

This effort would review planning activities in the Coastal Zone to identify potential sites for offset projects and look at the effect of public investment on the extent and rate of change in land use in the Coastal Zone. Information gathered would include the amount of acreage by zoning category, location of Brownfields, location of critical natural areas, and location of public investment activities.

### Dose-Response Data

Dose-response data for sensitive indigenous or representative species (including vertebrates, invertebrates, and flora) is necessary to establish levels that are protective of the ecosystems of the CZ. This tool would develop data on the

concentrations at which specific chemicals and mixtures affect the survival, growth, and reproduction of species that represent ecosystems of the Coastal Zone. This information should be used in conjunction with loading data from all contributing sources to target chemicals of concern and determine the need for permit limits and other controls on a watershed basis. It should also be used to identify indicator species and set water quality objectives. The existing data is limited to a small set of chemicals for a limited number of species, some of which may not be representative of the Coastal Zone. Data on the interactions of chemical mixtures with species is almost non-existent. Dose response studies are very laborious and time consuming and therefore very expensive.

## Recommendations

*The Environmental Indicators Technical Advisory Committee (EITAC) has successfully completed their objectives as laid out by the Cabinet Secretary of the Delaware Department of Natural Resources and Environmental Control (DNREC). In the Cabinet Secretary's September 16, 1998 letter forming the committee, the EITAC was charged with:*

- 1. Identifying and refining a set of goals and their associated challenges for Delaware's Coastal Zone;*
- 2. Providing a detailed characterization of the issues or challenges associated with these goals; and,*
- 3. Developing the initial set of environmental indicators to assess our progress toward these goals.*

*In completing the outlined objectives over an intensive six-month period of work, the EITAC formulated the Environmental Goals and Indicators described in previous sections of this document. These include the description of four (4) broad Coastal Zone Environmental Goals and fourteen (14) prioritized Coastal Zone Environmental Indicators. The Environmental Indicators are derived as indices from various combinations of forty-seven (47) parameters.*

*The EITAC's findings establish a framework that should be a cornerstone of the initial implementation of Delaware's Coastal Zone Environmental Indicators. They set Delaware on a course to improve the management of its Coastal Zone. They will enable DNREC to start with numerous key parameters, while refining and adding to them based on the knowledge gained through experience and information gained from projects in other states and regions.*

*The EITAC recommends DNREC begin development and implementation of an Environmental Indicator monitoring program, while recognizing that initial set of Coastal Zone Environmental Indicators still requires refinement. DNREC should use a phased approach to the implementation of Environmental Indicators. DNREC should also issue an annual progress report on the Environmental Indicators program to keep stakeholder groups and the general public informed of their activities.*

*We recommend that DNREC accept the four Coastal Zone Environmental Goals as the guiding principles for protecting our coastal resources for uses addressed in the 1999 Regulations Governing Delaware's Coastal Zone. This will benefit present and*

*future generations. We also recommend that DNREC accept the Coastal Zone Environmental Indicators and their associated parameters as a starting point, and that they should refine them in accordance with scientific knowledge.*

*While the EITAC has met the objectives set before them, the strategic task of fully developing a useful set of prioritized environmental indicators is not complete. The EITAC fully recognizes that the Environmental Indicators recommended in this document require additional development and refinement to provide maximum value in implementation of the regulations. We recommend that this refinement of the Environmental Indicators should be accomplished using highly structured focus groups of scientific and technical experts and include the continuation of direct stakeholder and public input. A new committee should be established with a modified membership to provide oversight for the focus groups. The new committee will need a higher percentage of scientifically and technically trained members.*

*To help meet this remaining challenge, this section includes two parts. Part one takes a realistic look at the recommended indicators and provides a preliminary evaluation of the implementation status. It lays out a plan to begin implementation where DNREC can be successful in the short term, and it identifies a phasing in of other work to be completed. The partially implemented state of the current Environmental Indicators program is of limited value in carrying out the purposes outlined in the Regulations. Adequate funding and support from State Government is critical for further development. Therefore, the EITAC recommends that this proposal be fully funded and supported by DNREC, other State agencies, and the State Legislature.*

*Part two focuses on aspects of an unfinished agenda for ensuring the effective implementation of a useful set of environmental indicators. This includes a recommendation that DNREC develop a decision support information management system as an additional tool to ensure the efficient use of the Environmental Indicators program. This section charts some recommended next steps to help the State of Delaware meet the formidable challenge that still lies ahead.*

***Summary of Key Recommendations  
of the Environmental Indicators  
Technical Advisory Committee***

- 1. DNREC should accept the four Coastal Zone Environmental Goals as the guiding principles for protecting our coastal resources for uses addressed in the 1999 Regulations Governing Delaware's Coastal Zone, for the benefit of present and future generations.***
- 2. DNREC should accept the Coastal Zone Environmental Indicators and their associated parameters as a starting point, and refine them in accordance with scientific knowledge.***
- 3. DNREC should begin immediate development and implementation of an Environmental Indicator monitoring program, while recognizing that the initial set of Coastal Zone Environmental Indicators still requires refinements. DNREC should use a phased approach to the initial implementation of Environmental Indicators, focusing on those thirteen (13) parameters that have data available during year I. DNREC should address those eighteen (18) additional parameters with some data available by year II, and those remaining seventeen (17) parameters that require significant work and resources by year III. DNREC should also issue an annual progress report on the Environmental Indicators program.***
- 4. The refinement of the Environmental Indicators should be accomplished using highly structured focus groups of scientific and technical experts and should include the continuation of direct stakeholder and public input. A new committee, "EITAC II", should be established with a modified membership (from the original EITAC) to provide oversight for the focus groups. The new committee will need a considerably higher percentage of scientifically and technically trained members than the original EITAC.***
- 5. The partially implemented state of the current Environmental Indicators program is of limited value in carrying out the purposes outlined in the 1999 Regulations Governing Delaware's Coastal Zone. Adequate funding and support from State Government is critical for further development. Therefore, the EITAC recommends that work for phase II be fully funded and supported by DNREC, other State agencies, and the State Legislature.***
- 6. DNREC should develop a fully integrated information management system linked to a geographic information system as an additional support tool to manage the Coastal Zone Environmental Indicators program.***

## Status of the Recommended Coastal Zone Environmental Goals and Indicators

Upon completion of the workshop and processing of the organizational structure for the Coastal Zone Environmental Goals and Indicators, the EITAC Support Staff conducted a preliminary evaluation of the implementation status of the parameters that make up each Indicator. This was necessary to understand how soon Environmental Indicators could potentially be used as outlined in the new Regulations Governing the Use of Delaware’s Coastal Zone. The regulations specifically identify the indicators as a tool to assess Coastal Zone Permits and their offset proposals, and for assessing the long-term environmental quality within the Coastal Zone.

The EITAC reviewed the preliminary implementation status of the Environmental Indicators, and used this as the basis for some of their insights regarding the unfinished agenda and recommended next steps described later in these recommendations.

**Table 1. Summary of implementation status for parameters that comprise the Coastal Zone Environmental Indicators**

CZA Environmental Indicator Title	Dec. 1999	Year II	Outyear	Total
Habitat Change	2	4	4	10
Keystone Species	0	0	7	7
Biodiversity	0	2	0	2
Ambient Air Quality	3	1	0	4
Wetlands	2	0	2	4
Benthic Community	0	2	0	2
Contaminants/Toxicity	3	1	1	5
Ambient Water Quality	1	1	0	2
Watershed Pollutant Load	2	1	0	3
Affected Populations	0	1	2	3
Accidental Release/Spill	0	1	1	2
Atmospheric Deposition	0	4	0	4
Nonpoint Source Nutrient Mass Balance*	N/A	N/A	N/A	N/A
Trends in Quality of Contaminated Areas*	N/A	N/A	N/A	N/A
<b>Totals</b>	<b>13</b>	<b>18</b>	<b>17</b>	<b>48</b>

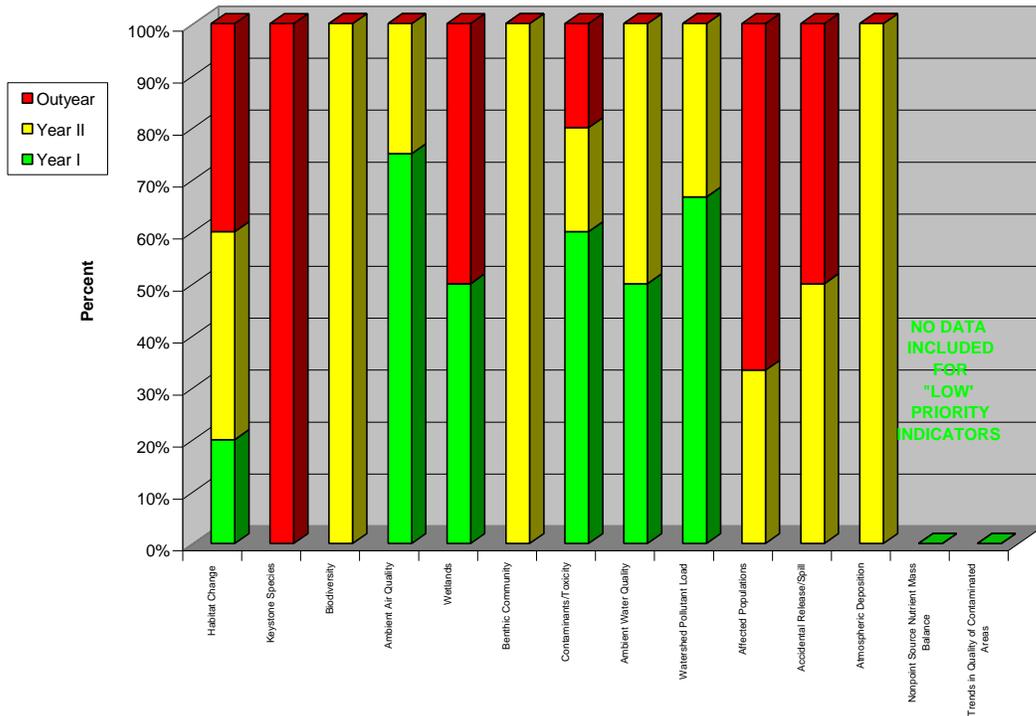
\* Low Priority Indicators were not to evaluated.

Table one provides the number of each parameter that DNREC believes can be implemented in each of the next three years provided resources are made available.

The results of this preliminary status review are summarized as follows.

- *By December of 1999 (Year 1), DNREC believes they can develop and use thirteen (13) of the 48 recommended parameters that comprise the indices for the Coastal Zone Environmental Indicators. Thirteen (13) have been studied by DNREC and other groups for years. Good historical data are available but will require some amount of reformatting and integration. Resources are now available within DNREC to develop these in a format suitable for use.*
- *By the year 2000, DNREC believes that they could develop an additional eighteen (18) indicators, but lack the required resources. Therefore, they can not start the work. These eighteen (18) have been studied somewhat by DNREC and some data are available. However the data are neither complete nor fully suitable; some additional data acquisition will be needed – and it first must be defined. The current budget proposal lacks funding (estimated by DNREC at \$150,000) for this effort in the next fiscal year. With adequate funding, these additional Indicators could be phased in over the years 2000-2002. The EITAC would prefer that this work begin immediately. We believe that regulatory control and industrial flexibility will suffer with a delay, and recommend restoration of the \$150,000 originally proposed in the FY2000 budget request for a total of \$254,000.*
- *The remaining seventeen (17) proposed indicators are new to DNREC, and currently we are not aware of the necessary protocols to obtain the needed data. In other words, in most cases the work will have to begin from scratch, the process will be lengthy, and required funding has not been proposed for fiscal year 2000.*

Figure 12. Percent Attainment of EITAC Recommended CZ Environmental Indicators



It should also be pointed out that only 24% of the parameters required for the Environmental Indicators ranked as very high, 46% of those ranked as “high”, and none of those ranked as “medium” are likely to be available in year I. Of these, most of the available information is currently collected for other regulatory programs. The EITAC identified most of this information as the type that is derived from historic, command and control regulatory programs; and believed that more ambient ecosystem monitoring information needs to be developed to successfully implement the 1999 Regulations Governing Delaware's Coastal Zone. Much of the information needed for the general assessment of the health of the coastal zone is still not available. The EITAC is concerned with this issue since it will not be possible to measure some important environmental improvements over time, a key condition for providing flexibility to industry through offsets that require a "net environmental improvement". However, this should not in anyway diminish the importance of the existing data collected for permits. This information can, in most cases, be linked directly back to its source and provides vital information about site specific activities. The existing data will also be extremely

helpful in evaluating offsets proposed by applicants for Coastal Zone Permits. Preferred “offsets” are environmental improvements that:

*... occur in the same environmental medium as the source of degradation of the environment, that occur at the same site as the proposed activity requiring a permit, and that occur simultaneously with the implementation of the proposed activity needing the offset.*

Section I.1 of 1999 Regulations Governing Delaware's Coastal Zone

**Table 2. Summary of implementation status for parameters that comprise Environmental Indicators by priority ranking**

Environmental Indicator Priority Ranking	Dec. 1999	Year II	Outyear
Very High	24%	31%	45%
High	46%	31%	23%
Medium	0%	83%	17%
Low	N/A	N/A	N/A

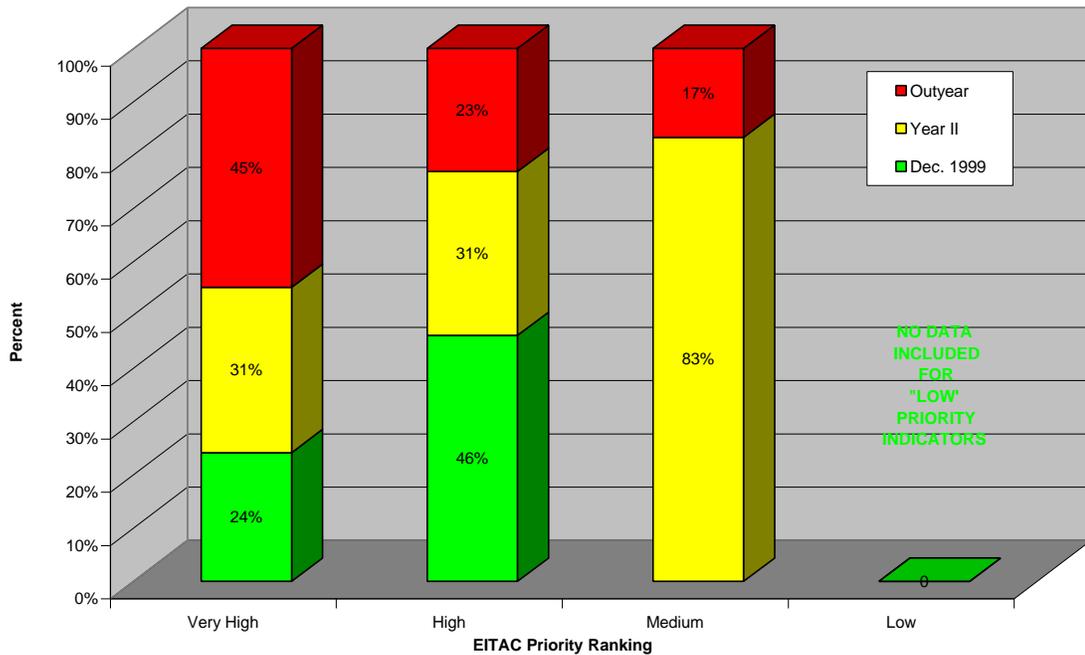
The increase in attainment of use of those parameters in the out-year status group is considerably more difficult to accurately predict. Our current level of ecological knowledge may limit the implementation of these parameters. They may also be limited by higher costs for their development and implementation.

The percentage of “high” and “very high” ranked parameters available for use does increase significantly in year two, provided resources are identified for their development and implementation. By year two, a total of 55% of the “very high” priority Indicators, 77 % of the “high priority” Indicators, and 83% of the “medium priority” Indicators could be in use. As discussed above, this will not happen without the requested funding.

The evaluations of the status of each parameter for the various Environmental Indicators, and their association with each of the recommended goals for Delaware's Coastal Zone, are depicted in figures 14 through 17.

Regardless of the complexity or anticipated cost, all parameters associated with the recommended Environmental Indicators should be thoroughly characterized and evaluated. Even those limited by current levels of scientific knowledge or cost are likely to become far more feasible with passing time due to scientific advancements and technological improvements. The recommended approach to characterizing these parameters will be described in the next section's discussion of the unfinished agenda.

**Figure 13. Percent Attainment of EITAC Recommended Coastal Zone Environmental Indicator by Priority**



**Set of Environmental Goals for Delaware's Coastal Zone**

*Air Quality: "Improve air quality which directly or indirectly affects all forms of life within the coastal zone."*

Preliminary Status of Coastal Zone Environmental Indicator Development & Use for Permitting

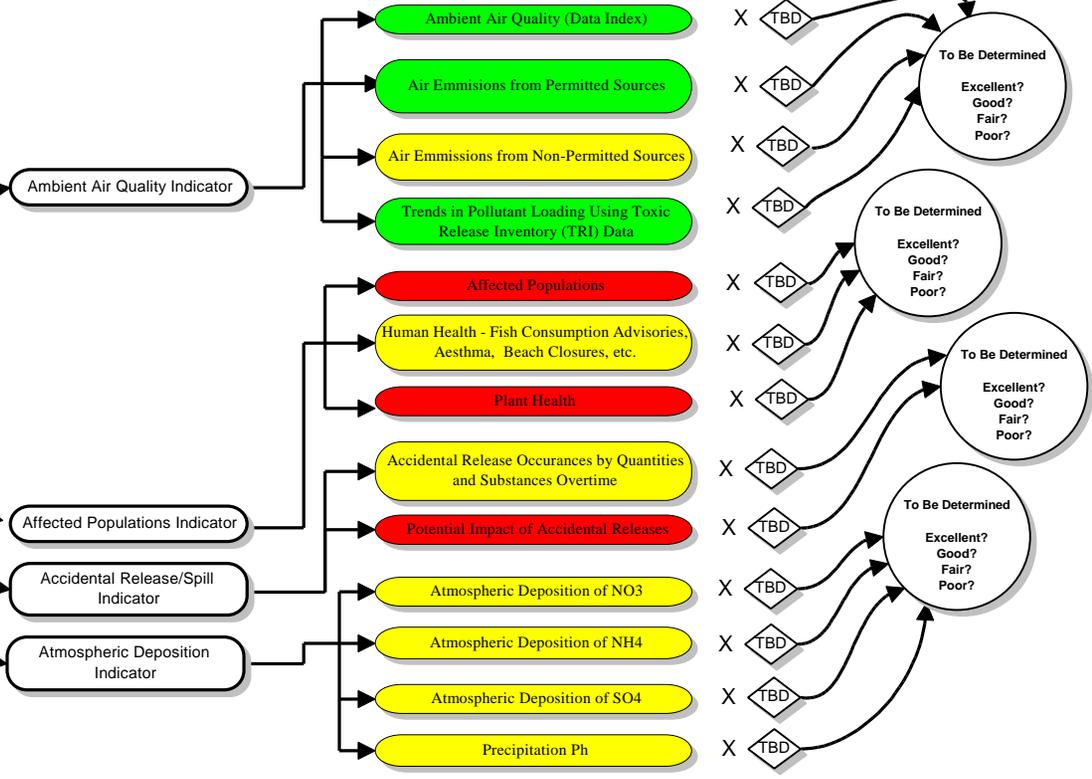
- Implemented by December 1999
- Partially Developed - Maybe Year 2 if funding is secured
- Much Work Required - Beyond 2 Years

Set of Coastal Zone Environmental Indicators

Set of Quantifiable Coastal Zone Parameters Comprising Each Environmental Indicator

Weight Factor

**Ranking of Environmental Quality**



# Set of Environmental Goals for Delaware's Coastal Zone

Preliminary Status of Coastal Zone Environmental Indicator Development & Use for Permitting

- Implemented by December 1999
- Partially Developed - Maybe Year 2 if funding is secured
- Much Work Required - Beyond 2 Years

*Water Quality: "Improve water quality and quantity which directly or indirectly affects all forms of life within the coastal zone."*

## Set of Coastal Zone Environmental Indicators

- Benthic Community Indicator
- Contaminants/Toxicity Indicator
- Ambient Water Quality Indicator
- Watershed Pollutant Load Indicator
- Affected Populations Indicator
- Accidental Release/Spill Indicator
- Nonpoint Source Nutrient Mass Balance Indicator

## Set of Quantifiable Coastal Zone Parameters Comprising Each Environmental Indicator

- Benthic Sampling Data
- Biological Monitoring for Benthic Diversity
- Trends in pollutant loading using TRI data
- Sediment Toxicity & Chemistry
- Prevalence of pathological condition in fish
- Increase/decrease/death of Flora and/or Fauna and/or interruption of reproduction
- Contaminant Concentration in Fish & Shellfish
- Surface Water Pollutants or Stressor Level
- Ground Water Pollutants or Stressor Level
- Point Source Pollutant Loads by Watershed
- Discharge levels from all NPDES sources by parameter
- Watershed pollutant loads from runoff & base flow
- Affected Populations
- Human Health - Fish Consumption Advisories, Aesthma, Beach Closures, etc
- Plant Health
- Accidental Release Occurances by Quantities and Substances Overtime
- Potential Impact of Accidental Releases

Weight Factor

- X
- X
- X
- X
- X
- X
- X
- X
- X
- X
- X
- X
- X
- X
- X
- X
- X
- X

- TBD

## Ranking of Environmental Quality

To Be Determined  
Excellent?  
Good?  
Fair?  
Poor?

To Be Determined

# Set of Environmental Goals for Delaware's Coastal Zone

*Habitat/Land Cover/Aesthetics "Protect the mosaic of land cover in the coastal zone, including upland, wetland, shoreline, and aquatic areas, to ensure a healthy ecosystem. Ensure the protection of natural vistas in the coastal zone for public enjoyment."*

Preliminary Status of Coastal Zone Environmental Indicator Development & Use for Permitting

- Implemented by December 1999
- Partially Developed - Maybe Year 2 if funding is secured
- Much Work Required - Beyond 2 Years

## Set of Coastal Zone Environmental Indicators

- Habitat Change Indicator
- Wetlands Indicator
- Trends in Quality of Contaminated Areas Indicator

## Set of Quantifiable Coastal Zone Parameters Comprising Each Environmental Indicator

- Forest Fragmentation/Loss in the Coastal Zone
- Inventory and trend analysis of land use/land cover
- Inventory of wetlands and adjacent land use/land cover impacts
- Wetlands Inventory
- Loss of natural habitat to development in the coastal zone
- Shoreline/riparian habitat loss
- Undisturbed perimeter to wetland areas
- Change in habitat types
- Amount of vegetative cover in the Coastal Zone
- Percent impervious cover
- Wetland Functions and Values
- Wetland Type
- Wetland Quality (e.g. Invasive Species, Percent Open Water, etc.)
- Wetlands Inventory

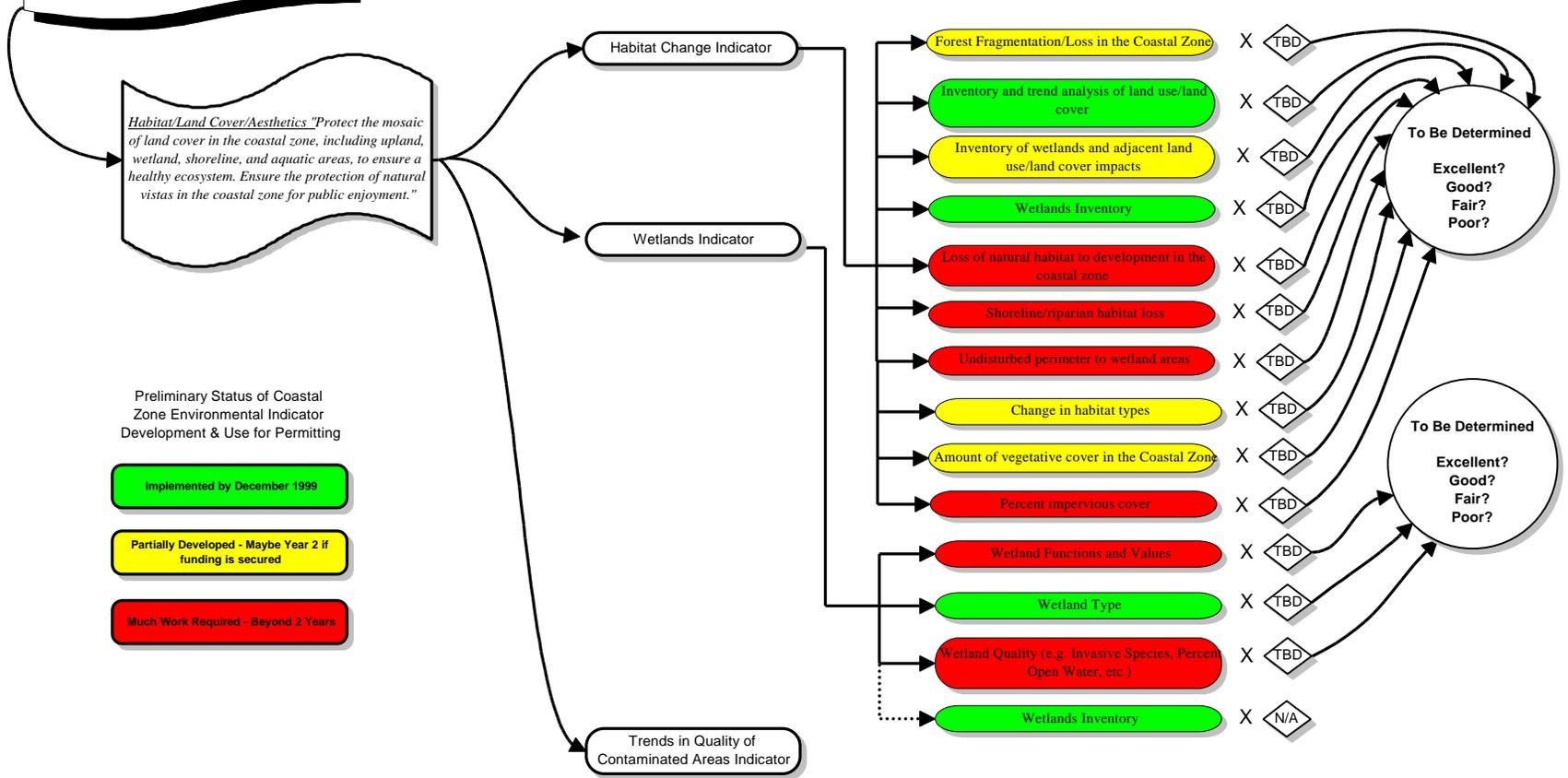
Weight Factor

- X TBD
- X N/A

## Ranking of Environmental Quality

To Be Determined  
Excellent?  
Good?  
Fair?  
Poor?

To Be Determined  
Excellent?  
Good?  
Fair?  
Poor?



# Set of Environmental Goals for Delaware's Coastal Zone

Preliminary Status of Coastal Zone Environmental Indicator Development & Use for Permitting

- Implemented by December 1999
- Partially Developed - Maybe Year 2 if funding is secured
- Much Work Required - Beyond 2 Years

*Living Resources: "Preserve and maintain healthy native animal and plant populations, or biodiversity, in the coastal zone. Preserve and improve the ability of non-invasive populations to live and thrive in the coastal zone."*

## Set of Coastal Zone Environmental Indicators

- Keystone Species Indicator
- Biodiversity Indicator
- Benthic Community Indicator

## Set of Quantifiable Coastal Zone Parameters Comprising Each Environmental Indicator

- Indicator Species for health of Coastal Zone (TBD - E.g. ODONATA, Stone corals, Tube Worms, Tiger Beetle, Osprey, Herons, Migratory shorebirds, horseshoe crabs, Green Tree frog, Diadromous and Demersal Fish)
- Assessment of the impact of riparian buffers
- Forest age/stability
- Degradation of habitats by invasive/exotic species
- Spatial quality of habitats
- Coastal Marsh zone selected bird populations
- Coastal Upland zone selected bird populations
- GAP Biodiversity Index
- Changes in populations of rare and uncommon species and natural communities of the Coastal Zone.
- Benthic Sampling Data
- Biological Monitoring for Benthic Diversity

Weight Factor

- X TBD

## Ranking of Environmental Quality

- To Be Determined  
Excellent?  
Good?  
Fair?  
Poor?
- To Be Determined  
Excellent?  
Good?  
Fair?  
Poor?
- To Be Determined  
Excellent?  
Good?  
Fair?  
Poor?

## The Unfinished Agenda and Recommended Next Steps

As previously discussed, the EITAC fully recognizes that the Environmental Indicators recommended in this document require additional development and refinement to be meaningful and useful in support of the 1999 Regulations Governing the Delaware's Coastal Zone. In addition, tools need to be developed to manage the disparate data and to help evaluate the information in a manner that supports sound and timely decision making.

The EITAC members are comfortable with the set of broad Environmental Goals they have recommended for the Coastal Zone. These have been set to guide the management of the State's coastal resources. The committee recognizes the need for improvements to the Environmental Indicators, largely through the characterization and refinement of the quantifiable parameters that comprise them. These were identified and selected based on the results of an intensive one-day workshop. We believe the 80 scientific and technical experts provided adequate information to structure these recommendations. Nevertheless, more detail must be provided as we move forward with implementation. We believe this refinement process for the Environmental Indicators should use structured focus groups of technical experts that include the continuation of public input.

We recommended a new committee be established to assist in this task, since its mission will dictate a different make-up of membership than the original EITAC membership established in September of 1998.

We provide the following recommendations related to completing the unfinished agenda. These include: 1) recommendations for the new committee; 2) an overview of an approach to refinement of the recommended Environmental Indicators and their parameters; and, 3) a recommendation that the Coastal Zone Environmental Indicator program be supported with the proposed decision-support system that uses integrated environmental data linked to a Geographic Information System.

It should also be noted that we can and should learn from the work done by other states, regions, and countries. To accomplish this, we should seek opportunities to network with others working on similar Environmental Goals and Indicators projects.

## *New Committee Make-up, Mission, and Organizational Structure*

The Environmental Indicators Technical Advisory Committee established on September 16, 1998 was well chosen. The committee was admirably suited to develop the strategic plan and work through increasingly detailed and technical issues culminating in the achievement of the objectives set out for them by the Cabinet Secretary of the Delaware Department of Natural Resources and Environmental Control.

However, the committee lacks necessary knowledge and skills for the increasingly scientific next steps. This involves moving from today's initial set of Environmental Indicators to the legislatively required set of prioritized Indicators suitable for regulatory use. These Environmental Indicators must also be both understood by and acceptable to the various stakeholder groups.

To move forward, it is recommended that a new committee be established with a modified membership. The new committee needs a higher number of scientifically and technically trained members. With the broader policy implications addressed through the setting of Environmental Goals and an initial set of Environmental Indicators for the Coastal Zone, a more technical committee could move forward concentrating on the science, rather than the policy issues critical to the stakeholder groups. Also, considering the likely funding concerns for further development, implementation and refinement; the committee needs members with high credibility among members of the Delaware legislature, DNREC, the Governor's office, and the identified stakeholder groups.

The Secretary should consult co-chairs of the current EITAC committee on proposed nominees for "EITAC II" in order to receive the benefit of the current committee's perspective.

The mission of "EITAC II" needs to be redefined – but the Committee should continue in its current role as an advisor to DNREC.

The structure of the new committee is important. Each of the four environmental goals needs to be managed and monitored by a separate subcommittee of committee members with recognized competence in that specific area. We see the reconstituted committee run by a small steering committee comprising the four-subcommittee leaders, the EITAC Chair, the lead person from DNREC and possibly a State legislative representative.

With regard to the continuing EITAC mission, we suggest the following operational mode for the continuing EITAC activity. We believe it clearly defines the committee's role, status and reporting line.

The EITAC will work with DNREC in an advisory capacity and will report directly to the Secretary. The Committee will provide technical and scientific input for the development and refinement of Environmental Indicators as described in the Coastal Zone regulations and the Memorandum of Understanding, which was the basis for the regulations.

We believe a draft point mission description consistent with EITAC thinking might be to:

- (1) *Provide DNREC with advice and recommendations and assist DNREC's formal adoption and implementation by year-end 1999 (following the appropriate public review and comment) of an initial set of prioritized environmental goals and indicators.*
- (2) *Ensure the Indicators are adequate to assist Secretarial decisions regarding Coastal Zone permit applications and that they have strong support from scientific and technical experts, whose opinions are viewed credibly by stakeholders and other Delawareans;*
- (3) *Keep stakeholder groups, legislators and the general public aware of program status – in part through quarterly progress reports. These reports would track indicator development status, opportunities for program acceleration based on added resources, major goals for the coming quarter, and direct program expenditures to date.*
- (4) *Oversee and assist with the development and publishing of an annual or biannual State of the Delaware Coastal Zone Report.*

### ***Approach to Initial Refinement of the Coastal Zone Environmental Indicators and Parameters***

The initial set of Coastal Zone Environmental Indicators, regardless of their previously described implementation status, require additional work prior to implementation.

It is recommended that this be completed through the use of "Focus Groups". These would preferably be established by the four goal subcommittees as described in the previous section. Focus groups will seek to identify the best specialists available on the subject matter for the parameters used to develop the Environmental Indicator indices. The primary responsibilities and activities for these groups are described below.

### ***Focus Group Responsibilities and Activities***

#### *Establishment of Focus Groups*

"Team Leaders" from the "EITAC II" together with a DNREC staff support person will initiate focus groups. The group leaders will contact individuals to participate in Focus Group work. Upon the first meeting, the team leader may be re-assigned if a technical expert outside the EITAC is interested in championing the effort. Focus Group membership will be flexible and based on the specific Environmental Indicator or parameter needs. They may range from moderate sized groups organized by "Environmental Indicator" or may be very focused to include the team leaders and a few experts with specific expertise related to the Environmental Indicator or parameter.

#### *Revision of Draft Environmental Indicator Descriptions*

The groups will start by building upon the Draft Environmental Indicator Descriptions compiled in the January 29, 1999 Workshop Summary Document. They will provide additional information to more accurately characterize the Environmental Indicator or specific parameter. This may include revision and/or the addition of information for:

- Indicator Title - Refine, if needed, to more accurately describe the content of description.

- Indicator Descriptions - A more detailed body of information of about 1-3 pages describing the Environmental Indicator or parameter. This should combine items #3, 5, 6, 7, 11, & 13 of the Draft Environmental Indicator Characterizations into a narrative description section.
- Describe any limitations of Environmental Indicator use. Combine #9 & 10 of the Draft Environmental Indicator Characterizations into a narrative description section.
- Identify historical data and availability.

Based on this refinement of the Draft Environmental Indicators, the focus group will take one of two possible courses, dependent upon the availability of the needed information. If data exists, the focus group will develop specific metadata descriptions for the data. If the data does not exist, the focus group will develop a strategy to obtain the information.

#### *Development of Metadata for Existing Environmental Indicator Information*

In order to make existing information useful for the Coastal Zone Environmental Indicator Project, it must first be described and evaluated. This process is commonly known as developing metadata. Metadata are needed to provide easy access to critical information about the content, availability, and utility of data. This must be completed as the first step for the integration of this information into the Coastal Zone Environmental Indicators GIS-based decision support system being developed by the Delaware Coastal Programs staff.

A general description of metadata, data documentation standards and contents are described below. All focus groups should make every effort to adhere to the standards outlined below and should use the standard template provided in Appendix C for documentation of metadata.

#### *Develop Strategies to Implement Collection of New Environmental Indicator Information*

For many of the Coastal Zone Environmental Indicators and the Environmental Indicator associated parameters, information is not currently collected. Detailed strategies must be developed to provide the work plan for filling these information voids. Doing this will require providing additional information to the refined descriptions completed in

section two of this focus group guidance. Specifically, a detailed strategy must also include:

- detailed descriptions of the steps/activities that must be taken to implement the collection of the information,
- a description of the institutional roles,
- a listing of the most relevant programs or authorities for implementation,
- an estimation of the implementation cost including start-up and long-term maintenance,
- potential sources of funding for implementation, and
- a description of any prerequisites.

More detailed information and templates for focus group work are included as Appendix C.

### ***Priorities***

Initially, attention will be focused on the Environmental Indicators and thirteen (13) parameters for which data are now available. These can be sufficiently defined in 1999 for use in Coastal Zone Regulatory decisions.

### ***Public Availability of Work Products***

Information will be provided to the public by the "EITAC II", rather than directly through the focus groups. This will ensure the coordination of the information and limit the misinterpretation of work to date.

## *Decision Support System*

The EITAC recommends that DNREC develop a fully integrated information system linked to a geographic information system as an additional support tool to manage the Coastal Zone Environmental Indicators program. Throughout the EITACs work, the Delaware Coastal Programs have been working on the development of the system described above in recognition of this need.

A preliminary prototype of this system was demonstrated to the EITAC during their February 19, 1999 meeting. The presentation showed a glimpse of how the existing Geographic Information System (GIS) could be used to aid in visualization and analysis of environmental conditions and parameters, in support of the Environmental Indicator program. The demonstration showed how a number of existing GIS data sets could meet specific information needs previously identified in EITAC work, as well as how they can be used for even more in-depth analyses when linked with monitoring data. It was also emphasized that while the Environmental Indicators are further refined, new data can be collected and included with the existing data for more comprehensive coverage of Coastal Zone issues and problems. A portfolio of maps depicting information from this preliminary prototype system is included as Appendix A. A system architecture implementation plan, developed as part of a partnership between the Delaware Coastal Programs and Environmental Systems Research Institute, Inc. is nearing completion. This implementation plan is expected to provide the detailed guidance for the effective use of the \$ 115,000 identified in the FY99 budget for the Coastal Zone Act Environmental Indicators program. It will provide the framework and technical assistance necessary to integrate the first phase of the program using existing data.

The project's implementation phase will require the development of an information management system to track and conduct a detailed assessment of the regulatory program. The monitoring of key Environmental Indicators that do not have monitoring programs in place should be initiated. The information system will bring disparate Coastal Zone Environmental Indicator data into a single computer system for data comparisons, display, and analysis. This will enable managers to view relationships between Environmental Indicators and CZA permit offset proposals and identify both potential improvement actions and the expected impact of those actions. It

will allow for evaluation of the efficacy of the Environmental Indicators for decision-making. The resulting system would enable an expedited comprehensive review of projects. It would be capable of queries with other spatially related information to help determine both cumulative impacts and potential opportunities for improvement in the Coastal Zone.

The Geographic Information System (GIS) based Information Management System will expedite project reviews and make environmental information generated by the review of CZA permit offsets available for use in other environmental initiatives. By putting the permit and Environmental Indicator information into a spatial data format in an integrated system where it can be organized, analyzed, and mapped, this tool would enable decision-makers to identify patterns and relationships previously unrecognized. The ease of interpreting and understanding information presented in a visual format would also yield more information and much less conjecture in the decision-making process.

The EITAC views this important effort as a "front loaded" project. It is expected that up-front costs will be most significant when establishing the system. But once in place it will have significantly reduced costs in the maintenance phase.



## Definition of Acronyms

ACOE - U.S. Army Corps of Engineers	NAAQS - National Ambient Air Quality Standards
AIRS – Aerometric Information Retrieval System	NADP - National Acid Deposition Program
AQM – Air Quality Management section of DNREC’s Division of Air and Waste Management	NCC - New Castle County
AQUIRE - AQUatic toxicity Information REtrieval (EPA)	NCDC – National Climatic Data Center
ASTM - American Society for Testing and Materials	NEP - National Estuary Program
BMP - Best management practices	NH4 - Ammonium
CE - ?	NO2 - Nitrous oxide
CO – Carbon monoxide	NO3 - Nitrate
CPUE - Catch per Unit Effort (Fisheries)	NOAA - National Oceanic and Atmospheric Administration
CZ - Coastal Zone	NPDES - National Pollutant Discharge Elimination System
CZA - Delaware Coastal Zone Act	NRCS - Natural Resources Conservation Service
DAWM – Division of Air and Waste Management, DNREC	NWI – National Wetland Inventory
DCP - DNREC's Delaware Coastal Programs	O3 - Ozone
DEDO – Delaware Development Office	ODSC - ?
DelDOT - Delaware Department of Transportation	OSPC – ?
DFW – Division of Fish and Wildlife	PAMS – Photochemical Air Monitoring System
DGS - Delaware Geologic Survey	PM10/PM2.5 – Particulate Matter smaller than 10 microns/2.5 microns
DNHP – Delaware Natural Heritage Program	PSI – Pollutant Standards Index
DNREC - Delaware Department of Natural Resources & Environmental Control	PWSS - Public Water Supply System (DPH)
DO - Dissolved oxygen	QA/QC - Quality Assurance/Quality Control
DPH - Department of Public Health	RMP - ?
DRBC - Delaware River and Bay Commission	SARA – Superfund Act Reauthorization Ammendments
DSW – Division of Soil and Water	SERT - State Emergency Response Team
DWR - Division of Water Resources	SO2 - Sulfur dioxide
EHS – Extremely hazardous substance	SO4 – Sulfate
EI - Environmental Indicator	sp. - Species
EITAC - Environmental Indicators Technical Advisory Committee	spp. - Species (plural)
EJ –Environmental justice	STATSGO - State Soil Geographic Database
EMAP - Environmental Monitoring & Assessment Program	STORET - Storage and Retrieval System, an EPA database for water quality and biological monitoring data
EPA - Environmental Protection Agency	SW - Surface water
EPCRA – Emergency Planning and Community Right-to-Know Act of 1986	SWDS - Surface Water Discharges Section
GIS - Geographic information system	TRI – Toxics Release Inventory
GW - Ground water	U of D – University of Delaware
I.B.I. - Index of biological integrity	USDA - United States Department of Agriculture
LULC - Land-use land cover	USFS – US Forest Service
M.A.I.A. - Mid-Atlantic Integrated Assessment	USFWS – United States Fish and Wildlife Service
MOU - Memorandum of Understanding	USGS - United States Geological Survey
	VAM - ?
	VOC – Volatile organic compounds
	WRPA - Water Resource Protection Area



**Appendix A. Map Portfolio**

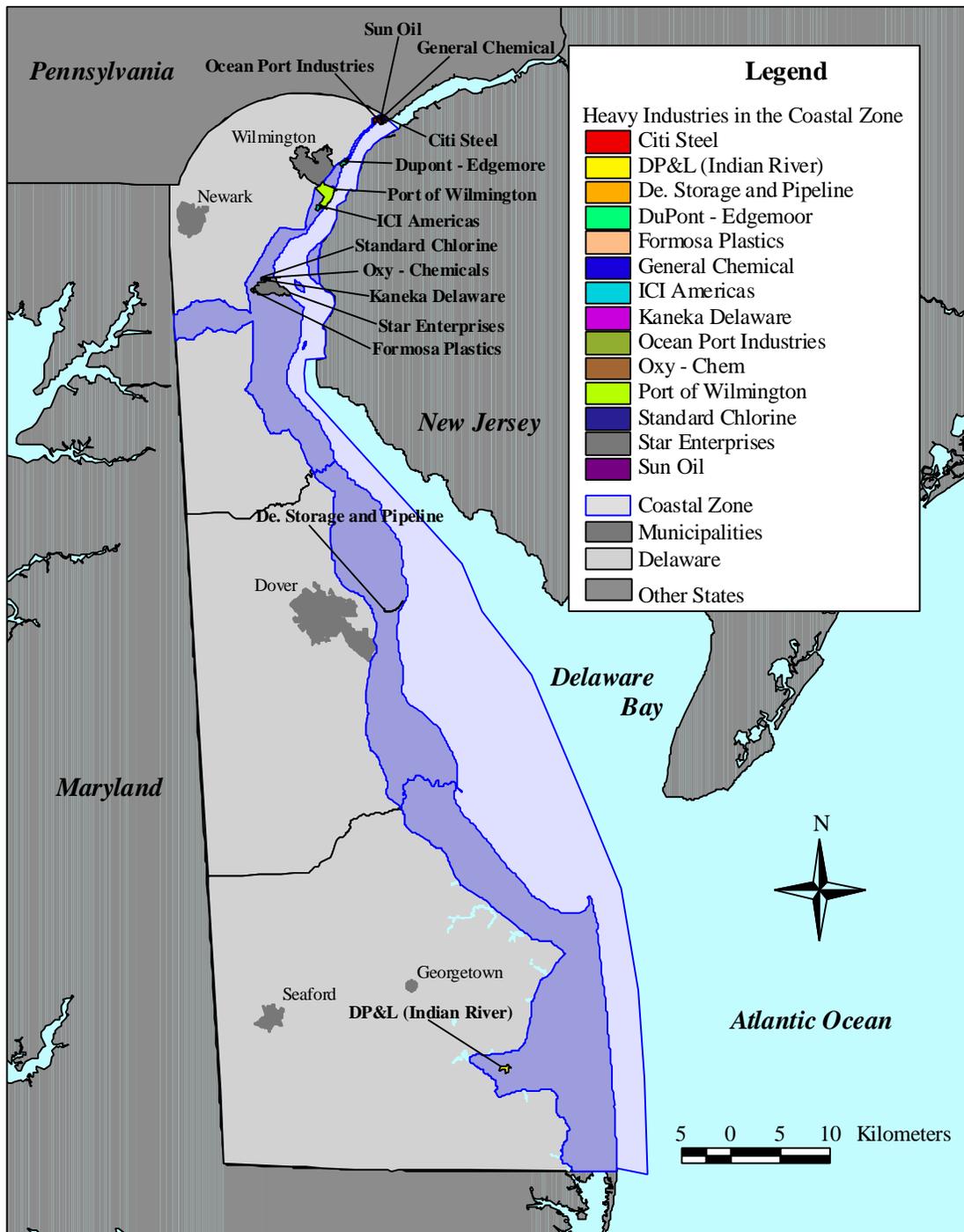


**DELAWARE  
COASTAL ZONE**  
.....  
ENVIRONMENTAL INDICATORS

The following maps represent examples of the types of spatial information currently available for use with the Environmental Indicators program. Additional information exists on most of the features displayed on the maps, as shown in the sample data tables included on a few of the maps.



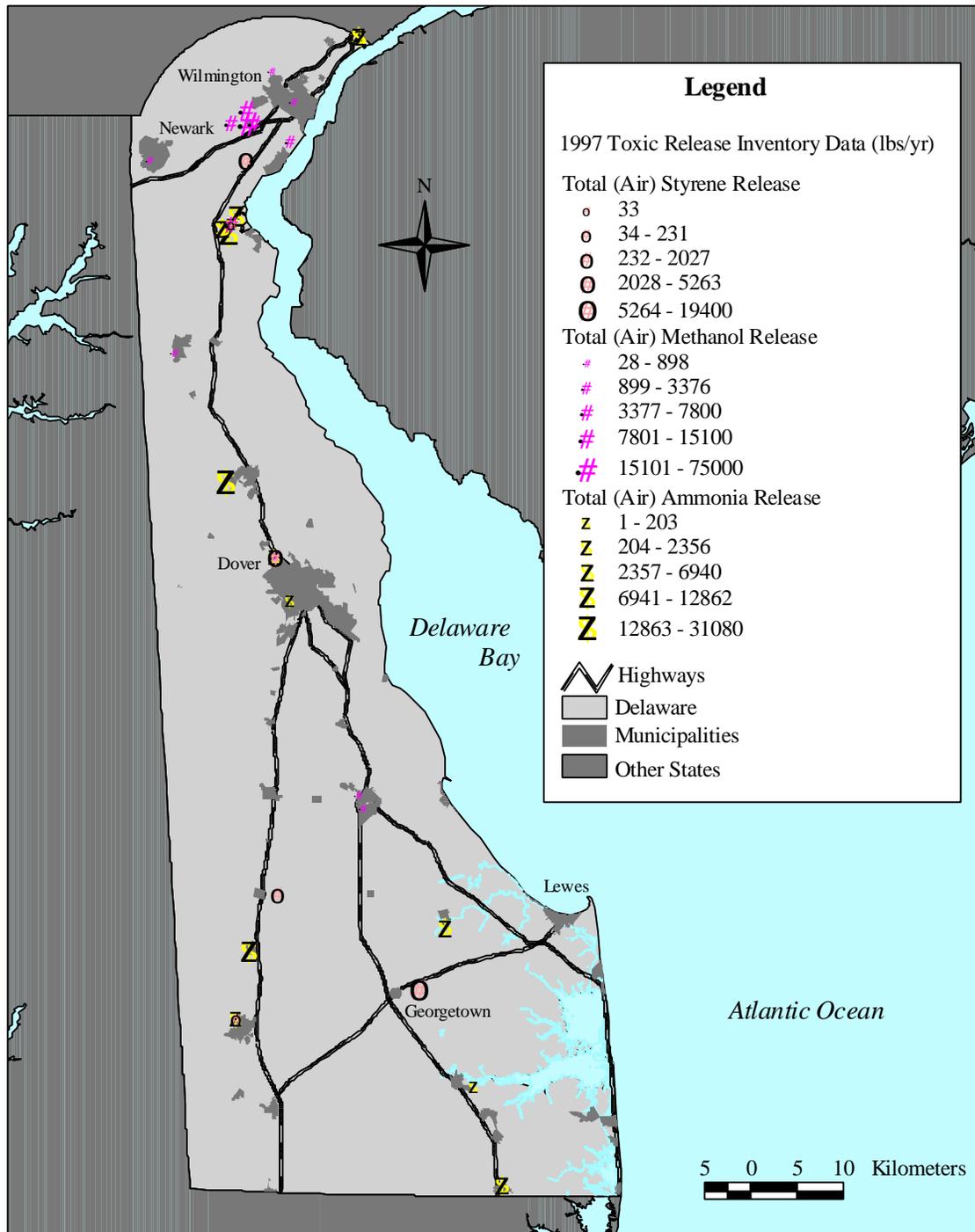
**Plate 1: Heavy Industry in the Coastal Zone**



The Delaware Coastal Programs produced this map for the Coastal Zone Environmental Indicators Technical Advisory Committee. Locations on this map should not be used for detailed analysis.



**Plate 2: Goal - Air Quality**  
**Environmental Indicator - Ambient Air Quality**  
**Parameter - Trends in Polutant Loading Using Toxic Release Inventory (TRI) Data**



The Delaware Coastal Programs produced this map for the Coastal Zone Environmental Indicators Technical Advisory Committee. Locations on this map should not be used for detailed analysis.



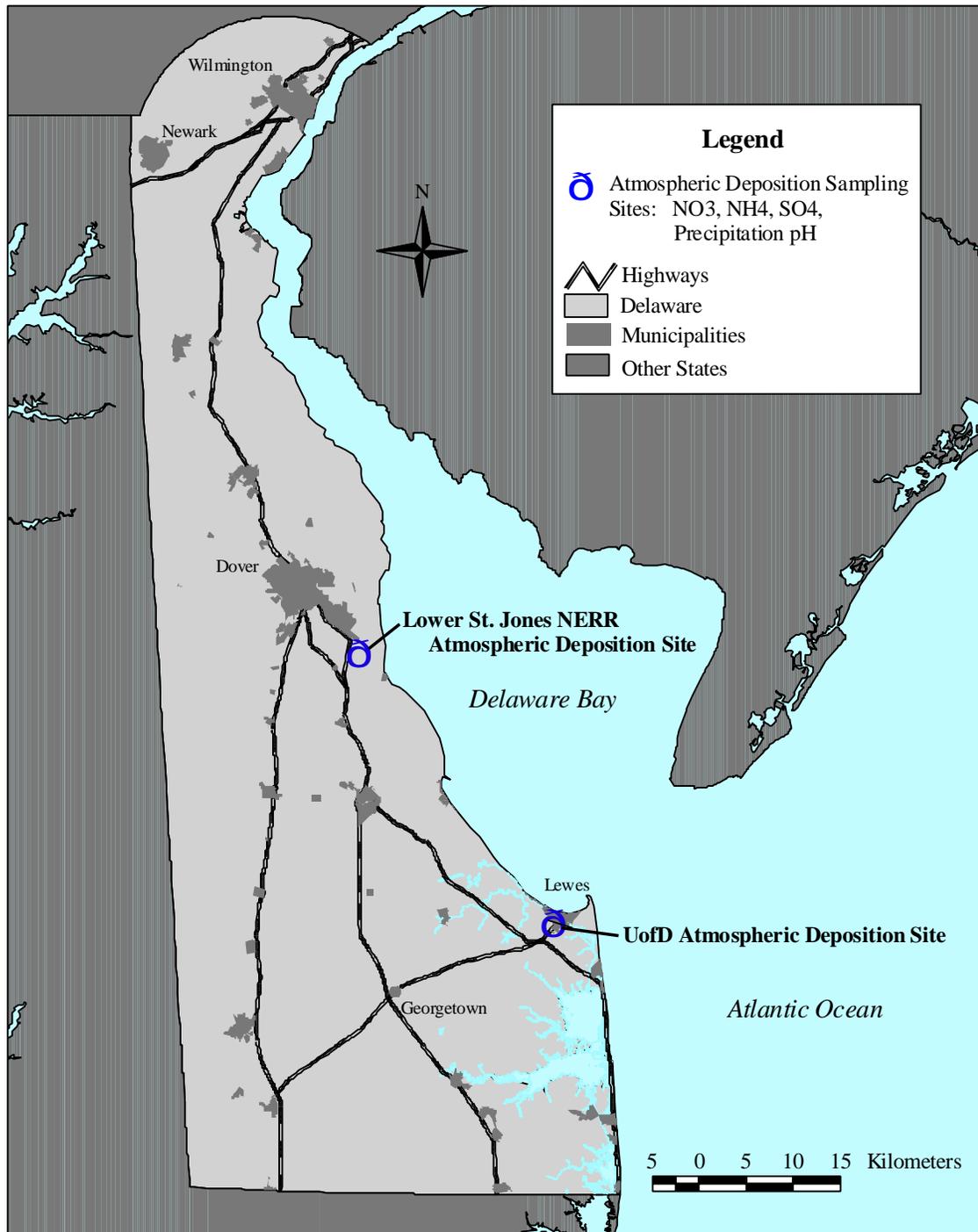
**Plate 3: Goal - Air Quality**  
**Environmental Indicator - Ambient Air Quality**  
**Parameter - Ambient Air Quality (Data Index)**



The Delaware Coastal Programs produced this map for the Coastal Zone Environmental Indicators Technical Advisory Committee. Locations on this map should not be used for detailed analysis.



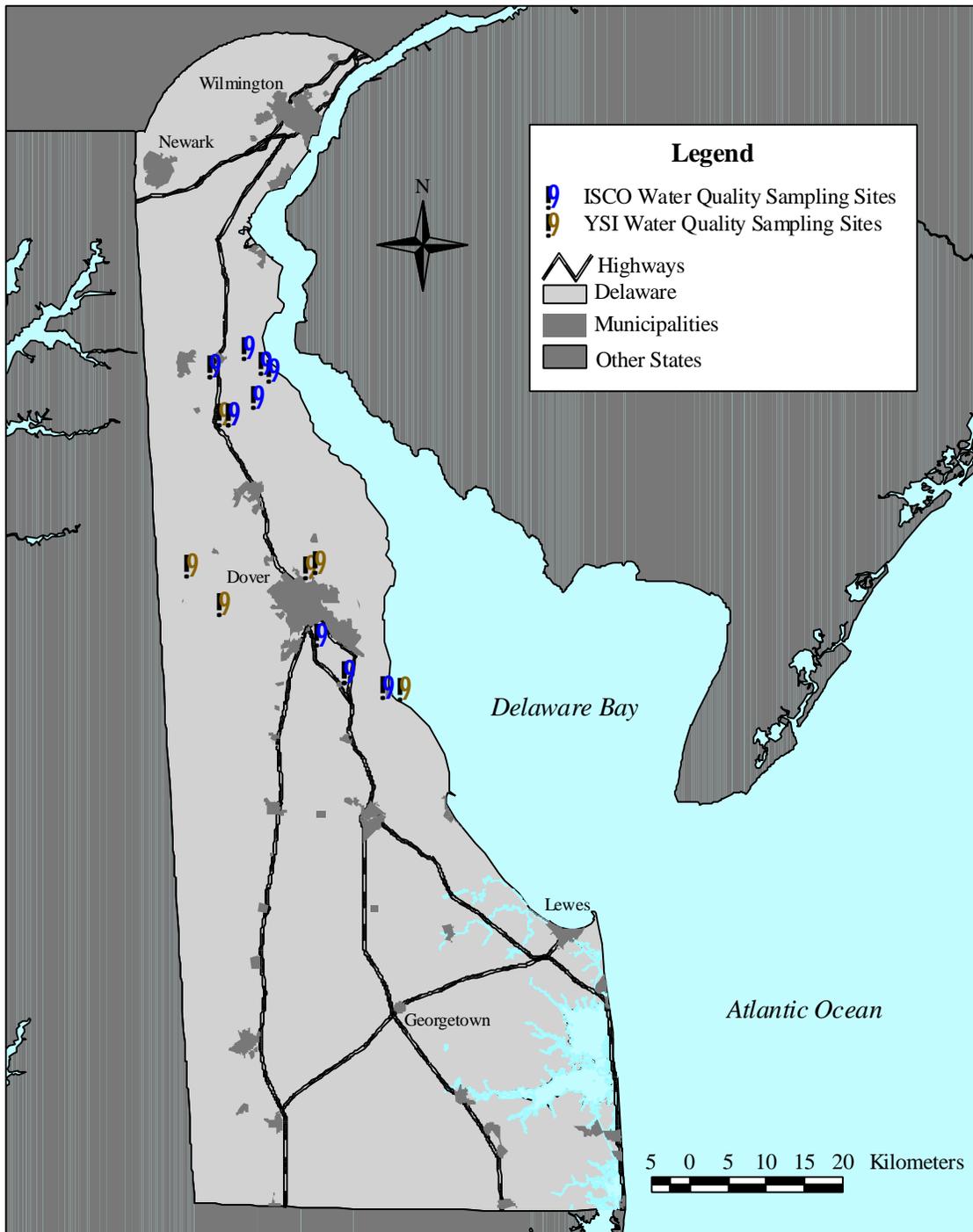
**Plate 4: Goal - Air Quality**  
**Environmental Indicator - Atmospheric Deposition**  
**Parameters - Atmospheric Deposition of NO<sub>3</sub>, NH<sub>4</sub>, SO<sub>4</sub>, Precipitation pH**



The Delaware Coastal Programs produced this map for the Coastal Zone Environmental Indicators Technical Advisory Committee. Locations on this map should not be used for detailed analysis.



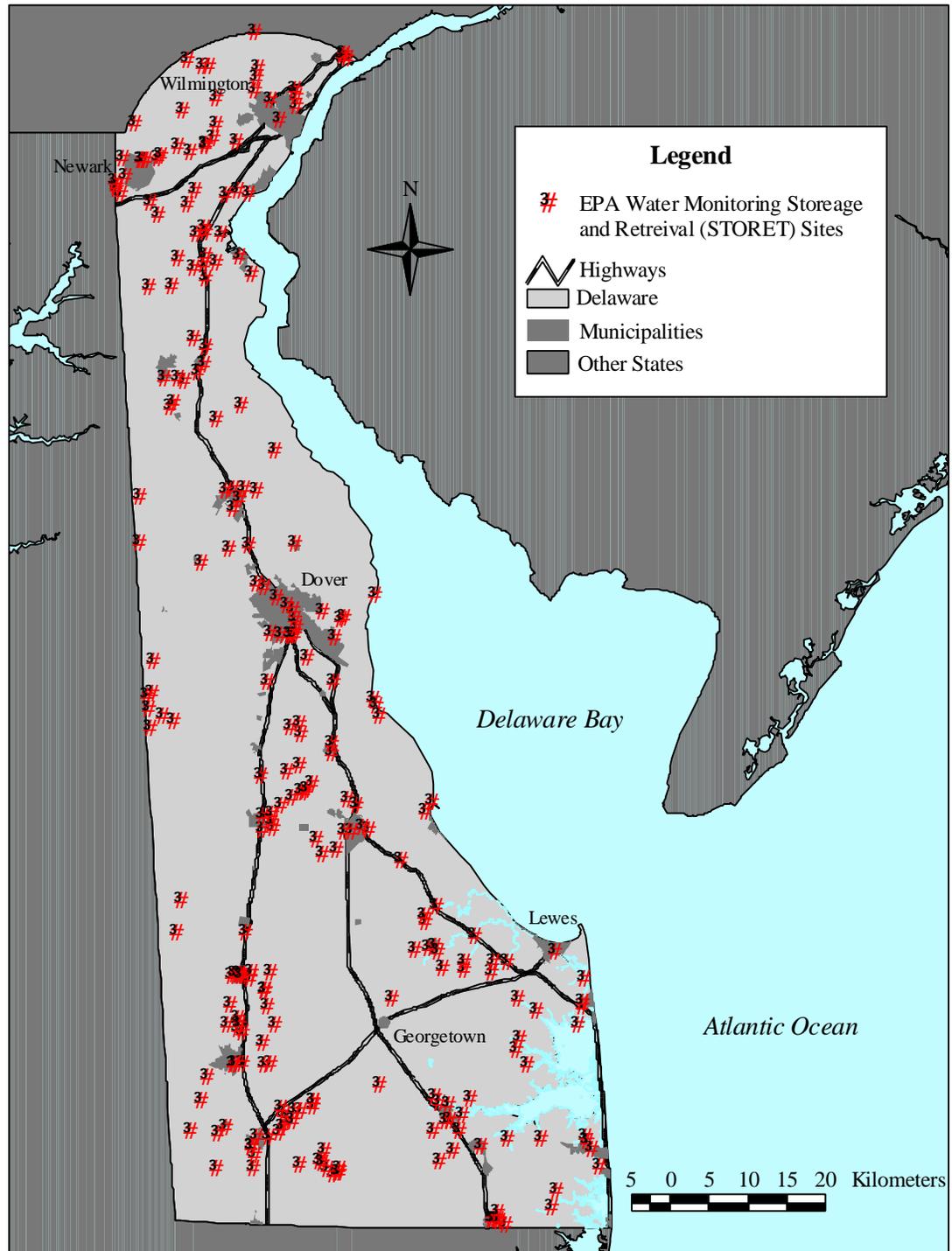
**Plate 5: Goal - Water Quality**  
**Environmental Indicator - Ambient Water Quality**  
**Parameter - Surface Water or Stressor Level**



The Delaware Coastal Programs produced this map for the Coastal Zone Environmental Indicators Technical Advisory Committee. Locations on this map should not be used for detailed analysis.



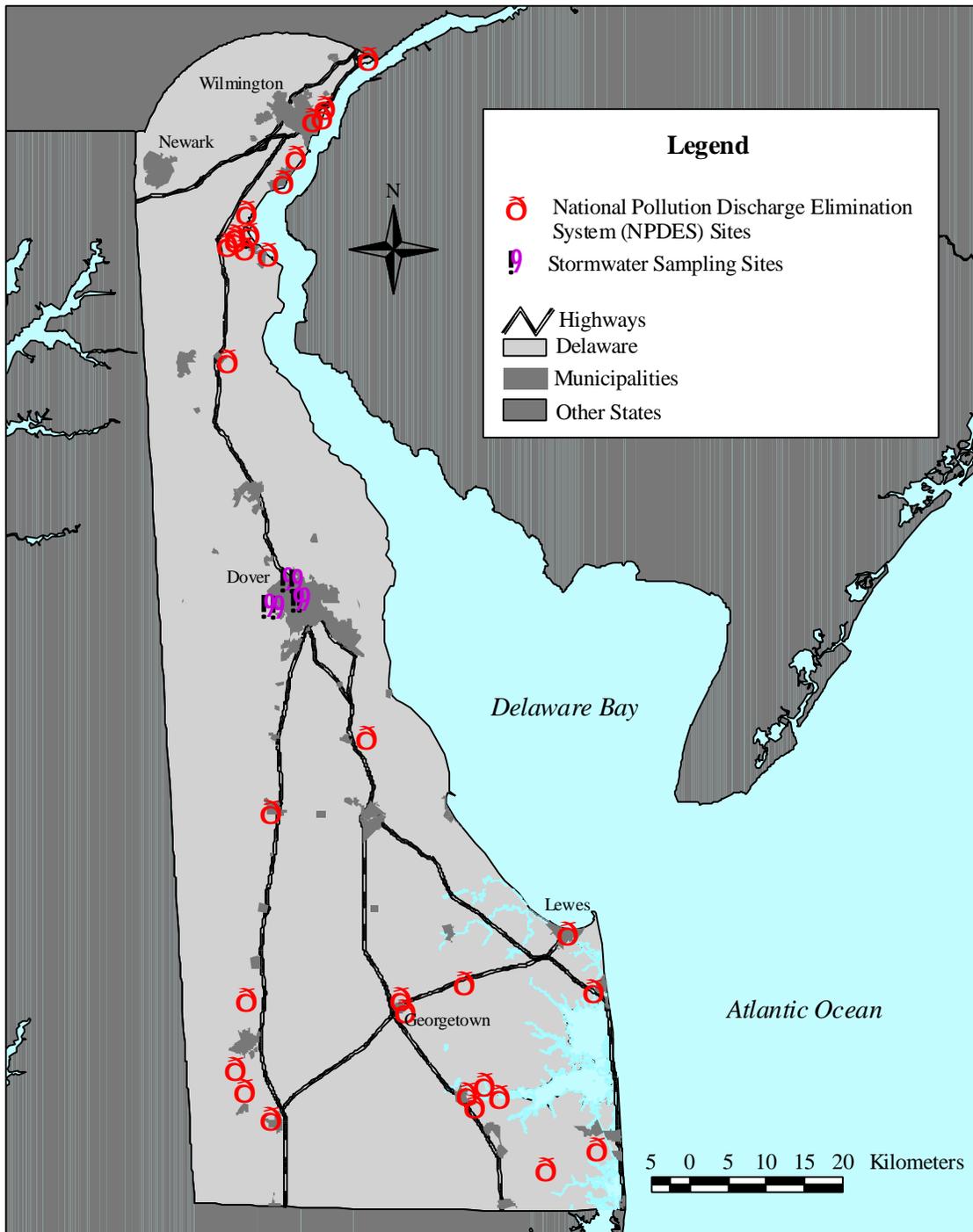
**Plate 6: Goal - Water Quality**  
**Environmental Indicator - Ambient Water Quality**  
**Parameter - Surface Water Pollutants or Stressor Level**



The Delaware Coastal Programs produced this map for the Coastal Zone Environmental Indicators Technical Advisory Committee. Locations on this map should not be used for detailed analysis.



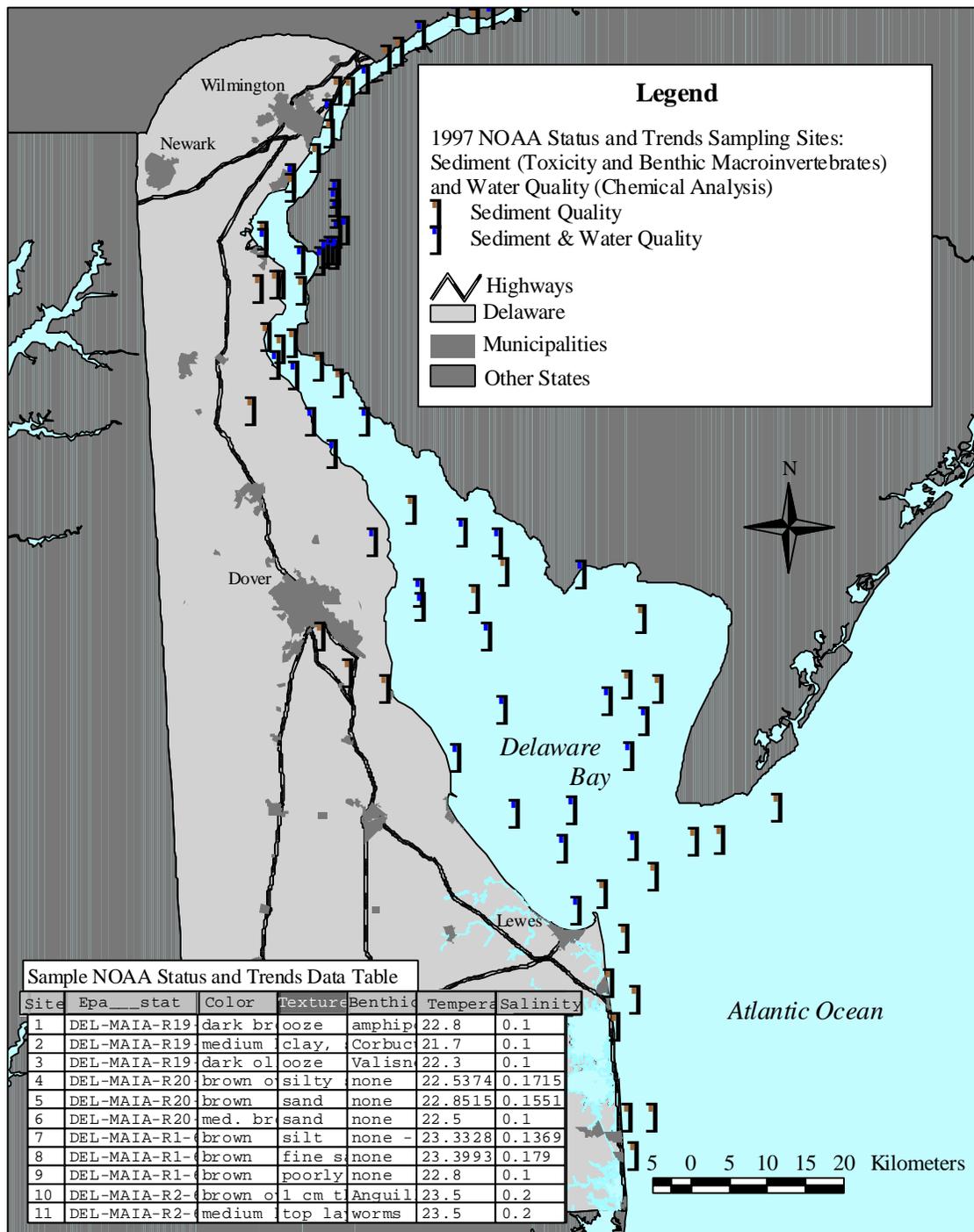
**Plate 7: Goal - Water Quality**  
**Environmental Indicator - Watershed Pollutant Load**  
**Parameters - Discharge Levels from NPDES Sources,**  
**Pollutant Loads by Watershed**



The Delaware Coastal Programs produced this map for the Coastal Zone Environmental Indicators Technical Advisory Committee. Locations on this map should not be used for detailed analysis.



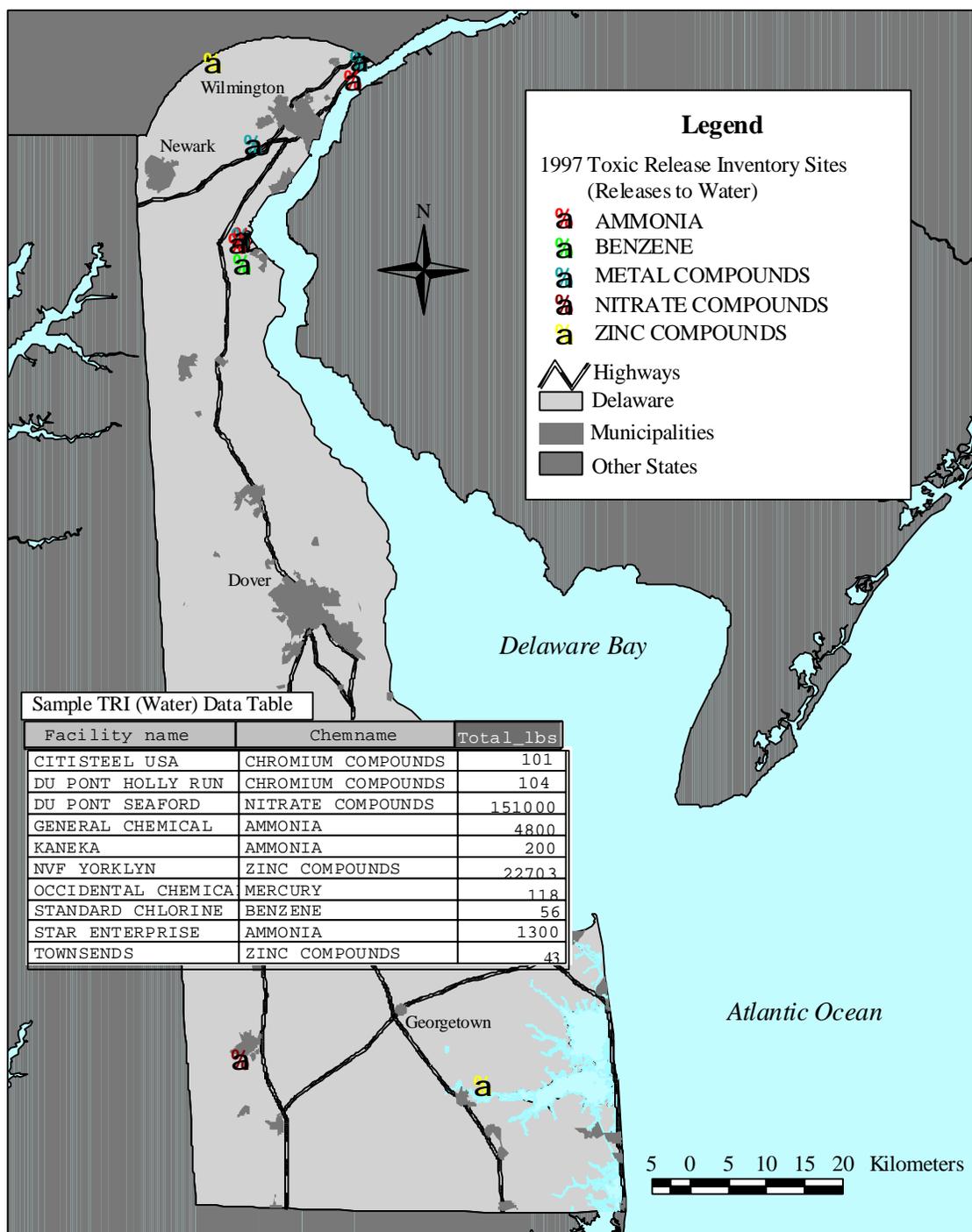
**Plate 8: Goals- Water Quality, Living Resources**  
**Environmental Indicators - Benthic Communities, Ambient Water Quality**  
**Parameters - Benthic Sampling Data, Water Pollutants or Stressor Levels**



The Delaware Coastal Programs produced this map for the Coastal Zone Environmental Indicators Technical Advisory Committee. Locations on this map should not be used for detailed analysis.



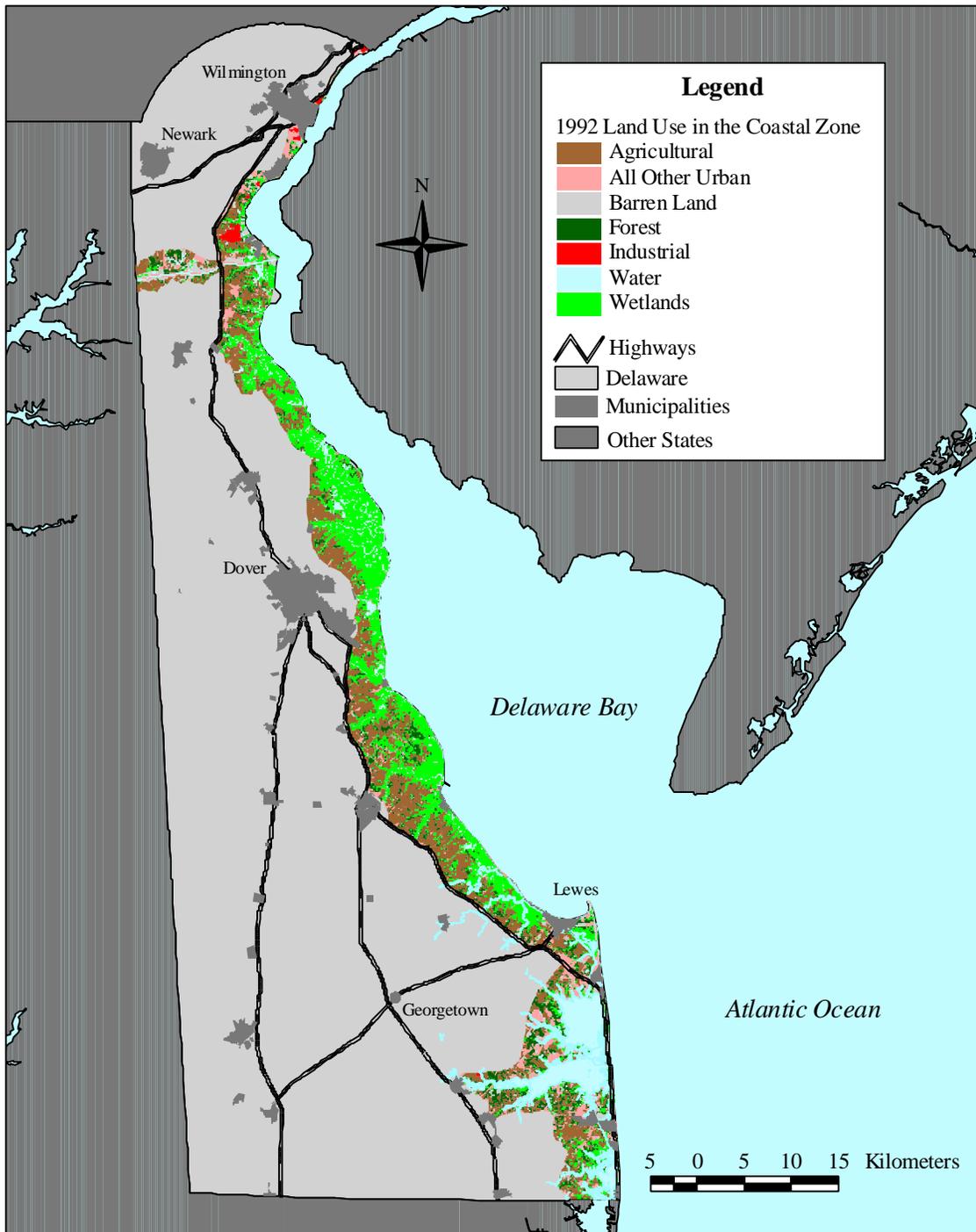
**Plate 9: Goal - Water Quality**  
**Environmental Indicator - Contaminants/Toxicity**  
**Parameter - Trends in Pollutant Loading Using Toxic Release Inventory (TRI) Data**



The Delaware Coastal Programs produced this map for the Coastal Zone Environmental Indicators Technical Advisory Committee. Locations on this map should not be used for detailed analysis.



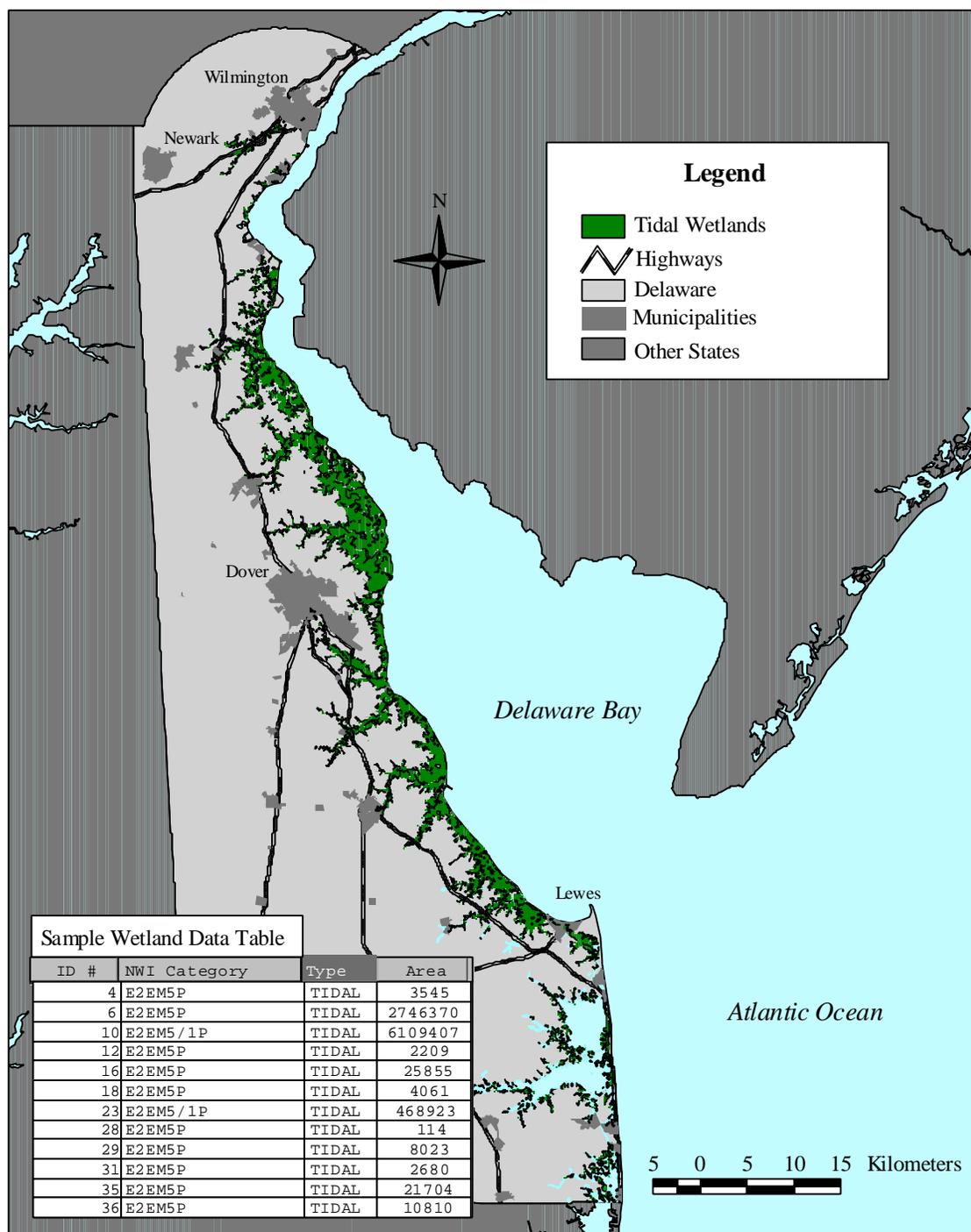
**Plate 10: Goal - Habitat/Land Cover/Aesthetics**  
**Environmental Indicator - Habitat Change**  
**Parameter - Inventory and Trend Analysis of Land Use/Land Cover**



The Delaware Coastal Programs produced this map for the Coastal Zone Environmental Indicators Technical Advisory Committee. Locations on this map should not be used for detailed analysis.



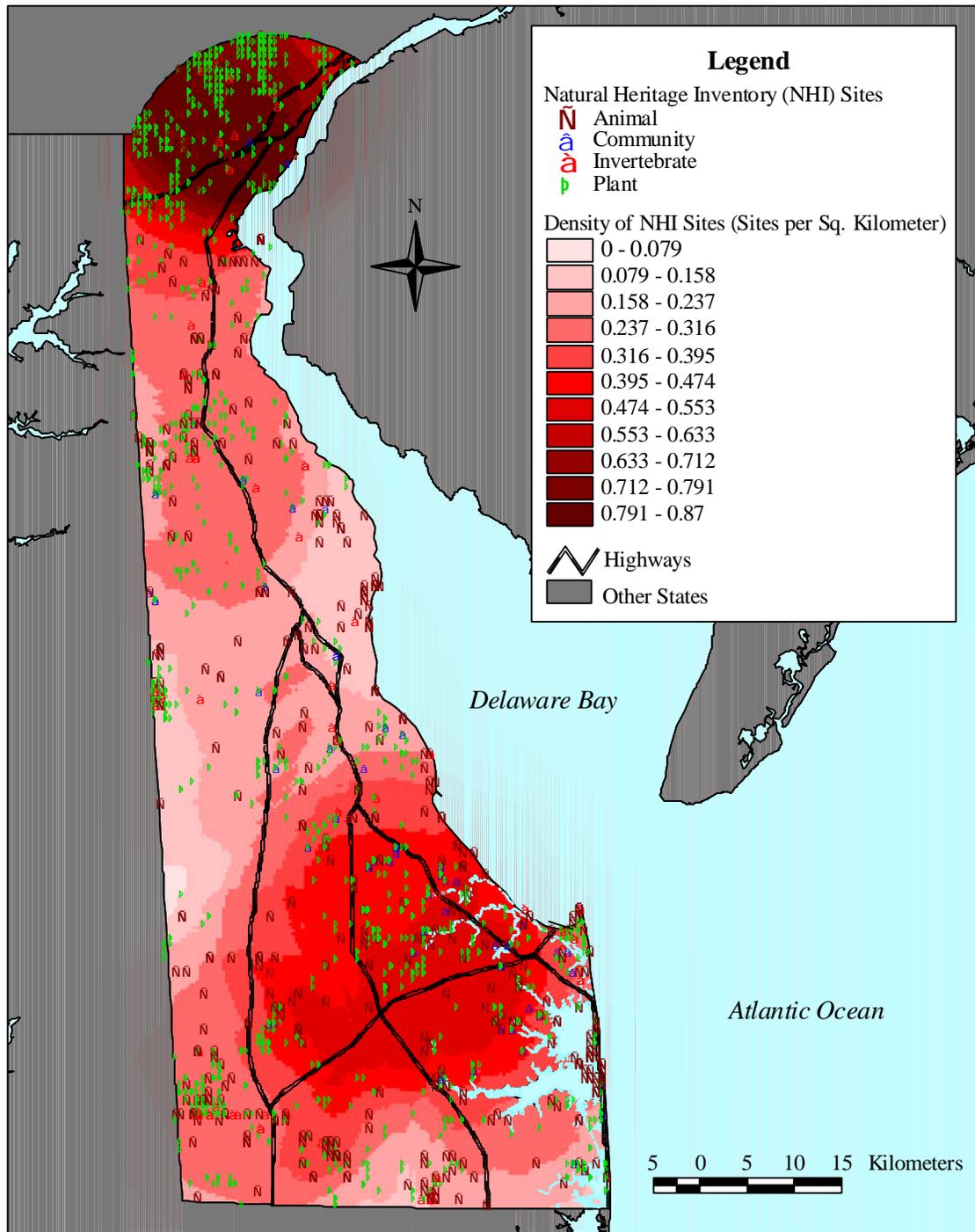
**Plate 11: Goal - Habitat/Land Cover/Aesthetics  
 Environmental Indicator - Habitat Change  
 Parameter - Wetland Inventory**



The Delaware Coastal Programs produced this map for the Coastal Zone Environmental Indicators Technical Advisory Committee. Locations on this map should not be used for detailed analysis.



**Plate 12: Goal - Living Resources**  
**Environmental Indicator - Biodiversity**  
**Parameter - Changes in Populations of Rare and Uncommon Species and Natural Communities in the Coastal Zone**



The Delaware Coastal Programs produced this map for the Coastal Zone Environmental Indicators Technical Advisory Committee. Locations on this map should not be used for detailed analysis.



**Appendix B. Workshop  
Participants**



**DELAWARE  
COASTAL ZONE**  
.....  
ENVIRONMENTAL INDICATORS

The following people attended the workshop at Clayton Hall. The list is organized according to the work group they participated in on January 29, 1999.



The following people attended the workshop at Clayton Hall. The list is organized according to the work group they participated in on January 29, 1999.

**EITAC Steering Committee  
Members visiting all Groups  
for Consistency and Cross  
Referencing of Content**

Dave Carter  
DNREC/DCMP  
89 Kings Hwy.  
Dover, DE 19901  
Phone: 302-739-3451  
Fax: 302-739-2048  
E-Mail: dcarter@dnrec.state.de.us

Richard Fleming  
Private Citizen  
19 Quail Crossing  
Wilmington, DE 19807  
Phone: 302-656-6232  
Fax: 302-656-3769  
E-Mail: rfleming@bigfoot.com

Tom Molin  
Steelworkers  
859 Flemings Landing Road  
Townsend, DE 19734  
Phone: 302-653-4346  
Fax: 302-427-1451  
E-Mail: tommolin@hotmail.com

**Air Quality**

Chris Berlin  
DNREC/DAWM/ERB  
89 Kings Hwy.  
Dover, DE 19901  
Phone: 302-739-3694

Barry Bowers  
ICI Surfactants, Atlas Point  
315 Cherry Lane  
New Castle, DE 19720  
Phone: 302-427-1458  
Fax: 302-427-1451

Susan Brenneman  
DuPont/Edgemoor  
4600 Hay Road  
Edgemoor, DE 19809  
Phone: 302-761-2027  
Fax: 302-761-2357

Deb Brown  
Delaware Chapter of American Lung  
Association  
1021 Gilpin Ave  
Wilmington, DE 19806  
Phone: 302-655-7258

Ken Christian  
ICI Polymers, Inc.

Sarah Cooksey  
DNREC/DCMP  
89 Kings Highway  
Dover, DE 19901  
Phone: 302-739-3451  
Fax: 302-739-2048  
E-Mail: scooksey@dnrec.state.de.us

Allen Denio  
102 Pine Circle  
Newark, DE 19711  
Phone: 302-455-0389

David Fees  
DNREC/DAWM  
89 Kings Highway  
Dover, DE 19901  
Phone: 302-739-4791  
E-Mail: dfees@dnrec.state.de.us

Betsy Frey  
DNREC/DAWM  
715 Grantham Lane  
New Castle, DE 19720  
Phone: 302-323-4542  
E-Mail: bfrey@dnrec.state.de.us

Nina Garfield  
NOAA/Estuarine Reserve Division  
NOAA/SSMC4/NORM2  
1305 East-West Highway, 11th floor  
Silver Spring, MD 20910  
Phone: 301-713-3141 ext. 171  
E-Mail: Nina.Garfield@noaa.gov

Mark Glaze  
DNREC/DAWM  
89 Kings Highway  
Dover, DE 19901  
Phone: 302-739-4791  
E-Mail: [mglaze@dnrec.state.de.us](mailto:mglaze@dnrec.state.de.us)

Glenn Hansen  
Environmental Protection Agency, RIII  
3AP01  
1650 Arch ST  
Philadelphia, PA 19103-2029  
Phone: 215-814-2053  
Fax: 215-814-2101  
E-Mail: [hansen.glenn@epamail.epa.gov](mailto:hansen.glenn@epamail.epa.gov)

Dan Leathers  
University of Delaware  
Geography Department  
216 Pearson Hall  
Newark, DE 19716  
Phone: (302) 831-8764  
Fax: (302) 831-6654  
E-Mail: [leathers@udel.edu](mailto:leathers@udel.edu)  
James R. May  
Widener Univ. School of Law  
4601 Concord Pike  
Wilmington, DE 19803  
Phone: 302-477-2100

Kent Price  
Univ. of DE, College of Marine Studies  
111 Robinson Hall  
Newark, DE 19716-3501  
Phone: 302-645-4256  
E-Mail: [kspice@udel.edu](mailto:kspice@udel.edu)

Robert Scarborough  
DNREC/DCMP  
89 Kings Hwy.  
Dover, DE 19901  
Phone: 302-739-3451  
Fax: 302-739-2048  
E-Mail: [bscarborough@state.de.us](mailto:bscarborough@state.de.us)

Carl Yetter  
DNREC/DCMP  
89 Kings Hwy.  
Dover, DE 19901  
Phone: 302-739-3451  
Fax: 302-739-2048  
E-Mail: [csetter@dnrec.state.de.us](mailto:csetter@dnrec.state.de.us)

## Water Quality

Betsy Archer  
DNREC/DCMP  
89 Kings Hwy.  
Dover, DE 19901  
Phone: 302-739-3451  
E-Mail: [bdarcher@dnrec.state.de.us](mailto:bdarcher@dnrec.state.de.us)

John Barndt  
DNREC/DWR  
89 Kings Highway  
Dover, DE 19901  
Phone: 302-739-4793  
E-Mail: [jbarndt@dnrec.state.de.us](mailto:jbarndt@dnrec.state.de.us)  
Tammy Brant  
Water Resources Agency for NCC

Pablo Clemente-Colon  
UDEL/CMS & NOAA/DESDIS  
Phone: 301-763-8231x168

Judy Denver  
USGS  
1289 Mc D Drive  
Dover, DE 19901  
Phone: 302-734-2506  
Fax: 302-734-2964  
E-Mail: [jmdenver@usgs.gov](mailto:jmdenver@usgs.gov)

Doug Dillon  
U.S. Coast Guard  
Marine Safety Office  
1 Washington Avenue  
Philadelphia, PA 19147-4395  
Phone: 215-271-4870  
Fax: (215)271-4833

Thomas Fikslin  
DRBC  
25 State Police Drive  
P.O. Box 7360  
West Trenton, NJ 08628-0360  
Phone: 609-883-9500 ext. 253  
Fax: (609)883-9522  
E-Mail: [tfikslin@drbc.state.nj.us](mailto:tfikslin@drbc.state.nj.us)

Randy Greer  
DNREC/DSWC  
89 Kings Highway  
Dover, DE 19901  
Phone: 302-739-4411  
E-Mail: [rgreer@dnrec.state.de.us](mailto:rgreer@dnrec.state.de.us)

Jawed Hameedi  
NOAA/ORCA  
N/ORCA22 Room 10225 SSMC4  
1305 East West Hwy  
Silver Spring, MD 20910-3281  
Phone: 301-713-3034 x170  
E-Mail: [Jawed.Hameedi@noaa.gov](mailto:Jawed.Hameedi@noaa.gov)

Peder Hansen  
DNREC/DWR  
89 Kings Highway  
Dover, DE 19901  
Phone: 302-739-5731  
E-Mail: [phansen@dnrec.state.de.us](mailto:phansen@dnrec.state.de.us)

Lyle Jones  
DNREC/DWR/Watershed Assessment  
89 Kings Highway  
Dover, DE 19901  
Phone: 302-739-6375  
E-Mail: [ljones@dnrec.state.de.us](mailto:ljones@dnrec.state.de.us)

Jerry Kauffman  
Water Resources Agency for NCC  
DGS Annex  
University of Delaware  
Newark, DE 19716  
Phone: 302-831-4925

Stewart Kerzner  
Environmental Protection Agency, Office of  
Environmental Data  
3RA1O  
1650 Arch Street  
Phila., PA 19103  
Phone: 215-814-2700  
Fax: 215-814-5718  
[KERZNER.STUART@epamail.epa.gov](mailto:KERZNER.STUART@epamail.epa.gov)

Gerald Llewellyn  
Public Health - DHSS  
Jesse Cooper Building  
P.O. Box 637  
Dover, DE 19903  
Phone: 302-739-6619  
Fax: 302-739-6617  
E-Mail: [Gerald.Llewellyn@DPHHMC@DHSS](mailto:Gerald.Llewellyn@DPHHMC@DHSS)

Alex Parker  
University of Delaware, CMS  
CMS Lewis  
700 Pilot Town Road  
Lewis, DE 19958  
Phone: 302-645-4289  
E-Mail: [parkera@udel.edu](mailto:parkera@udel.edu)  
Bruce Patrick

Kent County Engineering  
414 Federal Street  
Dover, DE 19901  
Phone: 302-736-2101  
Fax: 302-736-2100  
E-Mail: [brucepatrick@hotmail.com](mailto:brucepatrick@hotmail.com)

Fred Pinkney  
USFWS  
177 Admiral Cochrane Drive  
Annapolis, MD 21401  
Phone: 410-573-4519  
Fax: (410)269-0832  
E-Mail: [fredpinkney@mail.fws.gov](mailto:fredpinkney@mail.fws.gov)

Bill Ritter  
University of Delaware  
Townsend Hall Room 058  
Newark, DE 19717  
Phone: 302-831-2468  
Fax: 302-831-3651

Dan Russell  
USFWS - NJFO  
Bldg D-1  
927 N Main Street  
Pleasantville, NJ 08232  
Phone: 609-646-0620  
E-Mail: [Daniel\\_Russell@fws.gov](mailto:Daniel_Russell@fws.gov)

John Schneider  
DNREC/DWR/WAS  
820 Silver Lake Blvd.  
Suite 220  
Dover, DE 19904-2464  
Phone: 302-739-4590  
E-Mail: [Jschneider@state.de.us](mailto:Jschneider@state.de.us)

Victor Singer  
Coastal Zone Industrial Control Board  
1219 Stinsford Road  
Newark, DE 19713  
Phone: 302-366-8768

Mike Sprague  
Diamond State Port Corp.  
PO Box 1191  
Wilmington, DE 19899  
Phone: 302-571-4600  
Fax: 302-571-4646

Linda Stapleford  
Delaware Nature Society  
P.O. Box 700  
Hockessin, DE 19707  
Phone: 302-239-2334 ext 11

Kathy Stiller  
DNREC/DAWM  
Lukens Drive  
New Castle, DE N155  
Phone: 302-395-2500  
E-Mail: kstiller@dnrec.state.de.us

John Gaadt  
Consultant-NCC  
251 Fairville Rd  
Chadds Ford, PA 19417  
Phone: 610-388-7641  
Fax: 610-388-7642  
E-Mail: gaadt@erols.com

## Habitat/Land Cover/Aesthetics

David Baker  
Council of Farm Organizations  
665 Shallcross Lake Road  
Middletown, DE 19709-9440  
Phone: 302-378-3750  
Fax: 302-378-4579

Dennis Brown  
DNREC/Office of the Secretary  
89 Kings Hwy.  
Dover, DE 19901  
Phone: 302-739-6444

Kevin Coyle  
Kent County Dept. of Planning  
414 Federal Street  
Room 320  
Dover, DE 19901  
Phone: 302-736-2020

Tom Culliton  
Special Projects Office, NOS  
N/ORCA2, Building SSMC4, 9th floor  
1305 East West Highway  
Silver Spring, MD 20910-3241  
Phone: 301-713-3000  
E-Mail: Tom.Culliton@noaa.gov

Lonnie Dye  
DNREC/DCMP  
89 Kings Hwy.  
Dover, DE 19901  
Phone: 302-739-3451  
Fax: 302-739-2048  
E-Mail: ldye@dnrec.state.de.us

Lorraine Fleming  
Delaware Nature Society  
P.O. Box 700  
Hockessin, DE 19707  
Phone: 302-239-2334  
Fax: 302-239-2473

James Gorham  
USFWS, Delaware Bay Estuary Program  
2610 Whitehall Neck Road  
Smyrna, DE 19977  
Phone: 302-653-9152  
Fax: 302-653-9421

Victor Klemas  
Univ. of DE, College of Marine Studies  
111 Robinson Hall  
Newark, DE 19716-3501  
Phone: 302-831-8256  
E-Mail: klemas@mingming.cms.udel.edu

Mike Mahaffie  
State Office of Planning & Coordination  
Suite 7/ 3rd Floor Thomas Collins Bldg.  
540 S. DuPont Hwy.  
Dover, DE 19901  
Phone: 302-739-3090

Paul Morrill  
Delaware City - City Hall  
407 Clinton Sreet  
Delaware City, DE 19706  
Phone: 302-834-4573  
Fax: 302-832-5545

William Moyer  
DNREC/DWR  
89 Kings Highway  
Dover, DE 19901  
Phone: 302-739-4691  
E-Mail: bmoyer@dnrec.state.de.us

Ed O'Donnell  
Private Citizen  
103 St. Regis Drive  
Newark, DE 19711  
Phone: 302-737-9091  
Fax: 302-395-5443  
E-Mail: work: 302-395-5425

Paul Petrichenko  
USDA/NRCS  
1201 College Park Dr.  
Dover, DE 19904  
Phone: 302-678-2547

Grace Pierce-Beck  
Delaware Audobon Society  
20 Muirfield Court  
Dover, DE 19904  
Phone: 302-674-5568  
Fax: 302-674-4159

Alex Rittberg  
DNREC/DAWM/Hazardous Waste  
89 Kings Hwy  
Dover, DE 19901  
Phone: 302-739-3689  
E-Mail: Earl.A.Rittberg@AWM@DNREC

Charles Schonder  
DNREC/DCMP  
89 Kings Hwy.  
Dover, DE 19901  
Phone: 302-739-3451  
Fax: 302-739-2048  
E-Mail: cschonder@dnrec.state.de.us

Austin Short  
Delaware Forest Service  
2320 South DuPont Highway  
Dover, DE 19901  
Phone: 302-739-4811

Ron Vickers  
DNREC/DPR  
89 Kings Hwy.  
Dover, DE 19901  
Phone: 302-739-5285

## Living Resources

Greg Breese  
USFWS/DBEP  
2610 Whitehall Neck Road  
Smyrna, DE 19977  
Phone: 302-653-9152 ext. 15  
Fax: 302-653-9421  
E-Mail: gregory\_breese@fws.gov

Lynn Broaddus  
DNREC/DFW  
89 Kings Highway  
Dover, DE 19903  
Phone: 302-653-2882

John Clark  
DNREC/DFW  
89 Kings Hwy.  
Dover, DE 19901  
Phone: 302-739-4782

Tim Goodger  
National Marine Fisheries Service  
904 S. Morris Street  
Oxford, MD 21654  
Phone: 410-226-5771

Tim Goodspeed  
Special Projects Office, NOS  
N/ORCA2, Building SSMC4, 9th floor  
1305 East West Highway  
Silver Spring, MD 20910-3241  
Phone: 301-713-3000 ext. 144  
E-Mail: Tim.Goodspeed@noaa.gov

Gene Hess  
Delaware Museum of Natural History  
P.O. Box 3937  
Wilmington, DE 19807  
Phone: 302-658-9111  
E-Mail: hessgk@delmnh.org

William Jones  
DNREC/Division of Fish & Wildlife  
89 Kings Highway  
Dover, DE 19901  
Phone: 302-739-5297  
E-Mail: bjones@dnrec.state.de.us

Peter Martin  
Delaware Wild Lands  
3 Kwan Dr.  
Georgetown, DE 19937  
Phone: 302-378-2736  
Fax: 302-934-6504  
E-Mail: runners@ce.net

Wendy Myers  
Widener Univ. School of Law  
4601 Concord Pike  
Wilmington, DE 19803  
Phone: 302-477-2100

Moe Nelson  
Special Projects Office, NOS  
N/ORCA2, Building SSMC4, 9th floor  
1305 East West Highway  
Silver Spring, MD 20910-3241  
Phone: 301-713-3000  
E-Mail: Moe.Nelson@noaa.gov

Barnett Rattner  
Patuxent Wildlife Research Center, USGS  
12011 Beach Forest Road  
Laurel, MD 20708-4041  
Phone: 302-497-5671  
Fax: (301)497-5675  
E-Mail: Barnett\_Rattner@USGS.gov

Clyde Roberts  
Waterman  
4 N. Congress Street  
Port Penn, DE 19731  
Phone: 302-834-2421

Jim White  
Delaware Nature Society  
P.O. Box 700  
Hockessin, DE 19707  
Phone: 302-239-2334  
Fax: 302-239-2473

Mark Zankel  
The Nature Conservancy  
University Office Plaza  
260 Chapman Road 201-D  
Newark, DE 19713  
Phone: 302-369-4144  
Fax: (302)369-4143  
E-Mail: mzankel@tnc.org

**Appendix C. Focus Group  
Guidance Document**



**DELAWARE  
COASTAL ZONE**  
.....  
ENVIRONMENTAL INDICATORS

The following section and its attachments are provided as a Guidance for the Focus Groups that will continue the refinement of the Indicators.



## *Delaware Coastal Zone Environmental Indicator Project Focus Group Guidance Document*

The EITAC has identified fourteen preliminary Coastal Zone Environmental Indicators (EIs) and their respective parameters that are likely to comprise the final recommendations to the Delaware Department of Natural Resources and Environmental Control due for submission on March 31, 1999. These fourteen EIs were ranked in priority order for further development. The rankings were as follows:

**Very High** – Immediately form focus group for further refinement, to the extent feasible, for inclusion in March 31 Recommendation Document to DNREC. These focus groups are expected to continue beyond March 31, 1999 and should have most of their work completed by June 30, 1999. (i.e. guidance for monitoring/use starting July 1, 1999)

**High** – Coastal Zone Environmental Indicators and/or parameters shall be described in more detail (i.e. guidance for year-one monitoring plan). These focus groups will be formed as soon as EITAC members and/or Support Team staffing is available to support them. All should be established by July 15, 1999 to ensure all high priority EIs are refined during year one of the implementation of CZA regulations.

**Medium** – Coastal Zone Environmental Indicators and/or parameter may be written-up. EITAC will recommend that DNREC do more work in this EI during 1999.

**Low** – Coastal Zone Environmental Indicators and/or parameter are not likely to be written-up. EITAC will recommended that DNREC consider out-year development of this EI.

Focus groups are being formed for the six (6) very high priority Coastal Zone Environmental Indicators with their respective parameters. These groups will be comprised of individuals from the EITAC, EITAC Support Team, Technical Experts from the January 29 Workshop, and other technical experts as needed. The primary purpose of these groups is to immediately begin the further development/refinement of the very high priority EIs. These are summarized in Attachment B.

## ***Focus Group Responsibilities and Activities***

### ***I. Establish Focus Groups***

Focus groups will be initiated by “Team Leaders” from the EITAC and a staff support person from DNREC’s DCP. The group leaders will be responsible for contacting individuals to participate in focus group work. Upon the first meeting, the team leader may be re-assigned if a technical expert outside the EITAC is interested in championing the effort. Group participants will be flexible, and based on the specific EI or parameter needs. They may range from moderate sized groups by “Environmental Indicator” or may be very focused to include the team leaders and a few experts with specific expertise related to the EI or parameter.

### ***II. Revise Draft Environmental Indicator Descriptions***

The groups will start by building upon the Draft EI Descriptions compiled in the January 29 Workshop Summary Document. The group will provide additional information to more accurately describe the EI or specific parameter. This may include revision and addition of information for the following:

- Indicator Title (Refine if needed to more accurately describe the content of description)
- Indicator Descriptions (A more detailed body of information of about 1-3 pages describing the EI or parameter – This should combine items #3, 5, 6, 7, 11, & 13 of the Draft EI Characterizations into a narrative description section)
- Describe any limitations of EI use (combine #9 & 10 of the Draft EI Characterizations into a narrative description section)
- Identify Historical Data and their availability.

Based on this refinement of the Draft EIs, the focus group will take one of two possible courses dependent upon the availability of the needed information. If data exists, the focus group will develop specific metadata descriptions for the data. If the data does not exist, the focus group will develop a strategy to implement efforts to obtain the information.

### ***III. Development of Metadata for Existing EI Information***

In order to make existing information useful for the Coastal Zone Environmental Indicator Project, it must first be described and evaluated. This process is commonly known as developing metadata. Metadata are needed to provide easy access to critical information about the content, access, and utility of data. This must be completed as the first step for the integration of this information into the Coastal Zone Environmental Indicators GIS based decision support system under development by the Delaware Coastal Programs staff.

A general description of metadata, data documentation standards, and data documentation contents are described below. All focus groups should make every effort to adhere to the standards outlined below and should use the standard template provided in Attachment C for documentation of metadata.

#### *What is Metadata?*

Metadata are “data about data.” They describe the content, quality, condition, and other characteristics of data. Metadata help a person locate and understand data.

The concept of metadata is familiar to most people who deal with spatial and other data intensive issues. A map legend is pure metadata. The legend contains information about the publisher of the map,

the publication data, the type of map, a description of the map, spatial references, the map's scale and its accuracy, among many other things. Metadata are simply that type of descriptive information applied to a digital data file. They are a common set of terms and definitions to use when documenting data.

Effective coastal resource management is data intensive. Data acquisition is a considerable portion of the budget of most coastal resource and environmental management programs. Effective data documentation and management can significantly reduce the financial burden often associated with data acquisition and use. Metadata development is one of the first steps toward realizing these fiscal savings, since it organizes and maintains an organization's investment in data. As personnel change or time passes, information about an organization's data will be lost and the data may lose their value. Later staff and other data end users may have little understanding of the content and uses for a digital data base and may find that they can't trust results generated from these data. Complete metadata description of the content and accuracy of a geospatial and non-spatial data sets will encourage appropriate use of the data, alleviating the need for the purchase of replacement data and maximizing the use of data investments.

Metadata also provide information for cataloging one's data for clearinghouse uses. Applications of GIS often require many layers of data and other information that few organizations can afford to create. Non-spatial environmental data are also often beyond the reach of many organizations that need it to carryout their programmatic missions. Data created by others that is well documented can be readily shared. By making data catalogs, such as this one; organizations can find data to use, seek new partners to share data collection and maintenance efforts, and reduce the duplication of data development efforts.

### ***Data Documentation Standards***

When producing a map, the cartographer must organize all the descriptive information that goes into the map legend in a particular format. Titles are put in a specific place, tic marks are made a certain way, meters may be used instead of feet, and so forth. Metadata standards are simply a common set of terms and definition that describe geospatial and non-spatial data.

The Federal Geographic Data Committee (FGDC) recently adopted content standards for metadata. These standards provide a consistent approach and format for the description of data characteristics. They provide a way for data users to know:

- *What data are available*
- *Whether the data meet specific needs*
- *Where to find the data*
- *How to access the data*

### ***Delaware Coastal Zone Environmental Indicators Data Documentation Contents - A Subset of the FGDC Standard***

The Metadata content described below is a subset of the FGDC metadata content standard. It was developed directly from the FGDC standard. The decision to utilize a subset of the standard was driven by the need to develop a useful data catalog in a reasonable time period that included all data descriptions critical for effective data use for the first phase of implementing the CZA Environmental Indicators. A more expansive content will require a considerable increase in staff resources to attempt to collect a great deal of "data about the data" that would be extremely difficult, and in many cases impossible, to obtain.

The CZA EI data content should include critical information about each data set, grouped into the general categories of General Information, Contact Information, Data Description, Data Quality Information, Source Information, Attribute Information, and Metadata information. Some areas are self explanatory, but others are less obvious. A brief summary of the information included in each of these categories is outlined below.

General Information - This section should provide general information about the data set itself.

- *Data Name* - Provide the name of the data set
- *Edition* - If there is more than one edition of the data set (i.e. data set revised routinely) provide the edition of the data set.
- *Data Location* - Provide the server/pathname/filename or the Uniform Resource Locator (URL)  
example: file://arc3/data/streets
- *Originator* - Name of person and/or agency/organization which developed the data set.
- *Publication Date* - when was the data set published/completed and ready for distribution

Contact Information - This section provides information on who to contact to obtain the data set. All fields are self-explanatory.

Data Description - This section provides pertinent information about the data set.

- *Abstract* - Provide information on the data such as what they contain, point, polygon, line, scale, projection, date of compilation, etc.
- *Purpose* - What purpose were the data developed for? (ex. data developed to provide input to the SWMM model for the Dover Silver Lake project.)
- *Time Period* - What time frame do the data represent? (ex. 1992 Land Use)
- *Theme Keywords* - Provide all keywords which describe the subjects covered by the data set. (ex. wetlands, vegetation, land use, etc.)
- *Place Keywords* - Provide all keywords which describe the location for which the data is available. (ex. Silver Lake Watershed, Dover, Kent County, Delaware)
- *Access Constraints* - What restrictions and/or prerequisites are placed on access to the data? May include costs associated with obtaining data if applicable.
- *Use Constraints* - What are the restrictions and/or prerequisites to the use of the data after access has been granted.

Data Quality Information

- *Attribute Accuracy Report* - Provide an explanation of the accuracy of the identification of the data. Include information on verification testing methods, results of verification tests, etc.
- *Completeness Report* - Provide explanation of any omissions, selection criteria, generalizations, definitions used, and other rules used to derive the data.

Source Information - This section provides information on the ACTUAL SOURCE of the data. For instance if this data were land use information, and the land use was interpreted from aerial photography, this section would provide information on the aerial photography used to create the data set.

- Provide a list of sources and discussion of information contributed by each source to create the data coverage.
- *Source Originator* - Who was the originator of the source data? (ex. Photoscience, USGS, etc.)
- *Publication Date of Source* - What was the date which the source was published? (ex. 1992 aerial photography)
- *Title of Source* - What is the source's title (ex. Orthodigital Map of the Kent Quad, Delaware)
- *Edition* - If several editions of a data source are available, please provide the edition which was used to create the data set.
- *Geospatial Presentation* - Provide the geospatial form which the source data was in. (ex. was the source a map, image, remote sensing image, etc.)
- *Publisher of Source* - Who publishes the source (ex. USGS)

- *Process Description* - Describe what processes were used to create the data coverage. For instance, land use was interpreted using (whatever) method and then hand digitized or free hand drawn on overlay and then scanned into arc/info coverage.
- *Source Contact Person* - The remaining fields in this section provide information on how to obtain the ACTUAL SOURCE DATA and are self explanatory.

Attribute Information - This section provides information on any attributes and codes included in the data set. All fields are self explanatory.

Be sure to include a description of the physical structure of the data including; **sequence of variables**, range of measurements, **units**, resolution, and accuracy (bold items are mandatory). Indicate the field length of each variable or the character used to separate fields (i.e. "comma-delimited"). Indicate any coded variables and list the variable code definitions.

***This information is vital to the use of digital files. Without it, the user may be staring at a meaningless block of numbers with no way to interpret what they mean.***

Metadata Information - This section provides information on metadata creation for this data set. All fields are self explanatory.

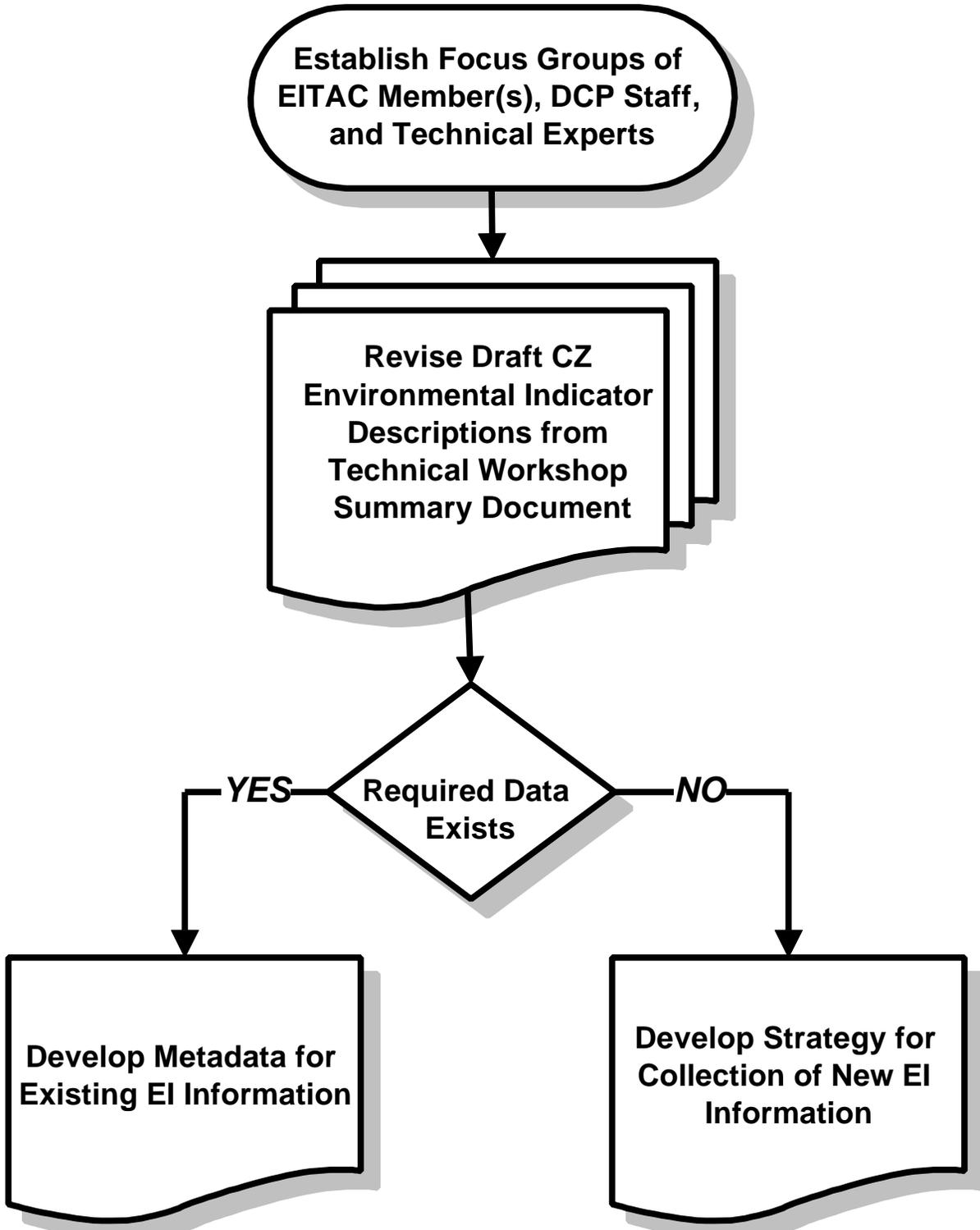
#### ***IV. Develop Strategies to Implement Collection of New EI Information***

*For many of the Coastal Zone Environmental Indicators and their associated parameters, information is not currently collected. Detailed implementation strategies must be developed to provide the work plan to fill these information voids. Doing this will require providing additional information to the refined descriptions completed in Section two of this focus group guidance. Specifically, a detailed strategy must also include:*

- detailed descriptions of the steps/activities that must be taken to implement the collection of the information,
- a description of the institutional roles,
- a listing of the most relevant programs or authorities for implementation,
- an estimation of the implementation cost including start-up and long-term maintenance,
- potential sources of funding for implementation,
- a description of any prerequisites.

A template for strategy development is included in Attachment D.

# ***Delaware CZA Environmental Indicators Diagram of Focus Group Activities***



Attachment A – Summary of Preliminary set of CZA Environmental Indicators

Environmental Indicator Number	Indicator Title	Overlapping Indicators	Priority for completion of Characterization	EITAC members in Focus Group
<b><u>Habitat Change</u></b>				
H/LC/A EI-1	Forest Fragmentation/Loss in the Coastal Zone	LR EI-1	<b>Very High (#1)</b>	Breese
H/LC/A EI-5	Inventory and trend analysis of land use/land cover	LR EI-1		Baker
H/LC/A EI-6	Inventory of wetlands and adjacent land use/land cover impacts	LR EI-1		Morrill O'Donnell
H/LC/A EI-7	Wetlands Inventory	LR EI-1		Pierce-Beck
H/LC/A EI-9	Loss of natural habitat to development in the coastal zone	LR EI-1		
H/LC/A EI-12	Shoreline/riparian habitat loss	LR EI-1		
H/LC/A EI-14	Undisturbed perimeter to wetland areas	LR EI-1		
LR EI-1	Change in habitat types	LR EI-1		
LR EI-14	Amount of vegetative cover in the Coastal Zone	LR EI-1		
WQ EI-6	Percent impervious cover	LR EI-1		
<b><u>Keystone Species</u></b>				
H/LC/A EI-8	Keystone and indicator species	LR EI 6	<b>Very High (#2)</b>	Breese
H/LC/A EI-11	Assessment of the impact of riparian buffers on the coastal zone habitat/land cover	H/LC/A 5		Roberts Cooksey Martin
LR EI-2	Forest age/stability (riparian?)	H/LC/A 5		
LR EI-4	Keystone Indicator Species-Diadromous and Demersal Fish	LR EI 6		
LR EI-5	Keystone Indicator Species-Green Tree frog (Hyla Cinerea)	LR EI 6		
LR EI-6	Indicator Species for health of Coastal Zone	LR EI 6		
LR EI-7	Degradation of habitats by invasive/exotic species	LR EI 7		
LR EI-8	Keystone Indicator Species-Osprey, Herons	LR EI 6		
LR EI-10	Keystone Indicator Species – Migratory shorebirds, horseshoe crabs	LR EI 6		
LR EI-11	Spatial quality of habitats	H/LC/A 5		
LR EI-12	Keystone Indicator Species-Stone corals, Tube Worms	LR EI 6		
LR EI-13	Keystone Indicator Species – Tiger Beetle (Beach dune tiger beetles: Cincidela hirticollis, C. lepida, C. marginata, C. dorsalis)	LR EI 6		
LR EI-15	Coastal Marsh zone selected bird populations	LR EI 6		
LR EI-16	Keystone Indicator Species-ODONATA (dragonflies, damselflies)	LR EI 6		
LR EI-17	Coastal Upland zone selected bird populations	LR EI 6		

Environmental Indicator Number	Indicator Title	Overlapping Indicators	Priority for completion of Characterization	EITAC members in Focus Group
<b><u>Biodiversity</u></b>				
H/LC/A EI-3	GAP Biodiversity Index	LR EI 9	<b>Very High (#3)</b>	Breese
LR EI-9	Changes in populations of rare and uncommon species and natural communities of the Coastal Zone.	LR EI 9		
<b><u>Ambient Air Quality</u></b>				
AQ EI-1	Ambient Air Quality (Data)	AQ EI 1	<b>Very High (#4)</b>	Fleming Ritter
AQ EI-11	Air Emissions from permitted sources	AQ EI 1		
AQ EI-9	Air Emissions from non-permitted sources	AQ EI 1		
H/LC/A EI-13	Trends in pollutant loading using TRI data	AQ EI 1		
<b><u>Wetland Inventory</u></b>				
H/LC/A EI-15	Wetland quality: Invasive species monitoring by aerial photos; Fraction of open water	H/LC/A 7	<b>Very High (#5)</b>	Morrill Baker Pierce-Beck
H/LC/A EI-16	Wetland Type	H/LC/A 7		
H/LC/A EI-17	Wetland Functions and Values	H/LC/A 7		
<b><u>Benthics</u></b>				
LR EI-3	Benthic Sampling Data	LR EI 3	<b>Very High (#6)</b>	Heaton Martin
WQ EI-4	Biological Monitoring for Benthic Diversity (and possibly fish in the future)	LR EI 3		
<b><u>Affected Populations</u></b>				
AQ EI-4	Affected Populations	AQ EI 4	<b>High</b>	
AQ EI-5	Human Health - Consumption Advisories, Beach Closures	AQ EI 4		
AQ EI-6	Plant Health	AQ EI 4		
<b><u>Contaminants/Toxicity</u></b>				
H/LC/A EI-13	Trends in pollutant loading using TRI data	WQ EI 11	<b>High</b>	
WQ EI-5	Sediment Toxicity & Chemistry	WQ EI 11		
WQ EI-8	Prevalence of pathological condition in fish (& shellfish? – question ability to do shellfish).	WQ EI 11		
WQ EI-10	Increase/decrease/death of Flora and/or Fauna and/or interruption of reproductive cycle	WQ EI 11		
WQ EI-11	Contaminant Concentration in Fish & Shellfish	WQ EI 11		
WQ EI-7	Level of a particular pollutant or stressor in a water environment; different sets for ground water & surface water.	WQ EI 7		
<b><u>Ambient Water Quality</u></b>				

Environmental Indicator Number	Indicator Title	Overlapping Indicators	Priority for completion of Characterization	EITAC members in Focus Group
<b><u>Watershed Loading</u></b>				
WQ EI-1	Point Source Pollutant Loads by Watershed	WQ EI 9	<b>High</b>	Fleming
WQ EI-2	Discharge levels from all NPDES sources by parameter	WQ EI 9		
WQ EI-9	Watershed pollutant loads from runoff & base flow	WQ EI 9		
<b><u>Accidental Releases</u></b>				
AQ EI-7	Accidental release occurrence by quantities & substances overtime-Low volume & high risk, High volume & low risk, High volume & high risk	AQ EI 8	<b>Medium</b>	
AQ EI 8	Potential impact of accidental releases	AQ EI 8		
<b><u>Atmospheric Deposition</u></b>				
AQ EI-10	Atmospheric Deposition of NO <sub>3</sub> , NH <sub>4</sub> , SO <sub>4</sub> , & pH	AQ EI 10	<b>Medium</b>	
<b><u>Nonpoint Source Nutrient Mass Balance</u></b>				
H/LC/A EI-10	Annual Nonpoint Source Nutrient Mass Balance Review	H/LC/A 10	<b>Low</b>	
<b><u>Trends in Contaminated (Hazmat) Areas</u></b>				
H/LC/A EI-4	Trends in the area of land known to be contaminated with hazardous substances.	H/LC/A 4	<b>Low</b>	
<b><u>Tools for Indicators</u></b>				
AQ EI-2	Real-time meteorological network availability			
AQ EI-3	Results of Airshed Modeling			
AQ EI-7	Accidental release occurrence by quantities & substances overtime-Low volume & high risk, High volume & low risk, High volume & high risk			
H/LC/A EI-2	Analysis of state/regional and local Comprehensive Plans			
WQ EI-3	Dose-response data			

Attachment B – Summary of Very High Priority CZA Environmental Indicators

*Habitat Change*

- Forest Fragmentation/Loss in the Coastal Zone
- Inventory and trend analysis of land use/land cover
- Inventory of wetlands and adjacent land use/land cover impacts
- Wetlands Inventory
- Loss of natural habitat to development in the coastal zone
- Shoreline/riparian habitat loss
- Undisturbed perimeter to wetland areas
- Change in habitat types
- Amount of vegetative cover in the Coastal Zone
- Percent impervious cover

*Keystone Species*

- Keystone and indicator species (7 specific proposed & characterized at Jan. 29 workshop-others needed)
- Assessment of the impact of riparian buffers on the coastal zone habitat/land cover
- Forest age/stability (riparian?)
- Indicator Species for health of Coastal Zone
- Degradation of habitats by invasive/exotic species
- Spatial quality of habitats
- Coastal Marsh zone selected bird populations
- Coastal Upland zone selected bird populations

*Biodiversity*

- GAP Biodiversity Index
- Changes in populations of rare and uncommon species and natural communities of the Coastal Zone.

*Ambient Air Quality*

- Ambient Air Quality (Data)
- Air Emissions from permitted sources
- Air Emissions from non-permitted sources
- Trends in pollutant loading using TRI data

*Wetland Inventory*

- Wetland quality: Invasive species monitoring by aerial photos; Fraction of open water
- Wetland Type
- Wetland Functions and Values

*Benthics*

- Benthic Sampling Data
- Biological Monitoring for Benthic Diversity (and possibly fish in the future)

## ***Attachment C - METADATA FORM***

### ***GENERAL INFORMATION***

Data Name: \_\_\_\_\_

Edition: \_\_\_\_\_

Data Location (ex. file//....): \_\_\_\_\_

Originator: \_\_\_\_\_

Publication Date: \_\_\_\_\_

Geospatial Presentation (ex. map, image, remote sensing image, etc.):

\_\_\_\_\_

### ***CONTACT INFORMATION***

Contact Person: \_\_\_\_\_

Contact Organization: \_\_\_\_\_

Contact Mailing Address: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Voice Telephone: \_\_\_\_\_

Facsimile Number: \_\_\_\_\_

Electronic Mail address: \_\_\_\_\_

***DATA DESCRIPTION***

Abstract (Provide information on the data such as point, polygon, line, scale, projection, date of compilation, etc.):

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Purpose: \_\_\_\_\_

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Time Period: \_\_\_\_\_

Theme Keywords (subjects covered by data set ex. wetlands, vegetation, land use, etc.):

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Place Keywords (geographic location ex. Kent County, Blackbird Creek watershed, etc.):

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Access Constraints (what restrictions and/or prerequisites are placed on access to the data):

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Use Constraints (what are the restrictions and/or prerequisites to the use of the data after access is granted):

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***DATA QUALITY INFORMATION***

Attribute Accuracy Report - Provide an explanation of the accuracy of the identification of the data:

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Completeness Report - Provide explanation of any omissions, selection criteria, generalization, definitions used and other rules used to derive the data: \_\_\_\_\_

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***SOURCE INFORMATION***

Provide a list of sources and discussion of information contributed by each source to create the data coverage:

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Source Originator (ex. USGS, etc.): \_\_\_\_\_

Publication Date of Source: \_\_\_\_\_

Title of Source (ex. Orthodigital maps, etc.): \_\_\_\_\_

Edition: \_\_\_\_\_

Geospatial Presentation of source: \_\_\_\_\_

Publisher of Source: \_\_\_\_\_

Process Description - what processes were used to create data coverage using this source:

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Source Contact Person: \_\_\_\_\_

Address of Source Contact: \_\_\_\_\_

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Voice Telephone: \_\_\_\_\_

Facsimile Number: \_\_\_\_\_

Electronic Mail Address: \_\_\_\_\_

***ATTRIBUTE INFORMATION***

List of attributes and associated codes:

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Data unit (ex. permit, sample, etc.):

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Coverage type (ex. point, polygon, or line):

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Data Organization (ex. watershed, quad sheet, county, etc.):

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If point coverage, are latitude and longitude values provided for data:

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If polygon or line coverage, is a graphical digital file available:

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Geographic Extent (ex. statewide, county, watershed, etc.):

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***METADATA INFORMATION***

Date Metadata was prepared: \_\_\_\_\_

Name of Metadata generator: \_\_\_\_\_

Contact for Metadata:	_____
Address:	_____
	_____
	_____
Voice Telephone:	_____
Facsimile Number:	_____
Electronic Mail address:	_____
Metadata Standard Used:	_____

***Attachment D***

*Delaware CZA Environmental Indicator  
Implementation Strategy Template*

Please use the back of the pages for additional space.

**(1) Indicator Title:**

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**(2) Authors:**

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**(3) Indicator Description (May also reference previously refined description):**

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**(6) Most Relevant Existing Programs/Authorities:**

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**(7) Cost Estimate:**

One time Cost: Capitol \$ \_\_\_\_\_

Labor \$ \_\_\_\_\_

Details:

Annual Cost: Operations and Maintenance \$ \_\_\_\_\_

Details:

**(8) Potential Sources of Funding:**

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**(9) Project Prerequisites:**

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Forms should be completed and given to Focus Group leaders. Completed forms may also be sent directly to:

*Carl Yetter or Dave Carter  
DNREC - Delaware Coastal Programs  
89 Kings Hwy.  
Dover, DE 19901*

*302-739-3451 phone  
302-739-2048 fax*