

# MANAGER'S GUIDE TO CORAL REEF RESTORATION PLANNING & DESIGN

## GUIDE WORKBOOK

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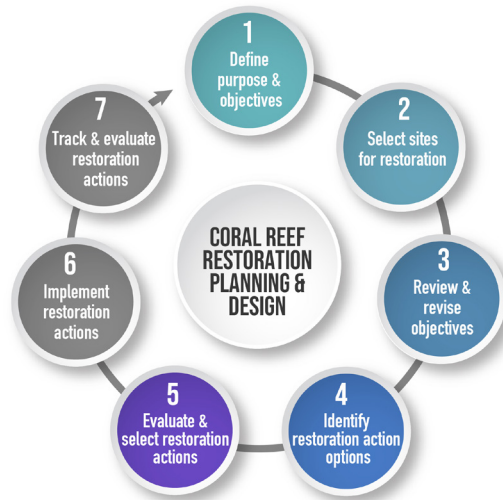
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## INTRODUCTION TO THE MANAGER'S GUIDE WORKBOOK

This document is a workbook that accompanies the strategic planning steps described in the “Manager’s Guide to Coral Reef Restoration Planning and Design” (Shaver et al. 2019). The Manager’s Guide describes five key steps intended to help managers design a comprehensive plan or strategy for coral reef restoration in their location. The five planning steps include:

- Step 1: Define Project Purpose and Objectives
- Step 2: Select Sites for Restoration
- Step 3: Review & Revise Objectives
- Step 4: Identify Restoration Action Options
- Step 5: Evaluate & Select Restoration Actions

These steps are illustrated by a cycle, but it should be noted that these steps can be completed in any order. The cycle diagram is shown at the beginning of each step in the Manager’s Guide and in this Workbook to remind you where you are in the planning process.



The Workbook is designed to be used with the Manager’s Guide as a place to collect information and ideas during each of the five planning steps. Workbook activities include strategic questions and tables or charts that can be filled out while working through the Manager’s Guide. At the end of the Workbook, information is gathered into a summary that can be used to develop a more comprehensive plan or proposal for coral reef restoration. The Workbook is a fillable PDF that can be filled in digitally or after printing.



The Workbook Icon is used throughout the Manager’s Guide and indicates when there is an accompanying Workbook Activity to conduct.

For questions on the Workbook or Manager’s Guide to Coral Reef Restoration Planning and Design, contact the Reef Resilience Network at [resilience@tnc.org](mailto:resilience@tnc.org).



## STEP 1: DEFINE SCOPE & OBJECTIVES

### 1A: STAKEHOLDER ENGAGEMENT

Use the following questions to identify key stakeholder groups that should be engaged in restoration planning and implementation. If some answers are dependent or vary based on sites, return to the questions after completing Step 2: Site Selection in the Manager's Guide and Workbook.

1. What stakeholders or stakeholder groups could be affected by the restoration program (positively or negatively), or affect the restoration program (e.g., by their actions)?

2. For negatively affected stakeholders, what public outreach will be needed to include these groups as allies of the project?

3. What is your strategy for engaging different stakeholders in the planning process?

### 1A: STAKEHOLDER NEEDS ASSESSMENT

Use this table to identify stakeholders and their potential capacity or contributions to the project. This table can be used for specific coral reef sites or locations where restoration is being considered. If specific sites have not yet been identified, disregard specifics about sites at this point and return to the table(s) after Step 2: Site Selection in the Manager’s Guide and Workbook. Refer back to this table after each step in the planning process.

Restoration Site:

Restoration Step	Key Stakeholders	Potential Role & Contribution
Step 1: Define planning purpose & objectives		
Step 2: Assess climate impacts & vulnerabilities		
Step 3: Review & revise goals & objectives		
Step 4: Identify restoration action options		
Step 5: Evaluate & select restoration actions		
Step 6: Implement priority restoration actions		
Step 7: Track & evaluate restoration actions		

### 1B: SITE CONTEXT ASSESSMENT

Use the questions below to assess the broader context of reef sites that are being considered for restoration.

1. What are the general sites or regions where restoration is being considered?

2. What are the primary threats to the coral reef site(s) being considered for restoration (e.g., local and climate threats)? Are local threats now under effective management?

3. What are the conservation or management goals in the region where restoration is being considered? How can the restoration project align with these goals?

4. How is the coral reef site(s) influenced or connected biologically to other habitats? What are the goals or strategies for managing these habitats?

5. How is the coral reef site(s) influenced or impacted by the surrounding physical landscape (e.g., upstream land use practices, coastal development)?

### 1C: TARGETS AND OBJECTIVES

Use the following questions to identify your target and general objectives:

1. List the target or 'control' ecosystem (or characteristics) that has been identified for your project. Or, describe the process to identify this target site.

2. List the general objectives (from page 4 of the lesson) that apply to your coral reef restoration project or program, tailoring them to be specific to your case.

3. List these general objectives in order of priority.

Objective 1:

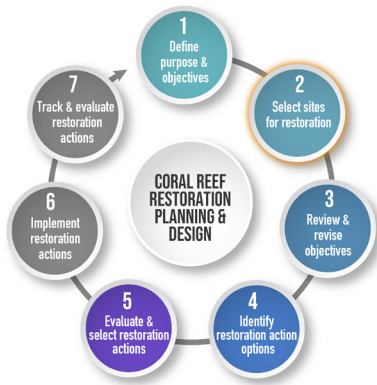
  

Objective 2:

Other objective(s):





## STEP 2: SELECT SITES FOR RESTORATION

### 2A: VULNERABILITY ASSESSMENT

Below is an example of a completed Vulnerability Assessment from Hawai'i.

<b>Target Resource:</b> Coral reefs in West Maui, Hawai'i, USA					<b>Rating of Condition &amp; Trends</b>
<b>Description of Condition and Trends:</b> Coral reefs in the area are in fair condition but declining due to unsustainable harvesting and illegal fishing of regulated herbivores, invasive species, and land-based nutrient and sediment runoff. Nutrient and contaminant sources include injection wells, urban pollutants, and legacy groundwater pollutants. Land-based pollutant and sediment sources include runoff from agricultural district areas and fallow fields, urban districts, and stream diversions. Overfishing of herbivorous reef fish combined with increased nutrient and sediment runoff is causing a shift to an algal dominated system.					FAIR
<b>Climate Threats</b>	<b>Exposure</b>	<b>Sensitivity</b>	<b>Potential Impact (Exposure + Sensitivity)</b>	<b>Adaptive Capacity</b>	<b>Vulnerability (Potential Impact + Adaptive Capacity)</b>
Increased sea-surface temperature resulting in increased incidence of coral bleaching  Ocean acidification resulting in declining coral calcification  Increased incidence of drought combined with heavy rainfall events resulting in increased soil erosion from existing and new non-vegetated areas	Very little protection from high degrees of exposure to a number of climate threats, particularly increased runoff, sea-surface temperature, and ocean acidification	Reefs have high sensitivity to increased sea-surface temperature due to climate change Coral bleaching was widespread during the 2014 and 2015 events, more bleaching occurred than in the previous event	Medium potential impact – Coral reefs are highly exposed to climate threats but moderately sensitive to these threats	Medium adaptive capacity – coral reefs exposed to previous bleaching events have recovered. Improved watershed management is needed to reduce land-based pollution	Coral reef vulnerability to climate change is rated as medium
	<b>Exposure Rating:</b> HIGH	<b>Sensitivity Rating:</b> HIGH	<b>Potential Impact Rating:</b> MED/HIGH	<b>Adaptive Capacity Rating:</b> MEDIUM	<b>Vulnerability Rating:</b> HIGH
<b>VULNERABILITY STATEMENT:</b>					
<ul style="list-style-type: none"> <li><b>Condition and Trends:</b> Coral reefs in the nearshore waters of the community are in fair condition but are becoming degraded by sedimentation and eutrophication from land-based pollution and unsustainable and illegal fishing of regulated herbivores</li> <li><b>Vulnerability:</b> Coral reefs are vulnerable to increased sea-surface temperature, ocean acidification, and increased sediment runoff from severe storms</li> <li><b>Resource Dependency:</b> West Maui coral reefs provide jobs and support a thriving tourism industry in the area</li> </ul>					



## 2A: VULNERABILITY ASSESSMENT

Use the template of a Vulnerability Assessment below to fill in information for your location. Start by thinking of your target resource (the reef sites or system to be restored) and its current condition and trends. Then, identify how climate change may threaten the resource (e.g., sea-level rise, warming), and describe and rank the exposure, sensitivity, potential impact, and adaptive capacity of the resource to these climate threats. Finally, describe the overall vulnerability to climate threats and summarize this information into a final Vulnerability Statement. This assessment should be applied to the scale of your restoration scope or management jurisdiction.

<b>Target Resource:</b>					<b>Rating of Condition &amp; Trends</b>
<b>Description of Condition and Trends:</b>					
<b>Climate Threats</b>	<b>Exposure</b>	<b>Sensitivity</b>	<b>Potential Impact (Exposure + Sensitivity)</b>	<b>Adaptive Capacity</b>	<b>Vulnerability (Potential Impact + Adaptive Capacity)</b>
	<b>Exposure Rating:</b>	<b>Sensitivity Rating:</b>	<b>Potential Impact Rating:</b>	<b>Adaptive Capacity Rating:</b>	<b>Vulnerability Rating:</b>
<b>VULNERABILITY STATEMENT:</b>					
<ul style="list-style-type: none"> <li>• <b>Condition and Trends:</b></li>   <li>• <b>Vulnerability:</b></li>   <li>• <b>Resource Dependency:</b></li> </ul>					

## 2A: VULNERABILITY ASSESSMENT

The following questions can be used to summarize results from a vulnerability assessment or to collect other information or knowledge available on climate change vulnerabilities in place of an assessment.

1. What are the primary drivers of change and coral reef degradation in your region?

2. What are the primary or major climate change threats in your region, and the projected direction and magnitude of change over time? Which sites will be least affected by these threats?

3. What are potential changes in environmental conditions resulting from climate change, and potential impacts on coral reefs from these changes?

4. What is the capacity of the system (ecological, social, and/or political) to acclimate or adapt to these changes?

## 2B: RESILIENCE ASSESSMENT

For reef sites being evaluated in a resilience assessment or considered for restoration, use the following questions to synthesize information on several key resilience indicators (more information here):

1. Rank potential sites in terms of the degree of coral species diversity and the proportion of coral species that appear to be more resistant to bleaching and disease.

2. Rank potential sites in terms of the degree of key ecosystem processes, including coral recruitment and herbivore abundance and diversity.

3. Rank potential sites in terms of the degree of favorable environmental conditions, such as low temperature and light variability, low fishing pressure or run-off, or high habitat complexity.

## 2C: SITE SELECTION

1. What other important considerations or factors must be taken into account that may affect which sites are selected for restoration?

2. Based on this section, list the reef sites or areas with the best combination of low vulnerability to climate change and human impacts and highest potential for resilience. If reef sites are chosen for restoration for other reasons, list them here.



## STEP 3: REVIEW & REVISE OBJECTIVES

### 3A: WRITING SMART OBJECTIVES

A SMART objective is specific, measurable, achievable, realistic, and timebound. Work from the example and template below to create restoration objectives that are SMART.

Example: Increase coral populations **[what sites, over what area, what species]** to support **[increase]** reproductive & recruitment potential **[define potential]** **[quantify potential e.g. by XX% compared to reference site]** **[specify year to achieve this result]**.

In each of the boxes provided, write your top priority general objective, then revise this objective to create a SMART objective using the template as guidance. Write the success metrics needed to measure and evaluate the success of the SMART objective.

**General Objective #1:**

**SMART Objective:**

**Possible Monitoring Metrics:**

**General Objective #2:**

**SMART Objective:**

**Possible Monitoring Metrics:**



## STEP 4: IDENTIFY RESTORATION ACTION OPTIONS

### 4A: BRAINSTORM RESTORATION OPTIONS

Use the questions below to collect your thoughts about key restoration actions you are considering, and their associated techniques, based on each objective:

**Objective #1:**

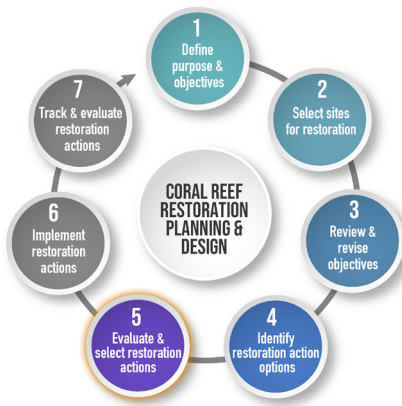
**Restoration actions you're considering:**

**What techniques are others using for these actions? Are they effective? If you have already tried some techniques, what was used and how did they work?**

**Objective #2:**

**Restoration actions you're considering:**

**What techniques are others using for these actions? Are they effective? If you have already tried some techniques, what was used and how did they work?**



## STEP 5: EVALUATE & SELECT RESTORATION ACTIONS

### 5A: SELECT ACTIONS

For this exercise, list your restoration objective and three restoration actions being considered for that objective. Then, use the criteria in the table to evaluate and compare each action against each other. You may “rank” the actions for each criteria using the stoplight system by marking an X on the appropriate color (best choice=green, worst choice=red). Repeat this process for each restoration objective if needed. Although this table is designed to compare 3 actions, it is meant to get you started with the evaluation process and can be done with any number of actions.

Objective 1:		
Action:	Action:	Action:
<b>Effectiveness</b> <ul style="list-style-type: none"> <li>Ability to achieve SMART objectives (considering future climate adaptation)</li> <li>Robust in the face of uncertainties</li> </ul>		
Description:	Description:	Description:
Ranking: <span style="display: inline-block; width: 15px; height: 15px; background-color: green; border: 1px solid black;"></span> <span style="display: inline-block; width: 15px; height: 15px; background-color: yellow; border: 1px solid black;"></span> <span style="display: inline-block; width: 15px; height: 15px; background-color: red; border: 1px solid black;"></span>	Ranking: <span style="display: inline-block; width: 15px; height: 15px; background-color: green; border: 1px solid black;"></span> <span style="display: inline-block; width: 15px; height: 15px; background-color: yellow; border: 1px solid black;"></span> <span style="display: inline-block; width: 15px; height: 15px; background-color: red; border: 1px solid black;"></span>	Ranking: <span style="display: inline-block; width: 15px; height: 15px; background-color: green; border: 1px solid black;"></span> <span style="display: inline-block; width: 15px; height: 15px; background-color: yellow; border: 1px solid black;"></span> <span style="display: inline-block; width: 15px; height: 15px; background-color: red; border: 1px solid black;"></span>
<b>Feasibility</b> <ul style="list-style-type: none"> <li>Implementation (and maintenance, if applicable) costs compared to budget</li> <li>Technical and institutional capacity to implement (data, technical knowledge)</li> <li>Permitting process and requirements for restoration actions</li> <li>Physical infrastructure needed to implement (practical constraints)</li> <li>Socio-political context: including legal/social/political constraints; acceptability to community</li> </ul>		
Description:	Description:	Description:
Ranking: <span style="display: inline-block; width: 15px; height: 15px; background-color: green; border: 1px solid black;"></span> <span style="display: inline-block; width: 15px; height: 15px; background-color: yellow; border: 1px solid black;"></span> <span style="display: inline-block; width: 15px; height: 15px; background-color: red; border: 1px solid black;"></span>	Ranking: <span style="display: inline-block; width: 15px; height: 15px; background-color: green; border: 1px solid black;"></span> <span style="display: inline-block; width: 15px; height: 15px; background-color: yellow; border: 1px solid black;"></span> <span style="display: inline-block; width: 15px; height: 15px; background-color: red; border: 1px solid black;"></span>	Ranking: <span style="display: inline-block; width: 15px; height: 15px; background-color: green; border: 1px solid black;"></span> <span style="display: inline-block; width: 15px; height: 15px; background-color: yellow; border: 1px solid black;"></span> <span style="display: inline-block; width: 15px; height: 15px; background-color: red; border: 1px solid black;"></span>



<b>Urgency</b> <ul style="list-style-type: none"> <li>Degree of threat, cost of inaction</li> <li>Time-sensitivities (e.g., partnership/funding opportunities, ability to align with existing efforts)</li> <li>Long lead times</li> </ul>		
Description:	Description:	Description:
Ranking: 	Ranking: 	Ranking: 
<b>Flexibility</b> <ul style="list-style-type: none"> <li>Agile, adjustable to accommodate changing climate conditions, adaptive strategies</li> <li>Reversibility if needed</li> </ul>		
Description:	Description:	Description:
Ranking: 	Ranking: 	Ranking: 
<b>Externalities</b> <ul style="list-style-type: none"> <li>Achieves benefits outside of the target system, to other ecosystem and/or human communities (including environmental justice and equity).</li> <li>Minimizes unintended negative consequences, including carbon footprint</li> </ul>		
Description:	Description:	Description:
Ranking: 	Ranking: 	Ranking: 

### 5A: SELECT ACTIONS CONTINUED

Use the questions below to summarize results of evaluating priority restoration actions:

1. For each objective, how are your restoration actions prioritized and why?

OBJECTIVE	Best Choice Action	Intermediate Choice	Worst Choice Action
Objective 1:			
Objective 2:			
Other objective:			

2. How will these restoration actions help you achieve your objectives?

3. Is there a need to review and refine your objective(s) based on the results of this exercise and the actions to be undertaken? If so, write your revised objective(s).

### **5B: CONSIDER CLIMATE ADAPTATION DESIGN**

Use the questions below to help identify how restoration actions can be climate adapted:

1. How will climate change threats affect the restoration actions being considered in the next 10, 20, or 50 years (e.g., could climate change damage structural additions or outplanted corals of a particular species)? Consider all possible climate change threats for each restoration action.

2. What are the implications of these threats for restoration in your chosen sites(s)?

3. How will the restoration action(s) need to be adapted (e.g., coral species, location, timing, engineering, or design)?



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## RESTORATION PLAN EXECUTIVE SUMMARY

Using the planning process in the “Manager’s Guide to Coral Reef Restoration Planning & Design”, you have thought critically about how to best conduct restoration in your location. In the table on the next page, summarize the information you gathered in the previous 5 planning steps. This summary can be printed separately from this workbook and share, or used to develop a broader proposal or strategy for coral reef restoration in your location.

1. List your priority SMART objective (including a timeframe and specifics).
2. List the stakeholders you need to involve and your engagement strategy.
3. List the priority sites selected for restoration.
4. List the restoration actions you will use to complete this objective.
5. List any additional needs and next steps for implementing your restoration strategy.
- 6. Repeat these questions for any additional priority objectives.**

Coral Reef Restoration Strategy – Executive Summary	
Developed by:	Date:
SMART Objective:	
Stakeholder Strategy:	
Priority Site(s):	
Restoration Action(s):	
Notes on additional needs and next steps:	





## RESTORATION RESOURCES ON THE REEF RESILIENCE NETWORK

The Reef Resilience Network toolkit is a global resource with more than 190,000 visitors annually. We've added best practices for coral reef restoration tailored to managers, based on published scientific and gray literature, and reviewed by experts. The toolkit contains the following topics:

- Restoration Introduction – includes key definitions, role of restoration in management, and the Coral Restoration Consortium
- Project Planning – guidance on deciding on restoration as a strategy, identifying objectives, selecting restoration sites, and engaging stakeholders
- Coral Populations – best practices for enhancing coral cover on reefs, coral nurseries and gardening, larval propagation, and monitoring
- Reef Substrate – how to add or enhance reef substrate through artificial structures and algae control
- Reef Environment – guidance on restoring the habitats surrounding reefs such as connected seagrass and mangrove

We thank our many partners and collaborators who helped create and refine the *Manager's Guide to Coral Reef Restoration Planning and Design* and this Workbook, including members of the NOAA Coral Reef Conservation Program, U.S. All Islands Committee, U.S. Environmental Protection Agency, Reef Restoration and Adaptation Program, TetraTech, and many coral reef resource managers from around the globe.



Toolkit: [reefresilience.org](http://reefresilience.org)  
Email: [resilience@tnc.org](mailto:resilience@tnc.org)