



THE GREAT BAY LIVING  
SHORELINE PROJECT  
PHASE II

# ROAD MAP

May 2022







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Great Bay National Estuarine Research Reserve  
New Hampshire Department of Environmental Services –Coastal Program  
University of New Hampshire  
Piscataqua Region Estuaries Partnership  
Strafford Regional Planning Commission  
Town of Durham, New Hampshire  
Great Bay Stewards

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The goal of the Great Bay Living Shorelines Project was to create a pipeline of living shoreline erosion management and asset protection projects that enhanced resilience of salt marsh habitat and coastal community assets and avoid future hard shoreline stabilization in the Great Bay Estuary.

NH partners achieved the Project goal through: site prioritization, landowner engagement, and a facilitated interdisciplinary training program for living shoreline design, which resulted in the completion of preliminary designs at the following living shoreline sites in Great Bay:

Site Name	Ownership Type	Town
Spur Road	Private residence	Dover
Chapmans Landing	State owned boat launch	Stratham
Moody Point	Homeowner association	Newmarket
Schanda Park	Municipal waterfront	Newmarket

The preliminary designs developed through the Great Bay Living Shoreline Project are meant to illustrate techniques to incorporate softer/green techniques into shoreline stabilization projects in coastal NH. The preliminary designs are not final, have not been granted regulatory approval, and are insufficient for construction. Advancing preliminary designs through subsequent steps of project development will require assistance from an environmental consulting firm to finalize: site assessment, engineering designs, permit applications, and construction specifications.

## DISCLAIMERS

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Image: Chris Peter

## EXECUTIVE SUMMARY

The goal of the Great Bay Living Shoreline project was to create a pipeline of living shoreline erosion management and asset protection projects that enhance resilience of salt marsh habitat and coastal communities and limit future hard shoreline stabilization. This project aimed to bring stakeholders together to better understand the opportunities and constraints of the process of selecting suitable sites and designing living shorelines at four distinct project sites.

Living shoreline approaches are still in the early stages of research and development in New Hampshire, and techniques that work elsewhere need to be modified to accommodate the wide tidal range and harsh winters of northern New England. In addition, specific shoreline solutions need to be carefully customized for different site conditions and goals, and more capacity is needed among professional engineers and wetland scientists working at consulting firms to design these projects.

The project was managed by a multi-organization team that included academic researchers and agency professionals involved in managing and promoting shoreline work. The project team went through an extensive process to select four sites for design work. The team intentionally chose a diverse set of properties and landowners, each with different reasons for pursuing shoreline restoration, including managing coastal erosion, conserving marsh habitats, and enhancing public access and shoreline aesthetics. The four sites also present unique design challenges because they include both public and private lands, highly urbanized shoreline, and a marsh that is home to rare bird species.

The Great Bay Living Shoreline project used an innovative approach to both build professional capacity and create customized site designs. The project team recruited 24 engineering, landscape design, and wetland science professionals to join a “Design Team” and participate in a seven month design and training program, in exchange for a small honoraria and a chance to build their own expertise. These professionals contributed a total of over 1,500 hours over the course of the seven months — an average of 64 hours per person — to assess their specific site and develop a preliminary design.

A broad suite of public and private sector professionals and coastal landowners were invited to join the culminating workshop virtually. Over 100 people joined the workshop to learn about living shoreline approaches and see the preliminary designs developed for four sites. Key deliverables for each site included a preliminary design and drawing, a memo explaining the team’s recommendations, and a recorded presentation. The project helped to identify regulatory issues and gaps and gathered recommendations for future living shoreline projects and programs.

# INTRODUCTION

## Project Background

The Great Bay Living Shoreline (GBLS) project created a pipeline for living shoreline projects that protect shorelines, salt marshes, and communities from erosion and sea-level rise in the Great Bay Estuary in New Hampshire. Great Bay is a nationally-recognized estuary, home to coastal communities that experienced severe damage in past floods and experience increasing vulnerability from sea-level rise. In response to accelerating erosion, landowner demand for hard shoreline protection is rising. Living shoreline projects are nature-based, resilient erosion management solutions. They are supported by dynamic physical and biological processes and are preferred to traditional, habitat-unfriendly, hard shoreline protection. Past advancement of living shoreline practice in New Hampshire strategically focused on laying the groundwork for success by implementing demonstration sites at publicly owned properties and through the promulgation of permitting rules.

The Project Team consisted of community resilience, engineering, and habitat experts at the New Hampshire Coastal Program (NHCP), University of New Hampshire (UNH), Strafford Regional Planning Commission (SRPC), Great Bay National Estuarine Research Reserve (GBNERR), Great Bay Stewards, Piscataqua Region Estuaries Partnership (PREP), and Town of Durham. A technical team aided in the living shoreline site selection process. Design teams comprised of six professionals were responsible creating preliminary designs for four living shoreline sites. A list of all participants is included in Appendix B.

The project had two phases:

- 1 Phase I Wagon Hill Farm Living Shoreline Management and Monitoring
- 2 Phase II Scaling Up Living Shorelines in the Great Bay Estuary

The Great Bay Living Shoreline project led to new knowledge about living shoreline effectiveness and a scaling up of living shoreline implementation to protect community assets and restore and protect salt marsh while avoiding installation of hardened stabilization.

This Road Map summarizes and discusses specific barriers to adoption of living shorelines and lays out next steps to increase the feasibility of implementing living shorelines in the Great Bay Estuary that were identified in Phase II of the Great Bay Living Shorelines project.

### Key Objectives of the Project:

- Complete and transfer lessons from a pilot living shoreline installation
- Develop criteria to prioritize 10-15 living shoreline sites
- Create an innovative living shoreline professional training program
- Complete 50% engineering designs for a subset of 3-4 sites
- Develop a Road Map



## How To Use This Document

This Road Map documents the process of implementing the project, Scaling Up Living Shorelines in the Great Bay Estuary, and summarizes what the Project and Design Teams learned. It identifies barriers to adoption of living shorelines and includes next steps and recommendations for landowners, state and local governments, and practitioners. It also serves as a resource to those interested in learning about all phases of living shoreline implementation — from planning to completion of a preliminary design — or replicating the Great Bay Living Shoreline process.

While the Road Map is not intended to be guidance on policy best management practice, a range of stakeholders including policy makers, state agencies, universities, and other stakeholders may be interested in this document.

The Road Map is organized into sections that describe WHAT WE DID and WHAT WE LEARNED in each phase of the project. It also includes a WHAT TO DO NEXT section that identifies next steps for the designs as well as recommended next steps for advancing living shorelines in general.

### What We Did

This section outlines the steps taken in each of the Great Bay Living Shoreline Phase II project that are relevant to the audience. Each section includes a list of actions completed during the project, who was involved, and what resources and information was needed.

### What We Learned

This section offers lessons learned and recommendations for specific audiences that worked on the project to aid with future replication and implementation efforts. It is organized around four questions:

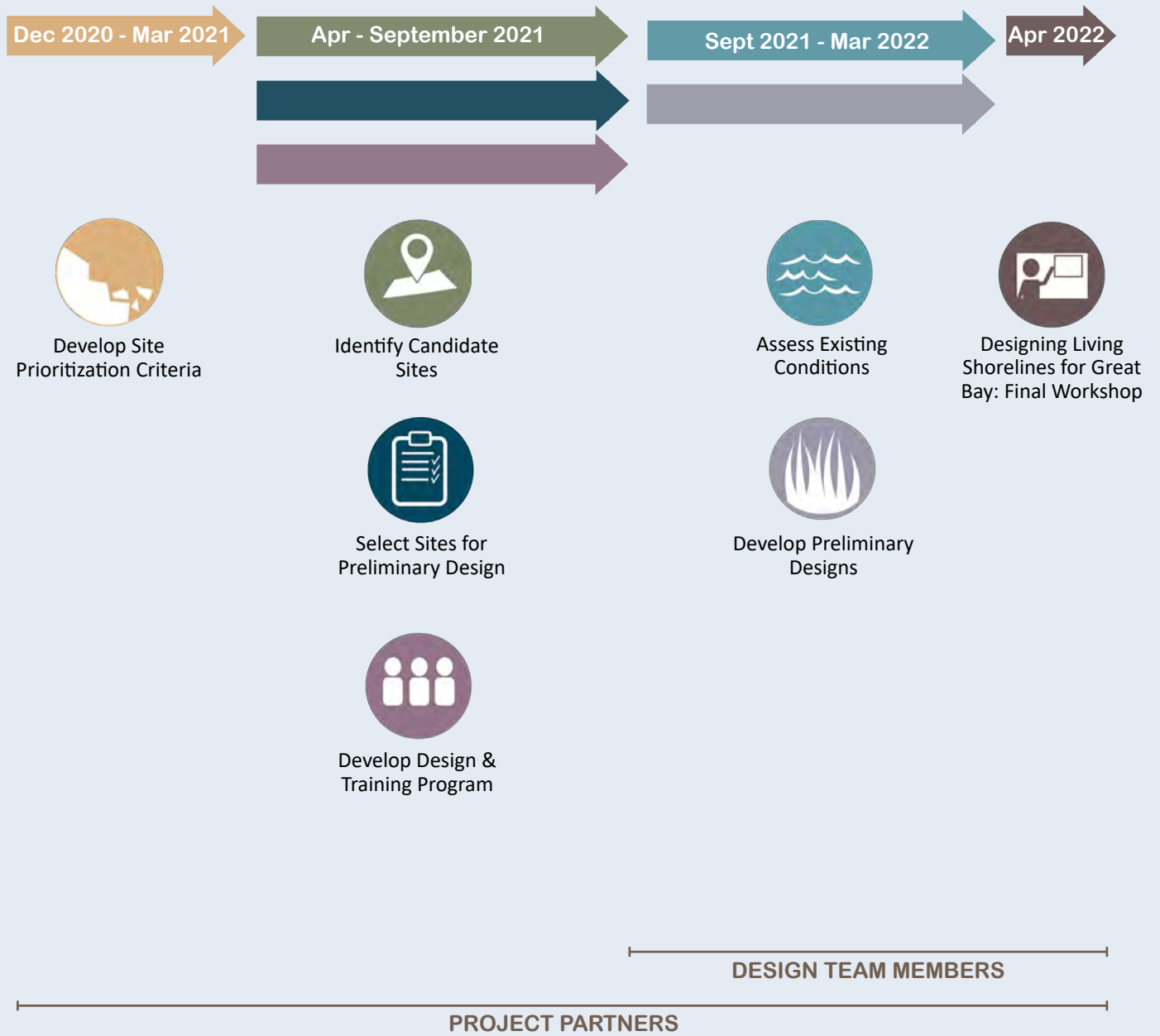
**What challenges did you come across during this activity?**

**What information do you wish you had when you started it?**

**If you were to do it again, what would you do differently?**

**When people replicate this step, what key information do they need to know?**

# Project Timeline



# IDENTIFY SITES FOR LIVING SHORELINE DESIGNS





## Develop Site Prioritization Criteria

*Lead Project Team Partner: NHCP; Supporting Partners: GBNERR, SRPC, UNH*

The Project Team's first step in selecting potential sites for living shorelines was to identify the objectives for using this technology in Great Bay and the objectives for this part of the project. Criteria were then developed to align with the objectives to identify the types of projects and places where they would be likely to succeed. Physical and social site characteristics informed by the [NH Living Shoreline Site Suitability Assessment](#) and lessons learned from the Wagon Hill Farm living shoreline, along with present-day and future erosion and flood risk, community asset protection, and tidal habitat functions and values were emphasized. The Project Team did not have a specific project site type in mind. Instead, the Team attempted to identify diverse project types (large vs. small, private vs. public, etc.) in order to investigate a wide range of living shoreline considerations that exist within Great Bay. Criteria were selected by a subgroup of the Project Team lead by NHCP with support from UNH and GBNERR and review by the full Project Team.

1. The Project Team developed objectives for consideration of candidate living shoreline sites including:
  - a. Manage erosion
  - b. Enable shorelines to adapt to sea-level rise (migration potential)
  - c. Protect or adapt existing land and/or assets
  - d. Protect, adapt, and/or create estuarine habitat functions and values and emphasize connectivity to similar and complimentary habitat types
  - e. Produce knowledge and educational benefits for living shoreline practitioners and landowners to serve as both outreach and the foundation to generate interest by other shoreline landowners
  - f. Have suitable construction site access
  - g. Provide a diversity of different living shoreline pilot project applications
    - i. Include both urban and natural site options
    - ii. Include low cost and higher cost options
    - iii. Include both publicly- and privately-owned sites, with considerations given to the additional regulations that may apply to privately-owned sites.
2. The Team finalized the site selection criteria and prioritization processes used by the Project Team to identify candidate sites that meet project objectives. This included determining if some criteria were more important than others and identifying any criteria that are fatal to site selection. Weights were then assigned to each objective. Criteria emphasized:
  - a. Present-day erosion rate
  - b. Flood risk
  - c. Future erosion
  - d. Community asset protection
  - e. Tidal habitat functions and values (salt marsh and coastal bank)
  - f. Physical and social site characteristics
  - g. Site access for construction phases (if equipment is needed)
  - h. Site security (from humans, pets, herbivory, etc.).
3. The Project Team selected the following datasets to identify candidate sites for inclusion in the project:
  - a. Selected data parameters:
    - i. Erosion risk (fetch, current velocity, and soils erodibility from the biophysical suitability index)
    - ii. Migration space
    - iii. Ecological value composite score.
  - b. Identified additional criteria to narrow down the site list:
    - i. Proximity to nearby suitable sites
    - ii. Existing habitats
    - iii. Segment length/site size
    - iv. Accessibility
    - v. Site diversity
    - vi. Landowner interest.
4. NHCP performed a desktop spatial analysis
5. Project Team reviewed and commented on site selection and NHCP reiterated desktop analysis, as needed.

▶ The Project Team was able to create a well-rounded set of selection criteria that reflects the diverse characteristics and conditions of the Great Bay shoreline.

### What challenges did you come across during this activity?

- It was difficult to limit the number of criteria used to select locations and avoid over-constraining the selection process and ending up with few locations that satisfied criteria.
- Developing meaningful criteria for this project — such as the initial scoring rubric, which was a coarse screening tool — while also understanding that living shoreline projects will not be implemented based on an optimization model or scoring rubric was something the Team grappled with. In reality, it is likely that living shoreline project implementation will be opportunistic based on the landowner need and interest.

### What information do you wish you had when you started it?

- It would have been beneficial to have more information about current erosion rates along the shorelines that were investigated prior to starting the project.
- Having readily available information about connectivity, lost habitats, species of concern and their habitat needs and other data in order to enhance the site selection criteria and better reflect the larger scale biological contexts would have helped refine the site selection process.

### If you were to do it again, what would you do differently?

- With a larger budget, the Project Team could have developed more system-wide information on marsh edge erosion rates.
- The landowner goals could have been used as site selection criteria.

### When people replicate this step, what key information do they need to know?

- The overall project goals may vary from project to project and site to site. In the case of this project, the criteria developed to select sites was not limited to ecological criteria.



## Identify Candidate Sites

*Lead Project Team Partner: NHCP; Supporting Partners: GBNER, SRPC, UNH*

The Project Team applied the criteria to select priority living shoreline sites. A desktop analysis was conducted to identify 10-15 priority sites based on a set of desired characteristics identified by the Project Team. The living shoreline sites were categorized based on erosion, salt marsh conservation potential, and/or public access. Field verification, discussions among Project Team, and anecdotal information about the sites also informed the site selection.

1. NHCP and SRPC completed a desktop spatial analysis to identify 10-15 priority living shoreline sites based on the previously developed criteria and process.

- a. Prioritized sites based on what suitable qualities they possessed:

- i. Salt marsh conservation potential
- ii. Erosion management site
- iii. Public access/aesthetics
- iv. Migration potential
- v. Site ownership
- vi. Potential for long term protection and maintenance

- b. Completed analyses within ArcGIS using the following methods:

- i. Salt Marsh Conservation

1. Selected all suitable marsh units using [Salt Marsh Plan](#) data. Defined as marsh units with high vulnerability and high adaptation potential within the study area.
2. Identified suitable marsh units that also have high wetland connectivity. Defined as marsh units selected in step 1 that have a connectedness score greater a certain cutoff.

- ii. Erosion Management

1. Selected all locations with existing salt marsh or vegetated low bank on the landward edge that are within the study area.
2. Identified sites with the potential for high demand for stabilization using [New Hampshire living shoreline site suitability assessment \(L3SA\) Biophysical Assessment](#) data, which synthesizes ecological, hydrodynamic, and geophysical data inputs.
  - a. Defined as points with moderate soil erodibility scores (3-5), favorable sun exposure (scores 4.5-6), and moderate northeast fetch/exposure scores (3-4)
  - b. Note that this analysis excluded sites within proximity to rivers because the ArcGIS fetch scores, which are based on length of water over which wind can blow, were not applicable to these smaller waterbodies.

- iii. Public Access/Aesthetics

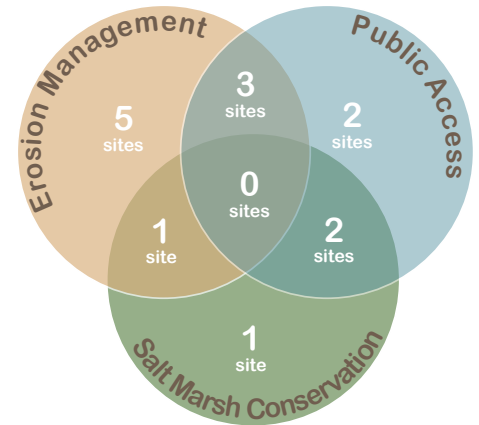
1. Identified public lands or public access using 3 data sets:
  - a. Data from L3SA Sociopolitical Feasibility Assessment, which considers likelihood of demand for stabilization, owner capacity/interest, vulnerability of a project to sea-level rise, regulatory considerations, and ecological values assigned by stakeholders to sites along the shoreline.
  - b. Publicly owned conservation lands
  - c. Suggested living shoreline sites
2. Cross referenced with erosion risk data obtained in ii. Erosion Management methods described above.

2. The Team conducted field verification visits by boat and land and assessed sites using a selection of criteria including shoreline characterization, vegetative characterization, tree coverage, built environment, salt marsh conservation potential, erosion management potential, and public access/aesthetic qualities.

- a. NHCP prepared field assessment sheets that allowed for quick characterization of on-site conditions (trees, seaward/landward erosion, seaward/landward erosion).

3. Anecdotal information about sites, input from the project team, and interviews with Project Team members that know the Great Bay shoreline well was also compiled to aid in site selection.

4. Narrowed site selection to 14 sites.





The Project Team succeeded in using the site prioritization criteria to aid in the process of identifying 14 potential sites from the nearly 150 miles of tidal shoreline in Great Bay.

### What challenges did you come across during this activity?

- It was important to do a site visit but challenging to schedule the site visits and accommodate weather, tides, and the availability of experts, Design Team members, and landowners.
- The potential sites were all limited size projects, with single landowners boxed in on all sides by constraints.
- It was difficult to directly relate the spatial parameters to a site (e.g., Does this area show signs of erosion?).

### What information do you wish you had when you started it?

- It would have been beneficial to have better knowledge of fetch and directions leading to the most severe erosion.
- It was nice to have the field assessment sheets that NHCP put together on site, but the sheets could have been more informative and less duplicative of what could be found from the desktop analysis.

### If you were to do it again, what would you do differently?

- Develop a cross-section of an 'ideal' living shoreline site to test the criteria out and help ensure that expectations for the site selection reflect the conditions of sites surrounding Great Bay.
- To enhance and expedite the site selection process, a preliminary, quick field assessment could be completed for the 10-15 sites that does not require experts. This would serve as a check to see if the conditions on site align with what was found via the GIS analysis. Following, the list could be narrowed through the interview process and then a minimal amount of field work to see which sites are most appropriate for a living shoreline.
- The Project Team could have incorporated a rapid field assessment (i.e., drive by on a boat in 1-2 days) with the desktop criteria development since the shoreline in question to scope out for potential sites was not too large.
- With a much larger budget, the Project Team could plan more outreach opportunities to communities and landowners, as well as develop more demonstration sites.

### When people replicate this step, what key information do they need to know?

- Landowner goals could be incorporated into the site selection process at an earlier phase, such as in this step, where a list of 14 sites was developed.
- The Project Team's site selection goals for the project were more diverse than most living shoreline sites implemented to date. This yielded different sites than an ecology-based selection process.



## Select Sites for Preliminary Design

*Lead Project Team Partner: SRPC; Supporting Partners: GBNERR, UNH, NHCP, Town of Durham*

To narrow down the list of 14 sites to 3-4 living shoreline design sites, the Project Team engaged communities and landowners about the need, project feasibility, and their interest in moving forward with preliminary design on 3-4 priority sites. The purpose of this step was to better understand factors including the landowner's:

- Observation of shoreline problems
- Interest in participating in the project
- Anticipated interest in pursuing final design, permitting and construction following the project
- Willingness to allow activities on their property
- Willingness to use their property as a case study if construction moves forward.

The process included the following:

1. Connected with landowners of the 14 living shoreline sites identified in previous step. SRPC, with team assistance, had a conversation about their needs, interest, goals, and actual feasibility of a living shoreline site. A survey/interview/questionnaire was developed to guide the discussion.
2. Scored sites using a point-based scoring system to rank qualitative information based on information gleaned from landowner interviews and site profiles.
3. Presented site scores and engaged coastal municipalities and other watershed-based organizations in assisting the Project Team with selection of the 3-4 living shoreline design sites based on their knowledge of criteria and the results of the survey/interview/questionnaire.
4. Signed a Landowner Memorandum of Understanding, a collaborative agreement between the lead agency and named applicant.

**Scoring criteria focused on determining:**

- Site accessibility
- Landowner ability to support the project
- Landowner interest, level of commitment, and motivation to participate in the project
- Capacity to continue the project to the final design (not just preliminary design)
- Overall project need based on site concerns (such as downed trees, potential for exposing buried waste, treacherous shoreline, soggy land, and wind activity)
- Likelihood of the project succeeding based on factors such as a motivated landowner, usefulness of the living shoreline to the community, commitment to conservation, or past attempts at restoring/conserving lands.



▶ The Project Team’s use of a ranking system in conjunction with landowner discussions proved to be effective in narrowing the list of candidate sites to 4 design sites.

### What challenges did you come across during this activity?

- When creating the scoring framework, it was challenging to ensure that scores were logical and translated to what the Project Team had envisioned being the most successful based on the information and background knowledge available.
- Project Team members had varying levels of familiarity with and interest in the candidate sites. It was challenging to avoid bias towards specific sites while scoring the candidate site profiles and infusing judgment into scores based on interview responses.
- Site ownership was a factor to consider that impacts feasibility of living shorelines. Private sites would likely be subject to more scrutiny from the local land use regulations than a municipal project on a municipally-owned site.
- Working with homeowners’ associations or properties where a single household wasn’t making the decision brought additional challenges to the process. It required more attention to relaying information to all parties, considering the rights of all property owners and how these rights might vary among members, and decision making among various entities.
- It was hard to communicate exactly what the end product would be. Many landowners had questions about what they would need to carry this forward. Funding was a key consideration, and the Team did not have a lot of information on what designs would entail or what a final cost would be.

### If you were to do it again, what would you do differently?

- Having a greater understanding of the entire process would have facilitated a better interview process and helped Team members to answer questions and represent the project more clearly.

### What information do you wish you had when you started it?

- At the start of the project, have a clear understanding of what the final product being delivered to the client will entail. Along with this, monetary projections to give property owners an idea of future investments they may have to make. Utilizing the plan and documents from this project may be useful for providing tangible examples during future interviews.
- It would have been beneficial to have more comprehensive scoring criteria or for more Project Team members to have provided more review and input on the criteria to ensure that it would accurately identify good living shoreline projects. While it worked well to defend the site selection decisions, having more structured criteria would have helped.

### When people replicate this step, what key information do they need to know?

- Scoring criteria should be a guide, not the end all be all. There is some flexibility within projects depending on what the goal is and what the bigger picture is. The guide should be incorporated into the process but should not necessarily dictate or veto a final decision.
- The connection that we made with the landowners at the beginning was important; we left it up to them to participate if they were interested. The initial contact via mail and then email follow-up was important to create some form of relationship before we got on the phone for an interview. So, relationship building was an essential part of the process.
- Keep conversation tone casual and allow property owners some time to talk about their property even if it doesn’t directly answer interview question(s).
- When communicating with landowners, maintain reasonable expectations and do not overextend beyond the scope of the project. Be transparent about what the project entails and the deliverables and information the property owner will receive from the project.
- Recognize that property owner goals and project goals do not always line up. For example, the Team may look at flood storage capacity or ecological value, while an owner may be more focused on aesthetics or water access.



# ESTABLISH DESIGN TEAMS





## Develop Design & Training Program

*Lead Project Team Partners: GBNERR, Great Bay Stewards, NHCP; Supporting Partners: SRPC, UNH, PREP*

The Project Team established four interdisciplinary Design Teams to engage in a structured professional development opportunity to learn about the living shoreline design process and contribute technical expertise to inform preliminary designs. Each team had a Project Team Coordinator that facilitated communication with the landowner and project experts, provided support during site visits and team calls, and ensured the teams received consistent messaging and had access to any resources they needed.

1. The Project Team set goals for the composition of each design team, identified learning objectives, and established a set of agreements and deliverables to guide the teams. Design Team Coordinators were identified for each group to facilitate communication, schedule site visits and meetings, and ensure each team had the resources they needed.
2. The Project Team recruited Design Team participants.
  - a. Released a [press release](#) in June 2021 announcing the project and the solicitation for Living Shoreline Design Team applications and distributed it to a number of professional societies through the Project Team.
  - b. Collected information about the applicants, employer interest, and time availability via an application form and narrative.
  - c. Received 39 applications from engineers, landscape architects and wetland science professionals who had an average of 12 years of professional experience.
3. The Project Team selected participants.
  - a. Ranked applications using standard criteria to ensure a diverse mix of interested professionals that had the flexibility or employer support to participate. Candidates with a high likelihood of applying their learning to shoreline projects within New England were prioritized.
  - b. Selected 24 professionals to participate in a 7-month design and training program.
    - i. Provided Design Team members with a \$1,000 stipend to help compensate them for their time and travel to project events.
    - ii. Design Team members attended 3 workshops, 2 site visits, participated in bi-weekly design team calls, and had interim milestone presentations to the Landowner and UNH experts.
    - iii. Provided Design Team members with 30 hours of professional training from UNH experts and about 12 hours of facilitated discussion.
    - iv. Awarded Design Team members with certificate of completion to enable them to get professional development credit for the hours dedicated to the program at the end of the program.
4. Formed 4 design teams, balancing years of experience, gender, and disciplinary expertise. Each team included a couple water resource engineers, a landscape architect, and a couple wetland or environmental scientists. Some team members also had extensive experience working with clients, managing projects, and engaging diverse community partners and permitting agencies.
5. Assigned Design Teams to one of the 4 project sites. Assigned a coordinator from the Project Team to each site to support the collaborative process.
6. Hosted an orientation call with all Design Team members prior to the first site visit to review project goals, expectations and the anticipated design process. Teams met as a group in person for the first time during their first field visit.
7. Developed a [resource list](#) for Design Team members to provide an introduction to living shoreline concepts.

Applicants submitted a statement of interest explaining their interest in being part of a Design Team, how the project aligns with professional and employer goals, and information on whether their organization or employer supports them spending 40-50 hours over the course of the year on the project.

A [resource list](#) was developed to ensure project partners and design team members had access to the foundational science this program was built on. The resource list was referenced heavily during the first field visit and workshop.



This project piloted a unique approach for engaging early/mid-career private sector professionals by combining professional development with a real world project. The approach enabled the team to integrate expertise from a range of consulting firms with relatively limited costs while expanding the pool of trained professionals. The Project Team attracted interest from a diverse and sizable pool of local and regional designers. The Design Team members remained committed to the project throughout its duration with the support of the Design Team Coordinators.

### What challenges did you come across during this activity?

- The project involved coordination among 7 internal sub-groups and 5 landowner constituencies, which created a significant project management challenge. Record keeping, meeting note preparation and tracking assignments was a constant effort. In addition, maintaining consistent messaging and conveying lessons learned in real time required the creation of a design coordinators subcommittee to enable GBNERR, PREP, and NHCP to compare notes as the teams advanced their designs.
- The Design Teams had very little background on their site or the people involved ahead of their first field visit.

### What information do you wish you had when you started it?

- It would have been helpful to have the CVs of the Design Team participants to better understand their experience and skills.
- Greater clarity on the number of hours and the range of skills needed for the design work would have helped in assembling the teams.

### If you were to do it again, what would you do differently?

- Time permitting, the Design Team members' preferred site(s) could have been incorporated in-to the matching process.
- Specific skill sets, beyond discipline (engineer, landscape architect), could inform team selection to ensure that all teams the capability of creating CAD drawings and renderings and calculating water level statistics.
- Creating smaller Design Teams and designating specific roles could have improved the efficiency of developing the preliminary designs.

### When people replicate this step, what key information do they need to know?

- The Project Team was thrilled to receive so many applications to participate on the Design Teams from individuals with 10+ years of professional experience. Our ability to recruit candidates benefited from prior programs that cultivated a living shoreline professional network, as well as the recognized credentials of our UNH project leads/experts. In addition, the Project Team had connections with professional societies, such as the NH Society of Professional Engineers.



## DEVELOP PRELIMINARY DESIGNS





## Assess Existing Conditions

*Lead Project Team Partners: UNH; Supporting Partners: NHCP, GBNERR*

The first step in the design process was to assess existing conditions at each living shoreline design site. The Design Teams, with assistance from Design Team Coordinators and UNH experts, were responsible for conducting the assessment. This included a topographical survey, water level monitoring, and site condition assessment. Two site visits occurred during the fall of 2021.

Design Teams were given freedom to determine the scope of their design project and move through the site evaluation and planning process in a way that worked for their group and site. The Project Team provided a [Design Process Template](#) and FAQ as guidance as well as a set of [scientific resources](#).

1. The Project Team (UNH, GBNERR, NHCP, PREP) assisted and guided Design Teams with a site assessment:
  - a. Characterized current erosion as well as marsh and buffer plan communities. Assessed habitat presence and condition, potential erosion and/or flood stressors, and likely future conditions at the site.
  - b. Obtained measurements to understand site conditions and design considerations.
  - c. Discussed goals, the site, and any design constraints with landowners.

1. Conducted Site Visit 1 to become familiar with the site and the landowner's goals.
  - a. Landowner goals for the shoreline (short term and longer term)
  - b. Current and anticipated human uses of the site
  - c. Existing habitats and ecological assets
  - d. Potential ecological goals for project and any tradeoffs to consider
  - e. Sources of impairment
  - f. Site and design constraints (budget, aesthetics, adjacent land use, bedrock, access for construction, rare or invasive plants, lifespan of living shorelines).
2. Assessed current site conditions and gathered key pieces of data that are critical for the engineering and design process in collaboration with UNH experts. This included:
  - a. Water levels – A pressure transducer was placed in the water, just below the low tide line, and collected data for 2 – 3 months. This data was used to calculate the specific water level information for the site, including Mean Higher High Water (MHHW), Mean High Water (MHW) and Mean Tide Level (MTL), which are critical for determining planting plans for high and low saltmarsh species.
  - b. Erosion rates – The Design Teams installed several erosion pins into the shoreline edge to measure the rate of erosion over the course of the project period (about 5 months).
  - c. Topographical survey – With significant involvement from project experts, the Design Teams performed an elevation survey along multiple transects, using a laser level as well as an RTK survey unit. Vertical and horizontal position of key features along each transect were recorded, including: vegetation community, changes in vegetation community, top of bank, observable tidal elevations, erosion pins, and other site features. At some design sites, elevations of nearby salt marsh plant communities were measured. The information was critical for developing cross sections of existing conditions and drafting proposed changes to the shoreline.
  - d. Plant community – The Design Teams documented plant species found along the shoreline and in reference areas and adjacent uplands. This was supplemented by information provided the New Hampshire Natural Heritage Bureau (NHB). These plant communities were then compared to the tidal datum to gather an understanding of baseline conditions of the project site. In addition, the teams submitted a project site request to the NHB to determine whether protected communities and/or individual species are present within the proximity of the project area. The presence/absence of specific species identified through the NHB influenced the team's preliminary designs.



The site assessment process provided a fantastic opportunity for collaboration among the Design Team professionals and UNH experts. Two 4-hour field visits provided an educational, hands-on experience for the Design Team members, who learned about and then collected a range of site specific data using various methods.

### What challenges did you come across during this activity?

- For a number of logistical reasons, the first field visit was the first meeting of each of the Design Teams and there were too many goals for this first visit. The iterative process needed for site assessment and project planning would have benefited from more time and guidance.
- Because the Design Teams did not have enough time to become familiar with the site prior to their first meeting, some data collection and rationale was overlooked. For example, data management of erosion pins (naming convention, location) was not recorded properly.
- The site assessment was rushed because of tides and trying to coordinate schedules of everyone involved.
- Because of the relatively short timeframe of the project, some baseline data may not be representative of the site. For example, erosion pin data was collected for approximately five months, which isn't enough to understand seasonal changes or project long term trends.
- The COVID-19 pandemic made schedule flexibility difficult.
- Design Team participants each brought unique skills to their project site. However, it was difficult to maximize their engagement throughout the project as not every step required an engineer, ecologist, or landscape architect.

### If you were to do it again, what would you do differently?

- Schedule a Design Team planning meeting prior to the first field visit.
- Add creation of a field plan to the list of project deliverables.
- The Project Team could provide the Design Team with more instruction on how to assess a living shoreline site.
- Clarify the decision making process for data collection, such as determining how many erosion pins are needed. It was unclear whether this was based on the size of the site, the landowner goals, or other factors.
- Consistent language is helpful to characterize the type of tidal shoreline erosion (impairment) as well as the cause (stressor). By properly identifying the shoreline stressors, the living shoreline design will solve the cause of erosion.

### When people replicate this step, what key information do they need to know?

- It is important to establish a clear process and plan for completing the existing conditions survey and site assessment and to consider what will be accomplished during this step ahead of time. Preparation leading up to the Design Team engaging in site assessment is imperative. The goals, objectives, and outcomes need to be clearly communicated with the landowner.
- The most important facet in the restoration of impaired aquatic systems is people. There are a variety of people involved from the property owner to regulators and abutters to professionals. Successful designs require open and frequent communication with all parties, especially in presenting, synthesizing, and ranking alternatives.
- Shoreline projects are dynamic by nature. Much of the project performance is focused on getting information.



## Develop Preliminary Designs

*Lead Project Team Partners: UNH; Supporting Partners: NHCP, GBNERR, SRPC, PREP*

The Design Team members collaborated across disciplines to develop site-specific preliminary designs that aligned with land owner goals and reflected the existing and projected future conditions at each site. To facilitate this planning and design process, the Project Team hosted two workshops and organized a series of work sessions and conference calls with each team.

1. The Project Team developed a [Design Process Template](#) to guide teams to the final goal of 50% design.<sup>1</sup> This also served as a checklist and reference for the Design Teams and a place to take notes during meetings.
2. The Project Team developed and expanded an FAQ document with questions and answers that arose as teams worked on the living shoreline designs.
3. The Design Team Coordinators served as the communicator with project managers, Project Team, and landowners.
4. The Design Team Coordinators and UNH experts assisted Design Teams with collecting and synthesizing field data.
5. The Project Team organized and conducted Workshop #1 at Wagon Hill Farm on October 1, 2021. The workshop included:
  - a. Short lectures with handouts to review key concepts related to saltmarsh ecology, shoreline restoration, identification of impairments, and how to assess a site.
  - b. A guided walk around a living shoreline project.
  - c. Review of strategies for restoring shorelines and examples around Great Bay.
  - d. Small group time to advance designs for each priority design site.
6. The Project Team organized and conducted Workshop #2 at the Hugh Gregg Coastal Conservation Center on December 3, 2021. The workshop included:
  - a. Presentations and Q&A on designing living shorelines and on construction and maintaining living shorelines.
  - b. A work session for Design Teams.
  - c. An introduction to the permitting process for living shorelines in New Hampshire.
  - d. Presentations and discussion about each team's initial design ideas.

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<sup>1</sup> *50% design* is a term used for a project design that is at a mid-point in the development process. Typically, a 50% design includes a well-thought-out plan for a particular location and set of objectives. The 50% design includes enough specifics — in terms of the site conditions/topography, suite of interventions proposed for a site, materials needed, and locations — that the project team can have a productive pre-permitting meeting with permitting agencies and confirm support from stakeholders. A 50% design may not include final specifications, materials, dimensions, or construction sequencing.

### Workshop 1 Objectives

- Review and apply key concepts related to saltmarsh ecosystems, signs and causes of impairment, and different restorative measures.
- Begin to generate restoration options for each priority living shoreline site and develop a plan for the second site visit.
- Connect with other professionals interested in living shoreline design and implementation.

### Workshop 2 Objectives

- Learn how to apply key concepts related to the design, construction, and maintenance of living shoreline projects.
- Discuss the regulations most relevant to living shoreline projects.
- Advance planning for individual living shoreline design projects.
- Present and gather feedback on initial plans for designs.

#### 1. Design Teams Identified and Refined Shoreline Design Ideas

Design Team members attended two full-day workshops to learn and discuss specific strategies for designing living shorelines. They refined the project scope and selected design options.

Design Teams consulted with site landowners to inform one round of design iteration. They developed performance/success metrics (Tier 1 and Tier 2 attributes) for long term monitoring for success of the living shoreline.

Based on conversations with their landowners and information presented in Workshop 1, Design Teams developed a preliminary plan for each site shoreline. In some cases, the landowner had many ideas and needs for the site and the Team had to narrow their scope to a manageable area. Preliminary plans were presented in Workshop 2 and the Design Teams gathered input from project experts as well as regulatory agencies to help refine plans.

#### 2. Design Teams Developed Preliminary Designs

Design Teams developed preliminary designs for their site, incorporating field data and input from the Project Team. The Teams met with landowners to review how the project addressed landowner goals. They also met with UNH experts to discuss technical aspects of the design. The purpose of these meetings was to enhance the draft designs before final deliverables were shared. Preliminary designs were shared with landowners through a final review meeting and then presented to a larger audience in the final workshop.

The Design Team deliverables are available online to catalyze additional work at these and other similar sites:

- a. Drawings – including cross sections and plan views of existing conditions and proposed changes. The drawings incorporated the survey data and tidal water heights.
- b. Design Basis Memo – narrative of the project site including site history, usage, landowner goals and proposed design description. The memo includes monitoring attributes that could be measured in the future to determine the success of the project. The Teams suggest next steps that may pertain to additional data, permitting, and/or plan refinements.
- c. Plant and Material List – includes potential plant species and material that may be added or repurposed to the living shoreline design.
- d. Slides – The Teams presented a 15-minute presentation of proposed designs at the final workshop.



Each of the 4 Design Teams met the project objectives and worked through a number of challenges to collaboratively prepare a site specific preliminary living shoreline design. Professional relationships between Project Team and Design Team members were strengthened and will further advance the practice of living shorelines in the state.

### What challenges did you come across during this activity?

- Design Team members reported spending an average of 64.4 hours on the program, with individual contributions ranging from 45 to 125 hours. This is significantly more than the 40 - 50 hours the Project Team originally estimated for the program. Some hours were billed to a participant's firm, other hours were volunteered. Those that contributed an above average amount likely learned more, but their individual contributions were not acknowledged separately from their Design Team.
- Some participants indicated their employer might be hesitant to support participation in the future if the work didn't have a higher likelihood of generating projects for their firm.
- Satisfying both landowner goals (such as costs, their wants for the site) and project goals was difficult. Future grant funding may make it easier to cater to landowner goals.
- It was hard to promise a specific product (living shoreline design) at the end because there is so much to learn still.
- Communicating about using grants for project implementation is a challenge. Some grantees do not fund projects on private property, while others do. Fiscal agents are often needed to move projects on private property forward and eligibility often hinges on substantial project benefits.
- 50% design proved to be a high bar to promise for this project. Additionally, the term *50% design* did not have a universal meaning to all project participants, so there was a lack of clarity about expectations for the final deliverables. For example, some individuals did not consider CAD designs to be required for a preliminary design while others did.
- Compared to an intensive short course, one challenge is the contact with Design Teams. The program occurred over months because instruction to field data collection to data synthesis to design requires time that an intensive short course does not provide. Maintaining contact and momentum with the team through web calls was often difficult, especially if no progress was made between meetings.
- Designing living shorelines is an inherently interdisciplinary endeavor that requires close collaboration of engineers, ecologists, and landscape architects. However, communication across these disciplines can sometimes inhibit progress and momentum.

### What information do you wish you had when you started it?

- In preparation for permitting and to determine opportunities for avoidance and mitigation, each site will need to use the NH National Heritage Bureau Data Check Tool to check for known locations of rare species and natural communities at the site. There is a \$25 fee for this. The party responsible for initiating this review (and paying the \$25 fee) should have been determined prior to the project.
- Water level is a very important consideration when assessing the existing conditions, future conditions, and almost every aspect of the living shoreline design. It is critical that the Design Team make sense of their tidal datum and select a defensible sea level rise scenario.
- Don't force solutions or living shorelines. An objective of this program was to educate and create a community knowledgeable about living shorelines, which means understanding when and if a living shoreline stabilization project is necessary. If conditions at a project site suggest that no action should be taken, then the Design Team should recommend this. For the purpose of this program, we did not want to eliminate that design experience from the Design Team members. The members may still go through the process of designing a living shoreline, but not recommend its installation at this time. This could provide the team with direction to assess for when a living shoreline may be reasonable. For example, "if erosion gets more aggressive, design for that."

### If you were to do it again, what would you do differently?

- Improve training for the Project Team and Design Team on the permitting process.
- Use NHDES liaisons as the central coordinator for Design Teams.
- Create templates for the technical work and a “how to” guide to aid in the preliminary site design process.
- The Design Process Template used at Workshop #1 provided good baseline material but it could have been refined and used more throughout the project.
- Use the term “preliminary” rather than 50% design.
- The programming was implemented during the COVID-19 Pandemic, during which time in person meetings were slowly being re-instituted. If we were to do it again, our decisions for convening in-person training opportunities would likely be different.

### When people replicate this step, what key information do they need to know?

- Projects can get big very quickly and it is important to be cognizant of the scope of the project and design. A Design Team may need assistance with creating a project scope that they can complete and with recognizing that everything that they would like to do at a site may not be feasible for this type of project.
- Provide the Design Team with the opportunity to meet with experts and ask questions. For this project, the UNH experts were Dave Burdick and Tom Ballestero and the Design Team met with them in February 2022.
- Facilitation skills or tips would be helpful for advancing group work.
- Constant communication with landowners, Project Team, and Design Team was essential for this project.
- A Design Team should understand and be prepared for landowner goals/needs to shift as data is collected and designs progress. Landowners should also be aware that installing a living shoreline may not solve all of the issues at their site; management of the current property may affect erosion rates.
- Incorporating sea level rise scenarios into living shoreline design has its limits. Because tidal wetland plants occur within a narrow vertical window, living shoreline design elements need to focus on existing and very near-term conditions rather than uncertain conditions 50 years in the future.
- Using a tool (NH Coastal Flood Risk Guidance) that was intended for community resilience planning does not necessarily translate well to habitat restoration/intervention planning. Alternative resources may be more appropriate for determining appropriate future conditions to plan for.
- Creating a visual rendering of the sea level rise scenario with a “do nothing approach” was a powerful tool that landowners responded to quite well.
- Landowners need a holistic understanding of the options they can take (no action, low cost/benefit, and high cost/benefit) based on sea level rise scenarios and time frames.
- The project was focused on design development more than process. However, while implementing the project, it became clear that the process was more important. The Project Team wanted the outcomes to include holistic designs and conversations with stakeholders who need to buy into the living shoreline design. That was sufficient and appropriate to achieve with this project.

## What challenges did you come across during this activity?

### Collaboration

- Collaborating across disciplines with new partners was challenging. Different disciplines work differently and have different languages. This made it hard to express ideas, communicate, and meld ideas, and it impacted group dynamic and the process.
- Individual Design Team members had to let go of some of their ideas and desires in order to move forward with the group. As a result, the final deliverables may not reflect the way individuals would have done it themselves.
- There was not an even distribution of expertise across all Design Teams. Design Team members could be polled on their skills to help create and balance out the teams. The topic itself – shoreline management – was not an area of expertise or familiarity of some individuals.
- The collaboration process created hurdles for managing the schedule and deliverables. For example, one individual team member, such as the individual responsible for the drawings, could delay the process. One solution could be to contract a draft person or other professional through the grant that could assist the Design Teams with certain aspects of the process. This would also aid in standardizing visuals across group.
- Collaborating across disciplines compounded the challenges of the short project timeline. Depending on the point in the process, engineers and landscape architects had to do things at different times. It was also difficult for teams to coordinate schedules and get together at a time that worked.

### Vision and Goals

- The Design Teams and landowners had different goals for the living shoreline design. Furthermore, the goals among landowners and decision makers about their site varied. For example, some landowners were interested in recreation while others focused on the marsh. Trade-offs such as the loss of lawn space also factor into the appeal of a living shoreline. This made living shoreline visioning difficult and also created challenges when trying to apply the NH Coastal Flood Risk Guidance.
- There were different perspectives on the problem the Team was trying to solve, particularly with respect to managing erosion, which is often a natural but undesirable occurrence when it interferes with development and infrastructure like docks.
- Landowners may have preconceived notions about how to manage their property. Education was an important element in moving forward with a living shoreline design that may be different than what they envisioned.

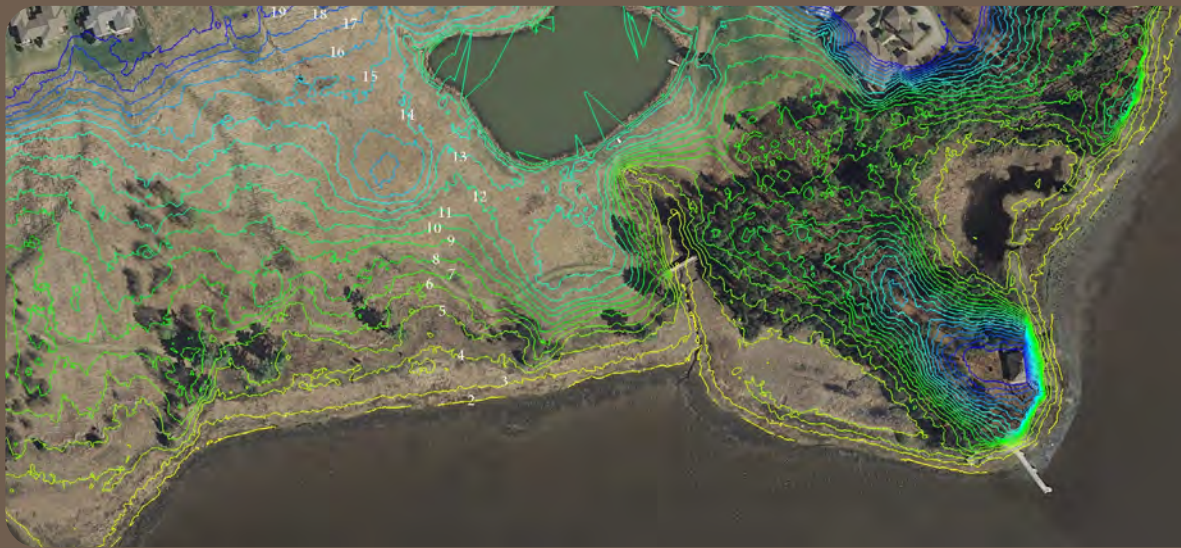


Image: Moody Point Design Team

## Broad Challenges Associated with LS

- Landowners and designers are used to and familiar with engineered shorelines. Factors like the actual or perceived lower cost, shorter installation time, and hard shoreline precedent make engineered solutions a more comfortable option than living shoreline. Even with strong interest in a living shoreline and awareness of the ecological benefits, it is difficult for a landowner to opt for a living shoreline over a proven and less costly engineered design. The cost of living shoreline materials are more expensive than hard options, but the installation labor and profit potential for engineering firms or contractors is less. There is less incentive for engineering firms to encourage softer shoreline management approaches, even if there is revenue associated with monitoring. The lack of information about the cost of living shorelines is a hurdle. Hardened shorelines can be designed and constructed quickly. Awareness of living shorelines also factors in. Many hardened shorelines are constructed because people are not aware of alternative options.
- A huge challenge with this kind of innovative project is that even if we design it we can't guarantee it will be built to our design.
- There is a lack of communication across disciplines. For example, transportation engineers are generally not necessarily talking to the ecologist, or even considering the need to, when designing a bridge.
- Regulations that require living shoreline and demand from the state and communities for living shorelines are necessary components in advancing living shorelines. NHDES has language that encourage but does not mandate living shorelines. If there was a mandate from NHDES, people would install living shorelines.
- Funding is a challenge. There is a need to identifying options to offset the cost of a living shorelines, such as through grants or incentives in the permitting process (ex. in the Chesapeake Bay, property owners were given money to offset cost to upgrade their septic systems). Aiding private property owners in accessing grant funding for living shorelines may foster more living shorelines installations but there are unknowns with regard to what implementing this would look like. Individuals have varying support of investing funds across the community. Details like whether more funds would be available to areas with greater risk of sea level rise impacts would need to be addressed.
- Funding so far has been through public-private partnerships. As more private people get involved, this may drive the market to find better technologies and less expensive materials.
- Local politics can be challenging.
- Implementing living shorelines is going to be different in every place, but this project takes the first step of demonstrating this innovative technology on public land so people can see them and use these sites for marketing.
- Durham envisioned Wagon Hill being the landing place for people to see that living shorelines are a better way to try and be resilient to sea level rise. How can we make more demonstration sites to show people success, especially for short term sea level rise? How and when will we know if living shorelines are more cost effective?
- There were many private landowners interested in the project but a lack of information about how to implement living shorelines.
- Landowners need to be open to investing in shoreline management that is in some ways experimental. They also need to be willing to maintain the living shorelines.
- Many consequences of shoreline erosion will occur in 50 years, so the benefit of investing in living shorelines now may not be clear. Communicating the long-term investment is important.
- Marshes are inherently less exciting than oyster reefs, so investing more time, resources, and creativity into building awareness and education of marshes may be needed.
- The significance of access to water cannot be understated or ignored when promoting living shorelines and creating designs that are acceptable to landowners. A sea wall allows people to walk along the coastline. Marshes create a barrier between people and the water.

## What information do you wish you had when you started?

### Knowledge

- As designers, we have the ability to help landowners craft goals for their property through education and information sharing. Even if a landowner states a goal at the outset, it may not be set in stone. Designers need to be aware of their preconceived ideas of what a landowner may or may not be open to.
- It may be necessary to reframe the discussion about living shorelines to effectively communicate with property owners that have different incentives and interests. For example, provide the perspective of what a site may look like in the future without intervention and the implications for future generations. Do not make the assumption that a landowner or client wants a living shoreline.

### Information, Resources, and Technical Support

- It is important to outline how much time and money it's going to take to plan, design, permit, and install a living shoreline.
- Resources like technical design guidance that brings together design recommendations from the UNH experts and an online library of references and bibliography would have been helpful.
- Better existing site information like maps and current aerials would have allowed Teams to focus more on the designs. The base maps took a lot of time to create. The Team should have had a base plan before the first site visit.
- If the Project Team hired a drafting team to do the CAD and GIS work, that would have left more time for creative design work.
- Examples of the cost of living shorelines are needed. The inability to cost out a living shoreline was a barrier to creating a design that the landowner may feasibly move forward with.





## General Lessons Learned & Recommendations

- Make biggest decisions first. The order of things is important. Figure out the design parameters like exact sea level rise scenarios and target slopes early on.
- Consider the do nothing alternative if appropriate.
- Consider omitting certain data collection if it is not appropriate for the site (i.e. erosion pins at a rocky site).
- Allocate time to thinking about a post installation maintenance plan.
- The Wagon Hill walk was good but it may have been better to do that earlier, and with the landowners, to help them better understand living shorelines and options for their property. Doing a field trip within the landowner to a complete project is a good educational opportunity. Looking at another type of project, like dunes or stream banks, could also be beneficial and provide the opportunity to learn more about different shoreline types other than low and high marsh, and to discuss solutions like breakwaters, etc.
- Design Team members and landowners could benefit from seeing case studies of living shorelines. Seeing failed projects would also be educational for the Design Team.
- Present the proposed living shoreline design to other landowners with similar shoreline conditions that may be thinking of doing a similar project (e.g., others in the neighborhood). Consider bringing in neighbors adjacent to a property into planning process as early as possible as it is more cost effective to do a comprehensive design over multiple properties. Ideally, plan for district scale resiliency. Think about whole neighborhoods when designing sites and interacting with landowners.
- Add additional expertise and skills to the Design Team. Contractors can provide valuable input as well and cost information and would benefit from being included in this course. This is a small scale contractor niche. Conservation agents/soil and water conservation districts would be an asset to the team. More representation from municipal staff (planning and public works departments) is recommended.
- Involve the landowner more. When the landowners were only tangentially involved, the living shoreline design project become more of an academic exercise and less of a real-world project. This resulted in a missed opportunity to be inspirational and a missed opportunity for education.

## Group Meeting Logistics

- Split apart the first meeting with the team, site, and landowner. The first visit was a bit chaotic and could have used better structure, perhaps a pre-site visit.
- Schedule more frequent check in points, more site visits, and more free time during meetings.
- Reserve the in person time for group work and save lectures for the virtual meetings.
- Provide the Design Team with a workspace near their site.
- Schedule longer, in person meetings rather than 1 hour Zoom meetings.
- Schedule less time between workshops with intermediate set milestone deliverables to keep the design teams accountable. Keeping momentum was hard when team members do not have a lot of time to give and meetings occurred every two weeks.
- Consider smaller design teams so that coordination outside of workshops is easier to schedule.
- Incorporate project management training into the project and assist Design Team with delegating tasks.

## WHAT THE DESIGN TEAM SHARED

When people replicate this project, what do they need to know?

- A multi-disciplinary team is a key ingredient for living shoreline design. Collaboration across disciplines was important. For example, getting the ecology in front of the engineer was important because elevations and vegetation are tied together.
- The UNH experts provided great information. It was good to get experience on the specific soil Tom Ballestero and Dave Burdick used for the living shoreline. It was also interesting to hear their perspectives on what actually worked in a real world experience.
- There are a variety of living shoreline solutions.
- The do nothing concept is important to convey. If there is limited erosion occurring, the no action approach may be most appropriate.
- This project has shown that living shorelines are possible in places that may not seem like feasible sites at first.
- It was valuable to divorce funding from design throughout the project.
- The landowner's planning timeline may be different from that of the Project and Design Teams.
- Communication is critical. The landowner needs to understand the value of the ecology to the community. The Design Team needs to be able to communicate the limits of how natural ecosystems can adapt and help the landowner understand and conceptualize a range of possible future conditions.
- This project required a lot of time from the Design Team members. Employers could be offered incentives for volunteering their employees' time. Tangible outputs like a certificate or special access to resources could be provided to employers.



Image: Lynn Vaccaro

# TECHNOLOGY TRANSFER





## Designing Living Shorelines for Great Bay: Final Workshop

*Lead Project Team Partners: NHCP, GBNERR; Supporting Partners: UNH, SRPC*

Organized a culminating workshop to present the preliminary designs and lessons learned.

1. Organized a workshop that included a hybrid Zoom and in person morning session and an in person component in the afternoon.
  - a. Forty design team members and project partners met in person at the NHDES office in Portsmouth.
  - b. A broader audience including landowners, neighbors, and stakeholders and committees connected to the design sites; people with a role in permitting or policy; and other professionals was invited to join by Zoom. A total of 101 people attended the morning session over Zoom.
2. Conducted Zoom polls and addressed participant comments and questions via the Q&A and chat. Encouraged Design Team members to log into the Zoom meeting to see the Q&A, chat, list of virtual participants, and to participate in the polls.
3. Shared presentations on overarching considerations for Great Bay living shorelines:
  - a. Introduction to Living shoreline approaches for Great Bay - Dave Burdick
  - b. Designing Living Shorelines - Tom Ballestero
  - c. Permitting Considerations - Kevin Lucey
4. Dedicated 15 minutes to a presentation by each Design Team on how they approached the design process and outlined their suggested living shoreline design that addresses their site's unique conditions and goals. The coordinators provided a presentation outline to each team to assist with presentation preparation. All team members participated in the presentation.
5. Conducted an afternoon session that included:
  - a. Time for networking during lunch.
  - b. The opportunity for Design Team Members to share feedback on elements they appreciated and suggestions for the living shoreline designs for each site using sticky notes.
  - c. Convened a series of small group discussions on lessons learned and next steps for the project sites and the field of living shoreline design and engineering:
    - i. Lessons Learned: What challenges did you come across during the design process? What were the most important technical lessons you learned that you'd pass on to another peer? How will your experience with this project impact your work?
    - ii. Improving this Program: If we were to repeat this training and design program, what changes would you recommend to make participation easier or more beneficial (e.g., design team structure, educational materials)? What information do you wish you had when you started?
    - iii. Broader Challenges & Opportunities: What do you see as the biggest challenges to getting more living shoreline projects implemented? What could be done to address these broad issues and help catalyze more projects (e.g., new policies, new science)
    - iv. New Programmatic Ideas: What additional support (i.e., references, field trips, workshops) could we provide for living shoreline work? What other topics would be suitable for a similar professional development program?
  - d. Provided Design Team members with a survey about the program and a form to track volunteer match for the grant at the end of the workshop.
  - e. Acknowledged and celebrated the hard work of Design Team members and presented certificates.

Presentations for each site and a [video recording](#) of the morning session are available on the [Great Bay Living Shoreline project website](#).



Image: Liz Durfee

▶ The Project Team hosted a well-attended workshop that provided the opportunity for the Design Teams to share and be recognized for their work. It also provided the broader living shoreline community with the opportunity to learn about living shorelines and the project.

### What challenges did you come across during this activity?

- The Project Team opted for a hybrid workshop event to reduce risks due to COVID-19. Planning for both in person and virtual engagement took additional time and resources. We were able to involve a larger suite of people through Zoom, but the experience may have been less impactful.
- Being a relatively new practice with few on-the-ground examples and a dearth of experts in the field, conveying regulatory perspective for living shorelines is inherently complicated. The source of the problem is that living shorelines are generally contrary to tidal wetland permitting to date. Even experts do not agree whether a living shoreline is a shoreline stabilization practice or habitat restoration and this affects permitting decision.
- We had a packed agenda with not enough time for Q&A and interaction. With more time we could have built in more engagement using virtual tools, for example to capture reactions to the project presentations.

### If you were to do it again, what would you do differently?

- Dedicate more time to the end life of the products after the project in advance.
- Allocate more time to final presentations. An extra half hour would have allowed for more Q&A and discussion following each project presentation, which would have been ideal. More time could have been allocated to reviewing the poster notes.
- It would have been ideal to have the design products already posted on the website and ready to share before the workshop. Final slides and design memos should be shared with the landowners before the workshop.
- The set up for the Design Team presentations could have been a bit better, including better positioning of the panel table and use of a remote mouse to point out items of interest on the slides.

### When people replicate this step, what key information do they need to know?

- Expertise and ability to organize and implement a hybrid (in person and remote) workshop was critical. It was helpful to take the time before the workshop to run through the logistics of a hybrid work-shop.
- Offer many points for the workshop participants and online attendees to engage (polls, Zoom chat box, Q&A, sticky notes, small group discussion).
- Celebrate and recognize the work of all participants.
- The hybrid approach allowed the Design Team Members to continue to develop as a cohort.
- Presenting the site where the no action alternative was recommended was an appropriate site to share last.

## Workshop Feedback from Design Team Participants

**How well did the workshop achieve each of these objectives?**  
(1=not at all, 5=very well)

Build skills and knowledge about living shoreline approaches **4.8**

Develop suggested designs for potential living shorelines **4.6**

Advance the state of living shoreline approaches in NH **4.5**

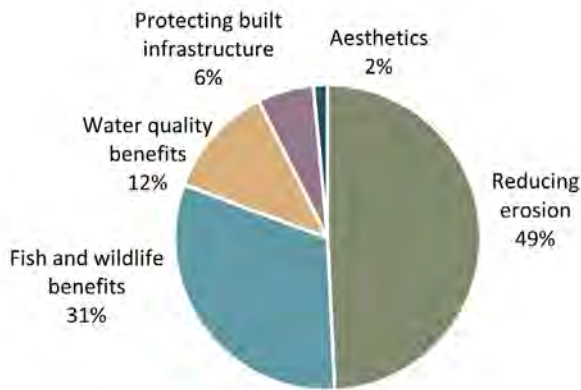
### Examples of what the Design Team participants learned or found useful:

- Collaborating with people from different disciplines.
- Gaining new friends and colleagues to reach out to.
- Utilizing adaptive pathway planning approach / management strategy for sea level rise planning.
- Applying the NH Coastal Flood Risk Guidance.
- Seeing that living shoreline design has a similar data approach to other projects.
- Considering a combination of gray and green shoreline management in living shoreline designs.
- Understanding important details about ecological limitations in living shorelines.
- Knowledge of the permitting process.
- Technical information such as:
  - Types of soil to use in salt marsh restoration.
  - How to calculate tidal datums and use in design.
  - How to identify different marsh / shoreline conditions.
  - Target design parameters such as slopes.
  - Importance of getting the engineering design right to support planting in dynamic environment.
  - Technical details around elevations to build sill height to spec for low marsh vegetation.
  - How different vegetation and marsh types fit in with tidal water levels.
  - Tidal datums and marsh plant zonation - understanding and predicting salt marsh migration with respect to sea level rise.
- Material comparisons for shoreline stabilization (coir, oyster, root wads) for future design projects.

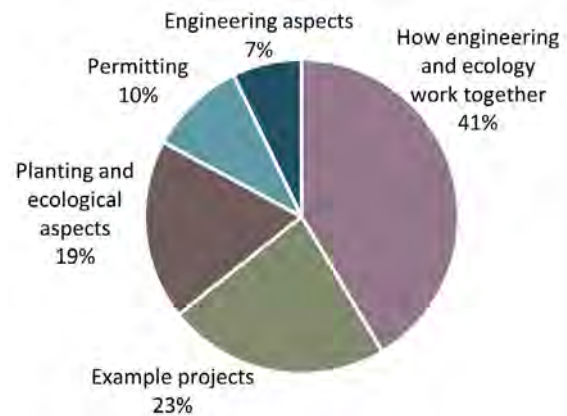
## Feedback from Broader Living Shoreline Community

A broad range of stakeholders from entities including local, state, regional, and federal governments, community organizations, businesses, academia, and non-profits participated remotely in the morning session of the final workshop. The attendees were polled about several living shoreline topics. Responses to the poll questions are shown below. Participants indicated that reducing erosion, followed by fish and wildlife benefits, were the most compelling reasons to use living shoreline approaches. The intersection of engineering and ecology was the topic of greatest interest to most people. Funding and permitting were identified as the biggest challenges to implementing living shorelines.

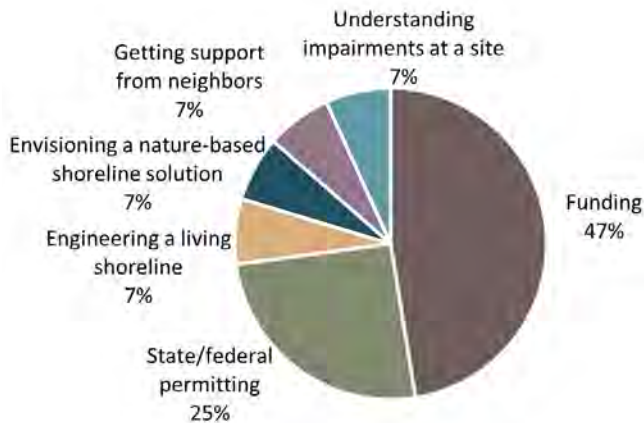
What do you see as the most compelling reason to use living shoreline approaches? (choose one)



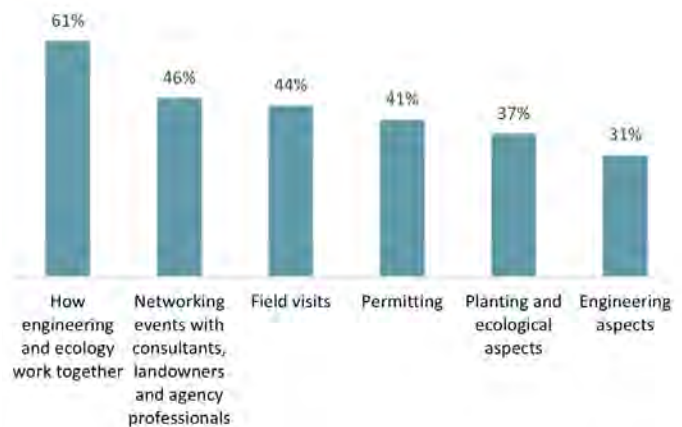
Which aspect of today's topic is most of interest to you? (choose one)



What do you see as the biggest challenge to implementing living shoreline approaches? (choose one)?



Are you interested in future living shoreline programs about...? (choose all that apply)



Participants asked for more information about:

- Experts to refer landowners to
- How local permitting and regulations apply
- Similarities and differences of permitting in different states
- Best management guidance for homeowners
- Cost estimates and funding or loans to support living shorelines



Image: Chapman's Landing Design Team



## WHAT TO DO NEXT

## Next Steps for Advancing Designs developed through the Great Bay Living Shoreline Project

This section includes next steps for advancing designs developed through the Great Bay Living Shoreline Project. These next steps represent a summary of next steps identified in the Design Team memos. This is not intended to be a comprehensive list of steps needed to construct a living shoreline. Specific next steps will vary depending on the site and living shoreline design. Some of the steps below may not be applicable to all sites. Refer to the [final memos](#) for each site for more details on the specific project sites.

### Pre-Permitting and Permitting

1. Landowner will need to hire a consultant to develop 100% design and prepare permit applications.
2. Project Team and partners continue monitoring, as needed, to determine in and when a living shoreline should be constructed along the marsh edge and to guide the level of intervention required. Depending on the site, recommended monitoring may include:
  - a. Erosion pin measurements every 6 months
  - b. Vegetation surveys to determine changes in species and density
  - c. Salt Marsh Sparrow nesting success monitoring
  - d. Marsh plain elevation monitoring.
3. Collect other site data such as
  - a. Topographic survey
  - b. Near shore survey
  - c. Exposed bedrock assessment
  - d. Comprehensive prevailing wave analysis
  - e. Numerical wave modeling
  - f. Longer tidal study to determine the local Highest Observable Tide (HOT) elevation
  - g. Additional field data.
4. Incorporate tolerance for changing conditions such as storm intensity, sea level rise, and groundwater rise.
5. Delineate wetlands.
6. Schedule/hold a pre-application meeting(s) with regulatory agencies (New Hampshire Department of Environmental Services (NHDES), United States Army Corps of Engineers (USACE)) to discuss the proposed design and get early feedback on any design changes or requirements that may be needed.
7. Conduct Phase IA cultural resources survey. Consult with an archaeological consultant to conduct a site walk and initiate state consultation. This information will be required during the permitting effort for any ground disturbing work. A Phase IA archaeological/cultural survey may be required.
8. Advance the design to the preliminary (approximately 75% complete) level to submit with permit applications.
9. Add erosion and sedimentation best management practices, water control measures, proposed access routes, and other details.
10. Develop technical specification and an opinion of probable construction cost (OPCC).
11. Prepare and submit permit application.
12. Hold/attend permit hearings and address questions from agencies and the public.

#### Permits Required will Vary by Site and Design, but may include:

- NHDES Standard Dredge & Fill – Major Impact Permit (required for work below the HOT line)
- NHDES Shoreland Permit (required for work within 250 feet of lakes and ponds greater than 10 acres in size, rivers or streams which are fourth order or greater, rivers designated under RSA-483, and tidal waters)
- USACE Section 404 Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899 Permit (required for discharge of dredged or fill material into waters of the US and for work in navigable waters of the US)
- Local permits from municipality, such as a conditional use or special use permit for operating within a wetland buffer or in proximity to a shoreline



Image: Lynn Vaccaro

### Grant Application Assistance

1. Identify funding opportunities and prepare grant application. The project consultant could assist with this.

### Final Design & Bidding

1. Prepare stamped final design plans.
2. Engineering consultant can then assist with the bidding of the project to contractors (e.g. preparation of bid documents, facilitation of a pre-bid meeting, contracting, etc.).

### Construction & Post-Construction Monitoring

1. Select contractor.
2. Construct living shoreline.
3. Monitor to ensure the success of the project per permitting requirements.

### Recommended Consultant Capabilities:

1. Professional Engineer licensed in New Hampshire
2. Civil or water resources engineer capable of designing the living shoreline
3. Structural engineer capable of analyzing the stability of the retaining wall
4. Certified Wetland Scientist capable of performing a wetland delineation
5. Cultural resources specialist capable of performing a Phase IA survey

# General Next Steps for Advancing the Practice of Living Shorelines in New Hampshire

This section includes input from Project Team and input from the Design Team members during a series of small group discussions at the culminating workshop for the project.

## Design Guidance & Resources

1. Develop a summary table of design recommendations for living shorelines, similar to the Planting Guide for Tidal Shoreline Erosion Management in New Hampshire, that shows design criteria (e.g., elevation and plants, elevation and design needs). Where possible, identify standard design principles that would help make a project easier to design in certain scenarios.
2. Create an online library or annotated bibliography of references.
3. Develop a qualified vendor/consultant contractor lists to issue RFPs and site applications.

## Education

1. Increase awareness of living shorelines as an option for shoreline management. Educate municipal officials, contractors, and private landowners about living shorelines
2. Educate and engage community members through hosting meetings, hanging educational posters and flyers in areas where shorelines are degraded, and developing visual aids that show what properties may look like in the future given sea level rise and erosion. Install living shoreline exhibits at places like libraries, Seacoast Science Center, and the Great Bay Discovery Center. Host volunteer opportunities to do plantings to build interest and educate.
3. Identify and train engineers and contractors for different size sites (ex. homeowners vs large sites). Create time lapse videos to show pre- to post-construction of living shorelines for contractors who are not familiar with living shorelines and their installation. Develop accessible language to encourage living shorelines, similar to that used for low impact development.
4. Develop outreach tools for local communities/ municipalities to learn about living shorelines and a general step by step process of a living shoreline project.

## Case Studies & Living Shoreline Examples

1. Compile case study reports or web list of resources for communities. Particularly, it would be interesting to see the permitting process documented in case studies.
2. Create demonstration sites in public areas (like Wagon Hill). Demonstration sites for landowners with small sites would also be useful for homeowners to understand living shorelines.
3. Learn from programs in other states (ex. Rhode Island's regulatory process, California's "Cut the green tape" program to streamline green projects, Philadelphia's green roof program).

## Permitting & Regulatory Considerations

1. Consider developing a New Hampshire specific regulatory guidance document for living shoreline that: is similar to the [NH Stream Crossing Guidance \(UNH, 2009\)](#), is suitable for reference in NHDES Permitting Rule, and includes considerations such as: best practice, recommendations, and design / permitting guidance.
2. Consider developing screening mechanisms for determining whether a proposed living shoreline site has the potential for sediment/soil contamination that would require evaluation of ecosystem risk in accordance with: [Evaluation of Sediment Quality Guidance Document \(NHDES, 2005\)](#).
3. Work with NH grant program partners to consider selection criteria that ensures investment in living shoreline sites that are high priority and have a high potential for success.
4. Continue to coordinate with local, state, and federal regulatory agencies to continuously improve processes, rules, guidance, and criteria for living shoreline permitting.

## Costs & Benefits

1. Provide information on upfront costs and long-term benefits.
2. Identify ways to share cost estimates among designers and contractors.
3. Be creative when investigating incentives for living shorelines and look to incentives for other types of projects and uses, like conservation easements, tax rebates, solar credits, accelerated review process. Identify ways to streamline projects and increase landowner willingness to try living shorelines.
4. Create a list of funding sources for living shorelines, including opportunities to fund living shorelines on private property.
5. Identify living shoreline yields to communicate the functional value of living shorelines and the measurable benefits to landowners.

## Scale

1. Address shoreline management and living shorelines from a regional perspective based on ecological and physical systems rather than political boundaries and lot lines. Investigate the feasibility of a neighborhood approach that is more comprehensive than parcel specific design.
2. Develop a master plan for the next 5 to 10 years that prioritizes a list of projects and identifies the sites where living shorelines are needed most immediately. Incorporate living shorelines into watershed management planning process. Prioritize critical areas, similar to that done for beach nourishment, in order to identify properties to focus on.
3. Coordinate with municipalities and across state borders.
4. Engage regional entities to lead outreach efforts.
5. Initiate grassroots organization for at-risk waterbodies.

### Improve Policy.

- Bring together agencies to better align regulations and funding.
- Provide opportunities for collaboration and networking with consultants, landowners, agency professionals and researchers.

### Improve Project Planning and Design Capacity.

- Develop/aggregate technical design resources including best practices, case studies, and cost/benefits relevant to this region.
- Offer professional trainings that further explore ecological design and engineering concepts.

### Increase Landowner Interest.

- Identify ways to make design, engineering, and construction cost effective for residential properties.
- Support programs to increase interest among landowners (incentives, outreach, demonstration sites, funding sources).



# Appendix A Great Bay Living Shoreline Project Website Material

## Project Website

<https://www.nhcaw.org/greatbaylivingshorelineproject/>

## Design Site Websites with Design Products and Presentations

Schanda Park: <https://www.nhcaw.org/great-bay-living-shorelines-schanda-park/>

Moody Point: <https://www.nhcaw.org/great-bay-living-shorelines-moody-point/>

Spur Road: <https://www.nhcaw.org/great-bay-living-shorelines-spur-road/>

Chapman's Landing: <https://www.nhcaw.org/great-bay-living-shorelines-chapmans-landing/>

## Other Material

Workshop 3 Video Recording: <https://www.youtube.com/playlist?list=PLR1Ecg25mMIScu74hE7TWWRdr3rHIXaVv>

Resources and References List: <https://www.nhcaw.org/wp-content/uploads/2022/05/Living-Shorelines-Resources-References.pdf>

Design Team Template: <https://www.nhcaw.org/wp-content/uploads/2022/05/Design-Team-Template.pdf>

# Appendix B Directory

## Project Team

Name	Email	Role in Project	Affiliation
Kirsten Howard	<a href="mailto:kirsten.howard@des.nh.gov">kirsten.howard@des.nh.gov</a>	Project manager and design team coordinator	NHDES Coastal Program
Aidan Barry	<a href="mailto:Aidan.T.Barry@des.nh.gov">Aidan.T.Barry@des.nh.gov</a>	Design team coordinator	NHDES Coastal Program
Trevor Mattera	<a href="mailto:tm2022@unh.edu">tm2022@unh.edu</a>	Design team coordinator	Piscataqua Region Estuaries Partnership
Lynn Vaccaro	<a href="mailto:Lynn.e.Vaccaro@wildlife.nh.gov">Lynn.e.Vaccaro@wildlife.nh.gov</a>	Design team coordinator	Great Bay National Estuarine Research Reserve
Cory Riley	<a href="mailto:Cory.A.Riley@wildlife.nh.gov">Cory.A.Riley@wildlife.nh.gov</a>	Design team management, Landowner	Great Bay National Estuarine Research Reserve
Steve Miller	<a href="mailto:sjm544@comcast.net">sjm544@comcast.net</a>	Design team coordinator back-up	Great Bay National Estuarine Research Reserve
Kevin Lucey	<a href="mailto:kevin.p.lucey@des.nh.gov">kevin.p.lucey@des.nh.gov</a>	Project Manager and Design Team Coordinator	NHDES Coastal Program
Kyle Pimental	<a href="mailto:kpimental@strafford.org">kpimental@strafford.org</a>	Site selection and outreach to towns	Stafford Regional Planning Commission
David Burdick	<a href="mailto:David.Burdick@unh.edu">David.Burdick@unh.edu</a>	Technical support for design teams	University of New Hampshire
Tom Ballestero	<a href="mailto:tom.ballestero@unh.edu">tom.ballestero@unh.edu</a>	Technical support for design teams	University of New Hampshire
Chris Peter	<a href="mailto:Christopher.R.Peter@wildlife.nh.gov">Christopher.R.Peter@wildlife.nh.gov</a>	Technical support	Great Bay National Estuarine Research Reserve
Rachel Stevens	<a href="mailto:Rachel.A.Stevens@wildlife.nh.gov">Rachel.A.Stevens@wildlife.nh.gov</a>	Technical support, Landowner	Great Bay National Estuarine Research Reserve
Heather Ballestero	<a href="mailto:Heather.R.Ballestero@wildlife.nh.gov">Heather.R.Ballestero@wildlife.nh.gov</a>	Technical support	Great Bay National Estuarine Research Reserve



## Design Team

Design Site	Name	Email	Profession	Affiliation
Moody Point	Cheryl Coviello	<a href="mailto:cheryl.coviello@gza.com">cheryl.coviello@gza.com</a>	Professional Engineer	GZA GeoEnvironmental, Inc.
	Conor Ofsthun	<a href="mailto:cofsthun@woodsholegroup.com">cofsthun@woodsholegroup.com</a>	Coastal Scientist	Woods Hole Group
	Cornelius R Murphy	<a href="mailto:cornelius@wsdcollective.com">cornelius@wsdcollective.com</a>	Landscape Architect	Whole Systems Design Collective, LLC
	Stephen Herzog	<a href="mailto:stephen.herzog@woodplc.com">stephen.herzog@woodplc.com</a>	Ecologist	Wood Environment & Infrastructure Solutions, Inc.
	Troy Barry	<a href="mailto:fluvialg@gmail.com">fluvialg@gmail.com</a>	Fluvial Geomorphologist/ Stream Restoration Specialist	Tighe & Bond
	Wickie Rowland	<a href="mailto:wickie@ForgetMeNot.design">wickie@ForgetMeNot.design</a>	Landscape Designer	Self employed/contract to Labrie Associates, No. Hampton
Spur Road	Annique Fleurat	<a href="mailto:AFleurat@VHB.com">AFleurat@VHB.com</a>	Water Resource Engineer	VHB
	Conor Madison	<a href="mailto:conor.madison@gza.com">conor.madison@gza.com</a>	Environmental Consultant (Ast. Project Manager)	GZA GeoEnvironmental Inc
	Derek Newhall	<a href="mailto:dnewhall@fando.com">dnewhall@fando.com</a>	Water Resource Engineer	Fuss & O'Neill, Inc.
	Jill Griffiths	<a href="mailto:jgriffiths@gomezandsullivan.com">jgriffiths@gomezandsullivan.com</a>	Water Resources Engineer/ Ecologist	Gomez and Sullivan Engineers
	Magdalena Ayed	<a href="mailto:Magdalena@harborkeepers.org">Magdalena@harborkeepers.org</a>	Non-profit administrator and coastal stewardship planner	The Harborkeepers
	Tom Brightman	<a href="mailto:tbrightman@me.com">tbrightman@me.com</a>	Land and Water Stewardship/Ecology	Osprey Ecological Services, LLC
Chapmans Landing	Grace Glynn	<a href="mailto:gglynn@dubois-king.com">gglynn@dubois-king.com</a>	Wetland Scientist	Dubois & King, Inc.
	Jennifer Riordan	<a href="mailto:jriordan@gm2inc.com">jriordan@gm2inc.com</a>	Senior Environmental Scientist	GM2 Associates, Inc.
	Kyle Johnson	<a href="mailto:KJohnson@kleinfelder.com">KJohnson@kleinfelder.com</a>	Water Resources Engineer / Climate Resiliency Reg. Lead	Kleinfelder (Boston office)
	Nathan Dill	<a href="mailto:nathan.dill@ransomenv.com">nathan.dill@ransomenv.com</a>	Coastal Engineer	Ransom Consulting, LLC
	Riana Kernan	<a href="mailto:rkernan@gomezandsullivan.com">rkernan@gomezandsullivan.com</a>	Water Resources Engineer	Gomez and Sullivan Engineers, DPC
	Susanne Smith Meyer	<a href="mailto:ssmla@comcast.net">ssmla@comcast.net</a>	Landscape architect	Self
Schanda Park	Bob Uhlig	<a href="mailto:bobu@halvorsondesign.com">bobu@halvorsondesign.com</a>	Landscape Architect	Halvorson   Tighe & Bond Studio
	Deanna Suzor	<a href="mailto:Dsuzor94@gmail.com">Dsuzor94@gmail.com</a>	Horticulturalist & Communications Assistant	Good Earth Gardens
	Elizabeth Olliver	<a href="mailto:eolliver@normandeau.com">eolliver@normandeau.com</a>	Environmental Consultant	Normandeau Associations, Inc.
	Jess Hunt	<a href="mailto:Jessica.hunt@stantec.com">Jessica.hunt@stantec.com</a>	Environmental Scientist	Stantect Consulting
	Patrick McNally	<a href="mailto:Mcnallypatrick13@gmail.com">Mcnallypatrick13@gmail.com</a>	Project Engineer	Lonza
	Tristan Donovan	<a href="mailto:Tristan.donovan@jacobs.com">Tristan.donovan@jacobs.com</a>	Engineer	Jacobs

# Appendix C Design Team Resources

Team Charter

Design Process Template

FAQ

Resource List



## Design Team Charter

Updated August 30, 2021

### About the Project

The Great Bay Living Shoreline Project aims to create a pipeline of new living shoreline projects in the Great Bay Estuary that will protect salt marsh habitat and coastal communities from erosion, sea level rise, and flooding. The project is supported by the National Fish and Wildlife Foundation (funding partner), the Town of Durham, the New Hampshire Department of Environmental Services Coastal Program, the University of New Hampshire, the Great Bay National Estuarine Research Reserve, the Great Bay Stewards, the Strafford Regional Planning Commission, and the Piscataqua Region Estuaries Partnership.

As part of this grant-funded effort, the project team will engage four “Design Teams” made up of restoration and shoreline management practitioners, including coastal and water resource engineers, landscape architects, marine construction professionals and design consultants to help develop 50% designs for four unique sites around the Great Bay Estuary.

### About this Document

This reference document outlines the roles and expectations for the professionals participating in the Design Teams for the Great Bay Living Shorelines Project. Project participants will all have access to this document ahead of the first field visit and should notify their team coordinators if they have any questions or concerns with the expectations summarized here. This document may be updated during the project if plans evolve.

### Purpose of the Design Teams

Design Team activities, including three workshops, site visits, and team meetings, are intended to achieve two core objectives:

- (1) Develop design solutions for four distinct shoreline sites by integrating a diverse suite of professional expertise; and
- (2) Provide a professional development opportunity that will help build interest and capacity to create living shorelines around Great Bay and beyond.

### Final Products

Each Design Team will be asked to produce a 50% living shoreline design concept for their designated shoreline site that takes into account the site’s unique physical and ecological conditions and the landowner’s goals. The final products created by each of the Design Teams, including all final design files and any analyses or field data collected, will be made publically accessible through the project webpage maintained by the NH Dept of Environmental Services Coastal Program. The contact information for all contributors will be acknowledged alongside these products. In addition, the designs and lessons learned will be shared broadly through a final workshop to stimulate interest in additional work around Great Bay.

## Communication with Landowners

During the project period (August 2021 – May 2022), Design Team members should focus on their collaborative design work and refrain from any personal communication with the landowners, for example about next steps. All Design Team communication with landowners should happen as a group during scheduled site visits. Your team coordinator can help address any additional questions that arise during the design process and will engage the landowner as needed.

## Expectations for Collaborating

The project team and all Design Team members are expected to be good collaborators throughout the project. Everyone should:

- Participate fully. We expect each team member to attend workshops, site visits and team work sessions.
- Openly share of information, including preliminary analyses and final 50% designs.
- Maintain an open, curious mindset during group work. Explore the possibilities of a new idea before identifying the faults.
- Capitalize on the varied expertise in each team. Look for ways to learn from and integrate the diverse expertise within your team and be innovative.
- Share ownership and recognition of the group's contributions during and after the project.
- Avoid side conversations. Include the full team on all email communications. Talk to your coordinator if you need more information from the landowner or other project experts.

## Field Work Risks

Field work at the project's living shoreline design sites will involve some inherent risks, including variable weather, unstable terrain, and exposure to sun and insects. As seasoned professionals, all Design Team participants are expected to weigh the potential risks and act responsibly based on their own physical abilities and comfort level. Participants should inform their team coordinator about any health issues that could impact their work in the field, such as an allergy to bee stings or mobility concerns.

Design Team participants should read all guidance provided ahead of their site visit and come prepared to be outside and subject to variable weather conditions for multiple hours. Recommended gear includes long pants, waterproof boots, sun and insect protection, water and snacks, a mask, hiking poles, and any other personal gear or medicine that might be needed (such as an EpiPen).

## Covid Precautions

This project will follow recommendations and guidance from the project team's home agencies and organizations, as well as our federal funder. Transmission rates and risks related to covid-19 are evolving and some project activities may need to be adjusted.

All project team members and design team participants should help protect the health of other participants throughout this project. The site visits, workshops, and design work will all benefit from face to face interactions, so we encourage participants to be vaccinated. Additional guidelines include: maintaining some distance while working together, bringing a mask in case we need to be in close quarters during field visits, and staying home if you feel sick or suspect a covid exposure. We are not planning to require masks while outdoors, however, masks will likely be encouraged or required for indoor group activities.

Missing a workshop or field visit or declining to participate in certain activities due to any concerns related to public health or your own personal safety and comfort will not jeopardize your ability to continue to participate in the project.

## Project Timeline

The table below outlines the timeline for the Design Teams.

	Aug 2021	Sept	Oct	Nov	Dec	Jan – Feb	Mar - Apr
<b>Kick off call</b>	CALL						
<b>Site visits (at least 2)</b>		VISIT	VISIT	VISIT			
<b>Team meetings</b>	Teams will meet approximately once a month						
<b>Full project team workshops: learning and design work</b>			WORKSHOP October 1		WORKSHOP December 3		
<b>Public workshop: present final designs</b>							WORKSHOP

## Time Commitment and Compensation

In total, we estimate that Design Team members will contribute approximately 40-50 hours of total effort between August 2021 and May 2022. This will include: site visits around Great Bay, NH; learning events; time to work on and refine your design with your team; and a final presentation at a culminating workshop.

A small stipend is available for those who are able to accept it. Stipend checks will be distributed after the first workshop and must be made out to individuals. Design Team members will receive a Certificate of Attendance with project description, outcomes, and number of contact hours.

## Project Sites and Coordinators

During the workshops, Design Team members will have a chance to learn more about the unique physical conditions, restoration goals and design constraints of these four sites chosen for design work. This [design team contact list](#) indicates who will be working on each site.

Site	Town	Notes	Coordinator
Moody Point	Newmarket, NH	This site is owned by a homeowner's association and includes a diverse mix of habitats and shoreline uses, contributing to erosion.	Trevor Mattera
Spur Road	Dover, NH	This is a private home with eroding salt marsh shoreline along the Bellamy River.	Lynn Vaccaro
Schanda Park	Newmarket, NH	This is a public park with a boat ramp on the Lamprey River with some shoreline armoring that the town hopes to improve and soften.	Kirsten Howard
Chapman's Landing	Stratham, NH	This site is owned by NH Fish and Game and includes a boat launch on the Squamscott R. and valuable saltmarsh that is eroding.	Kirsten Howard and new staff member

## Project Team Contacts

These individuals will be interfacing with Design Team members in different ways. For most inquiries, Design Team members are asked to direct questions to their team coordinator.

- **Project management**
  - Kirsten Howard, NH Coastal Program, [Kirsten.B.Howard@des.nh.gov](mailto:Kirsten.B.Howard@des.nh.gov)
- **Technical support for design teams**
  - David Burdick, University of New Hampshire, [david.burdick@unh.edu](mailto:david.burdick@unh.edu)
  - Tom Ballestero, University of New Hampshire, [tom.ballestero@unh.edu](mailto:tom.ballestero@unh.edu)
- **Site selection and outreach to towns**
  - Kyle Pimental, Stafford Regional Planning Commission, [kpimental@strafford.org](mailto:kpimental@strafford.org)
- **Design team oversight**
  - Cory Riley, Great Bay NERR, [Cory.A.Riley@wildlife.nh.gov](mailto:Cory.A.Riley@wildlife.nh.gov)
- **Design team coordinators**
  - Kirsten Howard, NH Coastal Program, [Kirsten.B.Howard@des.nh.gov](mailto:Kirsten.B.Howard@des.nh.gov)
  - Trevor Mattera, Piscataqua Region Estuaries Partnership, [Trevor.Mattera@unh.edu](mailto:Trevor.Mattera@unh.edu)
  - Lynn Vaccaro, Great Bay NERR, [Lynn.E.Vaccaro@wildlife.nh.gov](mailto:Lynn.E.Vaccaro@wildlife.nh.gov)

## Project References

- Project Website: <https://www.nhcaw.org/greatbaylivingshorelineproject>
- [Design Team Participant Contact Info and Site Assignments](#)
- [Design Team Workspace on Box](#)

# Living Shoreline Design Team Template

This template will help guide Design Teams through a process to get to our final goal of developing 50% designs for each site. This document can serve as a checklist and reference for the team and a place to take notes during meetings. Site assessment and design planning will not be a linear process and teams are encouraged to move iteratively between sections of this template and also modify this template to suit their project's needs.

## 1. Project Goals

**Guidance:** After reviewing the site profile and talking with the landowner, use this space to summarize and refine your understanding of the landowner's priorities and other ecological goals that are relevant to your design work. Over the course of the first two site visits, identify the bounds and scope of the design project. Make a note of any remaining questions or uncertainties; some of these could be addressed during a future conversation or next step of project.

### 1.A. Ecological Goals

Existing habitats and ecological assets	
Potential ecological goals for project and any tradeoffs to consider	
Potential eco/physical design constraints (e.g., invasive spp., elevations vs. flooding limitations)	

### 1.B. Landowner Goals

Landowner goals for the shoreline (short term and longer term)	
Current and anticipated human uses of the site	
Potential cultural design constraints (e.g., budget, aesthetics, adjacent land use)	

### 1.C. Site Considerations

Sources of impairment (e.g., human activity, stormwater, surrounding land use, boats, ice, shading etc.)	
Other site constraints (utilities, bedrock, access, property line, infrastructure, etc.)	

### 1.D. Design Team Project Scope, Objectives and Spatial Bounds (This may need to be refined over time in consultation with landowner)

- 
- 

### 1.E. Remaining Questions about Project Goals

- 
-



## 2. Site Assessment

**Guidance:** Use the tables below to document what you are learning about site conditions that could influence a living shoreline design. Not all of the variables below will be relevant to every site and project. Some can be assessed in a qualitative way visually or by consulting existing resources, some may require field measurements, and some may be important to consider at a later stage. This resource (page 16) – [Living Shorelines in New England: State of the Practice](#) - provides an explanation of some of the characteristics in Table 2A.

### 2.A. Site Characteristics to Select a Suitable Technique (some of this was considered prior to selecting site)

Attribute	Qualitative Observations
Existing environmental resources (e.g., habitats)	
Vegetation (description, shade, roots, etc.)	
Nearby sensitive resources	
Energy state (e.g., high, moderate, low)	
Tidal range	
Elevation of project site (relative to tidal range, e.g., above and/or below mean high water)	
Intertidal slope (e.g., flat, moderate, steep)	
Bathymetric slope (e.g., flat, moderate, steep)	
Signs of erosion	
Existence of scarp (location relative to tides, height, composition, vegetation, etc.)	
Traffic (evidence of wildlife, pet, or human impacts)	
Debris (wrack, trash, flotsam, partially buried)	

2.B. Potential Data Needs about Site

Variable	Specific Observations / Notes/Links to datasets
Topography	
Sediment/ soils	
Erosion rates	
Existing plant communities and elevation distribution	
Shoreline/marsh edge characteristics	
Wetland delineation	
Slopes and scarps to inform protection / fill / migration	
Local site materials appropriate for use	
Seaward fetch (length, direction, water depth)	
Wave climate	
Tides	
Property boundaries, easements, protections	
Archaeological resources	
Public site access (land and water)	
Utilities and buried infrastructure	

2.C. Objectives for Next Site Visits (Review plans with Dave and Tom)

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2.D. Additional Questions or Data Needs about Site Conditions

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### 3. Living Shoreline Design Concepts

**Guidance:** Refer to the resources provided about different living shoreline designs (such as the [NOAA Guidance](#), [New England Report](#) and [NH shoreline planting guide](#)) and, if needed, look for other examples relevant to your shoreline. Identify the categories of shoreline techniques that could be appropriate for your site and then brainstorm how the technique could be applied and other design concepts for your site. When you're ready, star the ideas that seem promising and make a note of remaining questions or information gaps.

**3.A. Types of Shoreline Techniques Relevant to your Site** (Indicate how each addresses site impairments and specify locations within site if needed.)

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**3.B. Design Concepts to Consider** (Brainstorm and then star ideas that seem promising for your site.)

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**3.C. Remaining Questions**

- 
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## 4. Evaluating and Refining Design Ideas

**Guidance:** As you refine your project ideas, be sure to consider the following additional factors and invite review from others outside your team. During the second workshop, we will discuss the first three topics below and there will be time to consult with project experts (e.g., Dave Burdick, Tom Ballestero, Kevin Lucey). Some teams may choose to share one or a couple draft design concepts with the landowner before developing final design documents. Use this space as a checklist to confirm you have considered each factor and make a note of key information learned.

Additional Considerations	Notes
Permitting concerns	
Construction constraints (e.g. access issues)	
Cost considerations	
Maintenance needs	
Consult with other experts	
Consult with landowner	
Performance monitoring needs	

## 5. 50% Design Elements

**Guidance:** For this project, 50% designs should include the rationale and details that would be useful to share with project stakeholders, confirm landowner support, and have a preliminary meeting with regulatory agencies. At the end of this initial planning phase, all layout decisions and big selections should be made. [Here](#) is a 50% design example from Wagon Hill Farm.

Once you have a design concept that works for your site, meets landowner’s goals, and protects and builds ecological functions, begin developing the 50% design documents. The table below lists the suggested elements to include with space for notes, e.g., people working on that piece, status, and/or next steps. This table can be modified to best support your team’s collaborative process.

Element to include	Notes (status, people involved and/or next steps)
Project drawings	
Suggested materials	
Suggested plant list	
Short narrative summary of concept and design justification	
Slides to present at final workshop	



## Frequently Asked Questions

This document provides answers to questions that have come up in relation to the Design Teams working on the Great Bay Living Shoreline Project. To learn more, visit the [project web page](#) or the team’s work space on Box.

### Categories of questions covered

- Programmatic Questions
- Design Questions
- Next Steps
- Permitting

### Programmatic Questions

**Q: Where are each of the Design Teams working?**

**A:** These are the four living shoreline design sites for this project. During the workshops, Design Team members will have a chance to learn more about the unique physical conditions, restoration goals, and design constraints of the sites. This [design team contact list](#) indicates who will be working on each site.

Site	Town	Notes	Coordinator
Moody Point	Newmarket, NH	This site is owned by a homeowner’s association and includes a diverse mix of habitats and shoreline uses, contributing to erosion.	Trevor Mattera
Spur Road	Dover, NH	This is a private home with eroding salt marsh shoreline along the Bellamy River.	Lynn Vaccaro
Schanda Park	Newmarket, NH	This is a public park with a boat ramp on the Lamprey River with some shoreline armoring that the town hopes to improve and soften.	Kirsten Howard/Lynn Vaccaro and Aidan Barry
Chapman’s Landing	Stratham, NH	This site is owned by NH Fish and Game and includes a boat launch on the Squamscott R. and valuable saltmarsh that is eroding.	Kirsten Howard/Chapman’s Landing and Aidan Barry

**Q: How were the four sites selected for this project?**

**A:** For the work of the Design Teams, we intentionally chose a diversity of project sites with different restoration goals (erosion management, habitat conservation, and public access/aesthetics) and that offered different design challenges (urban, natural, private, public).

Beginning in spring 2021, the project team has been working to select sites based on our project goals, best available data, field verification, and landowner interviews.

Key information used to inform the site selection included the [New Hampshire Living Shoreline Site Suitability Report](#) and [Maps and the New Hampshire Salt Marsh Plan](#). This data informed a desktop assessment that identified approximately 20 potentially suitable areas within the project study site, which was followed with field verification by boat and land to narrow down to 15 specific potential sites. Project team members reached out to the landowners of all 15 sites and conducted interviews with 7 of these landowners to better understand important factors such as landowner interest in participating and likelihood of proceeding with implementation, construction access feasibility, and other site goals and constraints. From these interviews and accounting for the original goal of site diversity, the project team narrowed down to four sites and secured landowner commitments to participate in the project.

## Design Questions

### **Q: What is the difference between a 50% and 100% design for a shoreline project?**

A: “50% Design” is a term used for a project design that is at a mid-point in the development process. Typically, a 50% design includes a well-thought-out plan for a particular location and set of objectives. The 50% design includes enough specifics - in terms of the site conditions/topography, suite of interventions proposed for a site, materials needed, and locations - that the project team can have a productive pre-permitting meeting with permitting agencies and confirm support from stakeholders. A 50% design may not include final specifications, materials, dimensions, or construction sequencing.

Here are a few examples from the Wagon Hill Farm living shoreline restoration project. These documents are provided as examples only to help clarify terms.

- An [example 10% Design](#) - This design concept includes the site's aerial image with topo lines and annotations about what actions could be taken at different locations.
- An [example 50 - 70% Design](#) - This package includes information about existing site conditions, a visual overview of the proposed design, and cross sections with suggested dimensions for the living shoreline, along with an explanation of how additional data could affect plans.
- An [example 100% Design](#) - This package, including engineering drawings, planting notes, tidal elevations, and proposed construction sequence, was used to secure permits and guide the construction team.

The project reference, [Timeline and Deliverables](#), provides guidance on what Design Teams are expected to develop as part of their 50% Designs.

### **Q: How should we incorporate the budget constraints our landowner has shared for the shoreline restoration?**

A: We want this design process to generate projects that can be implemented, so don't disregard the budget information provided by the landowner. However, we also don't want budget concerns to prematurely limit your creativity. Our suggestion is that you let your creative juices flow early in the planning process and let budget constraints enter the conversation after you have explored a few ideas for your site. There may be ways to leverage additional grant funds to support project implementation,

especially for public sites. It could be helpful to share a few different ideas with the landowner or offer suggestions for a phased implementation to make the project more feasible.

**Q: How might the living shoreline suitability modeling and GIS layer support our design work? (see: [Suitability Report](#) and Interactive [Mapping Tool](#))**

**A:** The living shoreline suitability model results were used to hone in on a set of candidate sites for this project. You may find it helpful to review the model output for your shoreline design site. The resolution may not be perfect for your design work, and scores may vary across your shoreline site. We suggest you dig into the data and explore how your site scored on the individual attributes used to evaluate that stretch of shoreline.

**Q: How should our design work incorporate sea level rise predictions?**

**A:** Sea level rise predictions for 2050 and perhaps for 2100 should be considered when designing your project. We suggest you review the [NH Coastal Flood Risk Summary, Part II: Guidance for Using Scientific Projections](#). Section E of the guidance includes a worksheet that walks you through a seven step process for using flood projections to plan projects. This is a process that will need to be applied for any shoreline project in NH. The specific guidance for a project depends on the project's sensitivity to inundation and the landowner's tolerance for flood risk as well as local sea level rise projections.

Design Teams should show the current and projected Mean Tide Line on cross sections (and consider including a projected MHHT on plan views) to help ensure that the design would be feasible at both current and projected levels. This can also help the landowner see how the site would look in the future with sea level rise.

In general, it is recommended that salt marsh plants should be installed at a higher elevation than they could survive for present day as well as they should not be installed lower than where they would not survive with 1.5-2ft SLR. For Wagon Hill, the sill elevation is approximately 1.7 ft higher than it needs to be for present day conditions – meaning plants could have been installed at lower elevations but weren't because SLR will likely drown them in the next 30-40 years. On the upland side, they made sure the land is properly graded to allow marsh migration over time.



**Q: What tidal water level data should be presented on the design concepts and how are they calculated? Why are these data important for living shoreline projects?**

**A:** The living shoreline project drawings should depict at a minimum three tidal water level elevations: Mean Tide Level (MTL), Mean High Water (MHW), and Mean Higher High Water (MHHW), please review [NOAA's tidal datum chart](#) for definitions as well as the forecasted sea-level rise above MHHW the project team has selected. Understanding a project site's inundation intensity via tidal elevation data will facilitate species selection for the living shoreline planting plan. Additional tidal elevations that may be required for permitting, though not required for your drawings, include but are not limited to Highest Observable Tide Line (HOTL), Mean Low Water (MLW) and Mean Lower Low Water (MLLW). All vertical elevation data should be referenced to North American Vertical Datum of 1988 (NAVD88).

Most teams collected water and air pressure data from September to November, and should use this timeframe to determine tidal elevations for their site.

To determine tidal elevation (relative pressure) for each data point:

- Relative pressure (psi) = Water Pressure (psi) – Air Pressure (psi)

To adjust the units to feet:

- Tidal Elevation (feet) = Relative Pressure (psi) x 144 ÷ 64

**Q: How should we incorporate the plant material and species into the design?**

**A:** Plants selected and proposed as part of the living shoreline design should match the environmental conditions of the site. We suggest the team initially observe which species are present around the site and assess their relative tolerance to salinity and disturbance. Once the team has an understanding of project site data (water level, sea level rise predictions, and salinity), the team should consult the [Planting Guide for Tidal Shoreline Erosion Management in New Hampshire](#). When the team proposes the elevations of selected plant species, current and future sea-level rise conditions should be considered.

## Design Memo Questions

**Q: The [guidance for the Design Memo](#) indicates we should identify “1-3 attributes that could be measured after implementation to determine how well the project is meeting its intended objectives.” Are there resources or additional guidance on how to identify these attributes?**

**A:** We suggest that all the Design Teams acknowledge in their memo that a living shoreline design may not develop and perform exactly as intended and regular monitoring and maintenance should be incorporated to enable adaptive management of the living shoreline. A monitoring plan is required for permit applications so we encourage Design Teams to provide a few suggestions to help a landowner in this process.

This comprehensive resource (which will be updated and publicly released soon) provides guidance for monitoring protocols for a range of living shoreline projects – [New England Living Shoreline Monitoring Metrics and Protocols Guide](#).

Design Teams should start by thinking about what attributes/metrics will indicate if the living shoreline is establishing properly. For example, was the project built to the intended specifications, is the shoreline remaining stable over time, and are plants surviving and growing as desired. These are

considered “performance metrics” and are foundational for any ecological outcomes. For some projects, there may be broader desired outcomes to monitor over time - using “outcome metrics” - that can help determine if a restored marsh is providing ecological benefits for wildlife or water quality or hazard reduction.

## Next Steps

**Q: What happens after this project end - will the program team construct the projects that are designed?**

**A:** There isn't any funding or a specific plan to implement these new living shoreline projects yet. The next steps will depend on how well the design process goes and interest among the landowners. Project partners, including the NH Coastal Program, are interested in supporting next steps and could help secure funding. In some cases, landowners may choose to move ahead with a project idea with their own resources.

**Q: What would it cost to get to a 100% design?**

**A:** This is hard to answer before we have a better sense of the project scope and size of the shoreline that will be included in the restoration work. We may be able to make some rough estimates after getting started in the design process. Permitting also typically has costs associated with it, so sometimes it's helpful to lump final design and permitting together, since typically the engineer doing the final design will also obtain appropriate permits for that design.

## Permitting

**Q: Will the 50% designs produced by teams be enough for permitting?**

**A:** No, but it will be enough to have a pre-permitting meeting with the NHDES Wetlands Bureau to get preliminary feedback and direction on a permit-able final design. 50% designs will lack important details about materials (stone size, etc.) and construction sequencing that will be needed for obtaining permits.

**Q: What is the permitting process for living shorelines like the ones that will be designed?**

**A:** This is something that we anticipate landowners will learn as part of their participation in the program. The permitting process will ultimately vary depending on the design concept itself. The project will definitely need a NHDES Wetlands Dredge and Fill permit which is also tied to an Army Corps permit approval. The project may also need local approvals and other federal approvals.

**Q: What are the rules around moving sediment from an adjacent waterway onto a shoreline restoration area?**

**A:** Typically, if sediment is added to living shoreline, it will come from a land-based source (fill) and be added to the eroding portion of the shoreline to build it out a bit. Permitting agencies generally will not favor plans to remove benthic/mudflat habitat from the river system to place on the landowner shoreline.

**Q: What should teams prepare to share with NHDES Wetlands Bureau during a pre-permitting meeting?**

**A:** The permitting process will vary depending on the site and design concept, therefore it is important to communicate proposed conditions clearly to NHDES Wetlands Bureau. This may be an iterative communicative process rather than a single pre-permitting meeting that will determine the tidal shoreline stabilization category and create a clearer permitting path trajectory. Depending on the project, a site walk may be the preferred strategy for a pre-permitting meeting. Please ensure the project complies with the [Tidal Shoreline Stabilization Rules and Regulations \(Env-Wt 609\)](#) and the [Coastal Vulnerability Assessment \(Env-Wt 603.05\)](#).

We suggest that the team provides several items to share with the Bureau prior to their meeting:

- A narrative/memo of existing conditions (causes and extent of erosion) and project design with sea-level rise projection included. Include potential funding sources if known. Photos can be helpful.
- Design concepts with water elevation data (including MLLW, MLW, MTL, MHW, MHHW, HOTEL, and predicted sea-level rise) presented on all plan sheets. A list of potential plants and other material to be added or pre-purposed for the project.

**Q: What are the dimensions for "minor" or "minimum" shoreline stabilization projects, including shoreline extent and how far into the water it would extend? Should we try to get design projects into the "minimum" category (which is the easiest permitting process)? What defines a "major" project?**

**A:** Please note that living shorelines are relatively new to the New Hampshire permitting realm, therefore teams should be really familiar with the existing regulations in order to make the case for which category their project fits under. You should refer to this DES permitting reference pdf, (Env-Wt 609.10 and 609.11), pages 31-32: <https://www.des.nh.gov/sites/g/files/ehbemt341/files/documents/env-wt600asof10-2020.pdf>.

Among other details, a **Minimum** project focuses on maintenance/repair of an existing bank stabilization/LS and is  $\leq 200$  Linear Feet with marsh restoration  $< 1$  acre and not extending more than 50 feet seaward of MLW. It needs to very clearly meet the definition of a living shoreline project. Stone can be part of the picture, so long as it meets the definition (it can't be a dominant part of the project and must be used with the purpose of protecting the marsh). You could also probably include repair of the seawall or conversion of the seawall to living shoreline and still meet minimum impact. If there were other pieces of the project that tackle different goals other than creating a living shoreline stabilization and/or repairing existing shoreline stabilization, like dock work to improve water access for example, then you'd likely get kicked into a higher permit category.

A stone sill shouldn't necessarily push a living shoreline to a minor project, but the project should make a case for why stone rather than a softer material. See the definition of a living shoreline: Env-Wt 602.30 "Living shoreline sill" means a low-elevation structure that is constructed parallel to the existing shoreline with the primary purpose of stabilizing the toe of a tidal marsh or coastal bank and which protects fringe marshes or banks that require a higher degree of stabilization at the seaward edge. Sills can be made of soft structural materials such as geotextiles or biologs made from coir fiber, or hard structural materials such as shell, wood, or stone. Private or public ownership shouldn't affect the category of permit.

A **Major** involves installing a hardened structure/armoring and is located in dunes, tidal wetlands, bogs that are within 100 ft of HOTL.

And a **Minor** project involves installing hardened structure but doesn't meet all of the criteria of either minimum or major projects.

**Q: Are there other documents that would be required for permitting that are not part of the GBLS Project?**

**A:** The short answer is yes. Env-Wt 609.11a states that a minimum, "A shoreline stabilization project shall require a standard permit" ([see standard wetland permit application](#); which would also require [the coastal resource worksheet](#)).

Site specific details and records may be required as part of the permitting process. These documents may include the Natural Heritage Bureau [DataCheck Tool](#) response letter and a Section 106 National Historic Preservation Act (NHPA) archaeological investigation. Information from these records may impact proposed designs.

NHB requests were submitted on each GBLS team's behalf. The request requires:

- Applicant and landowner information as well as landowner consent
- A map of the area may be mailed to NHB for a fee or the NHB DataCheck Tool allows the applicant to upload GIS point files.
- If there are no NHB species or communities within the project area, then an electronic letter stating such will be generated to the applicant at no cost.
- If there are NHB species or communities within the proximity of the project area, the applicant will be notified. To then obtain a formal letter determining which NHB records are within proximity of the project, the applicant must send NHB a check. The applicant will then receive a formal electronic response approximately 2-4 weeks after the check is received. Further discussions with NHB may be required depending on the details of the project.

# THE GREAT BAY LIVING SHORELINE PROJECT



## Resources & References Used to Guide Great Bay Living Shoreline Design Work

Below is a list of relevant resources for understanding and developing living shorelines in New Hampshire and beyond. These resources aided each of the Great Bay Living Shoreline Design Teams as they developed their suggested living shorelines. Target audiences vary among the documents from design professionals, ecologists, regulators, and curious landowners and stakeholders.

### NEW HAMPSHIRE LIVING SHORELINE RESOURCES

#### [An Ecological Approach to Designing Salt Marshes \(2022\)](#)

A technical report produced by the Great Bay Estuarine Research Reserve combines high resolution Coastal Change Analysis Program (C-CAP) tidal habitat data with high resolution light detection and ranging (Lidar) data to assess marsh health and resilience. The combination of the two datasets identify elevation ranges of plant species and ecotones within Great Bay Estuary.

#### [Living Shorelines in New England: State of the Practice Report \(2017\)](#)

In this document, the Coastal Zone Management Agencies of the five New England coastal states and the Northeast Regional Ocean Council (NROC) partnered with The Nature Conservancy under a grant from the National Oceanic and Atmospheric Administration (NOAA) to conduct an assessment of the State of The Practice on Living Shorelines and provide considerations for their application along the coast of New England. [Their website provides supplemental information and site profiles.](#)

#### [Living Shoreline Initiatives](#)

This webpage maintained by the New Hampshire Department of Environmental Services (NHDES) includes information about living shorelines, regional projects, and related programs.

#### [New Hampshire Living Shoreline Site Assessment Mapping Tool \(2019\)](#)

A companion to the L3SA, this mapping tool allows users to explore the suitability of New Hampshire's entire tidal coastline for living shorelines projects.



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## [New Hampshire Living Shoreline Site Suitability Assessment \(2019\)](#)

The goal of the New Hampshire living shoreline site suitability assessment (L3SA) is to identify sites (at the finest resolution possible given data availability) that may be suitable for specific living shoreline approaches in order to address erosion issues along the New Hampshire tidal shoreline.

## [New Hampshire Coastal Flood Risk Summary: Guidance for Using Scientific Projections \(2020\)](#)

Developed by the NH Coastal Flood Risk Science and Technical Advisory Panel, this document provides guiding principles for incorporating updated coastal flood risk projections into engineering projects, including living shorelines.

## [NHDES Coastal Lands/Tidal Waters Wetlands Rules \(2019\)](#)

Legal requirements for resource analysis, resource management, site alteration, and design and construction of structures in tidal waters and wetlands, in order to preserve the productive and protective functions of this resource area and prevent unreasonable encroachment on surface waters of the state. Chapter 600 describes [Coastal Lands and Tidal Waters/Wetlands](#) and living shoreline regulations are in Section 609 Tidal Shoreline Stabilization.

## [Tidal Erosion Planting Guide](#)

This resource provides information regarding shoreline environmental zones as well as tidal plant species and their preferred habitat conditions including approximate elevation in the shoreline zone, soil conditions, light conditions, and salt tolerance.

## [Wagon Hill Farm Living Shoreline Case Study \(2019\)](#)

The page includes a field trip video, final design plans, permits, and other useful tidbits about the living shoreline project at Wagon Hill Farm in Durham, NH.

## **NATIONAL LIVING SHORELINE RESOURCES**

### [Coastal Adaptation Strategies Handbook \(2015\)](#)

This National Parks Service handbook is a comprehensive report on the NPS's understanding of coastal adaptations as it pertains to its parks. The handbook identifies tools and strategies as well as provides examples of approaches that NPS and other parks have used to address coastal vulnerabilities.



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## [International Guidelines on Natural and Nature-Based Features for Flood Risk Management NNBF \(2021\)](#)

Flood risk management is a challenge worldwide, not just in the northeastern United States. The purpose of this document is to promote the technical advancement of nature-based solutions that increase coastal resilience and assist coastal habitats.

## [Living Shorelines Academy](#)

This website is rich in resources, from guides to primary literature. The Mission of the Academy is to: 1) Increase the abundance of coastal wetlands; 2) Advance the policy, science, and practice of living shorelines; 3) Enhance collaboration among governmental and private stakeholders. By working towards these goals, the Academy aims to reduce the degradation of coastal wetlands fringing shorelines and fish habitat that surrounds our nation's estuaries – one of our nation's most valuable ecological and economic resources.

## [Living Shorelines Engineering Guidelines \(2016\)](#)

This report targets design professionals, state regulators, and property owners within the state of New Jersey with the goal of providing parameters critical to the success of living shoreline projects.

## [Living Shorelines in New England: Site Characterization and Performance Monitoring Guidance \(2022\)](#)

This document was developed to promote standardization of data collection and performance assessment of living shorelines throughout New England. The two primary goals for this document are 1) to compare before and after living shoreline implementation to assess success or failure of projects and 2) to advance regional knowledge about the practice of living shorelines through various case studies and lessons learned which will inform design, permitting and construction, and monitoring and maintenance practices.

## [NOAA Guidance for Considering the Use of Living Shorelines \(2015\)](#)

This publication was developed in an agency-wide effort to clarify NOAA's encouragement for the use of living shorelines as a shoreline stabilization technique along sheltered coasts. Important components of the guidance include what to consider when selecting appropriate techniques (e.g., vegetation, edging, sills, vegetated breakwaters) to balance shoreline stabilization and coastal and marine resource conservation, and how to navigate NOAA's potential regulatory (consultation and permitting) and programmatic roles in living shorelines project planning.



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## [Research to Inform Living Shoreline Design, Placement, and Monitoring \(2019\)](#)

This report from a panel webinar hosted by the National Estuarine Research Reserve System (NERRS) Science Collaborative discusses lessons learned and next steps, opportunities, and needs for living shorelines management and research. Panelists included members of the NERRS and partners who have been studying how different living shoreline designs perform in a variety of coastal locations from the Alabama Gulf Coast to New York, and have been developing tools to enhance the use of these techniques.

## [Tidal Wetlands Guidance Document \(2017\)](#)

The state of New York developed this guidance document to promote living shoreline designs with a target audience of state regulators, design professionals, and property owners.





