US Virgin Islands Department of Planning and Natural Resources (DPNR)
Coral Mitigation Relocation Recommendations

This document is specific to coral relocation activities that are being conducted territory-wide for mitigation[1] purposes. This document is a living document and is updated as new information becomes available, or issues that need to be addressed are identified. For this reason, document dates are provided in the lower right hand corner for reference purposes.

Summary

In summary, DPNR recommends the following (summarized by document section):

- **Coral Resource Mitigation**
  Relocation of corals to suitable sites in regionally appropriate densities (current or historical) should occur on all coastal projects where complete avoidance is not possible. Coral relocation activities should be considered as minimization of project impacts, and not as compensatory mitigation. Coral relocation activities should not occur during the likely bleaching stress season (Aug. 1st through Jan. 30th), or during other times of severe stress (e.g., disease outbreak, coral bleaching, cold stress, significant algal blooms), unless there are extreme circumstances that warrant an exception. Compensatory mitigation should be required for all corals that may be impacted by project activities and will not be relocated. Compensatory mitigation may also be required in cases of critical coral habitat loss.

  - ***Coral-Specific Compensatory Mitigation Considerations***
    On a case-by-case basis, DPNR will consider and evaluate any request for relocation of corals from unstable habitats (e.g., rubble) to be used as a compensatory mitigation measure to offset direct effects from the proposed project. Also on a case-by-case basis, DPNR will consider and evaluate any request for relocation of corals that are considered by the DPNR to be sub-adult sized (< 5 cm), to be used as a compensatory mitigation measure to offset the loss of indirect effects[3] that are temporary (e.g., temporary reduction in larval output, temporary reduction in settlement). Evaluation of such requests will be based on available and appropriate documentation of sub-adult relocation activities (e.g., literature, monitoring reports), and amount of credit that is proposed to be provided for such activities. Also on a cases-by-case basis, DPNR will consider and evaluate any request for nursery-grown corals to be outplanted and used as compensatory mitigation.

  - ***Technical Assistance***
    DPNR is available to provide technical expertise to assist with mitigation assessment or the development or review of mitigation plans.

- **Coral Relocation Plans**
  Relocation methodologies alone do not constitute a relocation plan. Relocation plans should at a minimum include the following information (information requested is expanded upon within the document):
  - Summary of survey results, including detailed benthic habitat maps indicating the locations of corals.
  - Criteria for selection of corals that will be relocated.
  - List of corals selected for relocation.
  - Information regarding the removal, relocation and temporary holding sites.
  - Relocation methodologies.

[1] For purposes of this document, the term "mitigation" is all-encompassing and includes avoidance, minimization, and compensatory mitigation actions. The term "compensatory mitigation" is specific to actions that are intended to mitigate for impacts that are not avoided or minimized.

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Coral Mitigation Relocation Recommendations

There are a number of current relocation methodologies to successfully remove, relocate and reattach corals, and there may be additional successful methodologies developed in the future. As such, DPNR does not prefer to specify methodologies for these activities and would instead prefer to assist with development of methodologies or comment on proposed methodologies.

- **Coral Relocation Size**
  - ***ESA-Listed Coral Species***
    DPNR recommends relocation of all ESA-listed coral species regardless of size, unless a coral displays signs of disease pursuant to the attached "DPNR Coral Visual Health Assessment Protocols."

  - ***Non-ESA listed Coral Species***
    DPNR recommends relocation of all adult corals (corals ≥ 5 cm measured as live tissue diameter - continuous live tissue patch with a diameter of 5 cm or greater), unless a coral displays signs of disease pursuant to the attached "DPNR Coral Visual Health Assessment Protocols."

- **Non-ESA Listed Coral Species Prioritization**
  In the event that all corals ≥ 5 cm live tissue diameter will not be relocated, DPNR has provided a prioritized list of non-ESA listed coral species for relocation.

- **Coral Fragmentation Upon Removal**
  The potential exists for corals to fragment upon removal. For all ESA-listed species (regardless of relocation activity size) and for smaller-scale relocation activities, it is feasible for all fragments of the same broken coral to be kept together and reconstructed by reattaching fragments as close together as possible (like puzzle pieces – reattached within 0 - 5 cm apart from one another), to promote successful fusing. The re-constructed corals should be considered as one single coral for monitoring purposes.

- **Coral Visual Health Assessment**
  A visual health assessment should be required for each coral identified for relocation immediately prior to removal from the removal site (and again from a temporary holding site if one is used), pursuant to the attached "DPNR Coral Visual Health Assessment Protocols." Corals of any species exhibiting visual signs of disease should not be removed, held temporarily, or relocated unless identified exceptions are applicable, or additional project-specific exceptions are provided for by DPNR.

- **Temporary Holding of Corals Prior to Reattachment**
  If corals will be placed in a temporary holding site after removal and prior to reattachment at the relocation site (for caching, staging, acclimation, etc.), criteria are provided for the appropriate selection of a temporary holding site, maintenance of coral species while in a temporary holding site, and authorization of the installation of structures to facilitate temporary holding activities.

- **Coral Relocation Site Selection**
  Recommended criteria are provided for the appropriate selection of coral relocation sites.

- **Coral Relocation Monitoring**
  DPNR recommends corals that are relocated specifically for mitigation purposes are monitored for overall survival and attachment success during week one (may be conducted at any time during the seven days beginning the day immediately after the day relocation is conducted), at one month, at three months, at six months, at one year, and continued annually for five years post-relocation. DPNR emphasizes the need for all of these recommended monitoring events to be performed, and the recommended activities/data collection to be conducted for these events is provided.

  The following information is also provided with regards to monitoring coral mitigation relocation activities:
  - ***Monitoring Data to be Collected***
  - ***Numbers of Corals to be Monitored***
  - ***Reporting Schedule***
  - ***Technical Assistance***

- **Performance Standards**
  - ***Corals – Non-ESA Listed Species***
    The performance standard to determine mitigation success for coral relocation activities for non-ESA listed species should be at least 85% overall survival, with secure substrate attachment, five years after relocation. Overall survival of corals shall be defined as no net loss in pooled (by species) Live Tissue Area Index or an increase in pooled (by species) Live Tissue Area Index.

  - ***Corals – ESA-Listed Species***
    The performance standard to determine mitigation success for coral relocation activities for ESA-listed species will be determined by the federal Biological Opinion for the project, or should be 85% overall survival, with secure substrate attachment, five years after relocation if no Biological Opinion is provided.

  - ***Technical Assistance***
    DPNR is available to provide technical expertise to assist with the development or review of performance standards.

Definitions

For purposes of these Recommendations:

- "Coral" is a fragment or colony of any species of the Order **Scleractinia** and Order **Antipitharia,**
- "ESA-listed" are species that are federally-listed pursuant to the Endangered Species Act, or proposed to be federally-listed pursuant to the Endangered Species Act.
- "Interior waterways" are aquatic areas that have experienced physical restructuring of the shoreline (e.g., inner port harbors, marinas), or naturally occurring areas of low flushing (e.g., shallow bays, seawalls.)
- "Non-ESA listed" are species that are not ESA-listed.
- "Relocation" includes all activities that remove, relocate and reattach coral fragments or colonies from one location to another location (e.g., transplanting, outplanting), including but not limited to moving them into and out of temporary holding locations (e.g., cache, staging, acclimation locations) or nurseries.

Coral Resource Mitigation

Relocation of corals to suitable sites in regionally appropriate densities (current or historical) should occur on all coastal projects where complete avoidance is not possible. These coral relocation activities should be considered as minimization of project impacts and not as compensatory mitigation. Coral relocation activities conducted to minimize project impacts can be accommodated in Habitat Equivalency Analysis (HEA) and Resource Equivalency Analysis (REA) mitigation assessment methodologies, and would result in lower amounts of compensatory mitigation required for the project relative to the amount of mitigation that would be required if coral relocation was not performed. Compensatory mitigation should be required for all corals that may be impacted by project activities and will not be relocated.

Coral relocation activities should not occur during the season severe bleaching stress is likely to occur (Aug. 1st through Jan. 30th), or during other times of severe stress (e.g., disease outbreak, coral bleaching, cold stress, significant algal blooms), unless there are extreme circumstances that warrant an exception. DPNR will support relocation activities during times of severe stress or from locations being impacted by significant stress events on a case-by-case basis when resource or project impacts are imminent and cumulatively harmful, and when benefits outweigh potential risks. Please see the "Coral Visual Health Assessment" section of these Recommendations for exceptions that are applicable to coral relocation during times of severe stress or from locations being impacted by significant stress events.

Coral-Specific Compensatory Mitigation Considerations

On a case-by-case basis, DPNR will consider and evaluate any request for the relocation of corals from unstable habitats (e.g., rubble) to be used as a compensatory mitigation measure to offset direct effects from the proposed project.
Also on a case-by-case basis, DPNR will consider and evaluate any request for the relocation of corals that are considered by DPNR to be sub-adult sized (< 5 cm measured as live tissue diameter - continuous live tissue patch with a diameter of 5 cm or greater), to be used as a compensatory mitigation measure to offset the loss of indirect effects that are temporary (e.g., temporary reduction in larval output, temporary reduction in settlement). Evaluation of such requests will be based on available and appropriate documentation of sub-adult relocation activities (e.g., literature, monitoring reports), and amount of credit that is proposed to be provided for such activities.

Technical Assistance

DPNR is available to provide technical expertise to assist with mitigation assessment (e.g., HEA, REA), or the development or review of mitigation plans. DPNR would appreciate the ability to provide additional comments on mitigation assessment, mitigation plans or mitigation plan revisions if such information is not available at this time and becomes available in the future.

Coral Relocation Plans

At a minimum, Relocation Plans should include the following information:

- Summary of survey results – a summary of all coral species and sizes that were found (by location) during bottom surveys. Specific coordinates for each individual coral are not necessary unless the species is ESA- listed, then specific coordinates must be provided for each individual ESA-listed coral.
- Criteria for selection of corals that will be relocated - provide the criteria (e.g., size, species) that was used to select the corals that will be relocated.
- List of corals selected for relocation – identify corals by species, sizes and removal site that will be relocated. Again, specific coordinates for each individual coral are not necessary unless the species is ESA-listed, then specific coordinates must be provided for each individual ESA-listed coral.
- Removal site(s) – provide the following information for the removal site(s):
    - Site coordinates.
    - Substrate size and substrate type corals were found on (e.g., natural, artificial, boulders, structures).
    - Water depth.
    - Water quality (eg. turbidity, dissolved oxygen, salinity, temperature, nutrient content)
    - Water circulation.
    - Light availability.
    - Orientation of attachment.
- Temporary holding site(s) – if a temporary holding site will be used to cache, stage, acclimate corals prior to reattachment, provide the following information for the temporary holding site(s):
    - Site coordinates.
    - Proximity to both the removal and reattachment sites.
    - Estimated length of time corals will be maintained in the temporary holding site.
    - Water depth.
    - Identify if it is a low or high energy environment.
    - Level of sedimentation.
    - Presence/absence of freshwater input.
    - Verify that the temporary holding site is conservatively further from expected project-associated direct and indirect impact areas.
    - Identify how corals will be maintained in the temporary holding site.
    - Identify if any structures or systems will be installed to facilitate temporary holding of corals, and if this activity has been or will be included in the appropriate permit applications for this project.
- Relocation site(s) – provide the following information for the relocation site(s):
    - Site coordinates.
    - Proximity to the removal site.
    - Identify if there has been historic presence of the species to be relocated at the relocation site within recent decades.
    - Substrate size and substrate type corals will be reattached to (e.g., natural, artificial, boulders, structures).
    - Water depth.
    - Water quality in relation to the removal site.
    - Water circulation in relation to the removal site.
    - Light availability in relation to the removal site.
    - Orientation of reattachment.
    - Presence/absence of loose rubble.

  - Identify if it is a low or high energy environment.
  - Verify that the relocation site is not located within a direct or indirect impact area for any permitted, authorized or reasonably foreseeable marine coastal construction activity (e.g., dredging, beach nourishment, pipeline or communication cable installations), or within exclusion or buffer areas/zones (e.g., military, aquaculture, resource protection).
  - Provide information on spatial requirements for the species to be relocated which addresses how the relocation site will provide adequate and appropriate space to allow for: a) colony growth, tissue re-colonization and plating based on colony size, species growth rates, and maximum size capacity; and b) attachment density commensurate with regionally appropriate densities.
- Relocation methodologies – identify the methodologies that will be used to remove, transport, temporarily hold (if applicable), and reattach corals.

There are a number of current relocation methodologies to successfully remove, relocate and reattach corals, and there may be additional successful methodologies developed in the future. As such, DPNR does not prefer to specify methodologies for these activities and would instead prefer to assist with development of methodologies or comment on proposed methodologies.

Technical Assistance

DPNR is available to provide technical expertise to assist with the development or review of relocation plans, including relocation methodologies. DPNR would appreciate the ability to provide additional comments on relocation plans or relocation plan revisions if such information is not available at this time and becomes available in the future.

Staff of the NOAA National Marine Fisheries Service, The Nature Conservancy and the Center for Marine and Environmental Studies of the University of the Virgin Islands may also be available to provide technical expertise to assist with the development or review of relocation plans, including relocation methodologies. Contacts for each of these agencies respective programs can be provided on request.

Coral Relocation Size

ESA-Listed Coral Species

DPNR recommends relocation of all ESA-listed coral species regardless of size, unless a coral displays signs of disease pursuant to the attached "DPNR Coral Visual Health Assessment Protocols." The coral species that are currently listed are as follows:

- *Acropora cervicornis* (ESA listed as Threatened)
- *Acropora palmata* (ESA listed as Threatened)
- *Dendrogyra cylindrus* (ESA listed as Threatened)
- *Mycetophyllia ferox* (ESA listed as Threatened)
- *Orbicella annularis* (ESA listed as Threatened)
- *Orbicella faveolata* (ESA listed as Threatened)
- *Orbicella franksi* (ESA listed as Threatened)

Non-ESA listed Coral Species

For purposes of these Recommendations, the DPNR has determined corals that are ≥ 5 cm (measured as live tissue diameter - continuous live tissue patch with a diameter of 5 cm or greater) to be adult, although corals < 5 cm have been observed to be reproductive (Soong 1993, Lazar et al. 2011, Coastal Eco-Group Inc., 2015.) The DPNR determination of adult coral size was not solely based on reproductive capabilities and additionally considered:
At the 5 cm size, corals have a sufficient number of polyps and colony structure to obtain a positive identification using standard surveying methodologies. Corals below this size would require different surveying methodologies.
Corals ≥ 5 cm are generally considered to be adults (Bak and Engel 1979, Miller et al. 2000), based on average growth rates (Vaughn 1915) and estimated age of sexual maturity (Connell 1973.)

For non-ESA listed coral species, the DPNR recommends relocation of all adult corals (corals ≥ 5 cm live tissue diameter), unless a coral displays signs of disease pursuant to the attached "DPNR Coral Visual Health Assessment Protocols." Corals ≥ 5 cm live tissue diameter can be successfully relocated. Brownlee (2010) successfully transplanted small corals (*Siderastrea siderea, Dichocoenia stokesii*, and *Porites porites*) with greater than 80 percent survivorship after 13 months. Monty et al. (2006) successfully transplanted 250 corals (14 species) ranging from 5 to 40 cm in diameter with a high rate of survivorship. These corals were monitored for 13 months. Eight species had 100 percent survivorship, including 78 *Siderastrea siderea*. Thornton et al. (2000) transplanted 271 corals from an outfall pipe in Broward County to an articulated concrete mat. *Siderastrea siderea* comprised 90 percent of the corals <1 to 100 square centimeters in size. After 27 months, 266 of the corals had survived (87 percent), as compared to 83 percent survival for corals on the nearby natural substrate. In addition, Stephens (2007) analyzed monitoring data from a transplantation effort that salvaged multiple species of coral from a coastal construction impact site in Broward County; survival of the species ranged between 92 and 100 percent during monitoring periods varying between 18 and 24 months.

Non-ESA Listed Coral Species Prioritization

In the event that all corals ≥ 5 cm live tissue diameter will not be relocated, DPNR has prioritized non-ESA listed coral species for relocation. These coral species have been prioritized and binned based on a high conservation value (i.e., rare, slow-growing, low genetic diversity, slow to recover, sensitive to stress, poor-recruiter, high post-settlement mortality). The prioritized list is as follows:

HIGH PRIORITY SPECIES

- Order Antipatharia
- *Agaricia fragilis*
- *Agaricia lamarcki*
- *Colpophyllia natans*
- *Dichocoenia stokesii*
- *Diploria labyrinthiformis*
- *Favia fragum*
- *Isophyllia* spp.
- *Leptoseris cucullata*
- *Madracis* spp.
- *Manicina areolata*
- *Meandrina meandrites*
- *Montastraea cavernosa*
- *Mussa angulosa*
- *Mycetophyllia* spp.
- *Oculina diffusa*
- *Oculina robusta*
- *Solenastrea hyades*

MEDIUM PRIORITY SPECIES

- *Eusmilia fastigiata*
- *Porites divaricata, P. furcata, P. porites*
- *Pseudodiploria* spp. (formerly *Diploria*)
- *Siderastrea siderea* ≥10 cm
- *Solenastrea bournoni*
- *Stephanocoenia intersepta* ≥10 cm
- *Undaria* spp. (formerly *Agaricia*)

LOW PRIORITY

A lower amount of effort should be attributed to removing and relocating the following species, and compensatory mitigation should be designed to offset the loss of any corals not relocated. Alternatively, if the impact area is dominated by these species, effort would be still be justified to remove and relocate the following species:

- *Porites astreoides*
- *Siderastrea radians*
- *Siderastrea siderea* <10 cm
- *Stephanocoenia intersepta* <10 cm
- *Cladocora arbuscula*
- *Phyllangia* spp.
- *Scolymia* spp.

DPNR supports efforts to relocate corals that are less than 5 cm live tissue diameter (sub-adult sized), however we are aware that this may increase project costs due to additional survey design measures needed to accurately identify corals of this small size. For corals that will not be relocated (of any size), DPNR recommends coordination with permitted/approved research/restoration facilities within the project region, to determine if such facilities have interest and financial resources to remove corals or accept donated corals.

Coral Fragmentation Upon Removal

The potential exists for corals to fragment upon removal. For all listed or proposed species (regardless of relocation activity size) and for smaller-scale relocation activities, it is feasible for all fragments of the same broken coral to be kept together and reconstructed by reattaching fragments as close together as possible (like puzzle pieces – reattached within 0 - 5 cm apart from one another), to promote successful fusing. The re-constructed corals should be considered as one single coral for monitoring purposes. Research has shown that fragments of the same genet are known to readily and successfully fuse (Raymundo and Maypa 2004).

Coral Visual Health Assessment

To minimize the risk that diseases are not being spread from the removal site to a temporary holding or relocation site, the DPNR recommends a visual health assessment of each coral slated for temporary holding or direct relocation be conducted immediately prior to removal pursuant to the attached "DPNR Coral Visual Health Assessment Protocols" (Health Protocols). Corals exhibiting visual signs of disease or potential disease vectors should not be removed, held temporarily, or relocated. ***Exceptions:***

- As identified in the "Coral Resource Mitigation" section of these Recommendations, there may be extreme circumstances in which DPNR will support coral relocation during times of severe stress or significant stress events. For corals that will be relocated during times of severe stress or from locations being impacted by significant stress events, DPNR can provide an exception on a case-by-case basis from the "bleaching and partial bleaching" and "stress indicators" criterion identified in the Health Protocols ("Coral Visual Health Assessment" section, numbers 1)a. and 1)e. respectively. If an exception is provided by DPNR, these corals may be relocated provided that all other criterion in the Health Protocols are met.
- Corals surviving in interior waterways have demonstrated resilience in spite of the poor environmental conditions they are growing in and as such, have strong survival capabilities (potentially genetic) that are highly valued. Corals that will be relocated from interior waterways are provided with an automatic exception from the "bleaching and partial bleaching" and "stress indicators" criterion in the Health Protocols ("Coral Visual Health Assessment" section, numbers 1)a. and 1)e. respectively, and may be relocated provided that all other criterion identified in the Health Protocols are met.

Corals held in a temporary holding site should again be visually assessed for health pursuant to the Health Protocols immediately prior to removal from the temporary holding site and reattachment at the relocation site.

Exception **- The visual health assessment does not need to be conducted for corals that have been maintained in a temporary holding site for 48 hours or less.** Any corals displaying signs of disease in the temporary holding site should either be: a) removed and disposed of, or b) removed and donated for ex-situ research.

Any corals that were selected for relocation but were not relocated because they failed the visual health assessment should be documented in the "Diseased Coral Colony Info" data sheet provided for reporting requirements.

Temporary Holding of Corals Prior to Reattachment

If corals will be placed in a temporary holding site after removal and prior to reattachment at the relocation site (for caching, staging, acclimation, etc.), DPNR recommends the following criteria be adhered to:

- The temporary holding site for corals must be located in a stable area (e.g., low energy, low sedimentation, minimal freshwater input), and err conservatively on the side of being slightly farther from expected project-associated direct and indirect impact areas.
- Corals must be maintained in a temporary holding site either by affixing them to an elevated structure, or placing them in a suspended container in a manner wherein they are above the sea floor and do not touch each other. If corals are to remain in the temporary holding site for longer than two weeks, they must be cemented or epoxied to an elevated structure or to substrate elevated above the sea floor.
- The installation of any structure or system to facilitate the temporary holding of corals prior to reattachment must also be authorized by project permits.

Coral Relocation Site Selection

DPNR recommends that the selection of an appropriate relocation site(s) for corals meet the following general criteria:

- The relocation site must be as close in proximity to the removal site as possible to preserve the functional ecosystem value of the surrounding areas provided by the resources to be relocated, but err conservatively on the side of being slightly farther from expected project-associated direct and indirect impact areas.
- Relocation site must be suitable reef habitat, be within the known range of the species or genera, and have historic presence of the species to be relocated (in recent decades).
- Optimally, the relocation site should be located in similar water depths and have similar physical conditions (e.g., light availability, water quality, water circulation) to those at the removal site. It is recognized that this will not always be possible such as when relocating corals from interior waterways, and in these cases moving the corals offshore is acceptable.
- Optimally, the relocation site should have similar substrate orientation to removal site; i.e., if corals are being removed from a vertical or sloped elevated surface, then the relocation site should have similar vertical or sloped areas for relocation. It is recognized that this will not always be possible such as when relocating corals from vertical surfaces, and in these cases adopting a relocation orientation that mimics the orientation at the relocation site is acceptable.
- Relocation site must not contain large amounts of loose rubble and should not be an extremely high energy environment (Edwards and Clark 1998).
- Relocation site must not be located within a direct or indirect impact area for any permitted, authorized or reasonably foreseeable marine coastal construction activity (e.g., dredging, beach nourishment, pipeline or communication cable installations), or within exclusion or buffer areas/zones (e.g., military, aquaculture)
- Relocation site must have adequate and appropriate space to allow for: a) colony growth, tissue re-colonization and plating based on colony size, species growth rates, and maximum size capacity; and b) attachment density commensurate with regionally appropriate densities.

Coral Relocation Monitoring

DPNR recommends corals that are relocated specifically for mitigation purposes are monitored for overall survival and attachment success during week one (may be conducted at any time during the seven days beginning the day immediately after the day relocation is conducted), at one month, at three months, at six months, at one year and continued annually for five years post-relocation. DPNR emphasizes the need for all of these recommended monitoring events to be performed, and the recommended activities/data collection to be conducted for these events is provided in the attached "Monitoring Activities and Data Sheet Directions for Coral Mitigation Relocation Activities." Three (3) data sheets are also provided to facilitate capturing the data requested for monitoring and reporting purposes.

Monitoring Data to be Collected

The data requested to be collected for coral mitigation relocation monitoring activities are specific to determining overall survival and attachment success, thus determining achievement of performance standards for mitigation actions (i.e., mitigation success). The data requested to be collected for monitoring activities will also assist with determining potential factors that may have contributed to the inability for mitigation actions to achieve performance standards (i.e., mitigation failure), such as localized disease or bleaching events, severe storm events, relocation contractor performance, etc.

Numbers of Corals to be Monitored

If the total quantity of corals to be relocated comprises less than 4,000 colonies – select a representative subset of relocated corals to be used for monitoring events, comprising 25% (or 1,000 corals maximum) of the total number of corals relocated. This subset must be representative of the species composition and size classes of the total relocated corals, with no less than 10 corals of each species monitored. If less than 10 corals are relocated from a species, all relocated corals of that species must be included in the subset. It is possible that for smaller-scale relocation projects, one or both of these requirements will result in all of the relocated corals (i.e., set) needing to be monitored.

If the total quantity of coral to be relocated exceeds 4,000 colonies, DPNR will reach a consensus with the applicant and the permitting agency on the number of representative subset corals that will be monitored (the minimum will be 1,000 corals).

Reporting Schedule
The data collected during each monitoring event should be submitted according to the following schedule:
Relocation + one week event – information should be submitted within 21 days post-one week event.
One month through five year monitoring events - information should be submitted within 30 days post-event.

Technical Assistance
DPNR is available to provide technical expertise to assist with the development or review of monitoring plans. DPNR would appreciate the ability to provide additional comments on monitoring plans or monitoring plan revisions if such information is not available at this time and becomes available in the future.

Performance Standards
Corals – Non-ESA Listed Species
The performance standard to determine mitigation success for coral relocation activities for non-ESA listed species should be between 85% overall survival, with secure substrate attachment, five years after relocation. Overall survival of corals shall be defined as no net loss in pooled (by species) Live Tissue Area Index or an increase in pooled (by species) Live Tissue Area Index.

Live Tissue Area Index is calculated by averaging the coral maximum diameter and coral maximum height, then squaring the average dimension to determine Skeletal Area, then multiplying by the percent live tissue; formula as follows: ((D+H)/2)^2*%L (Williams and Miller 2012). All of the metrics needed to determine Live Tissue Area Index are either requested for collection during monitoring activities (e.g., max diameter, max height, percent live tissue), or are auto-populated in the "CoralColony" data sheet provided (e.g., skeletal area). The Live Tissue Area Index column in the data sheet will also auto-populate once the needed metrics are recorded.

To calculate pooled Live Tissue Area Index by species for purposes of identifying the overall survival percentage, sum the Live Tissue Area Indices by species (not individual coral) that was auto-populated for each coral colony that was monitored. This percentage should be recorded in the "Coral Summary" data sheet.

Corals – ESA-Listed Species
The performance standard to determine mitigation success for coral relocation activities for ESA-listed species will be determined by the federal Biological Opinion for the project, or should be 85% overall survival, with secure substrate attachment, three years after relocation if no Biological Opinion is provided.

Technical Assistance
DPNR is available to provide technical expertise to assist with the development or review of performance standards. DPNR would appreciate the ability to provide additional comments on performance standards or performance standard revisions if such information is not available at this time and becomes available in the future.

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US Virgin Islands Department of Planning and Natural Resources (DPNR)
Coral Visual Health Assessment Protocols for Mitigation Relocation Activities

CORALS

Definitions

For purposes of these Protocols:

1) "Bleaching" for purposes of coral relocation is defined as discolored coral tissue due to the loss or reduction in number of endosymbiotic algae (zooxanthellae (Genus *Symbiodinium*)). During bleaching, tissue is present but is pale to clear in color, and the white skeleton is visible underneath. A colony may be "bleached" (where 100% of colony tissue is affected by loss of zooxanthellae) or "partially bleached" (where < 100% of colony tissue is affected by loss of zooxanthellae, and a portion of colony tissue remains a healthy color).
2) "Coral" is a fragment or colony of any species of the Order **Scleractinia**, and Order **Antipitharia**.
3) "Interior waterways" are aquatic areas that have experienced physical restructuring of the shoreline (e.g., inner port harbors, marinas), or naturally occurring areas of low flushing (e.g., shallow bays.)
4) "Partial bleaching" is where only a portion of the coral has lost its zooxanthellae, and the remaining areas of tissue appear normal in color.
5) "Old mortality" is the non-living portion of exposed coral skeleton that has been overgrown by algae and other biofouling organisms and where the corallite structure has eroded over time and is no longer identifiable. *Not to be confused with "recent mortality."
6) "Recent mortality" is the non-living portion of recently exposed coral skeleton (i.e., skeleton is white and corallite structures are intact and identifiable), including the development of fine "fuzz" or turf algae on exposed skeleton (i.e., skeleton is yellowish in appearance and corallite structure may be slightly eroded but still identifiable), indicating that the mortality occurred within a couple of weeks prior to observation. *Not to be confused with "old mortality."
7) "Relocation" includes all activities that move coral fragments or colonies from one place to another (e.g., transplanting, outplanting), including but not limited to moving them into and out of temporary holding locations (e.g., cache, staging, acclimation locations) or nurseries.

Coral Visual Health Assessment

Each coral fragment or colony selected for relocation must be visually assessed pursuant to these Protocols to ensure that they appear to be in good health and are free from suspected disease. This visual health assessment must be conducted immediately prior to removal from each and any location, and may need to be conducted more than once before the relocation activity is completed (e.g., immediately prior to removal from an original collection location, a culture location (nursery), or a temporary holding location established for purposes of caching, staging, acclimation, etc.). **Exception - The visual health assessment does not need to be conducted for coral fragments or colonies that have been maintained in a temporary holding location for 48 hours or less.**

Coral fragments or colonies that are located in an original collection or culture location when the visual health assessment is conducted and are exhibiting visual signs of disease may not be removed and relocated to other in-water locations. Coral fragments or colonies that are located in a temporary holding location when the visual health assessment is conducted and are exhibiting visual signs of disease must be removed and disposed of, and this disposition must be noted in any post-relocation reporting documents. **Field personnel conducting coral visual health assessments should be proficient with species identification, and trained in coral disease, predation identification and removal, and survey techniques to assure accuracy of the assessment.** Each coral fragment or colony must meet the following criteria prior to relocation:

Each coral fragment or colony may not show any visible signs of disease or potential disease vectors based on the presence of:

1) Stress indicators (e.g., bleaching or partial bleaching; tissue sloughing, swelling, or thinning; excessive sedimentation; excessive mucous production). **Exceptions:**
    a. Partial bleaching (< 100% of colony tissue) is acceptable for relocation of specific coral species for which it is recognized as a part of these coral species' normal, healthy state. These coral species are as follows: *Oculina* spp., *Agaricia fragilis, Helioseris cucullata, Orbicella franksi, Siderastrea radians*, and *Undaria humilis.* Partial bleaching <2 cm on healthy, growing branch tips is also considered acceptable and normal for branching coral species including *Acropora cervicornis, Acropora palmata, Acropora prolifera.*

b. Exception to the "stress indicators" criterion is automatically provided for corals that are being removed and relocated from interior waterways as identified in the Mitigation Relocation Recommendations, "Coral Visual Health Assessment" section.

2) Recent mortality greater than 3% tissue loss exposing underlying skeleton. **Exception** - Old mortality is acceptable for corals that are to be relocated.
3) Active disease (e.g., white/black/yellow/red band diseases, white pox or plague diseases, white *Beggiatoa* mats, dark (purple) spot/blotch diseases, growth anomalies).
4) Suspect disease indicators (e.g., bands, spots, microbial mats, cyanobacteria colonization).
5) Predation such as fireworms (*Hermodice caruncunculata*) or snails (*e.g., Coralliophila abbreviata, Thais deltoidea*). **Exception** - Corals may be relocated once all predators have been removed.
6) Evidence of competition and overgrowth from organisms that cannot be removed (e.g., peeled off) prior to relocation such as: invasive, encrusting and/or overgrowing tunicates (e.g., Genus *Symplegma*, Genus *Botryllus*), sponges, octocorals (e.g., *Erythropodium caribaeorum, Briareum asbestinum*), or zoanthids (e.g., Genus *Palythoa*), or encrusting red algae (e.g., *Ramicrusta sp*). **Exception** - Corals containing boring sponges of the Genus *Cliona* are acceptable for relocation. Numbers of corals that are relocated containing boring sponges of the Genus *Cliona* must be noted in any post-relocation reporting documents.

Monitoring Activities and Data Sheet Directions for Coral Mitigation Relocation Activities

The following are monitoring activities and directions for filling out monitoring data sheets, for all coral mitigation relocation activities which include relocation and subsequent monitoring of relocated colonies. Additional monitoring events and additional data collection may be conducted as needed by the license holder to address individual project documentation needs.

List of Data Sheets

1) **Coral Summary** – this data sheet is for providing information on the removal, temporary holding, and relocation sites, and summarizing the monitoring information for all coral species.
2) **Coral Colony** – this data sheet is where the information from all of the monitoring events is recorded for relocated coral species.
3) **Disease Coral Colony Information –** this datasheet is for providing the information on both non-ESA listed and ESA-listed corals that did not pass the visual health assessment and were not relocated. This information is requested in the Coral Visual Health Assessment section of the Recommendations

Prior to Relocation:

- Review all permits issued by all agencies (and the Biological Opinion if applicable), and determine what format(s) the removal, temporary holding, and relocation site coordinates need to be provided in for reporting requirements. For ESA-listed species, the Biological Opinion will typically require single-point coordinates.
- Review the "Coral Summary" data sheet to be familiar with the format options for how to record site coordinates in the "Coral Summary" data sheet. Please note that the coordinates may need to be recorded in more than one format to meet multiple agency permit-required reporting requirements.

At Time of Relocation:

- Take site coordinates as determined to meet permit-required reporting requirements.
- Individually tag or location mark/tag and map the set or subset of relocated corals to be monitored (including assignment of an identification number or alphanumeric character for each coral), so that they can be tracked individually over time for monitoring events. Location marking and tagging for mapping purposes must include a sufficient number of markers/tags to be able to identify the locations of each relocated coral (e.g., corner point markers, central marker, tagging each row).
- Any corals that were identified as viable candidates for relocation but were not relocated because they failed the visual health assessment, should be documented in the "Diseased Coral Colony Info" data sheet.

During All Monitoring Events

- This same set or subset of corals must be used for all of the monitoring events.
- All loose or detached colonies must be reaffixed to their structure or substrate.

Recording Data

Each cell in all data sheets must have information recorded in it, or a value of zero. Do not include any symbols (e.g., %), or measurements (e.g., cm, ft, kts), unless specified in directions (e.g., 0-20, <1, 5+).

Coral Summary Data Sheet Directions

In the "Coral Summary" data sheet, record the following information for coral species PER SITE, PER SPECIES (not individual colonies):

- Row 2: Provide the project name, DPNR Permit number, person the license is issued to, and affiliation.

A. Coral Species –all possible coral species are listed in locked cells.
B. Total Number of Colonies Relocated – record the total number of colonies for each species that was relocated by relocation site on a separate row.
C. Total Number of Colonies to be Monitored – record either the total number of individual colonies for each species that will be monitored by relocation site, or the total number of individual colonies for each species that will comprise the "Subset" of colonies to be monitored, by relocation site.
D. Date Relocation Started – this is the date that relocation activities began.
E. Time Remained in Temporary Holding Site – provide the length of time (in # of days) that the corals were held in a temporary holding site before relocation was completed. Record a value of zero if not applicable.
F. Date Relocation Completed – this is the date that relocation activities were completed.
G. Removal Site Location Description – provide a brief description of where the removal site is located.
H. Removal Site Identifier – assign and provide a unique operational name/number/alphanumeric character for the removal site.
I. Removal Site Depth – provide the depth (in feet) of the removal site.

- Columns J. through T. –Provide Corner and Undefined coordinates for the removal site. Regardless of the design of the site, provide a single point coordinate of each corner of a site in Columns J. through Q., specifically the latitude and longitude (separate columns) of the single point coordinates of the NE, NW, SE, SW corners of the site, in decimal degree format. In columns R. and S. provide the latitude and longitude (separate columns) of the single center point coordinate in decimal degree format, and in column T provide a radius (in meters) from the single center point that will encompass the site.

★ The following columns U. through AH. only apply to temporary holding sites (e.g., cache, staging, acclimation). Only provide data for these columns if corals will not be directly relocated, and a temporary holding site will be used. Provide a value of zero if not applicable.

U. Temporary Holding Site Location Description – provide a brief description of where the temporary holding site is located.
V. Temporary Holding Site Identifier – assign and provide a unique operational name/number/alphanumeric character for the temporary holding site.
W. Temporary Holding Site Depth – provide the depth (in feet) of the temporary holding site.

- Columns X. through AH. – Provide Corner and Undefined coordinates for the removal site. Regardless of the design of the site, provide a single point coordinate of each corner of a site in Columns X. through AE, specifically the latitude and longitude (separate columns) of the single point coordinates of the NE, NW, SE, SW corners of the site, in decimal degree format. In columns AF. and AG. provide the latitude and longitude (separate columns) of the single center point coordinate in decimal degree format, and in column AH provide a radius (in meters) from the single center point that will encompass the site.

AI. Relocation Site Location Description – provide a brief description of where the relocation site is located.

AJ. Relocation Site Identifier – assign and provide a unique operational name/number/alphanumeric character for the relocation site.

AK. Relocation Site Depth – provide the depth (in feet) of the relocation site.

- Columns AL. through AV. – Provide Corner and Undefined coordinates for the removal site. Regardless of the design of the site, provide a single point coordinate of each corner of a site in Columns AL through AS., specifically the latitude and longitude (separate columns) of the single point coordinates of the NE, NW, SE, SW corners of the site, in decimal degree format. In columns AT. And AU. provide the latitude and longitude (separate columns) of the single center point coordinate in decimal degree format, and in column AV provide a radius (in meters) from the single center point that will encompass the site.

★ Columns AW. through BP. will auto-populate to provide the following summary data:

AW. At Relocation Monitoring (Pooled Coral Live Tissue Area Index) – this will auto-populate to the sum of the Live Tissue Area Indices auto-calculated for each coral colony by species (column "N" in the "Coral Colony" data sheet).

AX. 6 Month Monitoring (Pooled Coral Live Tissue Area Index) – this will auto-populate to the sum of the Live Tissue Area Indices auto-calculated for each coral colony by species (column "AJ" in the "Coral Colony" data sheet).

AY. 1 Year Monitoring (Pooled Coral Live Tissue Area Index) – this will auto-populate to the sum of the Live Tissue Area Indices auto-calculated for each coral colony by species (column "AU" in the "Coral Colony" data sheet).

AZ. 2 Year Monitoring (Pooled Coral Live Tissue Area Index) – this will auto-populate to the sum of the Live Tissue Area Indices auto-calculated for each coral colony by species (column "BF" in the "CoralColony" data sheet).

BA. 3 Year Monitoring (Pooled Coral Live Tissue Area Index) – this will auto-populate to the sum of the Live Tissue Area Indices auto-calculated for each coral colony by species (column "BQ" in the "CoralColony" data sheet).

BB. 4 Year Monitoring (Pooled Coral Live Tissue Area Index) – this will auto-populate to the sum of the Live Tissue Area Indices auto-calculated for each coral colony by species (column "CB" in the "CoralColony" data sheet).

BC. 5 Year Monitoring (Pooled Coral Live Tissue Area Index) – this will auto-populate to the sum of the Live Tissue Area Indices auto-calculated for each coral colony by species (column "CM" in the "CoralColony" data sheet).

BD. 6 month Change in pooled Live Tissue Area Index – this will auto-populate to provide any changes in the pooled live tissue area index by species and site.

BE. 6 month Percent (%) Change in pooled live Tissue Area Index – this will auto-populate to provide the percent change in pooled live tissue area index by species and site

BF. 1 Year Change in pooled Live Tissue Area Index – this will auto-populate to provide any changes in the pooled live tissue area index by species and site.

BG. 1 Year Percent (%) Change in pooled live Tissue Area Index – this will auto-populate to provide the percent change in pooled live tissue area index by species and site

BH. 2 Year Change in pooled Live Tissue Area Index – this will auto-populate to provide any changes in the pooled live tissue area index by species and site.

BI. 2 Year Percent (%) Change in pooled live Tissue Area Index – this will auto-populate to provide the percent change in pooled live tissue area index by species and site

BJ. 3 Year Change in pooled Live Tissue Area Index – this will auto-populate to provide any

changes in the pooled live tissue area index by species and site.

BK. 3 Year Percent (%) Change in pooled live Tissue Area Index – this will auto-populate to provide the percent change in pooled live tissue area index by species and site

BL. 4 Year Change in pooled Live Tissue Area Index – this will auto-populate to provide any changes in the pooled live tissue area index by species and site.

BM. 4 Year Percent (%) Change in pooled live Tissue Area Index – this will auto-populate to provide the percent change in pooled live tissue area index by species and site

BN. 5 Year Change in pooled Live Tissue Area Index – this will auto-populate to provide any changes in the pooled live tissue area index by species and site.

BO. 5 Year Percent (%) Change in pooled live Tissue Area Index – this will auto-populate to provide the percent change in pooled live tissue area index by species and site

BP. Overall Survival – this will auto-populate to provide overall survival by species and site.

BQ. Notes – document any additional information deemed relevant by the license holder.

Coral Colony Information Data Sheet Directions

In the "Coral Colony" datasheet, record the following information PER INDIVIDUAL COLONY for all relocated colonies that are being monitored:

At Relocation:

- Row 2: Provide the project name, DPNR permit number, person the license is issued to, and affiliation.

A. Event Date – provide the date that the colony was removed.

B. Removal Site Identifier – provide the unique operational name/number/alphanumeric character assigned to the removal site, as identified in the "Summary" data sheet.

C. Temporary Holding Site Identifier - provide the unique operational name/number assigned to the temporary holding site, if one was used, as identified in the "Summary" data sheet.

D. Relocation Site Identifier – provide the unique operational name/number assigned to the relocation site, as identified in the "Summary" data sheet.

E. Coral species – select each relocated coral by the species full taxonomic name (no abbreviations) on a separate row using the drop down menu.

F. Endangered Species Act status – record the status of the species as (E) = Endangered, (T) = Threatened, (N) = Not listed.

G. Colony Identifier – record the unique tag or map number/alphanumeric character assigned to each coral being monitored.

H. Coral Relocation Condition – record if the colony was removed and relocated as an (I) = Intact Colony; as a (SC) = Single Colony (i.e., portion of a colony that fragmented upon removal but is 5 cm or greater); or as a (RC) = Reconstructed Colony (i.e., colony that fragmented upon removal and was reconstructed.)

I. Attachment – conduct a visual survey for attachment condition of relocated colonies, and record condition status as (F) = Firm; (L) = Loose; (D) = Detached but still present nearby; (M) = Missing. All loose or detached colonies must be reaffixed to their structure or substrate.

J. Coral Max Width – the maximum coral width is measured as the outward-facing surface of the colony (perpendicular to the axis of growth). This measurement includes both living tissue and dead areas of the colony.

K. Coral Max Height – the maximum coral height is measured parallel to the axis of growth, perpendicular to growth bands, as viewed from the side of the colony.

L. Coral Skeletal Area – this will auto-populate, and is equal to the average of the two largest dimensions (maximum width and maximum height), squared. To apply this formula to all of the data in this column, you have two options: 1) drag the formula down the column by clicking in the cell in row 5 with the value of "0", and dragging the green box in the lower right hand corner of the cell down to the last colony that has data recorded; or 2) copy and paste the formula for each colony's data recorded.

M. Coral Tissue Condition – Live – Includes all live tissue, including any bleached tissue (pale or clear living tissue that has lost zooxanthellae), estimated as a percentage of the entire coral skeleton. Assign a tissue condition percentage for live tissue, and record as a decimal, with two decimal places – e.g., 10% = .10

N. Coral Tissue Condition – Dead – Includes both recent and old dead tissue; defined as either 1) bright white dead areas where corallite structure is still identifiable, estimated as a percentage of the entire coral skeleton. May be covered by sediment or thin layer of algae; or 2) dead areas that are not bright white and may be overgrown with algae or other encrusting organisms, estimated as

a percentage of the entire coral skeleton. Assign a tissue condition percentage for dead tissue, and record as a decimal, with two decimal places – e.g., 10% = .10

O. Coral Live Tissue Area Index (or estimate) – this will auto-populate, and is equal to the Skeletal Area times the % live tissue value. Please copy and paste the formula for each colony's data recorded, or drag the formula down the column by clicking in the cell in row 5 with the value of "0", and dragging the green box in the lower right hand corner of the cell down to the last colony that has data recorded.

P. Presence of Other Conditions (bleaching, predation, disease, *Cliona*).

Q. Comments/Observations – Document any localized event (not specific to relocated corals) that may have negative impacts on the relocation site (e.g., weather event, grounding, sedimentation, turbidity, disease, bleaching, predation, competition), and document any other information deemed relevant by the data collector.

<u>One Week After Relocation:</u>

R. Event Date – provide the date that the colony was monitored.

S. Attachment – conduct a visual survey for attachment condition of relocated colonies, and record condition status as: (F) = Firm; (L) = Loose; (D) = Detached but still present nearby; (M) = Missing. All loose or detached colonies must be reaffixed to their structure or substrate.

<u>At One Month After Relocation:</u>

T. Event date – provide the date that the colony was monitored.

U. Attachment – conduct a visual survey for attachment condition of relocated colonies, and record condition status as: (F) = Firm; (L) = Loose; (D) = Detached but still present nearby; (M) = Missing. All loose or detached colonies must be reaffixed to their structure or substrate.

V. Sediment Indicators – Record any indicators of sedimentation as follows:

- (SD) = Sediment Dusting - A fine powdering of sediment observable on the surface of the colony or individual. May occur in patches or over the entire organism. Powdering does not obscure features of the colony or individual (i.e., polyps are still observable).
- (SA) = Sediment Accumulation - Patches (areas) of sediment thicker than dusting are observable on the top or sides of the organism. Features of the colony or individual (i.e., polyps) are likely obscured by sediment patches.
- (PB) = Partial Burial - Portions of the organism are covered by sediment, including at least some portion of the base (point of attachment). Features of colonies and individuals are obscured.
- (BB) = Burial of the Base - Sediment covers the entire point of attachment / base of the organism.
- (B) = Burial - Entire organism is covered by sediment.
- (H) = Sediment Halo - A pattern of partial colony mortality in which a concentric ring of dead coral skeleton occurs at the base of the coral colony, as results from prior burial of the

colony edges. Sedimentation does not have to be present or observed for this indicator to be discernible.

W. Presence of Other Conditions – record observed conditions (bleaching, predation, disease, Cliona).

X. Comments/Observations – Document any localized event (not specific to relocated corals) that may have negative impacts on the relocation site (e.g., weather event, grounding, sedimentation, turbidity, disease, bleaching, predation, competition), and document any other information deemed relevant by the data collector.

At Three Months After Relocation

Repeat columns T. through X. for columns Y. through AC.

At Six Months After Relocation:

AD. Event date – provide the date that the colony was monitored.

AE. Attachment – conduct a visual survey for attachment condition of relocated colonies, and record condition status as: (F) = Firm; (L) = Loose; (D) = Detached but still present nearby; (M) = Missing. All loose or detached colonies must be reaffixed to their structure or substrate.

AF. Coral Max Width – the maximum coral width is measured as the outward-facing surface of the colony (perpendicular to the axis of growth). This measurement includes both living tissue and dead areas of the colony.

AG. Coral Max Height – the maximum coral height is measured parallel to the axis of growth, perpendicular to growth bands, as viewed from the side of the colony.

AH. Coral Skeletal area – this will auto-populate, and is equal to the average of the two largest dimensions (maximum width and maximum height), squared. Please copy and paste the formula for each colony's data recorded, or drag the formula down the column by clicking in the cell in row 5 with the value of "0", and dragging the green box in the lower right hand corner of the cell down to the last colony that has data recorded.

AI. Coral Tissue Condition – Live – Includes all live tissue, including bleached tissue, estimated as a percentage of the entire coral skeleton. Assign a tissue condition percentage for live tissue, and record as a decimal, with two decimal places – e.g., 10% = .10

AJ. Coral Tissue Condition – Dead – Includes both recent and old dead tissue; defined as either 1) bright white dead areas where corallite structure is still identifiable, estimated as a percentage of the entire coral skeleton. May be covered by sediment or thin layer of algae, or 2) dead areas that are not bright white and may be overgrown with algae or other encrusting organisms, estimated as a percentage of the entire coral skeleton. Assign a tissue condition percentage for dead tissue, and record as a decimal, with two decimal places – e.g., 10% = .10

AK. Coral Live Tissue Area Index (or estimate) – this will auto-populate, and is equal to the Skeletal Area times the % live tissue value. Please copy and paste the formula for each colony's data recorded, or drag the formula down the column by clicking in the cell in row 5 with the value of "0", and dragging the green box in the lower right hand corner of the cell down to the last colony that has data recorded.

AL. Sediment Indicators – Record any indicators of sedimentation as follows:

- (SD) = Sediment Dusting - A fine powdering of sediment observable on the surface of the colony or individual. May occur in patches or over the entire organism. Powdering does not obscure features of the colony or individual (i.e., polyps are still observable).
- (SA) = Sediment Accumulation - Patches (areas) of sediment thicker than dusting are observable on the top or sides of the organism. Features of the colony or individual (i.e., polyps) are likely obscured by sediment patches.
- (PB) = Partial Burial - Portions of the organism are covered by sediment, including at least some portion of the base (point of attachment). Features of colonies and individuals are obscured.
- (BB) = Burial of the Base - Sediment covers the entire point of attachment / base of the organism.
- (B) = Burial - Entire organism is covered by sediment.
- (H) = Sediment Halo - A pattern of partial colony mortality in which a concentric ring of dead coral skeleton occurs at the base of the coral colony, as results from prior burial of the colony edges. Sedimentation does not have to be present or observed for this indicator to be discernible.

AM. Presence of Other Conditions – record observed conditions (bleaching, predation, disease, Cliona).

AN. Comments/Observations – document any localized event (not specific to relocated corals) that may have negative impacts on the relocation site (e.g., weather event, grounding, sedimentation, turbidity, disease, bleaching, predation, competition), and document any other information deemed relevant by the data collector.

<u>At One Year After Relocation</u>
Repeat columns AD. through AN. for columns AO. through AY.

<u>At Two Years After Relocation</u>
Repeat columns AD. through AN. for columns AZ. through BJ.

<u>At Three Years After Relocation</u>
Repeat columns AD. through AN. for columns BK. through BU.

<u>At Four Years After Relocation</u>
Repeat columns AD. through AN. for columns BV. through CF.

<u>At Five Years After Relocation</u>
Repeat columns AD. through AN. for columns CG. through CQ.

Diseased Coral Colony Information Data Sheet Directions

In the "Diseased Coral Colony Info" data sheet, record the following information PER INDIVIDUAL COLONY of coral species that were not relocated due to suspect disease or other disqualifying conditions:

- Row 2: Provide the project name, DPNR permit number, person the license is issued to, and affiliation.

A. Event Date – provide the date that the colony was monitored.
B. Removal Site Identifier – provide the unique operational name/number/alphanumeric character assigned to the removal site, as identified in the "Summary" data sheet.
C. Temporary Holding Site Identifier (if applicable) – provide the unique operational name/number/ alphanumeric character assigned to the temporary holding site, as identified in the "Summary" data sheet.
D. Coral Species – select each diseased coral by the species full taxonomic name (no abbreviations) on a separate row using the drop down menu.
E. Coral Max Width – the maximum coral width is measured as the outward-facing surface of the colony (perpendicular to the axis of growth). This measurement includes both living tissue and dead areas of the colony.
F. Coral Max Height – the maximum coral height is measured parallel to the axis of growth, perpendicular to growth bands, as viewed from the side of the colony.
G. Coral Disqualifier – identify what condition disqualified the coral colony from relocation, using the key code provided.
H. Type of Coral Disqualifying Active Disease or Suspect Disease Indicator – if the coral was disqualified due to an active disease or suspect disease indicator, use the key code provided to identify the disease or disease indicator that disqualified the coral from relocation.
I. Type of Coral Disqualifying Stress Indicator – if the coral was disqualified due to a stress indicator, use the key code provided to identify the stress indicator that disqualified the coral from relocation.
J. Type of Coral Disqualifying Predation/Competition/Overgrowth Condition – if the coral was disqualified from relocation due to predation, competition or overgrowth, use the key code provided to identify the predator, competitor or overgrowth condition that disqualified the coral from relocation.
K. Disposition – identify how the coral was disposed of using the key code provided.
L. Comments/Observations - provide any observation details for unknown disease or conditions, name of entity that diseased corals were donated to (if donated), and any other information deemed relevant by the data collector