

12.0 Southern Estuaries CERP-Specific Conceptual Ecological Models and Performance Measures

Southern Estuaries influenced by CERP include Florida Bay, coastal lakes inland from Florida Bay, Biscayne Bay, and estuaries within southwest Florida's mangrove zone from Whitewater Bay to Lostman's River (**Figure 12-1**). The final draft of the *Monitoring and Assessment Plan (MAP), Part 2, 2006 Assessment Strategy for the MAP* (RECOVER 2006), referred to as the Assessment Strategy presents six CERP-specific conceptual ecological models for the Northern Estuaries. These models provide a visual description of causal pathways described in hypotheses clusters. These clusters reflect major attributes and/or stressors of systems expected to be affected by CERP: water quality, submerged aquatic vegetation (SAV), nearshore community structure, nearshore nursery function, and toxins and contaminants.

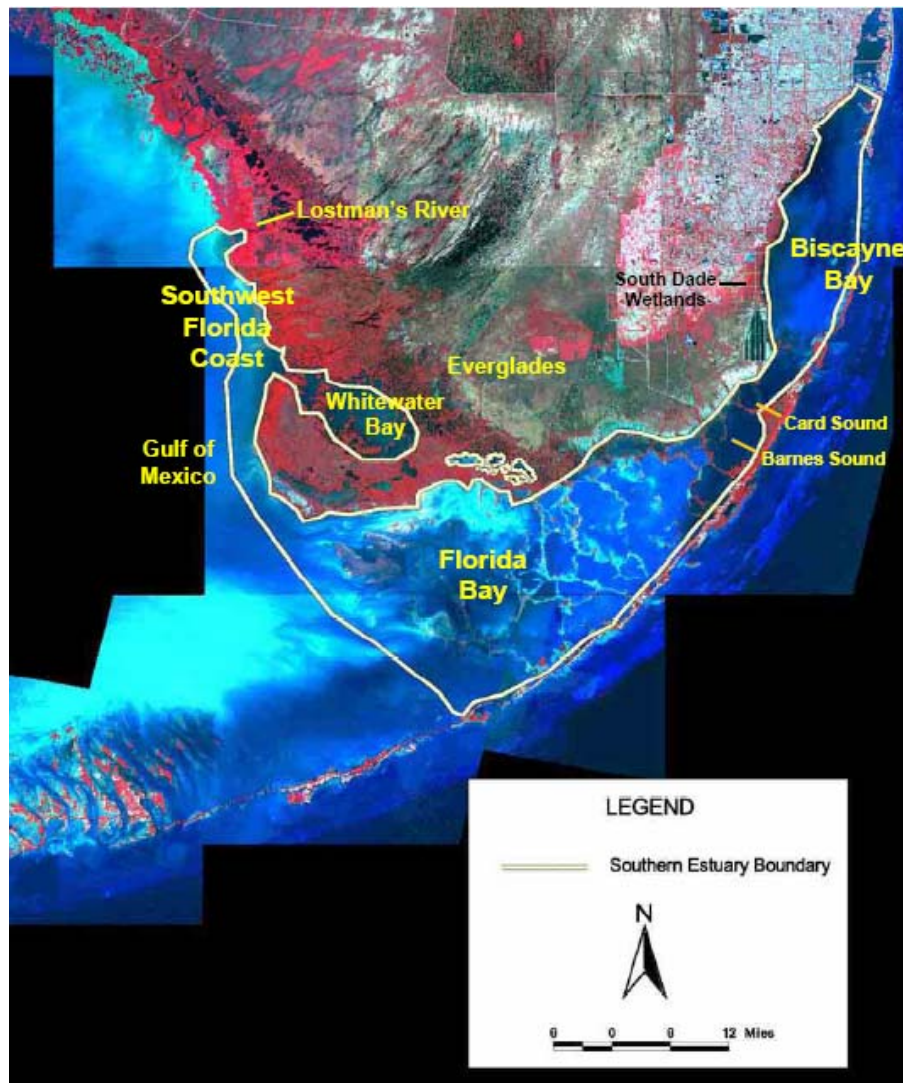


Figure 12-1. Southern Estuaries within CERP's influence

The following sections briefly summarize descriptive text for hypotheses clusters and present conceptual ecological model diagrams along with associated performance measures. Application of performance measures during evaluation (planning) and assessment processes, using the hypothesis-based approach, are discussed in more detail in Section 2. Full discussions of hypotheses clusters from the draft Assessment Strategy can be accessed from the CERP System-wide Performance Measures web page: http://www.evergladesplan.org/pm/recover/recover_docs/et/060507_pm_report/hypothesis_clusters_se.pdf.

12.1 Water Quality

Water quality in the Southern Estuaries is dependent upon the quantity, quality, timing and distribution of fresh water flowing to the system (**Figure 12-2**). Restoration of freshwater flow, both surface and ground water, by CERP will alter nutrient inputs and estuarine salinity, which will affect internal nutrient cycling and bioavailability of nutrients. Nutrient accumulation and retention in estuaries is also affected by episodic storm events, which can export nutrient rich sediments. Spatial extent, duration, density and composition of phytoplankton blooms are controlled by several factors that will be influenced by CERP: external nutrient loading, internal nutrient cycling (e.g., seagrass productivity/die-off, sediment resuspension), light availability, water residence time, and biomass of benthic grazers.

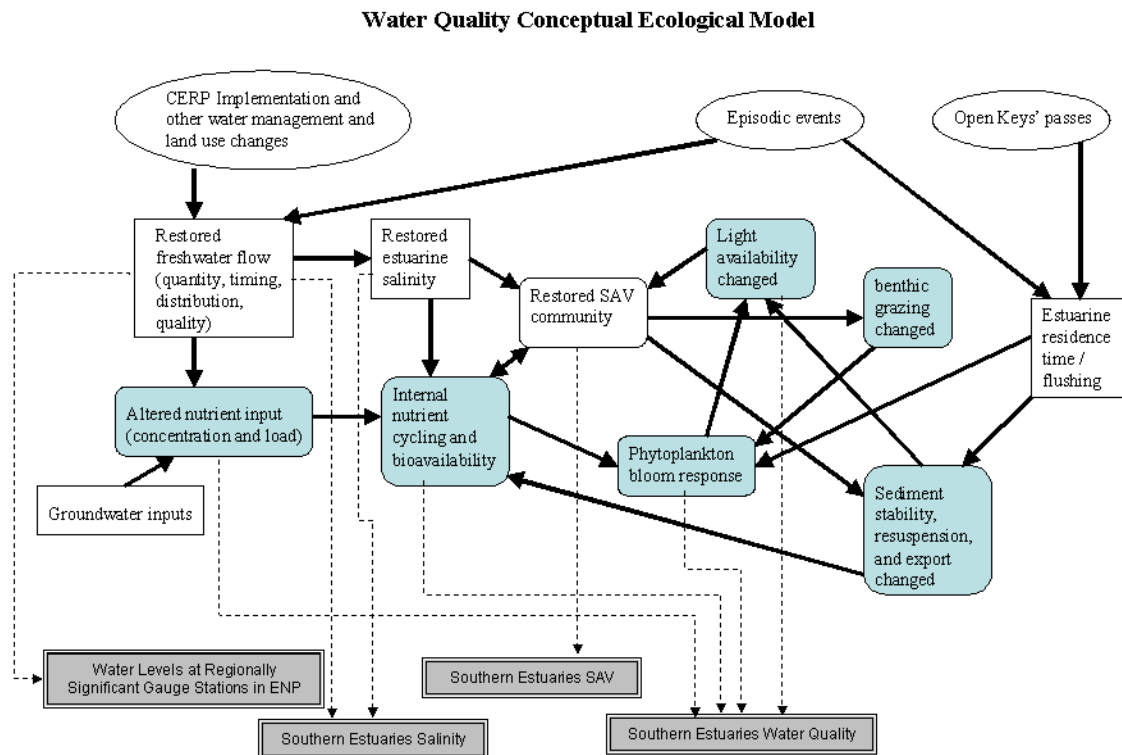


Figure 12-2. Southern Estuaries Water Quality Conceptual Ecological Model with associated performance measures

Four performance measures relate to the Water Quality Conceptual Ecological Model. A performance measure has been developed for water levels in Everglades National Park (ENP). The Southern Estuaries Salinity performance measure addresses both surface water discharge targets and salinity patterns. The Southern Estuaries Water Quality performance measure addresses both nutrients and algal blooms. A performance measure has also been developed for SAV.

12.2 Submerged Aquatic Vegetation

In Southern Estuaries, water management and land use, and episodic events affect freshwater flow, sediment loads and water quality (**Figure 12-3**). Changes in salinity and water quality result in changes in both seagrass and benthic algae. Seagrass is affected by changes in light penetration, epiphyte load, nutrient availability, salinity, hypoxia/anoxia, sulfide toxicity and disease. Benthic algae is affected by light penetration, nutrient availability, salinity, temperature and changes in seagrass density and species composition. Significant changes in benthic algae and seagrass distribution and density can affect susceptibility to sediment resuspension and stability of mud banks as well as nutrient availability to other primary producers.

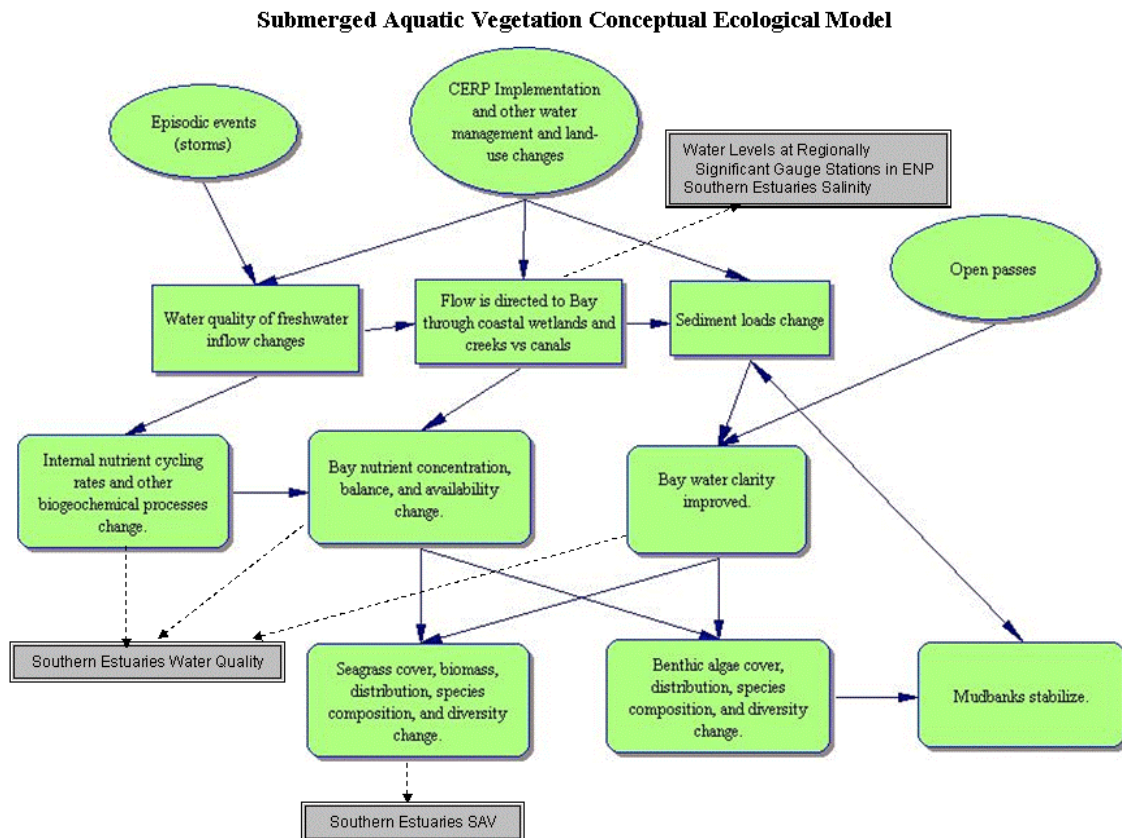


Figure 12-3. Submerged Aquatic Vegetation Conceptual Ecological Model with associated performance measures

CERP implementation will alter volume, timing and spatial distribution of freshwater inflow to Southern Estuaries. These alterations are expected to result in changes in nutrients and salinity patterns, which will affect seagrass and benthic algae.

Several performance measures have been developed to track affects of CERP implementation on Southern Estuaries. A performance measure has been developed for water levels in Everglades National Park. The Southern Estuary Salinity performance measure has targets for both salinity patterns and surface water discharge. The Southern Estuaries Water Quality performance measure has targets for nutrient loads and concentrations, water clarity/light penetration, algal blooms and toxicants and pathogens. An SAV performance measure has also been developed.

12.3 Nearshore Nursery Function

Shoreline and bottom configuration, vegetation and salinity patterns are characteristics that define estuarine nursery habitat and determine their productive capacity, and thereby abundance of species. Complex habitats increase productive capacity by reducing predation, providing a wider variety and abundance of food organisms, reducing physical disturbance, and providing substrates for attachment. Alteration of volume, timing and spatial distribution of freshwater inflow that occurred with past water management practices has decreased productive capacity of estuarine nursery grounds by altering both bottom and shoreline vegetation and salinity patterns and the area over which favorable zones of bottom vegetation and salinity overlap (**Figure 12-4**).

One of CERP's goals is to expand, in both space and time, favorable conditions for estuarine species that were historically characteristic of coastal wetlands and nearshore zones. Increased availability of complex mangrove-shoreline and seagrass habitat and a broadened salinity gradient will increase fish and macroinvertebrates diversity. Several performance measures have been developed for tracking CERP success in restoring nearshore community structure. Freshwater inflow patterns are simulated and determined using water levels at Everglades National Park gauge stations and surface water discharges. Surface water discharges are used as surrogate indicators in the Southern Estuaries Salinity performance measure. This measure also uses salinity patterns/gradients as indicators. Several attributes including SAV, pink shrimp and associated epifauna, and fish are also used as indicators in performance measures for the Southern Estuaries.

12.4 Nearshore Community

Many nearshore community habitats in Southern Estuaries have been diminished or eliminated by past and current water management practices. Waters that are consistently of intermediate salinity tend to support highly productive, but relatively low diversity, plant and animal communities. In many nearshore areas of Biscayne and Florida Bays, freshwater flow is so variable that downstream salinity regimes are suboptimal for freshwater, brackish and marine organisms alike.

Nearshore Community Structure Conceptual Ecological Model

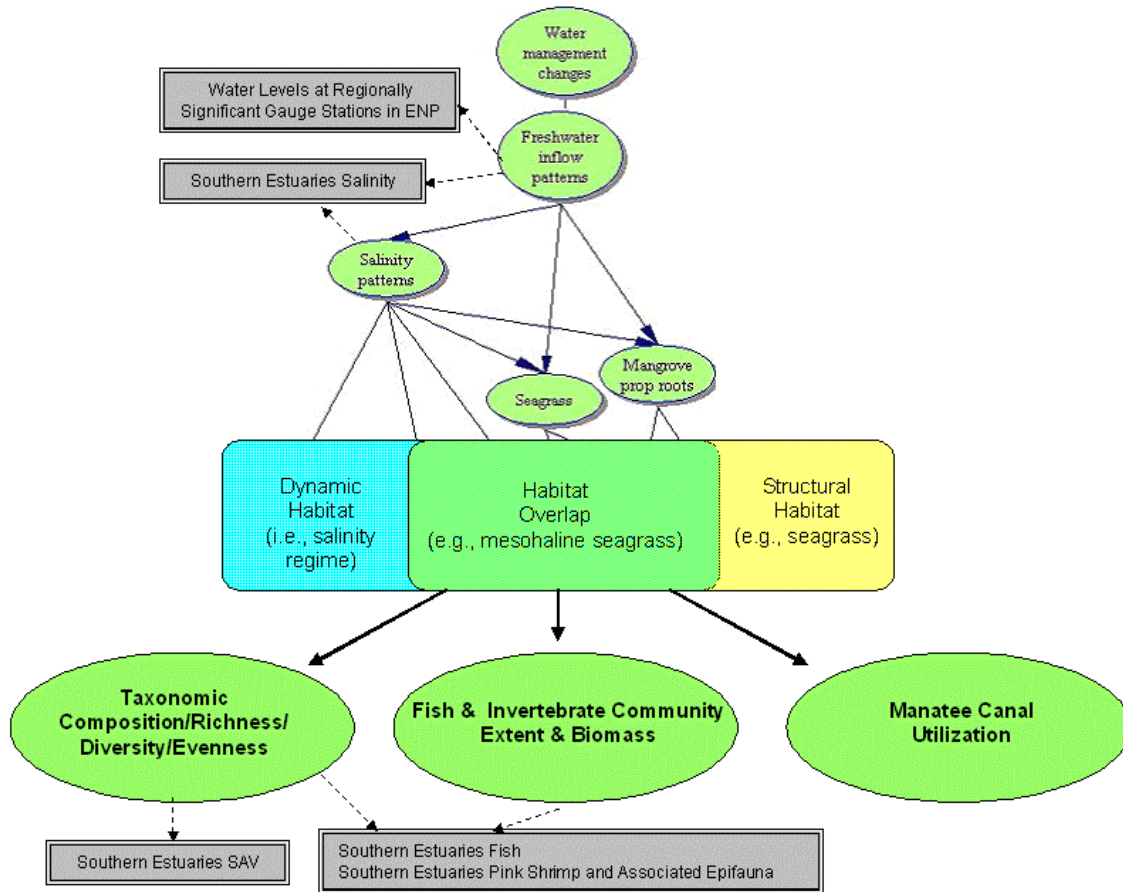


Figure 12-4. Nearshore Nursery Function Conceptual Ecological Model with associated performance measures

CERP is expected to restore freshwater inflow patterns to this region, which is expected to restore salinity patterns, and seagrass and mangrove communities (**Figure 12-5**). Restoration of salinity regime and plant communities and will provide dynamic and structural habitat, and habitat overlap for nearshore animal communities.

Performance measures have been developed to track the CERP success in restoring nearshore community in the Southern Estuaries. Two performance measures have been developed for stressors: water levels in ENP and salinity. The salinity performance measure has targets for surface water discharges, as well as for salinity patterns/gradients. Performance measures have also been developed for three attributes of Southern Estuaries nearshore community structure: SAV, fish community, and juvenile pink shrimp and associated epifauna.

Nearshore Community Structure Conceptual Ecological Model

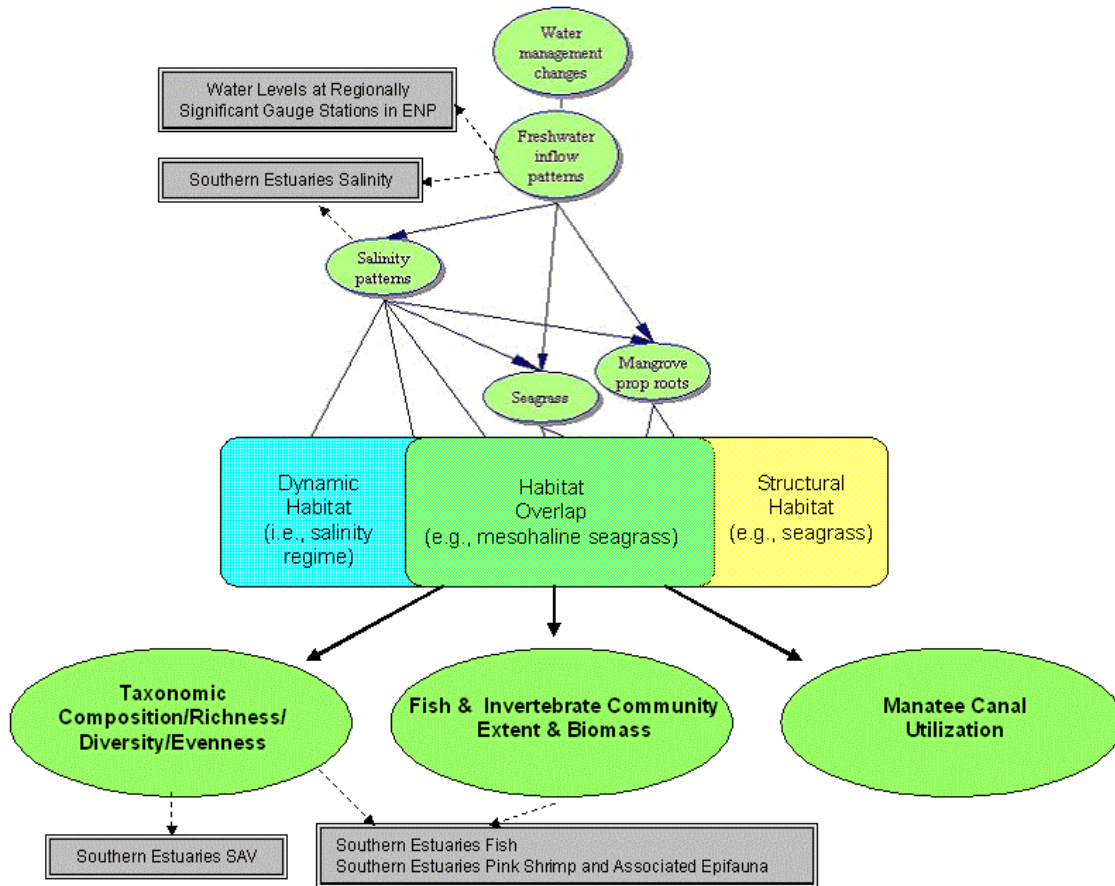


Figure 12-5. Nearshore Community Conceptual Ecological Model with associated performance measures

12.5 Toxins and Contaminants

Toxins and other contaminants are conveyed through surface and ground water to estuaries, where they accumulate in sediments, and eventually increase contaminant and toxin burdens in organisms inhabiting estuaries (**Figure 12-6**). Implementation of CERP along with increased urban and agricultural development will result in changes in distribution and sources of fresh and ground water entering estuaries. Sources of new water will include waste water reuse and urban and agricultural runoff, which may increase loads to estuaries. Water will also be routed through areas undergoing rapid urban development and redevelopment, which may also increase contaminant loads. Rerouting of water through coastal wetlands may reduce loads to bays. Increase in contaminants is expected to affect benthic community composition; growth, survival, development of invertebrates and fish; and dolphin health. It is also expected to increase prevalence of abnormal fish changes. Changes that occur in fish and pink shrimp and associated epifauna will be tracked by performance measures developed for these attributes.

Toxins and Contaminants Conceptual Ecological Model

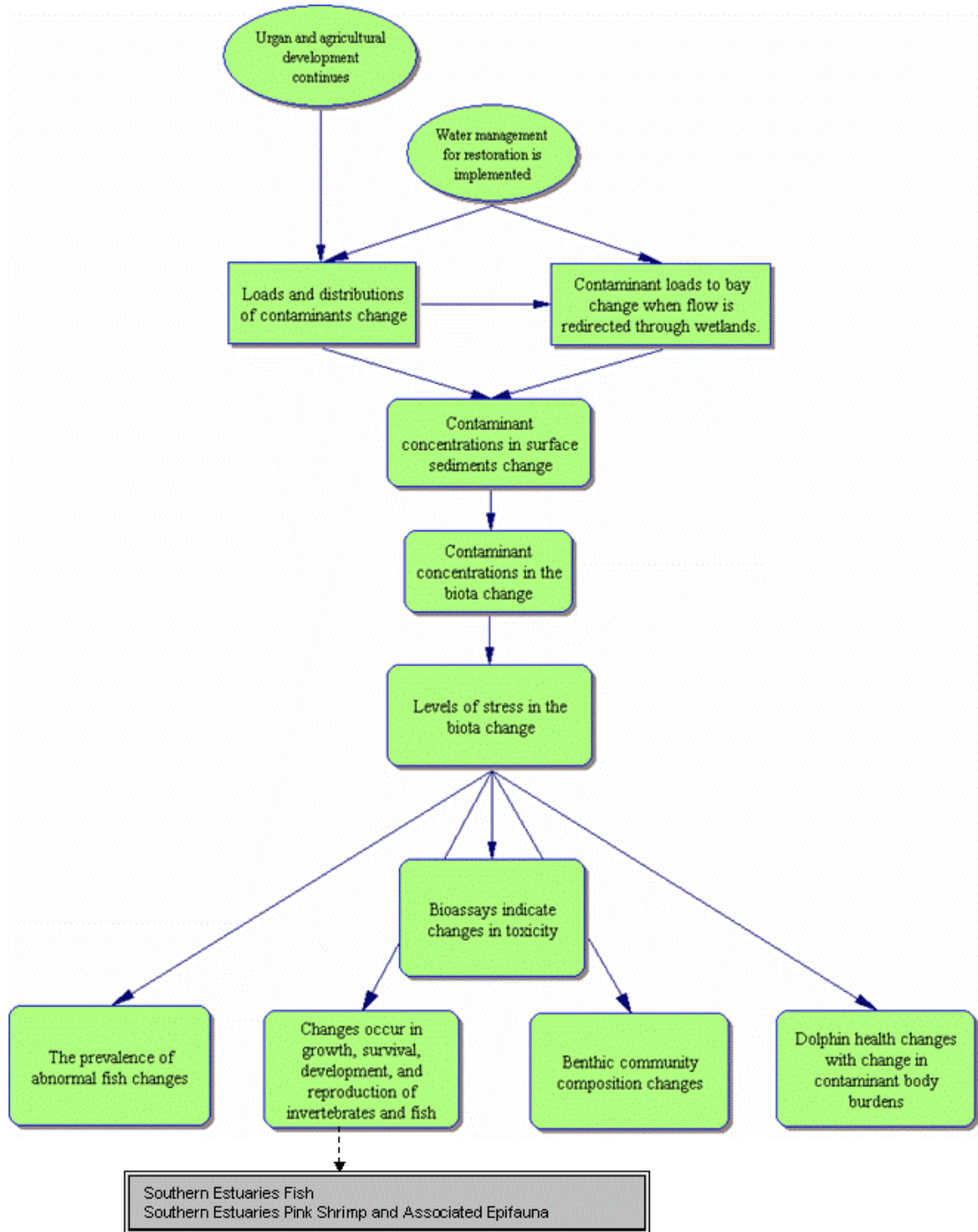


Figure 12-6. Toxins and Contaminants Conceptual Ecological Model with associated performance measures

12.6 Southern Estuaries Performance Measures

The performance measures for the Southern Estuaries region are as follows:

- Southern Estuaries Salinity
- Water Level at Regionally Significant Gauge Stations in Everglades National Park
- Southern Estuaries Submerged Aquatic Vegetation
- Southern Estuaries Juvenile Pink Shrimp and Associated Epifauna
- Southern Estuaries Fish Community
- Southern Estuaries Water Quality

Documentation sheets can be accessed from the Southern Estuaries Performance Measures web page: http://www.evergladesplan.org/pm/recover/perf_se.aspx.

12.7 References

RECOVER. 2006. Monitoring and Assessment Plan (MAP), Part 2, 2006 Assessment Strategy for the MAP, Final Draft. Restoration Coordination and Verification Program, c/o United States Army Corps of Engineers, Jacksonville District, Jacksonville, FL, and South Florida Water Management District, West Palm Beach, FL. December 2006.
http://www.evergladesplan.org/pm/recover/recover_map.aspx