Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection
100 Cambridge Street Suite 900 Boston, MA 02114 • 617-292-5500

Maura T. Healey
Governor

Kimberley Driscoll
Lieutenant Governor

Rebecca L. Tepper
Secretary

Bonnie Heiple
Commissioner

Wetlands Program Guidelines on Massachusetts Wetlands Protection Act and Water Quality Certification Provisions Regarding Management and Beneficial Reuse of Dredged and Fill Material for Salt Marsh Restoration: Thin Layer Placement
December 3, 2024

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Program Applicability: MassDEP Boston and MassDEP Regional Wetlands Program staff, municipal conservation commissions, state and federal resource agencies, project proponents, consultants, and others.

Supersedes Guidance: None

Approved by: Tim Jones, Acting Director, Division of Wetlands and Waterways

Purpose: MassDEP has developed this Guidance to improve the efficiency of permitting and implementation of projects to restore the elevation of degraded or subsided areas of Salt Marshes under the Wetlands Protection Act and other related regulations. MassDEP acknowledges and appreciates the input provided by the Massachusetts Department of Fish & Game and Office of Coastal Zone Management, and the other environmental agencies, organizations, consultants, and stakeholders who contributed to this effort.

MassDEP recognizes that Salt Marshes provide valuable ecosystem services by sequestering carbon, mitigating impacts of damaging coastal storms, filtering pollutants; and providing habitat for fish, shellfish, coastal birds, and other wildlife. However, Salt Marshes are becoming increasingly threatened by multiple stressors including sea level rise, storm surge, nutrient enrichment, sediment starvation, vegetation die-back due to water logging, sulfide toxicity and changes in marsh hydrology, crab herbivory, invasive species, legacy effects of historic activity, and encroaching development in and adjacent to Salt Marshes. As a result, there is an interest in acting quickly to maintain, restore, and protect Salt Marshes and their valuable functions.

Thin Layer Placement is a technique which proposes to restore Salt Marsh elevation by adding a layer of suitable sediment or soil onto existing marsh surfaces which have subsided or are degraded due to increased inundation or draining and increased tidal amplitude from sea level rise and storm activity, which inhibits marsh vegetation growth. This activity aims to restore and/or maintain the elevation of the marsh, counteracting subsidence, and maintaining the condition and resiliency of the Salt Marsh.

The purpose of this guidance is to facilitate implementation of Thin Layer Placement projects at suitable locations. The guidance details information to be collected and used during the planning, design, permitting, construction, and post-construction processes and monitoring to demonstrate that these projects meet existing regulatory performance standards of the Wetlands Protection Act (WPA) and Water Quality Certification (WQC) requirements. This

guidance also outlines recommendations for ensuring that measures of intended restoration milestones are properly established, any unanticipated adverse effects caused by the proposed project are identified and documented in a timely manner, and appropriate corrective actions are taken to address any unintended adverse effects and restore the Salt Marsh and its functions. This guidance has been prepared to be applicable for restoration projects with wide ranging size and site conditions. Issuing Authorities should evaluate each project based on specific characteristics of the site and on the anticipated benefits and risks of performing the restoration and implement permit reviews and conditions accordingly.

Although this guidance is intended to explain existing regulations that pertain to this technique to improve clarity and provide consistency, MassDEP is committed to developing regulatory strategies that facilitate and expedite well-planned projects designed to achieve Salt Marsh restoration objectives and improvement in Salt Marsh condition.

Statutory and Regulatory Background

M.G.L. c. 131 § 40: Wetlands Protection Act and Regulations at 310 CMR 10.00

M.G.L. c. 21 § 26 through 53: Massachusetts Clean Water Act and Regulations at 314 CMR 9.00, and Section 401 of the federal Clean Water Act and Regulations at 33 U.S.C. 1341.

It should be noted that other federal, state, and local permits may be required. See Appendix A for further information. The Office of Coastal Zone Management (CZM) provides a comprehensive review of potential permit requirements, regulatory summaries, and review processes associated with coastal projects in their Environmental Permitting in Coastal Massachusetts permit guide, which can be found at the following link: https://www.mass.gov/doc/environmental-permitting-in-coastal-massachusetts-0/download. Also, an abbreviated flowchart illustrating an estimated timeline for permitting for Salt Marsh restoration projects developed by the EPA Southeast New England Program can be found at the following link https://www.epa.gov/system/files/documents/2024-04/estimated-timeline-for-coastal-salt-marsh-permitting-in-ma.pdf.

I. Background

Thin Layer Placement is a targeted approach that uses the beneficial reuse and placement of dredged sediment or fill soil to address coastal Salt Marsh subsidence, drowning, sea level rise, artificially impounded or excessively ponded areas, and the resulting reduction in the marsh's ecological function.

Salt Marsh subsidence and drowning can result from increased inundation, lack of natural sediment inputs from reduced tidal flow and other barriers, interrupted biological activity of marsh vegetation, and historic anthropogenic impacts. Sediment inputs from the natural system can be disrupted by anthropogenic structures including tidal restrictions, dams, sea walls, historic agricultural structures, and other human-made coastal features which decrease the availability of sediment and its transport and deposition onto the Salt Marsh. Sediment supply can also be naturally limited due to the coastal geology of the area. (Evidence suggests that Massachusetts Salt Marshes are primarily dependent on marine sources of sediment.) Salt Marshes in microtidal environments are particularly vulnerable due to the low elevation of the platform relative to sea level.

The goal of the technique is to elevate the marsh platform, so that over time, these Salt Marsh areas will persist longer than if no interventions were implemented. Sediment or fill soil is placed directly on the marsh platform to elevate targeted areas to meet existing sea levels or elevation

ranges to enhance and support the existing ecological community by encouraging additional vegetation or revegetation, and to increase stability of the marsh.

For additional details and guidance related to ditch remediation, runnel, and marsh habit mound Salt Marsh restoration techniques, refer to MassDEP's "Wetlands Program Guidelines on Massachusetts Wetlands Protection Act and Water Quality Certification Provisions Regarding Salt Marsh Restoration Techniques, including. Ditch Remediation, Runnels, and Marsh Habitat Mounds," dated June 18, 2024.

Expanded definitions for Thin Layer Placement, as well as additional related definitions can be found in Appendix B. These definitions can help with project design and provide more information.

Passive Sediment Augmentation

Note that Passive Sediment Augmentation (PSA) has been identified as a potential mechanism to conserve suitable fine-grained sediments which are necessary to support elevation building in Salt Marshes. These sediments are typically removed and disposed of in an upland or offshore location after dredging as they are not suitable for beach nourishment. PSA is a concept where fine-grained dredged sediments of a suitable composition are redistributed to the marsh platform by tidal and storm driven action from a nearshore disposal or release site. MassDEP will consider the need for further guidance as this technique develops in Massachusetts. However, PSA project proponents may consider filing as an Ecological Restoration Limited Project under the "Other" category.

II. Wetlands Protection Act - Regulatory Standards

The following specific regulatory provisions are relevant to these guidelines:

1. 310 CMR 10.24(8) contains provisions for certain Ecological Restoration Limited projects as to how the issuing authority should review and exercise discretion in approving a project. The regulatory provision at 310 CMR 10.24(8)(e)3 contains "Other" ecological restoration limited projects that are not described in 310 CMR 10.24(8)(e)1 or 2. Thin Layer Placement designed for the sole purpose of Salt Marsh ecological restoration would most likely qualify under this Ecological Restoration Limited Project category.

2. When work is proposed in Areas of Critical Environmental Concern (ACEC), 310 CMR 10.24(5)(b) allows projects to proceed if the project is considered an Ecological Restoration Limited Project (under 310 CMR 10.24(8)). Certain surface waters within Areas of Critical Environmental Concern have been designated as Outstanding Resource Waters (ORW's) in accordance with 314 CMR 4.06 (see section below on 401 Water Quality Certification).

III. 401 Water Quality Certification - Regulatory Standards

Activities related to Thin Layer Placement restoration methods within Salt Marshes would involve the transport and discharge of dredged or fill material onto a Salt Marsh and may also include dredging of sediment for use as fill material to be placed, potentially requiring a Section 401 Water Quality Certification (WQC).

A 401 WQC is required if a Thin Layer Placement project proposes dredging or dredged material reuse or disposal of 100 cubic yards or greater (as described in 314 CMR 9.04(12)). Pursuant to 314 CMR 9.04(8), a 401 WQC for Fill/Excavation is also required for the discharge

of dredged or fill material onto a Salt Marsh. One WQC will be issued for both activities if a combined application is submitted on MassDEP's WW26 401 WQC License/Permit Application form.

Proponents should discuss with the issuing authority whether the individual project requires a fill/excavation and/or dredge WQC.

IV. Other Related Permits Applicable to Thin Layer Placement Projects

Additional reviews and approvals may be required under Chapter 91, MEPA and local bylaws and should be considered when permitting Salt Marsh restoration projects. More information and guidelines regarding these reviews and approvals are provided in Appendix A.

V. Notice of Intent and Water Quality Certification Application Submission

A Notice of Intent must be filed with the Conservation Commission and application for Water Quality Certification must be filed with MassDEP, if applicable; both should include the following and be in accordance with requirements for an Ecological Restoration Limited Project (under 310 CMR 10.11 and 10.12.):

1. A General Project Description and Project Narrative which clearly states project objectives and provides justification for the proposed project activities and associated impacts. The narrative would also describe in detail proposed restoration activities, means and methods, project proponents, design, and construction team members, etc. The applicant must show that the project qualifies as an Ecological Restoration Limited Project as defined in 310 CMR 10.00.

   If a project is within a mapped polygon on the most recent Estimated Habitat Maps of State-listed Rare Wetlands Wildlife published by the MA Natural Heritage and Endangered Species Program (MNHESP), then MNHESP shall be consulted in accordance with 310 CMR 10.59. See https://www.mass.gov/info-details/regulatory-maps-priority-estimated-habitats for MNHESP maps. The Massachusetts Division of Marine Fisheries (DMF) would provide comments on Notice of Intent (NOI) filings with respect to potential habitat and resource impacts in areas adjacent to the project (eelgrass, other submerged aquatic vegetation, shellfish flats/ tidal creeks / spawning areas). See https://www.mass.gov/info-details/massgis-data-massdep-eelgrass-mapping-project for eelgrass mapping information.

2. Discussion of Project Objectives (desired post-construction conditions of the site) includes a discussion and documentation of the project design, objectives and site trajectory including how project objectives will be met, and indicators specifying the target values for each collected dataset. Specific indicators collected in the Baseline Conditions Data Collection Plan (see section VI, below) will be the same indicators with restoration target values (intended outcomes). The Project Objectives will also serve to facilitate interpretation of the Post-Construction Monitoring results—progress is measured along the intended restoration trajectory (project progression towards improvement in marsh condition) and any unanticipated impacts will be captured in the Corrective Action Plan in order to redirect the project restoration trajectory back towards the Project Objectives. Applicants should provide a description of previous restoration projects conducted at the site (if known) or planned at the site, and discuss how this

project will enhance, align with, or provide a net benefit to completed and proposed Salt Marsh restoration projects.

3. A locus and map depicting the proposed sediment placement and intended areas of Salt Marsh restoration and the proposed activities.

4. A description of source of sediment or fill soil and grain size, and discussion, based on empirical evidence, of the suitability of the sediment or fill soil for placement. Refer to Appendix C for a detailed discussion on fill material evaluation requirements.

5. Project timeline including target dates for sediment placement, taking into account local weather and tidal conditions, and time of year restrictions, as applicable.

6. A project plan or plan set depicting baseline conditions with resource areas and tidal datums, proposed project area needed to achieve project objectives, cross-sections, restoration activity, existing and proposed elevation data with proposed fill quantities, sediment containment (e.g., coir logs, haybales, filter socks, shell bags), source and type of plants as applicable, construction sequence, and construction details, prepared by an environmental professional with experience and expertise in Salt Marsh restoration techniques (e.g., a Wetlands Scientist). The plan may also include sand fencing, geese exclusion fencing, or other applicable details. All elevation data should be submitted in accordance with the North American Vertical Datum (NAVD) 1988 and be absolute or relative based on a benchmark established outside of the marsh by a Professional Land Surveyor. GPS Units or other suitable methods may be used to collect elevation and survey data within the marsh, using the established benchmark to determine absolute NAVD88 elevations. The Project Plan Set should be submitted in an electronic format [e.g., Portable Document Format (PDF)] that can be easily reviewed. All design details requiring specific software (e.g., ArcGIS Online, AutoCAD, Excel) should be memorialized and exported to PDF.

7. Professional Engineer stamped plans for projects that are likely to change hydrologic and hydraulic conditions at the site, such as with the placement of any fill in or near existing waterways, channels, streams or runnels; generation of new drainage features on the marsh platform; changes to water surface elevations adjacent to flow-through streams or freshwater tidal systems; and changes to upgradient freshwater contribution or flow into the marsh. If projects do not anticipate impacts to hydrologic and hydraulic conditions and do not provide Professional Engineer stamped plans as part of the permitting applications, the proponent should demonstrate why impacts or changes are not anticipated. Following the construction of the project, submittals should include documentation of as-built conditions.

8. An analysis demonstrating that the proposed project activities/methodology incorporate all feasible measures to avoid or minimize impacts to wetland Resource Areas and migration of sediments to the subtidal or adjacent resource areas.

9. A Baseline Conditions Data Collection Plan including a comprehensive evaluation of site conditions. Additional details on Baseline Conditions Data Collection Plans are discussed in Section VI below.

10. A Construction and Post-Construction Period Monitoring Plan that includes the construction schedule and Environmental Monitor's (field monitoring) oversight schedule along with relevant phasing details. The Plan shall also include details of corrective actions deemed necessary during the reporting period. (See Item 12 below for additional details.) Additional details on Construction and Post-Construction Period Monitoring Plans are discussed in Sections VIII below.

11. Invasive species control and management plan, which includes a description of invasive species present on the site, proposed efforts to minimize the spread of existing species or to avoid introduction of invasive species during construction, and proposed efforts to remove invasive species attributed to restoration activities.

12. A Corrective Action Plan, reviewed and approved by the issuing authority, which includes measures to protect waters and wetlands from potential adverse impacts both during and after construction resulting from the restoration activities. The Corrective Action Plan shall also include a schedule with thresholds at which monitored metrics trigger corrective activities upon detection. The observed conditions requiring corrective actions should be noted in monitoring reports and should outline the proposed site-specific corrective actions. Additional details on Corrective Action Plans are discussed in Section VIII, below.

VI. Baseline Conditions Data Plan

A Baseline Conditions Data Collection Plan shall be developed and implemented to characterize historic and existing site baseline conditions, which would provide: a) justification for the selection of proposed restoration areas and methods, b) information for project planning, design and construction considerations, and c) a basis to measure project success. Baseline conditions data collection shall be a comprehensive evaluation, which may include, but is not limited to, some or all of the following:

1. Existing anthropogenic impacts in the area of proposed restoration, including but not limited to existing mosquito ditches, historical agricultural embankments or ditches, existing shoreline stabilization or Salt Marsh restoration project or studies conducted (if known), tidal restrictions, areas that were filled above marsh elevation, restrictions to tidal flow from undersized creek crossing (e.g., culverts). This information will facilitate an understanding of historic impacts and alterations which may have contributed to Salt Marsh degradation, which may inform the project restoration technique choice and design. Locations of any existing structures which may constrain the project such as utilities, buildings, boardwalks/platforms, etc. should also be identified.

2. Shoreline topographic, geologic, hydrogeologic, and hydrologic conditions in the area of proposed restoration, including: tidal range, tidal datums, marsh platform elevations and topographic features (pannes, pools, ditches, creeks, channels, artificial impoundments, etc.), marsh profile, etc., to understand site conditions to develop proposed restoration details such as intended habitat to be restored, placement locations, fill thickness, elevation targets, containment methods, potential for loss of placed materials, etc..

3. Sediment or soil characteristics at the subject site, including grain size, composition, soil sheer strength, density, organic and nutrient content, soil chemistry, porewater salinity, and chemical contaminants, if suspected present, to establish background conditions

based on a due diligence evaluation of known historic site chemical data. Knowledge of sediment or soil characteristics at the site will help determine compatibility with fill materials placed at the site, determine most appropriate fill materials to place to meet project objectives, allow for an evaluation on potential compaction of the Salt Marsh from construction activities and equipment, and help determine most appropriate best management practices to be utilized. An environmental professional with experience and expertise in sediment and soil characterization (e.g., a Licensed Site Professional, Qualified Environmental Professional, etc.) shall adequately evaluate the placement site to determine if it is likely to have concentrations of oil or hazardous materials (as defined in 310 CMR 40.0000), and if placed materials will have a detrimental effect on existing site and its ecological functions. A due diligence evaluation includes analysis of records accessed through the Department's Bureau of Waste Site Cleanup Site lookup tool, and, if available, information obtained from local authorities, and any other knowledge of historic land uses or discharges of pollutants in the project area.

4. Placement site habitat and ecological function evaluation, potentially including but not limited to characterization and survey of flora and fauna including presence of shellfish and other Salt Marsh species, plant abundance, unvegetated area to vegetated area ratio, existing range/elevations of target species, presence of Estimated Habitats of Rare Wildlife, sediment composition, and organic material (see number 3 above). An understanding of site habitat and functions should inform final restoration objectives, goals, and intended outcomes.

5. Characterization of tidal marsh changes and apparent causes, which would be used to evaluate and justify the restoration technique chosen and determine if additional or other restoration techniques shall be used.

6. Existing characteristics of the site that may generate erosion, including current and wave characteristics (e.g., is the site on the ocean or sheltered), tidal range, boat traffic frequency and wake impact, and surface water runoff, if known and available, which may affect the stability of fill materials, and contribute to the potential for offsite migration of placed materials. Also, identify any adjacent habitats at risk from movement of placed materials to areas outside of the proposed project footprint, such as fish passageways, eelgrass, known fish spawning areas needing a time of year restriction, or shellfish habitats. Understanding erosional forces present could help identify potential for risk to nearby sensitive resources, and focus suitable mitigation or containment methods.

7. Sediment dynamics of the system, i.e. source, supply, and accretion rate where that data exists and is available or proxy indicators such as Unvegetated to Vegetated Ratio (UVVR),[1] similar reference sites, published data, case studies, etc.

8. Potential construction vehicle access points and paths, and other construction considerations such as staging. This information would be used to plan the most efficient and least impactful routes on the Salt Marsh.

1 Unvegetated to Vegetated Ratio (UVVR) is a metric developed by the USGS, measuring how much vegetation a marsh area contains based on the multiyear-mean of the vegetated fraction. (Ganju, N.K., Couvillion, B.R., Defne, Z. et al. Development and Application of Landsat-Based Wetland Vegetation Cover and UnVegetated-Vegetated Marsh Ratio (UVVR) for the Conterminous United States. Estuaries and Coasts 45, 1861–1878 (2022).)

9. Property boundaries and ownership to understand and design restoration activities within limits of property or available restoration areas.

VII. Considerations for Project Development to Avoid Adverse Effects

Well-designed Thin Layer Placement projects are site and evidenced-based and are focused on restoring ecosystem processes rather than centered solely on beneficial reuse of available sediment. Targeted actions that may be suitable candidates for Thin Layer Placement include but are not limited to: 1) the placement of sediment or fill soil in degraded or subsided areas upgradient of tidal restrictions as part of a wider project to replace and increase the structure for tidal flow restoration, 2) raising the elevation of highly vulnerable marshes of low elevation in microtidal environments without migration potential, and 3) areas where the natural distribution of sediments and/or overwash have been severely interrupted over time. Placement of sediment at currently healthy and ecologically productive Salt Marshes and placement of sediment or fill soil solely for the purposes of beneficial reuse are not currently recommended.

Thin Layer Placement projects are most commonly associated with the placement of a thin layer of sediment or fill soil (i.e., 6-inches or less) at locations where the marsh is degraded due to sinking, drowning, and lack of sediment inputs, and where sediment or fill soil is placed to meet existing sea levels or target elevation range for habitat restoration to support the existing or ecologically appropriate community. Proposed placement of sediment or fill soil is ideally conducted to supplement natural coastal processes and sediment deposition rates, or aid in recovery of marshes affected by anthropogenic activities. Sediment or fill soil placement must not adversely impact existing plant communities unless specifically authorized within the Order of Conditions, and instead should allow existing plants to grow through the placed materials, thus maintaining and further enhancing existing plant communities and habitat. Sandy, coarse substrates are typically the most appropriate source of sediment to use in sediment or fill soil placement projects to avoid compaction, drainage issues, and chemical changes which can occur when finer sediments are used, creating conditions that are less conducive to vegetative growth and recovery. The use of finer sediment may be appropriate when demonstrated by appropriate testing and analysis to be compatible with existing Salt Marsh conditions and not result in an adverse effect to the marsh environment.

In rare cases, a thicker placement of sediment or fill soil (i.e., greater than 6-inches) may be warranted in targeted areas according to vulnerability and history of loss. An example is at bare spots where relic structures have caused deeper depressions and ponding. Thicker placement may be associated with placement of new plantings since existing plant habitat would be heavily impacted or plant communities are not present due to degree of degradation. However, natural colonization of desired plant communities may be preferred due to the potential for destruction of vegetation by wildlife and other associated issues.

To meet requirements at 310 CMR 10.24(8)(d), the project proponent should consider the condition of the existing Salt Marsh and the extent and severity of the site's impairment and reduced capacity as an ecologically productive and healthy resource area. This may be done in a number of ways, including but not limited: 1) demonstrating that the system is sediment limited and is not accreting relative to baseline, 2) providing evidence of subsidence as compared to surrounding areas through ground survey, or use of photos showing subsidence, and 3) demonstrating loss of vegetation over time, or other similar strategies.

The project should also consider the magnitude and significance of the overall benefits of the proposed restoration in improving the capacity of the Resource Area as compared to potential impacts or loss of the Resource Area and its functions resulting from restoration activities. When considering the potential impacts to existing resource areas, the applicant shall avoid adverse impacts to the extent possible without impeding the achievement of the project's ecological restoration goals, minimize adverse impacts that are necessary to achieving ecological restoration goals, and utilize best management practices to avoid and minimize adverse construction impacts to the resource areas. Proponents shall demonstrate why TLP is the most appropriate strategy for addressing these impacts, and how the specific project design will achieve the goals and objectives of the project while minimizing adverse impacts on ecological function, including temporary impacts of salt marsh function that may occur due to excessive thickness of sediment or soil layer. Multiple thinner placements may be more appropriate than a single thicker placement. In addition to the engineering and design considerations discussed below, project proponents must carefully consider the requirements at 310 CMR 10.24(8)(d) to determine the overall restoration approach and scale. See https://www.mass.gov/regulations/310-CMR-1000-wetlands-protection-act-regulations for 310 CMR 10.00.

Engineering and Design Considerations

Project proponents should evaluate engineering and design considerations to achieve successful outcomes and avoid and minimize potential adverse impacts resulting from Thin Layer Placement during Salt Marsh restoration construction activities. At a minimum, the major engineering and design considerations should include those specified below. Please refer to Appendix C for a more detailed discussion of engineering and design considerations.

- **Sediment or fill soil thickness**. Determination of sediment or fill soil layer thickness is a primary consideration in the design of a Thin Layer Placement restoration project. Factors such as likelihood of detrimental impacts to the existing Salt Marsh platform, tidal range, existing elevation and inundation, fill material availability, expected project timeline, and success of vegetation reestablishment must all be evaluated to determine the thickness of fill material to be placed to meet project objectives.

- **Methods of sediment or fill soil distribution and placement.** Determining the most effective, efficient, and least impactful methods of transport of suitable sediments or fill soil from material source to the proposed restoration site, and the methods of sediment distribution/placement to achieve precise thickness and/or elevation targets is another major design and construction consideration.

- **Fill material evaluation**. A detailed review and evaluation of the sediment or fill soil proposed to be placed is essential to determine that the material is appropriate for use at the restoration site.

- **Protection of Habitat**. Additional considerations for the protection of habitat and existing flora and fauna (such as shellfish flats, diadromous fish passage, birds, and eelgrass) at or nearby the placement site, including evaluating for the presence of Estimated Habitat of Rare Wildlife presence or potential of proliferation of invasive species, containment methods, and potential for sedimentation to areas surrounding the restoration site, including adherence to any time of year restrictions.

VIII. Establishing and Following Monitoring Plans and a Corrective Action Plan

The Construction Monitoring Plan, Post-Construction Monitoring Plan, and the Corrective Action Plan are discussed below.

1. Construction Monitoring Reports
   Monitoring reports should include the following key information, if applicable to or observable during construction period:
   a. The name of an environmental professional who will serve as the project's Environmental Monitor(s) (EM). This person or persons should have a minimum of 5 years of experience and be competent in coastal wetland ecology and Salt Marsh species and their habitats. Experience with Salt Marsh restoration is desirable.
   b. A construction schedule and EM's oversight schedule along with relevant phasing details, and any updates and future schedules.
   c. A description of construction status, activities completed and overall site conditions.
   d. Names of all responsible parties with assurances that all equipment operators and site contractors are trained in project methodologies and competent to perform the work with training documentation/details for collection, transport, and placement of sediment and fill soil.
   e. A description of visual, photographic, and other inspections to identify successes and determine if changes have occurred that require corrective action.
   f. Description of how the transport of construction equipment in the Salt Marsh is avoided or minimized to avoid compaction of the marsh soils and damage to vegetation. If access through the Salt Marsh cannot be avoided, construction mats or low-pressure equipment are potential strategies to minimize marsh degradation.
   g. Location of sediment placed, and the total sediment accumulation/thickness and elevation is as designed and as approved in the permits.
   h. Desired vegetation reestablishment growth, density, and species type is as proposed.
   i. A description of invasive species monitoring conducted, and results or actions completed.
   j. Documentation that erosion of channels, banks, or marsh platform resulting from the placement activities, and loss of placed sediment is not occurring in areas at or adjacent to the site, including, alteration in drainage processes on the platform, shoaling, bioturbation from burrowing crabs, geese, and other animals, windblown sediments, and other disturbance which may occur post-placement resulting from restoration activities. Although natural erosion is an ongoing, active and dynamic process, baseline data should document the conditions of these features, while ongoing site monitoring and understanding of restoration activities completed should be used to determine if the placement activities caused or significantly contributed to the erosion or loss of placed sediment. For example, did the placement of fill materials on or near a failing undercut bank contribute to the collapse or further erosion of the shoreline, or were placed fill materials washed offsite during a coastal storm due to inadequate material containment?
   k. Documentation to demonstrate that the intended compatible habitat for native flora and fauna are developed, and habitat and ecological function in surrounding areas remains intact.
   l. An assessment of Project Objectives (e.g., post-construction conditions of the site compared with baseline and objectives). Collected datasets should be used to show Project Objectives are being met, to identify deviations from the Project Objectives or permit noncompliance, and provide recommendations for corrective actions.

m. Communication with the issuing authority should be established following the first three years to determine compliance with project objectives, to assess corrective actions needed (if any), and to determine if additional time is needed for monitoring. An extension to the Orders of Conditions may be requested if additional time is needed, or the issuing authority may issue the original Order of Conditions to be valid for five years if desired.

2. Submission of Construction Period Monitoring Reports should be in accordance with the Construction Monitoring Plan identified in Section V. During the Construction Period, visual inspection of the entire site is required to ensure that construction is occurring as the design intended. The goal of the Construction Period Monitoring Reports is to document design implementation and to identify any and all deviations from the design occurring from contractor mishaps, severe weather events, unanticipated site constraints or other unforeseen scenarios. The recommended level of effort for Monitoring includes:
   a. Inspections need to occur regularly throughout the construction phase of the project, and until the site is stabilized. Inspections may be done in the field (on the ground, photographs, topographic survey) or via unmanned aerial vehicle (UAVs/drones), if appropriate. In general, the visual inspections should be more frequent than monitoring with the intent for data collection.
   b. At a minimum, biweekly monitoring reports (i.e., every two weeks) should be submitted to the Issuing Authority(s) by the EM(s) during active construction that summarize the site activities located within wetland resource areas and confirm that all activities are in compliance with the Order of Conditions and other related permit conditions or requirements. Biweekly reports should report on active construction during that period and do not need to be submitted during phases of construction where work has been interrupted.
   c. Regular communication and site walks as requested should be included in the Monitoring Plan to be conducted with permitting and resource agencies periodically during and following the completion of the restoration activities.

3. As – Built Construction Plans should be submitted within 30 days following completion of placement activities documenting that the installation conforms to the design plans, and to record any deviations. The Plan(s)/Report should include elevations collected from a benchmark established by a Licensed Surveyor with NAVD 1988 elevations. GPS Units or other suitable methods may be used. If any significant changes or corrective actions are made following submission of the as-built construction plan, the plan should be updated or amended to reflect those changes or actions completed.

4. Post-Construction Monitoring Reports Following construction but prior to site stabilization (i.e., plant growth present, loss of placed materials minimal, etc.), the EM(s) should submit reports twice during and immediately after the growing season, and if necessary, after large and acute disturbance events (e.g., coastal storms that damage vegetation or move sand onto or off of the marsh) to document that the site is stabilizing towards the design condition or to identify if corrective action is needed (or in the event of a coastal storm, if corrective action is desired). These reports should be submitted until such time that disturbed areas are stabilized and functioning in accordance with the project plans and Project Objectives, as determined by the Issuing Authority. Additional information about the Corrective Action Plan is located below. The Post-Construction Monitoring Reports should also assess metrics that identify whether the project has been successful

in achieving the proposed restoration trajectory or transition towards or away from Project Objectives.

Following site stabilization, the reports should be submitted annually, and should provide a description of the overall site conditions as compared to the target values for each collected dataset referenced in the Baseline Conditions Plan. A description of post-construction conditions and evaluation of marsh elevation, habitat, and vegetation shall be included and discussed. The entire site should be routinely inspected, but monitoring can be conducted on representative areas to convey overall project success. Condition observations may be collected using a variety of low or high resolution methods, including but not limited to; site photographs, long-term photograph stations, transect/plot monitoring to observe plant species types, abundance and coverage, aerial photographs, subsequent elevation /topographic surveys, permanent monuments or witness boards for elevation control and observations, pH probe monitoring, data loggers to document hydrologic and hydrogeologic conditions, and unmanned aerial vehicle (UAVs/drones)-facilitated survey, photography, infrared or Lidar remote sensing methods, etc.

5. Corrective Action Notifications and Activities should be conducted in accordance with the Corrective Action Plan and with the associated monitoring report. Corrective actions address inadvertent adverse impacts resulting from the completed restoration activities. It is understood that natural processes, such as coastal storms damaging vegetation or naturally moving sediment onto the Salt Marsh platform, may occur outside of the control of the project. These impacts may not be considered an adverse impact resulting from the restoration activities requiring corrective actions, however, proponents may choose to address these impacts to meet project goals.

   Adverse impact monitoring and potential corrective actions may be effectively organized into three categories: sediment, vegetation, and habitat monitoring. Each category plays a vital role in assessing and remediating unanticipated adverse effects and ensuring the project's alignment with its intended restoration results.
   - Sediment monitoring evaluates sediment placement location, volumes, thickness, characteristics, etc.
   - Vegetation monitoring observes the health, distribution, density and growth of desired species following sediment placement.
   - Habitat monitoring observes if restoration activities negatively impact existing plant or animal communities both inside the general project area and in areas of the Salt Marsh adjacent to the proposed restoration which may be directly impacted.

   Corrective Actions should be categorized into the following three categories:

   a. Category 1 - Activities which would likely require consultation with and approval by the issuing authority in consultation with Massachusetts Office of Coastal Zone Management (MA CZM) or other related agencies that have issued approvals for the work as necessary, prior to implementation. Examples include:
      - Restoration of topography and marsh platform elevation to baseline conditions or to a condition that is deemed as an ecological improvement, including additional placement of sediment to achieve the intended thickness in the case a too-thin layer is placed, or the removal of too-thick sediment greater than the proposed thickness.

- Use of additional or different matting or other low-pressure equipment to minimize or mitigate compaction due to construction equipment. Reconsider or reroute access to minimize travel or other access issues encountered.
- Impacts to adjacent habitats and resource areas from placement of sediment or construction activities.

b. Category 2 - Activities could be completed without additional approval or consultation and would be documented in the regularly scheduled EM monitoring reports. Examples include:
   - Targeted removal by hand of sediment inadvertently placed in areas not intended, to minimize impact to non-restoration areas and habitat.
   - Implementation of or adjustments to containment, erosion controls, and BMPs to minimize or mitigate offsite migration of sediment.
   - Planting of additional indigenous wetland plant species where either natural establishment or reestablishment has not occurred in the objective timeframe.
   - Removal of non-indigenous or invasive species colonizing newly placed sediment, and replacement with indigenous wetland plant species. If larger construction equipment is needed for removal, the issuing authority shall be notified to review proposed activities as a Category 1 corrective action.
   - Addition of any soil amendments (e.g. lime).

c. Category 3: Activities could be completed as immediate corrective actions, with subsequent notice to the issuing authority and MA CZM. Examples include:
   - Immediate cleanup of any spills or release of oil or hazardous materials.
   - Addition of or adjustments to health and safety controls or protocols.

IX. More Information

For additional information or inquiries regarding this Guidance, project proponents and readers are encouraged to reach out to the following contacts:

- Major Projects and Policies Unit – MassDEP Boston Wetlands Program
- MassDEP Northeast Regional Office Section Chief
- MassDEP Southeast Regional Office Section Chief

MassDEP requests that project proponents conducting Thin Layer Placement projects submit their monitoring data to MassDEP for web posting at:

MassDEP
Wetlands Program
100 Cambridge Street, Suite 900
Boston MA 02114

Information may also be emailed to kenneth.alepidis@mass.gov or christina.y.wu@mass.gov or dep.wetlands@mass.gov

Appendix A – Information on Other State Permits or Other State Programs Applicable to Thin Layer Placement Deposition Projects

Chapter 91 (M.G.L. c. 91)

Jurisdiction 310 CMR 9.04 – Coastal areas subject to M.G.L. c.91 and the Waterways Regulations include all present and former submerged lands, filled tidelands and lands subject to tidal action up to and including the historic high-water mark (HHWM). The HHWM is the high-water mark which existed prior to human alteration of the shoreline.

Activities Requiring a Permit 310 CMR 9.05(2) – A Chapter 91 permit is required for any dredging, (including backfilling of dredged materials), beach nourishment, subaqueous placement of unconsolidated materials below the low water mark, installation of temporary structures to be in-place not to exceed six months and the potential to impair public rights in tidelands, or test projects.

Activities Requiring a License 310 CMR 9.05(1) – A Chapter 91 license is required for any construction, placement, excavation, addition, improvement, maintenance, repair, replacement, reconstruction, demolition or removal of any fill or structures, not previously authorized, or for which a previous grant or license is not presently valid. In the context of salt marsh restoration, this typically includes the placement of fill.

Water Dependency 310 CMR 9.12(2)(a)15. – Salt marsh ecological restoration activities including thin layer placement of sediment are regulated under Chapter 91 as water-dependent use projects.

Activities within an Area of Critical Environmental Concern (ACEC) 310 CMR 9.40(1)(b) – Improvement dredging or the placement of fill within an ACEC may be allowed under Chapter 91 only if the work is part of an Ecological Restoration Project and/or meets the other specified criteria.

Salt marsh restoration activities subject to Chapter 91 include thin layer placement sediment for marsh restoration. The placement of sediment or any other unconsolidated material seaward of existing mean high water is regulated as fill (310 CMR 9.02). The placement of such fill requires a Chapter 91 Waterways License, pursuant to 310 CMR 9.05(1)(a).

MEPA (M.G.L. c. 30 § 61)

The Massachusetts Environmental Policy Act (MEPA) Office within the Executive Office of Energy and Environmental Affairs (EEA) conducts environmental reviews of public and private projects requiring approvals by state agencies and certain municipal authorities (“Agency Action” under MEPA). “Agency Action” can mean Agency undertaking a project, or involve Permits, Land Transfers, or Financial Assistance from an Agency. As stated in MEPA regulations, the purpose of the MEPA program is to “provide meaningful opportunities for public review of the potential environmental

impacts of projects for which Agency Action is required, and to assist each Agency in using (in addition to applying any other applicable statutory and regulatory standards and requirements) all feasible means to avoid Damage to the Environment or, to the extent Damage to the Environment cannot be avoided, to minimize and mitigate Damage to the Environment to the maximum extent practicable." 301 C.M.R. 11.01(1)(a); see also M.G.L. c. 30, § 61.

Any project that requires Agency Action and meets or exceeds any MEPA review threshold under 301 CMR 11.03 is subject to MEPA review. If the project meets/exceeds a "mandatory EIR threshold," review will consist of the filing of an Environmental Notification Form (ENF) to MEPA for public review, and, thereafter, the filing of one or more Environmental Impact Reports (EIRs). Effective December 24, 2021, a project that meets/exceeds any review threshold (not just mandatory EIR thresholds) and is located within a designated geographic area ("DGA") (at least 1 mile) of an Environmental Justice (EJ) Population as shown in EEA's EJ Mapper[2], must also undertake a full EIR review process.

Effective January 6, 2023, the MEPA Office amended its regulations at 301 CMR 11.01(2)(b)4. to streamline review of projects that qualify as (full) Ecological Restoration Projects under the WPA regulations at 310 CMR 10.11-10.14. For such projects, a Notice of Ecological Restoration Project may be filed with MEPA in lieu of an ENF, and, unless the EEA Secretary thereafter requires the filing of an ENF or other review process, the project may proceed to subsequent permitting. A project that is located within a DGA of an EJ Population must also undertake outreach and address potential impacts to those populations in the Notice of Ecological Restoration Project filed with MEPA[3].

The streamlining provisions under new 301 CMR 11.01(2)(b)4. do not apply to Ecological Restoration Limited Projects under 310 CMR 10.24(8) and 10.53(4). However, consistent with past practice, such projects may file an Expanded ENF with MEPA and request a waiver of the requirement to file an EIR as set forth in 301 CMR 11.11. Projects located within a DGA of an EJ Population are not eligible for an EIR waiver, but may request that a "Rollover EIR" be allowed under 301 CMR 11.05(9). A project proposing the salt marsh restoration techniques addressed by this guidance should demonstrate consistency with the best practices outlined herein if it intends to seek to streamline MEPA review procedures. The proponent should also consult any further changes to regulations, policies or guidance issued by the MEPA Office after the date of this MassDEP guidance.

Coastal Zone Management (CZM) Federal Consistency Review

Salt marsh restoration projects in Massachusetts are subject to CZM federal consistency review. This review process is mandated by the Coastal Zone Management Act and requires proposed projects in coastal areas to be consistent with the enforceable policies of the state's coastal management program and federal coastal management policies. For salt marsh restoration projects, CZM evaluates various factors such as impacts on coastal resources, water quality, wildlife habitat, and public access. The review aims to

2 - https://mass-eoeea.maps.arcgis.com/apps/MapSeries/index.html?appid=535e4419dc0545be980545a0eeaf9b53
3 - Further explanation of the MEPA review process for Ecological Restoration Projects is available here: https://www.mass.gov/info-details/streamlined-process-for-ecological-restoration-projects.

assess the project's potential effects on coastal resources and uses and determine whether it aligns with the state's coastal management goals, including the protection and restoration of salt marsh ecosystems. Through this process, CZM ensures that impacts to salt marsh resources are avoided and minimized.

The CZM Coastal Permitting Guide can be found here: https://www.mass.gov/info-details/environmental-permitting-in-coastal-massachusetts.

Massachusetts In-Lieu Fee (ILF) Program

The Massachusetts In-Lieu Fee (ILF) Program is an approach to compensate for unavoidable impacts to wetlands and water resources resulting from development projects under the Army Corps of Engineers Section 404 Dredge and Fill Permit requirements. The ILF Program is administered by the Department of Fish and Game and allows proponents to provide financial contributions to support wetland restoration, enhancement, and preservation projects instead of undertaking direct mitigation efforts on-site. These financial contributions are pooled into a fund and used to implement wetland restoration and conservation projects across the Commonwealth.

Salt marsh restoration projects funded by the Massachusetts ILF Program should follow the below guidelines:

- Proponents may use the baseline condition assessment developed for their mitigation project plan provided it follows the Baseline Conditions Data Collection Plan recommendations outlined in Section VI.
- Proponents may address the Project Objectives outlined in Section VII of this guidance in the Ecological Performance Standards in their mitigation project plans
- Proponents should incorporate the recommendations described in the Corrective Action Plan Section VIII of this guidance in the Adaptive Management Plan within their mitigation project plan.
- Regarding the Construction and Post-Construction Period Monitoring Plan described in Section VIII of this guidance, proponents may use the monitoring and reporting schedule established in their mitigation project plan for this purpose provided it is consistent with these recommendations.

Appendix B – Definitions

1. Beneficial reuse: (interchangeably with "beneficial use") of dredged material involves the placement or use of dredged material for some productive use. Examples of beneficial uses of dredged material include habitat development (e.g., wetland restoration or creation); development of parks and recreational facilities (e.g., walking and bicycle trails, wildlife viewing areas); agricultural, forestry, and horticultural uses; strip-mine reclamation/solid waste management (e.g., fill for strip mines, landfill capping); shoreline construction (e.g., levee and dike construction); construction/industrial development (e.g., bank stabilization, brownfields reclamation); and beach nourishment (e.g., restoration of eroding beaches).[4]

2. Discharge of Dredged or Fill Material: Any addition of dredged or fill material into, including any redeposit of dredged material within, waters of the United States within the Commonwealth. The term includes the direct placement of fill, including any material used for the primary purpose of replacing with dry land or of changing the bottom elevation of a wetland or water body. (314 CMR 9.02)

3. Dredging: The removal or repositioning of sediment or other material from below the mean high tide line for coastal waters and below the high water mark for inland waters. (314 CMR 9.02). Under 310 CMR 10.04, Dredge means to deepen, widen or excavate, either temporarily or permanently, land below the mean high tide line in coastal waters and below the high water mark for inland waters. The term dredge shall not include activities in Bordering or isolated vegetated wetlands.

4. Dredged Material: Sediment and associated materials that are moved from below the mean high tide line for coastal waters and below the high water mark for inland waters during dredging activities. (314 CMR 9.02)

5. Ecological Restoration Project: a project whose primary purpose is to restore or otherwise improve the natural capacity of a Resource Area(s) to protect and sustain the interests identified in M.G.L. c. 131, § 40, when such interests have been degraded or destroyed by anthropogenic influences. The term Ecological Restoration Project shall not include projects specifically intended to provide mitigation for the alteration of a Resource Area authorized by a Final Order or Variance issued pursuant to 310 CMR 10.00 or a 401 Water Quality Certification issued pursuant to 314 CMR 9.00: 401 Water Quality Certification for Discharge of Dredged or Fill Material, Dredging, and Dredged Material Disposal in Waters of the United States Within the Commonwealth other than projects implemented pursuant to a US Army Corps of Engineers approved in-lieu fee program. (310 CMR 10.04)

6. Ecological Restoration Limited Project means an Ecological Restoration Project that meets the eligibility criteria set forth in 310 CMR 10.24(8) or 10.53(4). (310 CMR 10.04)

7. Fill means to deposit any material so as to raise an elevation, either temporarily or permanently. (310 CMR 10.04)

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4 - The Role of the Federal Standard in the Beneficial Use of Dredged Material from U.S. Army Corps of Engineers New and Maintenance Navigation Projects Beneficial Uses of Dredged Materials, Oceans and Coastal Protection Division Office of Wetlands, Oceans, and Watersheds Office of Water, U.S. Environmental Protection Agency, EPA842-B-07-002, October 2007

8. Salt Marsh means a coastal wetland that extends landward up to the highest high tide line, that is, the highest spring tide of the year, and is characterized by plants that are well adapted to or prefer living in, saline soils. Dominant plants within Salt Marshes typically include salt meadow cord grass (*Spartina patens*) and/or Salt Marsh cord grass (*Spartina alterniflora*), but may also include, without limitation, spike grass (*Distichlis spicata*), high-tide bush (*Iva frutescens*), black grass (*Juncus gerardii*), and common reedgrass (*Phragmites*). A Salt Marsh may contain tidal creeks, ditches, and pools. (310 CMR 10.32(2))

9. Sediment, for the purpose of dredging, means all inorganic or organic matter including detritus situated under tidal waters below the mean high water line as defined in 310 CMR 10.23, and for inland waters, below the upper boundary of a bank, as defined in 310 CMR 10.54(2). (310 CMR 10.04)

10. Salt Marsh Thin Layer Placement (TLP) is the intentional placement of thin layers of dredged materials, sediment or soil to achieve an ecologically-derived target elevation or thickness to enhance, restore or otherwise improve the natural capacity of a Salt Marsh to protect and sustain the Interests Identified in M.G.L. c. 131, § 40, when such interests have been degraded or destroyed by anthropogenic influences. (Modified from ERDC TN-19-1, February 2019, Thin Layer Placement: Technical Definition for U.S. Army Corps of Engineers Applications, Berkowitz, et. al.).

Appendix C – Considerations for Project Development to Avoid Adverse Effects

The following paragraphs provide additional details pertaining to project considerations for Thin Layer Placement.

1. Engineering and Design Considerations

Project proponents should evaluate engineering and design considerations discussed below at a minimum, to achieve successful outcomes and to avoid, minimize, or mitigate potential adverse impacts resulting from Thin Layer Placement during Salt Marsh restoration construction activities:

a. **Sediment Thickness**

Recent studies and research conducted in New England[5,6,7] have demonstrated beneficial effects in the shortest period of time with placement of an approximate 3- to 6-inch-thick layer of coarse sediment or fill soil when weighing thickness/elevation achieved, existing plant survival, and plant establishment success. Therefore, 6-inch or less thickness of sediment or fill soil placement is currently recommended for Thin Layer Placement projects. Placement of a thicker fill layer may be justified to raise the marsh to surrounding grades in targeted discrete or isolated areas, or where a marsh has been completely, or nearly completely lost from a site.

In general, placing too thick of a layer and use of finer sediment has the potential to negatively impact the marsh platform and ecosystem. Compaction and smothering of existing sediment and organic materials within the Salt Marsh platform is known to affect root survival, increasing soil water saturation, reducing the amount of oxygen and the rate of nitrogen cycling in the soil, and increasing soil salinity.[8] Associated major concerns are related to plant reestablishment following placement of sediment or fill soil, where the lack of existing plant emergence or new plant growth, colonization of non-target plant or animal species, extended timeline for target plant species to reestablish, or lack of drainage in placement area are all potential impacts resulting in the short-term, long-term, or permanent loss of marsh functions.

The project should evaluate the best management option for successful vegetation /revegetation to achieve project objectives (i.e., allowing placement area to revegetate naturally or for integrating new plantings). If vegetation objectives (e.g., reestablishment growth, density, and species type) are not met the project may need to evaluate potential causes and determine if the fill material placement thickness and elevation range targeted and achieved were appropriate or compatible for intended vegetation objectives.

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5 - Kenneth B. Raposa et al. “Evaluating Thin-Layer Sediment Placement as a Tool for Enhancing Tidal Marsh Resilience: A Coordinated Experiment Across Eight US National Estuarine Research Reserves”; Estuaries and Coasts, January 2023.
6 - Puchkoff, A., Lawrence, BA. “Experimental sediment addition in salt-marsh restoration: plant soil carbon dynamics in southern New England.” Ecological Engineering 175, p. 106495, 2022.
7 - Andrew R. Payne et al. “Short-Term Effects of Thin-Layer Sand Placement on Salt Marsh Grasses: A Marsh Organ Field Experiment, J Coast Res., July 2021.
8 - Veldhuis ER, Schrama M, Staal M and Elzenga JTM (2019) Plant Stress-Tolerance Traits Predict Salt Marsh Vegetation Patterning. Front. Mar. Sci. 5:501., 2019.

Some studies conducted in New England have hypothesized that the patchy placement of sediment (placement in discontinuous areas across a marsh platform and allowing for natural processes to move and incorporate the sediment into the marsh), mimicking large-scale natural ice rafting and sediment deposition events, may promote rapid plant colonization and lessen the risks associated with larger scale placement.[9] However, patchy placement may not meet target elevation goals, may require supplemental placement events in the future (placement of additional sediment), and could be more difficult to implement. Additionally, an understanding of sediment dynamics is critical to understanding if this type of TLP placement will be beneficial and to understand dispersion and potential turbidity concerns. Therefore, the application should include an analysis of how the sediment may be dispersed and deposited once placed using this technique.

Finally, any potential or anticipated post-placement consolidation, settling, or loss of placed fill materials shall be evaluated when considering thickness of fill placement (see section d. below).

b. **Methods of Fill Material Placement and Distribution**

A thorough evaluation of physical site construction access needs to be conducted to determine access constraints, efficient transport routes across the Salt Marsh or from the water's edge to the placement sites, type (size, weight) of transport and distribution equipment to be used, pipeline corridors, and reach of placement methods. As noted above, compaction of the Salt Marsh platform can be a major concern depending on the sediment thickness placed and should be minimized or avoided. Compaction can be an even greater concern related to the transportation and distribution of sediment or fill soil at the site, especially when using large and heavy construction equipment where large areas of habitat can be significantly and irreversibly impacted.

Evaluation of the shortest and most efficient routes on the marsh, potential transport, and distribution from waterside rather than land-side options, use of low ground pressure equipment, use of weight-dispersing matting materials, minimizing construction vehicle travel and weight, etc., are all potential methods which should be evaluated to reduce travel and minimize compaction on the marsh and impacts to surrounding habitats (eelgrass, horseshoe crab spawning, diadromous fish passage, shellfish).

c. **Fill Material Evaluation**

- Sediment or soil fill proposed to be placed at the restoration site must be physically and chemically compatible with the new site to ensure that the habitat can respond to the new conditions to provide a consistent habitat with the desired vegetation, density, and species type. Evaluation should include habitat review at the sediment source, material grain size, density, organic and nutrient content, and soil chemistry.

- Evaluation of sediment or soil fill materials is required to determine if material placement could result in changes in pH levels at the restoration site which would contribute to the generation of sulfuric acid and iron sulfide materials to avoid such changes or to provide mitigation/corrective actions, if needed. The rapid generation of sulfuric acid and iron sulfide materials has been documented related to the

9 - Moore GE, Burdick DM, Routhier MR, Novak AB, Payne AR (2021) Effects of a large-scale, natural sediment deposition event on plant cover in a Massachusetts salt marsh.

placement of dredged sediment materials at Salt Marsh restoration sites.[10,11] The evaluation should include a review of soil chemistry and presence of acid sulfate soil.

- To evaluate if fill materials are contaminated and would detrimentally impact the receiving marsh's ecological functions or require additional permitting and compliance under the 310 CMR 40.00: Massachusetts Contingency Plan or 314 CMR 9.00 401 Water Quality Certification regulations, historic land uses and historic discharges of pollutants at the fill material source site, presence of debris in the material, and soil chemistry shall be evaluated. It is noted that upland fill materials and excavated Salt Marsh materials are considered as soil prior to and following placement on a Salt Marsh, and that dredged sediments are considered as soil once placed on the Salt Marsh. Placement of contaminated fill material can result in the loss of vegetation and potentially pose a threat to health, safety, public welfare or the environment via a new exposure to humans and Salt Marsh organisms.

- Proper and appropriate distribution, placement and containment methods and techniques are essential to minimize inadvertent placement and offsite loss of placed fill materials, which may impact existing and surrounding area habitats and resources. An evaluation of fill material grain size, organic content is required to determine best distribution, placement and containment methods.

d. **Protection of Habitat**

Additional considerations for the protection of habitat and existing flora and fauna at or nearby the placement site include the following:

- Estimated Habitat: See Section V.1. above for requirements.

- Presence of invasive species at the placement site. The existence of invasive species should be reviewed to ensure that there is no spread of existing invasive species or introduction of new invasive species as a result of the restoration activities, and preferably to remove those present in the vicinity of the work. An invasive species management and control plan to avoid spread on gear and equipment should be developed for the project.

- Temporary or permanent containment or confinement structures and/or approaches. Retention and consolidation of the placed sediment may be required to prevent loss of sediment, especially at creek network or Salt Marsh edges, and where energetic wave conditions may exist. Containment approaches could vary significantly according to site and project specific details, such as location on marsh (high marsh vs. low marsh), wind or wave energy and conditions, thickness of material placed, etc. If possible, the project should utilize appropriate containment to avoid adverse impacts to the surrounding environment, while minimizing interference with natural processes on the Salt Marsh. Use of biodegradable materials is recommended, when possible. The Issuing Authority may use discretion in requiring containment or level of containment for certain projects dependent on project design and site conditions. Project proponent would need to provide adequate justification as to why

10 - J. Berkowitz and C. VanZomeren, Rapid formation of iron sulfides alters soil morphology and chemistry following simulated marsh restoration, ERDC/EL, TR-20-1, January 2020.
11 - J. Berkowitz, et al., Evaluation of Iron Sulfide Soil Formation Following Coastal Marsh Restoration – Observations from Three Case Studies, ERDC, Geoderma 351 (2019).

containment would not be necessary to avoid adverse effects to the nearby Resource Areas.

Excessive or prolonged containment may present adverse effects, such as difficultly removing containment structures and the long-term prevention of natural sediment transport onto the marsh. The project shall evaluate the stability of the placed materials to determine the most appropriate time to remove containment structures.

- Potential for sedimentation in the surrounding Salt Marsh or surface water resulting from construction activities or post construction conditions. In the process of sediment placement, material may be released into areas outside of the immediate restoration site, or to tidal waters. This unanticipated result could occur due to excess placement via overspray, release during transport, or lack of adequate containment of placed sediment. This release of sediment to non-target areas may directly impact nearby healthy habitat such as the smothering of eelgrass, impacting fish and shellfish habitat, the alteration of marsh hydrology by filling, or clogging of existing ditches or runnels which could alter tidal connectivity.

2. Additional Construction Considerations

Many additional construction-related considerations need to be addressed in the design and implementation phases of a project, including the following:

a. Project implementation schedule development to meet required project benchmarks, regulatory and permitting timelines (if any), or other Time of Year or MNHESP restrictions.
b. Property owner and contiguous property owners review, notification, coordination, agreements, etc., to facilitate site access, as needed.
c. Monitoring and corrective actions activities. See Section VIII above for further details.
d. Other common construction-related concerns, such as release of oil or hazardous materials and health & safety concerns related to construction using heavy equipment and working on potential loose or unconsolidated materials on a Salt Marsh, etc.