A Community Resource Guide for Planning Living Shorelines Projects

New Jersey Resilient Coastlines Initiative

Ver 1 (March 2016)

Connecting Your Community to Living Shorelines

The Community Resource Guide provides community leaders, citizens, and contractors with guidance on key factors that should be considered when embarking on a living shoreline project and links to additional resources that could be consulted during the planning process. This guide is best used as a companion to The Nature Conservancy's Coastal Resilience Tool and the **Restoration Explorer**, an associated web-based application that allows users to visualize which living shoreline techniques are most appropriate for reducing erosion in a particular area of New Jersey's coastline.

Installing an oyster castle breakwater in the Delaware Bay. © The Nature Conservancy

Important: *Living shoreline projects have a variety of ecological and engineering requirements that can often be combined to tailor project designs to local conditions. It is important to consult with ecologists and engineers to determine the specific design requirements for any proposed project. It is also important to consult with federal, state and local officials regarding permitting requirements. Resources are listed throughout this guide. In addition, the Restoration Explorer application is not intended to provide rigid recommendations but rather to support initial collaborative discussions about implementing a living shoreline project.*

This guide provides summary information and additional resources on the benefits of incorporating living shorelines into community planning processes and key steps in identifying, planning and implementing living shorelines in your community. Topics covered include:

- Information on role and benefits of living shorelines
- How to incorporate living shorelines and other nature-based solutions into community planning efforts
- Tools for selecting living shoreline techniques
- Steps in planning and constructing living shoreline projects
- Major project costs and potential funding sources
- Permitting considerations
- Importance of project monitoring
- Additional partner resources

The Community Resource Guide was developed as part of the New Jersey Resilient Coastlines Initiative, a network of conservation, academic, state and federal partners supported by funding from the National Oceanic and Atmospheric Administration. The goal of the Initiative is to facilitate the use of living shorelines by communities when responding to coastal hazards. For information on the Initiative or living shorelines in general, contact Patty Doerr, The Nature Conservancy's Director of Coastal and Marine Programs, at pdoerr@tnc.org or any of the organizations listed on page 14.

Seeding oyster bags in the Delaware Bay. © American Littoral Society

Cover Caption: Installing an bio-log living shoreline in the Delaware Bay.© The Nature Conservancy

What are Living Shorelines?

Living shorelines are a nature-based solution to shoreline erosion and, when appropriately designed, to nuisance tidal flooding. They are defined by the State of New Jersey as a shoreline management practice that addresses the loss of vegetated shorelines and beaches by providing for the protection, restoration or enhancement of these habitats. This is accomplished through the strategic placement of plants, stone, sand or other living and non-living materials.

Categories of Living Shorelines:

- *Natural living shorelines* are typically used in lower energy environments. They include native vegetation (e.g., marsh grasses and seagrass), clean sediment and biodegradable organic materials (e.g., logs made from coconut fiber).
- *Hybrid living shorelines* are typically used in lower to moderate energy environments. They incorporate native vegetation, clean sediment, biodegradable organic materials, and low-profile rock structures such as segmented sills, stone containment, and concrete breakwaters (e.g., oyster castles and reef balls) which can be seeded with native shellfish.
- *Structural living shorelines,* typically used in higher energy environments, include revetments, breakwaters and groins. Although they have fewer ecological benefits, they allow for a natural connection between land and water to be maintained and, when used in conjunction with other techniques (e.g., natural living shorelines or planting vegetation), the ecological benefits can be increased.

The Restoration Explorer, an on-line tool discussed further on page 4, currently provides information on the applicability of six specific living shoreline techniques (graphics can be found on pages 5 and 6):

- Nature-Based Living Shoreline
- Beach Restoration
- Marsh Sill
- Living Reef Breakwater
- Breakwater
- Ecologically-Enhanced Revetment

Kayaking the back bays of Cape May County © The Nature Conservancy

Birdwatchers on the Delaware Bayshores © Haley Jorden

How Do Living Shorelines Benefit Communities?

Living shorelines simulate natural coastal processes, such as the collection of mud, sand and nutrients, which results in regrowth of vegetation. They are just one way to maintain the health and characteristics of New Jersey's coastal habitats, which are key to improving water quality, providing opportunities for recreational activities (e.g., kayaking, sport fishing, bird watching) and supporting key commercial and recreational fish species — among other benefits.

While traditional armoring approaches to address erosion problems (e.g., bulkheads) can be effective in the appropriate locations, they also reflect wave energy and in some cases result in erosional threats to neighboring coastal areas and to the upland shoreline directly in front of and behind the structure. In contrast, creating a healthier, more natural transition where land meets open water can help to absorb wave energy (rather than reflect it) while maintaining the multiple benefits of healthy coastal habitats.

Incorporating Nature-Based Solutions into Community Planning Efforts

Coastal adaptation planning efforts focused on improving both the civic and environmental health of coastal communities can improve a community's ability to respond to coastal hazards like erosion, flooding and sea level rise. There are multiple opportunities to employ nature-based coastal protection measures like living shorelines to reduce the impacts of coastal hazards that also improve the health and resilience of surrounding coastal habitats. Nature-based solutions can directly benefit communities in a number of ways. For example, healthy marshes and shorelines absorb wave energy, which in turn can reduce impacts of coastal flooding during storms and high tides. Other economic and social benefits of healthy, resilient coastlines include:

- Improved water quality from rainwater run-off from pavements being filtered through marshes and living shorelines;
- Healthy, critical nursery habitat for important commercial and recreational fisheries, which provides a positive impact on local employment; and
- Increase ecotourism revenue to local businesses from birders, recreational fishers, kayakers, wildlife photographers, etc.

Decision-Support Tools

There are a variety of on-line tools and documents to help inform community planning processes and identification of potential actions or projects. To support the planning of living shorelines, The Nature Conservancy's Coastal Resilience Tool (CR Tool) provides decision-makers with the best available information to inform their choices on actions that best reduce the risk to habitats, communities, businesses and critical infrastructure. It includes several web-based applications that help communities and their partners implement four different phases of climate adaption planning (Figure 1):

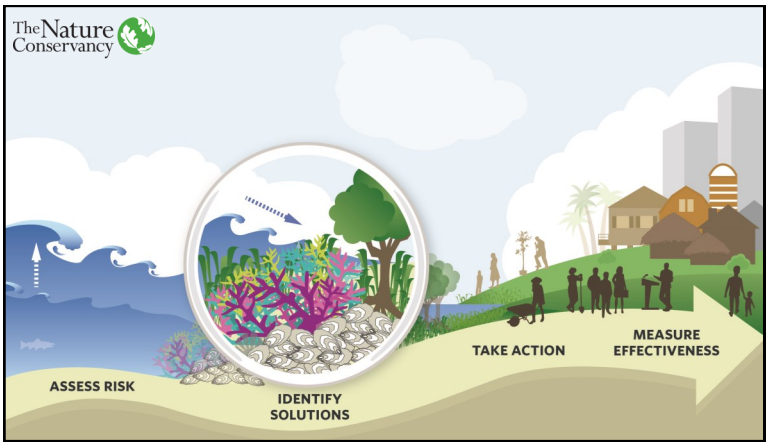


Figure 1. Coastal Resilience approach - www.coastalresilience.org

1. **Assess Risks and Vulnerabilities** to coastal hazards, including current and future storm and sea level rise scenarios,
2. **Identify Solutions** for reducing risk across our natural and human systems,
3. **Take Action** to help communities develop and implement nature-based solutions where appropriate and
4. **Measure Effectiveness** to ensure that our efforts to reduce risk from coastal hazards through restoration and adaptation are successful.

For more guidance on planning living shoreline projects, NOAA's Guidance for Considering Living Shorelines 2015 outlines twelve guiding questions and answers for communities to consider when planning to install living shorelines and the Partnership for the Delaware Estuary developed a Living Shoreline Best Practices Handbook based on their work in the Delaware Estuary to install nature-based living shorelines across the estuary. Getting to Resilience, an on-line self-assessment process, assists communities to reduce vulnerability and increase preparedness by linking planning, mitigation, and adaptation. Through this assessment municipalities will also discover how resilience actions and preparedness can be worth valuable points through the Federal Emergency Management Agency's Community Rating System and Sustainable Jersey.

USING THE COASTAL RESILIENCE TOOL

The Coastal Resilience Tool (CR Tool) is a web-based service that includes resources and information on improving the ability of coastal communities to adapt to and withstand coastal hazards. Specifically, it provides local decision makers and stakeholders with regional and local data, summaries and visualizations via the following applications (see figure 2):

- **Map Layers** includes the location of key infrastructure and facilities, habitat types and current shoreline conditions;
- **Flood and Sea Level Rise Viewer** displays current and possible future water levels under multiple sea level rise and storm surge scenarios;
- **Restoration Explorer** allows users to visualize what living shoreline techniques are most appropriate for a particular location;
- **Future Habitat** shows which salt marshes are most likely to convert to open water or mud flats and/or most able to advance inland under multiple sea level rise scenarios; and
- **Risk Explorer** informs users about the areas of coastline most at risk to sea level rise and where coastal habitats have the most risk-reduction benefit.

Each application is launched by clicking on the icons on the left-hand side of the screen. The data included within Map Layers can be shown in conjunction with the other applications. A series of videos tutorials for each application has been developed to inform interested users.

Identifying Living Shorelines via the Restoration Explorer

Those interested in embarking on living shoreline projects can utilize the Restoration Explorer (RE). The RE has multiple mapping views and the "Split Screen" option makes it possible for users to examine the information on coastal risks alongside potential living shoreline techniques. A step-by-step user guide for the Restoration Explorer is available online.

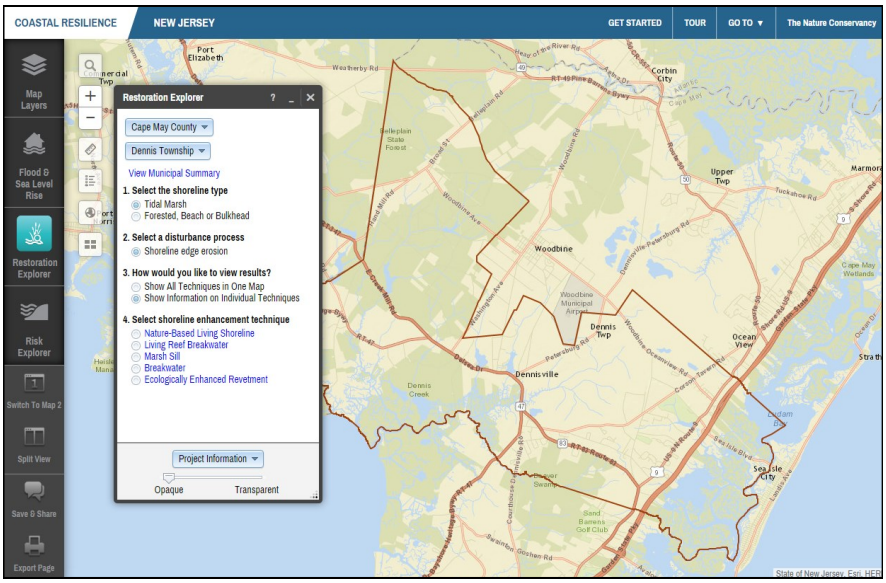


Figure 2. New Jersey's page on the CR Tool, with the Restoration Explorer application launched. (maps.coastalresilience.org/newjersey)

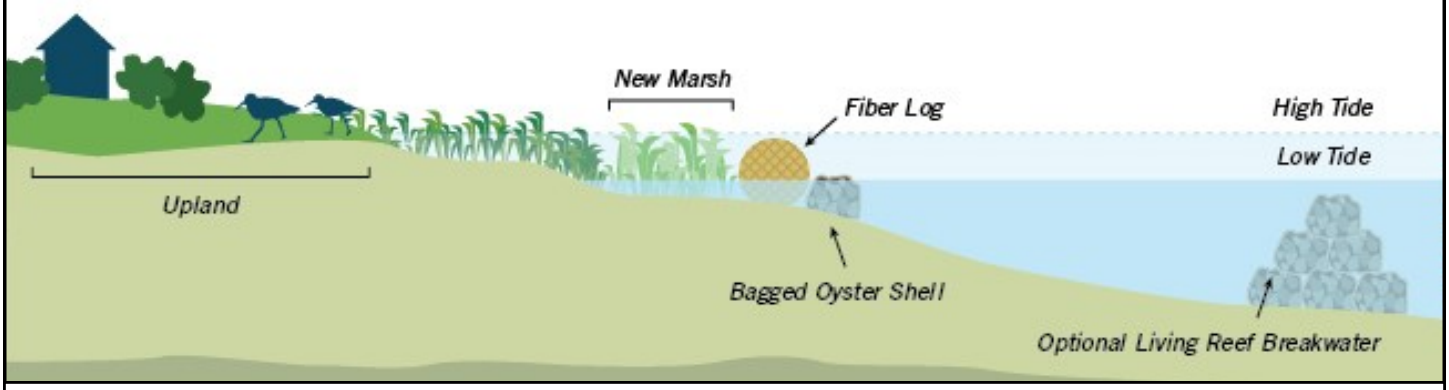
When using the RE, the user is provided with summary information on which living shoreline techniques (see pages 5 and 6) are applicable for a particular area of coastline. Via a decision-tree, the user can choose to view the applicability of all techniques on one map *or* choose to view more detailed information on individual techniques. If the viewer chooses to view all of the techniques on one map, s/he will be able to zoom in and select a square representing a 10 meter length of shoreline. By selecting a square, a pop-up box will be displayed that highlights whether or not each technique is appropriate within the selected area.

If the user chooses to view more detailed information on each technique's applicability at a particular location, s/he can click on each of the environmental conditions to view detailed information on how each of the conditions determines if a technique is applicable. *The data provided by the RE is high-level, so it is important to consult with engineers and ecologists when developing a project. Stevens Institute of Technology has created engineering guidelines that can help to inform the planning and design process*.

Techniques Included in the Restoration Explorer

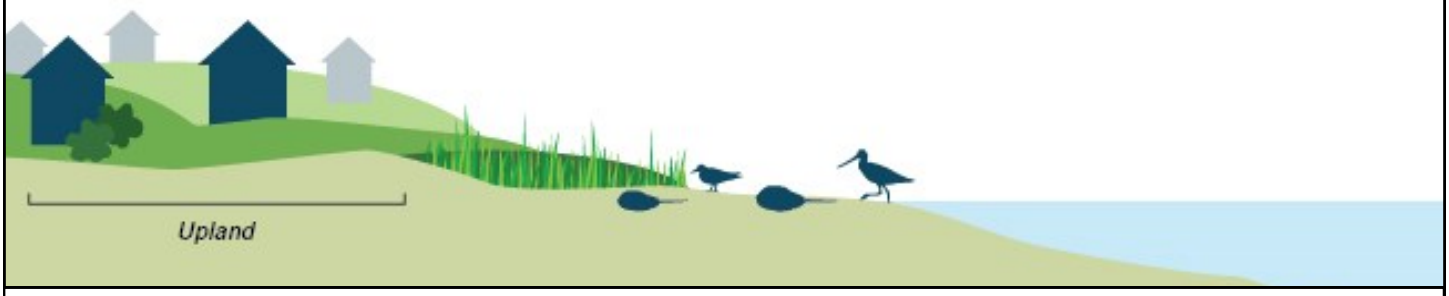
Nature-Based Living Shoreline

Nature-based living shorelines are best in low-energy areas. "Biological enhancements," like biodegradable fiber logs (which also provide habitat for ribbed mussels) or Christmas trees, are placed along the tidal marsh edge to provide a contained area for sediment to accumulate and marsh vegetation to grow. In more moderate energy areas, it might be possible to use a hybrid approach that pairs nature-based living shorelines with living reef breakwaters.



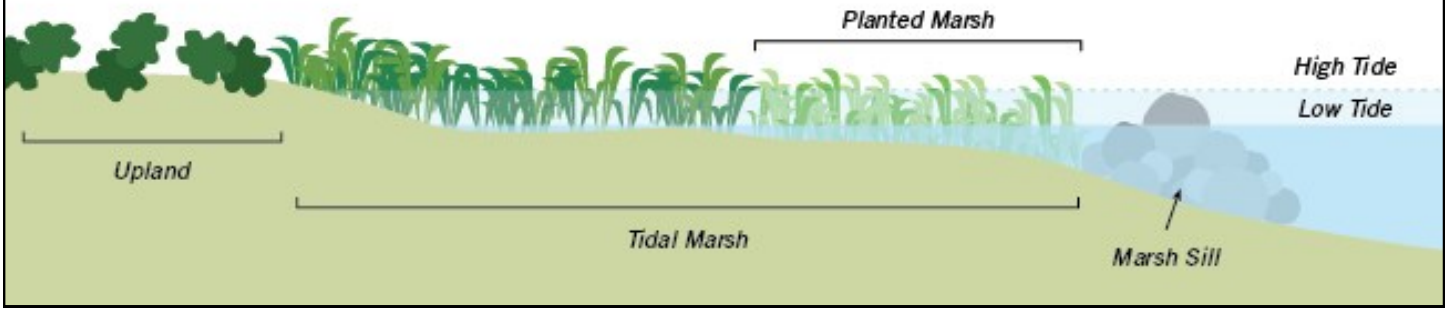
Beach Restoration

Restoring beaches requires placing additional sand along a shoreline to help maintain habitat for key species—like horseshoe crabs, red knots and piping plovers—that use sandy beaches for spawning or feeding. The natural sloping beach allows waves to break across the sand, minimizing erosion of the shoreline edge.



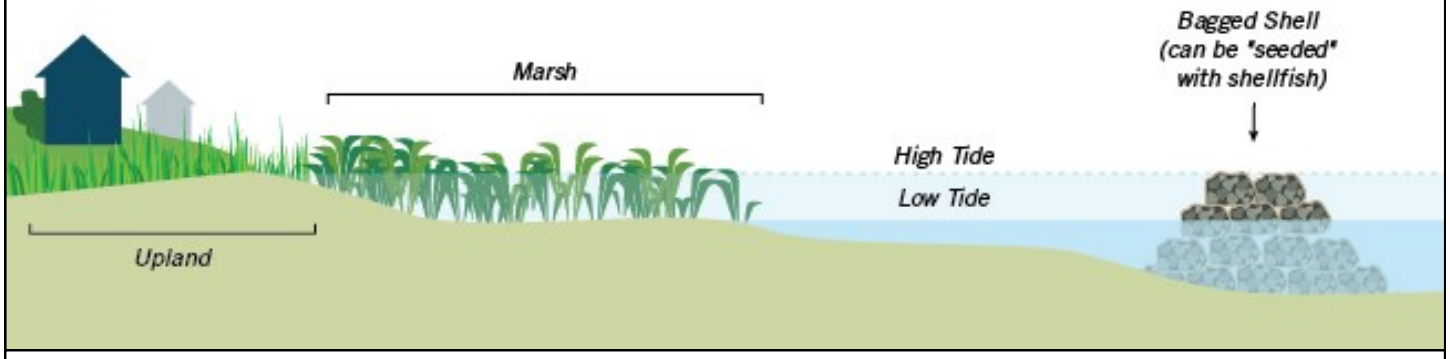
Marsh Sill

Marsh sills are low elevation structures (e.g., rocks or bagged oyster shell) that run parallel to the shoreline and are below water at high tide. The area between the sill and the marsh is often filled and planted with marsh vegetation to speed up shoreline stabilization.



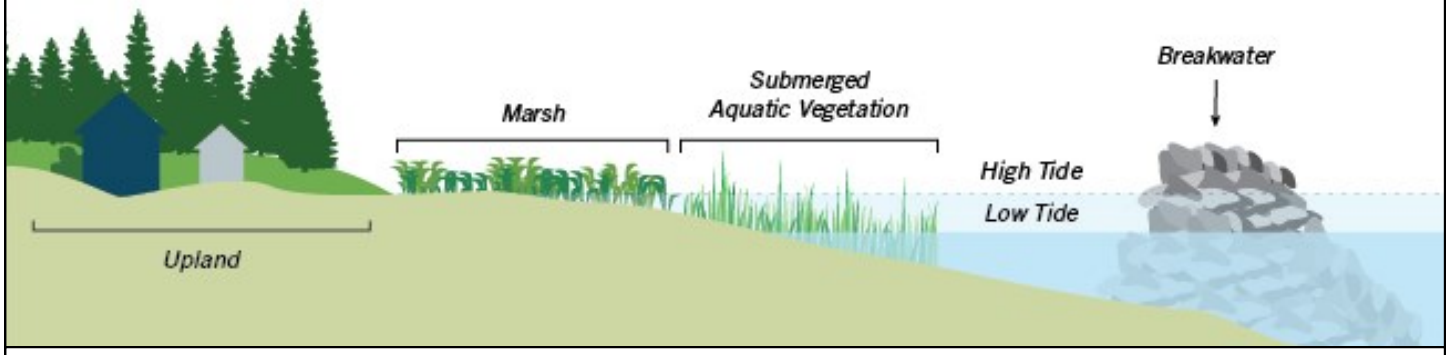
Living Reef Breakwaters

Living reef breakwaters function similarly to constructed breakwaters, but are built to provide habitat for baby oysters, mussels and other reef species to settle upon. Reef balls, oyster castles, bagged shell and other reef structures provide a durable and heavily-weighted substrate. Over time, large reef structures can form that not only serve as a natural breakwater, but also provide critical aquatic habitat.



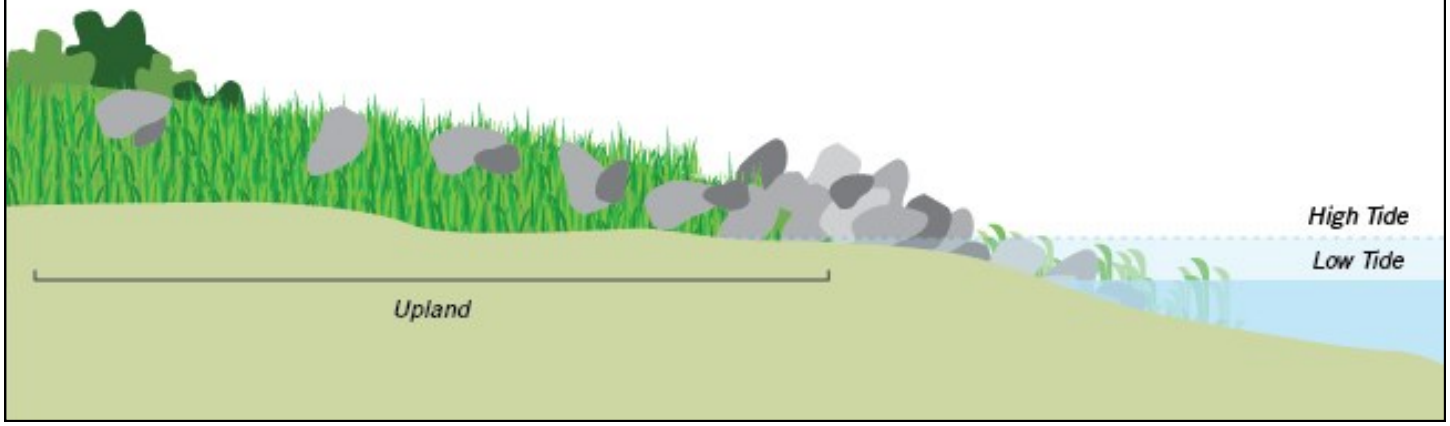
Breakwater

Breakwaters are typically constructed parallel to the shoreline and designed to reduce the amount of wave energy experienced by the shoreline directly behind them. Sometimes a vegetated (typically marsh) shoreline is established behind the breakwater. Unlike marsh sills, they are typically constructed in deeper water with more energetic waves. They also tend to be slightly larger and are typically visible at high tide.



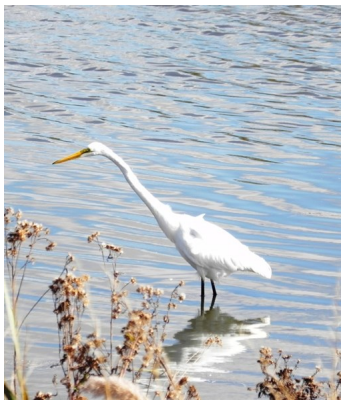
Ecologically Enhanced Revetment

Ecologically-enhanced revetments are porous, vegetated structures attached to the shore. They are typically constructed from rock or broken up concrete, although other materials can be used (e.g., gabion baskets, rubble/debris, and even felled trees). They can be used at both open coastal locations and on lower energy sheltered areas.



Planning and Constructing a Living Shoreline Project

Local conservation organizations, like those listed at the end of the guide, can be helpful advisors to municipalities that are interested in pursuing a living shoreline project. It's most useful to consult with local conservation groups, the landowner and permitting officials early in the planning process to ensure the highest likelihood of success. While the Restoration Explorer provides information that informs the planning process, it is just the first step of the process. **An effective planning process should include the steps below**. These are not necessarily in order, but each is important to address at some point in the planning process. More information is also available in the Partnership for the Delaware Estuary's Living Shoreline Best Practices Handbook.



Engage property owner. Property owners should be included in the planning and implementation of a living shoreline project from the outset to both minimize conflict and maximize project success.

Set project goals. Goal setting should take priority in the planning process, as it informs project design and monitoring. Determine what the project seeks to achieve (e.g., reduce erosion, reduce tidal flooding, etc.) and note the existing environmental conditions.

Determine a timeline. Understanding time constraints for permitting and construction will heavily determine the timing of the funding, design, permitting, construction and monitoring. Be sure to note all fixed dates for funding applications and consult with state and federal wildlife management agencies about the best time of year start a project to avoid disrupting migratory birds and fish.

Identify project partners. Project partners can assist with design, implementation, monitoring and maintenance of the project site. This can include conservation groups as well as community organizations interested in volunteering time and resources to the project.

Determine permitting requirements. Consult with municipal, state and federal officials to discuss project feasibility and permitting requirements. It is highly recommended to engage the NJDEP Coastal Land Use Office and the U.S. Army Corps of Engineers during the early planning stages of the project.

Develop your project budget and potential funding sources. Budgets for living shoreline projects can vary greatly depending on size and scope. Contact funding sources to determine the most applicable possibilities, timelines for proposal submission, and how the timelines of a funding source match up with your project timeline.

Determine site conditions and develop project design. Work with engineers and marine contractors to gather information on the project site and develop specific project designs. The RE data should only be used as a screening tool. Collecting site specific information is critical to engineering and design.

Develop a monitoring plan. Guidance on developing a monitoring plan can be found on page 13 and in "A Framework for Developing Monitoring Plans for Coastal Wetland Restoration and Living Shoreline Projects in New Jersey," which can be found online in March 2016.

Plan for project construction. Contact marine contractors to determine a construction schedule, access to materials, and pricing. Also, conduct site visits during preparation stages to monitor conditions. In preparation for the installation of the project, work with local conservation organizations to best coordinate volunteers, the construction schedule, preliminary site work, tools, access to the site and to galvanize media attention.

PROJECT COSTS & CONSIDERATIONS

The cost of a living shoreline project will vary based on size, location and complexity. The ***average*** cost data included in the table below are sample estimates for the ***materials*** of living shorelines (adapted from Seachange Consulting, 2011, Rella, A., & Miller, J. Ph.D., 2012, and Hafner, S., 2012). The cost information is presented to show how costs for one technique might compare relative to another and, therefore, should only be used as a guide. Additional research will be necessary to craft a full project budget. Additional factors to be included in a project budget (sample on page 10) are:

- Engineering and design of project*;
- Labor associated with the construction of the living shoreline;
- Shipping of materials;
- Accessibility and procurement of bagged shell, oyster castle material and stone;
- Annual or bi-annual project monitoring and maintenance (e.g., additional vegetation plantings, removal of debris at the project site, possible repositioning of structural project components)

* For reference, estimated costs for the engineering design work associated with a *nature-based living shoreline* that encompasses approximately 300 linear feet can range from $5,000-$30,000. The design cost is also heavily dependent on the amount of site specific information provided to the engineering firm, and the complexity of the proposed project. *Please consult engineering and design firms for more accurate estimates.*

Technique	Estimated Cost of Materials	Additional Benefits and Factors to Consider
Nature-Based Living Shoreline	**Coir Log (coconut fiber)** 12" X 10' $100.00—$150.00 per log	This is the most natural shoreline restoration option and it is only applicable in low energy areas. Additional factors to consider include accessibility of oyster and/or clam shell (price of shell bags does not include cost of shell), and the procurement of a bio-log. Please note, that if using bagged shell as part of the design, the state of New Jersey does not currently allow oysters to be "planted" in waters closed to shellfish harvest. More information on cost and construction of nature-based living shorelines can be found in the Partnership for the Delaware Estuary's Practitioner's Guide.
Beach Restoration	**Sand Replenishment** $7.00-17.50 per cubic yard	Depending on the location, beach restorations can also provide habitat for shorebirds and other key species that also provide ecotourism opportunities (e.g., Red Knots and horseshoe crabs). Factors to consider include slope of the beach, wave energy, storm frequency, beach density (volume/unit length) and granular fill, access to and transportation of material and labor.
Marsh Sill	$75.00-$150.00 per linear ft.	Marsh sills are more appropriate in low and moderate energy environments. Although marsh sills are able to function in a wide array of energy environments, it's important to consider site specific conditions. In addition, the cost of shell bags do not include the cost of the clam or oyster shell, which can be donated by local restaurants or purchased.

Technique	Estimated Cost of Materials	Additional Benefits and Factors to Consider
Living Reef Breakwater	$100.00-$150.00 per linear ft.	Breakwaters attenuate more energetic waves further off of the shore, ultimately reducing shoreline edge erosion. If living reef breakwaters are designed to promote oyster habitat, the development of three-dimensional reef habitat can improve water quality and support important fish species. Decisions to use bagged-shell, oyster castles, rock or marl need to take into account the need to stabilize the structures, as well as the ability of the substrate (i.e., the ground the breakwater will be sitting on) to withstand the weight of the structures. In addition, the cost of shell bags do not include the cost of the clam or oyster shell, which can be donated by local restaurants or purchased. In addition, the state of New Jersey does not currently allow oysters to be "planted" in waters closed to shellfish harvest.**
Breakwater	$90.00-$150.00 per linear ft.	Implementation of rock breakwaters in higher energy wave environments requires a scrutiny of the lower soil substrate conditions (i.e., what type of ground will the breakwater be sitting on). Breakwaters will reduce wave energy but careful attention should be placed on monitoring bottom scour, which can result in negative unforeseen consequences affecting neighboring coastal areas.**
Ecologically Enhanced Revetment	$90.00-$150.00 per linear ft.	Although ecologically enhanced revetments can be used in a wide range of energy environments, this technique lacks inherent environmental benefits associated with lower impact living shoreline projects. In addition, this technique stabilizes shorelines but lacks a component of sediment accretion. Therefore, it should mostly be considered in high energy environments and/or areas where other techniques will not work.
Bulkhead	$80-$1,200 per linear ft.	Bulkheads are considered a hard armoring traditional approach. Wave energy is reflected and not absorbed, which can result in bottom scour and loss of vegetation. The natural shoreline is eliminated, resulting in a loss of upland and shallow water habitat.

***For both Living Reef Breakwaters and Breakwaters, it is especially important to investigate permitting and licensing requirements early in the process. The U.S. Army Corps of Engineers have additional requirements given that breakwaters tend to be further offshore and the New Jersey's Bureau of Tidelands will require a license if installing in a Tidelands area.*

Budget Template

The budget categories in the budget template (Figure 3) are presented to show the range of costs associated with a living shoreline project. The materials listed are specific to a nature-based living shoreline that uses a combination of bio-logs and bagged shell. Please refer to the costs table on pages 8 and 9 for key materials associated with different living shoreline techniques and consult with engineers and ecologists to determine any other categories that should be included in a budget.

Creative partnerships with conservation and community groups can help reduce some costs. For example, it can save time and resources to contract with a conservation group to monitor projects and engaging community groups can both provide volunteer time for installation and maintenance (depending on the complexity and accessibility of the project).

Nature-Based Living Shoreline Budget	
Materials	
Bio-log (coconut fiber) Coir Log - 12' x 12' - 60lbs	$ -
Estimated total number of bio-logs required (12)	
Coir Mats 6.6' X 165' (est. quantity: 3)	$ -
Oyster Shell Bags (est. quantity: 600)	$ -
Vegetation for Replanting	$ -
Stakes for placement (est. quantity: 600)	$ -
Tools (Wheel Barrels, hammers, etc.)	$ -
Materials Total	**$ -**
Additional Costs	
Engineering Surveys and Design Contracts.	$ -
Permit Application and License Fees.	$ -
Site Assessment & Baseline Monitoring. Labor and materials	$ -
	$ -
Transportation of Material. Rental of truck, boat or barge	$ -
Installation. Labor and materials for site preparation, installation of nature-based living shoreline, planting, and site-clean-up	$ -
Monitoring. Labor and materials.	$ -
Post-Construction Site Assessment. Labor and any materials to replant vegetation and/or replace bio-logs.	$ -
Annual maintenance. Any materials to repair from damages to the project site.	$ -
Additional Total	**$ -**
Total Project Costs	**$ -**

SAMPLE

Figure 3. Sample project budget template.

Great Egg Harbor River © The Nature Conservancy

POTENTIAL FUNDING SOURCES

Although project funding cannot be guaranteed, resources are available for communities to explore. Additional information, as well as the hyperlink to the particular funding source, is included below.

NOAA Regional Coastal Resilience Grants Program. The NOAA Regional Coastal Resilience Grants Program helps communities increase preparedness and improve coastal resiliency measures. This program is applicable to nonprofit organizations, higher education institutions, regional organizations, private entities and local, State and tribal governments that work toward resiliency strategies for land and ocean use, disaster preparedness, environmental restoration and hazard mitigation projects benefiting coastal communities. Awards range from $500,000 to $1 million for projects lasting up to 36 months.

U.S. Department of the Interior's Fish and Wildlife Service (USFWS), Coastal Program. The USFWS's Coastal Program utilizes tax revenue from hunting, boating, and fishing in order to reinvest in conservation and coastal wetland ecosystems. A primary goal of the program is centered on seeking to help mitigate flooding and increase water quality. Most recently this program has helped to provide $21 million dollars in grant funding in order to help improve more than 11,000 acres.

U.S. Environmental Protection Agency (EPA) Urban Waters Small Grants Program. The Urban Waters Small Grants program addresses urban runoff pollution to best serve community health benefits, with importance on underserved communities and award amounts of up to $60,000. The proposed project must take place entirely within one of the Eligible Geographic Areas. This program helps to influence how healthy and accessible urban waters can help to grow local businesses and enhance educational, recreational and social and employment opportunities.

New Jersey Department of Environmental Protection (NJDEP) - Shore Protection Grants and Loans Program. In an effort to protect existing development from sea level rise, this NJDEP funding opportunity offers a cost share program whereby 25% of the cost is municipally funded and 75% of the cost is State funded. Loans are available from the State for the 25% of the cost owed by the municipality. For additional questions regarding qualification for this program contact the NJDEP-Office of Engineering and Construction.

New Jersey Corporate Wetlands Restoration Partnership. The New Jersey Corporate Wetlands Restoration Project (NJCWRP) is a public-private partnership that works to help fund a multitude of restoration work including living shorelines. The project must be located in New Jersey, have a Federal partner and meet a request for funding generally below $25,000.00. Each project will need to include the submittal of the NJCWRP Project Executive Summary Sheet and include a project location map. For examples and templates of submittal forms *click here*.

Environmental Solutions for Communities Initiative. Wells Fargo and the National Fish and Wildlife Foundation (NFWF) are supporting engagement with municipalities in order to help communities become more sustainable through conserving critical land and water resources, improving local water quality and restoring and managing natural habitat, species, and ecosystems. Wells Fargo and NFWF grants range from $25,000 to $100,000.

Sustainable Jersey Small Grants Program. Sustainable Jersey provides tools, training and financial incentives to support communities as they pursue sustainability programs, including financial resources in the form of grants and incentives. Sustainable Jersey registered towns get special priority access and notification of incentives and grants and are eligible for the Small Grants program.

GOVERNANCE AND PERMITTING

STATE AND FEDERAL PERMITTING

All living shoreline projects in New Jersey are subject to state and federal permitting requirements. It's recommended to consult with permitting agencies early in your planning process (prior to the completion of formal designs) to ensure that the potential project can be permitted. Should there be any issues with conceptual designs, representatives from the state and federal agencies can provide recommended changes to the project design to help ensure a smooth permitting process.

State Permitting Requirements

N.J.A.C. 7:7 Coastal Zone Management Rules. These regulations enable living shoreline projects to be implemented under the State of New Jersey Department of Environmental Protection (NJDEP) Division of Land Use Regulation. Lawfully this provision is recognized as Coastal General Permit 24 (N.J.A.C. 7:7-6.24.) Contact the NJDEP Coastal Land Use Office with any questions or concerns regarding regulations and permitting.

Federal Army Corps of Engineers (USACE) Permit

Depending on the goals and design of a living shoreline project, it will need either a "nationwide" or "individual" permit before construction can begin. Nationwide Permit 13 (NWP-13) is centered on shoreline bank stabilization. A Pre-Application Meeting Request Form is required to be completed *before* the NWP 13 application. In addition, the Individual Permit Application Submittal Form is a complementary procedure and only should be completed if the Nationwide Permit is not applicable for a specific project. For more information on the different permits and necessary forms, visit the USACE webpage.

NJ Bureau of Tidelands Requirements

The State of New Jersey has ownership of New Jersey's tidelands. Tidelands are public lands considered to be land currently and previously flooded by the mean high tide of a natural waterway. Written permission from the State and a fee are required in order to use these lands. A Tidelands license or lease is required for submerged structures (e.g., breakwaters or living reef breakwaters) that are constructed offshore and are situated anywhere in the tidelands.

INCORPORATING LIVING SHORELINE PROJECTS INTO MUNICIPAL PLANS

Incorporating living shoreline projects into municipal plans can help to facilitate project implementation by opening up funding opportunities and/or providing a community with the ability to budget for a future project. Updates and revisions to municipal coastal resilience measures, such as shoreline restoration and enhancement strategies, are becoming more easily adapted into local planning efforts. For example, the New Jersey Municipal Land Use Law (MLUL) requires each municipality in the State to review and update its local master plan regularly. This affords an opportunity to include shoreline restoration and enhancement strategies not only in the master plan but also in municipal floodplain management and hazard mitigation plans.

Inclusion of these strategies into different municipal plans can also benefit a community in its ability to budget and apply for State and Federal funding opportunities including, but not limited to, opportunities from the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Assistance, Pre-Disaster Mitigation, and Flood Mitigation Assistance programs. Communities that participate in FEMA's National Flood Insurance Program's Community Rating System can also receive discounted flood insurance premium rates to reward community actions related to hazard mitigation.

Monitoring Project Success & Benefits

A successful living shoreline project will require some long-term maintenance and adaptive management. Monitoring the project over time will help you determine how well the project is holding up and if it is providing the expected benefits. If the project is falling short of your expectations, monitoring can help identify maintenance or adaptive management actions to make the project more successful. For example, if you find that one area of the project site is washing out, a visual inspection of the living shoreline could show that the washout is the result of lack of vegetation or a bio-log having been dislodged during a storm. Once the issue is identified, you can determine if the project needs replanting or if the bio-log needs to be re-staked. An additional benefit of monitoring is that lessons can be learned from the project and shared with living shoreline practitioners, regulators, and the public that will help to improve site selection, design and maintenance of future projects.

A "how to" guide for developing a monitoring plan for living shoreline and coastal restoration projects is being developed as a part of the NJ Resilient Coastlines Initiative and will be available online in Spring 2016. Monitoring plans, which can fit a range of budgets and expertise, should be developed alongside your engineering and design plans. The collection of monitoring data should begin prior to construction in order to document conditions prior to project implementation. This information will provide a baseline with which to gauge the success of your project. Periodic monitoring of the same metrics should continue after construction. It is important to monitor a project site after a strong storm so that any repairs or maintenance can happen quickly. In addition, be sure to contact NJ DEP's Coastal Land Use Office to discuss any additional monitoring requirements based on state regulations and check with your funding source to determine their monitoring requirements.

Saltmarshes of the Delaware Bay. © The Nature Conservancy

Additional Considerations for Project Planning and Permitting

- Additional information on the design process and regulatory factors are discussed in the Stevens Institute of Technology (SIT): Guidelines to Living Shorelines. For more information on regulatory factors, please refer to the Permits/Regulatory section on page 31 of that document.
- Impacts to adjacent properties should be considered when identifying living shoreline project areas. When examining on-the-ground conditions, shifts in wave energy and bottom scour that can result in negative unforeseen consequences to neighboring locations should be thoroughly examined by engineers and ecologists.
- Careful attention should be placed on the nature and quality of materials used during project construction in order to ensure that the project utilizes the most ecologically conducive material.
- Project planners should engage state officials and federal regulators early in project planning when planting and/or seeding of commercial shellfish species (e.g., oysters) is included in the project plan.
- All living shoreline projects require a letter of approval from the landowner or land manager and a state or federal sponsor. Be sure to discuss property boundaries and relevant local concerns with local municipal officials.

Additional Resources & References

Several conservation non-profits, NJDEP, and academic partners throughout New Jersey, as well as federal partners, are actively involved in the identification, permitting and monitoring of living shoreline projects. We welcome the opportunity to support projects throughout the state.

American Littoral Society (ALS). ALS provides resources for communities and project leads about habitat restoration and overall environmental health. It can also assist in the development and possible implementation of living shoreline projects.

Barnegat Bay Partnership (BBP). BBP can assist communities and planners in the development and possible implementation of living shoreline projects, including ways in which community outreach can help project success. It's primary focus is on the Barnegat Bay, Ocean County.

NJ Department of Environmental Protection (NJDEP). NJDEP can assist communities and planners in better understanding State regulations concerning living shoreline management and permitting.

NY/NJ Baykeeper. The Baykeeper works to conserve the waterways and coastline of the NY-NJ Harbor Estuary, including repopulating the bays with oysters and creating sustainable habitat.

National Oceanic & Atmospheric Administration (NOAA). NOAA resources can help communities and planners better understand habitat zones and living shorelines treatments.

Partnership for the Delaware Estuary (PDE). PDE provides resources for communities and planners centered on implementation of living shorelines and scientific research in the Delaware Estuary.

Rutgers University's Center for Remote Sensing and Spatial Analysis (CRSSA). Rutgers CRSSA can be a useful resource to learn about geospatial information sciences, and to learn how mapping can be an effective tool for planning a project.

Society for Ecological Restoration (SER). SER resources include "Guidelines for Developing and Managing Ecological Restoration Projects" and other publications that can help guide the development of ecological restoration projects.

Stevens Institute of Technology (SIT): Guidelines to Living Shorelines. SIT can help municipalities and planners to better understand the engineering parameters and design process for living shoreline implementation.

The Nature Conservancy in New Jersey. The Conservancy's resources can help communities and project leads better understand coastal ecological benefits associated with living shoreline projects and assist in the development and possible implementation of living shoreline projects.

Additional References

Seachange Consuling. (2011). *Weighing your options: How to Protect Your Property From Shoreline Edge Erosion: A Handbook for Estuarine Property Owners in North Carolina*. Retrieved from Seachange Consulting, (2011)

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Hafner, S. 2012. Beach stabilization - Structure and beach nourishment alternatives. In 25-years of New Jersey coastal studies, February 15, 2012, The Richard Stockton College Coastal Research Center, Galloway, NJ.