U.S. ARMY CORPS OF ENGINEERS

APPLICATION FOR DEPARTMENT OF THE ARMY PERMIT

33 CFR 325. The proponent agency is CECW-CO-R.

Form Approved -
OMB No. 0710-0003
Expires: 30-SEPTEMBER-2015

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PRIVACY ACT STATEMENT

Authorities: Rivers and Harbors Act, Section 10, 33 USC 403; Clean Water Act, Section 404, 33 USC 1344; Marine Protection, Research, and Sanctuaries Act, Section 103, 33 USC 1413; Regulatory Programs of the Corps of Engineers; Final Rule 33 CFR 320-332. Principal Purpose: Information provided on this form will be used in evaluating the application for a permit. Routine Uses: This information may be shared with the Department of Justice and other federal, state, and local government agencies, and the public and may be made available as part of a public notice as required by Federal law. Submission of requested information is voluntary, however, if information is not provided the permit application cannot be evaluated nor can a permit be issued. One set of original drawings or good reproducible copies which show the location and character of the proposed activity must be attached to this application (see sample drawings and/or instructions) and be submitted to the District Engineer having jurisdiction over the location of the proposed activity. An application that is not completed in full will be returned.

(ITEMS 1 THRU 4 TO BE FILLED BY THE CORPS)

1. APPLICATION NO.	2. FIELD OFFICE CODE	3. DATE RECEIVED	4. DATE APPLICATION COMPLETE

(ITEMS BELOW TO BE FILLED BY APPLICANT)

5. APPLICANT'S NAME

First - Guillermo Middle - Last - Cañate

Company - TI Wholesale Services Puerto Rico, Inc.

E-mail Address - guillermo.canate@telefonica.com

8. AUTHORIZED AGENT'S NAME AND TITLE (agent is not required)

First - Belyneth Middle - Last - Deliz

Company - Environmental Resources Management

E-mail Address - belyneth.deliz@erm.com

6. APPLICANT'S ADDRESS:

Address- 1111 Brickell Avenue, Suite 1800

City - Miami State - FL Zip - 33131 Country - USA

9. AGENT'S ADDRESS:

Address- 250 Ponce de León Ave., City Tower, Suite 900

City - San Juan State - PR Zip - 00918 Country - USA

7. APPLICANT'S PHONE NOs. w/AREA CODE

a. Residence
b. Business 1-305-925-5433
c. Fax 1-305-374-8682

10. AGENTS PHONE NOs. w/AREA CODE

a. Residence
b. Business 1-787-622-0808
c. Fax 1-787-622-1262

STATEMENT OF AUTHORIZATION

11. I hereby authorize, Belyneth Deliz to act in my behalf as my agent in the processing of this application and to furnish, upon request, supplemental information in support of this permit application.

SIGNATURE OF APPLICANT

June 10th, 2016
DATE

DRNA

NAME, LOCATION, AND DESCRIPTION OF PROJECT OR ACTIVITY

№ 1 4 8 0 - 2

12. PROJECT NAME OR TITLE (see instructions)

BRUSA Cable System

13. NAME OF WATERBODY, IF KNOWN (if applicable)

Atlantic Ocean - Carolina coastal waters

14. PROJECT STREET ADDRESS (if applicable)

SOL. CONJUNTA

Address Beach access, Tartak Street End, Isla Verde

City - Carolina State- PR Zip- 00979

15. LOCATION OF PROJECT

Latitude: •N 18° 26.6090 N Longitude: •W 66° 01.2810 W

16. OTHER LOCATION DESCRIPTIONS, IF KNOWN (see instructions)

State Tax Parcel ID Municipality

Section - Township - Range -

DRNA
JUN 15 2016
RADICACIONES

17. DIRECTIONS TO THE SITE

The site is located on the beach at the end of Tartak Street in Carolina Municipality. From Baldorioty the Castro Expressway traveling east from San Juan to Carolina, turn left onto Isla Verde Avenue, continue until reaching José M. Tartak Street. Turn left on Tartak Street and ntinue to the end (ending at the beach).

18. Nature of Activity (Description of project, include all features)

The BRUSA submarine cable system project will install and operate a fiber-optic submarine cable system linking the continental United States (U.S.) and Brazil, with a link into San Juan, Puerto Rico. The segment of the BRUSA system that links to Puerto Rico is proposed to land in the metropolitan area of San Juan at the Tartak Street end beach area. The marine system will end at the beach manhole (BMH) and connect to a terrestrial network that utilizes existing infrastructure. For further details on the project components and installation, please see Exhibit 1: Project Description.

19. Project Purpose (Describe the reason or purpose of the project, see instructions)

The BRUSA system will substantially increase submarine cable capacity in the region and provide a robust platform to support future growth in advanced Internet Protocol applications and traffic, including multimedia and Internet video applications that depend on high bandwidth transmission facilities. Additionally, BRUSA will increase communications reliability and help reduce the risk of communications disruption by providing cable route diversity and alternative bandwidth access to existing cables in the region. The demand for both telephone and high-speed internet in Puerto Rico continues to rise. This infrastructure will help to provide the Island with the capacity necessary to handle the increasing demand for international communication, driven by a growing number of home and business broadband users.

USE BLOCKS 20-23 IF DREDGED AND/OR FILL MATERIAL IS TO BE DISCHARGED

20. Reason(s) for Discharge

Two types of sand discharge are proposed:

1. Discharge of Excavated Sand: 19 m (20.78 yards [yd]) of the proposed 57 m (62.35 yd) long trench for the cable landing will be located below the high tide line. This trench will be excavated and then backfilled with the same sand.
2. Discharge of Sand from Sand Bag Anchors: A sandbag anchor is a dead-weight anchor that provides the hold back capability needed for a shallow water installation vehicle (SWIV) to hold position. Approximately twenty-four 1.5 tonne sandbags are proposed for this project. The sand would be collected from two areas that have been surveyed by a marine biologist and confirmed to be located away from sensitive benthic habitat. The sand will be returned to the same location at the end of the installation.

Refer to Exhibit 2: Sand Volume Calculations and Exhibit 3: Mitigation and Monitoring for additional information.

21. Type(s) of Material Being Discharged and the Amount of Each Type in Cubic Yards:

Type / Amount in Cubic Yards	Type / Amount in Cubic Yards	Type / Amount in Cubic Yards
149.1 Cubic Yards sand, beach trench re-fill	47 Cubic Yards sand, sand bag anchors	

22. Surface Area in Acres of Wetlands or Other Waters Filled (see instructions)

Acres No wetlands or other waters will be filled.
or
Linear Feet

23. Description of Avoidance, Minimization, and Compensation (see instructions)

Avoidance and minimization measures related to sand discharge are described in detail in Exhibit 3. Key points include: 1. The sand used in the sand bags will be returned to the original source site. 2. The filling, transportation, positioning, removal and return f sand will be diver assisted under supervision of the environmental monitor. 3. The sand will be discharged under slow controlled release to comply with turbidity standards. 4. Excavated sand from the beach trench will be returned to the trench to cover the cable. Sand will not be removed from the area, nor will new materials be imported.

24. Is Any Portion of the Work Already Complete? ☐ Yes ☒ No IF YES, DESCRIBE THE COMPLETED WORK

25. Addresses of Adjoining Property Owners, Lessees, Etc., Whose Property Adjoins the Waterbody (If more than can be entered here, please attach a supplemental list).

a. Address- Coral Beach Condominium, 5859, Jose M. Tartak Street

City - Carolina State - PR Zip - 00979

b. Address- Racquet Club Condominium, 5803 Jose M. Tartak Street

City - Carolina State - PR Zip - 00979

c. Address- Racquet Club Condominium #102, El Alambique Beach Front Bar & Grill

City - Carolina State - PR Zip - 00979

d. Address- Racquet Club Condominium #101, Third Base Sport Cafe

City - Carolina State - PR Zip - 00979

e. Address-

City - State - Zip -

26. List of Other Certificates or Approvals/Denials received from other Federal, State, or Local Agencies for Work Described in This Application.

AGENCY	TYPE APPROVAL*	IDENTIFICATION NUMBER	DATE APPLIED	DATE APPROVED	DATE DENIED
None to date					

* Would include but is not restricted to zoning, building, and flood plain permits

27. Application is hereby made for permit or permits to authorize the work described in this application. I certify that this information in this application is complete and accurate. I further certify that I possess the authority to undertake the work described herein or am acting as the duly authorized agent of the applicant.

[signature] June 10th, 2016

SIGNATURE OF APPLICANT DATE SIGNATURE OF AGENT DATE

The Application must be signed by the person who desires to undertake the proposed activity (applicant) or it may be signed by a duly authorized agent if the statement in block 11 has been filled out and signed.

18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals, or covers up any trick, scheme, or disguises a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statements or entry, shall be fined not more than $10,000 or imprisoned not more than five years or both.

JOINT PERMIT APPLICATION
for the
BRUSA Cable System

Exhibit 1:

Project Description

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1 INTRODUCTION

1.1 PURPOSE AND NEED

The BRUSA Cable System Project (Project) will install and operate a fiber-optic submarine cable system linking the continental United States (U.S.) and Brazil, with a link into San Juan, Puerto Rico. (See Figure 1.)

The Project will increase route diversity on U.S.-South America routes with an entirely new cable landing point on the U.S. mainland at the Mid-Atlantic City of Virginia Beach. Other existing and planned U.S.-Brazil cable systems either land or plan to land in Florida or in the New York-New Jersey area; therefore, BRUSA provides a new path on the U.S.-Brazil route. Having diverse cable routes helps to minimize the risk that a single event, such as a hurricane or a fishing-net entanglement, could disrupt all U.S.-Brazil communications. Additionally, BRUSA will provide new, low-latency connectivity (in connection with terrestrial backhaul facilities) to a cluster of data centers in the Northern Virginia region in and around Ashburn, Dulles, and Vienna, known as "Data Center Alley." This connectivity will greatly benefit carriers and enterprises using such facilities. The BRUSA cable system will offer significant new capacity on a route where capacity demand is increasing substantially each year and where existing systems are nearing the ends of their useful lives. SAm-1, South American Crossing/Latin American Nautilus, and GlobeNet each entered into commercial service in 2001, while Americas-II entered into commercial service in 2000.

BRUSA will consist of eight fiber pairs with a design capacity of 13.5 terabits per second (Tbps) per fiber pair. The Project will provide critical new and replacement capacity on the U.S.-Brazil route, and will also offer capacity in large increments until the year 2042, far beyond the useful life of most existing systems serving the U.S.-Brazil route.

The proposed BRUSA project in Puerto Rico offers the additional advantage of using existing infrastructure. The Applicant, TI Wholesale Services Puerto Rico Inc. (TIWS PR), proposes to use the same beach landing site and terrestrial ducting as the Pacific-Caribbean Cable System (PCCS), which was installed in 2015. The routing in shallow waters for BRUSA builds on the recent experience from PCCS. The BRUSA project described herein has principally the same technical approach as PCCS, and applies the same environmental protections that were used for the successful installation of the PCCS system.

1.2 *PROJECT HIGHLIGHTS*

The following Table 1 provides a summary of key project activities or components that highlight similarities to or key differences from the PCCS submarine cable project. Figure 2 shows both the BRUSA and PCCS cable routes within U.S. waters.

Table 1 ***BRUSA Cable System, Puerto Rico Landing - Key Project Highlights***

Project Highlights
• **Existing infrastructure**. The Project will use the same existing beach manhole (BMH) and terrestrial infrastructure as the PCCS project, which avoids (or minimizes) disturbance to the landing area and upland Project area.
• **BRUSA follows previous cable routes**. The BRUSA route follows the recent PCCS cable route in shallower waters and the AMX cable route in deeper waters offshore of Puerto Rico, which were thoroughly analyzed during the previous projects.
• **Same installation techniques as PCCS and AMX.** The installation methods for BRUSA build on the successful implementation of the previous two cable systems.
• **Additional sand borrow locations proposed to reduce area of influence from sand bag anchors.** The Project will use sandbag anchors during installation, and will collect sand from two different sand borrow areas to decrease the travel distance to sand anchor locations and to avoid crossing the reef gap. The filling, transportation, positioning, removal, and return of sand will be diver-assisted under supervision of the environmental monitor. Additional details on the use of sand bags, and avoidance and mitigation measures, can be found in: JPA Exhibit 1: Project Description, Section 2.4.2; Exhibit 2: Sand Calculations; and Exhibit 3: Mitigation and Monitoring.
• **Robust sea turtle beach monitoring plan.** The BRUSA Mitigation and Monitoring Plan includes all provisions requested by U.S. Fish and Wildlife Service (USFWS) for the PCCS cable installation. Details on monitoring and reporting to USFWS are in JPA Exhibit 3: Mitigation and Monitoring.
• **Routing minimizes impacts to Coral Critical Habitat and hardbottom areas.** Cable route development was closely coordinated with the Project marine biological expert to plan the route away from hardbottom areas, Critical Habitat, and corals. The same approach was conducted for PCCS and AMX, as well as biological monitoring during installation to assure compliance with the mitigation plan. Habitat characterization and estimated area of impact are described in detail in JPA Exhibit 6: Biological Assessment, and avoidance and mitigation measures are provided in JPA Exhibit 3: Mitigation and Monitoring.

2 PROJECT DESCRIPTION

Alcatel-Lucent Submarine Networks (ASN) has been contracted by TIWS PR to design, engineer, manufacture, and install the 11,300 kilometer (km) BRUSA cable system. The proposed activity consists of the marine deployment, landing, and inland installation of a fiber optical cable for international communication.

The planned cable route will be approximately 11,300 km long and will have four landing stations, two in the U.S. (Virginia and Puerto Rico), and two in Brazil (Rio de Janeiro and Fortaleza) (Figure 1).

The segment of the BRUSA cable system connecting Puerto Rico is proposed to land in the metropolitan area of San Juan at the site known as Tartak Street end beach area. The marine system will end at the BMH and connect to an existing terrestrial network (Figure 3). The segment of the BRUSA cable system connecting Puerto Rico will include a second 35 km long branch that will be used for possible future connections. The branch diverges from the main cable at the 15.04 km point along the cable route from the shoreline (see Figure 2).

Figure 1 *Overview of the BRUSA Cable System*

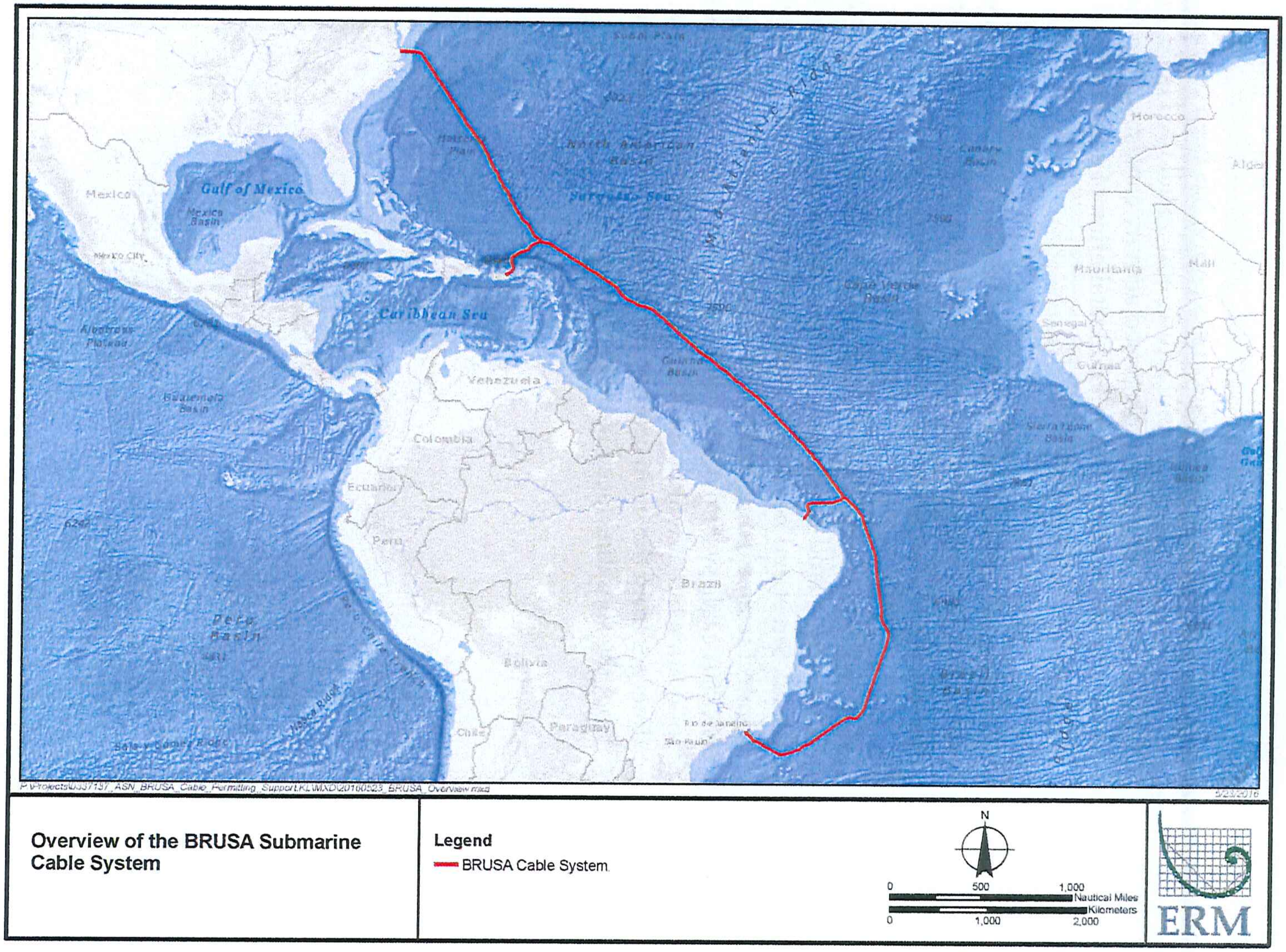


Figure 2 ***BRUSA and PCCS Submarine Cable Systems in U.S. Waters***

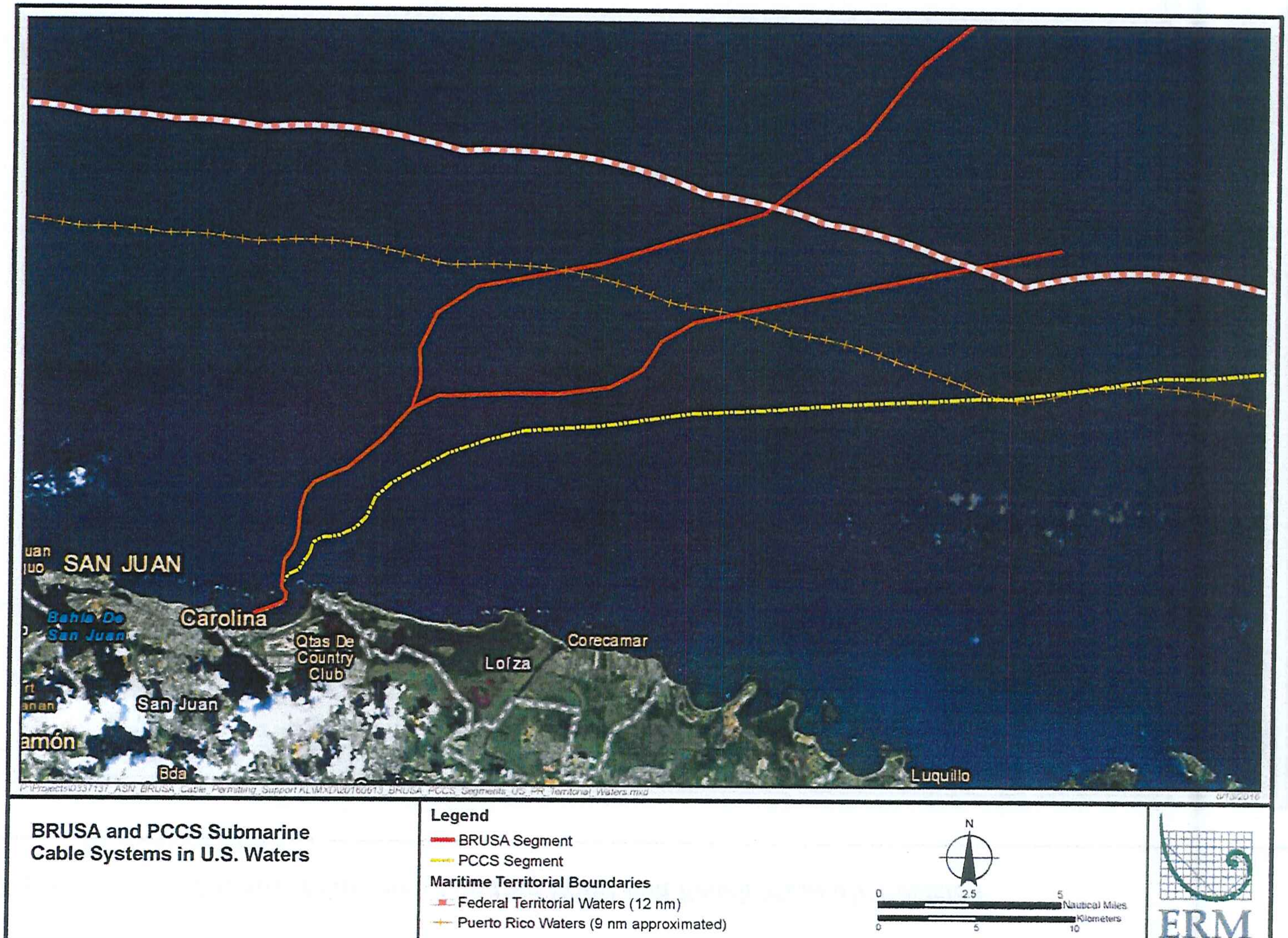


Figure 3 ***Proposed San Juan Landing Point and Beach Manhole Position***

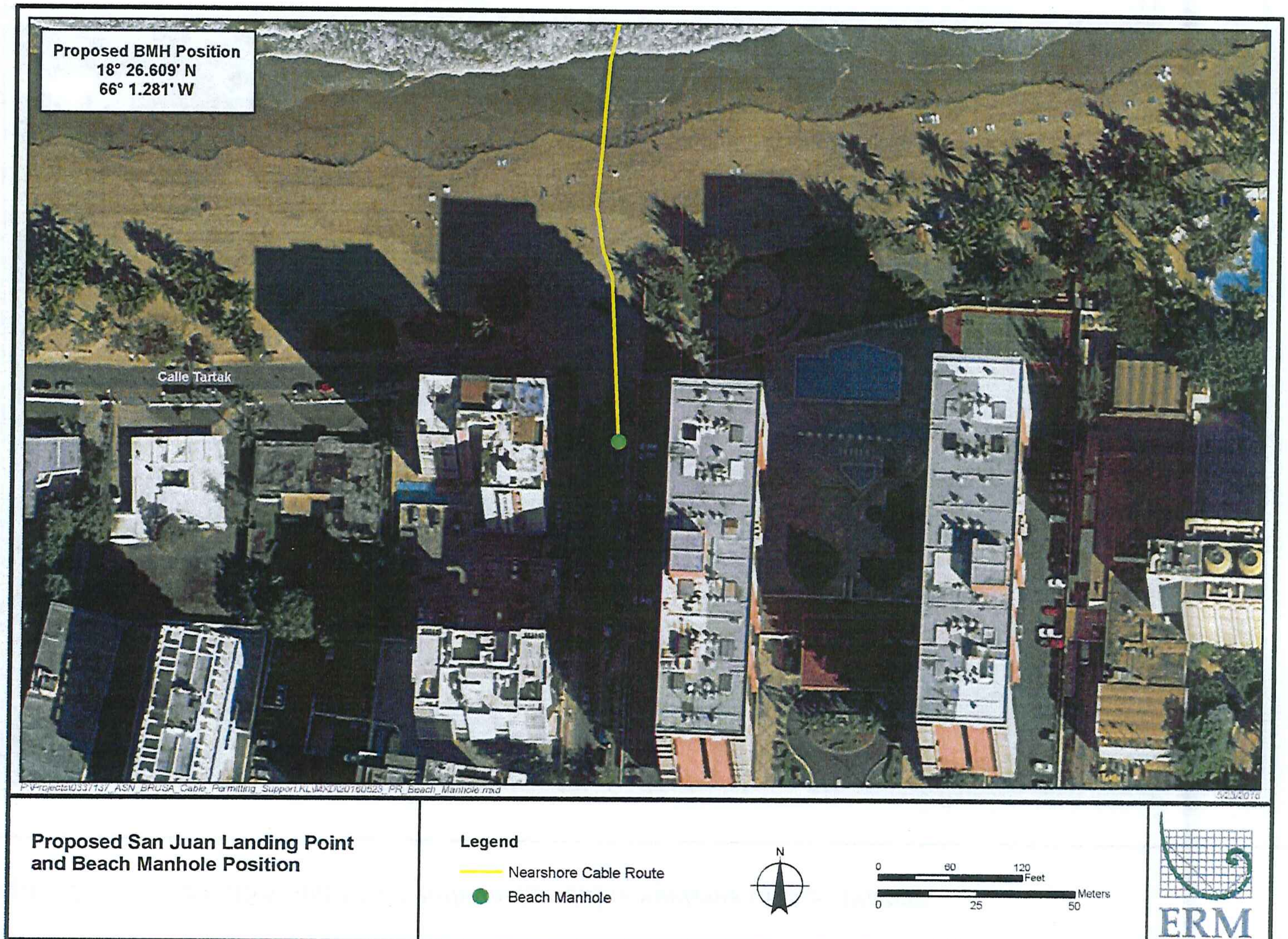
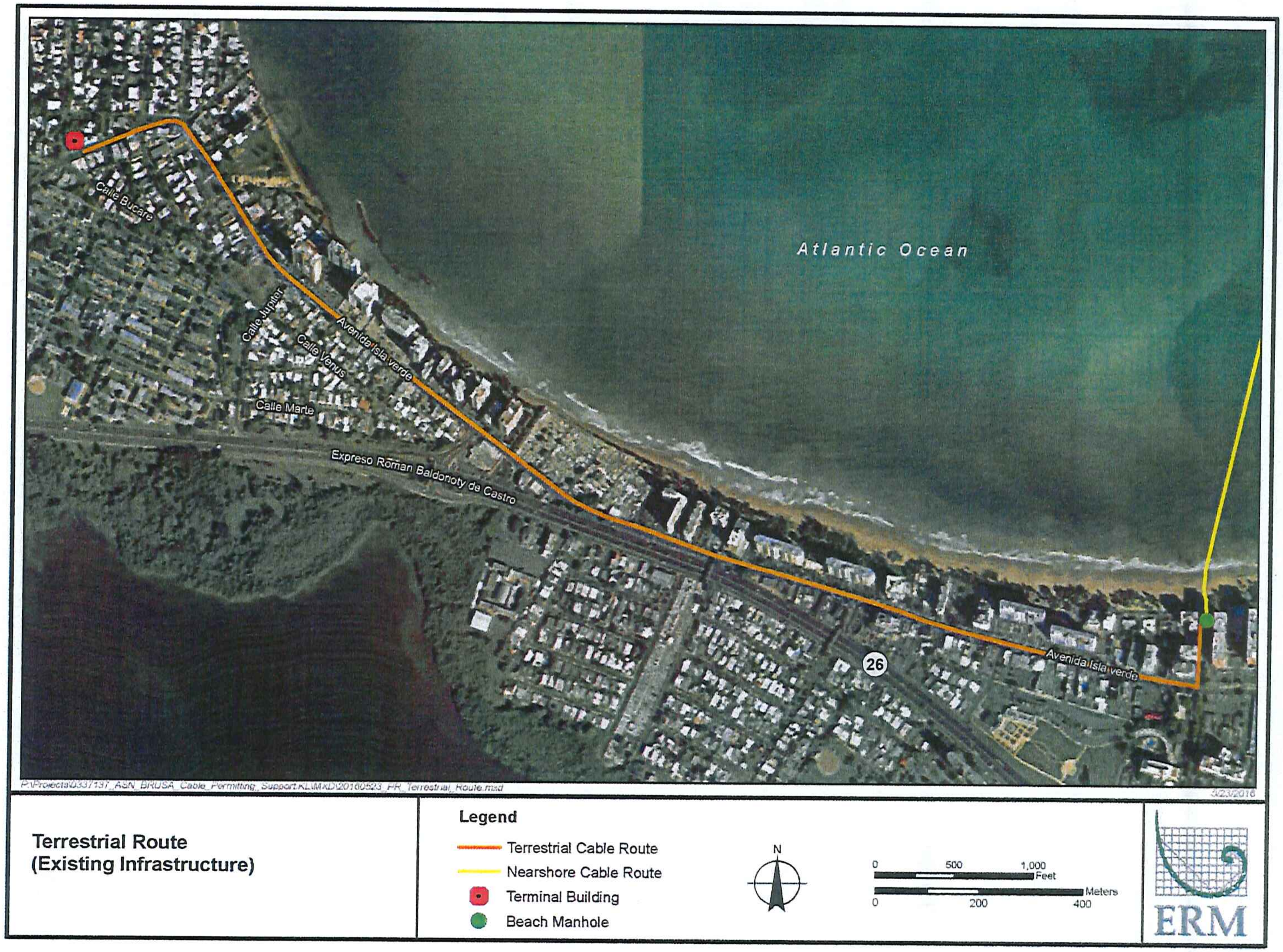


Figure 4 *Terrestrial Route Using Existing Infrastructure*



2.1 *Permits, Approvals, and Regulatory Requirements*

Table 2 lists the federal, state, and local agencies with permit or authority approval or consultation requirements for the portions of the BRUSA system offshore of San Juan, Puerto Rico, and within local and U.S. waters.

On March 30, 2016 Telefonica submitted a cable license application to the Federal Communications Commission (FCC). The application filing number is SCL-LIC-2016033000011.

Table 2 ***Federal, State, and Local Permits, Approvals and Consultations for the San Juan, Puerto Rico Segment of the BRUSA System***

Agency	Permit/Approval/Consultation
Federal	
US Army Corps of Engineers (USACE)	Individual Permit (Section 10 Rivers and Harbors Act/404 Clean Water Act)
National Oceanic and Atmospheric Administration (NOAA)	Protected Resources – Consultation
NOAA Fisheries (National Marine Fisheries Service)	Essential Fish Habitat Protection – Consultation
U.S. Fish and Wildlife Service	Section 7 Endangered Species Act: Consultation
State Historic Preservation Office (SHPO)	National Historic Preservation Act: Consultation
Local	
Oficina de Gerencia de Permisos (OGPe)/Carolina Municipality	Request for Environmental Assessment
Departamento de Recursos Naturales y Ambientales (DRNA)	Concession
Puerto Rico Planning Board (PRPB)	Coastal Consistency Certification
Environmental Quality Board (EQB)	Water Quality Certification
Instituto de Cultura de Puerto Rico	Consultation

2.2 *Cable Route Selection*

Cable design and selection of cable type are developed in the planning stages, based on engineering considerations identified during the route planning process. The landing was selected to optimize the approach to the existing infrastructure, to minimize interference with existing cables, and to use the seafloor features that effectively function as a natural corridor for the cable route (e.g., optimizing use of flat seabed, avoiding slopes, side-slopes, and hardbottom areas where possible).

The cable route was engineered to avoid potential hazards, other seabed users (such as naval areas), and disruption to marine resources and operations, and to secure long-term protection of the cable. The cable route and project design are developed and refined through two main stages: the Cable Route Study (CRS) - a detailed desktop review; and the Marine Survey - surveys of bathymetric and other data along the inshore and deep-water sections of the route. During the planning phase of the submarine cable systems, the Marine Survey and route selection exercises are optimized to select a route that will have minimal impact on the seabed.

An important component of the route planning process is the avoidance of impacts to the environment, particularly coral reefs (*Scleractinea*). To achieve this, a separate nearshore dive survey was conducted for the project, supported by environmental expertise. The route was refined to minimize hardbottom contact. For a discussion of the benthic survey findings for the proposed route indicated in the figure below, please see JPA Exhibit 6: Biological Assessment. A figure demonstrating the habitats crossed by the route in the nearshore approach to San Juan is provided in JPA Exhibit 4: Drawings and Charts.

2.2.1 *Fiber Optic Cable Features*

The BRUSA cable system connects the East Coast of the U.S., Puerto Rico, Fortaleza, and Rio de Janeiro. The trunk links Virginia Beach to Rio de Janeiro with two branches, one connecting San Juan (Puerto Rico) and the second connecting Fortaleza (Brazil). The segment connecting Puerto Rico will have a second branch for possible future cable connections. The second branch diverges from the main route at the 15.04 km point from shore and extends 35 km (see Figure 2). The system will provide critical new and replacement capacity on the U.S.-Brazil route. It will offer capacity in large increments until the year 2042, far beyond the useful life of most existing systems serving the U.S.-Brazil route.

The system is designed to carry 13.5 Tbps per fiber pair using the newest available, proven repeatered and unrepeatered technology. This system will consist of eight fiber pairs housed in a jelly-filled stainless steel tube, surrounded by two layers of steel wires that form a protective vault against pressure and external contact, as well as add tensile strength. The protective vault is enclosed in a hermetically sealed copper tube and insulated with a layer of polyethylene to form the basic deep-sea light weight (LW) cable. The outer low density polyethylene coating provides high voltage electrical insulation, as well as abrasion protection. Whenever possible, the raw materials selected are of the same type as those used in previous generations of coaxial and optical fiber cables, which have demonstrated more than 20 years of reliability.

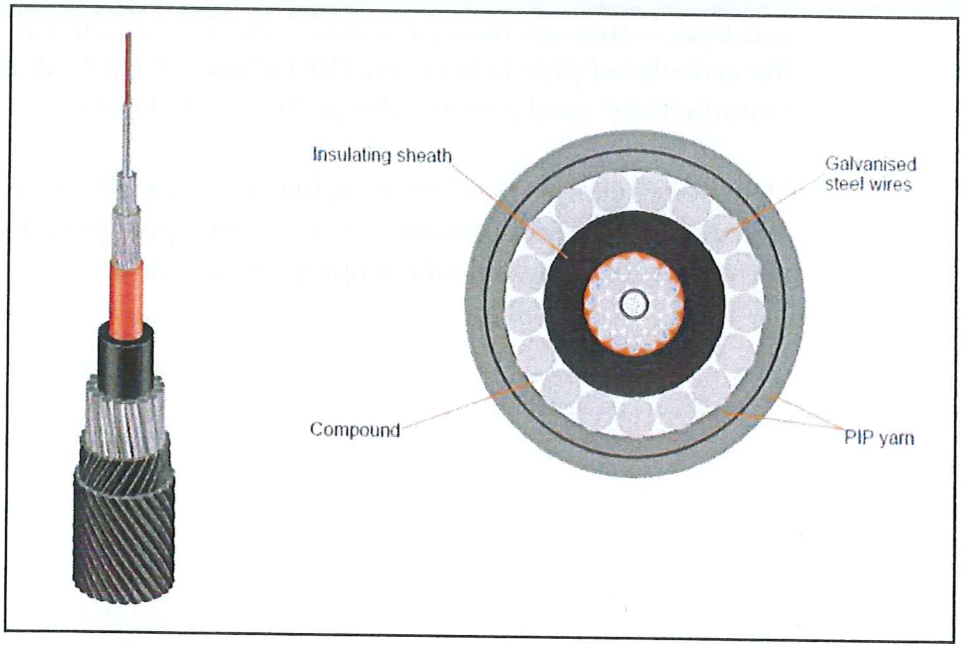
Single armor (SA) cable (Figure 5) is made by stranding a single layer of high strength galvanized steel wires over the basic LW cable structure. The steel wires are saturated with bituminous compound and covered by polypropylene yarns. SA cable is 26 millimeters (mm) (1.0 inch [in]) in diameter and will be used along 29.2 km (15.8 nautical miles [nm]) of the proposed route within U.S. waters in water depths between 200 meters (m) (656 feet [ft]) and 1,200 m (3,938 ft).

In shallow waters <200 m (656 ft), double armor (DA) cable will be used (Figure 6). DA cable is made by adding a second layer of galvanized steel wires around the SA cable, saturated with bituminous compound, and covered with polypropylene yarns. DA cable is 35 mm (1.4 in) in diameter and will be used along 6.9 km (3.7 nm) of the proposed route within local waters and a portion of federal waters in water depths ranging from 0 to 200 m (0 to 656 ft).

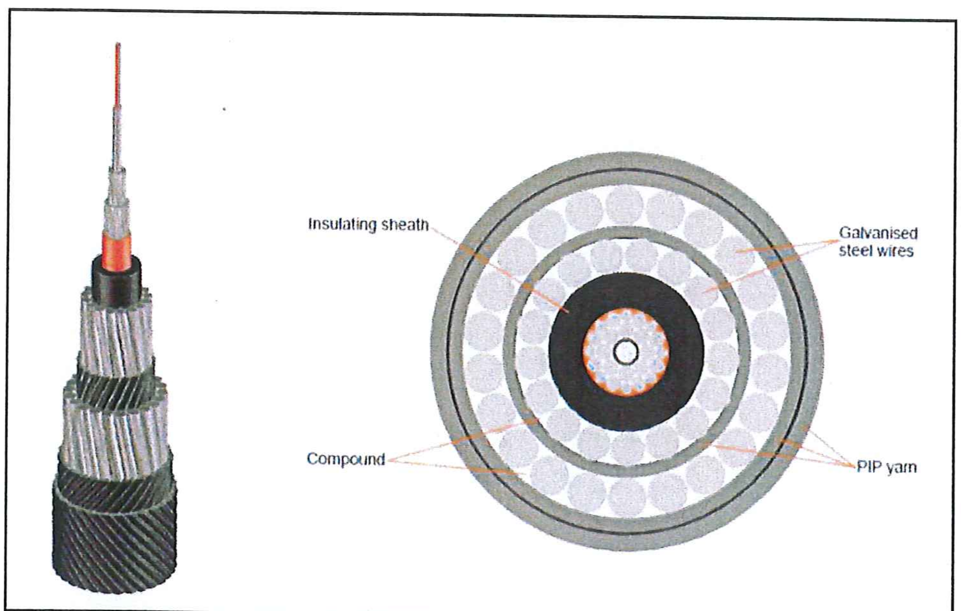
The cable design ensures that in the event of a break, high strain on the fibers and seawater ingress are limited to a short length, so that the bulk of the cable will remain serviceable.

Figure 5 Schematic of Single and Double Armored Fiber Optic Cables

Single Armored Cable



Double Armored Cable

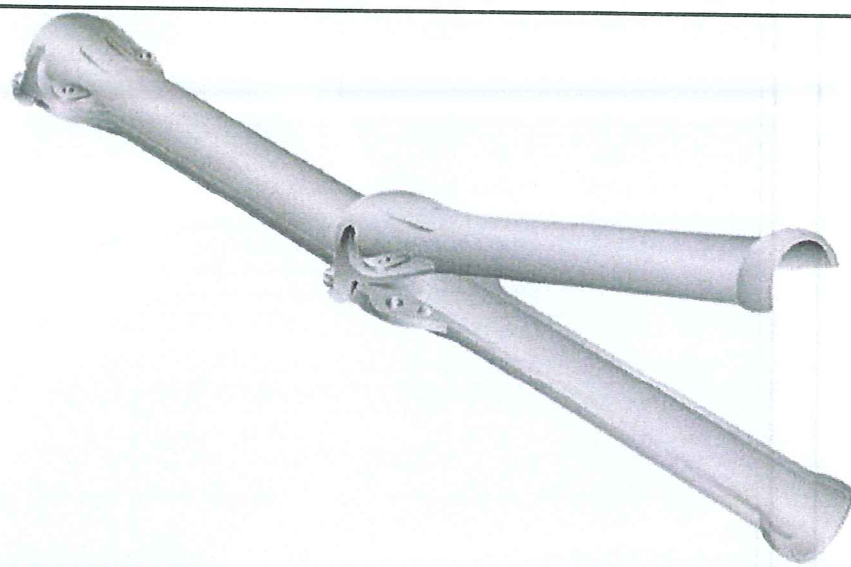


2.2.2 *Cable Protection – Articulated Pipe*

In order to improve cable stability and provide additional protection, articulated pipe will be fitted over the cable to be buried on the beach and continue within the nearshore surf zone. The maximum outer diameter of the articulated pipe is between 130-148 mm (5.1-5.8 in), depending on the manufacturer used (smaller design shown in Figure 6).

"Dogbone" clamps (see Figure 6) may occasionally be inserted in suitable articulated pipe sections between kilometer post (KP) 0.785 to KP 1.010, allowing more convenient clamping preparation.

Figure 6 *Schematic and Specifications of an Articulated Pipe Segment*



PS055/500/09

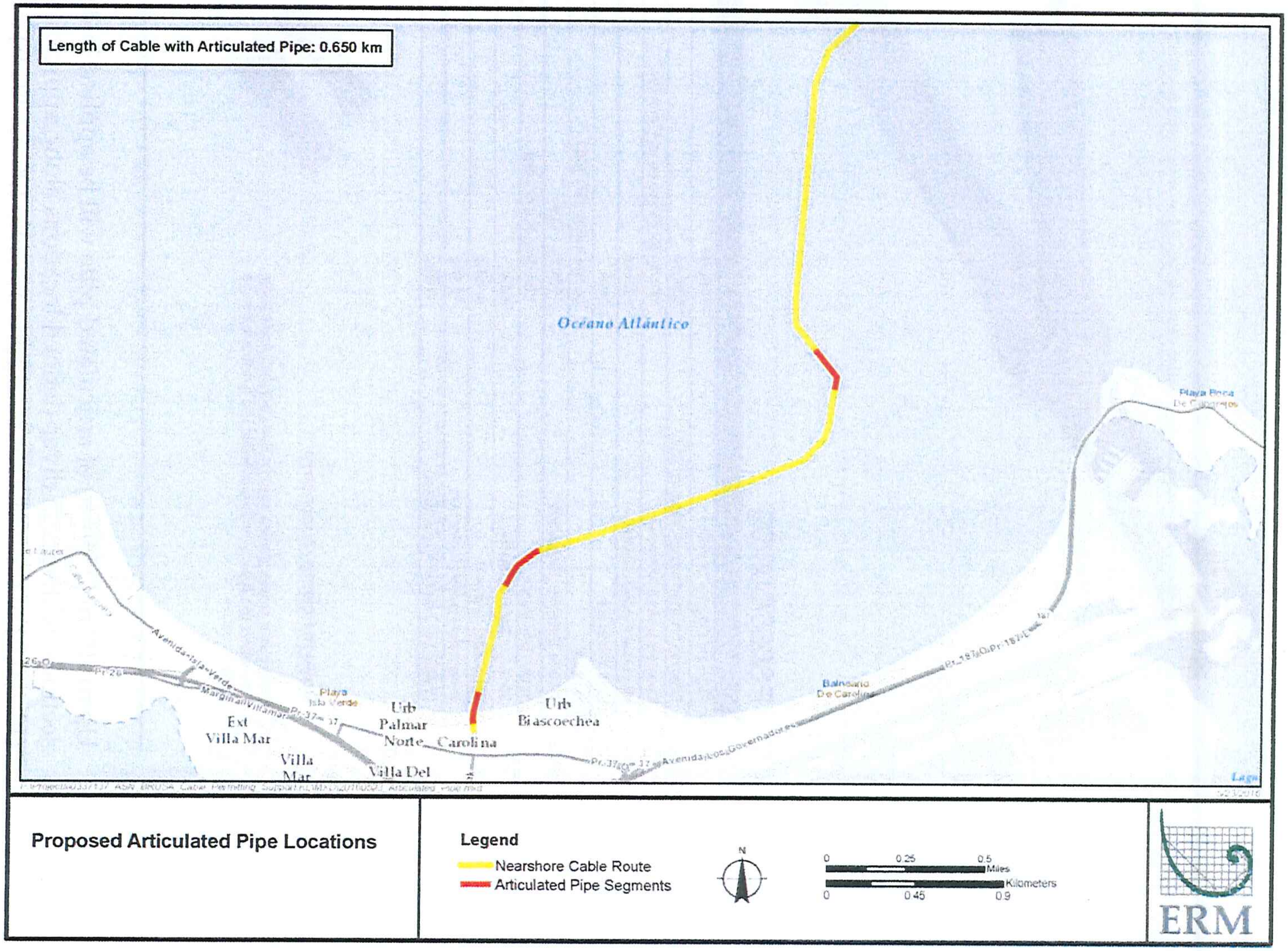
Specifications	
Segment Length - Overall	546mm
Effective Installed Length/segment pair	500mm
Minimum Internal Diameter	55mm - for cables up to 47mm Dia
Maximum External Diameter	130mm
Wall Thickness	9mm
Material	Ductile Iron to ISO 1083
Tensile Strength / Elongation	400MPa / 12%
Impact Resistance	12m Drop test or 28kg
Minimum Bend Diameter	4.0m
Weight per Segment	8.10kg
Weight per installed metre (air)	16.4kg
Weight per installed metre (water)	14.3kg

Dogbone clamp *(Tension clamp)*

Serves as a secure starting point for Protectorshell Application Also allows the application to proceed in two directions along a cable

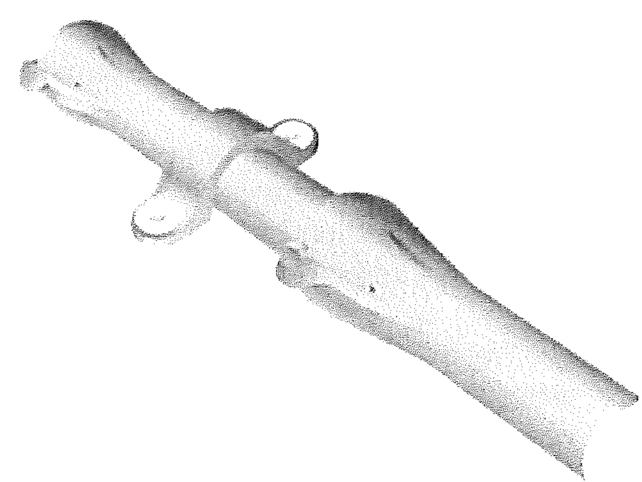
Up to 700 m (2,297 ft) of articulated pipe will be applied in discrete sections by divers in diver-defined locations along approximately 4,200 m (13,780 ft) of the cable route. Approximately 120 m (394 ft) of this total will be buried to a target depth of 2 m (6.6 ft) along the beach. Proposed locations for use of articulated pipe are shown in Figure 7. The exact location of articulated pipe will be adjusted to suit the as-laid cable, with more pipes used if needed.

Figure 7 ***Proposed Articulated Pipe Locations***



A number of "saddle clamps" may be required to affix the cable and articulated pipe to the seabed (see schematic in Figure 8). Cable clamps will be installed on cable sections fitted with articulated pipe at varying intervals between 8-25 m over suitable "rock" and solid seabed material in appropriate areas between KP 0.785 to KP 1.010. Clamping will be evaluated and reviewed when the cable is in its final position on the seabed, and will be subject to the availability of suitable rock to secure the clamps. One pair of M12 A4 stainless steel bolt sets will be installed at nominally 1 m intervals on the remainder of the articulated pipe sections, including ends. Provisional clamp locations are also shown on a figure in JPA Exhibit 3: Mitigation and Monitoring.

Figure 8 *Schematic of a Saddle Clamp Application*



The purpose of clamping is to maintain cable position in selected and suitable areas during tropical storms only where unusual and extremely high bottom oscillating current velocities (drag) is expected on cable not being perpendicular to the dominant wave front. This is a precautionary measure proposed by ASN for the part of the near shore cable (approximately 1,000 m) that will be positioned roughly parallel to the coastline.

2.2.3 *Beach Manhole*

The BRUSA project will use an existing BMH at the landing site, located on Jose M. Tartak Street. This is the same BMH that was used for the installations of SAm-1 Segments G and H in 2000; and for the SAm-1 Extension Segment G1.2 that was laid in 2008, and for the PCCS system installed in 2015. The BMH is a subterranean, vault-like structure where the joint is made connecting the submarine cable to the land cable. The cable will be installed through a pre-existing TIWS PR conduit (30 m long duct) that was installed approximately 2 m under the beach in order to avoid impacting the nearby road.

2.2.4 *System Ground (e.g., Sea Earth Plate)*

The BRUSA system will be repeatered, meaning that there will be power running through the cable. The "system ground" will be in the vicinity of the terminal building located at the end of the cable's terrestrial route.

2.3 CABLE INSTALLATION

The cable installation comprises two phases: the installation of a separate shore-end (SSE) section (approximately 5 km length in water depths of up to 35 m), and the main lay of the remainder of the route.

The SSE installation will be performed by a shallow water installation vessel (SWIV); maneuvering using defined mooring locations, as described in Section 2.4.2. This allows better control and accuracy during installation, and is done independently of the main lay.

The "main lay" will involve laying the cable along a pre-determined route using a special purpose cable ship, also referred to as the "main lay" vessel to distinguish it from support boats. The ship will be approximately 140 m (420 ft) long, and will have a dynamic positioning (DP) system that enables it to maneuver in the nearshore area without anchoring.

The cable ship will comply with applicable federal and international regulations and conventions addressing navigational safety, safe operations, and pollution prevention measures. The location and duration of the vessel's presence in the project area will be included in a notice submitted in advance, in accordance with U.S. Coast Guard (USCG) requirements. The USCG will issue a Notice to Mariners to alert other vessels of the cable ship's presence, expected time in the project area, and contact information.

The main lay will be conducted 24 hours per day until the ship reaches the end of the SSE section (~35 m water depth) where the shore-end will be jointed to the main lay cable. The timing of this connection will depend on the relative progress of each phase and may be delayed as necessary.

The main lay only includes the surface lay of cable, ranging from the deepest section at approximately 1,200 m (3,938 ft) to the shore-end at 35 m (115 ft). From the 35 m depth contour to the waterline, the cable will be surface laid and buried by diver jetting, where possible and allowed.

The components of the main lay operation are discussed in more detail in the sections that follow.

2.3.1 *Route Clearance and Pre-Lay Grapnel Run*

No Route Clearance or Pre-Lay Grapnel Run (PLGR) operations are required, as the cable will be surface laid.

2.3.2 *Main Lay Plowing*

No main lay plowing operations are required, as the cable will be surface laid.

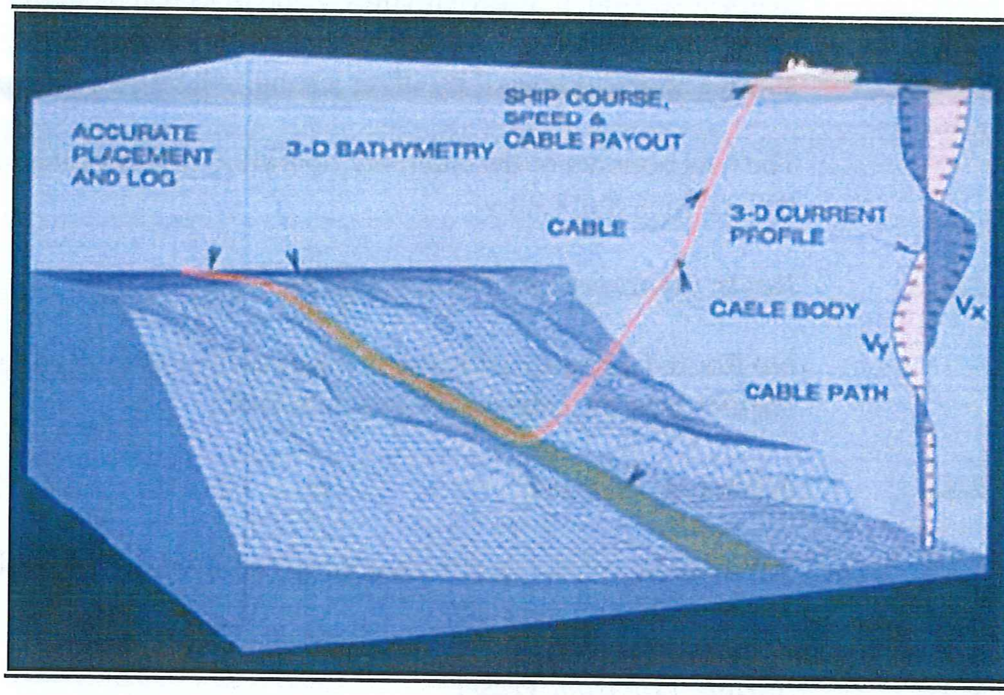
2.3.3 *Surface Lay from Vessel*

Surface laying of the cable will be conducted at a speed of approximately 4 knots (kt), slower as the ship is nearer to shore. The weight of the double armored cable will ensure that the cable will remain on the seafloor and minimizes movement of the cable on the seafloor. Changes in the heading of the cable will be very small, helping the cable to resist all but the most minor longitudinal movement. Cable will be installed with minimum bottom tension in order to avoid cable loops.

2.3.4 *Navigation and As-Laid Position*

The cable ship will use state-of-the-art navigational systems and cable lay software, such as MakaiLay® or a similar program, that allows precise surface positioning and prediction of the cable's installed position on the seabed. The cable lay software allows real time data inputs for finite elements. Information such as the planned cable route, the bathymetry, the ship heading, position and speed, the cable characteristics, and layout speed are integrated into the software to optimize the real time monitoring of the cable installation. This software will use an advanced two-dimensional (2D) force-based cable model to predict touchdown (10). The ship route will then be adjusted by the predicted offset distance calculated by the model, to ensure the cable touchdown point will be closely positioned along the planned route.

Figure 9 *Example of MakaiLay® Modeling*



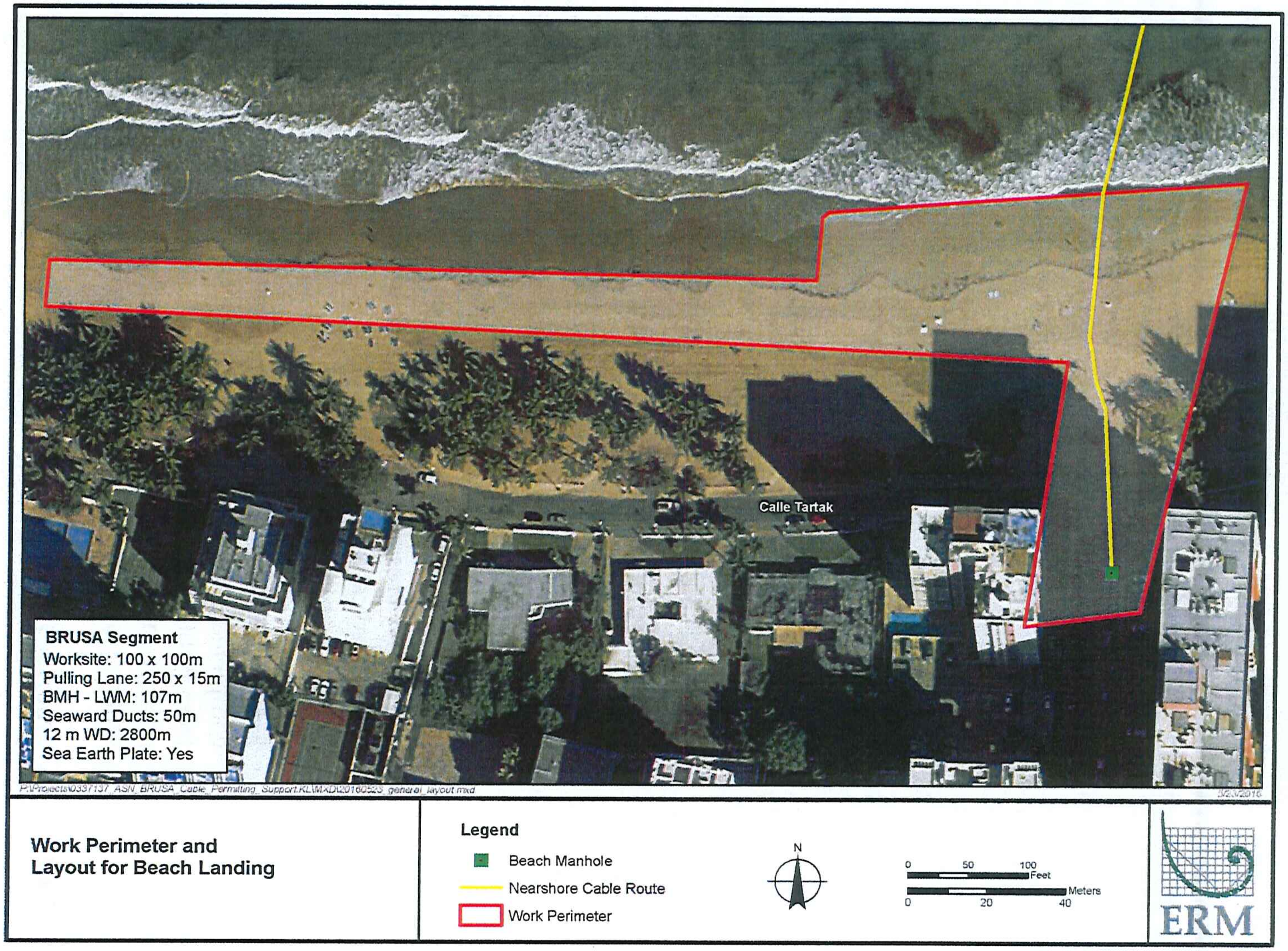
2.4 *Beach Landing Operation*

The beach landing operation will consist of the following key activities:

- Pre-lay meeting;
- Installation of temporary and permanent seabed fixings;
- Beach preparation and equipment staging;
- Cable landing operation;
- Diver-assisted installation on the seafloor, including application of cable protection where required; and
- Post-landing operations, including beach burial and restoration at the BMH.

Each of these activities is discussed in more detail in the sections that follow. Drawings of proposed structures and associated infrastructure are provided in JPA Exhibit 4. The general layout for beach activities is shown in Figure 10.

Figure 10 *Work Perimeter and Layout for the San Juan Beach Landing Activities*



2.4.1 *Beach Preparation*

Planning and preparations for the cable installation will begin approximately a week prior to commencement of the shore-end landing operations. Prior to the cable landing operation a Pre-Landing Meeting will be held to provide coordination between ASN representatives, the SWIV officers, and the Beach Contractor. All necessary equipment will have been mobilized to the site no later than the day before the planned landing. At minimum, the following equipment will be used on the beach to support the cable landing:

- Two excavators;
- Quadrant;
- Temporary fencing material;
- Hauling rope, stoppers, and floats;
- Cable detection equipment to detect existing cables on the beach;
- Shovels and miscellaneous hand tools; and
- Radio communication equipment.

The seaward end of the BMH ducts will be exposed, and a working perimeter will be clearly marked and defined. The Project will utilize entirely existing ducts; no new construction will be required (see JPA Exhibit 4 for drawings and figures). The location of the existing in-service cables and associated grounding cables will be identified and marked where they cross the beach. The existing cables will be identified using specialized cable detection equipment and localized digging as necessary to validate cable detection.

Final notification and coordination with local authorities will be completed before landing the cable. The worksite will be cordoned off from public access using temporary safety fencing. Markers and site control on the beach will identify and maintain a safe work area. Security will be provided for equipment that may be staged overnight.

2.4.2 *Mooring Points and Seabed Fixings*

Mooring Points

Mooring points will be installed in advance of the cable laying operation in order to provide secure points on the seabed to hold the SWIV in place during installation. Divers have verified suitable mooring point locations in advance by conducting dive surveys to assess the benthic habitat. Provisional locations for the vessel mooring points are provided in *Figure 11*. They are proposed in predominantly sandy bottom areas and hardground areas that are not sensitive habitats in order to avoid impacting sensitive benthic habitat. For discussion of the types of permanent and temporary mooring point types being considered by the project, please see Section 2.4.3.

A description of the benthic survey findings for the mooring point locations is provided in JPA Exhibit 6: Biological Assessment.

A summary of common seabed mooring point (anchor) types and their typical application is provided below:

Conventional Anchors (Bruce, Danforth)

These anchors generally can only be used in shallow water areas of sandy seafloor, and therefore have a limited area of use for this project. Their design requires embedment into the seabed which is achieved by dragging the anchors until they are set. They are suitable for making minor adjustments to a vessel's position so that the control cable deployment is possible.

Eye-Bolts and Screw Anchors

These types of devices are used in the cable industry for securing the cable on the seafloor along a selected route. These devices are neither intended to function as moorings for an installation vessel, nor are they adequate for securing a lay barge to maintain position.

Concrete Blocks

A concrete block is a dead-weight anchor that provides the hold back capability required to maintain position of the SWIV. A heavy lift crane barge would be required to deploy and recover concrete blocks. This additional vessel would require its own mooring arrangements to recover the concrete blocks, and thus repeat the same problem. The recovery of these concrete blocks would be very sensitive to weather and sea conditions, and it is possible these blocks would need to remain on the seabed for several months before recovery can be attempted safely.

Sandbag Anchors

A sandbag anchor is a dead-weight anchor that provides the hold back capability needed for a SWIV and cable to hold position. Approximately 24 1.5 tonne sandbags would be proposed for this project, 18 of which will be used as temporary anchors for the SWIV and six as temporary hold-back anchors for the cable. By comparison, 90 concrete blocks would be required for this installation, and the footprint on the seabed would be 55% greater. Sandbag anchors were used in the recent installation of the AMX and PCCS cable systems in this project area. The volume of sand required to fill 24 sandbags is estimated as 36 m^3 (47 cubic yards [yd^3]), or 1.5 m^3 (2.0 yd^3) per sandbag.

The sand would be collected from two areas identified in advance, located far away from sensitive benthic habitat and returned to the same location at the end of the installation exercise. There will be no excavation or discharge of sand in the Isla Verde Reserve.

Proposed avoidance and management measures associated with the use, deployment, and recovery of sandbag anchors are provided in JPA Exhibit 3: Mitigation and Monitoring.

Seabed fixings will be located at or close to the alter course (A/C) positions of the cable, elsewhere as necessary, and will allow divers to secure the cable on the seafloor during the installation process to ensure the cable will follow the agreed optimum route out through the reef tracts. Divers will swim the route a few days before the landing and install the temporary and permanent seabed fixings.

Temporary seabed fixings will be placed mostly in sand areas. In hard bottom areas, permanent seabed fixings will be considered. The depth of hand drilled holes and anchor size/rod diameter will be subject to seabed strength found at each location. During the detailed diver survey of the route, the specific type, quantity, and position of seabed fixings was determined. These include an estimated one permanent location and 25 temporary locations, which will be locally optimized prior to installation (Figure 11).

A brief description of the temporary and permanent seabed fixing types being considered is provided below.

Temporary seabed fixings under consideration include:

- Mushroom type, size up to 250 kilograms; footprint of varying size up to 1 x m^2; typically used in sandy bottom;
- Bruce anchor, size up to 30 kg; footprint of varying size up to 1 x m^2; typically used in sandy bottom;
- Clump weight type, chain/concrete block, size 25 to 500 kg; typically used in harder seabeds; and
- Screw anchors, all types, typically 0.3 m diameter x up to 1.5 m long; typically used in sandy bottom.

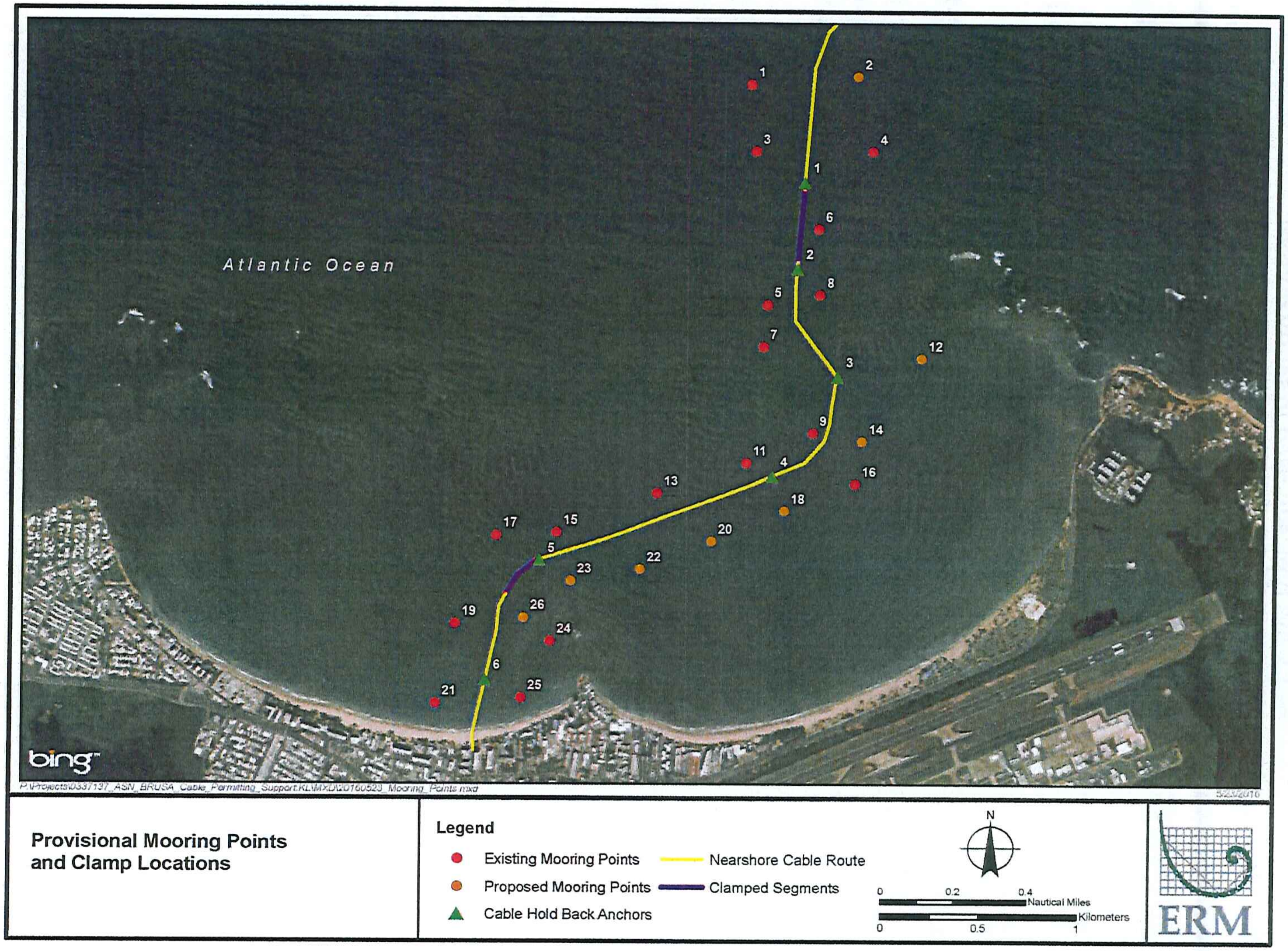
Permanent seabed fixings under consideration include the following:

- Stainless steel bar, typically 24 to 32 mm in diameter with eye, to be secured in a drilled hole using either underwater cement mix (will cure within days) or dual component epoxy resin for underwater use (will cure within hours at 15 degrees);
- Manta Ray type of anchor, hand drilled to suit the size of the anchor rod; depth of hole as required and subject to hardground strength; and
- Screwed anchor plate with padeye, size 0.5 m x 0.5, fixed in 4 x 250 mm drilled M24 holes.

Permanent seabed fixings will be installed using commercially available underwater drilling units and metal rods will be secured using commercially available underwater cement or two component epoxy resin. The permanent (drilled) anchors will be left in place due to the adverse impacts associated with removing them and the temporary anchors will be removed after the nearshore cable installation.

On the day of the cable installation, divers will deploy small marker buoys along the route at each seabed fixing location to provide the SWIV and dive support vessels with a visual reference for cable laying.

Figure 11 ***Provisional Mooring Points and Seabed Fixing Locations***



2.4.3 *Shore-end Operations*

Shore-end operations will normally be conducted within 20-24 working days, starting at first daylight. Throughout the installation activities, the shore-end SWIV's captain and diving contractors will review the weather forecasts to ensure that the following maximum weather parameters are met for operations:

- Wave height, max: 1.5 m (4.9 ft);
- Wind speed, max: 30 kt (15 meters/second [m/s]) direction predominantly from shore; and
- Wind speed, max: 20 kt (10 m/s) direction predominantly from sea.

The cable will normally be laid from the SWIV from offshore to onshore. The cable landing sequence, the final phase, will typically be as follows:

- Establish a temporary marker line in critical areas of the route;
- Establish a "messenger line" to the beach;
- Using excavators on the beach, conduct "beach pulls" to bring the cable to shore;
- Ensure there is sufficient cable slack on the beach;
- Reposition the cable on the surface with small boats to align with the required route/position;
- Divers will start to cut the floats and guide the cable to the seabed;
- Once the cable is on the seabed, divers will swim the route to confirm it is laid properly;
- Floats will be returned to the vessel; and
- Cable testing and beach jointing progress on the beach.

A team of divers will be deployed to install a temporary marker line along critical sections of the inshore route. The marker line will either be a 10 mm diameter metal core polypropylene line or 6-8 mm steel wire or equivalent, and will be utilized in areas of hardbottom along the optimized route to give divers visual guidance where the cable will be installed in critical areas (e.g., where the cable passes close to sensitive habitat). The marker line will be positioned using A/C positions in critical areas along the preferred route.

Immediately prior to the cable landing, the two excavators will prepare the beach by setting up in beach-pulling mode (one excavator is positioned near the landing point with a quadrant and the other excavator prepared with necessary rigging and pulling rope). A small diver workboat will meet with the work boat just outside of the surf zone and connect a messenger line to the cable, allowing the excavator to begin pulling the cable to the beach from the SWIV (Figure 12).

Figure 12 *Pulling the Cable from the SWIV to Shore*

One heavy excavator will be used as an anchor point for the quadrant. Another excavator will pull the rope attached to the cable for a distance of 100 to 200 m (328.1 to 656.2 ft) along the beach. The SWIV will pay out cable with floats at the same rate at which the excavator performs the beach pulls. The cable will be secured each time the excavator needs to reposition to perform a new pull.

Small support vessels will guide the floating cable into position on the surface of the water aligned with the surface marker buoys. Once the desired length of cable has been secured on the beach, divers will remove the floats from the cable one at a time and begin guiding the cable to the seafloor. In critical areas, the marker line will be used to aid divers in aligning the cable with the optimum route to avoid impacts to sensitive habitats. After the cable is resting on the seafloor, attached epifauna may be located beneath the cable. Divers, with knowledge of local benthic fauna, will be able to adjust the cable position up to approximately 0.3 m (1 ft) to remove the cable from resting on or avoid attached organisms and unpin erect soft coral or sponge specimens (i.e., *Plexaura sp., Pterogorgia sp.*, rope sponge).

The SWIV will stop as floats are removed and the cable sinks to the seafloor between two fixed points along the route. Each time the cable is secured to a seabed fixing by the divers, the SWIV cable vessel will be instructed to maneuver to the next holding position while laying/recovering the floating cable to ensure that excessive tension is not applied to the cable and also to maintain a safe separation distance from the diving and surface operations.

The securing of the cable at each seabed fixing location will prevent the cable from being pulled off the optimized route and ensure that sufficient slack is installed as required along the shore-end of the cable. Once the SWIV is secure in the next holding position, additional cable is laid out or recovered to enable the cable to be aligned and the cable floats are removed as the cable is secured at the next seabed fixing location.

Divers can normally support this activity out to approximately 25 m (82 ft) water depth with a horizontal positioning accuracy of +/- 10 m using commonly available GPS equipment.

The day of the shore-end connection to the main lay, the main lay vessel will move into position at or near the 35 m (115 ft) contour approximately 4.2 km (2.3 nm) from shore and pick up a buoy connected to the shore-end cable (prepared in advance by divers). A typical cable ship measures 140 m (459 ft) in length and drafts 8 m (26.2 ft) when fully weighted. The cable ship will set up and maintain position utilizing DP technologies, eliminating the need for anchors. The cable ship will be equipped with two bow and two stern enclosed 1,500 kw thrusters. The vessel is also equipped with one retractable thruster mounted in the hull which will not be utilized in shallow water. Both the bow and stern thrusters thrust in a horizontal plane, 50 m (164 ft) aft and 25 m (82 ft) to either side. Minimal turbulence (2 m [6.6 ft]) is created in a sideways and downward direction due to the efficient design of each thruster.

In total, the number and size of vessels involved in a typical shore-end operation is as follows:

- One shallow draught self-propelled barge, nominally 16 m in length;
- One zodiac/tender vessel, nominally 6-7 m in length;
- Two hard-boats, nominally 9 m in length;
- Three zodiacs/guard boats, nominally 5 m in length, not all needed at the same time; and
- One support tug, nominally 30 m in length - optional (only used if proven necessary).

In total, an estimated seven to eight vessels will be needed for the operation in addition to the SWIV; not all of these will necessarily be used at the same time.

2.4.4 *Post Landing Operations*

After the cable is placed on the seabed, the cable end, currently on the beach, will be installed in the BMH. Cable testing will be performed to ensure the cable is not damaged. The land cable team may then complete the beach joint – the transition between submarine cable and land cable. Articulated pipe and cable clamps will be fitted to the cable where required. Single sections of articulated pipe will be lowered by rope to the seabed under the control and instruction of the diver at each application location. Proposed locations for use of articulated pipe and cable clamps are provided in Section 2.2.2 and Figure 7.

This operation is expected to conclude by late morning. Excavators will then begin the beach burial, which will be to a minimum of 2 m (6.6 ft) below the surface or to hard ground, whichever comes first. The cable will be positioned in the bottom of the trench. The beach burial will extend from the seaward ducts of the BMH to near the waterline at low tide (Figure 13). As the trench approaches the low water mark, the trench depth will transition to approximately 2 m (6.6 ft) depth (i.e., the depth of cable burial offshore). The trench will be back-filled and the beach returned to its former condition. No sediments will be removed from the project area, nor will materials be introduced to the beach to fill the excavated area.

The length of proposed trench below the High Tide Mark toward the ocean is 19 m (62.3 ft), with the trench ending at the lowest astronomical tide (LAT) mark. The width of the trapezoidal trench is expected to be 5 m (16.4 ft) at the top and 1 m (3.3 ft) at the bottom. The volume of sand to be dredged for this portion of the trench is calculated as 114 m^3 (149.1 yd^3). This trench will be excavated and then backfilled with the same sand.

Table 3 provides the sand volume calculations for the portion of the trench located below the high tide line; the formula for the calculation of the area of a trapezoid is provided in Exhibit 2 of the JPA.

Table 3 ***Measurements of the Beach Trench below the High Tide Mark***

Length (L)	*Height (H)*	*Width (W_1)*	*Width (W_2)*	*Total Volume (m^3)*
62.3 ft	6.6 ft	16.4 ft	3.3 ft	149.1 yd^3

2.4.5 *Duration and Dimensions of Shore-end Activities*

The expected duration of the beach works and shore-end activities is approximately 20 to 24 days. All of the durations are dependent upon weather and swell conditions. An estimated breakdown of duration by activity is shown below.

Day 1-10: Install temporary and permanent seabed fixings.

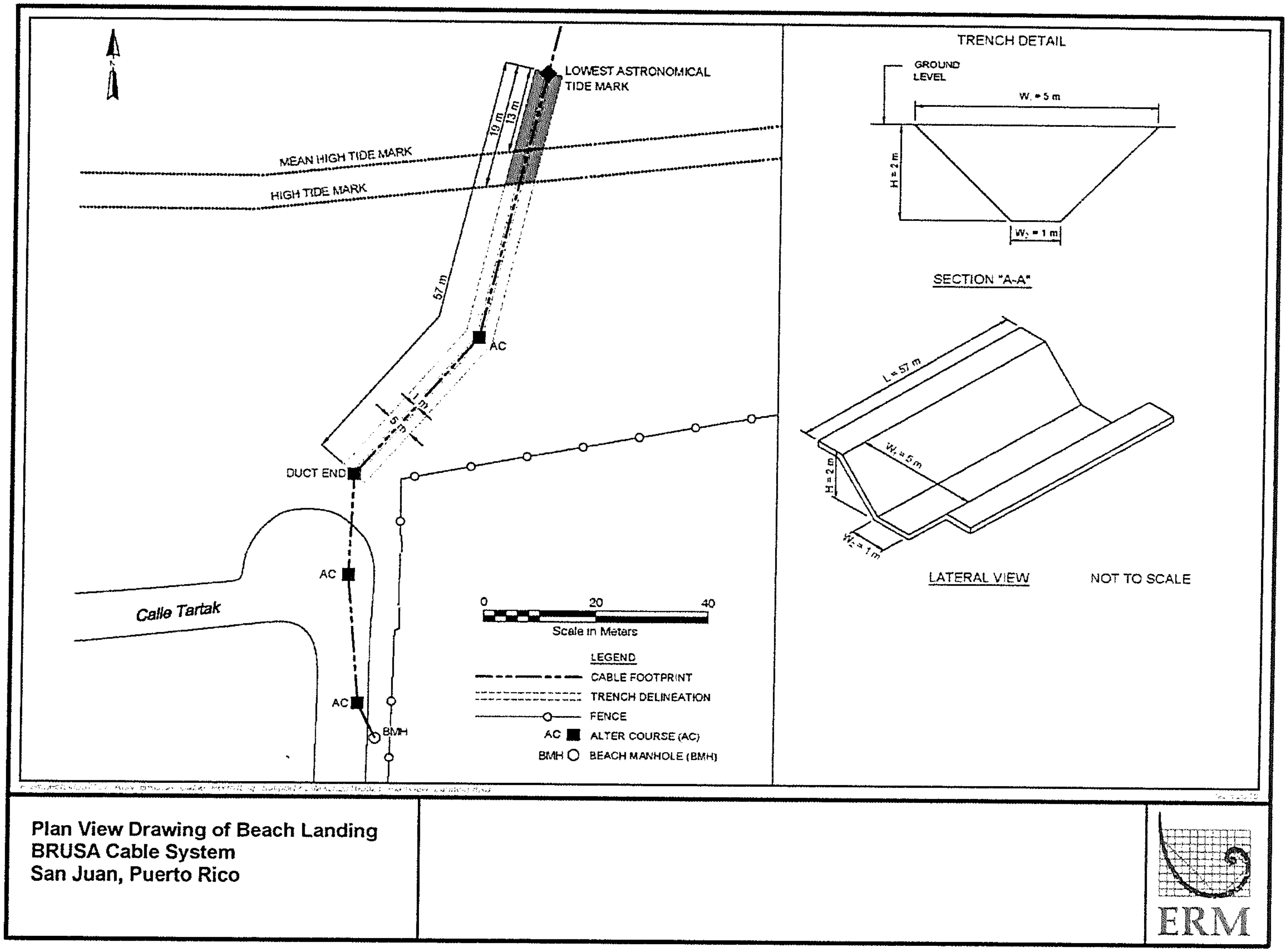
Day 10-17: Inshore cable lay from KP 4.200 to KP 0.300.

Day 18: Beach setup. Locate the BMH and excavate the ends of the ducts on the beach. Two excavators arrive on the site plus rigging equipment for shore-end landing. Prepare for shore-end landing (safety fencing and staging).

Day 19: Beach landing and post landing. The SWIV arrives at dawn at the 3.5 m depth contour and holds position. Cable pulled to shore, laid on seabed by divers, installed into BMH, and fitted with articulated pipe. Excavation and beach burial. Make beach joint at BMH.

Days 20-24: Contingency and restore site.

Figure 13 *Schematic of Excavation for Beach Burial*



2.5 AS-LAID ROUTE POSITION LIST

The as-laid route position list (RPL), available 4 weeks after installation, will provide additional A/C points that may have been required during installation to give an accurate track of cable on the seabed based on actual SWIV and main lay vessel movements during installation. For shore-end installation, the as-laid position after protection will be determined and recorded by divers. For main lay surface lay, the precise horizontal position of the main lay vessel and advanced cable lay software (MakaiLay® or a similar program) will predict where the cable will be on the seabed (see Section 2.3.4).

JOINT PERMIT APPLICATION
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Exhibit 2:

Sand Volume Calculations

EXHIBIT 2: SAND VOLUME CALCULATIONS

Beach Trench (Temporary Fill)

It is estimated that the trench at the beach will be about 57 meters (m) (87 feet [ft]) long, and the section of proposed trench that is below the mean high tide toward the ocean is 19 m (62.3 ft), with the trench ending at the lowest astronomical tide (LAT) mark. See Table 1 for estimated trench measurements.

Assuming that the cross section of the excavation is a trapezoidal area of 5 m (16.4 ft) wide at the surface, 1 m (3.3 ft) wide at the bottom, and 2 m (6.6 ft) deep, the cross-sectional area is 6 m^2 (7.8 yards $[yd]^3$) and the total excavation volume is approximately 342 m^3 (447.3 yd^3). The excavated volume of sand from the section of the trench below the high tide line to the ocean is approximately 114 m^3 (149.1yd ^{3}).

See Figure 1 for estimated total sand volume; and Figure 2 for the plan view drawing of the cable landing, including the mean high tide line and dimensions of the trench.

Table 1 ***Measurements of the Beach Trench – Total and Below the Mean High Tide Line***

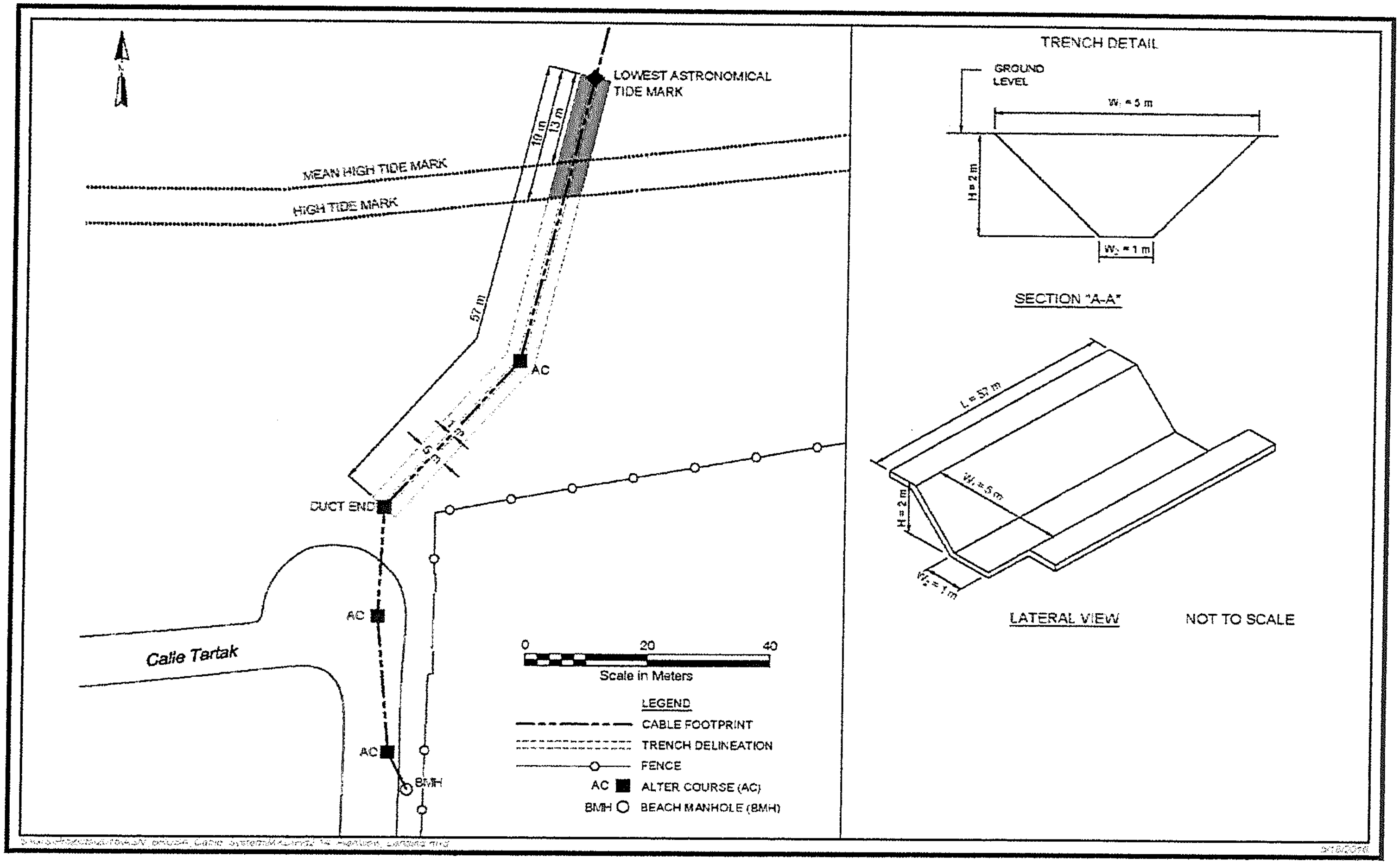
	Length (L)	*Height (H)*	*Width (W_1)*	*Width (W_2)*	*Total volume (m^3)*
Total	57 m	2 m	5 m	1 m	342 m^3
Below the Mean High Tide Line	19 m	2 m	5 m	1 m	114 m^3

The excavated material will be stored alongside the trench as it is dug and used to refill the trench upon completion. Once the trench has been excavated, the cable will be placed in the trench and articulated pipe will be installed around the cable. The trench will then be immediately re-filled with the excavated material. Sand will not be removed from the area, nor will additional fill material be required. The trench area will be restored to its original condition when the sand is returned to the trench. Refer to JPA Exhibit 3: Mitigation and Monitoring for additional detail on avoidance and management measures for beach excavation activities.

Figure 1 *Sand Volume Calculations*

Sand Volume Calculations
Volume (V) = Trapezoidal area (Length)
$V = (H)\left[\dfrac{W_1+W_2}{2}\right](L)$
$V = (2m)\left[\dfrac{5m+1m}{2}\right]57m$
$V = 342m^3$

Figure 2 Schematic of Excavation for Beach Burial



Sandbag Anchors

A sandbag anchor is a dead-weight anchor that provides the hold back capability needed for a shallow water installation vehicle (SWIV) and cable to hold position. Approximately 24 1.5 tonne sandbags would be proposed for this project, 18 of which will be used as temporary anchors for the SWIV and six as temporary hold-back anchors for the cable. By comparison, 90 concrete blocks would be required for this installation, and the footprint on the seabed would be 55% greater. Sandbag anchors were used in the recent installation of the AMX and PCCS cable systems in this project area.

The volume of sand required to fill 24 sandbags is estimated as 36 m^3 (47 yd^3), or 1.5 m^3 (2.0 yd^3) per sandbag. The sand would be collected from two areas located far away from sensitive benthic habitat and returned to the same location at the end of the installation exercise. Two areas have been proposed in order to minimize the travel distance of the sandbag anchors, and to avoid taking sandbag anchors across the reef gap. There will be no excavation or discharge of sand in the Isla Verde Reserve.

The proposed sand borrow locations are identified in Figure 3. The proposed offshore area is located in 12 meters sea water (msw) or (39.4 feet sea water [fsw]) and covers approximately 50 m L x 25 m W area (1,250 m^2 or 0.3 acres). The proposed in-shore area is located in 4 msw (13.1 fsw) and covers approximately 600 m L x 100 m W area (60,000 m^2 or 14.8 acres).

Proposed avoidance and management measures associated with the use, deployment, and recovery of sandbag anchors are detailed in Appendix A of JPA Exhibit 3: Mitigation and Monitoring. Key mitigation measures include:

- The sand used in the sandbags will be returned to the original source site.
- Filling, transportation, positioning, removal, and return of sand will be diver-assisted under supervision of the environmental monitor.
- Sand will be collected from two different sand borrow areas in order to decrease the travel distance of the sand anchor and to avoid crossing the reef gap.
- Sand will be discharged under slow controlled release to comply with turbidity standards. Divers will place the bag at the seafloor, make an

incision at the bottom, and hover it by means of diving lift bags while pushing the bag for even distribution.

- There will be no impact (0 m^2) to the substrate related to the suction dredging (to fill the bags) or from the disposal once bags are opened to discharge the sand. Sand will settle quickly to the seafloor after release.

Figure 3 Sand Borrow Areas

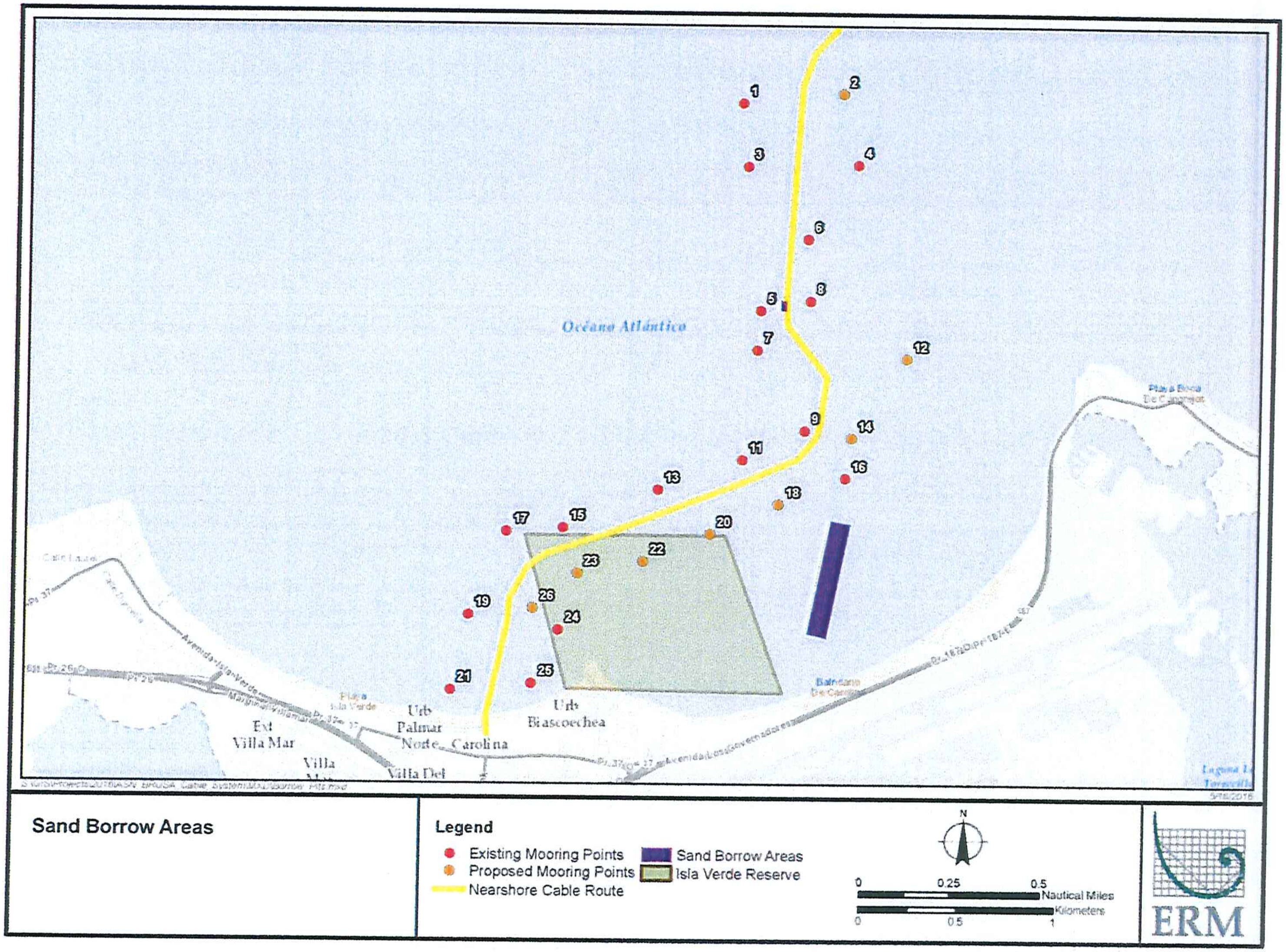


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Exhibit 3:

Mitigation and Monitoring

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1.0 *INTRODUCTION*

This mitigation and monitoring plan is submitted on behalf of Alcatel-Lucent Submarine Networks (ASN) for the proposed BRUSA Cable System Project (Project). A description of the Project is provided in the joint permit application (JPA) as Exhibit 1; and supporting studies are included in Exhibit 6.

This plan was developed based on prior experience in similar installations in the region and at the Project location, and using guidance to be compliant with the Fish and Wildlife Coordination Act, the Endangered Species Act, the U.S. Fish and Wildlife Service (USFWS) Mitigation Policy, the Magnuson-Stevens Fishery Conservation and Management Act, and the National Marine Fisheries Service (NMFS) for mitigating the potential adverse impacts to fish, wildlife, and their habitats due to water developments, and for the conservation of Essential Fish Habitats (EFH) as identified by the Caribbean Fishery Management Council.

The purpose of this mitigation and monitoring plan is to reduce the likelihood of damage to resources and to allow for planning for unavoidable impacts to resources during installation. Mitigation measures incorporated into the Project are described in this plan, as well as monitoring that will be conducted to assure the effectiveness of the measures.

This is a draft plan and will be finalized after permit conditions, if any, can be fully incorporated.

The remainder of the mitigation and monitoring plan is organized as follows:

- **Section 2.0:** Overview of Measures
- **Section 3.0:** Avoidance and Protective Measures
- **Section 4.0:** Monitoring
- **Section 5.0:** Reporting and Future Actions

2.0 OVERVIEW OF MEASURES

The BRUSA project team met with the U.S. Army Corps of Engineers (USACE) and local agencies in the early planning stage to discuss the Project and understand potential issues so that mitigation and minimization strategies could be incorporated at the planning stage. The mitigation plan also leverages the successful protective strategies used in the installation of the Pacific Caribbean Cable System (PCCS) in the same Project area in 2015. The Project includes a number of measures designed to avoid or reduce impacts to sensitive resources, summarized in Table 2.1.

Table 2.1 Overview of Avoidance and Protective Measures Incorporated into the Project

Project Element	Mitigation
Route Planning	• Cable route study to identify site-specific conditions • Cable route survey to investigate conditions further, adhering to international standards such as the International Cable Protection Committee (ICPC) recommendations • Specialist cable engineering and benthic surveys to identify options for fine tuning of the routes • Pre-application meetings to discuss the Project and identify concerns
Shore-end Installation Activities	• Avoidance of nesting seasons; turtle nest monitoring (if required) • Maximize use of existing infrastructure • Trained and experienced crews and divers • Detailed procedures, plan work, and daily reporting • Constant communication between ship and beach crew • Advance communication with agencies and local authorities • Site access control
Offshore Cable Installation Activities	• Maritime law and practices related to ship movements • Safe operating procedures • Trained crew and operators • Use of modern navigational equipment • Leaded line across hardbottom areas ahead of installation to be inspected by marine biologist • Safe operating procedures • Mammal and turtle avoidance protocol and trained crew on board • Vessel pollution prevention required by U.S. federal and international law

3.0 AVOIDANCE AND PROTECTIVE MEASURES

3.1 ROUTE PLANNING

The BRUSA cable route was developed at an early stage of the Project and refined through several subsequent phases of investigation in order to minimize impacts to coral and other benthic species, while meeting engineering standards and requirements for the safe installation and operation of the cable. The two main development stages include the Cable Route Study, comprised of a detailed desktop review; and the Marine Survey, comprised of the collection of bathymetric and other seabed data along the inshore and deep-water sections of the route.

In addition to the two main surveys associated with route development, a benthic habitat survey was conducted for the nearshore area with the objective of avoiding and minimizing impacts to hardbottom communities to the maximum extent practicable. This survey was undertaken concurrently with a survey conducted by the installer to ascertain that the route recommended by the marine biologist was safe and practicable from a cable installation perspective. The resulting routes avoid corals to the extent feasible and maximize routing in soft bottom areas. Based on the survey findings and familiarity with the area, the cable route was developed to minimize rock contact.

The BRUSA cable system will be landing at the Tartak Street landing site in Carolina Municipality, Puerto Rico, an area already used by a number of other submarine cable systems. This location will also enable the Project to connect to existing infrastructure onshore. This will reduce disruption to beach resources and activities, and is consistent with existing uses of the landing location.

3.2 BEACH/SHORE ACTIVITIES

Protective measures for the beach landing area include:

- Avoidance of turtle nesting season if feasible; if not, turtle monitoring will be implemented prior to the installation;
- Use of trained crews who will be informed of permit conditions and protective measures;

- Communications, including advance communication with agencies and local authorities;
- Site access control for public safety; and
- Site restoration after installation is complete.

Turtle Monitoring. If needed, turtle nest monitoring will be conducted 1 week before any beach operations commence, to be adjusted seasonally as necessary. Turtle monitoring will also be carried out during installation where the beach is going to be excavated for the cable to be installed. The purpose is to confirm the absence of turtles in the beach area before and during installation. Monitoring will also take place in the water for the turtles. The installation vessels are slow moving and incorporate mammal and turtle avoidance protocols during operations.

Beach Crew and Communication. The installation team is an experienced team familiar with the technical activity and local setting. They will have the requirements and the crews will be made aware of them. The monitors will provide a briefing to the crews before activity begins to assure that the measures will be implemented. Notifications will be made as required and appropriate to agencies and local authorities in advance of the beach work.

Public Safety. The work area will be cordoned off, and site access will be controlled for public safety.

Site Restoration. When installation is complete, the beach and surrounding work area will be restored to its prior condition. Equipment and materials will be removed, as well as any debris from the installation.

3.3 *NEARSHORE ACTIVITIES*

The installer for the Tartak Street landing has been selected because of the team's experience installing cables locally in Puerto Rico and in other areas of the world where there are sensitive resources on the seabed that require protection.

Installation by the shore-end vessel and mainlay ship will only occur:

- During safe operating conditions;
- With trained crew and staff;
- Within safe operating procedures both offshore and on the beach;

- In accordance with the navigational and notification requirements to other marine vessels;
- In accordance with vessel pollution control protocol; and
- In accordance with the National Oceanic and Atmospheric Administration's (NOAA's) marine mammal and turtle vessel strike avoidance protocol.

Based on the benthic survey findings along the BRUSA cable route, no listed coral species will be impacted during the installation; this is due to both the absence of colonies along the route, and diver-assisted cable lay in sensitive habitats or where colonies are near to (within 1 meter [m]) the route. As described in more detail in Exhibit 6, Attachment 1: Benthic Survey and in Section 3.1, route refinement has been used to select a route that crosses soft bottom areas to the extent possible.

As a protective measure and means of installing the cable along the planned and engineered route, divers will install a weighted/leaded line to mark the intended position of the cable along the final route position list (RPL). This pre-installation step will allow the engineering team and marine biologist to position the cable away from any protected species within the vicinity of the route. The weighted line method has been used previously and is an accurate way of installing a cable in shallow waters. Buoys will be used as markers along the weighted line to guide the installation route from the surface. The process of marking the route will be photographed by monitors.

The cable flexibility is limited, but allows for enough lateral movement during installation to avoid corals. The installation team will be educated concerning the chosen routes and corals that must be avoided. The cable will be initially floating before it is carefully and slowly guided to the bottom by divers. The biological monitoring team (BMT) will guide the cable away from sensitive areas. A qualified marine biologist designated as the environmental monitor (EM) will lead the BMT. The weighted line will be removed after the cable is installed.

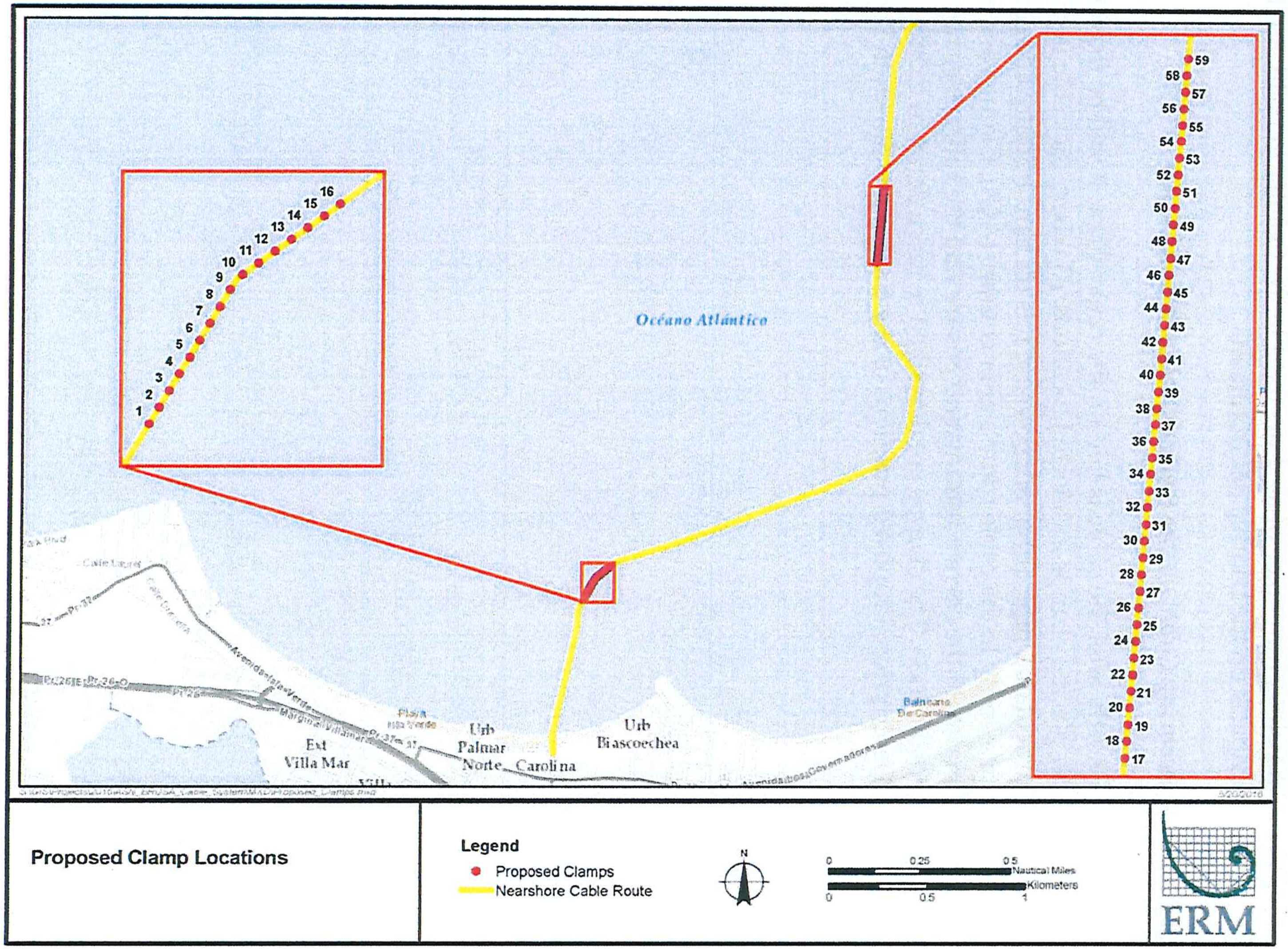
3.3.1 *Measures Specific to the Separate Shore-End Approach*

A separate shore-end method will be used for the installation at the Tartak Street landing due to the shallow water depths in the approach to the beach and the need to use a shallow water installation vessel (SWIV) to position the cable carefully near corals. Because the water is shallow in this area, the SWIV will be temporarily moored to the seabed using sandbag anchors. These anchors or "mooring points" and the procedures for preparing them are discussed in more detail in Exhibit 1: Project Description and in Appendix A of this exhibit. Benthic surveys were conducted to identify mooring point locations that are located on soft bottom to the extent possible; the choice of anchors used in the installation will aim to minimize impacts on the benthic environment.

3.3.2 *Securing Cable on the Seabed (Selected Locations)*

Shortly after the cable is laid on the ocean floor, it will be fixed to the seabed by placing clamps in selected locations: (i) where the cable is protected by articulated pipe; (ii) in areas where it is on hard bottom; and (iii) in proximity to the cable route's alter courses (ACs). Clamps are used to maintain the correct routing and ensure that the cable does not move during installation. The clamps are described in more detail in Exhibit 1: Project Description. Proposed positions of the clamps are shown in Figure 3.1 below.

Figure 3.1 Proposed Clamp Locations



3.4 OFFSHORE ACTIVITIES

Due to the nature and depth of the selected route for the BRUSA system, the sea cable will be placed directly from the ship to the bottom without need for burial. The vessel will make use of modern navigational equipment, such as the advanced cable lay software, MakaiLay, which predicts where the cable will be on the seabed to ensure an accurate position and stay away from sensitive areas. The BRUSA cable will be aligned in the corridors already in use by other submarine cable systems.

3.4.1 Avoidance Measures for Mesophotic Corals

Mesophotic Coral Ecosystems (MCEs) extend from 30 m (100 feet [ft]) to greater than 100 m (330 ft) and are characterized by the low availability of light for photosynthesis and the presence of corals, sponges, and algae as the dominant structural components[1].

There are seven coral species located in the Atlantic and Caribbean that have been listed as threatened under the Endangered Species Act (ESA). These species are listed in Table 3.1; a number of these species can be considered mesophotic corals and are found in water depths of up to 90 m deep. *Orbicella franksi* has been observed in the cable corridor.

Table 3.1 ESA Listed Coral Species Potentially in the Action Area

Scientific Name	Common Name	ESA Status	Typical Water Depth
Acropora cervicornis	Staghorn coral	T	5 – 30 m
Acropora palmata	Elkhorn coral	T	1 – 5 m
Dendrogyra cylindrus	Pillar coral	T	1 – 25 m depth
Mycetophyllia ferox	Rough cactus coral	T	5 – 90 m depth
Orbicella annularis	Lobed star coral	T	0.5 – 20 m depth
Orbicella faveolata	Mountainous star coral	T	0.5 – 90 m depth
Orbicella franksi	Knobby/Boulder star coral	T	5 – 90 m depth

Source: NOAA National Marine Fisheries Service. 2016. Draft Information Basis and Impact Considerations of Critical Habitat Designation for Threatened Caribbean Corals

[1] Caribbean Coral Reef Institute (CCRI), Puerto Rico. Mesophotic Coral Ecosystems. http://ccri.uprm.edu/media/Mesophotic_Web_page/mesophotic.html

The cable will be generally placed to avoid areas of dense coral, and will follow the route of previous cables (American Movil Submarine Cable System [AMX] and PCCS) through this area. However, the avoidance measures that will be implemented for shallow water are not feasible in the mesophotic zone due to depth limitations (i.e., no diving possible).

4.0 MONITORING

4.1 IN-WATER MONITORING BEFORE INSTALLATION

The EM will be on site during the installation to advise on final siting decisions concerning where anchors are to be placed, for the shore-end installation barge and also the temporary and permanent fixtures for the cable itself. The EM will also be on hand to determine the positioning of the weighted line.

Prior to the start of installation, the EM will swim the cable route with the installer, and the weighed line will be placed on the route. If required, fine tuning of the route will be agreed by the EM and the installer to avoid or determine which corals will be permanently impacted. The EM shall confirm that the cable route and an area 1 m either side of the cable route is devoid of listed corals. No corals will be relocated at this stage.

Special consideration will be taken to avoid the listed coral species if they are present along the route. All listed species will be avoided through route planning.

4.2 IN-WATER MONITORING DURING INSTALLATION

The EM will be on site to observe the installation and ensure that the cable is being installed as close to the agreed route as possible. The cable shall be moved off corals and sponges and any fragmented or dislodged corals shall be reattached to the substrate. Organisms that cannot be avoided by the cable alignment shall be relocated to areas adjoining the project corridor to the extent possible, unless the EM determines that such relocation is likely to cause increased damage to resources. Organisms to be relocated will be photographed prior to and after relocation, and the photographs will be made available to the USACE as part of the environmental monitoring report (see Section 5.0 of this plan).

4.3 IN-WATER MONITORING POST-INSTALLATION

Immediately after the cable is installed, the corridor and anchor points will be inspected by a biological monitoring team to assess the direct impact of the cable and the related laying activities. The inspection will occur in water depths of up to 30 m and will proceed from offshore towards the shore. The biological team will free any pinched gorgonians found under the cable by releasing the soft coral back into the water column. If a hard coral is found under the cable or in contact with the cable, the cable will be moved to the side on a coral-free surface. Impacts, if any, to hard corals and gorgonians will be documented by taking in situ notes and by photographing the cable during the inspection.

The principal monitoring investigator and BMT will swim along the cable to gather the corresponding data. The data to be gathered will include cable condition, species identification, and condition, as evidenced by photography and in situ annotations, and location along the cable. The divers will perform the survey observing organisms within 1.0 m to either side of the cable (i.e., 2 m total width), and describing the substrate features. The survey will start at the deepest cable section within safe diving limits (30 m/98 ft), up to the closest point to shoreline where there is benthic cover.

The assessment will focus on major dominant species inhabiting the study area. The organisms will be identified in situ at the lowest possible taxon and recorded into four major categories: macro algae, seagrasses, macro invertebrates (e.g., sponges, hard and soft corals, other macro invertebrates) and fishes. The substrate composition and cover by major biological components will be estimated as low (0-25%), medium (25-50%), high (50-75%), and very high (75-100%). For this, 1 m^2 quadrats will be used judgmentally, particularly in areas that are within the critical habitat definition.

The Project has been designed to avoid corals and to reduce potential contact with resources throughout the installation, and the activities are not expected to break or dislodge coral. The EM shall have the necessary tools available to fix corals in the event that any become detached from the bottom during installation. If this is required, the tagging and mapping of the reattached biota will be documented to allow ease of monitoring. As contingency mitigation, the biological team will restore (i.e., rehabilitate) hard coral or soft coral to the maximum extent possible. Stranded, dislodged, fractured, or split coral will be replanted, transplanted, repaired, and/or fixed back onto the bottom. The methodology used for restoration will be the most practicable for each species. The extent of the damages will be documented during the post-installation monitoring.

4.4 *WATER QUALITY MONITORING*

Water quality monitoring may be required as part of the Water Quality Certificate. Specific requirements, if any, will be included in the final Monitoring Plan.

5.0 *REPORTING AND FUTURE ACTIONS*

5.1 *DOCUMENTATION*

Installation and monitoring activity will be documented and provided to USACE in accordance with permit conditions (to be determined by the USACE). This is expected to include:

- A report compiling the results of the placement of the weighted line;
- Noteworthy events occurring during installation;
- Findings of the post installation monitoring dive; and
- Details of any injury to corals or relocated corals (including position of injury, determination and position of relocation).

The report will contain details of any impacts to the surrounding coral reefs and hardbottom areas, and the general condition of the surrounding areas after the deployment. The report will also describe details of mitigation performed to rehabilitate, relocate, and/or restore all coral that was impacted as a consequence of installation.

5.2 *FUTURE ACTIONS*

Future actions will be determined by permit conditions and the documented findings of the installation.

Compensatory mitigation may be provided for impacts to hardbottom communities (hard corals, gorgonians, sponges) as needed during the immediate post-deployment dive survey. Based on the results of the 1-year post-deployment monitoring, compensatory mitigation will be provided, if required, in the form of habitat replacement such as an artificial reef in a ratio to be determined in consultation with the USACE and NMFS. As needed, a detailed compensatory mitigation plan will be provided and include a description of the proposed location, amount, and monitoring of the artificial reef.

APPENDIX A: PROTECTIVE MEASURES RELATED TO SANDBAG ANCHORS

Sandbag anchors will be constructed from polypropylene impermeable "flexible intermediate bulk containers" (FIBC or bulk bags) to be filled with sand from identified borrow areas to anchor the SWIV and temporarily hold back the cable in the nearshore. There are two proposed locations for sourcing sand. The first site is a sand plain previously approved by NMFS, centered at position 18° 27.030'N / 066° 00.283'W. The benthic habitat at the proposed sand source area was characterized during the baseline survey of the marine biological benthic resources. The rectangle shaped sandy flat (600 m L x 100 m W, oriented NNE-SSW in the longest axis) sits in 12-14 ft depth and is devoid of biota. The second sand-borrow area is located at 18 27.804 N, 66 00.410 W and sites in 39-42 ft water. The second sand sourcing location was survey by the benthic diver and is characterized as having larger course clean sand. These areas do not qualify as coral critical habitat or EFH. There are no colonized grounds within a reasonable distance from the site. The habitat of the lagoon is depicted as "unknown" in the maps of NOAA Benthic Habitats of Puerto Rico and the U.S. Virgin Islands.

Filling, transportation, positioning, removal, and return of sand will be diver-assisted under supervision of the EM. The logistics and environmental basis of using sand filled bags (i.e., sandbags) is that they are easy to fill in the field, transportation is achieved by means of a small boat (~25 ft), and there is no need to preset all anchors at a time. Only 24 bags will be used and rotated/relocated as the cable deployment progresses. This type of anchor suits all substrates.

The dredging and disposition of sand to fill the bags will not impact sea turtles. The 4-inch diameter opening of the suctioning duct will be fitted with ½-inch mesh wire and a diver will keep the opening below the sand-water interface to avoid any intrusion other than sand. The pump to collect the sand is a low-pressure ventury-type pump. There are no moving parts (e.g., impeller) to produce suction. Staff in the working boat will shut-off the pump if a turtle is observed near the area.

Marine substrate colonized by coral and other sessile benthic organisms is located beyond a 500 m arc from the provided geographical position to collect sand. Designated travel corridors will be used to transport the sandbags, so that in the event of a sand leakage or droppage incident, the bag and/or its contents will not harm the underlying benthos. Surveyed corridors used during previous installations will be used.

The cable installer has suggested the option of double-bagging and to install individual rope lines distributing the pulling force on the bag. Both measures shall assure the bag will not break, which could result in sand leaks over colonized hardbottom. Sandbags on hardbottom will be located where there is adequate bare substrate to allow for a safety margin from coral colonies. Those sites were characterized during a benthic survey performed specifically for the anchor points. The weight and mass of a sandbag is as stable as a concrete sinker used for a U.S. Coast Guard buoy. Sand will not be released from the sea surface, neither near nor on coral grounds. The collection and release of sand at the selected location and the use of sandbags at selected anchor points will prevent impacts to corals.

To release the sand, bags will be returned to the original source site. Sand will be discharged under slow controlled release to comply with turbidity standards. Divers will place the bag at the sea floor, make an incision at the bottom, and hover it by means of diving lift bags while pushing the bag for even distribution. There will be no impact (0 m^2) to the substrate related to the suction dredging in order to fill the bags or to the disposal once bags are opened to return the sand. Sand will settle quickly after release.

Figure A.1 ***Coarse sand area in backreef at the proposed sand extraction site***

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Exhibit 4:

Drawings and Charts

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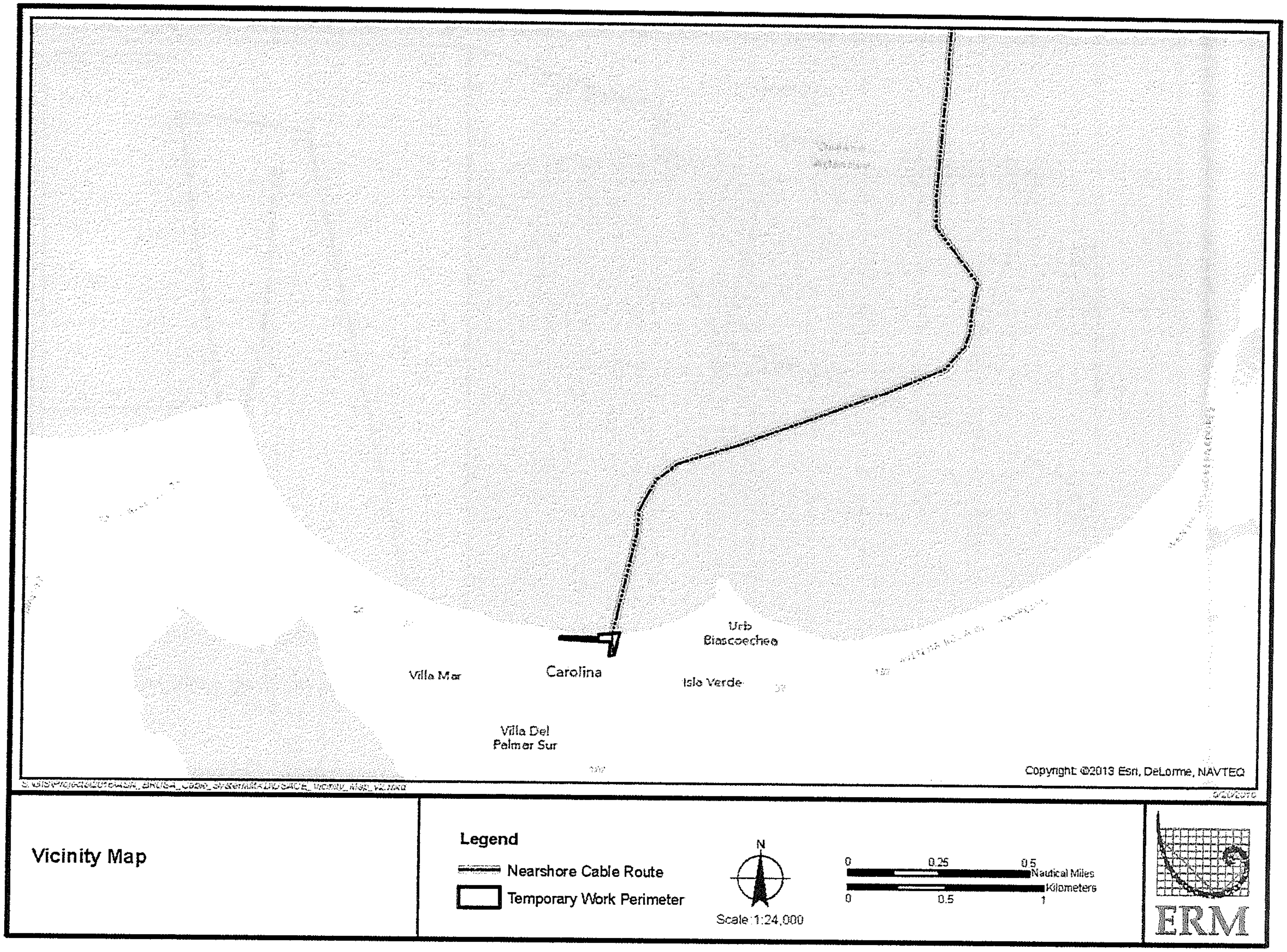


Figure 2 *Plan View - Overview*

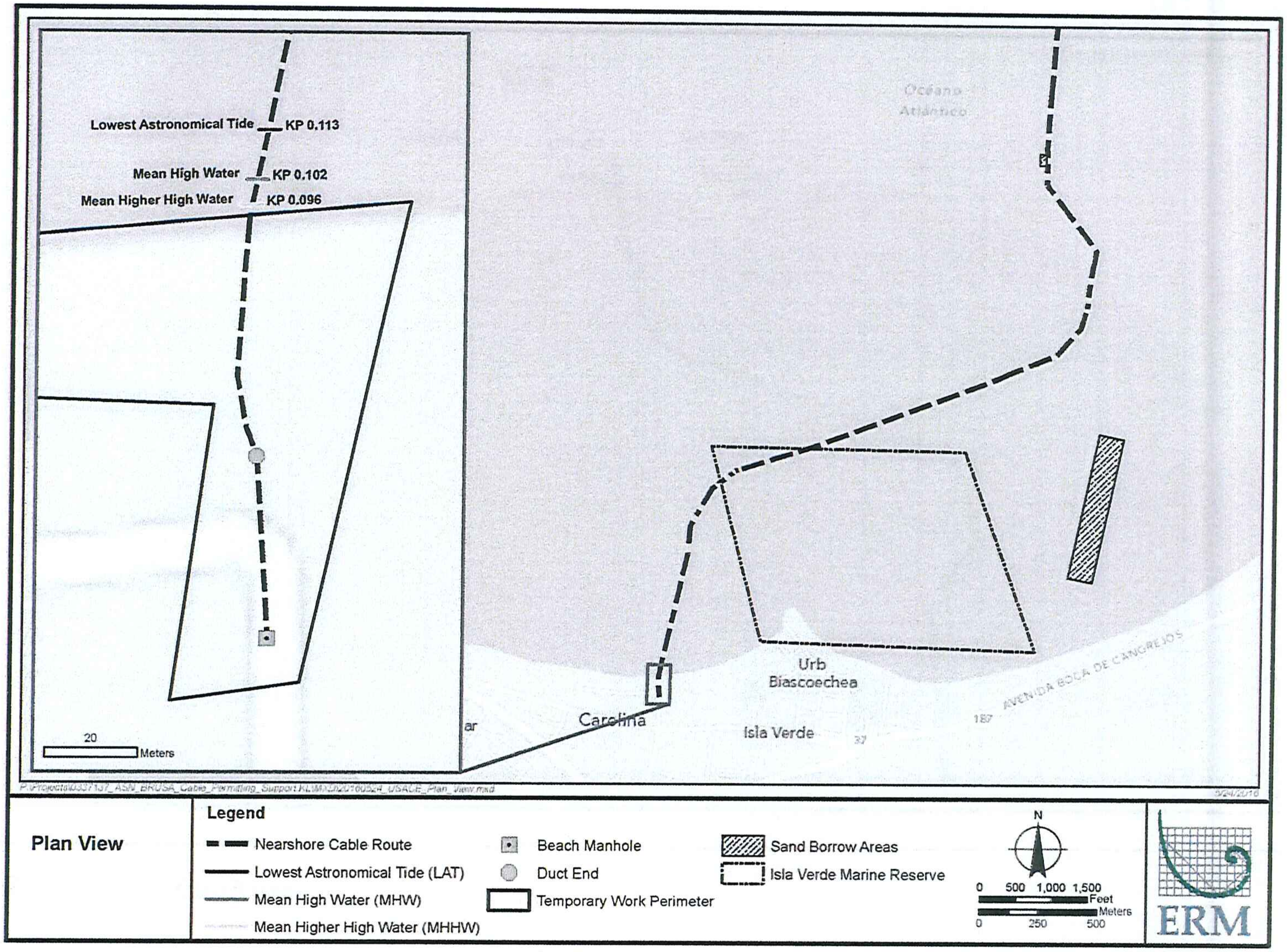


Figure 3 ***Plan View – San Juan Landing Area (Detail)***

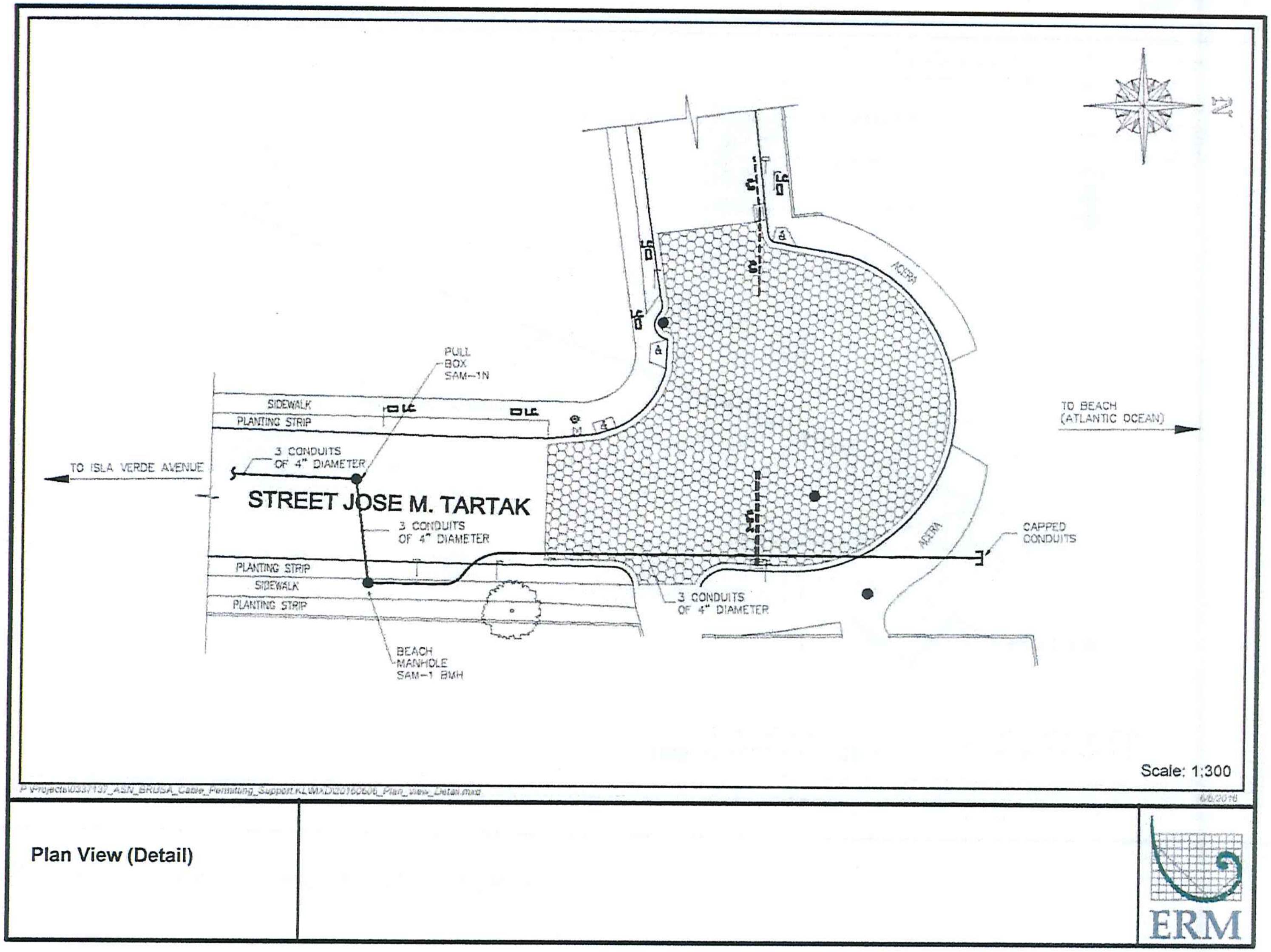
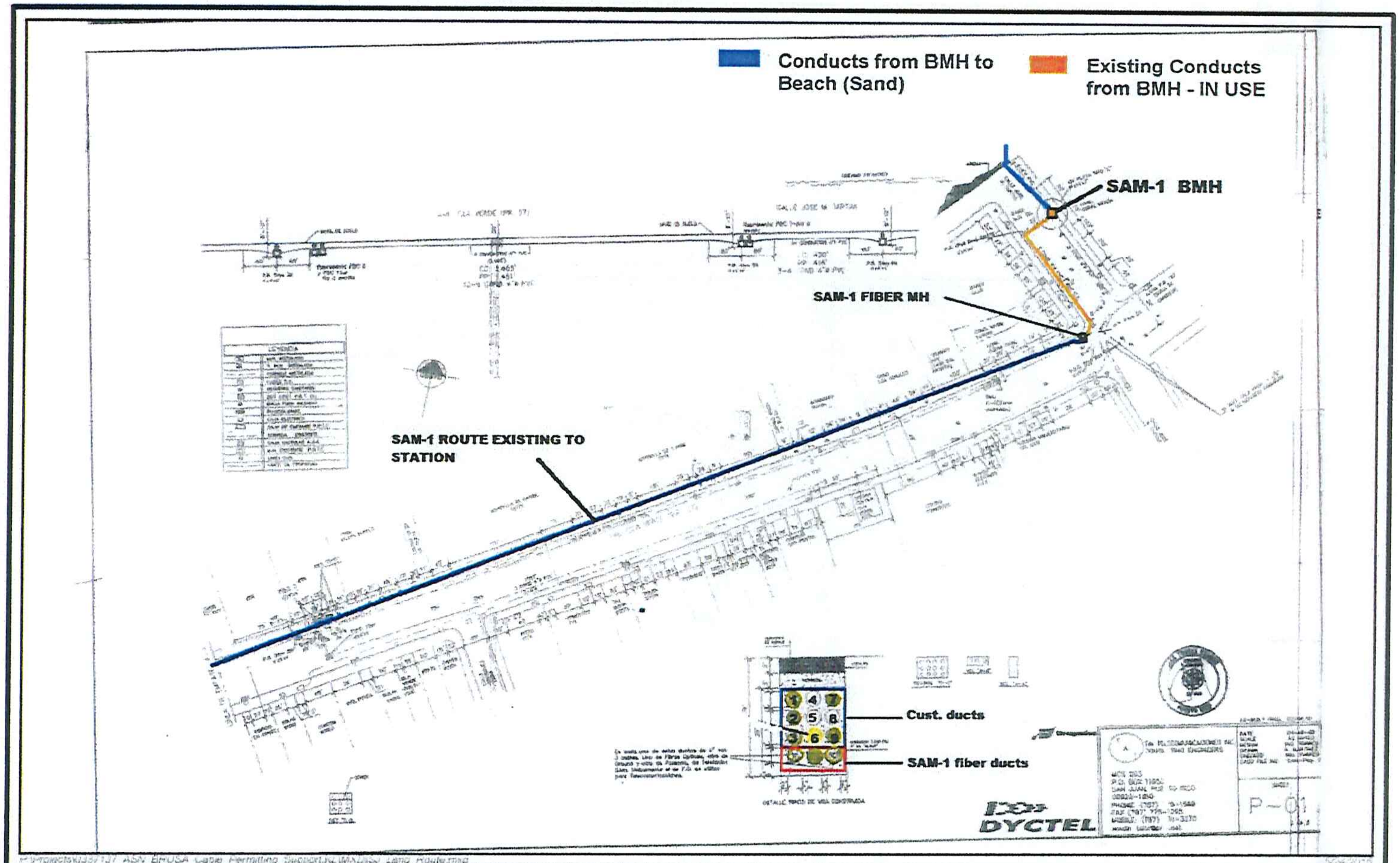
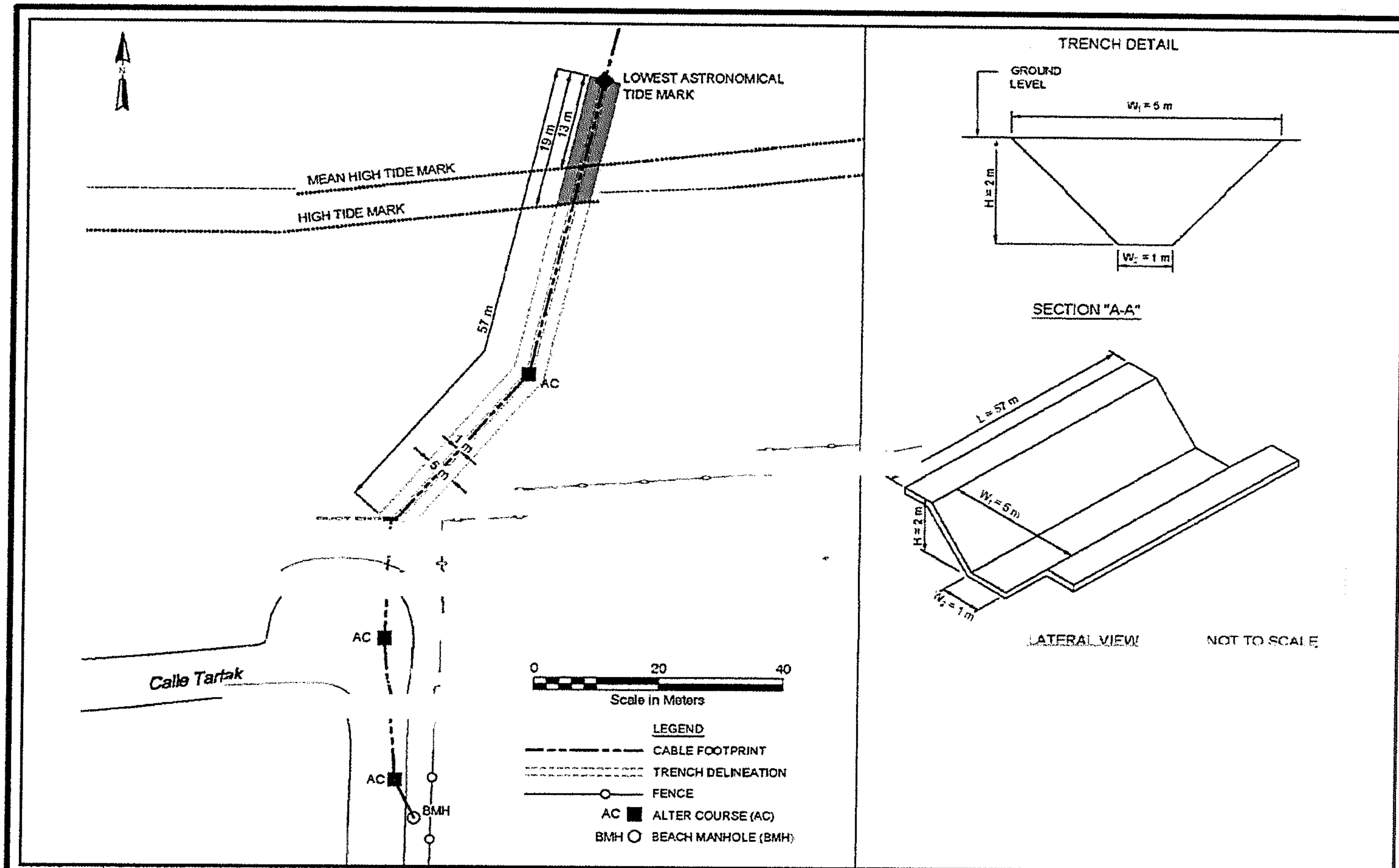


Figure 4 *Plan View – San Juan Land Route*



San Juan Land Route

Figure 5 *Cross Section View*



Cross Section View

Figure 6 *Photo of Existing Ducts at Tartak Beach Location*

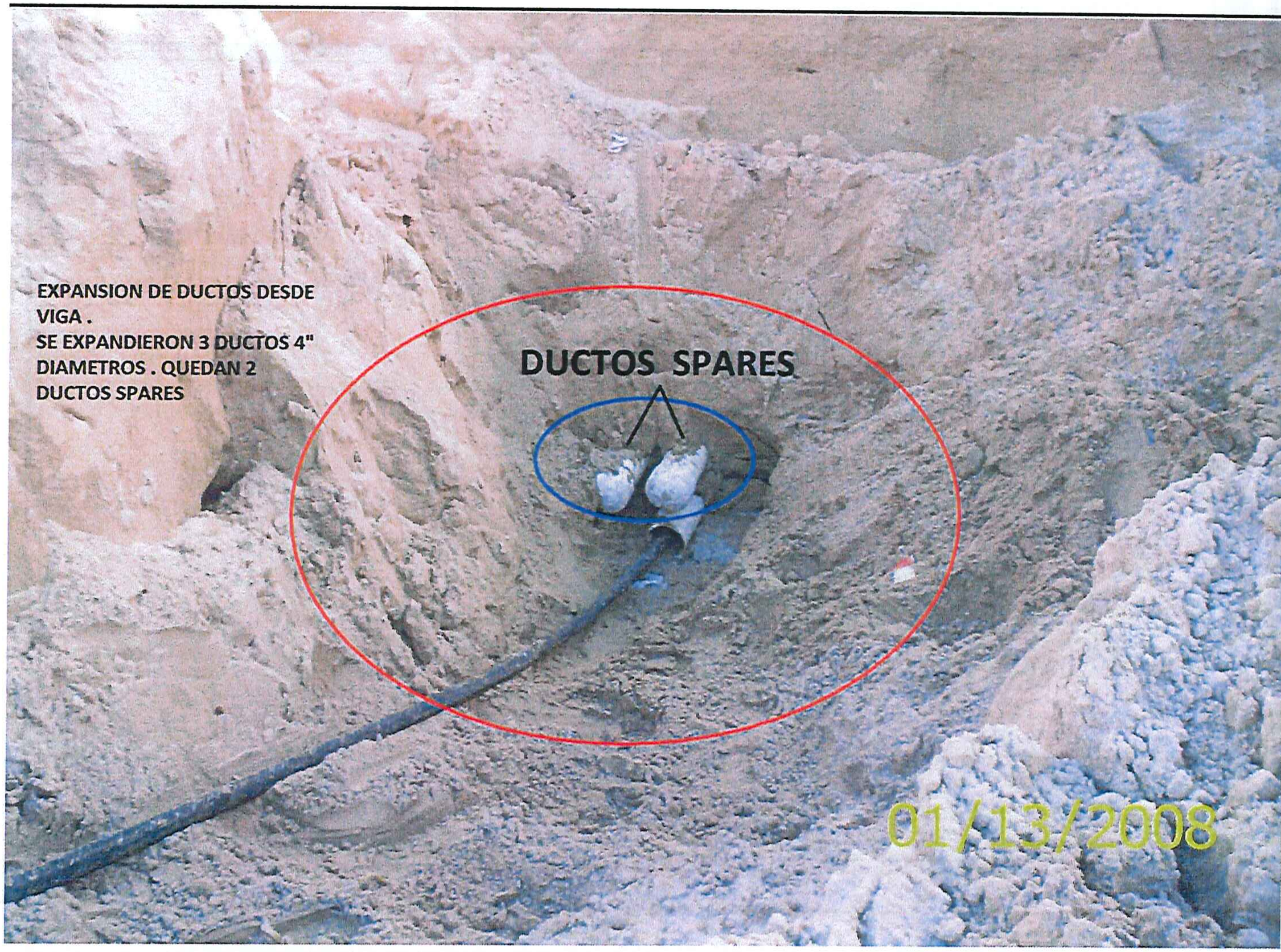


Figure 7 *Seabed Characteristics along Near-Shore Route*

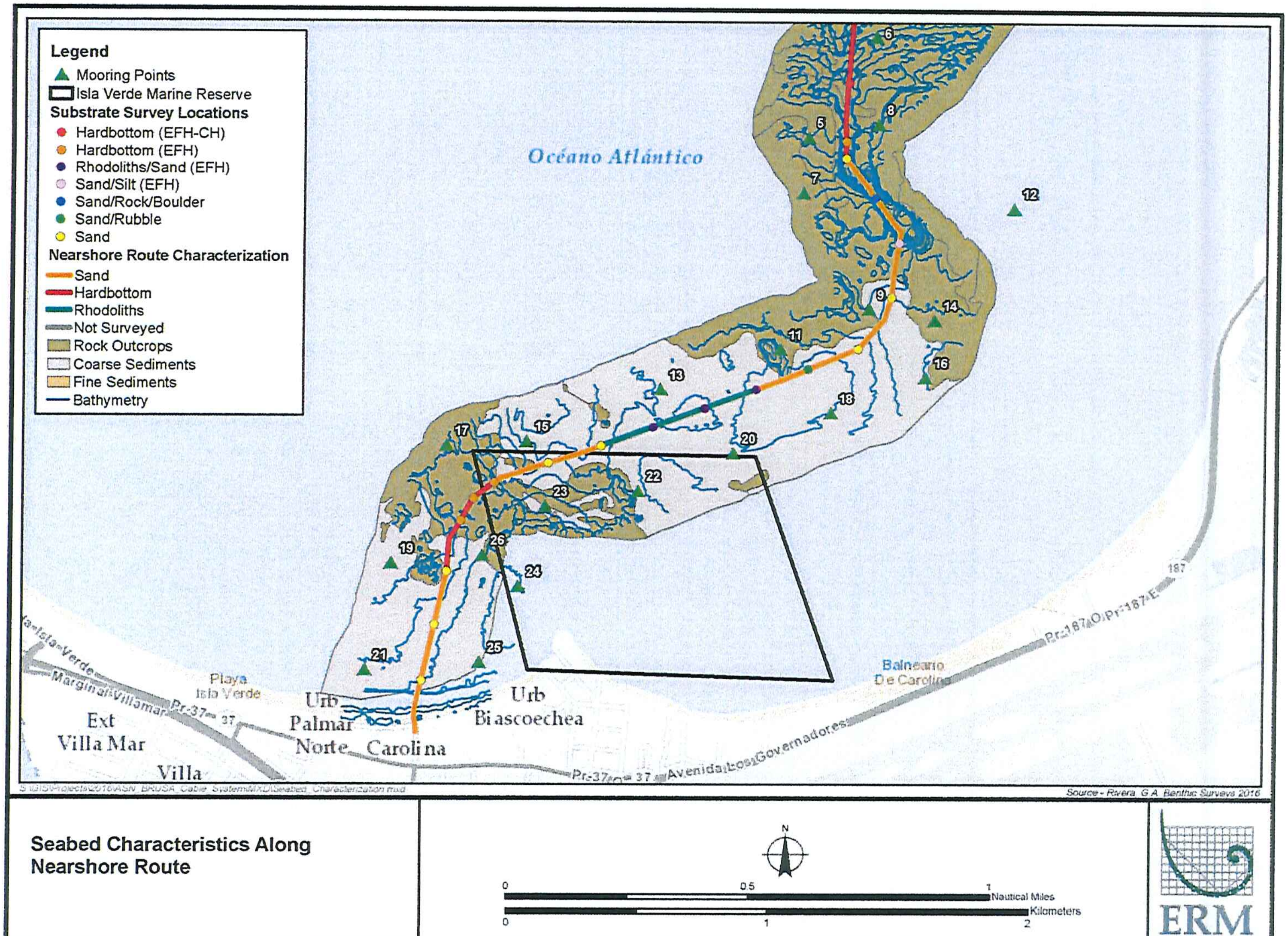


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Exhibit 5:

Environmental Supplement

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LIST OF ACRONYMS

AMX	American Movil Submarine Cable System
ASN	Alcatel-Lucent Submarine Networks
BMH	Beach manhole
CFMC	Caribbean Fishery Management Council
CPV	Colonized pavement
dB	Decibels
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EM	Environmental monitor
ESA	Endangered Species Act
FMP	Fishery Management Plan
GDP	Gross Domestic Product
HAPC	Habitat Areas of Particular Concern
km	Kilometer
m	Meter
MPAs	Marine protected areas
nm	Nautical mile
NINWR	Navassa Island National Wildlife Refuge
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
PCCS	Pacific Caribbean Cable System
PRF	Patch reefs
ROV	Remotely operated vehicle
SND	Sandy bottom
SWS	Sand with scattered rocks
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USVI	U.S. Virgin Islands

1.0 INTRODUCTION

Alcatel-Lucent Submarine Networks (ASN) has been contracted by the submarine cable owners, TI Wholesale Services Puerto Rico Inc. (TIWS PR), to design, engineer, manufacture, and install the 11,300 kilometer (km) BRUSA cable system. The proposed activity consists of the marine deployment, landing, and inland installation of a fiber optical cable for international communication. The planned cable route will consist of four landings, two in the United States (Virginia Beach and Puerto Rico) and two in Brazil (Rio de Janeiro and Fortaleza).

This document focuses on the landing in San Juan, Puerto Rico, and presents information on the potential environmental impacts of the proposed action described in Section 2.0. The project is described in full in Exhibit 1 of this application; charts and figures can be found in Exhibit 4. Protective measures are described in Exhibit 3 of this application.

This Environmental Supplement provides baseline information, as well as an assessment of likely effects of the project. It is organized into the following sections:

Section 1.0: Introduction

Section 2.0: Affected Environment

Section 3.0: Environmental Consequences

Section 4.0: Minimization and Mitigation Measures

2.0 AFFECTED ENVIRONMENT

This section describes the setting of and resources found within the project area. The upland portion of the project extends from the water up the beach to the beach manhole (BMH). The marine portion extends from the beach offshore to the boundary of the territorial sea (12 nautical miles [nm] offshore).

2.1 GEOLOGY

The landing site is a sandy beach, terminating at the BMH, which is in a paved, public street.

The Puerto Rico limestone (carbonate) platform accumulated in the northern coastal area during the middle Oligocene to early Pliocene (about 30 to 5 million years before present). This carbonate platform has risen in the subduction zone of the Caribbean and North America tectonic plates.

The resulting geology is a narrow strip of carbonate platform falling sharply in the Puerto Rico Trench. The trench is 800 km (500 miles) long and has a maximum depth of 8,800 meters (m) (28,232 feet) at the deepest point, the deepest in the Atlantic Ocean.

The insular shelf along the north coast of Puerto Rico is relatively narrow, in some places less than 3.2 nm, and deep waters over 30 m (~100 feet) are relatively close to the coast. The coast is fully exposed to the high energy of the Atlantic with swells usually greater than 5 feet between the fall and spring and prominently in the winter.

The seafloor descends gradually to about 3.5 – 9 m (12 to 30 feet). This narrow band is populated by platform carbonate outcrops and coral reefs. Then, at about 1.5 nm the bottom drops dramatically to about 30 fathoms (180 m) and continues descending toward the Puerto Rico Trench.

There are peaks that arise as small rocky islets. Most of the beaches in the area consist of fine sand deposits covering a low rocky beach.

According to the geological map of San Juan Quadrangle the project area comprises three geological units: beach deposits, silica sand, and artificial fill. The sand deposits are composed of grains of quartz, volcanic rock, and shells. The formation of silica sand is composed of pure sand leached from ferruginous material. The artificial fill consists of sand, limestone, and volcanic rock. This fill can be found in some valleys and swamps, and is part of the Bay of San Juan.

The topography of the Isla Verde area is relatively flat and coastal. Soils include beaches and areas susceptible to storm surges, erosion, and sand accumulation.

2.2 *SURFACE WATERS*

The Puerto Rico Water Quality Standards classifies coastal waters as Class SB saline surface waters (coastal and estuarine bodies) designated for primary and secondary contact recreation, fishing, and for the propagation and preservation of desirable species. This designation sets limits for dissolved oxygen, coliforms, pH, color, turbidity, substances that cause bad odor or taste, sulfates, and methylene blue active substances (surfactants).

2.3 *BIOLOGICAL RESOURCES*

2.3.1 *Habitat Types in the Project Area*

Habitat types in the Project area include marine water column, seafloor habitat consisting of soft bottoms and hardbottoms, and shoreline/sandy beach.

2.3.1.1 *Beach*

The planned landing point is the Isla Verde beach headwall at the end of Tartak Street, Carolina, Puerto Rico. This beach is the same used by several other existing submarine cable systems, including Pacific Caribbean Cable System (PCCS), the Americas Region Caribbean Ring System (ARCOS-1), Taino-Caribe, South America-1 (SAm-1), and the St. Maarten Puerto Rico-1 (SMPR-1) cable systems. Most beaches on this side of the island consist of thin deposits of sand covering a rocky lower foreshore. The environment at the landing site consists of a narrow strip of sandy beach along an urban coastline characterized by heavy development (primarily beach front hotels). Despite the presence of the dense upland built environment and heavy human use, the beaches in the area still provide nesting habitat for sea turtles, and roosting habitat for seabirds and shorebirds.

2.3.1.2 *Marine Environment*

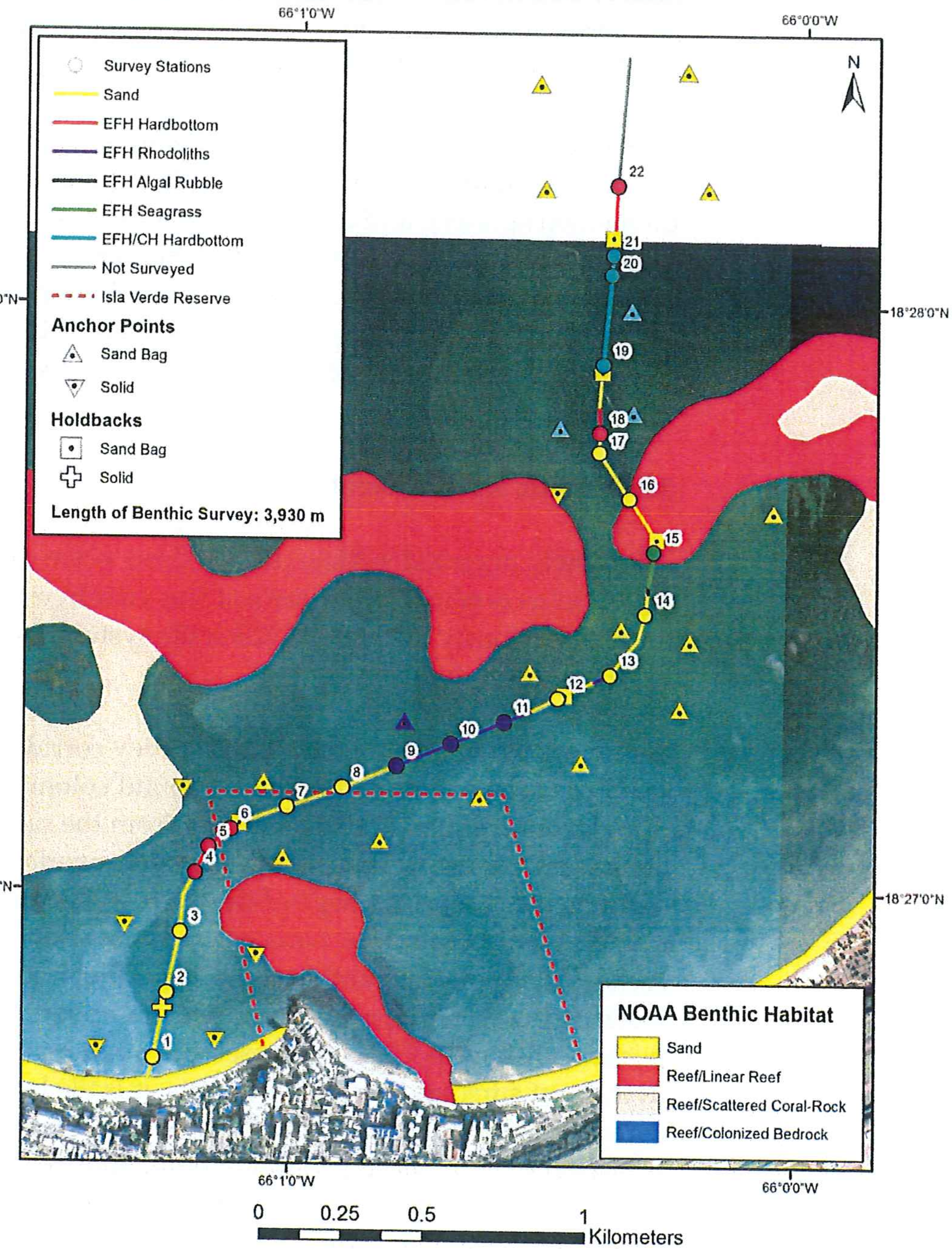
Nearshore Marine Environment

Longshore currents move material westward along the coast, which, combined with the strong bottom surge, removes the unconsolidated sediments and exposes the flat bottom relief (Pickard and Emery 1990). Wave action removes suitable substrate for algal growth in the sandy areas and limits the settlement of seagrasses and coral species. The dominance of plate and encrusting coral species is an indication of the high energy level in the area, characteristic of the north coast of Puerto Rico.

Linear reef is present offshore. The origin of the mid-shelf reef in the area is non-biogenic, comprised of fossil sand dunes (i.e., eolianites) that formed during lower sea levels (Hallock 1997). North of Isla Verde, and in several other places along the north shore, these ridges are exposed as small rocky islets. Physical conditions allow some coral reef formations on the low-wave action side of the reef. Possible factors controlling the coral reef development and distribution are intense wave action, light penetration, currents along the shore, and sediment abrasion generated by lateral transport. National Oceanic and Atmospheric Administration (NOAA) Benthic Habitat Maps (NOAA 2001) categorize formations in the project area as linear reef, aggregated patch reef, colonized pavement, colonized bedrock, and scattered coral-rock habitats. The habitat is critical for two species of federally listed coral, elkhorn coral (*Acropora palmata*) and staghorn coral (*A. cervicornis*).

A benthic survey was conducted along the proposed BRUSA cable route in May 2016, and focused on the dominant species inhabiting the study area with particular attention to habitat, corals listed under the Endangered Species Act (ESA), and fish species that are indicators of Essential Fish Habitat (EFH). The benthic survey report, including a description of methodology, photographs, and findings, is provided in Exhibit 6. Figure 1 depicts the 2016 survey area.

Figure 1 *Route Survey Stations and Benthic Mapping of EFH and Coral Critical Habitat*



Source: Rivera 2016

Over 22 stations, an approximate area of 4,400 m^2, was surveyed along the planned route. Diverse benthic biota was observed at the project site. Marine vegetation consisted of seagrasses and algae (turf, coralline, fleshy). Sessile and motile macro invertebrates were represented by poriferans (sponges), cnidarians (hydrozoans, zoanthids, soft and hard corals), mollusks, and echinoderms.

Species recorded along the proposed alignment were 18 algae, four seagrasses, eight sponges, 11 soft corals, 20 hard corals (including one threatened species), and eight other macroinvertebrates including one EFH indicator (see Table 9 of the benthic survey report). One ESA listed coral species was observed at five stations in two different geophysical zones (the reef gap and coral critical habitat are discussed further in Exhibit 6). Sixty-three species of fish were observed, of which 10 species were EFH indicators.

Mesophotic Environment

A remotely operated vehicle (ROV)/drop video camera survey of the offshore/mesophotic environment was conducted by Tetra Tech in 2013 for the previously installed PCCS cable system, from approximately 24 m to 102 m water depth.

Beginning at the inshore end of the survey corridor, results showed the seafloor was a primarily flat, hard ground colonized by benthic algae, or colonized pavement (CPV) emerging from the sandy substrate. A benthic habitat profile map of the survey corridor, overlaid on the multibeam bathymetry blueprint image of the route is shown in Figure 1. CPV was found as a discontinuous hard ground transitioning to sand with scattered rocks (SWS) bottom. Benthic algae, including both turf and fleshy macroalgae, were the most prominent component of the benthos. Sand pockets within the CPV comprised the other main substrate category. Due to the vast surrounding sand deposits, it is likely that the abiotic component within this habitat fluctuates markedly depending on sand transport over the hard ground habitat. Sponges were also common in terms of substrate cover. Large erect giant barrel sponges were the main species of the sponge assemblage.

Scleractinian corals were observed in the CPV habitat in low densities. Four species were observed, including *Orbicella franksi* and *Agarcia lamarki*. Sand abrasion and scouring likely associated with surge processes act to constrain development of scleractinian corals and other colonizing biota other than barrel (and few other) sponges within this habitat. Of particular relevance was the observation of feather black coral (*Antipathes pennacea*) at a depth of 34 m within the CPV habitat. Several colonies, typically of small size (< 30 cm), were observed attached to the hard bottom.

An irregular and discontinuous group of rock promontories, classified as patch reefs (PRF) of variable sizes and shapes surrounded by sand, was observed around a depth of 29 m. Benthic algae were the main biological agent colonizing the PRF habitat. It was mostly an algal turf, a combined assemblage of short filamentous brown and fleshy macroalgae growing as a carpet over hard ground substrates. Sandy sediments comprised the other main substrate category on the PRF. Scleractinian corals were represented by seven observed species, all present as isolated encrusting colonies of relatively small size providing minor contributions to the reef topographic relief. *Colpophyllia natans, Madracis decactis, Meandrina meandrites, Montastraea cavernosa, Porites astreoides, Siderastrea sidereal,* and *Orbicella franksi* were noted on the PRF.

Sponges, mostly the giant barrel sponge (*Xestospongia muta*) had the highest invertebrate mean substrate cover. A total of 28 sponge species was recognized from the photo gallery of the PRF habitat. Because of their size and erect growth, giant barrel sponges were the most prominent biological component contributing topographic relief in the PRF habitat. Patch reefs within this route section were observed to a maximum depth of 32 m, producing a total of five benthic habitat transitions to sandy bottom (SND) or SWS along the route.

2.3.2 *Essential Fish Habitat (EFH)*

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) directs federal agencies to consult with NOAA's National Marine Fisheries Service (NMFS) when any of their activities may have an adverse effect on EFH. EFH is defined in the Magnuson-Stevens Act as "…those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The promulgated rules also further clarify EFH with the following definitions: **waters** – aquatic areas and the associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; **substrate** – sediment, hardbottom, structures underlying the waters, and associated biological communities; **necessary** – the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and **spawning, breeding, feeding, or growth to maturity** – stages representing a species' full life cycle (NMFS 2010).

2.3.2.1 *Essential Fish Habitat in the Caribbean*

In the delineating EFH for the generic Fishery Management Plan (FMP) throughout the Caribbean, the Caribbean Fishery Management Council (CFMC) has identified representative, generalized categories of habitats broken into estuarine and marine areas that may serve as EFH for species or species assemblages covered by an FMP:

Table 1 EFH Categories according to the Caribbean FMP

Estuarine EFH	*Marine EFH*
• Water column	• Water column
• Salt marshes	• Seagrass
• Mangrove wetlands	• Sand and shell substrate
• Intertidal flats/salt ponds	• Coral reefs
• Sand and shell substrate	• Algal plains
• Live and hard bottoms	• Live and hard bottoms
• Mud flats	
• Sandy beaches	
• Rocky shores	

Furthermore, in alignment with the Magnuson-Stevens Act, the CFMC has defined Habitat Areas of Particular Concern (HAPC) which are subsets of EFH considered to be rare, particularly susceptible to human-induced degradation, especially ecologically important, or located in an environmentally stressed area (NMFS 2010). Additionally, there are areas regulated under federal or territorial law as marine protected areas (MPAs), national reserves, parks, or sites that are subject to fishing restrictions (e.g., gear type, season), including fishing exclusion zones.

2.3.2.2 *Essential Fish Habitat in Puerto Rico*

Caribbean FMPs were amended in 1998 to include EFH designations and establishment in the U.S. Caribbean, including Puerto Rico and surrounding waters from the shoreline out to the seaward limit of the Exclusive Economic Zone (EEZ) for spiny lobster, queen conch, shallow-water reef fish, and coral and reef associated invertebrate species (CFMC 2011). These habitats provide essential functions for federally managed species under a FMP. The EFH Generic Amendment to these FMPs includes identification of 40 discrete HAPC areas in the U.S. Caribbean, including Puerto Rico, that fall under three general HAPC categories characterized as reef fish spawning habitat, reef fish ecologically important habitats, and coral habitats (Fisheries Leadership & Sustainability Forum 2015).

All of the HAPCs found in the waters surrounding Puerto Rico are further recognized as areas of importance to other federally managed species, including marine mammals and sea turtles (CFMC 2011).

In addition to EFH and HAPC designations the Commonwealth of Puerto Rico recognizes a total of 40 MPAs. Thirty-five of the MPAs are territory MPAs, and five are federal MPAs that are managed jointly between federal governing agencies and Puerto Rico's Department of Natural and Environmental Resources (NOAA 2009).

2.3.2.3 *Essential Fish Habitat in the Project Area*

Several habitats classified as EFH occur along the proposed cable route, including:

- Hardbottom
- Rhodoliths
- Algal Rubble
- Seagrass
- Coral critical habitat

Exhibit 6 provides detailed observations of EFH along the proposed route.

Fish

Fish species observed in the Project area during the benthic survey are listed in Table 2. Table 2 also notes whether the species is an EFH Indicator.

Table 2 Fish Species Observed During Benthic Survey

Species	EFH Indicator
Abudefduf saxatilis	
Acanthurus bahianus	
A. chirurgus	
A. coeruleus	
Aeobatus narinari	
Amblycirrhitus pinos	

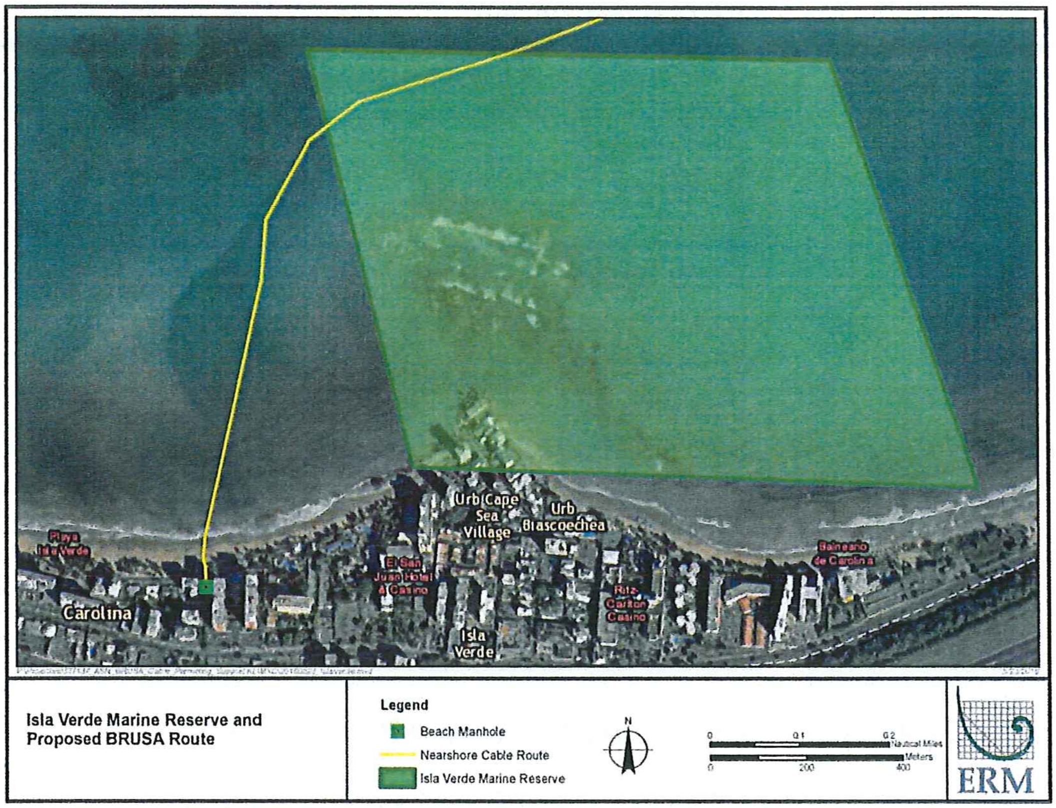
Species	EFH Indicator
Anisotremus virginicus	
Bodianus rufus	
Calamus bajonado	
Cantherhines macrocerus	
Canthigaster rostrata	
Caranx crysos	
Chaetodon capistratus	
C. ocellatus	
C. striatus	X
Chromis cyanea	
Coryphopterus glaucofraenum	
Dasyatis americana	
Diodon hystrix	
Elacatinus evelynae	
Epinephelus cruentatus	
E. fulvus	X
E. guttatus	X
Equetus punctatus	
Ginglymostoma cirratum	
Gramma loreto	
Haemulon aurolineatum	
H. carbonarium	
H. flavolineatum	
H. macrostomum	
H. sciurus	
Halichoeres bivittatus	
H. garnoti	
H. maculipinna	
H. radiatus	
H. tricolor	
Holocentrus adscensionis	X
H. rufus	
Lachnolaimus maximus	
Lactophrys triqueter	
Lutjanus analis	X
L. apodus	X
L. griseus	X
Melichthys niger	
Mulloidichthys martinicus	
Myripristis jacobus	

Species	EFH Indicator
Ocyurus chrysurus	X
Pomacanthus arcuatus	X
P. paru	
Pseudupeneus maculatus	X
Pterois volitans	
Scarus iserti	
S. vetula	
Serranus annularis	
S. tigrinnus	
Sparisoma aurofrenatum	
S. radians	
S. rubripinne	
S. viride	
Stegastes adustus	
S. leucostictus	
S. partitus	
Thalassoma bifasciatum	

2.3.4 *Managed and Sensitive Wildlife Areas*

Law 274 of 26 September 2012 designated an area near the Project as the Isla Verde Marine Reef Reserve (see Figure 2) for biodiversity conservation and its proper management. The preamble to the Act states that this is "one of the places that are emerging as an ecologically sensitive area that merits such protection ... The conservation of the north reef system is vital for its live coral cover, among these Acropora palmatta and Acropora cervicornis, both listed as endangered species. An extensive propagation of the ... Sea fan coral Gorgonia flabellum can be appreciated on the reef. It is also a spawning area for sea turtles such as the leatherback (*Dermochelys coriacea*) and Hawksbill (*Eretmochelys imbricata*) and is visited by a population of manatees (*Trichechus manatus manatus*) that come to shelter and feed in the Thalassia grasslands." One of the components of this reef includes sandy beaches for recreation.

Figure 2 *Isla Verde Marine Reserve and Proposed BRUSA Route*



2.3.5 *Federally Listed (Endangered and Threatened) Species*

Federally listed species potentially occurring in the Project area are listed in Table 3 below.

Table 3 *Threatened and Endangered Species Potentially Occurring in the Project Area*

Scientific Name	Common Name	ESA Status
Marine Mammals		
Balaenoptera musculus	Blue whale	Endangered
Balaenoptera physalus	Fin whale	Endangered
Balaenoptera borealis	Sei whale	Endangered
Megaptera novaeangliae	Humpback whale	Endangered
Physeter macrocephalus	Sperm whale	Endangered
Trichechus manatus	West Indian manatee	Endangered
Fish		
Sphyrna lewini	Scalloped hammerhead (Central & Southwest Atlantic DPS)	Threatened

Scientific Name	Common Name	ESA Status
Marine Reptiles		
Dermochelys coriacea	Leatherback turtle	Endangered
Caretta caretta	Loggerhead turtle (Northwest Atlantic DPS)	Threatened
Chelonia mydas	Green turtle (North Atlantic DPS)	Threatened
Eretmochelys imbricata	Hawksbill turtle	Endangered
Invertebrates		
Acropora cervicornis	Staghorn coral	Threatened
Acropora palamata	Elkhorn coral	Threatened
Dendrogyra cylindrus	Pillar coral	Threatened
Orbicella annularis	Lobed star coral	Threatened
Orbicella faveolata	Mountainous star coral	Threatened
Orbicella franksi	Boulder star coral	Threatened
Mycetophyllia ferox	Rough cactus coral	Threatened

In addition to the species noted above, the Nassau grouper (*Epinephelus striatus*) is a species of concern.

2.3.5.1 *Corals*

Seven species of coral are listed under the Endangered Species Act in the Caribbean: *Acropora palmata* (elkhorn coral) and *A. cervicornis* (staghorn coral) were listed as threatened species effective June 8, 2006 (71 FR 26852); critical habitat was designated for the species on November 26, 2008 (73 FR 72210). Five additional Caribbean coral species were listed as threatened effective October 10, 2014 (79 FR 53851), including pillar coral (*Dendrogyra cylindrus*), lobed star coral (*Orbicella annularis*), mountainous star coral (*Orbicella faveolata*), boulder star coral (*Orbicella franksi*), and rough cactus coral (*Mycetophyllia ferox*). The range of each species includes Puerto Rico, as shown in Table 4 below.

Table 4 ***Distribution of Threatened Coral Species in the Caribbean within US Jurisdiction (NMFS 2016)***

Species	Reef Environment	Depth Distribution	US Geographic Distribution
Acropora cervicornis	Spur and groove, bank reef, patch reef, and transitional reef habitats, as well as on limestone ridges, terraces, and hardbottom habitats	5-30 m	Southeast Florida from Boynton Inlet in Palm Beach County to the Dry Tortugas; Puerto Rico; U.S. Virgin Islands (USVI); Navassa Island National Wildlife Refuge (NINWR)

Species	Reef Environment	Depth Distribution	US Geographic Distribution
Acropora palmata	Fore-reef, reef crest, and shallow spur-and-groove zone	1-5 m	Southeast Florida from Broward County to the Dry Tortugas; FGBNMS; Puerto Rico; USVI, NINWR
Dendrogyra cylindrus	Most reef environments	1-25 m	Southeast Florida from Lake Worth Inlet in Palm Beach County to the Dry Tortugas; Puerto Rico; USVI; NINWR
Mycetophyllia ferox	Most reef environments	5-90 m	Southeast Florida from Broward County to the Dry Tortugas; Puerto Rico; USVI; NINWR
Orbicella annularis	Most reef environments	0.5-20 m	Southeast Florida from Lake Worth Inlet in Palm Beach County to the Dry Tortugas; FGBNMS; Puerto Rico; USVI; NINWR
Orbicella faveolata	Most reef environments	0.5-90 m	Southeast Florida from St. Lucie Inlet in Martin County to the Dry Tortugas; FGBNMS; Puerto Rico; USVI; NINWR
Orbicella franksi	Most reef environments	5-90 m	Southeast Florida from Lake Worth Inlet in Palm Beach County to the Dry Tortugas; FGBNMS; Puerto Rico; USVI; NINWR

Orbicella faveolata was the only listed species observed during the benthic survey; a total of 10 colonies were identified during the transect survey of the cable route out to 4.046 km offshore. These colonies were observed over five stations in the reef, forereef, and deep reef zones in different geophysical habitat types. Seven colonies were observed in the reef gap, and three in an area delineated as coral critical habitat. One colony was identified separate from the transect survey, during the swim survey at kilometer point 3.675, for an ultimate total of 11 colonies within the project area. Coral critical habitat was observed directly along the cable route between 3.471 and 3.839 km offshore. Another area of critical habitat was noted to be adjacent to the reef gap; however,8 the cable will not impact this substrate.

Benthic studies conducted in the project area and adjacent to it have noted instances of *Mycetophyllia ferox* colonies in the nearshore. Mesophotic surveys conducted in waters greater than 30 m deep near the BRUSA cable route observed colonies of *Orbicella franksi*. While these species were not directly observed during the benthic study it is possible that they may be present in the mesophotic zone of the project area since they are known to occur nearby.

2.3.5.2 *Sea Turtles*

Four species of sea turtles are reported for Puerto Rico. These include two threatened species, the green turtle (*Chelonia mydas*) and the loggerhead (*Caretta caretta*), and two endangered species, the hawksbill turtle (*Eretmochelys imbricata*) and the leatherback turtle (*Dermochelys coriacea*). The beach landing area consists of a wide sandy beach suitable for successful sea turtle arrival and nesting. The U.S. Fish and Wildlife Service (USFWS) has recorded the presence of nests on the beach and turtles in the water in the area (see Exhibit 6). Leatherback turtles may use sandy beaches in the area for nesting from February to July. Juveniles and adults of hawksbill turtles are permanent residents and are commonly observed at the surface and underwater while green turtles are less common. Loggerheads do not nest in Puerto Rico and few sightings are documented for the northeastern and southwestern coasts.

Table 5 ***Approximate Turtle Nesting Months in the Project Area***

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Loggerhead*												
Leatherback		■	■	■	■	■	■					
Green						■	■	■	■			
Hawksbill				■	■	■	■	■	■	■	■	

*Loggerheads do not nest in the Project area.

2.3.5.3 *Marine Mammals*

Whales

There are five species of ESA-listed whales (all endangered) that can potentially be found in the Project area: sei whale (*Balaenoptera borealis*), blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), and sperm whale (*Physeter macrocephalus*). These species could be affected by vessel transit during the installation of the submarine cable, in particular for installation in deeper, offshore waters. ESA-listed whale species are more common in the U.S. Caribbean during their winter migration to warmer waters from January to March of each year. Depending on when the cable installation takes place, there may be less likelihood of ESA-listed whales being in the Project area.

No sightings of ESA-listed whale species have been reported during past surveys conducted in the area, including mesophotic reef surveys in deep water areas, although these were done in September through November 2013 for the PCCS project. Anecdotal information from dive shop operators in Puerto Rico, as well as information from NOAA's Office of Law Enforcement, indicates that these animals are common in deeper waters off both the east and west coasts of Puerto Rico from January-March, with some humpbacks occasionally sighted off the east coast year-round (NMFS 2014). There is no information from previous cable installation projects within the same general area as the BRUSA system that indicates that ESA-listed whales were sighted during cable installations or that there were any interactions between ESA-listed whales and work vessels.

Manatees

Fresh water flows from the Condado lagoon and the San Juan bay mouth (1-3 nm west of Condado beach) and the Torrecillas lagoon through Boca de Cangrejos (approximately 1 nm east of the Isla Verde beach) thus attracting manatees to both areas. The endangered West Indian manatee (*Trichechus manatus*) inhabits both clear and muddy salt and freshwater, and can be found in canals, estuaries, bays, and nearshore marine habitats. This mammal prefers shallow waters, ranging 5 to 20 feet deep. Manatees are primarily herbivorous and feed on seagrass or any other aquatic vegetation. The USFWS and the Caribbean Stranding Network report manatee sightings at Boca de Cangrejos and east of that area.

2.4 *LAND USE AND RECREATION*

The Project area beaches are popular for recreation, and support numerous hotels, restaurants, and other establishments along the shoreline. The marine uses in the Project area are generally not intensive and tend to be recreational (jet ski rentals, etc.). There are several submarine communication cable systems that terminate at the proposed landing at Tartak Street. Local activities include subsistence and recreational fishing, and other recreational and water sport activities along the beaches. There are no intensive fishing practices such as trawling or deep-sea fishing zones off the coast of this location. Maritime traffic is located further northwest in deep waters and toward the San Juan Harbor entrance.

2.5 *CULTURAL RESOURCES*

Marine archaeological surveys were conducted for the PCCS segment 2A cable route in 2013 and for the American Movil Submarine Cable System (AMX) cable route in 2011, both located in the nearshore area of the BRUSA route. No archaeological materials were observed in either the remote sensing data or the visual inspections of the 2011 and 2013 dive surveys. The archaeological survey report for the 2013 survey is contained in Exhibit 7.

2.6 *SOCIOECONOMICS*

Puerto Rico has one of the most dynamic economies in the Caribbean region; however, the economy has had negative or flat growth for the last 9 years, with unemployment around 13.7% in 2014. The industrial sector has surpassed agriculture as the primary locus of economic activity and income. Mainland U.S. firms have invested heavily in Puerto Rico since the 1950s. Tourism has traditionally been an important source of income with estimated arrivals of more than 3.6 million tourists in 2008. Puerto Rico's trade surplus in merchandise is exceptionally strong, with exports nearly 50% greater than imports. The central concerns of the government remain to be closing the budget deficit while restoring economic growth and employment (CIA 2016).

Important industries include pharmaceuticals, electronics, textiles, petrochemicals, processed foods, clothing, and textiles. Puerto Rico's manufacturing sector has shifted from the original labor-intensive industries, such as the manufacturing of food, tobacco, leather, and apparel products, to more capital-intensive industries, such as pharmaceuticals, chemicals, machinery, and electronics. Major manufacturing activities contributing to domestic income include chemical and allied products, machinery and metal products, food and kindred products, and apparel and related products. The manufacturing industry accounts for 50.8% of Puerto Rico's Gross Domestic Product (GDP) (CIA 2016).

In 2015 the service industry in Puerto Rico accounted for 48.8%, while agriculture and fishing account for a relatively small fraction (0.9%) of the GDP (CIA 2016).

The main government expenditures are on health, education, and welfare.

2.7 *AIR QUALITY AND NOISE*

The San Juan – Carolina area is not listed in the U.S. Environmental Protection Agency (USEPA) air quality non-attainment areas for criteria pollutants (USEPA 2016).

The Environmental Quality Board Regulation for the Control of Noise Pollution of the 1987 establishes different criteria for sound level during day and night hours. A study of noise levels at 14 monitoring stations in the metropolitan area of San Juan showed average noise level readings for 30 minutes over a 24 hour period ranging from 67 decibels (dB) during the day and 57 dB at night (Alicea-Pou 2005).

The project landing site is located at the beach and adjacent to high-traffic areas. Therefore, the ambient noise is generally high because of the ocean and traffic. It is also near a major airport, contributing to high ambient noise.

3.0 ENVIRONMENTAL CONSEQUENCES

The environment of the proposed project, both along the coast and offshore, has been modified from its natural environment for business and tourism in addition to several undersea communication cables already installed in the immediate project area. The Project, as described in Exhibit 1, involves an installation period of short duration, and the operations require no routine maintenance. Once installed, there is no physical activity required to maintain the cable during the project life. Therefore, potential effects and disturbance are related to installation.

The following sections describe potential effects of the Project. Based on the location, nature, and scope of the Project, and through the application of appropriate avoidance and mitigation measures, it is anticipated that the impacts of the Project on the environment will be temporary, reversible, and less than significant.

3.1 GEOLOGY/SEDIMENT

Installation on the beach will require trenching to install the cable into the existing ducts, and bury the cable in the beach. All excavated material will be returned to the trench once the cable is installed and the beach will be restored to its pre-installation condition.

The potential for erosion and sedimentation is limited to the excavation operation for the trench in the beach sand and the manual positioning of the cable on the seabed. No significant erosion or sedimentation is anticipated due to the characteristics of the sand and the short duration of the operation.

3.2 SURFACE WATERS

Cable installation will involve placement of cable on the seafloor, which will disrupt sediments and cause localized and temporary turbidity. This will be minimal during installation in the nearshore area where the cable will be placed manually by divers to avoid and minimize impacts to communities of organisms (benthos) living in the sea bottom. Installation at the beach will cause greater sediment disturbance and potential for localized turbidity due to trenching and jetting at the landing site.

Vessels and beach equipment used will be operated in compliance with applicable regulations and best management practices to avoid storm water runoff/erosion, and release of fuel or chemicals during cable installation. It is anticipated that the project will have a temporary impact on water quality, in particular increased turbidity in the surrounding area during installation of the cable. No permanent or long-term adverse effects on surface waters are anticipated during cable installation.

3.3 *BIOLOGICAL RESOURCES*

Disturbance to biological resources at the beach landing site and along the routes offshore are primarily related to installation activity. Measures to avoid and mitigate effects on resources are described in Exhibit 3 of this application, and noted below.

3.3.1 *Benthic Communities and Corals*

The project could impact submerged aquatic vegetation and sessile organisms in benthic communities, such as sponges, soft and hard corals, and other macroinvertebrates. However, the impact would be localized in the immediate areas of seafloor contact and the effects would be expected to be limited due to the quick recovery of algae and seagrass, flexibility and low cover of the gorgonians, and the size and growth morphology in most of the hard corals. Also, given the low coverage and scattered distribution of hard corals, they will be avoided by the cable routing and during installation. The nearest pass to a colony of *O. faveolata* is at a distance of 1 m from the cable route, at Station 20 (Rivera 2016); with diver-assisted cable lay, avoidance of impacting this occurrence will be assured. Avoidance through cable route planning is a critical element in reducing impacts, as well as installation techniques that prepare for the planned route using weighted lines, and installation by divers. The cable will be secured to the seafloor in selected areas to avoid movement and the potential to damage benthic habitat after installation (see Exhibits 1 and 3). The resulting effects on the benthic habitat are expected to be less than significant, and will be documented by the environmental monitor (EM).

Listed coral species along the proposed route (or adjacent to it) will be avoided during installation. None of the observed ESA-proposed coral species were found either at the center of any of the route stations (i.e., zero point) or in contact with the weighted line along the cable routes. The closest colony to the center of a transect was an *O. faveolata,* observed at a distance of 1 m from the cable route and within the Station 20 transect.

Because the proposed route will avoid listed species through careful cable placement, coral species are not expected to be adversely affected by the project.

The BRUSA cable route closely parallels the PCCS route, which passes through an area with mesophotic corals, which were observed during the mesophotic coral survey conducted for the PCCS cable. Based on the water depths and proximity to the PCCS cable, the area crossed by the BRUSA route is expected to include similar substrate types, colonization patterns, biotic densities, coverage, and identified species that were observed during the mesophotic survey for the PCCS cable segment 2A. Potential effects on corals and habitats are also expected to be similar to that posed by the PCCS cable, which was determined to have "no effect" for four species, "may affect, but is not likely to adversely affect" for two species and "may affect, but is not likely to jeopardize the continued existence" for one species, as stated in the Biological Opinion prepared by NMFS (NMFS 2014).

3.3.2 *Marine Turtles*

Turtles are present in the project area and could be affected by beach activity and excavation, and installation of the cable in the water. Based on the seasonal activity, monitoring may be needed to confirm the absence of nesting turtles near the landing site on the beach and to avoid disturbance of nesting turtles. An in-water EM will be present during the installation and will alert divers if a turtle is present to avoid contact with the animals. Project vessels will also observe turtle avoidance protocols (NOAA guidance) (NMFS 2008). Impacts to turtles are not expected to occur with the application of avoidance and mitigation measures.

3.3.3 *Marine Mammals*

Project cable-laying vessels move along a defined path and at a steady speed, which reduces the potential for contact with mammals. Project vessels will implement avoidance protocols (according to NOAA guidance) to maintain a safe distance from animals if they are observed during installation (NMFS 2008). Therefore, impacts to marine mammals are expected to be avoided.

3.4 *LAND USE AND RECREATION*

The project will involve temporary disruption on the beach and in the water. The duration of the activity on- and offshore is brief. For public safety, the work area will be designated and access to it restricted. Project installation will not preclude the use of the beach and once completed, the site will be restored to pre-installation condition. Similarly, offshore project activity will be of short duration and, once complete, use of the area for recreation and fishing will be unchanged.

The Isla Verde Marine Reef reserve lies within the project area. As discussed above under biological resources, route planning and protective installation measures are intended to protect sensitive resources and habitats. The protection of these resources is consistent with the intent of the reserve to preserve the reef, its resources, and the enjoyment of the area.

3.5 *CULTURAL RESOURCES*

The cable route in the nearshore was surveyed to assess the presence of archaeological and cultural resources in the project area. The archaeological surveys conducted for the PCCS project in 2013 and for the AMX project in 2011, both located in the nearshore area of the BRUSA route, found no resources along the route from both visual inspection and remote data collection (see Exhibit 7). Therefore, no impacts to archaeological resources are expected.

The beach area is highly disturbed, and project beach activity is not expected to contact any undisturbed cultural or archaeological resources.

3.6 *SOCIOECONOMICS*

The project will have some short-term local benefits on the local economy through temporary jobs created during construction, short-term spending by installation crews (lodging, food, entertainment), and the purchase of supplies for the project. Over the longer term, the project will contribute to increased telecommunications capacity in Puerto Rico and the region, which also has a positive impact on the economy.

The temporary disruption of beach area by the project and its effect on tourism and recreation is expected to be negligible.

3.7 *AIR QUALITY AND NOISE*

Project vehicles, equipment, and vessels emit pollutants from internal combustion engines. The emission sources (vehicles, vessels) will be few and will be present for a short time, resulting in localized and temporary emissions in the project area. These effects are considered to have a non-significant impact on air quality.

Installation on the beach and at the BMH will use equipment that will cause an increase in noise levels in the immediate vicinity. The noise will be short-term and the public will not be allowed near the equipment, which provides some distance between the noise source and a receptor. The beach landing area has high ambient noise from naturally-occurring sources (ocean) and high level of anthropogenic activity (traffic, nearby airport).

The air quality and noise effects on the local receptors will be non-significant.

4.0 *MINIMIZATION AND MITIGATION MEASURES*

Please refer to JPA Exhibit 3 for project avoidance and mitigation measures.

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JOINT PERMIT APPLICATION
for the
BRUSA Cable System

Exhibit 6:

Biological Assessment

BRUSA Submarine Cable System

Biological Assessment

June 2016

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ATTACHMENT B: *2013 Final Report: Benthic Habitat Mapping and Mesophotic Coral Survey – PCCS Route Segments 2 and 2a*

ATTACHMENT C: *2014 National Marine Fisheries Service Biological Opinion for PCCS*

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LIST OF ACRONYMS

AA	Action Area
A/C	Alter course
ASN	Alcatel-Lucent Submarine Networks
BO	Biological Opinion
BMH	beach manhole
CPV	Colonized pavement
CRS	Cable Route Study
cm	Centimeters
DA	Double armor
DP	dynamic positioning
DPS	Distinct Population Segment
ESA	Endangered Species Act
EFH	Essential fish habitat
Ft	Feet
JPA	Joint Permit Application
kg	Kilograms
Km	Kilometers
KP	Kilometer post
LAT	Lowest astronomical tide
M	Meters
MLW	Mean low water

mm	Millimeter
nm	Nautical mile
NINWR	Navassa Island National Wildlife Refuge
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
PCCS	Pacific Caribbean Submarine Cable System
PRF	Patch reefs
RPL	Route position list
ROV	Remote operated vehicle
SA	Single armor
SND	Sandy bottom
SSE	Separate shore-end
SWIV	Shallow water installation vessel
SWS	Scattered rocks
TIWS PR	TI Wholesale Services Puerto Rico, Inc.
U.S.	United States
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USFWS	United States Fish and Wildlife Service
USVI	U.S. Virgin Islands
yd	Yard

1.0 INTRODUCTION

1.1 PURPOSE OF THE BIOLOGICAL ASSESSMENT

The purpose of this biological assessment is to review the proposed BRUSA Cable System Project (Project) in sufficient detail to determine to what extent the proposed action may affect any threatened, endangered, proposed, or sensitive species, as well as their designated or proposed critical habitats. In addition, the following information is provided to comply with statutory requirements to use the best scientific and commercial information available when assessing the risks posed to listed or proposed species and designated or proposed critical habitat by federal actions. This biological assessment is intended to support initiation of consultation in accordance with legal requirements set forth under regulations implementing Section 7 of the Endangered Species Act (50 CFR 402; 16 U.S.C. 1536 (c)).

1.2 REGULATORY BASIS

The Endangered Species Act (ESA) of 1973 (Section 9 and implementing regulations 50 CFR Part 17) protects threatened and endangered wildlife species, making it unlawful to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect an endangered species, or to attempt to engage in any such conduct. Any violations of the ESA and its regulations may be subject to a fine and imprisonment. "Endangered species" are defined by the Secretaries of the Department of the Interior and/or the Department of Commerce as any species that may be in danger of extinction throughout all or a portion of its range, while a "threatened species" is defined by the Department as any species likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. The United States Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) are responsible for implementation of the federal ESA.

Section 7(a)(2) of the ESA (16 U.S.C. § 1531 et seq.) requires that each federal agency ensure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. Regulations that implement Section 7(b)(2) define jeopardize the continued existence of as meaning "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02).

When the action of a federal agency may affect a listed species, that agency is required to consult with NMFS, USFWS, or both, depending upon the listed species that may be affected. At the conclusion of consultations these agencies issue biological opinions to assist federal agencies in complying with the requirements of Section 7 of the ESA. This biological assessment has been prepared in support of Section 7 consultation for the proposed action, as described below.

1.3 *PROPOSED ACTION*

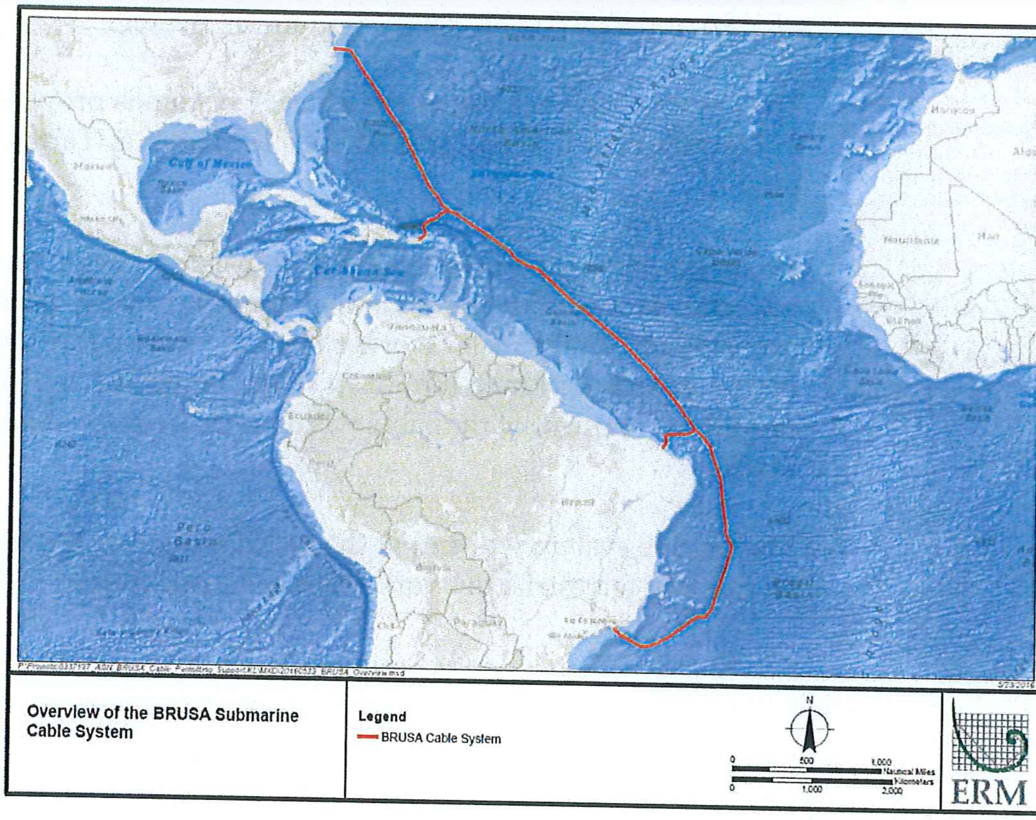
Alcatel-Lucent Submarine Networks (ASN) has been contracted by the submarine cable owners, TI Wholesale Services Puerto Rico, Inc. (TIWS PR), to design, engineer, manufacture, and install the BRUSA cable system linking the continental United States (U.S.) and Brazil, with a branching unit into San Juan, Puerto Rico.

The proposed action considered in this biological assessment is the marine deployment, landing, and inland installation of the BRUSA link in San Juan, Puerto Rico.

1.3.1 *Project Description*

The BRUSA Cable System Project (Project) consists of an 11,300 kilometer (km) cable system that will have four landing stations, two in the U.S. (Virginia and Puerto Rico), and two in Brazil (Rio de Janeiro and Fortaleza) (Figure 1.1).

Figure 1.1 ***Overview of the BRUSA Submarine Cable System***



The Project will increase route diversity on U.S.-South America routes with an entirely new cable landing point on the U.S. mainland at the Mid-Atlantic City of Virginia Beach. Other existing and planned U.S.-Brazil cable systems either land or plan to land in Florida or in the New York-New Jersey area; therefore, BRUSA provides a new path on the U.S.-Brazil route. Having diverse cable routes helps to minimize the risk that a single event, such as a hurricane or a fishing-net entanglement, could disrupt all U.S.-Brazil communications. The BRUSA cable system will offer significant new capacity on a route where capacity demand is increasing substantially each year and where existing systems are nearing the ends of their useful lives. SAm-1, South American Crossing/Latin American Nautilus, and GlobeNet each entered into commercial service in 2001, while Americas-II entered into commercial service in 2000.

The proposed BRUSA project in Puerto Rico offers the additional advantage of using existing infrastructure. The Applicant, TI Wholesale Services Puerto Rico Inc. (TIWS PR), proposes to use the same beach landing site and terrestrial ducting as the Pacific-Caribbean Cable System (PCCS), which was installed in 2015. The routing in shallow waters for BRUSA builds on the recent experience from PCCS. The BRUSA project described herein has principally the same technical approach as PCCS, and applies the same environmental protections that were used for the successful installation of the PCCS system. Figure 1.2 shows both the BRUSA and PCCS cable routes within U.S. waters.

The Puerto Rico Segment of the BRUSA system is proposed to land in the metropolitan area of San Juan at the site known as Tartak Street end beach area.

The segment of the BRUSA cable system connecting Puerto Rico will include a second 35-km-long branch that may be used for future connections. The branch diverges from the main cable segment approximately 15 km (8 nm) from shore. Figure 1.2 illustrates the proposed footprint of the cable within jurisdictional waters of the United States.

The marine system will end at the beach manhole (BMH) and connect to an existing terrestrial network (Figure 1.3 and Figure 1.4).

Figure 1.2 ***BRUSA and PCCS Submarine Cable Systems in U.S. Waters***

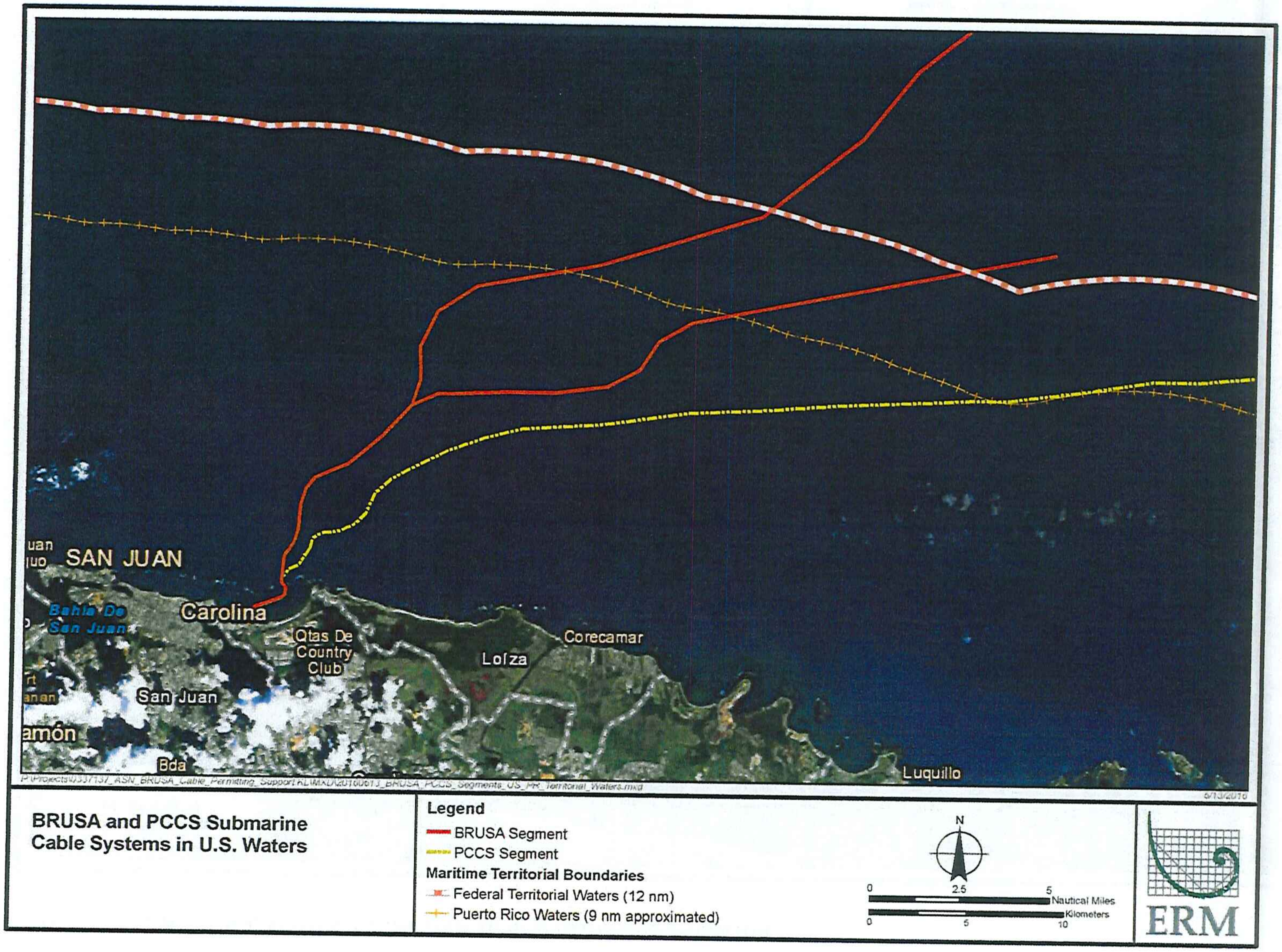


Figure 1.3 ***Proposed San Juan Landing Point and Beach Manhole Position***

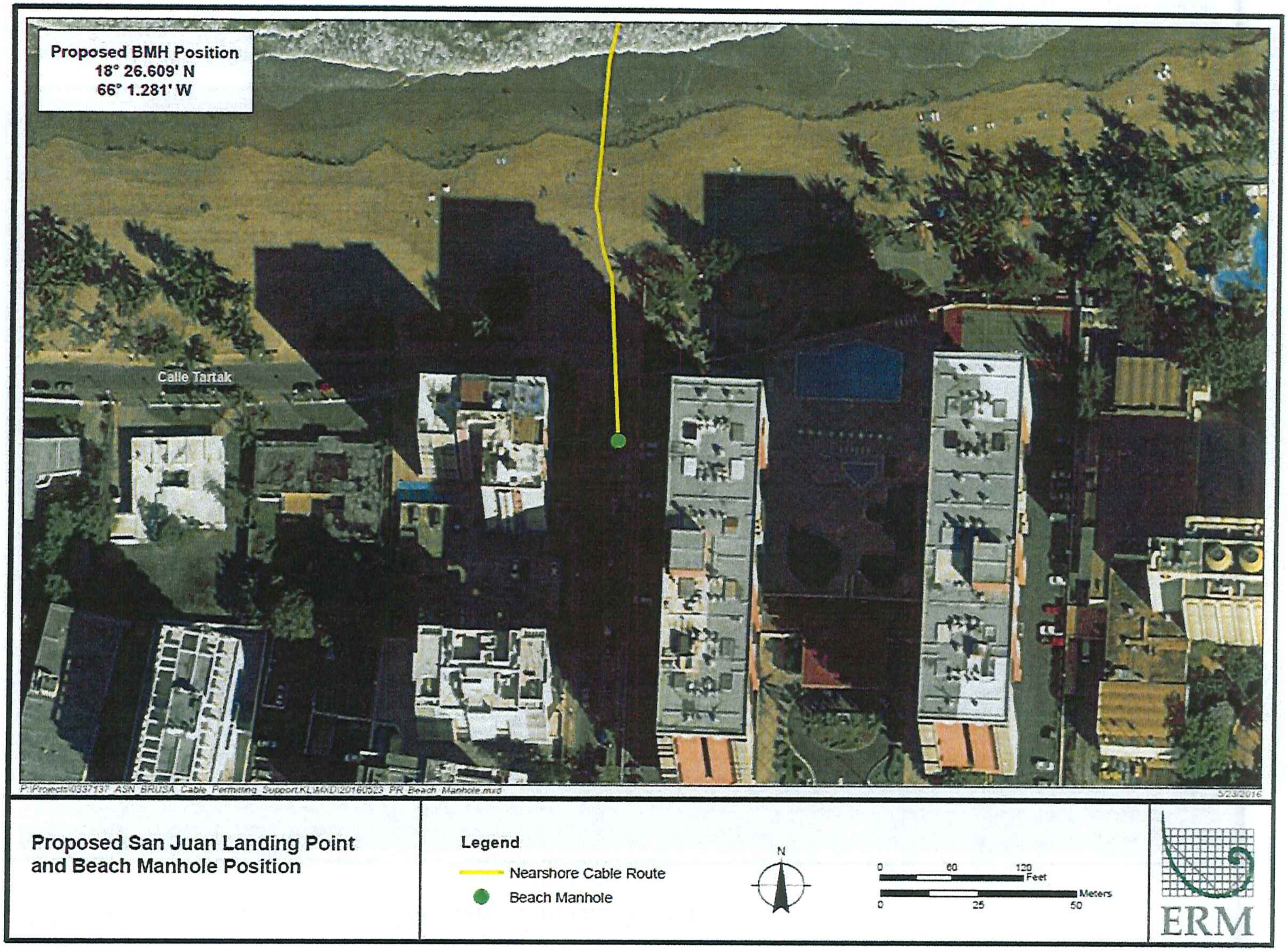
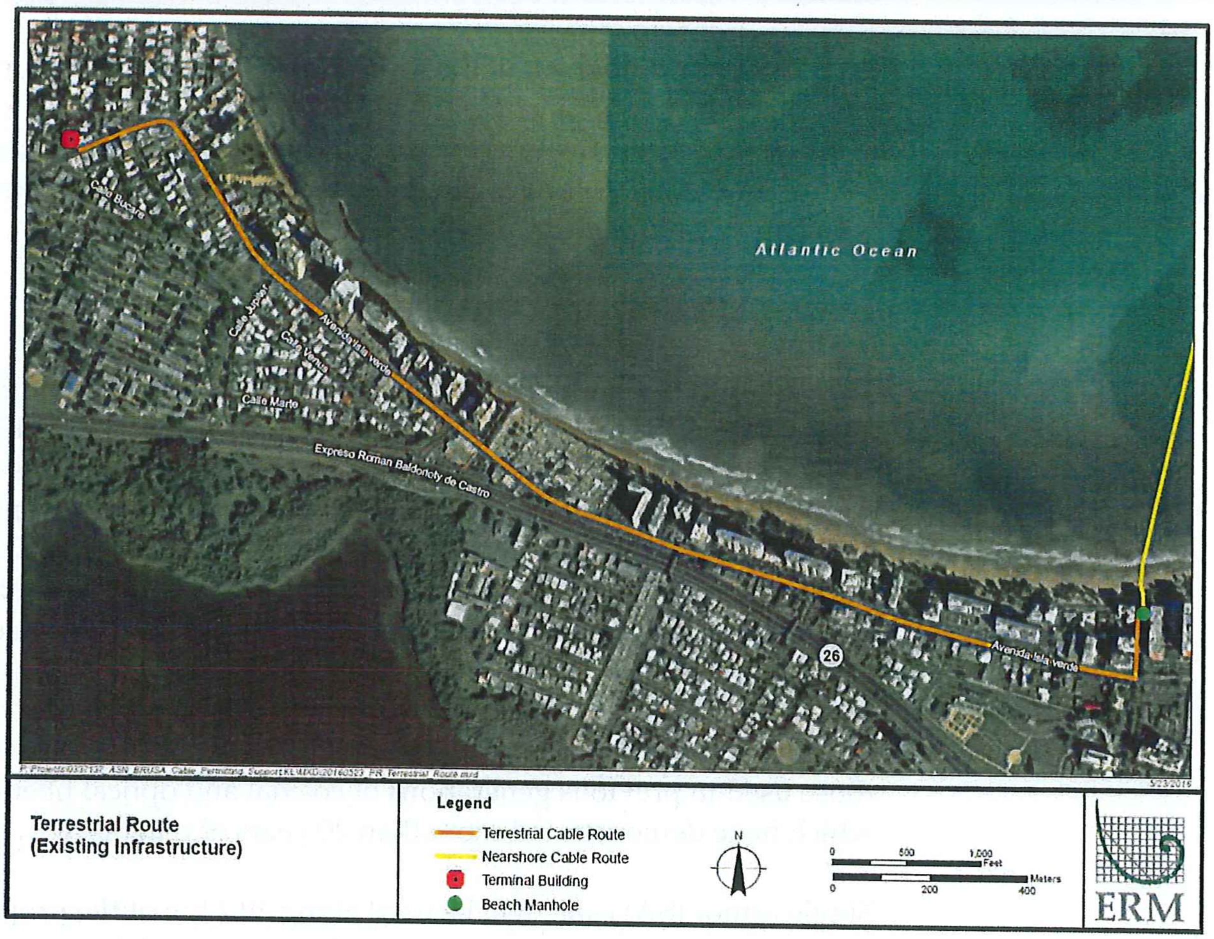


Figure 1.4 ***Terrestrial Route Using Existing Infrastructure***



1.3.1.1 *Cable Routing*

Cable design and selection of cable type are developed in the planning stages, based on engineering considerations identified during the route planning process. The landing was selected to optimize the approach to the existing infrastructure, to minimize interference with existing cables, and to use the seafloor features that effectively function as a natural corridor for the cable route (e.g., optimizing use of flat seabed, avoiding slopes, side-slopes, and hardbottom areas where possible).

The cable route was engineered to avoid potential hazards, other seabed users (such as naval areas), and disruption to marine resources and operations, and to secure long-term protection of the cable. The cable route and project design are developed and refined through two main stages: the Cable Route Study (CRS) – a detailed desktop review; and the Marine Survey – surveys of bathymetric and other data along the inshore and deep-water sections of the route. During the planning phase of the submarine cable systems, the Marine Survey and route selection exercises are optimized to select a route that will have minimal impact on the seabed.

An important component of the route planning process is the avoidance of impacts to the environment, particularly coral reefs. To achieve this, a separate nearshore dive survey was conducted for the project, supported by environmental expertise. The route was refined to minimize contact with hardbottom areas.

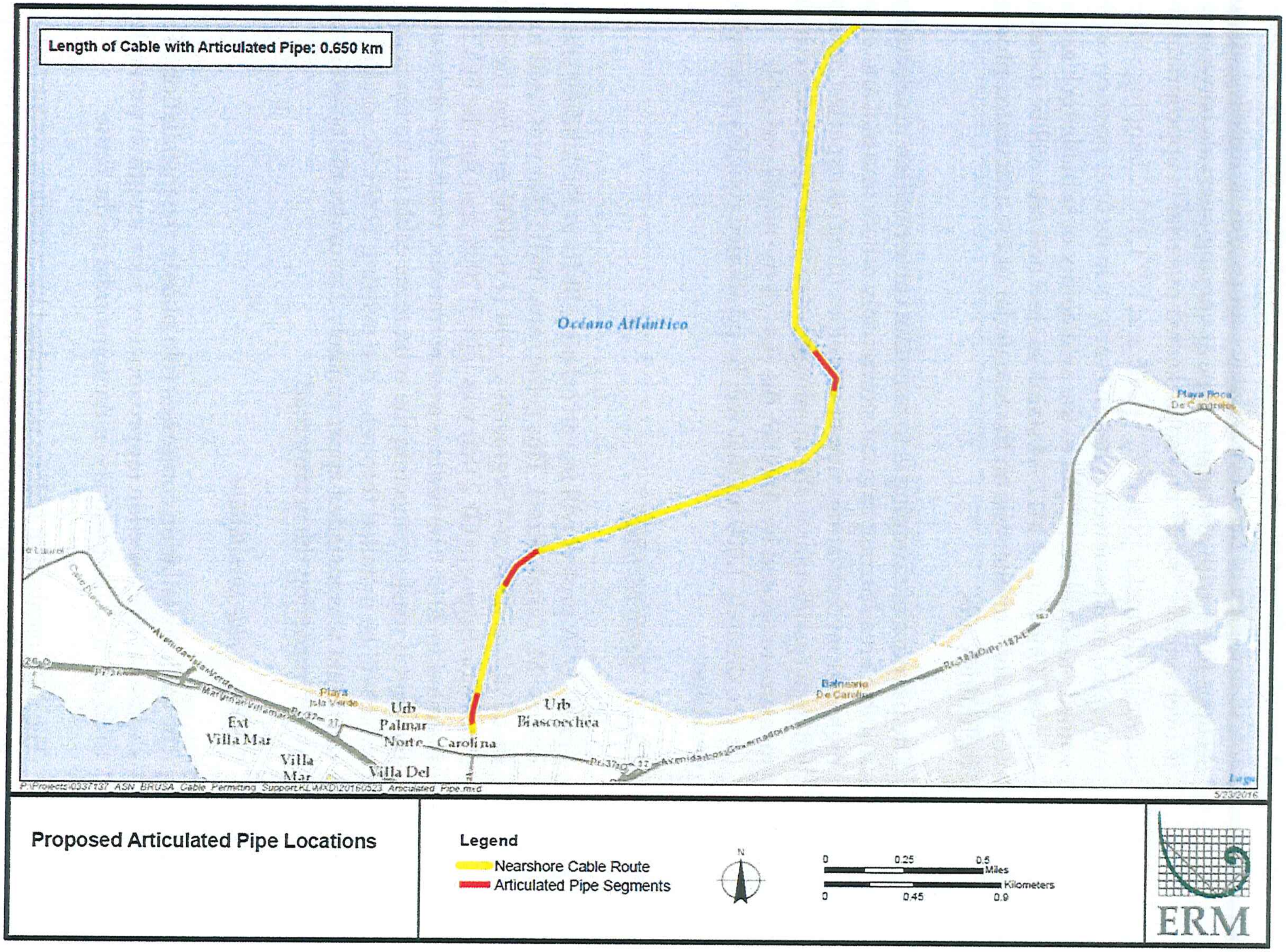
1.3.1.2 *Cable Design*

The system is designed to carry 13.5 Tbps per fiber pair using the newest available, proven repeatered and unrepeatered technology. This system will consist of eight fiber pairs housed in a jelly-filled stainless steel tube, surrounded by two layers of steel wires that form a protective vault against pressure and external contact, as well as add tensile strength. The protective vault is enclosed in a hermetically sealed copper tube and insulated with a layer of polyethylene to form the basic deep-sea light weight (LW) cable. The outer low density polyethylene coating provides high voltage electrical insulation, as well as abrasion protection. Whenever possible, the raw materials selected are of the same type as those used in previous generations of coaxial and optical fiber cables, which have demonstrated more than 20 years of reliability.

Single armor (SA) cable will be used along 29.2 km of the proposed route within U.S. waters in depths between 200 meters (m) (656 feet [ft]) and 1,200 m (3,938 ft). In shallow waters less than 200 m, double armor (DA) cable will be used. The cable design ensures that in the event of a break, high strain on the fibers and seawater ingress are limited to a short length, so that the bulk of the cable will remain serviceable. In order to improve cable stability and provide additional protection, articulated pipe will be fitted over the cable to be buried on the beach and continue within the nearshore surf zone.

Up to 700 m (2,297 ft) of articulated pipe will be applied in discrete sections by divers in diver-defined locations along approximately 4,200 m (13,780 ft) of the cable route. Approximately 120 m of this total will be buried to a target depth of 2 m along the beach. Proposed locations for use of articulated pipe are shown in Figure 1.5. The exact location of articulated pipe will be adjusted to suit the as-laid cable, with more pipes used if needed.

Figure 1.5 ***Proposed Articulated Pipe Locations***



A number of "saddle clamps" may be required to affix the cable and articulated pipe to the seabed. Cable clamps will be installed on cable sections fitted with articulated pipe at varying intervals between 8 and 25 m over suitable "rock" and solid seabed material in appropriate areas between kilometer post (KP) [1] 0.785 and KP 1.010. Clamping will be evaluated and reviewed when the cable is in its final position on the seabed, and will be subject to the availability of suitable rock to secure the clamps. One pair of M12 A4 stainless steel bolt sets will be installed at nominally 1 m intervals on the remainder of the articulated pipe sections, including ends.

The purpose of clamping is to maintain cable position in selected and suitable areas during tropical storms only where unusual and extremely high bottom oscillating current velocities (drag) is expected on cable not being perpendicular to the dominant wave front. This is a precautionary measure proposed by ASN for the part of the nearshore cable (approximately 1,000 m) that will be positioned roughly parallel to the coastline.

1.3.1.3 *Beach Manhole*

The BRUSA project will use an existing BMH at the landing site, located on Jose M. Tartak Street. This is the same BMH that was used for the installations of SAm-1 Segments G and H in 2000; and for the SAm-1 Extension Segment G1.2 that was laid in 2008, and for the PCCS system installed in 2015. The BMH is a subterranean, vault-like structure where the joint is made connecting the submarine cable to the land cable. The cable will be installed through a pre-existing TIWS PR conduit (30 m long duct) that was installed approximately 2 m under the beach in order to avoid impacting the nearby road.

1.3.1.4 *Cable Installation*

The cable installation comprises two phases: the installation of a separate shore-end (SSE) section (approximately 5 km length in water depths of up to 35 m), and the main lay of the remainder of the route.

The SSE installation will be performed by a shallow water installation vessel (SWIV); maneuvering using defined mooring locations, as

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[1] "KP" is commonly used to indicate a location at a point along the linear length of the cable route.

described in Section 1.3.1.6. This allows better control and accuracy during installation, and is done independently of the main lay.

The "main lay" will involve laying the cable along a pre-determined route using a special purpose cable ship, also referred to as the "main lay" vessel to distinguish it from support boats. The ship will be approximately 140 m long, and will have a dynamic positioning (DP) system that enables it to maneuver in the nearshore area without anchoring.

The cable ship will comply with applicable federal and international regulations and conventions addressing navigational safety, safe operations, and pollution prevention measures. The location and duration of the vessel's presence in the project area will be included in a notice submitted in advance, in accordance with U.S. Coast Guard (USCG) requirements. The USCG will issue a Notice to Mariners to alert other vessels of the cable ship's presence, expected time in the project area, and contact information.

The main lay will be conducted 24 hours per day until the ship reaches the end of the SSE section (~35 m water depth) where the shore-end will be jointed to the main lay cable. The timing of this connection will depend on the relative progress of each phase and may be delayed as necessary.

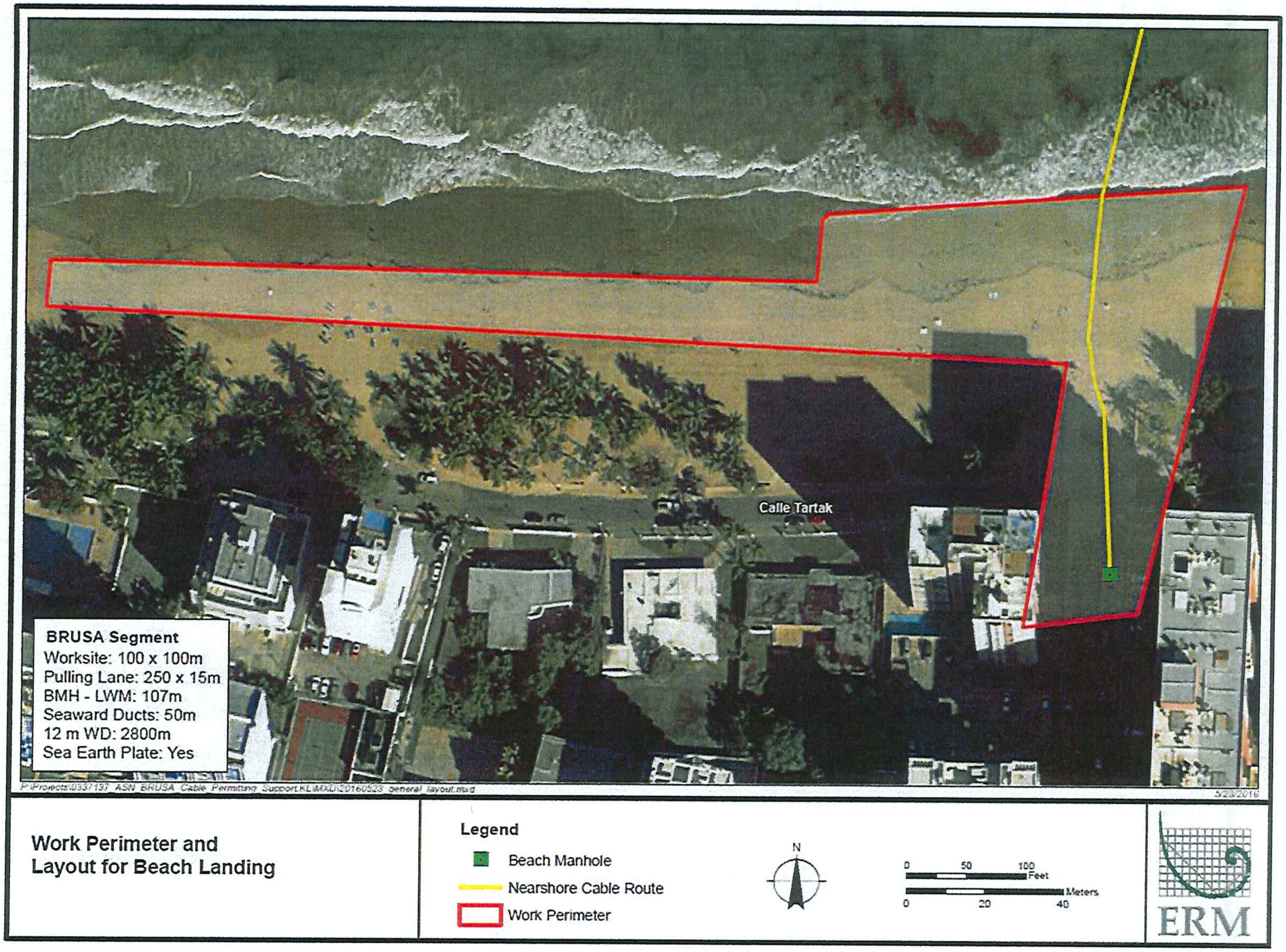
The main lay only includes the surface lay of cable, ranging from the deepest section at approximately 1,200 m to the shore-end at 35 m. From the 35 m depth contour to the waterline, the cable will be surface laid and buried by diver jetting, where possible and allowed.

1.3.1.5 *Beach Landing*

The beach landing operation will consist of the following key activities:

- Pre-lay meeting;
- Installation of temporary and permanent seabed fixings;
- Beach preparation and equipment staging;
- Cable landing operation;
- Diver-assisted installation on the seafloor, including application of cable protection where required; and
- Post-landing operations, including beach burial and restoration at the BMH.

Figure 1.6 *Work Perimeter and Layout for the San Juan Beach Landing Activities*



Planning and preparations for the cable installation will begin approximately 1 week prior to commencement of the shore-end landing operations. Prior to the cable landing operation, a pre-landing meeting will be held to provide coordination between Alcatel representatives, the SWIV officers, and the beach contractor.

The seaward end of the BMH ducts will be exposed, and a working perimeter will be clearly marked and defined. The project will utilize entirely existing ducts; no new construction will be required. The location of the existing in-service cables and associated grounding cables will be identified and marked where they cross the beach. The existing cables will be identified using specialized cable detection equipment and localized digging as necessary to validate cable detection.

Final notification and coordination with local authorities will be completed before landing the cable. The worksite will be cordoned off from public access using temporary safety fencing. Markers and site control on the beach will identify and maintain a safe work area. Security will be provided for equipment that may be staged overnight.

1.3.1.6 *Mooring Points and Seabed Fixings*

Mooring points will be installed in advance of the cable laying operation in order to provide secure points on the seabed to hold the SWIV in place during installation. Divers have verified suitable mooring point locations in advance by conducting dive surveys to assess the benthic habitat. Provisional locations for the vessel mooring points are provided in Figure 1.7. They are proposed in predominantly sandy bottom areas and hardground areas that are not sensitive habitats in order to avoid impacting sensitive benthic habitat.

A summary of common seabed mooring point (anchor) types and their typical application is provided below.

<u>Conventional Anchors (Bruce, Danforth)</u>

These anchors generally can only be used in shallow water areas of sandy seafloor, and therefore have a limited area of use for this project. Their design requires embedment into the seabed which is achieved by dragging the anchors until they are set. They are suitable for making minor adjustments to a vessel's position so that the control cable deployment is possible.

Eye-Bolts and Screw Anchors

These types of devices are used in the cable industry for securing the cable on the seafloor along a selected route. These devices are neither intended to function as moorings for an installation vessel, nor are they adequate for securing a lay barge to maintain position.

Concrete Blocks

A concrete block is a dead-weight anchor that provides the hold back capability required to maintain position of the SWIV. A heavy lift crane barge would be required to deploy and recover concrete blocks. This additional vessel would require its own mooring arrangements to recover the concrete blocks, and thus repeat the same problem. The recovery of these concrete blocks would be very sensitive to weather and sea conditions, and it is possible these blocks would need to remain on the seabed for several months before recovery can be attempted safely.

Sandbag Anchors

A sandbag anchor is a dead-weight anchor that provides the hold back capability needed for a SWIV and cable to hold position. Approximately 24 1.5 tonne sandbags would be proposed for this project, 18 of which will be used as temporary anchors for the SWIV and six as temporary hold-back anchors for the cable. By comparison, 90 concrete blocks would be required for this installation, and the footprint on the seabed would be 55 percent greater. Sandbag anchors were used in the recent installation of the AMX-1 and PCCS cable systems in this project area. The volume of sand required to fill 24 sandbags is estimated as 36 m^3 (47 yard [yd]^3), or 1.5 m^3 (2.0 yd^3) per sandbag.

The sand would be collected from an area identified in advance, located far away from sensitive benthic habitat, and returned to the same location at the end of the installation exercise. There will be no excavation or discharge of sand in the Isla Verde Reef Marine Reserve (also referred to as Isla Verde).

Seabed fixings will be located at or close to the alter course (A/C) positions of the cable, elsewhere as necessary, and will allow divers to secure the cable on the seafloor during the installation process to ensure the cable will follow the agreed optimum route out through the reef tracts. Divers will swim the route a few days before the landing and install the temporary and permanent seabed fixings.

Temporary seabed fixings will be placed mostly in sand areas. In areas of hardbottom, permanent seabed fixings will be considered. The depth of hand-drilled holes and anchor size/rod diameter will be subject to seabed strength found at each location. During the detailed diver survey of the route, the specific type, quantity, and position of seabed fixings was determined. These include an estimate of one permanent location and 25 temporary locations, which will be locally optimized prior to works (Figure 1.7).

A brief description of the temporary and permanent seabed fixing types being considered is provided below.

Temporary seabed fixings under consideration include:

- Mushroom type, size up to 250 kilograms (kg); footprint of varying size up to 1 x m^2; typically used in sandy bottom;
- Bruce anchor, size up to 30 kg; footprint of varying size up to 1 x m^2; typically used in sandy bottom;
- Clump weight type, chain/concrete block, size 25 to 500 kg; typically used in harder seabeds; and
- Screw anchors, all types, typically 0.3 m diameter x up to 1.5 m long; typically used in sandy bottom.

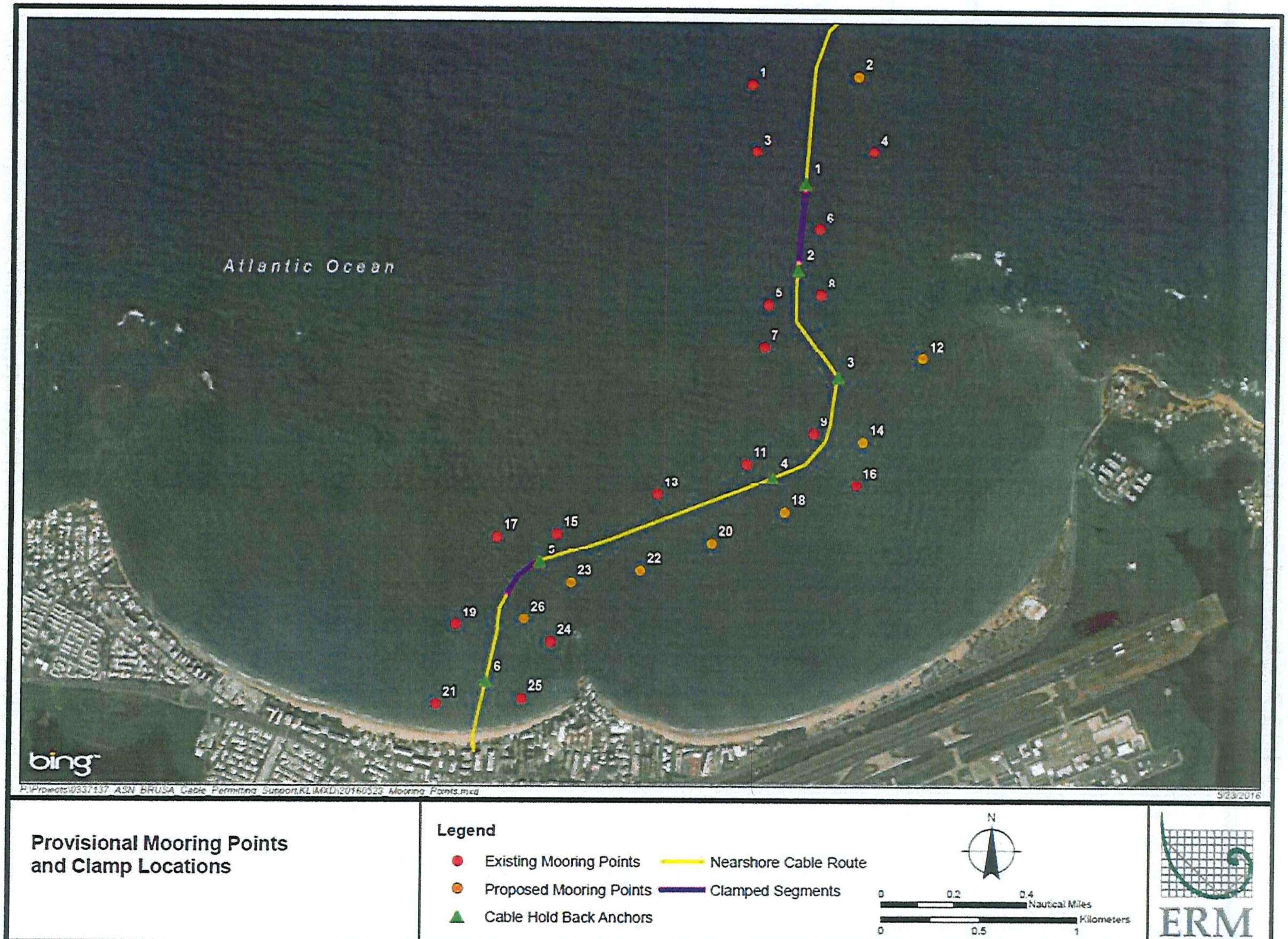
Permanent seabed fixings under consideration include the following:

- Stainless steel bar, typically 24 to 32 mm in diameter with eye, to be secured in a drilled hole using either underwater cement mix (will cure within days) or dual component epoxy resin for underwater use (will cure within hours at 15 degrees C);
- Manta Ray type of anchor, hand drilled to suit the size of the anchor rod; depth of hole as required and subject to hardground strength; and
- Screwed anchor plate with padeye, size 0.5 m x 0.5, fixed in 4 x 250 mm drilled M24 holes.

Permanent seabed fixings will be installed using commercially available underwater drilling units and metal rods will be secured using commercially available underwater cement or two component epoxy resin. The permanent (drilled) anchors will be left in place due to the adverse impacts associated with removing them and the temporary anchors will be removed after the nearshore cable installation.

On the day of the cable installation, divers will deploy small marker buoys along the route at each seabed fixing location to provide the SWIV and dive support vessels with a visual reference for cable laying.

Figure 1.7 ***Provisional Mooring Points and Seabed Fixing Locations***



1.3.1.7 *Shore-end Operations*

Shore-end operations will normally be conducted within 20-24 working days, starting at first daylight. Throughout the installation activities, the shore-end SWIV's captain and diving contractors will review the weather forecasts to ensure that the following maximum weather parameters are met for operations:

- Wave height, max: 1.5 m (4.9 ft);
- Wind speed, max: 30 kt (15 m/s) direction predominantly from shore; and
- Wind speed, max: 20 kt (10 m/s) direction predominantly from sea.

The cable will normally be laid from the SWIV from offshore to onshore, as described in Exhibit 1. The cable landing sequence, the final phase, will normally be as follows:

- Establish a temporary marker line in critical areas of the route;
- Establish a "messenger line" to beach;
- Using excavators on the beach, conduct "beach pulls" to bring the cable to shore;
- Ensure there is sufficient cable slack on the beach;
- Reposition the cable on the surface with small boats to align with the required route/position;
- Divers will start to cut the floats and guide the cable to the seabed;
- Once the cable is on the seabed, divers will swim the route to confirm it is laid properly;
- Floats will be returned to vessel; and
- Cable testing and beach jointing progress on the beach.

A team of divers will be deployed to install a temporary marker line along critical sections of the inshore route. The marker line will either be a 10 millimeter (mm) diameter metal core polypropylene line or 6-8 mm steel wire or equivalent and will be utilized in areas of hardbottom along the optimized route to give divers visual guidance where the cable will be installed in critical areas (e.g., where the cable passes close to sensitive habitat). The marker line will be positioned using A/C positions in critical areas along the preferred route.

Immediately prior to the cable landing, the two excavators will prepare the beach by setting up in beach pulling mode (one excavator is positioned near the landing point with a quadrant and the other excavator prepared with necessary rigging and pulling rope). A small diver workboat will meet with the work boat just outside of the surf zone and connect a messenger line to the cable, allowing the excavator to begin pulling the cable to the beach from the SWIV.

One heavy excavator will be used as an anchor point for the quadrant. Another excavator will pull the rope attached to the cable for a distance of 100 to 200 m (328.1 to 656.2 ft) along the beach. The SWIV will pay out cable with floats at the same rate at which the excavator performs the beach pulls. The cable will be secured each time the excavator needs to reposition to perform a new pull.

Small support vessels will guide the floating cable into position on the surface of the water aligned with the surface marker buoys. Once the desired length of cable has been secured on the beach, divers will remove the floats from the cable one at a time and begin guiding the cable to the seafloor. In critical areas, the marker line will be used to aid divers in aligning the cable with the optimum route to avoid impacts to sensitive habitats. After the cable is resting on the seafloor, attached epifauna may be located beneath the cable. Divers, with knowledge of local benthic fauna, will be able to adjust the cable position up to approximately 0.3 m (1 ft) to remove the cable from resting on or avoid attached organisms and unpin erect soft coral or sponge specimens (i.e., *Plexaura sp.*, *Pterogorgia sp.*, rope sponge).

The SWIV will stop as floats are removed and the cable sinks to the seafloor between two fixed points along the route. Each time the cable is secured to a seabed fixing by the divers, the SWIV cable vessel will be instructed to maneuver to the next holding position while laying/recovering the floating cable to ensure that excessive tension is not applied to the cable and also to maintain a safe separation distance from the diving and surface operations.

The securing of the cable at each seabed fixing location will prevent the cable from being pulled off the optimized route and ensure that sufficient slack is installed as required along the shore-end of the cable. Once the SWIV is secure in the next holding position, additional cable is laid out or recovered to enable the cable to be aligned and the cable floats are removed as the cable is secured at the next seabed fixing location. Divers can normally support this activity out to approximately 25 m (82 ft) water depth with a horizontal positioning accuracy of +/- 10 m using commonly available GPS equipment.

On the day of the shore-end connection to the main lay, the main lay vessel will move into position at or near the 35 m (115 ft) contour approximately 4.2 km (2.3 nm) from shore and pick up a buoy connected to the shore-end cable (prepared in advance by divers). A typical cable ship measures 140 m (459.3 ft) in length and drafts 8 m (26.2 ft) when fully weighted. The cable ship will set up and maintain position utilizing DP technologies, eliminating the need for anchors. The cable ship will be equipped with two bow and two stern enclosed 1,500-kw thrusters. The vessel is also equipped with one retractable thruster mounted in the hull which will not be utilized in shallow water. Both the bow and stern thrusters thrust in a horizontal plane, 50 m (164 ft) aft and 25 m (82 ft) to either side. Minimal turbulence (2 m [6.6 ft]) is created in a sideways and downward direction due to the efficient design of each thruster.

In total, the number and size of vessels involved in a typical shore-end operation is as follows:

- One shallow draught self-propelled barge, nominally 16 m in length;
- One zodiac/tender vessel, nominally 6-7 m in length;
- Two hard-boats, nominally 9 m in length;
- Three zodiacs/guard boats, nominally 5 m in length, not all needed at the same time; and
- One support tug, nominally 30 m in length – optional (only used if proven necessary).

In total, an estimated seven to eight vessels will be needed for the operation in addition to the SWIV; not all of these will necessarily be used at the same time.

1.3.1.8 *Post-Landing Operations*

After the cable is placed on the seabed, the cable end, currently on the beach, will be installed in the BMH. Cable testing will be performed to ensure cable is not damaged. The land cable team may then complete the beach joint – the transition between submarine cable and land cable. Articulated pipe and cable clamps will be fitted to the cable where required. Single sections of articulated pipe will be lowered by rope to the seabed under the control and instruction of the diver at each application location. Proposed locations for use of articulated pipe and cable clamps are provided in Figure 1.7.

This operation is expected to conclude by late morning. Excavators will then begin the beach burial, which will be to a minimum of 2 m (6.6 ft) below the surface or to hard ground, whichever comes first. The cable will be positioned in the bottom of the trench. The beach burial will extend from the seaward ducts of the BMH to near the waterline at low tide (Figure 1.8). As the trench approaches the low water mark, the trench depth will transition to approximately 2 m (6.6 ft) depth (i.e., the depth of cable burial offshore). The trench will be back-filled and the beach returned to its former condition. No sediments will be removed from the project area, nor will materials be introduced to the beach to fill the excavated area.

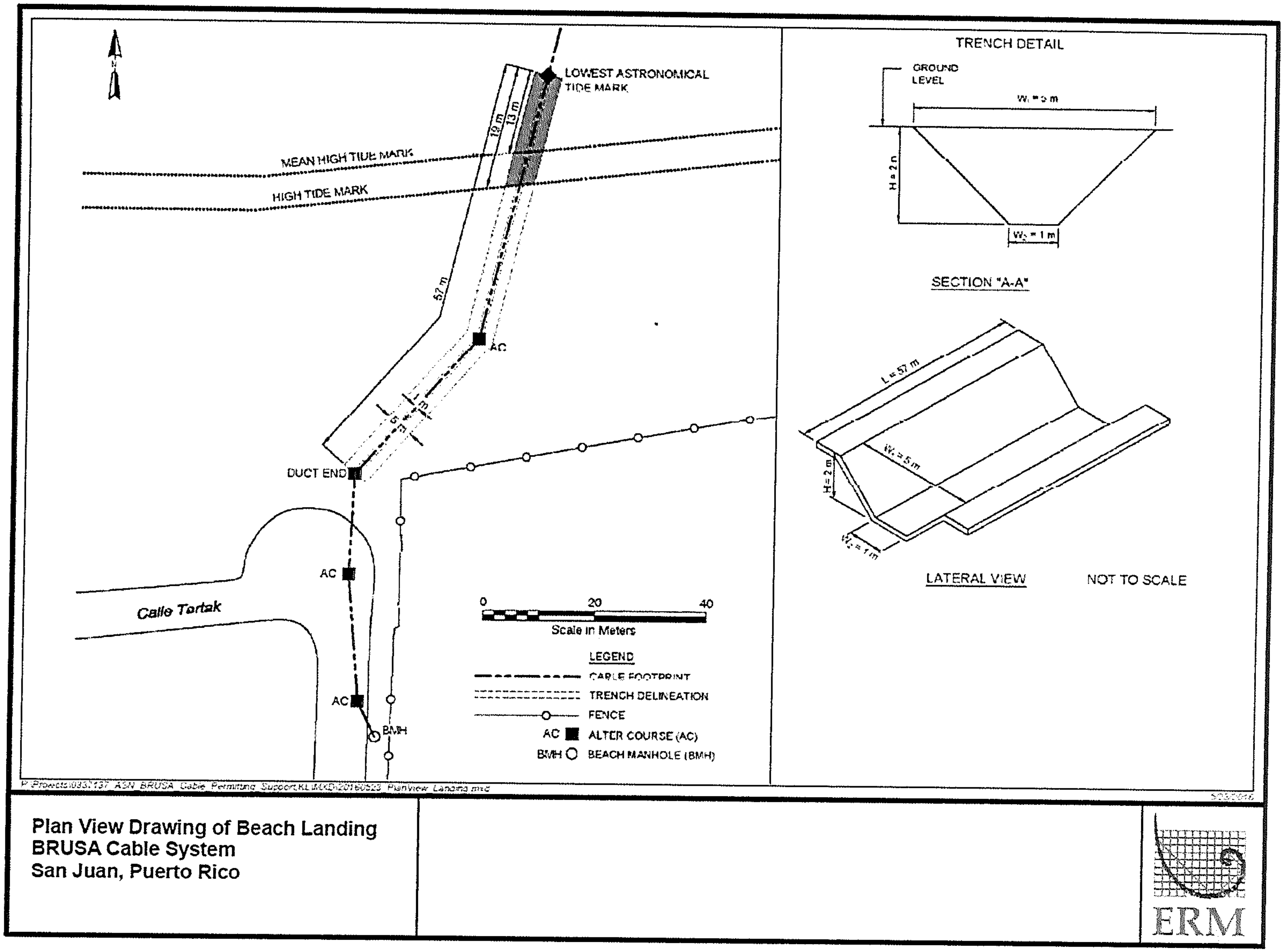
The length of proposed trench below the high tide mark toward the ocean is 19 m (62.3 ft), with the trench ending at the lowest astronomical tide (LAT) mark. The width of the trapezoidal trench is expected to be 5 m (16.4 ft) at the top and 1 m (3.3 ft) at the bottom. The volume of sand to be dredged for this portion of the trench is calculated as 114 m^3 (149.1 yd^3). This trench will be excavated and then backfilled with the same sand.

Table 1.1 provides the sand volume calculations for the portion of the trench located below the high tide line; the formula for the calculation of the area of a trapezoid is provided in Exhibit 2 of the Joint Permit Application (JPA).

Table 1.1 ***Measurements of the Beach Trench below the High Tide Mark***

Length (L)	*Height (H)*	*Width (W_1)*	*Width (W_2)*	*Total Volume (m^3)*
19 m	**2 m**	**5 m**	**1 m**	**114 m^3**

Figure 1.8 Schematic of Excavation for Beach Burial



1.3.1.9 *Duration of Shore-end Activities*

The expected duration of the beach works and shore-end activities is approximately 20-24 working days. All of the durations are dependent upon weather and swell conditions. An estimated break down of duration by activity is shown below.

Table 1.2 Duration and Dimensions of Shore-End Activities

Estimated Duration	*Activity*
Day 1 - 10	Install temporary and permanent seabed fixings.
Day 10 - 17	Inshore cable lay from KP 4.200 to KP 0.300.
Day 18	Beach setup. Locate the BMH and excavate the ends of the ducts on the beach. Two excavators arrive on the site plus rigging equipment for the shore landing. Prepare for shore-end landing (safety fencing and staging).
Day 19	Beach landing and post landing. The SWIV arrives at dawn at the 3.5 m depth contour and hold position. Cable pulled to shore, laid on seabed by divers, installed into BMH, and fitted with articulated pipe. Excavation and beach burial. Make beach joint at BMH.
Day 20 - 24	Contingency and restore site.

1.3.2 *Impact Factors*

The impact factors of the proposed action are associated with offshore and shore-end installation procedures:

- Vessel presence
- Cable lay
- Anchoring
- Beach installation

1.3.3 *Conservation Measures*

Several measures have been included in the design of the project to avoid or minimize potential impacts on the environment and listed species:

1. *Cable Route Selection* – as described above, the cable route was engineered to avoid areas of hardbottom habitat, where possible.
2. *Cable Installation on Seafloor* – several measures have been included in the installation methodology over the seafloor to avoid sensitive resources. These include:
    a. A pre-lay swim over the route position list (RPL) with a qualified biologist to examine, in detail, the proposed inshore route and adjust where necessary to avoid sensitive resources, particularly listed coral species;
    b. Installation of cable guided by a qualified biologist to make real-time adjustments where possible to avoid impacts to resources;
    c. Prior to any operations, personnel will be given environmental training focused on sensitive coral and other benthic species and precautions to avoid impacts to benthic communities during installation works;
    d. Weighting and clamping of cable in areas of hardbottom and sensitive resources to prevent its movement and subsequent damage to sessile marine life; and
    e. Post-installation monitoring to monitor for any unanticipated impacts to resources and to determine appropriate mitigation, where necessary.

    It should be noted that past projects in the area have performed coral relocations in areas where the cable could not be re-routed.
3. *In-water Works* – measures to avoid impacts to marine life from in-water works include:
    a. All vessel operations will incorporate marine mammal and sea turtle avoidance protocols during operations;
    b. Installation works will comply with NMFS's Vessel Strike Avoidance Measures and Reporting for Mariners; and
    c. Installation works will comply with NMFS's Sea Turtle and Smalltooth Sawfish Construction Conditions.
4. *Beach Installation* – The shore-end approach is aligned within an existing cable corridor used by other recent subsea cable systems. The following measures will be implemented to avoid impacts to marine resources during installation:
    a. Because the beach at Tartak Street serves as sea turtle nesting habitat, nesting season will be avoided, if possible. If not

feasible, sea turtle monitoring will be conducted 70 days prior to any beach operations during nesting season.

b. A biological monitor will also be present for the shore landing to monitor for swimming sea turtles and manatees during installation, turbidity, and sea turtle nesting at the landing site.

c. No open trenches will be left open overnight, and the beach will be returned to its pre-construction condition once installation is complete.

5. A *Mitigation and Monitoring Plan* will be prepared and implemented by ASN to avoid potential impacts to ESA-listed species and critical habitat during installation.

1.3.4 *Benthic Assessments Conducted*

A shallow water benthic survey of the proposed BRUSA route was conducted in May 2016. Surveys conducted for the PCCS system, which is proximal to the BRUSA Project area, included a marine geophysical survey and a mesophotic coral survey, which provide applicable information about benthic characteristics and species anticipated. Both the 2016 benthic survey and PCCS mesophotic survey reports are included as appendices to this biological assessment.

A marine geophysical survey was conducted for the BRUSA system and the reports are expected to be available in late June 2016.

1.3.5 *Contents of the Biological Assessment*

This document describes observed species and habitats in the Project area, potential effects, protective measures incorporated into the Project, and provides appendices with supporting reports and data.

2.0 *DESCRIPTION OF AFFECTED ENVIRONMENT*

The following is a description of the existing environmental resources within the project area, with emphasis on those natural resources that are capable of supporting federally threatened and endangered species.

2.1 *ASSESSMENTS CONDUCTED IN THE ACTION AREA*

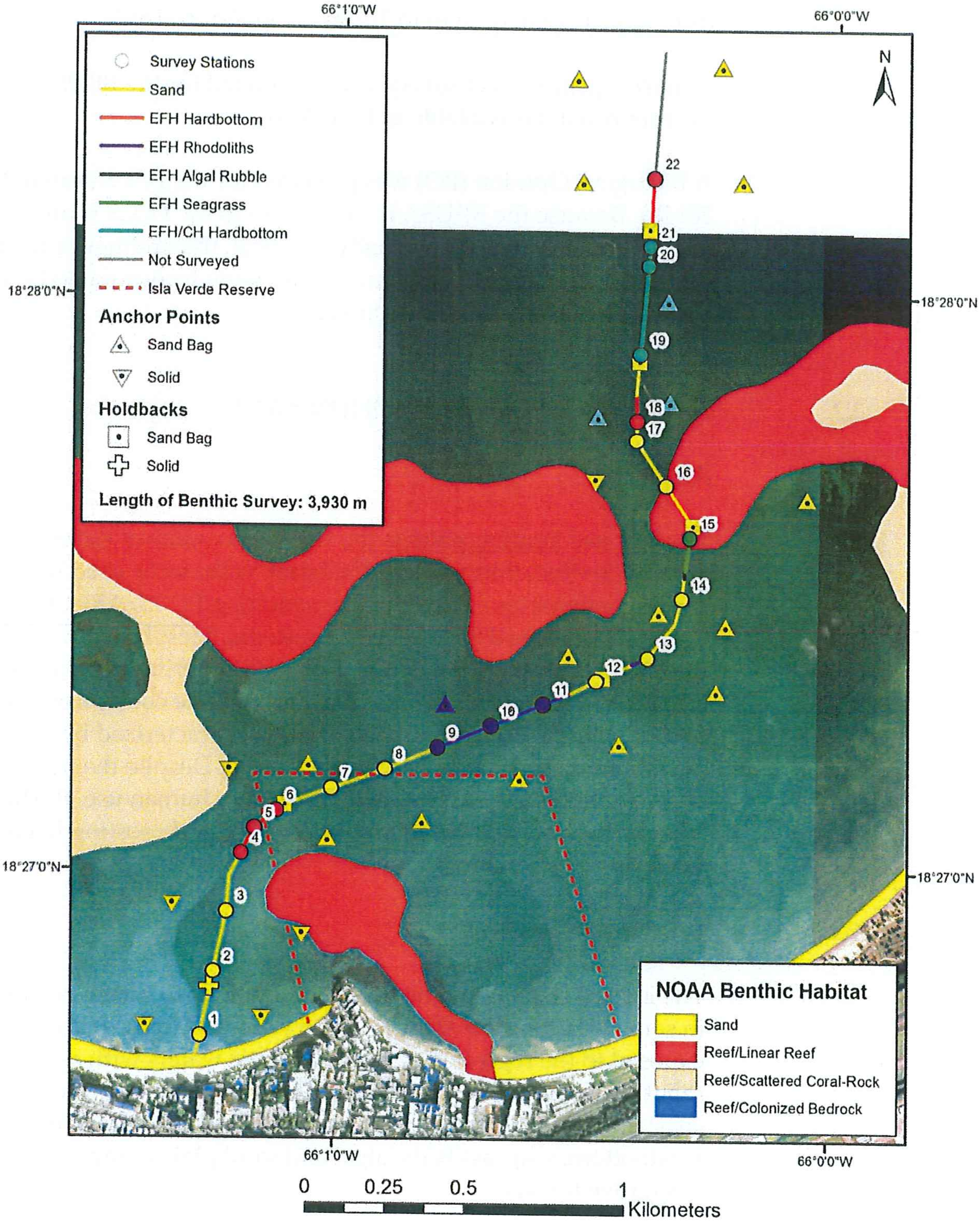
The Action Area (AA) for the proposed project includes the proposed cable route within Puerto Rican exclusive economic zone to the shoreline and within the proposed construction area along the beach in the vicinity of the BMH. Site-specific surveys conducted that are applicable to this Biological Assessment are:

- Benthic survey of nearshore area, May 2016 (Rivera 2016)
- Mesophotic coral survey for PCCS system, Segment 2A, 2013 (Tetra Tech 2013)
- Marine geophysical survey for PCCS system, Segment 2A, 2013

The May 2016 survey consisted of two diving operations to refine and characterize the cable route and associated benthic resources. First, the cable route was verified jointly by the scientific dive team and the installer during which agreements to alter the route slightly could be made in order to avoid or minimize impacts to sensitive habitats and species. Second, the benthic survey was conducted and involved characterization of 22 stations along the cable route using transect quantification and qualitative descriptions of benthic substrate, species composition, abundance, and percent cover.

The benthic habitat mapping and biological survey was performed in situ from the shoreline out to approximately 30 m water depth and approximately 4 km offshore. Between the 22 station locations, general descriptions of benthic substrate, essential fish habitat (EFH), and coral critical habitat were documented. Locations of federally listed coral species observed during the survey were identified and recorded relative to their distance from the route. Methodology and results of the 2016 benthic survey can be found in Appendix A to this document. Figure 2.1 shows benthic substrate observed during the 2016 survey, and denotes the stations used in the survey.

Figure 2.1 ***Results of Benthic Habitat Mapping along Proposed BRUSA Cable Route and Temporary Anchoring Locations***



Source: Rivera 2016

For the PCCS system, which includes a segment in the immediate BRUSA project area, a remotely operated vehicle (ROV)/drop video camera survey of the offshore/mesophotic environment was conducted in 2013, from approximately 24 m to 102 m (79 to 335 ft) depth.

A marine geophysical survey was conducted for the BRUSA system, and the report will be available in June 2016.

A Biological Opinion (BO) was prepared for the PCCS system (NMFS 2014b). Because the BRUSA route is close to the PCCS route, and the installation methods are virtually identical, the findings of the BO are relevant to the BRUSA assessment, and were incorporated by reference in a number of places in this document.

2.2 *HABITAT TYPES IN THE ACTION AREA*

2.2.1 *Beach*

The planned landing point is the Isla Verde beach at the end of Tartak Street, Carolina, Puerto Rico. The beach is the same used by several other existing submarine cable systems, including PCCS, ARCOS-1, Taino-Caribe, SAm-1, and SMPR-1 cable systems. Most beaches on this side of the island consist of thin deposits of sand covering a rocky lower foreshore. The environment at the landings site consists of a narrow strip of sandy beach along an urban coastline characterized by heavy development (primarily beachfront hotels). Despite the presence of the dense upland built environment and heavy human use, the beaches in the area provide nesting habitat for sea turtles, and roosting habitat for seabirds and shorebirds.

2.2.2 *Benthic Environment*

The insular shelf along the north coast of Puerto Rico is relatively narrow, in some locations less than 3.7 to 5.5 km (2 to 3 nm). The coast is fully exposed to the high energy of the Atlantic waters with seas usually high (>5 ft) between fall and spring, and highest in winter. A diversity of coastal marine habitats is present including reefs and colonized hardbottom, seagrass beds, algal and sand plains, estuaries, and mangrove forests.

There is little reef development on the north coast except for patchy coral and narrow linear "reefs." The origin of the mid-shelf reef in the area is non-biogenic, comprised of fossil sand dunes (i.e., eolianites) that formed during lower sea levels and the relief varies from low to high. North of Isla Verde Reef Marine Reserve, and in several other places along the north shore, these ridges are exposed as small rocky islets. Physical conditions allow some coral reef formations on the low-wave action side of eolianites. Possible factors controlling the coral reef development and distribution are intense wave action, light penetration, currents along the shore, and sediment abrasion generated by lateral transport. NOAA Benthic Habitat Maps (NOAA 2001) categorize these areas as linear reef, aggregated patch reef, colonized pavement, colonized bedrock, and scattered coral-rock habitats. Encrusting coral morphology is the major growth form of the scattered coral community covering this ridge (García et al. 2003; Goenaga and Cintrón 1979).

Unconsolidated bottoms are also present, composed of uncolonized sand, sand with macroalgae, seagrass beds, and rhodolith beds that often support macroalgae. Further detail on the habitat types along the proposed route are provided under the following sections.

2.2.2.1 *Characteristics of the Nearshore Route (<30 m Water Depth)*

The nearshore area (<30 m [<98 ft] depth) has been well-documented in recent years, with several previous benthic surveys having been conducted in the area for other cable systems, as well as the 2016 benthic survey along the proposed BRUSA route.

Results of the 2016 survey indicate four distinct zones proceeding offshore: backreef, reef, forereef, and deep reef, as categorized by bathymetry and habitat characteristics. A detailed description by zone is provided below.

<u>Backreef</u>

Survey stations 1 through 15 were located in the backreef zone, which ranged from the shoreline out to approximately 2.83 km offshore at depths from 3 to 7 m (9 to 25 ft). The shoreline stations (1-3) are characterized mostly by sand until the substrate transitions into the Isla Verde Reef Marine Reserve, which was described by the dive team to be predominantly hardbottom habitat with some sandy pockets. The Isla Verde Reef Marine Reserve (stations 4-6) was noted to be the only area with vertical relief in the backreef zone. Geophysical benthic zones present in the backreef progressed from sand at the shoreline through the marine reserve areas of hardbottom described above, into sand, algal rhodolith, and mixed (sand, rhodolith, rubble) substrates terminating with a seagrass bed at Station 15.

The sandy bottom stations near the shore lacked biota. The Isla Verde Reef Marine Reserve has hardbottom substrate that was characterized as EFH with low densities and cover (5-25 percent) of sponges, soft and hard corals, *Dictyota* species (spp.) where algae was present, and observations of EFH indicator reef fish species *Epinephelus fulvus* and *Chaetodon striatus*. The marine reserve had the highest number of fish species for stations in the backreef. At Station 5, 12 species were observed, including mostly small sized and juvenile wrasses, damselfish, surgeon fish, and parrotfish. The substrate shifted back to sand bottom following the Isla Verde Reef Marine Reserve and biota was not observed until sand became mixed with algal rhodolith.

The algal rhodolith benthos had low to medium (5-50 percent) cover where there was vegetation, rhodophytae and chlorophytae were common at Stations 9 and 11, and the survey team noted observations of *Strombus pugilis*, and EFH indicator *Strombus gigas* in this area. Algal rhodolith, rubble, and sand with few seagrass shoots predominated through the seaward extension of the backreef until Station 15 where a dense seagrass bed was observed. The final station in the backreef zone (Station 15) was described as a highly dense seagrass meadow that had cover ranging from medium to very high throughout the transect of *Thalassia testudinum*, *Syringodium filiforme*, and *Halophila decipiens* with some grass-free depressions within and observations of reef fish indicator species *E. fulvus* and *Ocyurus chrysurus*.

<u>Reef</u>

The reef zone along the survey route extends over two stations (16 and 17) along the cable route through a region where a man-made navigation channel has been cut to 18 to 21 m (59 to 68 ft) deep and 40 to 80 m (131 to 262 ft) wide. The channel is characterized by steep slopes and vertical walls with substrate that varies as some combination of sand, rubble or rock, and water depths range from 8 to 20 m (26 to 65 ft). The area flanking Stations 16 and 17 within this zone had shallow colonized hardbottom substrate. These shallow areas bordering the channel had moderate rugosity and structural complexity on which corals succeed; this habitat was considered EFH and coral critical habitat.

Station 16 possessed four colonies of *Orbicella faveolata* at least 26 m (85 ft) from the cable route. Station 17 possessed two colonies of *O. faveolata* at least 28 m (92 ft) from the cable route. Together, the shallow area of the reef zone had the highest abundance of *O. faveolata* observed during any span of the cable route benthic survey. Station 16 had the highest number of soft coral species (seven species) of any station surveyed, but a fairly low cover (5-25 percent) with *Plexaura* spp. being the dominant species. Hard coral cover was also considered to have low coverage, between 5-25 percent with 13 species recorded; *Siderastrea siderea, Diploria strigosa, Montastrea cavernosa*, and *Porites astreoides* were the most abundant. *S. siderea* and *D. strigosa* had the highest cover observed, mostly in plate and small boulder growth forms. In addition to corals, the team reported low cover of macroalgae, small sized sponges, zoanthids, urchins, and 29 fish species, four of those being reef fish EFH indicator species.

Only the shallow areas of the reef zone were considered to be coral critical habitat and EFH. The reef gap is not characterized as critical habitat or EFH. Likewise, the reef gap is already a disturbed site; two submarine cables were observed along the seafloor in the gap.

Forereef

The forereef zone extends over three stations (18-20) along the cable route, with depths ranging from 12 to 19 m (41 to 63 ft). Algal cover was low (5-25 percent) and predominantly *Dictyota*. Similarly, sponge cover was low (5-25 percent) where *Xestospongia muta, Ircinia* spp. were the most abundant sponges. No seagrass was observed. The forereef zone had the highest number of soft corals (Station 19) and the highest number of hard coral (Station 20) species observed during the survey. Soft corals were dominated by *Eunicea* spp., and the most common hard coral colonies were *Montastrea cavernosa* and *Siderastrea sidereal*, followed by *Meandrina meandrites* and *Porites astreoides*. One colony of *Orbicella faveolata* was observed at both Station 18 (28 m [92 ft] from the route) and Station 20 (at 1 m [3.3 ft] from the route). The forereef zone also had the most diversity of fish among other zones with 42 different species; seven of which were EFH indicator species.

Deep Reef

The deep reef zone included the final two stations along the benthic survey route, Stations 21 and 22 along the cable route, with depths ranging from 21 to 30 m (70 to 98 ft). Station 21 was described as hardbottom near the slope break and coral critical habitat. Station 22 was described as EFH flat hardbottom on an eolianite reef with some areas covered in fine sand. There was no significant vegetation at these stations. *Xestospongia muta* and *Ircinia* spp. were dominant and conspicuous sponges. *Plexaura* spp. were the dominant soft corals, but had low coverage (< 5 percent), and small colonies of hard corals (*M. cavernosa, D. strigosa, P. astreoides*, and *M. meandrites*) had low cover and predominantly plate morphology.

Coral Critical Habitat and Essential Fish Habitat

The scientific dive team identified coral critical habitat along the cable route over 3.471 to 3.839 km offshore, including stations 19-21. EFH was punctuated along the cable route and depended on habitat type and/or presence of indicator species but EFH was identified in all reef zones (backreef, reef, forereef, and deep reef).

The orientation and path of the BRUSA cable route does not require the relocation or take of any listed coral species. *Orbicella faveolata* was the only listed coral encountered during the dive survey and the nearest proximity of a colony to the route was at Station 20 at a distance of 1 m from the route.

Anchoring/Moorings Stations

As part of the benthic survey, the scientific dive team evaluated 25 potential temporary anchorage locations for the cable installation; 24 of which will involve the use of sandbag anchors. Seventeen of the surveyed temporary mooring locations have been used for recent cable laying projects (i.e., AMX-1, PCCS) and eight are new proposed sites. All of the newly proposed sites are located in sand areas where no live cover is present. Five anchoring locations that have been used during previous cable projects are situated within sensitive habitats, four in coral critical habitat, and one in algal rhodolith EFH. Sandbags placed in sensitive habitats will be placed in areas with the lowest biotic cover or in areas with a total absence of organisms.

2.2.2.2 *Characteristics of Mesophotic Habitats (>30 m Water Depth)*

The description of the mesophotic zone, obtained from the PCCS Segment 2A survey, is provided below. The BRUSA route is proximal and the PCCS characterization is considered to be representative of the BRUSA setting. Figure 2.2 shows the BRUSA and PCCS routes through the mesophotic area.

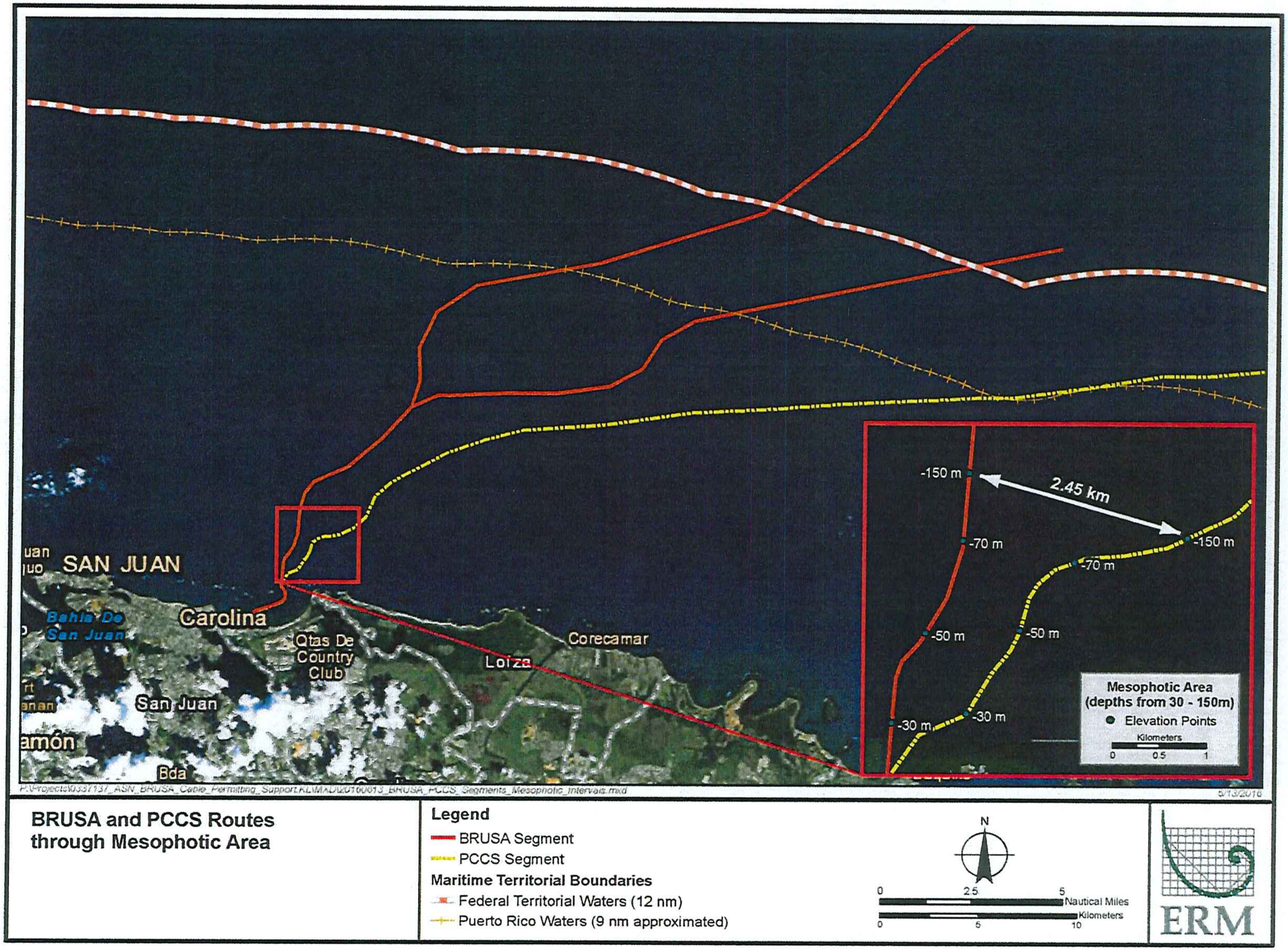
Beginning at the inshore end of the survey corridor, results showed the seafloor was a primarily flat, hard ground colonized by benthic algae, or colonized pavement (CPV) emerging from the sandy substrate. CPV was found as a discontinuous hard ground transitioning to sand with scattered rocks (SWS) bottom. Benthic algae, including both turf and fleshy macroalgae, were the most prominent component of the benthos. Sand pockets within the CPV comprised the other main substrate category. Due to the vast surrounding sand deposits, it is likely that the abiotic component within this habitat fluctuates markedly depending on sand transport over the hard ground habitat. Sponges were also common in terms of substrate cover. Large erect giant barrel sponges were the main species of the sponge assemblage.

Scleractinian corals were observed in the CPV habitat in low densities. Four species were observed, including *Orbicella franksi* and *Agarcia lamarki*. Sand abrasion and scouring likely associated with surge processes act to constrain development of scleractinian corals and other colonizing biota other than barrel (and few other) sponges within this habitat. Of particular relevance was the observation of feather black coral, *Antipathes pennacea* at a depth of 34 m within the CPV habitat. Several colonies, typically of small size (< 30 cm) were observed attached to the hardbottom.

An irregular and discontinuous group of rock promontories, classified as patch reefs (PRF) of variable sizes and shapes surrounded by sand was observed around a depth of 29 m. Benthic algae were the main biological agent colonizing the PRF habitat. It was mostly an algal turf, a combined assemblage of short filamentous brown and fleshy macroalgae growing as a carpet over hard ground substrates. Sandy sediments comprised the other main substrate category on PRF. Scleractinian corals were represented by seven observed species, all present as isolated encrusting colonies of relatively small size providing minor contributions to the reef topographic relief. *Colpophyllia natans, Madracis decactis, Meandrina meandrites, Montastraea cavernosa, Porites astreoides, Siderastrea sidereal,* and *Orbicella franksi* were noted on the PRF.

Sponges, mostly the giant barrel sponge, *Xestospongia muta*, had the highest invertebrate mean substrate cover. A total of 28 sponge species was recognized from the photo gallery of the PRF habitat. Because of their size and erect growth, giant barrel sponges were the most prominent biological component contributing topographic relief in the PRF habitat. Patch reefs within this route section were observed to a maximum depth of 32 m, producing a total of five benthic habitat transitions to sandy bottom (SND) or SWS along the route.

Figure 2.2 ***BRUSA and PCCS Routes through Mesophotic Area***



3.0 *DESCRIPTION OF SPECIES BIOLOGY*

The following species listed under the ESA are found in Puerto Rico and may occur in the AA:

Scientific Name	*Common Name*	*ESA Status*
Invertebrates		
Acropora cervicornis	Staghorn coral	Threatened
Acropora palmata	Elkhorn coral	Threatened
Dendrogyra cylindrus	Pillar coral	Threatened
Orbicella annularis	Lobed star coral	Threatened
Orbicella faveolata	Mountainous star coral	Threatened
Orbicella franksi	Boulder star coral	Threatened
Mycetophyllia ferox	Rough cactus coral	Threatened
Marine Reptiles		
Dermochelys coriacea	Leatherback turtle	Endangered
Caretta caretta	Loggerhead turtle (Northwest Atlantic Ocean Distinct Population Segment [DPS])	Threatened
Chelonia mydas	Green Turtle (North Atlantic DPS)	Threatened
Eretmochelys imbricata	Hawksbill turtle	Endangered
Marine Mammals		
Balaenoptera musculus	Blue whale	Endangered
Balaenoptera physalus	Fin whale	Endangered
Balaenoptera borealis	Sei whale	Endangered
Megaptera novaeangliae	Humpback whale	Endangered
Physeter macrocephalus	Sperm whale	Endangered
Trichechus manatus	West Indian manatee	Endangered
Fish		
Sphyrna lewini	Scalloped hammerhead (Central and Southwest Atlantic DPS)	Threatened

3.1 *INVERTEBRATES (CORALS)*

Seven species of coral are listed as threatened under the ESA in the Caribbean region: pillar coral (*Dendrogyra cylindrus*), lobed star coral

(*Orbicella annularis*), mountainous star coral (*Orbicella faveolata*), boulder star coral (*Orbicella franksi*), rough cactus coral (*Mycetophyllia ferox*), staghorn coral (*Acropora cervicornis*), and elkhorn coral (*Acropora palamata*). The range of each species includes Puerto Rico.

Table 3.1 ***Distribution of Threatened Coral Species in the Caribbean within U.S. Jurisdiction (NMFS 2016)***

Species	*Reef Environment*	*Depth Distribution*	*US Geographic Distribution*
Acropora cervicornis	Spur and groove, bank reef, patch reef, and transitional reef habitats, as well as on limestone ridges, terraces, and hardbottom habitats	5-30 m	Southeast Florida from Boynton Inlet in Palm Beach County to the Dry Tortugas; Puerto Rico; U.S. Virgin Islands (USVI); Navassa Island National Wildlife Refuge (NINWR)
Acropora palmata	Fore-reef, reef crest, and shallow spur-and-groove zone	1-5 m	Southeast Florida from Broward County to the Dry Tortugas; Flower Garden Banks National Marine Sanctuary; Puerto Rico; USVI, NINWR
Dendrogyra cylindrus	Most reef environments	1-25 m	Southeast Florida from Lake Worth Inlet in Palm Beach County to the Dry Tortugas; Puerto Rico; USVI; NINWR
Orbicella annularis	Most reef environments	0.5-20 m	Southeast Florida from Lake Worth Inlet in Palm Beach County to the Dry Tortugas; FGBNMS; Puerto Rico; USVI; NINWR
Orbicella faveolata	Most reef environments	0.5-90 m	Southeast Florida from St. Lucie Inlet in Martin County to the Dry Tortugas; FGBNMS; Puerto Rico; USVI; NINWR
Orbicella franksi	Most reef environments	5-90 m	Southeast Florida from Lake Worth Inlet in Palm Beach County to the Dry Tortugas; FGBNMS; Puerto

Species	*Reef Environment*	*Depth Distribution*	*US Geographic Distribution*
			Rico; USVI; NINWR
Mycetophyllia ferox	Most reef environments	5-90 m	Southeast Florida from Broward County to the Dry Tortugas; Puerto Rico; USVI; NINWR

3.1.1 *Staghorn Coral (Acropora cervicornis)*

3.1.1.1 *Range and Habitat*

Staghorn coral was once one of the most abundant reef-building species in Atlantic and Caribbean reefs, but have experienced significant declines quickly since the 1970s and 1980s throughout their range. Staghorn coral is identified and characterized by antler-like colonies with straight or slightly curved, cylindrical branches of diameters typically 0.25 to 5 centimeters (cm). This species historically formed expansive thickets prior to the decline observed since the 1970s and today are likely to be found as isolated branches and small thickets 0.5 to 1 m across. These species are found throughout the western Atlantic, Gulf of Mexico, and the Caribbean, including Puerto Rico (NMFS 2014a).

There are varying densities of staghorn coral present in Puerto Rico, off all coasts of the main island and around some of the smaller adjacent islands. Survey data has shown that there are several areas off the main island that possess dense, high profile thickets of staghorn coral, mainly at sites in the southwest, north, and west shores. Staghorn coral grows in water ranging from 5 to 30 m depth but rarely to 60 m. It commonly grows in areas with elkhorn coral; however, it generally occurs in deeper water and more protected from wave action (NMFS 2014a).

Staghorn coral requires consolidated substrate for settlement of larvae or reattachment of fragments in order to colonize; consolidated material includes stable, dead coral skeleton or hardbottom. High water clarity and circulation, as well as accessibility to sunlight for nourishment are all imperative habitat requirements for corals. Acroporids are unlikely to successfully substitute nourishment received from photosynthetic processes with alternative food sources; therefore, water clarity is paramount. Optimal growing temperatures range between 21° and 30° C, but there is some tolerance at either end during seasonal peaks and lows (NMFS 2014a).

3.1.1.2 *Presence in Action Area*

Acropora cervicornis is noted to have been observed in dense thickets off the north shore of Puerto Rico (NMFS 2014a); however, this species has not been observed in the AA. There were no colonies of *A. cervicornis* observed during the benthic dive survey conducted along the BRUSA cable route out to 4.046 km offshore (Rivera 2016). Similarly, there were no colonies observed in the mesophotic coral survey performed for the proximally located PCCS (Tetra Tech 2013).

3.1.2 *Elkhorn Coral (Acropora palmata)*

3.1.2.1 *Range and Habitat*

Elkhorn coral is the largest acroporid species found in the Atlantic and Caribbean and is found widely distributed throughout the western Atlantic, Gulf of Mexico, and Caribbean, including Puerto Rico. Colonies develop distinctive flattened-rounded frond-like branches up to 50 cm across and range in thickness from 4 to 5 cm; individual colonies can grow to 2 m in height and 4 m in diameter (NMFS 2014a).

Varying densities of elkhorn corals exist off the coast of the main island and also in areas surrounding some of the smaller adjacent islands. Survey data has shown that there are certain areas that possess dense, high-profile thickets of elkhorn coral mixed with staghorn coral, mainly at sites on the southwest, north, and west shores. By contrast, there are large areas of dead elkhorn colonies that exist on the fringing coral reefs along the shorelines in certain areas of the Puerto Rico coastline (NMFS 2014a).

Elkhorn coral can typically be found in the turbulent shallow waters from 1 to 5 m depth, on the forereef, reef crest, and shallow spur and groove zone; they have been found to 30 m and in backreef environments. Similar to staghorn coral, elkhorn coral requires consolidated substrate for settlement and colonization, water clarity, high circulation, and accessibility to sunlight for photosynthesis, with optimal growing water temperatures ranging from 21° to 30° C (NMFS 2014a).

3.1.2.2 *Presence in Action Area*

Acropora palmata has been observed in dense thickets off the north shore of Puerto Rico (NMFS 2014a). Colonies of this species have been found during previous surveys and installations in the area, though not directly within the BRUSA cable corridor. There were no colonies of *A. palmata* observed during the benthic dive survey conducted along the BRUSA cable route out to 4.046 km offshore (Rivera 2016).

3.1.3 *Pillar Coral (Dendrogyra cylindrus)*

3.1.3.1 *Range and Habitat*

Pillar coral, *Dendrogyra cylindrus*, is considered uncommon to rare throughout the Caribbean and off the southeast coast of Florida, appearing in scattered, isolated colonies (cover is generally less than one percent). It inhabits most reef environments between 1 and 25 m water depth. The species has relatively low annual egg production and sexual recruitment is low, but it can also propagate by fragmentation. The combination of low gamete production and low population density is thought to limit sexual reproduction rates and larval supply, thereby limiting genetic mixing and recovery from threat-induced mortality events (NMFS 2015a; 79 FR 53852).

3.1.3.2 *Presence in Action Area*

D. cylindrus is known to occur in Puerto Rico. Colonies have been observed in the AA during previous surveys and cable installations. There were no observations of *D. cylindrus* during the benthic dive survey conducted along the BRUSA cable route out to 4.046 km offshore (Rivera 2016).

3.1.4 *Lobed Star Coral (Orbicella annularis)*

3.1.4.1 *Range and Habitat*

Orbicella spp. historically dominated coral reef composition in both coverage and abundance throughout the Caribbean forming dense assemblages of hundreds-of-years-old colonies. Since the 1980s major declines, between 50 and 90 percent, have been reported for many locations; few areas have reported stable or increasing populations. The decline of *Orbicella* spp. has been associated with the concurrent decline in *Acropora* spp. throughout the Caribbean. The star corals have slow growth rates, late reproductive maturity, and low recruitment rates in alignment with other coral taxa life histories listed here. Partial mortality of the larger, older, and dense assemblages of *Orbicella* spp. tends to result in the production of genetically identical fragments and associated population shifts to smaller size class distributions (NMFS 2015a).

Orbicella annularis is distributed throughout the Caribbean and ranges in depth from the intertidal to over 80 m, but most common up to 20 m, and can show marked variation in form and phenotype across different depths, habitat types, and environments. Studies suggest that form varies in different microhabitats due to differences in light, competition, and bioerosion (Weil & Knowlton 1994).

3.1.4.2 *Presence in Action Area*

Orbicella annularis is thought to be present throughout its historical range which includes Puerto Rico (NMFS 2015a). This species was not observed during the benthic dive survey conducted along the BRUSA cable route out to 4.046 km offshore (Rivera 2016). Similarly, there were no colonies observed in the mesophotic coral survey performed for the proximally located PCCS Segment 2A cable route (Tetra Tech 2013).

3.1.5 ***Mountainous Star Coral (Orbicella faveolata)***

3.1.5.1 *Range and Habitat*

Mountainous star coral colonies are crustose, massive-rounded, hemispherical, or massive and tall with shingle-like lateral extensions that are found distributed throughout the Caribbean often among other members of *Orbicella*. The range of *O. faveolata* overlaps broadly with the depth distribution of *O. annularis*; however, it has been noted that *O. faveolata* can extend its range into shallower or deeper habitats than *O. annularis* (Weil & Knowlton 1994).

3.1.5.2 *Presence in Action Area*

Orbicella faveolata colonies have been identified in previous benthic surveys conducted along the PCCS cable route in three differentiated zones, including reef, forereef and deep reef zones (Rivera 2013).

Orbicella faveolata was observed during the benthic survey that was conducted along the BRUSA cable route out to 4.046 km offshore. A total of 10 colonies were observed over five stations in the reef, forereef, and deep reef zones in different geophysical habitat types; seven colonies within the reef gap, and three within coral critical habitat. Similarly, during the RPL swim survey two colonies of *O. faveolata* were recorded in the critical habitat zone offshore; one observation overlaps with the observation recorded at Station 20. Ultimately there were 11 colonies of *O. faveolata* observed along the cable route during the May 2016 survey (Rivera 2016).

There were no colonies of *O. faveolata* observed during the PCCS cable route mesophotic survey conducted in 2013.

3.1.6 Boulder Star Coral (*Orbicella franksi*)

3.1.6.1 *Range and Habitat*

Orbicella franksi forms massive, encrusting, plate or *subcolumnar plocoid* colonies through budding processes. Colonies that form in shallower waters tend to be crustose or submassive, whereas deeper (> 15 m) form massive heads, crustose sheets, massive plates, or stacks of wide plates. This species is distributed throughout the Caribbean and it has a wide, but consistently deeper depth range than *O. annularis* and *O. faveolata*. Small colonies have been recorded at 2 m; deeper colonies can be expected at depths > 50 m (Weil & Knowlton 1994).

3.1.6.2 *Presence in Action Area*

Orbicella franksi is thought to be present throughout its historical range which includes Puerto Rico (NMFS 2015a). *O. franksi* was not observed during benthic dive survey conducted along the BRUSA cable route out to KP 4.046 (Rivera 2016). This species was observed during the PCCS mesophotic survey (Tetra Tech 2013) and it is possible that there are colonies in the BRUSA corridor.

3.1.7 Rough Cactus Coral (*Mycetophyllia ferox*)

3.1.7.1 *Range and Habitat*

Rough cactus coral occurs throughout the Caribbean and off the coast of Florida; however, little detail is known about the species-level cover of *Mycetophyllia ferox* throughout its range. Low encounter rates and low percent cover combined with the tendency of surveys to identify to the genus level has made it difficult to estimate population trends from *M. ferox* monitoring data. *M. ferox* is a hermaphroditic, brooding, colony-forming species; the first reproduction typically occurs after the colony has reached an area greater than 100 cm^2. Present and historical data suggest that recruitment is low. The combination of low recruitment and time needed for the colony to grow into the size necessary for the first reproduction limit the capacity for recovery from mortality events (NMFS 2015a).

3.1.7.2 *Presence in Action Area*

Mycetophyllia ferox is known to occur in Puerto Rico. Multiple colonies of *M. ferox* were recorded during previous benthic surveys in the AA, primarily in deep water areas. There were no observations of *M. ferox* during the benthic dive survey conducted along the BRUSA cable route (Rivera 2016). Similarly, there were no colonies observed in the mesophotic coral survey performed for the proximally located PCCS Segment 2A cable route (Tetra Tech 2013).

3.1.8 *Status and Threats*

All of the corals described here are federally listed as threatened species under the ESA. This designation applies to any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

There are many threats to Caribbean corals, including local sources such as land-based pollution and water quality degradation, and overfishing; however, disease and ocean warming have been identified as the two largest threats that will impact coral recovery. Disease is widespread and episodic. Sea-surface temperatures are expected to continue to rise over time, exacerbating disease impacts and ocean acidification due to increased atmospheric carbon dioxide, which will inhibit coral recovery.

Coral species share many commonalities and are likely affected taxa-wide by threats to colonization, growth, reproduction, or survivability (NMFS 2015a).

Massive reductions in coral coverage and accretion rates throughout the Caribbean (and other areas of coral growth worldwide) have been occurring since the 1970s and 1980s. Since major die-offs began there have been additional catastrophic mortality events for *Acropora* spp. in the Caribbean due to mass bleaching events, disease, and destruction from hurricane activity; more events like these are expected in the future (NMFS 2014a).

Overall, threats to corals are synergistic and further actions will be necessary to determine causal and mechanistic interworkings of the natural and man-made processes at work (NMFS 2015a).

3.1.9 *Critical Habitat*

On November 26, 2008, NMFS designated critical habitat for elkhorn and staghorn corals covering approximately 2,959 square miles (mi^2), including marine habitat in Florida, Puerto Rico, and its associated islands, and in St. Thomas, St. John, and St. Croix, USVI. NMFS identified "substrate of suitable quality and availability to support larval settlement and recruitment, and reattachment and recruitment of asexual fragments" as the essential feature to their conservation. Suitable substrate qualifies as natural consolidated hard substrate or dead coral skeleton that is not covered in turf macroalgae or sediment. In Puerto Rico this essential feature has been designated for all waters 30 m and shallower up to the mean low water (MLW) line for the main island and associated islands. Natural sites, structures, and hard substrates that are covered with fleshy or turf macroalgae, seagrasses, or sediment do not provide the essential feature for these corals; similarly, all existing constructions federally-authorized or permitted man-made hard structures such as Aids To Navigation, artificial reefs, boat ramps, docks, pilings, channels, or marinas do not provide the essential feature (NMFS 2008).

Critical habitat has not been established for the five other threatened Caribbean species listed in 2014, *Orbicella annularis, O. faveolata, O. franksi, Mycetophyllia ferox*, and *Dendrogyra cylindrus*; however, the range of these scleractinians overlap broadly with those of the Acroporids. Coral critical habitat is present in the AA.

3.2 *MARINE REPTILES (SEA TURTLES)*

Four species of sea turtles have the potential to occur in the AA. These include two threatened species, the green turtle (*Chelonia mydas*) and the loggerhead (*Caretta caretta*), and two endangered species, the hawksbill turtle (*Eretmochelys imbricata*) and the leatherback turtle (*Dermochelys coriacea*). The area where the proposed cable will land consists of a sandy beach with a gentle slope and easy accessibility from the water. These characteristics are considered suitable for sea turtle nesting. The USFWS has recorded the presence of nests and turtles in the water in the AA (Rivera 2013). The scientific dive team communicated incidental observations of a small number of sea turtles during the benthic survey, but they were not identified to a species (Rivera pers. comm. 2016).

3.2.1 *Leatherback Turtle (Dermochelys coriacea)*

3.2.1.1 *Range and Habitat*

Leatherbacks are the largest living turtle with unique skeletal morphology, and a carapace distinguished by tough, rubber-like, oil-saturated connective tissue. Adult leatherbacks are highly migratory species and believed to be the most pelagic of all the marine turtle species; they migrate farther and into colder water than any other marine reptile. They are known to feed on pelagic medusae jellyfish, siphonophores, salps, "jellyballs" (*Stomolophus*), and they are also known to depredate baited fishing lines (NMFS & USFWS 1992).

By comparison to other regions in the Caribbean, the U.S. Caribbean supports minor nesting colonies on the order of 150 to 200 nesting adult females per year. Leatherback nesting has been documented in the U.S. Caribbean in the USVI and Puerto Rico including Culebra, Vieques, and Mona Islands. Culebra Island is one of the sites within the U.S. Caribbean that supports large nesting colonies of leatherback turtles with between 88 to 184 nests per year and predominantly on Resaca and Brava beaches. Leatherback nesting does occur on several beaches of the main island, but not in large numbers (NMFS & USFWS 1992).

3.2.1.2 *Presence in Action Area*

Dermochelys coriacea is known to occur and nest throughout the Caribbean and have been observed nesting in increasing numbers along the northern coast of Puerto Rico (CESAMPR 2014). In February of 2014 a leatherback nest was found on the beach at Isla Verde Marine Reserve which is immediately adjacent to the AA (CESAMPR 2014; Fox 2014).

3.2.2 *Loggerhead Turtle (Caretta caretta)*

3.2.2.1 *Range and Habitat*

The AA falls within the range of the Northwest Atlantic Ocean DPS of loggerhead turtles, defined by NMFS as north of the equator, south of 60° N latitude and west of 40° W longitude. Loggerhead turtles are highly migratory species that inhabit temperate and tropical waters; they are commonly found throughout the North Atlantic, including the Gulf of Mexico, the northern Caribbean, Bahamas archipelago, and farther east to the coast of West Africa, the western Mediterranean, and the west coast of Europe. The recovery plan for *C. caretta* has further divided the DPS found in the Northwest Atlantic into five recovery units, one of which encompasses the greater Caribbean, but these areas do not include Puerto Rico (NMFS & USFWS 2008).

3.2.2.2 *Presence in Action Area*

Loggerheads have been sighted occasionally in the waters of Puerto Rico, but have not been directly observed during prior benthic surveys in the AA (Rivera 2013).

3.2.3 *Green Turtle (Chelonia mydas)*

3.2.3.1 *Range and Habitat*

Green turtles primarily occur in tropical and subtropical waters, in the U.S. This includes the Atlantic and Gulf of Mexico coastal waters from Massachusetts to Texas and in the U.S. Caribbean (USVI and Puerto Rico). The natal beaches and offshore seagrass beds of Culebra Island are critical in supporting green turtle reproduction, hatchling convergence zones, and juvenile feeding grounds in relatively protected waters (NMFS 1998a).

The waters surrounding Mona Island, Puerto Rico support a small green turtle population, thought to be surviving due to Mona's remote location and the full-time presence of Puerto Rico's Department of Natural and Environmental Resources fisheries and wildlife enforcement personnel. Limited green turtle nesting occurs on Mona Island (NMFS 1998a).

The Culebra archipelago is also important green turtle developmental habitat, supporting juvenile and subadult green turtle populations and a small population of adults. Additionally, the coral reefs and other topographic features within these waters provide green turtles with refuge from predators (NMFS 1998a).

3.2.3.2 *Presence in Action Area*

Green turtles are known to occur and nest throughout the Caribbean including the waters/beaches of Puerto Rico. Green turtles have been sighted previously within the AA.

3.2.4 *Hawksbill Turtle (Eretmochelys imbricata)*

3.2.4.1 *Range and Habitat*

The hawksbill turtle is distributed through the Caribbean, Atlantic coastline, and Gulf of Mexico. *E. imbricata* occurs in tropical and subtropical waters and within the U.S., and is most common in Puerto Rico, its associated islands, the USVI, and Florida. Juveniles are thought to be predominantly pelagic before recruiting to benthic foraging grounds. Coral reef habitats surrounding Mona and Monito Islands in Puerto Rico are widely recognized as the primary foraging habitat of juvenile, subadult, and adult hawksbill turtles; these reefs are among the few known remaining locations in the Caribbean where hawksbill turtles occur with considerable density (NMFS 1998a).

Hawksbill nesting occurs principally in Puerto Rico and in the USVI; Mona Island supports the largest population of nesting hawksbill turtles in the U.S. Caribbean. Considerable nesting activity and apparent site fidelity has also been observed on the beaches of Culebra Island, Vieques, and mainland Puerto Rico (NMFS 1998a).

3.2.4.2 *Presence in the Action Area*

Hawksbill turtles are permanent residents in the waters of Puerto Rico. They are commonly observed at the surface and underwater, nest on local beaches, and are likely to occur in the AA.

3.2.5 *Status and Threats*

Today, the primary threats to sea turtles in general stem from beach erosion, beach renourishment projects, coastal development, artificial lighting (disrupting sea finding behavior in hatchlings), beach cleaning, increased human presence, use of recreational beach equipment, hatchling mortality, entanglement in fishing gear, drowning as a result of depredation, incidental bycatch, ingestion of marine debris, vessel strike, and pollution; these tend to be the largest threats and act synergistically to degrade the natural environment (NMFS & USFWS 1992).

Leatherbacks were never harvested to a great extent for commercial sale or illegal trade, although there have been reports of rare take of leatherbacks in the USVI for their meat, in Puerto Rico for meat and oil, and their eggs may be poached from nests (NMFS & USFWS 1992).

Green turtle populations decreased significantly from their historical levels due to directed turtle fishery operations that existed prior to listing under the ESA. Additionally, green turtle populations have been greatly reduced and stressed due to habitat loss throughout their range. Degradation of seagrass meadows has slowed recovery of turtle populations by effectively reducing foraging grounds that support all turtle life stages (NMFS 1998a).

International commerce in hawksbill turtle carapaces or "bekko" is considered to be the most significant factor endangering this species worldwide. Sale and distribution of hawksbill shells is internationally banned, but is still sold through illegal trade routes (NMFS 1998a).

3.2.6 *Critical Habitat*

Currently the only critical habitat (CH) for leatherback turtles in the Atlantic falls within St. Croix, in the USVI. In June of 2012, NMFS denied a petition to revise the existing critical habitat designation for the leatherback sea turtle to include the coastline and offshore waters of the Northeast Ecological Corridor in Puerto Rico, citing a lack of reasonably defined physical or biological features that are essential to the leatherback turtle's conservation that may require special management considerations of protection (NMFS 2012).

In July of 2014, NMFS issued a final rule to designate critical habitat for the Northwest Atlantic Ocean DPS of the loggerhead sea turtle, including one or a combination of habitat types: nearshore reproductive habitat, winter area, breeding areas constructed migratory corridors, and/or *Sargassum* habitat. Furthermore, USFWS issued a separate document for terrestrial areas of critical habitat necessary for turtle nesting (NMFS 2012). Neither the marine areas CH designated by NMFS, nor the nesting beaches CH designated by USFWS for the Northwest Atlantic DPS of loggerhead turtles include any areas within Puerto Rico.

In September 1998, NMFS issued a final rule to designate critical habitat for the threatened green sea turtle to include coastal waters surrounding Culebra Island, Puerto Rico, and the endangered hawksbill sea turtle to include coastal waters surrounding Mona and Monito Islands, Puerto Rico. The seagrass beds of the Culebra archipelago have been well documented as critically important as developmental habitat for the green turtle and additionally supporting juvenile and subadult green turtle populations along with a small population of adults. Coral reefs in this area further support green turtles with shelter during interforaging periods and provide refuge from predators. The seagrass beds also provide habitat to endangered hawksbills and leatherbacks that use Culebra's coastal waters to access nesting beaches (NMFS 1998a).

Nesting and foraging habitat for sea turtles is present within the AA; however, no critical habitat for any of these species is present.

3.3 *MARINE MAMMALS*

There are five species of ESA-listed whales (blue, finback, sei, humpback, and sperm) that can possibly be found in or near the AA.

3.3.1 *Blue Whale (Balaenoptera musculus)*

3.3.1.1 *Range and Habitat*

Blue whales are found worldwide and are separated into populations based on the ocean basin system in which they are found, including North Atlantic, North Pacific, and Southern Hemisphere. *B. musculus* feed on euphausiids and zooplankton, and appear gray in color or light blue when viewed underwater. Although blue whale populations were severely decimated due to whaling operations globally, there is no evidence to suggest that whaling has altered their global distribution presently. Research suggests that their distribution is based on availability of a food source, and that populations migrate with the seasons. Movement toward the poles during the spring corresponds with maximum zooplankton return in foraging grounds during the summer, and movement toward the subtropics in the fall reduces energy expenditure, avoidance of ice entrapment in higher latitudes, and allows engagement in reproductive activities (NMFS 1998b).

3.3.1.2 *Presence in Action Area*

Blue whales have been reported off the coast of Vieques, Puerto Rico along with other cetaceans and marine mammals.

3.3.2 *Fin Whale (Balaenoptera physalus)*

3.3.2.1 *Range and Habitat*

Fin whales are widely distributed throughout the Atlantic, Pacific, and Southern Hemisphere. The population structure and genetic differences between populations in different oceanic basins are currently not well defined. Recent estimates for the Western North Atlantic stock that is primarily located northward of Cape Hatteras, North Carolina to Nova Scotia predict the existence of approximately 1,618 individuals. Fin whales are common in these high productivity northern and temperate waters foraging for pelagic crustaceans and schooling fish. This stock shows evidence of site fidelity by females; however, little is known about where reproductive behaviors and calving take place. There is evidence for seasonal movements in the northern latitudes and some individuals may migrate southward towards the tropics, but there is no convincing evidence for distinct, annual, population-wide migrations as there are with other species of baleen whales (NMFS 2015b; NMFS 2010a).

3.3.2.2 *Presence in Action Area*

Fin whales tend to stay generally anti-tropical, centered within their more temperate zones and there is little movement between populations in the three defined regions (North Atlantic Ocean, North Pacific Ocean, and Southern Hemisphere; NMFS 2010a). Therefore, it is highly unlikely that fin whales would be present within the AA and have not been observed along the proposed cable route during prior surveys. Fin whales have been reported off the coast of Vieques, Puerto Rico, along with other cetaceans and marine mammals (USFWS 2015).

3.3.3 *Sei Whale (Balaenoptera borealis)*

3.3.3.1 *Range and Habitat*

Sei whales are widely distributed throughout the world's oceans, predominating in the temperate to subpolar regions. Population structures are thought to be discrete and divided into their respective ocean basins, except in the Southern Ocean where populations may mix. Sei whales are not definitively resident in any of their populations; they are highly mobile species and typically feed on calanoid copepods and eupausiids near the poles and winter in warmer temperate or subtropical waters. The range of sei whales in the western North Atlantic extends from Greenland down to the southeastern U.S., and occasionally the Gulf of Mexico and the Caribbean Sea; they tend to occur in deep water most commonly over the continental slope and are not typically found in semi-enclosed water bodies (NMFS 2011). The latest abundance estimate for sei whales in the Nova Scotia stock (formerly named the Western North Atlantic) predicts approximately 357 individuals, with no discernable population trend (NFMS 2015c). The southernmost confirmed records of sei whales in the western Atlantic are cases of strandings along the northern Gulf of Mexico and in the Greater Antilles (NMFS 2011).

3.3.3.2 *Presence in Action Area*

Sei whales have been reported off the coast of Vieques, Puerto Rico, along with other cetaceans and marine mammals (USFWS 2015).

3.3.4 *Humpback Whale (Megaptera novaeangliae)*

3.3.4.1 *Range and Habitat*

Humpback whales are widely distributed throughout the world's oceans. In the Gulf of Maine stock (formerly named the Western North Atlantic), humpbacks forage for fish or euphausiids over the spring and summer from western Greenland south to the eastern coast of the U.S. Portions of this population (and regional subpopulations based on matrilineal fidelity) will migrate during winter months southward to the West Indies to mate and calve; however, it is still common to find them in mid- and high-latitudes during the winter. During reproductive activities humpbacks are most commonly found in the waters of the Dominican Republic, but also at much lower densities throughout the Antillean arc from Puerto Rico to the coast of Venezuela. The overall North Atlantic population, including the Gulf of Maine stock, was estimated from breeding ground genetic tagging data to be 4,894 males and 2,804 females (NMFS 2015d).

3.3.4.2 *Presence in Action Area*

Humpback whales mate and calve off the coast of Puerto Rico and throughout the Antillean archipelago (NMFS 2015d).

3.3.5 *Sperm Whale (Physeter macrocephalus)*

3.3.5.1 *Range and Habitat*

Sperm whales are distributed throughout the world's oceans. Females and juveniles tend to inhabit tropical and subtropical waters, whereas males form bachelor groups, but with age become more isolated and wide-ranging, inhabiting temperate and polar waters (NMFS 2010c). Sperm whales forage through the entire water column, predominantly at 500 – 1,000 m, on squids and other cephalopods, and medium- to large-sized demersal fish such as rays, sharks, and teleosts (NMFS 2010b). In the Caribbean, reviews of literature have indicated that the greatest abundance of sperm whales occurs in continental slope and oceanic waters from late fall through early spring, but that encounters are rare from April to September. Abundance estimates and stock trends are currently unavailable for the Puerto Rico and USVI sperm whale population (NMFS 2010c).

3.3.5.2 *Presence in Action Area*

Sperm whales are known to occur throughout the Caribbean, including the coast of Puerto Rico.

3.3.6 *Status and Threats*

Historically, whale populations were significantly reduced due to directed fisheries, necessitating whaling restrictions, and ultimately an international moratorium on take outside of special circumstance. Presently anthropogenic threats to whales involves a number of synergistic forces, including acoustic pollution and vessel disturbance, ship strike, entrapment and entanglement with fishing gear, prey stock collapse due to overfishing, oceanic debris, habitat degradation, chemical pollution, military operations, hunting, and poaching (NMFS 1998b). Non-anthropogenic causes of death may include predation, competition, and disease (NMFS 2010b).

3.3.7 *West Indian Manatee (Trichechus manatus)*

3.3.7.1 *Range and Habitat*

The West Indian Manatee is distributed throughout coastal areas and riverine reaches from Virginia to Espiritu Santo, Brazil. The Puerto Rico stock, Antillean subspecies *Trichechus manatus manatus*, is genetically isolated from the Florida and Dominican Republic manatee populations and only occurs in areas close to the Puerto Rico coast. Manatees in Puerto Rico tend to aggregate in protected areas around cays, secluded bays, and shallow seagrass beds (east of San Juan, east, south, and southwest coasts) adjacent to freshwater sources. Manatees are not abundant on the north coast of the island, but have been observed in areas immediately adjacent to San Juan (USFWS 2009).

3.3.7.2 *Presence in Action Area*

The West Indian Manatee is known to occur off the coast of San Juan; however, sightings are rare and this species tends to inhabit protected coastline environments.

3.3.7.3 *Status and Threats*

Main threats to this species include watercraft collision and habitat degradation, specifically marine construction, seagrass bed damage through propeller scarring and anchoring, oil spills, and availability of freshwater sources. Vessel strike causing blunt head trauma is a leading cause of anthropogenic manatee mortality in Puerto Rico. There are no reports of propeller related mortality. Entanglement in fishing line has historically been a cause of manatee mortality, but has been mitigated since implementation of gear restrictions. Natural causes of mortality primarily involve disease. Mass mortality events due to algal blooms have not been observed in the Puerto Rico population (USFWS 2009). Currently there is not sufficient data to predict the population size or the status trends (USFWS 2009).

3.4 *FISH*

The only species of fish that is provided direct federal protection under the ESA that occurs in Puerto Rico is the scalloped hammerhead; this is aside from fish indirectly protected through critical habitat designation. NOAA is currently publishing a final rule to protect four distinct population segments of scalloped hammerhead sharks, one of which is found off the coast of Puerto Rico.

3.4.1 *Scalloped Hammerhead (Central and Southwest Atlantic DPS)*

3.4.1.1 *Range and Habitat*

Scalloped hammerheads are distributed throughout the world in warm coastal and temperate waters (seldom less than 22° C) typically over continental and insular shelves, but range from the intertidal out to deeper waters (450-512 m and greater). Adults aggregate commonly near seamounts and near islands; juveniles and neonates aggregate in nearshore nursery habitats protected from predators for up to a year after birth. Scalloped hammerheads are opportunistic feeders, but commonly forage on teleosts, cephalopods, crustaceans, and rays (NMFS 2015e).

3.4.1.2 *Presence in the Action Area*

The geographic range of the Central and Southwest Atlantic DPS includes the coastal waters of Puerto Rico and the USVI, but little information is available on the occurrence or distribution within these areas at the time of listing (NMFS 2015e).

3.4.1.3 *Status and Threats*

The Central and Southwest Atlantic DPS of scalloped hammerheads are listed as threatened where the predominant causes of population decline involve overutilization from directed shark fisheries, incidental bycatch, and illegal fishing both commercially and recreationally (i.e., tuna and swordfish pelagic longline, gill net, purse seine, and artisanal fisheries). Significant reductions in female populations, juvenile, and neonate scalloped hammerheads have resulted from documented heavy inshore fishing, areas which are likely used as nursery grounds. Brazil reports the highest quantity of scalloped hammerhead landings in South America and maintains heavy industrial fishing of this DPS. There is no evidence to suggest that this species is or will be significantly reduced due to competition, disease, or predation (NMFS 2014c).

4.0 *EFFECTS OF PROPOSED ACTION ON LISTED SPECIES, CONSERVATION MEASURES, AND EFFECTS DETERMINATIONS*

This section describes how the proposed actions will affect threatened and endangered species or any critical habitats that occur in the project area. The ESA requires that all effects be considered when determining if an action may affect listed species. Direct effects, indirect effects, and interrelated or interdependent actions are all considered. Direct effects are defined as those caused by the action and occur at the same time and place as the action. Indirect effects are caused by the action at a later time, but are reasonably certain to occur. Interrelated actions are those that are part of the primary action and depend on the primary action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration.

4.1 *DIRECT AND INDIRECT EFFECTS*

Impacting factors of the proposed action are described in Section 1.0. Direct effects include placement of the cable related components (e.g., articulated pipe, clamps, etc.) directly on benthic substrate. This action may directly impact habitat and has the potential to impact benthic species. Temporary impacts may occur during placement if the cable has to be adjusted during installation. Other potential direct impacts include interactions with lay vessel and other equipment. Temporary impacts to beach habitat will occur during beach installation, though this habitat will be returned to pre-construction conditions.

Indirect effects may occur from induced turbidity during filling and emptying of sandbag anchors, and beach works. Such impacts would be localized and short-term.

Potential impacts to each ESA-listed species considered in this biological assessment are detailed in the following sections.

4.2 *INVERTEBRATES (CORALS)*

The cable route was selected to minimize potential impacts to benthic habitats, in particular those containing corals. The selection of the route that passes through a natural channel in the reefs will avoid cable suspensions between high points, such as large coral colonies, to minimize the chance for the cable to swing and cause breakage and abrasion of corals.

The shallow water route will be verified prior to installation by divers, who will mark the cable route in the field for the installation vessel to follow. Slack in the cable will allow divers to relocate the cable off of sessile benthic invertebrates if necessary. The cable will be stabilized with articulated pipe in shallow waters to prevent lateral movement that can cause abrasion of substrate. Locations of proposed articulate pipe are shown in Figure 1.5.

4.2.1 *Coral Species*

One listed species of coral was observed during the 2016 benthic survey (<30 m water depth) for the BRUSA cable system, *O. faveolata*. There will be at least 1 m separation between the colony and the cable alignment. No other ESA-listed coral species were observed along the cable route during the benthic survey; therefore, these species will not be impacted by cable installation in the nearshore area.

Conservation measures are described in Section 1.3.3, and include the following measures that will avoid adverse effects on coral species:

- Pre-determined and surveyed anchor locations for the shallow water vessel to avoid inadvertent contact the coral species
- Diver installation guided by a qualified Biological Monitor
- Weighting and clamping of cables in the vicinity of hardbottom and sensitive resources to prevent cable movement
- Post-installation monitoring

Based on these avoidance and protective measures, and prior experience with the PCCS cable project and other recent installations in the Project area, impacts to ESA-listed coral species will be avoided.

The mesophotic survey for the PCCS cable system (Segment 2A), which is in close proximity to the BRUSA route, found colonies of the boulder star coral, *O. franksi*, in deeper portions of the reef. NMFS, in its 2014 Biological Opinion for the PCCS cable system, used an average colony size for bounder star corals to estimate the number of colonies to which this equates. It was estimated that up to one boulder star coral colony may be directly affected by the cable route. Because the BRUSA route is in close proximity to the PCCS Segment 2A route, it is expected the benthic characteristics of PCCS are representative of the BRUSA route.

Because of depth restrictions, the same avoidance measures applied in the nearshore area cannot be applied in the mesophotic environment during installation. Post-installation, because of the water depths and the weight of the cable, there will be no cable movement in deep waters once installation is complete.

The BO concluded the PCCS installation was not likely to jeopardize the continued existence of boulder star corals (mesophotic species) for the reasons noted above. Because the two projects are in close proximity and the installation techniques are the same, it is anticipated the BRUSA installation would have similar and equivalent effects.

Coral Critical Habitat

The results of the benthic dive survey showed that the BRUSA cable is expected to cross over 2,352 m (59.9 percent) of sandy, rubble, or rocky substrate. The total cable route that lies over sensitive natural resources was measured to be 1,578 m (40.1 percent); of that length, EFH over non-consolidated substrate accounts for approximately 709 m (18 percent of the total route; e.g., seagrass, algal plains), and 869 m (22.1 percent) consolidated substrate. The consolidated substrate was further characterized as being composed of 368 m (12.7 percent) of colonized hardbottom, and 368 m (9.4 percent of the total cable route) over coral critical habitat.

Stabilization and reinforcement of the cable is proposed in two locations with sensitive habitat to protect both the cable and benthic resources. Articulated pipe is proposed to be mounted at the shallow 210 m stretch of hardbottom in the Isla Verde Reef Marine Reserve. Additionally, a minimum of 40 cable clamps are suggested to fix the cable along a 368 m section that runs through coral critical habitat. The estimated permanent impacts to the cable area was calculated by the benthic dive team and presented in Table 4.2. The impact of cable and/or articulated pipe over non-consolidated EFH, colonized hardbottom, and coral critical habitat are expected to be 24.8 m^2, 37.5 m^2, and 12.9 m^2 respectively, for a total impact area of 50.4 m^2 over consolidated substrate and 75.2 m^2 for work proposed in the nearshore area. The footprint calculated for clamps to be used in securing the cable is estimated to cover an area of 0.2 m^2.

Impacts to substrate resulting from temporary anchoring for the SWIV are expected to be 1 m^2 for single sandbags, approximately 3.21 m^2 for the use of three sandbags together forming a 'solid anchor,' and one steel plate bolted onto coral critical habitat.

Table 4.2 ***Estimated permanent cable footprint over non-cemented EFH, hardbottom EFH and coral Critical Habitat (EFH/CH) out to 98 ft (30 m) water depth***

Cable Type (m)	Cable Length (m)			Cable Footprint (m^2)				
	Non cemented*	Hardbottom (non-CH)	CH	Non cemented*	Hardbottom (non-CH)	CH	Total cemented	Totals
Double Armor (0.035 m)	709	291	368	24.8	10.2	12.9	23.1	47.9
Articulated Pipe (0.130 m)	0	210	0	0	27.3	0	27.3	27.3
Total	709	501	368	24.8	37.5	12.9	50.4	75.2

Source: Rivera 2016

*algal grounds and seagrass combined

4.3 MARINE REPTILES (SEA TURTLES)

Loggerhead sea turtles may be found in or near the AA, though they are not common in the U.S. Caribbean. Green, hawksbill, and leatherback sea turtles are more common and leatherback turtles are known to nest in Isla Verde. The Conservation measures described in Section 1.3.3 will be implemented, and include compliance with the NMFS *Sea Turtle and Smalltooth Sawfish Construction Conditions.*

Depending on the time of year the BRUSA cable installation takes place, leatherback turtles may not be present because they are an offshore species that is only found nearshore during nesting season, which peaks around April to May. If cable installation operations do take place during the nesting season of any of the sea turtle species, turtle nest monitoring will be implemented to ensure installation operations do not affect nests or hatchlings. This will include monitoring for 70 days prior to any excavations and selecting excavation sites to avoid any nests if necessary or delaying excavation activities to avoid impacts to nests and hatchling sea turtles.

During installation, monitoring will be conducted from a vessel in order to look for any hatchlings in the water to ensure cable installation activities will not impact these animals.

Based on implementation of the measures described above, impacts to sea turtles will be avoided.

4.4 *MARINE MAMMALS*

4.4.1 *Whales*

These species could be affected by vessel transit during the installation of the submarine cable, in particular for installation in deeper, offshore waters. ESA-listed whale species are more common in the U.S. Caribbean during their winter migration to warmer waters from January to March of each year. Depending on when the cable installation takes place, there may be less likelihood of ESA-listed whales being in the AA.

No sightings of ESA-listed whale species were reported during the most recent benthic survey, nor have been reported during past surveys conducted in the area, including mesophotic reef surveys in deep water areas, although these were done in September through November 2013 for PCCS. Anecdotal information from dive shop operators in Puerto Rico, as well as information from NOAA's Office of Law Enforcement, indicates that these animals are common in deeper waters off both the east and west coasts of Puerto Rico from January-March, with some humpbacks occasionally sighted off the east coast year-round (NMFS 2014b).

The cable installation will be completed by an experienced operator who has worked in the AA in the past. There is no information from previous cable installation projects within the same general area that indicates that ESA-listed whales were sighted during cable installations or that there were any interactions between ESA-listed whales and work vessels.

As noted in Section 1.3.3, the Project will implement NMFS's *Vessel Strike Avoidance Measures and Reporting for Mariners,* including maintaining safe distances. Cable-laying vessels operate at controlled, slow speeds during cable installation in order to ensure that the cable is installed along the proposed route and to avoid any entanglement or other complications with the installation. Based on the above-mentioned factors and Project measures, the potential project impacts to ESA-listed whale species from the BRUSA cable installation will be avoided.

4.4.2 *Manatees*

The endangered Antillean manatee *(Trichechus manatus manatus)* inhabits both clear and muddy salt and freshwater, and can be found in canals, estuaries, bays, and nearshore marine habitats, and may occur in the shallow waters of the nearshore in the AA. The USFWS and the Caribbean Stranding Network report manatee sightings at Boca de Cangrejos and east of that area. As such, this species may be affected by project activities in the nearshore. As part of pre-construction works, environmental awareness training will be provided to all workers, and will include information about manatees. A safety buffer will be implanted for all in-water work with shutdown occurring if a manatee comes within 50 ft of project works, and workers will log and notify agencies of any manatee injury or collision. Vessels will also be shallow-draft and slow-moving in the nearshore. As noted in Section 1.3.3, the Project will implement NMFS's *Vessel Strike Avoidance Measures and Reporting for Mariners,* including maintaining safe distances. Based on the above-mentioned factors and Project measures, the potential project impacts to the ESA-listed manatee from the BRUSA cable installation will be avoided.

4.5 *FISH*

The scalloped hammerhead occurs in the waters off Puerto Rico. However, it typically occurs well offshore in waters hundreds of meters deep. This species has never been reported during offshore surveys for cable projects in the area. Given the likely low frequency of occurrence, and the slow nature of cable-lay vessels and installation of the cable offshore, the likelihood of interaction with this species is considered low.

4.6 *ESSENTIAL FISH HABITAT*

Table 4.2 provides estimates of permanent cable footprint over non-cemented EFH, hardbottom EFH and coral Critical Habitat (EFH/CH). A total of 50.4 m^2 of hardbottom will be permanently impacted by the installation of the BRUSA cable system. Of this only 12.9 m^2 contain the essential feature of acroporid coral critical habitat.

Temporary impact areas are estimated along the cable route as 1-m-wide corridors to either side. Up to approximately 740 m^2 of elkhorn and staghorn coral critical habitat could be temporarily affected by the installation of the cable in the nearshore region. This is based on a 1 m corridor to either side of the cable (368 m) and includes the impacts of the use of sandbag anchors to serve as temporary mooring points for the shallow draft cable-laying vessel. This is likely an overestimate of potential impacts, but was calculated by the applicant in case there is a need to shift the cable route slightly during installation and to account for any relocation of sessile benthic invertebrates that may be necessary along the cable route because this will result in habitat disturbance. The hardbottom habitat where the cable route is proposed is a historic cable landing site with several other cable segments already present.

5.0 *CONCLUSION*

Table 5.1 presents a summary of expected effects for each species based on the existing information available for each species and its occurrence, project design, and conservation measures discussed in Section 1.0.

Table 5.1 Expected Effects for Each Species

Scientific Name	Common Name	Effects Determination
Invertebrates		
Acropora cervicornis	Staghorn coral	No Effect
Acropora palmata	Elkhorn coral	May Affect, Not Likely to Adversely Affect
Dendrogyra cylindrus	Pillar coral	May Affect, Not Likely to Adversely Affect
Orbicella annularis	Lobed star coral	No Effect
Orbicella faveolata	Mountainous star coral	May Affect, Not Likely to Adversely Affect
Orbicella franksi	Boulder star coral	May Affect, Not Likely to Adversely Affect
Mycetophyllia ferox	Rough cactus coral	May Affect, Not Likely to Adversely Affect
Marine Reptiles		
Dermochelys coriacea	Leatherback turtle	May Affect, Not Likely to Adversely Affect
Caretta caretta	Loggerhead turtle (Northwest Atlantic Ocean DPS)	May Affect, Not Likely to Adversely Affect
Chelonia mydas	Green Turtle (North Atlantic DPS)	May Affect, Not Likely to Adversely Affect
Eretmochelys imbricata	Hawksbill turtle	May Affect, Not Likely to Adversely Affect
Marine Mammals		
Balaenoptera musculus	Blue whale	May Affect, Not Likely to Adversely Affect
Balaenoptera physalus	Fin whale	May Affect, Not Likely to Adversely Affect
Balaenoptera borealis	Sei whale	May Affect, Not Likely to Adversely Affect
Megaptera novaeangliae	Humpback whale	May Affect, Not Likely to Adversely Affect

Scientific Name	Common Name	Effects Determination
Physeter macrocephalus	Sperm whale	May Affect, Not Likely to Adversely Affect
Trichechus manatus	West Indian manatee	May Affect, Not Likely to Adversely Affect
Fish		
Sphyrna lewini	Scalloped hammerhead (Central & Southwest Atlantic DPS)	No Effect

The potential effects on ESA-listed corals and coral critical habitat are avoided or minimized through site-specific route planning, installation method and conservation measures (including a biological monitor present before, during and after installation). It is anticipated that *Orbicella faveolata* can be completely avoided during installation, although it is present near the cable route. Coral critical habitat estimated for the Project footprint is small relative to available habitat in the AA.

Potential impacts to *Orbicella franksi* as determined by the PCCS BO are considered to be representative for BRUSA based on the close proximity of the two routes, and use of the same installation techniques. The BO concluded the PCCS Project was not likely to jeopardize the continued existence of boulder star corals.

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Attachment A
2016 Marine Benthic Resources Baseline Survey Report – BRUSA Cable System

Marine Benthic Resources
Baseline Survey Report
BRUSA Cable System – Segment 4.3
Tartak St. Shore End Route, Puerto Rico

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INTRODUCTION

Project description

As part of providing an efficient communication infrastructure to Puerto Rico and the Wider Caribbean, Telefónica International Wholesale Services (TIWS) proposes to install a new submarine cable in the region. The project, named **BRUSA**, will provide connections between Virginia Beach, Puerto Rico and Brazil (Fig. 1). A cable segment is proposed to connect Puerto Rico to the main cable, crossing territorial waters of Puerto Rico, navigable waters of the United States and waters of the United States. The shore end approach will be aligned, for the most part, in a corridor already in use by the AMX and PCCS cable systems. The planned landing entry point is the Isla Verde beach headwall at the end of the Tartak Street, Carolina, Puerto Rico. The headwall is the same used by several other existing submarine cable systems, including ARCOS-1, Taino-Caribe, SAm-1, SMPR-1, AMX and PCCS cable systems.

The offshore cable will be surface laid and does not involve jet burial in said waters. The shore end cable segment approaching Carolina beach will be installed as a separate portion to be spliced to the section deployed by the cable ship in deeper water beyond the Boca de Cangrejos aids to navigation buoy in Carolina. To accomplish this task a shallow water installation vessel (SWIV) will deploy the shallow water segment shoreward from the deep water location. Free lay and diver assisted installation will be employed in order to avoid and minimize impacts to epibenthic communities and natural resources at the maximum practicable extent. The shore end approach procedure requires an open trench in the beach to lead the cable towards the upland connecting point. The material will be side casted, stored in place and the trench will be backfilled with the same sand material. Beach will be restored to original condition. The larger cable lay vessel and the SWIV use modern navigational systems to assure its position, staying away from sensitive areas. A system of 26 temporary anchoring points is proposed to secure the SWIV to its pre-determined positions. Six cable hold back anchors are proposed to secure the cable in position during the cable lay.

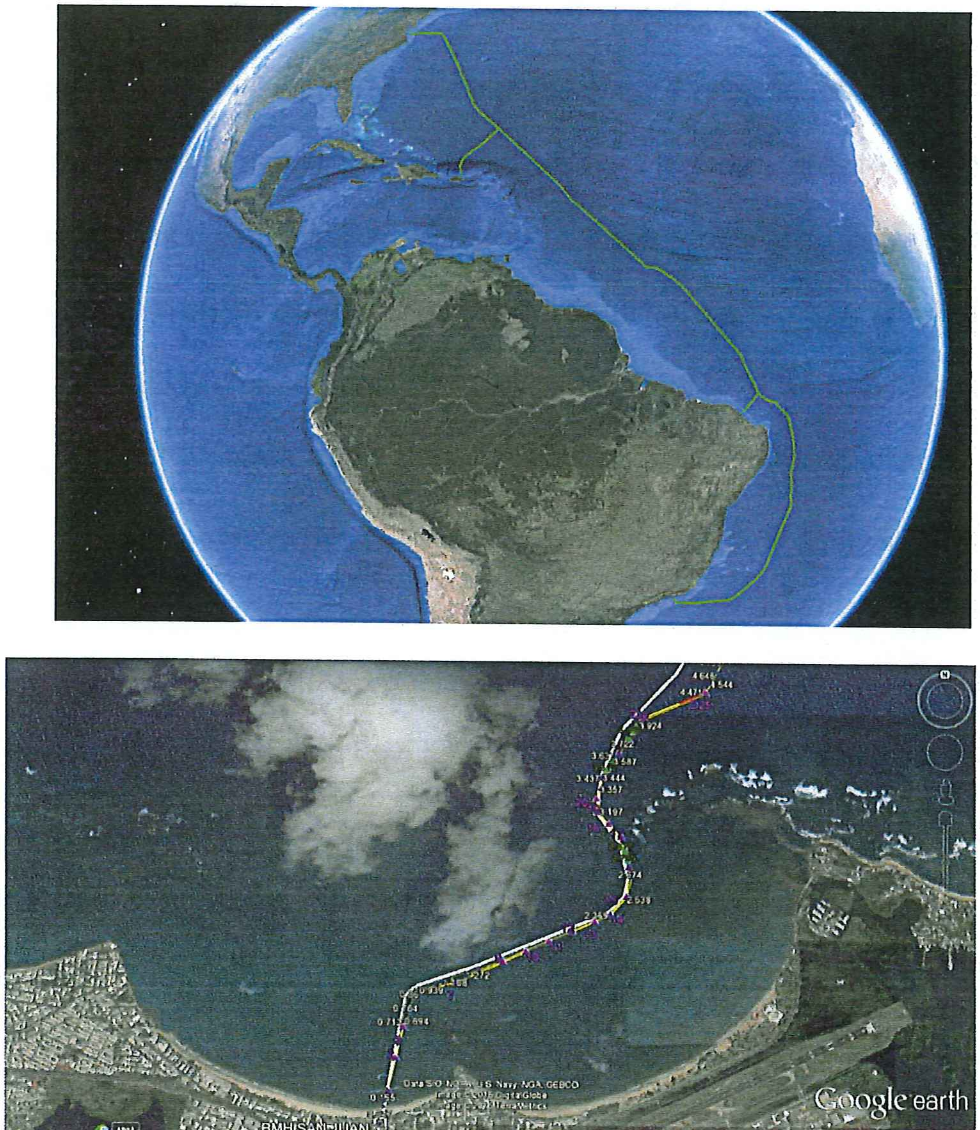

Figure 1. Proposed BRUSA cable routing (white line) to Puerto Rico (top) and the shore approach section to Tartak street (bottom).

This report addresses the physical setting and the biological composition of the different marine communities and protected resources where the proposed action will be located in order to record baseline data. The objective of this survey is to provide a quantification of the substrate cover and a qualitative description of the communities and habitats that might be impacted by the action previously described. The study presents information required to comply with Federal and Commonwealth laws and regulations.

As part of the route refinement process, the proposed shore end approach for the BRUSA cable was refined to minimize contact with hardbottom. This report covers the planned route as shown in Figure 3.

Site description and benthic habitat

The insular shelf along the north coast of Puerto Rico is relatively narrow, in some locations less than 2-3 nautical miles, and deep water (>100 ft) is close to shore. The coast is fully exposed to the high energy of the Atlantic waters with seas usually high (>5ft) between fall and spring, prominently in winter. A diversity of coastal marine habitats is present including reefs and colonized hardbottom, seagrass beds, algal and sand plains, estuaries and mangrove forests.

There is little reef development on the north coast except for patchy coral growth and narrow linear "reefs". The origin of the mid-shelf reef in the area is non-biogenic (Hallock 1997) and the relief varies from low to high. North of Isla Verde, and in several other places along the north shore, these ridges are exposed as small rocky islets. The coral development in the linear reef consist of a coral community covering the fossil sand dunes (i.e., eolianites) formed during lower sea levels, colonized nearshore hardbottom and colonized rock reefs. Benthic Habitat Maps (U.S. NOAA 2001) illustrate the sites as linear reef, aggregated patch reef, colonized pavement, colonized bedrock and scattered coral-rock habitats. Encrusting coral morphology is the major growth form of the scattered coral community covering this ridge (García et al. 2003, Goenaga and Cintrón 1979). Physical conditions allow some coral reef formations on the low wave action side of eolianites. Possible factors controlling the coral reef development and distribution are intense wave action, light penetration, currents along the shore and sediment abrasion generated by lateral transport. This habitat supports artisanal (i.e., subsistence) and recreational fishing. No major commercial fishing practices (e.g., trawling) take place in the site. Most beaches on this side of the island consist of thin deposits of sand covering a rocky lower foreshore.

The observed habitat is a critical habitat (CH) for the two federally ESA listed coral species *Acropora palmata* and *A. cervicornis* (Fig. 2), newly ESA listed and other non-listed coral species. Critical habitat is defined as an area designated for the survival and recovery of species listed as threatened or endangered under the Endangered Species Act (ESA). Critical habitat includes those areas occupied by the species, in which essential physical and biological features to the conservation of an ESA listed species are found and which may require special management considerations or protection.

Coral reefs and hardbottom are one of the most important ecological and economical resources in the world. They are also some of the most productive and diverse tropical marine habitat. The reef acts as barrier to storm waves and provides habitat for a wide variety of organisms including economically important tropical fisheries species.

Marine communities at the area has been studied for cable related projects (Ecology & Environment 2005, García-Sais 2001, 2005a, 2005b, The Louis Berger Group 2000, Rivera 2003, 2006a, 2006b, 2009, 2011, 2013, Vicente 2000, Vicente & Associates 2004, 2005a, 2006a, 2006b). None of the previous studies report the presence of coral reef (i.e., biogenic) systems along cable corridors.

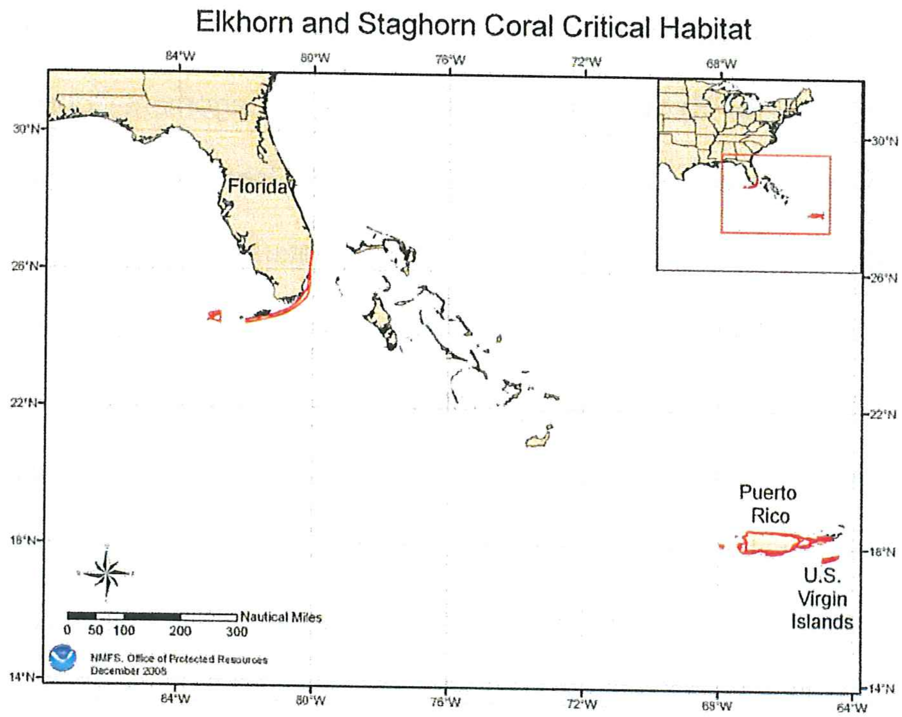

Figure 2. Critical habitat for *Acropora palmata* (elkhorn coral) and *A. cervicornis* (staghorn coral) in waters of the U.S.

Seagrass beds are also one of the highest primary production systems in the tropics (García 1990, Dawes 1998, Kirkman 1990). Seven species of seagrass occur in Puerto Rico, the most common species being *Thalassia testudinum* (turtle grass), *Syringodium filiforme* (manatee grass), *Halodule wrightii* (shoal grass) and *Halophila decipiens* (sea vine) (Vicente 1975). This system also provides shelter, nursery grounds, and food for commercially important larvae and juvenile of finfish and invertebrate species (Vicente 1992). One threatened and one endangered species, *Chelonia mydas* (green sea turtle) and *Trichechus manatus manatus* (Antillean manatee), respectively, depend on seagrass for foraging. Therefore, this system is considered a habitat of concern for sea turtles and manatee. Seagrasses help reduce coastal erosion by trapping unconsolidated sediments with their extensive root and rhizome systems.

The abovementioned habitats, present within the project area, are classified as Essential Fish Habitat (EFH) by the Caribbean Fishery Management Council (CFMC) pursuant to the requirements of the Magnuson-Stevens Fishery Conservation and Management Act (CFMC 1998). EFH means "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity". For the purpose of interpreting the definition of EFH: *waters* include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; *substrate* includes sediment, hard bottom, structures underlying the waters, and associated biological communities; *necessary* means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and *spawning, breeding, feeding, or growth to maturity* covers the stages representing a species' full life cycle. Fish is defined to include finfish, mollusks, crustaceans, and all other forms of marine and plant life other than marine mammals and birds.

These habitats provide essential functions for federally managed species under a fishery management plan (FMP). Local federally managed fishery species on this EFH includes corals, Queen conch, spiny lobster, reef fishes and bill fishes (Table 1) and some were observed in the project area during marine flora and fauna surveys conducted for other cable projects evaluated by State and Federal agencies. The CFMC has not implemented habitat areas of particular concern (HAPC) in the project area.

Ecological considerations and environmental constraints

Local fishery species managed by the CFMC includes corals, Queen conch, spiny lobster, reef fishes, billfishes and highly migratory species (Table 1). Some of these "fish" species are protected by FMPs, their habitat is protected and are considered EFH indicators.

Table 1. Species managed by CFMC occurring in the nearshore area of the BRUSA approach end and within the EEZ in northern Puerto Rico.

Scientific Name	**Common Name**
Cnidarians	All corals
Strombus gigas	Queen conch
Panulirus argus	Spiny lobster
Epinephelus struiatus	Nassau grouper
E. guttatus	Red hind
E. fulvus	Coney
Ocyurus chrysurus	Yellowtail snapper
Lutjanus analis	Mutton snapper
L. apodus	Schoolmaster
L. gruiseus	Grey snapper
L. vivanus	Silk snapper
Chaetodon striatus	Butterflyfish
Holocentrus ascensionis	Squirrel fish
Haemulon plumieri	White grunt
Balistes vetula	Queen triggerfish
Malacanthus plumieri	Sandtilefish
Sparisoma chrysopterum	Redtail parrotfish
Lactophrys quadricornis	Trunkfish
-	Sharks and Tunas
-	Swordfish and Billfishes

The area is home to endangered and threatened species managed by either the U.S. Fish and Wildlife Service (FWS) or the Office of Protected Resources (OPR) of NOAA Fisheries. Protected corals, sea turtles and mammals are listed in Table 2 (USFWS 2000). Whales shall be protected from the operation of the cable-laying vessel. Said species are protected by the Endangered Species Act (ESA). Additionally, all marine mammals are protected under the Marine Mammal Protection Act (MMPA). NOAA Fisheries lists the Nassau grouper (*Epinephelus striatus*) as a species of concern and may be observed in this location.

Table 2. Threatened and endangered species under ESA potentially occurring in the area of the BRUSA approach end in northern Puerto Rico.

Scientific Name	**Common Name**	**Status[1,2]**
Acropora palmata	Elkhorn coral	T
Acropora cervicornis	Staghorn coral	T
Orbicella annularis	Lobed star coral	T
O. faveolata	Mountainous star coral	T
O. franksi	Boulder star coral	T
Dendrogyra cylindrus	Pillar coral	T
Mycetophyllia ferox	Rough cactus coral	T
Eretmochelys imbricata	Hawksbill sea turtle	E
Dermochelys coriacea	Leatherback sea turtle	E
Chelonia mydas	Green sea turtle	T
Caretta caretta	Loggerhead sea turtle	T
Pelecanus occidentalis occidentalis	Brown pelican	E
Trichechus manatus manatus	West Indian manatee	E
Megaptera novaeangliae	Humpback whale	E/D[2]
Balaenoptera physalus	Finback whale	E

[1] Status under the ESA: T=threatened; E=endangered
[2] Status under the MMPA: D=depleted

Of the 85 species protected by the Endangered Species Act (ESA) in Puerto Rico, 35 are animals. NOAA Fisheries and FWS require a Section 7 consultation for actions in the vicinity of such species.

Acropora palmata (elkhorn coral) and *A. cervicornis* (staghorn coral) were listed as threatened species effective June 8, 2006 (Federal Register Vol. 71, No. 89, May 9, 2006). *Dendrogyra cylindrus* (pillar coral), *Mycetophyllia ferox* (rough cactus coral), *Orbicella annularis* (lobed star coral), *O. faveolata* (mountainous star coral), and *O. franksi* (boulder star coral) were listed as threatened under the ESA effective September 10, 2014 (79 FR 53852)

Four species of sea turtles are reported for Puerto Rico. These include two threatened species, the green turtle (*Chelonia mydas*) and the loggerhead (*Caretta caretta*), and two endangered species, the hawksbill turtle (*Eretmochelys imbricata*) and the leatherback turtle (*Dermochelys coriacea*). The area where the proposed cable will land consists of a wide sandy beach with a gentle slope and easy accessibility from the water. These characteristics are suitable for successful sea turtle arrival and nesting. The FWS has recorded the presence of nests and turtles in the water in the area (Félix López, FWS, personal communication).

Leatherback turtles may use sandy beaches on the sites for nesting during February to July. Juveniles and adults of hawksbill turtle are permanent residents and are commonly observed at the surface and underwater while green turtles are less common. Loggerheads do not nest in Puerto Rico and few sightings are documented for the northeastern and southwestern coasts. Coastal waters and waters within the EEZ are visited by whales during winter for mating and birthing.

Fresh water flows from the Torrecillas lagoon thru Boca de Cangrejos (approximately 1nm east of the Isla Verde beach) thus attracting manatees to the area. The endangered Antillean manatee (*Trichechus manatus manatus*) inhabits both clear and muddy salt and freshwater, and can be found in canals, estuaries, bays and nearshore marine habitats. This mammal prefers shallow waters, ranging 5-20 feet deep. Manatees are primarily herbivorous and feed on seagrass or any other aquatic vegetation. FWS and the Caribbean Stranding Network report manatee sightings at Boca de Cangrejos and east of that area, approximately 1 nautical mile east of the cable corridor (Félix López, personal communication).

The Isla Verde Reef Marine Reserve (IVRMR), a small protected area managed by the Puerto Rico Department of Natural and Environmental Resources (DNER), is barely crossed by its northwestern corner. The reserve is watched by a community-based group and enforced by the DNER, Municipal Police and Puerto Rico Police Departement.

METHODS

RPL swim survey

A diver team from GARA accompanied a diver team from the installer in a swim using SCUBA along an initial version of the cable route point list (RPL) provided by Alcatel-Lucent Submarine Networks (ASN) and to survey 26 sites selected for temporary mooring of the SWIV out to 98 ft /30 m or less prior to the start of the benthic survey to jointly validate the RPL and the sites and/or find and suggest the best alternative options for routing from an environmental impact avoidance standpoint, as well as engineering feasibility. Details of the survey at the anchoring sites are described in next section. Cable hold back locations for temporary anchors to secure the cable during the cable lay were identified along the swim survey. An offshore site to borrow sand and fill sand bags for moorings north of the lineal reef was identified and surveyed.

Fieldwork was performed under fair atmospheric and marine weather conditions during March 31 – April 15, 2016.

Biological survey

Fieldwork was performed under fair atmospheric and marine weather conditions during April 25 – May 3, 2016. Baseline data from the NOAA nautical charts, NOAA's Benthic Habitat Maps for Puerto Rico and the U.S. Virgin Islands (U.S. NOAA 2001) and aerial pictures were evaluated beforehand. The revised cable route resultant after the RPL swim survey was approved and provided by ASN to conduct the biological survey (Table 3).

A "live boat" was used at all times flying "alpha" and "diver down" flags. A leaded marking buoy was deployed once the vessel reached the sampling station waypoint. Scientists on SCUBA entered the water at and down the marking buoy. The captain maneuvered away to a safe distance until they surfaced while the survey team dragged a floated diver's flag at all times. The boat kept a safe distance thus adding a safe perimeter. Anchoring was not necessary thus impacts to the benthic organisms were avoided.

Twenty-two stations were established to characterize zones in the near shore waters of the approach cable corridor. Some survey stations correspond with RPL positions while others are intermediate stations. The intermediate stations were added in order to gather additional benthic information of the route due to a wide separation between the initially provided points. Geographical positions of areas of substrate change were recorded. Depth was initially measured using the boat-mounted depth finder and confirmed by means of a digital dive computer. Hypack™ software interphased with a Garmin 76Cx handheld GPS (datum WGS 84) was used to plot and navigate the proposed route and additional stations.

A 50 m measure tape was extended from the plumb, perpendicular to the bearing of each segment in which a station was established, to mark half of the sampling transect. The divers proceeded to perform the survey observing organisms 1.0m apart on each side of the transect line (i.e., 2m total width) and estimated cover, described substrate features and photo documented the site. The same procedure was performed on the opposite side of the plumb thus completing a 100m transect for $200m^2$ area of sampling per station. The benthic cover along the station was determined using five $1m^2$ quadrat.

The survey along the route was performed by SCUBA from Station 1 to Station 22. A leaded line was deployed from the survey boat navigating sections of the route using GPS waypoints (Table 3). Divers observed a 2m wide corridor to record organisms, describe substrate features, document the site with underwater pictures and estimate cover by categories. Geographical position of changes in substrate was obtained from the readings of GPS receiver after divers pulled (i.e., bobbed) the dive buoy at the transition point.

A drift dive was conducted over Station 22 to locate areas with none or minimum benthic biota for possible routing that would avoid coral habitat. Divers were deployed 200 m west of the station and drifted to the east leveled 80ft deep in the water column.

The survey included twenty-six areas off the route intended for temporary anchor points for the SWIV (Table 11). A 5 m radius circular survey was employed to asses each temporary anchor site. Each survey area was $78.5m^2$. A measure tape was extended from the plumb and pulled around the point to delimit the sampling area. Divers proceeded to perform the survey by listing the present organisms to the lowest possible taxon, describing the substrate features and composition, and photodocumenting the site for organisms and habitat characteristics. The benthic cover around the station was determined using five 1m^2 quadrat.

The assessment focused on the major dominant species inhabiting the study area with particular attention to habitat, ESA corals and fish species that are indicators of EFH. The organisms were identified *in situ* at the lowest possible taxon into four major groups: macro algae, seagrasses, macro invertebrates (e.g., sponges, hard and soft corals, other macro invertebrates) and fishes (Cintrón et al. 1994). Percentage of live benthic cover by large taxonomic groups or sub-groups was categorized. Cover categories were recorded as very low (<5%), low (5-25%), medium (25-50%), high (50-75%) and very high (75-100%) in an effort to indicate density in the study area. Taxonomic survey and habitat characteristics were complemented by still images and *in situ* annotations. Unidentified specimens were photographed for further identification following taxonomy references (Almy and Carrión 1963, Colin 1978, Grana-Rafucci 1996, Hendler et al. 1995, Humann 1989, 1993, 2002, Littler et al. 1989, Randall 1983, Sprung 1999, Veron 2000, Zea 1987). Underwater pictures were taken using a Cannon PowerShot G-15™ digital camera placed into a Fantasea FG15™ underwater housing.

The permanent footprint of the cable across sensitive substrate (i.e., CH and EFH) was calculated based on the estimated length and width of double armor cable and articulated pipe, where applicable, along the route. The width of double armor cable is 35 mm and the maximum outer diameter of the articulated pipe is 130 mm.

RESULTS

RPL swim survey

The installer and GARA agreed on minimum but significant changes to the route that reduced the impact footprint over the seafloor in the hardbottom of the IVRMR and in the hardbottom that includes the coral critical habitat. The latter was achieved by routing the leaded line over areas of either none or less coral cover in flat areas and by following sand channels (i.e., gullies) until the deep reef break.

Biological survey

A total of 14,222.5 m^2 were surveyed for the proposed project. A plot of the route, survey stations and locations for temporary anchors and cable hold backs is shown in Figures 3-5. Some large scale benthic features are noticeable in the aerial photo and the nautical chart of the project site. Site was divided in four distinct different zones parallel to the coast: backreef, reef, forereef and deep reef. These zones corresponded in terms of bathymetry and habitat.

Diverse benthic biota was observed at the project site. Marine vegetation consisted of seagrasses and algae (turf, coralline, fleshy). Sessile and motile macro invertebrates were represented by poriferans (sponges), cnidarians (hydrozoans, zoanthids, soft and hard corals), mollusks and echinoderms. ESA coral species were recorded. Fish associated with the benthos included species of fishery, ecological and ornamental value. EFH finfish were documented.

Characterization by zones

The 22 survey stations provided an area of 4,400 m^2 (Table 3) in four zones. A total of 18 algal and 4 seagrass, 7 porifera, 11 soft and 20 hard coral (including 1 ESA coral) and 8 other macroinvertebrate species (including 1 EFH indicator) were observed in this survey (Table 4). Locations of ESA coral are presented in Table 5. The fish group was composed of 63 species (including 10 EFH finfish indicators) (Table 6).

Backreef

Stations 1-15 were located within this zone (Table 3). Water depth range was 9-25 feet and seafloor lacked relief by the most part. Remarkable differences were noted among stations. Stations 1-3, 7-8 and 12-14 were either mostly or completely sand. Hardbottom with sand pockets, within the IVRMR, was found in Stations 4-6 being the only area providing vertical relief in this zone. Rhodoliths with algal cover (Stations 9-11), and sand-silt stabilized by seagrass (Station 15) were documented. Stations 4-6, 9-11 and 15 were categorized as EFH. No station was considered coral critical habitat.

There was no biota at Stations 1-3, 7-8, 12 and 14 (Table 4, Fig. 6). Station 13 supported a few small scattered patches of very low cover seagrass shoots and scarce green algae.

Algal cover was either low (5-25%) or medium (25-50%) in Stations with vegetation (Fig. 6). *Dictyota* spp. was dominant at Stations 4-6 while rhodophytae and chlorophytae were common at Stations 9-11 (Table 4).

A seagrass bed was located at Station 15. Interspersed *T. testudinum, S. filiforme* and *H. decipiens* covered most of the substrate composing a highly dense meadow (Table 4, Fig. 6). High cover (50-75%) decreased to very low cover at 39 m northwest of the half transect. Few blowouts, grass-free depressions within seagrass beds, were observed along the transect. High-very high (50-100%) cover ended at 4 m southeast of the half transect. A substrate change to hardbottom occurred at 41 m SE of the half transect where few sponges and soft corals strived.

Low density and cover (5-25%) of sponges were observed at Stations 4-6 (Fig. 6). Same occurred with soft (e.g., *Gorgonia* spp., *Eunicea* spp., *Plexaura* spp.) and hard corals (*M. cavernosa, P. clivosa, P. astreoides, S. radians*). ESA coral species were not observed in this zone (Table 5). Eight species of macroinvertebrates were observed among all stations including zoanthids, urchins, sea stars and mollusks (Table 4), but only one specie was EFH indicator

The highest number of fish species (n=12) was observed for Station 5 (Table 6), mostly small sized and juvenile wrasses, damselfishes, surgeonfishes and parrotfishes. This observation can be linked to the structure provided by the substrate. Most of the fishes observed in the other stations were also either small sized or juveniles. Only three fish species were EFH indicators.

Transects crossed submarine cables in Stations 4-6, 10-12 and 14 (Table 3, Fig. 6).

<u>Reef</u>

Two stations (16-17) of this zone were located on the navigation channel at depths of 60-67 ft (Table 3). Steep slopes and vertical walls delineated the 40-80m wide channel. A mooring block with heavy chain was located at Station 17. Substrate at the stations consisted of a combination of sand, rubble or rock harboring almost no biota. The substrate in deep water was highly covered by turf.

A shallow colonized hardbottom reef (6-25 ft deep) was next to the man-made channel. Substrate bordering the shallower waters of the channel edge had a moderate rugosity providing structural complexity (i.e., relief) on which corals succeeded. The seafloor flattened away from the edges by the end of each 50m half transect. Only the shallow water habitat was categorized as EFH and CH.

Few macroalgae were observed, providing a very low cover (<5%) (Fig. 7). Seagrasses were absent in this zone (Table 4).

Low cover of small sized sponges was noted in the shallow waters. Station 16 had the highest number of soft corals species (n=7) among all the stations of the whole route, being *Plexaura* spp the dominant specie (Table 4, Fig. 7). Soft corals were in higher density when compared to other zones but cover was low (5-25%).

Station 16 had the second highest number of hard corals species (n=13). *S. siderea*, *P. strigosa*, *M. cavernosa,* and *P. astreoides* were more abundant than other hard corals (Table 4, Fig. 7). Hard coral cover was low (5-25%). *S. siderea* and *D. strigosa* had the highest cover among species and were mostly observed in plate and small boulder growth form. Zoanthids and sea urchins composed the small group of other invertebrates.

O. faveolata was the only ESA coral specie observed at both stations (Table 4-5, Fig. 7), showing highest abundance in this zone (n= 6 colonies).

Twenty-nine fish species were observed, including 4 EFH species (Table 6). Station 16 had the highest richness with 22 species.

Two submarine cables were observed along the Reef Gap.

Forereef

Three stations were set up in this zone. Station 18 was 40 ft deep before the end of the Reef Gap. The center of station was over a small hardbottom immediately bordered by sand then followed by steeply sloping hardbottom towards the shallow lineal reef. Stations 19-20 were set up in a continuous midshelf hardbottom area 42-63 ft deep (Table 3). Center of Station 18 was categorized as EFH but only the shallow water habitat away from center was categorized as CH. Stations 19-20 were also classified as CH.

Dictyota spp. was the common algal specie but its cover was low (5-25%). No seagrass species were observed (Table 4).

Xetospongia muta, *Ircina campana* and *Ircina* spp. were the most abundant sponges but in low cover (5-25%). Station 19 showed the highest number of soft coral species (n= 6), dominated by *Eunicea* spp. (Table 4, Fig. 8). The highest number of hard coral species in this zone (n=14) was observed at Station 20. *M. cavernosa* and *S. siderea* were the most common hard corals among the four stations, followed by *M. meandrites* and *P. astreoides* (Table 4, Fig. 8). These corals were scattered and growing in encrusting, platy and small boulder forms with a low cover percent (5-25%) and low density. Macroinvertebrate species were absent in transects on this zone.

ESA coral specie *O. faveolata* was present at Stations 18 and 20, one colony at each station (Table 4-5, Fig. 8).

This zone was the most diverse in fishes (n=42 species) where 7 species were EFH indicators (Table 6). Station 20 was the most diverse fish station (n=35). Invasive lionfish *P. volitans* was observed at Stations 19-20.

Submarine cables were observed by the three stations transects.

<u>Deep reef</u>

Two stations (21-22) were established in this zone in 70-98 ft water depth (Table

3). Station 21 was located at the hardbottom near the slope break and categorized as coral critical habitat. Station 22 was a flat hardbottom on an eolianite reef intermittently covered by fine sand (Fig. 9) deemed an EFH.

There was no significant vegetation except for some turf (Table 4). *X. muta*, *Ircina* spp. and *I. campana* were the dominant and most conspicuous sponges. *Plexaura* spp. was the dominant soft corals species but in very low cover (<5%) (Table 4, Fig. 9). Small colonies of *M. cavernosa*, *D. strigosa, P. astreoides* and *M. meandrites* were the common species but in low cover (5-25%) and plate morphology. There were no macroinvertebrates present.

Two *O. faveolata* colonies were the only ESA corals, both present at Station 21 (Table 4-5).

Station 21 was the second most fish diverse (n=24 species) station (Table 6). Thirty species were observed between both stations but only four species were EFH indicators.

Two cables were crossed by the transect in Station 21.

Characterization along the route

The estimated length of the route survey was 3,930 m, for an survey area of 7,860 m^2 along the route (Table 7, Fig. 5). The survey resulted in 11 main KP (i.e., kilometer point of cable route) sections within four geophysical zones along the proposed route, crossing non-consolidated and consolidated substrates. Section KP 2.102-2.715 (i.e., “Mixed”) had several short substrate changes thus all grouped together. Species recorded along the proposed alignment were 19 algae, 4 seagrasses, 7 sponges, 11 soft corals, 19 hard corals (including 1 ESA coral) and 6 other macroinvertebrates (including 1 EFH indicator) (Table 8). Locations of ESA coral species are presented in Table 9. Forty-one species of fish were observed, of which 5 species were EFH indicators (Table 10).

Seven KP sections and sub-sections of the proposed route crossed substrate of sand, rubble, rhodoliths, rock or a combination of any of those (Table 7, Fig. 10) and not considered neither EFH nor critical habitat. Four sections were clearly distinguished but three sections were within what was called a "Mixed" section due to quick successive changes in substrate. A few scattered patches of very low cover seagrass shoots were observed in section 2.395-2.468. Turf was present at the bottom of the Reef Gap at section 2.830-3.022. There was very few fish present at these sections. The man-made channel crossing the reef is relatively wide and deep. Sand, rubble and rocks were within the walls of the channel where rocks were the substrate for the few small coral and sponges.

The following seven sections along the proposed cable route were deemed EFH. Section #6 was determined CH as well (Table 7, Fig. 5 and 10).

1) Hardbottom, 210 m long section in the backreef situated in the IVRMR between KP 0.778-0.988. Algae (n=8 species), mainly *Dictyota* spp., was present in low (5-25%) cover. Sponges, soft (e.g., *Gorgonia* spp., *Eunicea* spp., *Plexaura* spp.) and hard corals (*P. clivosa, P. astreoides, S. radians*) were in low cover as well. There was low diversity of fish species (n=7), just one EFH species recorded. One submarine cable was crossed.

2) Rhodolith ground, 503 m long segment located in the backreef between KP 1.599-2.102. Thirteen algae species provided low cover (5-25%) to medium (25-50%)

to the substrate. Five species of small sized fishes were observed. Invertebrates present were sea starts (*Oreaster reticulatus*), *Strombus gigas* (EFH indicator) and *S. pugilis*.

3) Rhodolith/rubble grounds: 91 m long segment composed by three short segments in the "Mixed" area. Algal rubble was located between KP 2.215-2.225 (10 m) and between KP 2.683-2.715 (32 m). Algal rhodoliths were located between KP 2.334-2.383 (49 m). Algae (n=13 species) and few seagrass were in low cover. Other biotic groups were poorly represented or absent. There were a few juvenile acanthurids.

4) Seagrasses: 115 m long portion extending between KP 2.715-2.824 in the backreef. *T. testudinum*, *S. filiforme* and *H. decipiens* provided stabilization to the substrate. Cover range was very low-very high (0-100%). Transition areas were interspersed by low cover (5-25%) green algae. There were three fish species observed in this section.

5) Hardbottom: 84 m long section between KP 3.264-3.348 in the forereef. The hardbottom was covered by a sand veneer in several areas. *Dictyota* spp. and some soft corals colonized he first 10 m of substrate were two rocky outcrops served to aggregate the five fish species observed, one of which was an EFH indicator. The remaining 74 m of substrate were colonized by an assemble of red algae.

6) Hardbottom: 368 m long section of the forereef between KP 3.471-3.839. Approximately, the first 180 m of the route pass over low relief substrate until about KP 3.650. The route then continued by sand channels and wide open areas with low coral cover, by the most part, between higher grounds (e.g., mounds) until reaching the slope

break from 70 ft to 80 ft depth. At instances, the route crosses by denser areas where there are no sand channels. The dominant alga was *Dicyiota* spp. but in low cover (0-25%). This section had the highest diversity of sponges (n=7 species), soft corals (n=7 species) and hard corals (n=18 species) among all sections, being the main organisms colonizing the substrate. Nonetheless, very low-low cover (0-25%) was recorded except for some particular higher density avoidable aggregations. Relative highest abundance and diversity of species could be related to variability of seascape. Common hard corals (e.g., *D. strigosa, M. cavernosa*) had plate morphology in most of the colonies.

Orbicella faveolata (n= 2 colonies) was the only ESA proposed coral specie present in this section (Table 8-9).

Thirty-one fish species inhabited this section, the highest among all sections, however only 3 species were EFH indicators (Table 10).

Two submarine cables were crossed in this section.

7) Hardbottom: 207 m long stretch of the deep flat hardbottom, located between KP 3.839-4.046. Sand covered two sections of the hardbottom and two sections were fully exposed. Sponges (n=5 species) and antipatharian were the two prominent groups over the substrate. Density and cover of these were low.

ESA coral species were not observed along this section.

Six fish species were present, only one was EFH indicator.

One submarine cable was crossed in this section.

Drift dive over station 22

Divers deployed at Station 22 drifted approximately 400 m to the East. Substrate was similar to that found along the transect over Station 22, a flat hardbottom on an eolianite reef intermittently covered by fine sand, where *X. muta* was the prominent organism (Fig. 11). A few rocky outcrops provided vertical relief that aggregated some fish. A submarine cable was installed east of the proposed cable route.

Utilization of temporary anchors

A site previously approved by NMFS-PRD to borrow sand and fill sand bags in two recent cable projects was proposed for use again. The area was located in a large sand plain at 18 27.030 N / 66 00.283 W. This area is intended to fill sand bags to be placed south of the lineal reef.

A new large sand borrow area was identified at 18 27.804 N / 66 00.410 W in 42 ft depth. The area provided larger grain sized clean sand. Filling sand bags offshore avoids transiting the Reef Gap / channel which is bordered by shallow waters where ESA corals were documented.

Cable barge mooring anchors

Twenty-five temporary anchor locations were evaluated, providing a total survey area of 1,962.5 m^2 (Table 11). It was not possible to survey Site 10 thus the installer decided not to use it. Eight proposed sites are new (e.g., 2, 12, 14, 18, 20, 23, 24, 26) and seventeen were used on recent cable projects (e.g., AMX, PCCS). Observed benthic organisms (Table 12, Fig. 12) were algae (n=8 species), sponges (n=5 species), soft corals (n=4 species), hard corals (n=8 species) and other macroinvertebrates (n=1 species). ESA coral species were not observed.

Sites 5, 6 and 8 were located on hardbottom at the forereef in suitable depth, 29-46 ft, for sand bag use. Site 7 was also situated in hardbottom but in the shallower (17 ft deep) lineal reef thus a steel plate bolted to the substrate was proposed. *Dictyota* spp. in very low cover was the common algae. Sponges (*X. muta*, *Ircina* spp.), soft (*Plexaura* spp.) and hard corals (*P. strigosa, M. cavernosa, P. astreoides*) dominated the seascape but provided low cover (0-25%) at all four sites (Fig. 12). Areas to place the 1 m^2 sand bag offered the lowest cover or total absence of organisms. The four sites were classified as CH.

Site 13 was located in the algal rhodolith grounds, classified as EFH, were algae cover was low and no other major dominant groups inhabited the area. A sand bag was proposed for this site.

All other 20 sites were located in sand were no live cover was present. Sand bags were proposed for Sites 1, 2, 3, 4, 9, 11, 12, 14, 15, 16, 18, 20, 23, 24 and 26. Solid anchors were proposed for Sites 17, 19, 21, 24 and 25.

Hold back anchors

All six locations to place cable hold back anchors were situated in sandy substrate lacking live benthic cover (Table 13). Positions were identified during the RPL swim survey and agreed in the field. Sand bags will be placed at Sites 1 – 5 while a solid anchor will be used instead at Site 6.

Permanent and temporary impacts to substrate

The estimated lengths of cable route crossing different categories of substrate and habitat in nearshore waters are shown in Table 14. The cable route crossed over 2,352 m (59.9%) of sandy, rubble or rocky substrate. Total cable routing over sensitive resources was 1,578 m (40.1%). EFH was sub-categorized in 709 m (18.0 %) over non-cemented substrate (e.g., seagrass, algal plains) and 869 m (22.1%) consolidated substrate, in which 501 m (12.7%) were over colonized hardbottom and 368 m (9.4%) crossed over coral critical habitat.

Two locations in sensitive habitat were proposed to install stabilization devices to protect the benthic resources and the cable. Articulated pipe is planned to be mounted at the shallow 210 m hardbottom section at the IVRMR. A minimum of 40 cable clamps (approximately 10 cm x 5 cm) is suggested to fix the cable along the 368 m section over the coral critical habitat.

The estimated permanent area of direct and permanent cable impact on the substrate was calculated for each section supporting sensitive resources (Table 15). The impact of cable and/or articulated pipe over non-cemented EFH was estimated in 24.8 m^2, and 37.5 m^2 and 12.9 m^2 over colonized hardbottom and coral critical habitat respectively for a total impact over 50.4 m^2 over consolidated substrate and a total of 75.2 m^2 overall for the proposed work. The calculated total footprint of cable clamps was 0.2 m^2.

Temporary impact over the substrate resulting from the use of two types of anchoring methods was estimated in 1 m^2 for one sand bag on non-cemented EFH and 3.21 m^2 for three sand bags and a steel plate on coral critical habitat.

Table 3. Geographical position, mean depth and remarks of the survey stations by geophysical zones. (source file: BRUSA_S4.3_BMH SAN JUAN TO BU4 SAN JUAN_PSR01_19-APRIL-16).

Zone	St #	Lat N		Long W		D (ft)	Comment	Substrate	Biota	Notes
Back reef	1	18	26.712	66	1.269	9		sand	none	
	2	18	26.823	66	1.244	12		sand	none	
	3	18	26.928	66	1.219	16	AC RPL point # 16	sand	none	
	4	18	27.029	66	1.191	11		hardbottom	low cover of algae, sponges and soft corals, few hard corals	EFH no ESA corals 2 cables crossed
	5	18	27.073	66	1.165	11	AC RPL point # 20	hardbottom	low cover of algae, sponges and soft corals, few hard corals	EFH no ESA corals 2 cables crossed
	6	18	27.104	66	1.122	12		hardbottom	low cover of algae and soft corals, few hard corals	EFH no ESA corals 2 cables crossed
	7	18	27.143	66	1.011	25		sand	none	
	8	18	27.177	66	0.903	25		sand	none	
	9	18	27.215	66	0.796	23		rhodoliths/sand	low algal cover no corals	EFH
	10	18	27.253	66	0.690	23		rhodoliths/sand	medium algal cover no corals	EFH 1 cable crossed
	11	18	27.291	66	0.584	24		rhodoliths/sand	low algal cover no corals	EFH 1 cable crossed
	12	18	27.332	66	0.478	25		sand/rubble	none	1 cable crossed
	13	18	27.373	66	0.375	22	AC RPL point # 31	sand	very low cover of algae and seagrass shoots	
	14	18	27.476	66	0.307	17	AC RPL point # 34	sand	none	1 cable crossed
	15	18	27.583	66	0.292	25		sand/silt	high cover seagrass bed, very few sponge, soft/hard corals	EFH no ESA corals
Reef	16	18	27.673	66	0.342	60		sand/rock/boulder at station, reef at upper edges of channel	no biota at station	*O. faveolata* 27 m E 26, 39, 45 m W
	17	18	27.751	66	0.403	67	AC RPL point # 46	sand at station reef at upper edges of channel	no biota at station	*O. faveolata* 28 m E 36 m W

Zone	St #	Lat N		Long W		D (ft)	Comment	Substrate	Biota	Notes
Fore reef	18	18	27.785	66	0.403	40		hardbottom at station, reef at upper edges of channel	algae at station, low cover of soft/hard corals	EFH *O. faveolata* 28 m E 2 cables crossed
Fore reef	19	18	27.901	66	0.398	42		hardbottom	low cover of soft/hard corals, plate morphology	EFH-CH 1 cable crossed
Fore reef	20	18	28.054	66	0.383	63		hardbottom	low cover of soft/hard corals,plate morphology	EFH-CH *O. faveolata* 1 m E 2 cables crossed
Deep reef	21	18	28.088	66	0.380	70		hardbottom	low cover of soft/hard corals, mostly plate morphology	EFH-CH *O. faveolata* 8, 13 m E 2 cables crossed
Deep reef	22	18	28.207	66	0.374	98		hardbottom	very low cover of soft/hard corals	EFH no ESA corals

Table 4. Benthic biota present by survey stations. (Species in bold are ESA corals).

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Algae																						
Halimeda incrassata										x	x											
H. discoidea				x	x	x				x	x				x							
Udotea spp.											1											
Padina sanctae-crucis				x	x											x						
Caulerpa prolifera										x	x		x									
C. cupressoides											x											
C. racemosa				x		x																
C. mexicana					x					x	x											
Penicillus spp.										x												
Dictyota spp.				x	x	x										x	x	x	x	x		
Dictyopteris spp.					x						x											
Hypnea spp.									x	x	x											
Bryothamnion triquetrum										x	x											
Chondria spp.									x	x												
Laurencia spp.									x	x	x											
Gracilaria spp.									x	x	x											
Sargassum spp.				x	x																	
Acanthophora spicifera									x	x	x											
Seagrasses																						
Halodule wrightii													x									
Thalassia testudinum															x							
Syringodium filiforme													x		x							
Halophila decipiens															x							
Sponges																						
Ircina spp.				x	x	x												x	x			x
Ircina campana																				x	x	
Xetospongia muta															x	x	x	x	x	x	x	x
Aplysina spp.				x												x	x	x	x	x		
Callyspongia vaginalis																	x	x	x		x	
Geodia neptuni																				x	x	

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Verongula gigantea																						x
unident sponge				x	x											x	x	x		x	x	x
Zoanthids																						
Palythoa caribaeorum						x										x	x	x	x	x		
Soft corals																						
Gorgonia spp.				x	x	x										x	x	x	x			
Pterogorgia spp.				x	x	x													x			
Pseudopterogorgia spp.																x	x	x	x	x		
Plexaura spp.					x										x	x	x	x	x	x	x	
Pseudoplexaura spp.															x	x		x	x	x		
Plexaurella spp.																	x					
Eunicea spp.				x		x									x	x	x					
Erythropodium caribaeorum																x				x		
Muricea spp.																x	x	x		x		
Muriceopsis spp.																			x			
Anthipathes spp.																						x
Hard corals																						
Millepora alcicornis																x	x	x	x	x		
M. complanata																x						
Stylaster roseus																				x		
Montastraea cavernosa						x									x	x	x	x	x	x	x	
Orbicella faveolata																x	x	x		x	x	
Madracis decactis																x				x	x	
Porites porites																x						
P. astreoides				x	x	x										x	x	x	x	x	x	
Siderastrea siderea				x	x											x	x	x	x	x		
S. radians					x																	
Meandrina meandrites																	x	x	x	x	x	
Agaricia agaricites																x			x	x	x	
Agaricia spp.																					x	
Leptoseris cucullata																x						
Pseudodiploria strigosa				x	x	x										x	x	x	x	x	x	
P. clivosa				x	x	x										x		x				

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Dichocoenia stokesii																	x	x	x	x		x
Stephanocoenia intersepta																x	x			x	x	x
Mycetophyllia danaana																		x				
M. aliciae																				x		
Colpophyllia natans																		x		x	x	
Other Invertebrates																						
Diadema antillarum				x	x	x																
Eucidaris tribuloides				x	x						x											
Tripneustes ventricosus											x											
Echinometra lucunter																x						
Oreaster reticulatus										x												
Strombus pugilis									x				x									
S. gigas										x	x											

Table 5. Abundance and location of ESA coral species by survey stations. (W=western section of the transect, E=eastern section of the transect; #@# = abundance@distance from point zero).

Species	**16**		**17**		**18**		**20**		**21**	
	W	E	W	E	W	E	W	E	W	E
Orbicella faveolata	1@26 1@39 1@45	1@27	1@36	1@28		1@28		1@1		1@8 1@13

Table 6. Fish species present by survey stations. (Species in bold are EFH indicators).

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Abudefduf saxatilis																x	x					
Acanthurus bahianus				x	x											x	x	x		x		
A. chirurgus																			x	x		
A. coeruleus					x					x					x	x	x	x	x	x	x	x
Aeobatus narinari				x																		
Amblycirrhitus pinos																	x			x	x	x
Anisotremus virginicus						x										x		x		x		
Bodianus rufus					x											x			x	x	x	
Calamus bajonado					x																	
Catherhines macrocerus																			x			
Canthigaster rostrata															x	x						
Caranx crysos																			x			
Chaetodon capistratus					x											x	x					
C. ocellatus																	x			x		
C. striatus					x												x	x	x	x		
Chromis cyanea																			x	x	x	
Coryphopterus glaucofraenum						x																
Dasyatis americana															x							
Epinephelus cruentatus																x				x		
E. fulva				x	x	x									x	x	x	x	x	x	x	x
E. guttatus																						x
Equetus punctatus										x						x						x
Ginglymostoma cirratum					x																	
Gobiosoma evelynae																				x		x
Gramma loreto																				x		
Haemulon aurolineatum																				x		
H. carbonarium																				x		
H. flavolineatum										x									x	x	x	
H. macrostomum																x			x	x	x	
H. sciurus																						x
Halichoeres bivittatus				x	x					x						x			x	x		
H. garnoti															x		x				x	

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
H. maculipinna																			x			
H. radiatus																						x
H. tricolor																					x	
Holocentrus adscensionis																x	x		x	x	x	
H. rufus																	x			x	x	
Lachnolaimus maximus																		x				
Lactophrys triqueter																						x
Lutjanus analis																				x	x	
L. apodus																				x	x	
L. griseus																x						
Melichthys niger																				x	x	
Myripristis jacobus																	x		x	x	x	x
Mulloides martinicus																		x		x		
Ocyurus chrysurus															x				x		x	
Pomacanthus arcuatus																				x		
Pomacanthus paru																		x		x		
Pseudupeneus maculatus															x	x			x			
Pterois volitans																			x	x		
Scarus iserti																x			x	x		
S.vetula										x								x				
Serranus annularis															x							
S. tigrinnus																x		x	x	x	x	
Sparisoma aurofrenatum																x		x	x	x	x	
S. radians																					x	
S. rubripinne					x											x					x	
S. viride																x	x					
Stegastes adustus					x	x										x			x	x	x	
S. leucostictus				x													x	x		x	x	
S. partitus																			x	x	x	x
Thalassoma bifasciatum					x											x	x	x	x	x	x	

Table 7. Geographical position and remarks of the survey across geophysical zones along the route. (source file: BRUSA_S4.3_BMH SAN JUAN TO BU4 SAN JUAN_PSR01_19-APRIL-16).

Zone	RPL Point No	KP	Lat N	Long W	D (ft)	Comment	Substrate	Biota	Notes
Back reef	14	0.116	18 26.671	66 1.280	0	shore START BENTHIC SURVEY	sand	none	
		0.200	18 26.712	66 1.269	9				station 1
		0.400	18 26.823	66 1.244	12				station 2
	16	0.602	18 26.928	66 1.219	17	AC - DIVE SURVEY			station 3
	18	0.716	18 26.990	66 1.214	17	AC - DIVE SURVEY			
		0.778	18 27.019	66 1.197	9		hardbottom sand pockets EFH	low cover of algae, sponges and soft corals, fvery ew hard corals no ESA corals	end sand - start hardbottom IVRMR
		0.800	18 27.029	66 1.191	11				station 4
	20	0.892	18 27.073	66 1.165	12	AC - DIVE SURVEY			station 5
		0.988	18 27.104	66 1.122	9				station 6 end hardbottom IVRMR - start sand
	22	1.014	18 27.113	66 1.110	17	AC - DIVE SURVEY	sand	none	
		1.200	18 27.143	66 1.011	25				station 7
	27	1.347	18 27.167	66 0.930	23	AC			
		1.398	18 27.177	66 0.903	25				station 8
		1.599	18 27.215	66 0.796	24		rhodoliths EFH	low-medium algal cover no sponges no corals	station 9 end sand - start algal rhodolith
		1.798	18 27.253	66 0.690	23				station 10
		1.997	18 27.291	66 0.584	24				station 11
	29	2.102	18 27.311	66 0.528	25	AC - DIVE SURVEY			end algal rhodolith-start plain rhodolith
		2.113	18 27.313	66 0.522	25		sand/rhodoliths	none	end plain rhodoliths - start sand
		2.198	18 27.332	66 0.478	25		sand/rubble		station 12
		2.215	18 27.335	66 0.470	25		rubble EFH	low algal cover	end sand - start algal rubble
	30	2.225	18 27.338	66 0.464	25	AC	sand	none	end algal rubble - start sand

Zone	RPL Point No	KP	Lat N	Long W	D (ft)	Comment	Substrate	Biota	Notes
		2.334	18 27.361	66 0.407	24		rhodoliths EFH	low algal cover	end sand - start algal rhodolith
		2.383	18 27.371	66 0.381	25		sand		end algal rhodolith - start sand with few seagrass shoots
	31	2.395	18 27.373	66 0.375	15	AC		few scatterd patches of very low cover seagrass shoots	station13
		2.468	18 27.403	66 0.348	15				end few seagrass shoots - start sand
	33	2.538	18 27.432	66 0.321	15	AC		none	
	34	2.624	18 27.476	66 0.307	18	AC			station 14
		2.683	18 27.512	66 0.303	22		rubble EFH	low algal cover	end sand - start algal rubble
	35	2.713	18 27.524	66 0.302	20	AC			algal rubble
		2.715	18 27.525	66 0.301	20		sand EFH	seagrass meadow	end algal rubble - start seagrass
	36	2.789	18 27.565	66 0.295	26	CX IS PCCS S2A			
	37	2.817	18 27.580	66 0.292	25	ENTER REEF GAP			
		2.824	18 27.583	66 0.292	25		rubble EFH	low cover seagrass-algae	station 15 end seagrass - start algal/seagrass rubble
Reef		2.830	18 27.585	66 0.291	26				end algal/seagrass rubble - start rubble
	38	2.833	18 27.588	66 0.291	35	CX IS AMX-1 SEG 1.3	sand/rubble	turf	
	39	2.863	18 27.604	66 0.288	48	AC - DIVE SURVEY			
		3.022	18 27.673	66 0.342	60	Reef Gap - channel	sand/rock		station 16
	46	3.202	18 27.751	66 0.403	66	AC, concrete block	sand		station 17
Fore reef		3.264	18 27.785	66 0.403	41		hardbottom EFH	low-medium algal cover low cover of soft/hard corals no ESA corals	end sand - start hardbottom station 18
	48	3.348	18 27.831	66 0.404	43	AC			end hardbottom - start sand
	49	3.410	18 27.864	66 0.402	44	EXIT REEF GAP	sand	none	
	50	3.426	18 27.872	66 0.402	45	AC			
		3.471	18 27.896	66 0.398	44		hardbottom coral Critical Habitat	low –medium algal cover; scattered sponges, low density soft/hard corals except for some avoidable high density hard coral patches 2 colonies *O. faveolata*	end sand - start hardbottom
		3.480	18 27.901	66 0.398	42				station 19
		3.756	18 28.054	66 0.383	63				station 20
Deep reef		3.829	18 28.088	66 0.380	70				station 21
		3.839	18 28.094	66 0.379	76				end hardbottom - start thin sand layer over hardbottom

Zone	RPL Point No	KP	Lat N	Long W	D (ft)	Comment	Substrate	Biota	Notes
		3.842	18 28.097	66 0.379	80		thin sand layer over hardbottom EFH	few algae, antipatharians and isolated *X. muta*	thin sand layer over hardbottom
		3.968	18 28.166	66 0.376	93		hardbottom EFH	scattered sponges low /cover of soft/hard corals no ESA corals	end thin sand layer over hardbottom - start hardbottom
		3.979	18 28.171	66 0.376	93		thin sand layer over hardbottom EFH	few algae, antipatharians and isolated *X. muta*	end hardbottom - start thin sand layer over hardbottom
		4.016	18 28.192	66 0.375	98				end thin sand layer over hardbottom - start hardbottom
	56	4.032	18 28.200	66 0.375	98	WD 30	hardbottom EFH	scattered sponges low /cover of soft/hard corals no ESA corals	
		4.046	18 28.207	66 0.374	98	change to WD 99 ft END BENTHIC SURVEY			station 22 end hardbottom - start sand

Table 8. Benthic biota present by KP segments across geophysical zones along the route. (Species in bold are ESA corals)

Species	Sand 0.116-0.778	IVRMR 0.778-0.988	Sand 0.989-1.599	Algal Rhodolith 1.599-2.102	Mixed 2.102-2.715	Seagrass 2.715-2.824	Reef Gap 2.824-3.264	North of Reef Gap 3.264-3.348	Sand 3.348-3.471	Critical Habitat 3.471-3.839	Deep reef 3.839-4.046
Algae											
H. incrassata				x	x	x	x	x			
H. discoidea		x		x	x			x			
Udotea spp.				x	x		x				
Avrainvillea spp.		x			x	x					
Padina sanctae-crucis		x				x					
Caulerpa prolifera				x							
C. taxifolia		x			x						
C. cupressoides				x	x						
C. racemosa		x									
C. mexicana				x	x						
Penicillus spp.				x	x						
Dictyota spp.		x			x			x		x	
Dictyopteris spp.		x		x							
Hypnea spp.				x	x						
Laurencia spp.				x	x						
Gracilaria spp.				x	x						
Bryothamnion triquetrum				x							
Sargassum spp.		x									
Acanthophora spicifera				x	x						
unident. red								x			x
Seagrasses											
Thalassia testudinum						x					
Halodule wrightii					x						
Syringodium filiforme					x	x					
Halophila decipiens						x					

Species	Sand 0.116-0.778	IVRMR 0.778-0.988	Sand 0.989-1.599	Algal Rhodolith 1.599-2.102	Mixed 2.102-2.715	Seagrass 2.715-2.824	Reef Gap 2.824-3.264	North of Reef Gap 3.264-3.348	Sand 3.348-3.471	Critical Habitat 3.471-3.839	Deep reef 3.839-4.046
Sponges											
Ircina spp.		x					x	x		x	x
Ircina campana										x	x
Xetospongia muta							x			x	x
Aplysina spp.		x								x	
Callyspongia vaginalis										x	
Geodia neptuni		x								x	x
Agelas spp.										x	
unident sponge		x			x		x	x		x	x
Zoanthids											
Palythoa caribaeorum										x	
Soft corals											
Gorgonia spp.		x			x			x			
Pterogorgia spp.		x						x			
Pseudopterogorgia spp.										x	
Plexaura spp.		x						x		x	
Pseudoplexaura spp										x	
Plexaurella spp.										x	
Eunicea spp.		x			x			x		x	
Erythropodium caribaeorum										x	
Muricea spp.								x		x	
Muriceopsis spp.											x
Plumapathes spp.											x
Hard corals											
Millepora alcicornis		x								x	
Montastraea cavernosa										x	
Orbicella faveolata										x	
Madracis decactis										x	
Porites astreoides		x								x	
Siderastrea siderea		x					x			x	

Species	Sand 0.116-0.778	IVRMR 0.778-0.988	Sand 0.989-1.599	Algal Rhodolith 1.599-2.102	Mixed 2.102-2.715	Seagrass 2.715-2.824	Reef Gap 2.824-3.264	North of Reef Gap 3.264-3.348	Sand 3.348-3.471	Critical Habitat 3.471-3.839	Deep reef 3.839-4.046
Meandrina meandrites										x	
Agaricia agaricites										x	
Leptoseris cucullata										x	
Pseudodiploria strigosa								x		x	
P. clivosa		x									
P. labyrinthiformes										x	
Dichocoenia stokesii										x	x
Stephanocoenia intersepta										x	x
Mycetophyllia danaana										x	
M. aliciae										x	
Colpophyllia natans										x	
Isophyllia rigida										x	
I. sinuosa										x	
Other Invertebrates											
Diadema antillarum		x									
Eucidaris tribuloides		x									
Oreaster reticulatus	x	x		x							
Strombus gigas				x							
S. pugilis				x							

Table 9. Abundance of ESA coral species across cable segments along the route.

Species	Critical Habitat 3.471-3.839
Orbicella faveolata	2 colonies @ KP 3.675, 3.750

Table 10. Fish species present by KP segments across geophysical zones along the route. (Species in bold are EFH indicators).

Species	Sand 0.116-0.778	IVRMR 0.778-0.988	Sand 0.989-1.599	Algal Rhodolith 1.599-2.113	Mixed 2.102-2.715	Seagrass 2.715-2.824	Reef Gap 2.824-3.264	North of Reef Gap 3.264-3.348	Sand 3.348-3.471	Critical Habitat 3.471-3.839	Deep reef 3.839-4.046
Acanthurus bahianus							x	x		x	
A. chirurgus											
A. coeruleus		x		x	x						x
Amblycirrhitus pinos											x
Anisotremus surinamensis										x	
Anisotremus virginicus										x	
Bodianus rufus										x	
Calamus bajonado							x			x	
Cantherhines macrocerus										x	
Canthigaster rostrata										x	
C. striatus										x	
Chromis cyanea										x	
Coryphopterus glaucofraenum										x	
Epinephelus fulva		x						x		x	x
Equetus punctatus				x							
Gobiosoma evelynae								x			x
Haemulon plumieri										x	
H. flavolineatum				x						x	
Halichoeres bivittatus		x		x		x		x		x	
H. garnoti						x				x	
H. maculipinna		x				x					
Holacanthus tricolor										x	
Holocentrus rufus										x	
Lachnolaimus maximus										x	
L.mahogany										x	
L. apodus										x	
Melichthys niger										x	

Species	Sand 0.116-0.778	IVRMR 0.778-0.988	Sand 0.989-1.599	Algal Rhodolith 1.599-2.113	Mixed 2.102-2.715	Seagrass 2.715-2.824	Reef Gap 2.824-3.264	North of Reef Gap 3.264-3.348	Sand 3.348-3.471	Critical Habitat 3.471-3.839	Deep reef 3.839-4.046
Mulloides martinicus										x	
Myripristis jacobus										x	x
Ocyurus chrysurus											
Pomacanthus arcuatus		x									
Pseudupeneus maculatus										x	
Serranus tigrinnus										x	
Scarus iserti										x	
S. vetula				x							
Sparisoma aurofrenatum		x									
S. viride										x	
Stegastes adustus							x			x	
S. leucostictus										x	
S. partitus										x	x
Synodus intermedius										x	
Thalassoma bifasciatum		x						x		x	

Table 11. Geographical position and remarks of the sites for placement of temporary SWIV anchors.

No	Lat N		Long W		D (ft)	Substrate	Biota	Notes
1	18	28.379	66	0.531	135	sand	none	AMX #1, sand bag
2	18	28.401	66	0.238	142	sand	none	NEW, sand bag
3	18	28.200	66	0.517	104	sand	none	AMX #3, sand bag
4	18	28.200	66	0.193	100	sand	none	PCCS #3, sand bag
5	18	27.793	66	0.481	29	hardbottom	low %cover of soft and hard corals no ESA corals	AMX #5, sandbag can be placed in lowest cover substrate CH-EFH
6	18	27.994	66	0.342	46	hardbottom	low cover of algae, sponges and soft/hard corals no ESA corals	AMX #6, sandbag can be placed in lowest cover substrate CH-EFH
7	18	27.684	66	0.489	17	hardbottom	low cover of algae, sponges and soft/hard corals no ESA corals	AMX #7, steel plane to be placed in clear substrate CH-EFH
8	18	27.819	66	0.336	30	hardbottom	low cover of sponges and soft/hard corals no ESA corals	AMX #8, sandbag can be placed in lowest cover substrate CH-EFH
9	18	27.452	66	0.353	20	sand	none	AMX #9, sand bag
10	-	-	-	-	-	-	-	-
11	18	27.377	66	0.534	21	sand	none	AMX #11, sand bag
12	18	27.652	66	0.055	22	sand	none	NEW, sand bag
13	18	27.291	66	0.781	22	rhodoliths/sand	low %cover algae	AMX #13, sand bag EFH
14	18	27.430	66	0.217	16	sand	none	NEW, sand bag
15	18	27.186	66	1.057	27	sand	none	AMX #15, sand bag
16	18	27.316	66	0.235	13	sand	none	AMX #16, sand bag
17	18	27.178	66	1.222	11	sand	algal hardbottom around with low cover of algae	AMX #17, solid anchor
18	18	27.224	66	0.430	23	sand	none	NEW, sand bag
19	18	26.944	66	1.334	18	sand	none	AMX #19, solid anchor
20	18	27.163	66	0.630	23	sand	none	NEW, sand bag
21	18	26.733	66	1.387	13	sand	none	AMX #21, solid anchor
22	18	27.088	66	0.826	20	sand	none	NEW, sand bag
23	18	27.057	66	1.017	15	sand	none	NEW, sand bag
24	18	26.894	66	1.072	13	sand	none	AMX #24, solid anchor
25	18	26.748	66	1.151	9	sand	none	AMX #25, solid anchor
26	16	26.960	66	1.146	11	sand	none	NEW, solid anchor

Table 12. Biota present at the sites for placement of temporary SWIV anchors.

Species	Anchor Site				
	5	6	7	8	13
Algae					
Dictyota spp.		x	x		
Dictyopteris spp.			x		
Hypnea spp.					x
Bryothamnion triquetrum					x
Laurencia spp.					x
Gracilaria spp.					x
Sargassum spp.			x		
Acanthophora spicifera					x
Sponges					
Ircina spp.			x		
Ircina campana		x			
Xetospongia muta		x		x	
Aplysina spp.			x		
Callyspongia vaginalis		x			
Zoanthids					
Palythoa caribaeorum			x		
Soft corals					
Gorgonia spp.			x		
Pseudopterogorgia spp.		x			
Plexaura spp.	x		x	x	
Eunicea spp.			x		
Hard corals					
Millepora alcicornis		x	x		
Montastraea cavernosa	x	x	x	x	
P. astreoides	x	x	x	x	
Siderastrea siderea	x		x		
Meandrina meandrites		x			
Pseudodiploria strigosa	x	x		x	
P. clivosa	x				
Dichocoenia stokesii		x		x	

Table 13. Geographical position and remarks of the sites for placement of temporary cable hold back anchors along the route.

No	KP	Lat N	Long W	D (ft)	Substrate	Biota	Notes
1	3.875	18 28.117	66 0.381	80	sand layer over hardbottom	none	2 x Sand bags
2	3.450	18 27.888	66 0.399	44	sand	none	Sand bag
3	2.860	18 27.603	66 0.286	26	sand/rubble	none	Sand bag
4	2.225	18 27.337	66 0.464	25	sand	none	Sand bag
5	1.025	18 27.114	66 1.104	17	sand	none	Sand bag
6	0.350	18 26.797	66 1.251	12	sand	none	Solid anchor

Table 14. Estimated cable lengths over non-cemented substrate, non-cemented EFH*, hardbottom EFH and coral Critical Habitat (EFH/CH) out to 98 ft (30 m) depth. (Number in parenthesis indicates percentage [%]).

Substrate	**Stabilization**	**Cable length (m) over habitat category**				**Totals**
		Non-cemented	EFH	EFH/CH	Subtotal EFH + EFH/CH	
non-cemented (sand, rubble, rocky)	none	2,152 (54.8)	709 (18.0)*	n/a	709 (18.0)	3,061 (77.9)
	AP	200 (5.1)	-	n/a		
	clamps	n/a	n/a	n/a		
hardbottom	none	n/a	291 (7.4)	-	869 (22.1)	869 (22.1)
	AP	n/a	210 (5.3)	-		
	clamps	n/a	-	368 (9.4)		
Subtotal non-cemented		2,352 (59.9)	709 (18.0)*	-	709 (18.0)*	3,061 (77.9)
Subtotal hardbottom		-	501 (12.7)	368 (9.4)	869 (22.1)	869 (22.1)
Total Cable Length (out to 98 ft depth)		2,352 (59.9)	1,578 (40.1)		1,578 (40.1)	**3,930 (100)**

*algal grounds and seagrass combined