EVALUATING ALTERNATIVE PLANS FOR THE COMPREHENSIVE EVERGLADES RESTORATION PLAN (CERP)

BISCAYNE BAY COASTAL WETLANDS PROJECT (BBCW)

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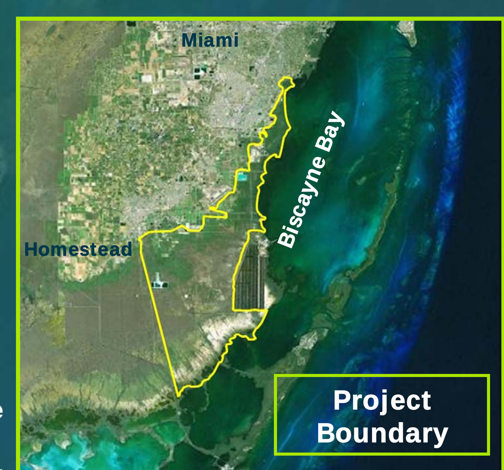
BACKGROUND

The Biscayne Bay Coastal Wetlands (BBCW) Project

is part of the Comprehensive Everglades Restoration Plan (CERP). The BBCW study area is southeast Miami-Dade County where coastal freshwater and saltwater wetlands have been fragmented and/or converted for agricultural and suburban development. In addition the historic flows to Biscayne Bay have been significantly altered by humans. The project seeks to improve the quality, quantity, timing and distribution of flows to restore and maintain desirable biological communities in Biscayne Bay, Biscayne Bay National Park, and adjacent coastal wetlands.

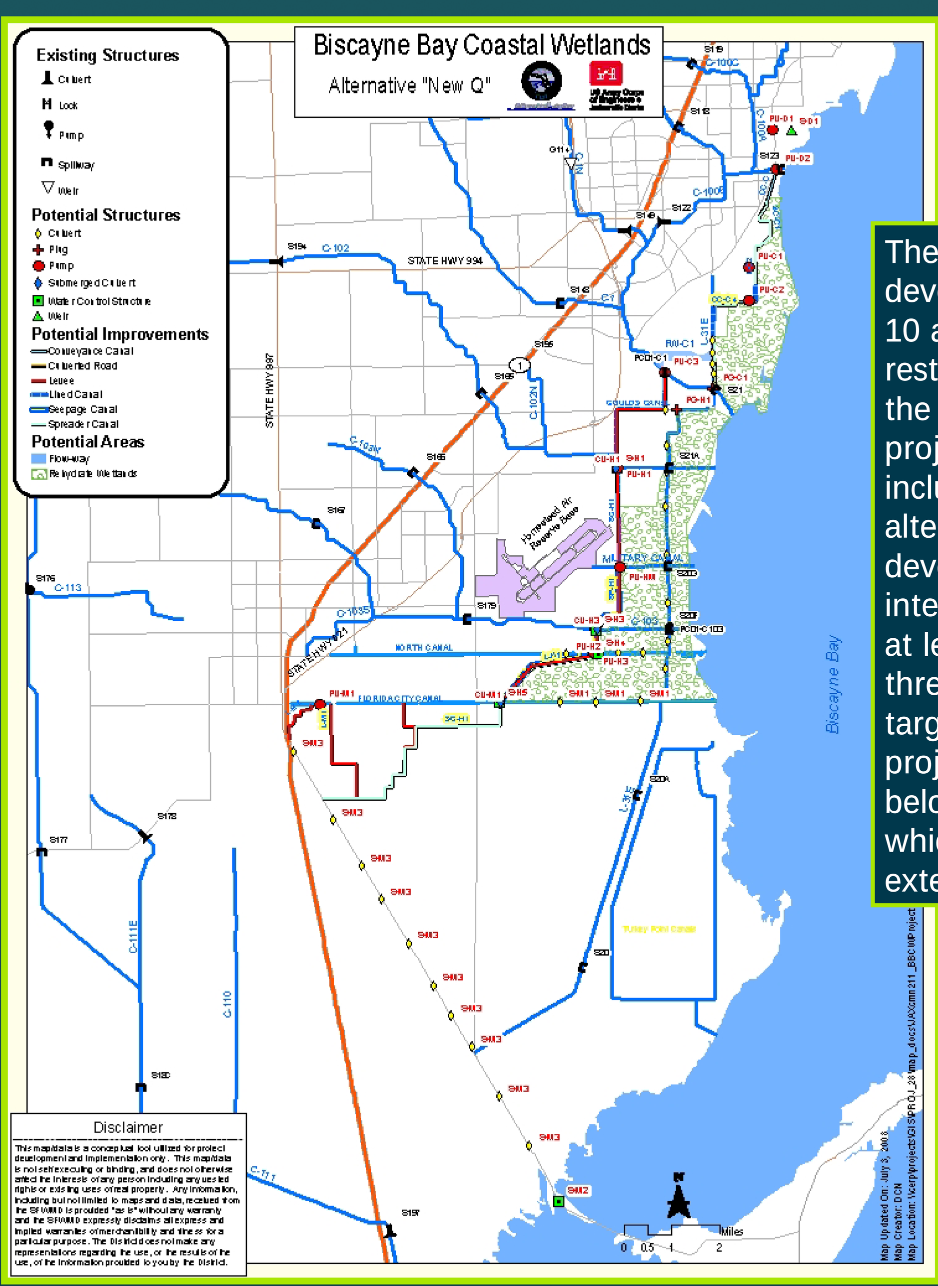
Regulations dictate how USACE Civil Works projects are formulated, evaluated and selected for implementation. In USACE mission areas where both costs and benefits can be calculated in monetary terms, alternative plans are evaluated using benefit-cost ratio analysis and net economic development (NED) outputs. While monetary costs can be determined for ecosystem restoration projects, no equivalent, universal method for monetizing environmental benefits exists. Instead, the economic tools of cost effectiveness analysis and incremental cost analysis, are used to support decision making. To conduct these analyses, ecosystem restoration outputs must be clearly identified and quantified in measures comparable across alternatives.

For the BBCW project, a multi-agency study team developed a unique tool called the Criteria Based Ecological Evaluation Matrix (CBEEM) to compare alternative restoration plans. The CBEEM was derived from a well documented method known as the Multi-Criteria Decision Making (MCDM) approach. The CBEEM uses eight performance metrics to compute and aggregate the estimated restoration benefits that will accrue to three ecozones (near shore, tidal wetlands, and freshwater wetlands).



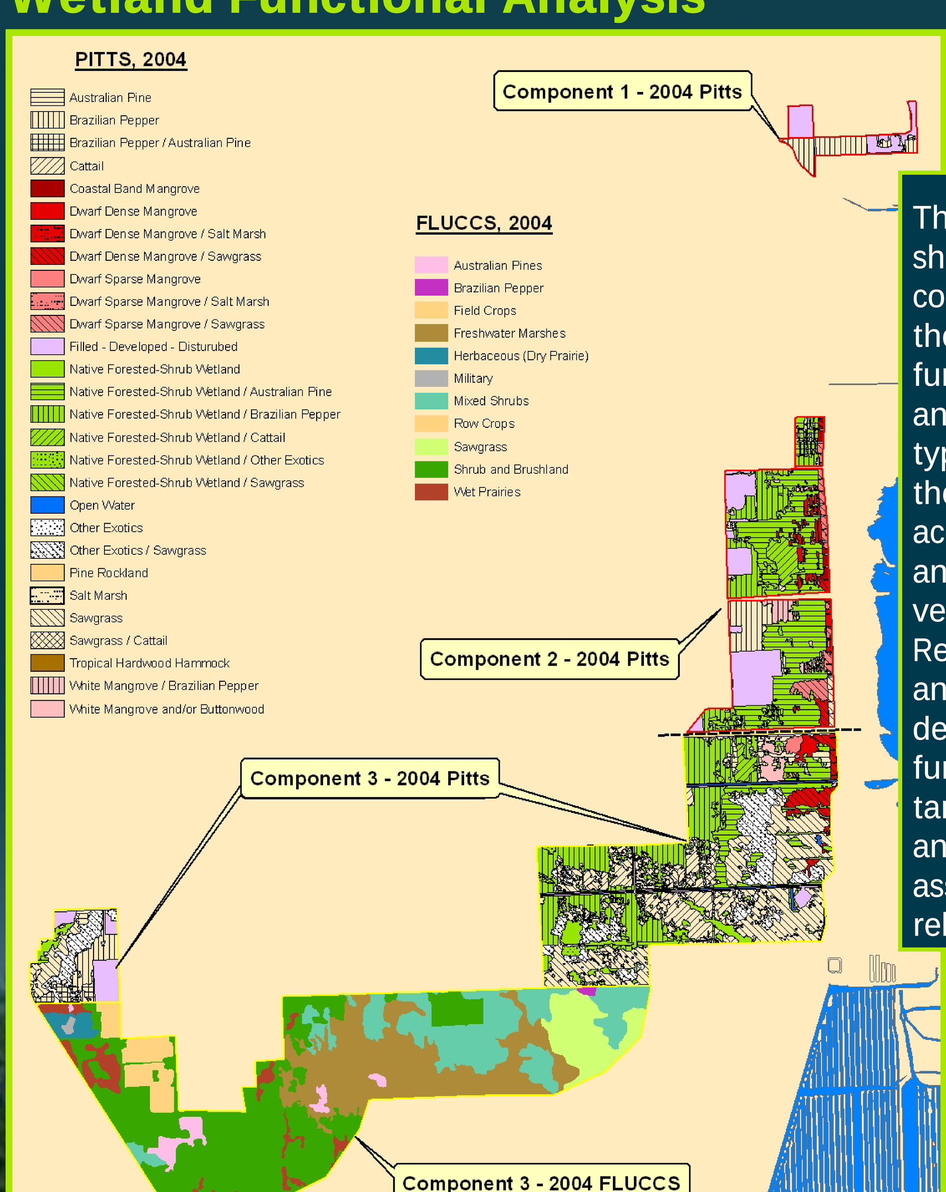
The CBEEM was developed as a result of unacceptable levels of uncertainty in the numerical models (WASH-123D for the watershed, and TABS-MDS for the Biscayne Bay Hydrodynamics). This methodology attempts to incorporate aspects of acceptable hydrological modeling and ecological modeling and professional/expert judgment in examining how efficiently alternatives attempt to achieve historical ecological and hydrologic conditions. This poster describes CBEEM and provides examples of its output.

Alternatives



The study team developed more than 10 alternative restoration plans for the area. The project features included in the alternatives were developed with the intent of enhancing at least one of the three ecozones targeted in this project. The map below shows Alt Q which is the most extensive in scope.

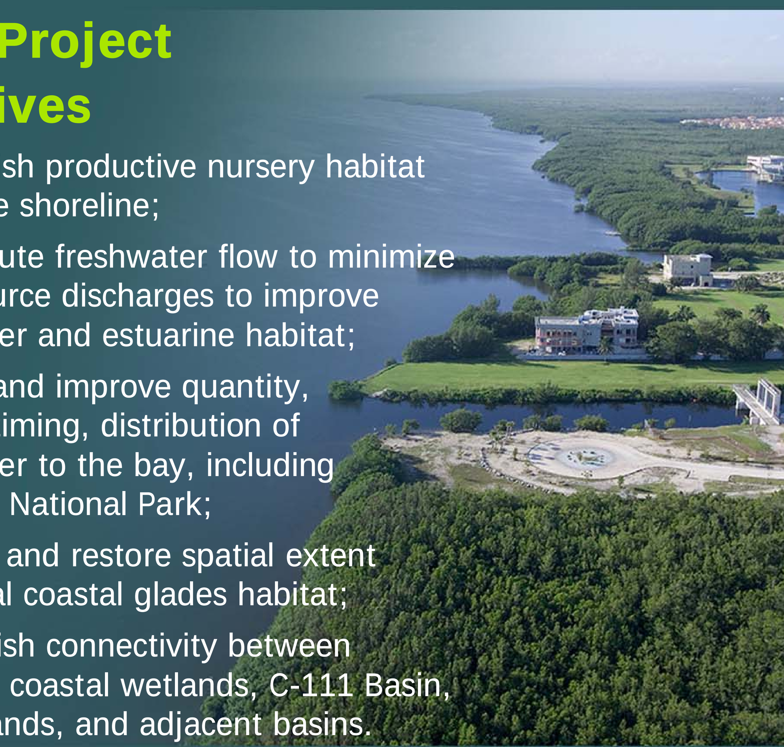
Wetland Functional Analysis



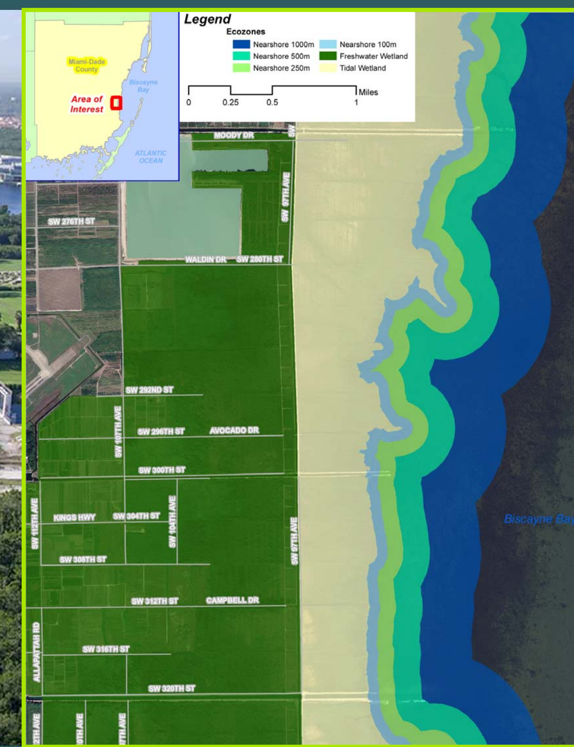
The map below shows the 3 components used in the wetland functional analysis and the vegetation types in each of those components according to USFWS and FLUCCS vegetation maps. Results of functional analysis were used to determine overall functional capacity of targeted wetlands and the available lift associated with rehydration.

METHODOLOGY

BBCW Project Objectives



1. Reestablish productive nursery habitat along the shoreline;
2. Redistribute freshwater flow to minimize point source discharges to improve freshwater and estuarine habitat;
3. Restore and improve quantity, quality, timing, distribution of freshwater to the bay, including Biscayne National Park;
4. Preserve and restore spatial extent of natural coastal glades habitat;
5. Reestablish connectivity between Biscayne coastal wetlands, C-111 Basin, Model Lands, and adjacent basins.



CBEEM Performance Measures

PERFORMANCE MEASURE	OBJECTIVE (see list above)				
	1	2	3	4	5
1. Restore near shore salinity regime	Near shore				
2. Restore tidal wetland salinity regime	Saltwater		Saltwater		
3. Reduce direct canal discharge	Near shore Saltwater Freshwater	Near shore Saltwater Freshwater	Near shore Saltwater Freshwater	Near shore Saltwater Freshwater	
4. Potential freshwater wetland rehydration			Freshwater	Freshwater	
5. Reduce nitrogen concentrations			Near shore		
6. Reduce phosphorus concentrations			Near shore		
7. Reduce non-native vegetation				Freshwater	
8. Restore connections between basins and wetlands			Freshwater Saltwater	Freshwater Saltwater	Freshwater Saltwater

Performance Measure 1: Restore near shore salinity regime

Metric **Near shore; acres of bay bottom meeting salinity criteria (<=20 ppt)**

Evaluated using measured salinity in the near shore area for existing conditions and Scenario 10 of the TABS-MDS Preliminary Scenario Runs (PSR) to estimate the effect on near shore salinity of diverting water into the tidal wetlands. The near shore zone is defined as the area between the shoreline out to 500 meters. The ability of each alternative to meet the target salinity is evaluated by comparing the volume of diverted water and the Scenario 10 flows required to meet the salinity. The volume of daily flows diverted into the saltwater (tidal) wetlands for each of the four zones is calculated based on water available at the coastal water control structures and pump sizes and operations defined by each alternative.

Performance Measure 2: Restore tidal wetland salinity regime

Metric **Saltwater wetlands; acres of tidal wetlands meeting 0-20 ppt criteria**

Performance Measure 3: Reduce direct canal discharge

Metric **Near shore; potential percent of surface water diverted from canal**

Metric **Saltwater wetland; potential percent of surface water diverted to saltwater wetlands**

Metric **Freshwater wetland; potential percent of surface water diverted to freshwater wetlands**

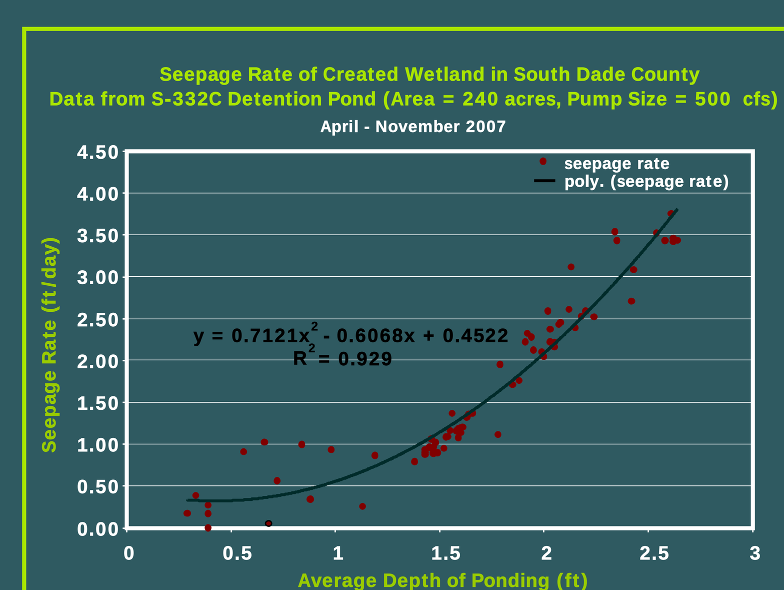
Performance Measure 4: Potential freshwater wetland rehydration

Metric **Freshwater; wetlands with sufficient water**

The method used to estimate wetland rehydration benefits associated with wet but not saturated soils relies upon the assumption that an acre of land is sufficiently hydrated to support wetland vegetation if the quantity of surface water applied on a given day at least equals the expected seepage losses to the groundwater system. The equation used here to estimate wetland lift is L = Q /(S*CF), where:

- L = wetland lift (acres of lift),
- Q = flow diverted into wetland (cfs),
- S = Seepage rate (ft/hr), and
- CF = Conversion factor (86400 sec/day/43560 ft^2/acre).

The most relevant source of data for the seepage rate of southern Miami-Dade County constructed wetlands comes from the S-332B, S-332C, and S-332D detention areas constructed along L-31N and L-31W canal/levees in western Dade County. The chart to the right shows seepage as a function of depth of inundation at S-332C pond. The seepage rates used for the wetland lift calculations for the BBCW project are 0.6 ft/day for the wet season and 1.2 ft/day for the dry season.



Performance Measure 5: Reduce nitrogen concentrations

Metric **Near shore; nitrate load reduction**

The estimated amount of nitrate removed by the project alternatives is based upon the amount of water diverted to the wetlands, the effective treatment area of the wetlands, and the concentration of nitrate once the water has passed through the wetland.

Performance Measure 6: Reduce total phosphorous loading to Biscayne Bay

Metric **Peak Phosphorus Load Reduction**

Incorporates flow based concentration estimation equations developed by the USGS (Lietz, 1996) and the pump size to estimate the fraction of peak concentration load that is diverted from the canals.

Performance Measure 7: Reduce non-native vegetation

Metric **Freshwater, Reduced Invasive Non-native Plants**

Assumes that all non-native vegetation within the footprint of a given alternative will be controlled or eliminated by changes in hydrology resulting from the project and other means, if necessary (e.g., mechanical and/or chemical removal).

Performance Measure 8: Restore connections between basins and wetlands

Metric **Freshwater, Expanded Wildlife Corridors**

The analysis was limited to major features identified for removal, backfilling, or culverting in descriptions of alternatives, including the Yellow Book alternative. The target is based on features envisioned for removal by all project alternatives combined, and include: Military Canal, North Canal, North Canal Drive, Palm Drive, Florida City Canal, Card Sound Road Canal, Tallahassee Road, SW 360th Street, and L-31E (from C-1 to Palm Drive and the Model Lands dogleg).

ANALYSIS AND NEXT STEPS

CBEEM Output Summary

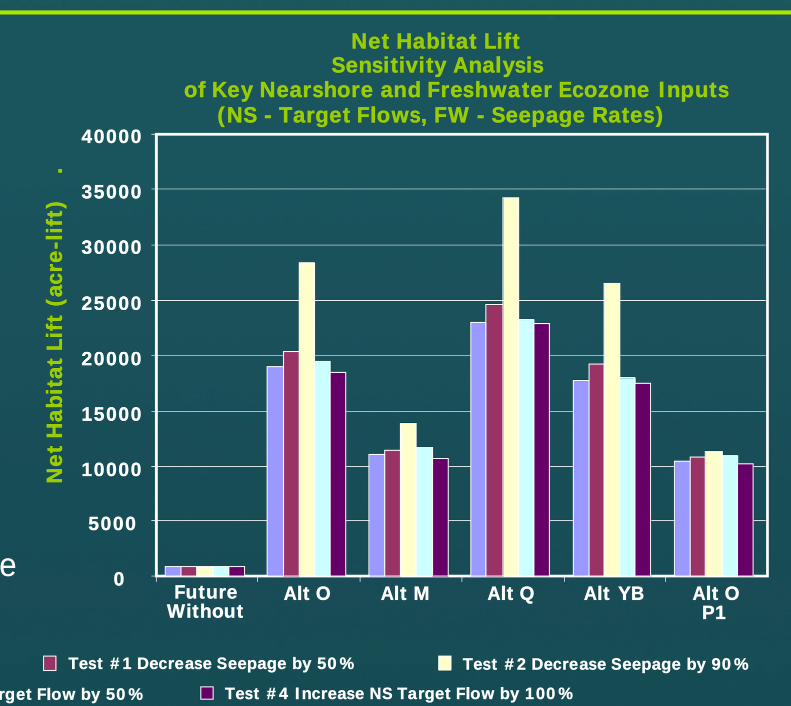
The performance metrics applicable to each ecozone are normalized on a 0-1 scale and then aggregated and averaged to produce a habitat quality index for each zone. This normalization is a measure of how well each performance measure attains its target, which is essentially a goal of historic conditions or full restoration that is based on empirical or theoretical ecological thresholds.

Each ecozone habitat quality index is then multiplied by the appropriate maximum number of acres within a given ecozone to compute the ecozone benefits. Combining the performance metrics and applying to the project area available for restoration using this methodology is a common procedure for CERP benefit evaluation.

	Existing Condition	Future Without	Alt O	Alt M	Alt Q	Alt YB	Alt O, P1
	Performance Criteria Averaged as Equal (No Weighting)						
Nearshore Indicies	0.09	0.19	0.52	0.45	0.44	0.35	0.48
Acres	8,585	8,585	8,585	8,585	8,585	8,585	8,585
Habitat Units	773	1,631	4,464	3,863	3,777	3,005	4,121
2050 HU Lift		859	2,833	2,232	2,146	1,374	2,490
Average Annual Lift			2,964	2,410	2,331	1,618	2,647
Saltwater Indicies	0.04	0.04	0.32	0.32	0.23	0.18	0.31
Acres	22,550	22,550	22,550	22,550	22,550	22,550	22,550
Habitat Units	902	902	7,216	7,216	5,187	4,059	6,991
2050 HU Lift			6,314	6,314	4,285	3,157	6,089
Average Annual Lift							
Freshwater Indicies	0.00	0.00	0.29	0.08	0.48	0.38	0.15
Acres	34,862	34,862	34,862	34,862	34,862	34,862	34,862
Habitat Units			10,110	2,789	16,734	13,248	5,229
2050 HU Lift			10,110	2,789	16,734	13,248	5,229
Average Annual Lift			9,321	2,789	16,734	13,248	4,821

Sensitivity Analysis

The sensitivity of the CBEEM results was assessed by varying the estimated groundwater seepage rates and the near shore target flows. CBEEM Results are very sensitive to the assumed seepage rate for freshwater wetlands and less sensitive to nearshore target flows.



Cost Effectiveness / Incremental Cost Analysis

The purpose of a cost effectiveness / incremental cost analysis (CE/ICA) is to evaluate and compare the production efficiency of a given set of alternatives and identify the plan that maximizes ecosystem restoration. Cost effectiveness analysis begins with a comparison of the costs and outputs of alternative plans to identify the least cost plan for every level of output considered. Alternative plans are compared to identify those that would produce greater levels of output at the same cost, or at a lesser cost, as other alternative plans, i.e., the cost effective alternative plans. Next, through ICA, the cost effective alternative plans are compared to identify the most economically efficient alternative plans, that is, the "Best Buy" alternative plans. Cost effective plans are compared by examining the additional (incremental) costs for the additional (incremental) amounts of output produced by successively larger cost effective plans. The plans with the lowest incremental costs per unit of output for successively larger levels of output are the best buy plans. The results of these calculations and comparisons of costs and outputs between alternative plans provide a basis for addressing the decision question "Is it worth it?" i.e., are the additional outputs worth the costs incurred to achieve them?

Cost and Outputs Used in CE / ICA

Alternative	Annual Cost	Freshwater HU's	Saltwater HU's	Nearhore HU's	Total System-wide HU's
Alternative YB	$62,250,000	12,213	2,910	1,618	16,741
Alternative O	$35,920,000	9,320	5,821	2,963	18,104
Alternative M	$25,510,000	2,571	5,821	2,409	10,801
Alternative Q	$60,310,000	15,427	3,950	2,330	21,707
Alternative O, P1	$12,690,000	4,821	5,613	2,647	13,081

Results of Cost Effectiveness Analysis

Name	Average Annual Cost	Combined Habitat Units	AAC/AAHU	Cost Effective
Alternative YB	$62,250,000	16,741	$3,718	No
Alternative O	$35,920,000	18,104	$1,984	Best Buy
Alternative M	$25,510,000	10,801	$2,362	No
Alternative Q	$60,310,000	21,707	$2,778	Best Buy
Alternative O, P1	$12,690,000	13,081	$970	Best Buy

Next Steps

- Complete Draft Project Implementation Report (PIR) that identifies selected plan using CBEEM and CE/ICA
- Finalize PIR and submit to HQ and Congress
- Submit CBEEM to Corps Center for Planning Expertise to undergo Model Review and Certification
- Begin design and construction of Alternative O, Phase I

For additional information about the Biscayne Bay Coastal Wetlands and other CERP projects, visit www.evergladesplan.org