E.9. Restore and Enhance Submerged Aquatic Vegetation: Monitoring Guidance

This guidance is intended to promote consistency in data collection among similar types of projects and allow for future analysis across TIGs and Restoration Types, (Section 10.6.2 of SOP; DWH NRDA Trustees, 2016). This guidance may also assist the TIGs by providing recommended methodologies for monitoring restoration projects, saving time and money spent developing suitable monitoring protocols for individual restoration projects. If adjustments from this monitoring guidance are needed for a particular project, these adjustments should be described in the project-specific MAM Plan and agreed to by the TIG (Section 10.6.3 of SOP; DWH NRDA Trustees, 2016). Project teams within each TIG will identify parameters applicable to the objectives for each individual restoration project when developing the project MAM Plan. In addition to the project monitoring guidance identified in this Manual, specific monitoring may be required to comply with permits granted by regulatory agencies. The TIGs are not restricted from adding additional parameters, and other project monitoring that may be needed for specific projects should be determined by the TIGs.

The Cross-TIG MAM work group developed this monitoring guidance by following the process described in the Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0 (MAM Manual Version 1.0; DWH NRDA Trustees, 2017). This new guidance is being released as a supplement to MAM Manual Version 1.0.

This guidance is intended to assist the TIGs in developing MAM Plans for restoration projects, as appropriate. Specifically, it provides:

- Examples of Restoration Techniques
- Guidance on example restoration objectives, example drivers, and example uncertainties
- Guidance on core performance monitoring parameters for projects within the Restoration Approach
- Guidance on supplemental performance monitoring parameters for specific restoration objectives.

The monitoring parameters identified within a Restore and Enhance Submerged Aquatic Vegetation project MAM Plan should be consistent with the recommended monitoring defined within this guidance document, wherever appropriate. Depending on the nature of the restoration project, TIGs may choose not to include some of the elements described in this guidance document (e.g., drivers, uncertainties). If adjustments from the monitoring guidance are needed, these adjustments should be described in the project-specific MAM Plan and agreed to by the TIG (Section 10.6.3 of SOP; DWH NRDA Trustees, 2016b). The guidance provided should not be considered exhaustive. Therefore, TIGs may develop project-level

objectives, drivers, uncertainties, and monitoring parameters that have not been previously identified. The TIGs will develop MAM objectives and monitoring parameters that pertain to their restoration activities; and will determine the frequency and duration of monitoring, and the associated budget they deem appropriate. Finally, this guidance may change as new monitoring parameters, methods, and technologies are identified and/or developed.

The monitoring parameters recommended in this guidance document are further detailed in Attachment E Section E.3, which includes a complete list of core- and objective-specific monitoring parameters identified by the Cross-TIG MAM work group and guidance on measurement unit(s) and monitoring methods. Guidance on monitoring locations, frequencies, durations of sampling and potential analyses is also provided where appropriate.

E.9.1. Restoration Techniques

Restoration Techniques are specific restoration actions the Trustees identified for each of the Restoration Approaches. Restoration Techniques may be used individually or in combination. See Appendix 5.D of the PDARP/PEIS (DWH NRDA Trustees, 2016a). The following are example Restoration Techniques included in the PDARP/PEIS for this Restoration Approach. This list should not be considered exhaustive; additional Restoration Techniques may be developed and/or identified.

1. Backfill scars with sediment
2. Revegetate SAV beds via propagation and/or transplanting
3. Enhance SAV beds through nutrient addition
4. Protect SAV beds with buoys, signage, and/or other protective measures
5. Protect and enhance SAV through wave attenuation structures

E.9.2. Example Project-Level Restoration Objectives

Project-level restoration objectives should be specific to the resource injuries and clearly specify the desired outcome(s) of the restoration project (15 CFR § 990.55(b)(2)). See Section 2.4.1 of the MAM Manual Version 1.0 for guidance on establishing restoration objectives. The following are example project-level restoration objectives that may apply to one or more of the above-mentioned Restoration Techniques. This list should not be considered exhaustive; additional objectives may be developed and/or identified.

- Restore sea floor elevation to promote SAV
- Promote regrowth of native SAV
- Increase or maintain native SAV
- Increase or maintain site-specific nutrient levels to enhance SAV beds (e.g., bird stakes)
- Improve or maintain water quality
- Reduce current velocity and wave action to protect or restore SAV
- Provide habitat for targeted species (e.g., fish, wildlife)
- Increase abundance of targeted injured species (e.g., fish, wildlife)

E.9.3. Example Drivers

Drivers are outside forces, natural or anthropogenic, that have the potential to influence the outcome(s) of a restoration project. Drivers tend to be large-scale, long-term forces that are not easily controlled at the scale of a single restoration project (Harwell et al., 2016). See Section 2.4.2 of the MAM Manual Version 1.0 for guidance on establishing the conceptual setting for a MAM Plan, including identifying drivers. The following are example drivers that may

be applicable to this Restoration Approach. This list should not be considered exhaustive; additional drivers may be identified.

- Hydrologic regime
- Freshwater inflow
- Precipitation
- Sediment input/load
- Burial
- Subsidence
- Nutrients
- Sea level rise
- Storms/wave energy
- Sediment accretion/erosion
- Grazing/herbivory
- Hard-freeze events
- Invasive species
- Physical impacts, including boat scarring
- Boat wakes
- Adjacent development/land use
- Chemical impacts (e.g., oil spills)

E.9.4. Example Uncertainties

Uncertainties or information gaps have the potential to affect adaptive management decisions for individual or multiple restoration projects. These decisions may include how to improve the likelihood of achieving favorable project outcomes or selecting corrective actions in the event a project is not performing as intended. See Section 2.4.3 of the MAM Manual Version 1.0 for guidance on identifying potential sources of uncertainty for a MAM Plan. The following are example uncertainties that may be applicable to this Restoration Approach. This list should not be considered exhaustive; additional uncertainties may be identified.

- Local subsidence and accretion rates (e.g., organic, mineral)
- Optimal hydrologic conditions (e.g., turbidity, wave energy) for sustainability of the SAV bed
- Sediment and nutrient inputs
- Vegetation stress due to herbivory, disease, competition by invasive species
- Best method to revegetate SAV bed (e.g., seed, propagule)
- Appropriate habitat characteristics for targeted species, whether the habitat is a limiting factor for the species
- Use of the habitat by targeted species
- Adjacent habitat conversion, management, and restoration activities
- Presence of floating aquatic vegetation (FAV)
- Germination or general reproductive triggers
- Frequency/intensity of tropical storms

E.9.5. Guidance on Developing Parameters for Project-Level Performance

This section includes two types of monitoring parameters for consideration under the Restore and Enhance Submerged Aquatic Vegetation Restoration Approach:

3. Core performance monitoring parameters applicable to projects within a Restoration Approach (core performance monitoring parameters are those used consistently across projects in order to facilitate the aggregation of project monitoring results and the evaluation

of restoration progress for each Restoration Type; Appendix 5.E.4 of PDARP/PEIS; DWH NRDA, 2016a).

4. Objective-specific performance monitoring parameters that are only applicable to projects with a particular restoration objective.

Additional adaptive management and/or validation monitoring parameters for consideration have also been identified. These additional parameters may be helpful for resolving uncertainties, explaining outside drivers, optimizing project implementation, supporting decisions about corrective actions and other adaptive management of the project, and informing the planning of future DWH NRDA restoration projects. Tables E.9.1 and E.9.2 should not be considered exhaustive, and other parameters may be considered, as appropriate. See the complete list of core- and objective-specific monitoring parameters, Section E.3 above, for details on the core performance monitoring parameters including definitions, units, and other guidance.

Table E.9.1. Core performance monitoring parameters and additional parameters for consideration under the Restore and Enhance Submerged Aquatic Vegetation restoration approach.

Core performance monitoring parameters	Parameters for consideration (as appropriate)
• Area • Vegetation percent cover • Vegetation species composition • Vegetation survival[a]	• Aboveground biomass • Accretion • Belowground biomass • Current velocity • Floating aquatic vegetation (FAV) percent cover • Photosynthetically active radiation (PAR) • Salinity (surface water) • Secchi depth • Sediment nutrients • Sediment organic matter • Sediment texture • Shoot density • Temperature • Turbidity • Water level • Wave energy

[a] If project is planted with vegetation.

Table E.9.2. Performance monitoring parameters and additional parameters for consideration for projects with specific restoration objectives. These would be collected in addition to the parameters listed in Table E.9.1.

Project-specific objective	Objective-specific performance monitoring parameters	Parameters for consideration (as appropriate)
Restore sea floor elevation to promote SAV (water depth)	• Elevation • Water Level	• Subsidence • Currents • Wave energy

Project-specific objective	Objective-specific performance monitoring parameters	Parameters for consideration (as appropriate)
Promote regrowth of native SAV	• Area of Scarring (length, number, depth, and/or area of scars) [a]	• Dissolved oxygen (DO) • Light availability • pH • Salinity (surface water) • Specific conductance • Temperature • TN (Total Nitrogen) • TP (Total Phosphorus) • Turbidity • Water Level
Increase or maintain nutrient levels to enhance SAV beds	• Structural integrity of constructed features (e.g., bird stakes, signage, and/or buoys)[b] • TN (Total Nitrogen) • TP (Total Phosphorus)	• Hydroperiod • Tidal regime
Increase or maintain water quality	• Dissolved oxygen (DO) • pH • Salinity (surface water) • Specific conductance • Temperature • Turbidity	• Cloud cover • Day length • Discharge or velocity (water flow) • Fetch • Frequency and duration of storms • Hydroperiod • Tidal regime
Reduce current velocity and wave action to protect or restore SAV	• Structural integrity and function of constructed features (e.g. oyster reefs) • Wave height, period, and direction	• Currents • Elevation • Fetch • Longshore drift and currents • Sediment consolidation
Increase the abundance of targeted injured species	• Targeted injured species abundance/density	• Abundance of preferred food/prey species for targeted species • Abundance/density of competing species, invasives, or predators for targeted species • Reproductive capacity of targeted species

[a] If project is addressing prop scars.

[b] If project includes the construction of structural features.

References

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