

# Pathway to Natural and Nature-Based Solutions

The journey to a completed natural or nature-based project (NNBS; also known as a green infrastructure project) follows the same path used for traditional, grey infrastructure. However, there are some minor differences within each step of the pathway, most notably an added education component for green projects. This pathway identifies the similarities and differences between green (NNBS) and grey projects.

## 1 IDENTIFY ISSUES & OPPORTUNITIES

**!** Consider who you can educate about NNBS during this step...  
For example, the project team, client and/or owner.



### Green & Grey

- Identify a site or project
- Identify issues and/or opportunities at the site
- Work closely with client and/or owner

## 2 RESEARCH & FEASIBILITY

### Green

- Research past and present site conditions, natural cycles and systems, and local plant and animal species
- Gather community knowledge on the site's use, value, and impact
- Incorporate risk into models

### Grey

- Research existing conditions
- Use standard models

**!** Consider educating the project team, funders and community members about NNBS during this step.

## 3 DESIGN PROCESS

### Green

- Follow design standards
- Refer to Best Practices
- Create initial design
- Consider different iterations to maximize benefits

### Grey

- Follow design standards
- Refer to Technical Manuals
- Create initial design

**?** Permit not required? Go to step 5!

## 4 PERMITTING PROCESS

### Green

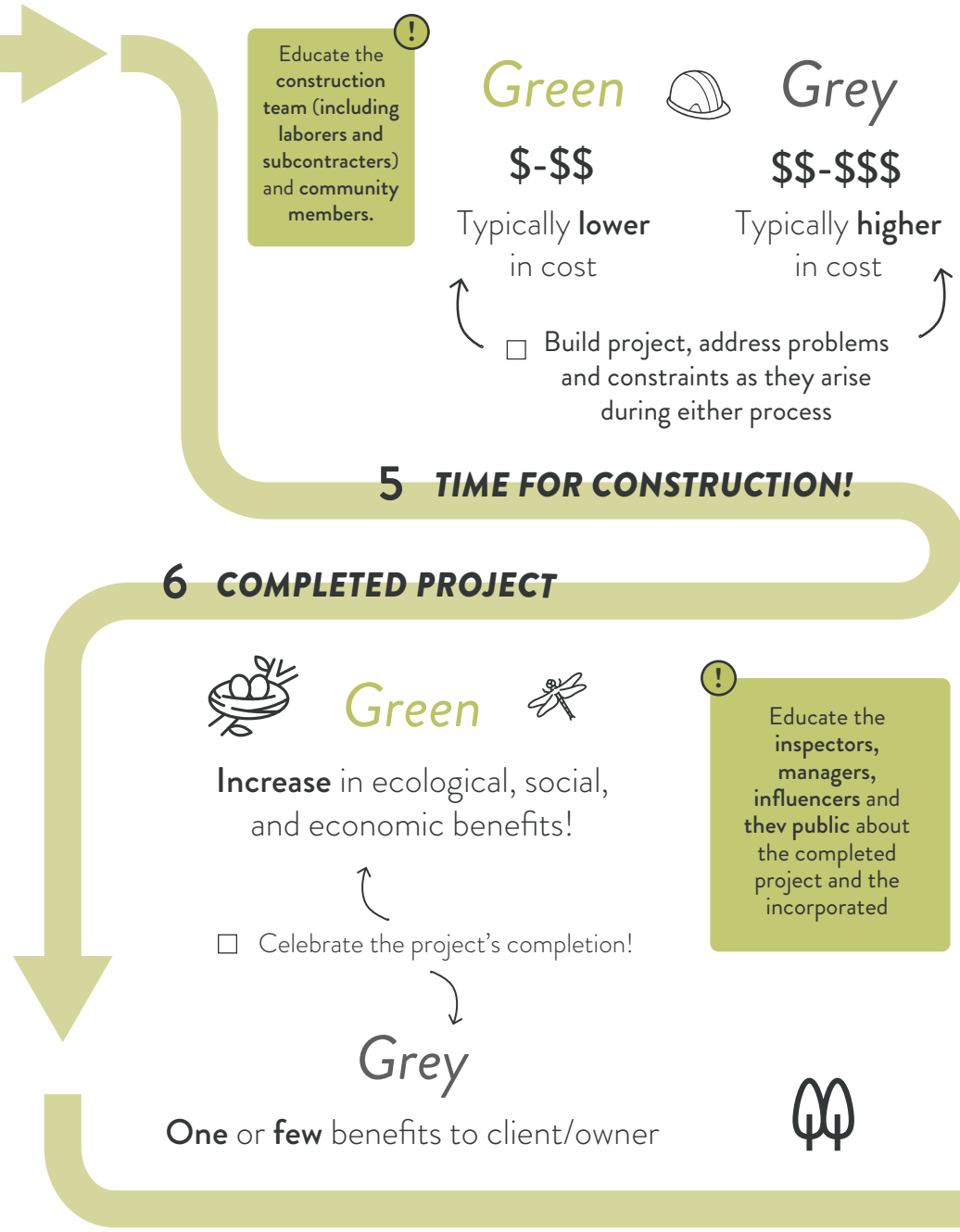
Note that this may take longer

### Grey

Note that this may take less time

- If the project requires this step, work with permitting agencies to finalize design during either process

**!** Consider educating the permitting agencies, and decision makers about NNBS during this step.





### CASE STUDY SCENARIO // CROWFIELDS CONDOMINIUMS

Asheville, North Carolina

**Issue identified:** Creek bisected by a bridge culvert has severe undermining concerns and will need repair and/or replacement.

**Opportunity identified:** During the repair phase, with grading work unavoidable, an opportunity was identified to install a bioretention feature to alleviate sediment going straight into the creek, filter runoff from the road and incorporate native plants.

Photo provided by Robinson Design Engineers.

## 1 STEP ONE Identify Issues and Opportunities

The process of identifying issues and opportunities related to environmental concerns involves a thorough assessment of various factors. **Factors to consider include flooding, habitat and diversity loss, water quality, and heat-related problems.** Alternatively, opportunities may emerge, like land restoration or new development initiatives. When a group decides to address a specific issue or seize an opportunity, they must navigate a complex web of decision-makers. This typically includes private or public owners who possess decision-making authority. Additionally, it involves the community, which must establish a connection with these decision-makers, as well as third parties like research groups or non-profits who play a role in facilitating these connections.

**Securing funding** for the proposed project is a critical step in the process. Groups must weigh the options of public versus private funding sources, taking into account the urgency of the problem they are addressing. Ideally, the funding should encompass various phases, such as design, community engagement, engineering, permitting, construction, maintenance, and long-term monitoring.

To ensure the success of the project, it is essential to hire professionals with expertise in design and engineering, **preferably those with knowledge of and experience in natural resource enhancement or ecological design.** These experts will play a crucial role in guiding the project towards its environmental and community-oriented goals.

### POSSIBLE QUESTIONS TO ASK YOURSELF DURING THIS PHASE ?

Does my site feel unproductive in terms of biodiversity?

Do I feel comfortable with having areas that can be managed and areas that can be left “wild”?

Will I contact nearby property owners to see if they are willing to participate in the overall watershed-based planning?



### CASE STUDY SCENARIO // ANGEL OAK PRESERVE

Angel Oak Park, Johns Island, South Carolina

**Research conducted:** Research was conducted to get a better understanding of the Angel Oak's size and health as well as the surrounding area. Archaeologists found evidence that revealed the past locations of cabins of enslaved people, a plantation house, and an oak alleé. This knowledge led the designers to include opportunities along the boardwalks for historical interpretation.

**Feasibility analysis:** To ensure project feasibility, research results are used to inform all design decisions. Designers also consider the needs of the Angel Oak and the other surrounding plants, such as the space their roots require to grow and flourish without interruption.

Photo provided by the Lowcountry Land Trust.

## 2 STEP TWO Research and Feasibility

Conducting research and determining design feasibility are critical to produce a successful nature-based project that offers long-term social and ecological benefits. Research is needed to fully understand the context of the issue or opportunity; only once understood can the best solution for the site be determined.

Ecological data on past and present site conditions is vital. Research should encompass **natural cycles** (including water, nutrient, energy, and climate) as well as **physical landscape features** (such as water, elevation, light, wind, and human impact), **plant composition and placement**, and **soils**. **Fauna** should also be considered (including habitat and food web needs) in present and future contexts.

**The affected community should be engaged during the research phase to identify issues and potential solutions and offer valuable knowledge on the site's use, value, and impact.** Early and often engagement with community members will not only provide valuable information but it can also lead to increased community buy-in.

Risk and adaptive management should be considered to ensure project feasibility. Incorporating risk models and future models can address, and hopefully reduce, risk.

### POSSIBLE QUESTIONS TO ASK YOURSELF DURING THIS PHASE



Has the site been thoroughly researched?

Do I understand the issues and opportunities present at the site through an ecologic, social, and economic lens?

Has the affected community been involved in the research-gathering phase?

Does the risk of implementing a project outweigh the risk of leaving the site as-is?



### CASE STUDY SCENARIO // ANDREWS RAIN GARDENS

Andrews, South Carolina

**Design Process:** In the spring of 2022, The Nature Conservancy and Clemson Extension installed two small rain gardens in the Town of Andrews. After the two sites were chosen, the design team calculated the ideal size and placement of the gardens based on runoff patterns and other factors. Both gardens followed a standard bean-shape design with a rock outfall, although one garden was connected to a cistern to slowly receive additional water. The selection and placement of plants were dependent on the amount of water and sunlight at each location in the garden, requiring a detailed understanding of the site and the flow of water within the garden. Native plants were chosen for their ecosystem benefits.

Photo provided by Tanya Ackerman; photo of Andrews Library Rain Garden.

## 3 STEP THREE Design Process

The design phase incorporates all the data collected during the research and feasibility phase. If nature-based solutions have not been part of the conversation, this is the time for them to be introduced. The design team should use existing design standards and technical guidance, when available. When designing nature-based elements, designers should **incorporate best practices** when design standards do not exist.

The design should fully address the issue or opportunity present at the site and should be designed in a way that meets community needs and desires, when possible. Designers should present a suite of solutions to the client that **fit within budget, are appropriate for site conditions, are culturally sensitive, and fit within the regulatory framework**. Ideally some, if not all, of the proposed solutions will be natural or nature-based with the ultimate goal being that the client chooses a green design over a grey one.

### POSSIBLE QUESTIONS TO ASK YOURSELF DURING THIS PHASE ?

Were feasible, appropriate nature-based solutions offered to the client?

Was the client educated on the benefits of a nature-based approach and the value added over a traditional grey design?

Did I ask anyone in the community if this design would be accepted and maintained?



### CASE STUDY SCENARIO // BARBERRY WOODS

Johns Island, South Carolina

**Permitting process:** The Barberry Woods project was driven by repetitive flooding that impeded egress from this residential neighborhood from hours to days depending on storm severity. The project incorporated ecological enhancements and bio-engineering designs, including new wetlands for flood storage, stream stabilization, enhanced floodplain storage, and improved overall infiltration through bio-infiltration practices, to alleviate flooding in the community. Permitting efforts include an Individual Permit with the USACE, Erosion and Sediment Control and Coastal Zone Consistency (CZC) permitting with SC DEHC, Site Plan Permitting with Charleston County and the City of Charleston and a FEMA No-Rise submittal. Checklists devised by permitting agencies do not always account for nature-based solutions, making the permitting process tricky and sometimes illogical (like paying a wetland mitigation fee to help wetlands). Working through this process can require time and coordination.

Photo provided by WK Dickson.

## 4 STEP FOUR Permitting Process

Just like in traditional infrastructure, permitting is often an iterative process with design as the design team make changes requested by the permitting agencies. It is during the permitting phase that the design transitions from the initial design to the final design (which will be used for construction). To make permitting easier, it's important to **engage regulatory agencies early and often** in the design process to address questions and concerns and ensure regulatory requirements are met.

General permits often provide for faster review and approval. Unfortunately for South Carolina, **many nature-based projects do not currently fall under general permits**. As a result, the permitting process for a nature-based solution can be longer and more cumbersome for the design team than a traditional grey design. Allowing ample time in the project timeline to receive permits can avoid frustration and keep the project on track.

### POSSIBLE QUESTIONS TO ASK YOURSELF DURING THIS PHASE ?

Am I familiar with the permitting process for the nature-based solution being proposed?

Is a pre-application meeting an option prior to permit submittal? If so, have I taken the opportunity to meet with the permitting agency to discuss project specifics?

Am I prepared to be flexible with the design depending on the response from the permitting agency?



### CASE STUDY SCENARIO // CRAB BANK RESTORATION

Off the coast of Mount Pleasant, South Carolina

**Construction process:** In 2017 Crab Bank, a bird sanctuary, significantly eroded, and the Conservation League, SCDNR, conservation partners, and Coastal Expeditions came up with a solution to rebuild the bank with sand dredged during the Charleston Harbor's deepening project. Funding was initially a barrier with an estimation that was more than the actual cost, but because the Norfolk Southern Dredging Company had the necessary equipment already in the area, the cost was cut from the initial \$4 million to \$377,000. The US Army Corps of Engineers covered 65%, leaving \$132,000 for the community to raise which they did successfully.

Photo provided by Adam Boozer.

## 5 STEP FIVE Time for Construction!

The construction of a nature-based solution is like any project in that it alters the existing site to some degree and requires a skilled labor force with appropriate tools to build. **Ideally the construction company (including its laborers and subcontractors) has some knowledge of nature-based solutions, or, even better, is an expert in nature-based solutions.** While an uninformed crew can be educated and still yield a successful project, prior knowledge of nature-based solutions may reduce error, miscommunication, and timeline delays. Substitutions, especially for plants, is one area where the knowledge of nature-based solutions (or lack thereof) is apparent. Unknowingly, uninformed crews may substitute a non-native plant for a native one, which can reduce ecosystem services and benefits and, in some instances, can cause harm to native fauna or alter natural cycles.

Additional factors to consider during construction include time of year, plant availability and supply chain, length of construction, and community outreach. To maintain the integrity of the design, the designer/engineer will stay involved throughout the entire construction process. Their involvement is crucial to address any problems or constraints that may arise. It is imperative that the design team remains flexible and adaptable, especially when implementing new techniques and materials.

### POSSIBLE QUESTIONS TO ASK YOURSELF DURING THIS PHASE ?

Does the construction company (and any subcontractors and laborers) have knowledge of nature-based solutions? If not, how should I approach educating them to ensure all aspects of the design are executed as specified?

Are the plants specified in the design available and easily accessible?

How often is the designer/engineer checking in on the construction?



### CASE STUDY SCENARIO // PORT ROYAL SOUND LIVING SHORELINE

Port Royal Sound, South Carolina

**Project benefits:** The Port Royal Sound Living Shoreline was completed in April 2016 using funding from the SC Sea Grant Consortium and the Lowcountry Institute. Led by SCDNR, the project was constructed with the help of local student volunteers. Built as part of a pilot study to test living shoreline materials, the design used manufactured wire reefs to help stabilize the shoreline and provide essential habitat to finfish and invertebrates. Thanks to pilot projects like this one which provided SCDHEC with valuable data, new living shoreline regulations were passed in 2021 that aim to make it easier for property owners to permit and build similar projects.

Photo credited to SC Department of Natural Resources.

## 6 STEP SIX Completed Project

Whether construction took a few hours or many months, the completion of a nature-based project is one to celebrate. Unlike traditional infrastructure which may only provide benefits and value to the property owner, complete **nature-based projects can offer a suite of benefits to the entire community and surrounding ecosystem.** Benefits of nature-based solutions can include, but are not limited to:

- Climate mitigation (reduced greenhouse gas emissions and enhanced carbon storage)
- Reduction of major climate risks, such as:
  - Coastal floods and shoreline erosion
  - Inland floods
  - Stormwater and sewer overflow
  - Extreme heat
  - Wildfire
  - Drought
- Job opportunities
- Improved water and air quality
- Fish, timber, and other natural products
- Recreational opportunities and access
- More resilient infrastructure
- Improved physical and mental health
- Cultural benefits
- Wildlife and biodiversity support
- Community development and economic revitalization

### POSSIBLE QUESTIONS TO ASK YOURSELF DURING THIS PHASE ?

Did the construction of the project match the design specifications?

Is there educational signage at the site to inform visitors?

Who could benefit from the lessons learned during this project?

Benefits list taken from: White House Council on Environmental Quality, White House Office of Science and Technology Policy, White House Domestic Climate Policy Office, 2022. Opportunities for Accelerating Nature-Based Solutions: A Roadmap for Climate Progress, Thriving Nature, Equity, and Prosperity. Report to the National Climate Task Force. Washington, D.C





#### CASE STUDY SCENARIO // HORRY COUNTY RECYCLING CENTER BIORETENTION

Loris, South Carolina

**Maintenance process:** Upkeep such as weeding, raking, and mowing occur monthly while mulching occurs annually. Additional care, including replanting or cleaning, happen as needed. Cleaning could include removing trash, clearing out underdrains, or cleaning out sediment accumulation.

**Monitoring process:** The garden is inspected quarterly (every 3 months). The monitors look for signs of erosion, dead plants, and any ponding occurring for more than 3 days.

Photo provided by Horry County Stormwater Management & Clemson Carolina Clear.

## 7 STEP SEVEN Maintenance and Monitoring

Maintenance is a standard expectation for any project, green or grey. Ensuring that the project has a maintenance plan, budget, and responsible party will keep the site properly functioning for many years. With nature-based solutions, **maintenance is typically minimal and inexpensive** since the project relies on nature to heal itself. The type of maintenance needed will vary based on the type of project, but could include replacing or caring for plants, adding mulch or ground cover, altering sediment placement, and removing trash or debris.

Unlike traditional infrastructure, it is beneficial for a nature-based solution to also **have a long-term monitoring plan, budget, and responsible party**. The purpose of monitoring the project is to track changes (such as plant growth, species abundance, etc.) over time and verify the project is functioning properly and continuing to meet project goals. Monitoring can be very project- and site-specific but generally involves taking measurements, recording data and observations, and taking photographs. Regular site visits as well as observations after major weather events (such as hurricanes) help track progress and catch any problems that may arise.

#### POSSIBLE QUESTIONS TO ASK YOURSELF DURING THIS PHASE ?

Was money budgeted for long-term monitoring and maintenance?

Is the project being monitored and maintained at regular frequency?

Are the monitoring and maintenance crews' experts on nature-based solutions? If not, what can I teach them to ensure long-term project success?