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Supplemental Environmental Management Plan

Capital Improvements Projects

Great Stirrup Cay

The Bahamas

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GREAT STIRRUP CAY THE BAHAMAS

Supplemental Environmental Management Plan Coastal Improvements Project

Amendment	and	Date	Page(s)	Description
Revision				

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1.0 Executive Summary

Included in this Supplemental Environmental Management Plan (EMP) is a site-specific plan developed for the Coastal Improvements Project (Project) – East Beach Plan (Figure 1) along the north coast of Great Stirrup Cay (GSC). This EMP was developed to identify and support implementation of measures to protect the environment and comply with environmental legislation. This document serves as a reference manual providing construction staff and project managers with guidelines and recommendations for adherence to Bahamian environmental regulation. The EMP contains pertinent environmental information about the Project along with Best Management Practices (BMP) intended to optimize environmental conditions during construction. This EMP is specific to marine impact avoidance/minimization associated with groin/breakwater creation and beach enhancements. The terrestrial and watershed environmental impacts and management strategies associated with upland improvements and previously completed marine-based aspects are found in the Environmental Impact Assessment (EIA) for Great Stirrup Cay (Coastal Systems International, Inc., 2008¹). This supplemental EMP is ancillary to the previously approved EIA and describes how the proposed, redesigned coastal improvement designs and activities can be implemented and constructed while minimizing potential impacts to the natural environment.

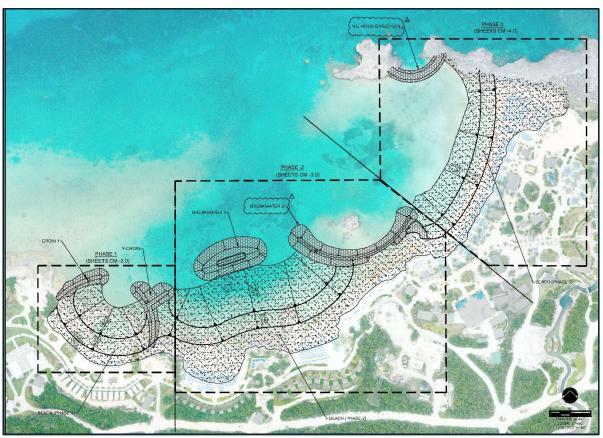


Figure 1. Coastal Improvement Project – East Beach Plan (Proposed). Source: Cummins Cederberg Coastal & Marine Engineering, Coastal Engineers (2020-06-30)

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¹ Coastal Systems International, Inc. 2008. Environmental Impact Assessment, Great Stirrup Cay, Berry Islands, Commonwealth of the Bahamas. Prepared for Norwegian Cruise Lines. 152 pp.

2.0 Purpose and Scope

An Environmental Management Plan (EMP) is a written guide that identifies relevant management techniques, BMPs, and Emergency Response Plans based on site-specific conditions and potential impacts, as documented in an Environmental Impact Assessment (EIA) or report of similar scope. An EMP is not a static document – it is a working document that changes during the life of a project.

This EMP pertains to the life cycle of construction and operations for the Coastal Improvements at East Beach. This document aims to meet the demands and expectations of The Bahamas Environment, Science and Technical Commission (BEST) and the utilization of and adherence to international standards for BMPs.

An EMP is the key to ensure human health and safety, as well as a clean environment. The EMP envisages the plans for the implementation of mitigation measures to reduce the adverse impacts that may result from project activities during pre-construction, construction and throughout operation. Effective management and monitoring provide the tools necessary to recognize potential impacts and to introduce corrective action if required.

3.0 Overview of Coastal Improvement Project

3.1 Project Description

3.1.1 Sand Source

Contractor shall ensure beach compatible sand for the coastal improvements project is sourced from an authorized vendor or mined from an approved borrow area. Any proposed source should have sufficient quality and quantity of sand and meet specifications for grain size distribution, composition (i.e., silt, shell, or gravel content), and color for fill nourishment projects in the Bahamas. Grain size is a key consideration to support ensure functionality and performance of the designed beach. Beach fill material shall be similar to existing beach sand and free of debris, rocks, or other foreign matter. All beach fill shall have <5% silt and be free any contaminants. Based upon prior project elements, it is assumed the approved beach sand will be transported to the island by tug and tender barge (Photo 1) and stockpiled at an existing sand and rock staging area on the southwestern tip of the island (Figure 2). If hydraulic placement methods are used, the material shall be screened to prevent rock or other unsuitable material from being placed on the beach.

3.1.2 Groin and Breakwater Construction

Two groins and two breakwaters are being constructed as Phase 1 and Phase 2 at the central beach on the northern extent of the island to prevent erosion and mitigate ocean wave energy along the recreational beaches. A third breakwater, the "N.E. Rock Structure" is planned as part of Phase 3 of the beach development. **Figure 1** and **Appendix A** show the plans for Groin 1 and "Y-Groin" (Phase 1) along the western-most portion of the coastal improvements project area, Breakwater 1 and Breakwater 2 (Phase 2), more centrally located, and the N.E. Rock Structure in the northeastern most portion of the beach areas. Groin 1 is constructed starting from the shoreline extending northeast while the Y-Groin, named for its Y-shape, extends north from the shoreline. To the east of the Phase 1 groins, two breakwaters are proposed. Breakwater 1 is shaped like an ellipse, while Breakwater 2 has a convex curvature, in relation to the shoreline. The N.E. Rock Structure curves from the northeast to the northwest between existing natural rock peninsula and neighboring rock island (aka Susan's Rock).



Figure 2. Sand and rock staging area

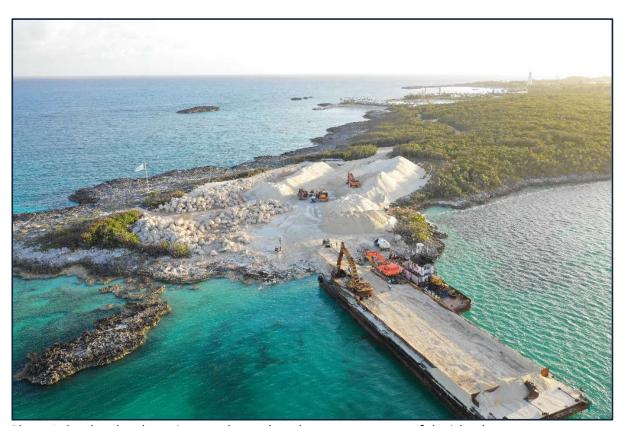


Photo 1. Sand and rock staging area located on the western corner of the island.

Per the construction plans, rocks should be rough angular quarried stone of a dense, hard durable character free of organic material. Native rock for the groin and breakwater construction is proposed to be sourced from Martin Marietta's Bahama Rock facility in Freeport. Rocks from one (1) to five (5) tons

Photo 1). Rocks will be placed in an articulated dump truck and hauled along an existing road and unloaded along the shoreline in piles. Groin 1 and the Y-Groin will be connected to land while Breakwater 1 will be constructed slightly offshore in approximately -10 fsw by creating a temporary land bridge, to be removed after completion. Breakwater 2 is connected to an existing rock structure. The N.E. Rock Structure build will also require a land bridge be installed and removed following completion of the breakwater.

3.1.3 Beach Enhancements

The central beach landward of the groins and breakwaters will be expanded to accommodate beachgoers and provide a safer and more comfortable visitor experience. Additional beach areas will be created using the previously specified beach-compatible sand. Sand will be graded in accordance with the construction plans at approved slopes and profiles to create wider recreational areas, stabilize the beach area, and improve aesthetics.

4.0 Laws and Regulations

4.1 National Environmental Policies

Relevant national government agencies and entities that have governance over or interest in this Supplemental EMP include, but are not limited to:

- Ministry of Environment and Housing
 - o Bahamas Environment, Science and Technology (BEST) Commission
- Bahamas Investment Authority
- Ministry of Tourism
- Department of Physical Planning
- Ministry of Works
- Port Department
- Berry Islands Department of Labour

Additionally, a series of laws and regulations have been accepted in The Bahamas which may affect activities occurring within the coastal zone, and include the following:

Ministry of Environment Bill (2019)

This Bill established the Ministry of the Environment which functions to maintain the "integrity of the environment of the Bahamas" by protecting and conserving all land, water, air, and living resources. As we will be altering and affecting these resources with the construction of groins and breakwaters and with beach nourishment, the Ministry of the Environment will be invested in the project

Environmental Planning and Protection Bill (2019)

This Bill established the Department of Environmental Protection and Planning, which serves to protect the environment of the Bahamas with an integrated environmental management system that provides a legal framework for the sustainable management, protection, conservation, development, and enjoyment of the people. The project involves the development of the environment, so the Department will be interested in the protection of the environment.

Environmental Protection (Control of Plastic Pollution) Bill (2019)

This Bill sets forth laws relating to the use of plastics, including: (1) prohibiting single use plastic food ware; (2) prohibiting non-biodegradable, oxo-biodegradable, and biodegradable single use plastic bags; (3) prohibiting the release of balloons; and (4) regulating the use of compostable single use plastic bags. During construction, personnel on the island will need to refrain from using the prohibited plastics to prevent degradation to the environment.

Conservation and Protection of the Physical Landscape of the Bahamas Act (1997)

This Act provides for the regulation of the physical landscape, including but not limited to: the filling up of lands and wetlands; any excavation that may affect the coastline; and the digging up or removal of sand from beaches and dunes. The Project involves the removal and transportation of sand from one beach to another to fill in the shoreline, which will be regulated by this Act

Environmental Health Services Act (1987)

This Act sets forth provisions to regulate both public health and environmental health through preventing pollution, managing wastes, maintaining general sanitation, training personnel, and several other measures. All construction personnel working on the island will need to follow the protocols and regulations provided in this Act

Wild Birds Protection Act (1987)

This Act protects wild birds by prohibiting the killing, capturing, or possession of specified wild birds. The Act specifically prohibits the kill or capture of the White Crowned Pigeon at any time of the year, which construction personnel may encounter on the island.

Coast Protection Act (1968)

This Act makes a provision for the protection of the coast, relative to erosion and encroachment by the sea. This will need to be considered when establishing erosion controls and protection measures to prevent erosion and ensure compliance with this Act.

Port Authorities Act (2006)

This Act sets forth provisions to appoint port authorities to all ports and harbours of the Bahamas to better regulate and control port operations.

Marine Mammal Protection Act (2005)

This Act sets forth provisions to protect marine mammals, including prohibiting import of marine mammals and prohibiting taking, harassing, etc. of marine mammals, among other guidelines. As construction will occur in the water where marine mammals may be found, construction personnel will need to follow all protocols regarding marine mammal protection.

4.2 International Policies and Standards

The Bahamas is a signatory to several international environmental agreements that either affect or may affect the management of the coastal resources of The Bahamas. For example, the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (The Cartagena Convention) (1986), coordinated by United Nations Environment Programme (UNEP), includes three protocols: the Oil Spill Protocol, the Specially Protected Areas and Wildlife (SPAW) Protocol, and the Land Based Sources of Marine Pollution (LBSMP) Protocol. The SPAW Protocol (2000) calls for the protection,

management, and development of marine and coastal resources individually and jointly among countries. Although the Bahamas is not a party to the Protocol, several other Caribbean countries have entered into these agreements and their actions may have impacts on the coastal zone of The Bahamas. Additionally, noise pollution standards of the World Bank and World Health Organization will be met. Also, the United Nations Convention on the Laws of the Sea should apply during construction and operations, to protect the marine waters of the Bahamas.

The Ramsar Convention

The Bahamas is a signatory to the Convention on Wetlands of International Importance, also known as the Ramsar Convention. This convention provides a framework for the international protection of wetlands as contributors for human resources and moreover, for avifauna which do not adhere to international boundaries. Ramsar defines wetlands as 'areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters'.

The Convention on Biological Diversity

The Bahamas is a signatory to the Convention on Biological Diversity which came into force December 1993. It has three main goals:

- The conservation of biological diversity
- The sustainable use of components of biological diversity
- The fair and equitable sharing of the benefits arising out of the utilization of genetic resources

5.0 Construction and Operational Activities and Best Management Practices

5.1 Site Safety and Health

5.1.1 Sanitary Conveniences

Great Stirrup Cay is a fully functional private island with existing sanitary conveniences for staff and employees. The island is equipped with all modern sanitary facilities with a reverse osmosis plant and sewage treatment plant. Employees have full access to indoor bathrooms, washing areas with hot water and soap, and plentiful fresh water.

5.1.2 Coronavirus Pandemic

The Coronavirus pandemic is having a major impact on public health, the economy, and the lives of people around the globe. To prevent the spread of the virus, The Center for Construction Research and Training (www.cpwr.com) has issued standards for all employers in response to their responsibility to provide a safe and healthy workplace. As part of the continued operations on GSC, the following recommendations should be considered and implemented, as appropriate throughout the Project.

- Educate all workers on the risk and control measures to prevent the spread of the virus, including handwashing, social distancing, and respiratory protection.
- Screen workers daily and ask them to self-identify symptoms associated with coronavirus such as coughing, shortness of breath, fever, headache, and muscle pain.
- Perform temperature checks of workers on a regular basis.

- Implement physical distancing procedures by creating at least 6 feet of space between workers and stage/stagger crews as much as possible.
- Provide appropriate respiratory protection including certified N95 medical grade masks, breathable synthetic fabric (disposable) surgical masks, or cloth masks such as homemade doit-yourself (DIY) or even bandanas. Although cloth masks tend to be less effective than their medical-grade counterparts, experimental results suggest they are far better than no mask at all when worn and constructed properly.

In response to the construction industry's recommendations regarding the COVID-19 outbreak, the following are steps workers should be taking now:

- Do not go to work if you are feeling sick.
- Do not go to work if you have a fever.
- Do not go to work if you have a cough or shortness of breath.
- Avoid contact with sick people.
- Do not shake hands when greeting others.
- Cover your mouth and nose with tissues if you cough or sneeze or do so into your elbow.
- Avoid touching your eyes, nose, or mouth with unwashed hands.
- Clean your hands often by washing them with soap and water for at least 20 seconds. When hand washing is not available, use an alcohol-based hand sanitizer with greater than 60% ethanol or 70% isopropanol. Soap and water should be used if hands are visibly dirty.
- Disinfect interiors and door handles of machines or construction vehicles, and the handles of equipment and tools that are shared.

5.1.3 Training

All onsite construction staff and management potentially exposed to an emergency requiring a response must receive emergency procedures and equipment training. Training should include environmental awareness and their responsibilities under the EMP, turbidity control measures, waste management, fuel and oil spill prevention, marine habitat sensitivity, fire safety and response, severe weather risks and procedures, personal safety and CPR/First Aid.

All first-time visitors to the site shall be accompanied by person(s) familiar with the health and safety policy, and should be briefed on the EMP. New employees shall receive training and demonstrate their capacity to respond in the event of an emergency. Further environmental and safety training will be provided for all employees as additional concerns emerge.

5.1.4 Personal Protective Equipment

Health and safety equipment, commonly referred to as Personal Protective Equipment (PPE), shall be available or provided for use at all work sites. PPE may include protective clothing, boots, hard hats, eye protection, hand protection, hearing protection and respiratory protection. Individual PPE will depend on the task or job performed and may include a fall protection harness while working in the cab of heavy machinery, for example.

5.2 Sediment Control and Erosion Plan

Groin and breakwater construction may require removal of vegetation to access construction transit paths and staging areas. Excessive runoff from upland sources or deposited sediment can increase turbidity and reduce light penetration in adjacent marine waters, and should be managed to reduce excessive runoff,

limit erosion, and decrease the possibility of the introduction of undesired sediments into the marine environment.

5.2.1 Sediment Control Measures

To control sediment runoff, construction zones should be delineated. Effort should be taken to retain the maximum amount of surrounding native vegetation. If vegetation is removed or new vegetation is planted in areas where sediment could runoff, ensure sediments are unable to wash out promptly by stabilizing the soils after construction. Removed vegetation can leave bare soil that is much more vulnerable to erosion, resulting in sediment moving into receiving waters. Establish perimeter controls with either silt fencing and/or sediment barriers.

5.2.2 Erosion Prevention

Runoff from construction sites can be a source of sedimentation of adjacent water bodies in areas under development. Ensure beach enhancements are constructed at correct slopes and grading, and if hydraulic fill placement is utilized, a spreader and pocket pipe shall be used to prevent gullying and erosion of the beach. Protect slopes by diverging any water from the slope and control de-watering and irrigation uphill of the construction area. No direct open water discharge will be permitted. If necessary, erosion control blankets may be used to stabilize highly erosive soils. Blankets are typically made of natural fibers such as coconut or straw, synthetic materials, or a biodegradable netting. Gravel and rip rap may also be used to protect hillsides, drainage channels, and pipe outlets from erosion due to surface water flow.

5.3 Turbidity Control Plan

Turbidity is a measure of the degree to which the water loses its transparency due to the presence of suspended particulates; measuring turbidity assesses the amount of suspended solids in the water column. Suspended solids, or particulates, are commonly associated with shoreline erosion and resuspended sediments from coastal construction projects and dredging. Suspended solids in the water (turbidity) is measured by assessing the scattering effect that suspended solids have on the propagation of light through the water. The higher the intensity of the scattered light, the higher the turbidity value. Suspended and colloidal matter such as clay, silt, finely divided organic and inorganic matter, and plankton and other microscopic organisms cause turbidity in water.

Contractor shall develop a turbidity control plan and put into effect prior to construction, and contractor shall implement turbidity control measures (e.g. turbidity curtains) as required to minimize the potential for increased turbidity levels outside the immediate area of construction activity. Background and compliance measurements should be taken to identify baseline turbidity levels. The distance between these locations should also be documented. Turbidity is generally reported in nephelometric turbidity units (NTUs) with an instrument called a turbidimeter which estimates how the light is scattered by the suspended particulates in the water. The measurement generally provides a very good correlation of the concentration of particles in the water that affect clarity.

The Bahamas does not have legislation mandating acceptable turbidity levels associated with construction. Therefore, it is proposed the Project follow the Florida Department of Environmental Protection's (FDEP) turbidity criteria of 29 NTU and levels shall not exceed 29 NTU's above the associated background turbidity levels beyond the established mixing zone.

5.3.1 Turbidity Curtains

Turbidity curtains allow suspended sediment to settle out of the water column in a controlled area, thus minimizing the sediment transport from the area of disturbance. Turbidity curtains should be selected by



Photo 2. Example of a turbidity curtain utilized to contain turbidity. Photo from The Bahamas Weekly.

the contractor and be appropriate for use in tidal areas or areas where wind and wave activity may be present (Photo 2). These barriers are one of the primary methods for controlling turbidity generated from coastal construction activities. During the GSC groin/breakwater construction and beach contractors placement, should, practicable, use turbidity curtains and ensure that sufficient length of curtain remains available onsite. Turbidity barriers are less effective in project locations with high winds, open water bodies, and areas with excessive wave heights, but should be utilized whenever possible. These practices have proven themselves successful elsewhere in the Bahamas in limiting movement of silt outside

of the construction area. Daily inspections of the curtains are recommended, and repairs or replacements will be done, as necessary. Prior to removing the turbidity curtain, the turbidity inside the curtain must return to ambient conditions.

5.3.2 Turbidity Monitoring and Reporting

Prescribed monitoring of turbidity levels in accordance with the turbidity control plan will be conducted to document silt loads related to groin/breakwater construction and beach enhancements. Measurements shall be made by a trained employee using a turbidimeter calibrated to manufacturer's standards and zeroed at the start of each measurement event. Turbidity measurements are recommended to be made at the site in three locations: within the densest portion of the turbidity plume ("inside"), down current of the construction zone, and at a location beyond the approximate influence of construction activity to serve as background. Turbidity measurements are recommended to be collected three times each day during in-water works. During construction, measurements will be collected 1) before daily works begin, 2) mid-day while work is ongoing, and 3) at the end of the day after in-water works have been completed. Testing will occur at mid depth or greater to ensure resources on the bottom are monitored/protected.

Turbidity measurements shall be recorded on a turbidity monitoring report form (**Appendix B**), analyzed and the results ultimately submitted to the Environmental Manager for review. If at any time, turbidity readings are found to exceed 29 NTU above background levels, remedial actions such as redeployment of turbidity control devices, or modification of construction activity shall be performed. Contractor shall identify the cause of the increase and make all attempts to contain the excessive turbidity. Related construction activity shall not recommence until compliance readings fall below 29 NTU.

5.4 Pollution Control

5.4.1 Material Storage and Staging Areas

All building and hazardous materials that could possibly contaminate stormwater must be stored in a dedicated area located away from a water resource or surface water body. Hazardous materials such as oils and paints shall be stored in a secondary container designated as hazardous in specifically designed storage facilities. Hazardous materials will always be stored under cover and out of direct sunlight and rain. Employees will be trained in storage techniques for hazardous materials and inspections will be made regularly of all containers and labeling for any leaks or irregularities.

5.4.2 Waste Management Plan

5.4.2.1 Liquid Waste Stream

Liquid waste streams shall be managed and treated to prevent pollution of the groundwater. The contractor shall ensure that all heavy equipment and vehicle maintenance, fueling and storage is performed in such a manner that no fuels, oils, lubricants, chemicals or other toxic materials can gain access to the soil, groundwater and surface water. The following BMPs should be put in place for managing liquid waste:

- Utilize designated back of house wash down areas where wash water can be contained. Each wash down area will be designated with appropriate signage. Wash down will be restricted to these areas.
- No wash down water shall be reused and wash down should be limited to high-pressure water, and no detergents shall be used to clean the equipment or vehicles.
- Wash down of equipment shall not be used to wash any chemicals or occur near the storage of hydrocarbon products, if any, on site.
- Proper disposal of oils and pollutants. Proper collection and disposal of oil is necessary to prevent soil and water contamination. During equipment maintenance used oil should be collected and stored until properly disposed. No discharge of oils, pollutants or other liquid waste shall be allowed to any water body

5.4.2.2 Solid Waste Stream

A sufficient number of garbage bins and containers are available on the island, with specific areas set aside for construction material waste. Garbage and other waste will be regularly collected and transported to a designated waste transfer site. These containers/bins will be emptied at regular intervals and the collected waste will then be transported to transfer site and either incinerated or be transported for final disposal offsite. BMPs for waste management include:

- Do not stockpile or store solid waste near or close to any water bodies.
- Clean up construction areas daily of debris and litter.
- Utilize existing on island transportation methods between front of house operations, construction areas, and waste storage areas.
- Segregate waste that can be incinerated from recyclable and hazardous wastes.
- Provide continuing education and training for crew and staff on waste management.

5.4.3 Equipment, Maintenance, Fueling and Storage

5.4.3.1 Fuel Spill Prevention

Application of safe practice in fuel usage will minimize the likelihood of any accidental leak or spill. Contractor shall develop or utilize an existing fuel Spill Prevention and Recovery Plan. Currently, all fuel on the island is stored in a central fuel facility located within the back-of-house area (**Photo 3**). The storage tanks are double-walled and situated on an enclosed slab with surrounding concrete walls. To minimize the potential of spills, the following BMPs shall be followed:

- Ensure signs are posted on the proper operating and safety procedures at the fueling facility.
- Keeping fuel pumps locked except when in active use.
- Ensure that clearly marked emergency shut-off switches, communications, and spill containment equipment are visible from all fueling areas.
- Attend to all loading, unloading or fueling events.
- Have drip pans or pads within sight of any fuel transfer procedure and using funnels plus pads or pans when transferring fuel to portable containers
- Ensure responsibility for all portable containers in use at any time and return them to the proper storage location after use.
- If any oil/fuel leakages have occurred, all contaminated soils or materials must be removed and disposed of at a permitted site.



Photo 3. Existing GSC back-of-house facilities

5.4.3.2 Vehicle and Equipment Fueling

The contractor shall ensure all vehicle and heavy equipment fueling, or vehicle repairs, are performed at the central fuel facility. All electrical components used in the fuel pumps, lights or other electrical components are water- and explosion-proof in accordance with section 3902 of The Bahamas Building Code, Second Edition 1987, and are subject further to the specific requirements of the Inspector of Volatile

Substances, Ministry of Public Works and Urban Renewal Commission. The following BMPs shall be followed for safe fueling:

- Provide fuel absorbent pads at all fueling stations
- Provide funnels, marked for oil and gas in the fueling area
- Rags for small spills with dedicated fireproof rag container
- Fire extinguishers available at each of the fueling locations
- Visually inspect hoses and supply lines for wear or damage
- Fuel dispensers equipped with back pressure shut off valve
- Ensure fueling area is free of debris and obstructions and that safe fueling materials are in place
- Provide signs in the fueling areas stating the following:
 - Smoking is prohibited
 - o Turn engines off before fueling
 - Avoid overfilling of tanks
 - Report all spills, no matter how small

5.5 Communication and Traffic Control

There will be an increase in vehicle usage and traffic during both the construction of the groins/breakwaters and beach enhancements. Vehicular traffic will include golf carts, trucks, and heavy construction equipment. Existing roads shall be used, and construction zones will be marked off to limit access from visitors while ships are in port. Coordinating construction activities while visitors are on the island shall be done to minimize potential passing of heavy equipment and vehicles while the ship is docked offshore, and passengers are on moving about GSC. Speed limit signs (**Photo 4**) shall be placed along roadsides, ingress and egress routes shall be clearly marked, and traffic cones shall be placed clearly marking of exclusion zones.



Photo 4. Traffic control sign on GSC

Construction crew and staff shall be provided radios and maintain contact with each other and communicate activities to ensure roadways are clear of visitors when heavy equipment is moving large loads near areas where passengers may be located. Construction vehicle flow shall be continually communicated and around monitored the construction routes and areas. If problems arise due to conflicts between vehicle and visitor traffic, traffic flow and movements may need to be ceased or modified to ensure minimal risk to the safety of persons and equipment.

5.6 Emergency Contingency Plan

5.6.1 Inclement Weather

Contractor shall have a Tropical Storm and Hurricane Preparedness and Evacuation Plan in place and follow all preparations and protocols for the safety of visitors, personnel, and staff, and the safeguarding of all infrastructure, buildings, equipment, and vessels. This includes but is not limited to ensuring all supplies, fuel tanks, office equipment, food stores, documents, and personal belongings are inventoried and safeguarded. In general, during inclement weather, all work will be stopped, heavy equipment and vehicles will be moved upland and stored in designated areas. Loose materials and equipment will be secured such that they will not become mobile or wash out to sea. Barges and vessels will be secured per the preparedness plan. For a Category three (3) or higher storm, all non-essential personnel will be evacuated, and equipment and materials will be tie-downed or stored inside for added protection.

5.6.2 Fuel Spill Response

Increased use of petroleum products (e.g., diesel and gasoline fuels) presents an increased risk of accidental spillage or release into the environment, which could negatively impact marine water quality and groundwater quality, if not properly managed. Proper procedures will be observed with a focus on spill prevention and safe operations. Proper fuel spill response procedures shall include containment and clean up and include training of personnel on the proper use of spill containment booms and clean up absorbent materials. A spill control kit shall be in a location where trained employees can easily access in the event of a spill. The kit will include a PPE (e.g., gloves, coveralls, goggles), a spill containment boom, fuel absorbent materials, hazardous material disposal bags and containment bags. The following is a list of BMPs that shall be used to prevent and respond to fuel spills:

- Upon discovering a spill, make every effort to stop the source of the spill and contain the spilled materials.
- Clean up leaks and spills immediately using rags if on paved surfaces (using as little water as possible), or absorbent pads if in the water.
 - o Small spills cleaned with rags should be placed in a fireproof container.
 - If absorbent pads were used, place the pads in the marked container for transport to the hazardous waste disposal facility.
- If the spilled material is hazardous, cleanup materials must be disposed of as hazardous waste.
- If the spill is gasoline on land, it should be allowed to dissipate due to its high explosion/flammability, and volatility. Cordon off the area and restrict access until it can be deemed safe. If gasoline is spilled in the water, do not boom the spill but remove any potential source of ignition from the area.
- Signage should be placed will information on who to contact and immediate first steps to take to ensure safety of staff and visitors in the event of a spill.
- Report all spills including small ones with details on location, time, source, estimated volume, actions taken, weather at the time of the spill, and contact information of the responsible party and those who responded.

5.6.3 Fire Control Measures

As an active private island resort destination, GSC is a fully functional facility with existing fire-control systems and an emergency response plan in place. One of the greatest fire threats during the coastal improvement construction activities is lack of proper maintenance of the heavy equipment. The two

contributing factors to any fire include a source of ignition and a source of fuel. Overheated components, frayed wiring, batteries, and even tires, when a tire with metal shards become overheated due to under inflation, can act as ignition points. Fuels sources such as diesel fuel, hydraulic fluid, and debris (e.g., vegetation) are all flammable and hazardous materials that can be ignited by a spark or excessive heat. To reduce the potential for fires in vehicles and heavy equipment, the following BMPs are suggested:

- Properly maintain and clean equipment on a regular basis
- Check for debris, one of the number one causes of fires
- Look for hydraulic of fuel-system leaks, and for hoses rubbing together
- Ensure all electrical system components are properly insulated and mounted
- Make sure fire extinguishers are fully charged and accessible
- Training of employees of pre-shift and post-shift inspections and fire safety

6.0 Environmental Mitigation Plan

6.1 Benthic Survey

The marine environment within the Project area is typical of shallow embayments in the Bahamas. Water depths gradually increase from the shoreline to approximately 12-15 feet of seawater (fsw) until dropping off at the edge of the primary coastline to approximately 30–40 fsw. Primary marine habitats colonizing the shallow bay area include seagrass, unvegetated soft bottom (i.e., sand-dominated), and hardbottom colonized with corals, soft corals, macroalgae, and sponges.

The area surrounding the proposed Phase 1 structures (Groin 1 and Y-Groin) was previously surveyed by NOVA Southeastern University (various dates); the survey documented elkhorn coral (*Acropora palmata* [Photo 5]) and staghorn (*Acropora cervicornis*) coral colonies (Figure 3). In March 2020, Cummins Cederberg, Inc. conducted a benthic survey to specifically document marine habitats around the proposed Phase 2 structures (Breakwater 1 and Breakwater 2) [Figure 4] and Phase 3 structure (N.E. Rock Structure) [Figure 5]. The survey characterized the benthic habitat and their extents within the footprints of the proposed breakwater structures and areas surrounding the proposed breakwaters, as well as documented the location of coral colonies. The full report is provided in Appendix C.



Photo 5. Elkhorn coral (Acropora palmata) (Photo credit: Cummins Cederberg, Inc.)



Figure 3. Elkhorn and staghorn coral sites (figure credit: NSU)

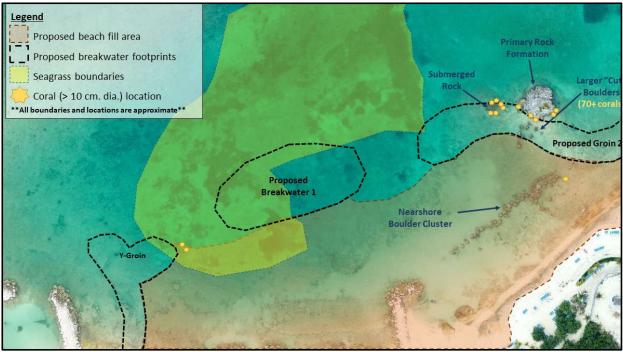


Figure 4. Marine habitats around proposed Breakwater 1 and Breakwater 2 (Phase 2, before redesign) (Cummins Cederberg, 2020)

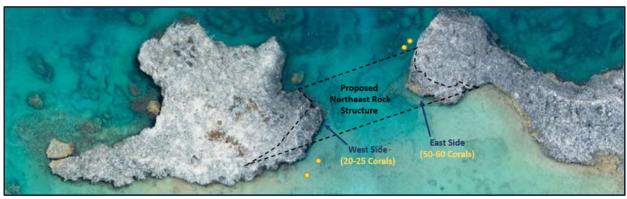


Figure 5. Coral colonies around proposed N.E. Rock Structure (Phase 3, before redesign) (Cummins Cederberg, 2020)

The nearshore submerged substrate adjacent to the beach where Breakwater 1 and Breakwater 2 are located generally consists of sand and occasional larger rocks (50 cm – 1 m). Approximately 250 linear feet (LF) waterward (north) toward the footprint of Breakwater 1, the substrate transitions to fractured carbonate rock and hardbottom covered in various fleshy brown and green algae, with occasional small colonies (<5-7 cm [2-3 inches]) of the ubiquitous starlet corals (*Siderastrea spp.*) and small octocorals, with scattered patches of turtle grass (*Thalassia testudinum*). Progressing northward, the turtle grass habitat transitions to a denser mixed seagrass bed of turtle grass and manatee grass (*Syringodium filiforme*) which continues for another approximately 30 LF where it becomes less dense, continuing northward well beyond the survey area. The seagrass bed continues east and west and transitions to patchy seagrass and eventually back to fractured carbonate rock colonized with macroalgae. On the western extent of the proposed beach fill footprint, are two large (>1.5 m [5 feet] in diameter) boulder

corals (*Orbicella faveolata* [**Photo 6**]) outside of the proposed breakwaters but potentially within the beach fill area.



Photo 6. Boulder coral (Orbicella faveolata) east of the proposed Y-Groin

The original design footprint of Breakwater 2 (Figure 6) encompassed a natural emergent rock formation as well as approximately a dozen 'cut' boulders in the shape of cubes (~ 6'L x 6'W x 6'H) that appear to be manufactured and placed on site many years ago (Photo 7). Coral were present on the sloping and vertical faces of the primary rock formation, the submerged natural rock, and on the sides of the larger "cut" boulders. There were approximately 60 colonies of finger coral, Porites porites, and 10 colonies of mustard hill coral, P. astreoides, that were ≥10 cm observed growing on the cut boulders. Macroalgae, sponges, and fire coral (Millepora spp.) were also observed growing on the boulders. On the south side of the rock formation and the adjacent submerged rock to the west, eleven colonies ≥10 cm of varying coral species were documented. Corals were observed growing on the north side of the rock; however, this is outside of the project area, so the corals were not enumerated. To the southwest and closer to shore, another cluster of smaller boulders are present; these colonies are primarily colonized by macroalgae with only a few small starlet corals observed. One knobby brain coral colony (Pseudodiploria clivosa [Photo 8]), approximately 0.7 m. x 0.45 m., was documented growing on the substrate directly southeast of the nearshore boulders, approximately 130 LF south of the rock formation. The general extents of these benthic habitats, key features, and coral colonies are shown presented in Figures 4 and **5** and the entire report is provided as **Appendix C**.



Photo 7. Cube-shaped boulder near proposed Breakwater 2



Photo 8. Knobby brain coral (*Pseudodiploria clivosa*)

The original design configuration for the N.E. Rock Structure (Phase 3) encompassed deeper water to the north where larger boulders in approximately 18-20 fsw are scoured from heavy waves and have very few coral colonies colonizing them. However, along the shallower sloping rock faces on the eastern side of the original design, there were numerous coral colonies (50-60) growing on the vertical and horizontal substrate, and beneath overhangs. An additional 20-30 colonies were observed within the westernmost extent of the footprint. **Figure 5** shows the locations of the coral colonies observed and documented during the March 2020 survey.

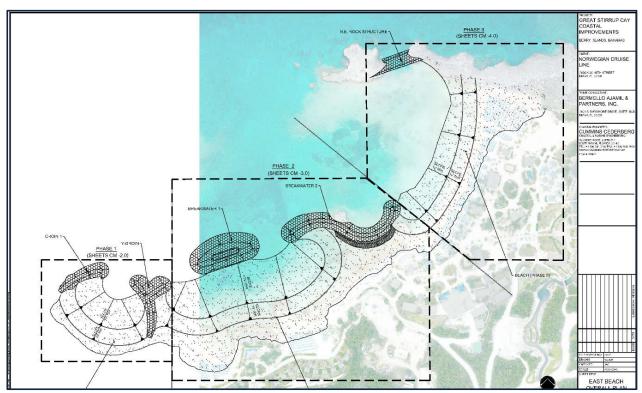


Figure 6. Original design of Breakwater 2 and the N.E. Rock Structure before benthic habitat survey and redesign (Source: East Beach Plan, Cummins Cederberg Coastal and Marine Engineering (2019-12-02)

6.2 Avoidance of Corals and Breakwater Redesign

To avoid any impacts to corals around the Phase I area (Groin 1 and Y-Groin), contractor should use the map provided by NOVA Southeastern University (**Figure 5**) and confirm the coral colonies are not within the construction footprint. Contractor should clearly mark coral colonies with high-visibility buoys, follow the turbidity control plan, and survey the area before and following construction to document coral colonies were not impacted during construction.

To avoid direct coral impacts around the footprint of Breakwater 2 (Phase II) and the N.E. Rock Structure, the structures were redesigned by the engineering team (**Figures 7** and **8**). The location of Breakwater 2 was originally proposed to border the existing boulders and rocks where several corals were documented in the benthic survey (Cummins Cederberg, 2020). These corals would have needed relocation prior to construction of the breakwater, but it was determined redesign of the structure would remove the direct impacts entirely, eliminate the need for coral relocation, and reduce the indirect impacts to these coral colonies. The footprint of the breakwater was shifted to the southeast, intentionally circumventing the

areas with corals to avoid previously anticipated impacts, while maintaining beach stabilization functionality. During construction, contractors should use the benthic habitat map (**Figure 4**) to identify and clearly mark the location of coral colonies within the immediate surrounding area with high-visibility buoys, follow the turbidity control plan, and inspect the coral colonies following construction to document coral colonies were not impacted during construction.

To avoid impacts to coral colonies during Phase 3 (N.E. Rock Structure), the location and configuration of the design was shifted to avoid corals colonized on the western and eastern vertical slopes and beneath overhangs. The new redesign (**Figure 8**) located the structure southward, thereby avoiding direct impacts to 70 to 90 coral colonies.

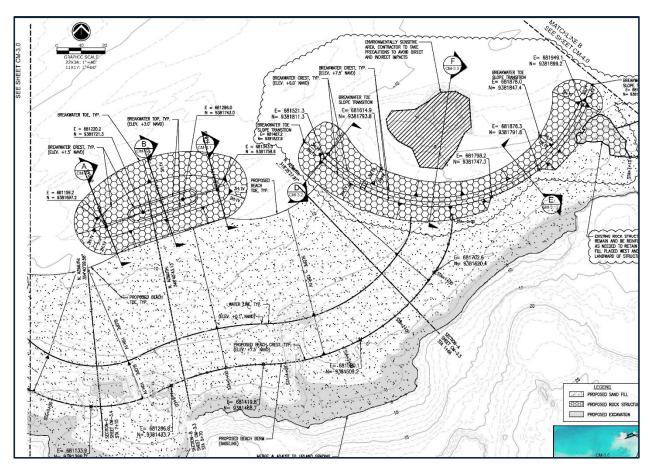


Figure 7. Redesign of Breakwater 2 (Source: East Beach Plan, Cummins Cederberg Coastal and Marine Engineering (2020-04-16)

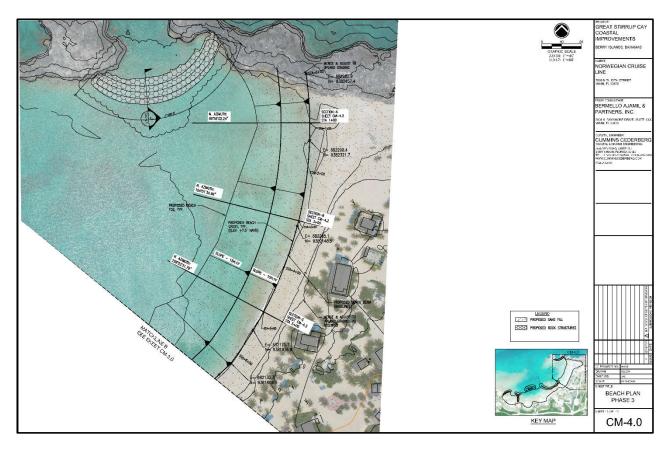
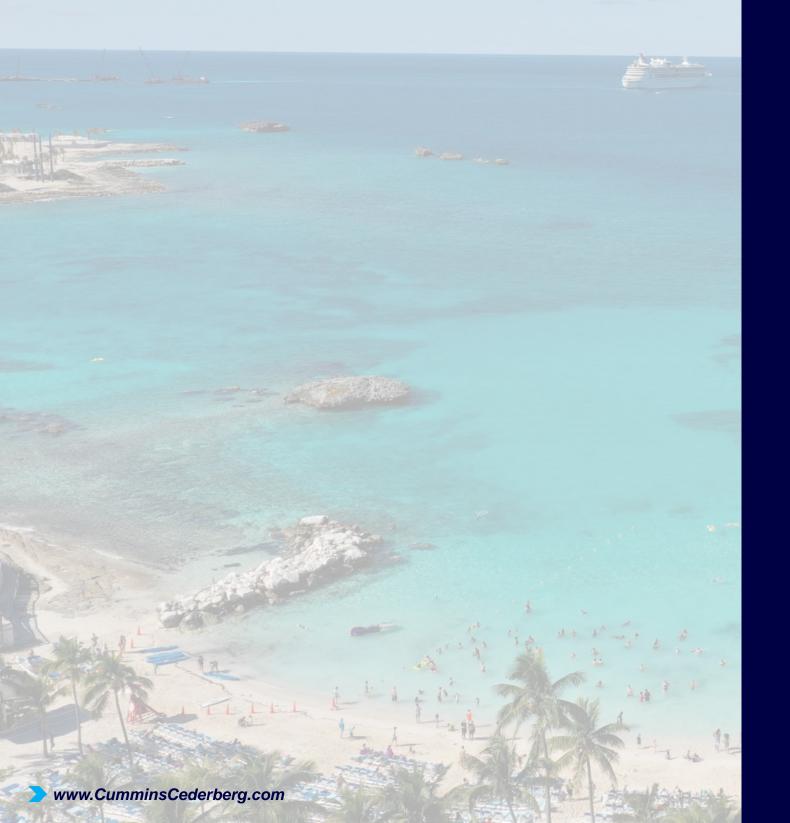


Figure 8. Redesign of the N.E. Rock Structure (Source: East Beach Plan, Cummins Cederberg Coastal and Marine Engineering (2020-06-03).

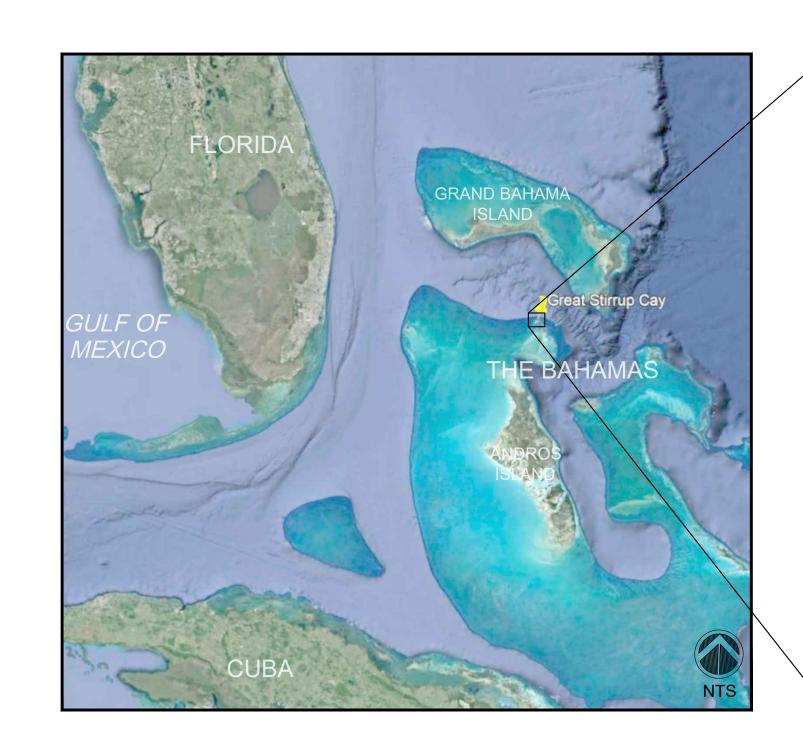
APPENDICES

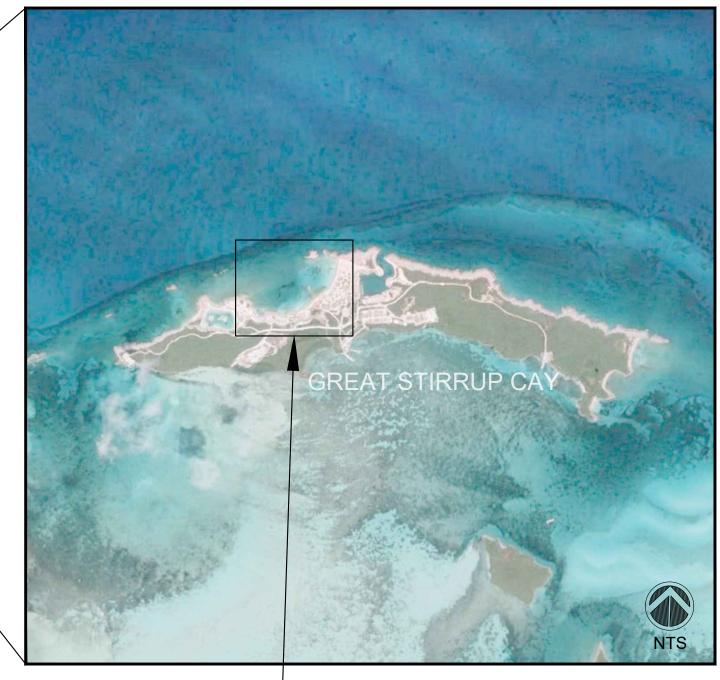
Appendix A – East Beach Plan



GREAT STIRRUP CAY COASTAL IMPROVEMENTS PROJECT

BERRY ISLANDS, BAHAMAS









Sheet List Table				
Sheet	Sheet Title			
Number	Onoot mio			
	COVER			
CM-1.0	GENERAL NOTES			
CM-1.1	EAST BEACH OVERALL PLAN			
CM-2.0	BEACH & ROCK STRUCTURES PLAN - PHASE 1			
CM-2.1	ROCK STRUCTURES SECTIONS - PHASE 1			
CM-2.2	BEACH SECTIONS - PHASE 1			
CM-2.3	BEACH SECTIONS - PHASE 1			
CM-3.0	BEÁCH & ROCK STŘÚCTÚRĚS PLÁN - PHÁSĚ 2			
CM-3.1	BREAKWATER 1 SECTIONS - PHASE 2			
(CM-3.2	BŘĚAKWÁTĚŘ Ž SĚČŤIONŠ - PHÁŠE 2)A			
CM-3.3	BEACH SECTIONS - PHASE 2			
CM-3.4	BEACH SECTIONS - PHASE 2			
CM-3.5	BEACH & ROCK STRUCTURES PLAN - PHASE 3			
CM-4.0	N.E. STRUCTURE SECTION - PHASE 3			
CM-4.1	BEACH SECTIONS - PHASE 3			
CM-4.2	BEACH SECTIONS - PHASE 3			

OWNER:



7665 N.W. 19TH STREET MIAMI, FL 33126

PRIME CONSULTANT:



2601 S BAYSHORE DRIVE, SUITE 1000 MIAMI, FL 33133 COASTAL ENGINEER:



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JUPITER ■ TALLAHASSEE

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GENERAL NOTES:

- THE WORK CONSISTS OF FURNISHING ALL CONSTRUCTION, LABOR, EQUIPMENT AND MATERIALS AND PERFORMING ALL OPERATIONS IN CONNECTION WITH THE CONSTRUCTION OF THE MARINE WORKS AS SHOWN ON THESE DRAWINGS.
- 2. THE CONTRACTOR SHALL ABIDE BY ALL NOTES AND CONDITIONS INDICATED ON THE CONSTRUCTION PLANS AND SPECIFICATIONS. IF THE CONTRACTOR VIOLATES ANY CONDITION OF THE SPECIFICATIONS AND WORK IS STOPPED BY THE GOVERNMENT, THEN ANY ADDITIONAL COSTS INCURRED BY THE CONTRACTOR SHALL BE PAID BY THE CONTRACTOR AND NOT CHARGED TO THE OWNER.
- 3. FOR LEGEND SYMBOLS REFER TO INDIVIDUAL PLAN SHEETS.
- MARINE WORK TO BE COORDINATED WITH UPLAND WORK. REFER TO SEPARATE DRAWINGS FOR CIVIL, LANDSCAPING, AND GRADING.
- 5. ANY DISCREPANCIES IN THE PLANS WITH FIELD CONDITIONS SHALL BE BROUGHT TO THE IMMEDIATE ATTENTION OF THE ENGINEER.

SURVEY NOTES:

- SURVEY PROVIDED BY ARC SURVEYNG AND MAPPING, INC. CONDUCTED AUGUST 2019
- ELEVATIONS AND CONTOURS ARE IN FEET REFERENCED TO PROJECT DATUM.
- TOPOGRAPHIC AND BATHYMETRIC DATA PROVIDED BY CLIENT. IN AREA WITH DATA GAPS CUMMINS CEDERBERG, INC HAS MADE ASSUMPTIONS BASED ON FIELD OBSERVATIONS. ALL ELEVATIONS TO BE VERIFIED IN FIELD.
- CONTOURS GENERATED BY CUMMINS CEDERBERG, INC AND ARE ONLY FOR REFERENCE.
- WATER LEVELS ARE APPROXIMATE AND TO BE CONFIRMED BY CLIENT OR CONTRACTOR.
- 6. COORDINATE SYSTEM BASED ON UTM ZONE 17N, NAD27 BAHAMAS (CLARKE 1866), INTERNATIONAL FEET.

GEOTECHNICAL NOTES:

GEOTECHNICAL INVESTIGATION INFO WAS NOT AVAILABLE. CONTRACTOR IS RESPONSIBLE FOR CONFIRMING GEOTECHNICAL ASSUMPTIONS DEPICTED IN THESE PLANS.

BEACH FILL NOTES:

- ENGINEER TO APPROVE SOURCE AND CHARACTERISTICS OF PROPOSED BEACH FILL PRIOR TO PLACEMENT
- 2. PLACE FILL TO THE GRADES SHOWN. COMPACT FILL WITH TRACKED DOZER.
- ALL FILL MATERIAL MUST BE SAND THAT IS SIMILAR TO THAT ALREADY EXISTING AT THE BEACH SITE IN BOTH COLORATION AND GRAIN SIZE DISTRIBUTION. ALL SUCH FILL MATERIAL MUST BE FREE OF CONSTRUCTION DEBRIS. ROCKS. OR OTHER FOREIGN MATTER.
- 4. FILL MATERIAL USED WITH THIS PROJECT SHALL BE LIMITED TO SUITABLE, CLEAN FILL MATERIAL, WHICH EXCLUDES MATERIAL SUCH AS TRASH, DEBRIS, AND ANY SOILS CONTAMINATED WITH ANY TOXIC SUBSTANCE IN TOXIC AMOUNTS.
- 5. IF HYDRAULIC PLACEMENT METHODS ARE UTILIZED, THE DISCHARGE PIPE MAY NEED TO BE SCREENED TO PREVENT ROCK OR OTHER UNSUITABLE MATERIALS FROM BEING PLACED ON THE BEACH.
- 6. THE VERTICAL TOLERANCE FOR EACH FILL TEMPLATE IS 0.5 FEET.
- 7. CONTRACTOR TO CONDUCT PRE/POST FILL SURVEYS OF PLACEMENT AREAS FOR APPROVAL BY ENGINEER.
- BEACH FILL TO MERGE AND COVER WITH ROCK STRUCTURES AS APPLICABLE RELATIVE TO ADJACENT BEACH FILL ELEVATION.
- GENERAL FILL TO HAVE LESS THAN 5% SILT AND FREE OF ROCKS OR DEBRIS. MATERIAL TO BE APPROVED BY ENGINEER.

REVETMENT AND GROIN MATERIAL:

1. ARMOR ROCKS SHALL BE ROUGH ANGULAR QUARRIED STONE OF A DENSE, HARD, DURABLE CHARACTER, FREE OF ORGANIC MATERIAL, INFILLED JOINTS, SEAMS OR OTHER DEFECTS, RESISTANT TO BREAKDOWN BY HANDLING, FROST ACTION OR WEATHERING, AND NOT SUBJECT TO DETERIORATION IN SEA WATER. ALL ROCKS SHALL MEET THE FOLLOWING TEST REQUIREMENT:

ROCK ACCEPTANCE CRITERIA							
TEST	ASTM	TYPE A,B,C ARMOR & BEDDING ROCK	CORE MATERIAL				
BULK SPECIFIC GRAVITY	C-127	MIN. 2.4					
ABSORPTION	C-127	LESS THAN 5% LOSS	LESS THAN 5% LOSS				
SULFATE SOUNDNESS, 5 CYCLES	C-88	LESS THAN 15% LOSS	LESS THAN 15% LOSS				
LA ABRASION 500 REV.	C-535	LESS THAN 40% LOSS	LESS THAN 40% LOSS				

ARMOR ROCK SHALL MEET THE FOLLOWING GRADATION:

TYPE A ROCK GR	ADE CRITERIA		
PERCENTAGE LESS THAN (BY MASS)	NOMINAL SIZE (FT)		
100	4.5		
50	4.0		
0	3.5		

3. FOR ARMOR ROCK, SIZE GOVERNS THE GRADATION AND THE NOMINAL SIZE IS DEFINED AS

 $D=(W/150)^{1/3}$

WHERE D IS THE NOMINAL SIZE IN FEET W IS THE MASS IN POUNDS.

- 4. ARMOR ROCK SHALL BE GRADED BETWEEN THE LIMITS SPECIFIED, WITH THE LONGEST DIMENSION OF ANY PIECE NOT GREATER THAN 2.5 TIMES ITS LEAST DIMENSION.
- CONTRACTOR SHALL CONDUCT PRE/POST PLACEMENT SURVEYS FOR APPROVAL BY ENGINEER.
- ENGINEER TO APPROVE ROCK SOURCE
- 7. GEOTEXTILE SHALL BE NILEX 4516E OR APPROVED EQUIVALENT.

TURBIDITY CONTROL NOTES:

- 1. CONTRACTOR SHALL SUBMIT TURBIDITY CONTROL PLAN FOR MARINE WORKS PRIOR TO CONSTRUCTION FOR REVIEW AND APPROVAL BY THE OWNER.
- 1. DEPLOY APPROVED TURBIDITY CURTAINS TO CONTROL TURBIDITY AS REQUIRED.
- 2. CONTRACTOR SHALL RETAIN PLACED FILL WITHIN THE DESIGN TEMPLATE.
- 3. IF HYDRAULIC FILL PLACEMENT IS UTILIZED, THEN A SPREADER AND POCKET PIPE SHALL BE USED TO PREVENT GULLYING AND EROSION OF THE BEACH AND HYDRAULICALLY PLACED FILL AND TO CONTROL TURBIDITY.

REVETMENT AND GROINS EXECUTION:

- 1. INSTALLATION OF GEOTEXTILE
- a. INSTALL GEOTEXTILE AS INDICATED ON THE DRAWINGS AND IN ACCORDANCE WITH THE MANUFACTURERS INSTRUCTIONS.
- b. PLACE GEOTEXTILE ON A SMOOTH GRADED SURFACE APPROVED BY THE OWNER. PLACE GEOTEXTILE IN IMMEDIATE CONTACT WITH THE PREPARED SLOPE SUCH THAT THERE ARE NO VOIDS, IN SUCH MANNER THAT IT WILL NOT BE EXCESSIVELY STRETCHED OR TORN UPON PLACEMENT OF OVERLYING MATERIALS.
- c. ANCHOR THE GEOTEXTILE USING ANCHOR PINS RECOMMENDED BY THE MANUFACTURER.
- d. JOIN GEOTEXTILE SHEETS BY OVERLAPPING A MINIMUM OF 3 FEET

2. PLACEMENT OF ROCK

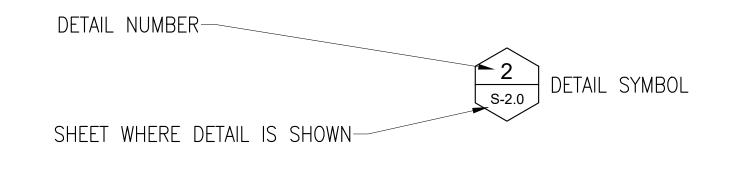
- a. PLACE EACH TYPE OF ROCK IN THE LOCATIONS, THICKNESS AND DETAILS INDICATED ON THE DRAWINGS AND AS DIRECTED BY THE OWNER. USE METHODS TO ENSURE THAT THE FINER ONE OF THE GRADATION IS EVENLY DISTRIBUTED THROUGHOUT THE LAYER AND OVER THE SURFACE BEING COVFRFD.
- c. BEGIN PLACEMENT OF ARMOR & FILTER BEDDING AT THE TOE OF THE SLOPE AND CONTINUE PLACEMENT WORKING UP THE SLOPE. PLACE THE ROCK IN SUCH A MANNER AS TO CREATE FIRM BEDDING AND INTERLOCKING OF INDIVIDUAL PIECES TO OBTAIN A TIGHTLY PACKED STRUCTURE. THE FINISHED SURFACE SHALL BE DENSELY PLACED, WELL-KEYED, AND UNIFORM. FILL VOIDS, REWORK ROCKS NOT PROPERLY EMBEDDED, AND REMOVE PROTUBERANCES TO THE SATISFACTION OF THE OWNER. REMOVE AND REPLACE THE PORTION OF ANY LAYER IN WHICH MATERIAL BECOMES SEGREGATED DURING SPREADING. ROCK SHALL BE PLACED IN A MANNER NOT TO TEAR OR PUNCTURE GEOTEXTILE.
- d. ALL ROCK SHALL BE LOWERED TO REST. ROCKS SHALL NOT BE DROPPED. ROCKS SHALL BE PLACED IN A MANNER TO PREVENT ROLLING OR SLIDING DOWN THE SLOPE. PLACING THE ROCKS INTO CHUTES OR OTHER METHODS THAT CAUSE SEGREGATION OF THE VARIOUS ROCK SIZES WILL NOT BE ALLOWED.
- e. SLOPES OF GENERAL FILL SHALL BE PREPARED TO THE LINES, GRADES, AND ELEVATIONS INDICATED ON THE DRAWING. THE MAXIMUM PERMISSIBLE VARIATIONS IN ELEVATION FROM THE PRESCRIBED LINES, MEASURE VERTICALLY, SHALL BE ±1 FT.
- f. FOR ARMOR ROCK & CORE MATERIAL THE MAXIMUM PERMISSIBLE VARIATION IN THE FINISHED THICKNESS OF ROCK LAYER, WHEN MEASURED AS THE PERPENDICULAR DIMENSION BETWEEN THE TOP AND BOTTOM SURFACE PLANES, SHALL BE ±1FT. & ±0.5FT, RESPECTIVELY.

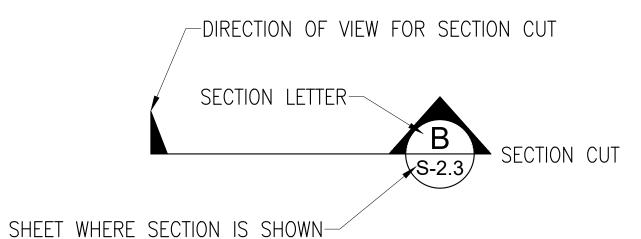
SHOP DRAWINGS:

PROVIDE SHOP DRAWINGS AND/OR CATALOG CUTS FOR THE FOLLOWING ITEMS FOR REVIEW AND APPROVAL BY THE ENGINEER PRIOR TO CONSTRUCTION:

- 1. ROCK QUARRY AND MATERIAL TESTING DATA
- 2. GEOTEXTILE
- 3. BEACH FILL TESTING DATA
- 4. TURBIDITY CONTROL PLAN
- 5. FILL AND RECLAMATION MATERIAL
- 6. VINYL SHEETS
- 7. ROCK GABION BASKET

SYMBOLS LEGEND





GREAT STIRRUP CAY COASTAL **IMPROVEMENTS** BERRY ISLANDS, BAHAMAS

NORWEGIAN CRUISE

7665 N.W. 19TH STREET MIAMI, FL 33126

PRIME CONSULTANT:

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COA # 29062

CC PROJECT NO: 61600 DRAWN JAC CHECKED SCALE AS SHOWN SHEET TITLE

GENERAL NOTES

SHEET 2 OF 16

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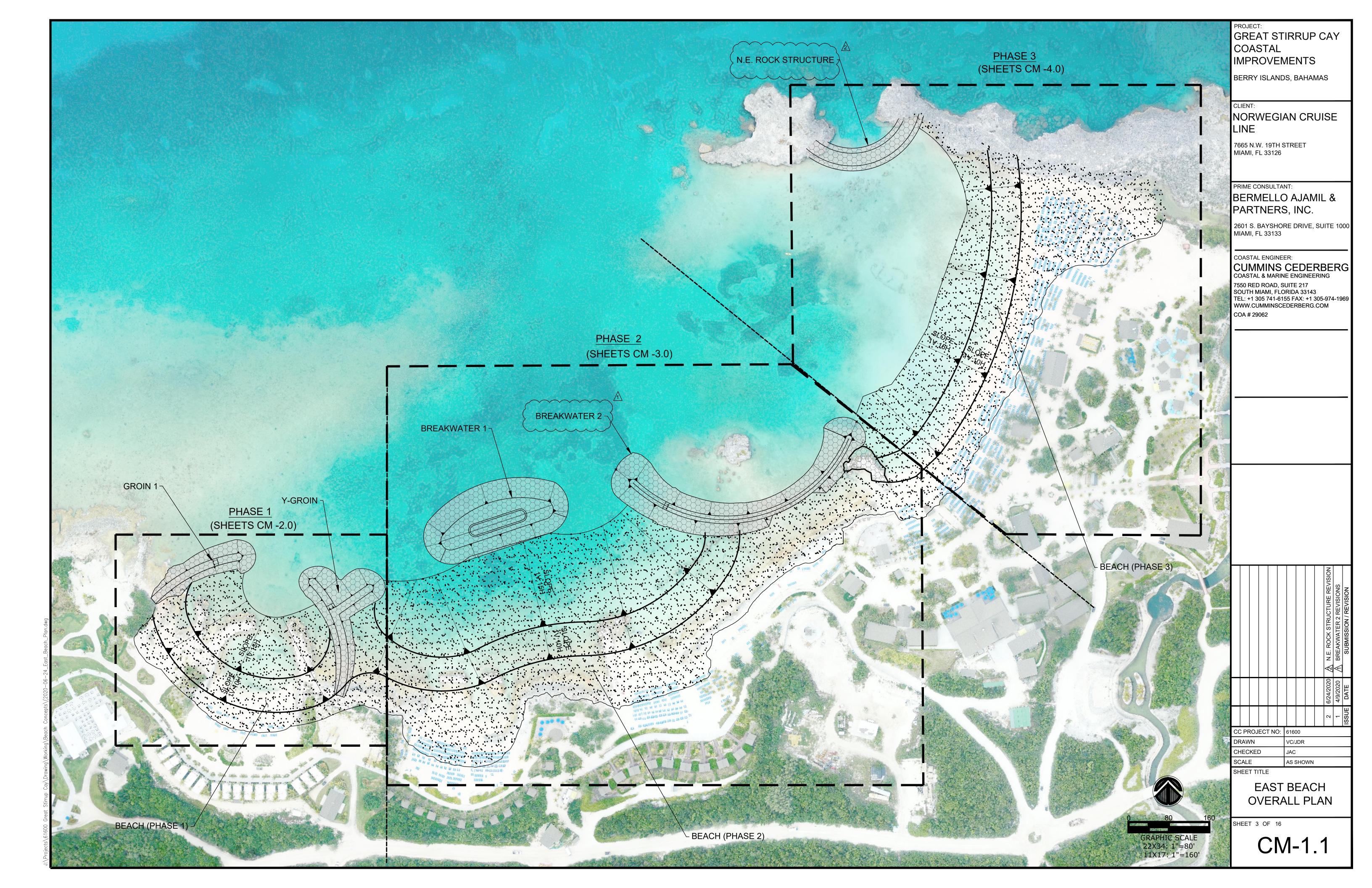
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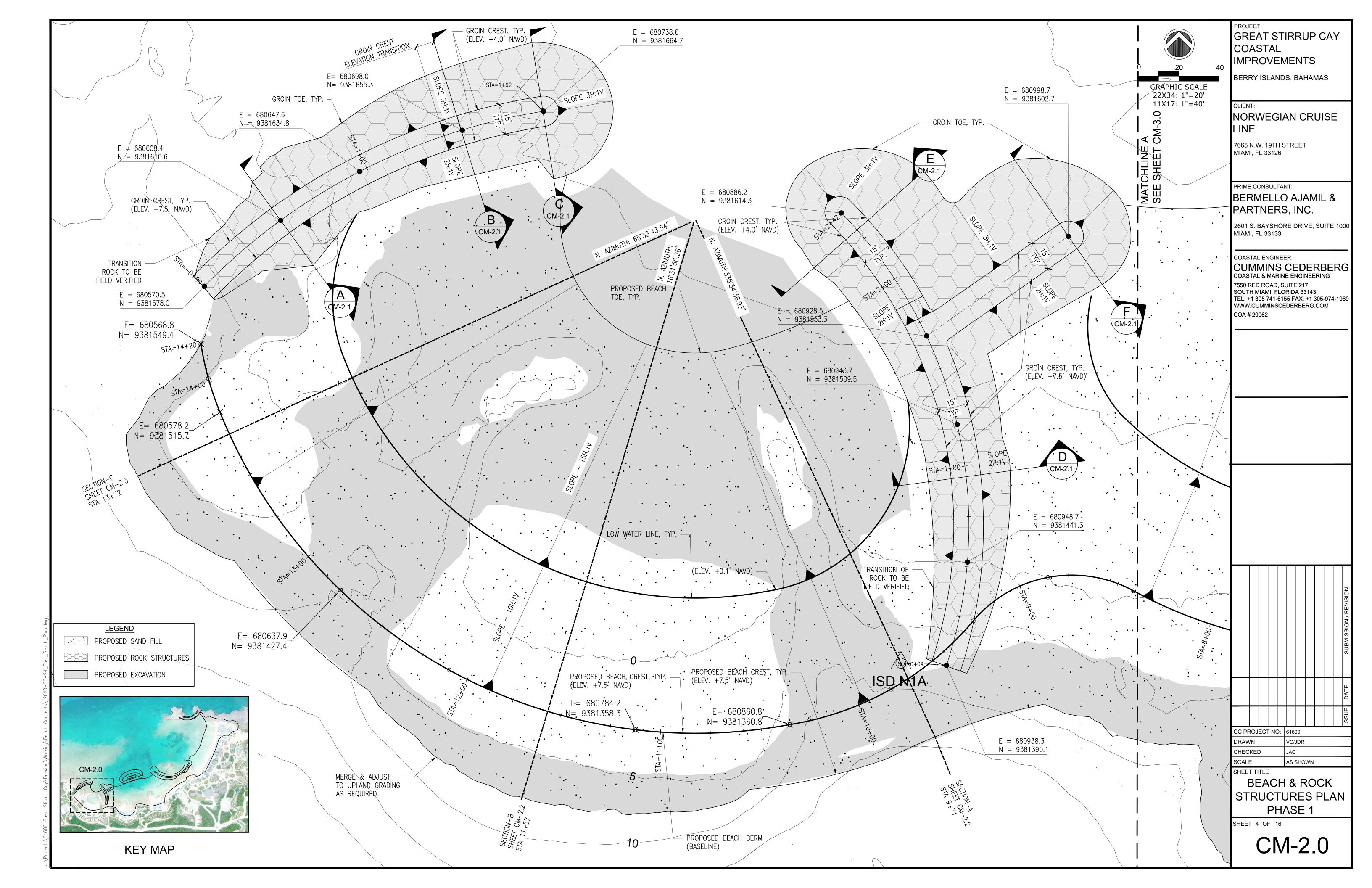
- ALUMINUM LGTH. ALUM. _ APPROX. _APPROXIMATE CENTER LINE LWL ___ CLEAR _CONCRETE CONT. _CONTINUOUS _CUBIC METER MSL CU. M. _ DIAMETER EACH ELEVATION O'H ELEV. / EL. <u>EXPANSION JOINT OPP.</u> EXP. JT. _____ EXISTING _HIGH WATER LINE R / RAL

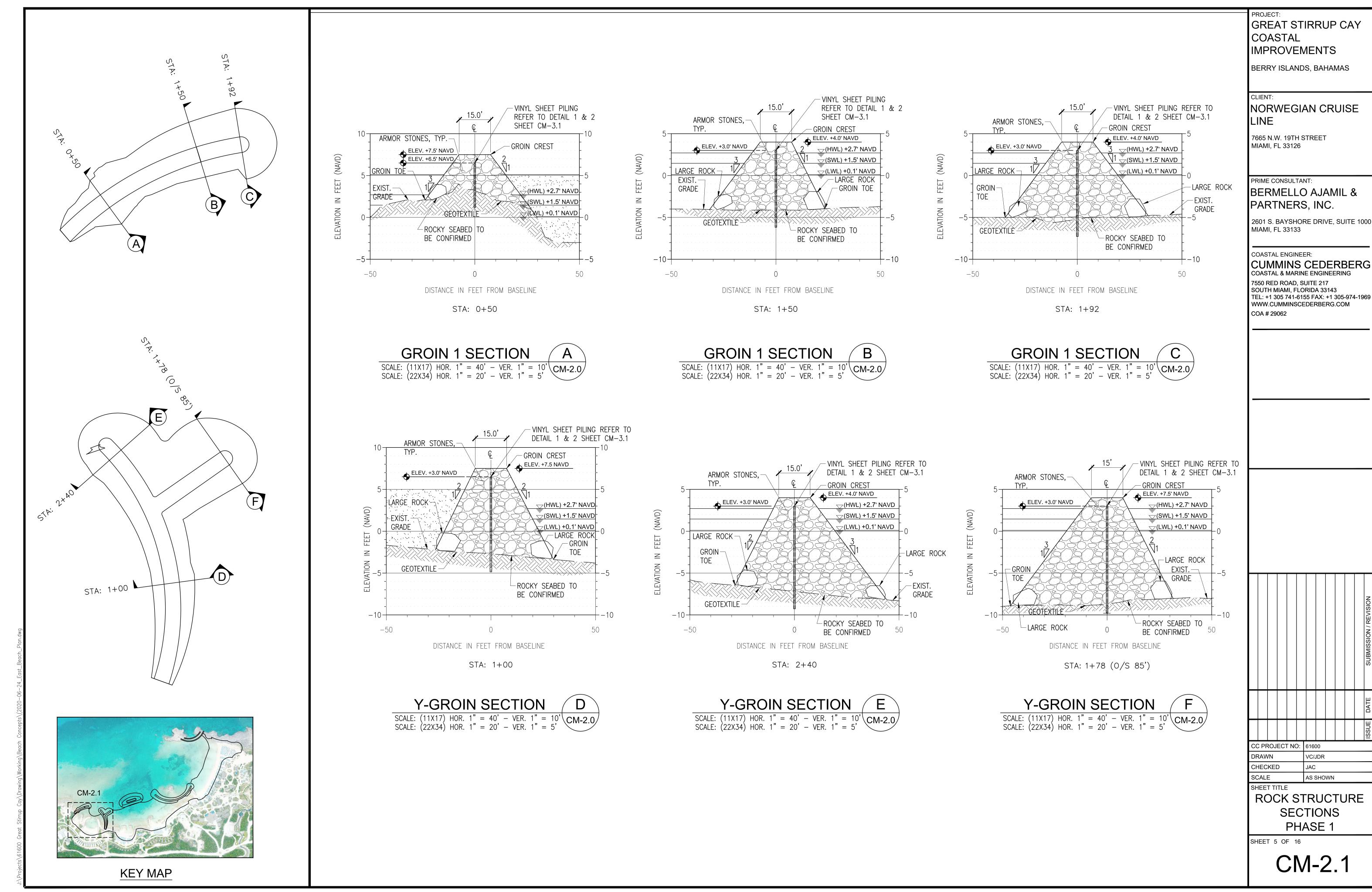
_LENGTH __LINEAR LIVE LOAD _LOW WATER LINE _MINIMUM MEAN SEA LEVEL ON CENTER OUTSIDE DIAMETER _OVER HEAD _OPPOSITE _SQUARE SQUARE METER STAINLESS STEEL

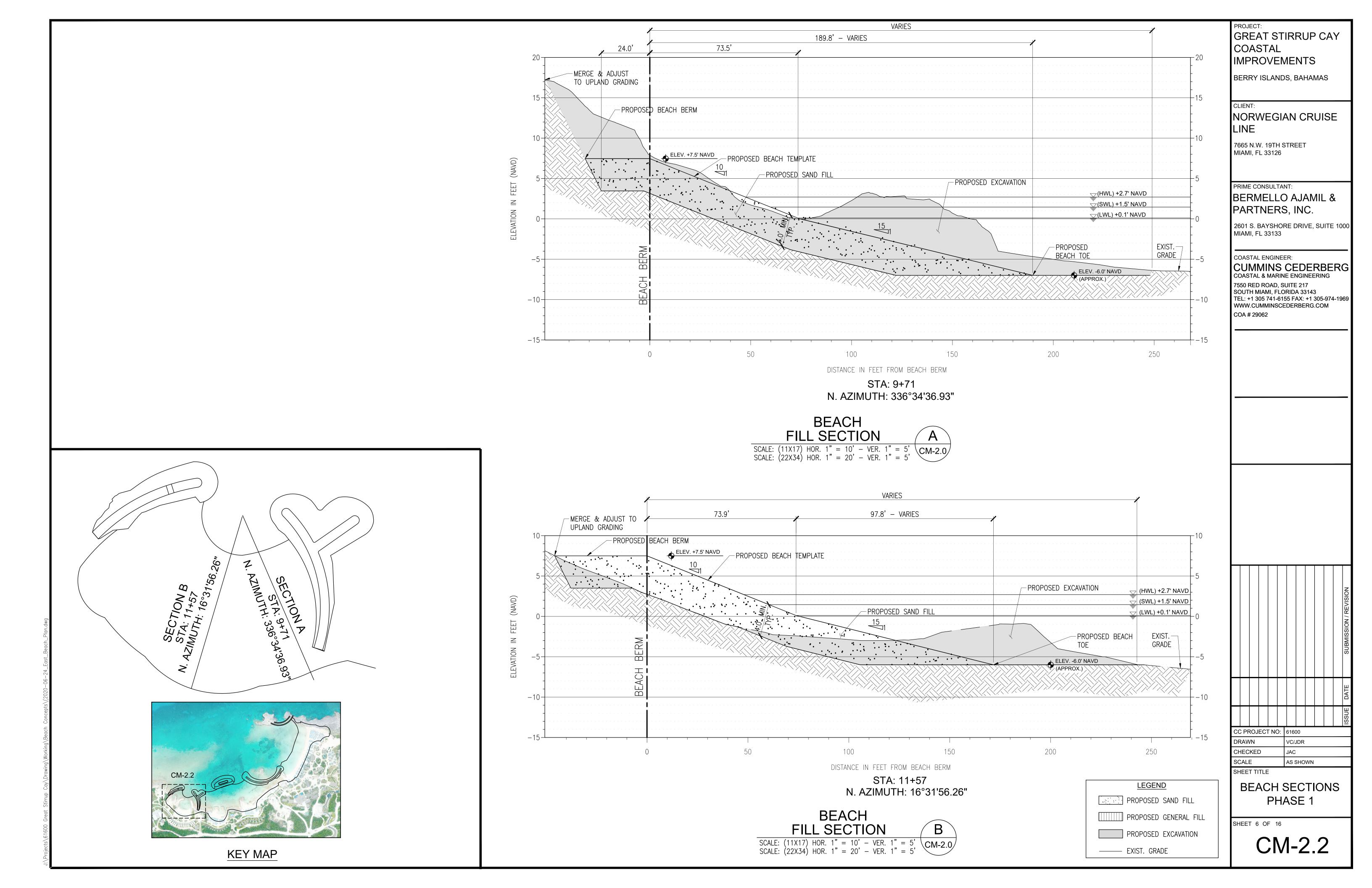
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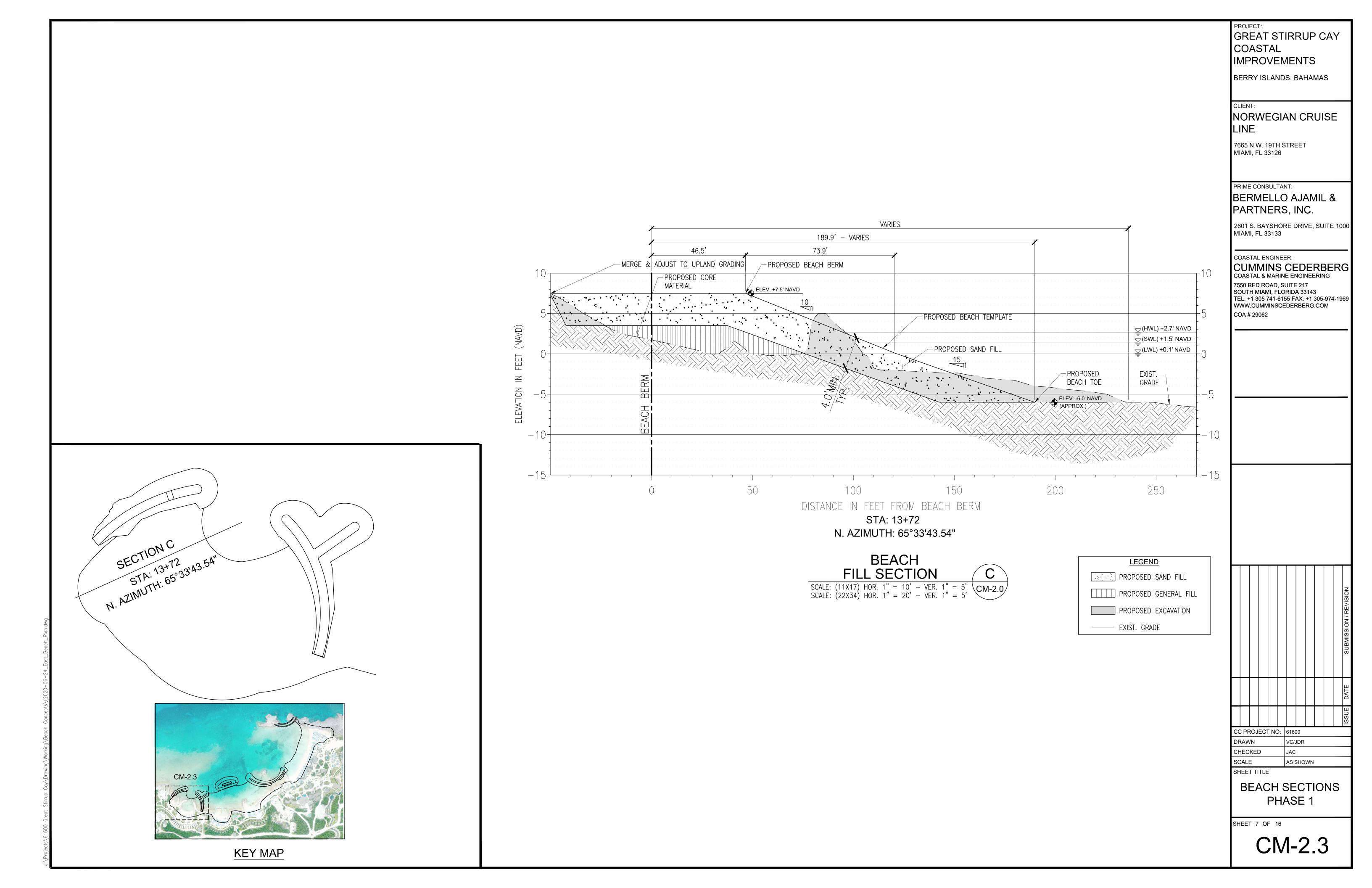
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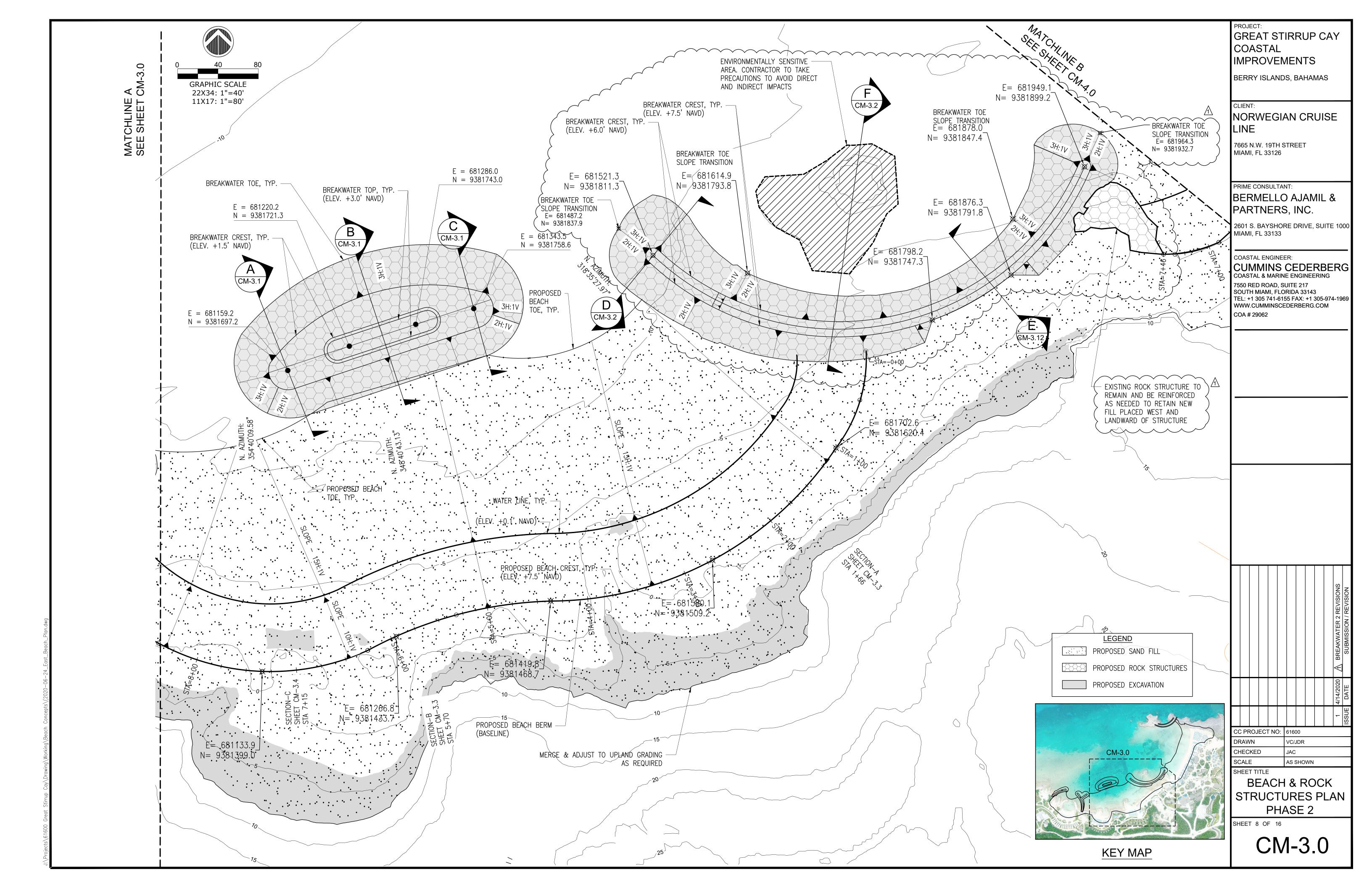


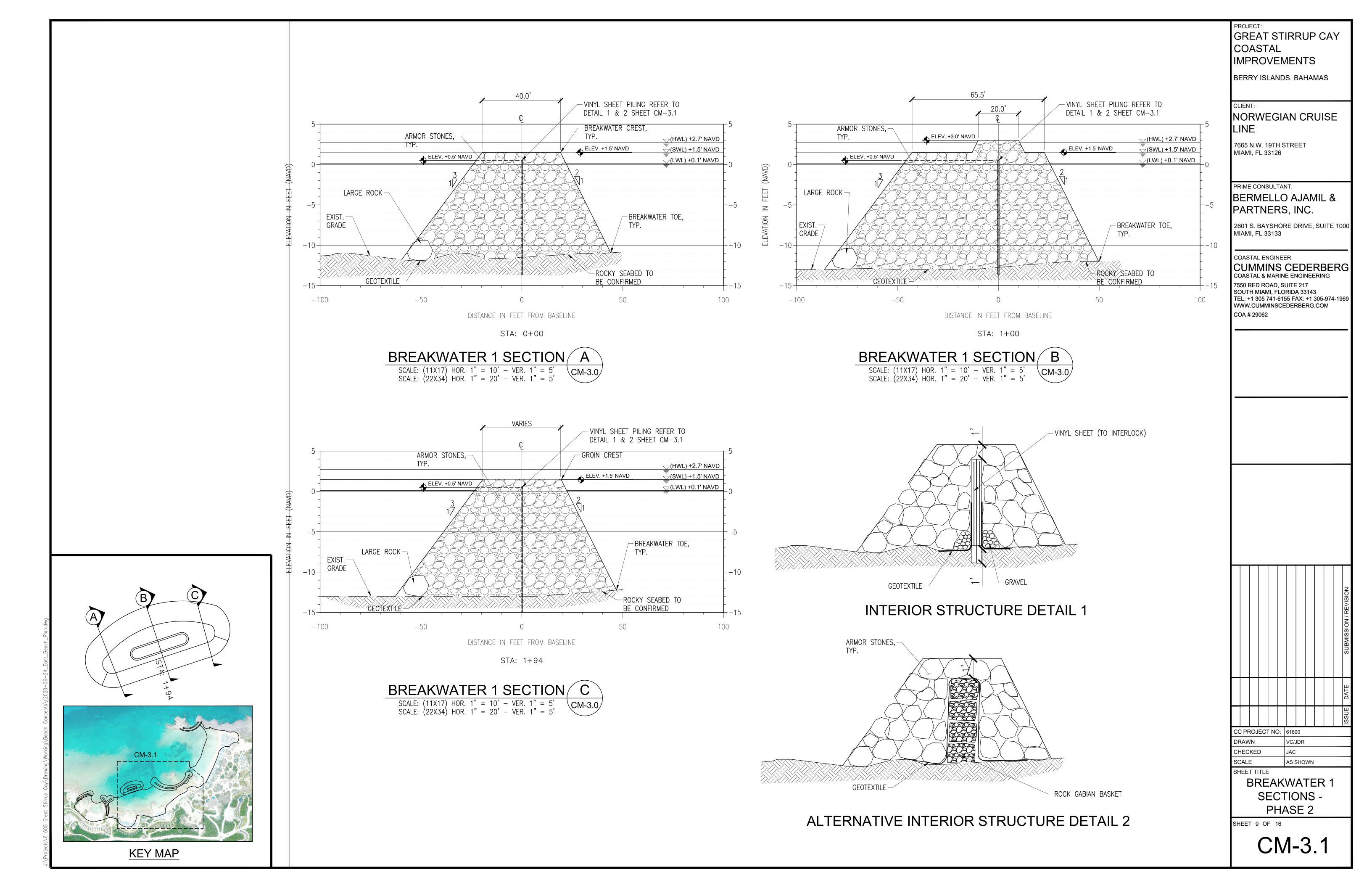


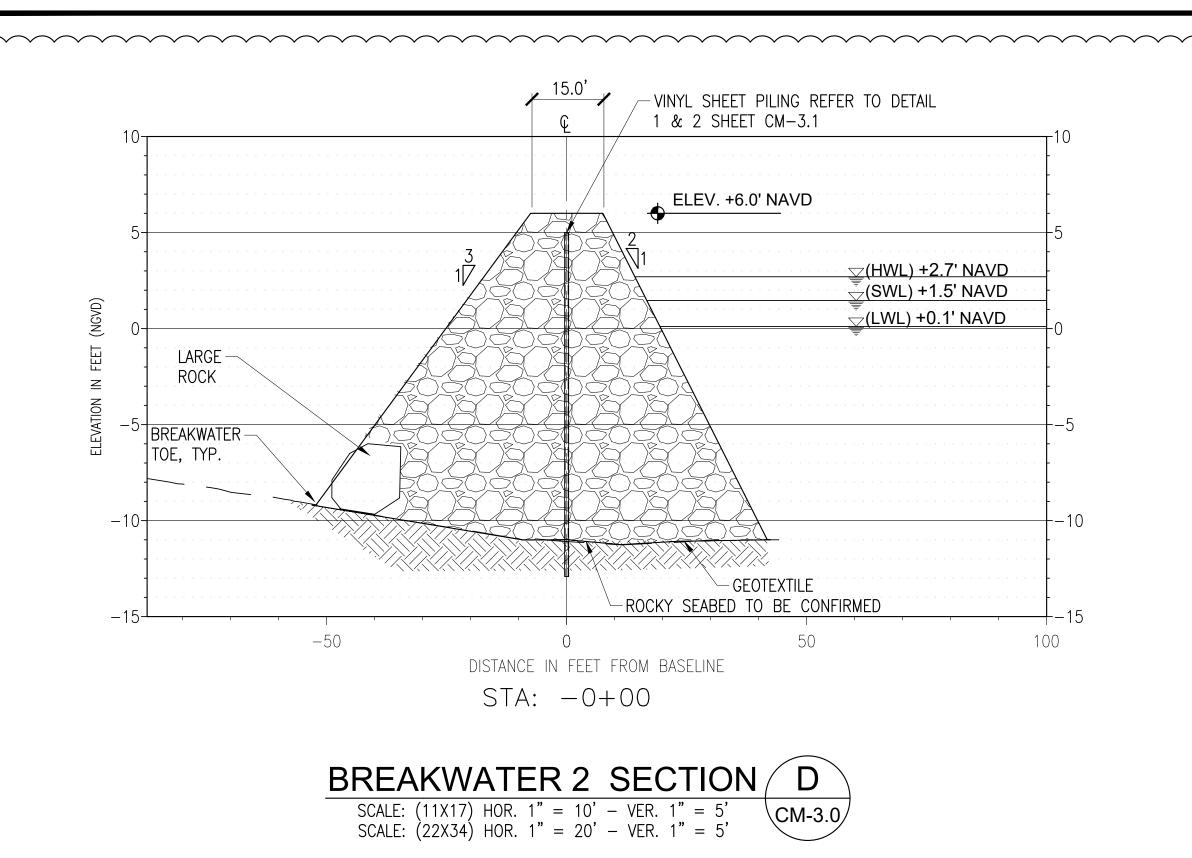


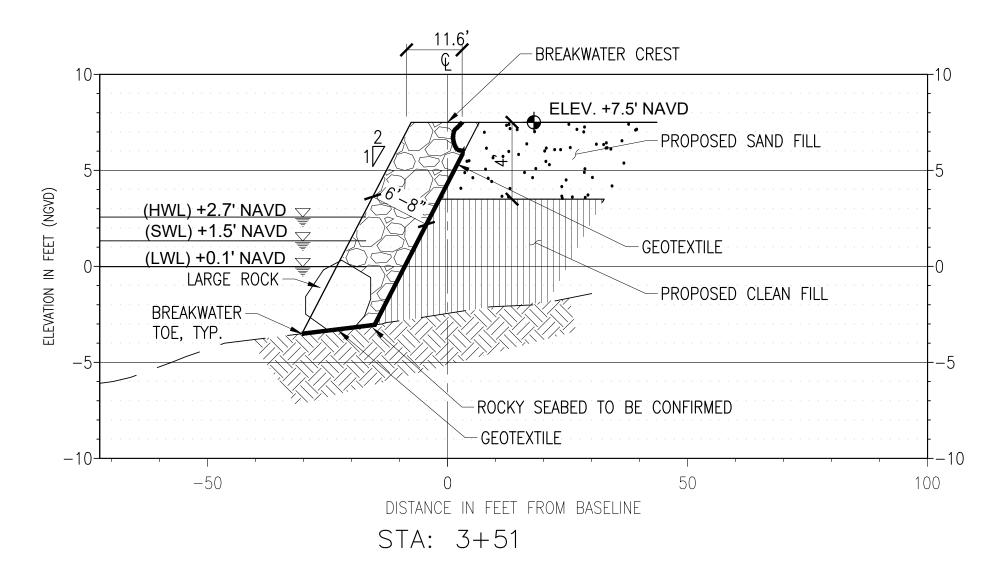


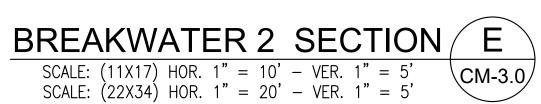


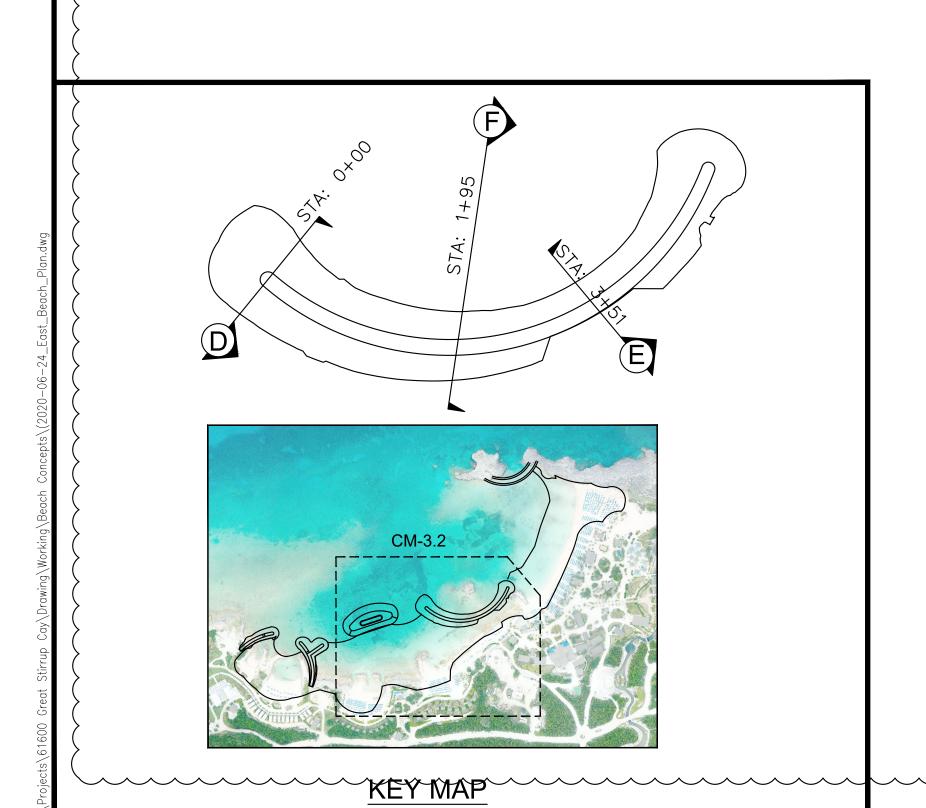


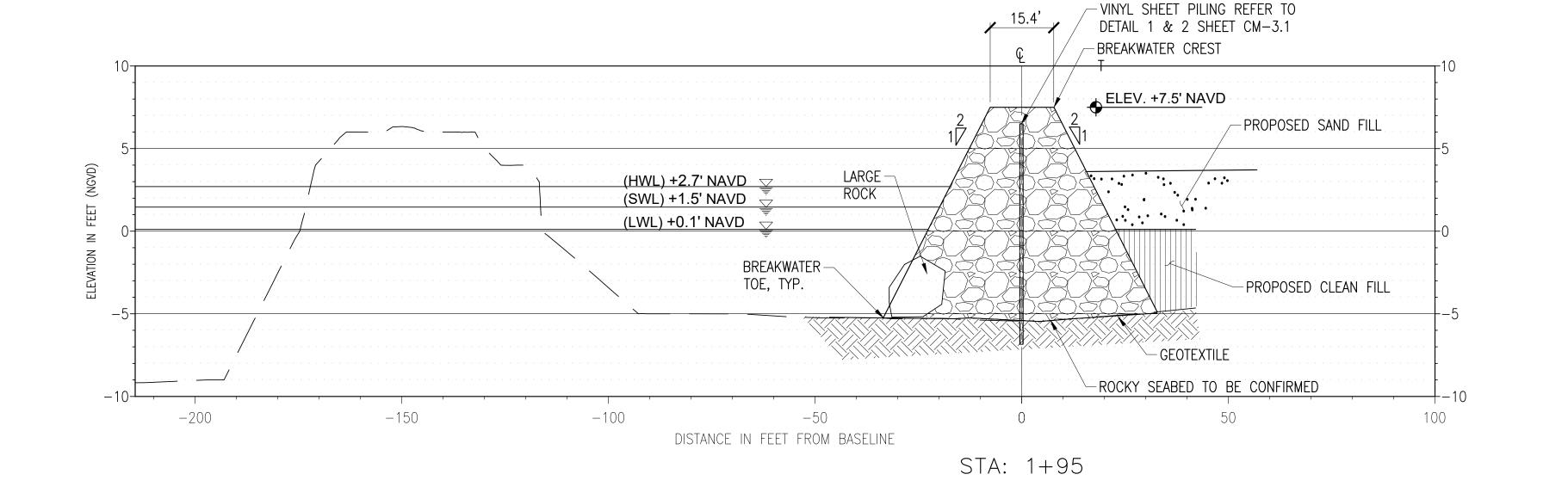


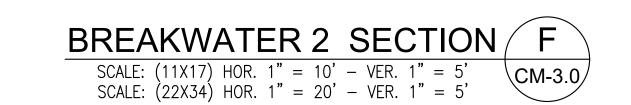












GREAT STIRRUP CAY COASTAL **IMPROVEMENTS**

BERRY ISLANDS, BAHAMAS

NORWEGIAN CRUISE

7665 N.W. 19TH STREET MIAMI, FL 33126

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COA # 29062

CC PROJECT NO: 61600 CHECKED AS SHOWN SHEET TITLE

SHEET 10 OF 16

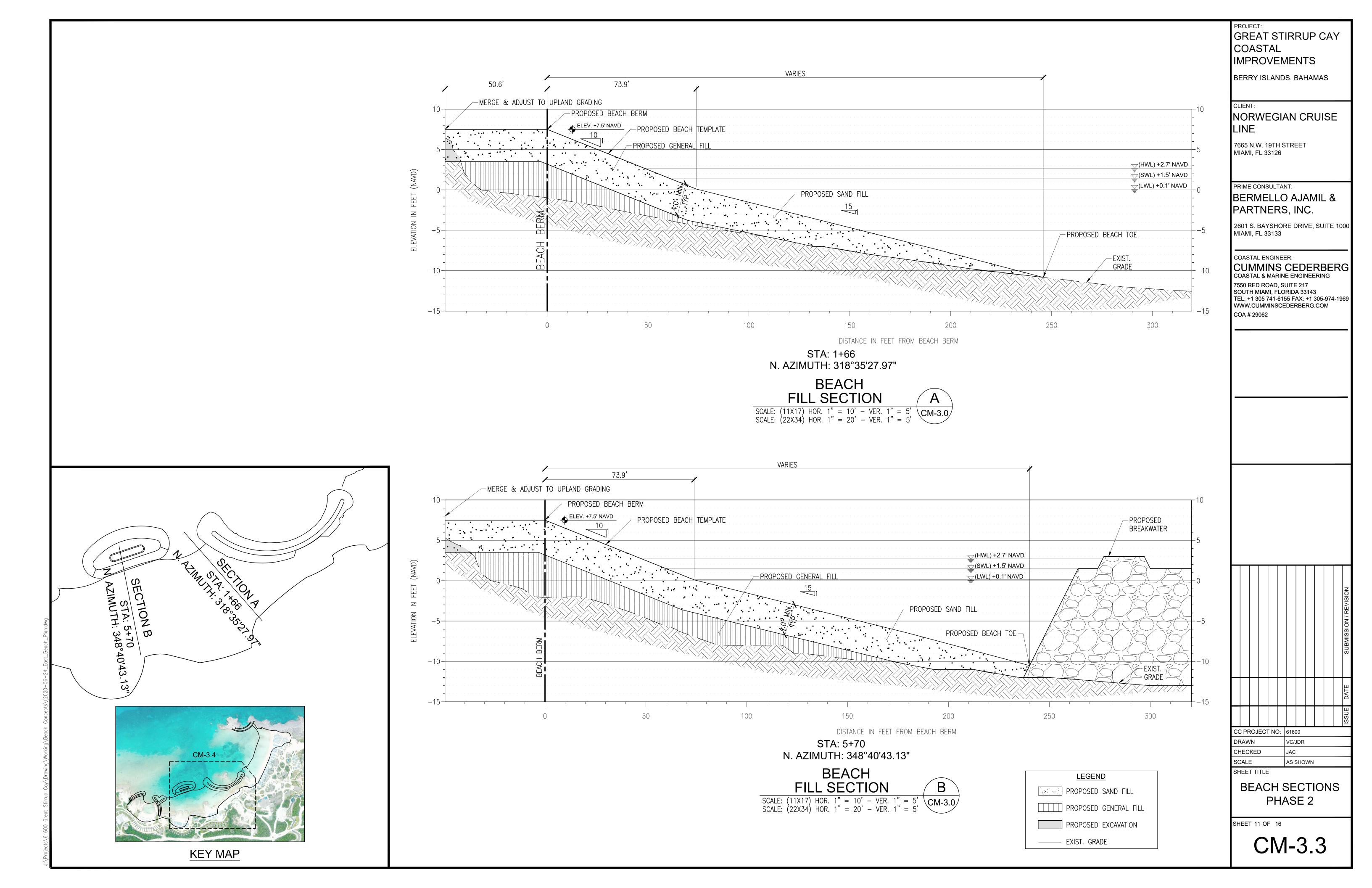
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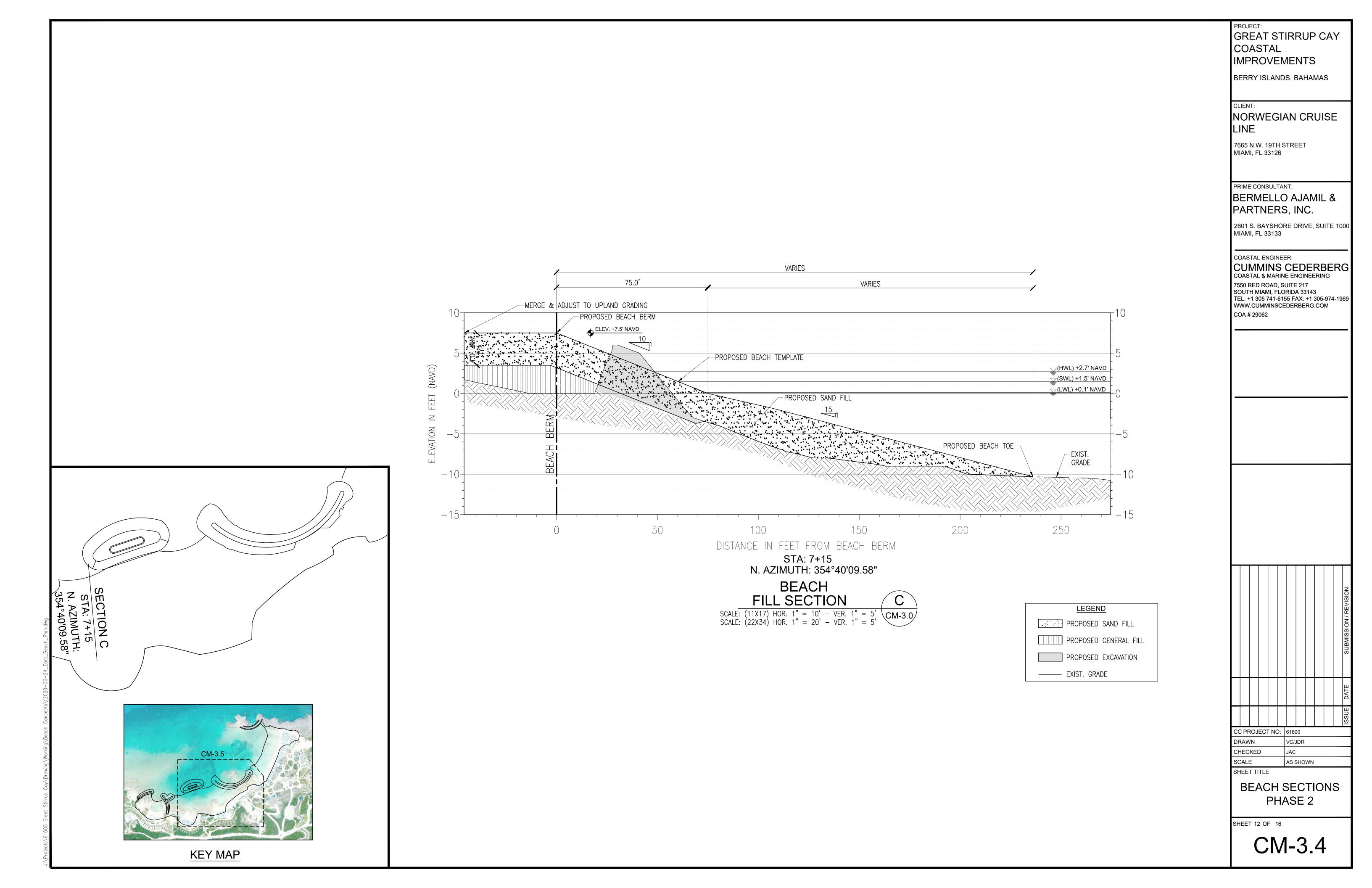
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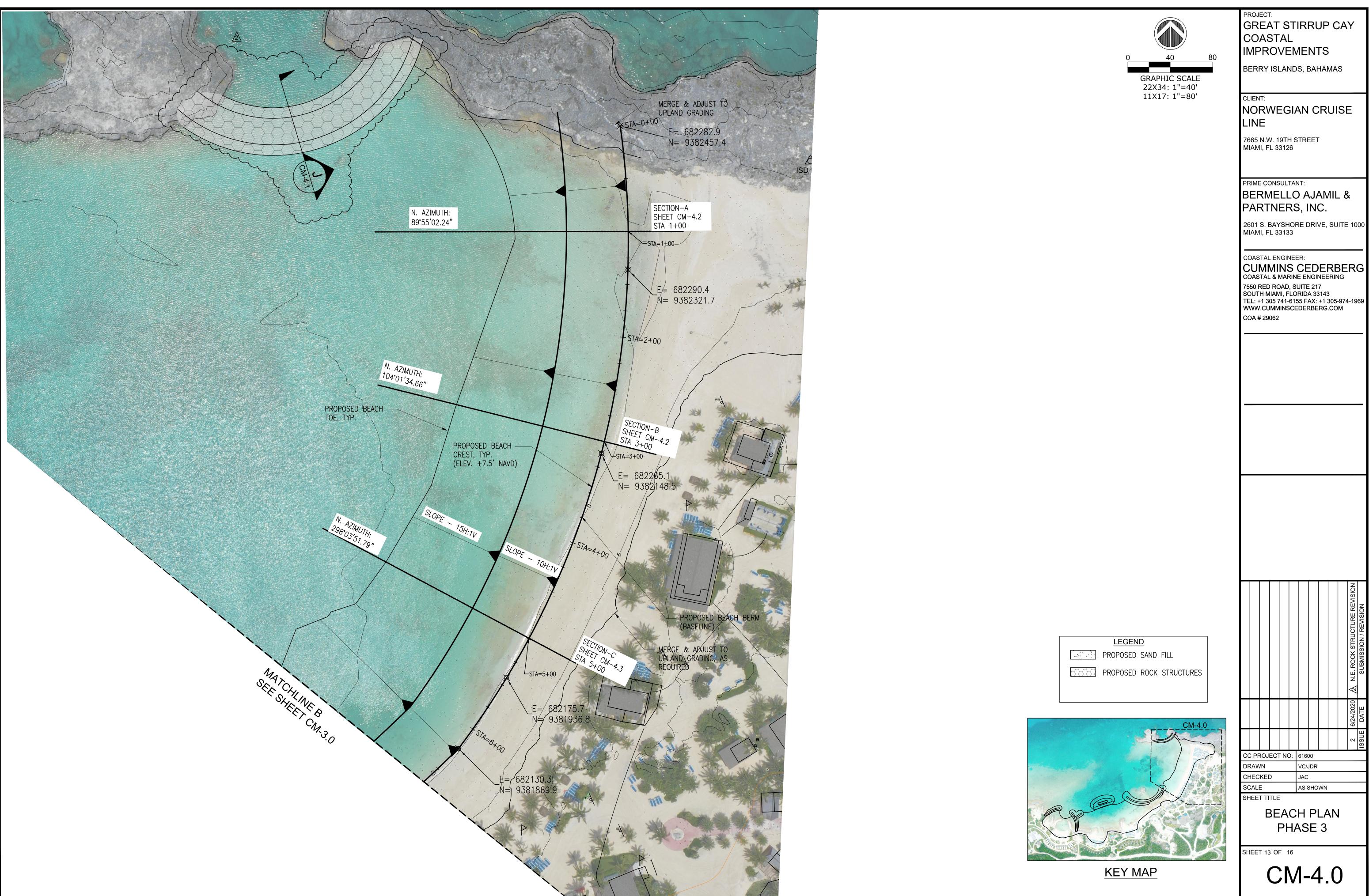
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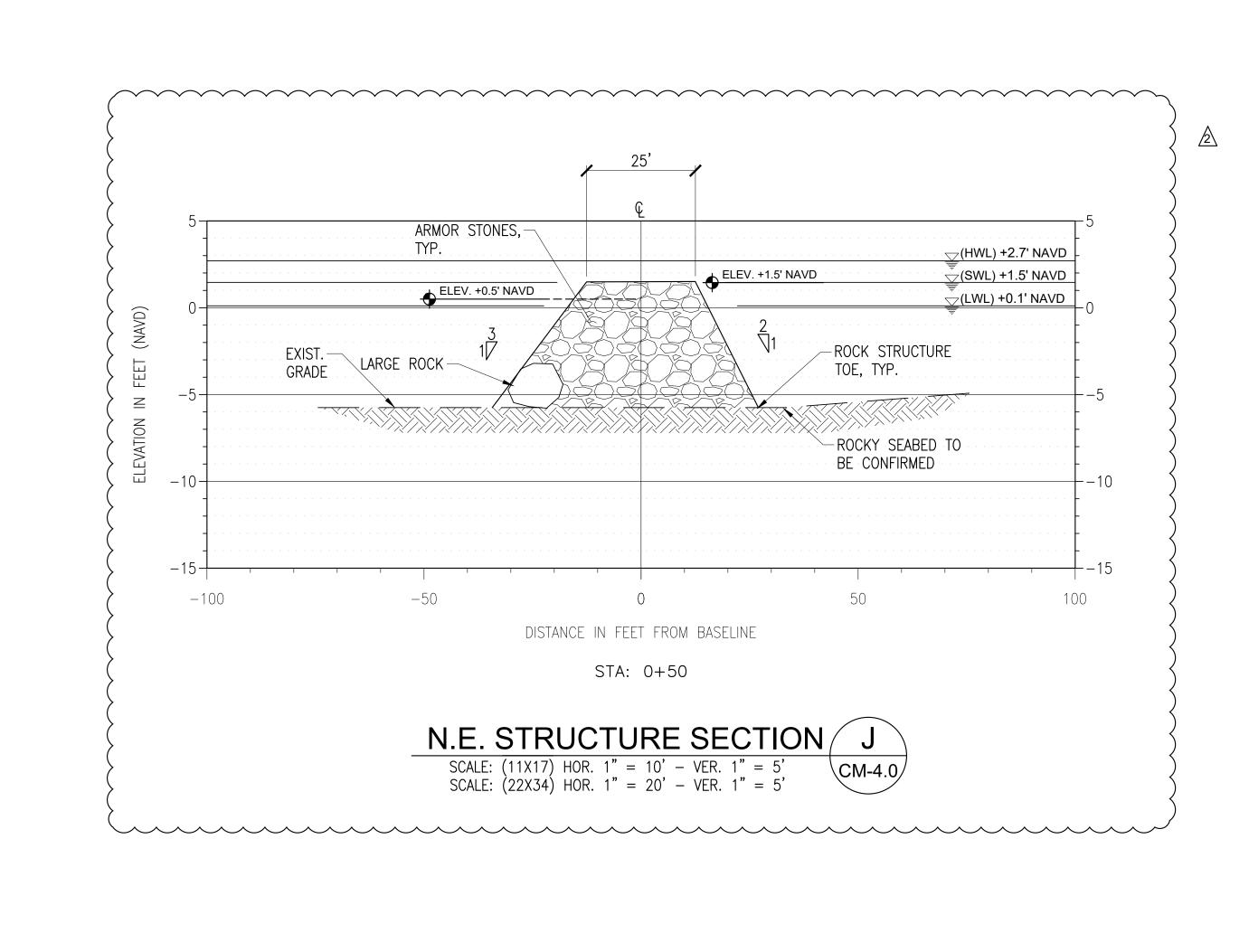
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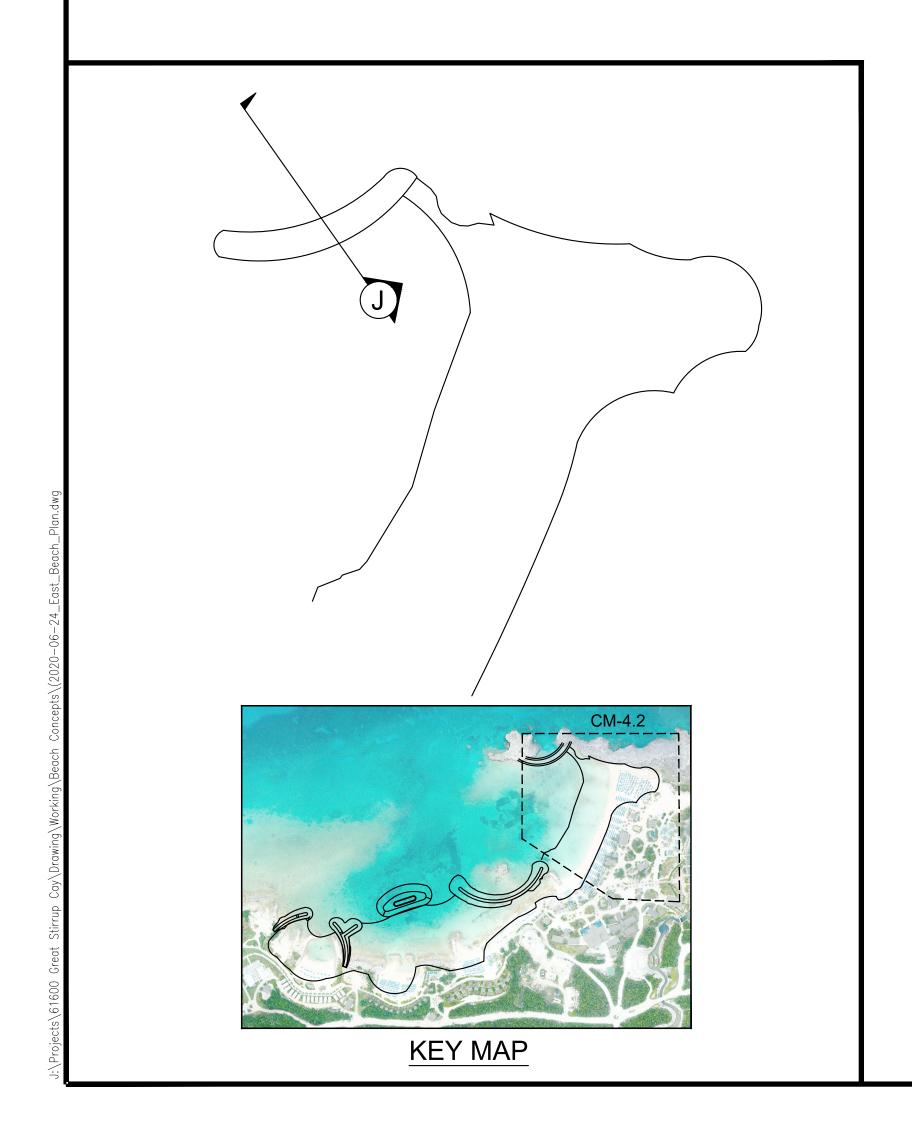
PHASE 2











PROJECT:
GREAT STIRRUP CAY
COASTAL
IMPROVEMENTS

BERRY ISLANDS, BAHAMAS

CLIEN

NORWEGIAN CRUISE

7665 N.W. 19TH STREET MIAMI, FL 33126

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CC PROJECT NO: 61600

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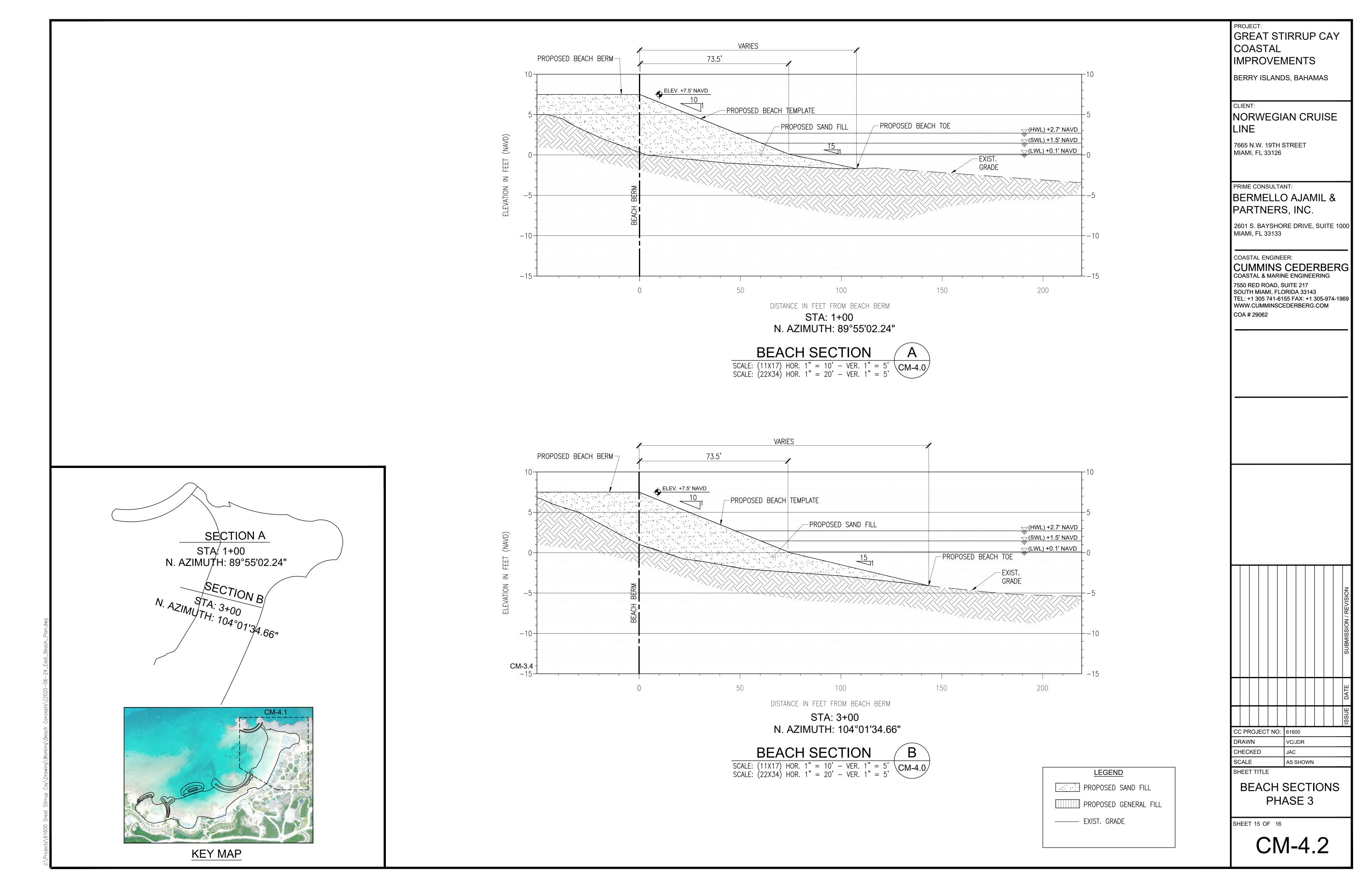
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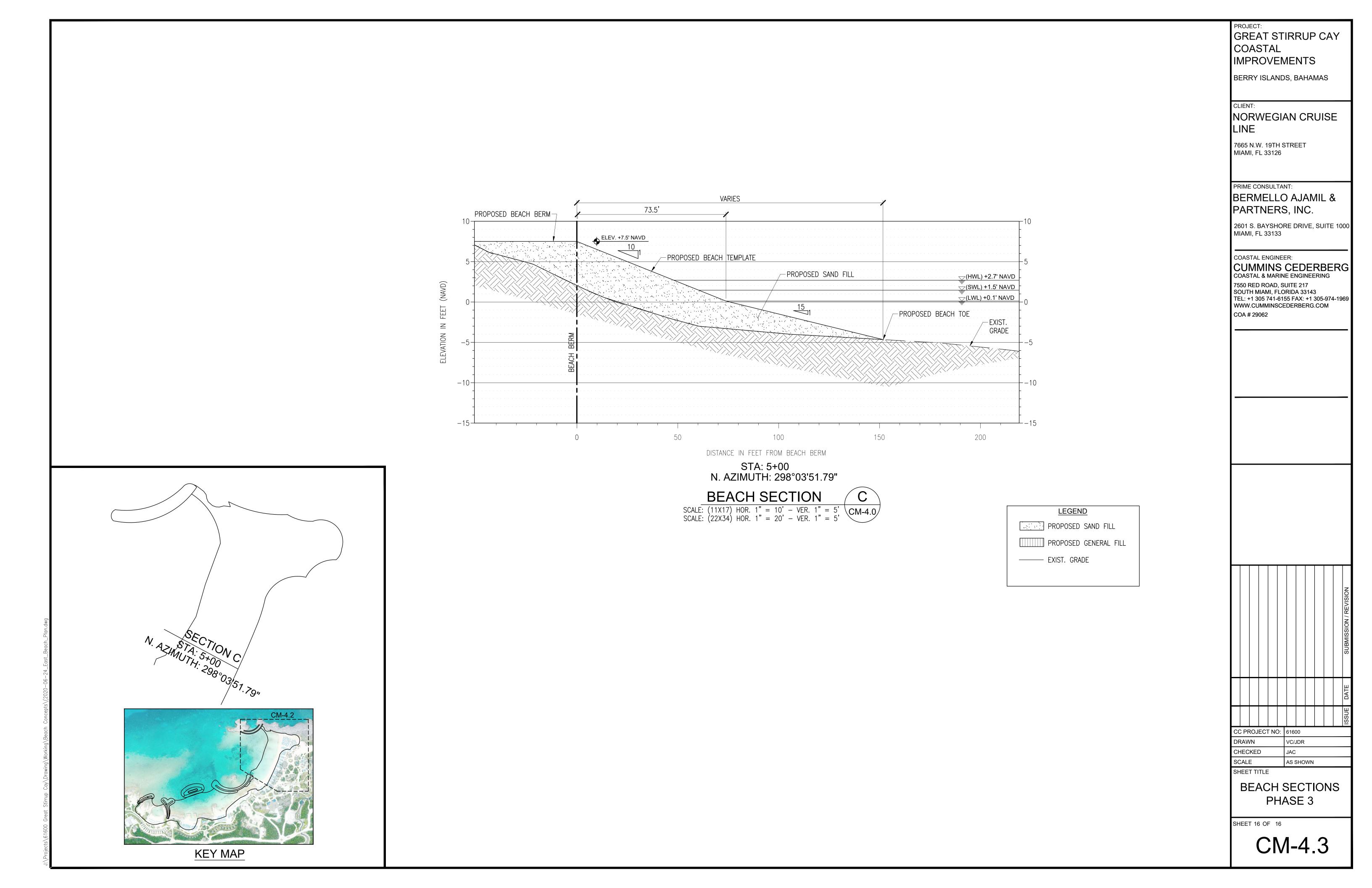
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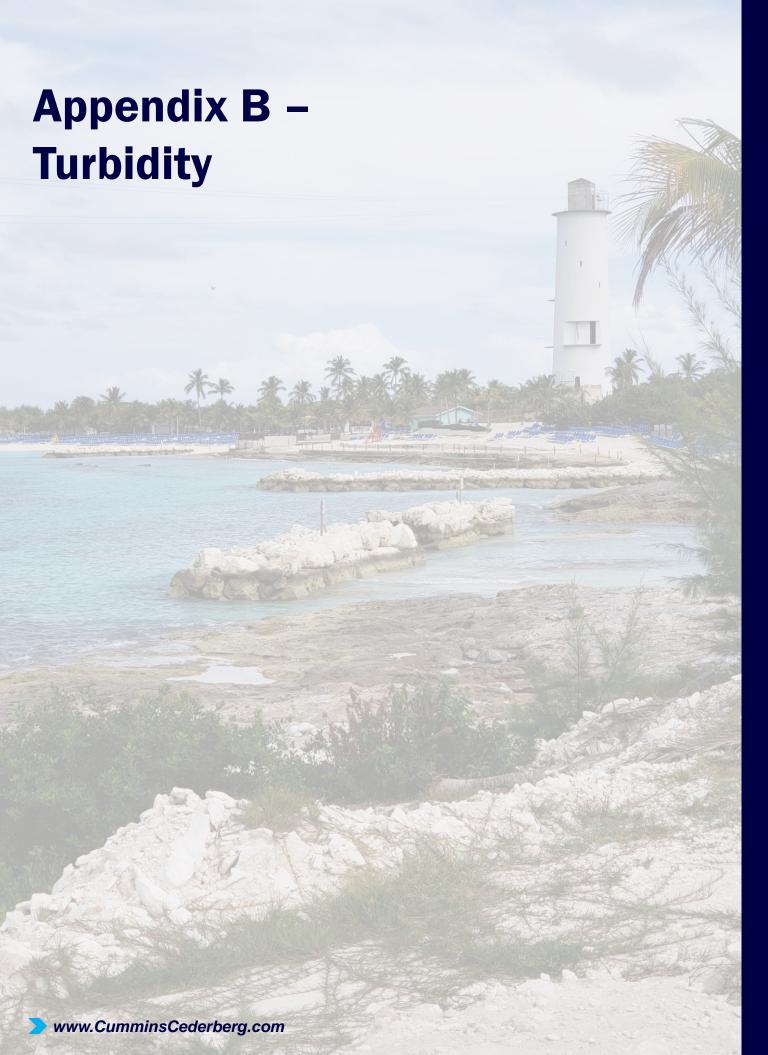
N.E. STRUCTURE SECTION PHASE 3

SHEET 14 OF 16

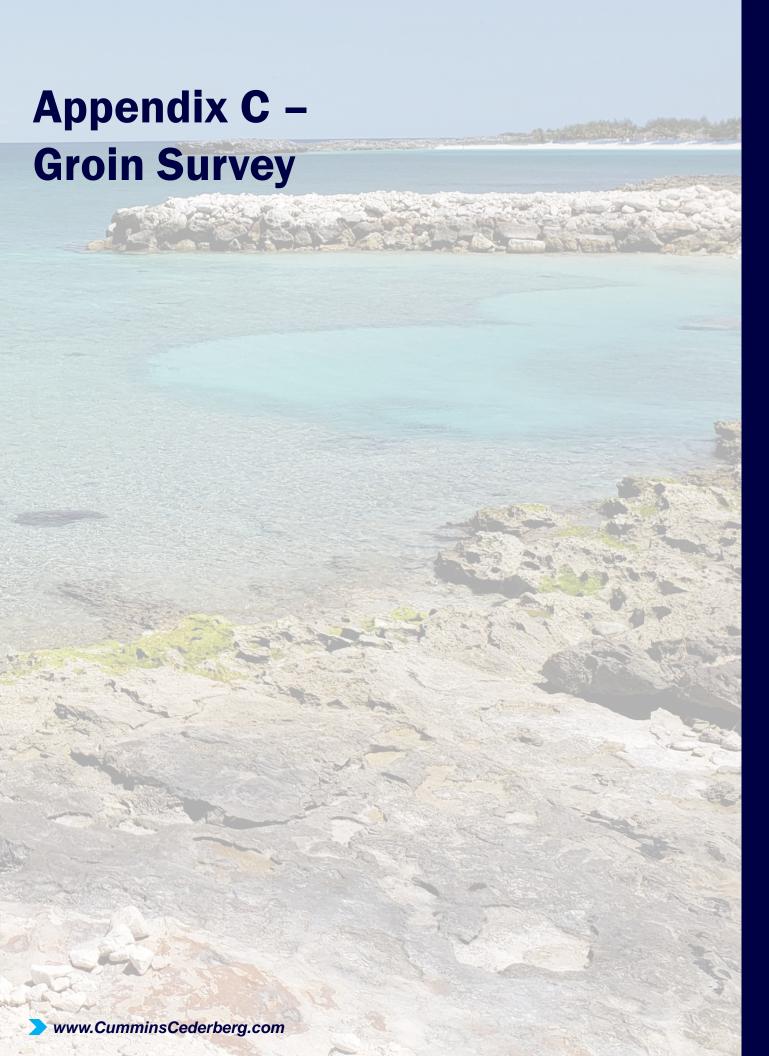
CM-4.1







Turbidity Monitoring Report								
Project:								
Background Turbidity					Date			
Sample 1								
NTU					Time			
GPS Coordinates	Northing				Easting			
Weather	Clear		Partly Cloudy		Cloudy		Rain	
Tide	High				Low			
Wind	Speed				Direction			
Sample 2								
NTU				Time				
GPS Coordinates	Northing				Easting			
Weather	Clear		Partly Cloudy		Cloudy		Rain	
Tide	High				Low			
Wind	Speed				Direction			
Sample 3								
NTU					Time			
GPS Coordinates	Northing				Easting			
Weather	Clear		Partly Cloudy		Cloudy		Rain	
Tide	High				Low			
Wind	Speed				Direction			
Environmental Manager Signature								







Field Observation Report

Project Name: Great Stirrup Cay Lagoon—Benthic Survey within Proposed Breakwater Areas

Report Date: March 06, 2020

Date of Survey: March 03 - 04, 2020

Marine Biologists: Ms. Anne Laird and Ms. Rebecah Delp

1.0 INTRODUCTION

Benthic habitat mapping was performed by Cummins Cederberg, Inc. (Cummins Cederberg) at Great Stirrup Cay, a privately owned Norwegian Cruise Line resort island, located north of Great Harbour Cay within the Berry Islands chain in the Bahamas (Project). Refer to **Figure 1** for a general location map of the Project site. The island is approximately 268 acres with both natural and man-made beachfront along the northern and eastern shorelines. Breakwater construction and beach fill are being proposed as a part of Phase I of a multi-phase project. As such, potential impacts to submerged aquatic resources from the proposed scope of work need to be considered.

Three breakwaters, consisting of boulders and sand material, are to be constructed as part of this Phase I of the Project: two located more centrally within the east beach area; and a third between two natural rock formations on the northeastern portion of the east beach area, north of the main beach. In addition, beach fill is proposed at the centrally located beach to increase beachfront area for patrons of the island.

2.0 METHODOLOGY

Surveying was conducted by two (2) qualified marine biologists via snorkel and SCUBA on March 03-04, 2020. The bulk of the marine resource survey consisted of a qualitative investigation to characterize the benthic habitat and their extents within the footprints of the proposed breakwater structures, beach fill areas, and areas surrounding the proposed breakwaters. Additional quantitative data collection was performed within areas containing coral colonies greater than approximately 10 cm (4 in.) ¹. All data was collected on underwater paper and representative photographs were taken throughout both survey areas.

To map benthic habitat extents within the Breakwater 1 area, biologists used beachfront rock formations (**Photo 1**) as point references and laid a measuring tape on the seabed to deploy marker buoys indicating the general northern and southern boundaries of the location of Breakwater 1. To estimate the spatial extent of Breakwater 2 and the "Northeast Rock Structure," biologists used natural formations (**Photo 2**) and the East Beach Overall Plan (i.e., engineering drawings, dated 10/25/2019) to determine the where the survey should be conducted. Conservatively, biologists surveyed the immediate surrounding areas as well.

In each of the three areas, the seabed was surveyed to document the approximate boundaries of distinct benthic habitats and document the marine resources present within the survey area (e.g., seagrasses, coral,

¹ Corals ≥10 cm in diameter are considered "corals of significance" strictly for the purposes of this report. This measurement does not consider regulatory agency requirements.

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macroalgae). Within Breakwater 2 and "Northeast Rock Structure" locations, biologists surveyed both the seabed and the vertical and sloping faces of the rock formations to document marine resources. Where coral colonies ≥10 cm were observed, biologists collected additional information on species and conducted an approximate count of these coral colonies.

3.0 RESULTS

The nearshore submerged substrate adjacent to the beach where Breakwater 1 and Breakwater 2 are located generally consists of sand (**Photo 3**) and occasional larger rocks. Approximately 250 linear feet (LF) waterward (north) toward the footprint of Breakwater 1, the substrate transitions to fractured carbonate rock (**Photo 4**) and hardbottom covered in various fleshy brown and green algae (**Photo 5**), with occasional small colonies (<5-7 cm [2-3 inches]) of the ubiquitous starlet corals (*Siderastrea spp.*) and small octocorals, and scattered patches of turtle grass (*Thalassia testudinum*). Progressing northward, the turtle grass habitat transitions to a denser mixed seagrass bed (**Photo 6**) of turtle grass and manatee grass (*Syringodium filiforme*) which continues for another approximately 30 LF where it becomes less dense, continuing northward well beyond the survey area. The seagrass bed continues east and west and transitions to patchy seagrass and eventually back to fractured carbonate rock with macroalgae. On the western extent of the proposed beach fill footprint, there are two large (>1.5 m [5 feet] in diameter) boulder corals (*Orbicella faveolata*) (**Photo 7**) outside of the proposed breakwaters but potentially within the beach fill area. The general extents of these benthic habitats, key features (e.g. rock formations) and coral colonies are shown in **Figure 2**.

The design footprint of Breakwater 2 incorporates a natural emergent rock formation (as seen in **Photo 2**) as well as approximately a dozen 'cut' boulders in the shape of cubes (~ 6 'L x 6'W x 6'H) that appear to be manufactured and placed on site many years ago. Coral were present on the sloping and vertical faces of the primary rock formation, the submerged natural rock, and on the sides of the larger "cut" boulders (**Photo 8**). There were approximately 60 colonies of finger coral, *Porites porites*, and 10 colonies of mustard hill coral, *P. astreoides*, that were ≥ 10 cm observed growing on the cut boulders. Macroalgae, sponges, and fire coral (*Millepora spp.*) were also observed growing on the boulders. On the south side of the rock formation and the adjacent submerged rock to the west, eleven colonies ≥ 10 cm of varying coral species were documented (**Photo 9**). Corals were observed growing on the north side of the rock; however, this is outside of the project area, so the corals were not enumerated. To the southwest and closer to shore, another cluster of smaller boulders are present (**Photo 10**); these colonies are primarily colonized by macroalgae with only a few small starlet corals observed. One large *Pseudodiploria clivosa* colony (0.7 m. x 0.45 m.) was documented growing on the substrate (**Photo 11**) directly southeast of the nearshore boulders, approximately 130 LF south of the rock formation.

Within the footprint of the "Northeast Rock Structure", water depths along the southern perimeter are relatively shallow (< 10 ft) and consistent with the surrounding depths of the lagoon. The seabed consists of fractured carbonate rock and hardbottom with sand, macroalgae coverage, and sparse, smaller coral colonies. Progressing northward within the central portion of the footprint and between the primary rock formations (**Photo 12**), water depths quickly increase to 18 to 20 ft. Large, scoured boulders are present

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and interspersed with sand depressions (**Photos 13** and **14**). Few coral colonies are present within the central sections, likely due to the heavy wave action causing the boulders to be nearly barren of marine growth. Further north and outside of the project area, water depths increase and the benthic community transitions to a sandy bottom with scattered, large rock formations. Along the eastern and western perimeters of the footprint and along the slopes of the rock formations (**Photos 15 and 16**), approximately 50-60 coral colonies (≥10 cm) were observed on the sloping rock, vertical faces, and overhangs. Approximately 20-30 colonies were observed within the western extent of the footprint. Species observed included *Agaricia spp.*, *P. astreoides*, *P. clivosa*, and *Siderastrea siderea* (**Photos 17 - 19**).

4.0 SUMMARY

The Breakwater 1 area is located within a mixed habitat of sand, fractured carbonate rock, and seagrass with only small colonies of the common starlet coral (*Siderastrea* spp.). Breakwater 2 proposed footprint contains numerous coral colonies (≥10 cm) of several different species colonizing both naturally occurring rock formations and 'cut' manmade boulders. The current design configuration for the "Northeast Rock Structure" encompasses deep water habitat with very few coral colonies, and shallower sloping rock with numerous colonies growing on the vertical and horizontal substrate, and beneath overhangs.

Cummins Cederberg biologists only documented coral colonies greater than 10 cm. (4 in.) based on prior history working in Florida and other locations. Additionally, the project footprint locations were estimated using the design drawing therefore, the numbers may be conservative or slightly overestimated. If a surveyor marked the absolute design footprints or if the design changes, the estimated total number of coral colonies may change.

PHOTOGRAPHS



Photo 1. View of the centrally located beach shoreline and rock formation used as reference, looking west.



Photo 2. Northeast view of the natural occurring rock formation where Breakwater 2 is proposed.



Photo 3. Photo of the nearshore sandy substrate adjacent to the centrally located beach.



Photo 4. Example of fractured carbonate rock hardbottom and macroalgae overgrowth observed during the survey.



Photo 5. Example of the brown algae overgrowth observed within the centrally located beach submerged lands.



Photo 6. Mixed seagrass present offshore of the central beach shoreline.



Photo 7. One of the *Orbicella faveolata* boulder corals documented west of Breakwater 1 footprint.



Photo 8. Example of the coral colonies on the larger, cut boulders located southwest of the rock formation within the Breakwater 2 footprint.



Photo 9. Example of a coral colony (*P. porites*), > 10 cm, on the south side of the rock formation with Breakwater 2 footprint.



Photo 10. Smaller, nearshore boulders southwest of the Breakwater 2 footprint.



Photo 11. *P. clivosa* colony documented south Breakwater 2.



Photo 12. The two large natural rock formations that the "Northeast Rock Structure" is proposed to be constructed between.



Photo 13. Scoured rocks and sand patch at the bottom of the seabed where "Northeast Rock Structure" is proposed, looking north.



Photo 14. View of the seabed looking north of where "Northeast Rock Structure" is proposed.



Photo 15. Example of rock formation within "Northeast Rock Structure" footprint.



Photo 16. View of the bottom of the seabed where "Northeast Rock Structure" is proposed, looking south.



Photo 17. A colony of *Agaricia agaricites* growing on the rock overhangs present within the proposed footprint of "Northeast Rock Structure."



Photo 18. A colony of *P. astreoides* colony within the proposed footprint of the "Northeast Rock Structure."



Photo 19. Example of a *P. clivosa*, >10 cm, observed growing on a rock within the proposed footprint the "Northeast Rock Structure."

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Figure 1 – Location Map



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Figure 2 – Basemap Legend Proposed beach fill area **Primary Rock** Formation I Proposed breakwater footprints Submerged Seagrass boundaries Larger "Cut Boulders Coral (> 10 cm. dia.) location **All boundaries and locations are approximate** Proposed Groin 2 Proposed Breakwater 1 Nearshore **Boulder Cluster** Y-Groin Proposed Northeast Rock (20-25 Corals

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