Project brief background.

Belize Cable Feasibility Study project was firstly conceived to provide a reliable service to the current and future electricity supplies for Caye Caulker. Current supply is from an on-site local diesel generator which causes potential for pollution and is not sustainable in the long term. The future growth projected in Caye Caulker, related largely to growth in the tourism industry, means that increased electricity supply will be required soon. An assessment was carried out to forecast the magnitude of the future demand and this estimation predicts a doubling in maximum load demand by 2037.

The project's aim is to connect Caye Caulker to the main network grid, which will improve reliability and sustainability of the electricity supply. The preferred option, which is described later in this document, has been evaluated upon the overall project objectives which are listed below:

1. Meet the required future electricity demands
2. Improve system reliability and ensure continuity
3. Reduce system loss

This document aims to provide to relevant stakeholders a summary of the project, what has been done so far and the future steps. The following sections provide a description of the preferred option and the process that has been undertaken to select it as well as a summary of the Environmental and Social Impact Assessment (ESIA) report that is currently under development.

Assessment of options

To assess the best option to upgrade the electricity supply in Caye Caulker, a feasibility study has been conducted which has looked at a number of different options, and assessed these against various criteria covering technical, environmental, social, economic and sustainable factors. Following the initial data collection exercises, several different options for connecting Caye Caulker to the main grid were considered and are recorded as part of a wider assessment of the Cayes between Belize and San Pedro. This included connecting directly to the mainland via Maskall or Belize City as well as connecting via San Pedro.

The most effective method to connect Caye Caulker to the main grid was determined to be through a connection to Ambergris Caye. This was preferred due to the significant proximity and cost advantages over alternative connections. The shorter cable will also reduce marine ecology impacts, and the shorter construction time associated reduces disruption during the construction activities.

Once this stage of the process was accomplished, the next step was to decide on the best options for submarine, landfall and power station connection to Caye Caulker for which a constraints map was developed. The map included constraints such as shipping lines, shallow areas, land uses, environmental protected areas and key habitats, and assigned risk classifications depending on the existing sensitivity of the key area i.e. Landfall, Submarine and Power Station areas. A total of five routes for the interconnection were identified which then where scrutinised through a Multi-Criteria Analysis (MCA) which ultimately provided the preferred option. The shortlisted routes are outlined below:

- Route 1: North Point landing with new Caye Caulker North Island substation.
- Route 2: North Point landing with re-development of Caye Caulker diesel power station substation.
- Route 3: Caye Caulker diesel power station landing with substation re-development.

- Route 4: Landing south of forest reserve with new Caye Caulker North Island substation.
- Route 5: Landing south of forest reserve with re-development of Caye Caulker diesel power station substation.

What's common to all Routes?

The differentiators between the routes are driven by the arrangements by Caye Caulker. All shortlisted routes will intercept the existing land circuit on Ambergis Caye. This is currently connected to the mainland at Maskall through a submarine cable (see Figure 1). It should be noted that there are also currently feasibility studies ongoing to look at upgrading the supply to Ambergis Caye which will provide increased reliability in source energy.

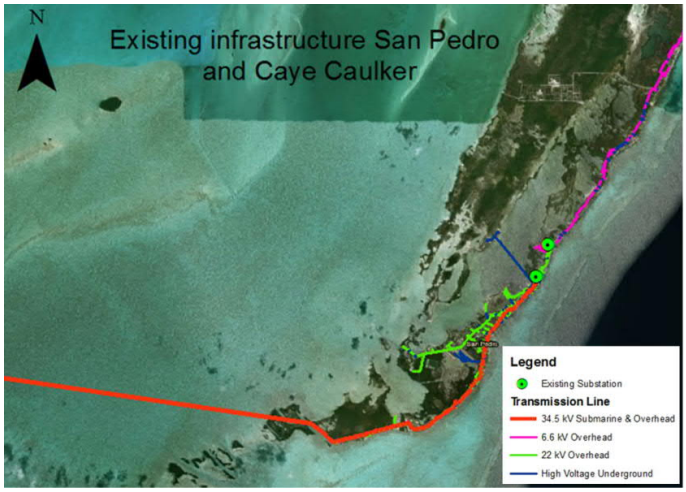


Figure 1. Land circuit between San Pedro and mainland Maskall to which the preferred route will intercept.

Please refer to Figure 2 below showing the routes that were shortlisted as part of the assessment.

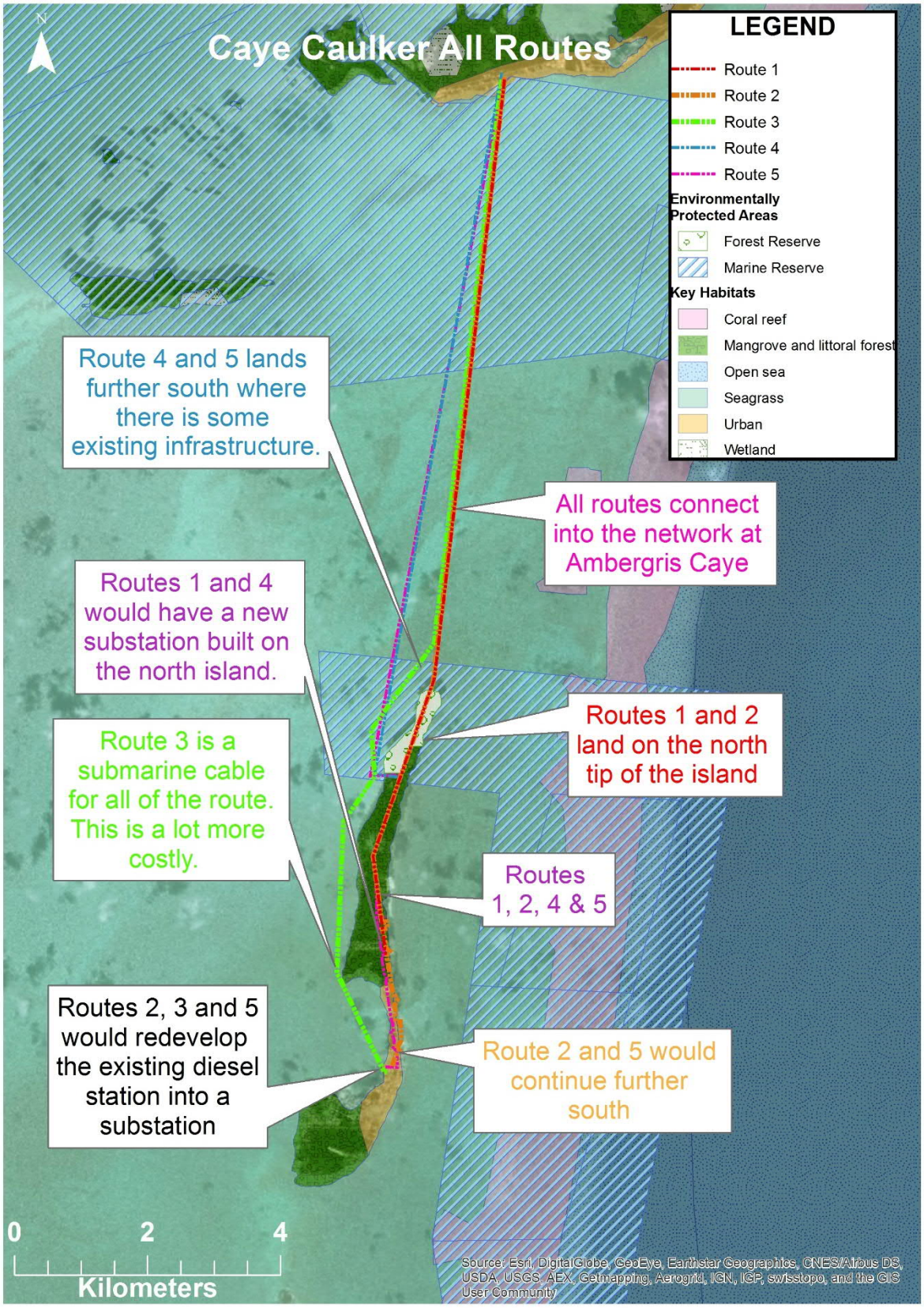


Figure 2. Caye Caulker - five option routes map

Output from the Multi-Criteria Analysis

Table 1 shows a visual comparison of the different routes and the results from the MCA in a coloured scale, whereby Green means that the overall impact is positive and Yellow that there is a negligible impact.

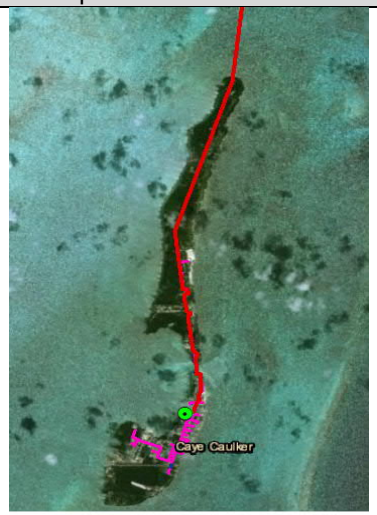
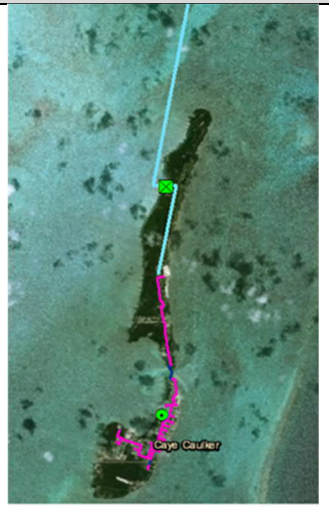
The most relevant findings from the MCA are highlighted below:

- Terrestrial construction practicality and impacts on flora and fauna: The construction of Routes 1 and 2 meant that overhead lines would need to clear 6m width of forest allowing access and construction. Dense mangroves would make construction difficult as well as nesting birds issues from erecting overhead lines. Tall poles would be difficult to source. Clearance of mangroves at the landing site would have a large impact on fish and marine mammals.
- Terrestrial construction practicality: Routes 4 and 5 shorten the length of overhead lines and avoid area of densest mangroves. There is a reduction in risks in terms of technical and construction practicalities by landing where the mangroves are less dense and there is existing infrastructure. Route 4 requires purchase of new land whereas Route 5 re-develops the existing site.
- Construction and maintenance costs: Even though Route 3 would bring a significant reduction in operation costs due to the low maintenance of submarine cables, its construction costs together with the redevelopment of the existing power station on Route 3 resulted in its rejection due to the high costs that this option involved.
- Social feasibility: All options would have a positive impact on the community due to the reduction of noise and pollution as well as addressing the power shortages. This is especially the case for Routes 2 and 5 which would have a significant positive impact on the community and in tourism since the redevelopment of the substation would be within existing footprint of site and would not impact on new areas.

Through assessment of this work and undertaking further discussions with relevant stakeholders through an exhibition with the public in Caye Caulker, it was agreed that Option 5 was the best option for going forward. This is because it:

- Provides more cost-effective route than Route 3
- Reduces installation risks and costs relative to Route 1, while protecting the highest quality area of forest at the northern tip of Caye Caulker, and
- Reduces the amount of new infrastructure required for cable installation and operation/ maintenance.

Table 1. Multi-Criteria Assessment summary of findings with coloured rating on the shortlisted routes.

ROUTES	1	2	3	4	5
BRIEF DESCRIPTION	North point landing + North Island Substation	North point landing + Re-development of Diesel PS	Diesel PS Landing + Re-development of Diesel PS	Forest Reserve landing + North Island Substation	Forest Reserve landing + Re-development of Diesel PS
					
OBJECTIVES	O1: Meet the required future electricity demands. O2: Improve system reliability and ensure continuity. O3: Reduce system loss				
TECHNICAL	Marine Construction Practicality. Terrestrial Construction Practicality. Health & Safety				
ECONOMIC	Construction Cost. Operation and Maintenance Cost.				
ENVIRONMENTAL	Impacts on Marine Flora and Fauna. Impacts on Terrestrial Flora and Fauna. Coastal Processes. Landscape and Heritage Impacts				
SOCIAL	Tourism Impact. Community Impact. Planning, Legal and property				
FUTURE	Adaptability / Versatility for future Requirements. System Resilience to Disasters E.g. Hurricanes				

The Preferred option: Landing south of forest reserve with re-development of Caye Caulker diesel power station substation

Cable description

The submarine cable from San Pedro to Caye Caulker will have a 95 mm2 cross-sectional-area (csa), and be buried 0.5m below the seabed. The future electrical infrastructure will be designed for a larger load requirements to account for future development and potential increase in the electricity demand in the long term.

Furthermore, the design will be embedding a fibre optic cable within the submarine cable which have been defined through discussions with Belize Telemedia Limited (BTL) and Smart (a subsidiary of Speednet Communications Ltd) infrastructure.

Figure 3 shows a detailed map of the preferred option.

Increasing the resilience of the infrastructure

The resilience of the infrastructure has considered the potential future damages caused by events such as tropical storms and hurricanes. The climate resilience study carried out demonstrates that over a 40 year period, when considering potential costs of repairing infrastructure following a major storm, initial burial of the cable underground provides long term cost savings.

Landing Sites

Landing sites were selected to optimise construction practicality, cost, and to minimise environmental impacts. On Caye Caulker an area of the coastline was selected just south of Caye Caulker forest reserve. This landing site had the advantages of less dense mangroves, existing tracks and clearings to the site, as well as more preferential bathymetry for installation.

The south of Ambergris Caye was selected for the cable landfall to minimize the length of the submarine cable. The bathymetry becomes easier for construction of the landfall further east along the south of Ambergris Caye, however the landfall area also becomes more densely urban further east. Finally, the landfall site selection balances a number of factors including dredging and shipping channels to the west, and the proximity to the existing cable's landfall as well as urban areas.

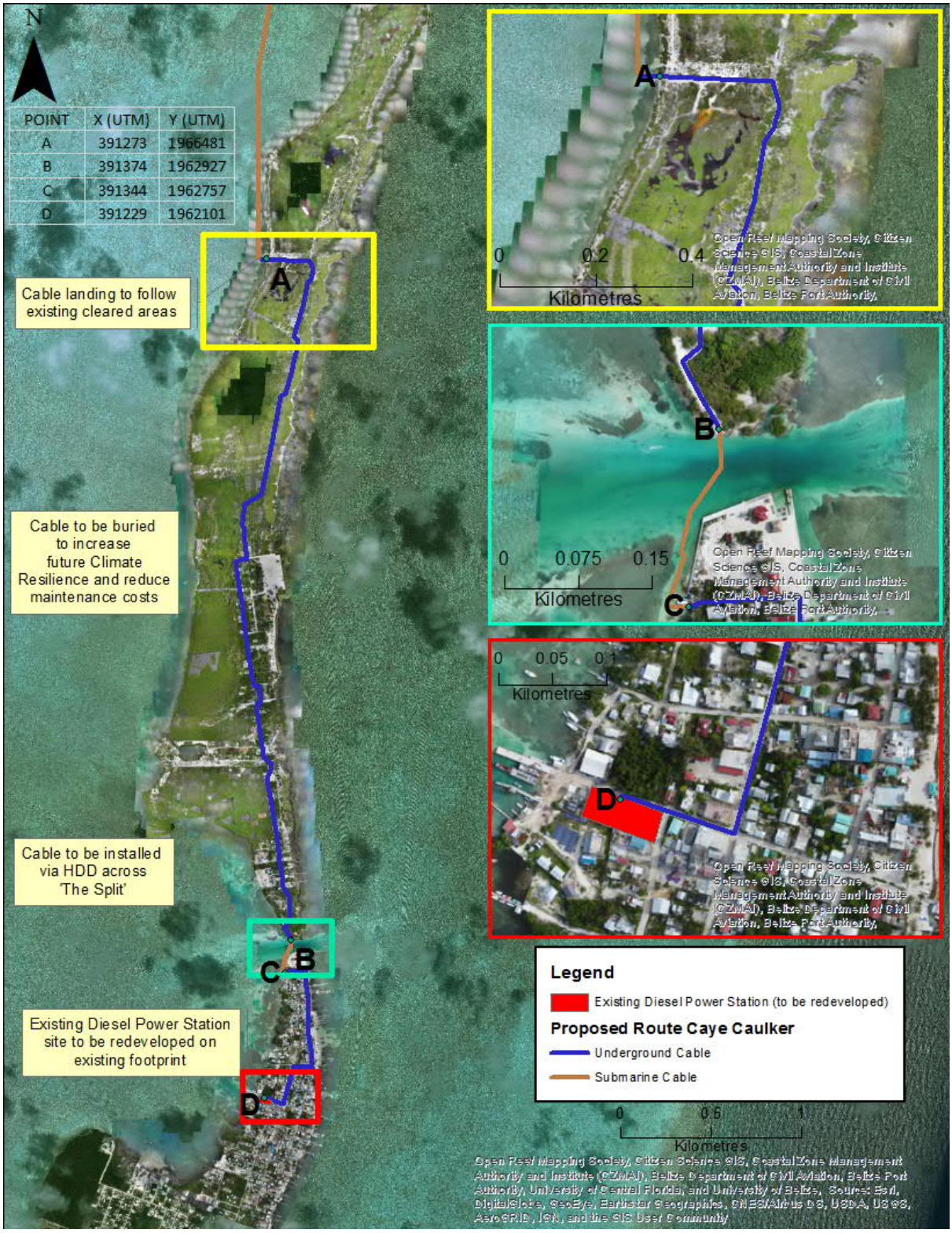


Figure 3. Detailed map of preferred route.

Installation Techniques

The Table 2 below shows a summary of the various installation methods along the cable route.

Table 2: Preferred installation technique

Zones	Method	Approximate burial depth below seabed (m)
Subsea - Shallow areas (depths less than 1.5m)	Divers jetting trench for cable	~1
Subsea - Deeper areas (depths greater than 1.5m)	Cable trenching by installation vessel	~0.5
Caye Caulker's Split	Horizontal Directional Drilling (HDD)	~5
Landfall (transition between land and sea)	HDD or open trench	≥1.5
Land installation	Direct buried or ducted solution with J-tubes at the termination	0.75-1.5

Source: Mott MacDonald

The advantages and disadvantages of using each of the above techniques as well as alternative techniques are also provided in Table 3 below:

Table 3. Advantages and disadvantages of cable installation techniques

Installation Methodology	Advantages	Disadvantages
Laying directly cable on sea bed	• Better thermal characteristics, therefore greater rated ampacity • New environmental habitat created, adds feature to area and may act as a fish aggregation device	• Vulnerable to damage (vessel impacts, anchors, fishing, waves, currents, seabed level variations etc.) • Greater environmental impact from EMF • Non-native habitat
Using submersible or tracked ROV's to trench	• Reduced requirement for divers, • Improved Health and Safety	• Power required would need larger vessel which would be problematic due to shallow depths
HDD for all landfalls	• Improved protection from damage by third parties.	• A deeper burial depth causes worse thermal rating capacity • Uncertain ground conditions can lead to drilling challenges • Specialist contractors are required that may not be locally/regionally available • More expensive than direct burial
Divers jetting throughout	• Reduced environmental footprint*	• Diving operations increase health and safety risk especially as depth of works increases
Trenching by vessel in shallow areas	• Reduced requirement for divers, • Improved Health and Safety	• Too shallow for vessels to be powered by engines – anchor propelled barges are likely to be utilised which will increase installation programme

Source: Mott MacDonald

Environmental and Social Impact Assessment (ESIA)

Mott MacDonald has produced a draft of the ESIA which aims to highlight and mitigate the potential environmental impacts of the project, while meeting the needs of the Department of Environment (DoE) and the Caribbean Development Bank.

An ESIA is the process of compiling, evaluating and presenting the significant environmental and social effects of a proposed project so that the scheme is designed environmentally and socially sensitive. One way in which this can be accomplished is through the early detection of adverse environmental and societal impacts allowing the project to be altered to avoid these impacts, to

create mitigation strategies to help reduce them and set out monitoring requirements to ensure any residual risks are monitored with further mitigation identified if required.

The key milestones projected for the project are presented below. It should be noted that efficiencies and programme reductions will be sought where possible, but cable procurement as well as procurement of Contractors can be lengthy processes.

- Environmental and Social Impact Assessment Process:
  - Submission to Department of Environment – November 2018
  - Public consultation events – January 2019
  - Receive response from Department of Environment – February/March 2019
- Procurement of Design and Build Contractor
  - General Procurement Notice provided on Caribbean Development Bank website – October 2018
  - Prequalification process for Contractors -November 2018 to January 2019
  - Tendering/Procurement of Design and Build Contractor – January to May 2019
- Design and Build
  - Detailed design – June 2019 to October 2019
  - Mobilisation, confirmation of supervision and environmental coordinator, procurement of cables - August to December 2019
  - Construction – December 2019 to May 2020

Key Impacts and Mitigations

To extract and evaluate the main impacts so that mitigation measures could be developed the following methodology was adopted:

- Consultations conducted by Mott MacDonald and BEL;
- Baseline studies and evaluation of environmental and social receptors;
- Identification and characterization of potential impacts;
- Defining significance of effects;
- Ecological and geomorphic survey transects;
- Establishment of baseline conditions per stage of works (third party data sources and cable route survey undertaken by the project team);
- Identification of effects from potential impacts upon receptors from construction phase per stage of works;
- Identification of operational effects; and
- Assessment of cumulative effects, required mitigation and monitoring actions.

The above processes have all been undertaken and are part of the main ESIA document. This ESIA assesses in great depth the key environmental impacts that the works could have for each of the receptors. They are assessed during both construction and operational periods and a detailed list of mitigation measures is provided for each case. The table below shows a summary of the key impacts and mitigations over the environmental and social receptors.

Receptor	Key (cumulative) Impacts	Mitigation measure
Marine fauna	Disturbance during construction due to movement of vessels, noise, light and	Works carefully managed to avoid lasting effects. Construction phase will provide moderate overall

Receptor	Key (cumulative) Impacts	Mitigation measure
	disturbance of sediment/habitats throughout the installation process	disturbance magnitude. Route not affecting any coral reefs. Negligible impact during operation
Marine flora	During construction, removal of sea grass habitat to undertake the trenching of the cable. Suspended sediments released resulting in sea grass blanketing.	Medium-term impacts. Encourage of regrowth after construction. Negligible impact during operation. The proposed cable route established to avoid sensitive marine flora habitat regions. Width of trench will be minimal and sediments will be used to fill in trench.
Terrestrial fauna	Disturbance during construction due to the movement of vehicles and equipment, noise, light and disturbance of sediment/habitats where the cable is buried or installed overhead.	Construction footprint be confined as much as possible. A survey of nesting bird locations will be completed prior to the work to deter nesting prior to construction. No works during nesting periods. Negligible impact during operation.
Terrestrial flora	During construction, the cable landing and building of the infrastructure required will require the removal of some mangrove habitat.	Minimise the imposed mangrove clearance footprint. Construction footprint must be as narrow as possible. Vehicles will be required to stick to designated access routes. Negligible impact during operation.
Sediment Transport	During construction, the sand and mud layers on the seabed along the proposed route will be become stirred up and suspended due to changes in currents caused by the trenching activities. Exposure of cable could lead to change in sediment transport trends during operation.	Short-term impact and low magnitude when effectively managed. Implementation of best practice guide. Route through shallow waters so minimal disturbance. Design to address any potential impact during operation, right buried depth and re-profiling of sea bed near to cable landing areas.
Water Quality	During construction, there will be a potential increase of suspended sediments, unintentional pollution and/or spillage from vessels into the water column, contamination of sensitive marine habitats.	Oil spill and monitoring plan to be adopted by vessels. Currents of these coastal waters mean that any small pollution would be quickly dispersed, causing a very short-term impact. Risk of pollution controlled carefully, and best practice applied. Negligible impact during operation.
Air Quality	During construction, there will be potentially emission of gases from vessels and vehicles reducing air quality. Dust generation from road traffic through unpaved roads, impacting habitats within the access routes vicinity.	Materials to be sourced locally where possible. Wheels washing, modern and vehicles well maintained. Impact on dust emissions could be reduced by covering access routes with tarpaulin for distances >1km in sensitive areas. Beneficial impact in the long term due to the decommissioning of the Diesel Power Generator.
Geology and Seafloor Sediments	Trenching activities during construction may present alterations to the bathymetry or beach drawdowns if undertaken close to the shore which can expose the cable and increase scour potential around the cable.	Trenching will only impact the top 1-2m of soil/seabed sediments and only a very small section of ground radially from the installation will be impacted. These effects can be further mitigated by considering potential beach fluctuations regarding design depth. No impacts in the long term.
Navigation – large vessels	Areas where vessel movements will be restricted during construction could be impacted.	The construction area between Caye Caulker and San Pedro is not a key area for larger vessel movements. No impacts during operation.
Navigation – small vessels	During construction there will be restriction of movement for smaller fishing vessels, transport vessels and recreational vessels which provide a source of income for the community.	Peak period of activities in the fishing industry to be considered in the programme. Diversions to be put in place so that the link between Caye Caulker and San Pedro can still be undertaken by boat. Early engagement with stakeholders to reduce impact on disruption. Monitoring of vessel activity during construction. No impacts during operation.
Social Factors	Disruption to the community on Caye Caulker and Ambergris Caye due to construction vehicles, noise, restricted access in areas and visual disturbance. Some fishers affected having to move their static gear to avoid loss or damage.	Grievance Management Plan will be in place to engage with stakeholders about any required beach closures and disturbances to tourist diving and water sport activities that bring economic benefits to the region. Additionally, disturbance managed through stakeholder engagement. Impact only during construction. Beneficial impact during operation.

Source: Mott MacDonald

Overall, although the construction will take place within sensitive marine environments, the level of trenching and small cable size mean that majority of the impacts can be mitigated and will be short term and reversible.

Mitigation and monitoring

In order to be able to comply and make possible all the proposed mitigation measures and minimisation of potential impacts, the ESIA provides two mitigation plans to be adopted during construction and operation respectively. The report also outlines an Environmental Monitoring Plan (EMP) which is used for assessing any changes in environmental conditions, or to identify mitigation measures that might be required, as a result of the proposed project implementation. The EMP shall be implemented by an independent and adequately qualified environmental consultant. The Environmental Consultant must be qualified in Environmental Impact Assessments and in general Natural Resources Management issues. Such a person must also be well versed with the local environmental condition, environmental laws and policies. The EMP will be further developed as part of the Contractor's contract and will form a binding part of their scope.

What's next?

We hope that this letter has provided you with the relevant information regarding the current stage of the Belize Cable Feasibility project. As highlighted in the above sections we are looking to issue the final ESIA in November 2018 but wanted to provide you with the opportunity to provide any feedback and/or ask any questions before then. This means that we can look to capture as much knowledge and concerns as possible.

Belize Electricity Limited is looking to get Contractor on board for the Construction works in spring 2019. Detail design will be provided by appointed contractor before construction.

Please, should you have any questions or require further information, do not hesitate to get in touch and we will be very happy to respond at the earliest opportunity. We welcome any feedback that you might have and would be very grateful for any opinions from your part in this early engagement.