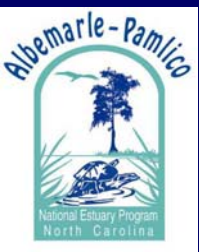




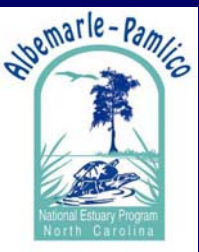
APNEP Terrestrial Resources Monitoring Workshop

- Develop a **monitoring strategy** for Terrestrial Resource metrics within the APNEP region
- Regional ecosystem **test** module
- Metric-specific monitoring **proposals**



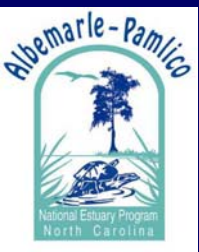
APNEP Background

- APNEP staff adopt indicators/metrics in December 2007
- Plan in 2008-2009 to develop an integrated monitoring strategy for those indicators
- In concert with APNEP revising its Comprehensive Conservation & Management Plan (CCMP) in 2009
- "Living Aquatic Resources" goal first, monitoring design development address LAR indicators first



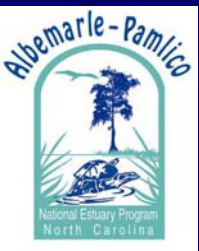
Terrestrial Resources Monitoring Workshop Invitees

- **APNEP**
- NC-DCM
- **NC-DFR**
- NC-DLR
- **NC-DPR**
- **NC-EEP**
- **NC-DOT**
- NC-WRC
- ACE
- **EPA**
- **FS**
- FWS
- **NPS**
- NRCS
- **USGS**
- **STAC**



Ecosystem-Based Management

- Tenet: EBM improves natural resource management by forging more effective political connections among humans, nature, science, and government.*
- Alternative terminology: Landscape-Based Management



*Cortner & Moote. 1999. The Politics of Ecosystem Management. Page 1.

Information to Evaluate Natural Resource Policy

- Evaluation of the impact of conservation policy intervention lags other policy fields
- Paucity of data on the response of the species to which the intervention is targeted
- Poor understanding of the cost effectiveness of the relevant policy instruments
- Reduced opportunities for policy improvement
- Exposure of policy to criticism

APNEP Accepts Challenge?

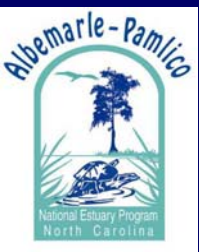
- How can today's operational systems for monitoring and reporting on environmental and social conditions be **integrated** or extended to provide more useful guidance for efforts to navigate a transition toward sustainability?
- How can today's relatively independent activities of research planning, monitoring, assessment, and decision support be better **integrated** into systems for adaptive management and societal learning?



Source: Kates et al. 2000. Sustainability science. Science 292(5517):641-642.

APNEP Ecosystem Assessment

- **Who** will contribute?
 - APNEP federal, state, local partners
- **What** will the assessment contain?
 - Timely technical information within a decision support system to help answer seven policy-based questions: magnitude, extent, trend, cause, source, risk, and solutions
- **When** is the target date for the DSS?
 - ASAP! Last assessment was 1991



APNEP Ecosystem Assessment

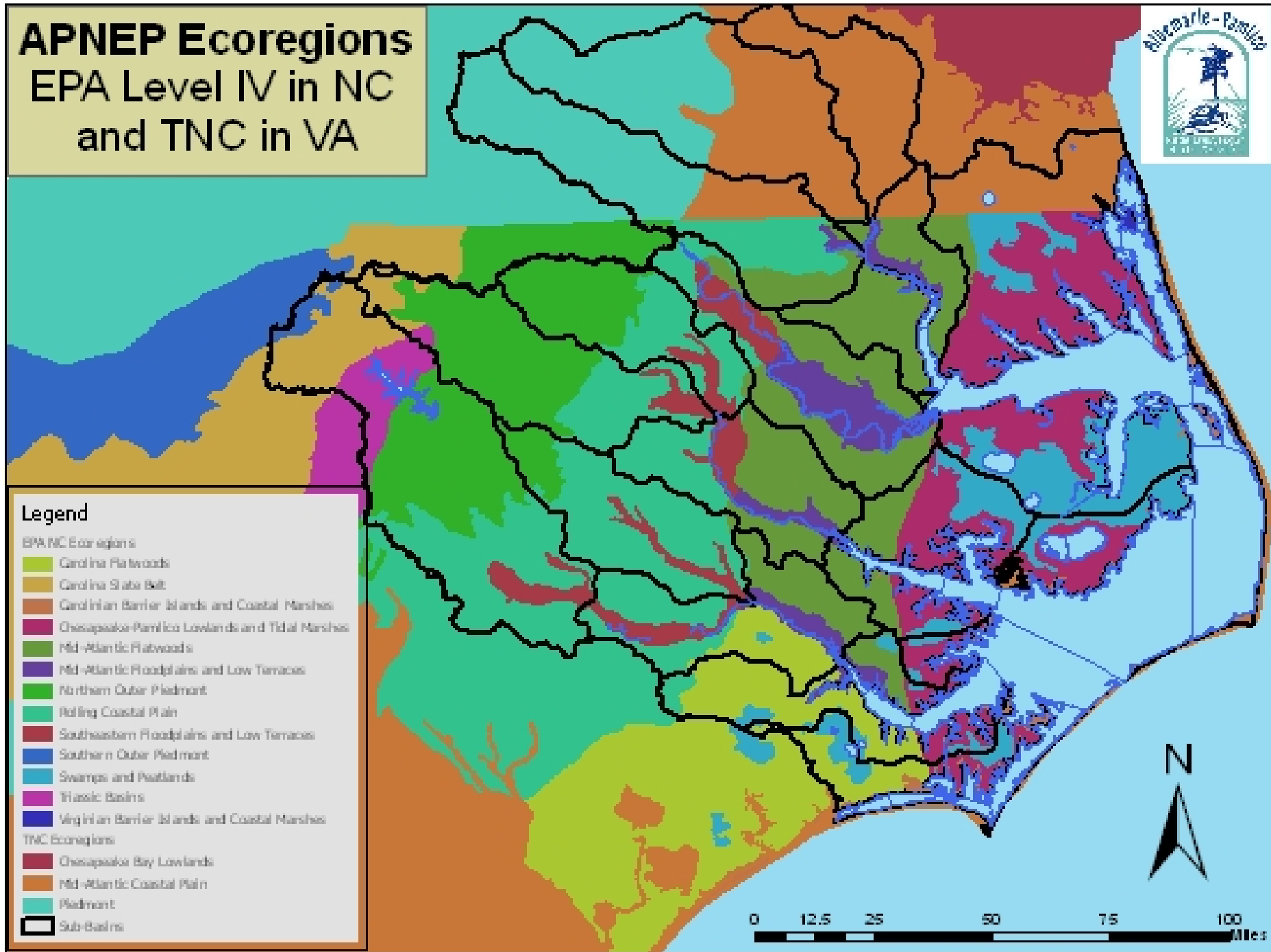
- **Where** are the areas to be assessed?
 - Region and sub-regions
- **Why** will the assessment be developed?
 - To support the APNEP-CCMP, NC-CHPP, NC/VA basinwide planning
 - To evaluate restoration success, APNEP must have a reliable pre-restoration baseline for ecosystem condition
- **How** will the assessment be constructed?
 - Plan and implement a regional ecosystem assessment infrastructure. The “engine” of this infrastructure would be a long-term ambient monitoring program.



Spatial Assessment Continuum

- 
- Global
 - Sub Global: North America
 - Regional: South Atlantic Large Marine Ecosystem
 - Basin: APES
 - Watershed
 - Local

APNEP Ecoregions EPA Level IV in NC and TNC in VA



Legend

- EPA NC Ecoregions**
- Carolina Plateaus
 - Carolina State Belt
 - Carolinian Barrier Islands and Coastal Marshes
 - Chesapeake-Pamlico Lowlands and Tidal Marshes
 - Mid-Atlantic Plateaus
 - Mid-Atlantic Floodplains and Low Terraces
 - Northern Outer Piedmont
 - Rolling Coastal Plain
 - Southeastern Floodplains and Low Terraces
 - Southern Outer Piedmont
 - Swamps and Pastlands
 - Triassic Basins
 - Virginian Barrier Islands and Coastal Marshes
- TNC Ecoregions**
- Chesapeake Bay Lowlands
 - Mid-Atlantic Coastal Plain
 - Piedmont
 - Sub-Basins



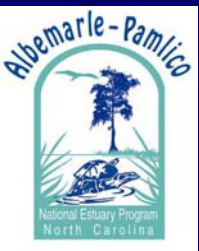
Temporal Assessment Continuum

- 
- Century
 - Decade
 - Annual
 - Monthly
 - Daily



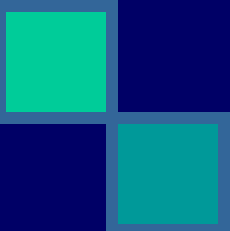
Governance Assessment Continuum

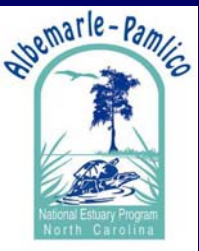
- Global
- National
- Regional: North Carolina and Virginia
- State
- County
- Municipalities





Ecosystem Science

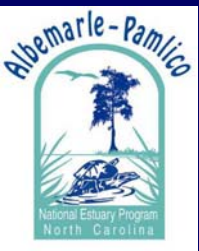
- 
- Tenet: Integrated and comprehensive nature of ecosystem science is critical to ecosystem management at the landscape scale.



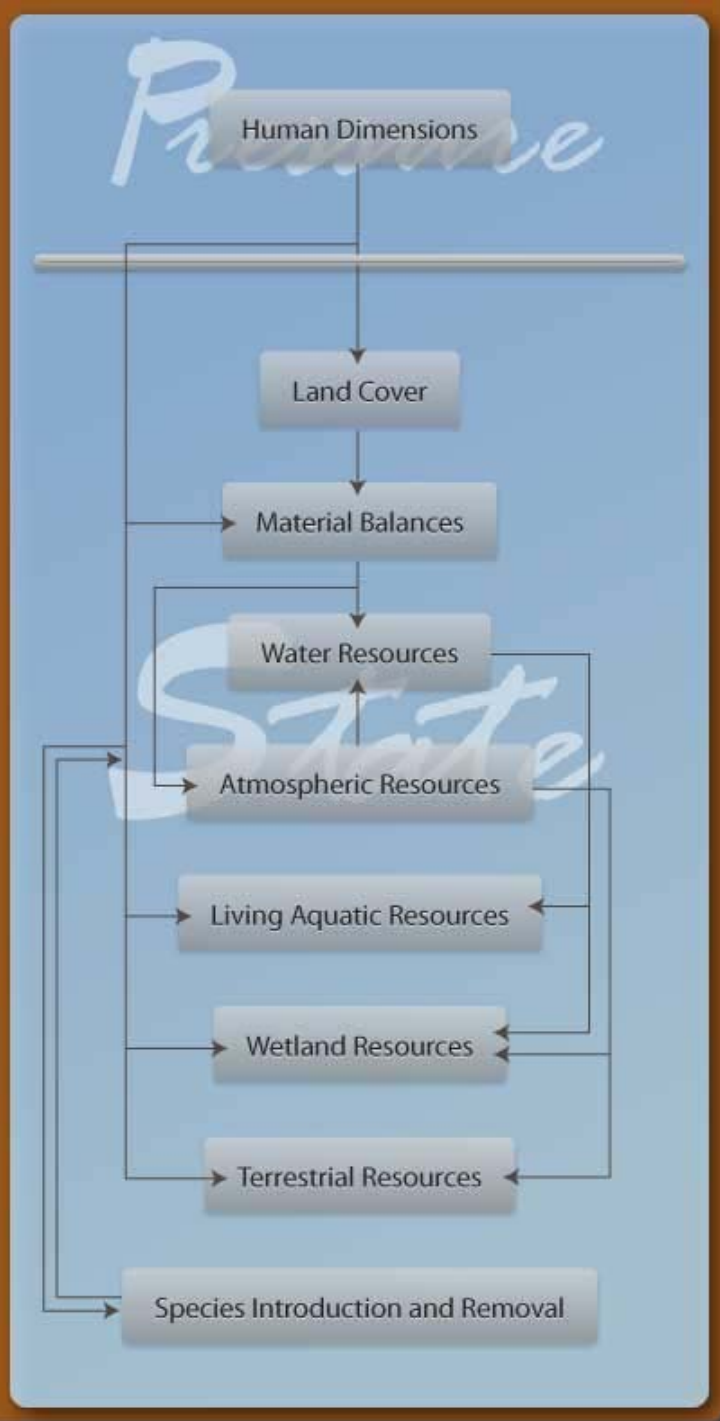
Cortner & Moots. 1999. The Politics of Ecosystem Management.
Page 25.

EPA Indicator Development for Estuaries

- Program Planning
- Conceptual Model Development
- Indicator Specification
- Monitoring Program Development
- Implementation
- Reassessment



Regional Ecosystem Model



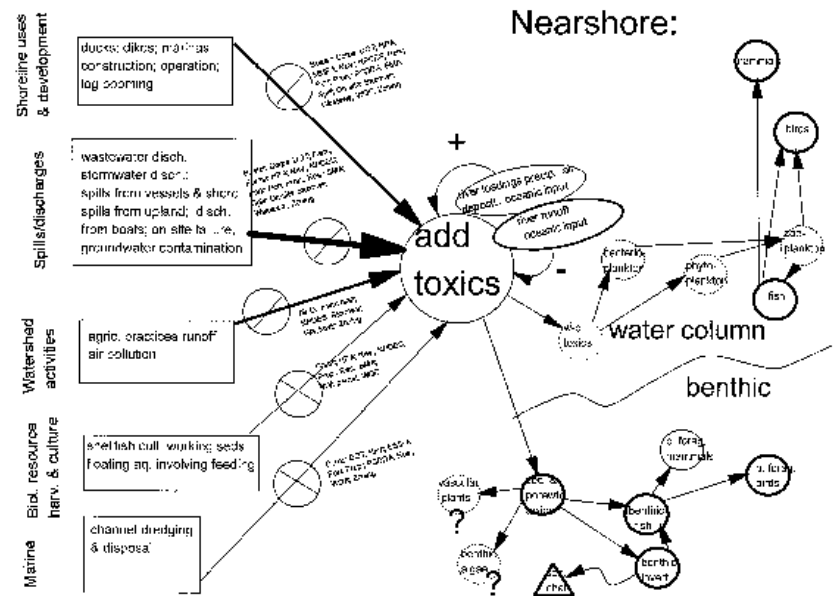


Figure 3. Stressor-based conceptual sub-model for toxics in the nearshore environment. Weighting of line around ecosystem component circles indicates amount of monitoring data available.

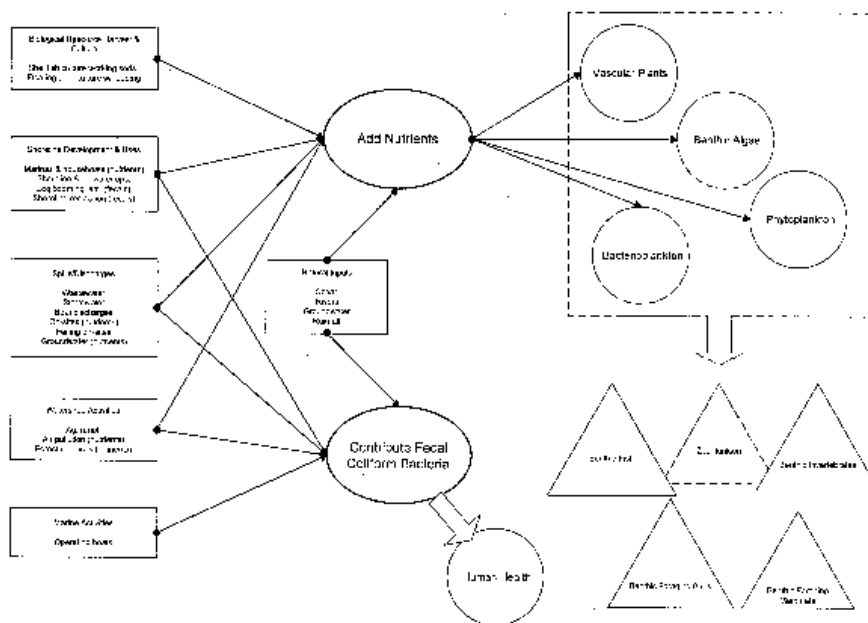
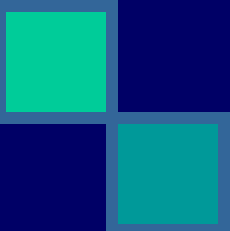


Figure 6. Conceptual model of nutrient and pathogen stresses in Puget Sound.



APNEP Indicator Definition



“A **numerical value** derived from actual measurements of a pressure, state or ambient condition, exposure, ecological condition, or measure of human health or wellbeing over a specified **geographic domain**, whose trends over time represent or draw attention to underlying **trends** in the condition of the environment in the A-P region.”

APNEP Indicator Criteria

- **Utilization:** Address a key process or property, and answers (or makes an important contribution toward answering) an important question about conditions in the A-P region
- **Objectivity:** Developed and presented in an accurate, clear, complete, and unbiased manner
- **Integrity:** Underlying data should be characterized by sound collection methodologies and data management systems adequate to protect its integrity, and to comply with quality assurance procedures
- **Availability:** Data should be available and timely, or will likely be available in the future, to maintain the indicator's utility
- **Representation:** Trends should accurately represent the underlying trends in the target population
- **Clarity:** The indicator should be clearly defined and reproducible. The specific data used and the specific assumptions, analytical methods, and statistical procedures employed are clearly stated

A-P INDICATORS: LINKS TO REGIONAL ECOSYSTEM MODEL

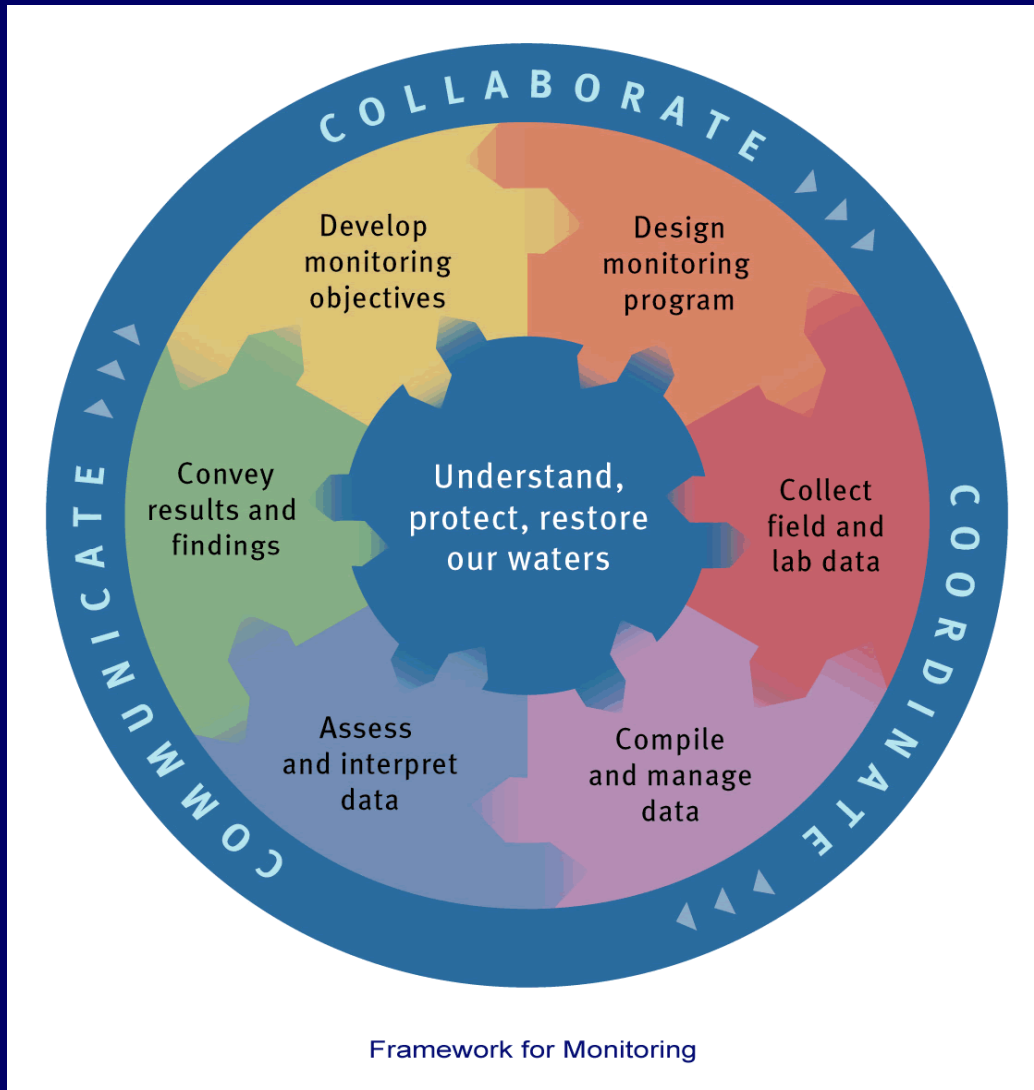
Module	Category	Dimension	Indicator	CCMP Indicator	STAC Indicator	ASC Indicator	ACE-INC Indicator	
1: Human Population	Regional Population	Human Presence	Total population in basin		Demographic Structure Human Presence			
		Human Urban Presence	Total urban population		Human Presence			
		Population by demographic class			Demographic Structure			
		Localized population change			Human Presence			
		Human waste production						
2: Human Needs	Food Water	Drinking water uses						
		Water supply infrastructure						
	Fiber	Housing			Housing Price & Affordability			
		Energy supply infrastructure						
	Health Economy							





APNEP Objectives-Metrics Hierarchy

- Modules
- Categories
- Dimensions
- Metrics



NEP Monitoring Plan Outline

- Define monitoring objectives & performance criteria
- Identify testable hypotheses
- Specify monitoring variables, including sampling locations, monitoring frequency, field and laboratory methods and QA/QC procedures
- Specify data management system and statistical tests to analyze the monitoring data
- Describe the expected performance of the initial sampling design
- Provide a timetable for analyzing data and assessing program performance





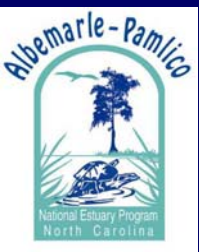
Initial APNEP Indicator-Metric Proposal

- Monitoring objective
- Measurable goals
- Data quality objectives
- Data analysis, statistical methods and hypothesis
- Data Source



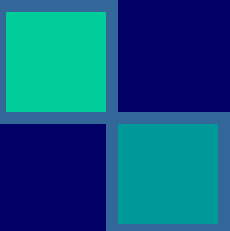
APNEP Indicator-Metric Proposal

- Introduction
- Monitoring objective under present sampling program
- Existing program costs
- Monitoring objectives under enhanced sampling program
- Estimated enhancement costs
- Measurable goal
- Data quality objectives under present sampling program
- Data quality objectives under enhanced sampling program
- Data analysis, statistical methods and hypothesis
- Data Sources
- Reference(s)
- Contact Person



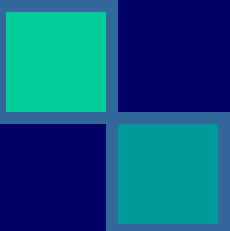


A-P Ambient Monitoring Program

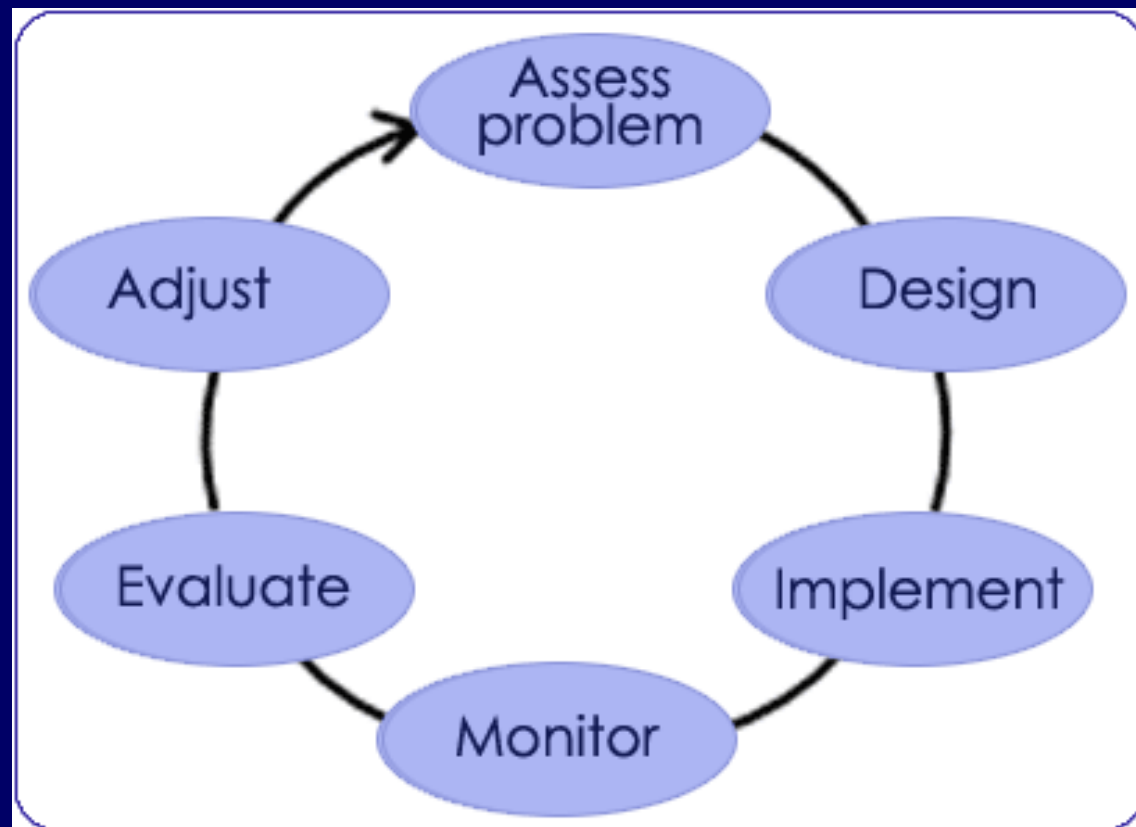
- 
- Precise goals and specific measures for monitoring policy effectiveness should be designed and tested at the time that a policy is implemented
 - Status Quo: APNEP 2000 monitoring survey update



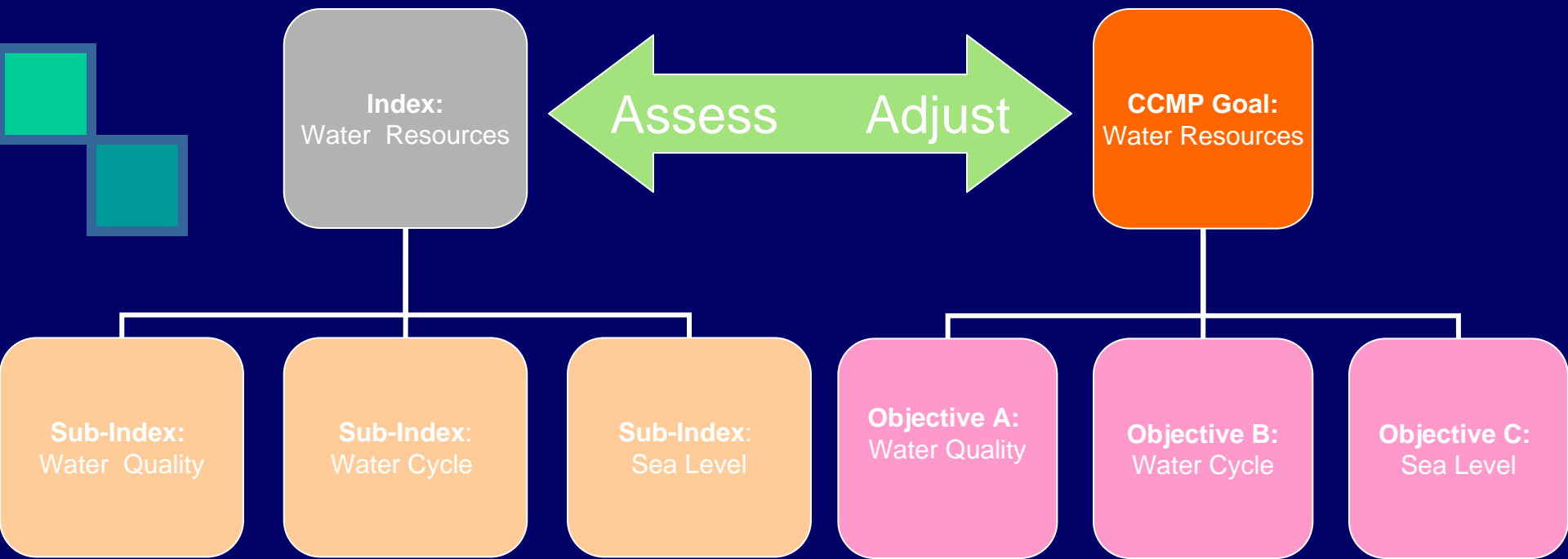
Monitoring Integration Continuum

- 
- Independence: Knowledge of partners monitoring strategies
 - Cooperation: Taking advantage of common geography, timing
 - Collaboration: Opportunities to leverage partners' monitoring networks
 - Integration: Working toward a common set of regional ecosystem objectives

APNEP CCMP 2009: A New Paradigm of *Adaptive* Ecosystem Management



An Integrated Framework

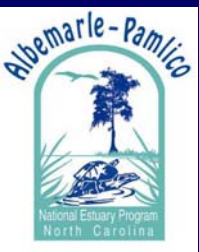


Indicators

Framework

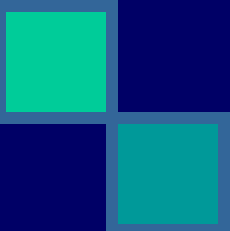
CCMP

Framework





Regional Ecosystem Services

- 
- Provisioning (e.g., food, water, timber, fiber)
 - Regulating (climate, floods, disease, wastes)
 - Cultural (recreational, aesthetic, spiritual)
 - Supporting (e.g., soil formation, photosynthesis, nutrient cycling)

DSS Construction Phase I

- Initial Objective: An integrated GIS environmental database portal
- IT Objective: Spatially-enabled content management system
 - First compilation: NC-DENR- and VA-DEQ/DCR/DFG/DF- sponsored environmental data
 - Second compilation: environmental databases from other North Carolina and Virginia agencies
 - Third compilation: federal, university (non-DENR funded), local databases



DSS = Digital Basin (Landscape)



- Ecosystem State

- Land Cover
- Material Balance
- Atmospheric
- Water Quality
- Living Aquatic Resources
- Wetlands
- Terrestrial
- Species Introductions & Removals

- Human Dimensions

- Management Actions

- Uncertainty