Florida Bay / Florida Keys Feasibility Study (FBFKFS) RECOVER EVALUATION OF PROJECT-LEVEL PERFORMANCE MEASURES (Final 061804)

Prepared by the Regional Evaluation Team (RET) and Water Quality Team (WQT)

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1.0 Introduction

The role of the Restoration Coordination and Verification (RECOVER) team is to organize and apply scientific and technical information in ways that are most effective in supporting the objectives of the Comprehensive Everglades Restoration Plan (CERP). RECOVER links science and the tools of science to a set of system-wide planning, evaluation and assessment tasks. These links provide RECOVER with the scientific basis for meeting its overall objectives of evaluating and assessing Comprehensive Plan performance and refining and improving the plan during the implementation period. RECOVER fulfills this role by working with the project delivery teams (PDTs) to help them meet CERP's system-wide goals and objectives. Specifically, RECOVER reviews the performance measures for project-level evaluation of alternatives for consistency with the system-wide evaluation performance measures developed by RECOVER.

The purpose of this performance measures consistency review is: 1) to identify general compatibility of project-level performance measures with applicable system-wide performance measures, and 2) to provide information to project mangers and others, as appropriate, regarding compatibility of project-level and system-wide performance measures of the FBFKFS as submitted to RECOVER in April 2004. RECOVER recognizes and appreciates the time and effort that went into developing these performance measures. The review comments below are intended to enhance the existing set of performance measures. Comments on the specific project-level performance measure are presented in the attached table (Attachment A).

2.0 General Document Comments

The FBFKFS PMs are generally well-developed. RECOVER does however have suggestions regarding the PM fact sheets, the development of evaluation indices, and areas of evaluation to provide additional information for document reviewers and developers.

Utility of PMs in Evaluating Project Alternatives - Several of the habitat and organism PMs do not have clear numeric targets that lend themselves for use in an evaluation methodology, and is not conducive to making decisions in distinguishing between alternatives. Such terms as "minimize", "maximize", "increase", and "no significant decrease" should be replaced by numeric targets where possible. Documenting the linkage between the PM target and the evaluation methodology would clearly show how

the PMs could be used to make decisions. As currently written, these PMs may be more appropriate as performance indicators or constraints in screening alternatives.

Performance Indices – Several PMs appear to lend themselves to the development of indices to address multiple aspects of a parameter. For instance, dissolved oxygen, nutrient loadings, or algal bloom PMs could each develop a water quality index that addresses the parameters that affect that specific water quality component. Similarly, SAV or ecological habitat suitability indices (HSIs) could be developed.

Performance Measure Documentation Sheets (Fact Sheets) – FBFKFS PM fact sheets are generally well developed; RECOVER does however have some suggestions to improve the clarity of some fact sheets. Documentation could be added to several of the PM fact sheets to indicate why particular target ranges were chosen and references as to why certain targets were selected (i.e. scientific studies, best professional judgment, etc.). Specific comments on documentation and references are included in Attachment A.

Modeling – RECOVER recognizes a significant effort will be needed to create and support the models necessary to support the FBFKFS PMs. There is some concern that the various hydrologic, hydrodynamic, water quality, and ecological models on which these performance measures depend will be available in time to conduct evaluations.

3.0 Consistency with RECOVER System-Wide Evaluation Performance Measures

There is general compatibility between the project-level performance measures developed by the PDT for the FBFKFS and the system-wide evaluation performance measures developed for the Comprehensive Plan by RECOVER. RECOVER does however have suggestions regarding the content, target and classification for several of the performance measures/evaluation criteria. General comments of significance are noted below, while comments on each specific project-level performance measure are presented in the attached table (Attachment A).

Salinity – In general, targets for PM SPM-1 appear consistent with SE-E2 in terms of salinity thresholds, however, SPM-1 measures exceedences of the thresholds in time units of weeks. SE-E2 (Interim), the PM used for the Initial CERP Update (ICU) measures exceedences in time units of months. SE-E2 (Proposed), the PM being developed for the area, measures exceedences in frequency (percent) of days in the evaluation period (e.g., for ICU that would be the 36-year evaluation period). Also, SPM-1 calculates a mean of exceedence values (high and low) and duration of exceedence periods, whereas SE-E2 does not.

The specific salinity targets for Zone 5 salinities are not consistent with SE-E2 (see Terrapin Bay), and targets for Manatee Bay are inconsistent with targets for SE-E4. Additionally, the RET has a wet and dry season target for Manatee Bay/Barnes Sound (Zone 13) in SE-E4. The PDT may want to refer to RECOVER PMs SE-E2 and SE-E4 and determine if existing PM targets should be adjusted for consistency or refined to account for seasonal changes.

For SPM-3, there is no corresponding RECOVER PM for comparison; however, the nomenclature and metrics used in this PM may be inconsistent with terms used in similar RECOVER PMs. For instance RECOVER PM SE-E4 specifies an *average* wet season salinity rather than a *mean* wet season salinity and defines the wet season as June-October rather than May-October.

Uncertainty and CERP Influences – Some ecological PMs may be inappropriate for the project, as a number of influences other than those imposed by Florida Bay waters or the Keys may have significant impacts on the parameters. For example, non-CERP influences that significantly impact coral cover include nutrients or disease entrained by the Florida Current from upstream, nutrients and cold stress caused by local upwelling events, and hurricanes. Another example is the Adult Pink-Shrimp, which was removed from the IG/IT list of indicators because the indicator's target is measured outside the project area (in the Dry Tortugas) and is subject to a large amount of uncertainty. Additionally, RECOVER recognizes that there may not be sufficient information or a scientific basis for the Pre-Adult Snook PM. No larval snook have been caught in Florida Bay. Juvenile snook have been caught in Florida Bay, but there is little information on stages before pre-adult. There may not be sufficient information or a scientific basis for determining that larval snook are or have been present in Florida Bay.

Consistency Among Projects and RECOVER – There are several metrics within the FBFKFS suite of PMs that are also present in neighboring projects like Biscayne Bay Coastal Wetlands (BBCW) and C-111 Spreader Canal. RECOVER suggests the PDT review these project PMs as well as RECOVER PMs to ensure that PM targets, metrics, and evaluation methodologies are consistent. This will enable the comparison of evaluation data among projects and RECOVER. Specific comments on consistency among PM targets and evaluation methodologies are included in Attachment A.

RECOVER also notes there may be some inconsistency between RECOVER PMs, which measure watershed flows and upstream conditions, and FBFKFS PMs, which measure effects on Florida Bay. RECOVER suggests the upstream hydrodynamic conditions be considered to determine the effects on Florida Bay when upstream (RECOVER) targets are not met.

4.0 Conclusions

There is general compatibility between the project-level performance measures and evaluation criteria developed for the FBFKFS and the system-wide performance measures of the Comprehensive Plan. Some revisions are suggested to increase the degree of consistency between project and system-wide performance measures. RECOVER suggests that the PDT reexamine some PM targets to address their utility to differentiate between alternatives. RECOVER also suggests considering the creation of indices for water quality and ecological indicators. Additionally, RECOVER suggests that some of the FBFKFS PMs be reviewed for applicability, uncertainty, and consistency with neighboring projects and RECOVER.

Attachment A: FBFK PM CONSISTENCY REVIEW RECOVER COMMENT TABLE

Objective 1: Physical Conditions and Water Quality

SALINITY

Salinity Performance Measure 1 (SPM-1): annual range

For each bay zone, salinity typically oscillates from a wet season low to a dry season high. Based on studies of bay history and best professional judgment (expressed in the Restudy and CERP development), an expected annual range per zone has been proposed.

Target:

Minimize the magnitude (SPM-1a) and maximize the frequency and duration (components SPM-1b and c, respectively) of low exceedences.
Specified annual salinity ranges in ppt (SPM-1a):
Zone1. 5-15 for Long Sound and Joe Bay, 15-25 in Little Madeira Bay
Zone 2. 15-30
Zone 3. 25-35
Zone 4. 30-35
Zone 5. 15-35
Zone 6. 25-35
Zones 7,8,9. ≤ base
Zone 10,11,12 no change in base
Zones 13 5-15 near shore (including all Manatee Bay), 10-30 off shore
Zone 14 10-20 in Little Blackwater, 15-30 in Blackwater
Zone 15 0-5
Zone 16 < base

Evaluation Method:

For each zone a spatially weighted (per m^2 per zone) daily and weekly mean salinity will be calculated for the evaluation period. From these data, the following aspects of the SPM-1 will be calculated for each evaluation water year:
SPM-1a. mean of all daily low exceedences (when below a zone's specified salinity range) and all high exceedences (when above a zone's specified salinity range);
SPM-1b. total number of low and high exceedence weeks
SPM-1c. duration (number of consecutive weeks) of low/high exceedence periods

Is this PM consistent with RECOVER PMs?

In general, targets for this PM appear consistent with SE-E2 in terms of salinity thresholds, but uses exceedences of the thresholds in time units of weeks. SE-E2 (Interim), the PM used for the Initial CERP Update (ICU) measures exceedences in time units of months. SE-E2 (Proposed), the PM being developed for the area, measures exceedences in frequency (percent) of days in the evaluation period (e.g., for ICU that would be the 36-year evaluation period). Also, FBFKFS looks at mean of exceedence values (high and low) and duration of exceedence periods, whereas SE-E2 does not.

The specific salinity targets for Zone 5 salinities are not consistent with SE-E2 (see Terrapin Bay), and targets for Manatee Bay above are inconsistent with targets for SE-E4. Additionally, the RET has a wet and dry season target for Manatee Bay/Barnes Sound (Zone 13) in SE-E4. The PDT may want to refer to RECOVER PMs SE-E2 and SE-E4 and determine if existing PM target should be adjusted for consistency or refined to account for seasonal changes.

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Salinity Performance Measure 2 (SPM-2): occurrence of rapid salinity decrease.

Target:
A restoration target is to minimize rapid salinity decreases that are at least partially caused by water management. For near shore areas (zones 1, 2, 5,13,15), SPM-2 will be the sum of all days when salinity drops at least 4 ppt and the target is to minimize this sum. Zone 13 will require calculations for at least two subzones (near shore and off shore, with a boundary to be determined).

Evaluation Method:
Manual Calculations

Is this PM consistent with RECOVER PMs?
There is no corresponding RECOVER PM for comparison. The target for this PM seems reasonable, however the PDT may want to document why a salinity drop of 4 ppt is used as the amplitude for rapid salinity change and check consistency with the C-111SC project, which uses 7 ppt for this target. RECOVER also suggests the PDT make the target for this PM more specific in terms of the number of salinity decreases rather than the term minimize. Based on the target of "minimizing" salinity decreases, this PM may be more appropriate as a performance indicator or constraint as it is currently written.

Salinity Performance Measure 3 (SPM-3): timing of seasonal change.

Target:
For all zones in Florida Bay proper and associated near shore zones (zones 1-6 and 13-15), SPM-3 will be the number of consecutive weeks after the end of the wet season (May 1 – October 31) when weekly mean salinity is less than that year's mean wet season salinity

Evaluation Method:
None Identified

Is this PM consistent with RECOVER PMs?
There is no corresponding RECOVER PM for comparison; however, the nomenclature and metrics used in this PM may be inconsistent with terms used in similar RECOVER PMs. For instance RECOVER PM SE-E4 specifies an average wet season salinity rather than a mean wet season salinity and defines the wet season as June-October rather than May-October. RECOVER also suggests documentation be added to the PM to document why the target was chosen and specify whether it is based on best professional judgment (BPJ). Additionally, RECOVER suggests an evaluation method be identified for this PM.

RECOVER also suggests the PDT consider the affect this of this PM on water stages in area canals. Meeting salinity regimes in Florida Bay by holding groundwater stages in South Dade may have the potential to violate the stage duration curves in South Dade cells R10C25, R13C25, R17C27, R19C27, R15C26, and R20C27 (RECOVER PM WS-E3).

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WATER COLUMN LIGHT

Water Column Light Regime (WCL.PM)

Target:
Target performance metrics for water column light performance measures are presented here. Units are mean daily per cent surface irradiance for WCL.PM-1, attenuation coefficient in m^{-1} for WCL.PM-2 and WCL.PM-3, and mg cm^{-2} dry weight for epiphyte and benthic algal growth on seagrass plants and corals. As presented, all metrics are thresholds, with the target criterion sign indicating a "not-to-exceed" value. The targets for WCL.PM-1 and WCL.PM-2, WCL.PM-3 and WCL.PM-4 are valid for the ten year projections.

ZONE	WCL.PM-1 Bottom Illumination	WCL.PM-2 Chlor a Attenuation	SAV.SC.PM-3 Non-chla Attenuation	SAV.SC.PM-4 Epiphyte/algal surface load
1	>35% of surface	< 1.0	<0.45	<6 mg cm^{-2}
2	>35% of surface	< 1.0	<0.45	<6 mg cm^{-2}
3	>35% of surface	< 1.4	<0.45	<6 mg cm^{-2}
4	>35% of surface	< 1.4	<0.45	<6 mg cm^{-2}
5	>35% of surface	< 1.4	<0.25	<6 mg cm^{-2}
6	>35% of surface	< 1.4	<0.25	<6 mg cm^{-2}
7	>35% of surface	< 1.4	<0.25	<6 mg cm^{-2}
8	>35% of surface	< 1.4	<0.25	<6 mg cm^{-2}
9	>35% of surface	< 1.4	<0.25	<1 mg cm^{-2}
10	>30% of surface	< 0.05	<0.05	<1 mg cm^{-2}
11	>30% of surface	< 0.05	<0.05	<1 mg cm^{-2}
12	>30% of surface	< 0.05	<0.05	<1 mg cm^{-2}
13	>35% of surface	< 1.4	<0.25	<6 mg cm^{-2}
14	>35% of surface	< 1.4	<0.25	<6 mg cm^{-2}
15	>35% of surface	< 1.4	<0.25	<6 mg cm^{-2}
16	>35% of surface	< 1.4	<0.25	<6 mg cm^{-2}

Evaluation Method:
Evaluation of Alternatives will require the development and validation of WQ models.

Is this PM consistent with RECOVER PMs?
There is no corresponding RECOVER PM for comparison. Using water column light regime may be redundant to the nutrient and algal bloom PMs, which are the primary affecters of light that the project might manipulate. In other words, if the target nutrient loading and algal bloom are attained, the target light regime should also be attained. RECOVER suggests the PDT consider the redundancy of this PM. Additionally, the PDT could specify whether the target for this PM is no exceedances or if there may be some acceptable events?

Attachment A: FBFK PM CONSISTENCY REVIEW RECOVER COMMENT TABLE

DISSOLVED OXYGEN CONCENTRATIONS
Target: DO concentration means The target for this performance measure component is to minimize the frequency of these events. DO concentration minima. The target is to minimize anoxic or near anoxic events. Duration of anoxic and hypoxic conditions. The target is to minimize the above median and to minimize the total number of consecutive anoxic/hypoxic nights over the evaluation period. **Evaluation Method:** DO concentration means. Spatially averaged, daily means of modeled sub-daily DO estimates will be calculated for each zone. In a one-layer model, the following applies to the entire water column. In a 3-D model, the following metrics apply to the mean of all layers. The frequency of hypoxic events (< 2.0 mg/l) per year (per zone) will be tabulated and the median annual frequency of hypoxic days and maximum frequency (worst case year) of these low DO events for the FBFKFS evaluation period will be presented. DO concentration minima. Spatially averaged, hourly DO values will be calculated and daily minima tabulated for each zone for the evaluation period. The frequency of daily minima in two ranges (< 0.5 and 0.5-2.0 mg/l) over this period will be calculated. Duration of anoxic and hypoxic conditions. The duration (number of consecutive days, ≥ 2) of each anoxic or near anoxic event (with DO < 0.5 mg/l for at least one hour per day) that occurs will be tabulated for each zone. From these results, the median duration of these events (number of consecutive days) over the evaluation period will be calculated. The sum of all consecutive anoxic/hypoxic days over the evaluation period will also be calculated.
Is this PM consistent with RECOVER PMs? There is no corresponding RECOVER PM for comparison. RECOVER suggests the PDT make the target for this PM more specific in terms of the frequency of exceedances rather than the term minimize. Based on the target of "minimizing" the number of events, this PM may be more appropriate as a performance indicator. RECOVER recommends the target for DO concentration means be changed to zero events; the target for DO concentration minima be changed to zero occurrences; and the target for Duration of anoxic and hypoxic conditions be changed to zero occurrences.

Attachment A: FBFK PM CONSISTENCY REVIEW RECOVER COMMENT TABLE

NUTRIENT LOADING CONCENTRATIONS
Target: Concentration medians. For each zone, the target is to maximize the negative difference between modeled and empirical values (by minimizing modeled nutrient concentrations). Concentration maxima. For each zone, the target is to maximize the negative difference between modeled and empirical values (by minimizing modeled nutrient concentrations). Nutrient loading. The target for inputs to each zone, the northern and western boundaries, and the sum of these boundary zones, is to minimize nutrient loading that exceeds natural levels. Given that the magnitude of such natural levels are not known, it is considered desirable to minimize any future increases in nutrient loading. **Evaluation Method:** Concentration medians. For each zone, spatially averaged daily mean TP, TN, and DIN concentrations will be calculated from model results. For each month of evaluation, the median of these daily mean values will be determined. These values will be compared to empirical values from the SFWMD/FIU monitoring program's monthly grab samples. A median of each month for the period of record, reflecting a "typical" year, will be calculated from these field data. The difference between each month's modeled concentration (its median) and this typical empirical concentration will be calculated. From these results, a mean difference for each of 12 months will be computed and plotted over the evaluation period. A grand mean difference between modeled and empirical results also will be calculated from these monthly differences. Concentration maxima. For each zone, spatially averaged daily mean TP, TN, and DIN concentrations will be calculated from model results. For each month of evaluation, the maximum of these daily mean values will be determined. These values will be compared to empirical values from the SFWMD/FIU monitoring program's monthly grab samples. A maximum of each month for the period of record, reflecting a "worst case" year, will be calculated from these field data. The difference between each month's modeled concentrations and this worst-case empirical concentration will be calculated. From these results, a mean difference for each of 12 months will be computed and plotted over the evaluation period. A grand mean difference between modeled and empirical results also will be calculated from these monthly differences. Nutrient loading. Annual outputs of TP, TN, and DIN from the Everglades directly toward the Florida Bay boundary (direct inputs to northern Bay boundary zones 13, 1, 3, 15) and indirectly toward the Bay via the Gulf of Mexico (western Everglades' inputs to western Bay boundary zones 16 and 8) will be calculated. For the evaluation period, mean annual nutrient loading from the Everglades will be compared among alternatives.
Is this PM consistent with RECOVER PMs? There is no corresponding RECOVER PM for comparison. Based on the target of "minimizing" nutrient concentrations, this PM may be more appropriate as a performance indicator. A regulatory basis for nutrient loading would be easier to evaluate, or alternatively, a WQ index could be developed to provide a better tool for decision-making. Additionally, the target not to exceed values that have been "typical" since 1991 raises the questions regarding the POR for this determination. Nutrient levels during that relatively brief could be unnaturally high. Is there a longer period of record from which to establish this target? The PDT is also cautioned to recognized that increased flow to Florida Bay to meet salinity regimes may increase the loading of TP and TN to Florida Bay. Mainland sources of water are higher in nutrients than the atmospheric sources currently typical of Florida Bay (Walker 1997. , Rudnick et al, 1999). The PDT may want to consider this when setting baselines.

Attachment A: FBFK PM CONSISTENCY REVIEW RECOVER COMMENT TABLE

ALGAL BLOOMS

The general target for algal bloom performance measures is to prevent any increase in the extent or intensity of such blooms in Florida Bay or adjacent waters within the FBFKFS boundary. It is desired that restoration alternatives result in minimal algal blooms.

Target:

Components of the algal bloom performance measure are bloom intensity (chlorophyll a concentration as µg/l), spatial extent (m^2), and duration (weeks). For all zones, the target is to minimize all three of these components. In zones 9-12, no change in base is expected and the target is that there should be no increase in chlorophyll a.

A fourth component of the algal bloom performance measure is the taxonomic composition of algal blooms, distinguishing the dominance of cyanobacteria in central Florida Bay and diatoms in western Florida Bay. For zones 2-5, a decrease in the biomass of cyanobacteria from the 2000 base is targeted. For all zones, the target for the biomass of diatoms is no increase above the 2000 base

For each zone, an acceptable range of weekly mean chlorophyll a concentrations is specified as follows:

Zone1,2,4,6,9-14	0-2
Zone 3,5,8,16	0-5
Zone 7	0-3
Zone 15	no change from base

Evaluation Method:

For all zones, daily chlorophyll a concentrations will be estimated from a water quality model's output. For each year in each zone, the following components of the Algal Bloom Performance Measure (ABPM) will then be calculated:

- ABPM-a. mean concentration (spatially averaged per zone);
- ABPM-b. mean concentration during weeks when weekly mean concentrations exceed upper limit of specified range;
- ABPM-c. spatial extent (m^2) within a zone where weekly mean concentrations exceed upper limit of specified range;
- ABPM-d. duration (number of weeks) within a zone with weekly mean concentrations that exceed upper limit of specified range.

The water quality model will also estimate the proportion of algal biomass that is two taxonomic groups – cyanobacteria and diatoms. .

Is this PM consistent with RECOVER PMs?

There is no corresponding RECOVER PM for comparison. Because both dissolved oxygen deficits and algal blooms (chlorophyll) are driven by nutrients, there are questions of independence for these PMs. RECOVER suggest the PDT examine whether a water quality index could be developed to address these aspects of water quality. Additionally, RECOVER suggests documentation and references be added to document where the numbers representing acceptable ranges of weekly mean chlorophyll a concentrations for each zone originate.

Attachment A: FBFK PM CONSISTENCY REVIEW RECOVER COMMENT TABLE

Objective 2: Submerged Aquatic Vegetation

SUBMERGED AQUATIC VEGETATION BIOMASS

SAV biomass performance measure (SAV.B.PM-1): mean annual biomass.
This component is spatially averaged per zone or per sub-zone, as indicated.

SAV biomass performance measure (SAV.B.PM-2): seasonal variability. The second component is a metric that reflects seasonal variability, with the calculation of mean changes between wet and dry seasons. Variability in seasonal biomass is to be measured as the percent change of the mean seasonal biomass versus the mean annual biomass.

SAV biomass performance measure (SAV.B.PM-3): frequency of die-off events. The third component is a metric that will be used to track the frequency of die-off events, where a die-off event is considered to be an abrupt (month to month) loss of dense *Thalassia* to to zero g m^{-2}, forming bare patches that are larger than a specified minimum map unit (100 m^2). Species other than *Thalassia* do not experience the die-off phenomenon in Florida Bay

Target:
Target performance metrics for the SAV biomass performance measures are presented here. The targets for SAV.B.PM-1, SAV.B.PM-2 and SAV.B.PM-3 are valid for a minimum of ten year projections.

SAV.B.PM-1 units are mean annual biomass in dry weight m^{-2}. The SAV.B.PM-1 target range is ±20% of the stated criterion. Monthly values should not fall outside the target envelope more than two times consecutively or four times cumulatively per water year (June-June).

SAV.B.PM-2 units are % deviation of mean wet and dry season biomass from the annual mean. SAV.B.PM-2 is a per cent difference between wet and dry season biomass means and as such, are calculated only one time per water year. The stated envelopes cover a fairly large range and values should not fall outside this range.

SAV.B.PM-3 is the number of occurrences of die-off per zone for *Thalassia* only, per year. For SAV.B.PM-3, biomass goes to zero according to the criteria established in PM components section above. The criterion for this PM (zero in all cases) should not be exceeded at all during the water year.

ZONE	SAV.B.PM-1 Biomass	SAV.B.PM-2 Variability	SAV.B.PM-3 Die-off
1	50	Wet: 50 to 100% Dry: 50% to 100%	0
2	50	North Wet: 50 to 100% Dry: 50% to 100% South Wet: 25 to 50% Dry: 25% to 50%	0
3	North: 200 South:	North Wet: 50 to 100% Dry: 50% to 100% South Wet: 25 to 50% Dry: 25% to 50%	0
4	200	North	0

		Wet: 50 to 100% Dry: 50% to 100% South Wet: 25 to 50% Dry: 25% to 50%	
5	150	Wet: 50 to 100% Dry: 50% to 100%	0
6	100	Wet: 25 to 50% Dry: 25% to 50%	0
7	200	Wet: 25 to 50% Dry: 25% to 50%	0
8	200	Wet: 25 to 50% Dry: 25% to 50%	0
9	200	Wet: 25 to 50% Dry: 25% to 50%	0
10	150	Wet: 25 to 50% Dry: 25% to 50%	0
11	150	Wet: 25 to 50% Dry: 25% to 50%	0
12	150	Wet: 25 to 50% Dry: 25% to 50%	0
13	North: 300 South:	Wet: 50 to 100% Dry: 50% to 100%	0
14	North: 50 South:	Wet: 50 to 100% Dry: 50% to 100%	0
15	75	Wet: 50 to 100% Dry: 50% to 100%	0
16	200	Wet: 50 to 100% Dry: 50% to 100%	0

Evaluation Method:
Model not specified

Is this PM consistent with RECOVER PMs?
There is no corresponding RECOVER PM for comparison. RECOVER suggests the PDT examine the use of an SAV index (potentially an HSI). The PDT may also consider ensuring consistency among projects and RECOVER as to what aspect of SAV is being measured (to enable comparisons between PMs) and ensuring the evaluation method will be capable of providing the output required by the PM

Attachment A: FBFK PM CONSISTENCY REVIEW RECOVER COMMENT TABLE

TOTAL SAV COMMUNITY COVERAGE

Total SAV Community Coverage (SAV.CC.PM)

The SAV.CC.PM performance measure assesses the amount of bottom that is colonized by submersed aquatic vegetation (SAV), or seagrasses. Water quality conditions should be optimized under restoration alternatives such that conditions are favorable for species in Florida Bay

SAV.CC.PM-1 evaluates the areal coverage of the bed using Braun-Blanquet criteria.
Units = Percent of bottom within a zone that is covered by submersed aquatic vegetation

SAV.CC.PM-2 evaluates the occurrence of die-back areas or blow-out holes.
Units = Number of occurrances per zone per year of a die-back incident.

SAV.CC.PM-3 evaluates the intra-annual variability of seagrass coverage

Target:
Target performance metrics for the SAV PMs are presented here. The targets for SAV.CC.PM-1 and SAV.CC.PM-2 and SAV.CC.PM-3 for dry and wet seasons are valid for the ten year projections.

ZONE	SAV.CC.PM-1 Cover	SAV.CC.PM-2 Die-back	SAV.CC.PM-3 Seasonal Variability
1	4	0	<100%
2	3	0	<100%
3	4 or 5	0	<25%
4	4 or 5	0	<25%
5	4 or 5	0	<25%
6	4 or 5	0	<25%
7	5	0	<25%
8	5	0	<25%
9	5	0	<25%
10	5	0	<25%
11	5	0	<25%
12	5	0	<25%
13	4	0	<25%
14	4	0	<50%
15	5	0	<25%
16	5	0	<25%

Evaluation Method:
Model not specified

Is this PM consistent with RECOVER PMs?
There is no corresponding RECOVER PM for comparison. RECOVER suggests the PDT consider whether the sampling methodology is consistent with CERP estuary projects and potentially the BBCW sampling methodologies.

Attachment A: FBFK PM CONSISTENCY REVIEW RECOVER COMMENT TABLE

Submerged Aquatic Vegetation Species Composition (SAV.SC)

SAV.SC.PM-1: identification of the dominant species by Braun-Blanquet areal coverage

SAV.SC.PM-2: quantification of the relative Braun-Blanquet coverage for each species in a zone, expressed as four Braun-Blanquet scores in the order: Tt, Sf, Hw, Rm

SAV.SC.PM-3: qualitative expression of the seasonally averaged transition from current community composition to a new composition, probably with the first 5 y of restoration. The trend targeted is for coverage by four target species in this order: Tt Sf Hw Rm, by indicating either: "+," "0," or "-" to mean: increase, no change, decrease in Braun-Blanquet score from the initial structure.

Target:

ZONE	SAV.SC.PM-1 Dominance	SAV.SC.PM-2 Coverage Tt Sf Hw Rm	SAV.SC.PM-3 Trend Tt Sf Hw Rm
1	Rm	0,0,3,5	-,0,+,+
2	North: Rm South: Hw or Tt	North: 3,0,3,5 South: 4,0,4,1	North: -,0,+,+ South: 0,0,+,+
3	North: Rm or Hw South: Hw or Tt	North: 3,0,4,4 South: 4,0,4,1	North: -,0,+,+ South: 0,0,+,+
4	Tt	4,2,3,1	0,0,+,+
5	Rm or Hw	2,0,3,4	-,0,+,+
6	Tt	4,2,3,0	0,0,+,0
7	Tt or Sf	4,5,3,0	0,0,+,0
8	Tt or Sf	4,5,3,0	0,0,+,0
9	Tt or Sf	4,5,3,0	0,0,0,0
10	Tt	4, 3,2,0	0,0,0,0
11	Tt	4,3,2,0	0,0,0,0
12	Tt	4,3,2,0	0,0,0,0
13	North: Rm or Hw South: Hw or Tt	North: 2,0,3,4 South: 3,0,4,1	North: -,0,+,+ South: 0,0,+,+
14	North: Rm South: Tt or Hw	North: 2,0,3,4 South: 4,0,3,1	North: -,0,+,+ South: 0,0,+,+
15	Rm	0,0,1,5	0,0,0,+
16	Tt or Hw	4,3,4,1	0,0,+,+

Evaluation Method:
Model not specified

Is this PM consistent with RECOVER PMs?
There is no corresponding RECOVER PM for comparison. This PM anticipates that Ruppia and Halodule will supplant Thalassia based on salinity changes in the northern project area. Considering the fact that Thalassia can tolerate relatively low salinities, will some disturbance event, such as a hurricane, be required to jump-start the transition?

Attachment A: FBFK PM CONSISTENCY REVIEW RECOVER COMMENT TABLE

Objective 3: Coral Reef Ecosystem
CORAL COVER
A widely used parameter to gauge the health of coral reefs is the amount of live coral, typically measured as percent cover. Long-term, status-and-trends monitoring of coral reefs and hard-bottom communities in the Florida Keys National Marine Sanctuary, which began in 1996, has included this measure. Environmental factors that can affect coral changes and will be considered in this evaluation are temperature, salinity, light attenuation, nutrient concentrations, sedimentation, and subaquatic vegetation including seagrasses and benthic algae. **Target:** The target for coral cover (total percent cover and species composition) is no change over the period of evaluation (at least 10 years). This performance measure applies only to zones 10, 11, and 12. **Evaluation Method:** Model not specified
Is this PM consistent with RECOVER PMs? There is no corresponding RECOVER PM for comparison. This PM may be inappropriate for the project, as a number of influences other than those imposed by Florida Bay waters or the Keys may significantly impact coral cover (e.g. nutrients or disease entrained by the Florida Current from upstream; nutrients and cold stress caused by local upwelling events; hurricanes). If the PDT is able to determine what effects are due to CERP, an HSI model may be an initial start for a PM. Additionally, this PM and several of the habitat and organism PMs do not have clear targets that lead to decision-making. Evaluation methodology needs to be developed. For example how might changes in hydrology in the Everglades affect corals? How will changes between alternatives be sensed?

Attachment A: FBFK PM CONSISTENCY REVIEW RECOVER COMMENT TABLE

Objective 4: Upper Trophic Levels
PINK SHRIMP ABUNDANCE
Target: The target for all areas is an increase in pink shrimp density, but such an increase is not expected to be a result of restoration actions for zones outside of Florida Bay proper or in northeastern Florida Bay. In central and western Florida Bay zones, specific density thresholds that are based on historic trapping statistics (Robblee et al., unpublished) are as follows. Semi-annual density targets for Florida Bay Pink Shrimp: Zone 3: $\geq$ 5/ m^2 Zone 5 $\geq$ 5/m^2 Zone 16: $\geq$ 17/m^2 Zone 4: $\geq$ 17/m^2 Zone 6: $\geq$ 7/m^2 In order to account for potential spatial shifts in density among these zones and among other zones, a mean monthly density will be also calculated for the entire FBFKFS region (with all zones) and semi-annual peak densities tabulated. Alternatives will be evaluated with a target of maximizing this overall shrimp density. **Evaluation Method:** Pink shrimp growth and survival will be simulated for the evaluation period using a model of growth and survival as a function of salinity and temperature (Browder et al. 2002) in combination with empirical knowledge of seagrass habitat relationships (with rules based on statistical functions to be incorporated in this model). Input data to the pink shrimp model will be from the FBFKFS hydrodynamic and seagrass models. This model will not evaluate the effect of changing predation by the fish community and thus will represent a potential pink shrimp population response and not a prediction of realized abundance.
Is this PM consistent with RECOVER PMs? There is no corresponding RECOVER PM for comparison. RECOVER suggests documentation be added to detail the current pink shrimp densities and the relationship between these densities and the PM targets for Zones 3-6 and 16.

ADULT PINK SHRIMP HARVEST
Target: This FBFKFS Performance Measure will target the annual average catch of all shrimp (pounds of shrimp per vessel-day of fishing), as well as the catch of two size fractions of shrimp. The target is a catch of at least 520 pounds per vessel-day of total catch (combined small and large shrimp), with at least 400 pounds as large shrimp. **Evaluation Method:** Pink shrimp harvest will be calculated from statistical models of harvest as a function of Everglades hydrologic conditions (Sheridan 1996, Ehrhardt and Legault 1999). These conditions will be predicted by TIME or hydrologic models that are used to evaluate FBFKFS alternatives.
Is this PM consistent with RECOVER PMs? There is no corresponding RECOVER PM for comparison. While RECOVER recognizes that the numerical target for this PM is a good tool for decision-making and differentiating between alternatives, it is important to note that the Adult Pink-Shrimp was removed from the IG/IT list of indicators because the indicator's target is measured outside the project area (in the Dry Tortugas) and is subject to a large amount of uncertainty.

Attachment A: FBFK PM CONSISTENCY REVIEW RECOVER COMMENT TABLE

JUVENILE SPINY LOBSTER SURVIVORSHIP
Target: **1.** Minimize any decrease in survivorship for juvenile lobster (< 50 mm carapace length) in Zone 2. **2.** No change from baseline for juvenile lobster populations in Zones 4 and 6. **3.** No change from baseline for juvenile lobster populations in Zones 7, 8, 9, 10, 11, and 12. **Evaluation Method:** A lobster population model, similar to that of Butler (2003), will be used in the FBFKFS. This model will evaluate survivorship as a function of larval supply, environmental conditions, and habitat availability. The time step for models will be daily, while the evaluation intervals should be done monthly in order to evaluate how changing conditions in nursery areas will affect survival of juvenile lobsters. Units will be expressed as the percent survivorship.
Is this PM consistent with RECOVER PMs? There is no corresponding RECOVER PM for comparison. RECOVER suggests the PDT make the target for this PM more specific in terms of the frequency of survivorship rather than the term minimize. Based on the target of "minimizing" the decreases in survivorship, this PM may be more appropriate as a performance indicator or constraint as it is currently written.

DENSITY, BIOMASS, AND EVENNESS OF DOMINANT AND COMMON FORAGE FISH SPECIES.
Target: The target of this performance measure is an abundant and balanced set of dominant and common forage fish species with biomass distributed across species. Forage fish models should be evaluated in order to achieve the following outcomes: • Maximize density, biomass, and evenness in Florida Bay Zones 2, 3, 4, 5, 6, 13, 14, and 16 (to achieve Bay-wide increase) and mangrove transition Zones 1 and 15 (to achieve nearshore increase). • No significant decrease to baseline results in Gulf Transition Zones 7, 8, and 9 or Atlantic Zones 10, 11, and 12. Where community parameter increases in one Zone correspond to decreases in another, alternatives that maximize results in Zones 3 and 6 (areas of greatest seagrass dieoff) should be preferred over those that produce large declines in these Zones **Evaluation Method:** Models to be used to evaluate this performance measure may be based upon statistical relationships that have been established. Johnson et al. (2002a and 2002b) and Lorenz (1997) have analyzed empirical data from Florida Bay and its salinity Transition Zone and described relationships between forage fish species and environmental factors.
Is this PM consistent with RECOVER PMs? There is no corresponding RECOVER PM for comparisons. This PM and several of the habitat and organism PMs do not have clear targets that lead to decision-making. RECOVER suggests the target for this PM be more defined. The terms "abundant and balanced", "maximize", and "no significant decrease" should be replaced by numeric targets. As currently written, this PM may be more appropriate as a performance indicator or constraint.

Attachment A: FBFK PM CONSISTENCY REVIEW RECOVER COMMENT TABLE

DENSITY OF PRE-ADULT SPOTTED SEATROUT (CYNOSCION NEBULOSUS) [HTL.1A]
Target: The general target for this performance measure is an increase in the abundance of Florida Bay's seatrout population. Models should be evaluated in order to achieve the following outcomes: • Maximum increase to seatrout density in Zone 3. Increase in this Zone is expected if improvements are made to salinity and dissolved oxygen regimes (decrease in magnitude and duration of hypersaline events and improved water circulation, especially during summer months), SAV heterogeneity is increased, and the forage base is enhanced (pink shrimp and prey fish). • Moderate increases to pre-adult seatrout densities in Zones 4 and 16. Though buffered by Gulf of Mexico waters, these Zones may also experience some of the effects described above (to a lesser degree). • No appreciable changes from baseline densities in Zones 1, 2, 5, 6, 13, 14, and 15. **Evaluation Method:** A bioenergetic model (such as by Wuenschal (2002)) that considers environmental factors, such as salinity and temperature, may be employed for the FBFKFS evaluation. Any model will consider SAV habitat changes as an infuence on seatrout abundance and this relationship may be derived from empirical statistical functions.
Is this PM consistent with RECOVER PMs? There is no corresponding RECOVER PM for comparison. RECOVER notes that this target of "maximizing" abundance doesn't appear to lend itself for use in an evaluation methodology with which the Corps is familiar, and is not conducive to making decisions in distinguishing between alternatives. Documenting the linkage between the PM target and the evaluation methodology would clearly show how the PMs could be used to make decisions. This PM may be more appropriate as a constraint to evaluate alternatives.

CATCH OF ADULT SPOTTED SEATROUT (CYNOSCION NEBULOSUS)
Target: Models will be evaluated to achieve the following results: • Maximize CPUE (across all years, total CPUE) in Zones 1-6 and 13-16 (Zones 7-12 not applicable unless data become available). • Maximize number of years where CPUE > baseline CPUE **Evaluation Method:** Model not Specified
Is this PM consistent with RECOVER PMs? There is no corresponding RECOVER PM for comparison. RECOVER notes that this target of "maximizing" CPUE doesn't appear to lend itself for use in an evaluation methodology with which the Corps is familiar, and is not conducive to making decisions in distinguishing between alternatives. Documenting the linkage between the PM target and the evaluation methodology would clearly show how the PMs could be used to make decisions. This PM may be more appropriate as a constraint to evaluate alternatives.

Attachment A: FBFK PM CONSISTENCY REVIEW RECOVER COMMENT TABLE

DENSITY OF PRE-ADULT SNOOK
Target: The overall target is to maximize the snook population in Florida Bay. Models should be evaluated in order to achieve the following outcomes: • Densities > 0 larvae/m^2 in zones 1, 5, and 15 due to increased freshwater flow to these regions. • An increase over baseline densities of juveniles in Zones 1, 2, 3, 4, 5, 6, 13, 14, and 15 due to improved salinity and dissolved oxygen regimes (decrease in magnitude and duration of hypersaline events and improved water circulation, especially during summer months), increased heterogeneity in SAV communities, and enhanced forage base (crustaceans and prey fish). • No appreciable changes to baseline densities in Zones 8, 9, 10, 11, 12, and 16 (systems buffered by Gulf influence). **Evaluation Method:** Model not Specified
Is this PM consistent with RECOVER PMs? There is no corresponding RECOVER PM for comparison. RECOVER notes that this target of "maximizing" abundance doesn't appear to lend itself for use in an evaluation methodology with which the Corps is familiar, and is not conducive to making decisions in distinguishing between alternatives. Documenting the linkage between the PM target and the evaluation methodology would clearly show how the PMs could be used to make decisions. This PM may be more appropriate as a constraint to evaluate alternatives. RECOVER notes that there may not be sufficient information or a scientific basis for this PM. No larval snook have been caught in Florida Bay. Juvenile snook have been caught in Florida Bay, but there is little information stages before pre-adult. There may not be sufficient information or a scientific basis for determining that larval snook are or have been present in Florida Bay. The adults are reproducing in the Keys.

CATCH OF ADULT SNOOK (CENTROPOMUS UNDECIMALIS)
Target: Models will be evaluated to achieve the following results: • Maximize CPUE (across all years, total CPUE) in Zones 1-6 and 13-16 (Zones 7-12 not applicable unless data become available). • Maximize number of years where CPUE > baseline CPUE **Evaluation Method:** Model not Specified

Attachment A: FBFK PM CONSISTENCY REVIEW RECOVER COMMENT TABLE

Is this PM consistent with RECOVER PMs?

There is no corresponding RECOVER PM for comparison. RECOVER notes that this target of "maximizing" abundance doesn't appear to lend itself for use in an evaluation methodology with which the Corps is familiar, and is not conducive to making decisions in distinguishing between alternatives. Documenting the linkage between the PM target and the evaluation methodology would clearly show how the PMs could be used to make decisions. This PM may be more appropriate as a constraint to evaluate alternatives.

RECOVER notes that targets for this PM are identical to those for adult sea trout. Has the PDT considered combining these PMs?

ROSEATE SPOONBILL NEST ABUNDANCE

Target:

Models will be based on recent statistical relations that have been established (e.g. Lorenz 2002) and will be evaluated in order to achieve the following outcomes:

- Maximize Bay-wide number of nests (across all Zones), to a level $\geq$ 700. Although migration is possible among colonies, increases to nest numbers in one Zone should not come at the extreme loss (> 50% reduction between nesting years) of those in another Zone.
- Maximize increase in number of nests in Zone 2, $\geq$ 500 nests. This Zone encompasses present and former spoonbill colonies within the northeastern and southeastern regions of Florida Bay.
- Sustain number of colonies in Zone 4, $\geq$ 200 nests. Surveys over the last 10 years have suggested that this area is able to support this number of nests (on average).
- Sustain number of colonies in Zone 6, $\geq$ 30 nests.
- Increase number of nests to > 0 in Zones 3, 13, and 15 (Cuthbert Lake rookery).

Evaluation Method:

No Model Specified

Is this PM consistent with RECOVER PMs?

There is no corresponding RECOVER PM for comparison. RECOVER recognizes that roseate spoonbills are a good indicator from hydrologic modeling and their nesting and feeding habits cover the project area. RECOVER also notes that this target of "maximizing" abundance doesn't appear to lend itself for use in an evaluation methodology, and is not conducive to making decisions in distinguishing between alternatives. Documenting the linkage between the PM target and the evaluation methodology or redefining a numeric target would clearly show how the PMs could be used to make decisions. This PM may be more appropriate as a constraint to evaluate alternatives.

ROSEATE SPOONBILL NESTING SUCCESS

Target:

Models should be evaluated in order to achieve the following outcomes:

- Maximize colony success in Zones 2 and 4 to respectively average (across nesting seasons) $\geq$ 1.25 chicks per nest, with success (> 1 chick per nest) occurring at least 75% of nesting seasons.
- Sustained colony success in Zone 6 to average $\geq$ 1.0 chick per nest (across nesting seasons), with success (> 1 chick per nest) occurring at least 75% of nesting seasons.
- Evidence of colony success in Zones 3, 13, and 15.

Attachment A: FBFK PM CONSISTENCY REVIEW RECOVER COMMENT TABLE

Evaluation Method:
No Model Specified

Is this PM consistent with RECOVER PMs?
There is no corresponding RECOVER PM for comparison. RECOVER recognizes that roseate spoonbills are a good indicator from hydrologic modeling and their nesting and feeding habits cover the project area. RECOVER also notes that this target of "maximizing" colony sucess doesn't appear to lend itself for use in an evaluation methodology, and is not conducive to making decisions in distinguishing between alternatives. Documenting the linkage between the PM target and the evaluation methodology or redefining a numeric target would clearly show how the PMs could be used to make decisions. This PM may be more appropriate as a constraint to evaluate alternatives.

AMERICAN CROCODILE NEST SUCCESS AND PRE-ADULT LIFE HISTORY

Target:
Models should be evaluated in order to achieve the following outcomes:

- Maximize colony success in Zones 2 and 4 to respectively average (across nesting seasons) $\geq$ 1.25 chicks per nest, with success (> 1 chick per nest) occurring at least 75% of nesting seasons.
- Sustained colony success in Zone 6 to average $\geq$ 1.0 chick per nest (across nesting seasons), with success (> 1 chick per nest) occurring at least 75% of nesting seasons.
- Evidence of colony success in Zones 3, 13, and 15.

Evaluation Method:
No Model Specified

Is this PM consistent with RECOVER PMs?
There is no corresponding RECOVER PM for comparison.

GENERAL COMMENTS

RECOVER notes there may be some inconsistency between RECOVER PMs, which measure watershed flows and upstream conditions, and FBFKFS PMs, which measure effects on Florida Bay. RECOVER suggests the upstream hydrodynamic conditions be considered to determine the effects on Florida Bay when upstream (RECOVER) targets are not met.

RECOVER suggests all PMs be consistent with the Florida Bay Conceptual Ecological Model.

RECOVER recognizes a significant effort will be needed to create and support the models necessary to support these PMs. There is some concern that the various hydrologic, hydrodynamic, and ecological models on which these performance measures depend will be available/useful.