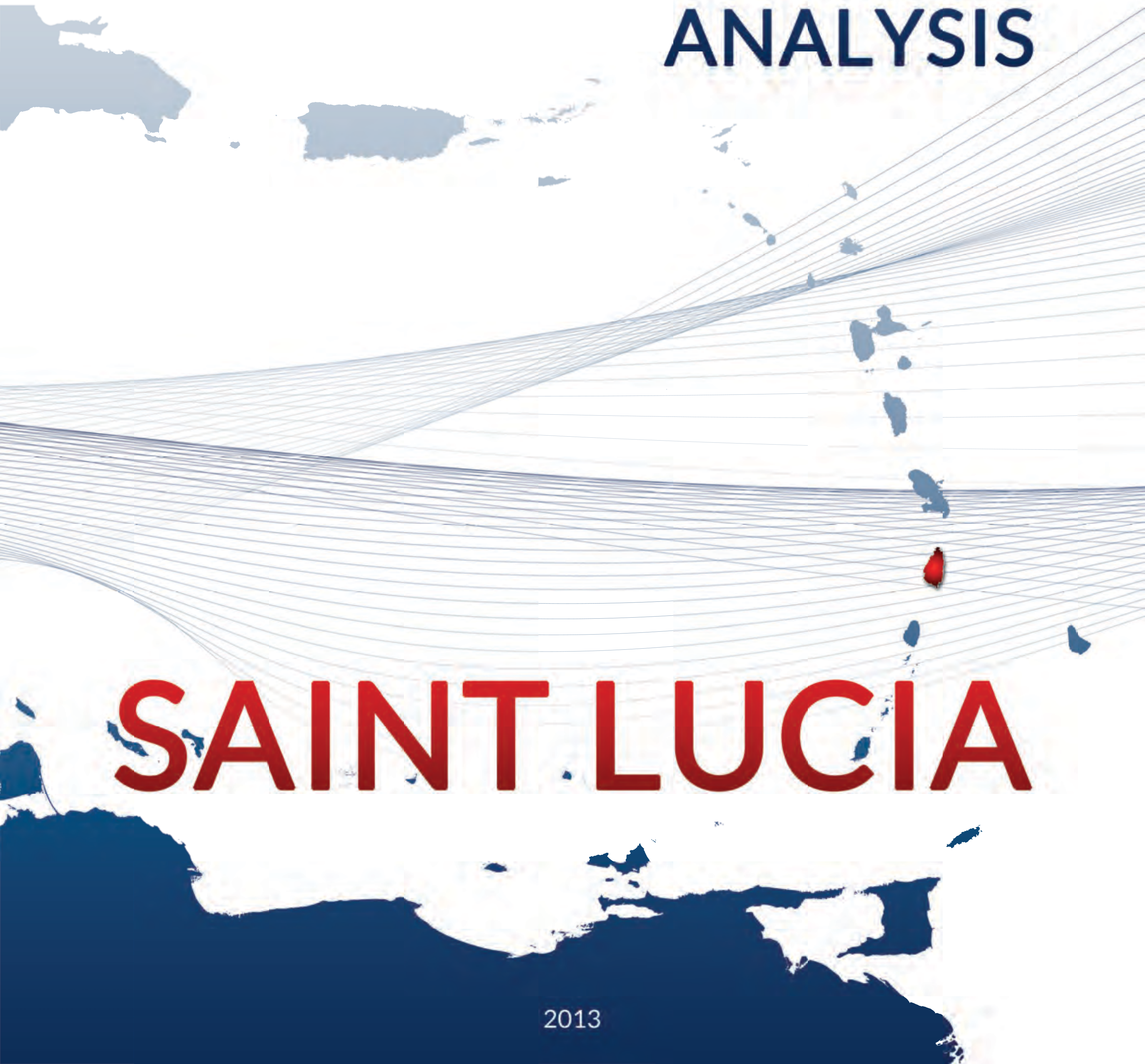
CREDP
Caribbean
Renewable
Energy
Development
Programme

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

On behalf of:
Federal Ministry for Economic Cooperation and Development

GEOMINDS
geo-solutions and consulting

HYDROPOWER POTENTIAL ANALYSIS



SAINT LUCIA

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Executive Summary

The purpose of this analysis is to assess the hydropower potential of the rivers on the island of Saint Lucia. To locate sites suitable for hydroelectric power generation, preliminary studies and sufficient knowledge of the topography, the stream network and its flow regime are required. This kind of data is only insufficiently available for the present study. Therefore, an innovative method using globally available satellite data, local rainfall data and terrestrial support data has been developed. The stream network of the island and the topography of the catchments were synthetically developed and the runoff processes modeled applying a hydrological model taking into account regional climate conditions.

In total, 20 primary rivers with a catchment size of at least 9 km^2 were detected and analyzed for their hydropower potential. As the John Compton Dam dams the Roseau River for freshwater storage reasons, the river and its upstream catchment have been excluded from the present analysis.

Due to the mounatinious conditions and high rainfall the highest theoretical technical hydropower potential was detected for rivers in the southern parts of the island with the highest potential being at the Troumassée River.

To evaluate the hydropower potential of the island, virtual projects were considered at all analyzed rivers and the technical and financial viability was assessed. As not every virtual project is eventually economically viable, only virtual projects with a positive net value after a considered operation time of 25 years have been filtered and ranked according to their respective internal rate of return. As all economically related parameters are very sensitive and may lead to skew results of the analysis, the parameters and assumptions have been determined very carefully according to local pricing conditions.

The economic viability of the virtual projects strongly depends on the remuneration for feeding-in electricity to the public grid. To allow for assessment of the sensitivities, five scenarios have been developed including feed-in tariffs of US$ 0.10, 0.125, 0.15, 0.175 and 0.20 per kWh.

Applying a feed-in tariff of US$ 0.10, only two viable virtual projects were identified on the island of Saint Lucia. Both of them are located in the catchment of the Troumassée River. When considering higher feed-in tariffs, revenues will increase and more virtual projects become viable, including the Dorée River, Canaries River and the Grande Rivière du Vieux Fort.

The results of this report are to be understood as a reliable data basis and allow concentrating time-consuming and cost-intensive further studies at the located potential sites.

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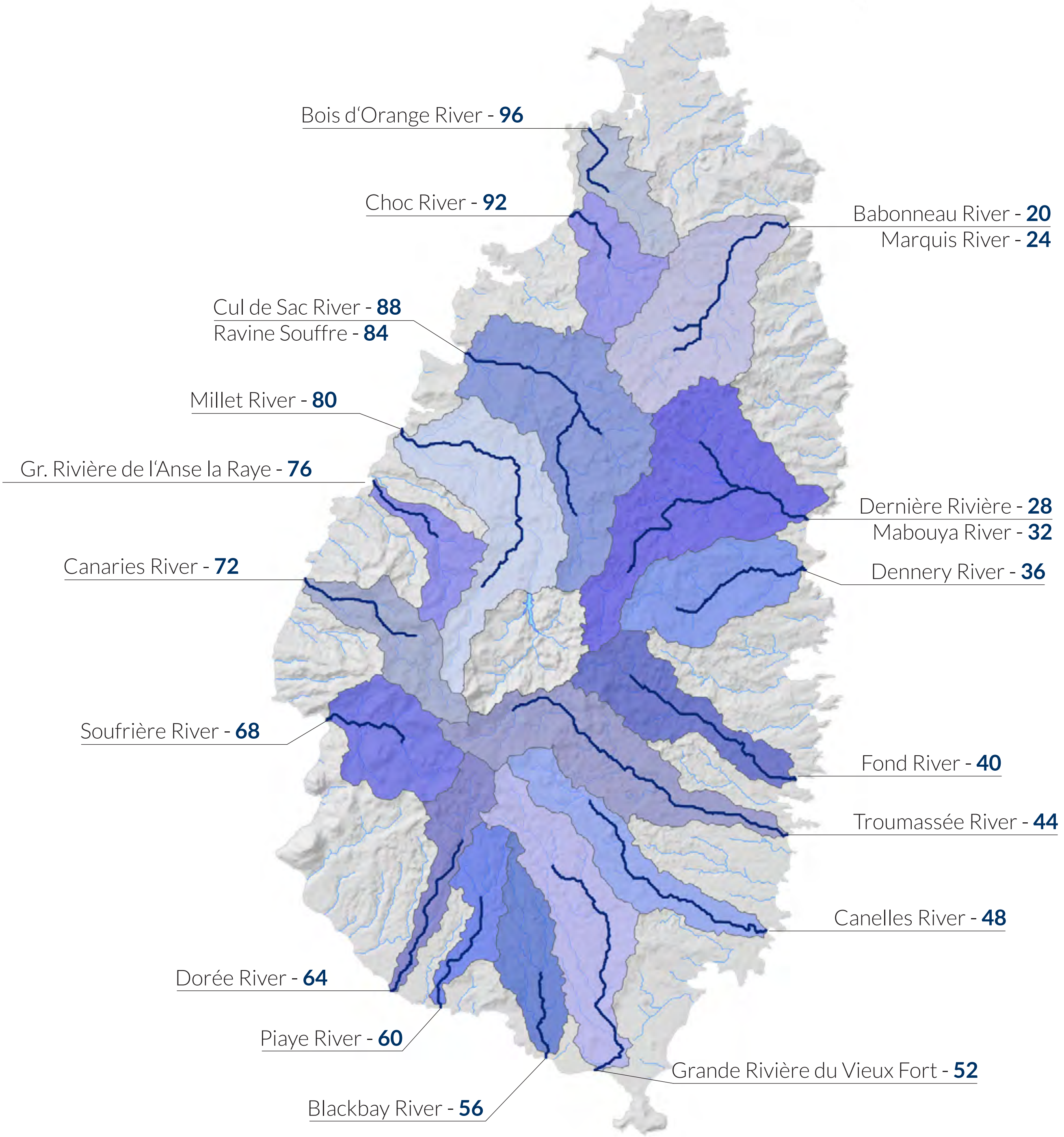


Accronyms and Abbreviations

ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
BMZ	Bundesministerium für wirtschaftliche Zusammenarbeit (German Federal Ministry of Economic Cooperation and Development)
CARICOM	Caribbean Community Secretariat
CEHI	Caribbean Environmental Health Institute
CIMH	Caribbean Institute for Meteorology and Hydrology
CN	Curve Number
CREDP	Caribbean Renewable Energy Development Programme
D8	Deterministic 8 Algorithm
DEM	Digital Elevation Model
ERSDAC	Earth Remote Sensing Data Analysis Center
FiT	Feed-in Tariff
GDEM	Global digital Elevation Model
GFRP	Glass Fiber Reinforced Polymer
GIS	Geographic Information System
GIZ	Gesellschaft für Internationale Zusammenarbeit (German Agency for International Cooperation)
GTZ	Gesellschaft für technische Zusammenarbeit (German Agency for technical Cooperation)
GOSL	Government of Saint Lucia
HSG	Hydrologic Soil Group
IEA	International Energy Agency
IRR	Internal Rate of Return
IRENA	International Renewable Energy Agency
kW	Kilowatt
kWh	Kilowatt hours
METI	Ministry of Economy, Trade and Industry (Japan)
NASA	National Aeronautics and Space Administration (USA)
NPV	Net Present Value
NWRA	National Water Resources Agency (Saint Lucia)
OECD	Organization of Economic Co-operation and Development
PTB	Physikalisch-Technische Bundesanstalt (Physical Technical Federal Institute; Germany)
SCS-CN	Soil Conservation Service Curve Number (USA)
US$	United States Dollar

[PART 1]

BACKGROUND INFORMATION

1. Introduction

The island of Saint Lucia, like many other Caribbean islands, traditionally used the power of water for productive use such as sugar cane milling. Proof of these activities can still be found on the island in the form of old hydro wheels, for instance at the Balembouche Estate. The mere fact that the water from the streams in Saint Lucia had been used as a source of energy suggests that there may be potential for the use of the streams for electricity generation with hydropower plants. The strong relief structure and the high amount of rainfall underline the favorable conditions for hydropower on the island.

The Caribbean Renewable Energy Development Programme (CREDP-GIZ), upon request from the Government of Saint Lucia, has been analyzing the hydropower potential in Saint Lucia in a systematic manner. To locate sites suitable for hydroelectric power generation, preliminary studies and sufficient knowledge of the topography, the stream network and its flow regime are required. This kind of data is only insufficiently available for the study of Saint Lucia's hydropower potential. However, an innovative method using globally available satellite data, local rainfall data and terrestrial support data allow a rough assessment of the island's hydropower potential.

Purpose and Scope

This report covers the analysis of the theoretical technical and economically viable hydropower potential of all major streams of the island of Saint Lucia. For this purpose, a computer-based analysis and decision-making tool was developed taking into account Saint Lucia's regional climatic conditions and relief structure. In this report, background information is given regarding the method and procedure of the analysis as well as all key parameters.

Several field visits were undertaken to obtain all available relevant local data from the responsible governmental institutions and agencies as well as to collect calibration and validation data. Any relevant but not available data was compensated for through information derived from several remote sensing data products.

The results of this up-to-date hydropower potential analysis are meant to support governments, policy-makers, investors and utilities to make informed decisions regarding the hydropower opportunities in Saint Lucia. This analysis was conducted under the Caribbean Renewable Energy Development Programme CREDP-GIZ.

2. Project Region: Saint Lucia

Situated in the middle of the arch of the Lesser Antilles, the island of Saint Lucia has a landmass area of 616 km². Martinique is located 32 km north and Saint Vincent 40 km south of the island. The largest distance in the north-south direction is about 43 km; about 21 km in the east-western direction. Saint Lucia has 176,000 inhabitants (World Bank 2011:4). Beside the capital Castries there are the major cities of Vieux Fort, Soufrière and Gros Islet.

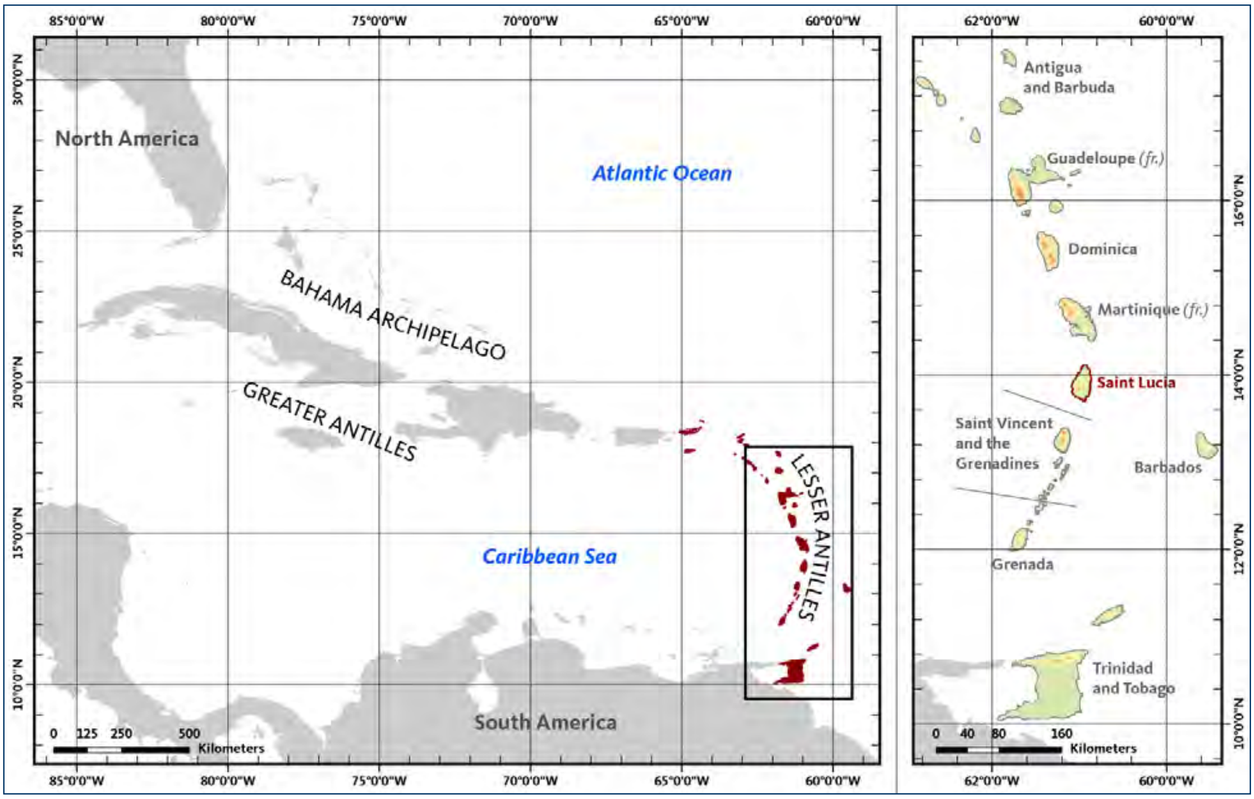
Due to volcanism, Saint Lucia has a mountainous topography. A central ridge ranges from north to south almost across the entire length of the island. In addition, numerous ridges reach out in an east-westly direction. At 958 m Mount Gimie is the highest peak of Saint Lucia's central highlands, located in the southwest part of the island (GOSL 2006:3). The coasts, especially in the central-eastern part, often show nearly vertical cliffs with a small strip of sandy beach. Some broad valleys are covered by large banana plantations, including Cul-de-Sac, Roseau and Mabouya. Together with the area around the town of Vieux Fort, these valleys make up the largest part of the flat land in Saint Lucia.

The tropical-maritime climate with relatively uniform temperatures dominates throughout the year with two distinct seasons. The dry season with mostly sunny and warm weather is from December to May and the rainy season with heavy rainfall starts in June and ends in late November.

The hottest period is from May to October, the coldest is from December to March, resulting in an annual average temperature of 26°C at sea level. The annual rainfall varies from 1,524 to 1,778 mm in the north and up to 2,540 to 3,683 mm in the central mountainous part in the south (GOSL 2011:18).

In total there are 21,700 hectares of natural vegetation in Saint Lucia, of which 9,196 hectares are in the state-protected forest reserve area in the center of the island (Morton 2009:4). Three dominant types of landscape can be identified on the island: rainforest, dry forest as well as areas with lower vegetation and grassland (Morton 2009:5).

Geographic Overview
of the Caribbean Region



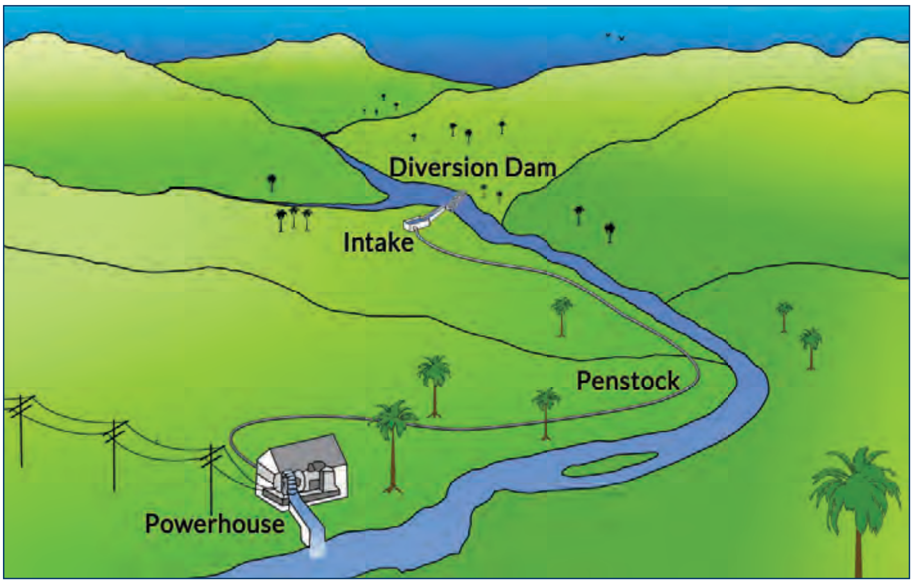
3. Hydroelectric Power Generation

Hydropower is a renewable energy source based on the natural water cycle and the most mature, reliable and cost-effective renewable power generation technology currently available (OECD/IEA 2011:27). Today, around 16% of the world's electricity and over 80% of the world's renewable electricity is produced by hydropower plants (IRENA 2012:4; IPCC 2011:441). Being one of the most flexible sources of electricity generation available, hydroelectric power plants are capable of responding to demand fluctuations in minutes and even seconds, delivering base-load power and, when a reservoir is present, storing energy (OECD/IEA 2011:27; IPCC 2011:442). Hydroelectric generating units are able to start up quickly and operate efficiently almost instantly, even when used only for a short time or at partial loads (OECD/IEA 2011:27). Hydropower can serve as a power source for large and small, centralized and isolated grids.

Small hydropower can be a cost-competitive option for rural electrification of remote communities in developed and developing countries and can displace a significant proportion of diesel-fired generation. In developing countries, another advantage of hydropower technology is that it can have important multiplier effects by providing both energy and water supply services (e.g. flood control and irrigation when used as a storage reservoir), thus bringing social and economic benefits (IRENA 2012:4).

Hydropower generating units are able to transform the potential energy of a mass of water flowing downhill in a river or stream into electricity. This is done by converting the energy potential of the water to turn a turbine, which, in turn, provides the mechanical energy required to drive a generator and produce electricity (IRENA 2012:6).

In run-of-river hydropower systems, electricity production is driven by two main parameters: the water flow in the river and the elevation drop of a river. These hydroelectric power generating systems have little or no storage, although even run-of-river hydropower schemes without storage will sometimes have a small diversion dam. This allows very short-term water storage (hourly or daily) and diverts a portion of the stream flow to a channel or penstock to convey the water to the turbine. Turbines and generators convert potential energy into electricity before the water returns to the stream (Giesecke a. Mosonyi 2006:29). Water courses suitable for hydropower generation ideally have sustainable and high flow rates as well as steep gradients between a virtual intake and a virtual powerhouse creating the necessary head.



Main Components of Run-of-River Hydropower Systems

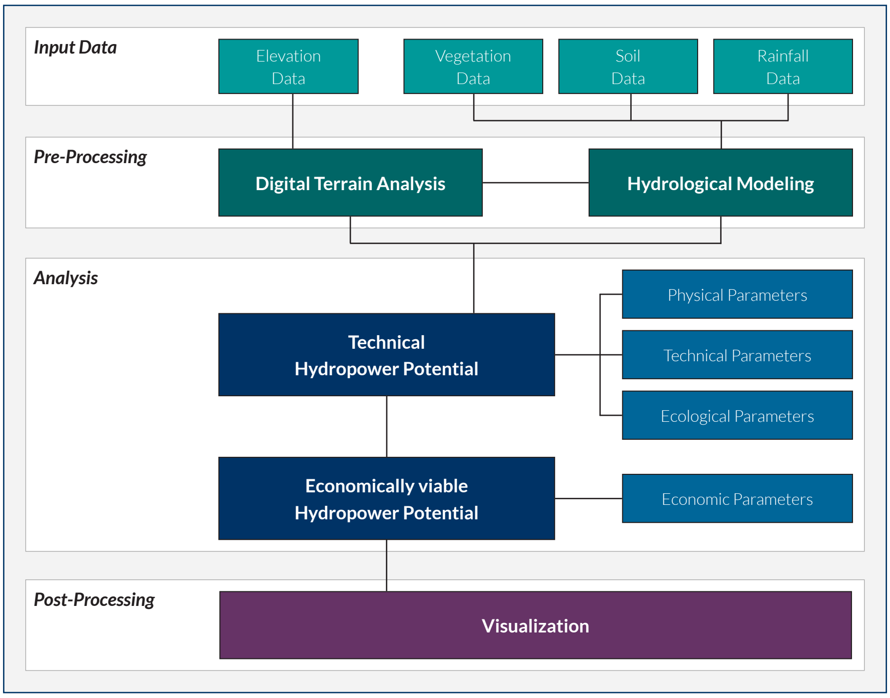
4. Method and Proceedings

To locate sites that are suitable for hydroelectric power generation on Saint Lucia, an analysis of the hydropower potential of the stream network was carried out. However, a reliable and accurate analysis of a stream network requires detailed and accurate data on elevation/head and available discharge of the stream network.

For Saint Lucia, only few long-term hydrological data records on the stream network were available. For this reason, a new GIS-based approach was developed that is able to cope with the limited data availabililty to allow first assumptions about the hydropower potential of the Saint Lucian stream network. Globally available satellite-based data products were obtained to compensate for any missing yet relevant input data.

Catchment boundaries and the stream network of Saint Lucia were derived from a digital elevation model. Based on vegetation, soil and rainfall data, the available discharge for the entire stream network was modeled applying a hydrologic Model suitable for the regional climate conditions on the island.

All spatial topographic and hydrological data was stored in a comprehensive SQL-database. Based on this database it was possible to estimate the technical hydropower potential of all streams according to physical, technical and ecological limitations. Taking into account local economic parameters allow the location of river sections suitable for implementing economically viable virtual hydropower projects.



Flow Chart
of the developed approach analyzing the hydropower potential of Saint Lucia

The GIS-based approach requires the following spatial data products as input data:

- **Elevation Data**
  [raster-based digital elevation data]
- **Vegetation Data**
  [raster-based data on vegetation structures]
- **Soil Data**
  [raster-based data on soil classification]
- **Rainfall Data**
  [point-based records of daily rainfall data]

4.1 Methodology

As all calculations of the hydropower potential analysis of Saint Lucia are referred to spatial information, a Geographic Information System (GIS) was established. For all calculations and data storage, a point grid layer of the study area was developed referring to the spatial resolution of the raster-based digital elevation model (DEM). The grid points represent cells with a square shape with the grid point being located in the center of the cell. All relevant spatial information was joined to the grid points according to its spatial location. The attribute data of all grid points was transferred to the database serving the computer-based analysis and decision-making tool to estimate the technically and economically viable hydropower potential. The GIS-based analysis can be divided into the Digital Terrain Analysis and the Hydrological Modeling.

Digital Terrain Analysis

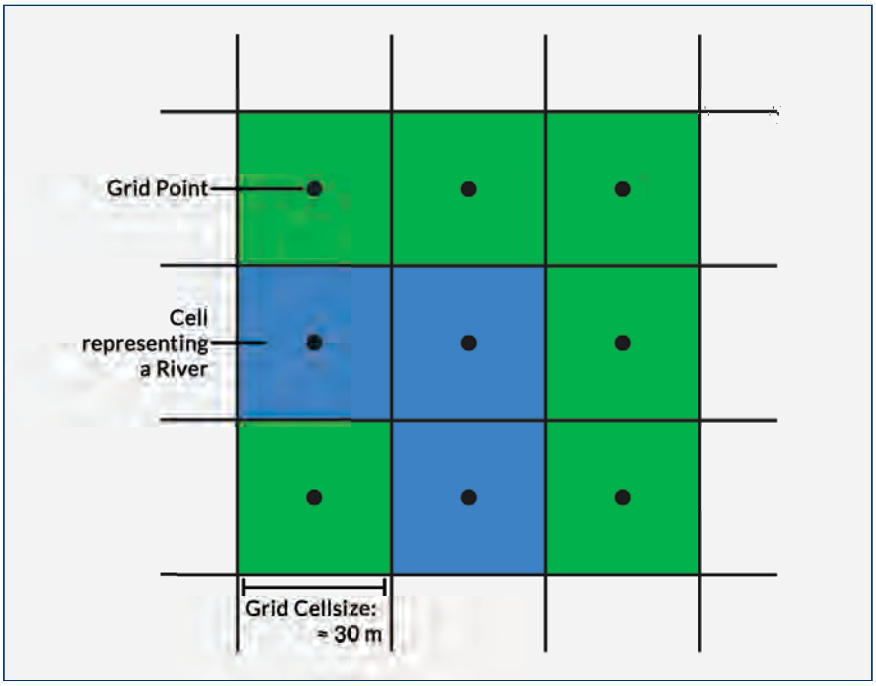
The objective of the Digital Terrain Analysis is to identify catchment boundaries and to model the topographic characteristics of the catchment as well as the resulting stream network.

The GIS-based terrain analysis was subject to the presumption that the direct runoff of any given cell flows downhill in the direction of the greatest slope. To allow all cells of the input DEM-data draining downhill, the elevation model was cleared of errors such as surface depressions, which would act as water sinks. To calculate the flow direction for each grid point, the deterministic 8 (D8) algorithm was applied (Jenson, Domingue 1988:326). According to the flow direction of all cells, each grid point was assigned a value corresponding to the number of cumulated cells flowing to it (O'Callaghan, Mark 1984:1594). Cells with no inflow correspond to the pattern of ridges and form catchment boundaries.

To introduce a lower boundary for the calculation of the hydropower potential, a minimum hydraulic head and a minimum area to accumulate runoff water were defined. The minimum size of the hydrologic catchments was set to 4.5 km² which allows a sensible minimum flow accumulation. The data processing routine recognizes only those grid points as "river" that are connected to at least the minimum catchment size. All "river" grid points of each catchment were joined to form the primary river of the respective catchment.

All other grid points which were not defined as water courses are assigned information about elevation, vegetation, soil and rainfall according to their spatial location, and were linked to the river data point they drain into. This allows the calculation of the discharge for every point in the river.

Schematic Illustration of the
Grid Point-Raster Analysis



Hydrological Modeling

The objective of the Hydrological Modeling is to estimate the runoff of all catchments based on rainfall, vegetation and soil parameters as well as topographic characteristics. The hydrologic model used in this analysis uses a modified version of the US Soil Conservation Service Curve Number (SCS-CN) method to model the rainfall-runoff processes. The original SCS-CN method is an empirical approach based on simplified, experimentally derived relationships. The combination of land-use, land-cover, hydrologic soil type and the antecedent moisture condition of a grid cell are reflected in regionally defined curve number values (USDA NRCS 2004:10-2).

According to the modified version of the method applied in this study, the direct runoff of each grid point was calculated under consideration of variable runoff coefficients depending on the CN value, the 21-day prior rainfall-index as well as regional climatic conditions (Zaiss 1989:3; Sartor 1999:3).

CN values suitable for Saint Lucia were transferred from a study on runoff processes of small watersheds on Saint Lucia from 2003 (Cox 2003:193). All available data on vegetation structure and soil type was pre-processed and re-classified to feed into the applied modified SCS-CN model. For every grid point of the study area this allowed determining CN values according to the spatial distribution of the vegetation and soil type.

Regional experts and hydrologists from the Caribbean Institute for Meteorology and Hydrology (CIMH) in Barbados confirmed the use of the modified SCS-CN approach to model the runoff processes on Eastern Caribbean Islands.

Verifications of the derived stream network have been made by optical comparison of the simulation results with the official maps of the Survey and Mapping Department of Saint Lucia. The simulated discharges were verified by spot-wise measurements.

	Hydrologic Soil Group			
Land Use	**A**	**B**	**C**	**D**
Wet Forest	45	50	55	60
Dry Forest	70	75	86	90
Low Vegetation and Agriculture	78	85	90	97
Urban Area	79	86	91	98

CN Values
for Saint Lucia of the four SCS Hydrological Soil Groups (Cox 2003:193)

4.2 Base Maps and Data

For the Hydropower Potential Analysis of all major rivers of the Saint Lucian stream network the following data products were obtained and pre-processed to serve as input data:

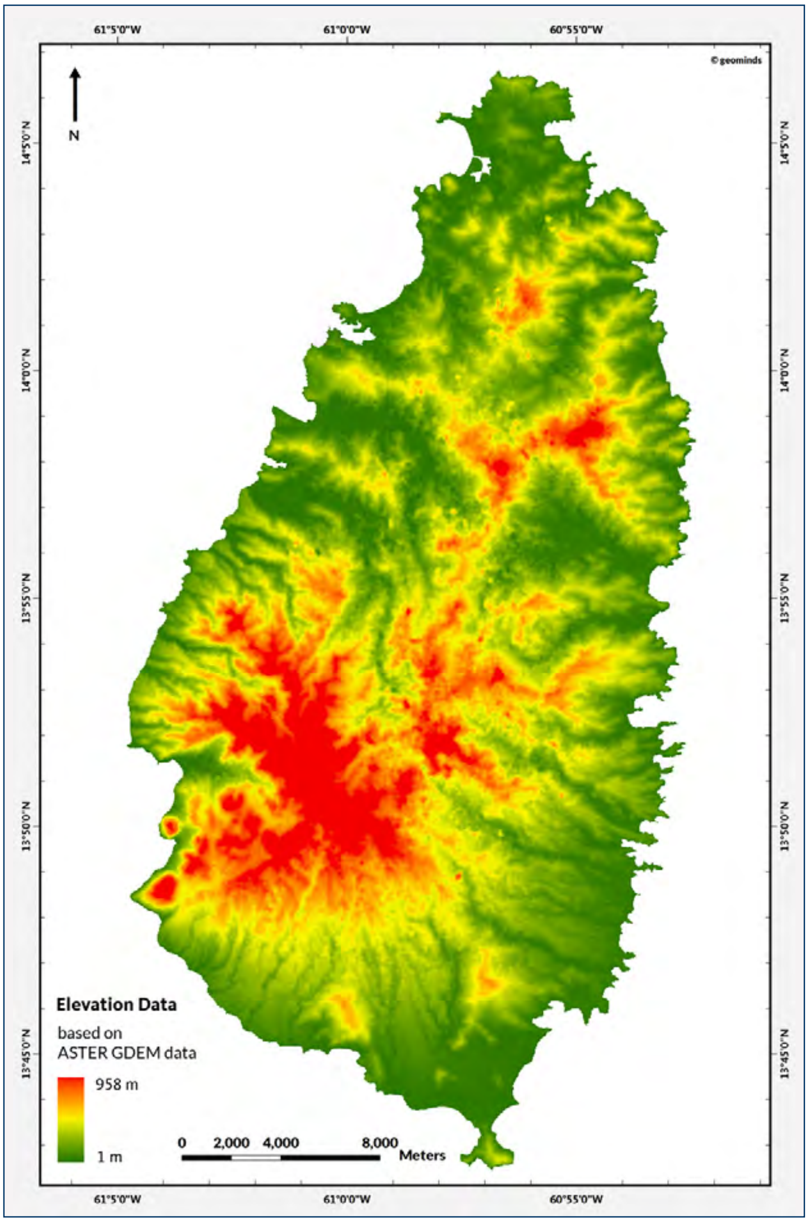
Elevation Data

The ASTER-GDEM V2 model was selected as elevation input data, which is a global digital elevation model that is able to represent the strong relief structure of the island of Saint Lucia. The Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Global Digital Elevation Model (GDEM) was developed jointly by the Ministry of Economy, Trade, and Industry (METI) of Japan and the United States National Aeronautics and Space Administration (NASA) (ERSDAC 2009:1).

The ASTER instrument was built by METI and launched on-board NASA's Terra satellite platform in December 1999. The sensor system has an along-track stereoscopic capability using its near infrared spectral band and its nadir-viewing and backward-viewing telescopes to acquire stereo image data. From this recorded stereo image data it is possible to calculate a digital elevation model using sophisticated spatial modeling software. The spatial resolution of the ASTER-GDEM is about 30 m x 30 m and covers land surfaces between 83°N and 83°S. An automated cloud masking and statistical approach reduces anomalies caused by clouds and allows the use of the data even in tropical regions.

Estimated accuracies for the ASTER-GDEM data is 17 m at 95% confidence for vertical data and 30 m at 95% confidence for horizontal data which offers the best resolution according to the currently available digital elevation models on a world wide scale at no charge (ERSDAC 2009:1; Tachikawa et al. 2011:2).

The digital elevation data for Saint Lucia was overlaid with the latest topographic maps of the island and no major differences between both data sets were detected.



Digital Elevation Model of Saint Lucia
derived from ASTER-GDEM satellite data

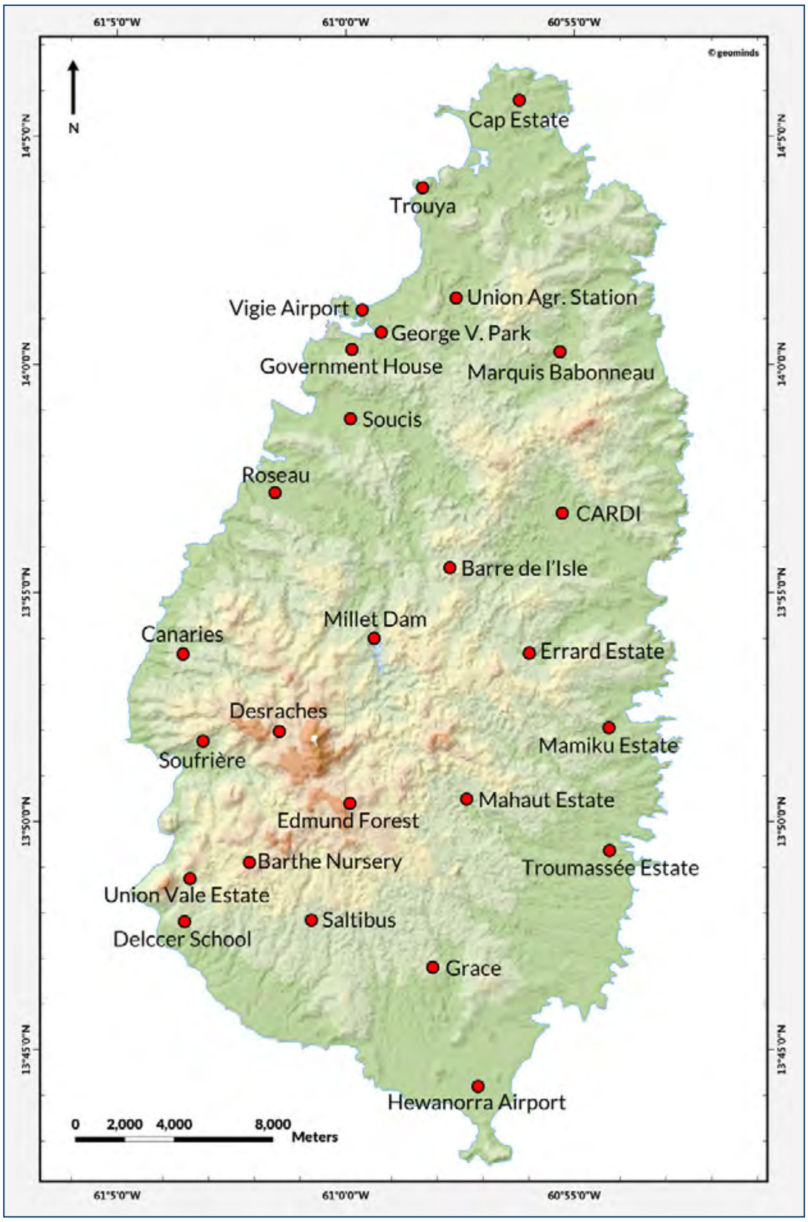
Rainfall Data

Information on rainfall was obtained spot-wise from rainfall gauging stations. An interpolation method was used to transfer the spot-wise measured information from the gauging station network to produce countrywide rain maps.

For this study rain maps are based on rainfall information of 26 gauging stations. The stations are located in a fairly equidistant network covering the whole island and record data on a daily basis. Some recordings of the national rainfall gauging stations network date back to 1955. Daily records of all stations were provided by the National Water Resources Agency (NWRA). The data for each station was pre-processed for the use as control points with the Natural Neighbor Interpolation method, a local interpolation method suitable to model spatial rainfall when having control points for all areas of the study area.

As a consequence of the strong relief structure and the prevailing trade winds from the northeast, rainfall is highest on Saint Lucia on steep, north-easterly facing mountain slopes. These local orographic conditions were taken into account according to the named influencing factors in a post-processing assessment of the spatially modeled rainfall.

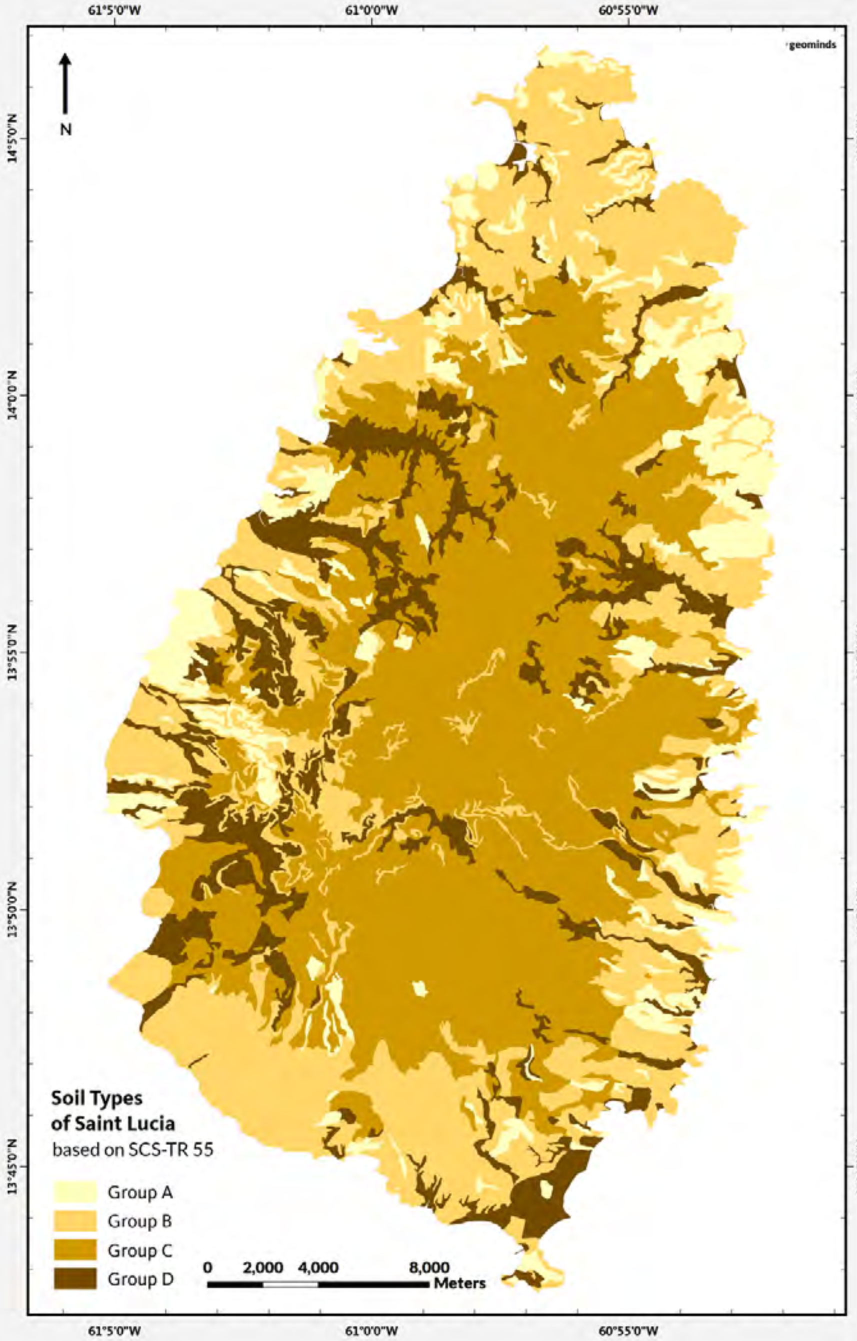
Rainfall Gauging Stations of Saint Lucia
Base map derived from ASTER-GDEM satellite data



Soil Data

The amount of surface runoff is greatly dependent on the catchment's relief, vegetation structure and the soil conditions. Data was provided by the Forestry Department, Survey and Mapping Department as well as the Caribbean Environmental Health Institute (CEHI).

A map showing the physical characteristics and relative distribution of dominating soil types on Saint Lucia was provided through CEHI. The soil data was re-classified according to four well-defined soil classes suitable to feed into the applied hydrologic model of the United States Soil Conservation Service. The SCS classifies soils into four hydrologic soil groups (HSG) according to minimum infiltration rates, controlled by the surface conditions, as well as transmission rates, controlled by the soil profile (USDA / NRCS 1986:A-1). The classification scheme according to the hydrologic soil groups is one element used in determining CN values.



Group A

Group A soils have low runoff potential and high infiltration rates even when thoroughly wetted. They consist of deep, well to excessively drained sands or gravels and have a high rate of water transmission.

Group B

Group B soils have moderate infiltration rates when thoroughly wetted and consist of moderately deep, moderately well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.

Group C

Group C soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. These soils have a low rate of water transmission.

Group D

Group D soils have high runoff potential. They have very low infiltration rates when thoroughly wetted and consist of clay soils with a high swelling potential, soils with a permanent high water table, soils with a clay pan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low rate of water transmission.

(Hydrologic Soil Group definitions based on USDA / NRCS 1986:A-1)

Soil Map of Saint Lucia
Re-Classification of Soil Data provided by CEHI

Vegetation Data

The spatial data on the vegetation structure of Saint Lucia is based on information derived from high resolution aerial images, a spectral analysis of a set of IKONOS satellite images and local expertise.

All available data sets of the vegetation structure of the island were overlaid as of their spatial location and transferred into one single data set. From the information on the vegetation structure, four well-defined vegetation structure classes were developed, each covering about a quarter of Saint Lucia's land surface. This vegetation structure classification is the other element used in determining CN values for each grid point.

Wet Forest Class

The wet forest class consists of seasonal evergreen and evergreen forest like sierra palm, transitional and tall cloud forest which can be found in the center of the island. This class also consists of forested wetland like mangroves as well as coastal sand and rock.

Dry Forest Class

Tropical and subtropical deciduous forests have developed in seasonal rainfall patterns. On Saint Lucia drought deciduous and coastal evergreen forest, mixed forest and shrubland with and without succulents are the main types of vegetation that can be found on the southern, easterly and westerly shores of the island.

Low Vegetation and Agriculture Class

Grassland and shrubland dominate this vegetation class. Trees are more restricted to the floodplains of streams and occur scattered at the transitions to the more humid vegetation classes. The south east coast and the lowlands in the northern part of Saint Lucia mainly make up this class. This vegetation class also includes agricultural farmland as well as the plantations in the flat river valleys of Roseau and Cul de Sac River.

Built-Up Area Class

Built-up areas are characterized by a mainly sealed surface and an artificial nearly 100% runoff. All sealed land and urban area of the island is comprised in this class generally covering the heavily populated north-western part of the island.

4.3 Hydropower Potential

With the attributed data of all grid points being added to the SQL-database the computer-based analysis and decision-making tool calculated the available stream flow discharge for all points of the analyzed primary rivers. Secondly, the technical hydropower potential of the entire stream network was estimated as well as river sections identified, suitable for realizing virtual, economically viable hydropower projects.

Estimating the Technical Hydropower Potential

The potential energy of downhill flowing water of a stream regardless of any physical, technical or economic limitations is defined as the gross theoretical hydropower potential. According to physical and technical reasons hydropower plants aren't able to fully use the gross theoretical hydropower potential. The technical potential of hydropower describes the energy capacity that is actually useable when technical, infrastructural, ecological and other conditions are taken into consideration (Horlacher 2003:9).

In this study, the technical hydropower potential was calculated for each grid point representing a river. Thus, each assessed river point forms the virtual powerhouse location. The virtual intake for the respective virtual project is defined being 1,000 m upstream. This assumption creates a series of virtual hydropower projects along the considered river to ensure compatibility.

The technical hydropower potential for every possible virtual project combination was calculated according to the following equation:

$$P = (h_{geo} - h_{loss}) \cdot (Q - Q_{eco}) \cdot g \cdot \rho \cdot \eta$$

h_{geo} = geodetic head between virtual intake and virtual powerhouse [m]

h_{loss} = friction loss from penstock [m]

Q = long-term mean stream flow at virtual intake [m³/s]

Q_{eco} = minimum amount of water remaining in the river for ecological reasons [m³/s]

g = gravity [9.78 m/s²; constant]

ρ = density of water [1,000kg/m³; constant]

η = plant efficiency [%]

In the case of the present analysis, the following technical, physical and ecological influences reducing the gross theoretical hydropower potential have been accounted for:

- Any friction losses, that occur from water flowing through hydraulic conduits such as the intake, the trash-rack, canals and penstock including valves and other installations, are taken into account by reducing the actual available gross head relative to the flow in the conduits. Thus, the net head is the geodetic elevation difference between virtual intake and virtual powerhouse (h_{geo}) minus hydraulic losses (h_{loss}) resulting from friction in the water conduit. For the purpose of this analysis, the friction losses are proportional to the penstock length and defined as 0.5 m loss of height per 100 m penstock length.

- The predicted discharge amount used for hydropower calculations is expected to be available statistically at 30% of days per year. To estimate the discharge with an exceedance probability of 30%, a flow duration curve was synthetically generated.

- The amount of discharge usable for hydropower in an ecologically sustainable way is set to 75% of the available discharge at any point of time, while 25% of the remains in the rivers as ecological flow (Q_{eco}) preserving the local aquatic ecosystem.

- The "plant efficiency" as used in this report summarizes all energy conversion losses occurring in the process of electricity generation using turbines, generators and related equipment and is assumed to be η = 0.80.

- The density of water is set to be ρ = 1,000 kg/m³.

- The strength of the gravitational field for the Caribbean region is set to be g = 9.78 m/s² (PTB 2013).

Estimating the Economically Viable Hydropower Potential

With extending the penstock of a virtual project a higher elevation difference may be utilized resulting in a higher hydroelectric production capacity, but also increasing investment costs. Thus, a filter routine was implemented, taking into account economic parameters such as investment costs of a virtual hydropower generation plant, average annual power production, project lifetime expectancy as well as the feed-in tariff for selling electricity, calculating the net value of the virtual project. The virtual projects that have a negative net value were excluded from further analysis. The Internal Rate of Return (IRR)-method was applied to identify the top economically viable hydropower projects.

As all economically related parameters are very sensitive and may lead to skew results of the analysis, the parameters and assumptions were determined very carefully according to local pricing conditions. For the purpose of this analysis, local experts, government agencies, manufactures and suppliers were consulted to provide input data. All received information was carefully evaluated and used to create mean values for the calculations of the computer based decision-making tool.

For every virtual project combination the net values were calculated using the following formula and assumptions:

***NET VALUE** = (Project Lifetime · Annual Profit) – Total Project Development Costs*

PROJECT LIFETIME

The project lifetime is assumed to be 25 years of operation.

ANNUAL PROFIT

The annual profit is calculated by subtracting the annual operation and maintenance costs from the annual revenue resulting from electricity sales relative to the design capacity of the project, capacity factor and the feed-in tariff. The calculation factors are estimated as follows:

***ANNUAL PROFIT** = (Installed Capacity · Capacity Factor · Feed-in Tariff) – O&M Costs*

- ***Installed Capacity***
  The installed capacity is the capacity corresponding to a discharge with an exceedance probability of 30% minus ecological minimum flow, and the head and the overall plant efficiency as used to estimate the technical hydropower potential.

- ***Capacity Factor***
  The capacity factor is the ratio of the annual hours the virtual hydropower plant is operated at full design capacity in relation to the plant operating at full capacity full time (8,760 hours per year). The capacity factor as used in this analysis is defined as 0.5.

- ***Feed-in Tariff***
  The feed-in tariff is the amount of money per unit that a generator of electricity is remunerated for feeding-in electricity to the public grid. The feed-in tariff is often used as a policy mechanism designed to promote renewable energies. For the purpose of this analysis, the feed-in tariff is assumed to be US$ 0.10 per kWh. However, there is no fixed feed-in tariff in Saint Lucia as yet.

- ***Operation and Maintenance Costs (O&M)***
  O&M costs are defined as a percentage of the investment cost of each individual virtual project. This includes the repair of mechanical and electrical equipment like turbine overhaul, reinvestments in auxiliary equipment such as communication and control systems. However, it does not cover the replacement of major electro-mechanical equipment or refurbishment of penstocks, tailraces, etc. The O&M costs are assumed to be 5% of the total investment cost.

TOTAL PROJECT DEVELOPMENT COSTS

The total project development costs are calculated by adding general base costs of a virtual project to the costs for electro-mechanical equipment and the costs for the penstock. The calculation factors are estimated as follows:

PROJECT DEVELOPMENT COSTS *= Base Costs of Virtual Project + Costs for electro-mechanical Equipment + Costs for Penstock*

- ***Base Costs of Virtual Project***
  The base costs are assumed to be a fixed amount of US$ 30,000 which is assumed to be the same for all virtual projects. These costs cover preliminary studies, designs and all costs that occur in any event when developing a project.

- ***Costs for electro-mechanical Equipment***
  The costs for the entire electro-mechanical equipment, site access infrastructure, grid connection and the construction of the powerhouse (excluding costs for the penstock) correlates with the installed design capacity of the hydropower plant and is assumed as US$ 3,333 per installed kW.

- ***Costs for the Penstock***
  The costs of the penstock are dependent on its length, the material used and its diameter. In addition to the material costs there are costs for construction, site preparation as well as shipment and transportation costs.

  Penstock Material Costs
  Corresponding to the design discharge, which was estimated for each river point, different diameters of the penstock are selected based on the rule of limiting the flow velocity in the penstock to 1.5 to 2.5 m/s.
  It is assumed that the penstock follows the course of the river. Therefore, bends and special penstock elements are required for curves exceeding a certain radius. These extra costs are reflected in 10% higher penstock material costs.
  It is assumed that all penstocks are made of glass fiber reinforced polymer (GFRP).

The following design criteria and related penstock costs are taken into account calculating the individually penstock costs:

Discharge Ranges [m³/s]	Diameter [mm]	Costs [US$/m]
0.106-0.177	300	103.73
0.188-0.314	400	122.55
0.295-0.491	500	144.79
0.424-0.707	600	171.54
0.577-0.962	700	201.73
0.954-1.590	900	281.36
1.696-2.827	1,200	465.81
2.651-4.418	1,500	768.87

Penstock Construction Costs
The penstock construction costs are based on local wage levels according to skill level and working time of personnel as well as foundation material costs according to local prices for concrete and steel. Each penstock segment is assumed to be installed over ground on reinforced concrete foundations. Its volume varies according to the diameter of the penstock. The overall penstock construction costs per meter vary from US$ 75.41 to US$ 83.04 according to the individual foundation material costs.

Overseas Shipment Costs
As no penstock manufacturer is available on the island of Saint Lucia, all materials have to be shipped. According to the penstock diameters, a different amount of segments fit into a 20' container. The cost for a shipped container is assumed to be US$ 1,355.88, including land transport.

For all virtual projects with a positive net value the Internal Rate of Return (IRR) was calculated to determine the interest rate that is equivalent to the returns expected from the project. The IRR is computed using an iterative calculation process, using different discount rates to get the discount rate that refers to a Net Present Value (NPV) = 0. The NPV of a virtual project is equal to the present value of future returns, discounted at the marginal cost of capital, minus the present value of the cost of the investment.

$$NPV = \sum_{t=4}^{28} \frac{R_t - (O\&M)_t}{(1+r)^t} - \sum_{t=0}^{3} \frac{I_t}{(1+r)^t} = 0$$

R = Electrictiy Revenues
O&M = Operation and Maintencance
I = Investment Costs
t = Year of Operation
r = Discount Rate

In this study it is assumed that every single virtual project will be developed and built in four years. In the first year expenses for the feasibility study, project design and management are incurred which is assumed to be 1/60 of the total project development costs. Costs for civil works and all electro-mechanical equipment are spread almost evenly over the remaining three years. At the end of the fourth year the whole development is finished and all funds disbursed. The project lifetime is assumed to be 25 years of operation.

For every river the computer-based decision-making tool identified the virtual project with the highest IRR of all possible combinations. This river section was blocked from further screening in order to avoid double selection of the same project. The virtual project with the next highest IRR is selected from the remaining non-blocked river sections. The maximum of 8 economically viable virtual hydropower projects per river were selected by the tool.

5. Presentation of Results

Each river was analyzed individually and the results are presented in several maps, charts and table format to allow comparison of all rivers in Saint Lucia.

Overview Map

A large topographic overview map illustrating the major rivers, streets and settlements introduces every analyzed river providing the reader with a first impression of the catchment and its characteristics. The locations of the rain gauging station network on the island are given. Detailed climate charts for all stations are compiled in the appendix.

A comprehensive key legend shows the specific characteristics and symbols as well as the major key facts about the catchment and its analyzed river:

- Size of Catchment
- Length of Primary River
- Elevation Difference
- Long-term Mean Stream Flow Discharge at River Mouth

Key Findings of the Analysis

A short introductory text pointing out the key findings of the analyzed catchment and its river as well as its geographic location and characteristics provides the reader with a brief overview of the results of each river's hydropower potential analysis.

A country-wide rating provides the reader with a clear and conclusive comparison of the river, its catchment and its economically viable hydropower potential. The scoring system indicates the rank of the considered river in relation to the highest ranked river in Saint Lucia. An index value of 100 for the respective categories refers to the values of the rivers/catchments presented in the table at the bottom of the page. The category "Econ. Potential FiT US$ 0.20" refers to the cummulative hydropower potential of all located economically viable virtual projects for the respective river applying a feed-in tariff of US$ 0.20.

Stream Flow Discharge Analysis

The "River Analysis Chart" provides an elevation profile along the course of the primary river from its highest elevation to its river mouth at sea level. The three blue curves in the chart represent the available long-term mean stream flow discharge for every point of the river as well as synthetically simulated daily flows with an exceedance of 110 and 255 days per year, respectively.

Analysis of the Normalized Technical Hydropower Potential

The map of the normalized technical hydropower potential provides the reader with a detailed individual analysis of the respective river. To locate the best hydroelectric power opportunities of a river, the hydropower potential of the entire river is set in relation to the river's maximum value, which represents 100%. Regardless of the absolute hydropower potential, these maps allow the reader to locate the most promising sections of the river for hydropower generation.

Category	River Name	Relating Value
Catchment Size	Grande Rivière du Mabouya/ Dernière Rivière	39.76 km^2
Mean Stream Flow at RM	Troumassée	0.724 m^3/s
Highest Elevation	Troumassée	282 m
Length of River	Troumassée	11.50 km
Econ. Potential (FiT US$ 0.20)	Troumassée	591 kW

Analysis of the Economically Viable Hydropower Potential

This section shows the results of the river analysis identifying economically viable virtual hydropower project locations. This was done taking into account several physical, technical and ecological parameters as well as carefully evaluated and selected economic parameters according to local pricing conditions. The calculation method, assumptions and parameters are described in detail in chapter 4.3.

The river sections of the top ranked virtual projects according to the applied IRR-method are highlighted on the map. A corresponding table provides the reader with all relevant information about the physical, technical and economic data of the respective virtual project. River sections where no economically viable virtual project was identified remain white.

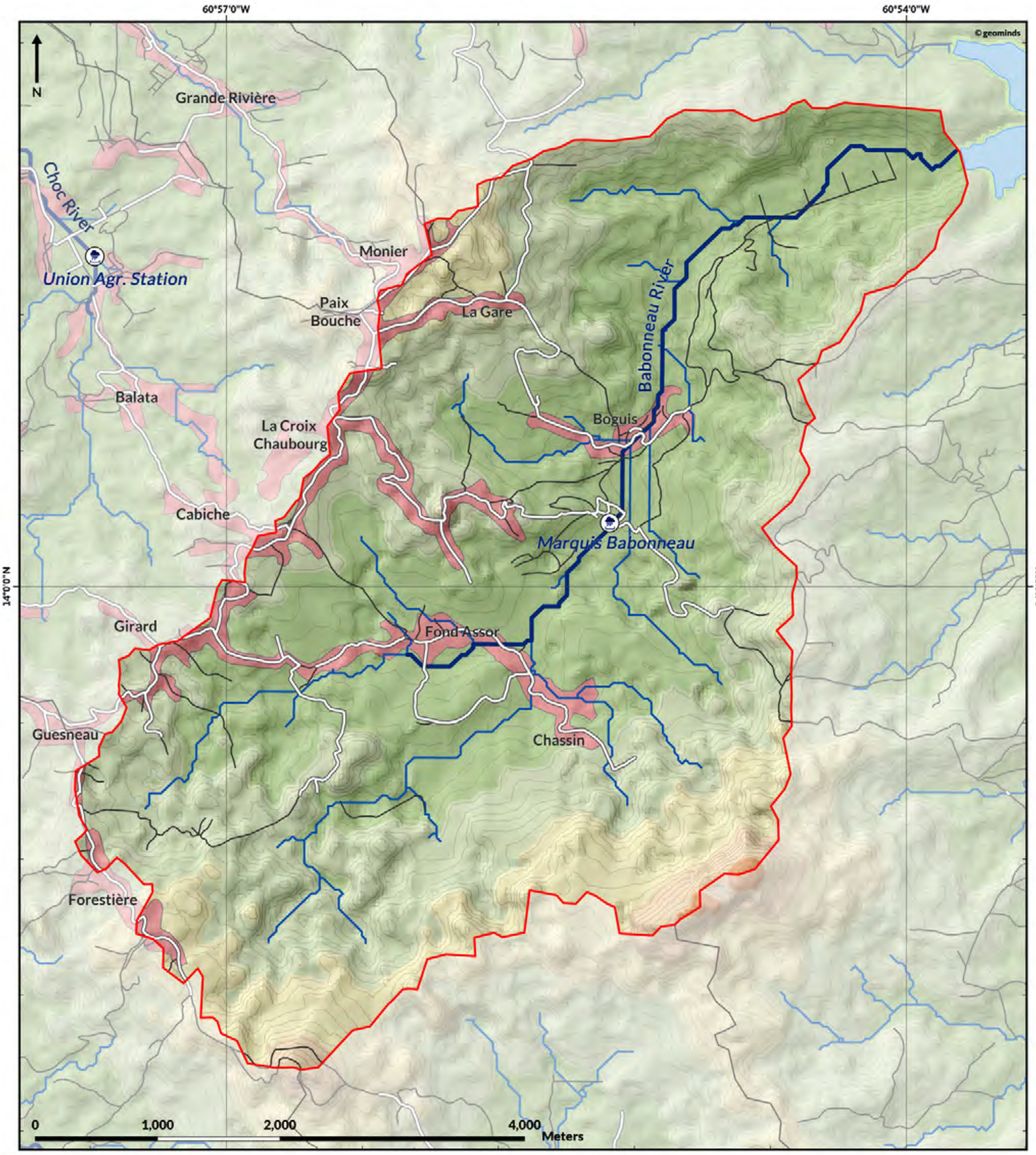
The economic viability of the virtual projects is strongly dependant on the feed-in tariff. To allow for assessment of the sensitivities, five scenarios were developed including feed-in tariffs of US$ 0.10, 0.125, 0.15, 0.175 and 0.20 per kWh.

[PART 2]

INDIVIDUAL RIVER ANALYSIS

1. BABONNEAU RIVER

1.1 • OVERVIEW MAP



Elevation

- > 900
- 750 - 900
- 600 - 750
- 450 - 600
- 300 - 450
- 150 - 300
- 0 - 150 m

Urban Area and Roads

- Major Village
- Settlements
- Major Roads
- Minor Roads and Tracks

Water Resources

- Primary Streams
- Secondary Streams
- Catchment Boundary
- Rainfall Gauging Station

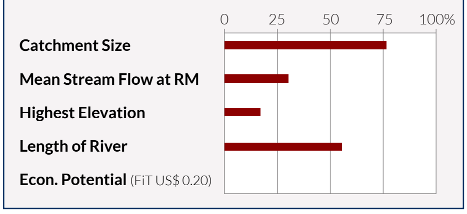
Facts about Catchment

- Catchment Size: . . . . 30.47 km^2
- Length of Primary River: . . . . 6.40 km
- Highest Elevation of Primary River: . . . . . 48 m
- Long-term Mean Stream Flow at River Mouth: . . . . 0.219 m^3/s

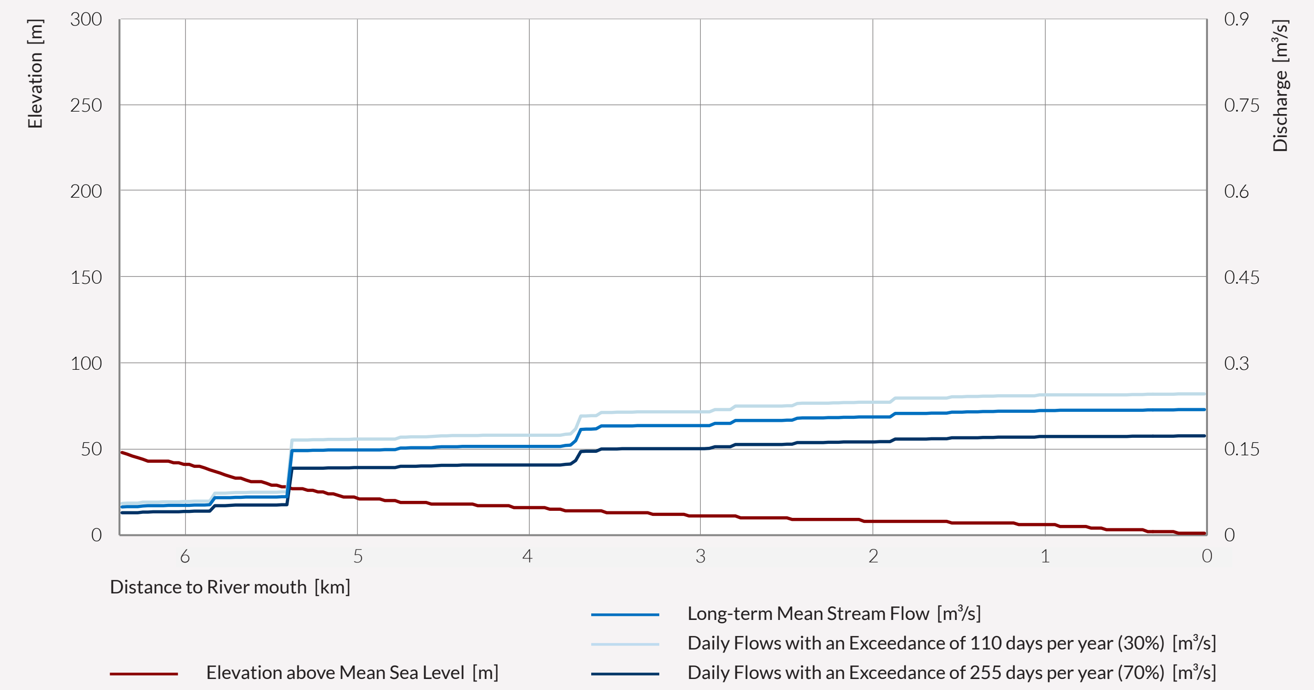
Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

The Babonneau and the Marquis River form a joint-catchment of about 30.47 km² north of Piton Flore at the north east coast of Saint Lucia. The two rivers accumulate 0.219 m³/s of mean annual discharge at the river mouth. As the north eastern part of Saint Lucia is not characterized by high elevations, the highest elevation of the Babonneau River is at about 48 m. The length of the river is 6.40 km resulting in one of the lowest gradients of all analyzed rivers. Thus, no economically viable virtual hydropower project was located according to the parameters and assumptions applied.

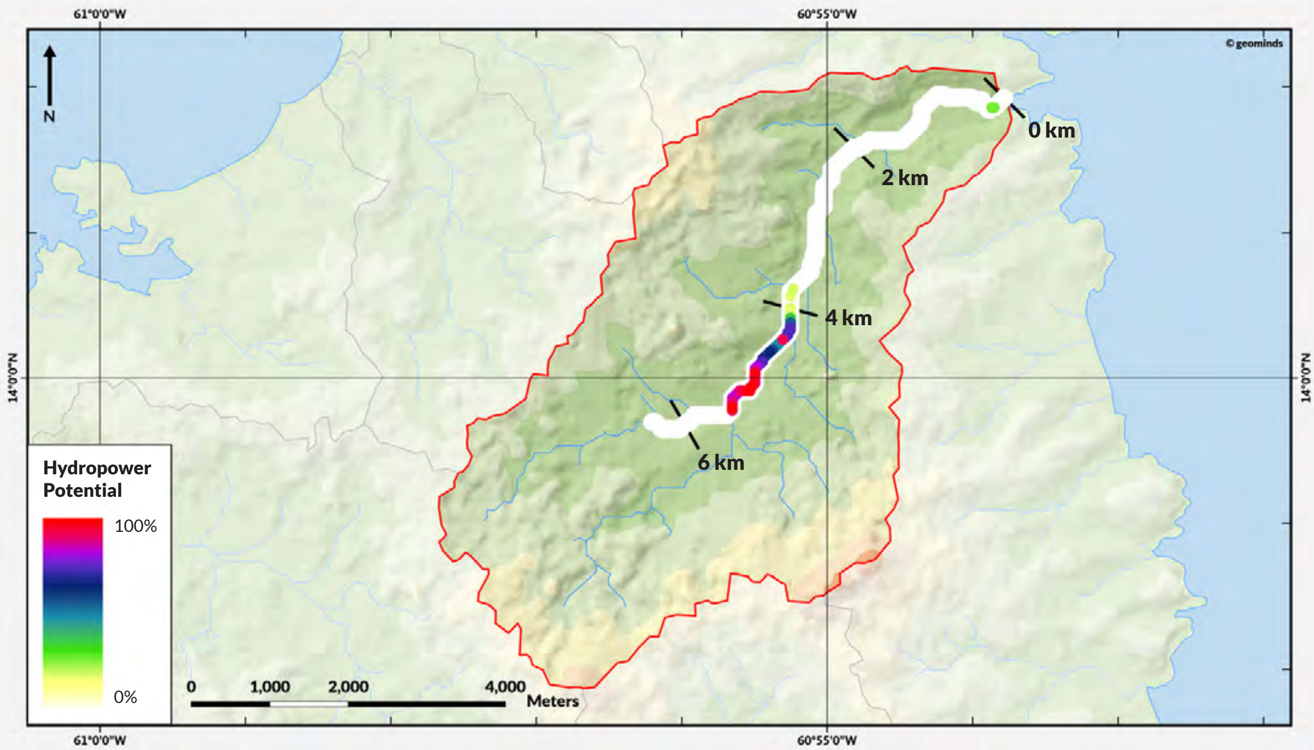
COUNTRY-WIDE RIVER RATING



1.2 • STREAM FLOW DISCHARGE ANALYSIS OF BABONNEAU RIVER

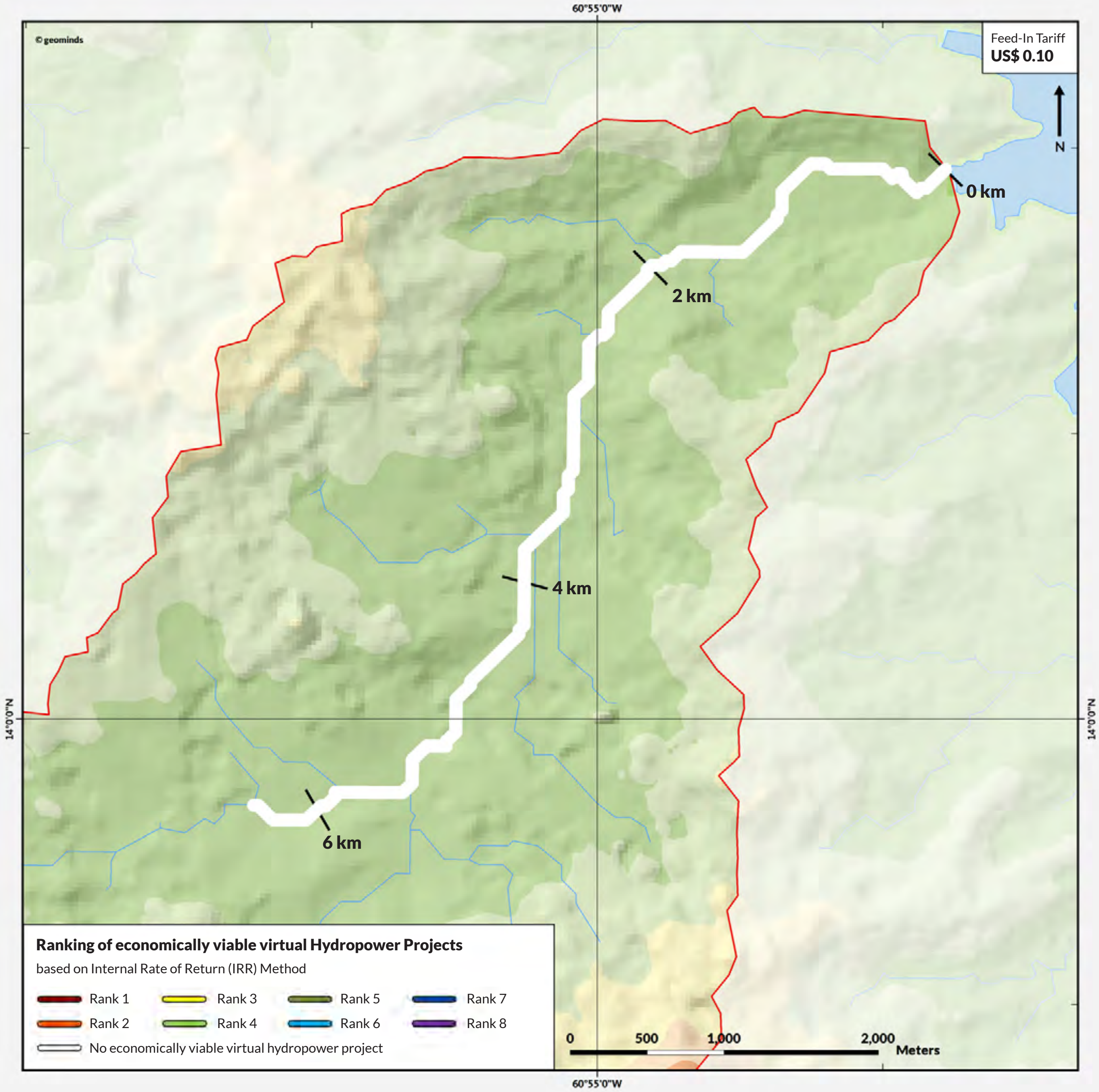


1.3 • OVERVIEW OF NORMALIZED TECHNICAL HYDROPOWER POTENTIAL



Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

1.4 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL



Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

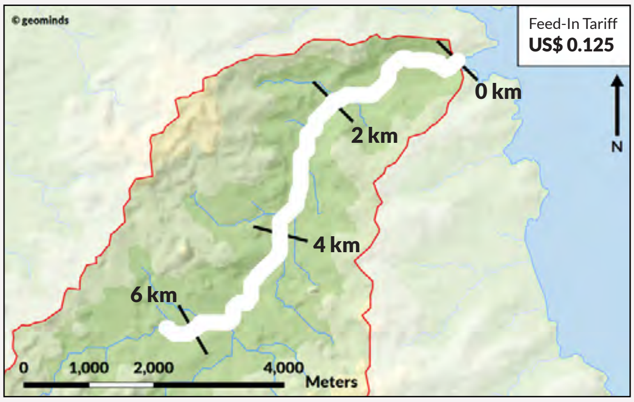
Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake	Length of Penstock	Gross Head	Daily Flows, exceeded on 110 days per year
1	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-

No economically viable virtual hydropower project was located!

For more information and all setting parameters used for this calculation, see page 12.

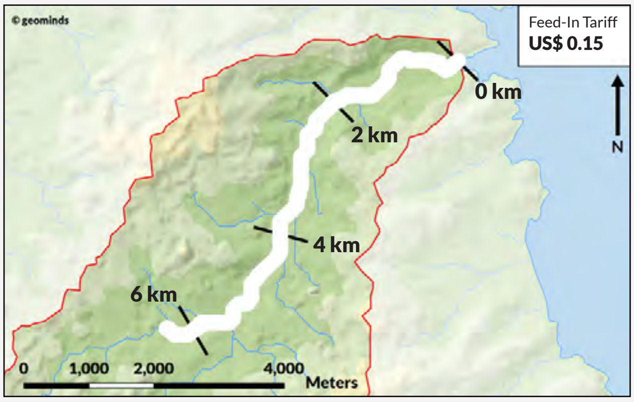
The information and statistical data with this report have not been independently verified and Geominds makes no representations or warranty as to its accuracy, completeness or correctness. This publication is for information purposes only and is not intended to provide professional, investment or any type of advice or recommendation. Geominds does not accept any responsibility and cannot be held liable for any person's use of or reliance on the information and opinions contained herein.

1.5 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL WITH RISING FEED-IN TARIFF



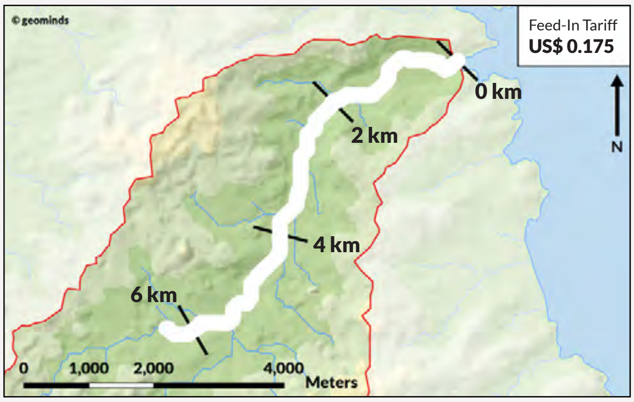
Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	
3	-	-	-	-
4	-	-		-
5	-		-	-
6	-	-	-	-
7		-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	
3	-	-	-	-
4	-	-		-
5	-		-	-
6	-	-	-	-
7		-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	
3	-	-	-	-
4	-	-		-
5	-		-	-
6	-	-	-	-
7		-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	
3	-	-	-	-
4	-	-		-
5	-		-	-
6	-	-	-	-
7		-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!

Ranking of economically viable virtual Hydropower Projects

based on Internal Rate of Return (IRR) Method

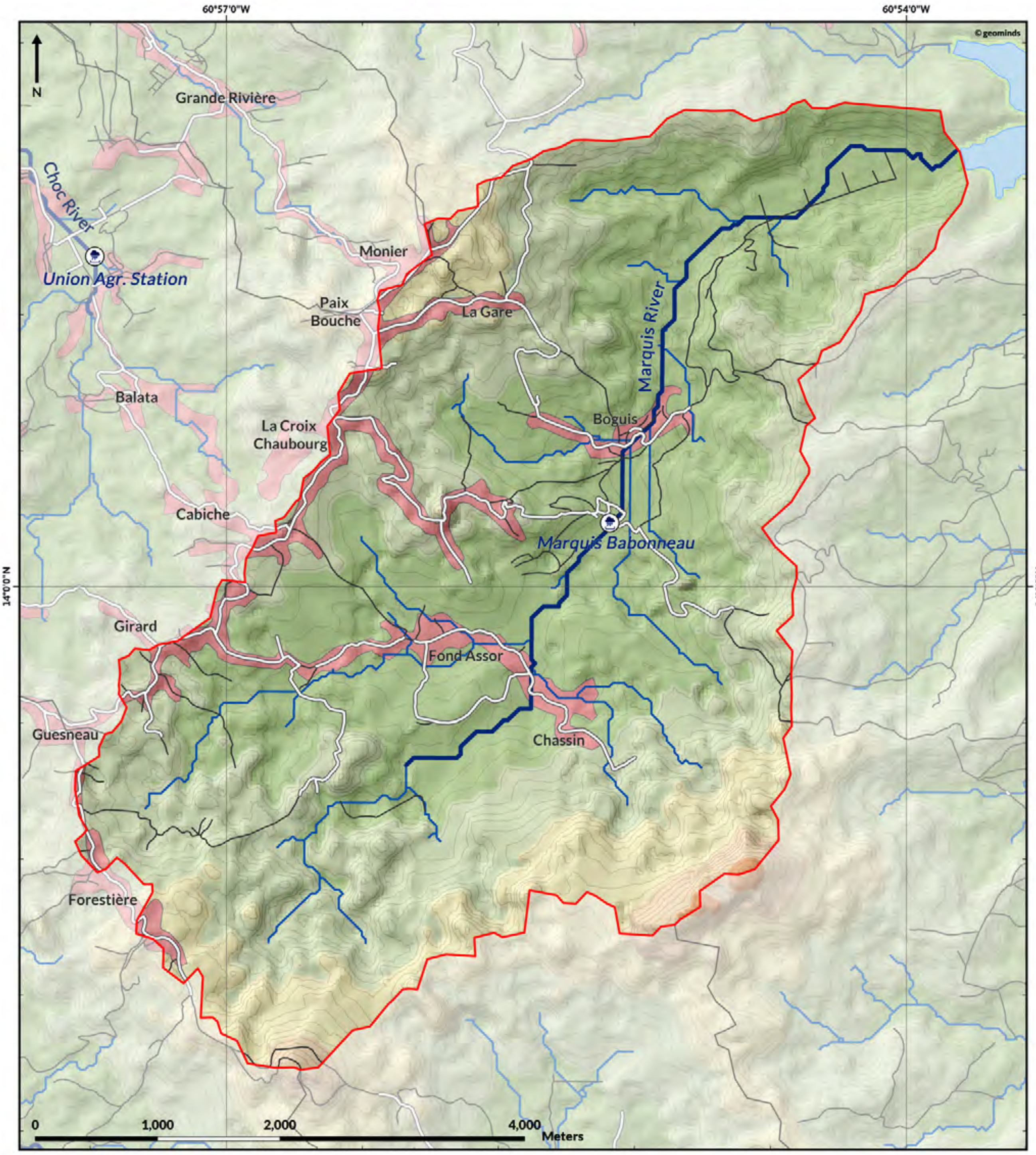
Rank 1 | Rank 3 | Rank 5 | Rank 7
Rank 2 | Rank 4 | Rank 6 | Rank 8
No economically viable virtual hydropower project

For more information and all setting parameters used for this calculation, see page 12.

Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

2. MARQUIS RIVER

2.1 • OVERVIEW MAP



Elevation

- > 900
- 750 - 900
- 600 - 750
- 450 - 600
- 300 - 450
- 150 - 300
- 0 - 150 m

Urban Area and Roads

- Major Village
- Settlements
- Major Roads
- Minor Roads and Tracks

Water Resources

- Primary Streams
- Secondary Streams
- Catchment Boundary
- Rainfall Gauging Station

Facts about Catchment

Catchment Size: . . . . 30.47 km²

Length of Primary River: . . . . 7.00 km

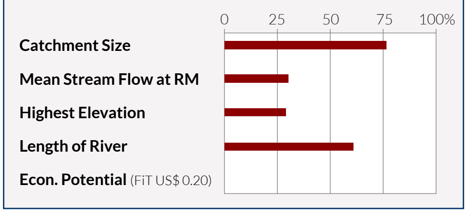
Highest Elevation of Primary River: . . . . . 82 m

Long-term Mean Stream Flow at River Mouth: . . . . 0.219 m³/s

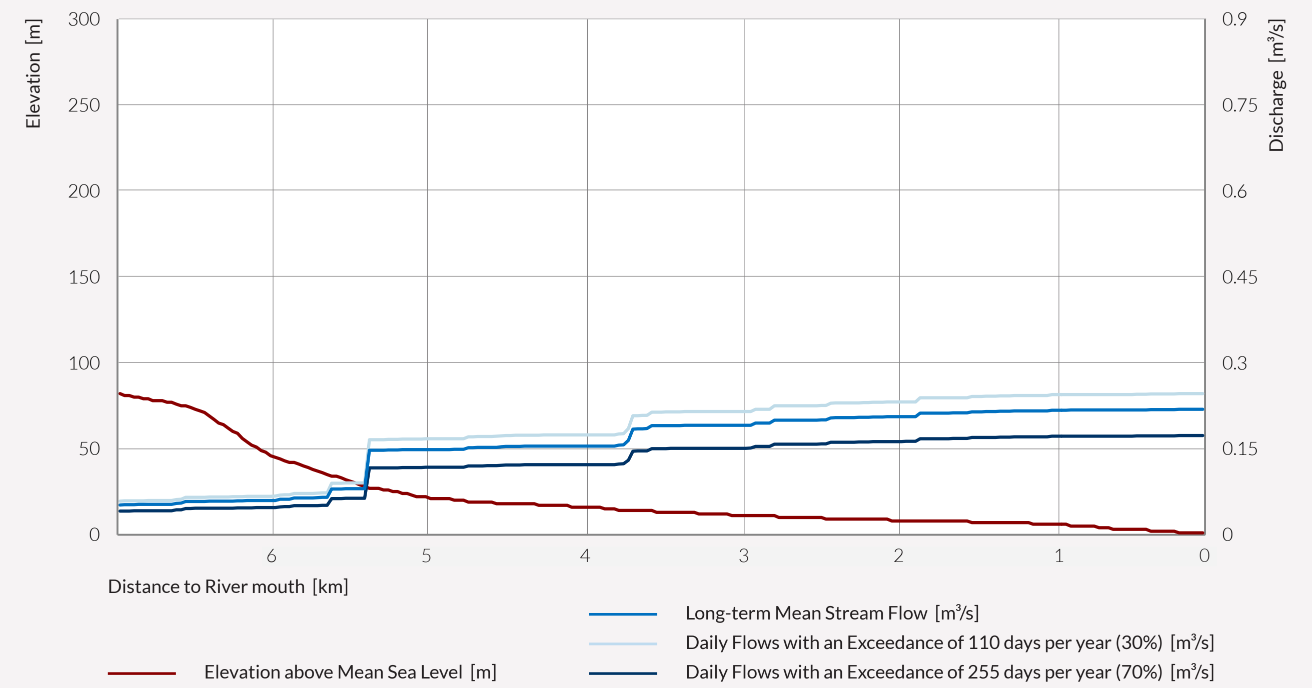
Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

The Marquis and the Babonneau River form a joint-catchment of about 30.47 km² north of Piton Flore at the north east coast of Saint Lucia. The two rivers accumulate 0.219 m³/s of mean annual discharge at the river mouth. The length of the Marquis River is about 7.00 km and its highest elevation is 82 m above sea level. Due to the low elevation level of the catchment resulting in less rainfall, no economically viable virtual hydropower project was located according to the parameters and assumptions applied.

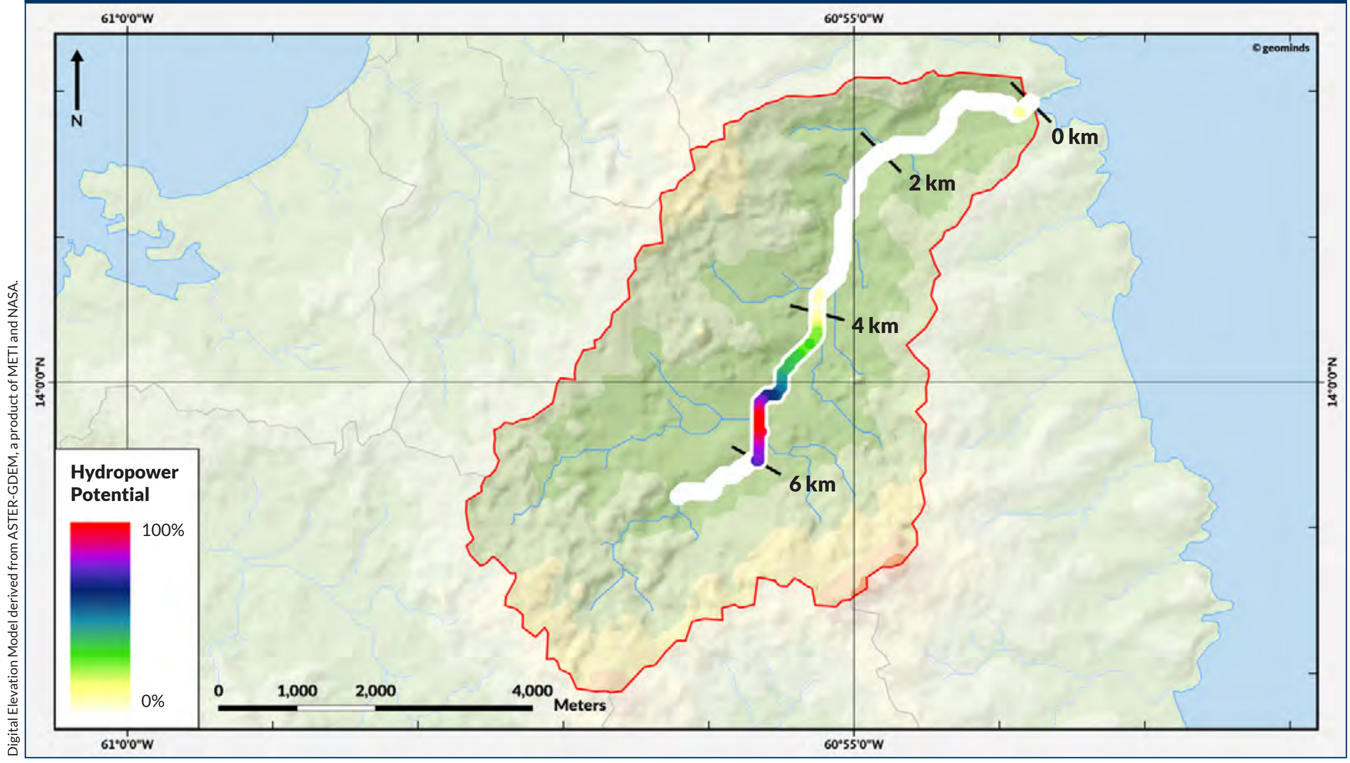
COUNTRY-WIDE RIVER RATING



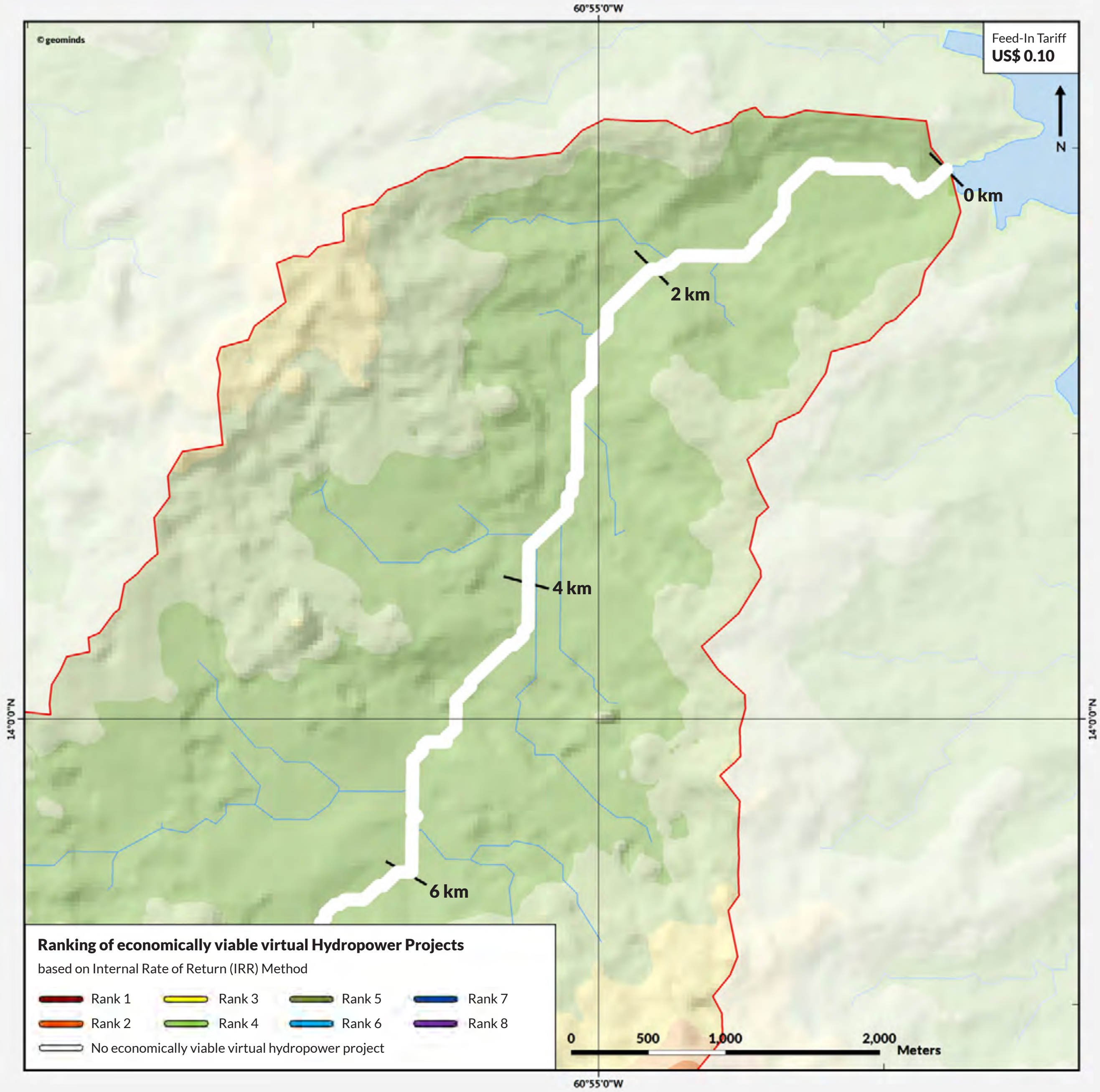
2.2 • STREAM FLOW DISCHARGE ANALYSIS OF MARQUIS RIVER



2.3 • OVERVIEW OF NORMALIZED TECHNICAL HYDROPOWER POTENTIAL



2.4 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL



Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake	Length of Penstock	Gross Head	Daily Flows, exceeded on 110 days per year
1	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-
5	-	-			-	-	-
6	-			-	-	-	-
7	-		-	-	-	-	-
8	-	-	-	-	-	-	-

No economically viable virtual hydropower project was located!

For more information and all setting parameters used for this calculation, see page 12.

2.5 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL WITH RISING FEED-IN TARIFF

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!

Ranking of economically viable virtual Hydropower Projects

based on Internal Rate of Return (IRR) Method

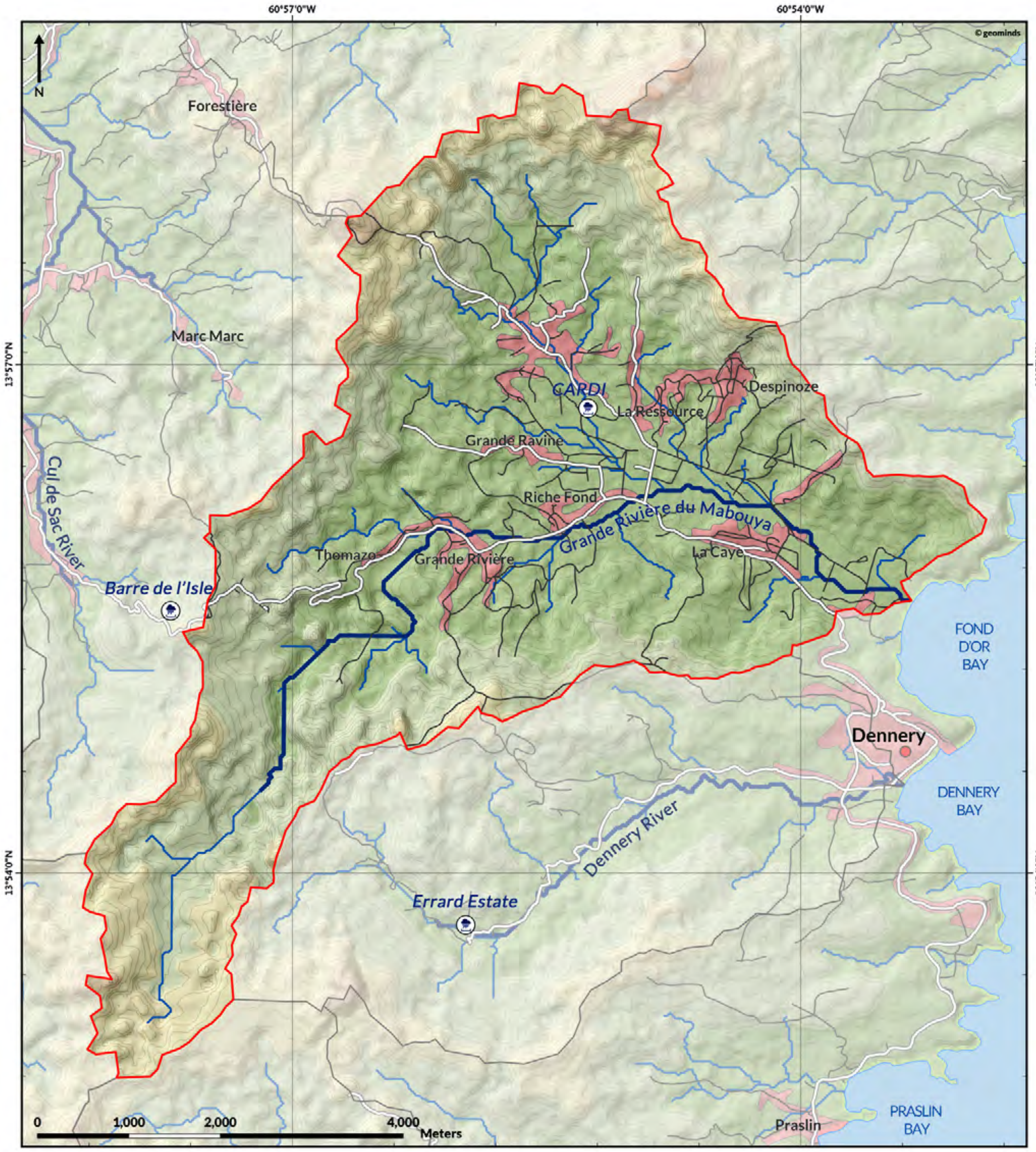
Rank 1 | Rank 3 | Rank 5 | Rank 7
Rank 2 | Rank 4 | Rank 6 | Rank 8
No economically viable virtual hydropower project

For more information and all setting parameters used for this calculation, see page 12.

Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

4. GRANDE RIVIÈRE DU MABOUYA

4.1 • OVERVIEW MAP



Elevation

> 900	
750 - 900	
600 - 750	
450 - 600	
300 - 450	
150 - 300	
0 - 150 m	

Urban Area and Roads

- Major Village
- Settlements
- Major Roads
- Minor Roads and Tracks

Water Resources

- Primary Streams
- Secondary Streams
- Catchment Boundary
- Rainfall Gauging Station

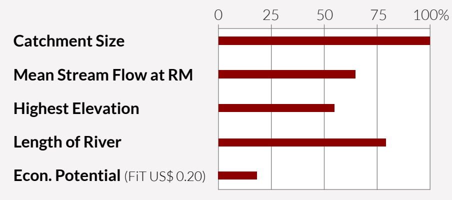
Facts about Catchment

Catchment Size:	39.76 km²
Length of Primary River:	9.12 km
Highest Elevation of Primary River:	155 m
Long-term Mean Stream Flow at River Mouth:	0.469 m³/s

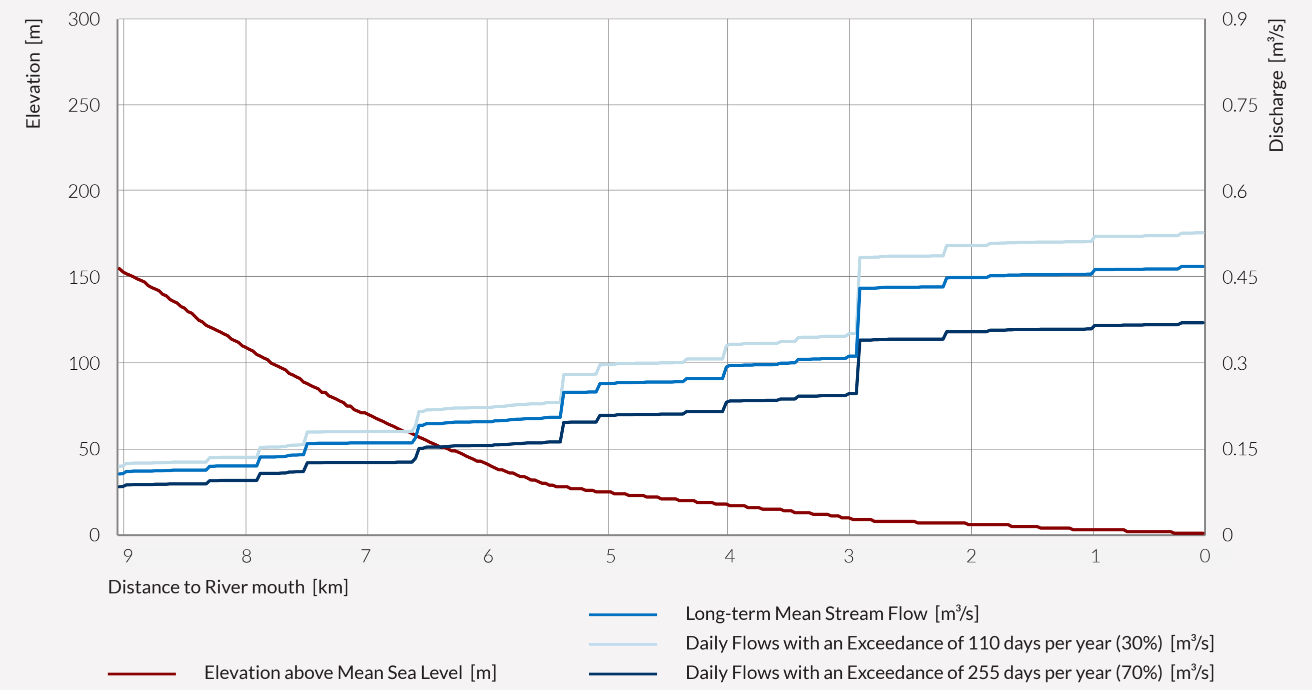
Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

The Grande Rivière du Mabouya and the smaller Dernière Rivière form together the Fond d'Or catchment, one of the largest catchments in Saint Lucia (39.76 km²). The Fond d'Or catchment collects about 0.469 m³/s of mean annual discharge available for generating hydropower at its river mouth. Accumulating its waters in the central highlands of the island around Mount la Combe and with a highest elevation of 155 m above sea level, the Grande Rivière du Mabouya has a total length of about 9.12 km with a joint-river section of 4 km. Even with a significant elevation drop of the primary river, economically viable virtual hydropower projects were located only when applying a feed-in tariff of US$ 0.20.

COUNTRY-WIDE RIVER RATING

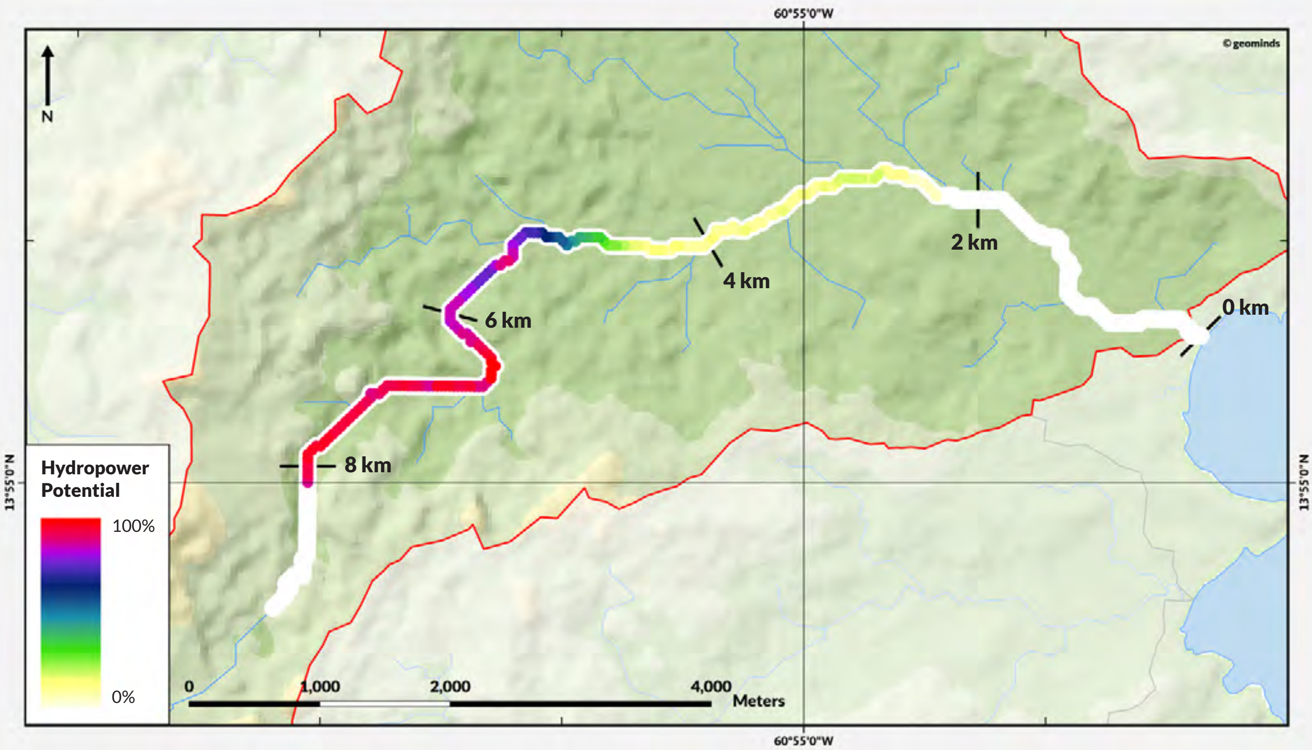


4.2 • STREAM FLOW ANALYSIS DISCHARGE OF GRANDE RIVIÈRE DU MABOUYA

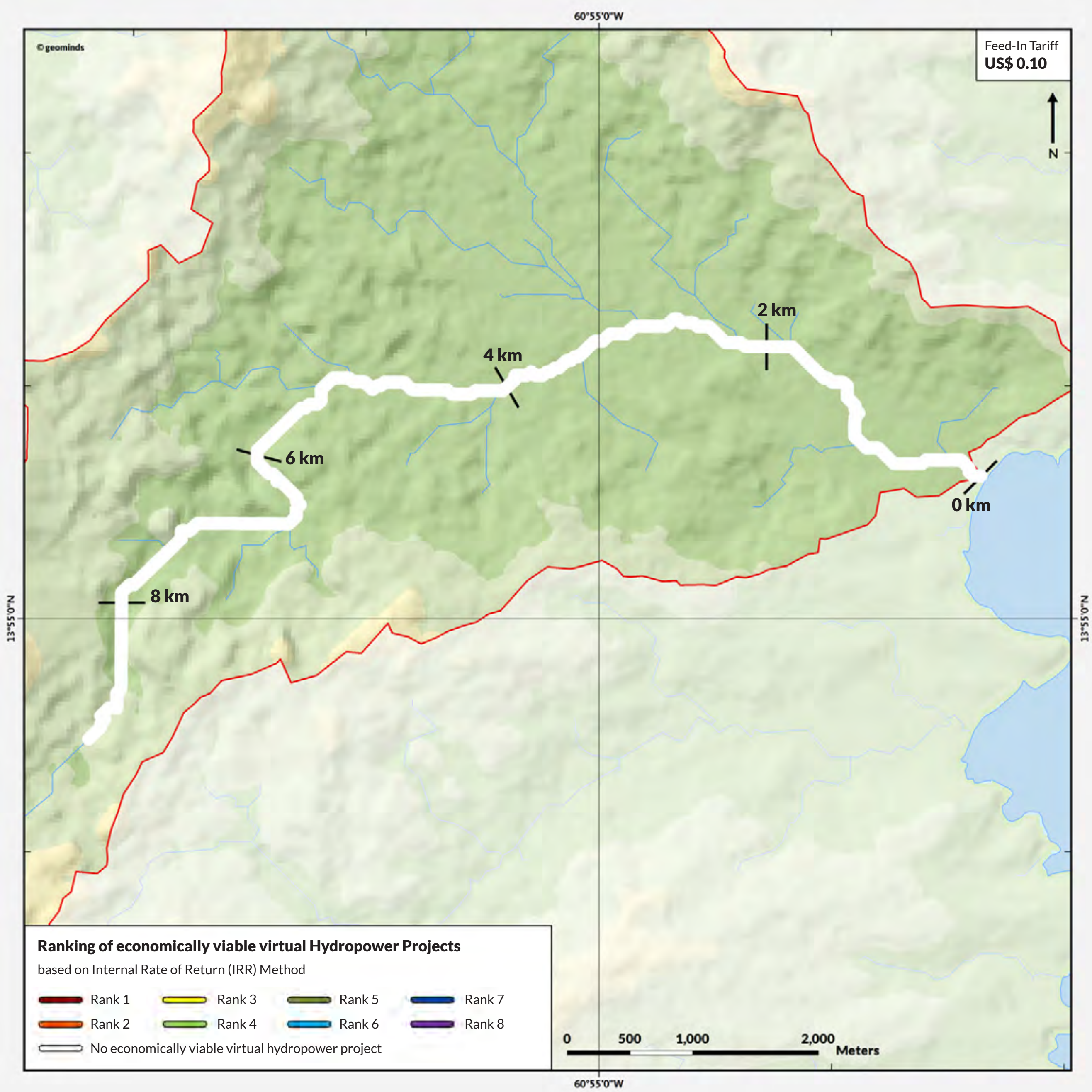


4.3 • OVERVIEW OF NORMALIZED TECHNICAL HYDROPOWER POTENTIAL

Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.



4.4 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL



Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake	Length of Penstock	Gross Head	Daily Flows, exceeded on 110 days per year
1	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-

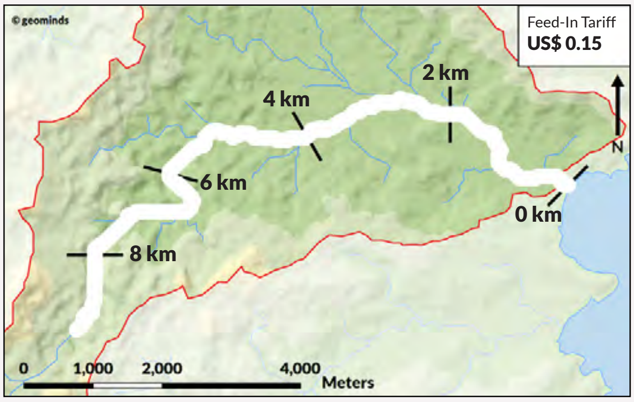
No economically viable virtual hydropower project was located!

For more information and all setting parameters used for this calculation, see page 12.

4.5 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL WITH RISING FEED-IN TARIFF

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	1.88%	34.84 kW	6.66 km	7.50 km
2	1.65%	46.16 kW	7.62 km	8.82 km
3	0.30%	27.92 kW	5.88 km	6.57 km
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

Ranking of economically viable virtual Hydropower Projects

based on Internal Rate of Return (IRR) Method

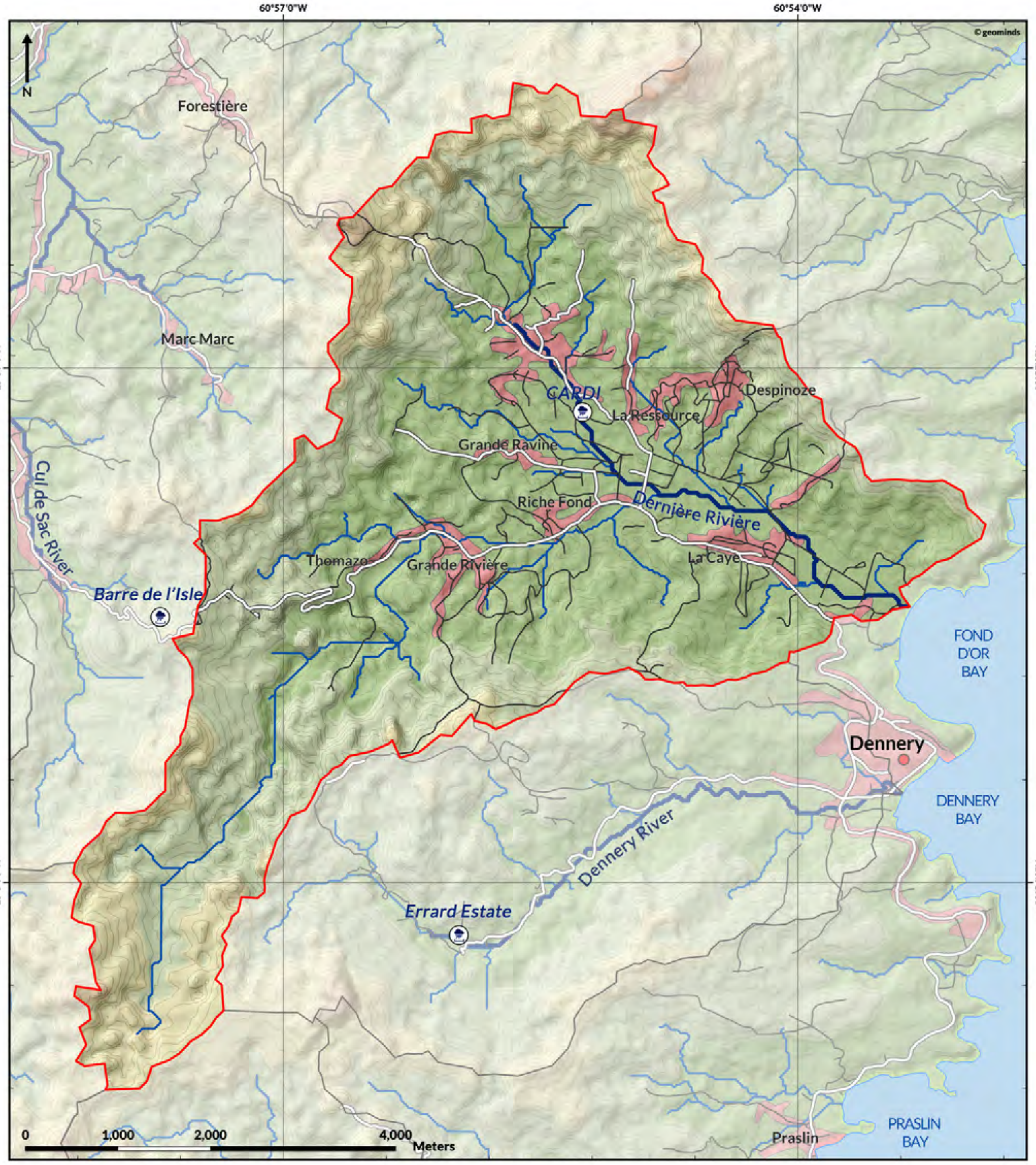
Rank 1 Rank 3 Rank 5 Rank 7
Rank 2 Rank 4 Rank 6 Rank 8
No economically viable virtual hydropower project

For more information and all setting parameters used for this calculation, see page 12.

Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

3. DERNIÈRE RIVIÈRE

3.1 • OVERVIEW MAP



Elevation	
> 900	
750 - 900	
600 - 750	
450 - 600	
300 - 450	
150 - 300	
0 - 150 m	

Urban Area and Roads
- Major Village
- Settlements
- Major Roads
- Minor Roads and Tracks

Water Resources
- Primary Streams
- Secondary Streams
- Catchment Boundary
- Rainfall Gauging Station

Facts about Catchment

Catchment Size: . . . . 39.76 km²

Length of Primary River: . . . . 5.07 km

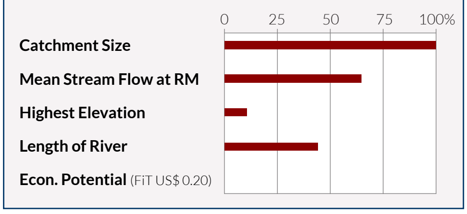
Highest Elevation of Primary River: . . . . . 30 m

Long-term Mean Stream Flow at River Mouth: . . . . 0.469 m³/s

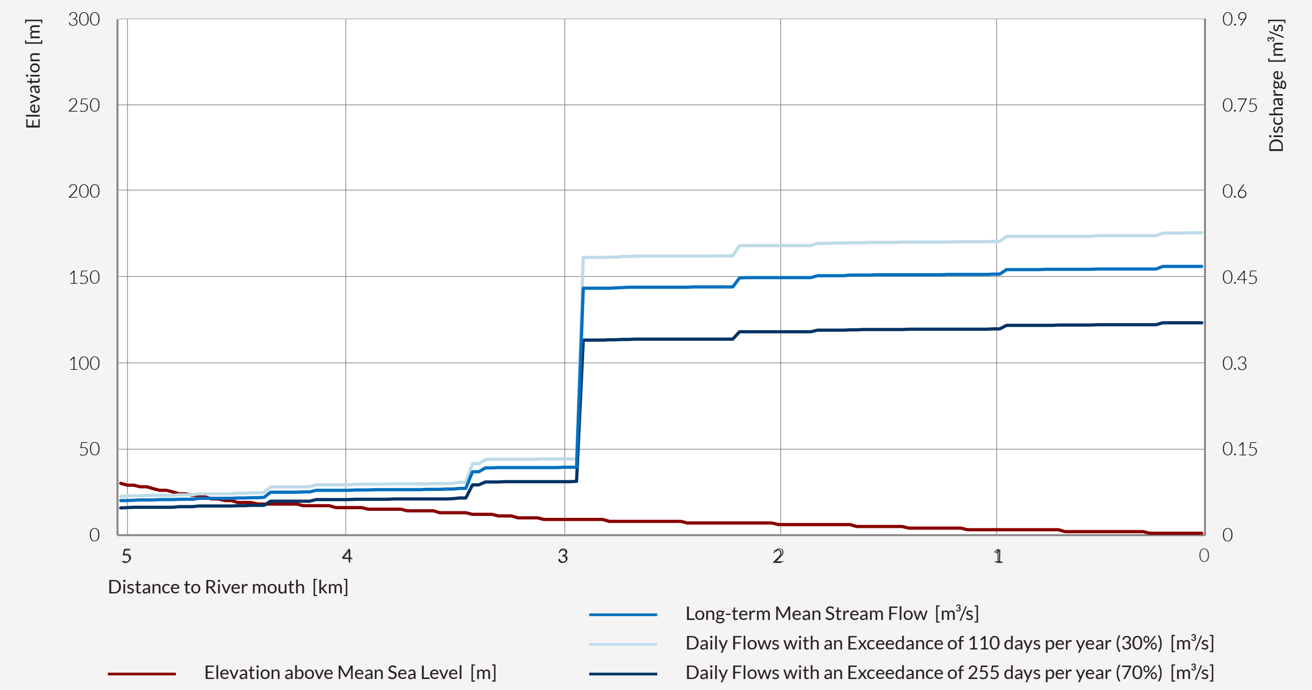
Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

The Dernière Rivière and the much larger Grande Rivière du Mabouya form together the Fond d'Or catchment, one of the largest catchments in Saint Lucia (39.76 km²). The Fond d'Or catchment collects about 0.469 m³/s of mean annual discharge available for generating hydropower at the river mouth. Accumulating its waters in the dryer north of the island, the Dernière Rivière has a total length of about 5.07 km from which the joint-river section is 4 km long. Due to the low elevation difference of just 30 m, no economically viable virtual hydropower project was located according to the parameters and assumptions applied.

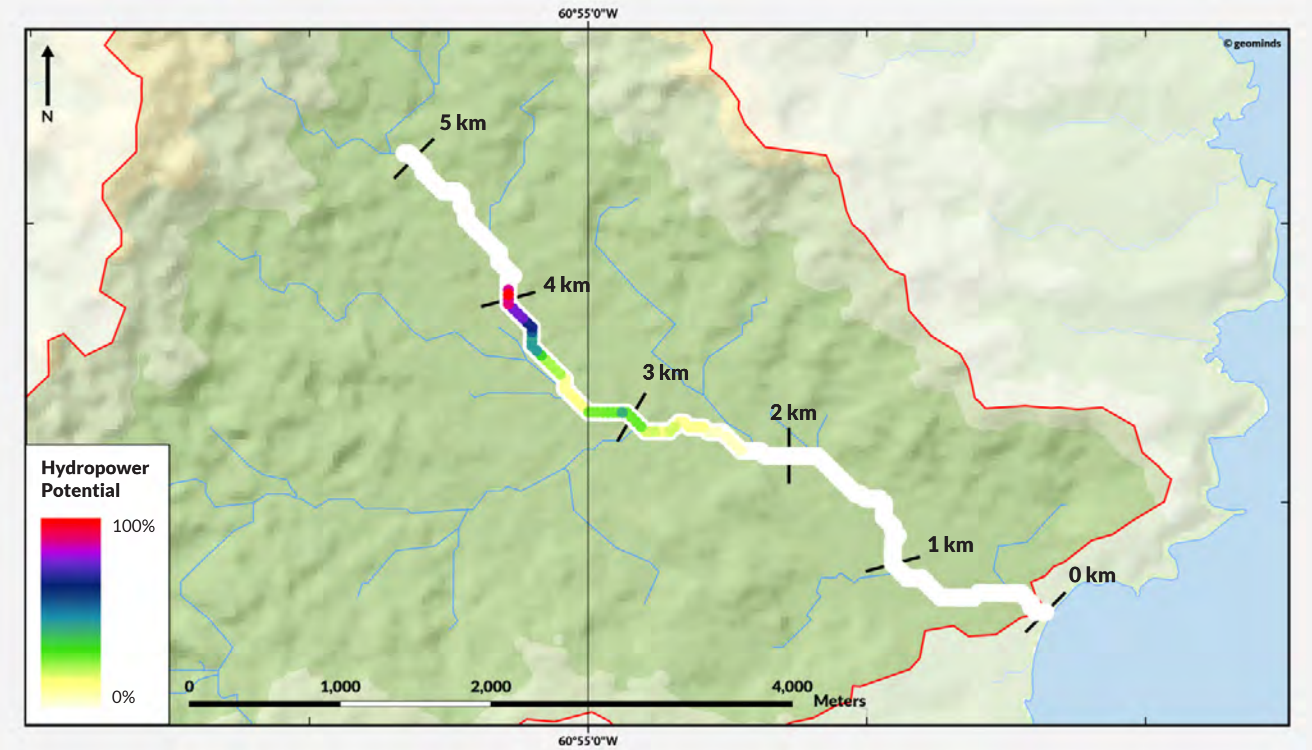
COUNTRY-WIDE RIVER RATING



3.2 • STREAM FLOW DISCHARGE ANALYSIS OF DERNIÈRE RIVIÈRE

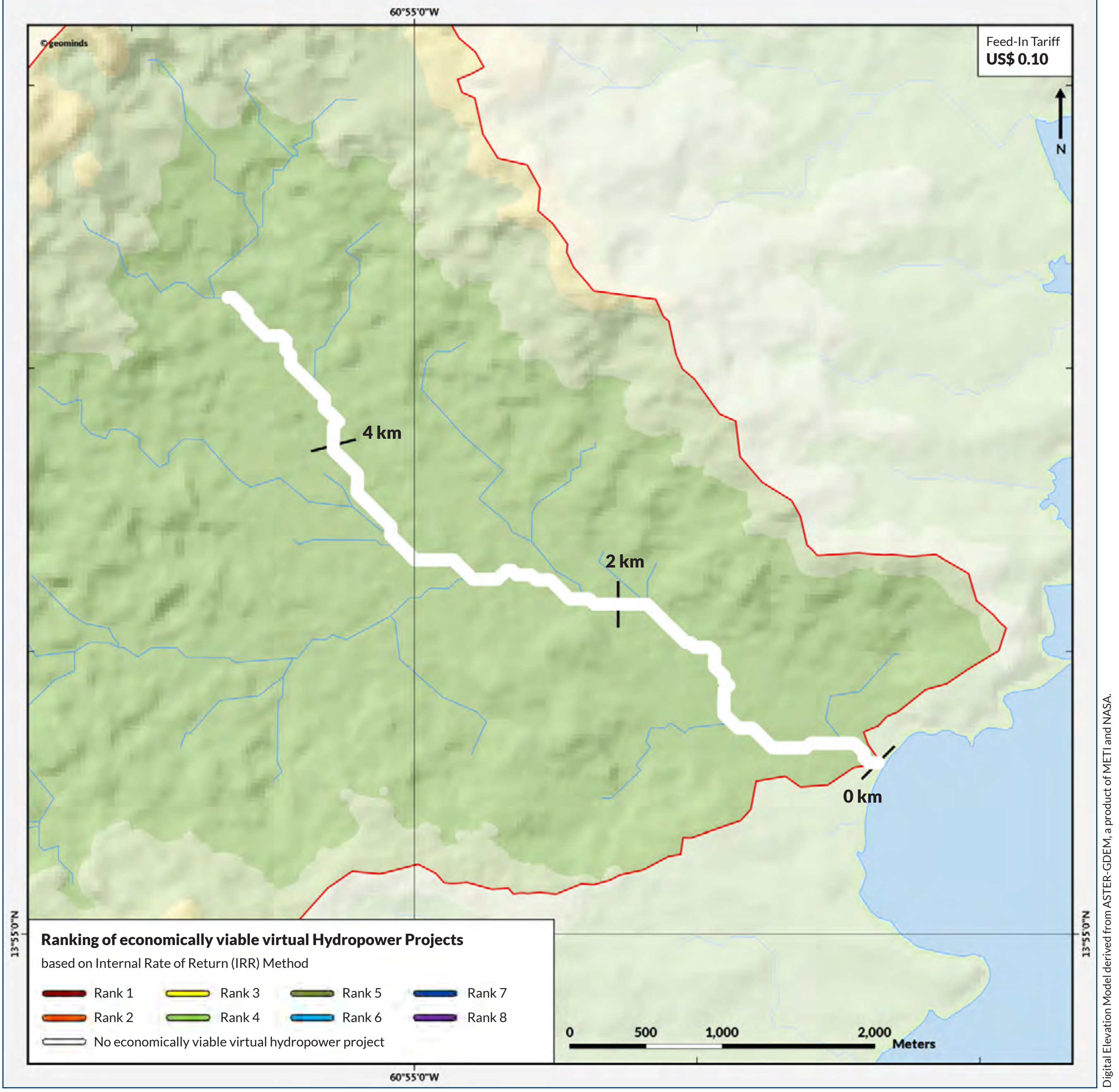


3.3 • OVERVIEW OF NORMALIZED TECHNICAL HYDROPOWER POTENTIAL



Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

3.4 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL

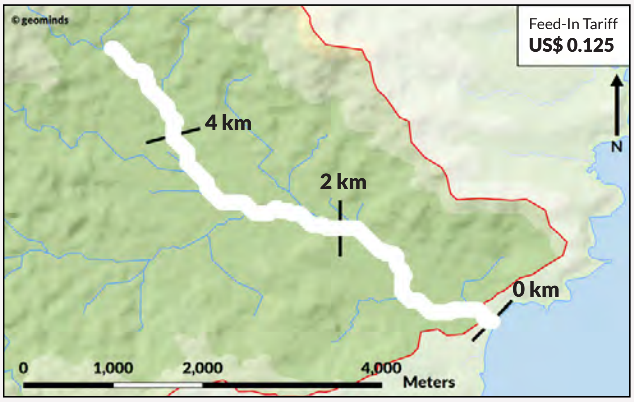


Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake	Length of Penstock	Gross Head	Daily Flows, exceeded on 110 days per year
1	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-

No economically viable virtual hydropower project was located!

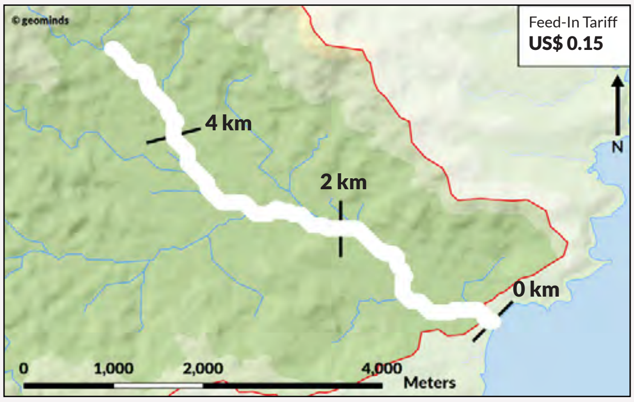
For more information and all setting parameters used for this calculation, see page 12.

3.5 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL WITH RISING FEED-IN TARIFF



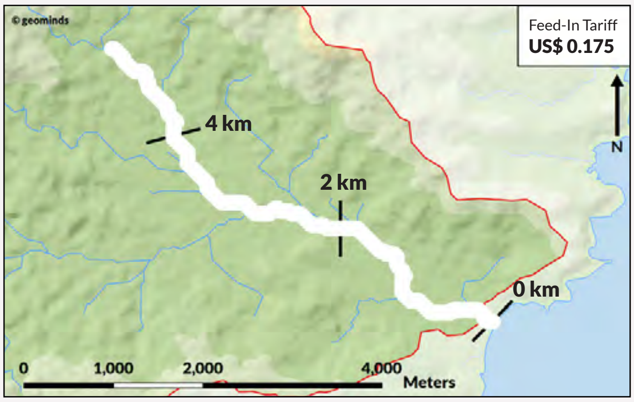
Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!



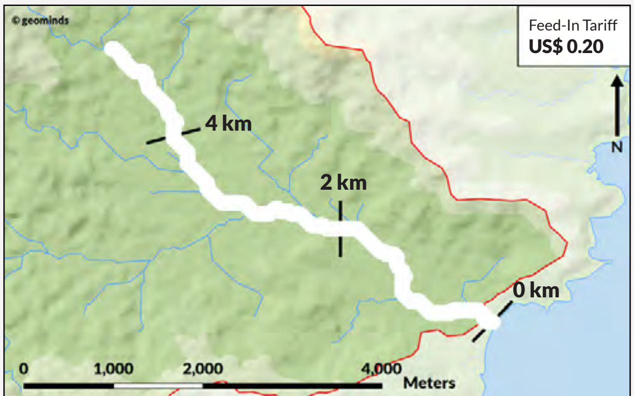
Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!

Ranking of economically viable virtual Hydropower Projects

based on Internal Rate of Return (IRR) Method

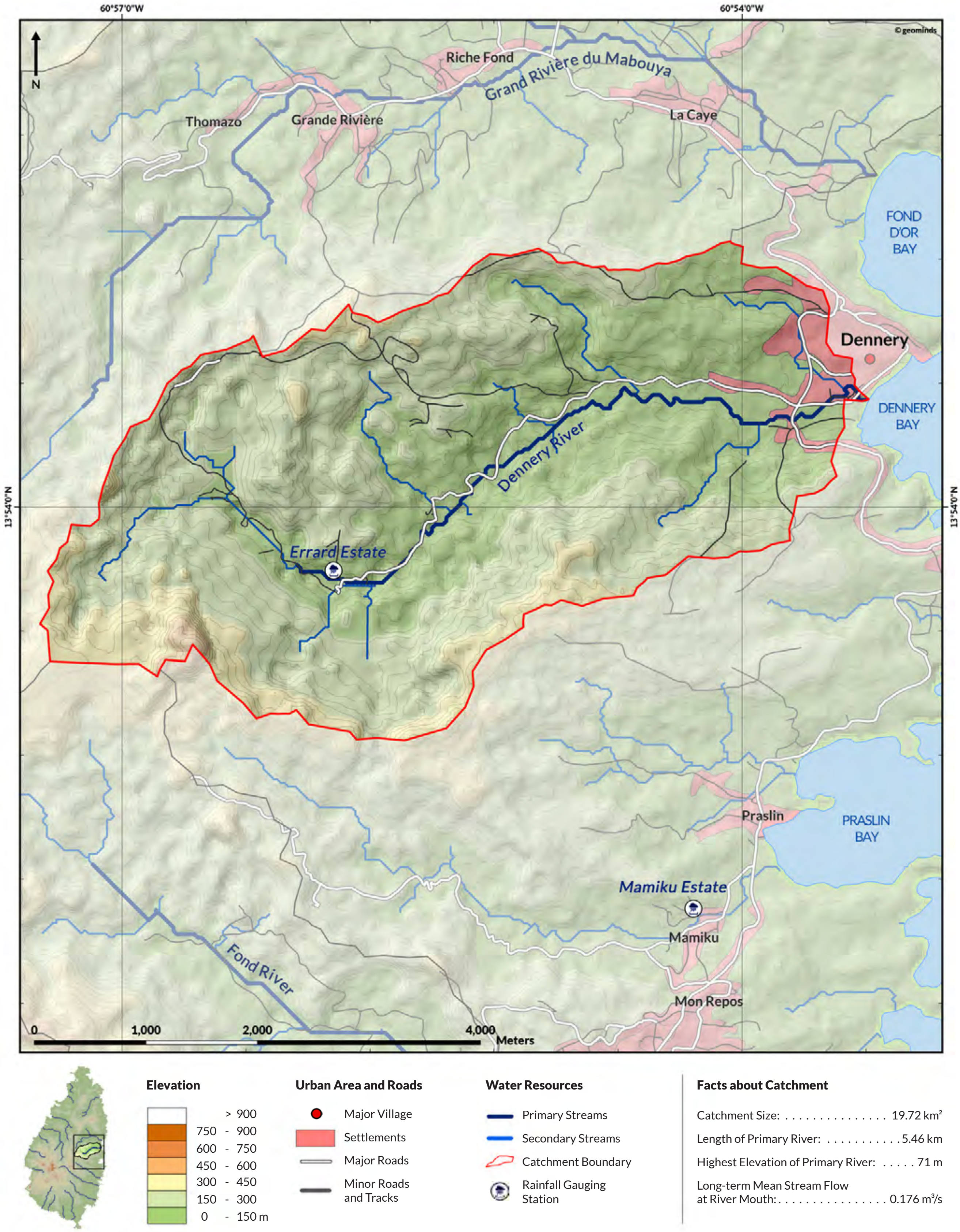
Rank 1 Rank 3 Rank 5 Rank 7
Rank 2 Rank 4 Rank 6 Rank 8
No economically viable virtual hydropower project

For more information and all setting parameters used for this calculation, see page 12.

Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

5. DENNERY RIVER

5.1 • OVERVIEW MAP



Facts about Catchment

Catchment Size: . . . . 19.72 km²

Length of Primary River: . . . . 5.46 km

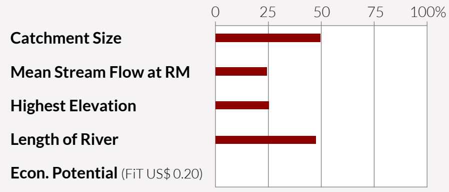
Highest Elevation of Primary River: . . . . . 71 m

Long-term Mean Stream Flow at River Mouth: . . . . 0.176 m³/s

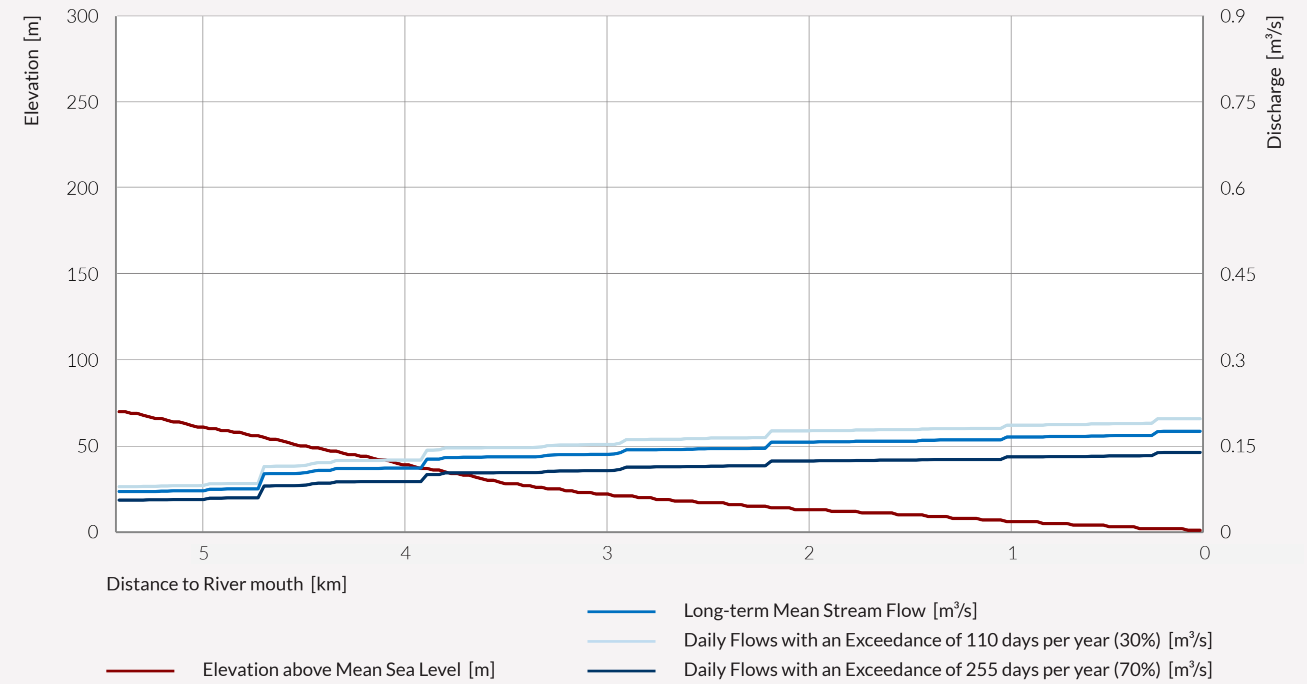
Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

The Dennery River has a catchment size of 19.72 km² and its analyzed primary stream is 5.46 km in length. Flowing into Dennery Bay on the east coast of Saint Lucia, the Dennery River has an annual mean discharge available for generating hydropower in an ecologically sustainable way of just 0.176 m³/s. Even with a primary river's maximum elevation of 71 m above sea level, no economically viable virtual hydropower project was located according to the parameters and assumptions applied.

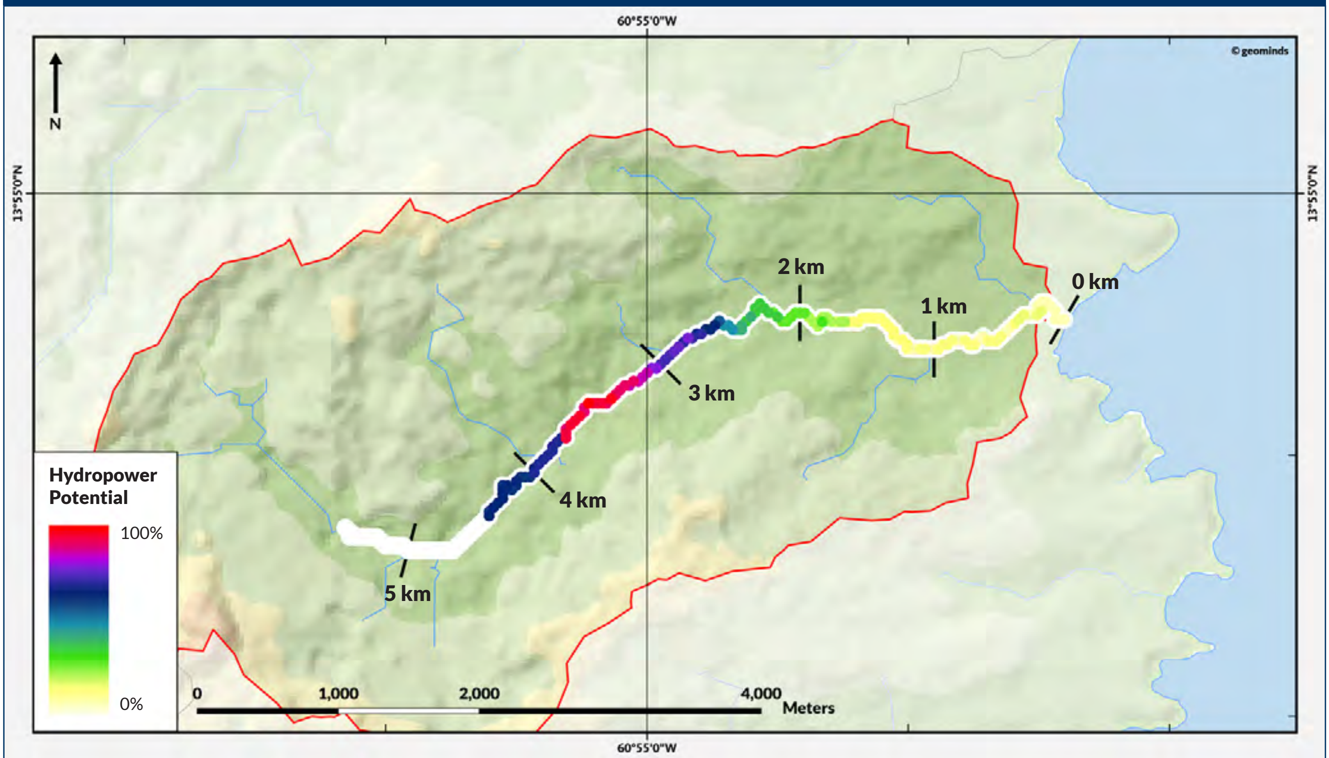
COUNTRY-WIDE RIVER RATING



5.2 • STREAM FLOW DISCHARGE ANALYSIS OF DENNERY RIVER

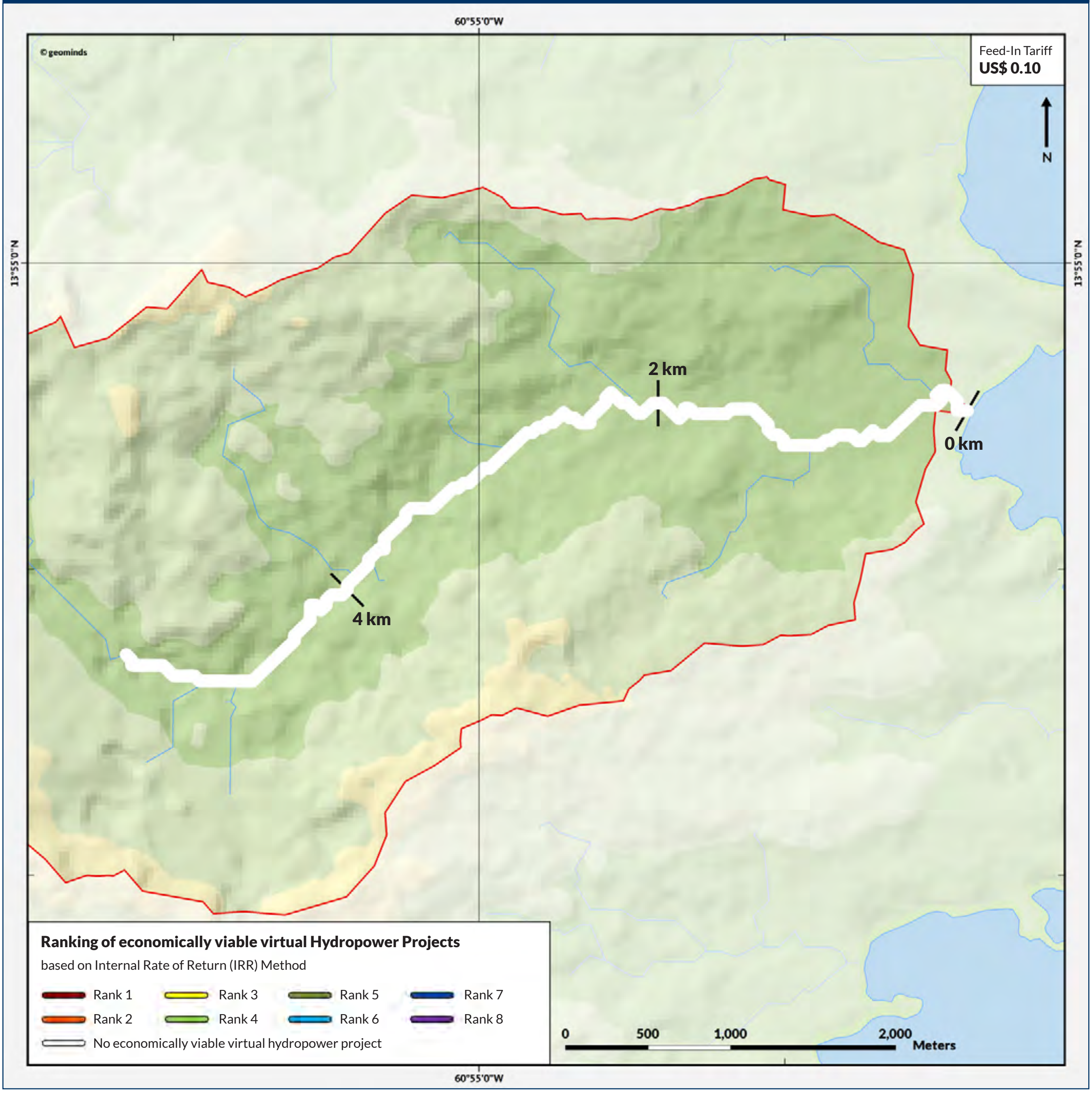


5.3 • OVERVIEW OF NORMALIZED TECHNICAL HYDROPOWER POTENTIAL



Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

5.4 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL



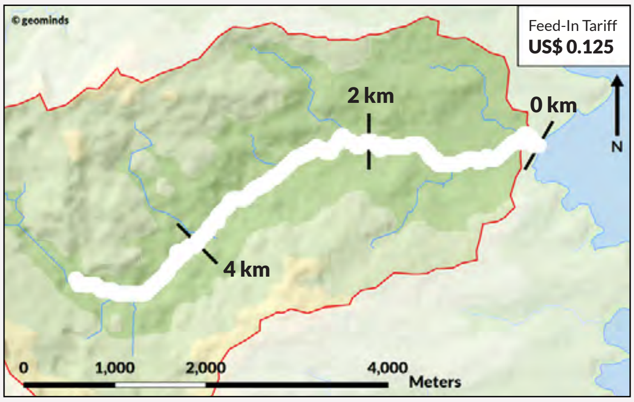
Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake	Length of Penstock	Gross Head	Daily Flows, exceeded on 110 days per year
1	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-

No economically viable virtual hydropower project was located!

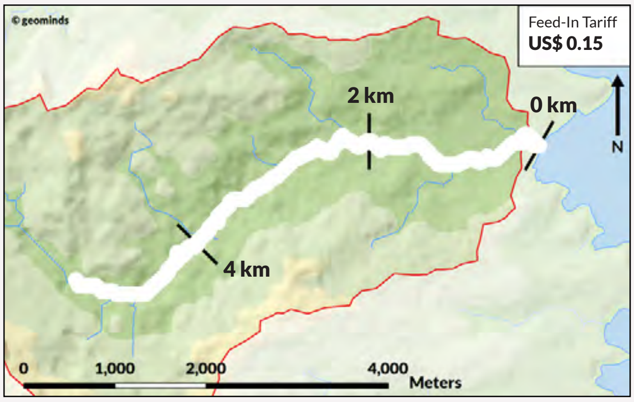
For more information and all setting parameters used for this calculation, see page 12.

5.5 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL WITH RISING FEED-IN TARIFF



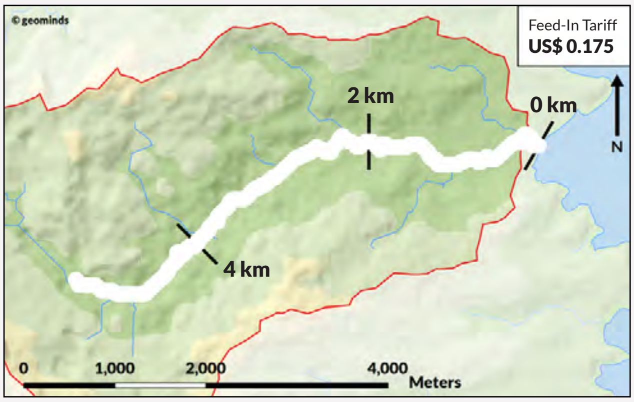
Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!



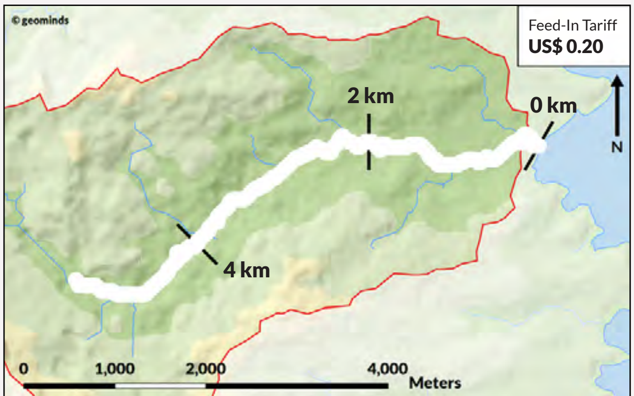
Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!

Ranking of economically viable virtual Hydropower Projects

based on Internal Rate of Return (IRR) Method

Rank 1 | Rank 3 | Rank 5 | Rank 7

Rank 2 | Rank 4 | Rank 6 | Rank 8

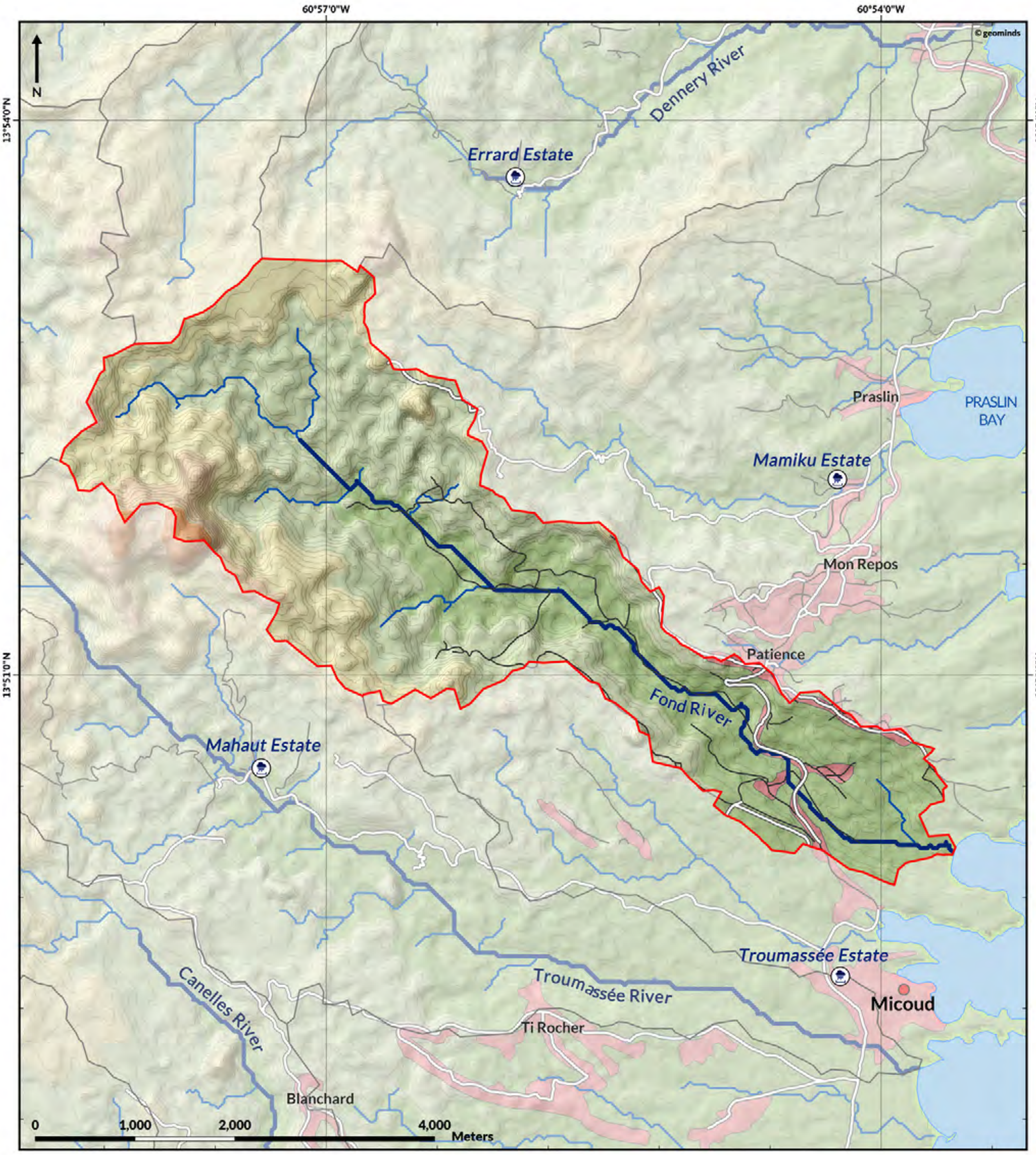
No economically viable virtual hydropower project

For more information and all setting parameters used for this calculation, see page 12.

Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

6. FOND RIVER

6.1 • OVERVIEW MAP



Elevation

- > 900
- 750 - 900
- 600 - 750
- 450 - 600
- 300 - 450
- 150 - 300
- 0 - 150 m

Urban Area and Roads

- Major Village
- Settlements
- Major Roads
- Minor Roads and Tracks

Water Resources

- Primary Streams
- Secondary Streams
- Catchment Boundary
- Rainfall Gauging Station

Facts about Catchment

Catchment Size: . . . . 17.91 km²

Length of Primary River: . . . . 7.09 km

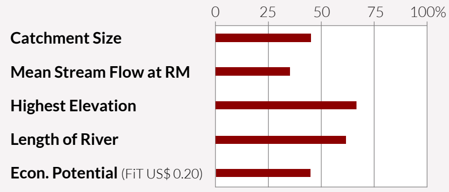
Highest Elevation of Primary River: . . . . 188 m

Long-term Mean Stream Flow at River Mouth: . . . . 0.255 m³/s

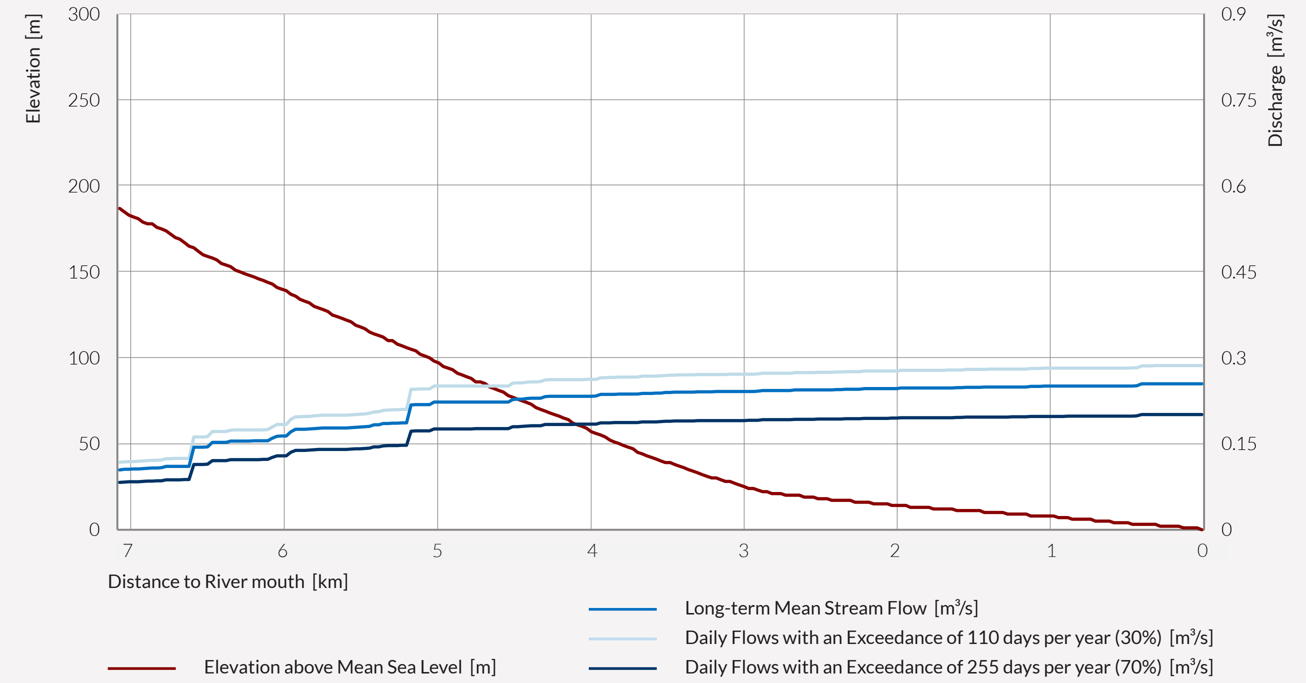
Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

The Fond River accumulates its waters from the central highlands around Mount Beaucoup north of the Troumassée catchment on the east coast of Saint Lucia. The elevation drop of 188 m of the primary river is one of the highest of all analyzed rivers. The catchment's size is about 17.91 km² and the length of the river is 7.09 km. The mean annual discharge available for generating hydroelectric power in an ecologically sustainable way is about 0.255 m³/s at the river mouth at Fond Bay. However, economically viable virtual hydropower projects were located only applying a feed-in tariff of at least US$ 0.15.

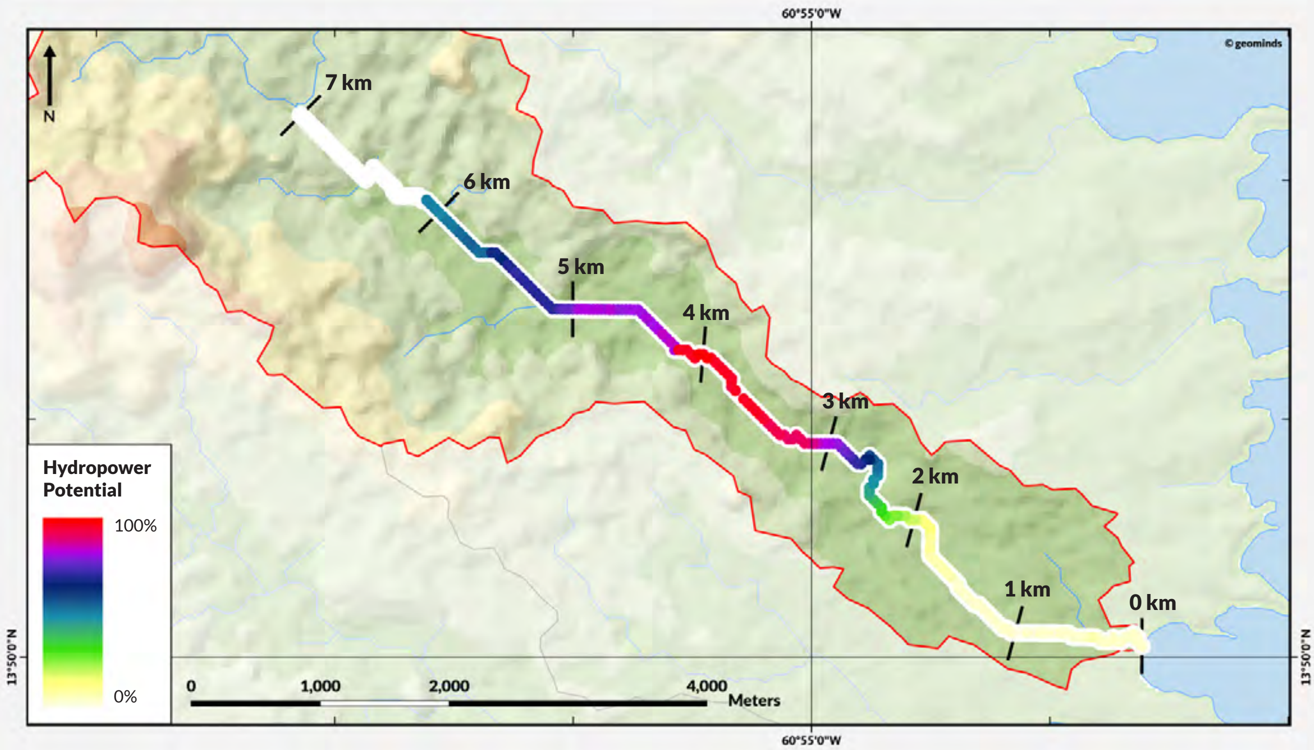
COUNTRY-WIDE RIVER RATING



6.2 • STREAM FLOW DISCHARGE ANALYSIS OF FOND RIVER

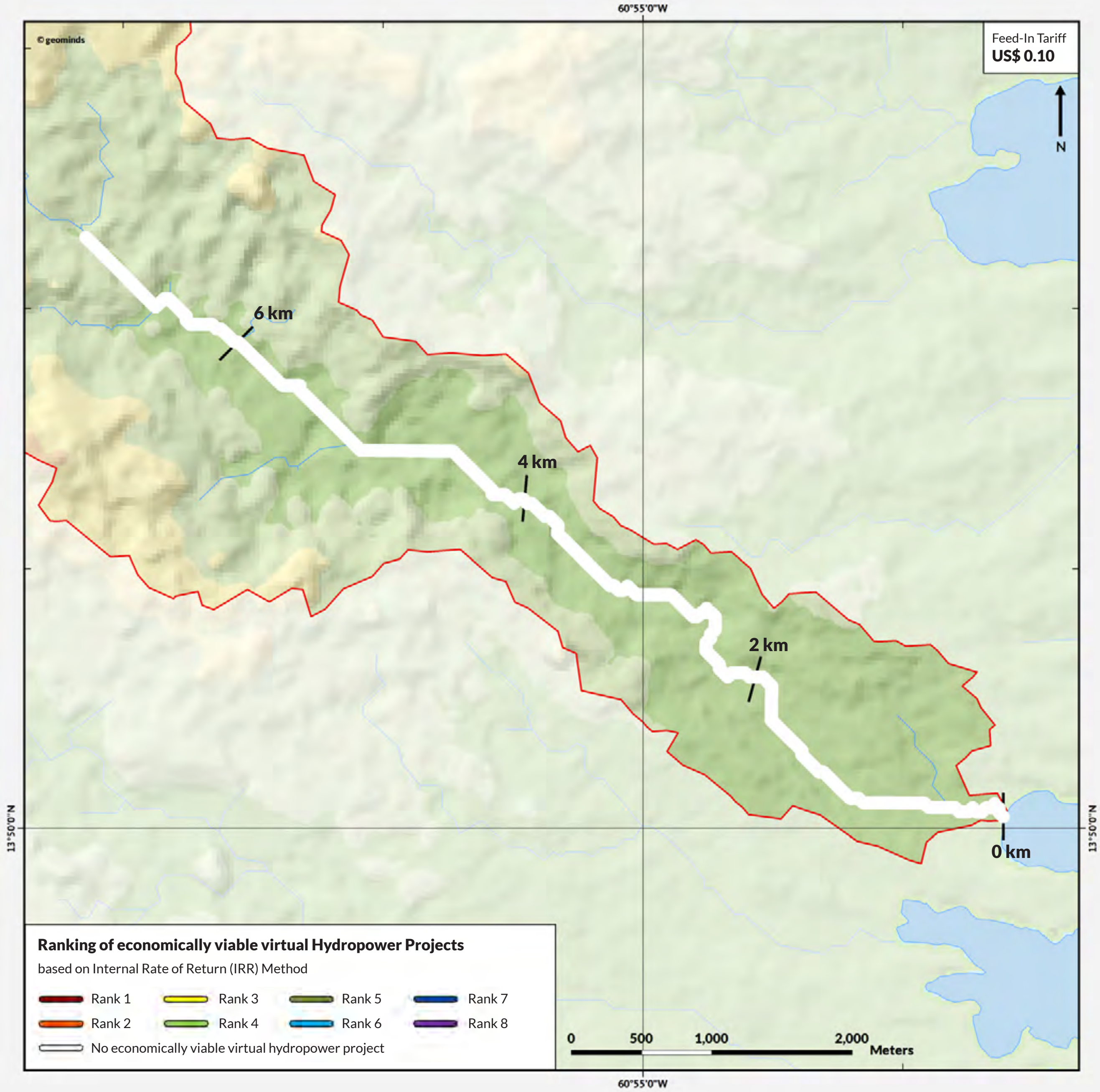


6.3 • OVERVIEW OF NORMALIZED TECHNICAL HYDROPOWER POTENTIAL



Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

6.4 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL



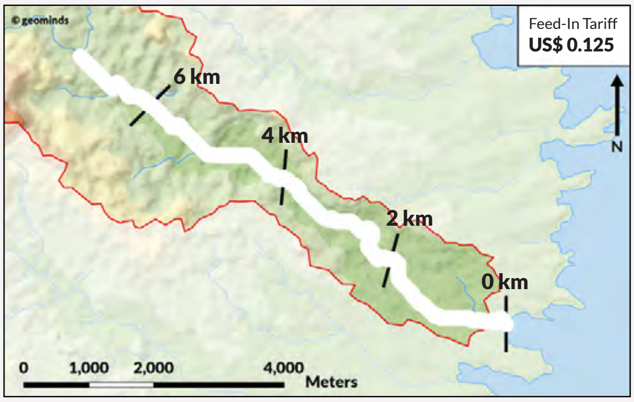
Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake	Length of Penstock	Gross Head	Daily Flows, exceeded on 110 days per year
1	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-

No economically viable virtual hydropower project was located!

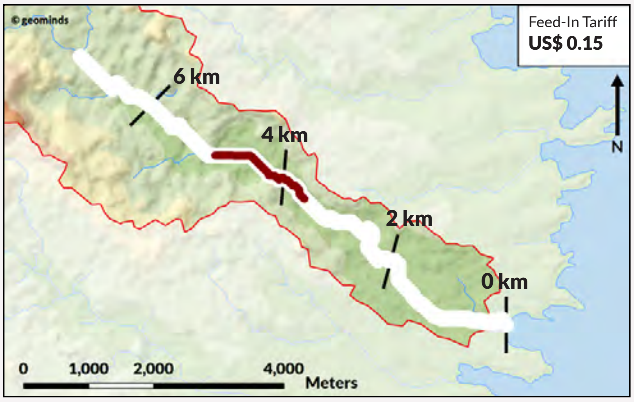
For more information and all setting parameters used for this calculation, see page 12.

6.5 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL WITH RISING FEED-IN TARIFF

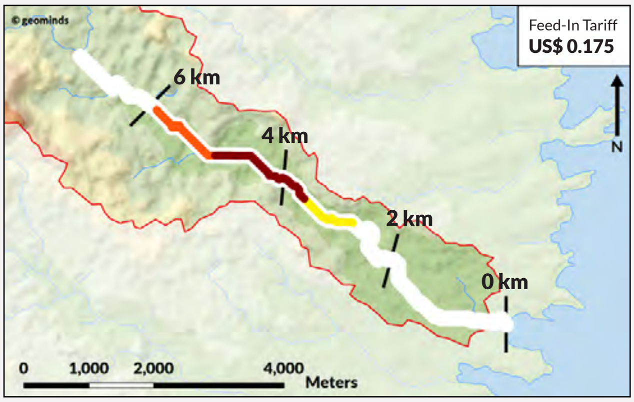


Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	1.56%	94.62 kW	3.66 km	5.01 km
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	3.91%	94.62 kW	3.66 km	5.01 km
2	1.76%	46.19 kW	5.07 km	5.88 km
3	0.33%	34.68 kW	2.94 km	3.63 km
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	5.93%	94.62 kW	3.66 km	5.01 km
2	3.80%	46.19 kW	5.07 km	5.88 km
3	2.41%	34.68 kW	2.94 km	3.63 km
4	2.36%	27.88 kW	5.97 km	6.57 km
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

Ranking of economically viable virtual Hydropower Projects

based on Internal Rate of Return (IRR) Method

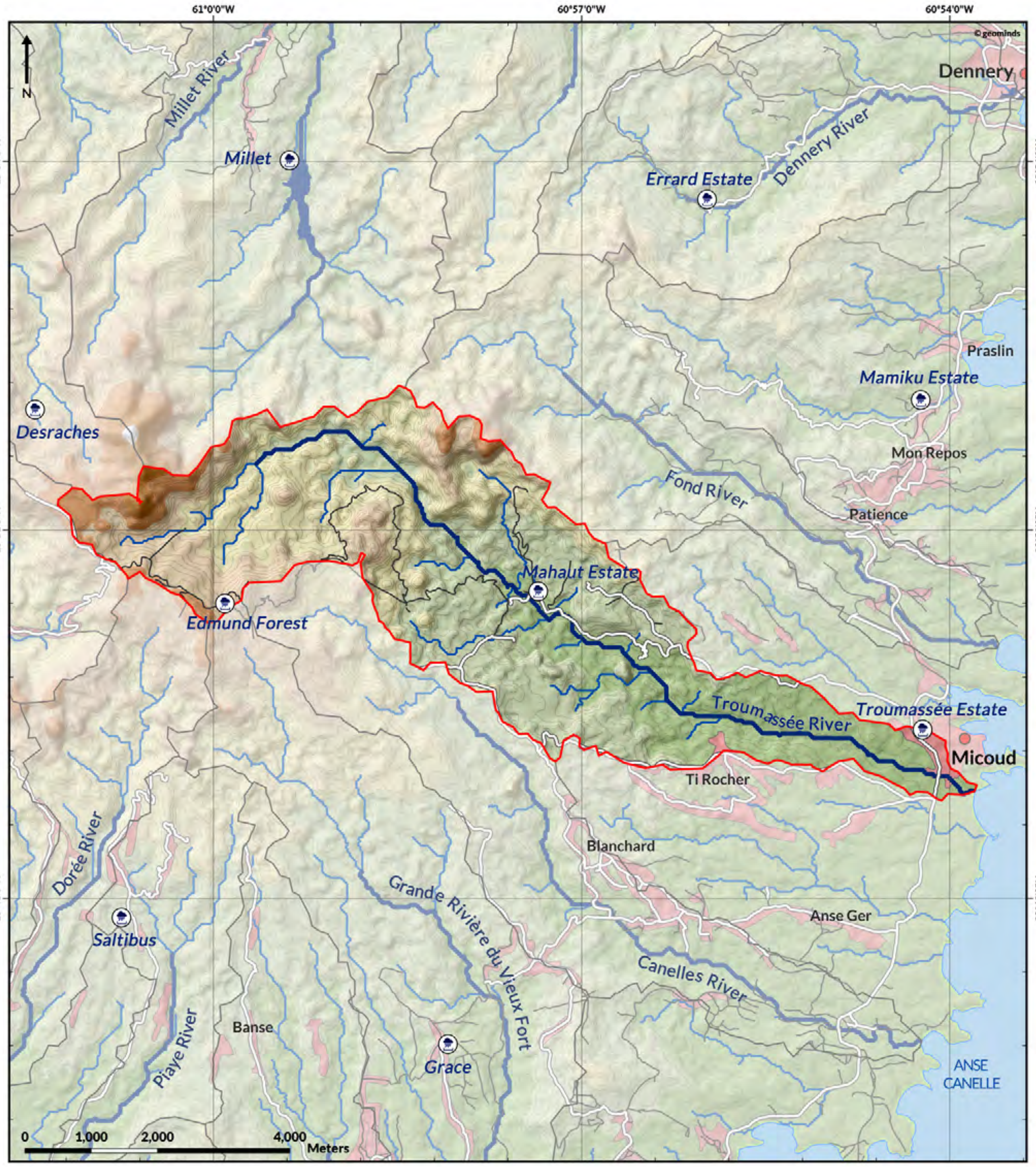
Rank 1 Rank 3 Rank 5 Rank 7
Rank 2 Rank 4 Rank 6 Rank 8
No economically viable virtual hydropower project

For more information and all setting parameters used for this calculation, see page 12.

Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

7. TROUMASSÉE RIVER

7.1 • OVERVIEW MAP



Elevation

- > 900
- 750 - 900
- 600 - 750
- 450 - 600
- 300 - 450
- 150 - 300
- 0 - 150 m

Urban Area and Roads

- Major Village
- Settlements
- Major Roads
- Minor Roads and Tracks

Water Resources

- Primary Streams
- Secondary Streams
- Catchment Boundary
- Rainfall Gauging Station

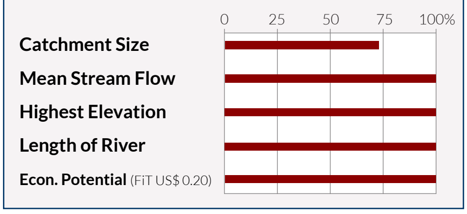
Facts about Catchment

Catchment Size:	29.01 km²
Length of Primary River:	11.50 km
Highest Elevation of Primary River:	281 m
Long-term Mean Stream Flow at River Mouth:	0.724 m³/s

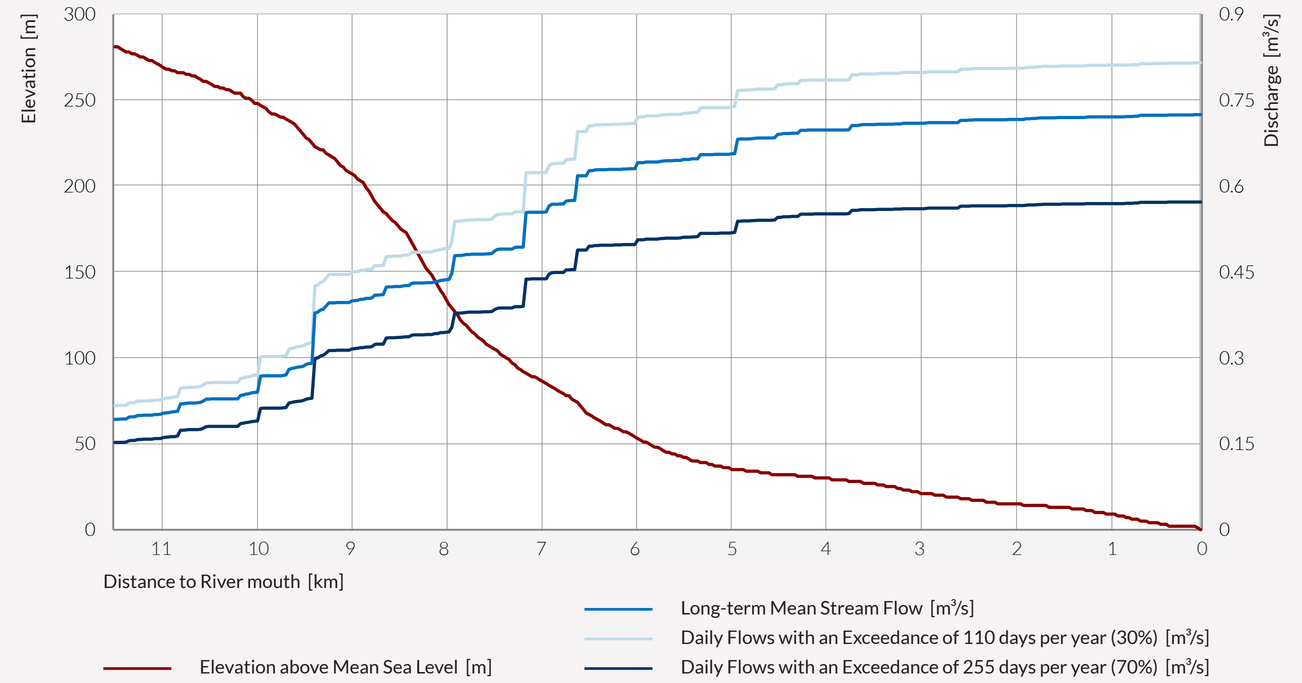
Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

The Troumassée River has a significant hydropower potential due to a high elevation drop of the primary river. The river has its source in the central highlands in the south-western part of the island, flowing southeast to its mouth close to the town of Micoud at the Atlantic coast. With a catchment size of roughly 30 km² it collects enough rainwater to reach a mean annual discharge at the river mouth of about 0.724 m³/s. With steep gradients and high-flows, the middle section of the river upstream of Mahaut Estate has the country's highest hydropower potentials.

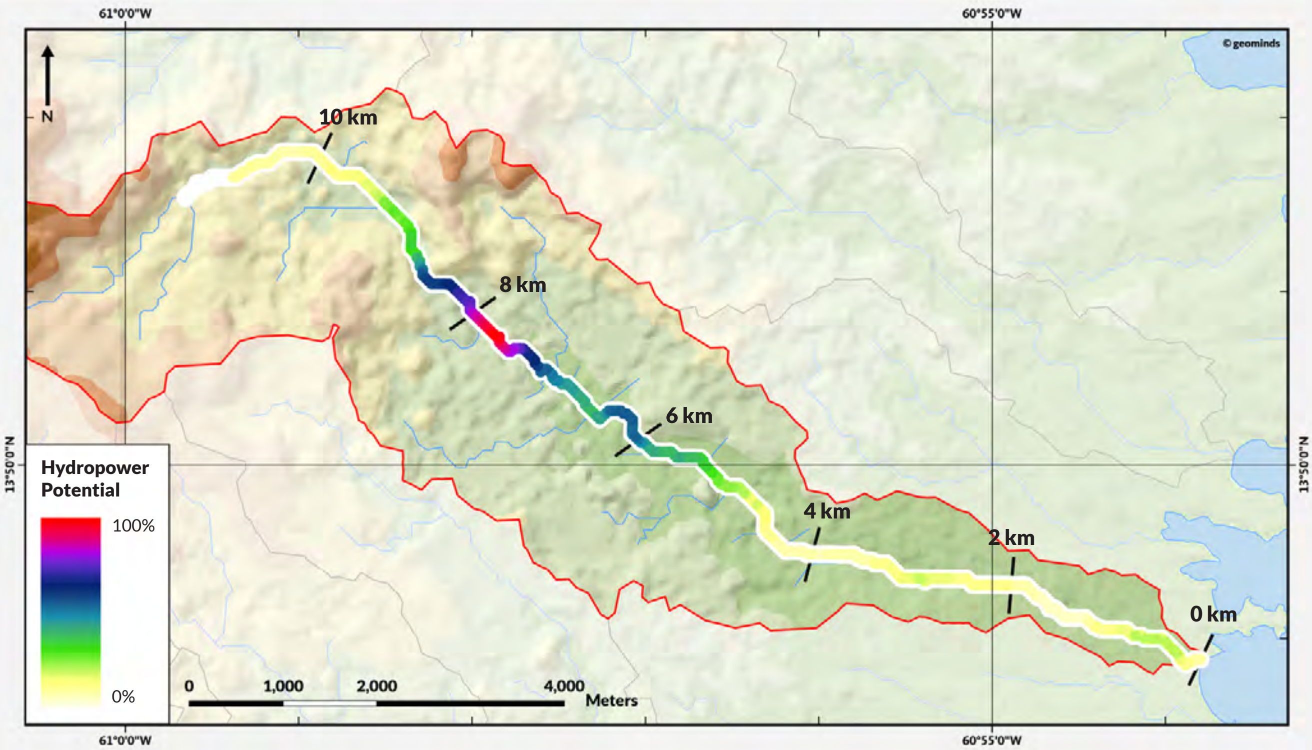
COUNTRY-WIDE RIVER RATING



7.2 • STREAM FLOW DISCHARGE ANALYSIS OF TROUMASSÉE RIVER

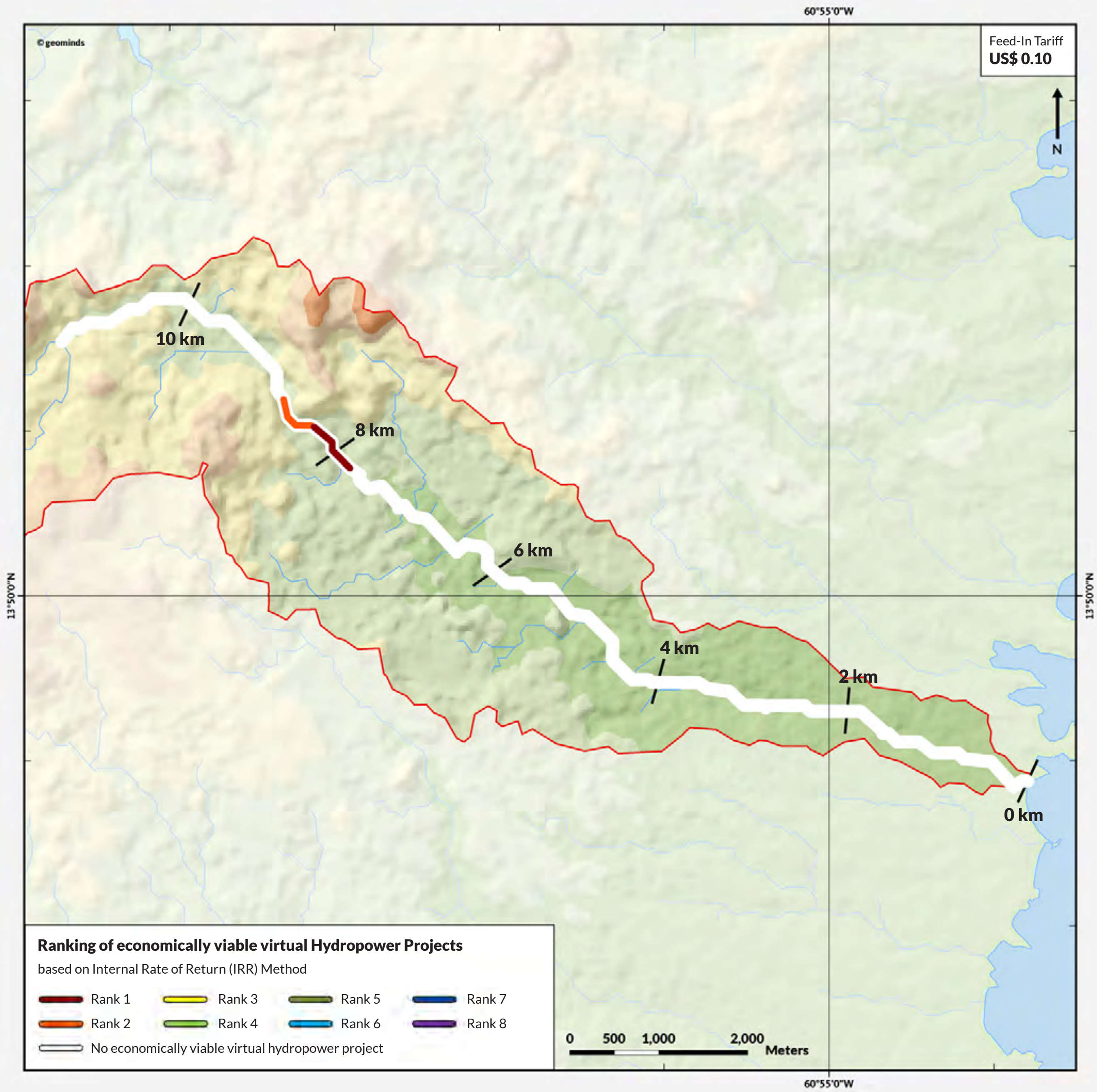


7.3 • OVERVIEW OF NORMALIZED TECHNICAL HYDROPOWER POTENTIAL



Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

7.4 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL

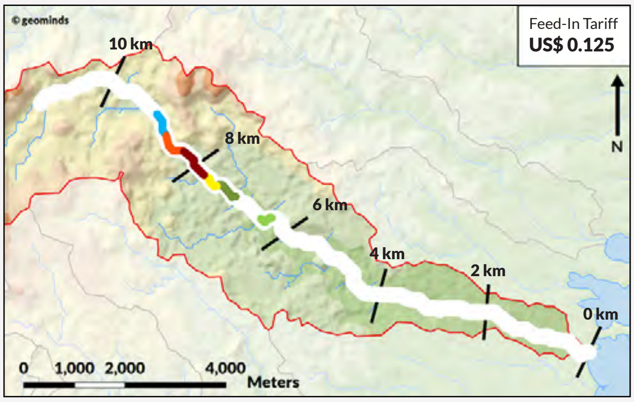


Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

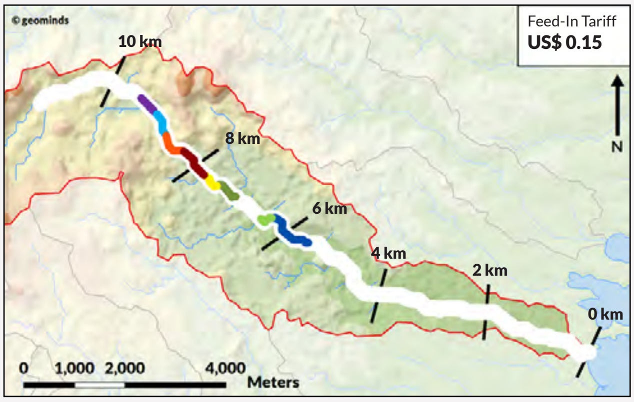
Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake	Length of Penstock	Gross Head	Daily Flows, exceeded on 110 days per year
1	1.83%	149.17 kW	7.89 km	8.34 km	0.45 km	42 m	0.480 m³/s
2	0.10%	89.01 kW	8.40 km	8.79 km	0.39 km	27 m	0.454 m³/s
3	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-
7		-	-	-	-	-	-
8		-	-	-	-	-	-

For more information and all setting parameters used for this calculation, see page 12.

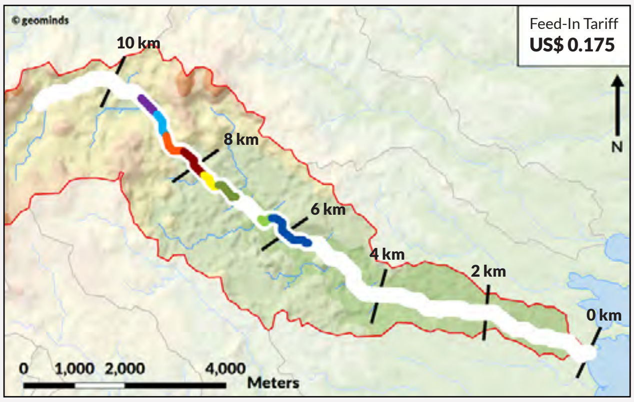
7.5 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL WITH RISING FEED-IN TARIFF



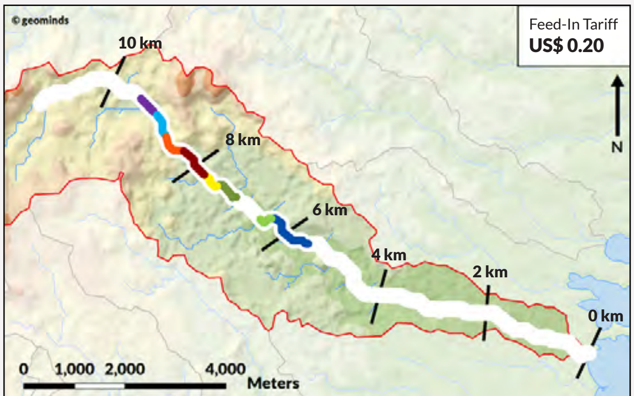
Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	5.22%	149.17 kW	7.89 km	8.34 km
2	3.55%	89.01 kW	8.40 km	8.79 km
3	3.45%	65.88 kW	7.59 km	7.86 km
4	2.38%	46.04 kW	6.45 km	6.63 km
5	1.84%	60.15 kW	7.17 km	7.53 km
6	0.96%	52.22 kW	8.85 km	9.21 km
7	-	-	-	-
8	-	-	-	-



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	8.02%	149.17 kW	7.89 km	8.34 km
2	6.31%	89.01 kW	8.40 km	8.79 km
3	6.21%	65.88 kW	7.59 km	7.86 km
4	5.14%	46.04 kW	6.45 km	6.63 km
5	4.61%	60.15 kW	7.17 km	7.53 km
6	3.75%	52.22 kW	8.85 km	9.21 km
7	2.56%	99.01 kW	5.61 km	6.42 km
8	2.48%	29.84 kW	9.30 km	9.51 km



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	10.49%	149.17 kW	7.89 km	8.34 km
2	8.71%	89.01 kW	8.40 km	8.79 km
3	8.60%	65.88 kW	7.59 km	7.86 km
4	7.50%	46.04 kW	6.45 km	6.63 km
5	6.96%	60.15 kW	7.17 km	7.53 km
6	6.09%	52.22 kW	8.85 km	9.21 km
7	4.89%	99.01 kW	5.61 km	6.42 km
8	4.82%	29.84 kW	9.30 km	9.51 km



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	12.85%	149.17 kW	7.89 km	8.34 km
2	10.87%	89.01 kW	8.40 km	8.79 km
3	10.76%	65.88 kW	7.59 km	7.86 km
4	9.61%	46.04 kW	6.45 km	6.63 km
5	9.05%	60.15 kW	7.17 km	7.53 km
6	8.15%	52.22 kW	8.85 km	9.21 km
7	6.93%	99.01 kW	5.61 km	6.42 km
8	6.85%	29.84 kW	9.30 km	9.51 km

Ranking of economically viable virtual Hydropower Projects

based on Internal Rate of Return (IRR) Method

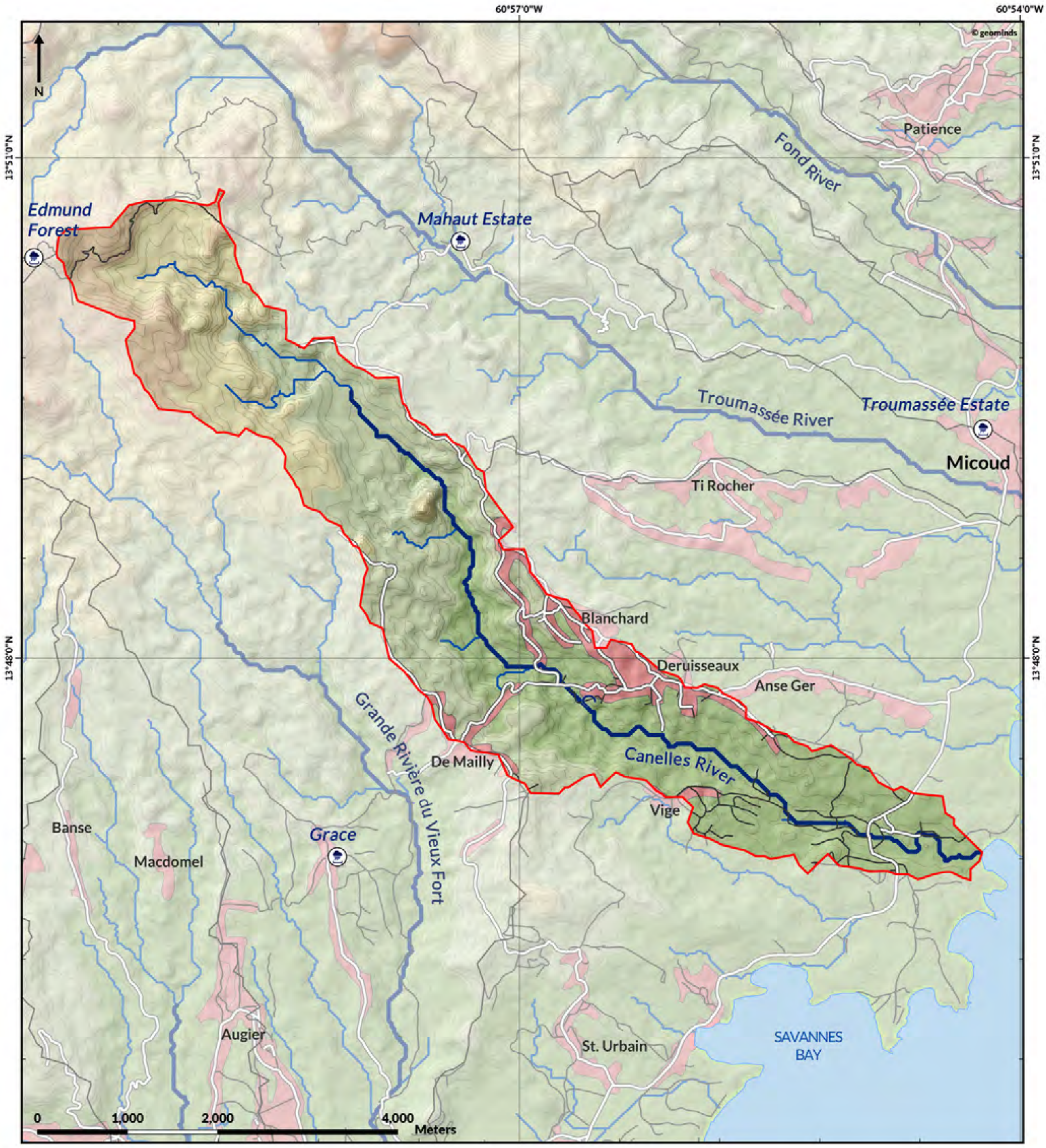
Rank 1 Rank 3 Rank 5 Rank 7
Rank 2 Rank 4 Rank 6 Rank 8
No economically viable virtual hydropower project

For more information and all setting parameters used for this calculation, see page 12.

Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

8. CANELLES RIVER

8.1 • OVERVIEW MAP



Elevation

- > 900
- 750 - 900
- 600 - 750
- 450 - 600
- 300 - 450
- 150 - 300
- 0 - 150 m

Urban Area and Roads

- Major Village
- Settlements
- Major Roads
- Minor Roads and Tracks

Water Resources

- Primary Streams
- Secondary Streams
- Catchment Boundary
- Rainfall Gauging Station

Facts about Catchment

Catchment Size: . . . . 17.48 km²

Length of Primary River: . . . . 8.94 km

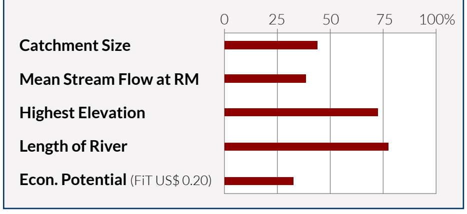
Highest Elevation of Primary River: . . . . 205 m

Long-term Mean Stream Flow at River Mouth: . . . . 0.279 m³/s

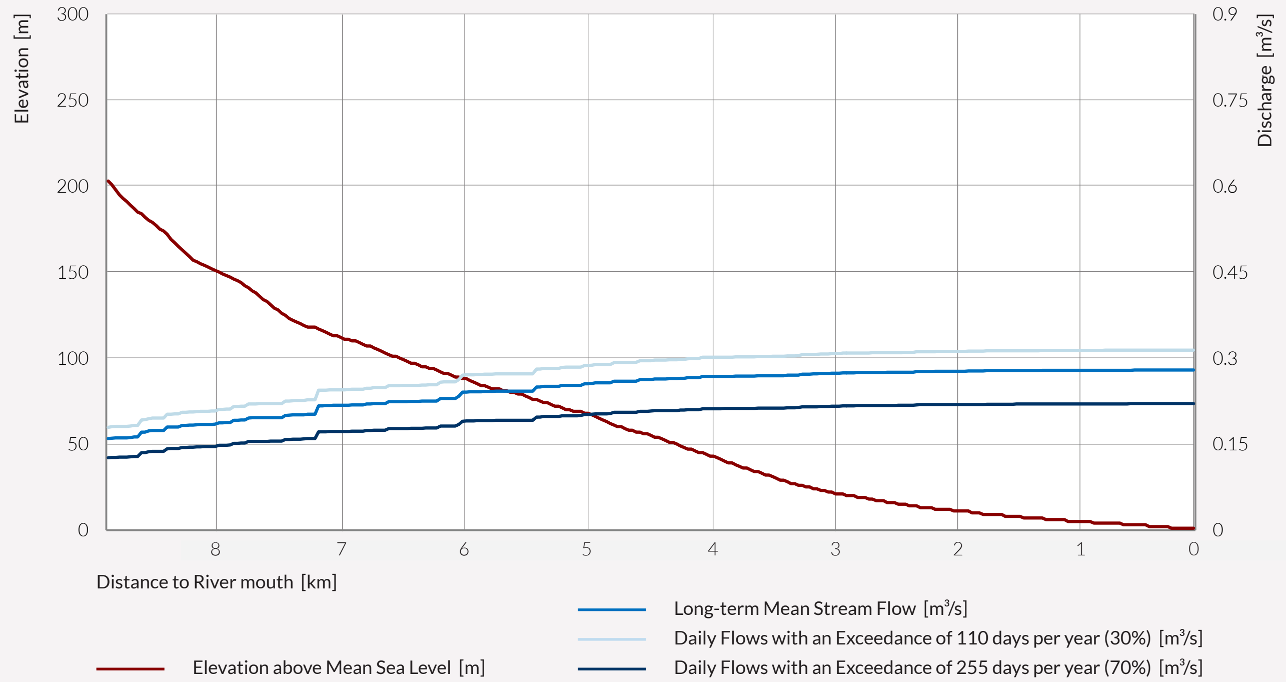
Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

The Canelles River is located at the south eastern coast of Saint Lucia having its source at Edmund Forest, in the central highlands of the island. The highest elevation of the Canelles River is about 205 m with a total length of almost 9 km. The shape of the catchment is long but narrow leading to an overall area of about 17.5 km². The average amount of discharge at the river mouth usable for hydropower in an ecologically sustainable way is about 0.279 m³/s. No economically viable virtual hydropower project were located applying a feed-in tariff of less than US$ 0.15.

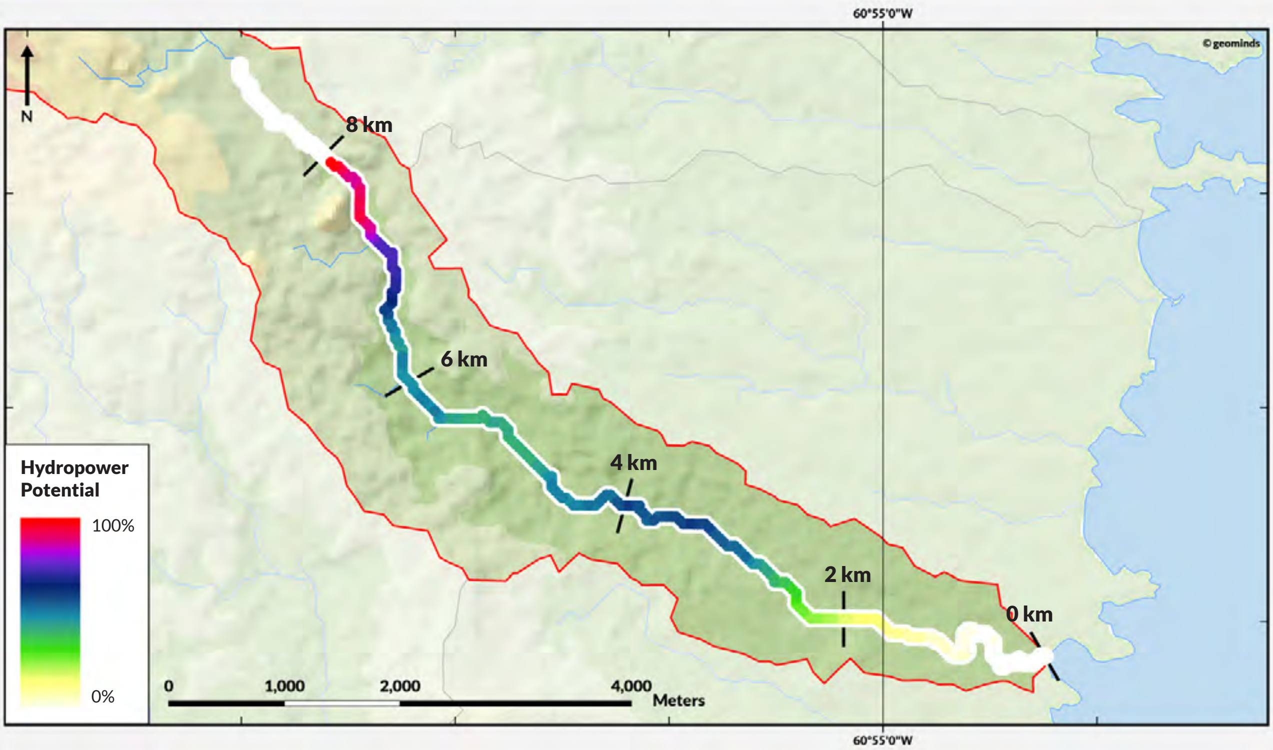
COUNTRY-WIDE RIVER RATING



8.2 • STREAM FLOW DISCHARGE ANALYSIS OF CANELLES RIVER

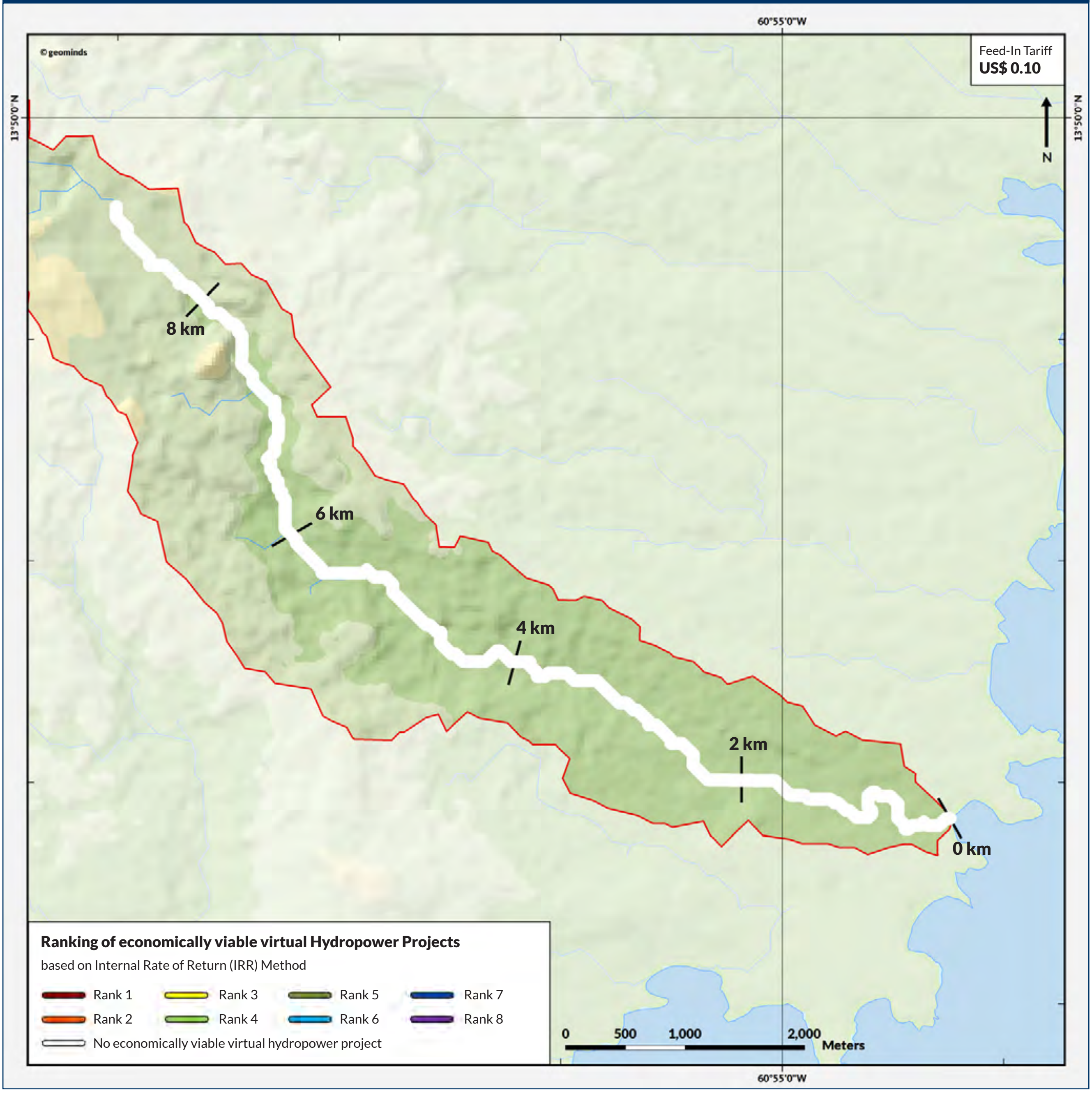


8.3 • OVERVIEW OF NORMALIZED TECHNICAL HYDROPOWER POTENTIAL



Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

8.4 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL



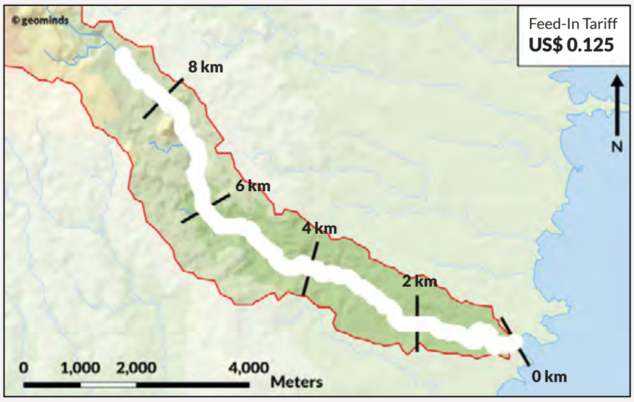
Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake	Length of Penstock	Gross Head	Daily Flows, exceeded on 110 days per year
1	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-

No economically viable virtual hydropower project was located!

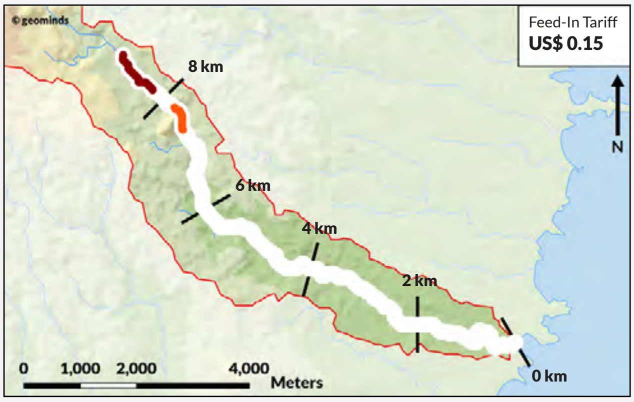
For more information and all setting parameters used for this calculation, see page 12.

8.5 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL WITH RISING FEED-IN TARIFF

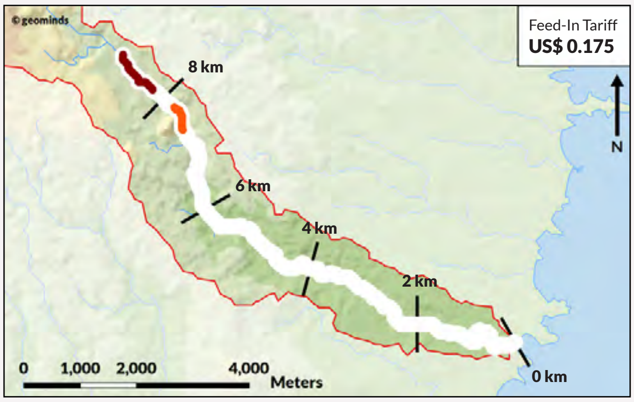


Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

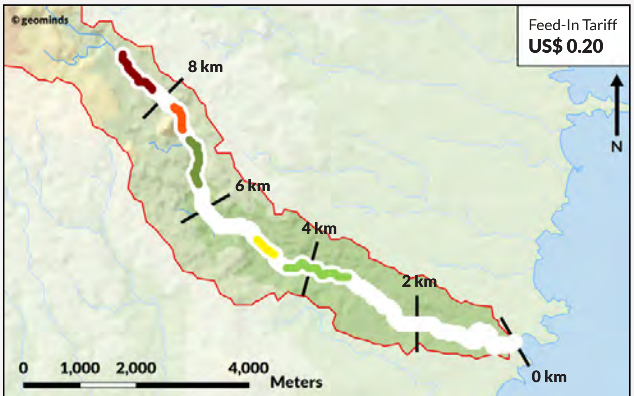
No economically viable virtual hydropower project was located!



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	2.50%	62.28 kW	8.16 km	8.88 km
2	1.13%	32.20 kW	7.38 km	7.77 km
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	4.84%	62.28 kW	8.16 km	8.88 km
2	3.49%	32.20 kW	7.38 km	7.77 km
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	6.87%	62.28 kW	8.16 km	8.88 km
2	5.52%	32.20 kW	7.38 km	7.77 km
3	1.96%	15.29 kW	4.71 km	4.95 km
4	1.29%	50.13 kW	3.30 km	4.38 km
5	0.88%	32.62 kW	6.39 km	7.17 km
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

Ranking of economically viable virtual Hydropower Projects

based on Internal Rate of Return (IRR) Method

Rank 1 Rank 3 Rank 5 Rank 7
Rank 2 Rank 4 Rank 6 Rank 8
No economically viable virtual hydropower project

Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

For more information and all setting parameters used for this calculation, see page 12.

9. GRANDE RIVIÈRE DU VIEUX FORT

9.1 • OVERVIEW MAP

Elevation

- > 900
- 750 - 900
- 600 - 750
- 450 - 600
- 300 - 450
- 150 - 300
- 0 - 150 m

Urban Area and Roads

- Major Village
- Settlements
- Major Roads
- Minor Roads and Tracks

Water Resources

- Primary Streams
- Secondary Streams
- Catchment Boundary
- Rainfall Gauging Station

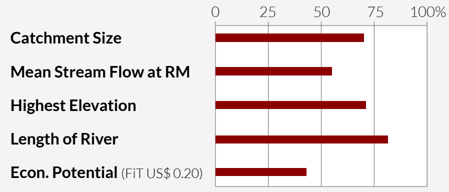
Facts about Catchment

Catchment Size:	27.92 km²
Length of Primary River:	9.39 km
Highest Elevation of Primary River:	201 m
Long-term Mean Stream Flow at River Mouth:	0.399 m³/s

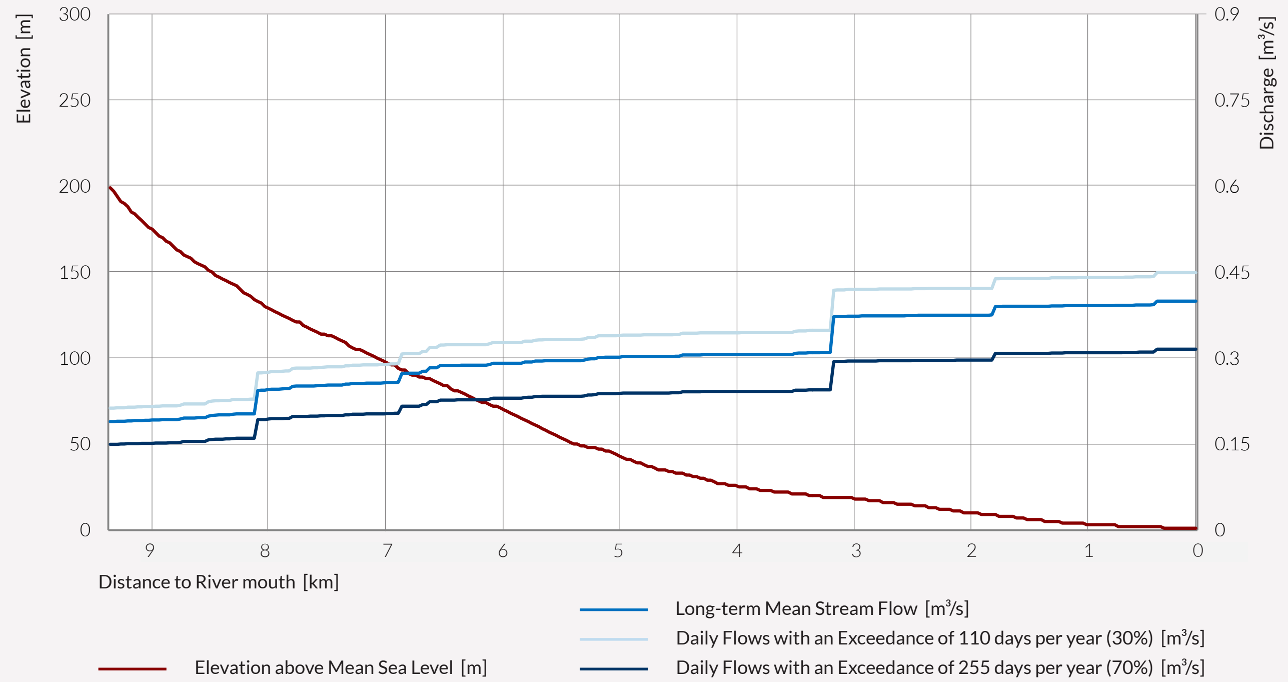
Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

The Grande Rivière du Vieux Fort has its source in the central highlands south of Mount Gimie on the southern coast of Saint Lucia. With a catchment area of 27.92 km² it collects rainwater leading to a mean annual discharge available for generating hydroelectric power in an ecologically sustainable way of 0.399 m³/s at its river mouth. The highest elevation of the primary river is about 201 m above sea level and its length is 9.39 km. However, no economically viable virtual hydropower project was located applying a feed-in tariff of less than US$ 0.125

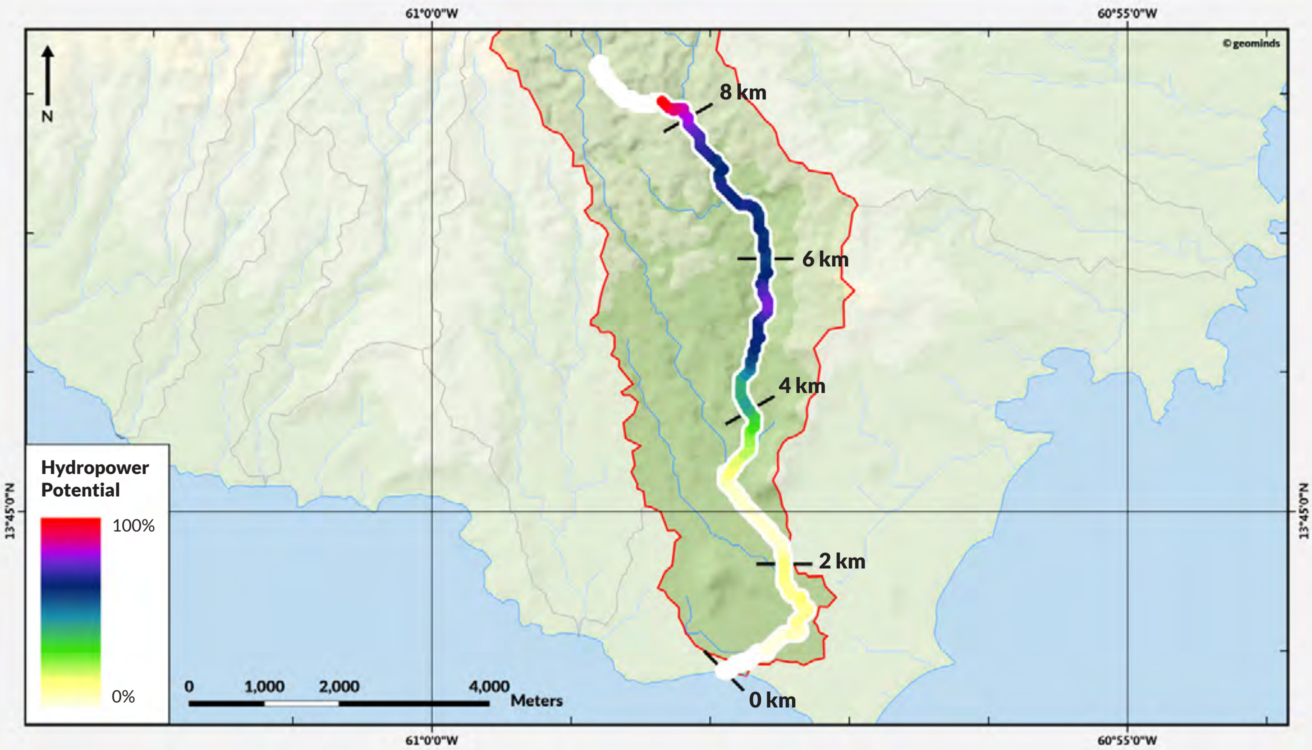
COUNTRY-WIDE RIVER RATING



9.2 • STREAM FLOW DISCHARGE ANALYSIS OF GRANDE RIVIÈRE DU VIEUX FORT



9.3 • OVERVIEW OF NORMALIZED TECHNICAL HYDROPOWER POTENTIAL



Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

9.4 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL

Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake	Length of Penstock	Gross Head	Daily Flows, exceeded on 110 days per year
1	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-

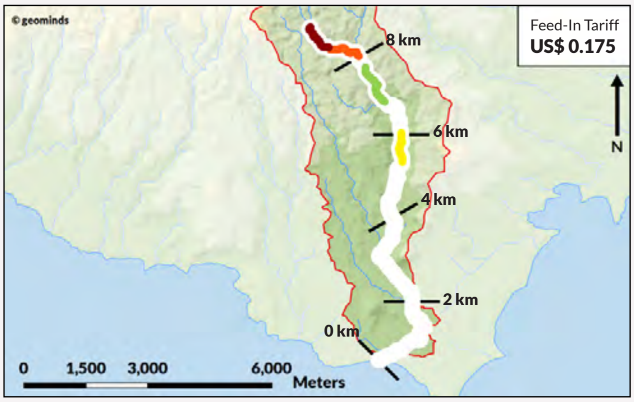
No economically viable virtual hydropower project was located!

For more information and all setting parameters used for this calculation, see page 12.

9.5 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL WITH RISING FEED-IN TARIFF

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	0.26%	58.28 kW	8.73 km	9.33 km
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	3.08%	58.28 kW	8.73 km	9.33 km
2	0.64%	48.84 kW	7.98 km	8.70 km
3	0.21%	47.88 kW	5.34 km	6.00 km
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	5.42%	58.28 kW	8.73 km	9.33 km
2	3.02%	48.84 kW	7.98 km	8.70 km
3	2.60%	47.88 kW	5.34 km	6.00 km
4	2.11%	46.63 kW	6.90 km	7.68 km
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	7.46%	58.28 kW	8.73 km	9.33 km
2	5.04%	48.84 kW	7.98 km	8.70 km
3	4.62%	47.88 kW	5.34 km	6.00 km
4	4.13%	46.63 kW	6.90 km	7.68 km
5	3.06%	29.28 kW	6.12 km	6.57 km
6	1.64%	23.60 kW	4.62 km	5.04 km
7	-	-	-	-
8	-	-	-	-

Ranking of economically viable virtual Hydropower Projects

based on Internal Rate of Return (IRR) Method

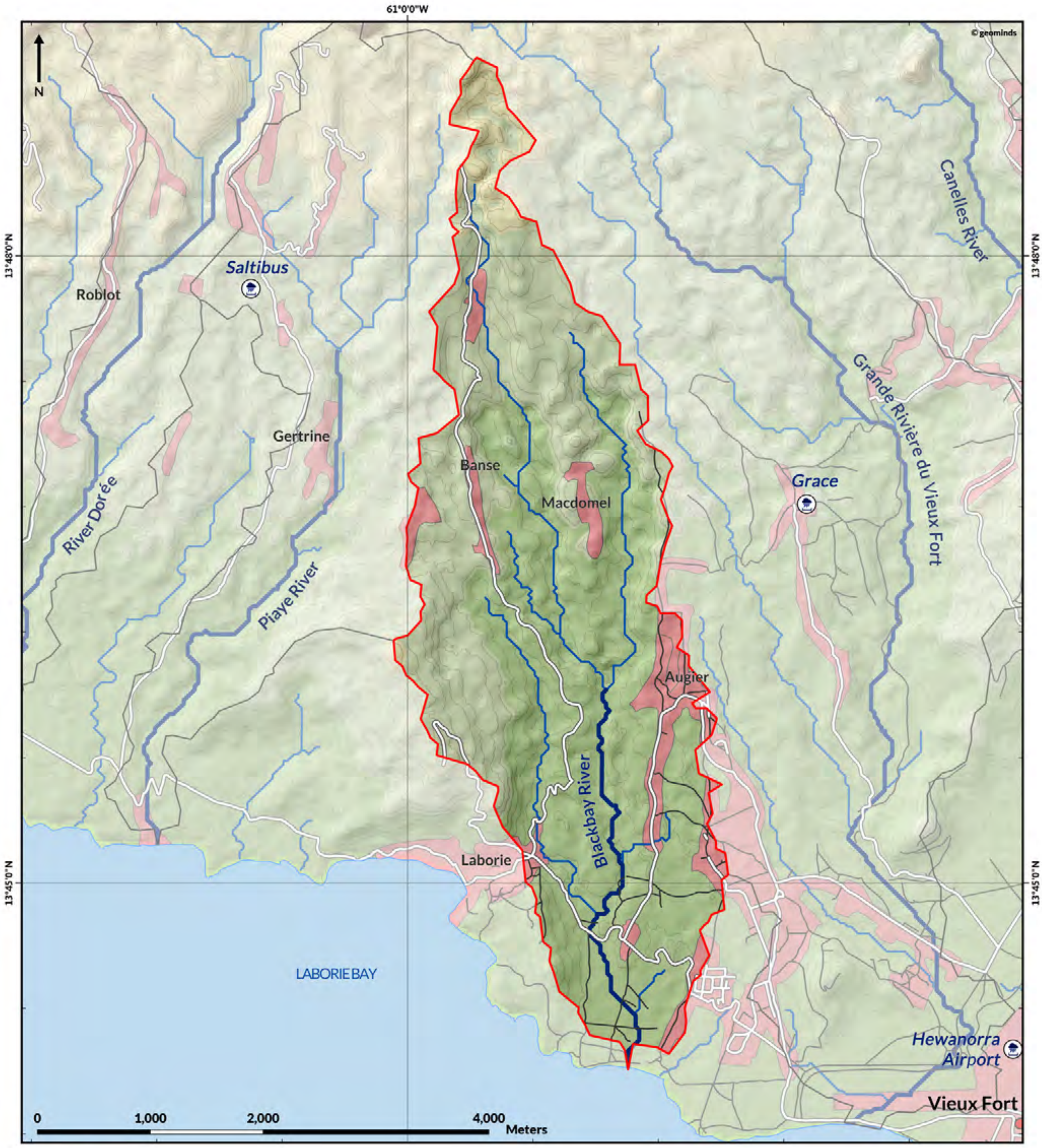
Rank 1 Rank 3 Rank 5 Rank 7
Rank 2 Rank 4 Rank 6 Rank 8
No economically viable virtual hydropower project

For more information and all setting parameters used for this calculation, see page 12.

Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

10. BLACKBAY RIVER

10.1 • OVERVIEW MAP



Elevation

- > 900
- 750 - 900
- 600 - 750
- 450 - 600
- 300 - 450
- 150 - 300
- 0 - 150 m

Urban Area and Roads

- Major Village
- Settlements
- Major Roads
- Minor Roads and Tracks

Water Resources

- Primary Streams
- Secondary Streams
- Catchment Boundary
- Rainfall Gauging Station

Facts about Catchment

Catchment Size: . . . . 13.35 km²

Length of Primary River: . . . . 3.44 km

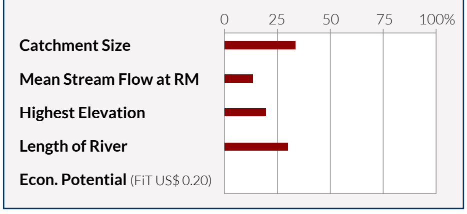
Highest Elevation of Primary River: . . . . . 55 m

Long-term Mean Stream Flow at River Mouth: . . . . 0.097 m³/s

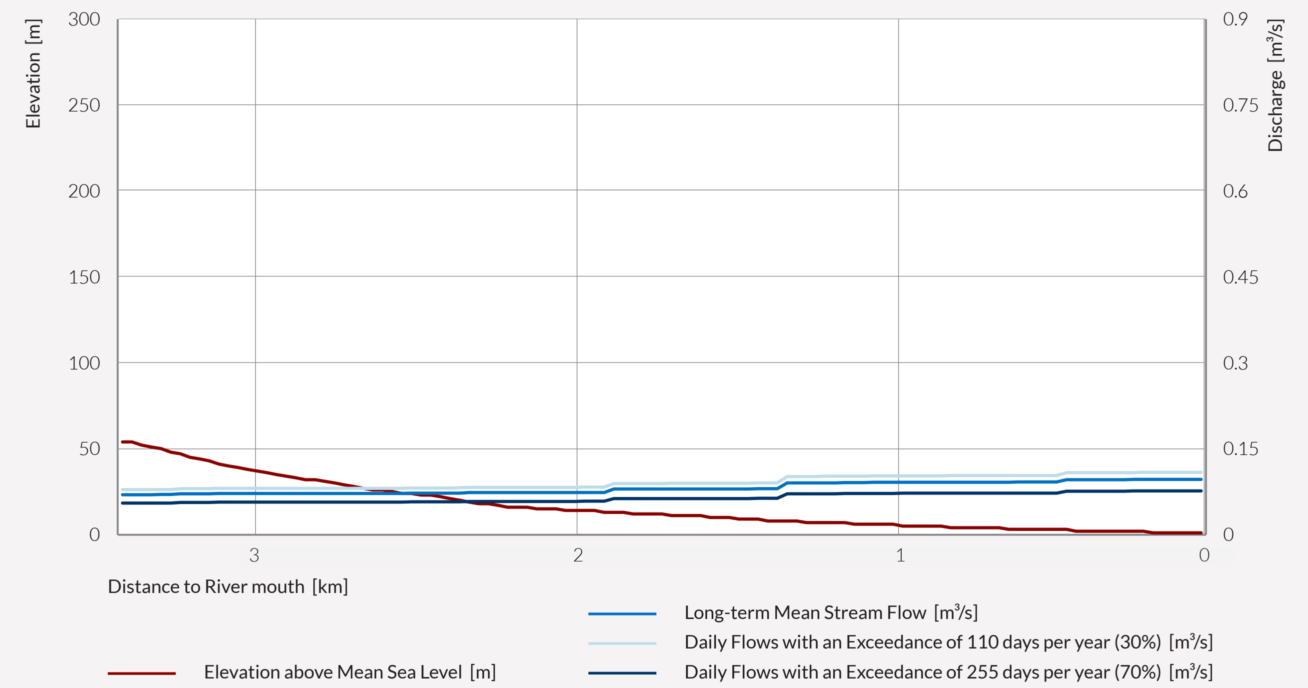
Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

The Blackbay River's catchment (13.35 km²) is located in the dryer southern part of Saint Lucia collecting little runoff water to reach a mean annual discharge available for generating hydropower of as little as 0.097 m³/s. The highest elevation of the river is about 55 m and its length not exceeding 3.4 km. No economically viable virtual hydropower project was located according to the parameters and assumptions applied.

COUNTRY-WIDE RIVER RATING

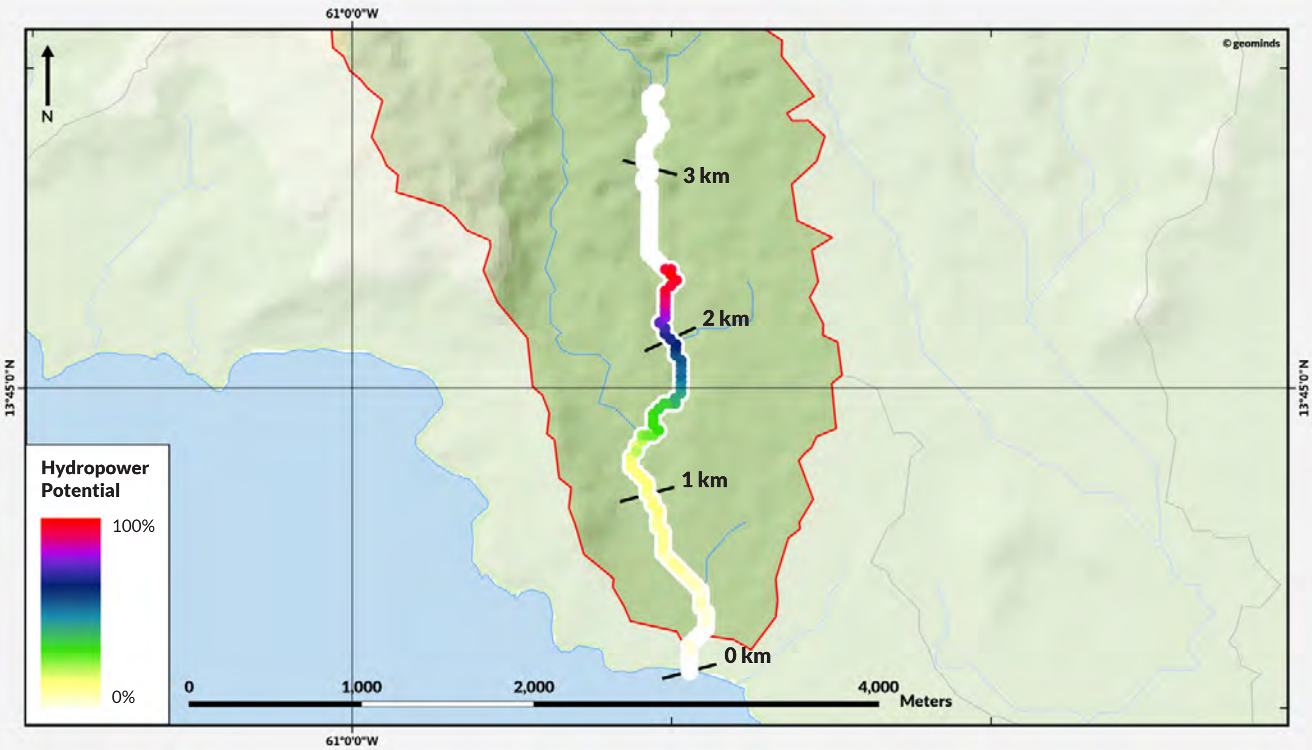


10.2 • STREAM FLOW DISCHARGE ANALYSIS OF BLACKBAY RIVER



10.3 • OVERVIEW OF NORMALIZED TECHNICAL HYDROPOWER POTENTIAL

Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.



10.4 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL

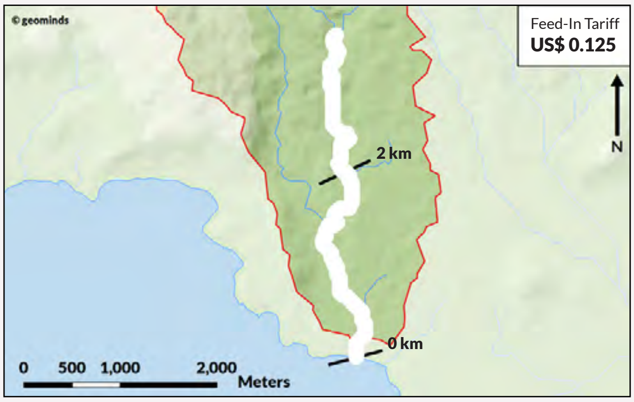
Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake	Length of Penstock	Gross Head	Daily Flows, exceeded on 110 days per year
1	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-

No economically viable virtual hydropower project was located!

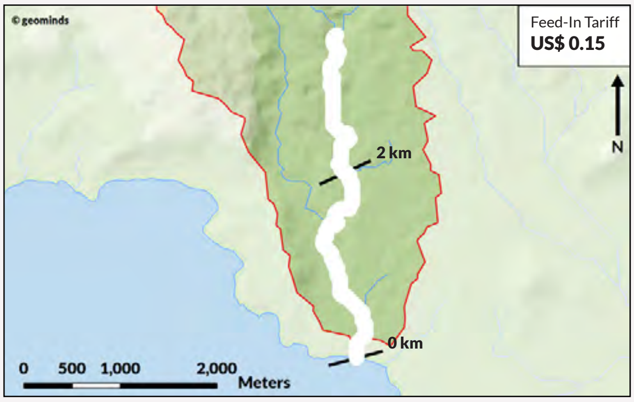
For more information and all setting parameters used for this calculation, see page 12.

10.5 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL WITH RISING FEED-IN TARIFF



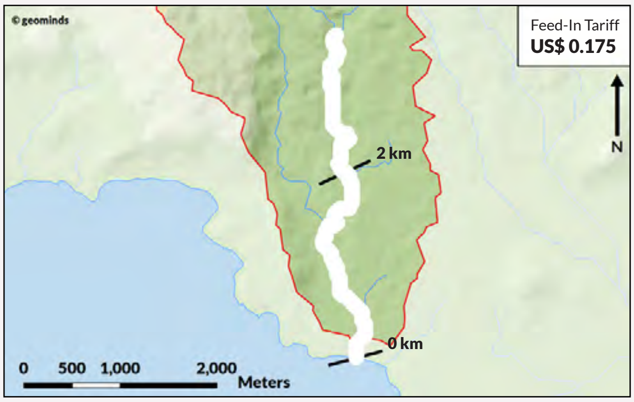
Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!



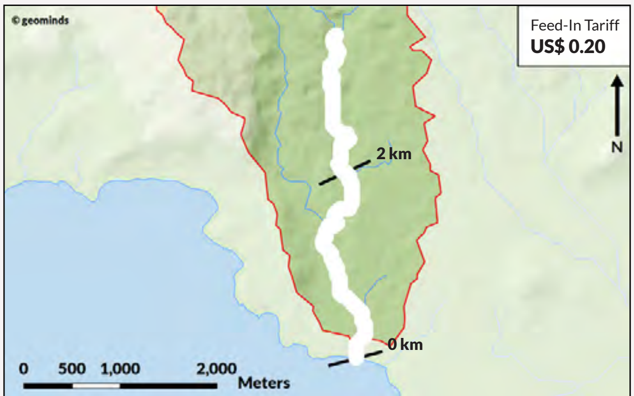
Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!

Ranking of economically viable virtual Hydropower Projects

based on Internal Rate of Return (IRR) Method

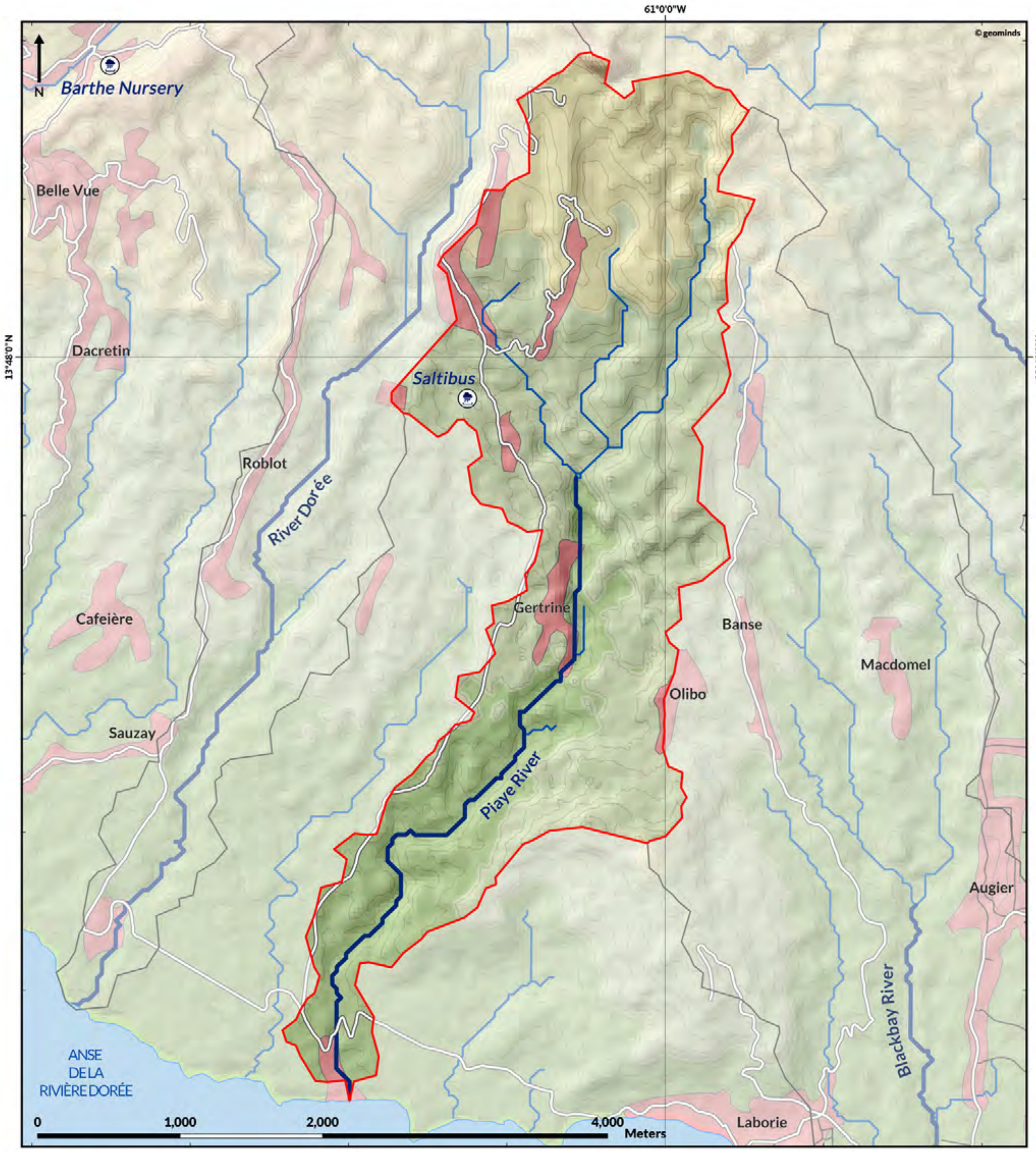
Rank 1 Rank 3 Rank 5 Rank 7
Rank 2 Rank 4 Rank 6 Rank 8
No economically viable virtual hydropower project

For more information and all setting parameters used for this calculation, see page 12.

Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

11. PIAYE RIVER

11.1 • OVERVIEW MAP



Elevation

- > 900
- 750 - 900
- 600 - 750
- 450 - 600
- 300 - 450
- 150 - 300
- 0 - 150 m

Urban Area and Roads

- Major Village
- Settlements
- Major Roads
- Minor Roads and Tracks

Water Resources

- Primary Streams
- Secondary Streams
- Catchment Boundary
- Rainfall Gauging Station

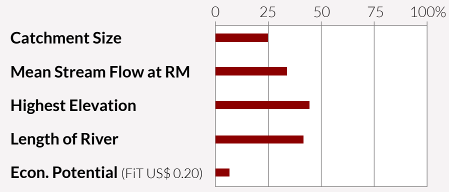
Facts about Catchment

Catchment Size:	9.87 km²
Length of Primary River:	4.77 km
Highest Elevation of Primary River:	125 m
Long-term Mean Stream Flow at River Mouth:	0.140 m³/s

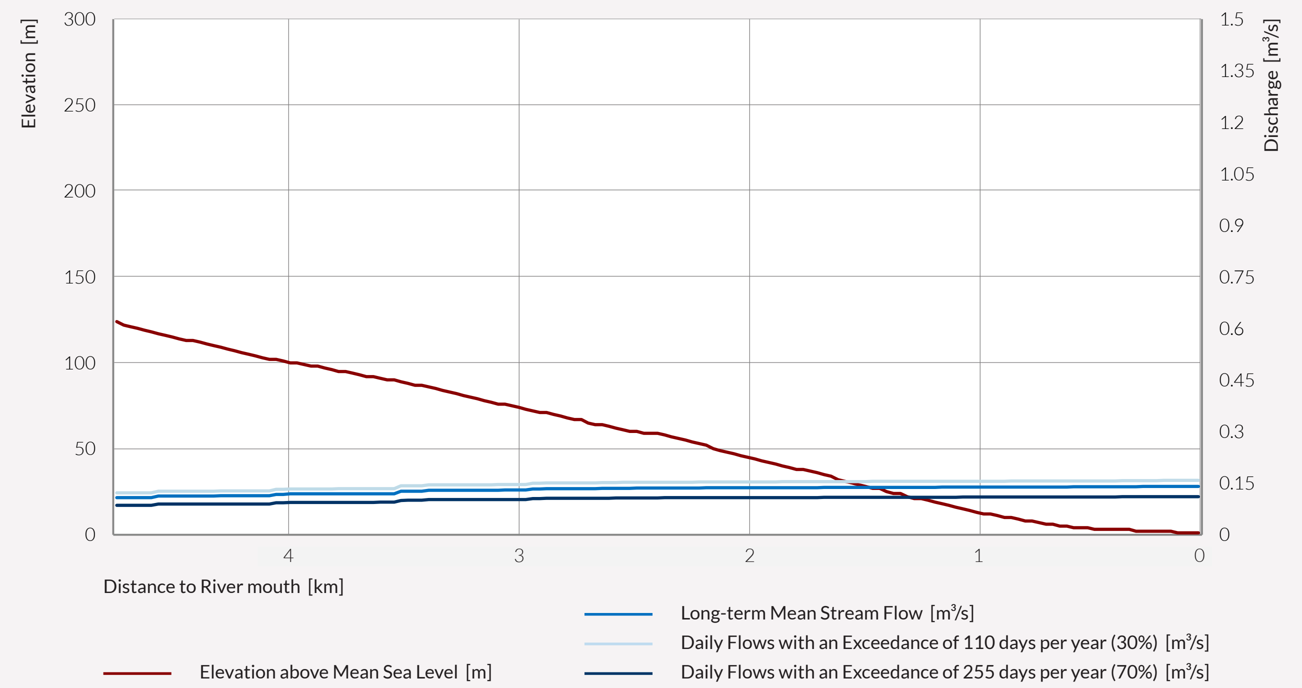
Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

The catchment of the Piaye River is located on the southern coast of Saint Lucia and covers an area of 9.87 km². The 4.77 km long primary stream has its source south of Mount Grand Magazin with a maximum difference in height of 125 m resulting in a relatively steep gradient. Despite this, only one economically viable virtual hydropower project was located at the Piaye River applying a feed-in tariff of US$ 0.20 due to the small amount of mean annual discharge (0.140 m³/s at its river mouth).

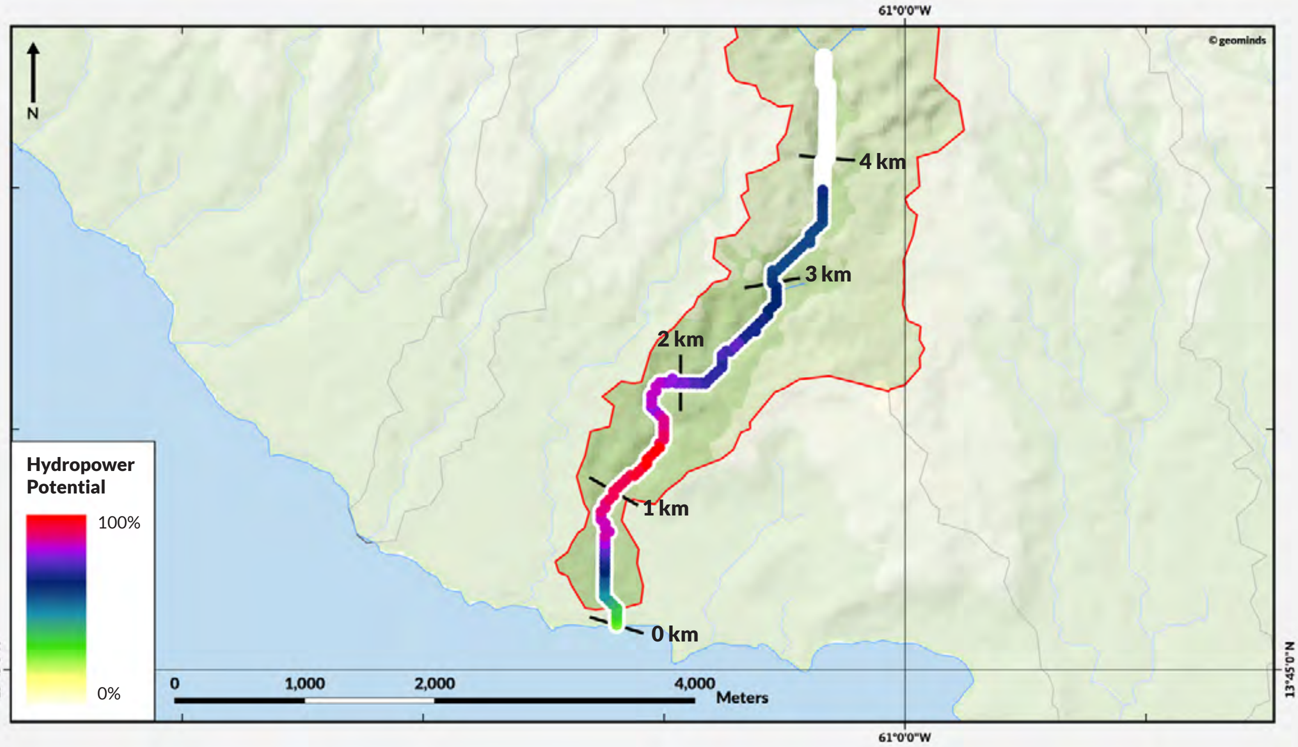
COUNTRY-WIDE RIVER RATING



11.2 • STREAM FLOW DISCHARGE ANALYSIS OF PIAYE RIVER



11.3 • OVERVIEW OF NORMALIZED TECHNICAL HYDROPOWER POTENTIAL



Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

11.4 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL

Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake	Length of Penstock	Gross Head	Daily Flows, exceeded on 110 days per year
1	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-
5	-	-			-	-	-
6	-			-	-	-	-
7	-		-	-	-	-	-
8	-	-	-	-	-	-	-

No economically viable virtual hydropower project was located!

For more information and all setting parameters used for this calculation, see page 12.

11.5 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL WITH RISING FEED-IN TARIFF

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	0.59%	38.74 kW	1.26 km	2.37 km
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

Ranking of economically viable virtual Hydropower Projects

based on Internal Rate of Return (IRR) Method

Rank 1, Rank 2, Rank 3, Rank 4, Rank 5, Rank 6, Rank 7, Rank 8

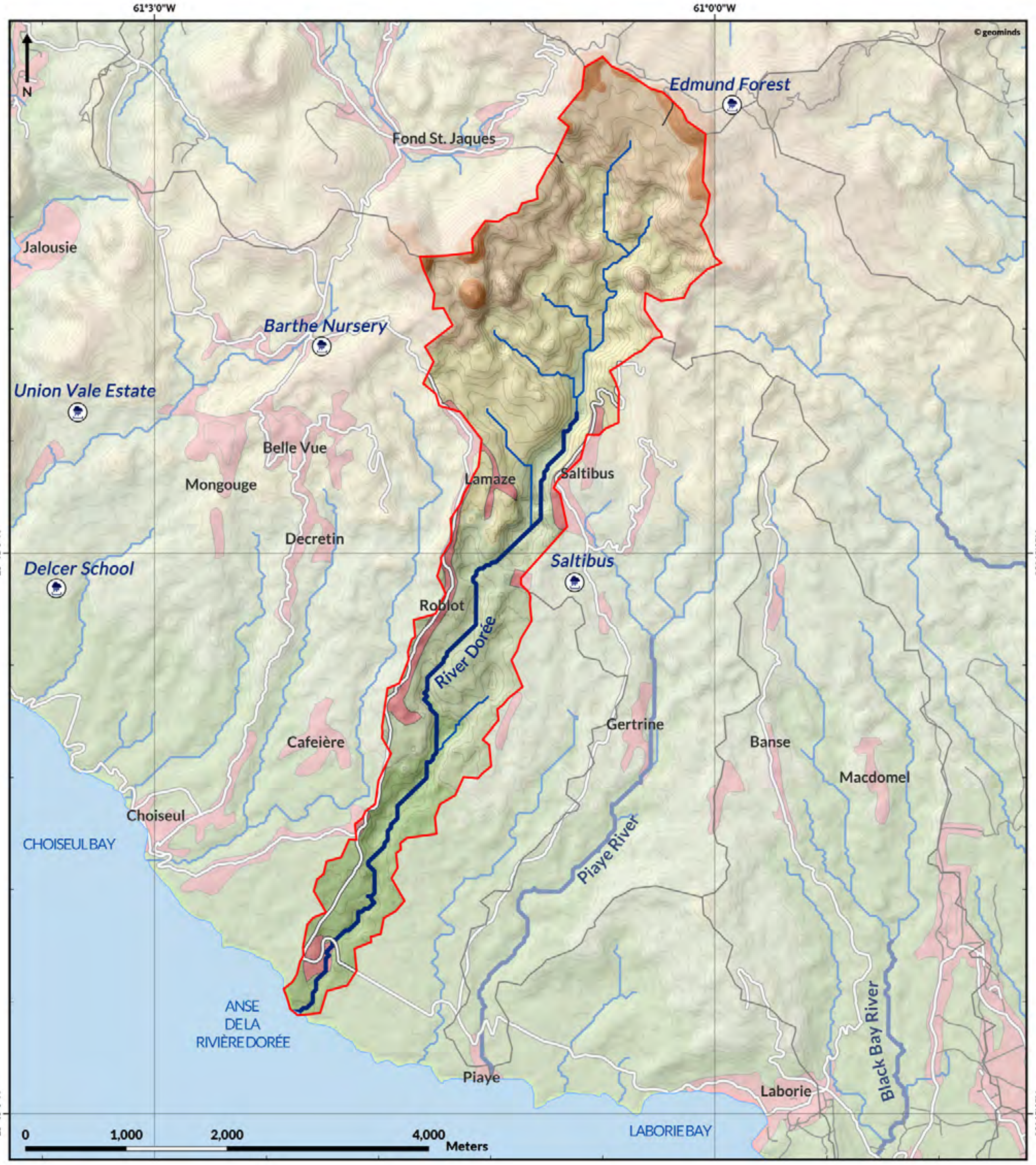
No economically viable virtual hydropower project

For more information and all setting parameters used for this calculation, see page 12.

Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

12. DORÉE RIVER

12.1 • OVERVIEW MAP



Elevation

- > 900
- 750 - 900
- 600 - 750
- 450 - 600
- 300 - 450
- 150 - 300
- 0 - 150 m

Urban Area and Roads

- Major Village
- Settlements
- Major Roads
- Minor Roads and Tracks

Water Resources

- Primary Streams
- Secondary Streams
- Catchment Boundary
- Rainfall Gauging Station

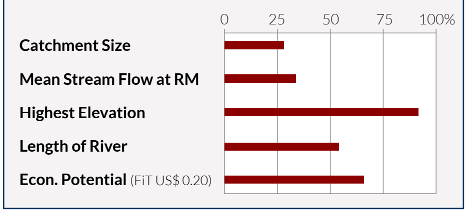
Facts about Catchment

Catchment Size:	11.16 km²
Length of Primary River:	6.22 km
Highest Elevation of Primary River:	259 m
Long-term Mean Stream Flow at River Mouth:	0.245 m³/s

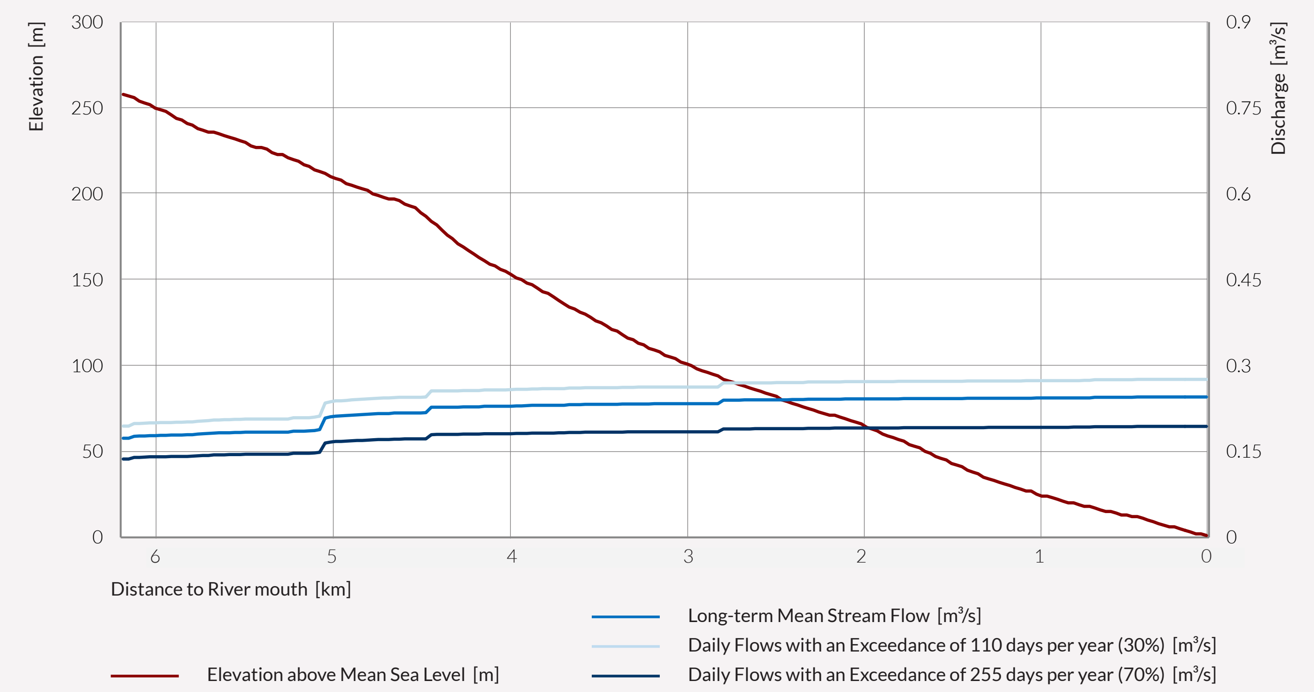
Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

As the Dorée River is located in the mountainous southwest of Saint Lucia it has one of the highest elevations differences of all analyzed rivers (259 m). Having a catchment area of 11.16 km² including the region around Morne Bonin and Mount Grand Magazin, the Dorée River accumulates enough water to reach a mean annual discharge usable for hydropower of 0.245 m³/s at its river mouth. Despite the high elevation of the 6.22 km long primary river, no economically viable virtual hydropower project was located applying a feed-in tariff of less than US$ 0.125.

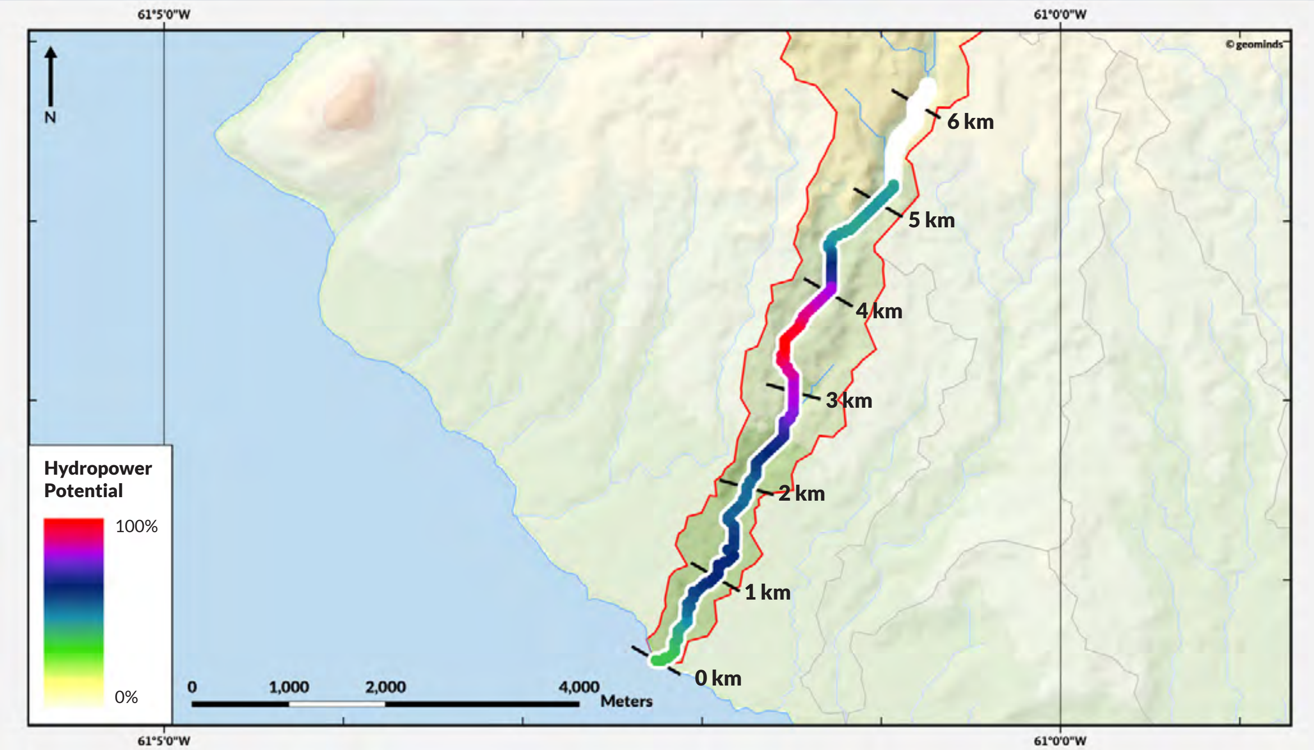
COUNTRY-WIDE RIVER RATING



12.2 • STREAM FLOW DISCHARGE ANALYSIS OF DORÉE RIVER



12.3 • OVERVIEW OF NORMALIZED TECHNICAL HYDROPOWER POTENTIAL



Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

12.4 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL

Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake	Length of Penstock	Gross Head	Daily Flows, exceeded on 110 days per year
1	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-

No economically viable virtual hydropower project was located!

For more information and all setting parameters used for this calculation, see page 12.

12.5 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL WITH RISING FEED-IN TARIFF

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	2.10%	59.12 kW	4.08 km	4.50 km
2	0.96%	82.59 kW	3.18 km	3.99 km
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	4.87%	59.12 kW	4.08 km	4.50 km
2	3.75%	82.59 kW	3.18 km	3.99 km
3	2.31%	58.63 kW	1.29 km	1.98 km
4	1.17%	57.37 kW	2.31 km	3.12 km
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	7.22%	59.12 kW	4.08 km	4.50 km
2	6.09%	82.59 kW	3.18 km	3.99 km
3	4.65%	58.63 kW	1.29 km	1.98 km
4	3.53%	57.37 kW	2.31 km	3.12 km
5	2.24%	76.67 kW	4.74 km	6.09 km
6	0.57%	55.88 kW	0.09 km	1.26 km
7	-	-	-	-
8	-	-	-	-

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	9.32%	59.12 kW	4.08 km	4.50 km
2	8.16%	82.59 kW	3.18 km	3.99 km
3	6.68%	58.63 kW	1.29 km	1.98 km
4	5.55%	57.37 kW	2.31 km	3.12 km
5	4.26%	76.67 kW	4.74 km	6.09 km
6	2.63%	55.88 kW	0.09 km	1.26 km
7	-	-	-	-
8	-	-	-	-

Ranking of economically viable virtual Hydropower Projects

based on Internal Rate of Return (IRR) Method

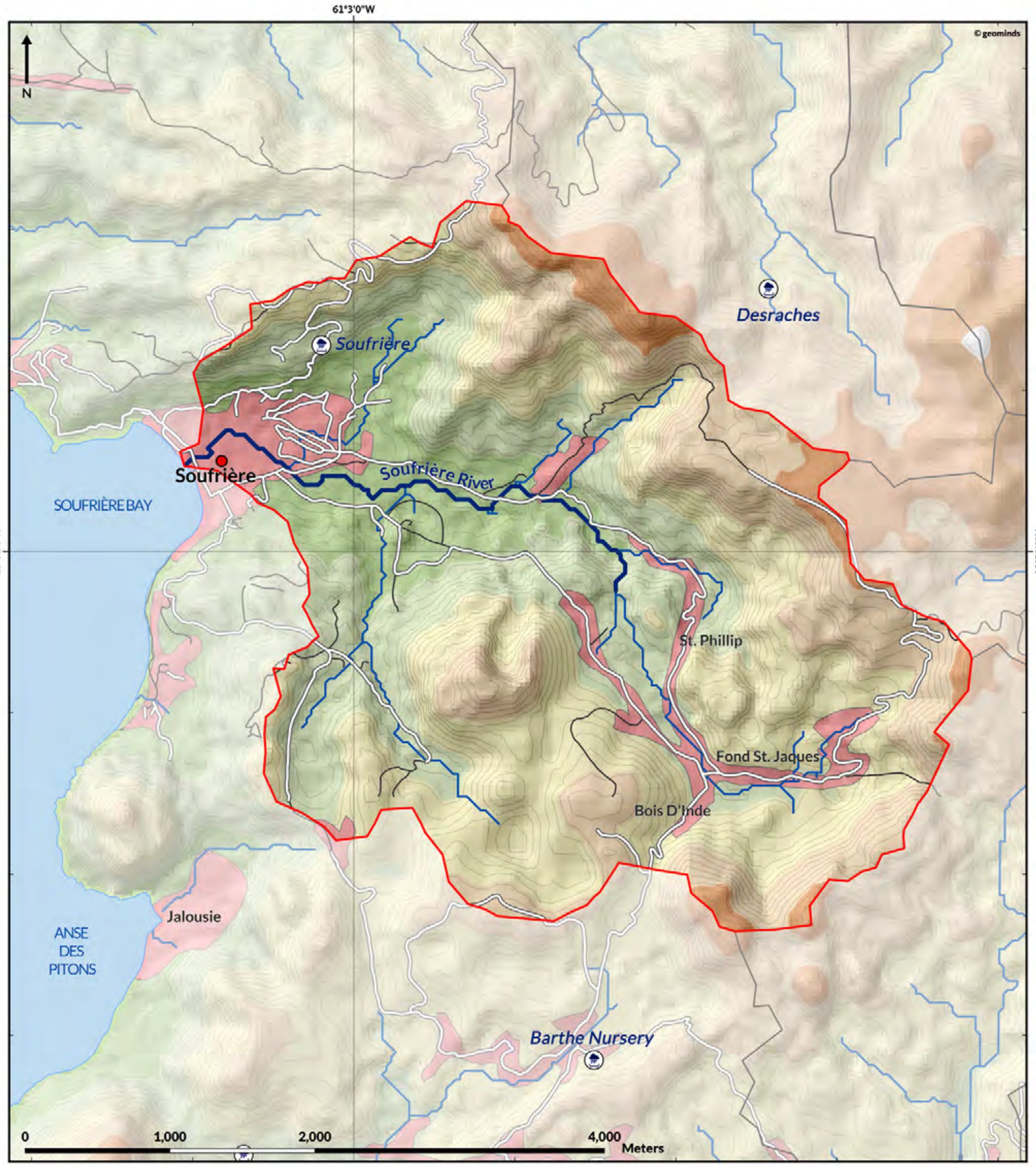
Rank 1 Rank 3 Rank 5 Rank 7
Rank 2 Rank 4 Rank 6 Rank 8
No economically viable virtual hydropower project

For more information and all setting parameters used for this calculation, see page 12.

Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

13. SOUFRIÈRE RIVER

13.1 • OVERVIEW MAP



Elevation

- > 900
- 750 - 900
- 600 - 750
- 450 - 600
- 300 - 450
- 150 - 300
- 0 - 150 m

Urban Area and Roads

- Major Village
- Settlements
- Major Roads
- Minor Roads and Tracks

Water Resources

- Primary Streams
- Secondary Streams
- Catchment Boundary
- Rainfall Gauging Station

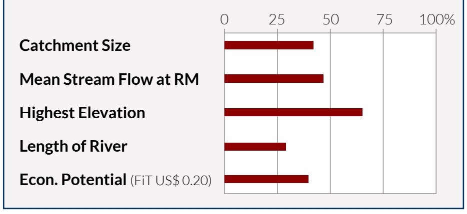
Facts about Catchment

Catchment Size:	16.76 km²
Length of Primary River:	3.35 km
Highest Elevation of Primary River:	184 m
Long-term Mean Stream Flow at River Mouth:	0.339 m³/s

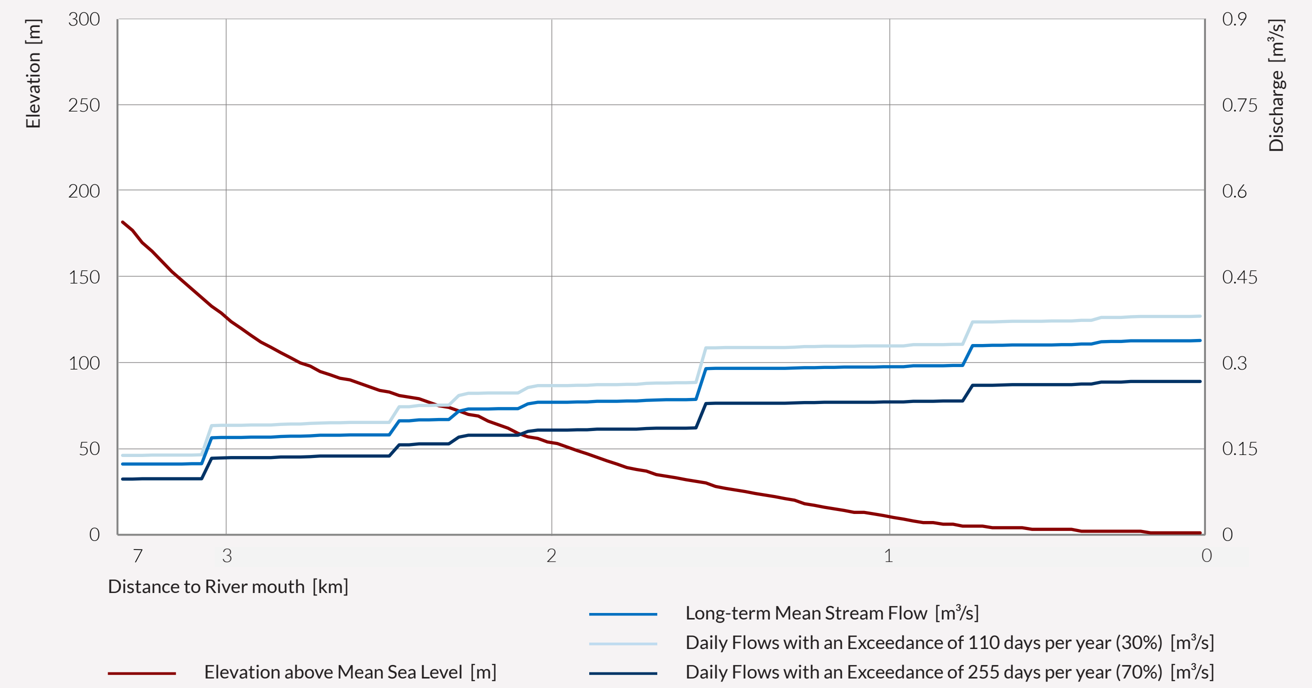
Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

The Soufrière River is located on the west coast with its source in the central highlands west of Mount Gimie flowing into the Caribbean Sea at the town of Soufrière. Having a catchment size of about 16.76 km² the primary river is just 3.35 km long. As the headwaters are located in the wettest part of the island, the mean annual discharge usable for hydropower generation in an eco-friendly way is reaching 0.339 m³/s at its river mouth. As the primary river has an elevation drop of about 184 m, it is the one with the steepest gradient of all analyzed rivers. However, considering a feed-in tariff of less than US$ 0.125, no economically viable hydropower project was located.

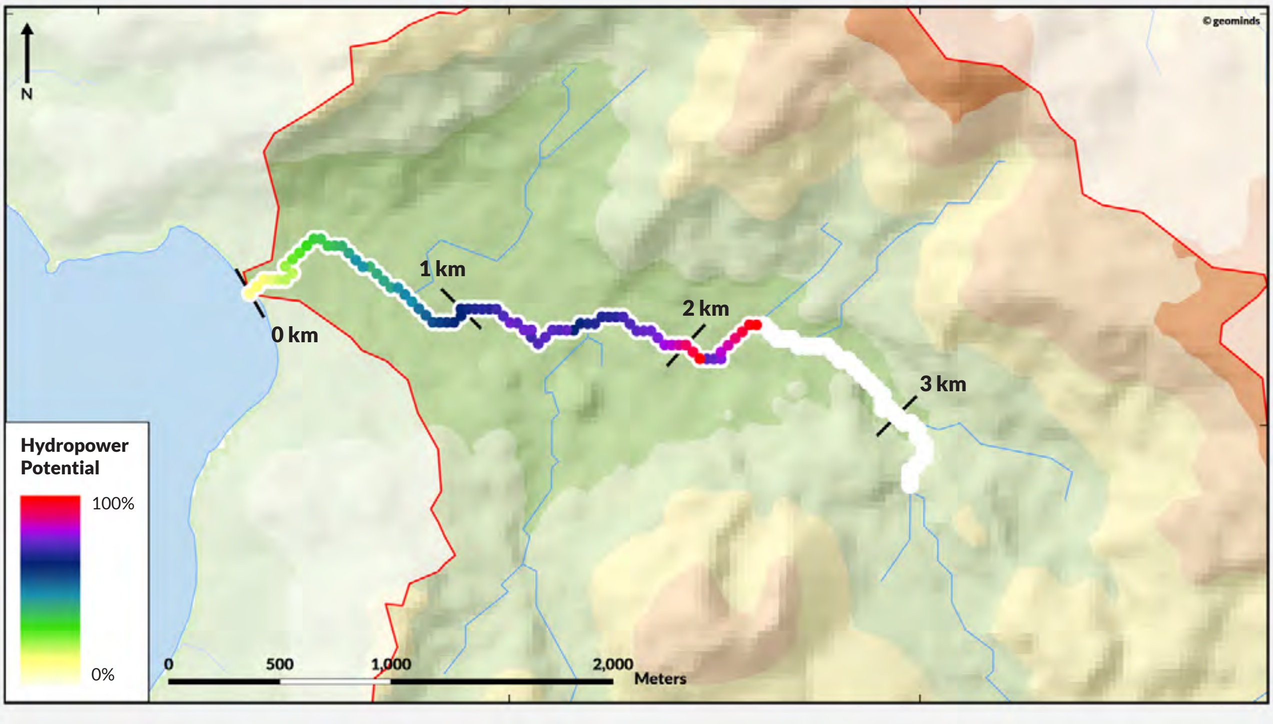
COUNTRY-WIDE RIVER RATING



13.2 • STREAM FLOW DISCHARGE ANALYSIS OF SOUFRIÈRE RIVER

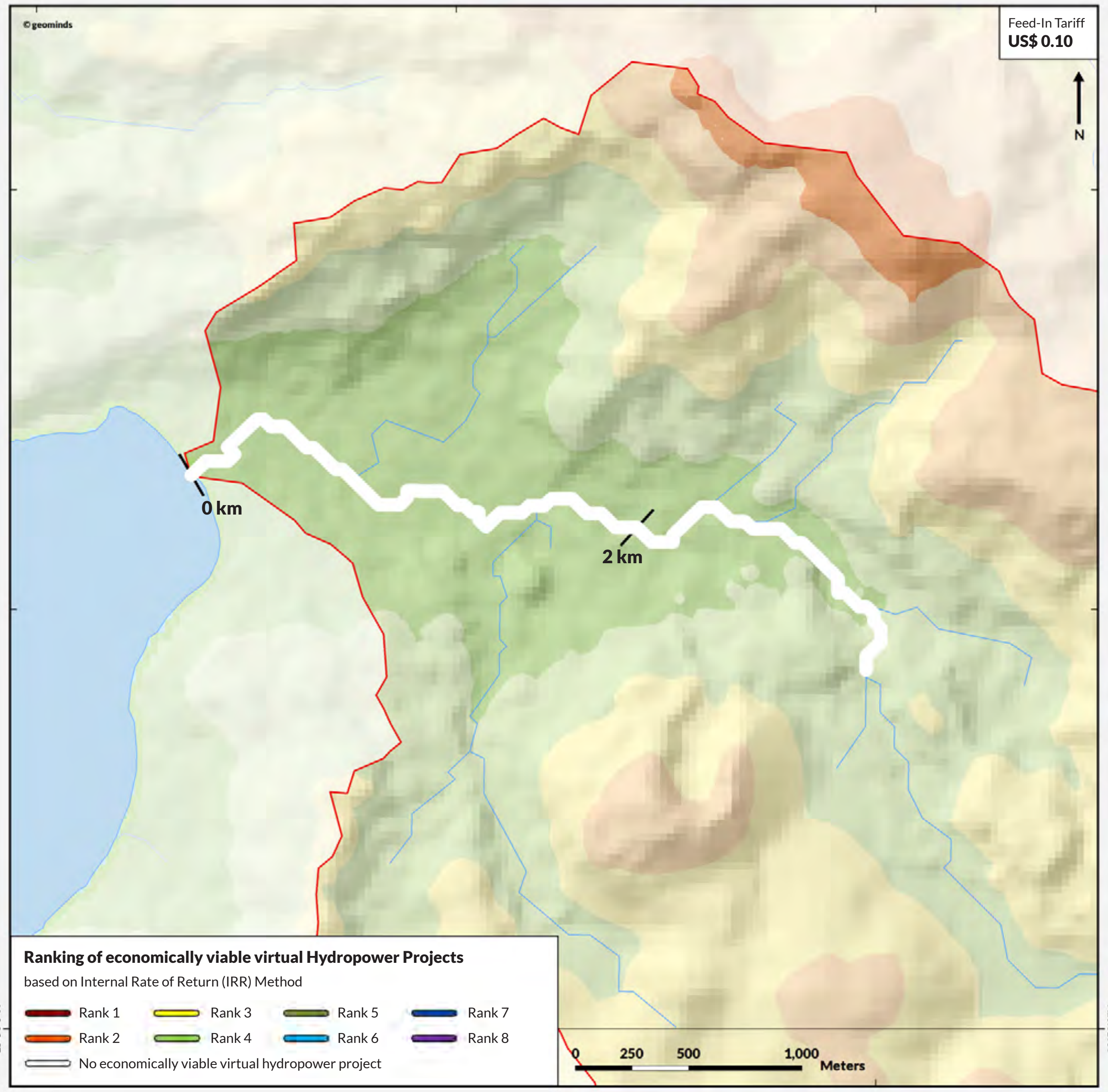


13.3 • OVERVIEW OF NORMALIZED TECHNICAL HYDROPOWER POTENTIAL



Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

13.4 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL



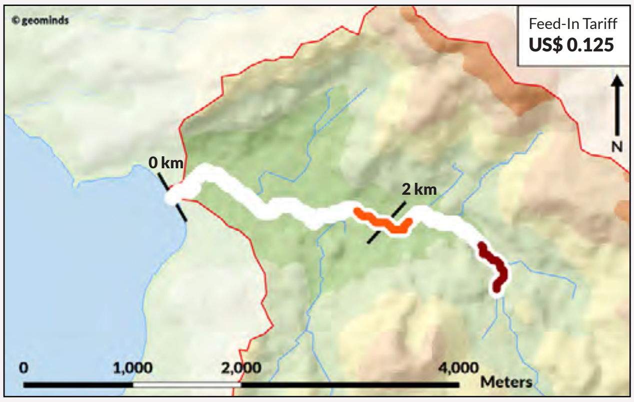
Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake	Length of Penstock	Gross Head	Daily Flows, exceeded on 110 days per year
1	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-

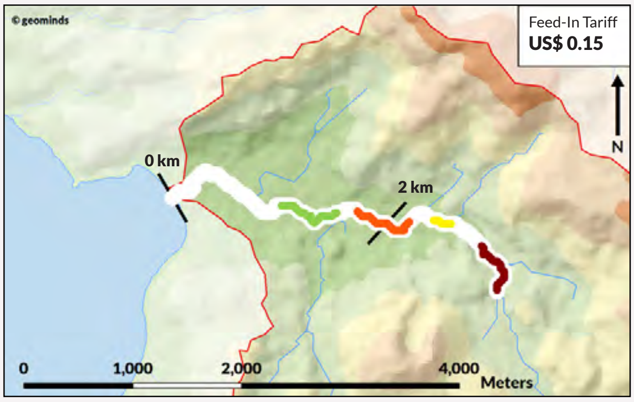
No economically viable virtual hydropower project was located!

For more information and all setting parameters used for this calculation, see page 12.

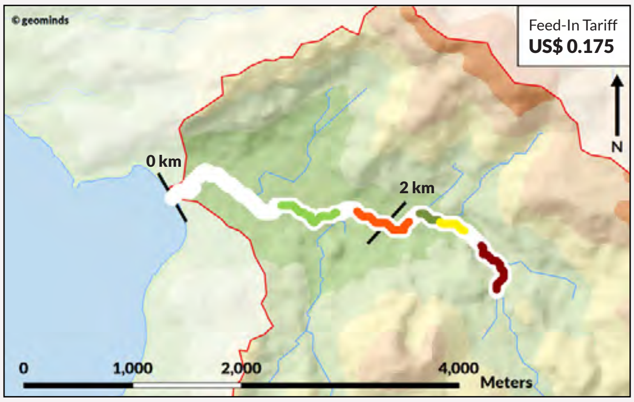
13.5 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL WITH RISING FEED-IN TARIFF



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	3.26%	73.56 kW	2.88 km	3.30 km
2	1.21%	53.65 kW	1.77 km	2.22 km
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	6.02%	73.56 kW	2.88 km	3.30 km
2	4.00%	53.65 kW	1.77 km	2.22 km
3	2.61%	39.27 kW	2.46 km	2.85 km
4	0.84%	39.83 kW	1.08 km	1.56 km
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	8.41%	73.56 kW	2.88 km	3.30 km
2	6.34%	53.65 kW	1.77 km	2.22 km
3	4.97%	35.20 kW	2.52 km	2.85 km
4	3.21%	39.83 kW	1.08 km	1.56 km
5	2.55%	20.62 kW	2.25 km	2.49 km
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	10.56%	73.56 kW	2.88 km	3.30 km
2	8.41%	53.65 kW	1.77 km	2.22 km
3	6.98%	39.27 kW	2.46 km	2.85 km
4	5.23%	39.83 kW	1.08 km	1.56 km
5	3.95%	14.56 kW	2.25 km	2.40 km
6	1.49%	13.14 kW	0.87 km	1.05 km
7	-	-	-	-
8	-	-	-	-

Ranking of economically viable virtual Hydropower Projects

based on Internal Rate of Return (IRR) Method

Rank 1 Rank 3 Rank 5 Rank 7
Rank 2 Rank 4 Rank 6 Rank 8
No economically viable virtual hydropower project

For more information and all setting parameters used for this calculation, see page 12.

Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

14. CANARIES RIVER

14.1 • OVERVIEW MAP

Elevation

- > 900
- 750 - 900
- 600 - 750
- 450 - 600
- 300 - 450
- 150 - 300
- 0 - 150 m

Urban Area and Roads

- Major Village
- Settlements
- Major Roads
- Minor Roads and Tracks

Water Resources

- Primary Streams
- Secondary Streams
- Catchment Boundary
- Rainfall Gauging Station

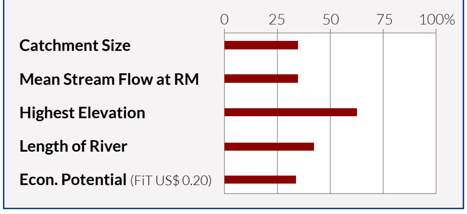
Facts about Catchment

Catchment Size:	13.80 km²
Length of Primary River:	4.86 km
Highest Elevation of Primary River:	177 m
Long-term Mean Stream Flow at River Mouth:	0.252 m³/s

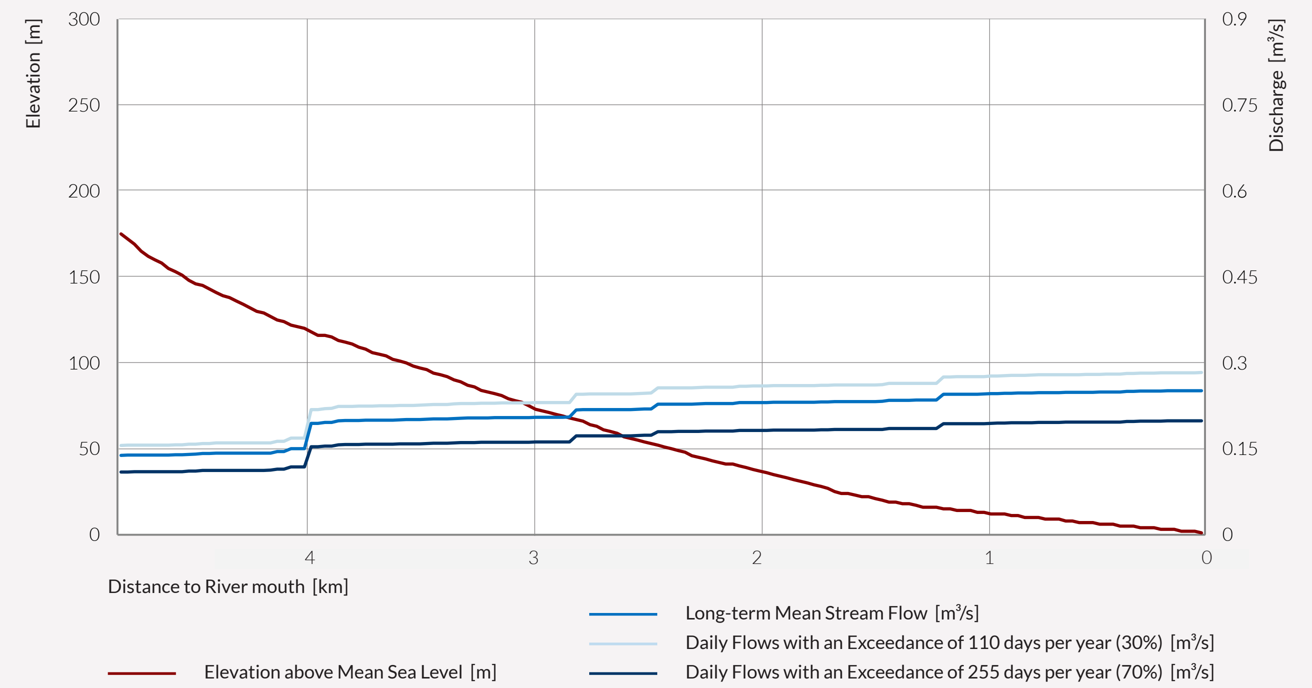
Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

With a catchment size of 13.8 km² the Canaries River makes its way through steep valleys in the mountainous region near Mount Gimie and Mount Tabac on the west coast of Saint Lucia. As the head waters are located in the central highlands, the Canaries River accumulates a mean annual discharge of about 0.252 m³/s at the town of Canaries flowing into the sea. The elevation maximum of the 4.85 km long primary river is about 177 m above sea level. Despite the steep valleys in the mid- and upper section of the river, no economically viable virtual hydropower project was located applying a feed-in tariff of less than US$ 0.15.

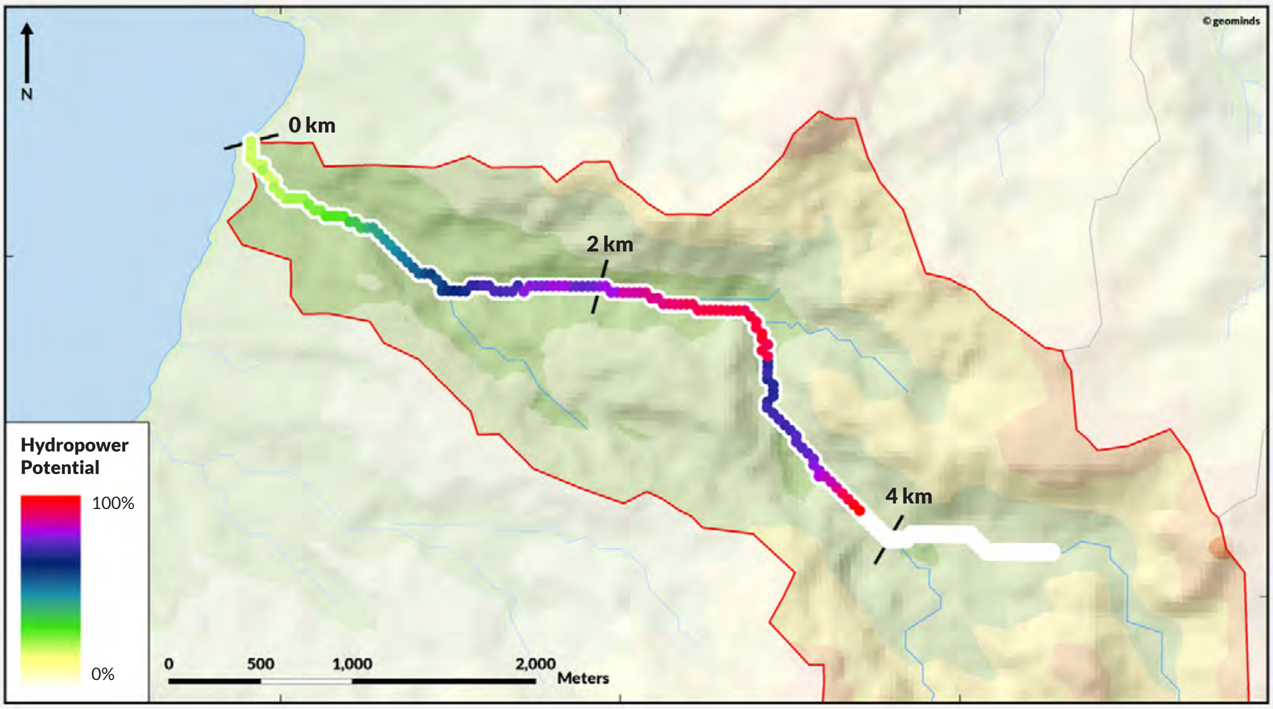
COUNTRY-WIDE RIVER RATING



14.2 • STREAM FLOW DISCHARGE ANALYSIS OF CANARIES RIVER

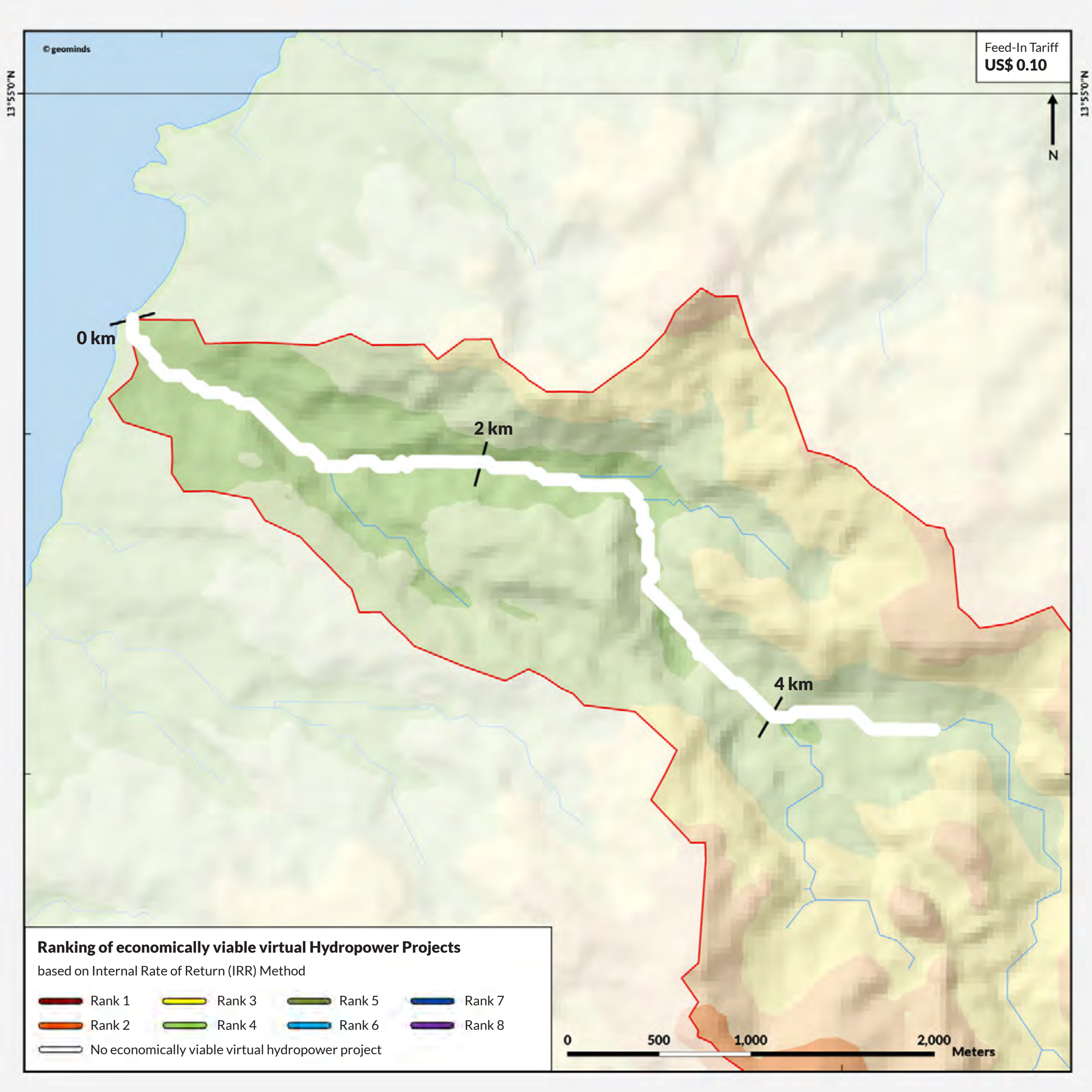


14.3 • OVERVIEW OF NORMALIZED TECHNICAL HYDROPOWER POTENTIAL



Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

14.4 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL



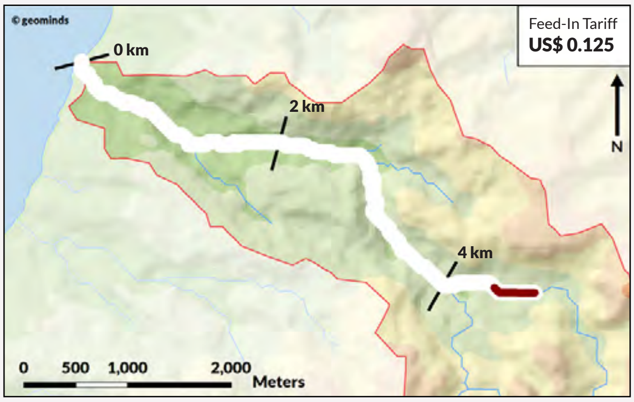
Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake	Length of Penstock	Gross Head	Daily Flows, exceeded on 110 days per year
1	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-

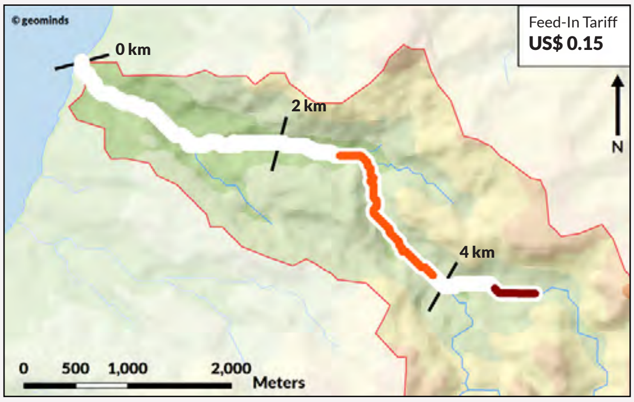
No economically viable virtual hydropower project was located!

For more information and all setting parameters used for this calculation, see page 12.

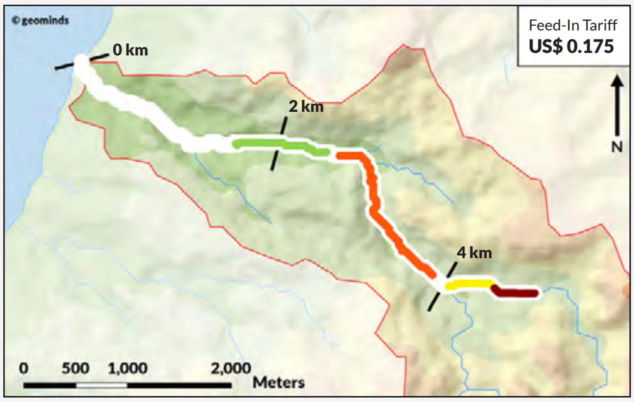
14.5 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL WITH RISING FEED-IN TARIFF



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	0.05%	35.61 kW	4.47 km	4.83 km
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	2.88%	35.61 kW	4.47 km	4.83 km
2	1.53%	90.18 kW	2.58 km	3.87 km
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	5.22%	35.61 kW	4.47 km	4.83 km
2	3.88%	90.18 kW	2.58 km	3.87 km
3	2.52%	26.23 kW	4.05 km	4.44 km
4	2.09%	47.98 kW	1.62 km	2.43 km
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	7.26%	35.61 kW	4.47 km	4.83 km
2	5.90%	90.18 kW	2.58 km	3.87 km
3	4.54%	26.23 kW	4.05 km	4.44 km
4	4.12%	47.98 kW	1.62 km	2.43 km
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

Ranking of economically viable virtual Hydropower Projects

based on Internal Rate of Return (IRR) Method

Rank 1 · Rank 2 · Rank 3 · Rank 4 · Rank 5 · Rank 6 · Rank 7 · Rank 8

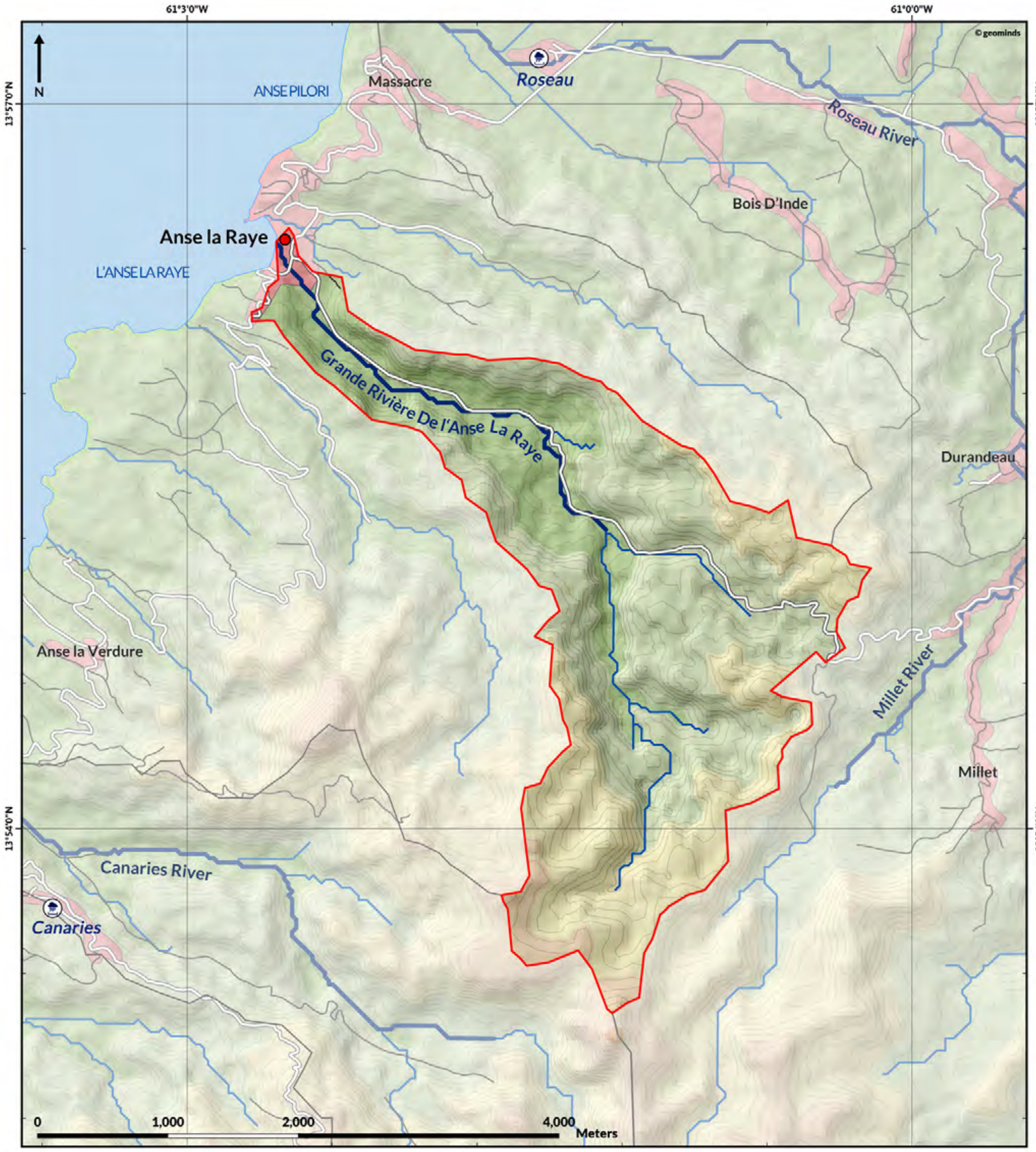
No economically viable virtual hydropower project

For more information and all setting parameters used for this calculation, see page 12.

Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

15. GRANDE RIVIÈRE DE L'ANSE LA RAYE

15.1 • OVERVIEW MAP



Elevation

- > 900
- 750 - 900
- 600 - 750
- 450 - 600
- 300 - 450
- 150 - 300
- 0 - 150 m

Urban Area and Roads

- Major Village
- Settlements
- Major Roads
- Minor Roads and Tracks

Water Resources

- Primary Streams
- Secondary Streams
- Catchment Boundary
- Rainfall Gauging Station

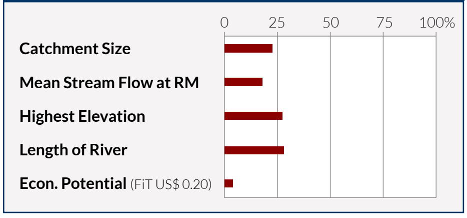
Facts about Catchment

Catchment Size:	9.01 km²
Length of Primary River:	3.23 km
Highest Elevation of Primary River:	77 m
Long-term Mean Stream Flow at River Mouth:	0.129 m³/s

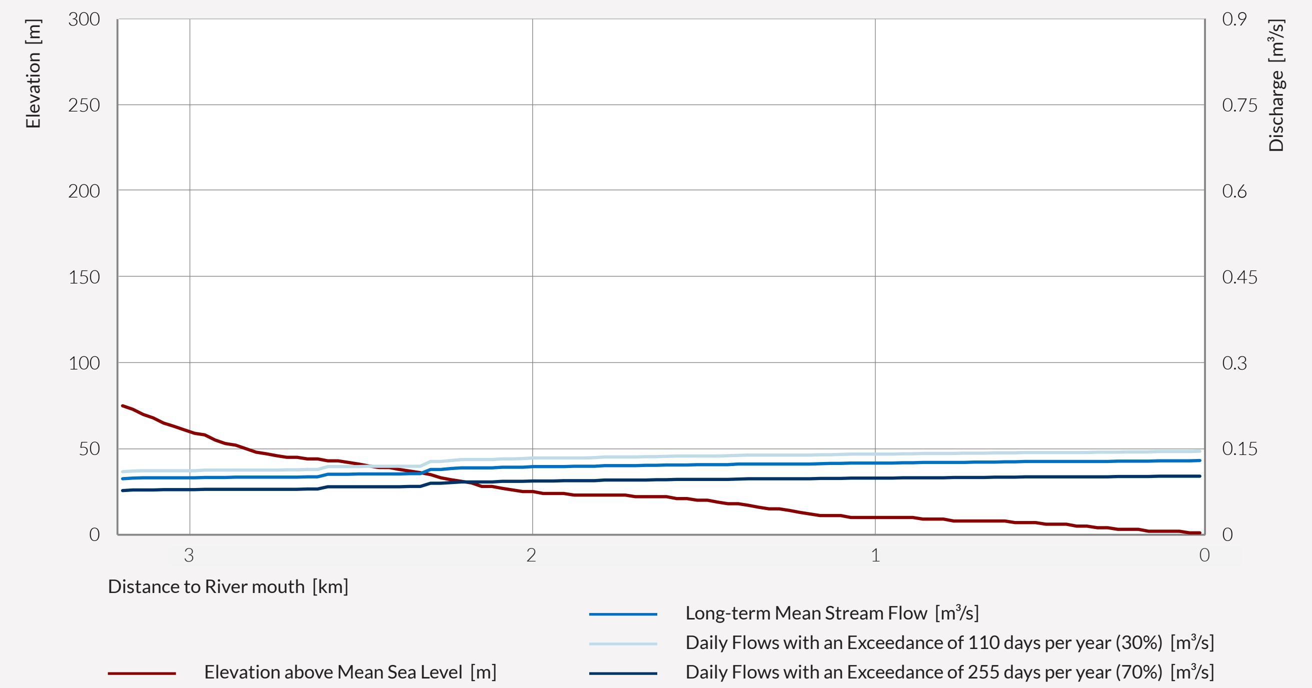
Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

The Grande Rivière de l'Anse la Raye has its catchment on the west coast flowing into the sea at the town of Anse La Raye. With just about 9.01 km² the river has the smallest catchment of all major rivers in Saint Lucia. Its highest elevation is at about 77 m above sea level and the river's length of 3.23 km makes it one of the shortest analyzed rivers. Because of the small catchment size resulting in a mean annual discharge of just 0.129 m³/s at its river mouth, no economically viable virtual hydropower project was located applying a feed-in tariff of less than US$0.175.

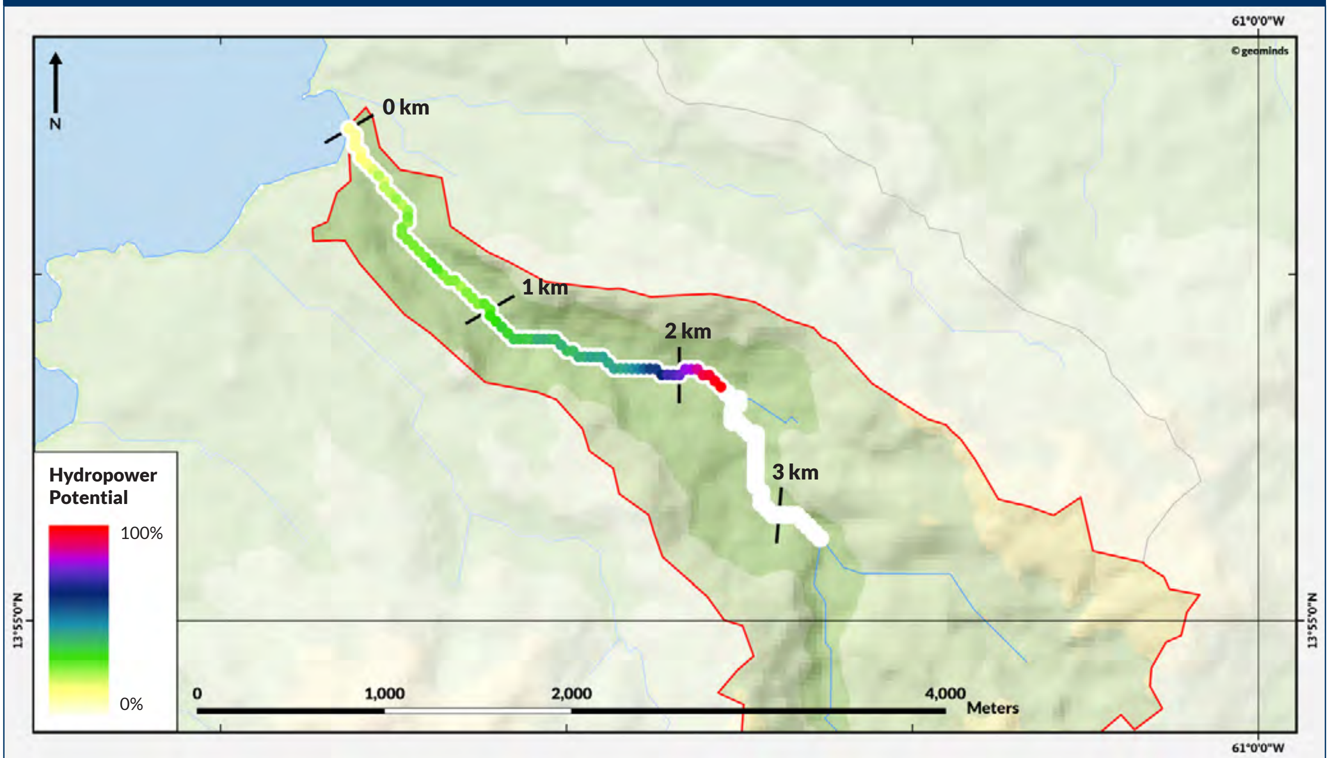
COUNTRY-WIDE RIVER RATING



15.2 • STREAM FLOW DISCHARGE ANALYSIS OF GRANDE RIVIÈRE DE L'ANSE LA RAYE

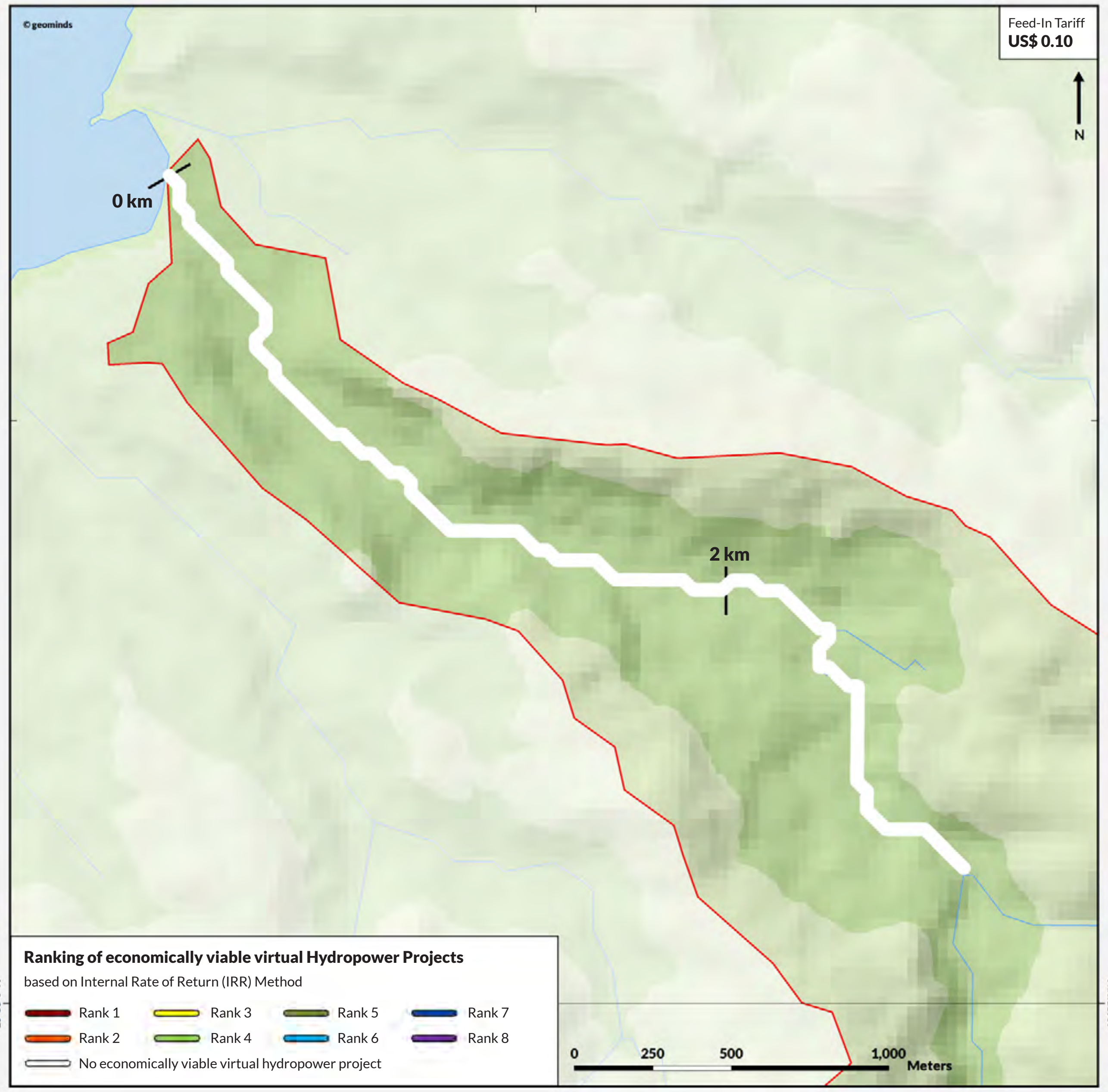


15.3 • OVERVIEW OF NORMALIZED TECHNICAL HYDROPOWER POTENTIAL



Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

15.4 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL



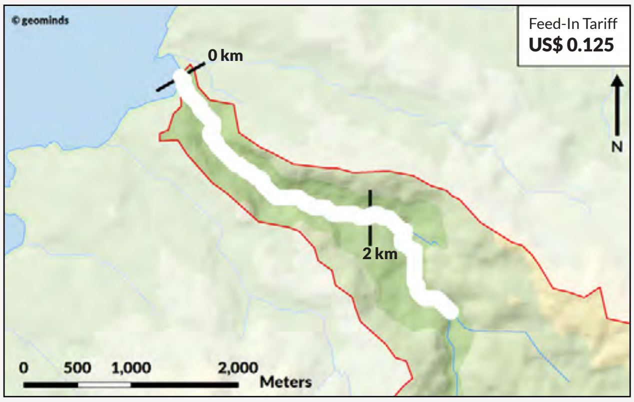
Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake	Length of Penstock	Gross Head	Daily Flows, exceeded on 110 days per year
1	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-
3	-	-	-	-	-		-
4	-	-	-	-		-	-
5	-	-			-	-	-
6	-			-	-	-	-
7	-		-	-	-	-	-
8	-	-	-	-	-	-	-

No economically viable virtual hydropower project was located!

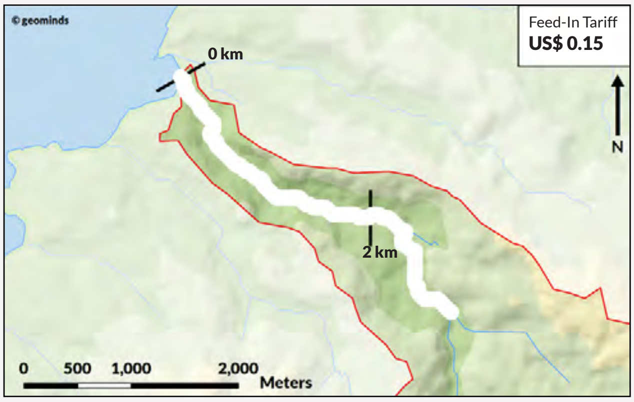
For more information and all setting parameters used for this calculation, see page 12.

15.5 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL WITH RISING FEED-IN TARIFF



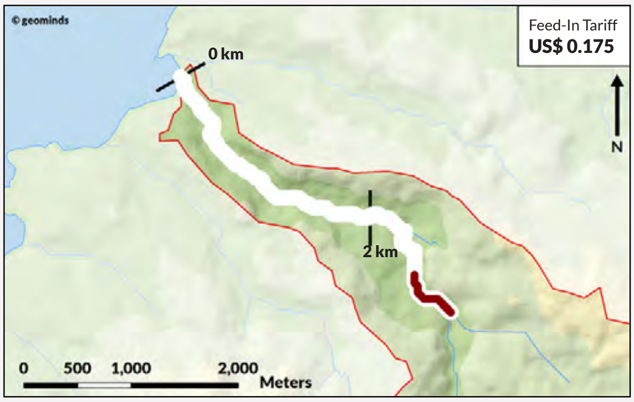
Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	
3	-	-	-	-
4	-	-		-
5	-		-	-
6	-	-	-	-
7		-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!

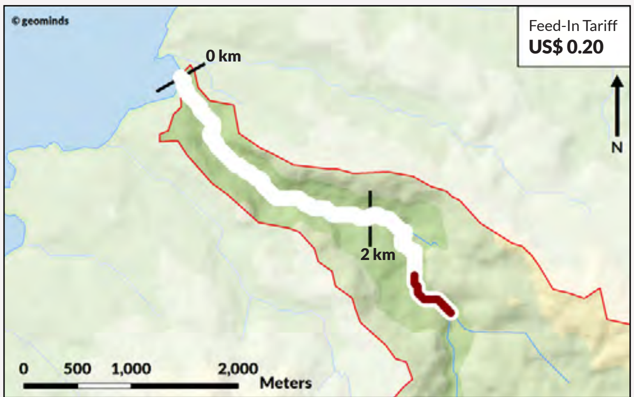


Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	
3	-	-	-	-
4	-	-		-
5	-		-	-
6	-	-	-	-
7		-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	0.97%	23.07 kW	2.79 km	3.21 km
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	3.02%	23.07 kW	2.79 km	3.21 km
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

Ranking of economically viable virtual Hydropower Projects
based on Internal Rate of Return (IRR) Method

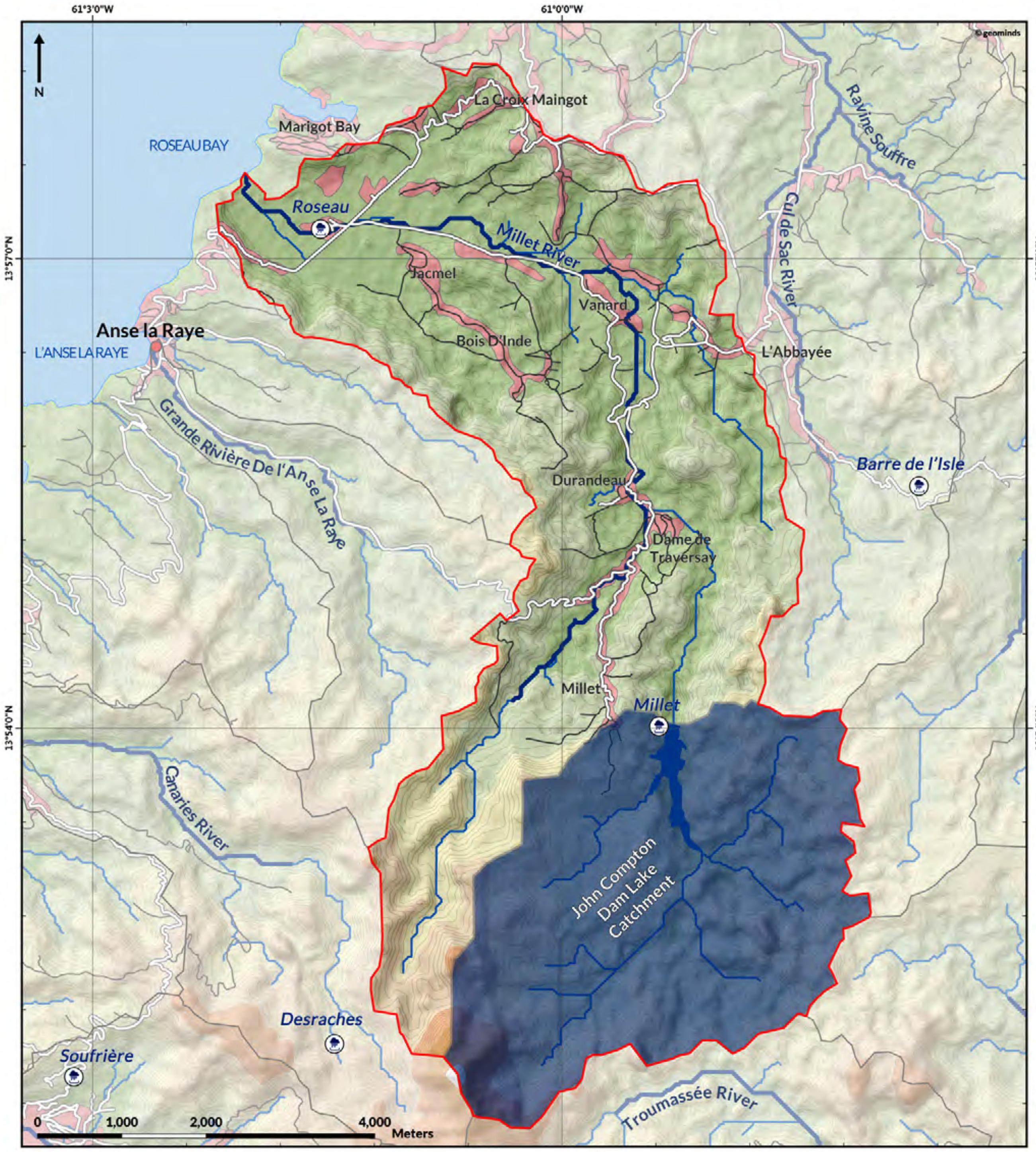
Rank 1 Rank 3 Rank 5 Rank 7
Rank 2 Rank 4 Rank 6 Rank 8
No economically viable virtual hydropower project

For more information and all setting parameters used for this calculation, see page 12.

Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

16. MILLET RIVER

16.1 • OVERVIEW MAP



Elevation

- > 900
- 750 - 900
- 600 - 750
- 450 - 600
- 300 - 450
- 150 - 300
- 0 - 150 m

Urban Area and Roads

- Major Village
- Settlements
- Major Roads
- Minor Roads and Tracks

Water Resources

- Primary Streams
- Secondary Streams
- Catchment Boundary
- Rainfall Gauging Station

Facts about Catchment

Catchment Size: . . . . 32.56 km²

Length of Primary River: . . . . 10.11 km

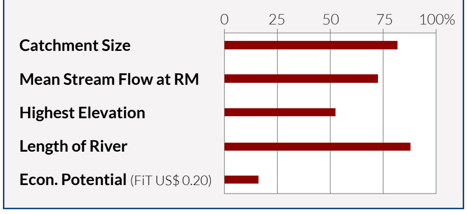
Highest Elevation of Primary River: . . . . 148 m

Long-term Mean Stream Flow at River Mouth: . . . . 0.525 m³/s

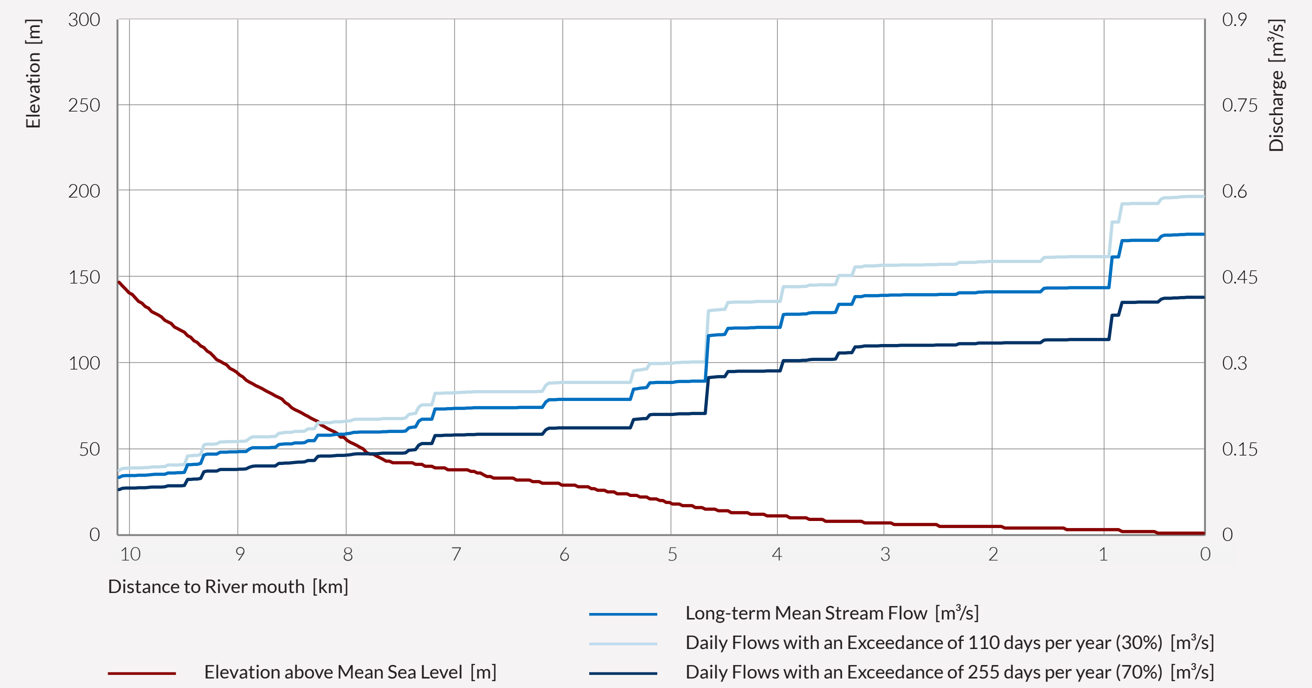
Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

The Millet River and the larger Roseau River together form the largest catchment on the island. As the Roseau River is dammed at the John Compton Dam for water storage supply of the northern island, the waters of the upper catchment were excluded from the hydropower analysis of the Millet River. Excluding these waters, the river still reaches a mean annual discharge at the river mouth of 0.525 m^3/s. The catchment size excluding the dam site area is about 32.56 km^2 and the length of the primary river is 10.11 km. Although the Millet has a maximum elevation of 148 m, no economically viable virtual hydropower project was located applying a feed-in tariff of less than US$ 0.175.

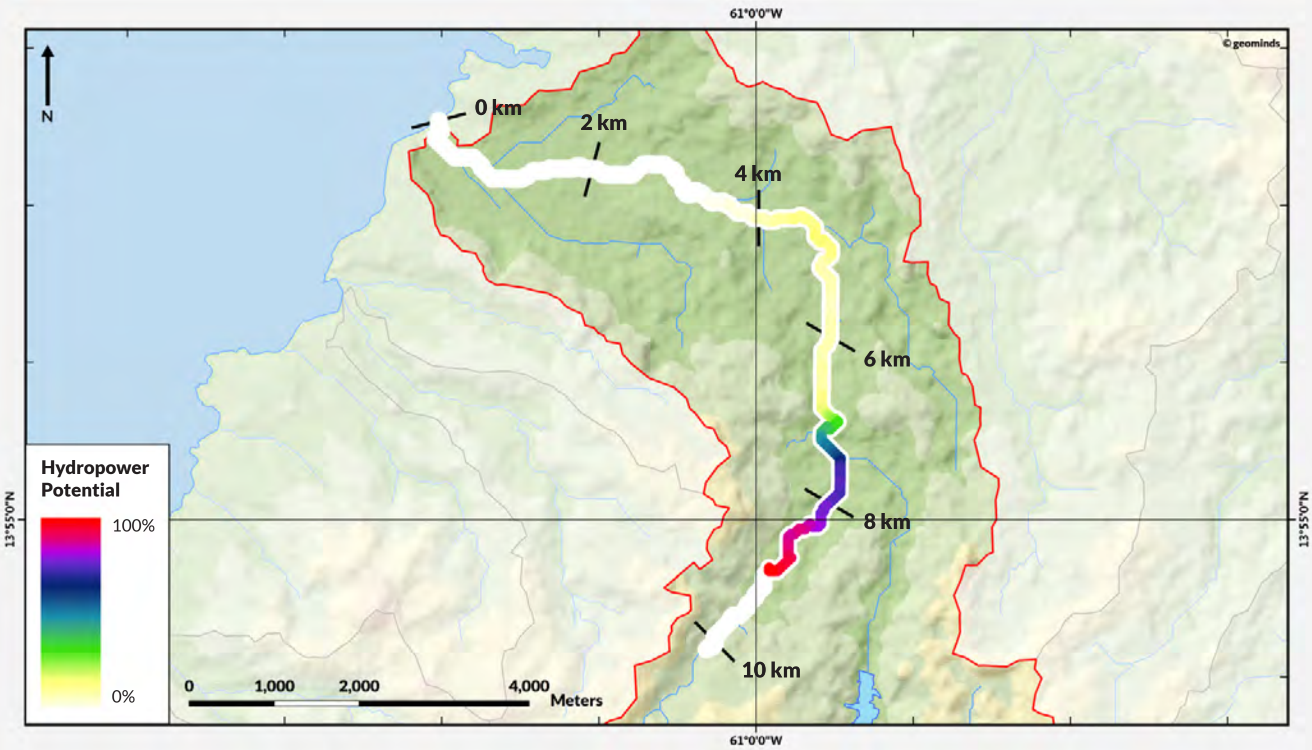
COUNTRY-WIDE RIVER RATING



16.2 • STREAM FLOW DISCHARGE ANALYSIS OF MILLET RIVER

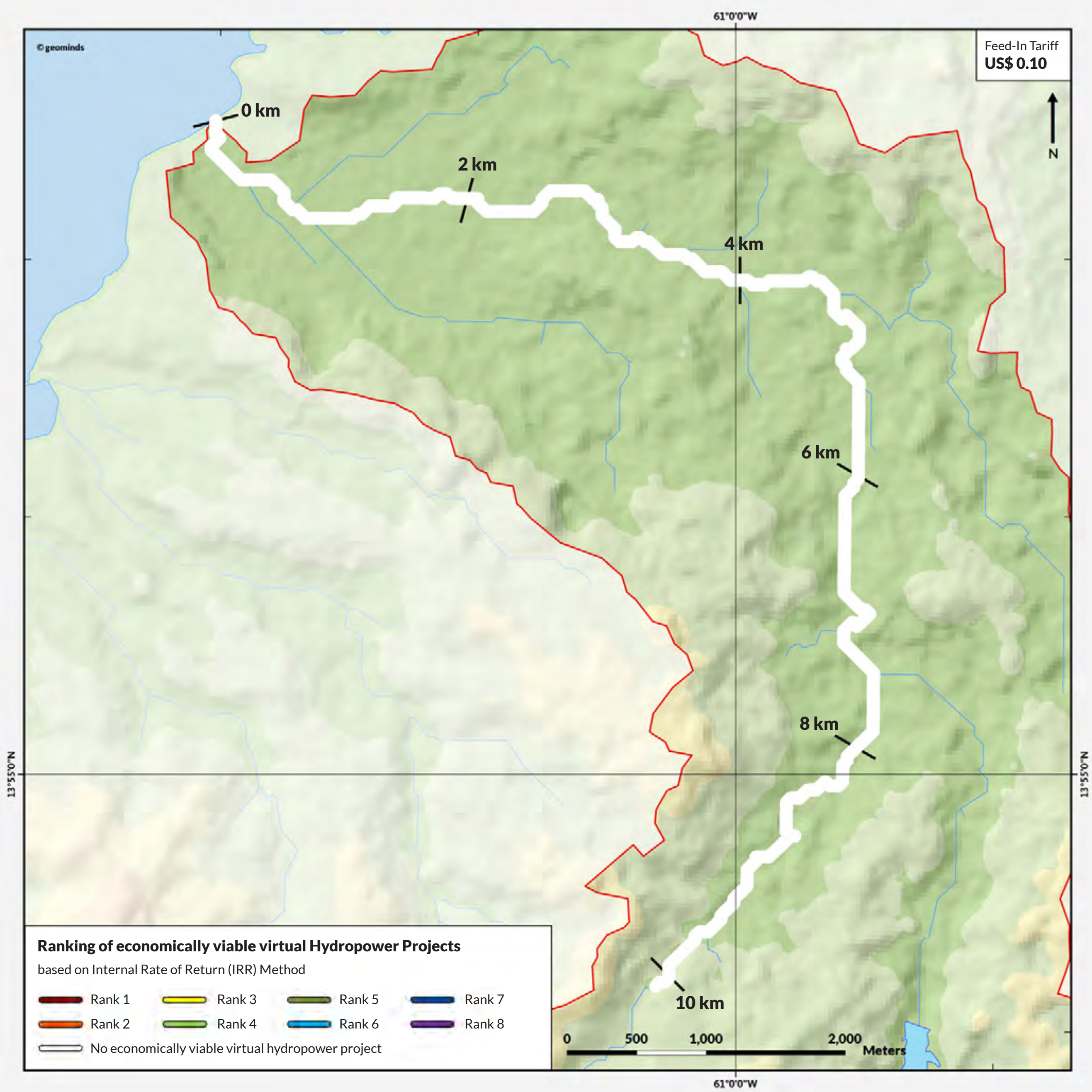


16.3 • OVERVIEW OF NORMALIZED TECHNICAL HYDROPOWER POTENTIAL



Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

16.4 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL



Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake	Length of Penstock	Gross Head	Daily Flows, exceeded on 110 days per year
1	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-

No economically viable virtual hydropower project was located!

For more information and all setting parameters used for this calculation, see page 12.

16.5 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL WITH RISING FEED-IN TARIFF

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	0.99%	38.41 kW	8.43 km	9.24 km
2	0.19%	25.44 kW	7.71 km	8.19 km
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	3.05%	38.41 kW	8.43 km	9.24 km
2	2.27%	25.44 kW	7.71 km	8.19 km
3	1.38%	30.17 kW	9.27 km	10.02 km
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

Ranking of economically viable virtual Hydropower Projects

based on Internal Rate of Return (IRR) Method

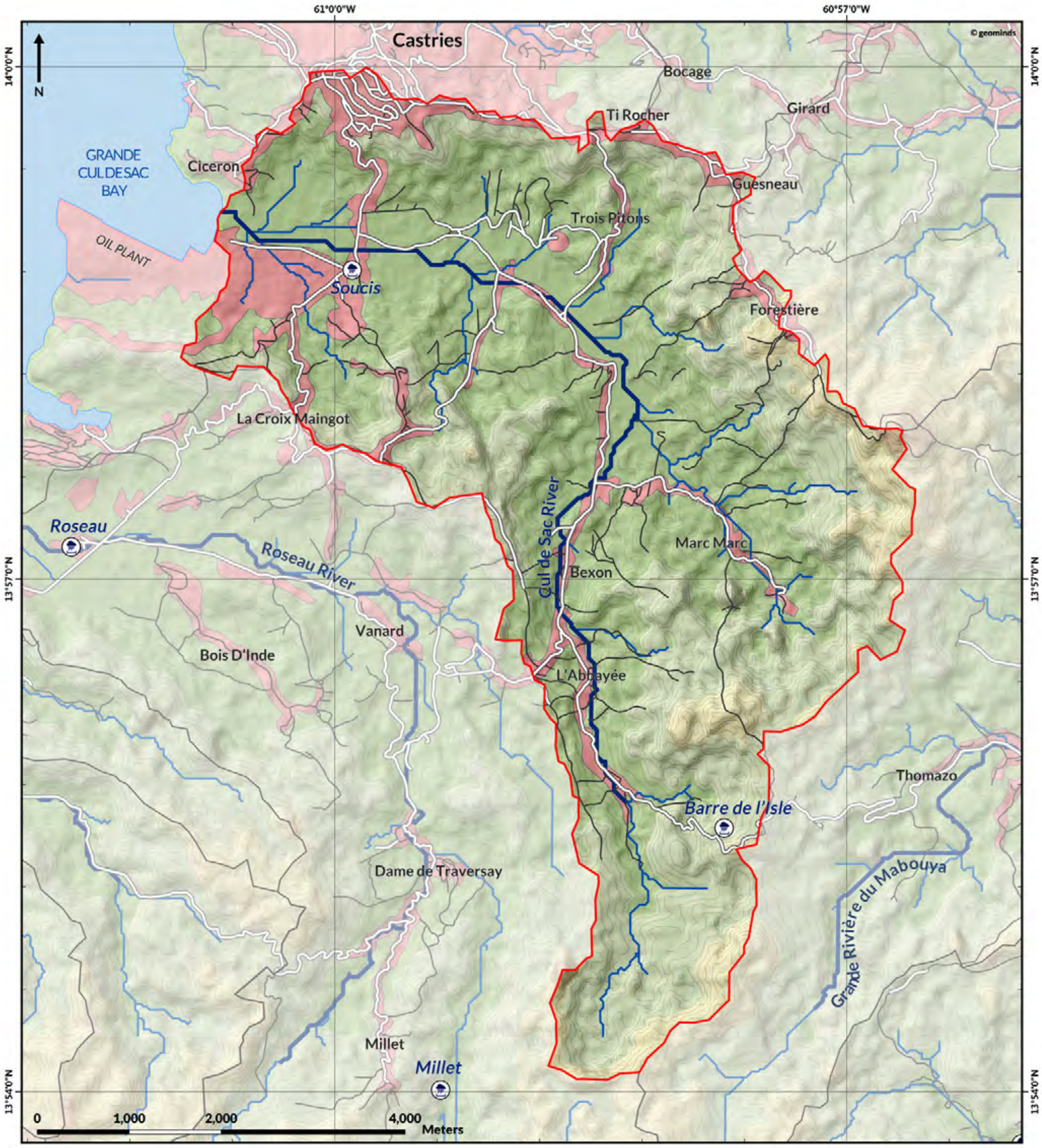
Rank 1 | Rank 3 | Rank 5 | Rank 7
Rank 2 | Rank 4 | Rank 6 | Rank 8
No economically viable virtual hydropower project

For more information and all setting parameters used for this calculation, see page 12.

Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

17. CUL DE SAC RIVER

17.1 • OVERVIEW MAP



Elevation

- > 900
- 750 - 900
- 600 - 750
- 450 - 600
- 300 - 450
- 150 - 300
- 0 - 150 m

Urban Area and Roads

- Major Village
- Settlements
- Major Roads
- Minor Roads and Tracks

Water Resources

- Primary Streams
- Secondary Streams
- Catchment Boundary
- Rainfall Gauging Station

Facts about Catchment

Catchment Size: . . . . 39.48 km²

Length of Primary River: . . . . 9.12 km

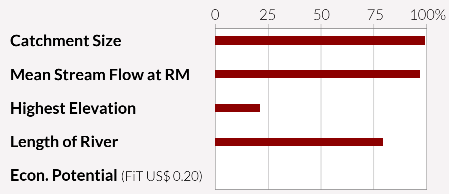
Highest Elevation of Primary River: . . . . . 59 m

Long-term Mean Stream Flow at River Mouth: . . . . 0.701 m³/s

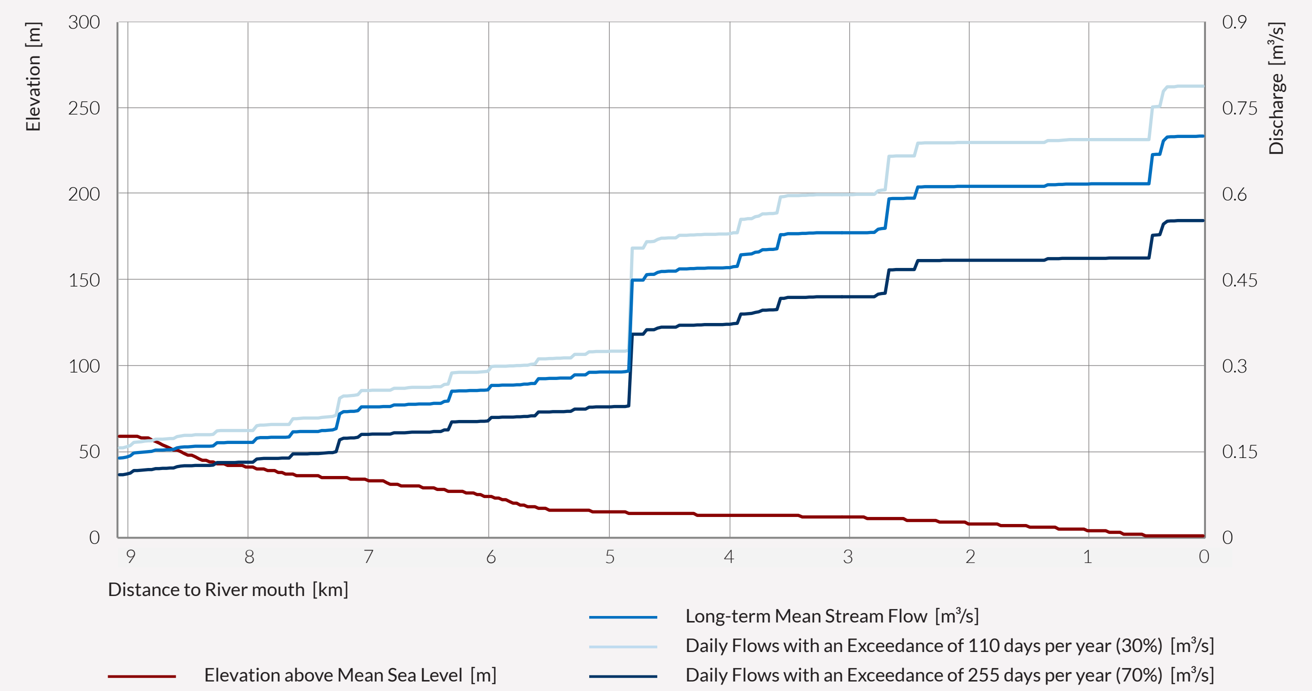
Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

The Cul de Sac River and the smaller Ravine Souffre form together one of the largest catchments in Saint Lucia (39.48 km²). Together with the waters of the Ravine Souffre the Cul de Sac River collects about 0.701 m³/s of mean annual discharge available for generating hydropower at its river mouth, one of the highest values of all catchments on the island. Accumulating its waters in the center of the island and with a highest elevation of only 59 m above sea level, the Cul de Sac River has a total length of about 9.12 km with a joint-river section of 4.8 km. Even with high discharges, no economically viable virtual hydropower project was located according to the parameters and assumptions applied.

COUNTRY-WIDE RIVER RATING

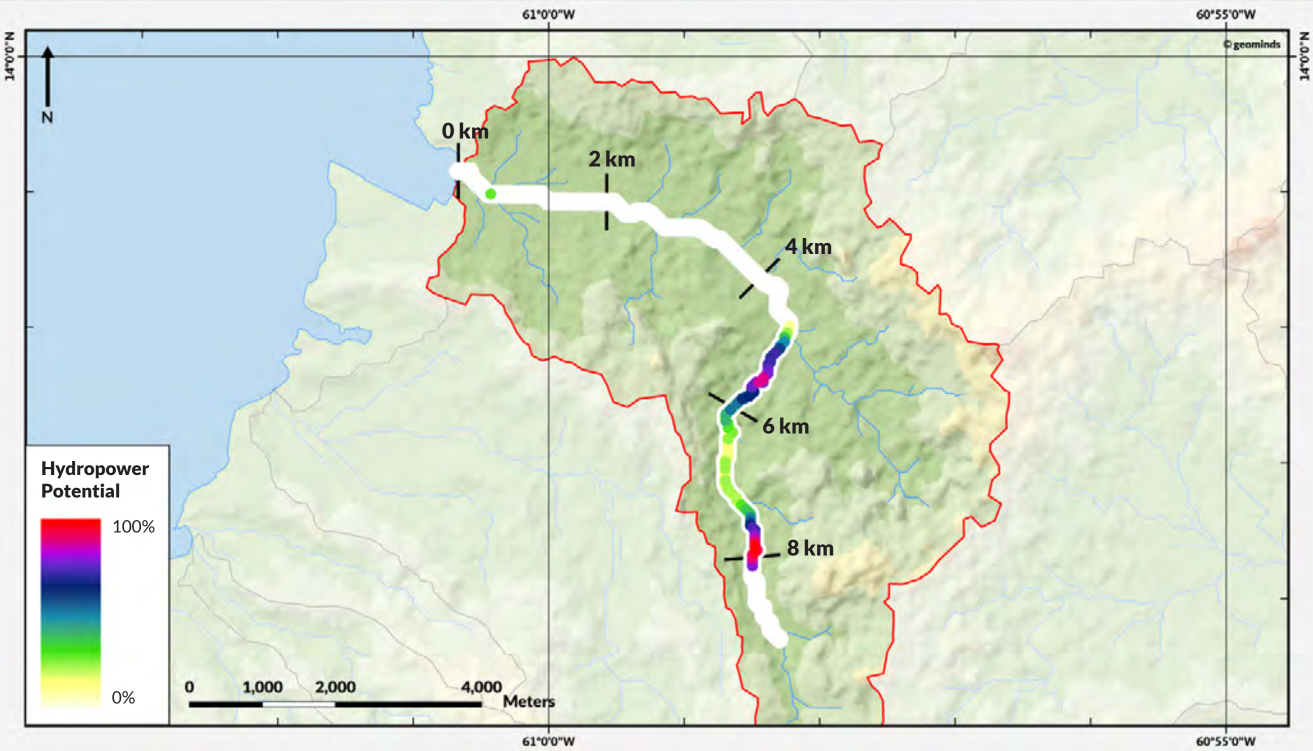


17.2 • STREAM FLOW DISCHARGE ANALYSIS OF CUL DE SAC RIVER

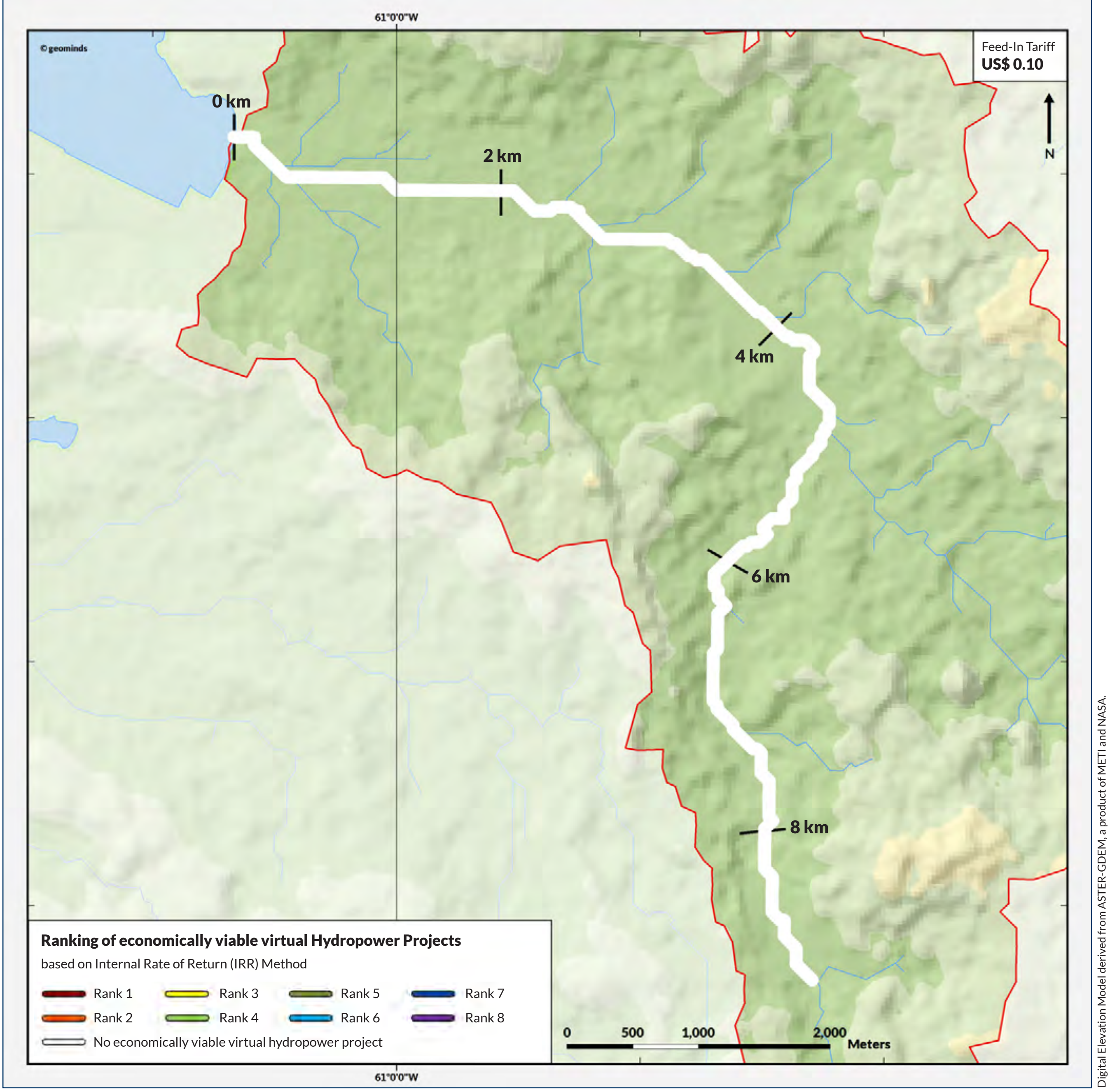


17.3 • OVERVIEW OF NORMALIZED TECHNICAL HYDROPOWER POTENTIAL

Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.



17.4 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake	Length of Penstock	Gross Head	Daily Flows, exceeded on 110 days per year
1	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-

No economically viable virtual hydropower project was located!

For more information and all setting parameters used for this calculation, see page 12.

17.5 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL WITH RISING FEED-IN TARIFF

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!

Ranking of economically viable virtual Hydropower Projects

based on Internal Rate of Return (IRR) Method

Rank 1 · Rank 2 · Rank 3 · Rank 4 · Rank 5 · Rank 6 · Rank 7 · Rank 8

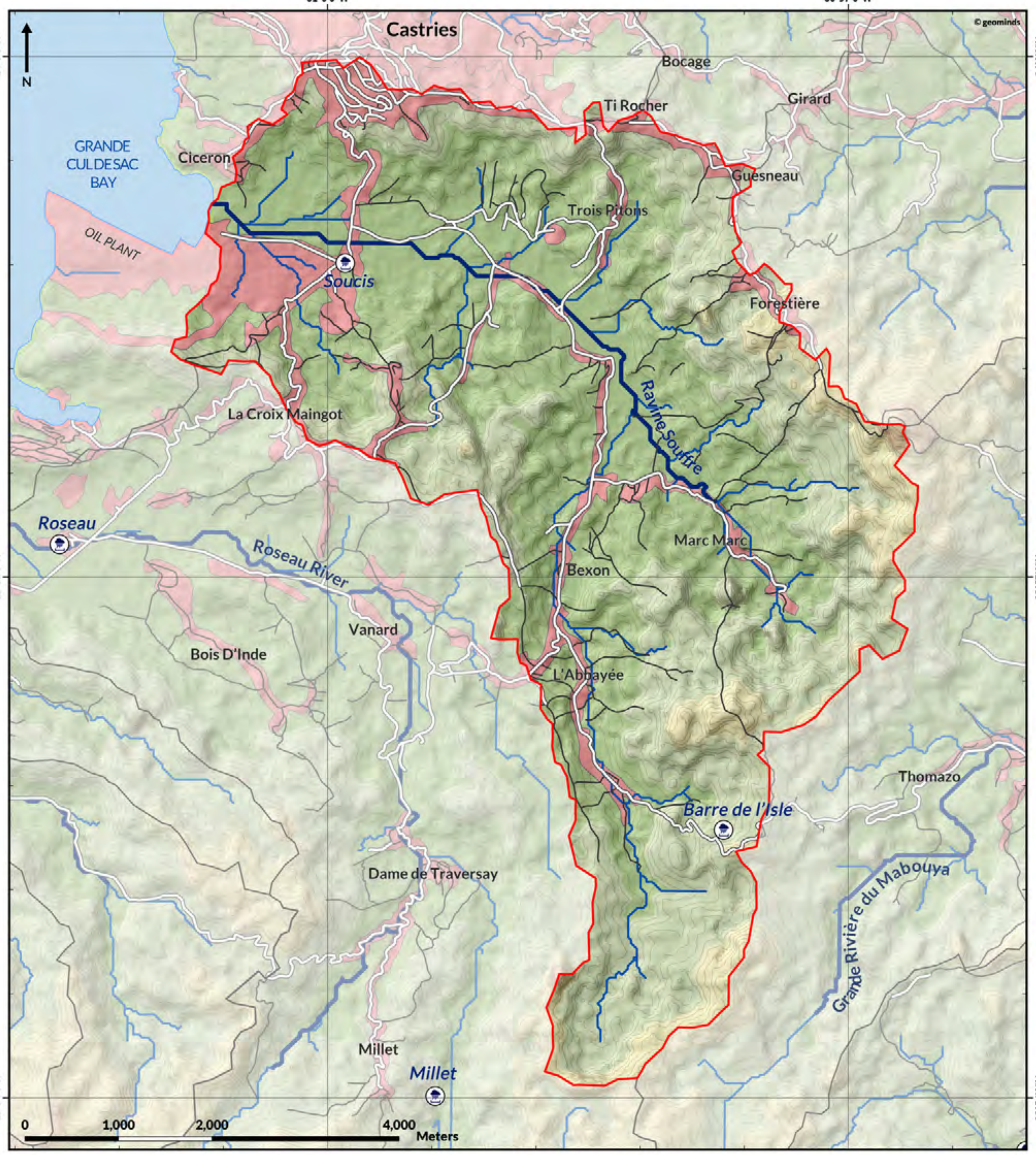
No economically viable virtual hydropower project

For more information and all setting parameters used for this calculation, see page 12.

Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

18. RAVINE SOUFFRE

18.1 • OVERVIEW MAP



Elevation

- > 900
- 750 - 900
- 600 - 750
- 450 - 600
- 300 - 450
- 150 - 300
- 0 - 150 m

Urban Area and Roads

- Major Village
- Settlements
- Major Roads
- Minor Roads and Tracks

Water Resources

- Primary Streams
- Secondary Streams
- Catchment Boundary
- Rainfall Gauging Station

Facts about Catchment

Catchment Size: . . . . 39.48 km²

Length of Primary River: . . . . 6.07 km

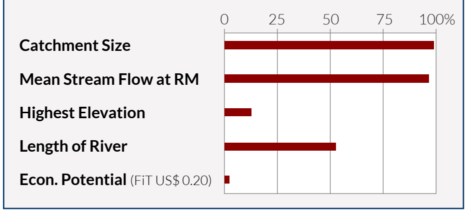
Highest Elevation of Primary River: . . . . . 36 m

Long-term Mean Stream Flow at River Mouth: . . . . 0.701 m³/s

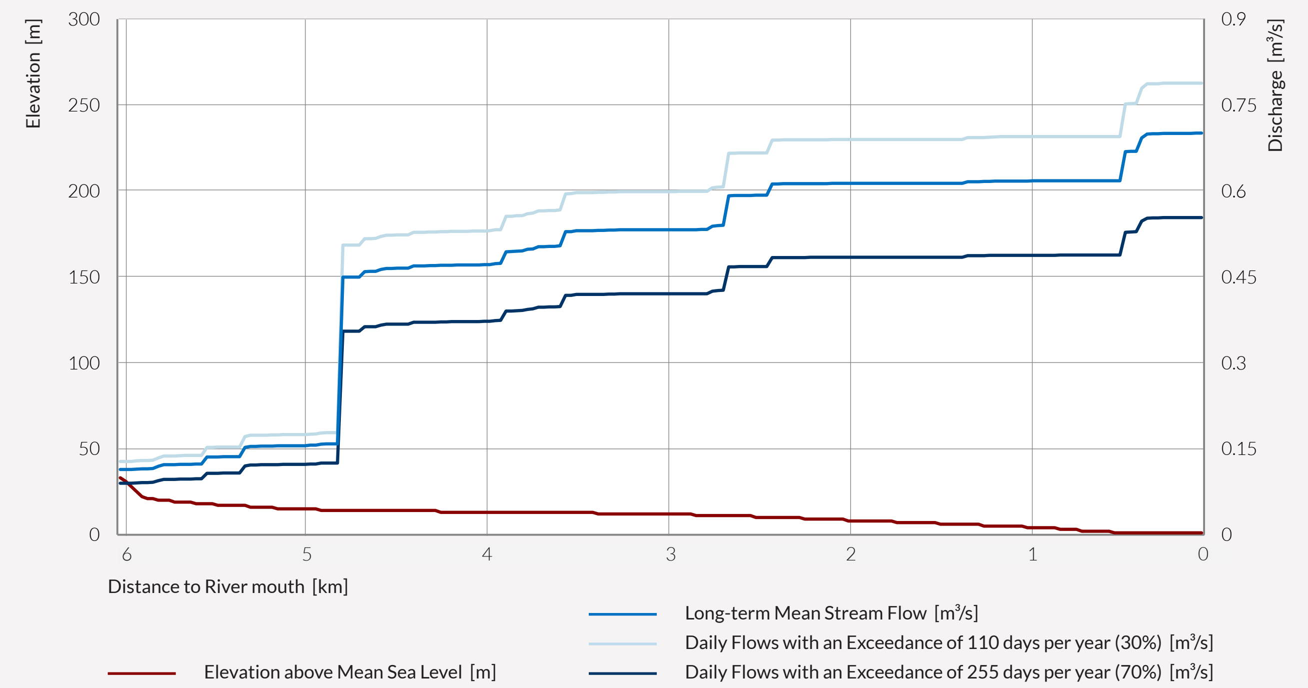
Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

The Ravine Souffre and the much larger Cul de Sac River form together one of the largest catchments in Saint Lucia (39.48 km²). Together with the Cul de Sac River the joint-river of the Cul de Sac catchment collects about 0.701 m³/s of mean annual discharge available for generating hydropower at its river mouth, one of the highest values of all catchments on the island. Accumulating its waters north of Barre de l'Isle Ridge and west of Piton Flore, the Ravine Souffre has a total length of about 6.07 km from which the joint-river section is 4.8 km long. Due to the low elevation difference of just 36 m , no economically viable virtual hydropower project was located applying a feed-in tariff of less than US$ 0.175.

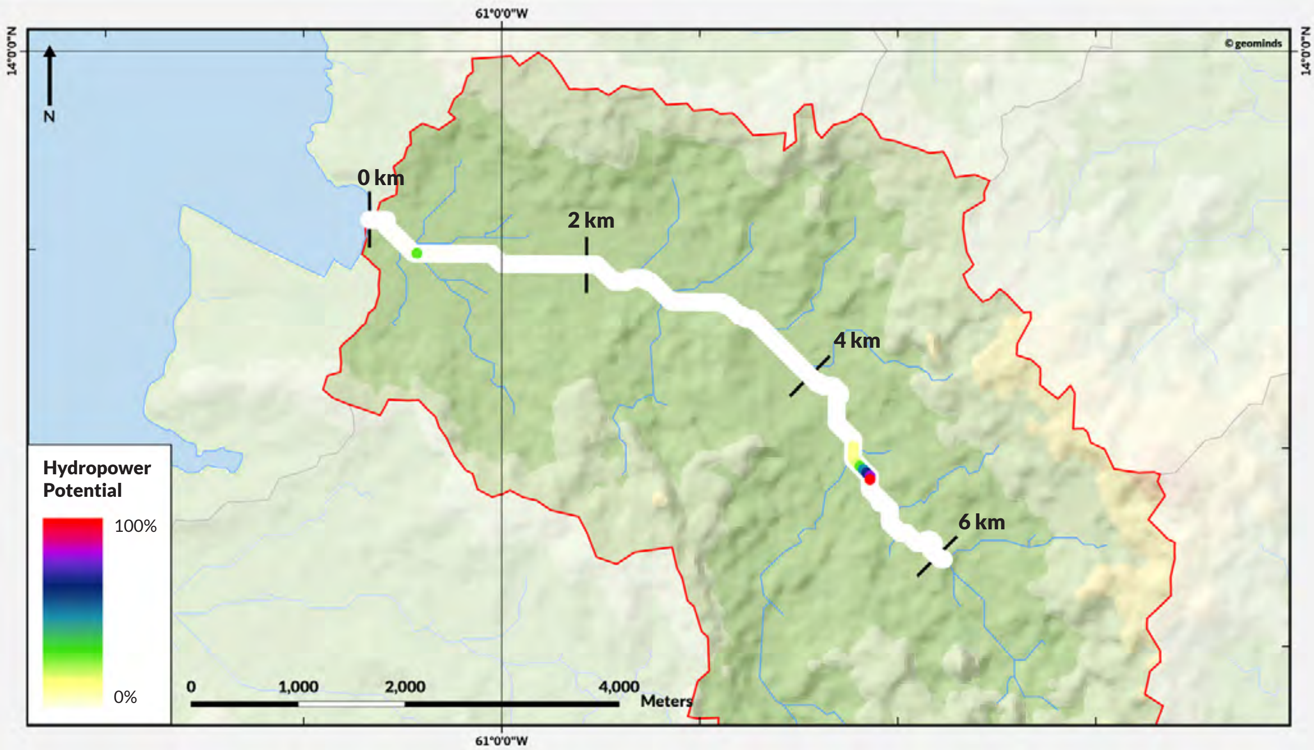
COUNTRY-WIDE RIVER RATING



18.2 • STREAM FLOW DISCHARGE ANALYSIS OF RAVINE SOUFFRE

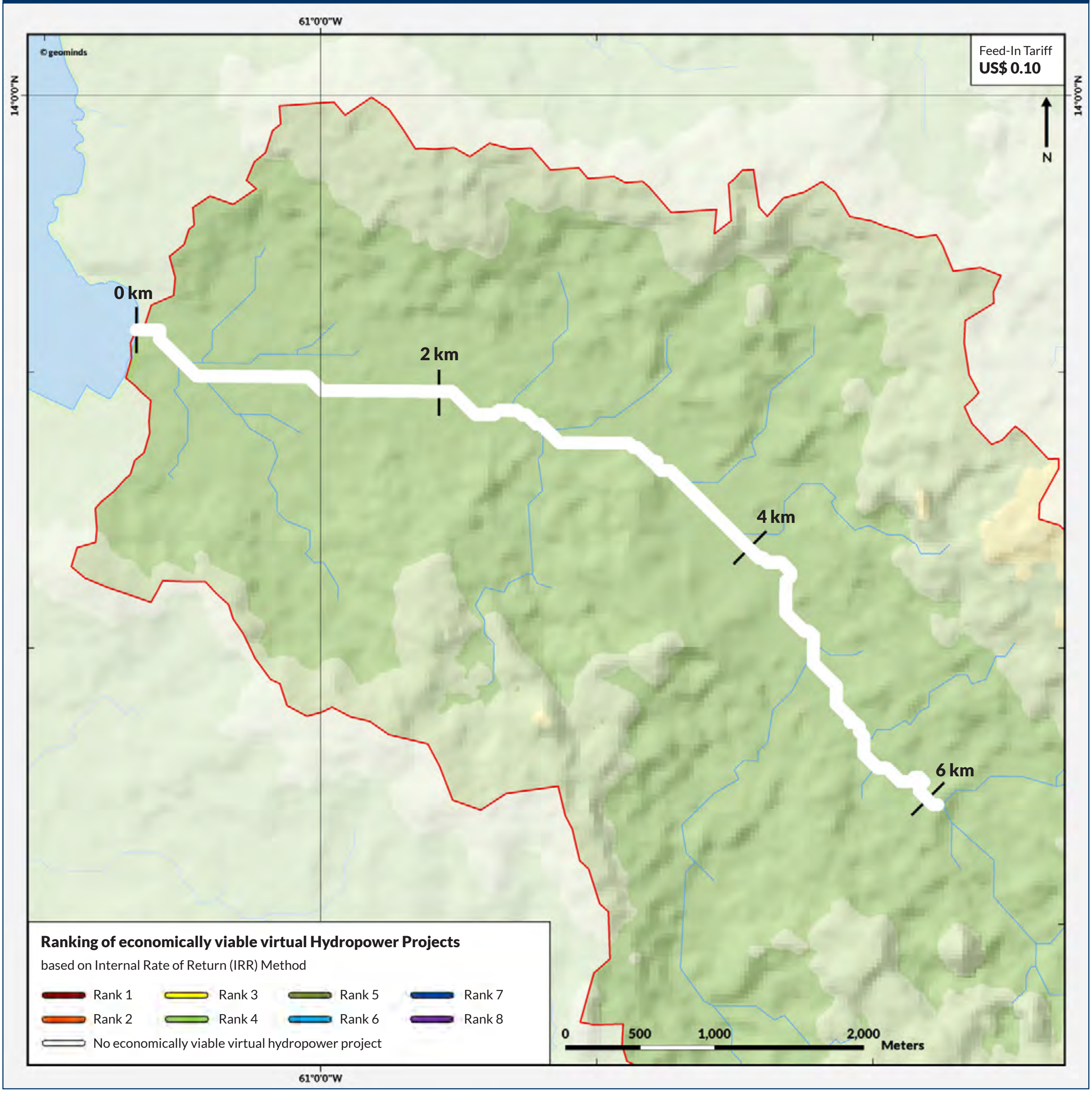


18.3 • OVERVIEW OF NORMALIZED TECHNICAL HYDROPOWER POTENTIAL



Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

18.4 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL



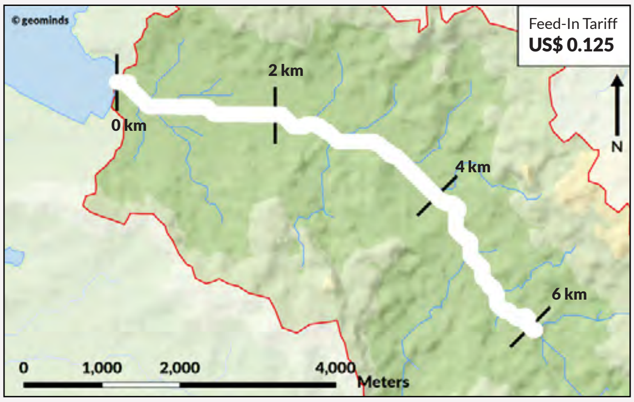
Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake	Length of Penstock	Gross Head	Daily Flows, exceeded on 110 days per year
1	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-

No economically viable virtual hydropower project was located!

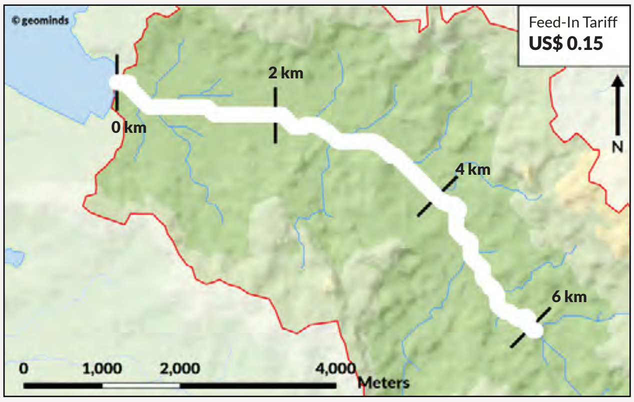
For more information and all setting parameters used for this calculation, see page 12.

18.5 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL WITH RISING FEED-IN TARIFF



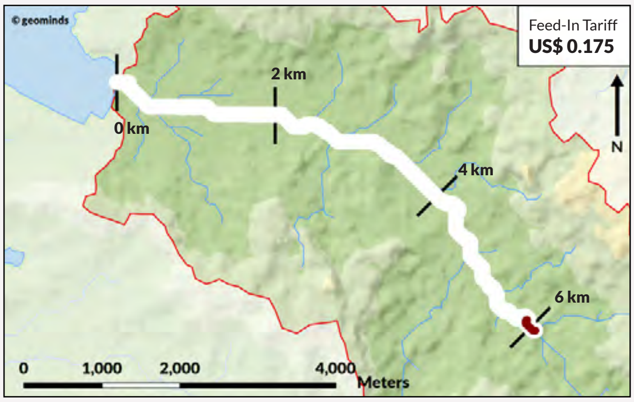
Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!

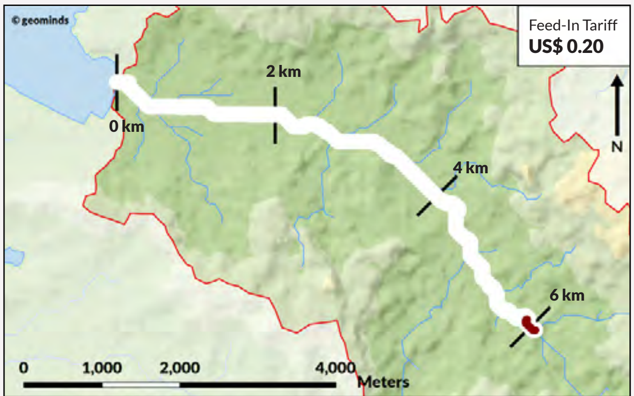


Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	1.52%	13.24 kW	5.88 km	6.03 km
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	3.56%	13.24 kW	5.88 km	6.03 km
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

Ranking of economically viable virtual Hydropower Projects
based on Internal Rate of Return (IRR) Method

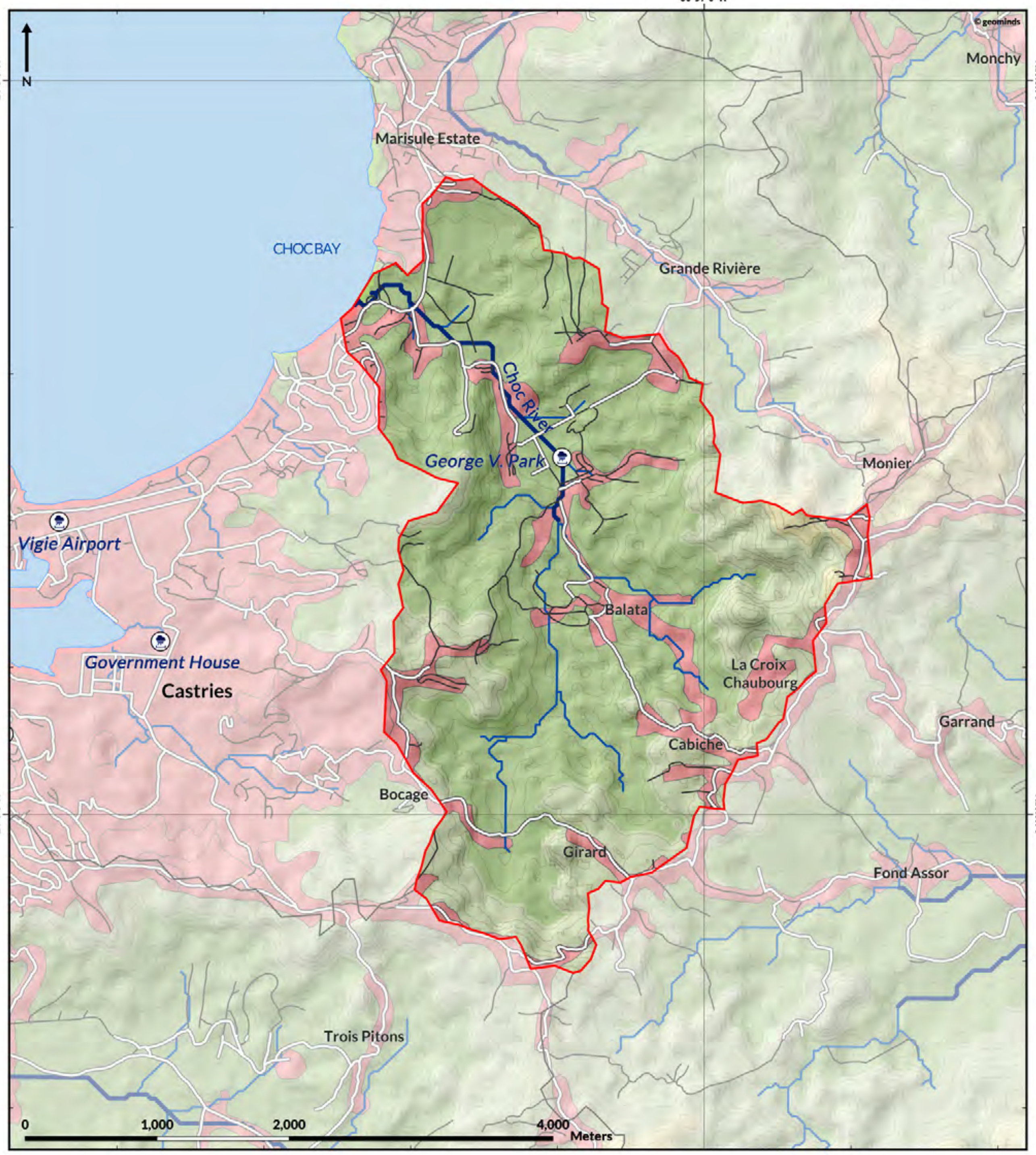
Rank 1 · Rank 3 · Rank 5 · Rank 7
Rank 2 · Rank 4 · Rank 6 · Rank 8
No economically viable virtual hydropower project

For more information and all setting parameters used for this calculation, see page 12.

Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

19. CHOC RIVER

19.1 • OVERVIEW MAP



Elevation

> 900	
750 - 900	
600 - 750	
450 - 600	
300 - 450	
150 - 300	
0 - 150 m	

Urban Area and Roads

- Major Village
- Settlements
- Major Roads
- Minor Roads and Tracks

Water Resources

- Primary Streams
- Secondary Streams
- Catchment Boundary
- Rainfall Gauging Station

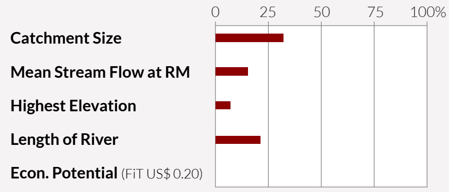
Facts about Catchment

Catchment Size:	12.78 km²
Length of Primary River:	2.45 km
Highest Elevation of Primary River:	20 m
Long-term Mean Stream Flow at River Mouth:	0.110 m³/s

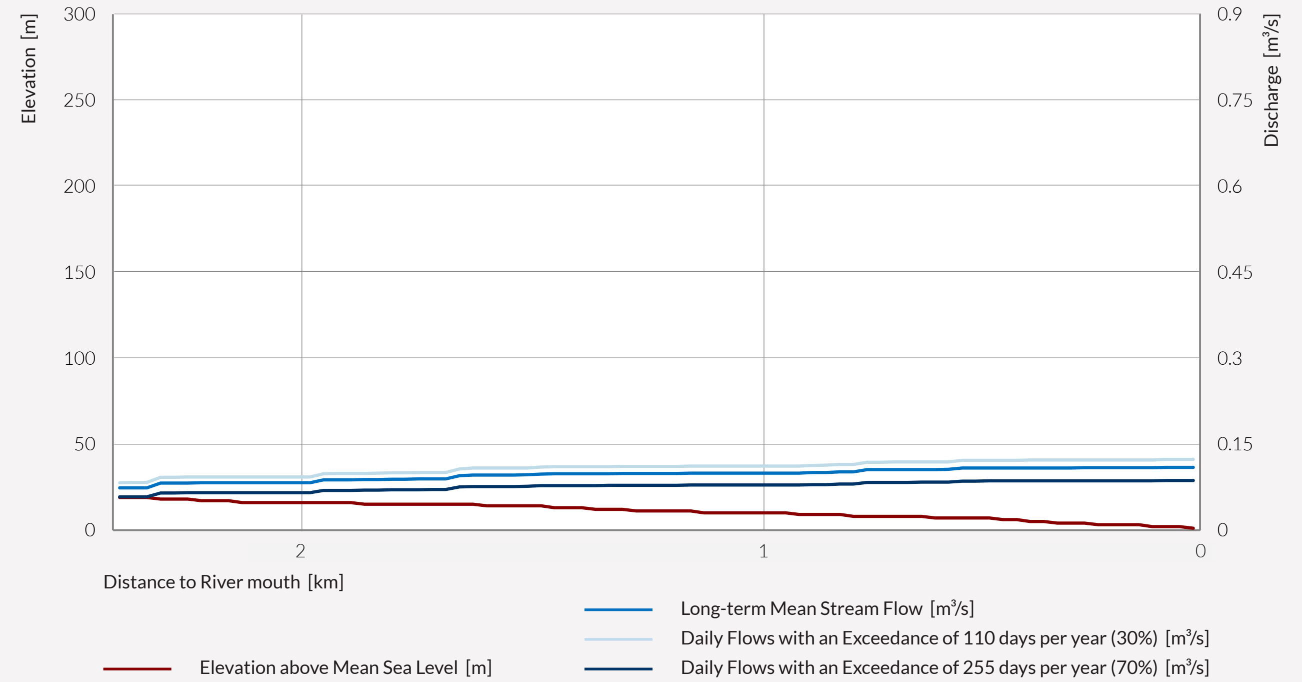
Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

The Choc River is located north of Castries and has a catchment size of about 12.78 km². The northern part of Saint Lucia generally has the lowest rainfall on the island. Being the shortest river Choc River also has one of the lowest elevation drops of the analyzed primary river (20 m) and also carries very little water to use for hydropower generation (0.110 m³/s). No economically viable virtual hydropower project was located according to the parameters and assumptions applied.

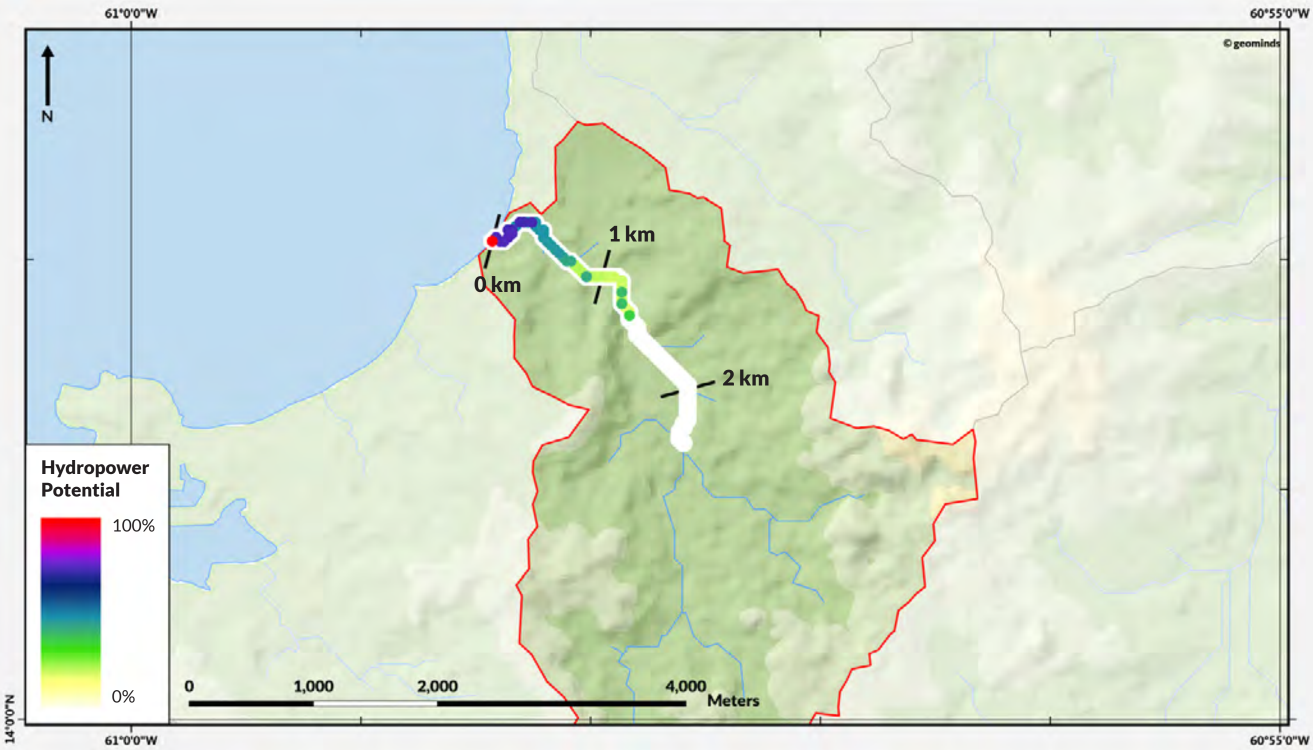
COUNTRY-WIDE RIVER RATING



19.2 • STREAM FLOW DISCHARGE ANALYSIS OF CHOC RIVER

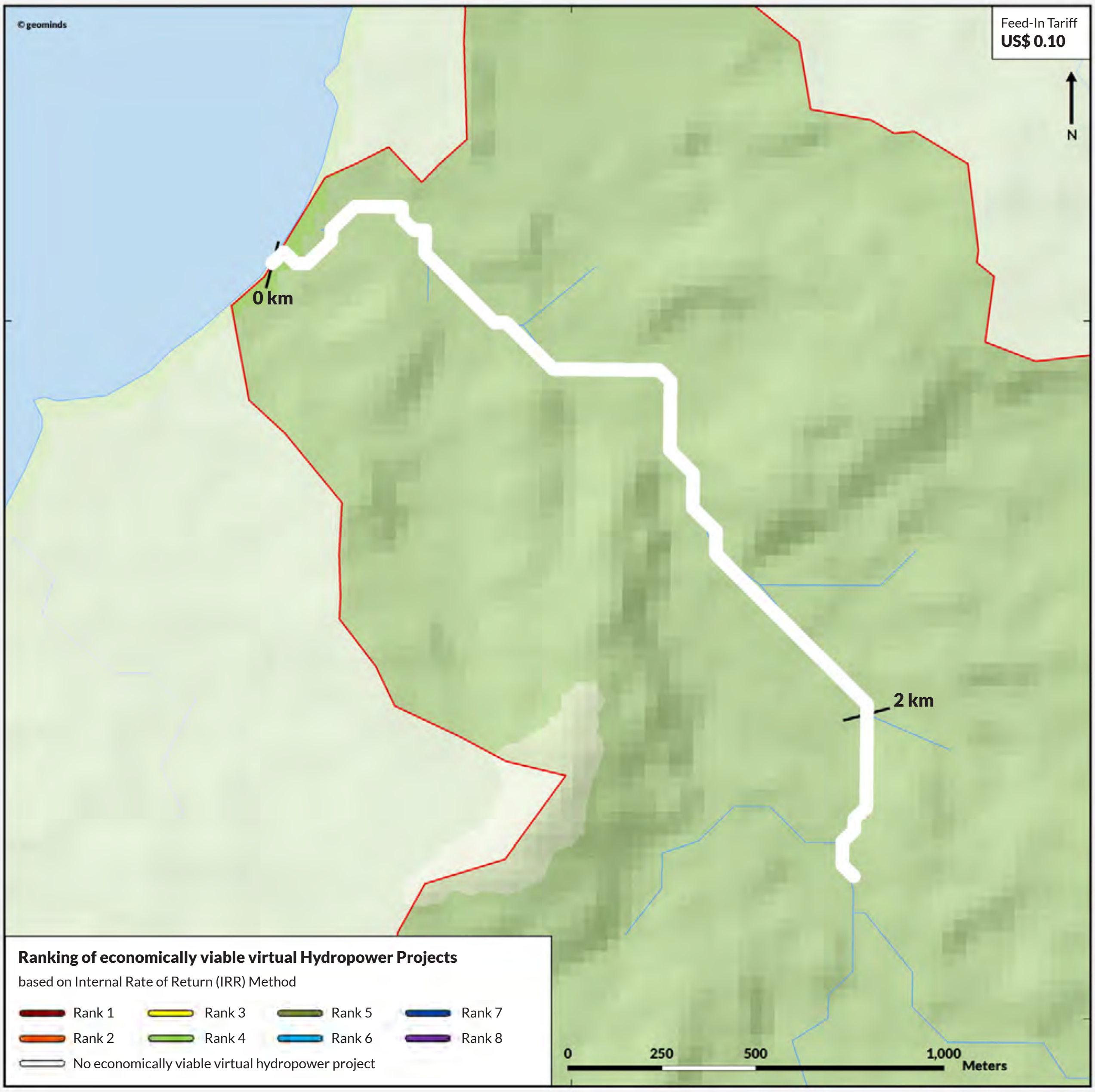


19.3 • OVERVIEW OF NORMALIZED TECHNICAL HYDROPOWER POTENTIAL



Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

19.4 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL



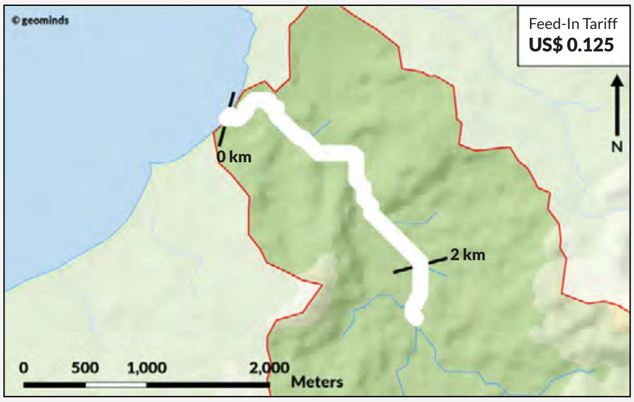
Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake	Length of Penstock	Gross Head	Daily Flows, exceeded on 110 days per year
1	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-

No economically viable virtual hydropower project was located!

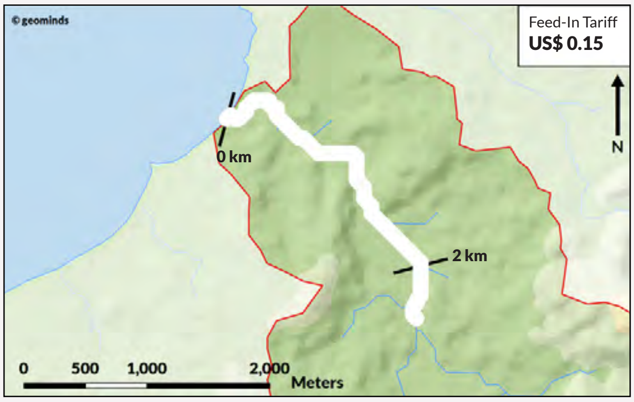
For more information and all setting parameters used for this calculation, see page 12.

19.5 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL WITH RISING FEED-IN TARIFF



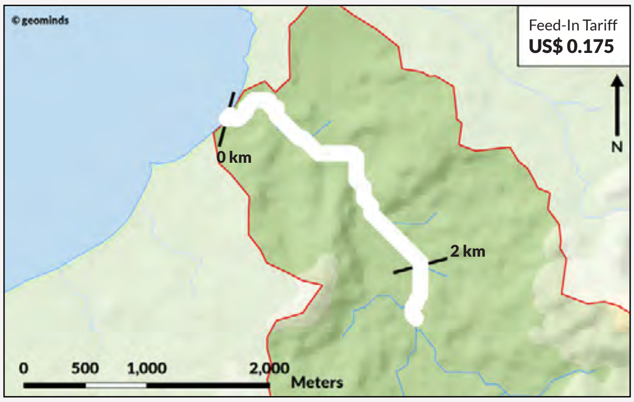
Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!



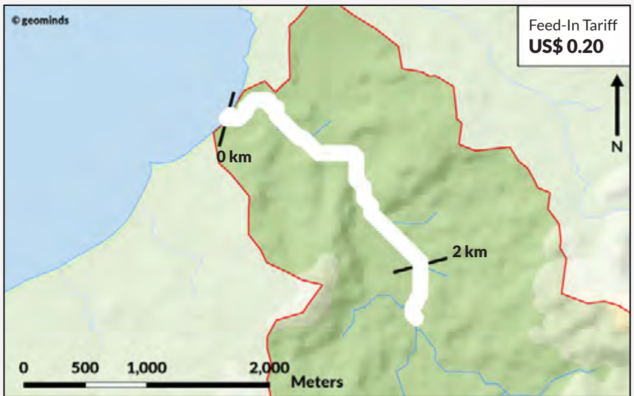
Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!

Ranking of economically viable virtual Hydropower Projects

based on Internal Rate of Return (IRR) Method

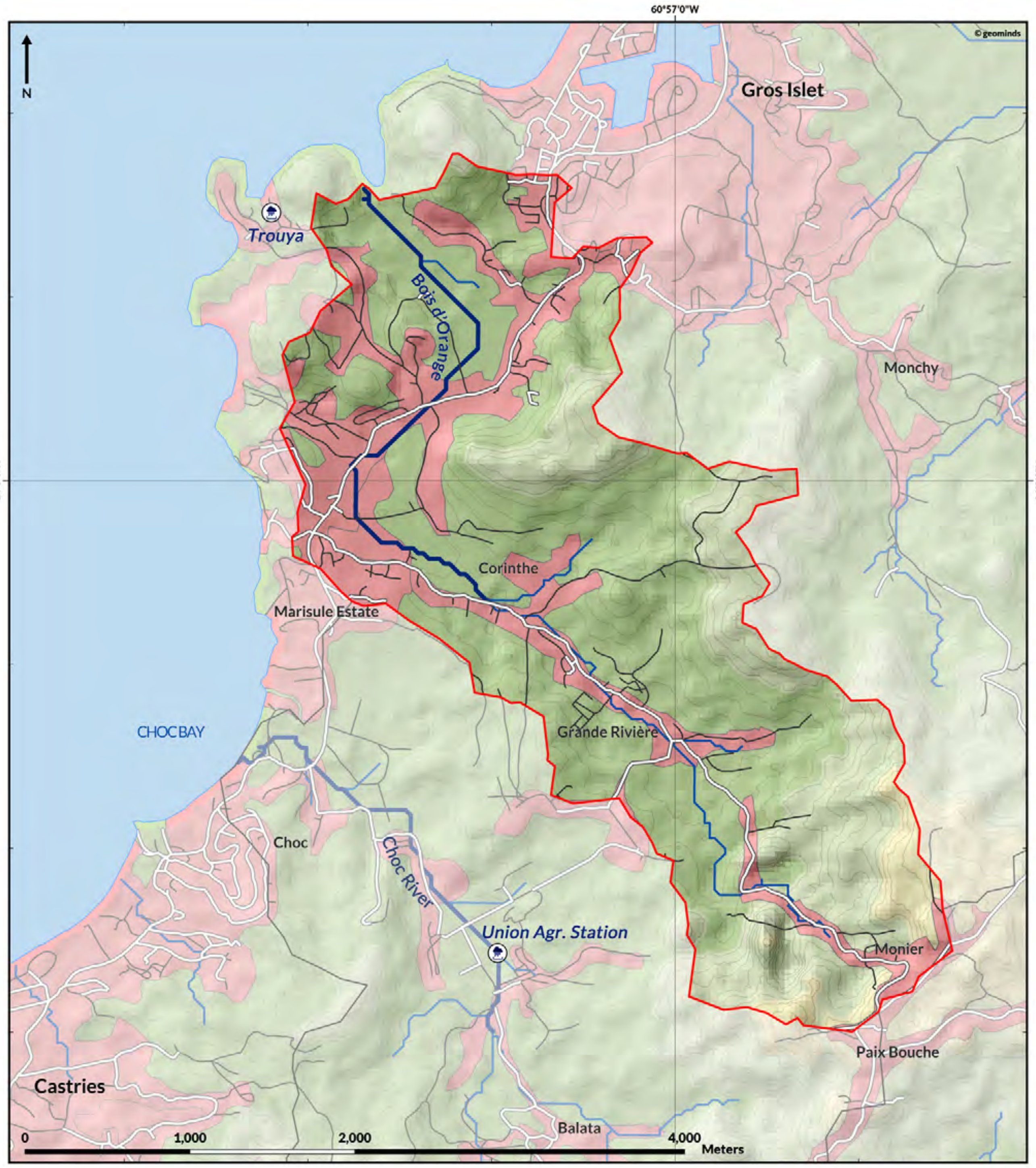
Rank 1 Rank 3 Rank 5 Rank 7
Rank 2 Rank 4 Rank 6 Rank 8
No economically viable virtual hydropower project

For more information and all setting parameters used for this calculation, see page 12.

Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

20. BOIS D'ORANGE RIVER

20.1 • OVERVIEW MAP



Elevation

- > 900
- 750 - 900
- 600 - 750
- 450 - 600
- 300 - 450
- 150 - 300
- 0 - 150 m

Urban Area and Roads

- Major Village
- Settlements
- Major Roads
- Minor Roads and Tracks

Water Resources

- Primary Streams
- Secondary Streams
- Catchment Boundary
- Rainfall Gauging Station

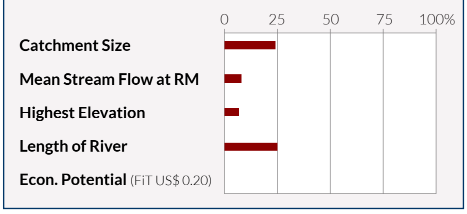
Facts about Catchment

Catchment Size:	9.59 km²
Length of Primary River:	2.87 km
Highest Elevation of Primary River:	19 m
Long-term Mean Stream Flow at River Mouth:	0.058 m³/s

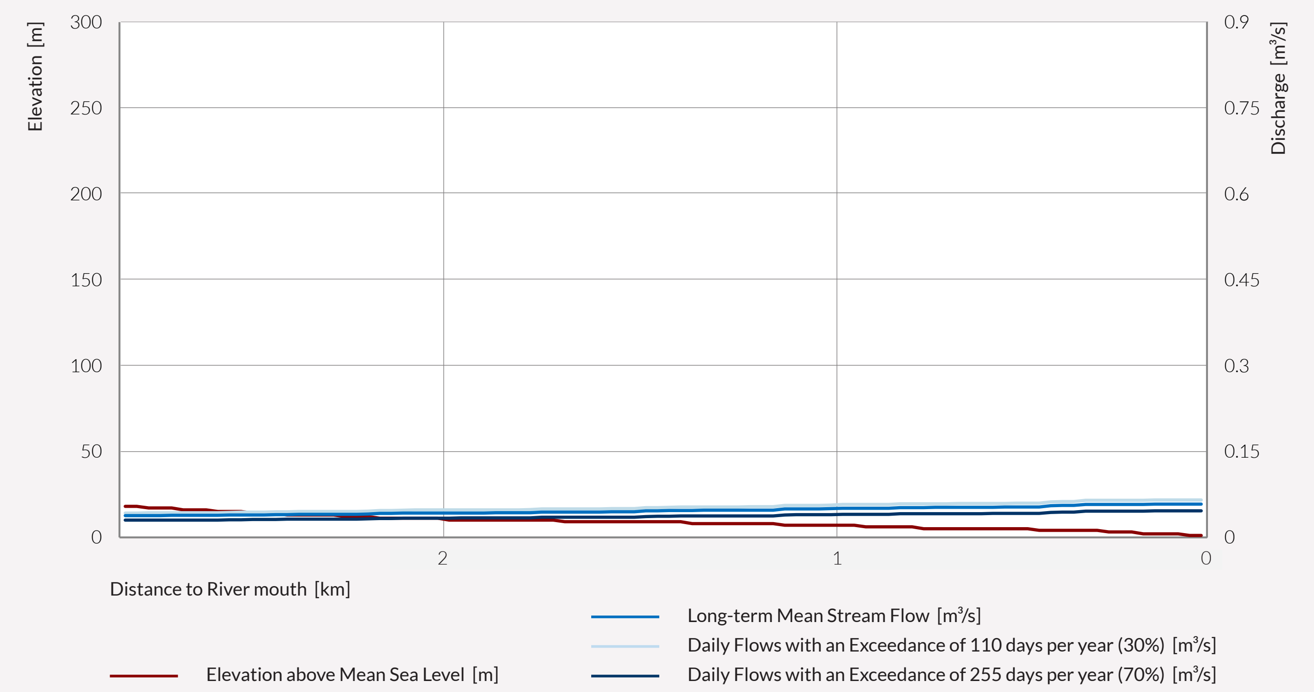
Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

The Bois d'Orange River is located in the flatter north-western part of Saint Lucia with a highest elevation of just 19 m above sea level. The primary river is less than 3 km long and its catchment is one of the smallest of all analyzed rivers (9.59 km²). As the north western part of the island generally has less rainfall the river scarcely lead water throughout the year. No economically viable virtual hydropower project was located according to the parameters and assumptions applied.

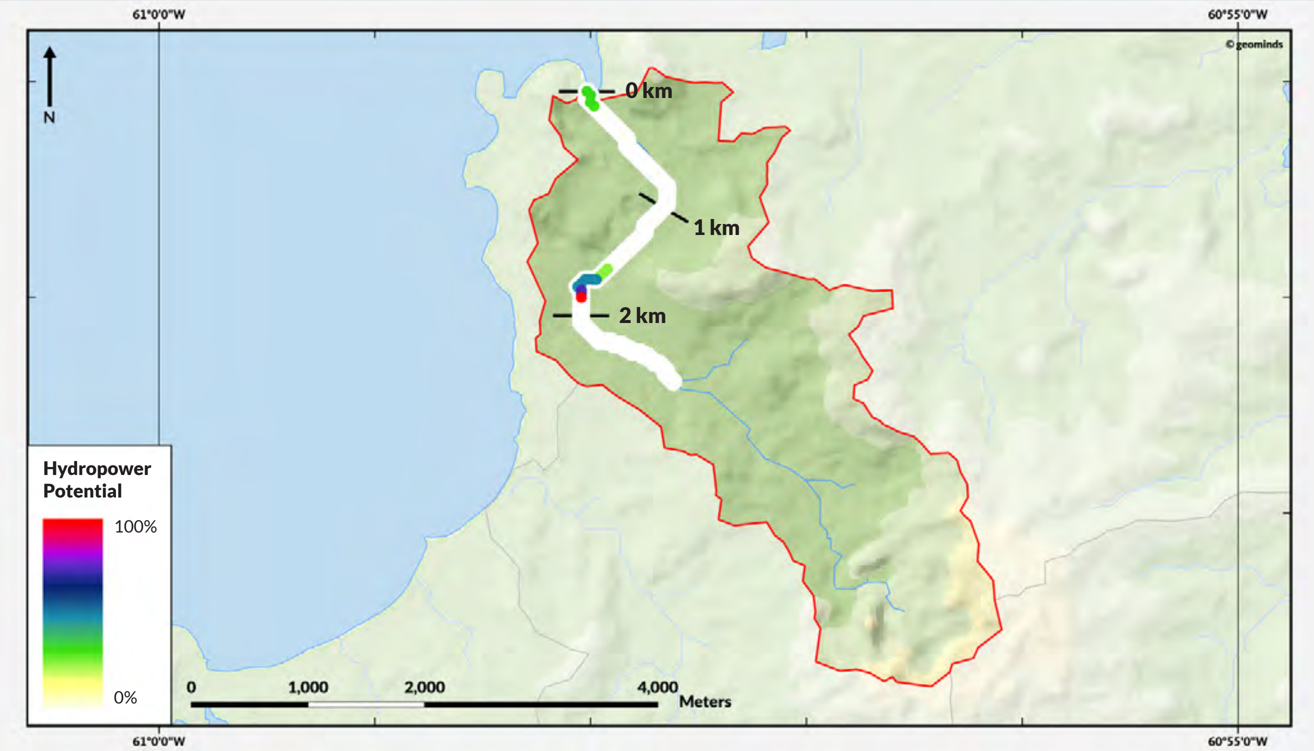
COUNTRY-WIDE RIVER RATING



20.2 • STREAM FLOW DISCHARGE ANALYSIS OF BOIS D'ORANGE RIVER

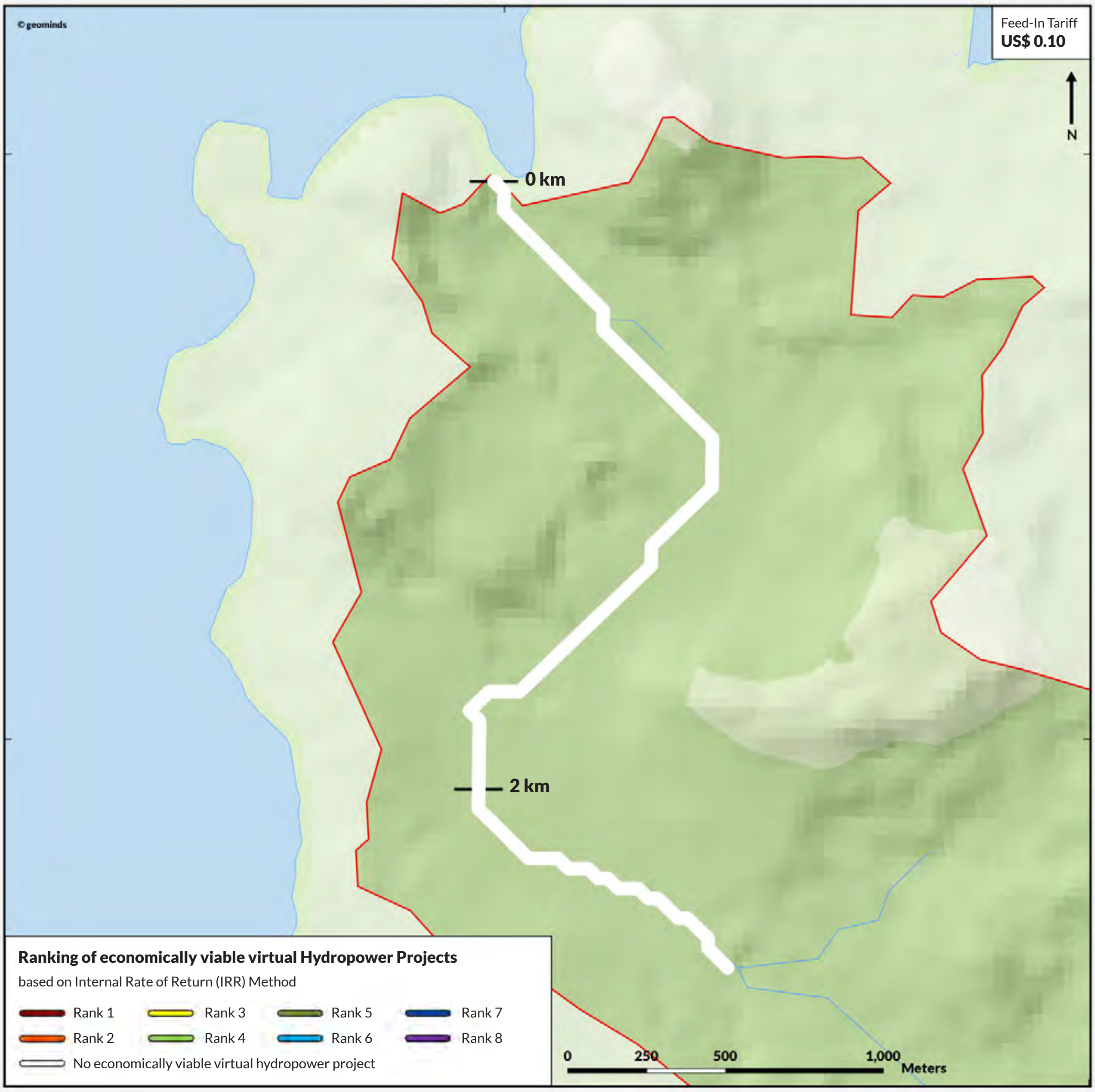


20.3 • OVERVIEW OF NORMALIZED TECHNICAL HYDROPOWER POTENTIAL



Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

20.4 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL



Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake	Length of Penstock	Gross Head	Daily Flows, exceeded on 110 days per year
1	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-

No economically viable virtual hydropower project was located!

For more information and all setting parameters used for this calculation, see page 12.

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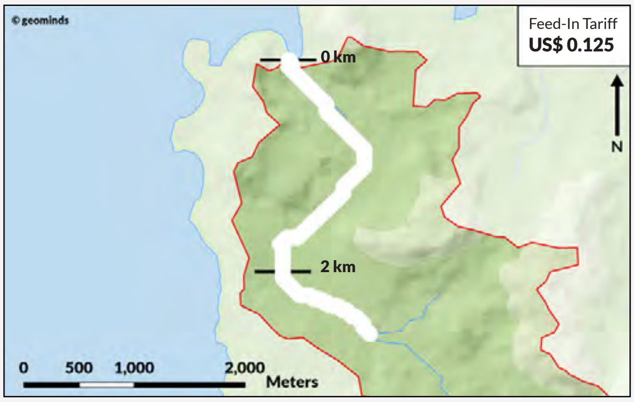
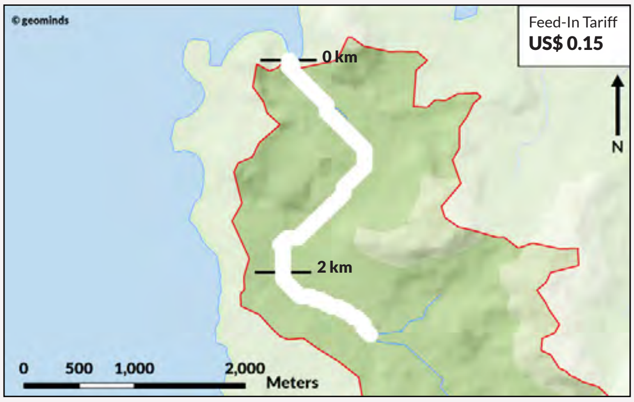
20.5 • ANALYSIS OF ECONOMICALLY VIABLE HYDROPOWER POTENTIAL WITH RISING FEED-IN TARIFF



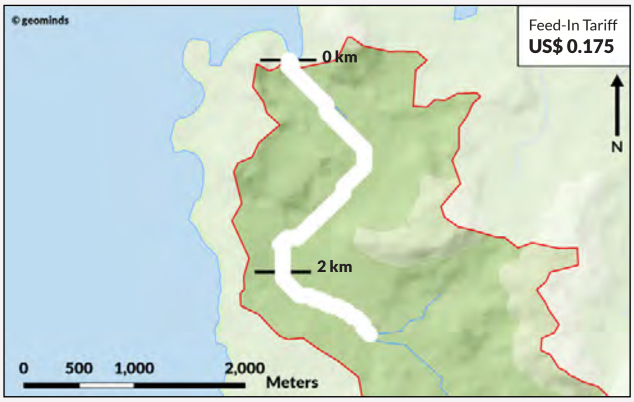
Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!



Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!

Rank	IRR	Hydropower Potential	Location of Powerhouse	Location of Intake
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-

No economically viable virtual hydropower project was located!

Ranking of economically viable virtual Hydropower Projects

based on Internal Rate of Return (IRR) Method

Rank 1 | Rank 3 | Rank 5 | Rank 7
Rank 2 | Rank 4 | Rank 6 | Rank 8
No economically viable virtual hydropower project

For more information and all setting parameters used for this calculation, see page 12.

Digital Elevation Model derived from ASTER-GDEM, a product of METI and NASA.

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APPENDIX

Table of Contents

A 01 - Comprehensive Overview of all Calculation Parameters

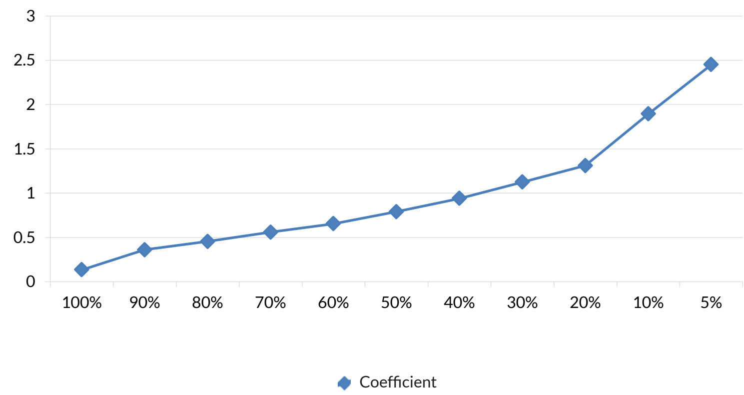
Local and regional experts, government agencies, manufactures and suppliers were consulted to provide input data for the analysis of the economical viable hydropower potential of Saint Lucia. All received information was carefully evaluated and used to create mean values for the calculations as follows:

TECHNICAL AND PHYSICAL PARAMETERS		
Hydraulic Losses	Fricton losses occuring in the water conduit	0.5 m/100 m
Ecologic Minimum Flow	Minimum amount of water remaining in the river for ecological reasons	25%
Gravity	Strength of the gravitational field in Saint Lucia	9.78 m/s²
Density of Water	Density of water is set to be 1,000 kg/m³	1,000 kg/m³
Plant Efficiency	Energy conversion losses occurring in the process of electricity generation using turbines, generators and related equipment	80%
Capacity Factor	Ratio of the annual hours the virtual hydropower plant is operated at full design capacity in relation to annual hours (8,760 hours)	50%

DETERMINING THE DESIGN DISCHARGE

The predicted discharge amount used for hydropower calculations for the analysis in this report is expected to be available statistically at 30% of days per year. The synthetically generated flow duration curve represents coefficients which allow estimating the exceedance probability in relation to the amount of the long-term mean annul stream flow.

Synthetically generated Flow Duration Curve



Percentage of Days	Days Exceeding	Coefficient
100%	365	0.135
90%	328.5	0.360
80%	292	0.455
70%	255.5	0.560
60%	219	0.655
50%	182.5	0.790
40%	146	0.940
30%	109.5	1.125
20%	73	1.310
10%	36.5	1.895
5%	18.25	2.450

ESTIMATING THE THEORETICAL TECHNICAL HYDROPOWER POTENTIAL

$$P = (h_{geo} - h_{loss}) \cdot (Q - Q_{eco}) \cdot g \cdot \rho \cdot \eta$$

h_{geo} = geodetic head between virtual intake and virtual powerhouse [m]
h_{loss} = hydraulic losses resulting from friction [m]
Q = long-term mean stream flow at virtual intake [m³/s]
Q_{eco} = minimum amount of water remaining in the river for ecological reasons [m³/s]
g = gravity [9.78 m/s²; constant]
ρ = density of water [1,000kg/m³; constant]
η = plant efficiency [%]

ECONOMIC BASE PARAMETERS		
Project Lifetime	Years of operation	25 years
Operation and Maintenance Costs	Operation and Maintenance Costs as a percentage of the total Project Development Costs	5%
Feed-In Tariff	Amount of money per unit that a generator of electricity is remunerated for feeding-in electricity to the public grid	US$ 0.10

PROJECT DEVELOPMENT COSTS		
Base Costs	Costs covering preliminary studies, designs and all costs that occur in any event when developing a project	US$ 30,000
Costs for electro-mechanical Equipment	Costs for the entire electro-mechanical equipment, site access infrastructure, grid connection and the construction of the powerhouse (excluding costs for the penstock) correlate with the design capacity of the plant	US$ 3,333 per installed kW
Costs for the Penstock	Costs of the penstock are dependent on the individual length, the material used and its diameter. In addition, costs for construction, site preparation as well as shipment and transportation costs occur.	
→ **Penstock Material Costs**	Calculations based on GFPR penstock material; costs are dependent on the available design stream flow to allow flow velocities in the penstock from 1.5 - 2.5 m/s:	

Available Design Stream Flow at virtual Intake *[m³/s]*	Penstock Diameter *[mm]*	Costs for Penstock *per m*
0.106 - 0.177	300	US$ 103.73
0.188 - 0.314	400	US$ 122.55
0.295 - 0.491	500	US$ 144.79
0.424 - 0.707	600	US$ 171.54
0.577 - 0.962	700	US$ 201.73
0.954 - 1.590	900	US$ 281.36
1.696 - 2.827	1200	US$ 465.81
2.651 - 4.418	1500	US$ 768.87

→ **Penstock Construction Costs**

Costs are based on local wage levels according to skill level and working time of personnel

Cost Indicators for Labour/Construction		
Type of Labour/Construction Machinery	*Workload per m Penstock [h]*	*Hourly Cost Rate*
Use of a Crane	0.25	US$ 94.34
Excavation	0.25	US$ 50.00
Foreman	0.10	US$ 37.74
Skilled Worker	0.33	US$ 22.64
Unskilled Worker	0.66	US$ 15.10

PROJECT DEVELOPMENT COSTS (cont'd)

→ **Penstock Foundation Material Costs**

Foundation material costs are dependent on the diameter of the penstock and are calculated based on local prices for concrete and steel.

Costs for Reinforced Concrete Foundations	
Costs for Concrete per m^3	US$ 133.41
Costs for Steel per t	US$ 2,376.15

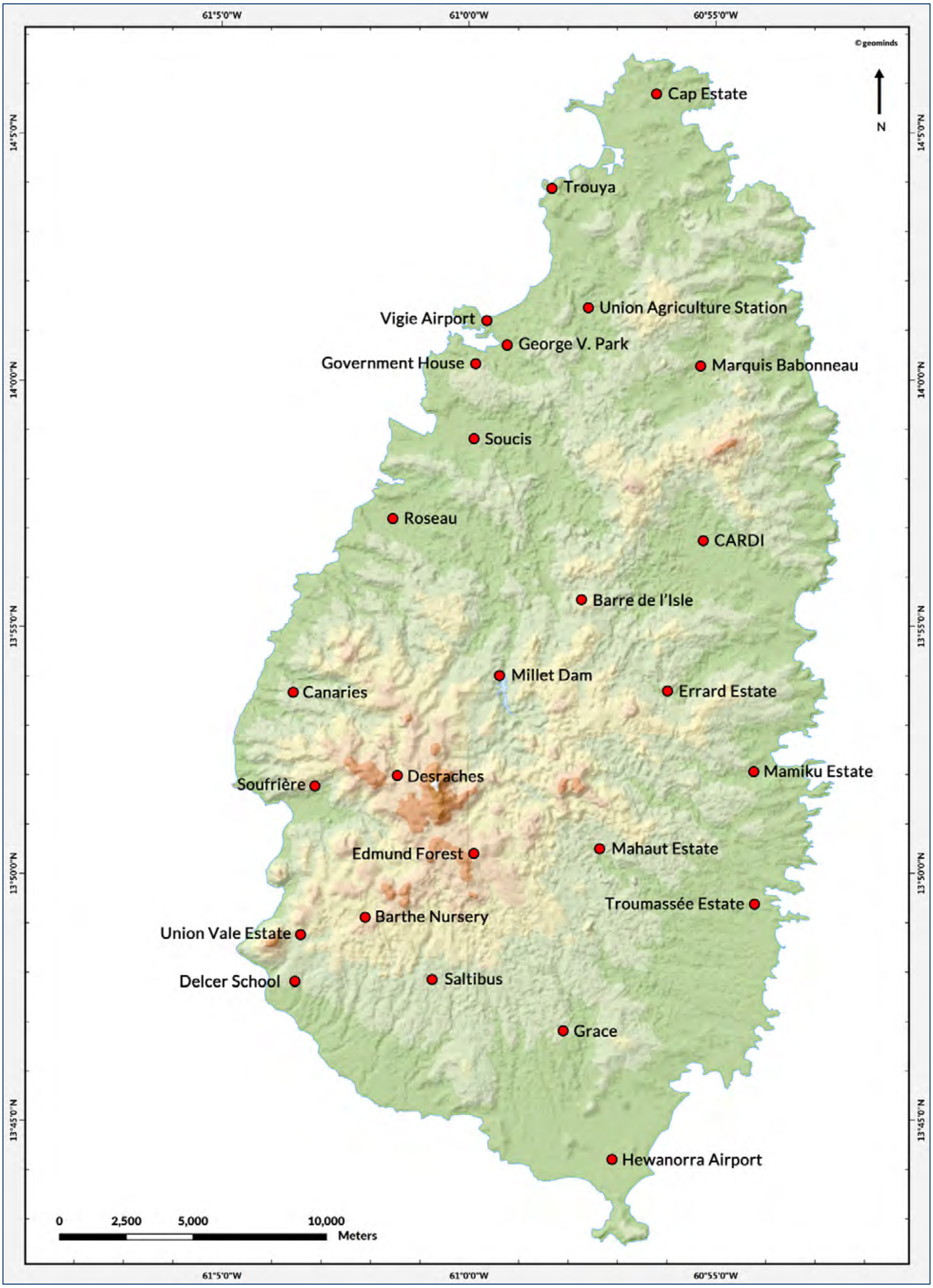
Penstock Diameter	Reinforced Concrete Foundation per 6m Penstock length	
[mm]	*Volume [m^3]*	*Cost per Unit*
300	0.027	US$ 108.70
400	0.035	US$ 111.37
500	0.044	US$ 114.25
600	0.054	US$ 117.34
700	0.064	US$ 120.63
900	0.086	US$ 127.85
1200	0.124	US$ 140.23
1500	0.168	US$ 154.49

→ **Penstock Overseas Shipment Costs**

Costs for shipment are dependent on amount of segments fitting in a 20' container and includes land transport. US$ 1,355.88

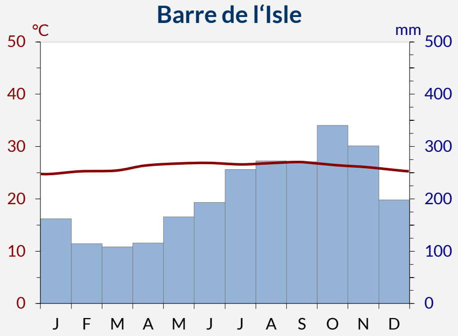
Penstock Diameter	Penstock Units per Container
[mm]	*Quantity*
300	52
400	27
500	18
600	15
700	7
900	5
1200	1
1500	1

A 02 - Long-term Rainfall Data of Saint Lucia

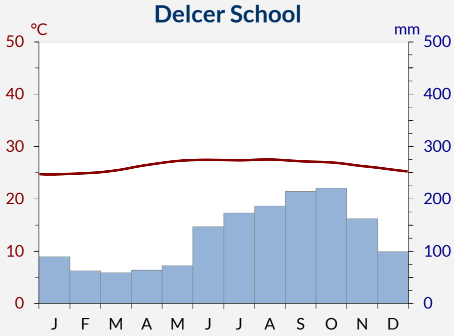


CLIMATE CHARTS OF THE RAINFALL GAUGING STATION NETWORK OF SAINT LUCIA

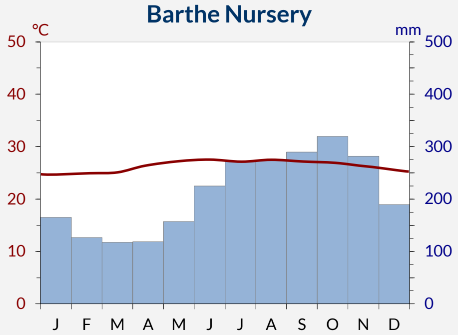
Barre de l'Isle



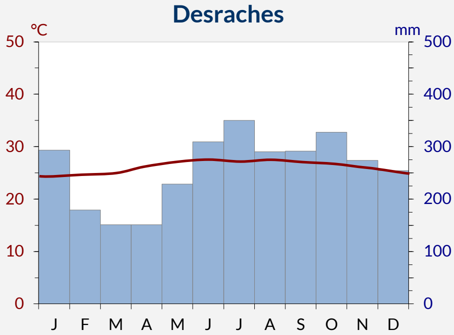
Delcer School



Barthe Nursery

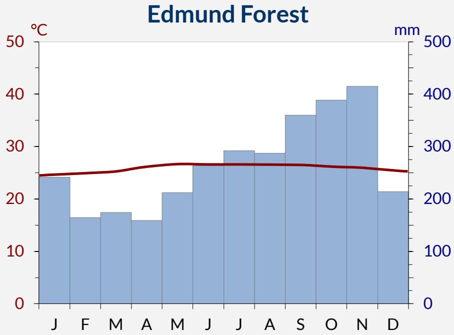


Desraches

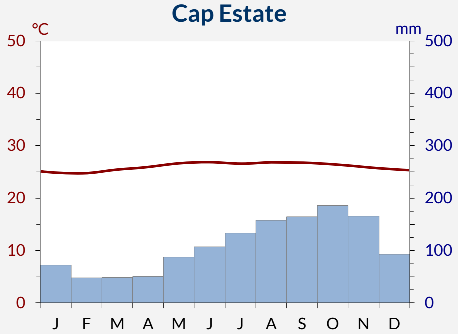


Canaries

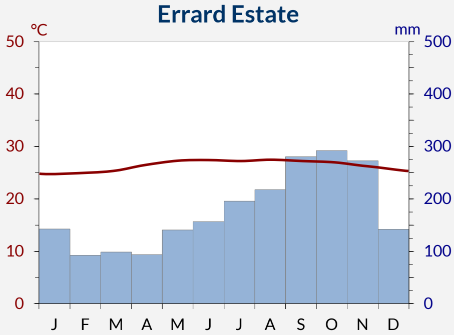
Edmund Forest



Cap Estate



Errard Estate



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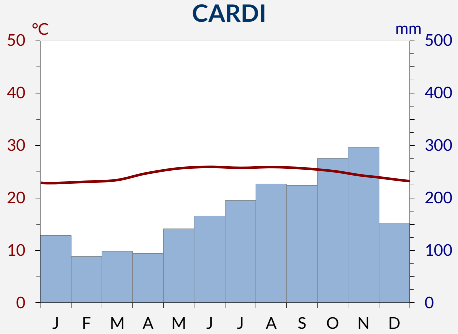
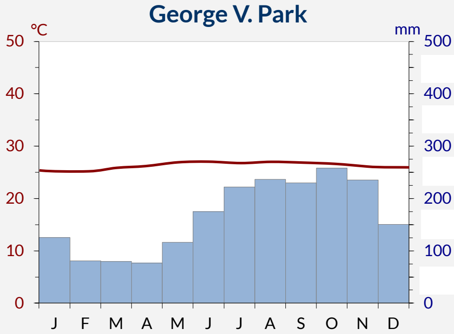
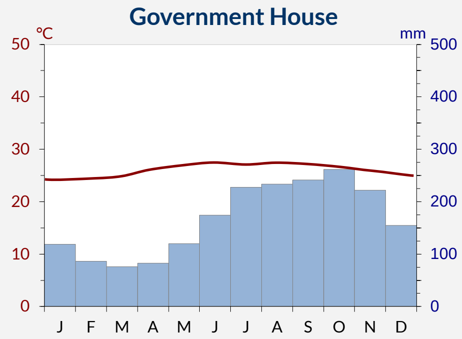
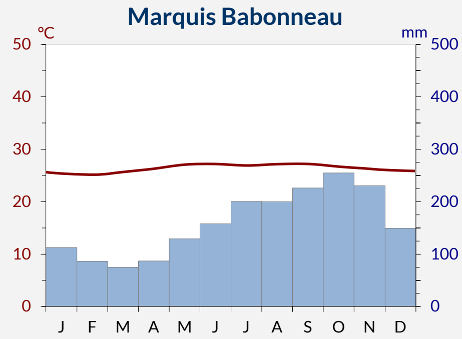


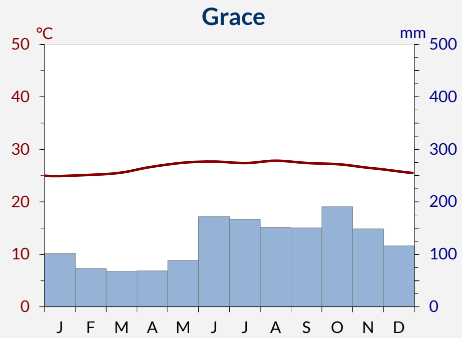
George V. Park

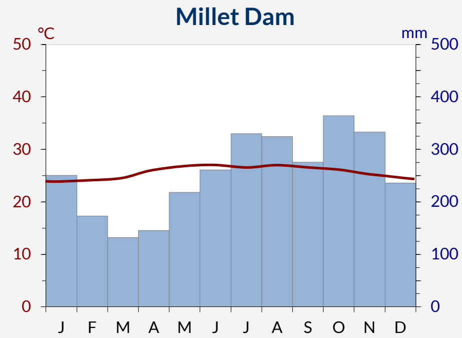


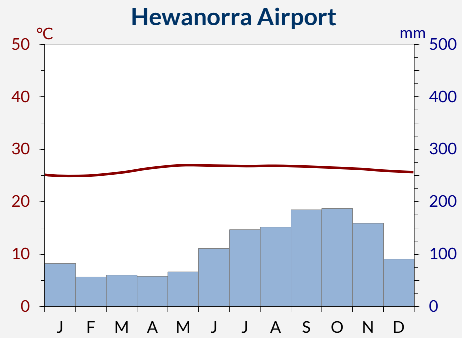
CLIMATE CHARTS OF THE RAINFALL GAUGING STATION NETWORK OF SAINT LUCIA (cont'd)

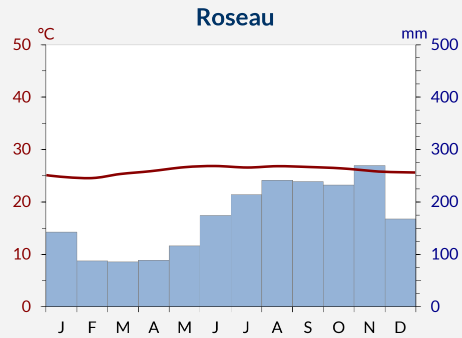


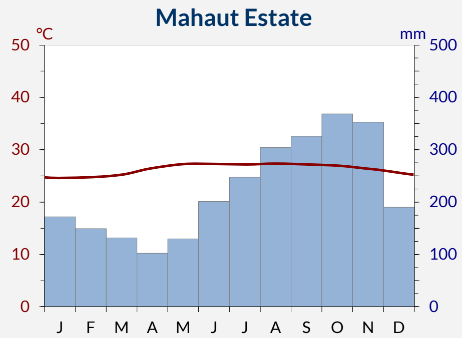


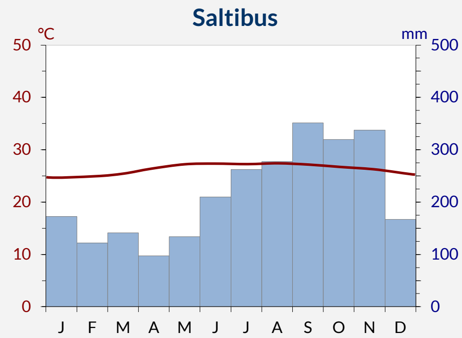


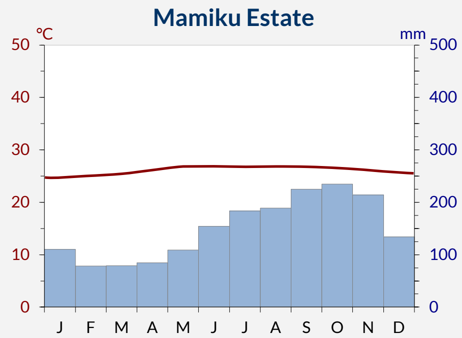


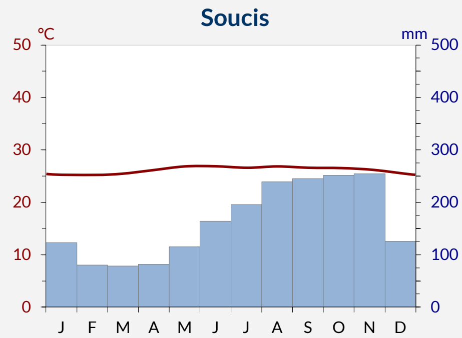




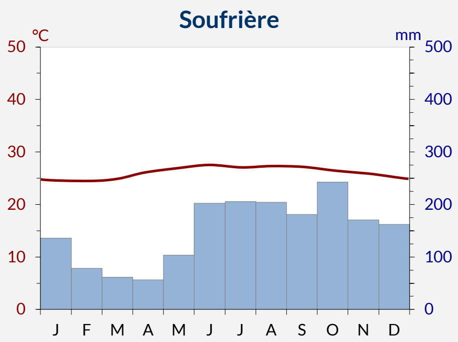


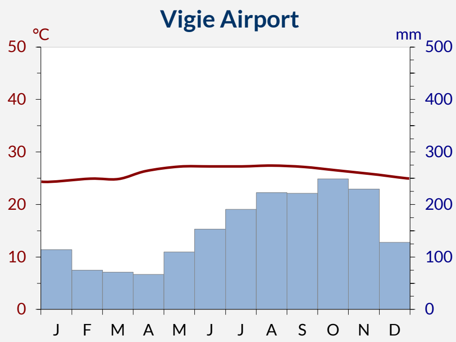


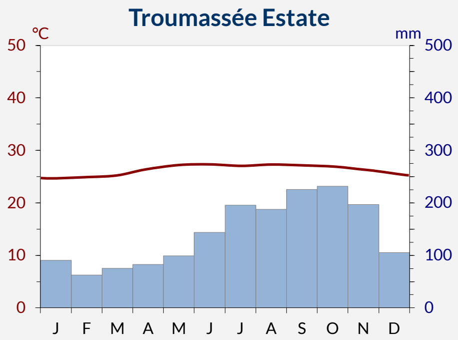


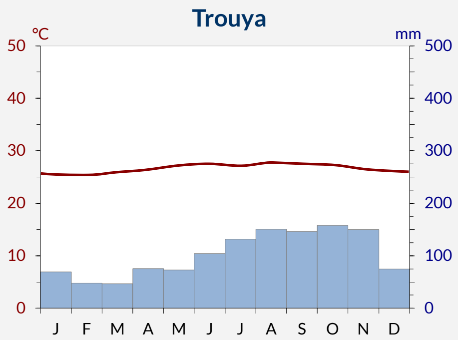


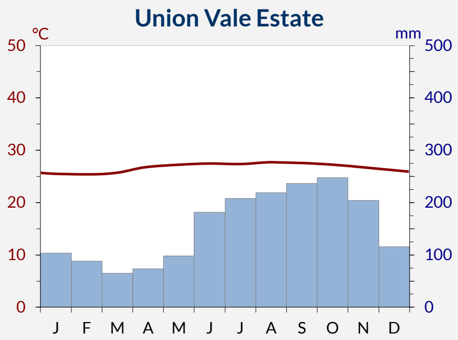
CLIMATE CHARTS OF THE RAINFALL GAUGING STATION NETWORK OF SAINT LUCIA (cont'd)

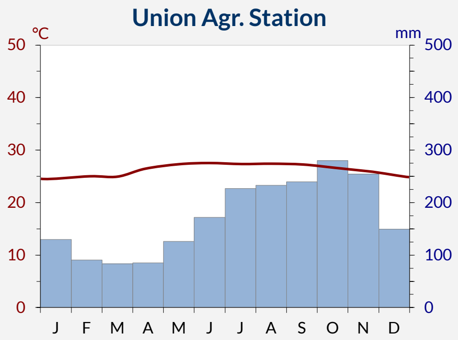




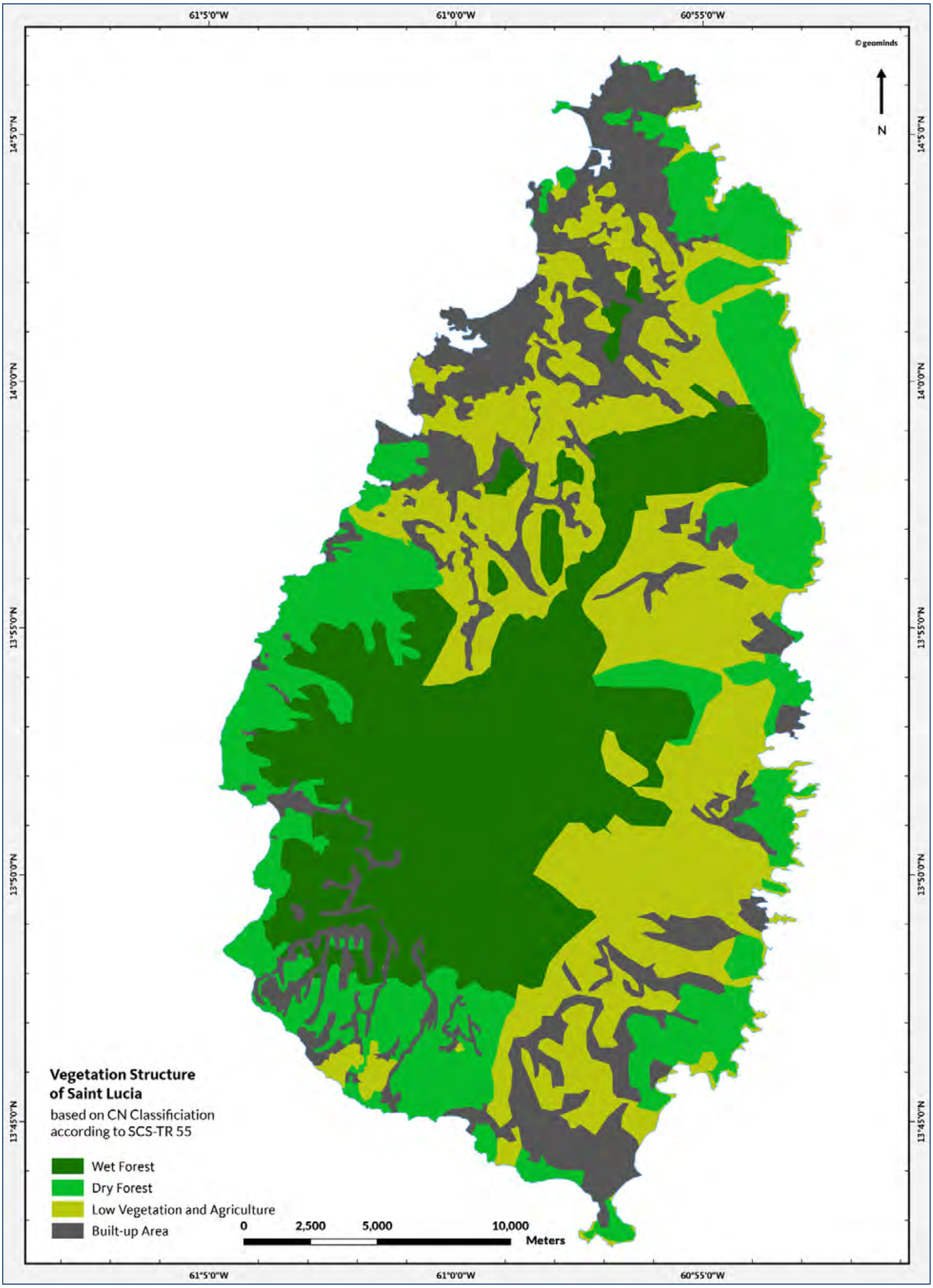








A 03 - Vegetation Structure Classification Map of Saint Lucia



A 04 - Soil Classification Map of Saint Lucia