

2020-2025

# United States Virgin Islands' Coral Reef Management Priorities



Department of Planning & Natural Resources  
Division of Coastal Zone Management

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**Prepared for:** The U.S. Virgin Islands Department of Planning & Natural Resources  
Division of Coastal Zone Management

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DPNR-CZM would like to thank the V.I. Coral Reef Advisory Group, as well as the other partners, listed in Appendix I, who provided input during the process to develop these priorities. The commitment, time and expertise provided by the process participants has resulted in a locally driven and relevant product which will be used by DPNR-CZM and partners to guide coral reef management efforts into the future. This work was supported through funding provided by the U.S. Department of the Interior, Office of Insular Affairs (award number CRI-USVI-5/D16AP00101).

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# Executive Summary

Coral reefs are critically important to the United States Virgin Islands. Coral reefs support our economy through the provision of food, livelihoods and recreation. Coral reefs are integral to our culture. Reef products can be seen in the walls of our historic buildings and streets. Reef fish are staples of island cuisine, and our reefs create the calm, clear bays that soothe the body and soul as we lime and bathe on weekends and holidays. Coral reefs are responsible for our beautiful beaches and colorful dive sites which lure tourists to our islands. Coral reefs are also a strong natural defense that protect our shorelines, homes, businesses and lives from natural hazards such as flooding caused by hurricanes. In fact, the protective ecosystem services provided by our coral reefs are sizable. Intact coral reefs provide the USVI with \$47 million in annual flood protection benefits in the form of averted damages to property and economic activities alone (Storlazzi et al., 2019).



Unfortunately, USVI coral reefs are in trouble and if actions are not taken we risk losing the numerous benefits and quality of life that they provide us. Our reefs are threatened by both global and localized stressors. Global stressors such as coral bleaching and others associated with climate change, can be difficult to manage at a local level. However, territorial reefs are also being negatively impacted by numerous local threats which damage our corals individually as well as collectively. Local threats such as nonpoint source pollution, unsustainable land use and fishing practices, physical damage from anchors and boat groundings and marine debris are caused by our own behaviors and choices – therefore we can do something about them.



The Department of Planning and Natural Resources, as trustee for the Territory's coastal and marine resources, recognizes the incredible economic and cultural value that coral reefs provide, and works in collaboration with our partners to manage these important habitats. These updated strategic coral reef management priorities reaffirm the territory's commitment to effective management of our coral reefs so they will continue to provide vital ecosystem services to our community for future generations.

The suite of coral reef management goals, objectives and activities presented here are wide-ranging and ambitious. Achieving them will require the buy-in and participation of all Virgin Islanders if we want to ensure the persistence of our coral reefs.

# Prioritized Coral Reef Management Goals & Objectives

## Land-Based Sources of Pollution (LBSP)



- *Comprehensive Land-Use Plan*
- *Watershed Management Plans*
- *Stormwater Mapping System*
- *USVI Environmental Protection Handbook*
- *LBSP Mapping*
- *Focus on Sewage Infrastructure*

## Enforcement



- *Increase DEE Capacity*
- *Improve Inter-Agency Communication*
- *Technology & Training*
- *Address DPNR Enforcement Gaps*
- *Simplify USVI Environmental Rules & Regulations*

## Restoration



- *Mooring Buoys, Navigational Aids/Markers*
- *Innovative Habitat Restoration*
- *Identify Target Areas for Restoration*
- *Physical Disturbance Restoration Response Strategy*
- *Herbivore and Bioturbator Restoration*
- *Coastal Habitat Restoration*

## Communication



- *Communicate Function, Importance and Value of Reefs to Key Constituencies*
- *Communicate Environmental Rules & Regulations to User Groups*
- *Communicate Information and Research Findings to Decision-Makers*

# Additional Coral Reef Management Goals

## Climate

*Manage for resilience to the effects of climate change and promote recovery of reefs from previous and ongoing impacts.*

## Fisheries

*Manage fishing impacts on critical stocks that most directly affect the health and resilience of the reef ecosystem.*

## Marine Pollution

*Reduce other sources of marine pollution and human impacts.*

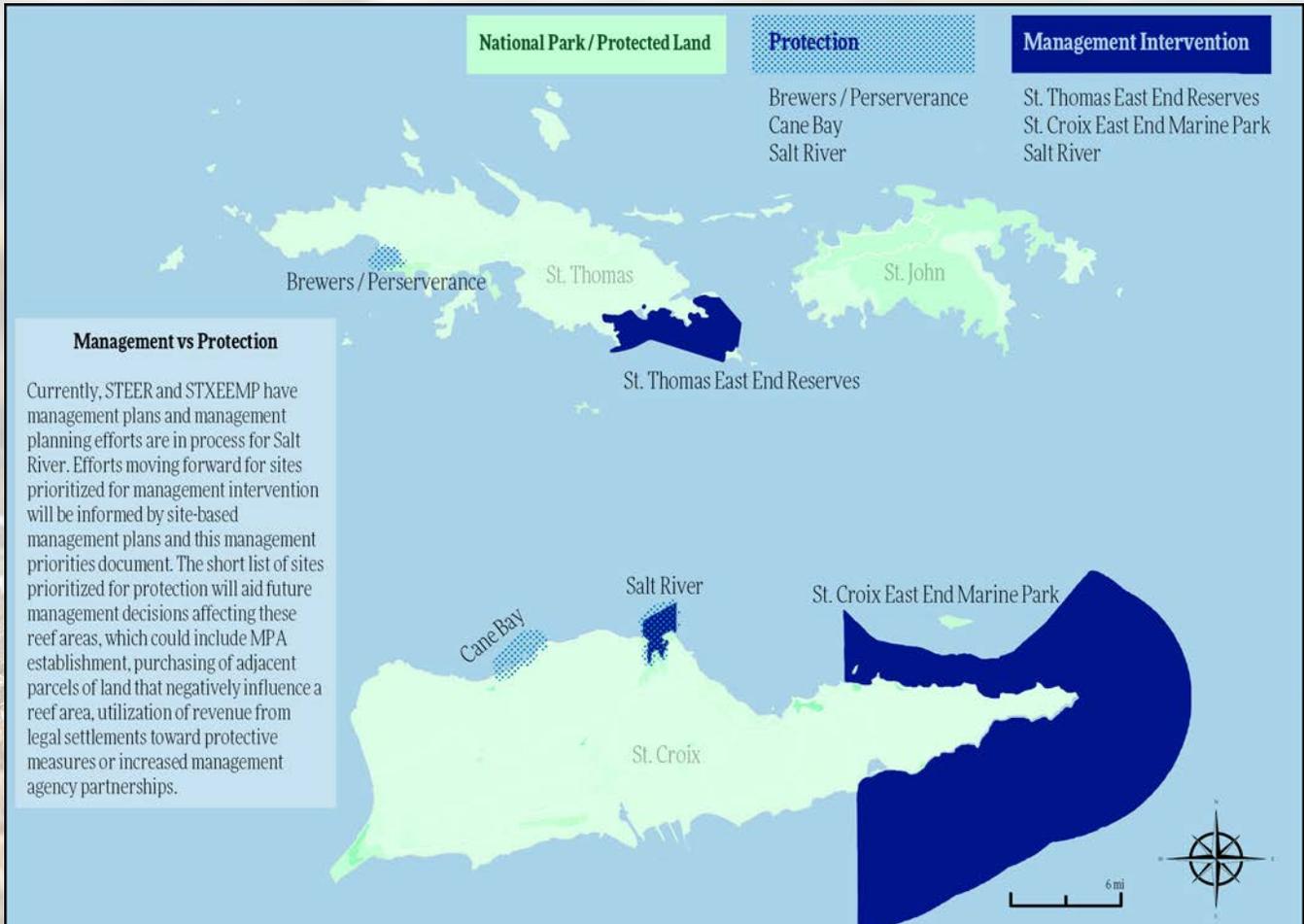
## Invasive & Nuisance Species

*Protect against, prepare for and control/manage invasive and nuisance species.*

## Prioritized Sites for Intervention and Protection



To increase opportunities for partnership, streamline implementation and amplify positive tangible outcomes for Territorial coral reefs, priority geographic areas were identified. These prioritized sites are areas where efforts to implement the goals and objectives will be focused for the next five year implementation cycle. By concentrating efforts in a few reef locations, partnerships and resources will be better leveraged, the effects of strategy implementation will be additive and as a result the likelihood of achieving positive outcomes for coral reef protection and persistence will increase. Due to the numerous challenges facing Territorial coral reefs and the urgency of these challenges, Virgin Islands Coral Reef Advisory Group (VICRAG) members identified sites prioritized for (1) management intervention and (2) protection value. The map below highlights coral reef areas prioritized for management intervention: St. Thomas East End Reserves (STEER), St. Croix East End Marine Park (STXEEMP) and Salt River, as well as sites prioritized for protection: Salt River, Brewers/Perseverance Bay and Cane Bay.



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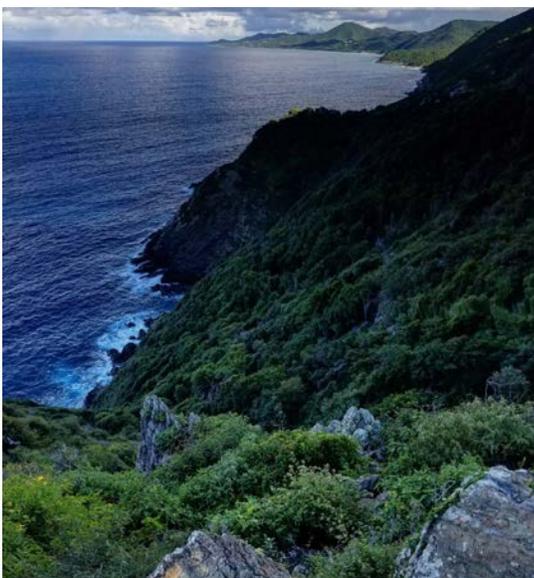
# Introduction



This document is the second in an adaptive planning process to develop strategic priorities for coral reef management in the United States Virgin Islands (USVI). The first USVI Coral Reef Management Priorities document was developed in 2010, with guidance, support and engagement from the National Oceanic and Atmospheric Administration's (NOAA) Coral Reef Conservation

Program (CRCP). The 2010 document was used to guide coral reef management activities within the territory as well as to inform CRCP's grant-making and other investment decisions.

Since the production of the 2010 document, there have been significant changes both in the capacity of the coral reef management community and in the status of territorial reefs. While important progress has been made in the areas of strategic planning, data collection, integration of data into the adaptive management process and implementing actions to benefit reefs, territorial reef condition, in general, continues to decline due to both local and global stressors. Emerging threats add to the challenges facing managers and researchers and compound the negative impacts of existing stressors. It is increasingly important that territorial managers have timely, relevant and adaptive tools available to support and focus work to protect coral reefs and the ecosystem services they provide to the territory.



In order to guide the DPNR Division of Coastal Zone Management's (CZM) coral reef management efforts for the next five-year implementation cycle, the VI Coral Reef Advisory Group (VICRAG), and other key partners identified by CZM (Appendix I) were engaged to update the strategic coral reef management goals and objectives, and to identify priority geographic coral reef sites for implementing the priorities. These updated strategic coral reef management priorities reflect a commitment to the adaptive management process, increasing implementation, scaling up efforts that are working and identifying of new management tools and actions.

## Updating the Strategic Priorities

Through a series of in-person facilitated workshops and remotely-facilitated activities, participants were engaged to review, discuss, develop, revise and build consensus on a set of updated strategic coral reef management goals, objectives and priority reef sites. The 2010 USVI priority document was used as zero draft material to begin the process of updating the strategic priorities. For the purposes of this activity participants were asked to consider reefs at the territorial, rather than the individual, site level.

Participating partner agencies provided background information on activities conducted since the 2010 document was created, how the 2010 document had been used, and on the status and trends of territorial coral reefs. Participants utilized this information to generate a suite of eight (8) key thematic areas for consideration and discussion, and to develop a collective long-term vision for territorial reefs which is supported by the updated strategic goals and objectives. Throughout the process, participants were tasked with progressively considering, discussing, developing and revising draft goals and objectives. Draft goals and objectives were crafted to be relevant and SMART (specific, measurable, achievable and assignable, realistic and results-oriented and time-bound). The draft goals and objectives were

### Vision Statement:

**Over the next 5-7 years, manage coral reefs so that ecosystem function, support of the USVI economy & provision of ecosystem services are preserved, & resilience is increased. At a minimum, no further degradation from current coral reef ecosystem condition.**

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## Stony Coral Tissue Loss Disease: An Emerging Threat and Challenge for Managers

During the process (January 2019) to update the USVI Coral Reef Management Priorities, Stony Coral Tissue Loss Disease (SCTLD) was reported in St. Thomas. SCTLD is a particularly virulent coral disease that was first documented in Florida in 2014. SCTLD is especially concerning because the outbreak in Florida has continued to spread since 2014, shows no seasonal patterns of slowing (unlike some other coral diseases), is highly transmissible and affects many coral species. Prevalence of SCTLD is high, and so are colony mortality rates. The causative agent of SCTLD is currently unknown. Managers and researchers from the USVI, Florida, NOAA and several academic institutions are working together to better understand SCTLD and to identify ways to effectively treat impacted corals. The emergence of SCTLD in the USVI highlights some of the challenges facing natural resource managers, and the need for both resources and flexibility to plan and respond to emerging threats and unexpected events in order to maximize the potential for positive outcomes. To learn the latest on the disease, visit [vicoraldisease.org](http://vicoraldisease.org).

prioritized through voting exercises. When voting, participants were asked to consider which goals and objectives would have the most positive impact on coral reef health and function, which were locally appropriate and amenable to local actions, which were SMART and which were less vulnerable to agency or community challenges, constraints and deficiencies. Only draft objectives that were nested under the resulting prioritized goals were voted upon. Prioritized goals and objectives were further refined, and participants developed suggested draft activities. The strategic coral reef management priorities update process occurred in 2018 and 2019, but participants agreed that the five-year implementation period will be from 2020 through 2025.



## Strategic Coral Reef Management Priorities

Eight (8) USVI-specific and relevant goals were developed by process participants. These goals represent a suite of important issues and threats facing USVI coral reefs, as well as management strategies to address those threats. Four (4) of the goals were prioritized for development and action within this implementation cycle (2020-2025). These prioritized goals are listed in bold font within colored text boxes. Prioritized objectives are identified in colored text. An additional four (4) goals, and nested objectives, are included in plain text. Additionally, participants developed potential draft activities for some objectives; those have been included here as well. Goals and objectives are listed in this section in order of prioritization.

### Linkages to the NOAA CRCP Strategic Plan

The following icons have been included to indicate where the USVI Coral Reef Management Priorities dovetail with the CRCP's Strategic Plan Pillars.



**Climate**



**Fisheries**



**Pollution**



**Restoration**

## Land-Based Sources of Pollution (LBSP)

Land-based sources of pollution include sediments, nutrients, toxins and other pollutants that enter coastal waters through indirect means such as runoff and erosion, or via direct means such as point and nonpoint discharges. LBSP can negatively affect coral reefs in many ways such as smothering corals, reducing light transmission and introducing disease vectors. Objectives within this goal are intended to directly address the sources of LBSP, to mitigate the impacts of LBSP and to strengthen the policy framework and territorial capacity needed to reduce LBSP.

**LBSP Goal: Reduce impacts to coral reef ecosystems by reducing erosion, terrestrial pollutants (including sediments) and improving water quality.**

**LBSP Obj. 1: Support the development of a comprehensive land-use plan that incorporates zoning, development risk, coral habitat maps and data, in order to provide numerous departments and agencies with a guidance document for the permitting of development as well as a tool for long-term conservation planning.**

Draft activities:

- Establish a land-use plan working group to lead development of project scope and assign responsibilities and tasks, including plan outline and timetable.
- Develop and write plan that includes an implementation process.

**LBSP Obj. 2: Document the types, spatial and temporal patterns of impacts to nearshore coral and adjacent habitats from LBSP and poor water quality (e.g., heavy metals, organochlorides, marine debris, microplastics, etc.).**

Draft activities:

- Develop a database/GIS layer to show active permits.
- Internal department training on what to look for when evaluating and investigating permits and/or violations.
- Comprehensive heavy metal studies in bays across territory.
- Re-evaluate 138 territorial water quality testing sites; realign with the updated coral priorities.
- Develop an app, similar to Muddy Waters Watch, that allows users to photograph and upload information on erosion sites or muddy run-off into a database. The data would feed into a GIS interactive map to identify erosion hotspots, inform CZM and better target management and education efforts, such as the use of appropriate best management practices (BMPs) and/or assistance installing sediment control devices.



**LBSP Obj. 3: Complete watershed management plans through inclusive, stakeholder-driven development processes within the next two (2) years for the top three (3) sites prioritized for management intervention identified within this document.**

Draft activities:

- Identify territorial watershed advisory team that will drive consistent process across priority watersheds.
- Update management plans for three (3) priority watersheds.

**LBSP Obj. 4: Support inter-agency development of a comprehensive public and private road and stormwater mapping system/tool consisting of existing unpaved and/or eroding roads with priority given to those with the most erosion potential into downslope coral reef habitat (or sensitive benthic communities).**

Draft activity:

- Create an inter-divisional protocol for sharing information on applications and progress of applications.

**LBSP Obj. 5: Revise and implement the USVI Environmental Protection Handbook and support the development and implementation of new and effective development permit conditions and their enforcement (permit conditions should also consider the cumulative impacts of stressors, including but not limited to existing and expected development).**

Draft activities:

- Explore new strategies to reduce soil erosion, runoff and sedimentation into the marine environment such as establishing a permit fee structure that ties the fees to the size of the proposed development or amount of soil to be disturbed. These fees could be used to pay for trainings for regulatory and permitting staff on new technologies and strategies for erosion and sediment control, as well as improved regulatory oversight and staffing.
- Re-engage with contractors to complete USVI Environmental Protection Handbook.
- Support making stormwater standards into regulations.
- Support the writing of stormwater best management legislation.
- Outreach to key stakeholders, simplified version of Environmental Protection Handbook for target audiences.
- Develop curriculum and identify person(s) in the Department/Contractor to carry out heavy equipment operator training.
- Consider a mechanism to hire an internal DPNR BMP operator.



**LBSP Obj. 6: Support improvements to a) sewage infrastructure to increase capabilities of processing plants to improve collection and delivery systems, and b) individual/household Individual Sewage Disposal Systems (ISDS) as well as provide incentives and education opportunities to increase public engagement and implementation.**

Draft activities:

- Create and implement a rebate program for residential systems.
- Develop a revised OSDS/ISDS handbook, as well as bolster and improve specific minimum design requirements within Territorial Pollutant Discharge Elimination System (TPDES) regulations (12VIRR184).
- Work with the VI Waste Management Authority (VIWMA) and the Department of Public Works (DPW) to improve infrastructure inventory, layout and geospatial information to better understand, assess, and repair/improve collection and delivery system, as well as apply for federal funds for infrastructure improvements.
- Request coastal infrastructure inventory data from M. Beck (2018).

LBSP Obj. 7: Develop additional coral reef-specific water quality standards and management plans (e.g. Total Maximum Daily Load [TMDL], Coral Biological Condition Gradient [BCG]) to be applied in impaired areas and incorporated in permits.

Draft activities:

- Begin to develop a biocriteria program that focuses on improving and expanding the existing biocriteria water quality standards, including development of a Coral BCG model that can be used to quantify the biological condition of coral (and other benthic) organisms, habitat and ecosystems, as well as their changes over time.
- Develop assessment methodologies that utilize the Coral BCG model and results to identify waters that are impaired for biological condition, in order to develop and improve management plans, strategies and TMDLs.

LBSP Obj. 8: In order to implement watershed management strategies necessary to protect coral ecosystems, ensure that the necessary and consistent regulatory and programmatic framework exists and is enforced.

LBSP Obj. 9: Update and implement existing watershed management plans.

LBSP Obj.10: Initiate strategic planning processes to outline needed actions to provide additional protections for the top three (3) sites prioritized for protection within this document in the next two (2) years and identify additional resilient or minimally impacted nearshore coral reefs and associated habitats that should be prioritized for enhanced protection.



LBSP Obj. 11: Support a well-informed, science-based decision-making process for granting construction permits, ensuring that decision makers and permit review staff have access to technical information and known BMPs to mitigate impacts on water quality.

LBSP Obj. 12: Provide education and outreach to upper level leadership (DPNR, DPW, other commissions) and Government House, legislators, CZM Commission, the general public and schools on the economic value of coral reefs and associated habitats and the importance of reducing impacts of LBSP on them.

LBSP Obj. 13: Improve or increase inland water quality monitoring in order to determine point and non-point sources of pollution contributing to increases in key pollutants such as sediments, oil and grease, nutrients, metals, pesticides, microplastics and other contaminants and determine pathways to reduce or eliminate loading.

LBSP Obj. 14: Build partnerships among local (DPW, VIWMA, owner associations, etc.), federal and nongovernmental entities to identify, leverage and apply financial and other resources to facilitate improved coastal and upland watershed management.

LBSP Obj. 15: Support the establishment of a policy that aligns with existing water quality standards language for “no or minimal net loss or degradation of ecosystem function” of any natural coastal features that would reduce and retain runoff, including coastal ponds, mangrove systems, etc.



## Enforcement

Enforcement comprises management strategies and actions to avoid and mitigate negative impacts to coral reefs. Enforcement includes the policies needed to protect coral reefs and to deter actions that negatively impact them, as well as the supportive actions required to successfully implement those policies. Effective, consistent enforcement of environmental regulations intended to protect coral reefs has been identified as a capacity gap within the territory. Objectives within this goal are intended to strengthen the legal framework and territorial capacity to protect coral reef habitats, to support actions needed to increase voluntary compliance with coral reef protective policies and to increase the effective processing of violations to deter noncompliant behaviors.

**Enforcement Goal: Increase the ability to effectively enforce existing rules, regulations and laws to protect coral reefs.**

### **Enforcement Obj. 1: Increase existing enforcement capacity within the Division of Environmental Enforcement (DEE).**

Draft activities:

- Create a law enforcement officer's guide within 1 year (use Puerto Rico's guide as a template).
- Develop a quick reference field guide version of the DEE officer's guide.
- Provide internal DPNR natural resource training for DEE.
- Provide in-the-field short courses or other training opportunities (e.g., swimming, SCUBA diving, species identification, boat handling skills, risk management, verbal judo and conflict management/de-escalation, etc.).
- Hire additional officers.
- Identify funding sources or support for enforcement blitzes using existing proposal.
- Create and implement multi-agency compliance teams to increase enforcement visibility and promote inter-agency cross learning.

**Enforcement Obj. 2: Improve communication within and between local and federal natural resource management agencies and the superior court in order to raise awareness of impacts to coral reefs and associated ecosystems within the judiciary, to increase the number of cases successfully prosecuted and to increase positive outcomes from both voluntary public compliance as well as enforcement actions.**



Draft activities:

- Identify and engage a point of contact for DPNR enforcement matters at the superior court within 18 months.
- Develop appropriate materials (e.g., briefing documents, seminars, etc.) that stress the importance of environmental laws in protecting the natural resources the territory depends upon.
- Identify and engage liaison or point of contact within legislature to support natural resource incidents/enforcement/development of policy (foundational activity for superior court point of contact).

**Enforcement Obj. 3: Invest in technology advances and training (including remote surveillance and data collection tools) that will help enforcement officers perform more effectively and efficiently.**

Draft activities:

- Support learning exchanges and external training opportunities for enforcement officers.
- Develop a public rapid reporting system that will allow USVI residents to take a more active role in assisting officers with identifying and documenting illegal activities (e.g., Hawaii's Department of Land and Natural Resources Tip App).
- Identify and secure funding to increase the use of technology to support enforcement activities (e.g., remotely operated vehicles, tablets, drones, hydrophones to detect vessel presence in protected areas, etc.).
- Develop and implement an online system for vessel registrations and moorings.
- Use current science and data to inform the development of enforcement schedules to maximize enforcement effort and efficiency, SMART scheduling of officers (e.g., patrols at spawning aggregation sites).

**Enforcement Obj. 4: Identify and address all administrative gaps in DPNR Enforcement and amend the DEE ticket schedule (e.g., St. Croix East End Marine Park [STXEEMP], moorings, DEP Action Policy, fisheries violations, etc.).**

Draft activities:

- CZM to establish a working group, with DEE and Division of Fish and Wildlife (DFW) participating, which meets at a regular frequency (e.g., monthly or quarterly) to review existing, known gaps and identify needed changes.
- Identify and implement the procedures necessary to address existing gaps (e.g. DEE ticket schedule amendment, use of law externship).



Enforcement Obj. 5: Initiate an inclusive process (e.g., federal and territorial agencies, Fishery Advisory Committees) to review, simplify and/or consolidate USVI environmental rules and regulations (e.g., gill net loophole, coral protection mandate, inconsistencies between federal and territorial regulations, such as size restrictions on parrotfish, etc.).

Draft activities:

- Create a working group that will aggregate rules and regulations up for review and assessment (e.g. Title 12, Division of Environmental Protection [DEP], DFW and CZM regulations, etc.).
- Task working group with generating recommendations for updating rules and regulations.
- Support revising and updating of Act 3330, USVI fishing regulations.

Enforcement Obj. 6: Fund a dedicated resource compliance officer to provide specialized knowledge to complement DEE officers within 2 years.

Draft activities:

- Develop a position scope of work using the MPA Enforcement International strategic plan (2018).
- Work with DPNR Human Resources to develop, approve, announce and fill position.

Enforcement Obj. 7: Develop Memoranda of Understanding (MOU) with the U.S. Coast Guard (USCG) and NOAA Fisheries Enforcement, using Puerto Rico's MOU as a template.

Draft activity:

- Use the USVI presence at Caribbean Fishery Management Council (CFMC) meetings to advance creation of these documents.

Enforcement Obj 8: Establish an environmental law externship and/or fellowship.

Draft Activity:

- Identify 2-3 tasks that externship candidates could work on.

Enforcement Obj. 9: Identify and engage a point of contact within Virgin Islands Waste Management Authority (VIWMA) for collaboration with DEE.



## Restoration and Interventions 🌱 🌡️

Restoration and interventions include actions implemented to avoid, minimize or mitigate negative impacts to coral reefs, or to restore them after an impact. Restoration and interventions might also occur in adjacent or supportive habitats to reduce an impact to coral reefs. Due to the numerous local and global stressors affecting territorial coral reefs, it is increasingly necessary for managers to implement actions locally, at the individual reef scale, to maintain coral habitats and secure the socioeconomic benefits they provide into the future. Objectives within this goal are intended to protect and rehabilitate reef areas through supporting the development and implementation of both passive and active restoration methods to reduce impacts to reefs, to increase resilience of reefs to impacts and to directly increase the number and diversity of corals on reef sites.

**Restoration and Interventions Goal: Utilize restoration and intervention principles and strategies to promote resilience, maintain ecosystem function and services and mitigate impacts to coral reefs and associated habitats.**

**Restoration Obj. 1: Prevent boat and anchor damage to coral reefs by installing and maintaining mooring buoys, navigational aids and markers (passive restoration).**

Draft activities:

- Create a territorial water-use plan which includes the implementation and maintenance of a transient mooring system and navigation markers/aids.
- Identify and consider high-risk, high-value, trouble-spot reef areas and channels that might need to be marked using pencil buoys or other navigational aids.
- Increase awareness of mesophotic reefs and education on risks to them from anchoring.
- Explore ways to identify responsible parties for derelict and abandoned vessels and grounding incidents and create effective mechanisms to hold those parties accountable, collect damages and utilize those damages to support removal of derelict and abandoned vessels.

**Restoration Obj. 2: Proactively work to respond to, and prevent, coral disease impacts to reefs.**

Draft activities:

- Identify and implement innovative ways to treat and manage active coral disease outbreaks.
- Identify and research methods to identify disease vectors and to prevent or limit the spread of putative pathogens.



- Explore creation and adoption of a ballast water policy to limit the introduction and spread of coral diseases.
- Create a response plan for coral disease outbreaks.
- Identify and secure funding to support implementation of coral disease surveillance and response activities.
- Research coral disease treatments being used in other geographies for application in the USVI.
- Explore novel treatments and/or actions to address colony-specific disease impacts as well as impacts at reef site and territorial levels.
- Identify and secure stable, continued funding to support coral disease treatment and response.

**Restoration Obj. 3: Support research into, and the development of, innovative habitat restoration techniques and monitoring of restoration impacts for coral reefs, mangroves, seagrass beds, watersheds, salt ponds, beaches and shorelines.**

Draft activities:

- Develop BMPs for mangrove, seagrass and shoreline restoration for resilience (diversity, spacing, maintenance, species, etc.).
- Invest in assisted evolution techniques, such as stress-hardening, disease resistance and resilience and selective breeding, in coral restoration operations.
- Support and incorporate land-based nursery operations into restoration work.
- Incorporate micro-fragmenting into coral nursery operations and enhanced sexual reproduction techniques into coral restoration activities.

**Restoration Obj. 4: Identify areas where restoration efforts will be most successful and beneficial, incorporating an assessment of multiple stressors and cumulative impacts considering environmental, ecological, economic and social factors.**

Draft activities:

- Determine the value of specific reef systems based on the infrastructure they protect from storm surge.
- Develop a prioritized restoration plan that identifies potential restoration sites to be used in mitigation of planned impacts and identify areas where previous restoration efforts were implemented.
- Support development of a more comprehensive inland waterbody inventory and mapping system, collecting existing information and current knowledge, identifying data gaps and doing field work to fill gaps or update information (such as changes due to hurricanes).



- Investigate environmental variables that impact restoration success, including *Ramificrasta*, *Sargassum*, water quality, invasive species, wave energy/action and nearshore sand and sediment movements.

**Restoration Obj. 5: Create and implement a coordinated restoration response strategy for disturbances (e.g. storms, spills, vessel impacts, bleaching, disease, etc.) to increase recovery of affected coral reef and associated ecosystems.**

Draft activities:

- Update the vessel grounding response plan.
- Identify clear protocol for mitigation funding from insurance/vessel owners after boat groundings and make sure the money makes it to mitigation.
- Create a hurricane/storm damage response plan that includes triage/coral restoration efforts short-term and long-term, as well as identifies potential funding sources for restoration (Federal Emergency Management Agency [FEMA], hazard mitigation, etc.).
- Ensure response plans for different disturbances are compatible with each other and can be integrated into one “master” response strategy.

**Restoration Obj. 6: Research methods and assess the feasibility of herbivore and bioturbator restoration (e.g. parrotfish, *Diadema*, crustaceans, etc.).**

Draft activities:

- Support research to incorporate and test the effect of herbivore restoration at coral restoration outplant sites (e.g., *Diadema*, parrotfish, etc.).
- Assess the feasibility of restoration potential for large parrotfish species through aquaculture.
- Investigate the effect of positive and/or facilitative interactions on mangrove and seagrass restoration success (e.g., bioturbators, crustaceans, etc.).
- Develop an herbivore restoration action plan.

**Restoration Obj. 7: Increase diversity, resilience and abundance of mangrove, seagrass and other coastal habitats through active restoration of those habitats.**

Draft activities:

- Support the development of mangrove and native coastal plant nurseries.
- Secure and increase funding dedicated to coastal habitat restoration activities.



Restoration Obj. 8: Increase coral diversity, resilience and abundance through coral nursery operations (both in-water and on-land nurseries).

Draft activities:

- Secure diverse and sustainable funding sources for coral nursery operations to increase their size and impact.
- Increase the number of species and genotypes that are grown in coral nurseries.
- Incorporate micro-fragmenting into coral nursery operations.
- Incorporate enhanced sexual reproduction techniques into coral restoration activities.
- Support and/or incorporate land-based nursery operations into restoration work.
- Monitor outplants with simple methods to determine success, failure, and associated ecosystem services and share results.

Restoration Obj. 9: Support research into and incorporation of green infrastructure.

Draft activity:

- Support programs that prioritize native vegetation (growing and reintroduction).

Restoration Obj. 10: Identify and implement projects that will conserve the genetic diversity of endangered and rare coral species, and species that are determined to be highly susceptible to disease.

Restoration Obj. 11: Create education and outreach opportunities about restoration of coral reefs and associated ecosystems to target audiences (e.g., legislature, schools, citizen scientists, etc.).

Draft activity:

- Create citizen science programs to advance restoration.

Restoration Obj. 12: Support research into, and establishment of, restoration benchmarks and targets.

Draft activities:

- Research and quantify historical benchmarks.
- Align benchmarks and targets with Coral BCG models.



## Communication

Communication comprises management strategies and actions to avoid and mitigate negative impacts to coral reefs. The communication goal relates to and supports the other coral reef management goals in this document. Effective communication with and among diverse audiences about coral reefs is critical to building a solid foundation for effective management. Objectives within this goal are intended to improve public communication efforts, to increase communication within certain constituencies and to better understand linkages between understanding and behavior.

**Communication Goal: Increase the awareness of and appreciation for USVI coral reefs and associated ecosystems by implementing more frequent, evidence-based, effective communication strategies that target resource users, the general public, decision-makers and the management community. These strategies are intended to remove barriers to positive behavior changes, increase political will, improve management effectiveness, enhance territorial environmental literacy, and ultimately improve resource condition.**

**Communication Obj. 1: Convey the functioning of, importance of and economic value of coral reefs and associated ecosystems to key constituencies, and measure their understanding of, and attitudes and behaviors concerning the human impacts, such as pollution, overfishing, etc., on the value of coral reefs.**

Draft activities:

- Use coral reef data and science to create communication products for priority target audiences.
- Develop and release Coral Reef Benefits public service announcements to be distributed (e.g., on social media, radio, TV, print.)
- Develop materials to communicate monetary value of coral reefs derived from past and upcoming studies and tools.
- Identify and develop communication strategies for priority target audiences such as hotel associations, dive shops, homeowner's associations (HOAs) and others (e.g. MOES-VI).
- Develop, implement and measure impact of strategies to reduce damage to reefs (no-touch policies, safer or no-sunscreen policies, etc.).
- Liaise with NOAA National Coral Reef Monitoring Program (NCRMP) and any additional tools to measure public understanding and behavior change.



**Communication Obj. 2: Develop and implement communication, education and outreach strategies (e.g., workshops, orientations, rapid reporting systems, service opportunities, etc.) in partnership with other agencies and programs to work with user groups (e.g., HOAs, recreational users, developers, fishers, etc.) to increase knowledge of and compliance with environmental rules and regulations.**

Draft activities:

- Increase print, radio and TV public service announcements that inform the public about coral reef resources and encourage responsible behavior.
- Develop, schedule and implement workshops or other communication strategies to provide a regular mode of information dissemination.
- Support implementation and expansion of the VI Clean Coast certification program.
- Assess changes in community environmental literacy and behavior resulting from these communication activities.
- Create new informal science learning opportunities and measure their impact.

**Communication Obj. 3: Emphasize the transfer of information and research findings to decision-makers (e.g. legislators, policy makers, agency heads, political appointees, etc.) so that they are enabled to develop more effective policy and management actions.**

Draft activities:

- Use coral reef data and science to create communication products for priority target audiences.
- Develop and release Coral Reef Benefits PSAs to be distributed (e.g., on social media, radio, TV, print).
- Pursue and document learning exchanges for policy and decision makers, such as, field trips, trainings and/or de-briefings for the Governor, Senators and their staff.
- Support and advocate for evidence-based internal policy development and changes.
- Work with policy makers to advocate for changes that will reduce impacts to coral reef ecosystems (such as adoption of safer sunscreen legislation).
- Support the USVI Coral Reef Management fellows that are embedded in local government and territorial agencies, increasing capacity and access to scientific expertise.

**Communication Obj. 4: Build and support life-long commitment to coral reefs and associated ecosystems, in order to increase public support for resource management actions, and seek partnerships with existing organizations (educational, civic, etc.). Encourage greater participation in resource stewardship at all levels of society to affect long-term behavioral change.**



Draft activities:

- Encourage participation in, and development of communication strategies and tools to support existing partner organizations (e.g., VIMAS, CZM, VI EPSCoR, SEA, VICS, NPS, Junior Scientists in the Sea, World Ocean School, National Association of Black Scuba Divers), their outreach programs (e.g., EcoSchools, Youth Ocean Explorers, Coral Conservation Academy) and coral reef communication efforts.
- Support programs that connect youth classroom experience with field experience. Build upon and support existing programs and curricula. Design and implement another Youth Summit.
- Create opportunities to keep coral reef stewards who were nurtured in the youth programs engaged in coral reef conservation, policy and advocacy through aligned programming (e.g., internships, university curriculum and coral scholarships).
- Assess the impact of these efforts.

Communication Obj. 5: Raise awareness of the distribution, importance and vulnerabilities of mesophotic reefs in the general public, and in particular among resource users (e.g. fishers) and policy makers.

Draft activity:

- Develop and deliver presentations.

Communication Obj. 6: Incorporate evidence-based best practices, techniques and interventions from current scholarship on influencing behavior change, into communication strategies.

Communication Obj. 7: Improve and enable coordination and communication among USVI coral reef practitioners.

Draft activities:

- Strengthen the VICRAG as a mechanism for improved cooperation and collaborative action (e.g., directing science, conservation and management goals of the territory, influencing messaging and communication strategies, etc.) to conserve and manage the coral reef ecosystems of the USVI.
- Develop and implement specific mechanisms, such as reports, technical briefs and a science-to-management summit to enable improved communications between the coral reef science and coral reef management communities in the USVI and to provide current science-based information and recommendations for management action.



- Develop and implement specific mechanisms, such as CZM consistency, inter-agency, pre-application meetings and permit application checklists and permit process summary guides, to enable improved cooperation between permitting authorities at the territorial and federal government levels.
- Improve intra- and inter-agency communication (including DPNR, NPS, etc.) on scientific permitting for coral reef and associated habitat research (e.g., host a list of scientific permits with a 1-2 sentence description and contact info for the primary investigator on the DPNR website).

## Environmental Education Spotlight

While there are numerous summer enrichment opportunities available to Virgin Islands youth, there are very few that engage them in the marine sciences and highlight career pathways within this field. The **Ocean Explorers Summer Programs** which are offered by VIMAS at the University of the Virgin Islands have been able to bridge that gap. These programs, which now operate on both St. Thomas and St. Croix, are open to children in grades 3-6 (Junior Ocean Explorers Summer Program – St. Thomas only) and grades 7-12 (Youth Ocean Explorers Summer Program). Both programs focus on utilizing marine and terrestrial environments found in the USVI to teach students marine and geoscience concepts. Since 2015, all programs combined have engaged approximately 150 students, scuba certified 38, and provided professional training and certifications to 21 students. These programs have been instrumental in highlighting potential career opportunities for students by connecting them with Underrepresented Minority STEM-based scientists from the Coastal and Estuarine Research Federation so that they can engage with them either virtually or in-person and potentially transform their perspective of what a modern scientist looks like. With professional training, newfound knowledge in marine science topics, and scuba diving skills, these programs aim to increase the number of locally-trained marine scientists within the USVI to better help and protect the natural resources that support our territory.



## Climate

Changes in the global climate such as increasing sea surface temperatures, ocean acidification and increased frequency and strength of storms are having detrimental impacts on local reefs. Impacts of climate change include seasonal coral bleaching events, changes in species composition and weakening of the 3-dimensional framework of reefs, as well as compounding the negative effects of other stressors such as diseases and invasive and nuisance species. Within the USVI there is limited ability to impact and reduce the drivers of global climate change so the focus for this goal is on activities that will increase coral resilience (to include resistance to and recovery from disturbances) and reduce localized compounding stressors. Objectives within this goal are intended to generate necessary data to better inform management strategies, to ramp up implementation of existing effective strategies and to expand participation and collaboration with other agencies and areas to identify additional solutions.

### **Climate Goal: Manage for resilience to the effects of climate change and promote recovery of reefs from previous and ongoing impacts.**

Climate Obj. 1: Support more research on, leading to a better understanding of, the following priority climate-related issues:

- a. Climate change projections for the USVI (including surface and bottom seawater temperatures, projected changes in pH and salinity)
- b. Possible effects of climate change on shallow and mesophotic coral reefs and associated ecosystems
- c. The impact of climate change on coral disease ecology and etiologies
- d. The impact of climate change on the coral holobiont
- e. Relationship between thermal stress and disease
- f. Coral resistance to thermal stress and disease
- g. Effective responses to coral disease outbreaks, including treatment, containment and prevention
- h. Identification and cultivation of stress-tolerant corals
- i. Cumulative effects of multiple stressors to include both chronic/creeping (e.g., sea level rise) and acute (e.g., storm event) stressors
- j. Resilience following global, regional and local stressors
- k. Physiological tolerances and predicted shifts in species distributions
- l. Distribution patterns and potential changes to oceanographic currents
- m. Thresholds and/or tolerated ranges for stressors (e.g. sediment, pollutants, temp, pH, etc.) which compromise health/resilience of holobiont
- n. Short - and long-term effects of stressors on coral reef ecosystems and ecosystem function



- o. Identification of vulnerable/high risk coral areas
- p. Impacts to mesophotic reefs
- q. Impacts on reproductive output of corals and other commercially important species
- r. Impacts of climate change on invasive species that negatively impact corals and coral ecosystems
- s. Tools that help integrate climate impacts into management decisions
- t. Assessment of potential to intervene (e.g. cloud-seeding, deep water pumping) during severe bleaching events

Climate Obj. 2: Identify and protect areas of high resilience and areas that are sources of coral juveniles/recruits.

Climate Obj. 3: Continue to support and provide training opportunities to natural resource managers, policy and decision makers and other relevant stakeholders to increase their understanding of the impacts of climate change on coral reef ecosystems, the predicted range and uncertainty of changes that will occur, and management strategies, tools and technology to assess risk and mitigate adverse impacts of climate change and related stressors (includes training a coordinated response team).

Draft activity:

- Increase local participation in the U.S. Coral Reef Task Force Climate Change Working Group.

Climate Obj. 4: Develop island-specific coral thermal stress thresholds (degree heating weeks).

Climate Obj. 5: Give advisories when bleaching and disease or hurricane damages are extensive to reduce activities and pressures compounding thermal stress and to increase potential recovery of reef areas.

Draft activities:

- Implement territorial bleaching response plan.
- Develop a template for coral stress alerts to be used during events.
- Establish a protocol for releasing advisories that specifies responsible parties and threshold at which the advisory is released.
- Create and/or implement territorial coral disease and physical disturbance (e.g., vessel grounding, storm damage) response plans.
- Develop a web portal with a user-friendly interface to share information and advisories.



Climate Obj. 6: Support and participate in VICRAG to incorporate knowledge into management action and policy (e.g., marine protected areas [MPAs], closures, permit conditions, etc.).

Draft activities:

- Encourage participation of at least one representative from each member agency in quarterly VICRAG calls.
- Secure funding for regular in-person meetings and workshops for VICRAG members.

Climate Obj. 7: Establish and maintain a contingency fund to monitor and assess severe bleaching events.

Climate Obj. 8: Develop and support education and outreach programs and tools that involve citizens in detecting bleaching events as well as other disturbances, such as pollution, storm damage and groundings (e.g., BleachWatch, MOES-VI).

Draft activities:

- Explore ways to increase public participation in existing programs and tools.
- Develop 'ghostbusters' guide to help public detect disturbances, collect the correct information and report it to the correct parties.
- Facilitate citizen science opportunities.
- Identify funding sources for programs.

Climate Obj. 9: Increase participation in, and communication among, regional resource managers (Puerto Rico, Culebra, British Virgin Islands [BVI], etc.) to alert to disturbance events and disease outbreaks, leverage resources, etc. (opportunities/venues include: climate change response plan quarterly calls, NOAA in the Caribbean quarterly calls, Reef Resilience program, Coral Restoration Consortium, CARICOOS and other regional planning groups).

Draft activity:

- Collaborate with regional agencies (Florida, Puerto Rico, BVI, etc.) to ameliorate the impacts of climate change, communicate relevant research and manage issues from a larger-scale perspective.

Climate Obj. 10: Look to other locations for tools and management strategies that could be adapted and transferred to USVI.



Climate Obj. 11: Educate public about climate change impacts to corals and how to reduce personal carbon footprint, using culturally relevant, place-based, formal and informal science learning opportunities.

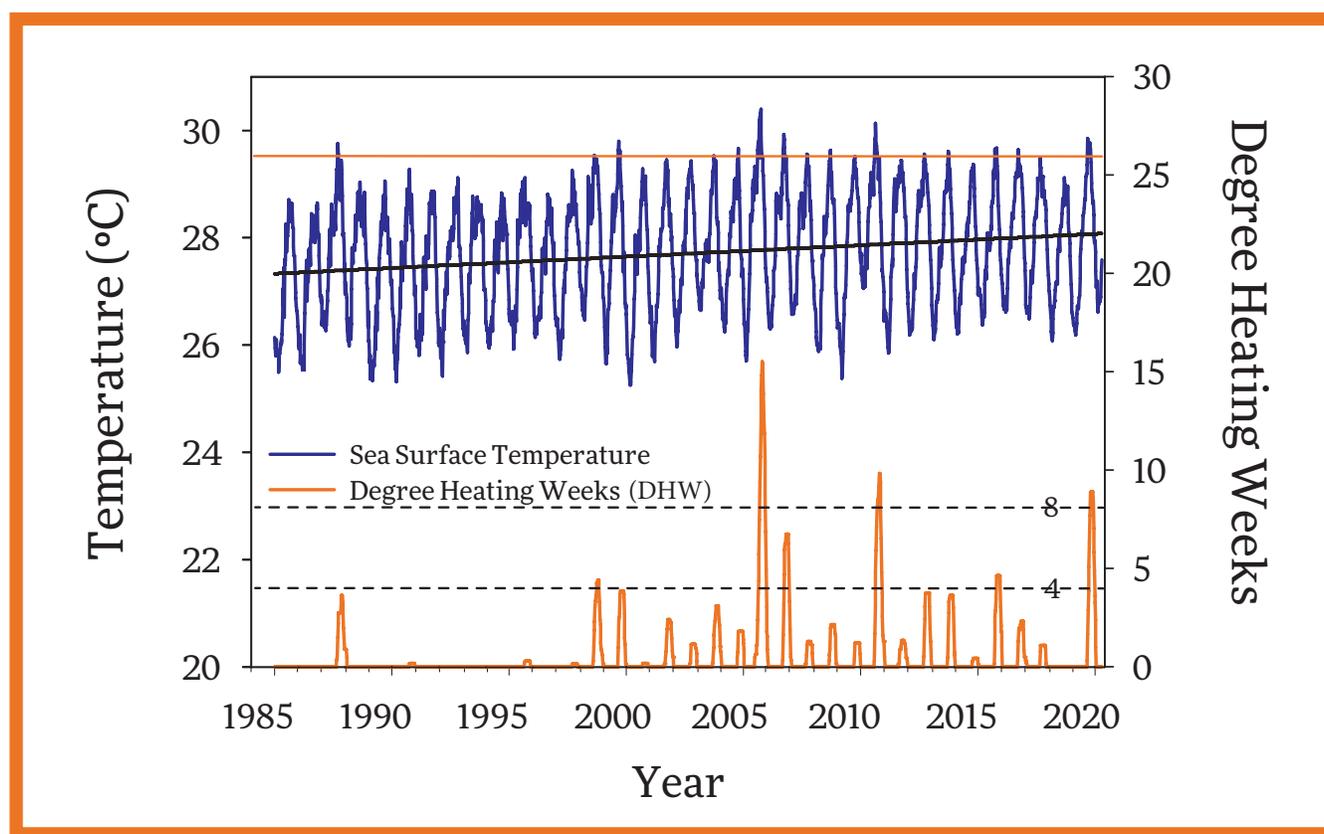
Draft Activity:

- Participate in community forums and/or plan workshops.

Climate Obj. 12: Coordinate with the territorial climate change task force to leverage collective impact of activities and actions.

Draft Activity:

- Identify most appropriate way to introduce discussion of climate impacts to coral reef ecosystems to this body (e.g., provision of outreach or training).



Sea surface temperatures and degree heating weeks of the USVI from 1984-2020. Temperatures have been increasing at about 0.2°C per decade across this record, leading to increasing frequency and severity of coral bleaching events. DHW take into account the duration and severity of heating above the bleaching threshold temperature (red line at 29.5°C). DHW above four are associated with the onset of coral bleaching and above eight are associated with mass bleaching and the start of coral mortality. Data from NOAA Coral Reef Watch 5 km product (<https://coralreefwatch.noaa.gov/satellite/ge/index.php>; accessed April 20, 2020).



## Fisheries

Fisheries includes both the state of the resource (stock) and the health and productivity of the fishery (ecosystem service). Sustainable stocks of coral reef fish are vital to ecosystem function and declines in key functional groups, such as herbivores, facilitate negative changes in coral reef habitats. Objectives within this goal are intended to track the condition of, generate data on and better understand the resource and the fishery, as well as to utilize that information to inform adaptive and effective fishery management practices.

**Fisheries Goal: Manage fishing impacts on critical stocks that most directly affect the health and resilience of the reef ecosystem.**

Fisheries Obj. 1:

- a. Improve understanding of district-specific (St. Thomas/St. John, St. Croix) fisheries resources and patterns of fishing effort through collaboration with local and federal researchers pursuing management – driven fisheries science.
- b. Compile and assess USVI commercial fisheries trend data and fishery data analysis (e.g. landings, size frequency, size, age, first reproduction, etc.), both species- specific and site-specific data, identify data gaps and use this to create a baseline.
- c. Combine outputs from a) and b) into a report that shows the current state of the fisheries for each district in the USVI and includes recommendations for management.

Fisheries Obj. 2: Develop and implement enhanced tools to remotely collect data for MPA compliance and fishery resources.

Draft activities:

- Explore use of hydrophones to detect boat presence in MPAs.
- Develop an enforcement schedule at fish spawning aggregation sites based on timing of aggregation formation.
- Explore use of drones to aid enforcement efforts.

Fisheries Obj. 3: Continue to assess the effectiveness of MPAs in meeting their stated management goals.

Draft activities:

- Identify and monitor fish spawning aggregations inside and outside MPAs and in mesophotic areas.



- Conduct surveys of commercially-important reef species inside and outside MPAs.
- Conduct acoustic telemetry studies to look at movements of commercial species into and outside of MPAs and connectivity among MPAs.
- Publicize or share results through VICRAG and other avenues.

#### Fisheries Obj. 4: Quantify and regulate recreational fishing in the USVI.

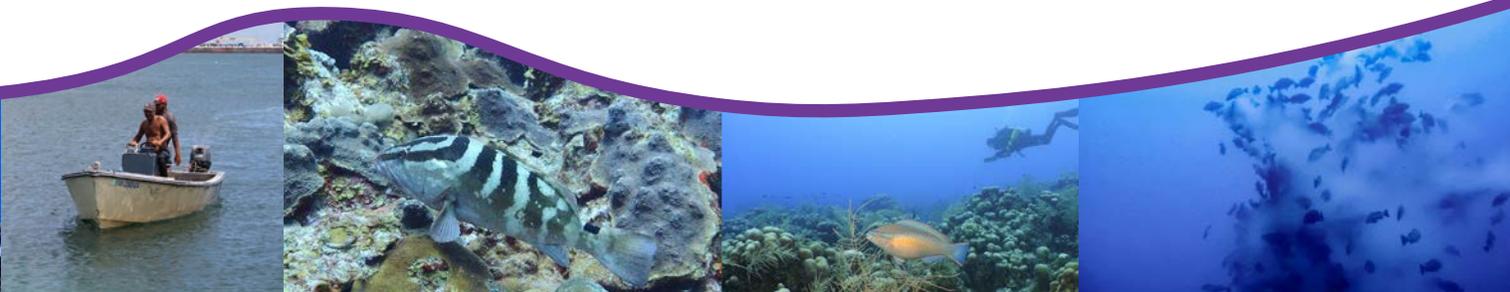
##### Draft activities:

- Obtain the necessary information to understand the impacts of recreational fisheries in the USVI through creel, or similar, surveys.
- Compile existing recreational fishery data and identify data gaps.
- Support development of a recreational fishing license program with associated legislation for recreational fishing regulations with clear requirements and authorities for monitoring, enforcement and penalties.
- Develop an electronic reporting system to facilitate reporting of landings data by recreational fishers.

#### Fisheries Obj. 5: Manage fishing effort on prioritized coral reef-associated species, functional groups or areas (e.g., herbivores, juveniles, apex predators, biodiversity hotspots, spawning sites, nursery habitat, etc.).

##### Draft activities:

- Clarify current recreational and commercial fishing regulations and identify gaps.
- Identify incompatible regulations between local and federal waters and develop a strategy to address the inconsistencies.
- Draft proposed regulations to enhance functional groups.
- Establish territory-wide size limits (upper and lower) on parrotfish.
- Reduce fishing of large predators such as sharks.
- Protect and enhance juvenile nursery habitat.
- Include in outreach materials the importance of protecting the large females in fish and invertebrate populations.
- Revisit queen conch (*Strombus gigas*) and Caribbean spiny lobster (*Panulirus argus*) regulations to include best available science for improved protection and population sustainability.
- Engage stakeholders including fishers, the Fisheries Advisory Committees and CFMC in efforts to improve regulations and management of functional groups.



Fisheries Obj. 6: Continue to improve commercial fisheries record-keeping and fisher compliance by developing and implementing an effective mechanism to improve the current data-gathering process.

Draft activities:

- Increase frequency and quality of port surveys.
- Explore new methods for port sampling (e.g., digital image capture system which makes port sampling more efficient and accurate and facilitates data summary and reporting efforts).
- Explore new methods for fisheries-dependent fish sampling.
- Identify programs that have contributed to improvements in fisheries record-keeping from other areas and apply these programs in the USVI.

Fisheries Obj. 7: Understand ecological connectivity through dispersal of eggs and larvae to identify key sources and sinks; assess connectivity between existing and potential MPAs and between spawning aggregations and juvenile habitat to identify resilient areas for protection.

Draft activities:

- Utilize existing information and models to create predictions of source/sink dynamics.
- Start plankton sampling program to examine abundance and distribution patterns of reef fish larvae with a focus on grouper, snapper and parrotfishes and model potential contribution of self-recruitment from local spawning aggregations.

Fisheries Obj. 8: Understand the impact of the loss of the big three protected parrotfish species (midnight, rainbow, blue) on coral reefs and explore methods of restoring populations.

Draft activities:

- Identify locations of remaining populations.
- Support parrotfish restoration research and operations.
- Include big three parrotfish into reporting tools (e.g., Bleach Watch).
- Fund, produce and disseminate 'Detective Goo Too Comic' and/or other outreach materials.



Fisheries Obj. 9: Reduce the use of inappropriate gear and poaching in MPAs through educational efforts and enforcement.

Draft activities:

- Educate the public about baitfish and line fishing permits needed in locally-managed MPAs and issue permits where appropriate.
- Continue STXEEMP and St. Thomas East End Reserves (STEER) signage and informational campaigns for shoreline and resource users.

Fisheries Obj. 10: Develop and implement effective strategies created and enforced by fishers to identify, understand and apply fisheries self-management practices.

Draft activities:

- Increase fishers' opportunities and participation in research and monitoring.
- Expand Reef Responsible, or similar, initiative throughout USVI and to supermarkets, consumers, and restaurants.
- Ramp up media coverage during key time periods relevant to biological events (seasonal closures, etc.).

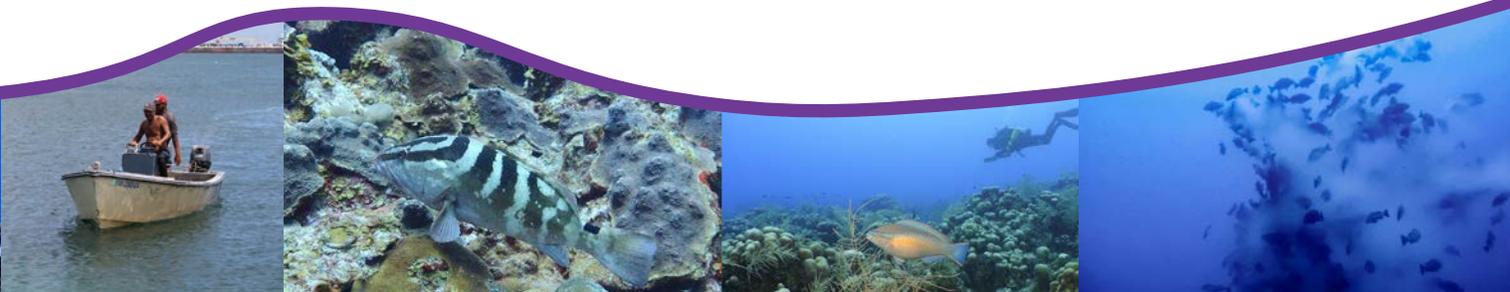
Fisheries Obj. 11: Provide support for legal counsel in order to update fishing regulations through promulgation.

Draft activity:

- Establish and utilize an Environmental Law internship and/or fellowship.

Fisheries Obj. 12: Update the USVI benthic habitat maps.

Fisheries Obj. 13: Understand the social impacts of legislation and regulatory actions on the fishing community and identify alternatives to mitigate negative impacts of these actions.



## Marine Pollution

Marine pollution includes debris, nutrients, toxins, pathogens and other pollutants that enter coastal waters. Marine pollution can originate from land-based (e.g., garbage and litter) or water-based (marinas, vessels) activities and sources. Marine pollution can negatively affect coral reefs by causing direct physical damage, by negatively impacting coastal water quality and by introducing pathogens. Objectives within this goal are intended to directly address the sources of marine pollution and engage the wider community to change behaviors resulting in marine pollution.

### **Marine Pollution Goal: Reduce sources of marine pollution and human impacts (beyond Goal 1 LBSP).**

Marine Pollution Obj. 1: Work with federal and territorial governments and the private sector to inventory, assess and understand marina needs in the territory.

Draft activities:

- Explore options for pump-out systems that could be made available and easily accessible for recreational vessels (access funds through the Clean Vessel Act and Boating Infrastructure Grant).
- Inventory all existing marinas and assess their flushing capabilities, dredging needs, potential pollution sources, and rate their pollution risk based on this information to better address needs and minimize environmental impact.

Marine Pollution Obj. 2: Reduce marine and coastal debris by implementing strategies to reduce production and use of items which constitute debris, improve the collection and storage of debris, as well as debris clean-up activities.

Draft activities:

- Develop and implement territorial marine debris action plan.
- Pursue legislative changes regulating single-use plastics.



Marine Pollution Obj. 3: Develop and distribute accessible materials to improve the ability of the public to prevent and report marine pollution, and to inform vessel users about mooring buoys and navigational aids.

Draft activity:

- Produce and distribute Marine Conservation Resource Guide developed by the Coral Management Fellow.

Marine Pollution Obj. 4: Inform community about their role/relationship with marine debris (e.g. school programs, public events).

Draft activities:

- Support existing programs (eg. International Coastal Cleanup).
- Provide information on effects of marine pollution on the reef to educators.
- Participate in Reef Fest, Eco Fair and other public events.

Marine Pollution Obj. 5: Actively participate in Caribbean Regional Response Team (CRRT) trainings and drills.

Draft activities:

- Encourage greater participation from DPNR in CRRT.
- Seek a CRRT meeting to identify and/or update map products for use in case of an incident involving protected species.

Marine Pollution Obj. 6: Work with federal and local governments to develop a draft USVI ballast water policy to reduce negative impacts to coral reef ecosystems.

Marine Pollution Obj. 7: Support effective implementation of existing and developing Clean Marina and Blue Flag programs for the USVI to promote clean and environmentally-compliant marinas and beaches.

Marine Pollution Obj. 8: Identify/Assess the reefs most impacted by diving, swimming and tourism.



## Invasive and Nuisance Species

Invasive and nuisance species affecting territorial reefs include lionfish, *Halophila stipulacea*, *Sargassum* and species of *Ramicrusta* macroalgae. These species currently pose a threat to territorial reefs by altering native fish populations and by out-competing reef building coral species, potentially compounding negative effects of other stressors to reefs and exacerbating phase shifts. Invasive and nuisance species can be challenging to address, they are often emerging threats that require the coral reef community to collect and analyze data to inform management actions while simultaneously acting to address a potential threat. Objectives within this goal are intended to collect data necessary to inform management strategies, to proactively plan for increased incidences of invasive and nuisance species and to identify and implement actions to reduce negative impacts from these species.

**Invasive and Nuisance Species Goal: Protect against, prepare for and control/ manage invasive and nuisance species.**

Invasive Obj.1: Research and compile best practices and lessons-learned for species management in affected locations (impacts, methods, etc.).

Invasive Obj. 2: Monitor (continue territorial and national coral reef monitoring programs [TCRMP, NCRMP], seagrass monitoring, etc.) and predict possible distribution and movement (including predictive modelling based on lessons-learned from other areas).

Invasive Obj. 3: Prepare, implement and fund response strategies, including standard operating procedures for each invasive and/or nuisance species (defines how agencies, public, etc. react and respond).

Invasive Obj. 4: Generate incentives to encourage public/resource user identification and removal of invasive and nuisance species.

Invasive Obj. 5: Encourage/establish regional work groups to identify patterns of spread and distribution; communicate lessons-learned; control species movement.

Invasive Obj. 6: Develop a reporting hotline/protocol.

Invasive Obj. 7: Develop an invasive and nuisance species outreach strategy to help the public understand dangers and how they can help with the problem.



## Priority Sites



In order to focus coral reef management efforts and leverage collective action, geographic reef sites were prioritized. The site list from the 2010 document was used as a starting point for the site prioritization discussion. The University of the Virgin Islands’ (UVI) Center for Marine and Environmental Studies (CMES) presented data from the Territorial Coral Reef Monitoring Program (TCRMP) to the group and led a discussion of what the information might mean for identifying and prioritizing reef sites for management activities. Parameters discussed included coral cover, taxonomic diversity, hotspots, species richness, structure, recruitment, resistance to bleaching and recovery after bleaching. Also discussed were resilience (resistance and recovery) and recovery (time to recover to 2006 levels assuming no management intervention, further impacts and linear rate of recovery) indicators that had been developed for the TCRMP sites and how this information might inform which sites might be most responsive to positive management actions. As a result of this presentation and discussion, CZM decided that it would be informative for the program to have reef sites prioritized for both management intervention value and for protection value (regardless of management status). Several additional coral reef areas were also added to the list of sites for consideration (for a full list of sites please see Appendix II).

Since significantly more is now known about VI coral reef status and trends than during the 2010 effort, participants were asked to revise the ranking criteria for the site prioritization voting. A weighted vote was conducted to prioritize coral reef sites with a high value for management intervention and for protection. The following table includes the prioritized sites and the categories used to score and rank them.

<b>US Virgin Islands Priority Sites</b>	
<b>Management Intervention</b>	<b>Protection</b>
<ol style="list-style-type: none"> <li>1. St. Thomas East End Reserves (STEER)</li> <li>2. St. Croix East End Marine Park (EEMP)</li> <li>3. Salt River, St. Croix</li> </ol> <p><b>Scoring Categories</b></p> <ul style="list-style-type: none"> <li>● Management effectiveness</li> <li>● Ability to achieve priority goals and objectives</li> <li>● Degree of risk and threat</li> <li>● Socio-economic value</li> <li>● Socio-cultural value</li> <li>● Biological value</li> </ul>	<ol style="list-style-type: none"> <li>1. Brewers / Perverserance, St. Thomas</li> <li>2. Cane Bay, St. Croix</li> <li>3. Salt River, St. Croix</li> </ol> <p><b>Scoring Categories</b></p> <ul style="list-style-type: none"> <li>● Ability to achieve priority goals and objectives</li> <li>● Absence of risk and threat</li> <li>● Socio-economic value</li> <li>● Socio-cultural value</li> <li>● Resistance</li> <li>● Recovery</li> <li>● Coral diversity</li> <li>● Coral cover</li> <li>● High-quality adjacent habitats</li> <li>● Uniqueness/irreplaceability</li> </ul>

## Appendix I: Participant List

<b>Name</b>	<b>Agency/Affiliation*</b>
Jean-Pierre Oriol	DPNR
Leslie Henderson	DPNR-CZM
Kristina Edwards	DPNR-CZM
Hilary Lohmann	DPNR-CZM
Caroline Pott	DPNR-CZM-STXEEMP
Austen Stovall	DPNR-CZM-STXEEMP
Benjamin Keularts	DPNR-DEP
Vanessa Rogers	DPNR-DEP
Nicole Angeli	DPNR-DFW
Alexis Sabine	DPNR-DFW
Eric Wooden	DPNR-DFW
Tyler Smith	UVI-CMES
Rick Nemeth	UVI-CMES
Marilyn Brandt	UVI
Kristin Grimes	UVI
Marcia Taylor	UVI
Howard Forbes Jr.	UVI – VIMAS
Jarvon Stout	VI EPSCoR
Marlon Hibbert	NOAA/OCM & DPNR-CZM
Ashley Ruffo	NOAA NMFS HCD
Laura Palma	NPS
Nathaniel Hanna Holloway	NPS
James Yrigoyen	USFWS
Ashlee Lillis	TNC
Lisa Terry	TNC
Emmanuel Irizarry Soto	TNC

\*For a full list of acronyms please see Appendix IV

## Appendix II: Geographic Site Votes

A total of 19 coral reef sites were considered by the group. Sites were evaluated against a number of different criteria to determine their appropriateness for management intervention and for protection value (see Section IV for criteria). Participants ranked sites using a weighted criteria matrix; assigning a weight, or indicator of relative importance to each of the ranking criteria through consensus. Criteria were weighted on a scale of one to five, with a value of one indicating that the criteria at each site was of low importance for achieving a management or protection, and a value of five indicating the criteria was very important (values in between represent intermediate importance). The weights are listed in parentheses following the ranking criteria in the tables below. The summary ranking tables for the management intervention (A) and protection (B) votes are below.

Table A: Summary of participant votes to rank coral reef sites on suitability for management intervention.

Cumulative Rankings of Geographic Sites for Management Intervention							
	Management effectiveness (2)	Ability to achieve priority goals & obj (3)	Degree of risk and threat (3)	Socio-economic value (3)	Socio-cultural value (1)	Biological value (2)	SCORE
STEER, STT	148.76	181.68	229.5	232.68	68.5	144.5	1005.62
STXEEMP, STX	154.06	213.57	188.07	194.43	61.63	142.38	954.14
Salt River, STX	125	183	207	204	73	146	938
Brewers/Perseverance, STT	112.62	175.32	204	196.02	72.81	146.62	907.39
Coral Bay, STJ	132	180	213	186	57.5	138	906.5
Cane Bay, STX	98.82	162.57	183.3	229.5	69.06	154.06	897.31
Magens Bay, STT	125.38	173.88	180.12	235.89	73.31	93.5	882.08
Hawksnest Bay, STJ	121	169.5	153	205.5	60.5	123	832.5
West End, STX	82.88	130.68	188.07	204	64.81	119	789.44
Mesophotic Reefs	77.56	130.68	135.51	172.14	40.94	153	709.83
Long Reef, STX	79.68	121.14	173	180.12	59	93.5	706.44
Offshore Cays, STT	91.38	146.64	122.76	156.18	46.75	142.38	706.09
Flat Cay, STT	96.68	159.39	143.43	143.43	47.81	114.76	705.5
Fish Bay, STJ	102	141	192	135	37.5	88	695.5
NW Shore, STX	72.26	137.07	146.64	145.05	52.06	131.76	684.84
South Industrial Area, STX	80.76	86.07	239.07	146.64	32.94	76.5	661.98
Botany Bay, STT	85	140.25	153	110.01	39.31	116.88	644.45
Haulover Bay, STJ	92	138	126	126	43	110	635
Midshelf Reef, STJ	88	135	123	120	35	122	623

Table B: Summary of participant votes to rank coral reef sites on suitability for protection.

Cumulative Rankings of Geographic Sites for Protection										
	Ability to achieve priority goals	Absence of risk and	Socio-economic	Socio-cultural value	Resistance	Recovery	Diversity (3)	Coral Cover (3)	High quality adj	Irreplaceability
Salt River, STX	174	114	180	65	94	112	195	133.5	192	198
Brewer's/Perseverance, STT	162	133.5	172.5	64.5	92	90	180	201	177	174
Cane Bay, STX	139.5	124.5	204	60	78	110	216	160.5	112.5	207
Coral Bay, STJ	173.5	93	159	54	88	104	210	165	174	150
STXEEMP, STX	189	127.5	177	60	80	89	165	132	192	147
STEER, STT	174	78	204	63.5	90	102	145.5	120	178.5	162
Mesophotic Reefs	111	138	132	34	108	68	162	207	103.5	186
Magens Bay, STT	165	99	216	68	128	96	117	67.5	142.5	123
Offshore Cays, STT	135	151.5	130.5	43	82	92	177	129	117	165
Hawksnest Bay, STJ	162	132	175.5	51.5	72	82	133.5	130.5	123	147
NW Shore, STX	117	150	135	47	86	84	159	148.5	114	162
Flat Cay, STT	144	118.5	136.5	42.5	94	92	186	144	90	141
West End, STX	117	91.5	177	58	82	90	144	126	123	124.5
Midshelf Reef, STJ	108	132	102	34	98	78	150	153	105	141
Botany Bay, STT	126	139.5	102	41.5	78	56	171	105	123	142.5
Long Reef, STX	102	108	151.5	44.5	80	82	151.5	109.5	100.5	123
Haulover Bay, STJ	120	139.5	108	37	72	68	111	117	99	123
Fish Bay, STJ	47.5	114	76	72	76	82	114	103.5	130.5	111
South Industrial Area, STX	72	84	102	25	64	54	99	78	90	78

### Appendix III: Goal and Objective Prioritization Voting Summary Table

Participants voted to prioritize coral reef management goals, and subsequently objectives within the prioritized goals. The table below summarizes the total vote count for the goals and objectives (limited to objectives nested in the prioritized goals). Goal and objective text listed in the table below is that from the raw voting ballot used by participants; text may differ slightly from that in the main document body as a result of the revision and editing processes. Goals that were prioritized as a result of voting are listed in **bold** font; non-prioritized objectives (as a result of voting) are listed in *italicized* font. Goals and objectives are listed in order of prioritization.

*Table C:* Summary of participant votes for prioritizing coral reef management goals and objectives (within the priority goals).

SUMMARY OF GOAL & OBJECTIVE VOTES	Total # of Votes
<b>LBSP Goal: Reduce impacts to coral reef ecosystems by reducing erosion, terrestrial pollutants (including sediments) and improving water quality.</b>	<b>14</b>
LBSP 1: Support the development of a comprehensive land-use plan that incorporates zoning, development risk, coral habitat maps and data, in order to provide numerous departments and agencies with a guidance document for permitting of development as well as a tool for long-term conservation planning.	17
LBSP 2: Document the types, spatial, and temporal patterns of impacts to nearshore coral and adjacent habitats from LBSP and poor water quality (e.g., heavy metals, organochlorides, marine debris, microplastics, etc.)	12
LBSP 3: Complete watershed management plans through inclusive, stakeholder-driven development processes within the next two (2) years for the top three (3) sites prioritized for management intervention identified within this document.	8
LBSP 4: Support inter-agency development of a comprehensive public and private road and stormwater mapping system/tool consisting of existing unpaved and/or eroding roads with priority given to those with the most erosion potential into downslope coral reef habitat (or sensitive benthic communities).	8
LBSP 5: Revise and implement the USVI Environmental Protection Handbook and support the development and implementation of new and effective development permit conditions and their enforcement (permit conditions should also consider the cumulative impact of stressors, including but not limited to existing and expected development).	6
LBSP 6: Support improvements to a) the sewage infrastructure to increase capabilities of processing plants to improve collection and delivery systems, and b) individual/household Individual Sewage Disposal Systems (ISDS) as well as provide incentives and education opportunities to increase public engagement and implementation.	6
<i>LBSP 7: Develop additional coral reef-specific water quality standards and management plans (e.g., Total Maximum Daily Load [TMDL], Coral Biological Condition Gradient) to be applied in impaired areas and incorporated in permits.</i>	5
<i>LBSP 8: In order to implement watershed management strategies necessary to protect coral ecosystems, ensure that the necessary and consistent regulatory and programmatic framework exists and is enforced.</i>	5

Appendix III: Goal and Objective Prioritization Voting Summary Table

LBSP 9: <i>Update and implement existing watershed management plans.</i>	4
LBSP 10: <i>Initiate strategic planning processes to outline needed actions to provide additional protections for the top three (3) sites prioritized for protection within this document in the next two (2) years and identify additional resilient or minimally impacted nearshore coral reefs and associated habitats that should be prioritized for enhanced protection.</i>	4
LBSP 11: <i>Support a well-informed, science-based decision-making process for granting construction permits, ensuring that decision makers and permit review staff have access to technical information and known BMPs to mitigate impacts on water quality.</i>	4
LBSP 12: <i>Provide education and outreach to upper level leadership (DPNR, DPW, other commissions) and Government House, legislators, CZM Commission, the general public and schools on the economic value of coral reefs and associated habitats and the importance of reducing impacts of LBSP on them.</i>	4
LBSP 13: <i>Improve or increase inland water quality monitoring in order to determine point and non-point sources of pollution contributing to increases in key pollutants such as sediments, oil and grease, nutrients, metals, pesticides, microplastics and other contaminants and determine pathways to reduce or eliminate loading</i>	3
LBSP 14: <i>Build partnerships among local (DPW, VIWMA, owner associations, etc.), federal and nongovernmental entities to identify, leverage and apply financial and other resources to facilitate improved coastal and upland watershed management.</i>	3
LBSP 15: <i>Support the establishment of a policy that aligns existing water quality standards language for “no or minimal net loss or degradation of ecosystem function” of any natural coastal features that would reduce and retain runoff, including coastal ponds, mangrove systems, etc.</i>	1
<b>Enforcement Goal: Increase the ability to effectively enforce existing rules, regulations and laws to protect coral reefs.</b>	<b>13</b>
ENF 1: <i>Increase existing enforcement capacity within Division of Environmental Enforcement (DEE)</i>	17
ENF 2: <i>Improve communication within and between local and federal natural resource management agencies and the superior court in order to raise awareness of impacts to coral reefs and associated ecosystems within the judiciary, to increase the number of cases successfully prosecuted and to increase positive outcomes from both voluntary public compliance as well as enforcement actions.</i>	14
ENF 3: <i>Invest in technology advances and training (including remote surveillance and data collection tools) that will help enforcement officers perform more effectively and efficiently</i>	14
ENF 4: <i>Identify and address all administrative gaps in DPNR Enforcement and amend the DEE ticket schedule (e.g., St. Croix East End Marine Park [STXEEMP], moorings, DEP Action Policy, fisheries violations, etc.).</i>	13
ENF 5: <i>Initiate an inclusive process (e.g., federal and territorial agencies, Fishery Advisory Committees) to review, simplify and/or consolidate USVI environmental rules and regulations (e.g., gill net loophole, coral protection mandate, inconsistencies between federal and territorial regulations, such as size restrictions on parrotfish, etc.).</i>	11
ENF 6: <i>Fund a dedicated resource compliance officer to provide specialized knowledge to complement DEE officers within 2 years.</i>	9
ENF 7: <i>Develop Memoranda of Understanding (MOU) with the US Coast Guard and NOAA Fisheries Enforcement, using Puerto Rico’s MOU as a template.</i>	8

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ENF 8: Establish an environmental law externship and/or fellowship.	3
ENF 9: Identify and engage a point of contact within Virgin Islands Waste Management Authority for collaboration with DEE.	1
<b>Restoration and Interventions Goal: Utilize restoration and intervention principles and strategies to promote resilience, maintain ecosystem function and services and mitigate impacts to coral reefs and associated habitats.</b>	<b>11</b>
R&I 1: Prevent boat and anchor damage to coral reefs by installing and maintaining mooring buoys, navigational aids and markers (passive restoration).	15
R&I 2: Proactively work to respond to, and prevent, coral disease impacts to reefs.	12
R&I 3: Support research into, and the development of, innovative habitat restoration techniques and monitoring of restoration impacts for coral reefs, mangroves, seagrass beds, watersheds, salt ponds, beaches and shorelines.	12
R&I 4: Identify areas where restoration efforts will be most successful and beneficial, incorporating an assessment of multiple stressors and cumulative impacts considering environmental, ecological, economic and social factors.	12
R&I 5: Create and implement a coordinated restoration response strategy for physical disturbances (e.g. storms, spills, vessel impacts, bleaching, disease, etc.) to increase recovery of affected coral reef and associated ecosystems.	8
R&I 6: Research methods and assess the feasibility of herbivore and bioturbator restoration (e.g. parrotfish, <i>Diadema</i> , crustaceans, etc.)	8
R&I 7: Increase diversity, resilience and abundance of mangrove, seagrass and other coastal habitats through active restoration of those habitats.	8
R&I 8: Increase coral diversity, resilience and abundance through coral nursery operations (both in-water and on-land nurseries)	6
R&I 9: Support research into and incorporation of green infrastructure.	4
R&I 10: Identify and implement projects that will conserve the genetic diversity of endangered and rare coral species, and species that are determined to be highly susceptible to disease.	3
R&I 11: Create education and outreach opportunities about restoration of coral reefs and associated ecosystems to target audiences (e.g., legislature, schools, citizen scientists, etc.).	2
R&I 12: Support research into, and establishment of, restoration benchmarks and targets	0
<b>Communication Goal: Increase the awareness of and appreciation for USVI coral reefs and associated ecosystems by implementing more frequent, evidence-based, effective communication strategies that target resource users, the general public, decision-makers and the management community. These strategies are intended to remove barriers to positive behavior changes, increase political will, improve management effectiveness, enhance territorial environmental literacy, and ultimately improve resource condition.</b>	<b>9</b>
COMM 1: Convey the functioning of, importance of and economic value of coral reefs and associated ecosystems to key constituencies, and measure their understanding of, and attitudes and behaviors concerning the human impacts, such as pollution, over-fishing, etc., on the value of coral reefs.	13
COMM 2: Develop and implement communication, education and outreach strategies (e.g., workshops, orientations, rapid reporting systems, service opportunities, etc.) in partnership with other agencies and programs to work with user groups (e.g., HOAs, recreational users, developers, fishers, etc.) to increase knowledge of and compliance with environmental rules and regulations.	12

Appendix III: Goal and Objective Prioritization Voting Summary Table

COMM 3: Emphasize the transfer of information and research findings to decision-makers (e.g. legislators, policy makers, agency heads, political appointees, etc.) so that they are enabled to develop more effective policy and management actions.	10
COMM 4: <i>In order to build and support life-long commitment to coral reefs and associated ecosystems, in order to increase public support for resource management actions, and seek partnerships with existing organizations (educational, civic, etc.). Encourage greater participation in resource stewardship at all levels of society to affect long-term behavioral change.</i>	8
COMM 5: <i>Raise awareness of the distribution, importance and vulnerabilities of mesophotic reefs in the general public, and in particular among resource users (e.g. fishers) and policy makers.</i>	4
COMM 6: <i>Incorporate evidence-based best practices, techniques and interventions from current scholarship on influencing behavior change, into communication strategies.</i>	4
COMM 7: <i>Improve and enable coordination and communication among USVI coral reef practitioners.</i>	3
Climate Goal: Manage for resilience to the effects of climate change and promote recovery of reefs from previous and ongoing impacts.	6
Fisheries Goal: Manage fishing impacts on critical stocks that most directly affect the health and resilience of the reef ecosystem.	6
Marine Pollution Goal: Reduce sources of marine pollution and human impacts (beyond Goal 1 LBSP).	5
Invasive and Nuisance Species Goal: Protect against, prepare for and control/manage invasive and nuisance species	1

## **Appendix IV: List of Abbreviations**

BCG	Biological Condition Gradient
BMP	Best Management Practice
BVI	British Virgin Islands
CARICOOS	Caribbean Regional Association for Coastal Ocean Observing
CFMC	Caribbean Fishery Management Council
CMES	Center for Marine and Environmental Studies
CRCP	Coral Reef Conservation Program
CRRT	Caribbean Regional Response Team
CZM	Division of Coastal Zone Management
DEE	Division of Environmental Enforcement
DEP	Division of Environmental Protection
DFW	Division of Fish and Wildlife
DPNR	Department of Planning and Natural Resources
DPW	Department of Public Works
GIS	Geographic Information System
HOA	Homeowners' Association
ISDS	Individual Sewage Disposal System
LBSA	Land Based Sources of Pollution
MOES-VI	Marine Outreach and Education US Virgin Islands Style
MOU	Memorandum of Understanding
MPA	Marine Protected Area
NCRMP	National Coral Reef Monitoring Program
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
OSDS	On-site Sewage Disposal System
SEA	St. Croix Environmental Association
STEER	St. Thomas East End Reserves
STJ	St. John
STT	St. Thomas
STX	St. Croix
STXEEMP	St. Croix East End Marine Park
TCRMP	Territorial Coral Reef Monitoring Program
TMDL	Total Maximum Daily Load
US	United States
USCG	United States Coast Guard
USVI	United States Virgin Islands
UVI	University of the Virgin Islands
VI	Virgin Islands
VICRAG	VI Coral Reef Advisory Group
VICS	VI Conservation Society
VI EPSCoR	VI Experimental Program to Stimulate Competitive Research
VIMAS	VI Marine Advisory Service
VIWMA	VI Waste Management Authority

## **Appendix V: References and Resources**

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