Lake Okeechobee Ecological Indicator Score Performance Measure Comment Response Matrix for the public review period from August 18 – 31, 2016.

Public Review Comments	**Lake Okeechobee Ecological Indicator Score (LOEIS) PM Comments From The Public Review Period**	**Lake Okeechobee Regional Coordinator Responses**
U.S. Sugar Corporation Comment 1	With the limited information provided to date, it is difficult to assess, in isolation, how the proposed LOEIS Performance Measure may be applied or weighted in comparison to non-environmental performance measures, such as protecting water supply, when selecting a project alternative.	The LOEIS does not address water supply. There are other approved performance measures that are used for this purpose. The LOEIS would typically be used in the same way as currently approved Lake Okeechobee hydrologic surrogates for ecological benefits.
U.S. Sugar Corporation Comment 2	Of concern is the potential to apply the proposed LOEIS Performance Measure in favor of alternative CERP projects and Lake regulation schedules that, if implemented, might result in unprecedented low Lake level operations.	The range of stages that characterize LOEIS output are not that different from the approved Lake Okeechobee stage envelope PM, except that they examine lake stages in particular months for various ecological attributes.
U.S. Sugar Corporation Comment 3	The draft LOEIS Performance Measure, as currently proposed, may result in the continued application of an adversely impacted level of certainty for Lake water users, per the Interim 2008 Lake Okeechobee Regulation Schedule (2008 LORS), as a level of performance. This is not an acceptable level of performance and is in direct contravention to CERP.	The LOEIS PM is based on actual lake data that extends beyond the period of time that the lake has been operated under the 2008 LORS schedule. Therefore, the LOEIS PM does not selectively favor any particular operating schedule.
U.S. Sugar Corporation Comment 4	The Congressional mandate to protect water supply is clear. Restoration of the Everglades ecosystem, including Lake Okeechobee's ecology, must be incrementally implemented while also "…providing for other water related needs of the region, including water supply and flood protection." CERP project development must accord sufficient weight to meeting existing and future water supply demands, including restoration of water supply performance for Lake users from a diminished 2008 LORS performance to the "1 in 10 level of certainty" which serves as the predicate for federal and state law water supply assurances.	See responses to Comments 1-3.

U.S. Sugar Corporation Comment 5	If the LOEIS Performance Measure as proposed is implemented as a primary (or even secondary LOW Project goal), it may result in selection of LOW Project alternative(s) that yield an unacceptable reallocation of Lake water away from Florida's permitted users in violation of state and federal laws, including CERP. This unauthorized and unsatisfactory situation is exacerbated by the on-going failure to renew the currently suspended SFWMD portable forward pumps (PFP) permit, without constraints, as modeled in 2008 LORS. For these and other reasons, the proposed draft LOEIS Performance Measure appears inappropriate in light of implementation principles, agreements, processes and assumptions for CERP that are crafted to assure achievement of CERP's overarching objective.	The LOEIS PM is based on an extensive temporal monitoring data set for a variety of key Lake Okeechobee ecological indicators. It is not intended to evaluate any other aspect of lake performance except the impact of stage on these indicator group abundances or plant coverage.
U.S. Sugar Corporation Comment 6	The draft LOEIS Performance Measure, if approved for use, will substantially affect CERP project development, including the LOW Project alternative selection.	If used in the LOWP, the draft LOEIS PM will be only one of a suite of PMs used to evaluate various project alternatives. It is therefore unlikely to have an undue effect on selection of the TSP.
U.S. Sugar Corporation Comment 7	The scores are based on "empirically derived statistical relationships between lake stage and associated measured ecological responses". LOEIS Performance Measure, p. 1 at 27-28. The raw data, statistical analyses and the metadata relating to the collection of measured ecological responses are not provided.	The raw data and statistical results for the strongest correlations are presented in the Appendix A graphs.
U.S. Sugar Corporation Comment 8	It appears the scoring is tied primarily to Lake stage in certain months, which is problematic because additional confounding ecological conditions beyond Lake Stage affect the ecology of the Lake.	Lake stage integrates and modifies most of the major Lake Okeechobee ecological processes. It also drives most lake management activities, therefore it is a critical metric for lake ecological performance.
U.S. Sugar Corporation Comment 9	It is unclear whether the "strongest statistical relationship" between ecological indicator and lake stage is truly statistically significant (see Appendix A of the draft LOEIS Performance Measure), whether the short period of record for the measurements of ecological responses impacts the	The correlation r and p-values are listed for each relationship on the graph, so it is clearly illustrated that these relationships are statistically significant. Also, the period of record for each indicator except for the two periphyton indicators range between 9 and 14 years, while the two

	ability to draw conclusions from the data, and whether additional analysis of the other statistical relationships that were not the "strongest" are appropriate to review before assigning scores to certain stages.	periphyton indicators are each based on approximately 6.5 years of data. The Yellow Book stipulated that 5 years of baseline data were a suitable period prior to the operational onset of any CERP project.
U.S. Sugar Corporation Comment 10	Correlating the WSE and Interim 2008 LORS Lake Okeechobee regulation schedule hydrographs and associated ecological scores does not generate an accurate comparison of ecological conditions resulting from the different regulation schedules.	The WSE and LORS2008 regulation schedule hydrographs were not correlated and the ecological scores do generate a relative comparison of how similar/different the ecological indicator abundances (cyanobacteria, bluegill and redear sunfish, periphyton and areal coverage (Chara and vascular SAV) scores are influenced by the 41 year POR under a wide variety of simulated operations.
U.S. Sugar Corporation Comment 11	Stochastic events confound predictive models in regard to ecology, making their impacts difficult to model and calibrate. Therefore, scoring based on Lake stage as a surrogate for an ecological indicator does not appear to be justified and requires further analysis.	The period over which the empirical data was collected was reasonably representative of prevailing Lake Okeechobee climactic conditions. The correlation analyses using lake stages and abundances or areal coverage indicate that using lake stages as a surrogate for ecological indicators is justified and does not require further analysis for these ecological indicators.
U.S. Sugar Corporation Comment 12	In addition to these stochastic events, SFWMD has, for many years undertaken extensive efforts to restore Lake Okeechobee's littoral zone. Muck scraping and burning, vegetation planting and exotic vegetation treatment have all yielded beneficial effects in the Lake's ecological performance. These restoration efforts further underscore the inability to correlate Lake hydrology and ecology as a scientific predicate for a CERP project performance measure.	None of the individual ecological PM's are directly associated with littoral zone restoration efforts, nor would they be particularly responsive to these levels of littoral zone modification since all of these indicators are found in the nearshore or pelagic zones.
U.S. Sugar Corporation Comment 13	There are unanswered questions that should be addressed before finalization of the draft LOEIS Performance Measure. Therefore, the LOEIS Performance Measure is too controversial to finalize at this time and should not be used for formulation of the LOW Project alternatives.	We are addressing unanswered questions submitted during the RECOVER RLG (Recover Leadership Group) and Public Review periods to help finalize the draft LOEIS PM. Its use will be dependent on licensing by US ACOE ECO-PCX.
FFWCC Comment 14	The Draft Lake Okeechobee Ecological Indicator Score Performance Measure is a predictive tool to compare regulation schedules, varying climate conditions or the effects	We agree with FFWCC view of the importance of the upper marsh in Lake Okeechobee ecology. Unfortunately, we lack data that can be used to interpret hydrologic model output

	of projects on lake ecology. However, the Performance Measure does not include components to evaluate the health of the upper marsh. We feel the predictive nature of this performance measure would be improved by incorporating a metric for emergent plants to assess the upper marsh habitat in the lake. Additionally, a relationship exists between wading bird abundance, water levels and changes in lake levels (David 1994, enclosed). Therefore, the known correlation between wading bird foraging and/or nesting could be incorporated to more effectively predict the effects of projects on lake ecology.	(lake stage time series). However, an emergent vegetation performance measure for the marsh which is comprised of metrics for emergent plants is currently in the RECOVER RLG review and once their comments are addressed, this PM will be available for Public Review. Additionally, we are developing wading bird performance measures based on empirical data and hydrology, which we hope to have available for RECOVER review in the near future.
FFWCC Comment 15	The Draft Ecological Score Performance Measure is assessed through the application of several statistical correlations. The correlation between lake stage and cyanobacteria abundance is not as strong as the relationships between lake stage and other selected ecological indicators. This suggests that lake stage is not the sole predictor of cyanobacteria abundance or that additional metrics may be necessary to more accurately quantify cyanobacteria abundance. We recommend continual refinement of the cyanobacteria abundance estimates by conducting more comprehensive and frequent surveys of bloom extent, persistence and succession via aerial flyovers, satellite chlorophyll products, or vertically integrated sampling. Integrated sampling that includes observations of taxonomic composition, cyanotoxin concentrations and water quality parameters may help refine and strengthen the correlative relationship and improve the predictive nature of the Performance Measure.	While the correlation between lake stage and cyanobacteria abundance is not as strong as the correlations between lake stage and the other ecological indicators, it is still statistically significant. We realize that for all of the performance indicators, there are probably other parameters that influence their abundance or coverage. However, since the intention of this PM is to evaluate hydrologic model output, only lake stage can be used as the input variable. The integrated sampling items being suggested are currently being conducted for phytoplankton. The authors agree that more frequent and intensive monitoring might improve the accuracy of the PM predictions.
FFWCC Comment 16	The correlation between creel data and water levels as a linear relationship provides a simplistic analysis which does not account for the complexity inherent in fish populations affected by multiple components. FWC staff agrees that water levels affect fish populations and creel data, but angles catch can be influenced by a number of non-biological factors	We ran correlations in 2013 between lake stages and the FFWCC lake-wide electrofishing and trawl data collected during 2005, 2006 and 2008-2012. There were no statistically significant correlations with either of those data sets, which included total fish abundances and the individual taxa. Black crappie and bluegill were not statistically

	such as access to the fishery, access to boating and fishing equipment and the economy. Our scientists feel that lakewide electrofishing data, trawl data and black crappie may be more representative of the lake condition than bluegill and redear sunfish. Black crappie are dependent on different food types during their life history, making healthy populations dependent on more factors of the lake and therefore a bellwether for lake health. Our recommendation is to reconsider the use of the FWC's extensive lakewide electrofishing data and trawl data for incorporation into the Performance Measure.	correlated with lake stages in the trawl data set, and bluegill were not statistically correlated with lake stages in the electrofishing data set, for example. We appreciate that the creel data's response to lake stage may not be solely a function of fish biology. However, trawl data insensitivity to lake stage probably reflects independence from lake stage, of conditions in the pelagic zone. Similarly, since electrofishing sites are relocated each year in response to lake stage, it is possible that the sampling technique is masking any lake stage relationship to abundance.
FFWCC Comment 17	The robustness of the statistical approach to evaluate indicators is potentially limited by the appearance of the authors running all possible combinations and selecting only those correlations with the greatest significance. Additionally, we remain concerned by the small sample size and limited conditions observed for the calculation of the maximum cumulative score and correlations used in the predictive measure. Analyses run for the development of the performance measure scoring metrics appear to show correlations between various lake stages and significant ecological responses. Running top scoring scenarios show that a high score can be achieved for all metrics with a lake level at 12 ft for 8 months of the year. This is a reflection of the performance measure's reliance on exclusively nearshore metrics. At 12 ft, a majority of Lake Okeechobee's littoral zone is exposed. This scenario would not allow littoral zone inundation without the potential of ecologically damaging ascension and recession rates. Given the ecological importance of the littoral zone, we would prefer that high scores should not be achievable with conditions that would adversely impact the marsh above 12 ft. Similarly we would	Our statistical approach is not potentially limited since we used 7 period sets of lake stages and used only the strongest statistically significant correlated relationships to develop the scoring for each indicator. We also disagree that the sample sizes are small and that limited conditions were observed for the calculation of the maximum cumulative score, six months of average lake stages plus two additional previous year monthly average lake stages were used to calculate annual combined scores. Because of data availability and the importance of the parameters included in this analysis, it was intended to be focused primarily on the nearshore and to a lesser degree, the pelagic zone (two of the cyanobacteria sites). Since none of the indicator scores are highest when the lake is >15.5 ft, the way this PM scores does indirectly reflect potential damage from extreme lake stages to the littoral zone. As more frequent emergent vegetation sampling is conducted through our sentinel site mapping program, we hope to be able to develop a littoral zone PM that can be coupled to hydrologic model output.

	prefer that high scores are not achievable while maintaining undesirable or prolonged static high water levels.	
FFWCC Comment 18	Given the described metrics and scoring system, the Performance Measure predicts a maximum possible cumulative score of 488; however, given the overlapping nature of *Chara* abundance and SAV communities, the maximum possible score may be an overestimate. The Performance Measure assumes that the six ecological metrics are independent when, in fact, they are not. For example, any individual metric can produce a score of [0,1,2] and therefore any two metrics combined can produce a combined score of [0,1,2,3,4]. However, a full suite is in fact not possible for *Chara* and SAV and for Epipelon and Epiphyte (while both overlap, only *Chara* and SAV impact the maximum possible cumulative score; Epipelon and Epiphyte represent a reduced set of possible combinations). With *Chara* and SAV the only possible combinations are [0,2,3] and the maximum combined value of 4 is not possible to achieve. This means that the maximum score summed across all indicators for any individual year is 11 and not 12. Therefore, the total maximum cumulative score across all 41 years (including only 40 years for Epipelon and Epiphyte) is 447, not 488. In addition to the differences in maximum possible outcomes, this mathematical discrepancy also implies that each individual ecological indicator is not contributing equally to the overall score, as we would assume from the description. We recommend the authors consider the underlying assumptions and how the calculation of the maximum possible cumulative scores may affect the predictive capabilities of the Performance Measure.	It is correct that a full suite of 4 points is not possible for *Chara* and vascular SAV, since their scoring is both based on average July lake stages, but it is possible for Epipelon and Epiphytes since there is no overlap; Epipelon scoring is based on the previous years' same spring and fall months that the data were collected, while the Epiphyte scoring is based on the previous spring and fall month immediately prior to the months the data were collected. With *Chara* and vascular SAV, the possible combinations are [0,1,2,3] (1 pt for vascular SAV when the lake is >15.5 ft on average in July). The comment that the maximum summed annual score is only 11 pts and the maximum cumulative score over the current 41 yr POR is actually 447 points, since Epipelon and Panfish scores for 1965 are based on 1964 data, which is not available. However, when comparing each indicator score on an annual basis, they are contributing equally to the annual summed score. *Chara* and vascular SAV are not contributing equally to the overall summed POR score, we have adjusted the PM text to indicate that for POR overall combined score evaluations. However, since this calculation is reduced by 8%, we do not consider that the predictive capabilities of the PM are significantly affected. Plus, this reduction in maximum POR combined scores applies to any alternative model output, so it is consistent in comparing potential overall ecological scores. The doc sheets will be modified to reflect the suggested score changes.
Glenn Landers Comment 19	Both of these PMs relate to Interim Targets. Do we need to indicate the future conditions that could or will trigger an update in the Interim Targets and/or PMs?	Targets and Interim Goals for this PM is based on lake operating schedules and the availability of recoverable Lake Okeechobee watershed storage. Neither of these parameters are well defined at present time, it is difficult to

		establish future targets. As additional watershed storage comes on line and/or the operational schedule changes, the Interim goals will be periodically re-evaluated.
Glenn Landers Comment 20	Need to recognize and consider the impacts of rising temperatures (seasonal and monthly averages, daily max/min and extreme max/min) on different Lake O. ecosystem variables. For example, cyanobacteria grows faster and may be more potent in warmer waters, so harmful concentrations of this bacteria could occur for more days each year and/or reach high concentrations as global temperatures warm. Could these potential impacts be decreased by holding higher lake stages (more and deeper water) for more of each year? Is the risk of especially harmful bacteria concentrations increased when the average depth of the lake is below 2, 3, 4 feet or some other depth, and thus there is value in minimizing this condition?	The LOEIS PM is designed to evaluate hydrologic model output which only responds indirectly to temperature change through its evapotranspiration function. Climate change scenarios can be scored; based on lake stage responses to climate driven changes in rainfall and evapotranspiration. Based on the current data sets, potential impacts of cyanobacteria concentrations would be decreased by holding lake stages lower, rather than higher, since cyanobacteria abundances have been higher under higher lake stages. As additional data becomes available over time, performance measure scoring may be revised to reflect new information.
Glenn Landers Comment 21	Both PMs need to address Climate Preparedness and Resilience as it relates to Lake Okeechobee water levels, operating rules and restoration goals for the lake and downstream areas which are impacted by or benefit from Lake O discharges. It is anticipated that climate change impacts will include higher temperatures (w/ increased evapotranspiration losses) and potentially longer dry periods (droughts) between significant rainfall events. The advantages of increased water storage in Lake O and the benefits to overall Everglades Restoration goals should be considered in addition to the benefits to the Lake Okeechobee ecosystem of the narrow operating range currently proposed.	The Overall Combined Ecological Score PM can be used to generate scores based on changes in water levels modeled under changing climate change scenarios. Sensitivity runs have already been done based on the SFWMM model output, reflecting changes in evapotranspiration rate, and rainfall data sets, developed in the 2013 CES climate change workshop. As we indicated in the PM, because the scoring is based on empirical data acquired over a particular range of lake stages, use of the PM over a dramatically different range of lake stages may increase the uncertainty of model output.
Glenn Landers Comment 22	Opportunities to expand the available littoral zone to make possible a wider range of Lake O water levels needs to be considered as it relates to achieving a healthy Lake O	Both of these PM's scoring focus on the long hydro-period nearshore zone rather than the shorter hydro-period emergent marsh. Model runs reflective of changing climate

	ecosystem and increasing the resiliency of the Lake and the downstream areas to changing historic rainfall and evaporation patterns.	can be evaluated subject to the limitations noted in the PM in the response to Comment 21.
Glenn Landers Comment 23	These PMs or other PMs need to include criteria for a minimum acreage of deep water refuge to help fish better regulate body temperature in extreme hot or cold conditions, and to increase resilience to potential drought conditions.	These PM's cannot include minimum deep water acreage refuge since they are only correlated with lake stages. None of our empirical data inflect the need for Panfish deep water refuges. In fact, the Lake Okeechobee water column is generally well mixed and lacks any significant temperature stratification, unlike typical temperate lakes.
Rebecca Elliot Comment 24	Four of the six indicators receive the most points when LO stage goes below 12 ft NGVD. This may be how the statistical relationships worked out, but it is a curious outcome when the preferred stage envelope is 12.5 ft NGVD- 15.5 ft. NGVD. RECOVER will need to consider how to reconcile this scoring scheme with the preferred stage envelope. I feel other aspects of the ecological inputs and response are driving this outcome but they are not accounted for in this PM.	This interpretation of model scoring is not correct. Only 3 of the 6 (Cyano, Chara and Epipel) indicator PMs score the most points when the lake is <12 ft and the cyano scoring is reversed. We recognize that there may be other factors that influence areal coverage and abundance of the indicator organisms but this PM was developed to evaluate hydrologic model output and therefore focuses on lake stage. Higher overall scores are obtained when the lake is within the preferred ecological stage envelope rather than above or below it.
Rebecca Elliot Comment 25	Some of the statistics and correlations are not very strong - particularly for Cyanobacteria.	Based on the accepted interpretation of the Spearman rho (r) statistic, all of the indicator correlations are statistically significant.
Rebecca Elliot Comment 26	I feel that stronger correlations are perhaps relying too much on the inclusion of the hurricane impact years of 2004, 2005, and 2006 depending on when the data was collected. I recommend that data measuring hurricane impacts more that hydrological stage relationships be removed from the data sets for this PM.	Because the scoring is based on specific months of the year, actual hurricane impacts only affect a range of 7.7% to 31% of the data, depending on the length and specific temporal range of each data set. Therefore, we do not believe that these effects had an undue influence on the statistical analyses of these data.
Rebecca Elliot Comment 27	If I am reading it right, both the Chara and the SAV indicators rely on July's average lake stage as the predictor. This creates a "competition" between the two indicators which probably plays out in the real world too. Below is what I think happens when you combine the two indicators: 4 points - not possible	The scoring on the vascular SAV and Chara reflect real world conditions. Vascular SAV is favored when the lake is somewhat higher while Chara is favored when the lake is somewhat lower. The scoring reflects these habitat preferences. Since we do not have convincing data to demonstrate that vascular SAV and Chara have different

	3 points if 10 ft. NGVD - 15.5 ft. NGVD 2 points if < 10 ft NGVD 1 point if 15.5 ft. NGVD - 18 ft. NGVD 0 points if > 18 ft. NGVD	ecological values they are scored and weighted the same in the PM.
Rebecca Elliot Comment 28	If 4) is correct, then the math in the tables for maximum points possible is incorrect since the highest combined score is 11 - not 12. And because of this, Chara and SAV do not get equal weight in the scoring methodology compared to other indicators.	The max combined score has been updated to now read 11 pts. Without further explanation, we do not understand why you believe the Chara and vascular SAV do not get equal weight.
Rebecca Elliot Comment 29	Given that Chara and SAV compete for points, any point difference of 1 or less for the combined score as graphed in Figure 1 is definitely not significant and probably up to 2 points difference is not significant. To really understand what is happening to the ecology of LO - good, bad or indifferent - you need more information than the point system.	Chara and vascular SAV do not compete for points although their responses to lake stage trend in the opposite direction. Scoring is based on the difference between the 41 year POR hydrologic model output scores rather than the annual scores. Point scores spreads when comparing different model runs over the 41 year POR tend to be much larger than 1 or 2 points.
Rebecca Elliot Comment 30	With 6) as an example, needing more information on other ecological inputs in addition to LO stage is a pervasive concern of mine regarding this PM.	Prior to the development of this PM, the only available hydrologic model output tools were the RECOVER lake stage envelope PM and related hydrologic metrics (>17 ft, <10 ft, etc). This is the first evaluative PM for Lake Okeechobee that addresses real ecological conditions. While we recognize that other factors in addition to lake stage influence Lake Okeechobee ecology, model output only predicts lake stage, which limits our ability to develop more inclusive evaluative PMs.
Rebecca Elliot Comment 31	I am concerned about drawing conclusions in isolation from events associated with data. My example here is the conclusion that the change from WSE to LORS08 is the only reason the lake ecology has been better under LORS08. Consider:	Most of the empirical data sets that this PM is based on cover a range of years that encompasses portions of both the WSE and LORS 2008 schedules. We are not using the PM to directly compare the actual WSE years to the LORS years but comparing 41 year POR simulations using the same hydrologic and climatologic data, managed under either of

	WSE 2000 - 2007 - Subject to wetter years, major deviations from the regulation schedule, and two - three years of hurricane impacts. LORS08 2008 - 2015- No hurricanes - yet, Drier years overall despite 2013 and 2015-16, more flexibility within operational bands.	these two schedules or any other combination of operating schedule and structural changes.
Rebecca Elliot Comment 32	I am concerned that a target based on the highest annual score being achieved every year for 41 years is excessive and problematic in this case since LO needs to be less than 12 ft. NGVD for much of the year to receive this score. This is inconsistent with the preferred stage envelope and the typical seasonal fluctuations of LO. See 1) above.	The interim goal for this PM is based on the existing condition baseline output for the SFWMM, which is 72% of the potential maximum score for this PM. The full restoration target is based on the score for the best year of the existing condition baseline output, which is 96% of the potential maximum score for this PM. Each indicator score is based on one or two months and when the three PM's that score better when the lake is <12 ft, are combined, they represent 25% of the annual hydrograph, which is not "much of the year." Keep in mind that the original definition of the stage envelope is based primarily on best professional judgement and it appears that our baseline monitoring data indicates that a slightly lower bottom to the stage envelope might be more ecologically beneficial to the lake.
Rebecca Elliot Comment 33	It seems there should be a bottom to the < 12 ft. indicators that receives 0 points as there is for the high levels > 18 receiving 0 points.	Vascular SAV receives a zero score when the lake stage is <10ft. For the other PM indicators, there is no evidence from our data that they would be directly severely negatively impacted (score of 0) by lake stages under 10 ft.