

Ecosystem Amendment Performance Measures Independent Scientific Review

Stephen Crooks

Silvestrum Climate Associates LLC, 25 Taylor Street, California 94102

Steve.Crooks@silvestrum.com

Performance Measure 4.12: Subsidence Reversal for Tidal Reconnection

Charge Question 1:

How clear and thorough are the performance measure's metric, baseline and target? What, if any, additional information is needed?

The performance measure's metrics, baseline and target are incomplete. Performance measure for 4.12 describes 'subsidence reversal activities located at shallow subtidal elevations to prevent net loss of future opportunities to restore tidal wetlands in the Delta and Suisun.' This measure is likely feasible, particularly if enacted early so that soils are building while rates of sea level rise are relatively low. However, performance measure metrics, baseline and targets are set only through year 2030, and not a trajectory through 2100, or even 2050. The reason given is lack of confidence in projections and untried nature of subsidence reversal in shallow areas. 2030 is only 10 years away. This seems insufficiently ambitious.

It is stated in the target methods that "The land loss is calculated for 2020-2030 because projections of sea level rise and rate of subsidence reversal after 2030 have a high uncertainty. A longer-term target requires more foreknowledge of sea level rise and future development of subsidence reversal technology." Yet, in the section describing relationship to performance measure 5.2 (Subsidence Reversal and Carbon Sequestration) it is recognized that shallow subsided areas tend not to emit high amounts of carbon dioxide compared to deeply subsided areas." Unlike the deeper areas of the Delta, with emitting and subsiding organic soils, the shallow areas are not losing soil, and even if they were, rewetting them would slow/ halt that subsidence. It should therefore be possible to bracket future needs for subsidence reversal based upon projections of eustatic sea level rise and local tectonic subsidence. **I therefore suggest that the metrics, baseline and targets be extended at least through 2050.**

It should also be considered that there is likely a timelag between initiating a subsidence reversal project and achieving an optimal rate of soil building. The demonstration project on Twitchell Island was enacted on organic soils, a ready substrate for plant growth. Shallow subsided areas (unless have been maintained wet, such as perhaps duck clubs) likely have a dense mineral soils. It was observed at Liberty Island under the

Breach 3 project (Sloey et al. 2015) that expansion of vegetation can be slow on such substrate but accelerated by planting. **I suggest that the metrics reflect not area of land with project reversal activities but area of land with achieved subsidence reversal. Consider also enacting projects on greater areas than minimum need to provide a buffer for project performance.**

Charge Question 2:

How clear is the basis for selection of the performance measure? How complete are the scientific rationale, the justification, and the supporting references for the selection?

The basis for selection of performance criteria is clearly articulated. There is sufficient science to suggest that subsidence reversal is possible at rates greater than sea level rise, but that maintenance work may be needed to sustain these rates long term. Not mentioned is the potential to harvest or clear senesced reeds, build up of which may limit wetland productivity over time (on a natural marsh these would be cleared by flood events.) As part of the performance measure there may be the opportunity to explore uses for harvested biomass. In traditional communities reeds are used for various materials and in a number of countries reeds are being tested for biofuel application¹.

Charge Question 3:

How clear and complete is the scientific basis for setting the targets? How complete is the consideration of key scientific references, available data, and existing monitoring capabilities?

Per above, I suggest the science justifies projections of targets beyond 2030. The science distinguishing PM 4.12 and 5.2 with respect to greenhouse gases is not clearly articulated. The basic monitoring of soil building is the fundamental metric that defines success for this performance measure. No science to inform, or trigger to initiate, adaptive management is described within the text. Monitoring of soil building is relatively simple and achievable science.

Charge Question 4:

How achievable are the targets relative to the stated time scales?

2030 is only 10 years away. Given the time required to enact projects particularly at the scale of several thousand acres there will be a need to start soon to meet 2030 performance criteria. Acquiring, or otherwise arranging easements on, private land may be a limitation of progress.

¹ [Evaluation of giant knotweed and bulrush as perspective non-traditional herbaceous energy plants and quality assessment of biofuel produced from these plants](#)

Charge Question 5:

How well were scientific uncertainties (both outside and within management control) incorporated in the development of the targets and in the assessment of progress toward the targets?

The performance measure provides a narrative of potential uncertainties. While no quantification of performance targets sensitivity to those uncertainty is given some suggestions for managing uncertainty are provided. An approach not considered is to restore more and sooner.

There is inconstancy in use of units in the text (cm/yr for accretion, feet for sea level rise).

Charge Question 6:

Are the identified data sources complete and appropriate to support robust assessment of the performance measure?

Consider linking to the San Francisco Estuary Research Reserve who may develop related science for Suisun Bay.

Charge Question 7:

How well are adaptive management and alternative actions considered in performance assessments and reporting?

Adaptive management and alternative actions are not considered in performance assessments and reporting, except to mention that reporting every five years will inform the Council's adaptive management and other relevant decision-making.

References

Sloey, T.M., Willis, J.M. and Hester, M.W. (2015), Hydrologic and edaphic constraints on *Schoenoplectus acutus*, *Schoenoplectus californicus*, and *Typha latifolia* in tidal marsh restoration. *Restor Ecol*, 23: 430-438. doi:[10.1111/rec.12212](https://doi.org/10.1111/rec.12212)

Performance Measure 4.15: Seasonal Inundation

Charge Question 1:

How clear and thorough are the performance measure's metric, baseline and target? What, if any, additional information is needed?

The performance measure is clear, though there is a presumption that is focused on surface water. It would be helpful to clarify if groundwater is a metric under this measure. It is encouraging to see that the target for extends to a 2050 timeline. Is it possible to include an interim target to benchmark progress?

Charge Question 2:

How clear is the basis for selection of the performance measure? How complete are the scientific rationale, the justification, and the supporting references for the selection?

The basis for selecting the performance measure is quite complete, with particular reference to food webs and nutrient cycling. The targets recognize the importance of the 2 year flood frequency in the ecological and geomorphic functioning of linked floodplain and channel systems. Implicit in the targets is the inclusion of floodplains at other elevations relative to the hydrograph (target of 19,000 acres of additional 51,000 acres). It would be beneficial to reference the value of mosaics and ecotone in the supporting text. Not recognized are the carbon sequestration benefits of reconnecting floodplains (e.g. [Human-induced and natural carbon storage in floodplains of the Central Valley of California](#)), which may provide an opportunity to connect to California's climate policies and associate financing measures for climate risk reduction.

Charge Question 3:

How clear and complete is the scientific basis for setting the targets? How complete is the consideration of key scientific references, available data, and existing monitoring capabilities?

The targets are based on an appropriate ecological and geomorphic conceptual models for seasonal floodplain functioning and areal extents set forth in prior consultations.

With respect to monitoring capabilities, additional satellite platforms are coming on line for monitoring, wetlands, surface and groundwaters (e.g. SWOT and NISAR). I shall leave it to Kristin Byrd to opine on those.

Charge Question 4:

How achievable are the targets relative to the stated time scales?

As with all land use changes in the Delta there are the challenges of target lands being in private ownership and gaining the support of local government that may not want to lose a tax base provided by existing uses. Engineering feasibility will depend upon selecting appropriate land parcels.

Charge Question 5:

How well were scientific uncertainties (both outside and within management control) incorporated in the development of the targets and in the assessment of progress toward the targets?

The text does not address scientific uncertainty. Consider a process of prioritizing restoration opportunities based upon ecological and hydrogeomorphic metrics, and having an implementation framework that is adaptive to opportunities as they arise recognizing landscape considerations.

Charge Question 6:

Are the identified data sources complete and appropriate to support robust assessment of the performance measure?

Additional sources of information required for remote sensing of hydrology (SWOT, NISAR), carbon sequestration on floodplains, and state climate policies and (?) resilience policies.

Charge Question 7:

How well are adaptive management and alternative actions considered in performance assessments and reporting?

Adaptive management and alternative actions are not considered in performance assessments and reporting, except to mention that reporting every five years will inform the Council's adaptive management and other relevant decision-making.

Performance Measure 4.16: Acres of Natural Communities Restored

Charge Question 1:

How clear and thorough are the performance measure's metric, baseline and target? What, if any, additional information is needed?

The metric, baseline and target for acres of natural communities restored is clear. Consider including an interim target (2030 or 2035) against which progress is reviewed.

Charge Question 2:

How clear is the basis for selection of the performance measure? How complete are the scientific rationale, the justification, and the supporting references for the selection?

Through reference to other conservation and restoration plans the basis of the performance measures is clear. Rationale and justification are well set out. A mix of habitat types are provided based upon a range of existing plans. The location of the potential restoration actions is not set out in the datasheets. There is precedence in the delta of upland habitat being created by mitigation banks on lands below sea level, which are inherently vulnerable to climate change and earthquakes. Unless considered part of an interim and phased long term plan to locate upland habitat in upland locations, the creation of upland habitat below tides should be undertaken with appropriate consideration.

Charge Question 3:

How clear and complete is the scientific basis for setting the targets? How complete is the consideration of key scientific references, available data, and existing monitoring capabilities?

The scientific basis for setting the targets is not fully set out in datasheets beyond reference to prior analyses to support conservation and restoration plans. It would be beneficial to provide a justification for these targets, with mention also to potential areas for restoration action. Some of the targets for restoration are very small, such as 230 acres of alkali seasonal wetland complex, and grasslands are mentioned with a target of 0 acres of restoration. What are the scientific basis of these targets?

Charge Question 4:

How achievable are the targets relative to the stated time scales?

As with all land use changes in the Delta there are the challenges of target lands being in private ownership and gaining the support of local government that may not want to lose a tax base provided by existing uses. Engineering aspects of restoration feasibility will depend upon selecting appropriate land parcels, particularly for tidal wetlands. Restoration of seasonal wetlands, wet meadow, non-tidal wetlands and riparian scrub-shrub are likely to be technically less challenging and achievable. Many habitat

restoration actions, particularly those affecting regional hydrology, could require over a decade to plan, fund and implement and this time lag should be factored into planning to meet performance measure targets.

Charge Question 5:

How well were scientific uncertainties (both outside and within management control) incorporated in the development of the targets and in the assessment of progress toward the targets?

Scientific uncertainty is not discussed in the performance measure. Discussion is provided of uncertainties in the broad planning process. Reference is made to restoration actions not providing benefits in a linear manner but emerging as larger projects are enacted. Here we see a reflection that projects take time to implement. Earlier in this review I recommend interim performance targets before 2050 to track progress. To inform decision making it would be helpful to project restoration trajectories for each habitat class, updated for projects in progress and implemented. This would support decision making for adaptive management.

Charge Question 6:

Are the identified data sources complete and appropriate to support robust assessment of the performance measure?

The data sources are appropriate. New data sources and the resolution of mapping products are constantly improving. NOAA CCAP, for example, which provides landcover mapping based on Landsat in coastal regions, which includes the Delta, has historically been updated at 5 year intervals since 1996. This data source is being revised to provide products at 3 year and possible 1 year intervals. Spatial resolution may also improve to 1m pixel size which will provide increasing relevance to mapping small wetland areas. Consider updating the list of data sources at 5 year intervals to inform management decision making.

Charge Question 7:

How well are adaptive management and alternative actions considered in performance assessments and reporting?

Adaptive management and alternative actions are not considered in performance assessments and reporting, except to mention that reporting every five years will inform the Council's adaptive management and other relevant decision-making.