BSC GROUP

MEMORANDUM

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To:	Amesbury MVP Natural Resources Infrastructure Assessment coordinator	**Date:**	May 6, 2019
From:	BSC Group Inc. -Ecological & Landscape	**Proj. No.**	89492.46
Re:	**Climate-Resilient Sites and Ecological Restoration Planning**		

SECTION 1 Using This Memorandum

Notes on interpreting and using the MVP memoranda for planning purposes

The projects described in the planning matrix, field maps and under Section 3 are prepared for use in selecting projects prior to a complete analysis and design process for a specific site.

They represent an initial designers' opinion of limiting factors and opportunities based on the available understanding of each site. These are not to be used as a direct source for design or construction budgeting. They do not provide comprehensive scope for permitting, design, construction, or environmental monitoring but will provide a starting point for evaluation.

They are organized by the following headings.

Project number per matrix: (#)
Organized by columns in the matrix. Site numbers from each of the named study area locations from the aerial photo maps connect the approximate location within each site to a project name.
Project Name: **Name**
Organized by rows in the matrix. This number and name refer to the table providing a pairing of project types, and locations within the study area where we have determined sufficient feasibility for study and recommended a rating of overall value.

Prerequisites:
A number of conditions must be addressed before any project can be executed. This discussion point is intended to bring these factors to bear before significant investment of time and effort. These are notes for discussion to ensure limiting prerequisite factors are addressed before any project is considered or pursued. Any final limiting factors of an individual project will be discovered through analysis and design.

Description:
This section provides a simplified list of significant activities that will likely be part of the construction process and should be considered in relation to prerequisites, environmental impacts, volunteer opportunities, etc.

Recommendation:
This section provides an initial list of recommendations to spur discussion of the opportunities and constraints of a given project.

Budget Order of Magnitude: ($## - $##)
Often the aspect of planning with the most limited availability of early references for comparison and assessment of scope and feasibility. This report provides some basis for development of preliminary budgets per a designer's opinion of cost as broken down to minimum feasible units.
These numbers can provide a rough order of magnitude cost for a given unit of the project named.
This report was issued in 2019. For each year from that date consider including an escalation cost of 3% per year to the

date of construction or appropriate inflation. As a conceptual tool, this is based on certain assumptions about project location, subsurface information, and observed conditions which must be fleshed out in greater detail as individual project scope is developed.

Unit: (Each, sy. square yard, lf. linear foot, sf square foot, ksf. Thousand square feet, ac. Acre etc.)
This provides an opinion of minimum practical unit for any project. The *Unit size* and *Budget Order of Magnitude* are affected by a number of factors such as full truckloads of material, an average amount of labor per unit, and practical limits of ecological function or critical mass needed for effective establishment.
Provided for reference with this are a series of bullets further describing units of measure that drive the core of the *Budget Order of Magnitude*. These are intended to help users in understanding project costs and variables affecting them. These are also intended to allow for refinement of budgets for project sizes that fall between the units listed above.

Schedule: (#days) (# years establishment)
This describes the core construction schedule for a project *Unit*. Consider also weather and climate constraints, mobilization, bidding, survey, design schedule, environmental testing, follow up monitoring, establishment of vegetation and maintenance constraints.

SECTION 2 Planning and Permitting

Section 2.1 Generalized Project Planning Process

For all projects suggested below and in the attachments to this report, a multi-step planning process would be required, likely entailing the following elements:

1. Identification of project goals, in collaboration with stakeholders, property owners, potential partners, community members.
2. Identification of project scope.
3. Detailed feasibility assessment.
4. Development of specific project and design plans and sequencing, including:
    a. feasibility and constructability studies,
    b. stakeholder, community, and volunteer outreach and involvement,
    c. permit planning and implementation,
    d. assessment and resolution of subsidiary issues that are identified during planning process (such as disposal of contaminated sediments, historical, archaeological, and rare species issues, etc.),
    e. define performance standards and measures of project success,
    f. plans for post-construction or post-implementation monitoring,
    g. plans for long-term maintenance, where necessary.
    h. Site topographic survey
5. Project implementation.
6. Post-project monitoring, assessment and reporting.
7. Long-term maintenance, where necessary.

Section 2.2 Generalized Project Permitting Process

The project area includes multiple wetlands, waterways, streams, rivers (Powow and Back), a major tidal river (the Merrimack), and two lakes (Attitash and Gardner) and includes land owned by the state, the municipality and private property. Numerous federal, state and local laws and regulations apply to work within the project area. Once a specific project has been selected, and specific project designs are developed, the permit requirements specific to that project will be identifiable. Generally speaking, projects should be screened for permits/authorizations required under the following laws and regulations:

- Section 401 Clean Water Act/Water Quality Certification program,

- Section 404 of the Clean Water Act,
- Section 10 of the Rivers and Harbors Act,
- National Pollutant Discharge Elimination System (NPDES) permit program,
- Federal Endangered Species Act,
- Section 106 of the National Historic Preservation Act of 1966,
- Massachusetts Environmental Policy Act (MEPA),
- Chapter 91 Massachusetts Public Waterfront Act,
- Massachusetts Wetlands Protection Act
- City of Amesbury Ordinances, regulations and guidance
- Massachusetts General Laws Chapter 9, sections 26-27c (Massachusetts Historical Commission - historical and archaeological review/authorization),
- Massachusetts Endangered Species Act,
- Potential soil/sediment contamination issues would need to be considered where potentially contaminated soil or sediment removal/disturbance occurs.

SECTION 3 Projects

Project Number per matrix: **(1,2)**
Project Name: **Invasive species management, Riverbank revegetation**

Prerequisites:

- Requires licensed herbicide applicator.
- Restoration is coordinated with appropriate partners and grant providers.
- City/Concom./ land owner approval.
- Appropriate permits are obtained. See discussion in Section 2.1 of report.

Description:

- Installation of erosion control measures where required.
- No intentional soil disruption or significant excavation beyond that necessary to install restoration plantings.
- Site preparation, herbicide or clear & grub, through a private contractor. Site preparation to include invasive vegetation removal.
- Planting through Volunteer efforts or private contractor. Methods may include but are not limited to the following: live-stake of armored banks, live-stake of wetland, live fascines for bank stabilization/revegetation, plug/container planting, conservation seeding, seeded compost top-dress, seeded wattle, use of tree trunks and root masses.
- Follow up: maintenance period 60 days. Establishment period two (2) years. Maintenance period to include watering twice weekly, hand weeding & replacement of failed plantings. Establishment period to include biannual removal of invasive plants and weeds, annual replacement of failed plantings, and watering as needed to naturalize plantings.

Recommendation:

- Coordinate efforts to pair invasive control with public amenity features to ensure community investment, visibility, and assessment of best practices.
- Coordinate location of invasive control to achieve stability through critical mass.
- Assess bordering threats such as proximity of established invasive seed sources.
- Assess opportunities for coordinated habitat enhancement, educational resources.
- Ensure project budgets and contracts with private companies include sufficient retainage for maintenance and establishment period, and coordination costs for oversight.

Budget Order of Magnitude: $1,000-$5,000
Square Yard Cost. Minimum Area 10 yd.

- Coordination costs 5%
- Design costs 1%
- Mobilization 5%
- Material costs $50-$100/yd.
- Labor Volunteer or $3000/day contractor team of Four: 1 Foreman & 3 Laborers.
- Licensed Herbicide applicator or machine operator. $1000/ day. Three (3) treatments prior to planting.
- For projects requiring Contract labor assume 20% Overhead and Profit.

Schedule:

- 1-day construction per unit.
- 2 years' establishment, permanent, once annual maintenance.

Project Number per matrix: **(3-4)**
Project Name: **Grassland Meadow/ Shrubland Heath management/ Restoration - Conversion.**

Prerequisites:

- Requires licensed herbicide applicator.
- Restoration is coordinated appropriate partners and grant providers.
- City Concom/ land owner approval.
- Soils assessment & amendment.
- Appropriate permits are obtained. See discussion in Section 2.1 of report.

Description:

- Evaluation of existing turf species for effective naturalization with soil test and amendment.
- Installation of erosion control measures if required.
- No intentional soil disruption or significant excavation beyond that necessary to install restoration plantings.
- Site preparation to include selective invasive vegetation removal, assessment of solar aspect, & threats.
- Reduction of mowing to twice annually, modification of mowing practice to allow meadow species 10" mow height. Planting of key meadow species through volunteer efforts or private contractor. Methods may include but are not limited to the following: compost top-dress, conservation seeding, plug/container planting of forbes. See details and specifications.
- Follow up: Establishment period two (2) years. Establishment period to include biannual removal of invasive plants and weeds, annual replacement of failed plantings, and watering as needed to naturalize plantings.
- Perpetual maintenance program as coordinated with managing stakeholder.

Recommendations:

- Include mowed turf borders and signage for control of encroaching woody vegetation, clear boundary of intentional meadow, visibility, and value as a passive recreation feature.
- Maintain stability through critical mass, solar exposure, soil assessment and amendment, and coordinated invasive control.
- Assess bordering threats such as proximity of established invasive seed sources.
- Assess opportunities for coordinated habitat enhancement, educational resources.
- Ensure clear communication and understanding of maintenance personnel.

Budget Order of Magnitude: $500-$1000
Square Yard Cost. Minimum Area 30 yd.

- Coordination costs 5%
- Design & testing costs 5%
- Mobilization 5%
- Material costs $3-$10/yd.
- Labor $3000/day contractor team of four: 1 Foreman & 3 Laborers. (Volunteer opportunities)
- Licensed Herbicide applicator. $1000/ day. Three (3) treatments prior to planting.
- For projects requiring Contract labor add 20% Overhead and Profit.

Schedule:

- Change to maintenance methods. One (1) day per year, modification, twice-annual establishment.
- Permanent biannual maintenance.
- Annual assessment & modification.

Project Number per matrix: **Project (5)**
Project Name: **Wetland Management Restoration (Invasive Control/ Revegetation)**

Prerequisites:

- Requires licensed herbicide applicator.
- Restoration is coordinated with appropriate partners and grant providers.
- City Concom/ land owner approval.
- Appropriate permits are obtained. See discussion in Section 2.1 of report.

Description:

- Evaluation of existing native shrub/tree species for effective naturalization.
- Installation of erosion control measures where required.
- Limited soil disruption or significant excavation beyond that necessary to install restoration plantings.
- Site preparation to include selective invasive vegetation removal.
- Planting of select native species, mulching, watering, and weeding during maintenance period.
- Follow up: Establishment period two (2) years. Establishment period to include biannual removal of invasive plants and weeds, annual replacement of failed plantings, and watering as needed to naturalize plantings.

Recommendation:

- Assess potential erosion or habitat disruption impacts.
- Maintain stability through critical mass, and coordinated invasive control.
- Assess bordering threats such as proximity of established invasive seed sources.
- Assess opportunities for coordinated habitat enhancement, flood storage and storm water controls.
- Ensure clear communication and understanding of maintenance personnel.

Budget Order of Magnitude: $1,500-$6,000
Unit: Square Yard Cost. Minimum Area 10 yd.

- Coordination costs 5%
- Design costs 8%
- Material costs $10-$30/yd.
- Labor cost $3000/day contractor team of four: 1 Foreman & 3 Laborers. (volunteer opportunities)
- Licensed Herbicide applicator. $1000/ day. Three (3) treatments prior to planting. (Cut & Brush Selective Treatment).
- Access controls: swamp mats & erosion control barrier. 10%
- For Contract labor assume 20% Overhead and Profit.

Schedule:

- 1 year preparation,
- 1 day/ unit construction,
- 2 years' establishment,
- Permanent once-annual maintenance.

Project Name: **(6) Habitat Enhancement**

Prerequisites:

- Restoration is coordinated with appropriate partners and grant providers.
- City Concom/ land owner approval.
- Appropriate permits are obtained. See discussion in Section 2.1 of report.

Description:

- Installation of erosion control measures where required.
- Installation of snag trees, brush piles, stone cairns, logs, nesting boxes, nesting terrain, forage plantings, habitat plantings, and or interpretation features.
- No intentional soil disruption or significant excavation beyond that necessary to install enhancements.
- Site preparation, or clear & grub, through DCR or private contractor. Site preparation to include invasive vegetation removal.
- Installation through Volunteer efforts or private contractor.
- Follow up: general annual maintenance for constructed features and standard maintenance and establishment practices for plantings, replacement of failed plantings, and watering as needed to naturalize plantings.

Recommendation:

- Coordinate efforts to support or retain species that are present but threatened.
- Select locations based on connections to necessary species resources.
- Assess bordering threats such as human interference, predators, and microclimate, or vegetation constraints
- Use materials found on site to the extent feasible.
- Assess opportunities for coordinated habitat enhancement, educational resources.
- Ensure project budgets and contracts with private companies include sufficient retainage for maintenance and establishment period, and coordination costs for oversight.

Budget Order of Magnitude: $1,000-$5,000
Square Yard Cost. Minimum Area 10 yd.

- Coordination costs 5%
- Design costs 1%
- Mobilization 5%
- Material costs $5-$100/yd.
- Labor $3000/day contractor team of four: 1 Foreman & 3 Laborers. (Volunteer opportunities)
- Machine operator. $1000/ day.
- For projects requiring Contract labor assume 20% Overhead and Profit.

Schedule:

- 1-day construction per unit.

Project Number per matrix: **(7)**
Project Name: **New Wetland Construction/ Flood storage Expansion/ alteration**

Prerequisites:

- Requires permitted excavation adjacent to wetlands.
- Restoration is coordinated with appropriate partners and grant providers.
- City Concom/ land owner approval.
- Appropriate permits are obtained. See discussion in Section 2.1 of report.
- Soil testing for contamination if contamination is a possibility.
- LSP (Licensed Site Professional) available for unexpected hazards, if contamination is a possibility.

Description:

- Evaluation of water table & soil profile for effective wetland establishment, groundwater monitoring well(s).
- Evaluation of existing native shrub/tree species for effective naturalization.
- Installation of access control measures where required.
- Significant soil disruption.
- Site preparation to include erosion control & stock pile/mobilization staging area.
- Planting of select native species, mulching, watering, and weeding during maintenance period.
- Plan for construction period and post-construction period environmental monitoring.
- Volunteers could design, build and install signage explaining ecological and climate resiliency value of restoration effort.
- Follow up: Establishment period (2) two years. Establishment period to include biannual removal of invasive plants and weeds, annual replacement of failed plantings, and watering as needed to naturalize plantings.

Recommendation:

- Assess potential erosion contamination impacts.
- Maintain stability through critical mass, and coordinated invasive control.
- Assess invasive soil seed bank & root stock.
- Assess bordering threats such as proximity of established invasive seed sources.
- Assess opportunities for coordinated habitat enhancement flood storage and storm water controls.
- Ensure clear communication and understanding of maintenance personnel costs for oversight.

Budget Order of Magnitude: $15,000-$20,000
Unit: Minimum Area 10yd.

- Coordination costs 5%
- Design costs 10%
- Mobilization 5%
- Plant material costs $5-$50/yd.
- Labor cost for planting/ seeding and or $3000/day-unit contractor team of four 1 Foreman & 3 Laborers. (Possible volunteer opportunities)
- Machine operator $1000/ day-unit.
- Access controls swamp mats & erosion control barrier $500-$1000
- Excavation: $25/cy. = $25/sy.
- Material disposal: on site $50/cy. offsite $70/cy., Contaminated soils disposal offsite $300/cy.
- Placement of wetland soils $80/cy. = $20/sy.
- Seed establishment $5/yd.
- Groundwater Monitoring well $1200 ea.,
- For projects requiring Contract labor add 20% Overhead and Profit.
- Construction and post-construction environmental monitoring: Variable costs

Schedule: Pre-construction monitoring of groundwater table (minimum 1 growing season, preferably multiple growing seasons), 2-day construction, 2 years' establishment.

Project Number per matrix: **(8)**
Project Name: **Floodplain construction/ expansion** reconnection
Prerequisites:

- Where dewatering is required, confirm adjacent upland area is available for dewatering (2:1 ratio for dewatering area to areas of dredge).
- Requires permitted excavation adjacent to wetlands.
- Restoration is coordinated with appropriate partners and grant providers.
- City Concom/ land owner approval.
- Appropriate permits are obtained. See discussion in Section 2.1 of report.
- Soil testing for contamination if contamination is a possibility.
- LSP (Licensed Site Professional) available for unexpected hazards if contamination is a possibility.

Description:

- Evaluation of water table & soil profile for effective wetland establishment, groundwater monitoring well(s).
- Evaluation of existing native shrub/tree species for effective naturalization.
- Installation of access control measures where required.
- Site preparation to include erosion control & stock pile/mobilization staging area
- Significant soil disruption, peninsulas, islands, bends banks and or dredge.
- Placement of depth altering features such as shelves peninsulas, islands, basins.
- Planting of select native species, mulching, watering, and weeding during maintenance period.
- Plan for construction period and post-construction period environmental monitoring.
- Volunteers could design, build and install signage explaining ecological and climate resiliency value of restoration effort.
- Follow up: Establishment period (2) two years. Establishment period to include biannual removal of invasive plants and weeds, annual replacement of failed plantings, and watering as needed to naturalize plantings.

Recommendation:

- Assess potential erosion contamination impacts.
- Maintain stability through critical mass and coordinated invasive control.
- Assess invasive soil seed bank & root stock.
- Assess bordering threats such as proximity of established invasive seed sources.
- Assess opportunities for coordinated habitat enhancement flood storage and storm water controls.
- Ensure clear communication and understanding of maintenance personnel. costs for oversight.

Budget Order of Magnitude: $25,000-$85,000/Acre dredge Heavy
Budget Order of Magnitude: $15,000-$25,000/Acre dredge Light
Budget Order of Magnitude: $5,000-$9,000/Linear bank modified 10 yd.
Budget Order of Magnitude: $3,000-$7,000/Adjacent Upland 10 cy.

Unit: Minimum Area 10yd.

- Coordination costs 5%
- Design costs 10%
- Mobilization 5%
- Erosion and sedimentation control 5%.
- Soft cape flow alteration features ($1,000-$3000)
- Dredging operations $10000/day-unit contractor team and equipment heavy. (half using pumps.)
- Access controls swamp mats & erosion control barrier $500-$1000
- Upland excavation: $25/cy. = $25/sy.
- Material disposal: on site $50/cy. offsite $70/cy. Contaminated soils disposal offsite $300/cy.

- Placement of wetland soils $80/cy. = $20/sy.
- Plant material costs $5-$50/yd.
- Labor cost for planting/ seeding and or $3000/day-unit contractor team of four 1 Foreman & 3 Laborers. (Possible volunteer opportunities)
- Machine operator $1000/ day-unit.
- Seed establishment $5/yd.
- Groundwater Monitoring well $1200 ea.,
- For projects requiring Contract labor add 20% Overhead and Profit.
- Construction and post-construction environmental monitoring: Variable costs

Schedule: Pre-construction monitoring of groundwater table (minimum 1 growing season, preferably multiple growing seasons), 2-day construction, 2 years' establishment.

Project Number per matrix: **(9)**
Project Name: **Pond creation alterations**

Prerequisites:

- Where dewatering is required, confirm adjacent upland area is available for dewatering (2:1 ratio for dewatering area to areas of dredge).
- .
- Requires permitted excavation adjacent to wetlands.
- Restoration is coordinated with appropriate partners and grant providers.
- City Concom/ land owner approval.
- Appropriate permits are obtained. See discussion in Section 2.1 of report.
- Soil testing for contamination if contamination is a possibility.
- LSP (Licensed Site Professional) available for unexpected hazards if contamination is a possibility.

Description:

- Evaluation of water table & soil profile for effective wetland establishment, groundwater monitoring well(s).
- Evaluation of existing native shrub/tree species for effective naturalization.
- Installation of access control measures where required.
- Site preparation to include erosion control & stock pile/mobilization staging area
- Significant soil disruption, Peninsulas, Islands, bends banks and or dredge.
- Placement of depth altering features shelves peninsulas, Islands, basins.
- Planting of select native species, mulching, watering, and weeding during maintenance period.
- Plan for construction period and post-construction period environmental monitoring.
- Volunteers could design, build and install signage explaining ecological and climate resiliency value of restoration effort.
- Follow up: Establishment period (2) two years. Establishment period to include biannual removal of invasive plants and weeds, annual replacement of failed plantings, and watering as needed to naturalize plantings.

Recommendation:

- Assess potential erosion contamination impacts.
- Maintain stability through critical mass and coordinated invasive control.
- Assess invasive soil seed bank & root stock.
- Assess bordering threats such as proximity of established invasive seed sources.
- Assess opportunities for coordinated habitat enhancement flood storage and storm water controls.
- Ensure clear communication and understanding of maintenance personnel. costs for oversight.

Budget Order of Magnitude: $25,000-$85,000/Acre dredge Heavy
Budget Order of Magnitude: $15,000-$25,000/Acre dredge Light
Budget Order of Magnitude: $5,000-$9,000/Linear bank modified 10 yd.
Unit: Minimum Area 10yd.

- Coordination costs 5%
- Design costs 10%
- Mobilization 5%
- Erosion and sedimentation control 5%.
- Soft cape flow alteration features ($1,000-$3000)
- Dredging operations $10000/day-unit contractor team and equipment heavy. (half using pumps.)
- Access controls swamp mats & erosion control barrier $500-$1000
- Upland excavation: $25/cy. = $25/sy.
- Material disposal: on site $50/cy. offsite $70/cy., Contaminated soils disposal offsite $300/cy.

- Placement of wetland soils $80/cy. = $20/sy.
- Plant material costs $5-$50/yd.
- Labor cost for planting/ seeding and or $3000/day-unit contractor team of four 1 Foreman & 3 Laborers. (Possible volunteer opportunities)
- Machine operator $1000/ day-unit.
- Seed establishment $5/yd.
- Groundwater Monitoring well $1200 ea.,
- For projects requiring Contract labor add 20% Overhead and Profit.
- Construction and post-construction environmental monitoring: Variable costs

Schedule: Pre-construction monitoring of groundwater table (minimum 1 growing season, preferably multiple growing seasons), 2-day construction, 2 years' establishment.

Project Number per matrix: **(10)**
Project Name: **River flow and function alterations**

Prerequisites:

- Where dewatering is required, confirm adjacent upland area is available for dewatering (2:1 ratio for dewatering area to areas of dredge).
- .
- Requires permitted excavation adjacent to wetlands.
- Restoration is coordinated with appropriate partners and grant providers.
- City Concom./ land owner approval.
- Appropriate permits are obtained. See discussion in Section 2.1 of report.
- Soil testing for contamination if contamination is a possibility.
- LSP (Licensed Site Professional) available for unexpected hazards if contamination is a possibility.

Description:

- Evaluation of water table & soil profile for effective wetland establishment, groundwater monitoring well(s).
- Evaluation of existing native shrub/tree species for effective naturalization.
- Installation of access control measures where required.
- Site preparation to include erosion control & stock pile/mobilization staging area
- Significant soil disruption, peninsulas, islands, bends banks and or dredge.
- Placement of flow altering features root wads, vegetative rafts.
- Planting of select native species, mulching, watering, and weeding during maintenance period.
- Plan for construction period and post-construction period environmental monitoring.
- Volunteers could design, build and install signage explaining ecological and climate resiliency value of restoration effort.
- Follow up: Establishment period (2) two years. Establishment period to include biannual removal of invasive plants and weeds, annual replacement of failed plantings, and watering as needed to naturalize plantings.

Recommendation:

- Assess potential erosion contamination impacts.
- Maintain stability through critical mass, and coordinated invasive control.
- Assess invasive soil seed bank & root stock.
- Assess bordering threats such as proximity of established invasive seed sources.
- Assess opportunities for coordinated habitat enhancement flood storage and storm water controls.
- Ensure clear communication and understanding of maintenance personnel. costs for oversight.

Budget Order of Magnitude: $25,000-$85,000/Acre Heavy
Budget Order of Magnitude: $15,000-$25,000/Acre Light
Budget Order of Magnitude: $5,000-$9,000/Linear 10 yd.
Unit: Minimum Area 10yd.

- Coordination costs 5%
- Design costs 10%
- Mobilization 5%
- Erosion and sedimentation control 5%.
- Soft cape flow alteration features ($1,000-$3000)
- Dredging operations $10000/day-unit contractor team and equipment heavy. (half using pumps.)
- Access controls swamp mats & erosion control barrier $500-$1000
- Upland excavation: $25/cy. = $25/sy.
- Material disposal: on site $50/cy. offsite $70/cy., Contaminated soils disposal offsite $300/cy.

- Placement of wetland soils $80/cy. = $20/sy.
- Plant material costs $5-$50/yd.
- Labor cost for planting/ seeding and or $3000/day-unit contractor team of four 1 Foreman & 3 Laborers. (Possible volunteer opportunities)
- Machine operator $1000/ day-unit.
- Seed establishment $5/yd.
- Groundwater Monitoring well $1200 ea.,
- For projects requiring Contract labor add 20% Overhead and Profit.
- Construction and post-construction environmental monitoring: Variable costs

Schedule: Pre-construction monitoring of groundwater table (minimum 1 growing season, preferably multiple growing seasons), 2-day construction, 2 years' establishment.

Project Number per matrix: **(11, 12, 13)**
Project Name: Stormwater treatment wetland, **Upstream BMP's (Roadside and site drainage improvements A, B, C), Standard Street Trees**
A Infiltration street tree planting, B Bio-swales, C Raingardens. D Standard street tree planting.

Prerequisites:

- Coordination with DPW (Set new construction standards requiring BMP redevelopment).
- Restoration is coordinated with appropriate partners and grant providers.
- City Concom/ land owner approval.
- Appropriate permits are obtained. See discussion in Section 2.1 of report.
- Soil testing for infiltration, contamination, roadside hazards/ impacts.

Description: This category covers a number of project options. Included here are basic descriptions for common elements followed by details affecting each project.

A. Infiltration street tree planting: Tree plantings with expanded sub sidewalk soil space, and curb cuts allowing stormwater infiltration, with connections to overflow drainage often coordinated with pervious pavement.
B. Bio swales: Roadside swales with heavy sediment trap inlets, sub drain storage chambers, and or filter media, paired with flood/drought adapted vegetation.
C. Rain Gardens: Infiltration basins with flood/drought adapted vegetation.
D. Standard street tree planting with supplemented soils.

- Evaluation of water table & soil profile for effective establishment, drainage connection(s).
- Site preparation to include erosion control & stock pile/mobilization staging area
- Significant traffic and soil disruption required.
- Connection to systemic drainage systems.
- Replacement/ amendment of soils, installation of drainage structures.
- Planting of select species Stormwater infiltration species, mulching, watering, and weeding during maintenance period.
- Plan for construction period and post-construction period environmental monitoring.
- Follow up: Establishment period (2) two years. Establishment period to include biannual removal of invasive plants and weeds, annual replacement of failed plantings, and watering as needed to naturalize plantings.
- Annual maintenance comparable to standard roadside drainage and planting features.

Recommendation:

- Assess potential erosion contamination impacts.
- Establish standard procedures and requirements for all infrastructure and new development projects to include storm resiliency measures.

Budgeting:

Budget Order of Magnitude A: Infiltration tree planting $4,000-$7,000/each
Budget Order of Magnitude B: Bio-swale $150-$300/ sq.yd. Linear
Budget Order of Magnitude C: Rain garden $200/sy intensive, $100/sy. extensive (light construction)
Budget Order of Magnitude D: Standard street tree planting $2000/ each

- Coordination costs 5%
- Design costs 5%
- Mobilization 5%
- Erosion and sedimentation control 1%.

- Access controls & erosion control barrier $5-$25/lf.
- Upland excavation: $25/cy. = $25/sy.
- Material disposal: on site $50/cy. offsite $70/cy., Contaminated soils disposal offsite $300/cy.
- Placement of infiltration soils $80/cy. = $20/sy.
- Plant material costs $5-$50/yd.
- Labor cost for earthwork planting/ seeding $3000/day-unit contractor team of four 1 Foreman & 3 Laborers. (Possible volunteer opportunities)
- Machine operator $1000/ day-unit.
- Seed establishment $5/yd.
- Groundwater monitoring well $1200 ea.,
- Contract labor add 20% Overhead and Profit.
- Construction and post-construction environmental monitoring: Variable costs

Schedule: 2-day construction/ unit, 2 years' establishment.

Project Number per matrix: **(14, 15)**
Project Name: **MSCS Culvert Improvement, Fish Ladder**
A Culvert improvement, B Bridge replacement, C Fish ladder.

Prerequisites:

- MA Department of Ecological Restoration approval. (fish ladder)
- Flow analysis
- Coordination with DPW (Set new construction standards requiring BMP redevelopment).
- Restoration is coordinated with appropriate partners and grant providers.
- City Concom/ abutter approval.
- Appropriate permits are obtained. Chapter 91 license for navigable waters. See discussion in Section 2.1 of report.
- Soil testing for infiltration, contamination, roadside hazards/ impacts.

Description:

- Replacement of standard culvert with one or more Massachusetts Stream Crossing Standard (MSCS) structures such as graduated weirs, widened culverts and wildlife tunnels.
- Replacement or alteration of dams and stream channels to include fish ladder.
- Reconstruction of associated roadway/ dam.
- Reconstruction of stream channel.
- Reconstruction of abutting wetlands (see also construction of new wetlands).
- Temporary diversion of flow.
- Site preparation to include erosion control & stock pile/mobilization staging area.
- Significant traffic and soil disruption required.
- Connection to systemic drainage systems. (see roadside BMP's).
- Planting of select species Stormwater infiltration species, mulching, watering, and weeding during maintenance period.
- Plan for construction period and post-construction period environmental monitoring.
- Follow up: Establishment period (2) two years. Establishment period to include biannual removal of invasive plants and weeds, annual replacement of failed plantings, and watering as needed to naturalize plantings.
- Annual maintenance comparable to standard roadside drainage and planting features.

Recommendation:

- Assess upstream flood/ down stream flow impacts.
- Assess potential erosion contamination impacts.
- Establish standard procedures and requirements for all infrastructure and new development projects to include storm resiliency measures.

Budgeting:

Budget Order of Magnitude A: Culvert $10,000/lf.; Width up to 5' $15,000/lf; Width up to 12' (local collector or lower).
Budget Order of Magnitude B: Bridge $1,500,000-$2,500,000/ two lane up to 40' span.
Budget Order of Magnitude C: Fish ladder $20,000/ vertical foot.

- Access controls & erosion control barrier $5-$25/lf.
- Precast concrete structures $19/cf.
- Culvert stone footing $50/lf.
- Upland excavation $25/cy. = $25/sy.

- Wetland/ stream excavation $80/cy.
- Material disposal: on site $50/cy. offsite $70/cy. Contaminated soils disposal offsite $300/cy.
- Asphalt pavement reconstruction $40/sy.
- Plant material costs $5-$50/yd.
- Seed establishment $5/yd.
- Coordination costs 10%
- Design costs 10%
- Mobilization 20%
- Erosion and sedimentation control 5%.
- Contract labor 20% Overhead and Profit.
- Construction and post-construction environmental monitoring: Variable costs

Schedule: Varies by/ unit, plus 2 years establishment and monitoring.

Project Number per matrix: **(16,17)**

Project Name: **Flood Storage-sub-grade Structures, Pervious Pavements Parking/ walking areas**

Prerequisites:

- Restoration is coordinated with appropriate partners and grant providers.
- City Concom/ approval.
- Appropriate permits are obtained. See discussion in Section 2.1 of report.
- Soil testing for infiltration, contamination, structure hazards/ impacts.

Description:

- Addition of collection/ infiltration structures in hardscape areas.
- Pervious pavements with infiltration media base.
- Reconstruction of associated hardscape.
- Reconstruction of storm drainage systems.
- Temporary diversion of flow.
- Site preparation to include erosion control & stock pile/mobilization staging area.
- Significant traffic and soil disruption required.
- Disposal of excess soils.
- Annual maintenance comparable to standard roadside drainage structures.

Recommendation:

- Assess upstream flood/ down stream flow impacts.
- Assess potential erosion contamination impacts.
- Establish standard procedures and requirements for all infrastructure and new development projects to include storm resiliency measures.

Budgeting:

Budget Order of Magnitude A: Pervious paving $300/ sq,yd.
Budget Order of Magnitude B: Infiltration chambers $800-$1200/ sq,yd.
Budget Order of Magnitude C: Storm water storage chambers $1500-$2000/ cubic yard.

- Coordination costs 5%
- Design costs 5%
- Mobilization 5%
- Erosion and sedimentation control 1%.
- Access controls & erosion control barrier $5-$25/lf.
- Upland excavation: $25/cy. = $25/sy.
- Material disposal: on site $50/cy. offsite $70/cy. Contaminated soils disposal offsite $300/cy.
- Pervious Paving$220/ sq,yd.
- Infiltration chambers $120/ sq.yd.
- Concrete cisterns/ storage structures $1000 sq. yd.
- Asphalt pavement reconstruction $40/sy. (consider alternate low SRI pavements, pervious Pavements)
- Contract labor 20% Overhead and Profit.

Schedule: Varies by/ unit.

Project Number per matrix: **(18, 19)**
Project Name: **Island creation/ Floating island flood structure**

Schedule: Pre-construction monitoring of groundwater table (minimum 1 growing season, preferably multiple growing seasons), 2-day construction, 2 years' establishment.

Prerequisites:

- Where dewatering is required, confirm adjacent upland area is available for dewatering (2:1 ratio for dewatering area to areas of dredge).
- .
- Requires permitted excavation adjacent to wetlands.
- Restoration is coordinated with appropriate partners and grant providers.
- City Concom./ land owner approval.
- Appropriate permits are obtained. See discussion in Section 2.1 of report.
- Soil testing for contamination if contamination is a possibility.
- LSP (Licensed Site Professional) available for unexpected hazards if contamination is a possibility.

Description:

- Evaluation of water table & soil profile for effective wetland establishment, groundwater monitoring well(s).
- Evaluation of existing native shrub/tree species for effective naturalization.
- Installation of access control measures where required.
- Site preparation to include erosion control & stock pile/mobilization staging area.
- Significant soil disruption, peninsulas, islands, bends banks and or dredge.
- Placement of depth altering features shelves peninsulas, Islands, basins.
- Planting of select native species, mulching, watering, and weeding during maintenance period.
- Plan for construction period and post-construction period environmental monitoring.
- Volunteers could design, build and install signage explaining ecological and climate resiliency value of restoration effort.
- Follow up: Establishment period (2) two years. Establishment period to include biannual removal of invasive plants and weeds, annual replacement of failed plantings, and watering as needed to naturalize plantings.

Recommendation:

- Assess potential erosion contamination impacts.
- Maintain stability through critical mass and coordinated invasive control.
- Assess invasive soil seed bank & root stock.
- Assess bordering threats such as proximity of established invasive seed sources.
- Assess opportunities for coordinated habitat enhancement flood storage and storm water controls.

Ensure clear communication and understanding of maintenance personnel. costs for oversight.

Budget Order of Magnitude: $30,000-$85,000/Acre drain, dredge, stabilize & revegetate.
Budget Order of Magnitude: $5,000-$10,000/ksf. floating island flood structure.

Unit: Minimum Area 10 yd.

- Coordination costs 5%
- Design costs 10%
- Mobilization 5%
- Erosion and sedimentation control 5%
- Pre-vegetated Island features ($1,000-$3000), Buoyant concrete frames ($1,000-$3000)

- Dredging operations $10000/day-unit contractor team and equipment heavy (half using pumps)
- Access controls swamp mats & erosion control barrier $500-$1000
- Upland excavation: $25/cy. = $25/sy.
- Material disposal: on site $50/cy. offsite $70/cy. Contaminated soils disposal offsite $300/cy.
- Placement of wetland soils $80/cy. = $20/sy.
- Plant material costs $5-$50/yd.
- Labor cost for planting/ seeding and or $3000/day-unit contractor team of four 1 Foreman & 3 Laborers. (Possible volunteer opportunities)
- Machine operator $1000/ day-unit.
- Seed establishment $5/yd.
- Groundwater Monitoring well $1200 ea.
- For projects requiring Contract labor add 20% Overhead and Profit.
- Construction and post-construction environmental monitoring: Variable costs.

Project Number per matrix: **(19)**
Project Name: **Temporary Ice Erosion Measures**
(See also River flow alteration project 10 for naturalized bank stabilization and revegetation measures which must be executed in conjunction with this work for long term bank stability)

Prerequisites:

- Requires approval by Amesbury Harbor Master or designated official per Chapter 91 for the use of a seasonal floating, and sub surface water dependent features and associated moorings. Where new moorings may be needed a Chapter 91 license will be needed.
- Restoration is coordinated with appropriate partners and grant providers.
- City Concom/ land owner approval.
- Appropriate permits are obtained. See discussion in Section 2.1 of report.

Description:

- This project includes no intentional soil disruption or significant excavation and is intended as a temporary erosion control measure. Its goal is to slow the rate of ice erosion to allow naturalized bank enhancements to establish a sustainable vegetated buffer limiting long term erosion.
- Where needed, moorings (both existing and new moorings) will be equipped with channel flow generators to power aerator tubes. Aerators provide a convection current from the bottom of the channel to create a weak point in river ice. This is typically used to protect docks where ice heave lifts moorings. In this case it may allow higher velocity heavy ice jams to move down the river without collecting sediment and cobble from the adjacent banks.
- A second measure is the addition of moorings with strings of floats to create a similar false edge.
- Areas where de-icers are in use should be clearly marked to identify thin ice for safety, including on banks.

- A third measure is the addition of flow disrupting baffles or islands which can alter flow and increase the deposition of fine sediment needed for bank stabilization. (See MIT, Design Guidelines for Urban Stormwater Wetlands 2018) These measures require significant additional flow analysis and permitting and as such go beyond the scope of this study.

Recommendation:

- Coordinate with private mooring owners to test efficacy at this scale.
- Assess structural stability of existing moorings to act as structure supports.
- Assess opportunities for coordinated habitat enhancement, with Bank restorations per project #10.
- Provide as schedule for observations to ensure system function.

Budget Order of Magnitude: $$11,000
Unit 100 lf.

- Material costs Aerator $1,000/100lf. or more powerful mooring mounted propeller de-icer $500/ 50lf. Mooring mounted generator $3,000-7,000
- Pile driven steel mooring post $2,000 each. (access to be determined)
- Labor Volunteer or $3000/day contractor team of Four: 1 Foreman & 3 Laborers.
- Coordination costs 5%
- Design costs 10%
- Mobilization 10%
- Contract labor assume 20% Overhead and Profit

Schedule:

- 1-day construction per unit.

- 5 years' establishment, or as needed until vegetated banks show regenerative stability.

Project Number per matrix **(20, 21)**
Project Name: **(20) Educational or Interpretive features (21) Furnishings, Gathering Space**

Prerequisites:

- Restoration is coordinated with appropriate partners and grant providers.
- City Concom/ land owner approval.
- Accessible per Massachusetts Architectural Access Board (MAAB).

Description:

- Preparation of installation setting. Concrete pad foundations.
- Installation of benches, furnishings, interpretive signage, display bulletin case, kiosk, art works, view finders, or other interpretation features and their associated footings.
- No intentional soil disruption or significant excavation beyond that necessary to install enhancements.
- Installation through Volunteer efforts may be possible but typically requiring private contractors for footings.
- Follow up: general annual maintenance for constructed features.

Recommendation:

- Coordinate furnishings interpretive features with specific context or associated conservation efforts.
  Ensure project budgets and contracts with private companies include sufficient retainage for coordination costs and oversight.

Budget Order of Magnitude: A temporary $250 each
Budget Order of Magnitude: B Permanent $4,500 each

Per unit cost each.

- Coordination costs 5%
- Design costs 20%
- Mobilization 5%
- Material costs $50-$2,500/ea.
  Labor $1500/day contractor team of two: 1 Foreman & 1 Laborers.
- Machine operator. $1000/ day.
- For projects requiring Contract labor assume 20% Overhead and Profit.

Schedule:

- 1-day construction per unit.

Project Number per matrix: **Project (22)**
Project Name: **Soft Trail**

Prerequisites:

- Trail is coordinated with appropriate partners and grant providers.
- City Concom/ land owner approval.
- Appropriate permits are obtained. See discussion in Section 2.1 of report.
- Grades meet ADA trail requirements (Non-Massachusetts Architectural Access Board (MAAB) project).

Description:

- Installation of access control measures where required.
- Moderate soil disruption.
- Site preparation to include erosion control & stock pile/mobilization staging area.
- Volunteers could perform preliminary layout and clearing, significant grubbing or excavation will require machinery/ professional labor. Recommendation:
- Assess visibility and safety concerns.
- Choose trail locations based on existing wear tracks and desire lines.
- Assess bordering threats such as proximity of aggressive vegetation, soil and erosion issues.
- Assess opportunities for coordinated education and recreation features.
- Ensure clear communication and understanding of maintenance personnel to maintain access.

Budget Order of Magnitude: $1,000-$5,00$
Unit: Minimum Area 30yd. average 5' wide 55' long

- Coordination costs 5%
- Design costs 5%
- Mobilization 5%
- Labor cost Volunteer clearing/ grading and or $3000/ day contractor team of four 1 Foreman & 3 Laborers.
- Machine operator $1000/ day. Chipper rental $200/day.
- Erosion control barrier, 10/lf.
- Excavation and grading $15/sy.
- Material disposal: on site $50/cy. offsite $70/cy, contaminated soils disposal offsite $300/cy.
- Low end surface: compaction of soils placement of woodchip granular pavement. $10/sy.
- High end surface: placement of stabilized inorganic granular pavement. $60/sy.
- Seed establishment $5/yd.
- Construction monitoring: variable depending on project specifics.
- For projects requiring contract labor assume 20% overhead and profit.

Schedule:

- 1-2-day construction per unit.

Project Number per matrix: **Project (23)**
Project Name: **Hard Trail**

Prerequisites:

- Trails coordinated with appropriate partners and grant providers.
- City Concom/ land owner approval.
- Appropriate permits are obtained. See discussion in Section 2.1 of report.
- Accessible surface to meet ADA/ trails requirements.
- Connection to drainage systems structures where necessary.

Description:

- Installation of access control measures where required.
- Moderate soil disruption.
- Site preparation to include erosion control & stock pile/mobilization staging area.
- Installation of pavement and related improvements.

Budget Order of Magnitude: $15,000-$25,000
Unit: Minimum Area 50yd. average 8' wide 60' long

- Coordination costs 5%
- Design costs 10%
- Mobilization 5%
- Labor cost $2000/ day contractor team of four 1 Foreman & 2 Laborers.
- Machine operator $1000/ day.
- Erosion control barrier, 10/lf.
- Excavation and grading $15/sy.
- Material disposal: on site $50/cy. offsite $70/cy. Contaminated soils disposal offsite $300/cy.
- Low end surface: Asphalt/ Chip-seal, $40/sy. complete in place with base.
- High end surface: Pervious pavers, Bricks. $235/sy. complete in place with base.
- Seed establishment $5/yd.
- For projects requiring contract labor assume 20% overhead and profit.

Schedule:
4-day construction per unit.

Recommendation:

- Assess visibility and safety concerns.
- Consider volume of regular visitors and of event visitors.
- Consider pervious surface alternatives and benefits.
- Asses potential risks to water quality and contingency for controls.

Project Number per matrix: **Project (24)**
Project Name: Accessible **Canoe Launch**

Prerequisites:

- Vehicle access & parking must be in place.
- Requires permitted disturbance excavation within riverfront area.
- Development is coordinated with appropriate partners and grant providers.
- City Concom/land owner approval.
- Appropriate permits are obtained, potential Chapter 91 license. See discussion in Section 2.1 of report.
- Soil testing for contamination.
- LSP (Licensed Site Professional) available for unexpected hazards (Known contamination at Back River.)

Description:

- Installation of access control measures where required.
- Site preparation to include erosion control & stock pile/mobilization staging area.
- Significant soil disruption and permanent impervious surfaces or structures.
- Installation of precast reinforced concrete or prefabricated dock/deck, signage and access road.

Recommendation:

- Assess potential erosion contamination impacts.
- Assess opportunities for pedestrian connections and educational opportunities.
- Target underutilized high visibility and easy access sites.
- While resource access amenities do not specifically increase storm resiliency or ecological services public awareness and appreciation are essential to non-point solutions these complex issues.

Budget Order of Magnitude: $65,000-$80,000
Unit: Ramp + access road

- Coordination costs 10%
- Design costs 10%
- Mobilization 5%
- Labor cost $3000/day-unit contractor team of four: 1 Foreman & 3 Laborers.
- Machine operator $1000/ day-unit.
- Access controls & erosion control barriers $20/lf.
- Aquatic silt barrier $10-50/lf.
- Excavation & grading $25/sy.
- Material disposal: on site $50/cy. offsite $75/cy. Contaminated soils disposal offsite $300/cy.
- Concrete Ramp $200/sy. 10x10
- Asphalt path for accessible route.
- Signage $200 ea.
- Placement of crushed stone access $35 sy.
- Legal disposal of contaminated soils $300 cy.
- 20% Overhead and Profit.
- Construction and post-construction environmental monitoring: Variable costs

Schedule:

- 5-day construction plus mobilization.

Project Number per matrix: **Project (26)**
Project Name: **Boardwalk, Overlook**

Prerequisites:

- Requires permitted clearing and excavation adjacent to wetlands and river banks. See discussion in Section 2.1 of report. May also require Chapter 91 license for crossing of navigable waters (up to two-year process).
- Development is coordinated with appropriate partners and grant providers.
- City Concom/land owner approval.
- Soil testing for contamination this guides footing selection. LSP (Licensed Site Professional) available for unexpected hazards, if needed.
- Structures not classified as hiking trails will require universal access per Massachusetts Architectural Access Board (MAAB)/ ADA evaluate route grades and flood elevations/ floodways.

Description:

- Installation of access control measures where required.
- Minor soil disruption, where systems meet grade, or where excavated footings are employed.
- Site preparation to include erosion control & stock pile/mobilization staging area.
- Modular deck sections may be installed from the top down to limit disturbance. Decks requiring substantial footings to be installed with heavy machinery may require swamp matt access.
- Decks lower than 36" may employ surface pan footings for non-soil disrupting installation. This requires adjustable legs, and annual inspection for adjustments.
- Decks are available in, wood, aluminum, steel and fiberglass. Wood decks may be stick built in situ for greater flexibility of custom forms or prefabricated. Other systems are typically prefabricated in sizes varying based on material.
- Assume 8 ft. wide for high traffic areas or areas accessed by maintenance and security vehicles. Less than 8' feels awkward when passing if rails are included. Costs increase more quickly over 8' width.
- Deck supports for elevated decks may include full depth concrete footings where soil conditions allow or driven piles. Where soft or contaminated soils are prohibitive consider pan footings, helical pile or injection pile, supports.
- Decks over three feet high will require cross bracing of supports.
- Decks over 29" height require fall protection.
- Clear and suppress vegetation that may pose a risk to the structure, or that may grow up through structures. Sub deck barriers can be added for this.
- Plastic, fiberglass, or composite decks may benefit from static dissipaters.
- Wood decks require more frequent maintenance costs but can be maintained. Modular systems typically have a longer service life and require removal and replacement at the end of that cycle.
- Plastic decks do not provide structure and require denser frames for higher overall costs.
- Plastic decks and rails require temperature expansion joints/ flexible mounts.

Recommendation:

- Select strong pedestrian connections & view shed opportunities.
- Consider flood elevations and debris flow in relation to elevation and position of any decks.
- Wood frames are the least expensive but require the most frequent replacement. Aluminum are currently the least expensive system, providing the greatest footing span and lowest maintenance. Steel frames will allow for light maintenance vehicle access.
- Where heavy construction vehicle access is limited fiberglass deck frames can be a solution.
- Consider vehicle turning requirements and clearance if vehicle access is anticipated.

- If bicycle access is possible consider turns or baffles to limit speed.
- Consider visibility, security and perceived security, and emergency egress.
- Provide points/ paths of refuge and rest.
- Sloped decks over 4.5% can become slippery in moist wooded areas.
- Consider lateral visibility across rail material selection and climb ability.
- Consider vegetation height and visibility. Tall grass areas may result in a canyon effect if decks are not elevated.
- Elevated decks also limit shading which is a Riverfront Area impact.
- Consider ice and debris flows when locating footings.

Budget Order of Magnitude: Widely variable calculate based on material and site conditions as noted here. And compare to available bids for comparable projects.

Unit: Suggested minimum 2 sections at 6 x12 for mobilization value.
Connective pathways not included in order of magnitude see hard path memo.

- Frame materials options/ Sq.Ft. Wood $10, Aluminum $20, Steel/pedestrian $30, Steel/vehicular $40 Fiberglass $35
- Deck surface material/ Sq.ft. PT wood $10, Aluminum $5, Plastic $15, Hardwood $20, Fiberglass $5. (aluminum and fiberglass decks are typically integral to pre-fabricated frames limiting installed cost.)
- Rail material option/ lf.: Wood $12, Aluminum $15, Wire-mesh $20, Steel $25, Fiberglass $25, Cable $55
- Vegetation clearing $500 per 24' unit, contract labor.
- Labor cost $3000/day per unit, contractor team of four: 1 Foreman & 3 Laborers.
- Machine operator $1000/ day-unit.
- Access controls & erosion control barrier $20/lf.
- Excavation and grading: $25/cy. $5/sy surficial.
- Footings, 2 per 12' span spread footing $500 ea., driven, helical, injection pile $1,000 ea. (depths under 10'), Where soils and footing costs pose a higher cost consider heavier aluminum frames for greater spans up to 40' to reduce footings.
- Cross bracing required for elevated decks add $300/footing.
- Add $10 per vertical foot of footing above grade.
- Coordination costs 10%
- Design costs 10%
- Mobilization 5%
- Include 20% of enumerated costs for contractors overhead and profit.
- Construction and post-construction environmental monitoring: Variable costs.

Schedule:

- 4-day construction per unit, varies by method and mobilization.

Project Number per matrix: **Project (26)**
Project Name: **Pedestrian Bridge**

Prerequisites:

- Requires Chapter 91 license for crossing of navigable waters (up to two-year process).
- Requires permitted clearing and excavation adjacent to wetlands and river banks. See discussion in Section 2.1 of report.
- Development is coordinated with appropriate partners and grant providers.
- City Concom/land owner approval.
- Soil testing for contamination (this guides footing selection). LSP (Licensed Site Professional) available for unexpected hazards, if needed.

Description:

- Installation of access control measures where required.
- Major soil/ riverbank disruption, or elevated footings.
- Site preparation to include erosion control & stock pile/mobilization staging area.
- Modular steel, wood or aluminum prefabricated bridge complete to be mounted on bridge abutments.
- Bridge supports may include full depth excavation and placement of concrete footings where feasible, where soft or contaminated soils are prohibitive consider helical pile, injection pile, supports.
- Connective pathways or deck transition ramps not included in order of magnitude.

Recommendation:

- Select strong pedestrian connections & view shed opportunities.

Consider flood elevations and debris flow in relation to elevation and position of any pedestrian bridge.

Budget Order of Magnitude: $100,000-$200,000
Unit: Each. Per 6'x 50' bridge.

- Frame materials options/ Sq. Ft. Wood $70, Aluminum $80, Steel/pedestrian $90, Steel/vehicular $100 Fiberglass $90
- Deck surface material/ Sq.ft. PT wood $15, Aluminum $15, Plastic $25, Hardwood $25, Fiberglass $20. (aluminum and fiberglass decks are typically integral to pre-fabricated frames)
- Rail material option/ Lf: Wood $12, Aluminum $10, Steel $25, Fiberglass $25
- Labor cost $6000/ unit, contractor team of four: 1 Foreman & 3 Laborers.
- Reinforced concrete seat abutment $600/cy. 1cy/ lf. width.
- Abutment sub wall reinforced concrete $600/cy. 3cy/lf. bridge width each side. (helical piles option $20,000 per abutment)
- Crane installation & related $5000/day, 1-day typ.
- Vegetation clearing $20/yd. contract labor.
- Access controls & erosion control barrier $20/lf.
- Excavation and grading: $25/cy. = +/-$25/sy.
- Material disposal: on site $50/cy. offsite $70/cy. Contaminated soils disposal offsite $300/cy.
- Abutments, 2 per Bridge $10,000-$15000.
- Coordination costs 10%
- Design costs 10%
- Mobilization 10%
- Include 20% of enumerated costs for contractors overhead and profit.
- Construction and post-construction environmental monitoring: Variable costs.

Schedule:

- 15-day construction + coordination +1 per unit.