Proposed Expansion of Rodrigues Airport

Draft Environmental and Social Impact Assessment Report

VOLUME 1 OF 3

Report prepared for Airport of Rodrigues Ltd.

Airport of Rodrigues Ltd.

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AFD Agence Française de Développement
AGL Airfield Ground Lighting
AOI Area of Influence
AQNR Anse Quitor Natural Reserve
ARL Airport of Rodrigues Ltd
AML Airports of Mauritius Co Ltd
ASDA Accelerate-Stop Distance Available
ATC Air Traffic Control
CIA Cumulative Impact Assessment
CCR Constant Current Regulators
CCTV Close Circuit TeleVision
DVOR Doppler VHF Omnidirectional Radio Range
DME Distance Measuring Equipment
EC European Commission
EHS Environment Health Safety
EHSG Environmental, Health and Safety Guidelines
EIA Environmental Impact Assessment
EPA Environment Protection Act
E&S Environmental & Social
ESIA Environmental and Social Impact Assessment
ESCP Environmental and Social Commitment Plan
ESF Environmental and Social Framewor
ESMP Environmental and Social Management Plan
ESS Environmental and Social Standard
ESS1 Assessment and Management of Environmental and Social Risks and Impacts
EU European Union
E&S Environmental and Social
GoM Government of Mauritius
GSE Ground Service Equipment
HVAC Heating, Ventilation, and Air Conditioning
ICAO International Civil Aviation Organisation
IFC International Finance Corporation
MDGs Millennium Development Goals
LDA Landing Distance Available
LED Light Emitting Diode
LON Length of need
NDB Non-Directional Beacon
OLS Obstacle Limitation Surface
PAPI Precision Approach Path Indicator
PCA Plaine Corail Airport
PDR Preliminary Design Report
PQC Pavement Quality Concrete
RAL Runway Approach Lights
RCSS Rodrigues council of Social Services

RESA Runway End Safety Area
RESA-O Overshoot Runway End Safety Area
RESA-U Undershoot Runway End Safety Area
RFF Rescue and Fire Fighting
RFFS Rescue and Fire Fighting Services
RGL Runway Guard Lights
RRA Rodrigues Regional Assembly
RTIL Runway Threshold Identification Lights
TODA Take Off Distance Available
ToR Terms of Reference
TORA Take Off Runway Available
SCP Stakeholder Commitment Plan
SEP Stakeholder Engagement Plan
SIDPR Sustainable Integrated Development Plan for Rodrigues
VDGS Visual Docking Guidance System
VEC Valued environmental and Social component
VHF / UHF Radio frequencies
VIP Very Important Person
VSAT Very Small Aperture Terminal
WB World Bank
World Bank ESF World Bank Environmental and Social Framework
WTP Wastewater Treatment Plant

1 Non-Technical Executive Summary

1.1 Introduction

Plaine Corail Airport in Rodrigues Island is managed by Airport of Rodrigues Ltd. (ARL), a subsidiary of the Airports of Mauritius Co. Ltd. (AML).

An Environmental and Social Impact Assessment for the New runway at Plaine Corail Airport in Rodrigues Island was prepared in 2019 to meet the requirements of the Government of Mauritius and those of the Agence Française de Développement (AFD) and the European Union (EU).

Airport of Rodrigues Ltd is now proposing to seek financing support from the World Bank for the proposed expansion of the Rodrigues Airport, and is therefore required to update the ESIA to meet the requirements of the World Bank Environmental and Social Framework (ESF).

This draft ESIA document has therefore been updated to meet the requirements of the World Bank ESF and will be finalized once the detailed design has been completed

A final version of the ESIA will be prepared and disclosed before project appraisal (preliminarily planned for April 23) based on the additional studies identified in the draft ESIA (this document) and the finalization of the airport design.

1.2 Project description

The updated scope of the proposed expansion of the Rodrigues Airport is as follows:

Infrastructure works

- New runway 2100x45m
- Taxiway and aprons
- Airfield ground lighting
- Approach lights
- Flood lights masts
- PAPIs
- CNS equipment and landing procedures
- Landside car park
- Stormwater network
- Potable water network
- Sewerage network
- Sewerage treatment plant
- Maritime rock revetment works
- Desalination plant

Building works

- Air traffic control tower
- Rescue and fire fighting station
- Meteo building
- Quarantine building
- Incinerator and associated building
- Boat house for the national coast guard
- Power centre
- Cold storage building

Note that the Air Traffic Control tower and the Rescue and Fire Fighting Station, initially located within the perimeter of Anse Quitor Nature Reserve, has been relocated outside the reserve. Hence the draft ESIA is updated accordingly.

1.3 Environmental and social baseline conditions

1.3.1 Physical environment

For the purposes of the physical environment baseline description, the Area of Influence shown in Figure 1 as defined in the initial ESIA 2019 had been subdivided into:

- The “large area” includes the airport and its remote surroundings, which are known to be influenced by the direct and indirect impacts of the airport;
- The “restricted area” is the project footprint’s direct surroundings, which are considered potentially directly impacted by the project.

The area of Influence will be reviewed further, in a manner consistent with the requirements of the ESSs, in the light of the detailed design and technical information gathered on the project on the one hand, and the collection and analysis of environmental and social baseline information and data on the other hand.

As such the biophysical area of influence will include ground and underground areas as appropriate, being on the landward side the adjoining Anse Quitor Nature Reserve, the river and its estuary and on the seaward side a portion of lagoon and islets. The aerial area of influence will include the area potentially affected by emission of pollutants in the atmosphere.

It is recalled that an area of influence encompasses, as appropriate[1]:

(i) the primary project site(s) and related facilities that the client (including its contractors) develops or controls, such as power transmission corridors, pipelines, canals, tunnels, relocation and access roads, borrow and disposal areas, construction camps;

(ii) associated facilities that are not funded as part of the project (funding may be provided separately by the client or by third parties including the government), and whose viability and existence depend exclusively on the project and whose goods or services are essential for the successful operation of the project;

(iii) areas potentially impacted by cumulative impacts from further planned development of the project, any existing project or condition, and other project-related developments that are realistically defined at the time the Social and Environmental Assessment is undertaken; and

(iv) areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location.

The area of influence does not include potential impacts that would occur without the project or independently of the project.

[1] International Finance Corporation, Performance Standard 1 Social and Environmental Assessment and Management Systems

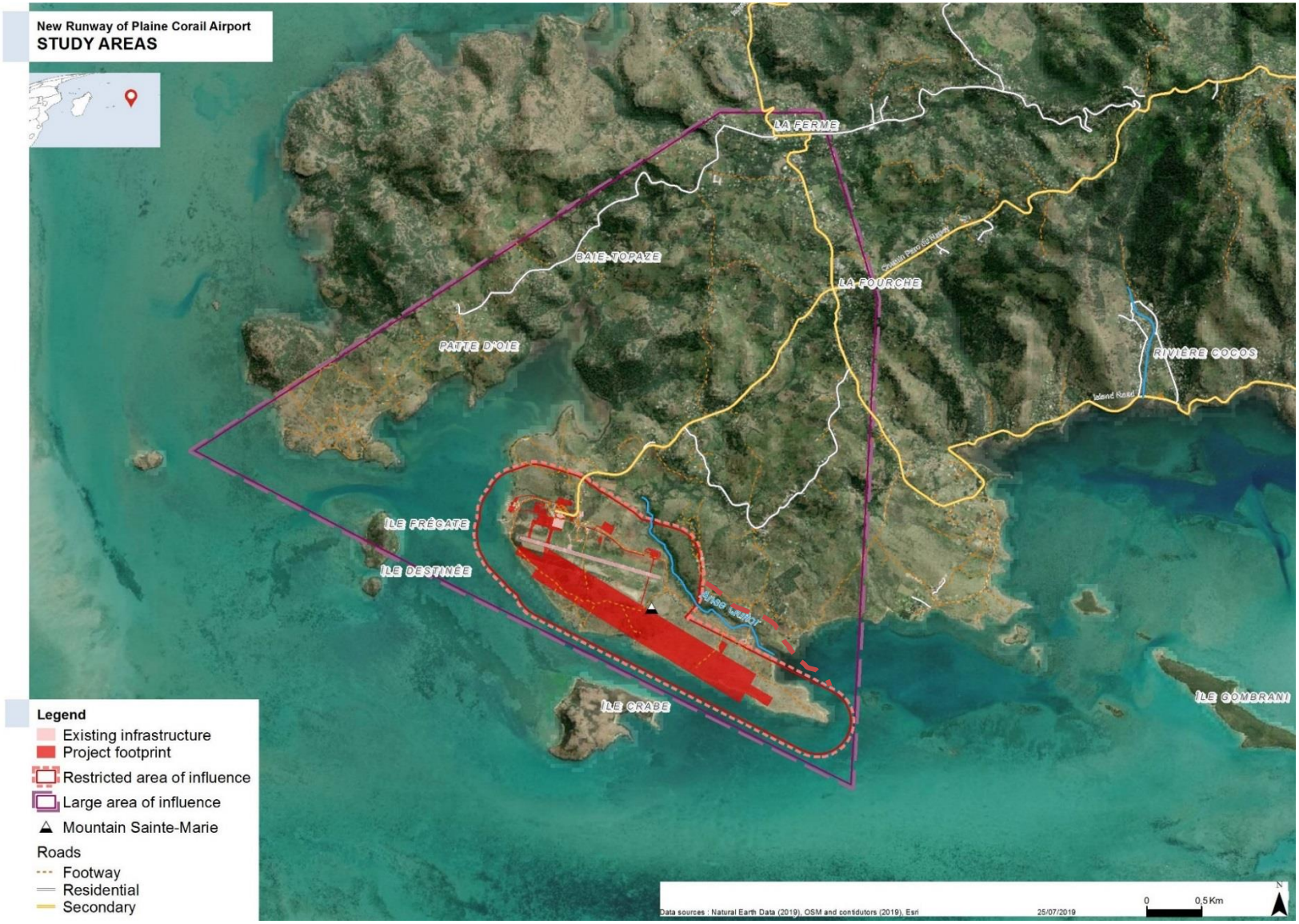


Figure 1: Area of influence (to be updated at final ESIA stage)

1.3.1.1 Geographical overview

Rodrigues is an island of volcanic origin belonging to the Mascarene Islands, located in the South Western Indian Ocean. It is 18 km long, 6.5 km wide and covers a surface area of 108 km².

The capital city is Port Mathurin, located on the opposite side of the island from Plaine Corail, in the northeast.

The island has a general mountainous topography with alluvial plains in the north and south. It is organized around a central ridge, from which steep ravines radiate. The valley bottoms usually remain dry and are only affected by torrential flows during heavy cyclonic rains.

However, the southwestern part of the island is dominated by a karst plain of coral sandstone over an area of about 10 km².

The island is surrounded by a large coral reef with several islets that emerge from it.

1.3.1.2 Climate and meteorological conditions

Rodrigues lies near the edge of the southern tropical belt. The climatological regime is mild tropical maritime, determined by the alternation of the two seasons:

- Summer from November to April, the rainier and warmer season, during which tropical cyclones occur,
- Winter from May to October which is cooler and relatively drier.

The average annual rainfall over Rodrigues is 1348 mm. The rainfall increases from 800 mm on the coast to over 1,600 mm on the summits.

The wind pattern on the coast of Rodrigues is influenced year-round by two types of persistent winds: south-easterly trade winds and Austral westerly ones. Most of the wind comes from the East and South-Southeast directional sector with a mean velocity of 7.68 m/s. During extreme events, such as cyclones, wind gusts can reach a speed of up to 44.03m/s.

The most frequent natural disasters faced by Rodrigues are cyclones and high intensity rainfall: Rodrigues can be affected by hurricanes arriving from the east from November to April. Since the early 60's, 74 tropical disturbances have occurred in the vicinity of Rodrigues.

On the other hand, there is no record of any significant tsunami that has affected Rodrigues, but there is a possibility that a tsunami generated from either the Sumatra or the Makran source could affect the coasts of Rodrigues.

According to the 'update of the nationally determined contribution of the Republic of Mauritius' published on 1 October 2021, Rodrigues Island tends to be more affected by the strongest winds and deepest storm surge. On the island, a 100-year event would generate winds exceeding 200 km/h. As compared to the island of Mauritius, Rodrigues is more exposed to longer periods of water scarcity.

1.3.1.3 Marine conditions

The mean magnitude of current in deep water near Rodrigues is 0.17 m/s and most of the magnitude is inferior to 0.3 m/s, 89%. Directions vary with a predominance of South West – North East currents.

The reef lagoon's hydrodynamics are complex, although three lagoonal passes can be identified in the fringing reef around Rodrigues, none of them are in front of Plaine Corail.

Alongside the runway, currents are flowing from South-East to North-West throughout the duration of the year and fluctuate from almost no magnitude to 0.5 m/s with ebb and flow tide currents. They are tide-generated, the wave height inside the lagoon being very small. The current coefficient can briefly be reversed during light winds and strong tides.

Rodrigues' tides can be classified as meso-tidal due a tidal range inferior to 2 m. Sea level has risen by 6.7 cm between 1950 and 2001.

The coral reef fringing Rodrigues serves as a natural barrier that protects adjacent shorelines from offshore coastal hazards such as storms surges and waves. Plaine Corail is well protected from extreme waves due to the reef which is up to 8.3 km wide. In the canal between Crab Island and the runway, significant height reaches 45 cm when eastern wind blows with 10.5 m/s velocity (highest 10%) and 20 cm without wind.

Sea levels in the southwest Indian Ocean based on reconstructed tide gauge data and Topex/Poseiden altimeter for the period 1950-2001 shows a rise of around 1.5 mm/yr at Port Louis and 1.3 mm/yr at Rodrigues, (Church, et al., 2006). Analysis of Port Louis data for the period 1987-2007 gives a mean rise of 2.1 mm/yr for the last 10 years. This slightly higher rise is consistent with IPCC WGII AR4 conclusions, although longer period of measurements are necessary for reliable conclusions.

1.3.1.4 Climate Change

1.3.1.4.1 Sea level rise

Sea level have started to rise under the impact of climate change. This increase is estimated by the IPCC for different parts of the world. For the South Indian Ocean, the estimates are as follows compared to the period 1995-2014 according to 2 scenarios:

Period	Sea level rises	
	Scenario SSP2-4.5 *(middle-of-the-road development)*	Scenario SSP5-8.5 *(Fossil-fuelled development)*
Near term (2021-2040)	+0,1m	+0,1m
Medium Term (2041-2060)	+0,2m	+0,3m
Long Term (2081-2100)	+0,6m	+0,7m

1.3.1.4.2 Tropical cyclones

IPCC projections show medium confidence in evolution of tropical cyclones according to document: Climate Change 2021: The Physical Science Basis.

Projections for Madagascar (no projections for Indian Ocean) show medium confidence of decrease in frequency and increase in intensity. Cyclones will potentially be less numerous with more intense winds and rainfall. Lower minimum pressure and stronger winds may generate more significant surges. According to IPCC, "*The increase in global TC* [Tropical Storm] *maximum surface wind speeds is about 5% for a 2°C global warming across a number of high-resolution multi-decadal studies (Knutson et al., 2020)*" and "*A projected increase in*

global average TC [Tropical Storm] *rain rates of about 12% for a 2°C global warming* […] *(Knutson et al., 2020)".*

1.3.1.5 Terrestrial geology and geotechnics

Rodrigues Island is located on the eastern part of a roughly E-W trending fracture zone, east of the Mascarene Plateau.

The geological history of Rodrigues Island is marked by three separate volcanic activity periods:

- The first period led to the production of a basalt basement;
- The second period began with the formation of a central cone made up of aerial and subaerial lava, slags and cinders;
- The third period was a hydrothermal activity that took place on the centre of the cone, followed by an explosive episode. A volcanic plug of hawaiites and basalts filled the depression.

Located in the Southern part of Rodrigues Island, the general geological profile of the project's new runway, based on the results of in-situ ground investigations, is:

- Calcarenites composed of alternating fine to coarse sands and grained corals deposits rated by clayey beds (average thickness of 5 m) and with some areas affected by depressions in the calcarenites or by karstic evolution, including the formation of voids and caverns,
- Basalts – composed, from top to bottom of Basalt series, of highly to slightly weathered basalts, with high plasticity silty clays with intervals of gravels and cobbles (average thickness of 9.5m),
- Breccias – composed of highly weathered breccia, often located beneath Calcarenite deposits up to a 10 m depth, with high plasticity silty clays and medium to fine weathered basalts gravel (average thickness of 3 m).

Numerous voids have been located in the proposed runway area. It shows that the Eolian Calcarenite Formation is a geological unit affected by karstic dissolution. But uncertainties remain with regard to relationships between geophysical/drilling anomalies attributed to karstic features and the known caverns located along the western flank of Anse Quitor.

Plaine Corail's local topography ranges from 5 m to 39 m above mean sea level. The highest point near Plaine Corail is the Mount Sainte Marie.

Rodrigues Island is generally affected by important erosion resulting from:

- bad agricultural and grazing practices;
- past deforestation;
- poor building practices (especially the dispersed nature of settlements);
- steep topography;
- high intensity rainfall.

1.3.1.6 Marine and shores geology and marine turbidity

The coastal zone is mostly surrounded by fringing coral reef enclosing a shallow lagoon area – 0.5 to 3m – with local deeper channels. A shallow channel also separates the location of the future airport runway from Crab Island. The width of lagoons varies from 4-8km from the shore (4,6km from the airport runway).

The coastline is about 67 km long and is composed of different shore types: rocky stretches alternating with sandy beaches and smaller stretches of rock boulders and pebble shores. Plaine Corail shore is mostly rocky.

The western coastal area of Rodrigues lagoon is characterized by a significant amount of medium sand and mud. The Northern part of the bay is composed of mud due to the very weak current and the important water runoff during heavy rains. Bed load and resuspension occurs within the lagoon during each tidal cycle. Sediment transport under the influence of the flow is mainly from South-East to North-West.

The sea water around Rodrigues is usually very clear. However, rivers carry large amounts of debris and soil into the lagoons during heavy rain, increasing the sea water turbidity. In some places, mangroves have been planted that stabilize the sediments and prevent the turbidity spreading into the lagoon. In Baie Topaze, the northern area of Plaine Corail Airport, natural turbid plume was identified in the past.

1.3.1.7 Hydrology

Rodrigues Island is divided into 38 major river basins. The low permeability of soils generated by alteration of basalt suggests a generally low infiltration capacity, which is sometimes increased locally by the presence of fracture zones. Also, a significant proportion of surface run off water returns to the sea.

A geographical gradient is observed for the annual rainfall between coastal areas (less than 1000 mm) and the central plateau (more than 1,600 mm).

The airport is located near the Anse Quitor River which is quite deep near the actual airport runway, although as a result there is no potential flooding expected.

Runoff from the current runway flows to the shoulders and into the natural drains, thus directly discharged into the natural environment.

1.3.1.8 Hydrogeology

The hydrogeological units of the Rodrigues Islands are formed on the coast by mainly volcanic rocks and a minority of limestone rocks (called calcarenite hereby).

Plaine Corail is characterized by two types of potentially aquiferous formation:

- Basalts which are weak and altered and are defined as a fractured aquifer with double porosity: matrix and fracture porosity.
- Karst calacarenites which represent highly complex aquifers since they combine three types of porosities that contribute to groundwater flow: the matrix, fracture and karst network porosities.

The epikarst in the project area is partially represented by sinkholes when visible but also by numerous non-observable dissolution structures below the soil deposit. The process of recharging can occur from different mechanisms:

- Direct infiltration through the soil;
- Streambed infiltration (sinking stream);
- Lateral recharge from basaltic material.

In terms of volume, usually, sinking streams represent the one mode of recharge for the underlying karst aquifers. Flood events may temporarily create an inflow to the cave network through riverbeds like the Anse Quitor River or through the large number of cave collapse

sinkholes. In some areas, such as the Grande Caverne cave system's Canyon Tiyel section, the presence of an elongated collapsed depression could also act as preferential inflow during a rain event to the underground network. A considerable amount of water can circulate in the karstic network during rainstorms.

Basalt outcrops present in the new runway indicative of the potential presence of a basaltic fractured aquifer. This aquifer is probably in relation to the overall phreatic water in the Pointe Corail peninsula.

The three identified receiving environments are:

- Carbonate Karstic aquifer which has a consistent karst developed area with numerous open caves and gallery connections. The calcarenites in Plaine Corail are probably affected as well by karstic development and numerous entries of caves as identified. The cavities are mainly located below 10 m depth. This material seems to be relatively permeable.
- Basaltic aquifer which represents a small part of the geological material in the project area. No information on the groundwater level is available but probably lower than the deepest borehole that is to say 25m depth. Weathered basalt usually has high permeability compared to weathered basalt.
- Large caves and well-developed galleries. Three caves are located near Plaine Corail village, around the end of the projected runway's footprint (Caverne Bouteille, Caverne Petit Lac, Grotte Fougère).

There is no information regarding groundwater quality in the airport area. Water in the caves close to sea level is probably salty, at least in the tidal influence area. Stagnant freshwater ponds inside the caves are usually quickly invaded by biological elements and quickly become inappropriate for human consumption

Topsoil has been encountered in most exploratory holes with an average thickness of 0.25m and it was generally described as gravelled, low plasticity sandy silt with roots. This description of topsoil corresponds to a thin layer of permeable material which is a "first barrier" to a potential contamination on the surface.

1.3.1.9 Water resource and wastewater management

Drinking and fresh water needs and resource

Construction

The water requirement during construction is both for potable and non-potable use. The water demand is not known at this stage and shall be calculated by the contractor.

Given the water scarcity, it is proposed that a built in temporary containerised-type desalination plant be set up by the contractor, with all precautions taken to minimize the impact on the environment. Since only 20 feet containers can be unloaded at Port Mathurin Harbour, no 40 feet containers will be considered.

Operation

The daily water demand for Rodrigues is estimated to be 11,000 to 12,000 m³/day, satisfied by rainwater harvested by private individuals and by water provided by the public services. The daily freshwater production is provided by surface water harvesting, boreholes, and desalination of sea marine water.

The airport's water needs are used for the passenger terminal building and firefighting.

During November and December (highest passenger traffic period due to school holidays) the average daily water consumption reaches an average of 12.5 m^3 per day. For the rest of year when traffic is at its lowest, the airport's average minimum daily water consumption is 3.6 m^3 per day (rising over 12.5 in November-December).

Wastewater management

The existing airport has its own on-site wastewater treatment system consisting of a sceptic tank and a leaching field; which corresponds roughly to a primary treatment. The overflow from the septic tank is released to a leaching field. However, currently regular pumping of the overflow from the septic tank is done because the system does not work properly and the leaching field is not permeable enough. This pre-treated wastewater is carted away to the municipal wastewater treatment plant of Grenade.

The existing wastewater treatment plant will be dismantled once the new wastewater treatment plant is operational.

Stormwater management

Only natural drains enable the stormwater drainage on the Project's site, in addition to the natural slope of the existing runway which helps to drain the stormwater towards the sea, without any specific pre-treatment.

The fuel depot is equipped with a retention capacity (equipped with a disconnection valve) to collect stormwater generated therein. The loading / unloading platform is equipped with a disconnecting valve in order to direct the stormwater from the platform towards an open-air oil separator during "off duty" periods and to isolate the platform during fuel loading / unloading operations.

1.3.1.10 Physical environment sensitivity

The Physical Environment Sensitivity is summarised in Tale 1 hereafter.

Table 1: Physical Environment Sensitivity

Sub-theme	Receptor	Sensitivity
Marine and shores geology and marine turbidity	Marine sediment quality: contamination of marine sediments	Medium
	Marine sediment dynamics: physical disturbance of marine sediments	Medium
	Seawater quality: temperature, salinity, concentration of contaminant	High
	Physical coastal processes: shoreline, morphology, wave, currents	Medium
Hydrology	Stormwater management	Major
	Flooding of issues downstream of facilities	Low
	Transfer of pollution to the natural environment	Major
	Transfer of sediments to the lagoon	Major
Terrestrial geology and geotechnics and Hydrogeology Karstic environment	Carbonate Karstic aquifer	High
	Basaltic aquifer	Medium
	Caves (Plaine Corail)	Major

Water resource and wastewater management	Domestic wastewater management	High
	Water supply management	High

1.3.2 Biological environment

1.3.2.1 Terrestrial biological environment

Figure 2 shows the Area of Influence used to describe the terrestrial biological baseline conditions.

Anse Quitor is a 10.34 ha declared Nature Reserve as per the Second Schedule of the Forests and Reserves Act 1984 as amended; it was gazetted in 1982. Anse Quitor is one of the 4 nature reserves in Rodrigues and is a coastal dry ecosystem, with a limestone substrate. A Biodiversity Restoration Project was funded by the World Bank i.e. weeding of all weed-infested areas and replanting areas weeded with native species (1995-2001).

Anse Quitor is an interesting area with caves in which many bones of the extinct Solitaire and tortoise have been found, and plants grown in crater-like holes where little soil has gathered. Furthermore, Anse Quitor Nature Reserve holds the unique endemic tree of Zanthoxylum paniculatum and the rare Foetidia rodriguesiana, Terminalia benzoe, Antirhea bifurcata, and Gastonia rodriguesiana grow along the river banks in this nature reserve (source GEF SGP, 2011).

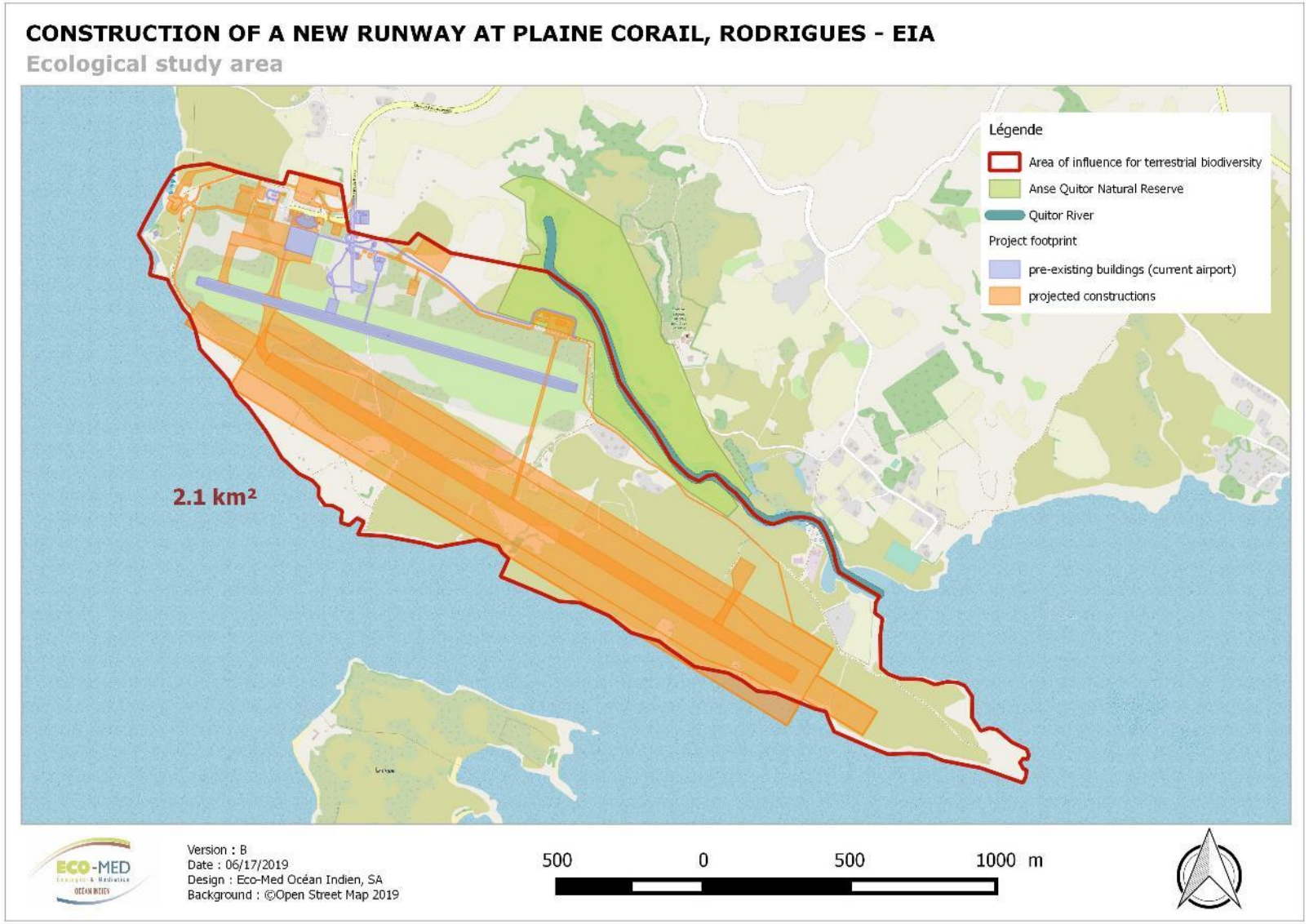


Figure 2: Area of influence – Terrestrial Biodiversity

1.3.2.1.1 Vegetation and flora

Ten terrestrial vegetation and habitat types are recorded in the area of influence (refer Table 2 and Figure 3).

Table 2: Habitat types recorded in the area of influence (ESIA 2018)

Sensitivity	Name	Area (ha)	% of the total surface
Medium	Grazing lands on basaltic resurgences	4.55	**2.03%**
Medium	Grazing lands on calcarenic substratum	66.61	**29.73%**
Medium	Coastal vegetation dominated by Ipomoea pes caprae (shore-line community)	11.52	**5.14%**
Negligible	Anthropized areas	62.77	**28.02%**
Major	Dry forest	17.57	**7.84%**
Medium	Riparian vegetation	1.20	**0.54%**
Medium	Estuarine habitat	8.25	**3.68%**
Medium	Calcarenic dry lawns of anthropogenic origin	2.19	**0.98%**
Low	Coastal grasslands dominated by secondarized thickets (*Lantana camara*)	25.55	**11.40%**
Negligible	Secondarized thickets (*Leucaena leucocephala*)	23.84	**10.64%**

As per the World Bank ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources, “Habitat” is defined as a terrestrial, freshwater, or marine geographical unit or airway that supports assemblages of living organisms and their interactions with the non-living environment.

ESS 6 requires a differentiated risk management approach to habitats based on their sensitivity and values. This ESS addresses all habitats, categorized as ‘modified habitat’, ‘natural habitat’, and ‘critical habitat’, along with ‘legally protected and internationally and regionally recognized areas of biodiversity value’ which may encompass habitat in any or all of these categories.

- AQNR is defined as a ‘critical habitat’ as per ESS6 in as much as it meets the definition below:
- Critical habitat is defined as areas with high biodiversity importance or value, including: (a) Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches; (b) Habitat of significant importance to endemic or restricted-range species; (c) Habitat supporting globally or nationally significant concentrations of migratory or congregatory species; (d) Highly threatened or unique ecosystems; and € Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).
-

Table 2 will be updated during the finalisation of the ESIA as part of the overall review of the terrestrial biodiversity study.

Note that the shores of Crab’s Island will need to be characterized following the additional baseline, if these shores are used for turtles nesting, it will be considered a critical habitat; Figure 3 will be updated accordingly.

Native flora recorded in the area of influence and sensitivity assessment are listed in Table 3. The most threatened species recorded in the area of influence for terrestrial biodiversity, as per IUCN red list of threatened species: (updated 2022):

- Critically endangered (CR) species are recorded at the study site, both are located inside the project area, such as *Hyophorbe verschaffeltii, Polyscias rodriguesiana, Latania verschaffeltii, Zanthoxylum paniculatum, Antirhea bifurcata Foetidia rodriguesiana;*
- Endangered (EN) species are recorded at the study site, which are all partially located inside the project footprint such as *Diospyros diversifolia , Fernelia buxifolia; Clerodendrum laciniatum*

Sarcostemma viminale (now referenced as *Cynanchum viminale (L.) L.*), *Terminalia bentzoe subsp. Rodriguesensis*.are not listed on the IUCN red list of threatened species; they are listed in the red list of Reunion Island.

Note that Figure 4 will be updated at final ESIA stage to reflect the above

Table 3: Native flora recorded in the area of influence and sensitivity assessment

Type	Status	Sub items	Area/number of specimens inside the area of influence	Sensitivity
Flora	Plant species of major sensitivity (IUCN - CR)	*Hyophorbe verschaffeltii*	43	**Major**
		Polyscias rodriguesiana	7	
		Latania verschaffeltii	10	
		Zanthoxylum paniculatum	1	
		Antirhea bifurcata	1	
		Foetidia rodriguesiana	3	
Flora	Plant species of high sensitivity (IUCN - EN)	*Diospyros diversifolia*	2	**High**
		Fernelia buxifolia	2	
		Clerodendrum laciniatum	3	
Flora	Plant species of high sensitivity (not found in IUCN)	*Terminalia bentzoe subsp. Rodriguesensis*	28	
Flora	Plant species of medium sensitivity: 13 species	*Adiantum rhizophorum, Camptocarpus sphenophyllus, Cyperus iria, Mathurina penduliflora, Nephrolepis biserrata, Pandanus heterocarpus, Paspalidium geminatum, Phymatosorus scolopendria, Pleurostylia putamen, Rhizophora mucronata, Sarcanthemum coronopus, Secamone rodriguesiana, Tournefortia argentea.*	118	**Medium**
Flora	Plant species of low sensitivity: 9 species	*Dodonaea viscosa, Dracaena reflexa, Elaeodendron orientale, Ficus reflexa, Ficus rubra, Phyllanthus dumentosus, Premna serratifolia, Sarcostemma viminale, Thespesia populnea*	287	**Low**

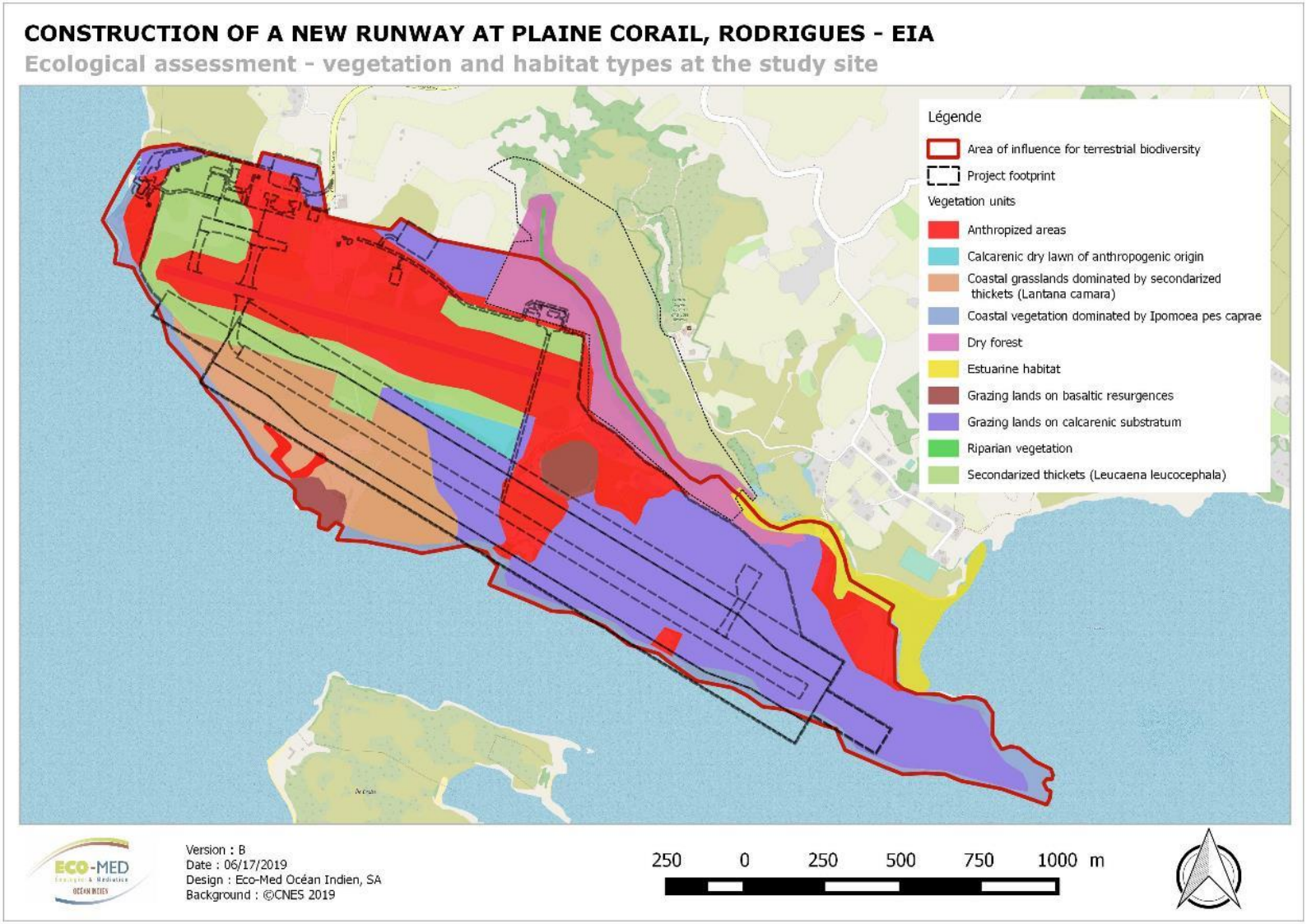


Figure 3: Vegetation and habitat types mapping

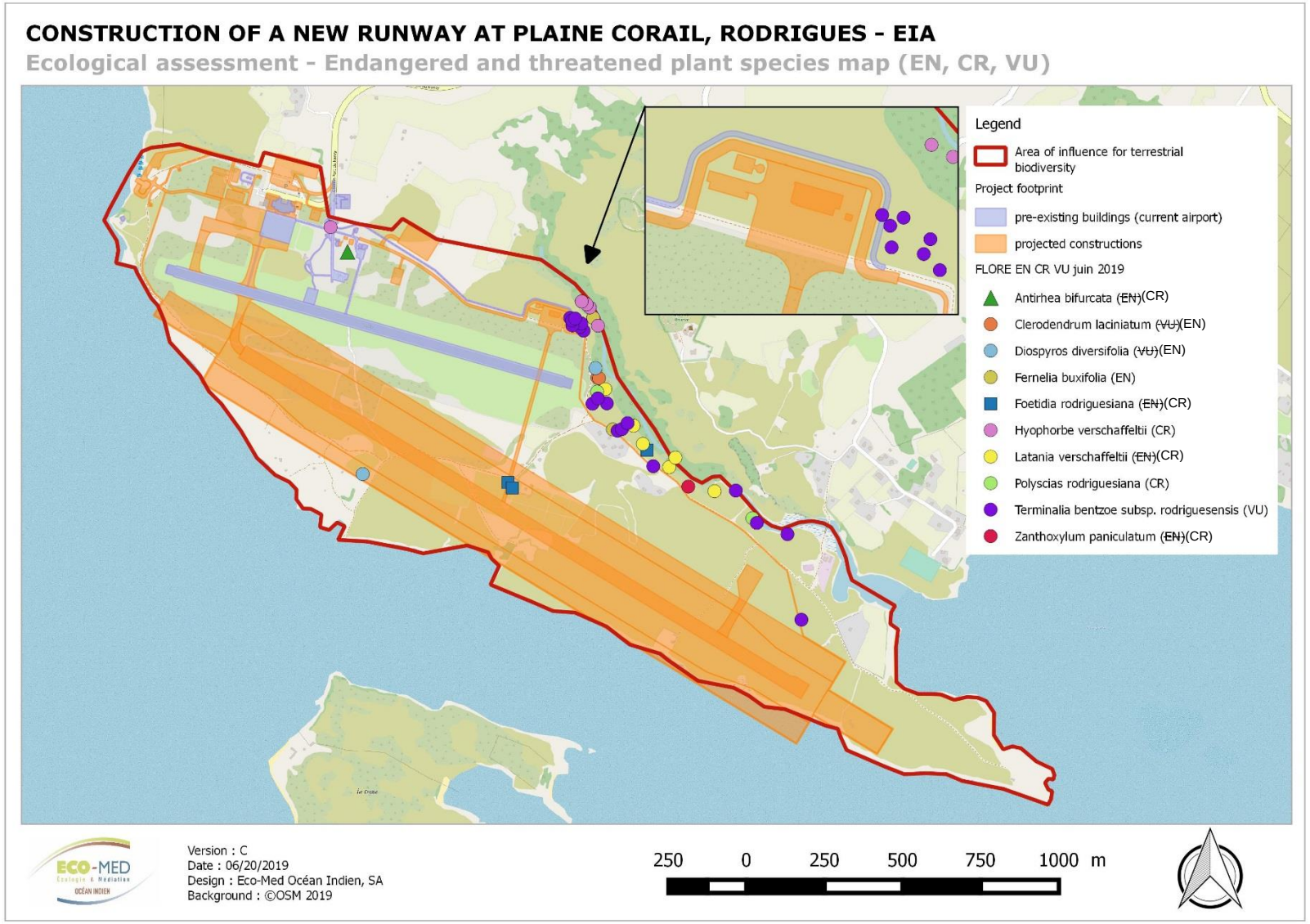


Figure 4: Endangered and threatened plant species map

1.3.2.1.2 Fauna

The baseline of terrestrial fauna is:

- Mammals: mainly bovid (cows, goats, sheep) and other domestic (cat, dog) or introduced animals (rats). There is only one native species, classified as endangered (IUCN): *Pteropus rodricensis*, an endemic bat. Only some individuals were observed flying over the area.
- Reptiles: mainly of exotic origin. Only one species is presumed to be native, *Lepidodactylus lugubris*.
- Birds: mainly exotic population. No species with a particular conservation status observed in the area.
- Molluscs: well represented by native and endemic species. *Tropidophora articulata* has an "endangered" status (IUCN red list). However only empty shells were found on the site.
- Crustaceans: no threatened species.
- Insects: no threatened species (note that the inventory period, one week after the passage of a cyclone, was not favourable to a representative vision).
- Arachnids: no threatened species.
- Myriapods: no threatened species.

1.3.2.1.3 Ecological continuities

The ecological network is presented in the table 4 below:

Table 4: List of ecological continuities included within the area of influence

Ecological continuites	Function	Species concerned
Anse Quitor river	**Terrestrial corridor**	Native breeding birds (*Acrocephalus rodericanus, Foudia flavicans*), bats (*Pteropus rodricensis*), waterbirds (*Butorides striata*), reptiles (L*ygodactylus lugubris*)
Anse Quitor river	**Aerial corridor**	Bats (*Pteropus rodricensis*), marine birds (*Phaeton lepturus*)
Anse Quitor Nature Reserve	**Biodiversity reservoir**	Native plant species, i.e.: *Camptocarpus sphenophyllus, Clerodendrum laciniatum, Diospyros diversifolia, Fernelia buxifolia, Foetidia rodriguesiana, Hyophorbe verschaffeltii, Latania verschaffeltii, Mathurina penduliflora, Pleurostylia putamen, Polyscias rodriguesiana, Sarcanthemum coronopus, Secamone rodriguesiana, Terminalia bentzoe subsp. rodriguesensis, Zanthoxylum paniculatum…* Native breeding birds (*Acrocephalus rodericanus, Foudia flavicans*), bats (*Pteropus rodricensis*), waterbirds (*Butorides striata*), reptiles (*Lygodactylus lugubris*)
Coast	**Terrestrial corridor**	Waterbirds (*Butorides striata*), waders (N*umenius phaeopus, Arenaria interpres…*)
Grazing lands		
Coast	**Aerial corridor**	Waterbirds (*Butorides striata*), waders (*Numenius phaeopus, Arenaria interpres…*), marine birds (*Phaeton lepturus, Anous*

Grazing lands		*ssp., Onychoprion ssp., Sterna dougallii, Ardenna pacifica, Gygis alba, etc*)

1.3.2.1.4 Critical habitats

As per the World Bank ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources, “Habitat” is defined as a terrestrial, freshwater, or marine geographical unit or airway that supports assemblages of living organisms and their interactions with the non-living environment.

ESS 6 requires a differentiated risk management approach to habitats based on their sensitivity and values. This ESS addresses all habitats, categorized as ‘modified habitat’, ‘natural habitat’, and ‘critical habitat’, along with ‘legally protected and internationally and regionally recognized areas of biodiversity value’ which may encompass habitat in any or all of these categories.

- AQNR is defined as a ‘critical habitat’ as per ESS6 in as such as it meets the definition below:
- Critical habitat is defined as areas with high biodiversity importance or value, including: (a) Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches; (b) Habitat of significant importance to endemic or restricted-range species; (c) Habitat supporting globally or nationally significant concentrations of migratory or congregatory species; (d) Highly threatened or unique ecosystems; and € Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).

1.3.2.2 Marine biological environment

Figure 5 shows the Area of Influence used to describe the marine biological baseline conditions.

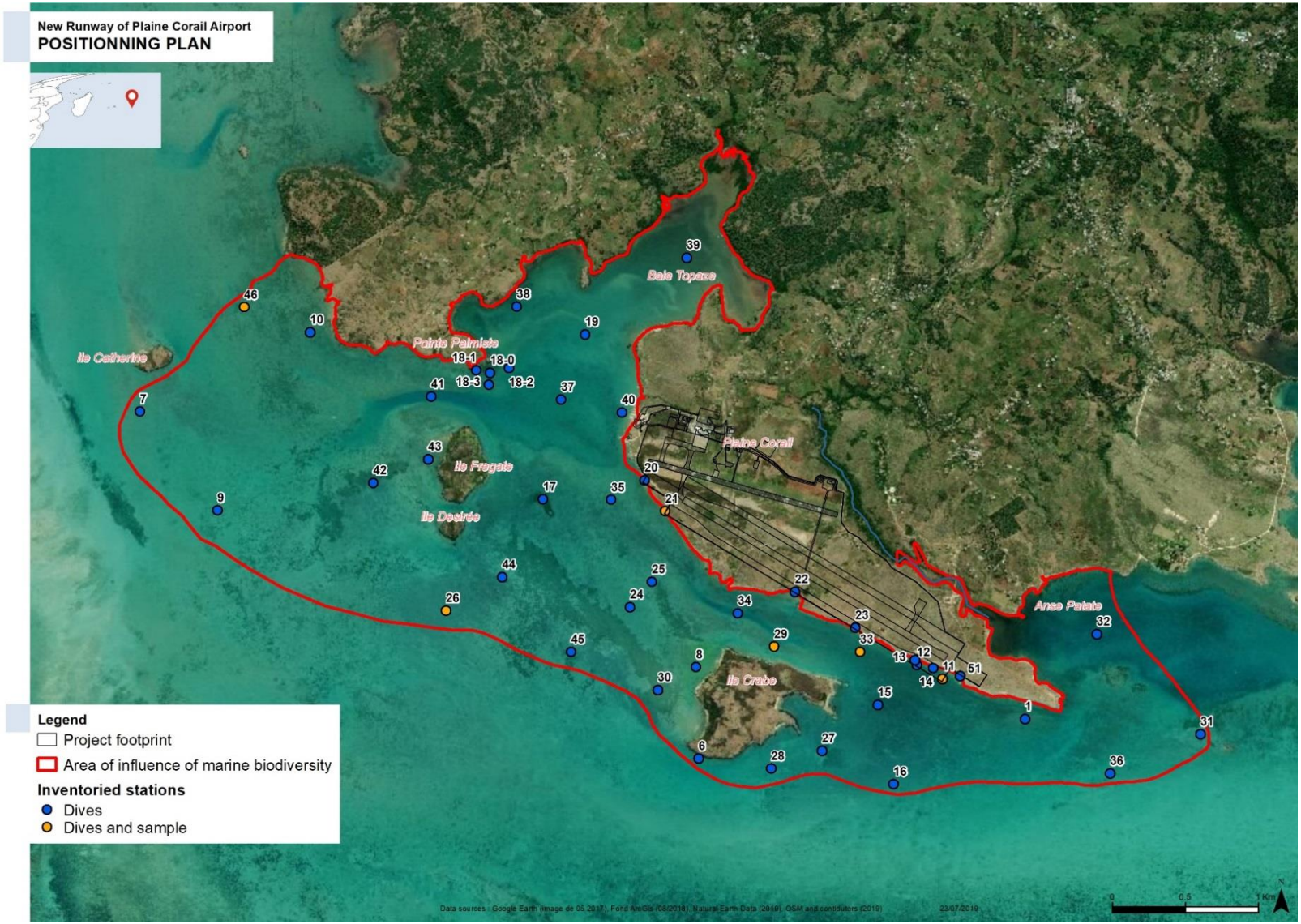


Figure 5: Area of influence for Marine biodiversity

1.3.2.2.1 Marine habitats

The habitats recorded at the area of influence are:

- Lagoon sedimentary plain: the most common profile of the study area. It includes Sandy facies, Sandy muddy facies, Muddy facies, Macro-algae facies dominated by *Caulerpa brachypus*, and Seagrass facies with *Halophila ovalis* (phanerogam)
- Infralittoral rocks dominated by photophilic algae
- Coral reef dominated by *Acropora formosa,* a species listed as Near Threatened in the latest update of the IUCN Red List of Threatened Species last Assessed (2008)

1.3.2.2.2 Marine species

Marine species are:

- Ichtyofauna: coral formations support the richest and most diverse populations, while meadows or soft areas, such as in the area of influence, are poorer. A dominance of Scaridae, Siganidae and Labridae is observed. At the edge of the sand, we find Nemipteridae, Mullidae and Dasyatidae. On the coral reef, damselfish dominate the fish community. Emperors, snappers, trevally and groupers are rare or absent and no triggerfish (ballistids) are observed.
- Marine turtles: six species of marine turtles are present in the Indian Ocean, but none were observed in the area of influence during the dives in July 2019. However, marine turtles (hawksbill turtle) occasionally visit Rodrigues. Additional marine baseline will confirm which turtle species are present if there are nesting sites in the project area of influence
- Marine mammals: No marine mammal was observed in the area of influence during the dives in July 2019 but five main species are observed in the coastal waters of Rodrigues (spinner dolphin, pantropical spotted dolphin, common bottlenose dolphin, Indo-Pacific bottlenose dolphin, humpback whale).

1.3.2.2.3 Summary: Biological environment sensitivity

Table 5: Summary of Biological Environmental Sensitivity

Theme	Sub-theme	Receptor	Sensi-tivity
Biological environment	Terrestrial habitats	Grazing lands on basaltic resurgences	Medium
		Grazing lands on calcarenic substratum	Medium
		Coastal vegetation dominated by Ipomoea pes caprae (shore-line community)	Medium
		Dry forest	Major
		Riparian vegetation	Medium
		Estuarine habitat	Medium
		Calcarenic dry lawns of anthropogenic origin	Medium
		Coastal grasslands dominated by secondarized thickets (Lantana camara)	Low
	Terrestrial flora	*Hyophorbe verschaffeltii, Polyscias rodriguesiana, Latania verschaffeltii, Zanthoxylum paniculatum, Antirhea bifurcate, Foetidia rodriguesiana*	Major
		Diospyros diversifolia, Fernelia buxifoli,a Clerodendrum laciniatum,	High
		Adiantum rhizophorum, Camptocarpus sphenophyllus, Cyperus iria, Mathurina penduliflora, Nephrolepis biserrata, Pandanus heterocarpus, Paspalidium geminatum, Phymatosorus scolopendria, Pleurostylia putamen, Rhizophora mucronata,	Medium

Theme	Sub-theme	Receptor	Sensi-tivity
		Sarcanthemum coronopus, Secamone rodriguesiana, Tournefortia argentea. Terminalia bentzoe subsp. Rodriguesensis,	
		Dodonaea viscosa, Dracaena reflexa, Elaeodendron orientale, Ficus reflexa, Ficus rubra, Phyllanthus dumentosus, Premna serratifolia, Sarcostemma viminale, Thespesia populnea	Low
	Terrestrial fauna	*Tropidophora articulata*	Medium/ High
		Tropidophora eugeniae, Lepidodactylus lugubris, Pteropus rodricensis	Low
	Marine habitats	Subalittoral rocks dominated by photophilic algae	Low
		Lagoon sedimentary plain, muddy facies	Low
		Lagoon sedimentary plain, sandy facies	Low
		Lagoon sedimentary plain, sandy-muddy facies	Low
		Lagoon sedimentary plain, macroalgae facies dominated by Caulerpa brachypus	Medium
		Lagoon sedimentary plain, seagrass facies with Halophila ovalis	Medium
	Marine fauna	Coral reef dominated by Acropora formosa	High
		Ichtyofauna	Low
		Marine turtles	High
		Marine mammals	Low

1.3.3 Transport network, electricity supply and waste management

1.3.3.1 Transport network

The road network is the main mode of transportation around the island. The main road crosses the island along a northeast-southwest axis with a secondary network that connects different municipalities.

There is one airport (Plaine Corail Airport), one port (located at Port Mathurin) and no rail network.

1.3.3.2 Electricity supply

Mauritius depends on imported petroleum products to meet most of its energy requirements. The distribution network emanates from the Port Mathurin power station where electricity is distributed. There is potential to increase the use of local and renewable energy sources such as biomass, hydro, solar and wind energy.

1.3.3.3 Solid waste management

Actually an amount of 86 tons of solid wastes are produced per week in Rodrigues. Since the year 1990 an open dump has been set up at Roche Bon Dieu but same is nearing saturation and other options had to be considered thereto.

The construction of a proper landfill is still under consideration as the site has already been vested thereto. A cell of size 50 m x 50 m has already been constructed to start receiving wastes.

The construction of the proper landfill rest on availability of funds.

Since the beginning of 2022 waste segregation at household levels has started and actually the following wastes are temporarily collected at a material recovery centre at Grenade which is under construction. It will be equipped with appropriate equipment and infrastructures such as conveyors, weighbridge, bailer machines, wheelie bins. During the actual phase, a levelled and fenced platform of area 80 m x 100 m has been constructed to receive the following segregated wastes:

- PET bottles and cans (food and drinks) -

- Glass bottles

Electronic wastes are collected through regular campaigns and temporarily stored for making available to local exporters.

Scrap metals are also collected by local exporters for shipment to Mauritius.

Actually green wastes are shredded and made available to planters for agricultural purposes. The population is sensitised on the adoption of composting at household levels; composting bins have also been granted to some families as part of a National project.

Glass bottles are shredded in view of minimising spaces and preventing eyesores; RRA is now considering the application of the shredded glasses in construction work, decoration and art work.

Construction wastes are disposed at Mt Plate which is a rock quarry site. Same upon approval of the Commission for Environment view the inert nature of such wastes.

1.3.3.4 Wastewater management

A wastewater treatment plant of capacity 50 m3 has just been constructed at Grenade. It is in the handing over phase and will be in operation shortly. In the meantime waste water is being disposed in a leaching field at Grenade itself

1.3.4 Social environment

Figure 6 shows the Area of Influence used to describe the socio-economic baseline conditions.

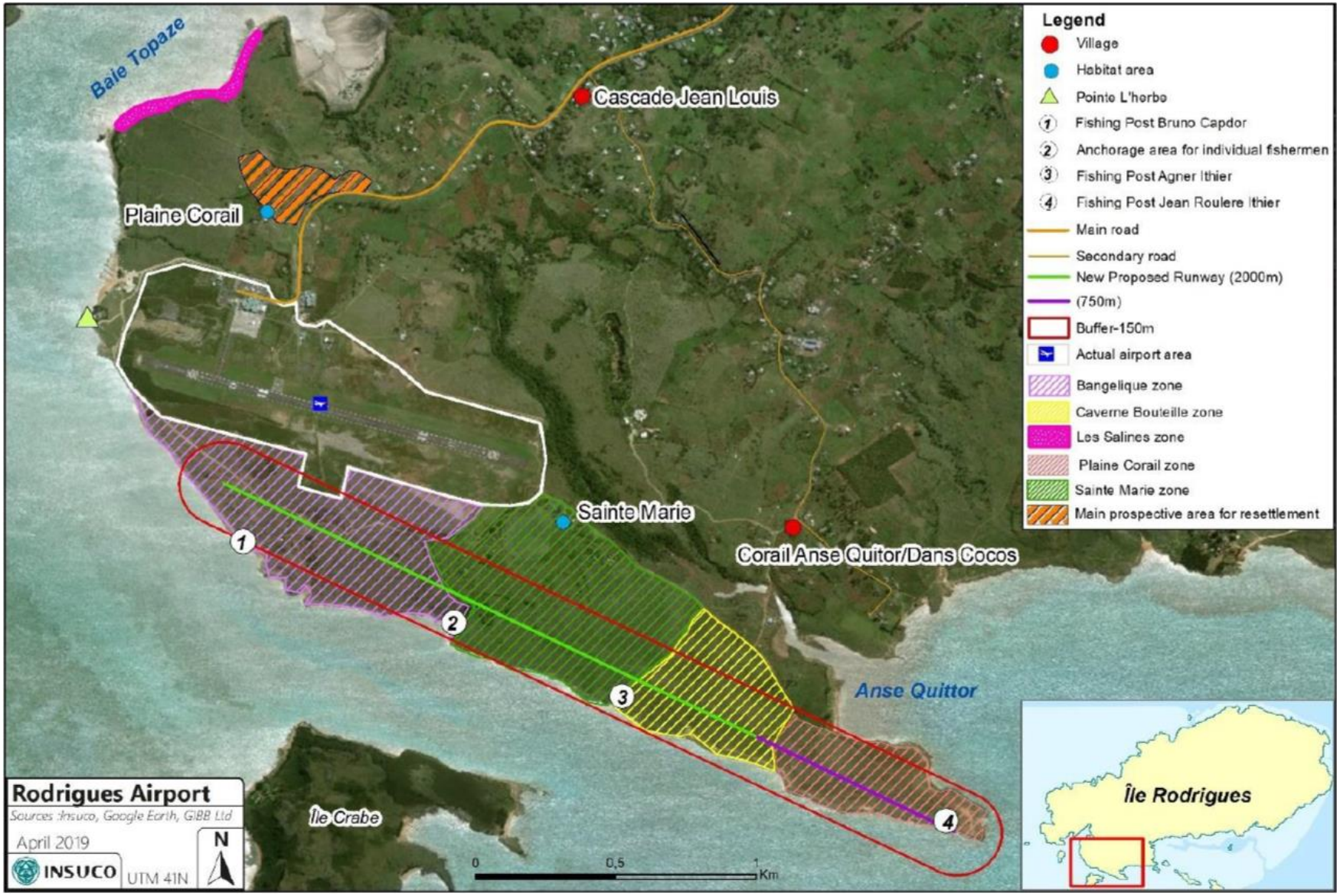


Figure 6: Area of influence of the Rodrigues Airport Extension Project

1.3.4.1 Administration and Governance

Rodrigues Island obtained its status as an autonomous territory of the Republic of Mauritius in October 2002. Its administration consists of a Parliamentary Assembly known as the Rodrigues Regional Assembly (RRA) and an Executive Council which frames and implements socio-economic policies. The Rodriguan autonomy is based on the Rodrigues Regional Assembly Act of 2001, voted in the National Assembly of the Republic of Mauritius.

The Rodrigues Regional Assembly consists of 17 members (10 elected representatives of the Government and 7 elected representatives of the opposition).

The Chief Commissioner represents the main authority of the island. The Executive Board consists of 7 Commissioners who take over the management of various commissions as shown in Figure 7.

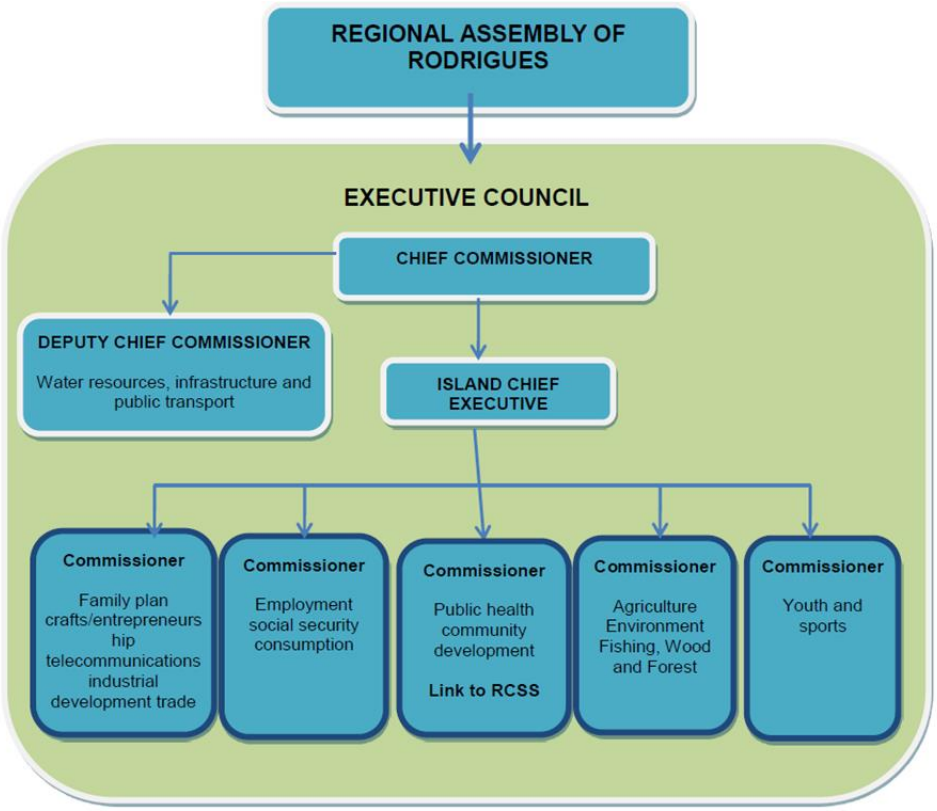


Figure 7: Rodrigues Regional Assembly (RRA) organizational chart

The Rodrigues Council of Social Services (RCSS) is an entity not dependent on the Regional Assembly of Rodrigues but which comprises all the villages of Rodrigues and which acts as a facilitator between the different stakeholders in community projects, namely the communities of the Regional Assembly, donors, private companies, etc. the RCSS organisational chart is shown in Figure 8.

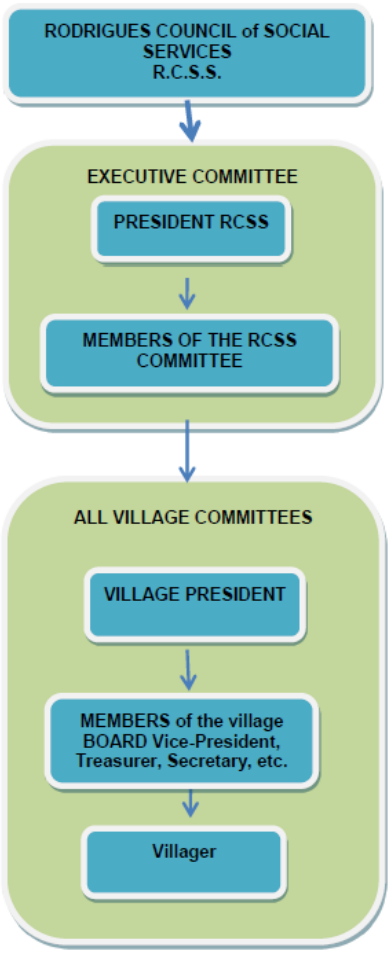


Figure 8: Rodrigues Council of Social Services (RCSS) organizational chart

1.3.4.2 Demographic and local governance

Sainte Marie is a small family community. Village-related issues are settled mainly through internal family mechanisms.

From an administrative point of view, Sainte Marie is not a village: it is an area of the Anse Quitor Village to which it is attached. However, the inhabitants of Sainte Marie do not participate in the public life of the connected village. De facto, they consider Sainte Marie as an autonomous socio-territorial entity.

1.3.4.3 Access to basic public services

Public infrastructure for civil status and administrative records management are mainly located in Port Mathurin. The other services are more spread out on the island as shown on Figure 9.

Figure 9: Access to basic public services (health, education) in the project area

1.3.4.4 Local economy

The main sectors of production in the area of social influence of the project are:

- Fishing
- Livestock
- Agriculture

1.3.4.5 Summary: social and economic sensitivity

Table 6: Summary of Social and Economic Sensitivity

Sub-theme	Receptor	Sensitivity
Social environment	Demographic and social dynamics	High
	Power, governance and civil society	High
	Land	Major
	Agriculture	Major
	Sainte Marie and Plaine Corail inhabitants	Major
	Bangelique breeders	Major
	Fishermen of the impacted zone	Major

1.3.5 Air quality and noise

Figure 10 shows the Area of Influence used to describe the air and noise baseline conditions.

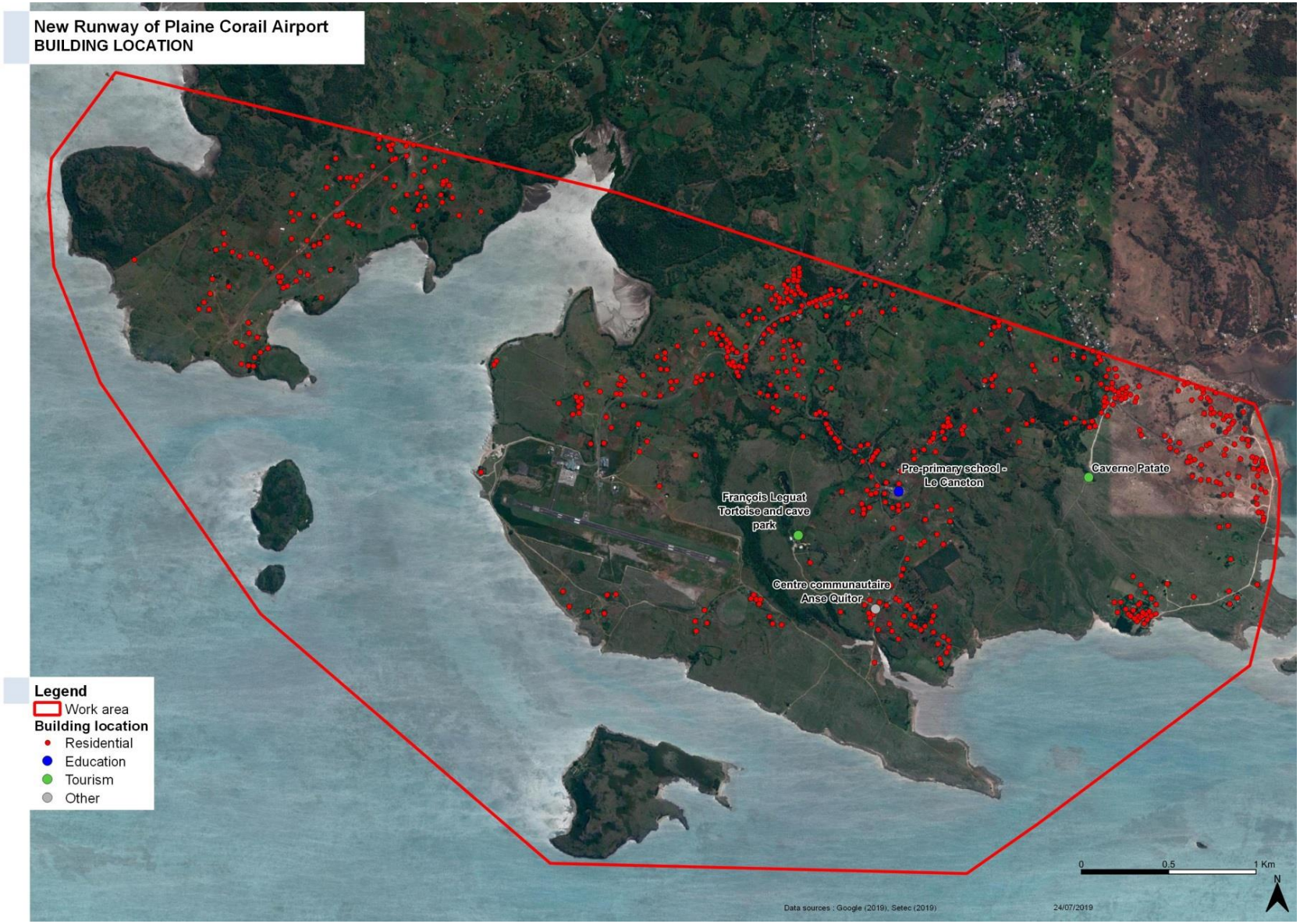


Figure 10: Building location map and area of influence

1.3.5.1 Air quality

The air quality issue is due to the presence of sensitive populations living nearby and of the pre-primary school Le Caneton. The presence of agricultural parcels is also to be taken into account.

The aircraft traffic growth will lead to a significant increase in pollutant emissions.

1.3.5.2 Noise

The noise issue is due to the presence of sensitive populations living nearby and of the pre-primary school Le Caneton.

The aircraft traffic growth will lead to a significant increase in noise.

1.3.5.3 Summary: air and noise sensitivity

Table 7: Summary of Air and Noise Sensitivity

Sub-theme	Receptor	Sensitivity
Air quality	Population exposed	High
Noise	Population exposed	High

1.3.6 Heritage resources and visual environment

1.3.6.1 Cultural heritage resources

There are six National Heritage Sites in Rodrigues:

- Cannon (Pointe Canon),
- Ex-Administration Block (Port Mathurin),
- Garde Post (Mont Venus),
- Ben Gontron House (Barclay Street, Port Mathurin),
- Lieu de Mémoire, L'Union, Rodrigues,
- Residency Buildings (Port Mathurin)
- None of them are located within the project area of influence.

1.3.6.2 Archaeology and palaeontology

In the restricted area, several sites have been identified as having a palaeontological interest. The underground hydrographic network has formed karst structures like cracks and caves throughout Plaine Corail.

These Karst formations in Plaine Corail are particularly interesting under the point of view of sedimentology and fossil conservation. Some caves such as Grotte Fougere are reported as containing sediment filled with a lot of fossils in an excellent state of conservation.

A conservation plan of sites of Archaeological and/or palaeontological interests that may be threatened by the expansion of Rodrigues airport will need to be set up.

1.3.6.3 Landscape and visual environment

The landscape components are:

- Large plain
- Field crop areas
- Urbanized spaces
- Artificial or semi-artificialized spaces

- Rivers

1.3.6.4 Summary: cultural and visual environment sensitivity

Table 8: Summary: cultural and visual environment sensitivity

Theme	Sub-theme	Receptor	Sensitivity
Heritage resources and visual environment	Cultural heritage resources	Presence of cultural site	Low
	Archaeology and palaeontology	Presence of cultural site of archaeological or palaeontological interest	High
	Landscape end visual environment	Living environment and site visibility	High

-

1.4 Summary of the Stakeholder Engagement Plan

The following is a summary of the stakeholder engagement activities conducted and detailed in the stakeholder engagement plan available in the appendix.

1.4.1 Engagement activities conducted prior to the ESIA

The community engagement activities began formally with regular relations and meetings between the Executive Council of the Rodrigues Regional Assembly and the directly impacted populations. These community engagement activities took place on the following timeline.

Date	Purpose of the consultation
25 June 2018	An internal meeting chaired by Davis Hee Hong Wye, Island Chief Executive (ICE), was held at the Central Administration conference room (Island Chief Executive's Office) in Port Mathurin for the community relocation plan. The main objective was to establish a steering committee composed of representatives of the various government entities and other stakeholders involved in the resettlement.
- 28 June, 2018 and 2 July, 2018	Preliminary census by the officers of the Land Registry Office and the officers of the Agriculture Commission for the identification of families eligible for resettlement and inventory.
- 5 July, 2018 -	An internal meeting chaired by Davis Hee Hong Wye (ICE) was held at La Résidence (Chief Commissioner's Office) in Port Mathurin to review the initial information already collected in the field and to assess the need to refine the data available, particularly with regard to the Agriculture Commission and the Fishing Commission.
- 13 July, 2018	Consultative assembly in the conference room of the Plaine Corail police station bringing together the entire Executive Council, the villagers of Sainte Marie and all those having an activity in the area concerned. The objective was to officially provide information about the project to expand the airport runway and therefore the need for relocation of homes in the impacted area and supporting those individuals who carry out an activity there.
- 9 August, 2018	Meeting of the Steering Committee established in June with the villagers concerned in order to collect their grievances and their choices or preference for the type of support procedures (compensation or relocation).

- 20 August, 2018 -	Development of a census timetable and sending of letters to the people concerned in order to communicate the dates of beginning and closing of the census.
- 22 - 24 August, 2018 -	Detailed census of dwellings and families taking into consideration their properties, main activities and attached buildings as well as the services and facilities available in the area.
- 31 August, 2018 -	Submission of the detailed census report.
- 4 September, 2018	Internal meeting of the Executive Committee for a presentation to the various Commissioners of the situation and progress concerning the relocation of the villagers of Sainte Marie.
- 12 September, 2018	Visit to the residential relocation sites proposed by the Commissioners, the Steering Committee of the resettlement project and the inhabitants to be relocated from the village of Sainte Marie.
- 27 September, 2018 -	Meeting of the Executive Committee chaired by Davis Hee Hong Wye (ICE) with the villagers of Sainte Marie, who have not approved the relocation site originally proposed.
- 26 October, 2018	Submission by the Land Registry Office of potential sites for the relocation of Sainte Marie's households to the Executive Committee.
- 22 November, 2018 -	Meeting of the Executive Committee chaired by Davis Hee Hong Wye (ICE) with villagers who had not approved the proposed relocation site initially for a presentation and visit of new proposed sites. Then presentation to all the villagers of Sainte Marie of a draft of the agreement documents for resettlement.
- 27 November, 2018 -	Submission by the land registry office of the report of the land parcels approved by the villagers of Sainte Marie.
- 10 January, 2019 -	Internal meeting of the Executive Committee with the Steering Committee of the resettlement project to take stock of all the advances made and measures taken during the last few months.
- 28 February, 2019 -	Submission of a report by the Agriculture Commission concerning the offers of compensation to the villagers of Sainte Marie in relation to food crops.
- 6 March, 2019 -	Submission of a report by the Fishing Commission on the compensation mechanism for the abandonment of net fishing activities (in accordance with the national budget of 2014).
- 8 March, 2019 -	Submission of the valuation report of the market value of the houses of the villagers of Sainte Marie by the evaluation department of the Ministry of Finance and Economic Development of Mauritius.
- 15 March, 2019 -	Submission of the report of the Fishing Commission concerning the census of fishing posts in the impacted area.
- 19 March, 2019 -	Submission of a report by the Agriculture Commission on the compensation mechanism for villagers engaged in animal husbandry.
- 2 April, 2019 -	Sending of letters by the Executive Committee to all the villagers of Sainte Marie to inform them of the amounts assessed by the evaluation department of the Ministry of Finance and Economic Development of Mauritius and to establish a date of meeting in order to discuss these announced amounts.
- 11 April, 2019 -	Meeting of the Executive Committee with the owners of the fishing posts of the impacted area of Plaine Corail.

1.4.2 Presentation of the consultations performed during the ESIA

During the preparation of the SEP, the following meetings and consultations were carried out and are still ongoing. Details of the consultations and the consultation reports are available in the Annexure 14, in the stakeholder engagement plan.

Phase	Date	Place of consultation	Entities represented/persons consulted	Medium
Exploratory	04/03/19	Plaine Corail	Airport Operational & Maintenance Manager ESIA project manager and SETEC consultants Environmental impact consultants	Meeting
Exploratory	04/03/19	Port Mathurin	Island Chief Executive and Assistant Airport Manager Airport Operational & Maintenance Manager ESIA project manager and SETEC consultants	Meeting
Exploratory	04/06/19	La Ferme	Island Chief Executive and assistants Airport Manager Airport Operational & Maintenance Manager External socio-economic study consultants	Lunch meeting
SEP	04/10/19	Caverne Bouteille	Fishing station manager (individuals)	Individual consultation
SEP	04/11/19	Sainte Marie	Village spokesperson	Individual consultation
SEP	04/11/19	Sainte Marie	Inhabitants of Sainte Marie	Public consultation
SEP	04/11/19	Sainte Marie	Fisherman of Sainte Marie	Individual consultation
SEP	04/12/19	Maréchal	Fishing station manager (Bangélique)	Individual consultation
SEP	04/13/19	Plaine Corail	Resident of Plaine Corail	Individual consultation
SEP	04/14/19	Sainte Marie	All the inhabitants of Sainte Marie	Public consultation
SEP	04/15/19	Plaine Corail	All the inhabitants of Plaine Corail	Public consultation
SEP	04/15/19	Bangélique	Bangélique livestock breeder (non-resident)	Individual consultation
SEP	05/03/19	Anse Quitor	Anse Quitor village committee	Public consultation
SEP	05/03/19	Cascade Jean Louis	President of the village of Cascade Jean Louis	Individual consultation
Exploratory	05/08/19	Port Mathurin	Resettlement Committee (RRA)	Meeting

Exploratory	05/09/19	Citronelle	Director of agricultural services	Meeting

1.4.3 Stakeholder engagement activities to be conducted

The stakeholder engagement plan is considered a living document and will be updated during the lifecycle of the project.

The list of stakeholders will be updated as the next phase of the ESIA and as the project evolves. Above all, the stakeholder analysis will particularly focus on the identification and consideration of disadvantaged or vulnerable people or groups. Further attention will also be paid to NGOs, which have a strong mobilization power.

Stakeholder engagements are ongoing and additional public consultations will be undertaken as part of the updating of the ESIA and the SEP. . Issues of communication, channels for submitting project related grievances, project information, and potential environmental and social impacts, risk and opportunities of the project will be revisited in public consultations in each affected locality

1.5 Potential impacts and measures

Potential environmental and social impacts and associated management measures are summarized in the next tables. Construction phase impacts which are temporary in nature are distinguished from the permanent impacts.

Impacts related to Operations are addressed in a third section.

1.5.1 Temporary impacts during works phase

Table 9: Summary of Temporary impacts during works phase

Context	Sub-context	Impact ID	Impact description	Positive / adverse	Impact rating before mitigation	Measure ID	Measure	Residual Impact rating
Physical	Marine	Phy-Mar-W-Temp-1	Increase in turbidity	Adverse	Major	Phy-Mar-Mit-1	Control of backfilling processes	High
						Phy-Mar-Mit-2	Optimisation of the location of discharges	
						Phy-Mar-Av-3	Optimisation of the discharges timetable to avoid times when currents reverse and/or already turbid condition	
						Phy-Mar-Mit-4	Silt curtain around discharges	
		Phy-Mar-W-Temp-2	Modification of the seabed	Adverse	Low	Phy-Mar-Mit-1	Control of backfilling processes	Low
						Phy-Mar-Mit-2	Optimisation of the location of discharges	
						Phy-Mar-Av-3	Optimisation of the discharges timetable to avoid times when currents reverse and/or already turbid condition	
						Phy-Mar-Mit-4	Mitigation - Silt curtain around discharges	
		Phy-Mar-W-Temp-3	Dredging in front of the boathouse	Adverse	Major	Phy-Mar-Av-3	Optimisation of the discharges timetable to avoid times when currents reverse and/or already turbid condition	High
						Phy-Mar-Mit-5	Mitigation - Silt curtain around dredging area	
	Hydrology	None	-	-	-	-	-	-
	Hydrogeology and geotechnics	Phy-Kar-W-Temp-1	Vibrations	Adverse	High	Phy-Kar-Mit-1	Reduce speed of trucks' movement to an acceptable level	Negligible
						Phy-Kar-Mit-2	Reduce rotations between embankment site and material storage site Carry out and document baseline observations at potentially exposed buildings to check on the presence of cracks ahead of works.	
		Phy-Kar-W-Temp-2	Mass haul - Hauling equipment movement inducing vibration and noise pollutions	Adverse	Major	Phy-Kar-Mit-3	Reuse of materials from cutting to embankment areas	Low
						Phy-Kar-Mit-4	Reuse of topsoil materials after works phase	
		Phy-Kar-W-Temp-3	Erosion/Groundwater ingress	Adverse	High	Phy-Kar-Mit-5	Infilling of local erosion features and use of a drainage system to manage the rainwater responsible for local erosion	Low
						Phy-Kar-Mit-6	Open blasting and site excavation works to be done during dry season	
		Phy-Kar-W-Temp-4	Noise Blasting	Adverse	High	Phy-Kar-Mit-7	Reduce unit explosive charge decreasing noise impact	Medium
						Phy-Kar-Mit-8	Concentrate open blasting operations in a short time	
						Phy-Kar-Mit-9	Work only during the day and inform local authorities and communities bout the health and safety plan applicable on work site	
						Phy-Kar-Mit-10	Avoid running excavator's engines in case of no use	
		Phy-Kar-W-Temp-5	Cut and fill balance impacts: transport	Adverse	Medium to Major	Phy-Kar-Mit-11	Chose the closest extraction site for fill material / Forbid the export of cuttings	Negligible to high
	Water resource and wastewater	Phy-Wat-W-Temp-1	Impact of water resource resulting from works' water supply	Adverse	Major	Phy-Wat-Mit-1	Install a desalination plant to supply drinking water to the workers' camp by sea water pumping	Negligible
		Phy-Wat-W-Temp-2	Impact of works on water resource resulting from impact on karstic groundwater	Adverse	Major	Phy-Wat-Comp-2	Temporarily replace the Caverne Bouteille intake by a sea water pumping Upgrade Caverne Bouteille plant to enable it to provide drinking water from sea water Thus, temporarily provide drinking water from sea water to people currently connected to Caverne Bouteille plant	Negligible
		Phy-Wat-W-Temp-3	Works wastewater	Adverse	Major	Phy-Wat-Av-3	Works wastewater treatment plant	Negligible
		Phy-Wat-W-Temp-4	Risk of accidental pollution	Adverse	High	Phy-Wat-Av/Mit-4	Preventive measures to reduce risks during the construction phase - Risk management plan	Negligible
		Phy-Wat-W-Temp-5	Desalination plant	Adverse	High	Phy-Wat-Av/Mit-5	Good engineering design and best site practices to reduce the impacts Importance of ESMP & ESCP in the contractor's contract	Negligible to low

Context	Sub-context	Impact ID	Impact description	Positive / adverse	Impact rating before mitigation	Measure ID	Measure	Residual Impact rating
Biological	Terrestrial habitat	None	-	-	-	-	-	-
	Terrestrial flora	None	-	-	-	-	-	-
	Terrestrial fauna	BioT-Fau-W-Temp-1	Impact on Pteropus rodricensis (Chiroptera)	Adverse	Low	None	None	Low
	Marine habitat	BioM-Hab-W-Temp-1	Degradation of coral reef dominated by Acropora formosa	Adverse	Low	BioM-Mit/-1	Installation of a floating boom to confine sediments and prevent their resuspension in the marine environment	Low
		BioM-Hab-W-Temp-2	Degradation of habitats dominated by macroalgae and seagrass	Adverse	Negligible			Negligible
		BioM-Hab-W-Temp-3	Modification of ecological functionality	Adverse	Negligible	None	-	-
	Marine species	BioM-Spe-W-Temp-1	Ichtyofauna	Adverse	Low	None	-	-
		BioM-Spe-W-Temp-2	Marine turtles	Adverse	Medium	BioM-Mit/-2	Monitoring for the possible presence of turtles in the project area and egg laying site on Crab Island	Low
		BioM-Spe-W-Temp-3	Marine mammals	Adverse	Low	None	-	Low
Transport network, electricity supply and waste management	Transport network	Trspt-W-Temp-1	Impact on the transport network	Adverse	Low	Inf-Mit-1	Transfer materials out of high traffic periods	Low
						Inf-Mit-2	Anticipate and supervise exceptional convoys	
						Inf-Mit-3	Rehabilitate roads that were used during construction and at the end of works	
	Electricity supply	Elec-W-Temp-1	Impact on electricity supply	Adverse	Low	Inf-Mit-4	Adapt the period of work	Low
						Inf-Mit-5	Use generators	
	Waste management	Sol-Wst-W-Temp-1	Impact on the solid waste management	Adverse	Low	Inf-Mit-6	Recycling and reuse materials	Low
Socio-economics	Demographics and social dynamics	SE-Demo-W-Temp-1	Increase of the population of Plaine Corail and its surroundings	Adverse	Low	SE-Mit-5	Communication plan for the integration of external workers	Negligible
						SE-Mit-6	Influx management plan	
		SE-Demo-W-Temp-2	Evolution of internal relations and in relation to foreign influx	Adverse	Medium	SE-Mit-5	Recruitment policy	Negligible
						SE-Mit-6	Influx management plan	
		SE-Demo-W-Temp-3	Social tensions arising from hiring conditions	Adverse	Low	SE-Mit-7	Communication and hiring management plan	Negligible
						SE-Mit-8	Communication and complaint management plan connected with employment	
		SE-Demo-W-Temp-4	Temporary employment opportunities for neighbouring residents	Positive	Low	SE-Mit-5	Communication plan for the integration of external workers	Medium
						SE-Mit-7	Communication and hiring management plan	
	Power, governance and civil society	SE-Gov-W-Temp-1	Risk of tension between the displaced community and the host community (of workers) (cumulative impact)	Adverse	Low	SE-Mit-3	Communication plan, complaint management and internal support for relocation.	Negligible
	Land	SE-Land-W-Temp-1	Increase in social tensions in relation to the land resource (cumulative impact)	Adverse	Major	SE-Mit-3	Communication plan, complaint management and internal support for relocation.	Medium
		SE-Land-W-Temp-2	Evolution of land management procedures (cumulative impact)	Adverse	Major	SE-Mit-3	Communication plan, complaint management and internal support for relocation.	Medium
						SE-Mit-9	Agricultural technical support plan.	

Context	Sub-context	Impact ID	Impact description	Positive / adverse	Impact rating before mitigation	Measure ID	Measure	Residual Impact rating
	Agriculture and livestock	SE-Agri-W-Temp-1	Decrease in income from agriculture during the adjustment period (cumulative impact)	Adverse	High	SE-Mit-10	RAP follow-up plan	Medium
		SE-Agri-W-Temp-2	Decrease in livestock breeding activity (cumulative impact)	Adverse	Major	SE-Mit-11	Community consultation plan for monitoring the evolution of the agro-pastoral system.	Medium
						SE-Mit-12	Support plan concerning livestock breeding techniques.	
		SE-Agri-W-Temp-3	Change of livestock breeding practices due to the reduction in available pasture land (cumulative impact)	Adverse	High	SE-Mit-11	Community consultation plan for monitoring the evolution of the agro-pastoral system.	Medium
						SE-Mit-12	Support plan concerning livestock breeding techniques.	
		SE-Agri-W-Temp-4	Increase in the rehabilitation time of agricultural surfaces (cumulative impact)	Adverse	High	SE-Mit-11	Community consultation plan for monitoring the evolution of the agro-pastoral system.	Medium
						SE-Mit-12	Support plan concerning livestock breeding techniques.	
	Local economic context	SE-Eco-W-Temp-1	Decrease in household incomes due to the potential decrease in the livestock (or even agricultural) activity of the people affected (indirect impact)	Adverse	Major	SE-Mit-10	RAP follow-up plan	Medium
						SE-Mit-14	Plan for consultation and support of the communities of the area concerning the development of income-generating activities.	
		SE-Eco-W-Temp-2	Increase in local production prices (indirect impact)	Positive	Low	SE-Mit-14	Plan for consultation and support of the communities of the area concerning the development of income-generating activities.	High
						SE-Mit-15	Economic support plan for households.	
		SE-Eco-W-Temp-3	Increase in local production prices – adverse for the local consumers (cumulative impact)	Adverse	High	SE-Mit-14	Plan for consultation and support of the communities of the area concerning the development of income-generating activities.	Medium
						SE-Mit-15	Economic support plan for households.	
		SE-Eco-W-Temp-4	Increase in local development initiatives – positive for the farmers (cumulative impact)	Positive	Medium	SE-Mit-14	Plan for consultation and support of the communities of the area concerning the development of income-generating activities.	High
						SE-Mit-15	Economic support plan for households.	
		SE-Eco-W-Temp-5	Increase in household incomes (cumulative impact)	Positive	Medium	SE-Mit-7	Communication and hiring management plan	High
		SE-Eco-W-Temp-6	Necessary adaptation to a new local economic landscape (cumulative impact)	Adverse	Low	SE-Mit-14	Plan for consultation and support of the communities of the area concerning the development of income-generating activities.	Negligible
						SE-Mit-15	Economic support plan for households.	
		SE-Eco-W-Temp-7	Collaborative partnership or operational opportunities between local communities (indirect impact)	Positive	Medium	SE-Mit-15	Economic support plan for households.	High
		SE-Eco-W-Temp-8	Reinforcement of professional skills (cumulative impact)	Positive	Medium	SE-Mit-7	Communication and hiring management plan	High
						SE-Mit-15	Economic support plan for households.	
	Health and safety of the communities	SE-Safe-W-Temp-1	Increased risk of accidents due to traffic	Adverse	High	SE-Mit-16	Mitigation - Communication plan for the communities and livestock breeders of the area concerning road safety.	Low
						SE-Mit-17	Facilitation of access to protected pedestrian lanes and safety signage management plan.	
		SE-Safe-W-Temp-2	Respiratory discomfort of the inhabitants of the towns closest to the building area	Adverse	Low	None	-	Low
	Health and safety of workers	SE-Wor-W-Temp-1	Increased risk of accidents and illnesses	Adverse	High	SE-Mit-18	Coordination with the contractors involved in the work sites for the implementation of specific Health-Safety training.	Medium
						SE-Mit-19	Communication plan for the communities concerning the importance of complying with safety instructions on construction sites	
Air quality and noise	Air quality	Phy-Air-W-Temp-1	Alteration of air quality due to construction activities	Adverse	Medium	Air-Mit-1	Institute a speed limit on all unpaved roads around the site (max 30 km/h)	Low

Context	Sub-context	Impact ID	Impact description	Positive / adverse	Impact rating before mitigation	Measure ID	Measure	Residual Impact rating
						Air-Mit-2	Regularly water the main roads and areas producing dust	Low
						Air-Mit-3	Limit the storage and handling of materials that may create dust	Low
						Air-Mit-4	Reduce road traffic to a minimum by optimizing the truck loading for the site supply	Low
						Air-Mit-5	Minimize on-site travel distances and avoid as far as possible traffic close to inhabited areas	Low
	Noise	Noi-W-Temp-1	Nuisance caused by noise due to construction activities	Adverse	Low	Noi-Mit-1	Avoid night work and limit work during evening period	Low
						Noi-Mit-2	Choose the least noisy techniques and equipements	Low
Heritage resources and visual environment	Landscape	Vis-W-Temp-1	Alteration of the living environment	Adverse	Medium	Land-Mit-1	Limit the vegetation clearing area during construction	Low
						Land-Mit-2	Prevent encroachment of areas outside designated boundaries	
						Land-Mit-3	Minimize the lighting of construction sites	
						Land-Mit-4	Minimize visual intrusion	
						Land-Mit-5	Ensure that platforms and construction work areas are maintained in a clean and orderly manner	
						Land-Mit-6	Perform temporary seeding	
						Land-Mit-7	Temporary fences and earthworks will be arranged to reduce visual intrusion	
						Land-Mit-8	Ensure that earth and material storage areas are not located directly on the coast	
						Land-Mit-9	Plantings are designed and arranged to form visual screens to mitigate visual impacts	
						Land-Mit-10	Rehabilitate areas that were temporarily used during construction.	
		Vis-W-Temp-2	Increasing pressure on island landscape	Adverse	Negligible	Land-Mit-11	Favour dispersed relocation building in existing communities	Negligible
						Land-Mit-12	Relocate families outside of the Zone of Visual Influence	
						Land-Mit-13	Community support in construction process	
	Palaeontology	Kar-W-Temp	Impacts on hydrogeology and geotechnics	-	-	Impacts on hydrogeology and geotechnics	Impacts on hydrogeology and geotechnics	-

1.5.2 Permanent and irreversible impacts during works phase

Table 10: Summary of Permanent and Irreversible Impacts during Works phase

Context	Sub-context	Impact ID	Impact description	Positive / adverse	Impact rating before mitigation	Measure ID	Measure	Residual Impact rating
Physical	Marine	Phy-Mar-W-Def-1	Alteration of the local bathymetry and shoreline	Adverse	Low	None	None	Low
		Phy-Mar-W-Def-2	Modification of the local hydrodynamic processes	Adverse	Negligible	None	None	Negligible
		Phy-Mar-W-Def-3	Modification of the sediment transit	Adverse	Low	None	None	Low
		Phy-Mar-W-Def-4	Modification of the bathymetry due to the dredging to access jetty facilities	Adverse	Low	None	None	Low
		Phy-Mar-W-Def-5	Remains of suspended particulate matter and sediment	Adverse	Low	None	None	Low
	Hydrology	Phy-Hyd-W-Def-1	Transfer of sediments to the lagoon	Adverse	Major	Phy-Hyd-Mit-1	Temporary sedimentation ponds	Low
	Hydrogeology and geotechnics	Phy-Kar-W-Def-1	Cavern collapse	Adverse	Medium	Phy-Kar-Mit/Av-12	Define a restricted area around the caverns with no heavy vehicles allowed to access	Low
						Phy-Kar-Mit-13	Reduce trucks' movement's speed to an acceptable level to minimize the induced vibrations	
						Phy-Kar-Av-14	Adapt and reduce trucks' movements and rotations between embankment filling site and material storage site	
		Phy-Kar-W-Def-2	Damage to caves	Adverse	Medium	Phy-Kar-Av-15	Restrict traffic in close vicinity of the caves	Low
						Phy-Kar-Av-16	Restrict access to airport to necessary construction and operations staff	
						Phy-Kar-Comp-17	Remove the remaining fossiliferous sediments from all threatened caves	
		Phy-Kar-W-Def-3	Groundwater flow disturbance	Adverse	High	Phy-Wat-Comp-5	Carry out measurements on Caverne Bouteille intake Go on supplying inhabitants from water supply during analysis and measurements According to measurements results, keep using seawater in a definitive manner or get back to the initial situation, pumping underground water in Caverne Bouteille intake	Low
		Phy-Kar-W-Def-4	Pollution of groundwater	Adverse	Medium	Phy-Kar-Av/Mit-18	Daily maintenance and inspection of excavators	Low
						Phy-Kar-Av/Mit-19	No maintenance and refuelling on the construction site (or with specific waterproof delimited zone)	
						Phy-Kar-Mit-20	Establishment of a storage site for earthworks wastes, close to the project site, in order to reduce pollution induced by traffic from storage activity	
						Phy-Wat-Comp-5	Carry out measurements on Caverne Bouteille intake Go on supplying inhabitants from water supply during analysis and measurements According to measurements results, keep using seawater in a definitive manner or get back to the initial situation, pumping underground water in Caverrne Bouteille intake	
		Phy-Kar-W-Def-5	Cut and fill balance: impacts of material importation of exportation on extraction and storage sites	Adverse	Unknown	Phy-Kar-Mit-21	Proceed to and impact assessment of the extraction site and have the site validated by the client	Low
						Phy-Kar-Mit-11	Chose the closest extraction site for fill material / Forbid the export of cuttings	

Context	Sub-context	Impact ID	Impact description	Positive / adverse	Impact rating before mitigation	Measure ID	Measure	Residual Impact rating
	Water resource and waste water	Phy-Wat-W-Def-1	Demolition of an unused reservoir	Adverse	Low	-	-	Low
		Phy-Wat-W-Def-2	Impact on water resource	Adverse	High	Phy-Wat-Av/Mit-4	Preventive measures to reduce risks during the construction phase - Risk management plan	Negligible
						Phy-Wat-Comp-5	Carry out measurements on Caverne Bouteille intake Go on supplying inhabitants from water supply during analysis and measurements According to measurements results, keep using seawater in a definitive manner or get back to the initial situation, pumping underground water in Caverne Bouteille intake	
Biological	Terrestrial habitat	BioT-Hab-W-Def-1	Impact on grazing lands on basaltic resurgences	Adverse	Low	none	None	Low
		BioT-Hab-W-Def-2	Impact on grazing lands on calcarenic substratum	Adverse	Low	none	None	Low
		BioT-Hab-W-Def-3	Impact on coastal vegetation dominated by Ipomoea pes caprae	Adverse	Low	none	None	Low
		BioT-Hab-W-Def-4	Impact on anthropized areas	Adverse	Negligible	none	None	Low
		BioT-Hab-W-Def-5	Impact on dry forest	Adverse	High	BioT-Av-1	Avoid remarkable trees located at the edge of the project Targeted species*: Antirhea bifurcata , Elaeodendron orientale, Fernelia buxifolia, Hyophorbe verschaffeltii, Terminalia bentzoe subsp. rodriguesensis*	Negligible
						BioT-Av-2	Moving the control tower out of the nature reserve	
						BioT-Mit-3	Creating an arboretum of endemic species inside the airport landscaping	
						BioT-Mit-4	Transplant remarkable trees and ferns intended to be cut down during the works phase	
						BioT-Mit-5	Genetic conservation of populations of impacted rare species : production and reintroduction of clones and genetic ancestors of these species	
						BioT-Comp-6	Action plan towards more sustainable agricultural practices for native biodiversity	
						BioT-Comp-7	Ecological restauration within the limits of the Anse Quitor nature reserve	
		BioT-Hab-W-Def-6	Impact on riparian vegetation	Adverse	Negligible	none	None	Negligible
		BioT-Hab-W-Def-7	Impact on estuarine habitat	Adverse	Negligible	none	None	Negligible
		BioT-Hab-W-Def-8	Impact on calcarenic dry lawns of anthropogenic origin	Adverse	Negligible	none	None	Negligible
		BioT-Hab-W-Def-9	Impact on coastal grasslands dominated by secondary thickets (Lantana camara)	Adverse	Low	none	None	Low
		BioT-Hab-W-Def-10	Impact on secondary thickets (Leucaena leucocephala)	Adverse	Negligible	none	None	Negligible
	Terrestrial flora	BioT-Flo-W-Def-1	Impact on Hyophorbe verschaffeltii	Adverse	Major	BioT-Av-1	Avoid trees worth conservation value located at the edge of the project Targeted species*: Antirhea bifurcata, Elaeodendron orientale, Fernelia buxifolia, Hyophorbe verschaffeltii, Terminalia bentzoe subsp. rodriguesensis*	Low
						BioT-Mit-3	Creating an arboretum of endemic species inside the airport landscaping	

Context	Sub-context	Impact ID	Impact description	Positive / adverse	Impact rating before mitigation	Measure ID	Measure	Residual Impact rating
						BioT-Mit-4	Transplant remarkable trees and ferns intended to be cut down during the works phase	
						BioT-Mit-5	Genetic conservation of populations of impacted rare species : production and reintroduction of clones and genetic ancestors of these species	
						BioT-Comp-6	Action plan towards more sustainable agricultural practices for native biodiversity	
						BioT-Comp-7	Ecological restauration within the limits of the Anse Quitor nature reserve	
		BioT-Flo-W-Def-2	Impact on Polyscias rodriguesiana	Adverse	Negligible	None	None	Negligible
		BioT-Flo-W-Def-3	Impact on Antirhea bifurcata	Adverse	Major	BioT-Av-1	Avoid remarkable trees located at the edge of the project Targeted species*: Antirhea bifurcata , Elaeodendron orientale, Fernelia buxifolia, Hyophorbe verschaffeltii, Terminalia bentzoe subsp. rodriguesensis*	Low
						BioT-Mit-3	Creating an arboretum of endemic species inside the airport landscaping	
						BioT-Mit-5	Genetic conservation of populations of impacted rare species : production and reintroduction of clones and genetic ancestors of these species	
						BioT-Comp-6	Action plan towards more sustainable agricultural practices for native biodiversity	
						BioT-Comp-7	Ecological restauration within the limits of the Anse Quitor nature reserve	
		BioT-Flo-W-Def-4	Impact on Clerodendrum laciniatum	Adverse	Negligible	None	None	Negligible
		BioT-Flo-W-Def-5	Impact on Diospyros diversifolia	Adverse	Major	BioT-Mit-3	Creating an arboretum of endemic species inside the airport landscaping	Low
						BioT-Mit-4	Transplant remarkable trees and ferns intended to be cut down during the works phase	
						BioT-Comp-6	Action plan towards more sustainable agricultural practices for native biodiversity	
						BioT-Comp-7	Ecological restauration within the limits of the Anse Quitor nature reserve	
		BioT-Flo-W-Def-6	Impact on Fernelia buxifolia	Adverse	High	BioT-Av-1	Avoid remarkable trees located at the edge of the project Targeted species*: Antirhea bifurcata , Elaeodendron orientale, Fernelia buxifolia, Hyophorbe verschaffeltii, Terminalia bentzoe subsp. rodriguesensis*	Low
						BioT-Mit-3	Creating an arboretum of endemic species inside the airport landscaping	
						BioT-Comp-6	Action plan towards more sustainable agricultural practices for native biodiversity	
						BioT-Comp-7	Ecological restauration within the limits of the Anse Quitor nature reserve	
		BioT-Flo-W-Def-7	Impact on Foetidia rodriguesiana	Adverse	High	BioT-Mit-3	Creating an arboretum of endemic species inside the airport landscaping	Low
						BioT-Mit-4	Transplant remarkable trees and ferns intended to be cut down during the works phase	
						BioT-Comp-6	Action plan towards more sustainable agricultural practices for native biodiversity	
						BioT-Comp-7	Ecological restauration within the limits of the Anse Quitor nature reserve	

Context	Sub-context	Impact ID	Impact description	Positive / adverse	Impact rating before mitigation	Measure ID	Measure	Residual Impact rating
		BioT-Flo-W-Def-8	Impact on Latania verschaffeltii	Adverse	Negligible	none	None	Negligible
		BioT-Flo-W-Def-9	Impact on Terminalia bentzoe subsp. Rodriguesensis	Adverse	High	BioT-Av-1	Avoid remarkable trees located at the edge of the project Targeted species*: Antirhea bifurcata , Elaeodendron orientale, Fernelia buxifolia, Hyophorbe verschaffeltii, Terminalia bentzoe subsp. rodriguesensis*	Low
						BioT-Av-2	Moving the control tower out of the nature reserve	
						BioT-Mit-3	Creating an arboretum of endemic species inside the airport landscaping	
						BioT-Mit-4	Transplant remarkable trees and ferns intended to be cut down during the works phase	
						BioT-Mit-5	Genetic conservation of populations of impacted rare species : production and reintroduction of clones and genetic ancestors of these species	
						BioT-Comp-6	Action plan towards more sustainable agricultural practices for native biodiversity	
						BioT-Comp-7	Ecological restauration within the limits of the Anse Quitor nature reserve	
		BioT-Flo-W-Def-10	Impact on Zanthoxylum paniculatum	Adverse	Negligeable	none	None	Negligible
		BioT-Flo-W-Def-11	Impact on plant species with medium sensitivity: Adiantum rhizophorum, Camptocarpus sphenophyllus, Cyperus iria, Mathurina penduliflora, Nephrolepis biserrata, Pandanus heterocarpus, Paspalidium geminatum, Phymatosorus scolopendria, Pleurostylia putamen, Rhizophora mucronata, Sarcanthemum coronopus, Secamone rodriguesiana, Tournefortia argentea.	Adverse	Medium	BioT-Av-2	Moving the control tower out of the nature reserve	Low
						BioT-Mit-3	Creating an arboretum of endemic species inside the airport landscaping	
						BioT-Mit-4	Transplant remarkable trees and ferns intended to be cut down during the works phase	
						BioT-Mit-5	Genetic conservation of populations of impacted rare species	
						BioT-Comp-6	Action plan towards more sustainable agricultural practices for native biodiversity	
						BioT-Comp-7	Ecological restauration within the limits of the Anse Quitor nature reserve	
		BioT-Flo-W-Def-12	Impact on plant species with low sensitivity: Dodonaea viscosa, Dracaena reflexa, Elaeodendron orientale, Ficus reflexa, Ficus rubra, Phyllanthus dumentosus, Premna serratifolia, Sarcostemma viminale, Thespesia populnea	Adverse	Low	BioT-Av-1	Avoid remarkable trees located at the edge of the project Targeted species*: Antirhea bifurcata , Elaeodendron orientale, Fernelia buxifolia, Hyophorbe verschaffeltii, Terminalia bentzoe subsp. rodriguesensis*	Low
						BioT-Av-2	Moving the control tower out of the nature reserve	
						BioT-Mit-3	Creating an arboretum of endemic species inside the airport landscaping	
						BioT-Mit-4	Transplant remarkable trees and ferns intended to be cut down during the works phase	
						BioT-Mit-5	Genetic conservation of populations of impacted rare species : production and reintroduction of clones and genetic ancestors of these species	
	Terrestrial fauna	BioT-Fau-W-Def-1	Impact on Pteropus rodricensis (Chiroptera)	Adverse	Low	None	None	Low
		BioT-Fau-W-Def-2	Impact on Tropidophora articulata (Gastropoda)	Adverse	Medium/High	BioT-Mit-8	Collect arthropods from the Tropiphodora genus before and during earthwork	Low
		BioT-Fau-W-Def-3	Impact on Tropidophora eugeniae (Gastropoda)	Adverse	Low	None	None	Low
		BioT-Fau-W-Def-4	Impact on Lygodactylus lugubris (Reptilia)	Adverse	Low	None	None	Low

Context	Sub-context	Impact ID	Impact description	Positive / adverse	Impact rating before mitigation	Measure ID	Measure	Residual Impact rating
	Marine habitat	BioM-Hab-W-Def-1	Destruction of natural habitats including a protected species Acropora formosa	Adverse	Major	BioM-Av-3	Avoid coral heads located at the edge of the project	Low
		BioM-Hab-W-Def-2	Modification of the physical functioning of habitats	Adverse	Negligible	none	-	Negligible
	Marine species	BioM-Spe-W-Def-1	Impact on soft bottom species	Adverse	Low	none	-	Low
		BioM-Spe-W-Def-2	Impact on mobile species	Adverse	Low	none	-	Low
Socio-economics	Demographics and social dynamics	SE-Demo-W-Def-1	Physical displacement of the population affected by the project	Adverse	Major	SE-Comp-1	Resettlement Action Plan (RAP).	Medium
						SE-Comp-2	Availability of farmland	
						SE-Mit-3	Communication plan, complaint management and internal support for relocation	
		SE-Demo-W-Def-2	Involuntary economic and physical displacement of the active and non-resident population affected by the project	Adverse	Major	SE-Comp-1	Resettlement Action Plan (RAP)	Medium
						SE-Comp-4	Provision of pasture areas and new fishing infrastructures	
						SE-Mit-3	Communication plan, complaint management and internal support for relocation	
	Land	SE-Land-Def-1	Loss of houses or infrastructure due to involuntary displacement of the population affected by the project	Adverse	Major	SE-Comp-1	Resettlement Action Plan (RAP)	Medium
						SE-Comp-2	Availability of farmland	
						SE-Mit-3	Communication plan, complaint management and internal support for relocation	
	Agriculture and livestock	SE-Agri-W-Def-1	Loss of farmland and pasture in the construction area	Adverse	Major	SE-Comp-1	Resettlement Action Plan (RAP)	Medium
						SE-Comp-2	Availability of farmland	
						SE-Mit-9	Agricultural technical support plan	
		SE-Agri-W-Def-2	Loss of perennial crops	Adverse	High	SE-Comp-1	Resettlement Action Plan (RAP)	Medium
		SE-Agri-W-Def-3	Loss of farmland (cumulative impact)	Adverse	High	SE-Comp-1	Resettlement Action Plan (RAP)	Medium
						SE-Comp-2	Availability of farmland	
						SE-Mit-9	Agricultural technical support plan	
		SE-Agri-W-Def-4	Change in animal husbandry and agricultural practices (cumulative impact)	Adverse	High	SE-Mit-9	Agricultural technical support plan	Low
						SE-Mit-11	Community consultation plan for monitoring the evolution of the agro-pastoral system	
	Fishing	SE-Fish-W-Def-1	Loss of direct access to the fishermen landing sites	Adverse	Major	SE-Comp-1	Resettlement Action Plan (RAP)	Medium
						SE-Mit-13	Support and fishermen's complaint management plan	
		SE-Fish-W-Def-2	Loss of fishing infrastructures	Adverse	Major	SE-Comp-1	Resettlement Action Plan (RAP)	Low
						SE-Mit-13	Support and fishermen's complaint management plan	
		SE-Fish-W-Def-3	Increased distances and travel times to fishermen landing sites	Adverse	Medium	SE-Comp-1	Resettlement Action Plan (RAP)	Low
						SE-Mit-13	Support and fishermen's complaint management plan	
		SE-Fish-W-Def-4	Increased time and distance to preferred fishing areas (cumulative impact)	Adverse	High	SE-Mit-10	RAP follow-up plan	Medium
						SE-Mit-13	Support and fishermen's complaint management plan	
	Community mobility	SE-Mob-W-Def-1	Resettlement of displaced people from the main road line	Positive	Medium	None	-	Medium
		SE-Mob-W-Def-2	Reduction of the time to travel to health and education infrastructures (cumulative impact)	Positive	High	None	-	High
Heritage resources and	Landscape	Vis-W-Def-1	Alteration of the living environment	Adverse	Major	Land-Mit-7	Permanent fences and earthworks will be arranged to reduce visual intrusion	High

Context	Sub-context	Impact ID	Impact description	Positive / adverse	Impact rating before mitigation	Measure ID	Measure	Residual Impact rating
visual environment						Land-Mit-9	Plantings are designed and arranged to form visual screen	
		Vis-W-Def-2	Increased pressure on island landscape	Adverse	High	Land-Mit-14	Establishment of an Airport Urban Development Master Plan to monitor and frame urban development related to airport activity and ensure sustainable good living conditions	Medium
						Land-Mit-13	Community support in construction process	
	Paleonthology	Kar-W-Def	Impacts on hydrogeology and geotechnics	-	-	Impacts on hydrogeology and geotechnics	Impacts on hydrogeology and geotechnics	-

Note: when no impacts are foreseen, ‘Impact ID’ column is marked ‘none’ and the following columns are hence not populated and marked ‘-‘

1.5.3 Permanent impacts during operation phase

Table 11: Summary of Permanent Impacts during Operation Phase

Context	Sub-context	Impact	Impact description	Positive / adverse	Impact rating before mitigation	Measure ID	Measure	Residual Impact rating
Physical	Marine	Phy-Mar-Op-1	Accidental spillage	Adverse	Major	Phy-Mar-Mit-6	Prevent spills and accidents : train staff to avoidance of spills.	Low
						Phy-Mar-Mit-7	Implementing methodologies for quick confining and treatment of pollutants and protocol for depollution in case of spill	
		Phy-Mar-Op-2	Uncontrolled waste water discharges	Adverse	Low	None	None	Low
	Hydrology	Phy-Hyd-Op-1	Stormwater management	Adverse	Major	Phy-Hyd-Mit-2	Stormwater network	Low
		Phy-Hyd-Op-2	Flooding issues downstream of airport facilities	Adverse	Low	Phy-Hyd-Mit-3	Stormwater ditch located to restore the watershed boundary	Negligible
						Phy-Hyd-Mit-4	Climate change adaptation: buffering storage and works facilitating infiltration	
		Phy-Hyd-Op-3	Transfer of pollution to the natural environment	Adverse	Major	Phy-Hyd-Mit-5	Treat chronic or accidental sources of pollution	Low
		Phy-Hyd-Op-4	Increase in supply of materials to the lagoon	Adverse	Major	Phy-Hyd-Mit-6	Vegetation of slopes and ditches and collection of infrastructures runoff	Low
	Hydrogeology and geotechnics	Phy-Kar-Op-1	Collapse/Erosion	Adverse	High	Phy-Kar-Av-22	Supplementary geotechnical and geophysical investigations to characterize karstic network (caves and voids)	Low
						Phy-Kar-Mit/Comp-23	In situ investigation diagnostic of infilled cavities (televisual cavity inspections)	Low
						Phy-Kar-Mit/Comp-24	Addition laboratory testings (Aggregate testings) to characterize erosive potential of in situ geological formations	Low
		Phy-Kar-Op-2	Access to caves	Adverse	High	Phy-Kar-Av-16	Restrict access to airport to necessary construction and operations staff	Low
		Phy-Kar-Op-3	Pollution of groundwater	Adverse	Medium	Phy-Kar-Av-25	All operations involving hydrocarbons must comply with current standards to prevent spills and, if necessary, implement emergency measures	Low
						Phy-Kar-Mit-26	Do not allow groundwater use downstream of airport infrastructure	
	Water resource and waste water	Phy-Wat-Op-1	Pollution of soil and surface water	Adverse	Major	Phy-Wat-Av-6	Integrated water management plan	Negligible
		Phy-Wat-Op-2	Peak flows resulting in increasing soil erosion	Adverse	Major	Phy-Wat-Av-6	Integrated water management plan	Negligible
		Phy-Wat-Op-3	Pollution of marine water	Adverse	Low	Phy-Wat-Mit-7	Water treatment plant	Negligible
		Phy-Wat-Op-4	Extra burden on the water supply public network	Adverse	High	Phy-Wat-Mit-8	Reuse water plan	Low
Biological	Terrestrial habitat	None	-	-	-	-	-	-

Context	Sub-context	Impact	Impact description	Positive / adverse	Impact rating before mitigation	Measure ID	Measure	Residual Impact rating
	Terrestrial flora	None	-	-	-	-	-	-
	Terrestrial fauna	None	-	-	-	-	-	-
	Marine habitat	BioM-Hab-Op-1	Modification of ecological functionality	Adverse	Negligible	none	-	-
		BioM-Hab-Op-2	Modification of the physical functioning of habitats	Adverse	Negligible	none	-	-
	Marine species	None	-	-	-	-	-	-
Transport network, electricity supply and waste management	Transport network	Trspt-Op-1	Impact on the transport network	Adverse	Low	Inf-Mit-7	Restore road connections	Low
	Electricity supply	Elec-Op-1	Impact on electricity supply	Adverse	Low	None	None	Low
	Waste management	Sol-Wst-Op-1	Impact on the solid waste	Adverse	Low	None	None	Low
Socio-economics	Power, governance and civil society	SE-Gov-Op-1	Improved relations with directly and indirectly impacted communities	Positive	Medium	SE-Mit-5	Communication plan for the integration of external workers	High
						SE-Mit-15	Economic support plan for households	
	Land	SE-Land-Op-1	Increasing social tensions in relation to the land resource	Adverse	Major	SE-Mit-3	Communication plan, complaint management and internal support for relocation	Medium
		SE-Land-Op-2	Evolution of land management procedures	Adverse	Major	SE-Mit-3	Mitigation - Communication plan, complaint management and internal support for relocation	Medium
						SE-Mit-9	Agricultural technical support plan	
	Agriculture and livestock	SE-Agri-Op-1	Change in livestock breeding procedures and farming methods	Adverse	High	SE-Mit-9	Agricultural technical support plan	Medium
						SE-Mit-11	Community consultation plan for monitoring the evolution of the agro-pastoral system	
		SE-Agri-Op-2	Need to regenerate the farmland	Adverse	High	SE-Mit-9	Agricultural technical support plan	Medium
						SE-Mit-11	Community consultation plan for monitoring the evolution of the agro-pastoral system	
		SE-Agri-Op-3	Decrease in livestock breeding activity	Adverse	Major	SE-Mit-11	Community consultation plan for monitoring the evolution of the agro-pastoral system	Medium
						SE-Mit-12	Support plan concerning livestock breeding techniques	
		SE-Agri-Op-4	Change of livestock breeding practices	Adverse	High	SE-Mit-11	Community consultation plan for monitoring the evolution of the agro-pastoral system	Low
						SE-Mit-12	Support plan concerning livestock breeding techniques	
		SE-Agri-Op-5	Increase in the rehabilitation time of agricultural surfaces	Adverse	High	SE-Mit-11	Community consultation plan for monitoring the evolution of the agro-pastoral system	Medium
						SE-Mit-12	Support plan concerning livestock breeding techniques	

Context	Sub-context	Impact	Impact description	Positive / adverse	Impact rating before mitigation	Measure ID	Measure	Residual Impact rating
	Local economic context	SE-Eco-Op-1	Decrease in household incomes	Adverse	Major	SE-Mit-14	Plan for consultation and support of the communities of the area concerning the development of income-generating activities	Medium
						SE-Mit-9	Agricultural technical support plan	
						SE-Mit-13	Support and fishermen's complaint management plan	
		SE-Eco-Op-2	Increase in local production prices	Positive	Low	SE-Mit-15	Economic support plan for households	High
		SE-Eco-Op-3	Increase in local production prices	Adverse	High	SE-Mit-14	Plan for consultation and support of the communities of the area concerning the development of income-generating activities	Medium
						SE-Mit-15	Economic support plan for households	
		SE-Eco-Op-4	Increase in local development initiatives	Positive	Medium	SE-Mit-15	Economic support plan for households	High
		SE-Eco-Op-5	Increase in household incomes	Positive	Medium	SE-Mit-7	Communication and hiring management plan	High
		SE-Eco-Op-6	Change of the local economic landscape	Adverse	Low	SE-Mit-15	Economic support plan for households	Medium
		SE-Eco-Op-7	Opportunities for partnerships or cooperative operations	Positive	Medium	SE-Mit-15	Economic support plan for households	High
		SE-Eco-Op-8	Reinforcement of professional skills	Positive	Medium	SE-Mit-7	Communication and hiring management plan	High
						SE-Mit-15	Economic support plan for households	
	Living environment and landscape	SE-Liv-Op-1	Noise and sound pollution	Adverse	Negligible	None	-	Negligible
Air quality and sound environment	Air quality	Air-Op-1	Deterioration of air quality due to increased airport capacity	Adverse	High	Air-Mit-6	If possible, limit the taxiing distance	High
						Air-Mit-7	Opt for technologies that limit aircraft pollutant emissions during taxiing	
						Air-Mit-8	Encourage pilots to shut down not needed engines when taxiing	
						Air-Mit-9	Limit congestion (aircraft queues) by making departures as fluid as possible	
						Air-Mit-10	Minimize the use of the APU and GPU	
						Air-Mit-11	Develop and implement procedures to limit the use of the thrust reverser	
						Air-Mit-12	Make ecological performance a criterion of choice for service vehicles and ground equipment	
						Air-Mit-13	Develop an efficient public transport system to limit the use of private vehicles	
	Noise	Noi-Op-1	Noise impact due to increased air traffic	Adverse	Medium	Noi-Mit-3	Limit air traffic at night and the use of noisy equipement	Medium
						Noi-Mit-4	Raise the ILS glide slope to reduce noise emissions during landing	
						Noi-Mit-5	Adapt departure procedures to minimize noise exposure on the ground during take-off	
						Noi-Mit-6	Limit the use of reverse thrust	
						Noi-Mit-7	Develop an efficient public transport system to limit the use of private vehicles	
Heritage resources and visual environment	Landscape	Vis-Op-1	Alteration of the living environment	Adverse	Major	Land-Mit-15	Airport buildings and infrastructures to reach architectural quality and soundness	High
						Land-Mit-7	Permanent fences and earthworks will be arranged to reduce visual intrusion	

Context	Sub-context	Impact	Impact description	Positive / adverse	Impact rating before mitigation	Measure ID	Measure	Residual Impact rating
						Land-Mit-9	Plantings are designed and arranged to form visual screens	
						Land-Mit-16	Touristic infrastructure to respect the scale of Rodrigues' landscape and sense of place	
						Land-Mit-17	Urban development to foster the development of public places and public amenities	
		Vis-Op-2	Alteration to landform outside the Airport	Adverse	Medium	Land-Mit-18	Establishment of local Urban Development Master Plan to monitor urban development related to tourism growth, to value and enhance local landscape	Low
						Land-Mit-19	Set up of green and blue grids	
						Land-Mit-20	Set up of sustainable and resilient city guidelines and architectural guidelines	
						Land-Mit-13	Community support in construction process	
		Vis-Op-3	Alteration to the island forest cover	Adverse	Medium	Land-Mit-21	Investment in woodland planting to feed the timber industry	Negligible
						Land-Mit-22	Set up sustainable timber management plan	
						Land-Mit-19	Set up of green and blue grids	
						Land-Mit-23	Ravine preservation and sanctuarisation of associated woodlands	
	Paleonthology	Kar-Op	Impacts on hydrogeology and geotechnics	-	-	Impacts on hydrogeology and geotechnics	Impacts on hydrogeology and geotechnics	-

Note: when no impacts are foreseen, 'Impact ID' column is marked 'none' and the following columns are hence not populated and marked '-'

1.6 Environment and social management plans for construction phase

1.6.1 Environmental Management Plan for the construction phase

Table 12 lists the plans to be developed and implemented to monitor all the environmental measures in the impact study.

Specific guides for preparing plans are provided in Chapter 9.1.2 and 9.1.3. of the ESIA.

Table 13 summarizes all the environmental measures in the impact study. The precise description of the measures is given in the impact study, in Chapter 8 of the ESIA.

The estimated cost associated with the environmental management and monitoring are provided in Chapter 12. The costs are considered indicative at this stage and will be updated during the life cycle of the project.

Table 12: Environmental Management Plans for Construction Phase

Plan	Measures that the plan must allow to implement and monitor	Person in charge of implementation and control	Activity / Procedures to include
Site and works facilities management and monitoring plan	Wor-Fac Inf-Mit-1 to 6 Phy-Kar-Mit-1 / 2 / 3 / 4 / 6 / 8 / 10 / 11 / 12 / 13 / 14 / 15 / 16 / 19 / 20 / 21 Phy-Wat-Av/Mit-4 Phy-Kar-Mit-19 Land-Mit-7 / 8	To be implemented by the Contractor Under ARL's control	- A waste management and monitoring plan, - An excavated soil management and monitoring plan, - A hazardous material management plan, - A spill risk management plan (Phy-Wat-Av/Mit-4), - A traffic management plan (inside and outside the works site), - A fencing plan and procedure, - A plants monitoring plan
Surface stormwater run-off, drinking and wastewater management and monitoring plan	Phy-Wat-Mit-1 Phy-Wat-Comp-2 Phy-Wat-Av-3 Phy-Hyd-Mit-1	To be implemented by the Contractor Under RRA and ARL's control	- A water management plan - A desalination skid, wastewater treatment plant and ponds monitoring - A water quality monitoring
Karst monitoring plan	Phy-Kar-Mit-5 / 7 / 18	To be implemented by the Contractor Under RRA and ARL's control	- Groundwater monitoring plan - Caves monitoring plan
	Phy-Kar-Comp-17	External specialist	- A plan to follow the sediments moving and storage

Plan	Measures that the plan must allow to implement and monitor	Person in charge of implementation and control	Activity / Procedures to include
		Under ARL's control	
Marine environment monitoring plan	Phy-Mar-Mit-1 / 2 Phy-Mar-Av-3	External consultancy engineering Under ARL's control	- Current and turbidity monitoring plan
	Phy-Mar-Mit-4 / 5	Contractor Under ARL's control	- Marine Works monitoring plan
	BioM-Mit-1 / 2 BioM-Av-3	Shoals Rodrigues / SEMPA Under ARL's control	- Coral reef protection and monitoring
Air quality and noise environment management and monitoring plan	Phy-Kar-Mit-9 Air-Mit-1 to 5 Noi-Mit-1 / 2	To be implemented by the Contractor Under ARL's control	- Air quality management and monitoring plan - Noise environment management and monitoring plan
Biodiversity management and monitoring plan	BioT-Av-1 and 2 BioT-Mit-4 and 5 BioT-Comp-6 BioT-Comp-7	External biodiversity specialists / RRA services Under RRA and ARL's control	- A biodiversity management plan to follow the implementation of measures to be implemented before the works phase (BioT-Av-1 and 2 / BioT-Mit-4 and 5) - A biodiversity management plan to follow the measures to be carried out by RRA on an island scale (BioT-Comp-6 / BioT-Comp-7)
	BioT-Mit-3 and 8	External biodiversity specialists / Contractor Under ARL's control	- A biodiversity management plan to manage and follow the implementation of measures BioT-Mit-3 and 8.
Landscape management and monitoring plan	Land-Mit-1 / 2 / 3 / 4 / 5 / 6 / 8 / 9 / 10 / 15	Detail Design Engineer and Architects ARL Under ARL's control	- A landscape management plan to follow the implementation of measures to be implemented before the works phase (Land-Mit-4 / 6 / 8 / 9 / 10 / 15)

Plan	Measures that the plan must allow to implement and monitor	Person in charge of implementation and control	Activity / Procedures to include
		Contractor Under ARL's control	- A landscape management and monitoring plan during the construction works (Land-Mit-1 / 2 / 3 / 4 / 5 / 6 / 8 / 9 / 10)
	Land-Mit-11 / 12 / 13 / 14 / 16 / 17 / 18	RRA Under RRA and ARL's control	- A management plan to follow the measures to be carried out by RRA on an island scale
Emergencies management plans		Contractor Under ARL's control	- Oil spill management plan - Fire Emergency plan - Archeological or patrimonial chance find procedure

Table 13: Summary of Environmental Measures and Monitoring for Construction Phase

Theme / Issue	Title and ID of the measure		Complementary description	Period of performance / Corresponding plan	Performance monitoring system	Performance indicators	Corrective measures	Responsible managers for implementation
Works facilities, buildings and plants	Wor-Fac	Works installations management plan	Plan describing each of the main works facilities and installations, and giving their emission limits, recommendation for installation on site and environmental measures	Works phase and prior to the works **Site and works facilities management and monitoring plan**	Control of the works environment chart and plans Site visits	Compliance of the installation to the recommendations	Replacement of installations which would not comply	To be implemented by the Contractor Under ARL's control
Marine environment	Phy-Mar-Mit-1	Control of backfilling processes	The construction processes must ensure a minimal volume of water in the low-lying embankment delimited area to insure the stability and sustainability of the runway.	Works phase and prior to the works **Marine environment monitoring plan**	Monitoring of turbidity level in the vicinity of the runway. Monitoring the water concentration in the embankment. Ensuring construction equipment are appropriate.	Compliance to water quality prevailing threshold.	Failure to meet the performance criteria shall be recorded as a non-conformance incident. In the case of structural failure or non-compliance turbidity level, works are to immediately cease. Incident has to be reported. Implementing protocol for depollution in case of spill.	External consultancy engineering Under ARL's control
	Phy-Mar-Mit-2	Optimisation of the location of discharges	The discharge should be located in order to promote a local settling of the inorganic matter. A hydrodynamic survey can be conducted to identify these optimal locations.	Works phase and prior to the works **Marine environment monitoring plan**	The discharge should be located in order to promote a local settling of the inorganic matter. A hydrodynamic survey can be conducted to identify these optimal locations.	Compliance for water quality prevailing threshold	Monitoring of turbidity levels.	External consultancy engineering Under ARL's control
	Phy-Mar-Av-3	Optimisation of the discharges timetable to avoid times when currents reverse and/or already turbid condition	In order to minimize the intensity and extent of the flume, discharge should occur with weak current and low level of turbidity.	Works phase and prior to the works **Marine environment monitoring plan**	Monitoring of turbidity levels in the vicinity of the runway. Monitoring of magnitude and direction of the current in the vicinity of the runway.	Compliance to water quality prevailing threshold. Compliance with current prevailing threshold.	Discharge to be stopped if non-compliance. Reducing the hydraulic flows of the deposited materials.	External consultancy engineering Under ARL's control
	Phy-Mar-Mit-4	Silt curtain around discharges	Silt curtains can be used to contain suspended sediments and to prevent sediment dispersal.	Works phase and prior to the works **Marine environment monitoring plan**	Monitoring of turbidity levels. Conducting daily visual inspection of the curtain.	Compliance to water quality prevailing threshold.	Failure to meet the performance criteria shall be recorded as a non-conformance incident. Discharge to be stopped if non-compliance. Verifying the operation of the equipment according to the	Contractor Under ARL's control

Theme / Issue	Title and ID of the measure		Complementary description	Period of performance / Corresponding plan	Performance monitoring system	Performance indicators	Corrective measures	Responsible managers for implementation
							manufacturer's specifications	
	Phy-Mar-Mit-5	Silt curtain around dredging area	Silt curtain controls the suspended solids generated by the dredging and is placed around the excavation site.	Works phase and prior to the works **Marine environment monitoring plan**	Monitoring of turbidity levels. Monitoring of contaminants in the water column.	Compliance to water quality prevailing threshold.	Dredging to be stopped if non-compliance. Verifying the operation of the equipment according to the manufacturer's specifications.	Contractor Under ARL's control
Hydrology - Stormwater management Waste water management / Water resource and water supply	Phy-Hyd-Mit-1	Temporary sedimentation ponds	Stormwater management from the modified natural watersheds: During the construction works, excavation of the terrain will facilitate transfer of sediments to the lagoon. => Implementation of specific temporary drains and buffer storage/sedimentation ponds	Works phase **Surface stormwater run-off, drinking and wastewater management and monitoring plan**	Monitoring of water quality at discharge; visual control.	Compliance with prevailing / target standards. Submission to local authorities once a month.	Discharge to be stopped if non-compliance. Informing of local authorities/client for remedial measures.	To be implemented by the Contractor Under RRA and ARL's control
	Phy-Wat-Mit-1	Install a desalination plant to supply drinking water to the workers' camp	Water supply for workers' site facilities and construction facilities: The construction works cannot create a burden on the existing water supply already suffering a severe deficiency Specific desalination skid for the water supply of the workers' site facilities and construction facilities	Works phase **Surface stormwater run-off, drinking and wastewater management and monitoring plan**	Monitoring of water quality at inlet and outlet of Treatment Plant; monitoring of water quality on distribution line; regular manual sampling/analysis (once a week) and visual control; automatic real time monitoring of main parameters (at least pH, turbidity and residual free chlorine) on distribution line.	Compliance with prevailing / target standards. Submission to local authorities once a month.	Water production to be stopped if non-compliance. Informing of local authorities/client for remedial measures.	To be implemented by the Contractor Under RRA and ARL's control
	Phy-Wat-Comp-2	Temporary or permanent relocation of the captation of actual Caverne Bouteille	Propose a new location for Caverne Bouteille, including a seawater pumping, settle a new pumping system and upgrade the existing treatment plant to provide water to the people currently supplied by Caverne Bouteille plant	Works phase and prior to the works **Surface stormwater run-off, drinking and wastewater management and monitoring plan**	Monitoring of water quality at inlet and outlet of Treatment Plant; monitoring of water quality on distribution line; regular manual sampling/analysis (once a week) and visual control; automatic real time monitoring of main parameters (at least pH, turbidity, salinity, temperature, TDS, electrical conductivity and residual free chlorine) on distribution line.	Compliance with prevailing / target standards. Submission to local authorities once a month. Significant change in the value of the measured parameters (e. g. +/- 20%) depending on the tolerance of the treatment system.	Water production to be stopped if non-compliance. Informing of local authorities/client for remedial measures. Temporary stop of pumping Identification of the source/cause of the water quality change Relocation of the catchment	To be implemented by the Contractor Under RRA and ARL's control
	Phy-Wat-Av-3	Works wastewater treatment plant	Wastewater management for the existing airport facilities and workers' site facilities: During the construction works, the existing wastewater treatment facilities will be	Works phase **Surface stormwater run-off, drinking and wastewater**	Monitoring of water quality at inlet and outlet of Treatment Plant; monitoring of water quality at discharge; regular manual	Compliance with prevailing / target standards. Submission to local authorities once a month.	Discharge to be stopped if non-compliance. Informing of local authorities/client for remedial measures.	To be implemented by the Contractor Under RRA and ARL's control

Theme / Issue	Title and ID of the measure		Complementary description	Period of performance / Corresponding plan	Performance monitoring system	Performance indicators	Corrective measures	Responsible managers for implementation
			dismantled. The sewage from the airport facilities will need to be treated to avoid direct discharge into the environment => Wastewater treatment skid of adequate capacity for both the airport facilities and for the workers' site facilities	**management and monitoring plan**	sampling/analysis (once a week) and visual control; automatic real time monitoring on main parameters usually monitored.			
	Phy-Wat-Av/Mit-4	Preventive measures to reduce risks during the construction phase - Risk management plan	Oil and other spills related to chemical products used during construction =>Implementation of specific retention / confining zones for storage and use Identification of threat activity that will cease to be or not become a significant threat to drinking water	Works phase **Site and works facilities management and monitoring plan**	Monitoring of any leakage from the specific retention zones Ensure that all site managers are aware of the RMP and are able to apply it Verify that the resources to apply the RMP are present on the site	Zero leakage observed Regular meetings between the project manager, the contracting authority and all site managers	Implementation of remedial confining procedure Training workshops for all site managers	To be implemented by the Contractor Under ARL's control
Karst	Phy-Kar-Mit-1	Reduce speed of trucks' movement to an acceptable level	-	Works phase **Site and works facilities management and monitoring plan**	Speed limit ≤ 30 km/h	Speed controls	Warning violators	To be implemented by the Contractor Under ARL's control
	Phy-Kar-Mit-2	Reduce rotations between embankment site and material storage site Carry out and document baseline observations at potentially exposed buildings to check on the presence of cracks ahead of works	-	Works phase **Site and works facilities management and monitoring plan**	Mass haul diagram	Check of plant's yield	Earth-moving plan adaptation	To be implemented by the Contractor Under ARL's control
	Phy-Kar-Mit-3	Reuse of materials from cutting to embankment areas	-	Works phase **Site and works facilities management and monitoring plan**	Mass haul diagram	Check of reuse-ratio	Soil aeration/soil stabilization	To be implemented by the Contractor Under ARL's control
	Phy-Kar-Mit-4	Reuse of topsoil materials after works phase	-	Works phase **Site and works facilities management and monitoring plan**	Mass haul diagram	Check of topsoil balance	Reuse exceeding quantities for landscaping	To be implemented by the Contractor Under ARL's control
	Phy-Kar-Mit-5	Infilling of local erosion features and use of drainage system to manage rainwater responsible for local erosion	-	Works phase **Karst monitoring plan**	Daily site visits	No gullies development	Drainage system improvement	To be implemented by the Contractor Under RRA and ARL's control

Theme / Issue	Title and ID of the measure		Complementary description	Period of performance / Corresponding plan	Performance monitoring system	Performance indicators	Corrective measures	Responsible managers for implementation
	Phy-Kar-Mit-6	Open blasting and site excavation works to be done during dry season	-	Works phase **Site and works facilities management and monitoring plan**	Work schedule	Shift of planned tasks	Additional equipment implementation	To be implemented by the Contractor Under ARL's control
	Phy-Kar-Mit-7	Reduce unit explosive charge decreasing noise impact	-	Works phase **Karst monitoring plan**	Vibration monitor device by geophones	Meet the targeted particle velocity	Corrective action plan implementation	To be implemented by the Contractor Under RRA and ARL's control
	Phy-Kar-Mit-8	Concentrate open blasting operations in a short amount of time	-	Works phase **Site and works facilities management and monitoring plan**	Work schedule	Shift of planned tasks	Additional equipment implementation	To be implemented by the Contractor Under ARL's control
	Phy-Kar-Mit-9	Work only during the day and inform local authorities and communities bout the health and safety plan applicable on work site	-	Works phase **Air quality and noise environment management and monitoring plan**	Work schedule	Construction supervisor check	Stop works at the scheduled time	To be implemented by the Contractor Under ARL's control
	Phy-Kar-Mit-10	Avoid running excavator's engines in case of no use	-	Works phase **Site and works facilities management and monitoring plan**	Planning of equipment use	Construction supervisor check	Stop of not planned machines	To be implemented by the Contractor Under ARL's control
	Phy-Kar-Mit-11	Chose the closest extraction site for fill material / Forbid the export of cuttings	-	Prior to the works **Site and works facilities management and monitoring plan**	Trucks and boat traffic / Noise and air pollution monitoring	Distance of the extraction site / No export traffic	Change site extraction / Explore on site storage solutions for cuttings	To be implemented by the Contractor Under ARL's control
	Phy-Kar-Mit/Av-12	Define a restricted area around the caverns with no allowed access to heavy vehicles	-	Works phase **Site and works facilities management and monitoring plan**	Enclosure tape around the restricted area	Construction supervisor check	Warning violators	To be implemented by the Contractor Under ARL's control
	Phy-Kar-Mit-13	Reduce trucks' movement's speed to an acceptable level to minimize the induced vibrations	-	Works phase **Site and works facilities management and monitoring plan**	Speed limit ≤ 30 km/h Checking visit inside the caves / Caves monitoring Plan	Speed controls	Warning violators	To be implemented by the Contractor Under ARL's control
	Phy-Kar-Av-14	Adapt and reduce trucks' movements and rotations between embankment filling site and material storage site	-	Works phase **Site and works facilities management and monitoring plan**	Mass haul diagram	Check of plant's yield	Excavation rate adaptation	To be implemented by the Contractor Under ARL's control

Theme / Issue	Title and ID of the measure		Complementary description	Period of performance / Corresponding plan	Performance monitoring system	Performance indicators	Corrective measures	Responsible managers for implementation
	Phy-Kar-Av-15	Restrict traffic in close vicinity of the caves	Retention measure for unauthorized access	Works phase **Site and works facilities management and monitoring plan**	Daily inspection of the condition of the barriers	Damage to facilities	Additional mobile fences where needed Replacement of damaged parts	To be implemented by the Contractor Under ARL's control
	Phy-Kar-Av-16	Installation of a protective formwork to ensure protection and controlled access by airport authorities	-	Works phase **Site and works facilities management and monitoring plan**	Security checkpoint	Airport security rules	Airport security corrective actions	To be implemented by the Contractor Under ARL's control
	Phy-Kar-Comp-17	Remove the remaining fossiliferous sediments from all threatened caves	Safe storage of sedimentary materials containing palaeontological and paleoenvironmental information	Prior to the works **Karst monitoring plan**	Preventive paleontological searches Supervision of excavation by experts and scientists	Preventive research regulation Complete and detailed list of materials removed and compliance of storage sites	Implementation of the planned correctives actions Final inspection and relocation of undisplaced materials	To be implemented by an external specialist Under ARL's control
	Phy-Kar-Av/Mit-18	Daily maintenance and inspection of excavators	Liquid leakage prevention measure (oil and fuel)	Works phase **Karst monitoring plan**	Inspection of logbooks of the maintenance of equipment	Missing information in the logbook Number and intensity of accidental spills of hydrocarbons and other chemicals	In case of a surface spill, the environmental response plan must be implemented immediately.	To be implemented by the Contractor Under RRA and ARL's control
	Phy-Kar-Av/Mit-19	No maintenance and refuelling on the construction site (or with specific waterproof delimited zone)	Vehicles must be refuelled on a dedicated site	Works phase **Site and works facilities management and monitoring plan**				To be implemented by the Contractor Under ARL's control
	Phy-Kar-Mit-20	Establishment of a storage site for earthworks wastes (wood from formwork, material and equipment wrappings, unusable cement / grouting mixes, damaged or contaminated construction material), close to the project site, in order to reduce pollution induced by traffic from storage activity	-	Works phase **Site and works facilities management and monitoring plan**	Installation of a network of observation wells upstream and downstream of the facilities to allow, on the one hand, sampling and analysis of groundwater to define reference values and, on the other hand, to establish a groundwater quality monitoring program (and levels) during the project development phases (construction and operation phases)	Number and intensity of accidental spills of hydrocarbons and other chemicals	In the event of a surface spill, the environmental response plan must be implemented immediately. In the event that there is a significant change in groundwater quality and/or a contaminant is detected, the environmental management plan will also have to be put in place to contain the contamination.	To be implemented by the Contractor Under ARL's control
	Phy-Kar-Av-21	Proceed to an impact assessment of the extraction site and have the material origin validate priori the works phase	-	Prior to the works phase **Site and works facilities management and monitoring plan**	-	-	-	To be implemented by the Contractor Under ARL's control

Theme / Issue	Title and ID of the measure		Complementary description	Period of performance / Corresponding plan	Performance monitoring system	Performance indicators	Corrective measures	Responsible managers for implementation
Biodiversity	BioT-Av-1	Avoid remarkable trees located at the edge of the project Targeted species*: Antirhea bifurcata , Elaeodendron orientale, Fernelia buxifolia, Hyophorbe verschaffeltii, Terminalia bentzoe subsp. rodriguesensis*	This measure consists in avoiding the destruction of remarkable trees located at the boundaries of the project footprint by locally adapting the project boundaries. A total of 19 trees could be easily avoided.	Works phase Before the work begins. **Biodiversity management and monitoring plan**	These 19 trees must be marked prior to the works phase with permanent devices (fences, ribbons, paintings..) and tagged with an identification number (ID) in order to be properly followed during the works phase	Number of trees left after the works phase (out of the 19)	Reinforcing measure BioT-Mit-3	External biodiversity specialists / RRA services Under RRA and ARL's control Potential partners : Wildlife Foundation, Forestry Services
	BioT-Av-2	Moving the control tower out of the nature reserve	This measure consists in avoiding the destruction of approximately 1 hectare of the buffer area of the Anse Quitor nature reserve. This measure allows to save 6 specimens of the following species: Elaeodendron orientale, Sarcanthemum coronopus, Terminalia bentzoe subsp. rodriguesensis	This measure must be anticipated in the project design **Biodiversity management and monitoring plan**	The official boundaries of the nature reserve will be provided by the forestry services	- Surface area left inside the Anse Quitor nature reserve (objective: 0) - Project design with a repositioning of the control tower	Reinforcing measure BioT-Comp-7	External biodiversity specialists / RRA services Under RRA and ARL's control Potential partners : Wildlife Foundation, Forestry Services for the official limits of the nature reserve
	BioT-Mit-3	Creating an arboretum of endemic species inside the airport landscaping	This measure consists in planting 80 specimens of rare and endangered endemic species within the airport limits after the extension airstrip project. This aims to protect, preserve and create an arboretum of endemic seeds that will be used afterwards to produce endemic plants for nature reserves in Rodrigues.	Works phase This measure must be implemented way before the works phase, in particular as regards with the collection of plant material from specimens outside the project area. **Biodiversity management and monitoring plan**	A partnership with the Forestry Services or the Mauritius Wildlife Foundation will be conducted in order to produce seedlings of native species from seeds, cuttings or juveniles collected from the nature reserves of Rodrigues and/or Mauritius. Collection of plant material will be authorized in advance by the reserve managers in any case. A specific protocol will be designed for tree transplantation.	- number of plants produced (objective : 100) - number of species planted	Reinforcing measure BioT-Comp-7	External biodiversity specialists / Contractor Under ARL's control Potential partners : Wildlife Foundation, Forestry Services
	BioT-Mit-4	Transplant remarkable trees and ferns intended to be cut down during the works phase	This measure consists in transplanting all or part of the remarkable trees and ferns intended to be destroyed by the project: in priority, Diospyros, Terminalia, Foetidia, Antirhea, Nephrolepis	Works phase Before and or during works phase (machines will be available during the works phase which optimizes costs) **Biodiversity management and monitoring plan**	A competent and trained external coordinator on the transplantation protocol will be mobilized	- number of trees transplanted - number of trees transplanted which survive the 1st, 2nd, 3rd, 4th and 5th year after transplantation	Reinforcing measures BioT-Mit-3, BioT-Mit-5, BioT-Comp-6	External biodiversity specialists / RRA services Under RRA and ARL's control Potential partners : Wildlife Foundation, Forestry Services

Theme / Issue	Title and ID of the measure		Complementary description	Period of performance / Corresponding plan	Performance monitoring system	Performance indicators	Corrective measures	Responsible managers for implementation
	BioT-Mit-5	Genetic conservation of populations of impacted rare species : production and reintroduction of clones and genetic ancestors of these species	In response to the destruction of several rare species specimens, this measure consists in ensuring the production and reintroduction of clones and genetic ancestors of these species in order to preserve their genetic lineage in the long term. A total of 14 to 35 specimens will be produced, depending on the results obtained by vegetative and sexual propagation.	This measure must be implemented way before the works phase, in particular as regards with the collection of plant material from specimens intended for destruction inside the project footprint. Several campaigns have to be scheduled in order to target the right periods of fruiting **Biodiversity management and monitoring plan**	A partnership with the Forestry Services or the Mauritius Wildlife Foundation will be conducted in order to produce seedlings of native species from seeds, cuttings or juveniles collected from the specimens located within the project footprint.	- number of plants produced (objective : 35) - number of species planted	Reinforcing measures BioT-Mit-3, BioT-Mit-4	External biodiversity specialists / RRA services Under RRA and ARL's control Potential partners : Wildlife Foundation, Forestry Services
	BioT-Comp-6	Action plan towards more sustainable agricultural practices for native biodiversity	This measure consists in initiating a new approach for the management of extensive agriculture on the island of Rodrigues by proposing a turnkey operational action plan.	Planning over 24 months will allow satisfactory consultation times for the implementation of the action plan in the short term **Biodiversity management and monitoring plan**	This action plan can be approached by: 1- the inventory and consultation of all agricultural and ecologist partners throughout the project; 2- the establishment of the development challenges of livestock breeding in Rodrigues; 3- drawing up an inventory of actions that can improve the quality and productivity of livestock farming by promoting local biodiversity; 4- proposing a fine cartographic work accompanied by spatialized actions throughout the territory of Rodrigues.	- Obtaining an action plan validated by the regional assembly in 2022	Reinforcing measure BioT-Comp-7	External biodiversity specialists / RRA services Under RRA and ARL's control Potential partners: Wildlife Foundation, Agricultural and Forestry Services, Regional Assemblee…

Theme / Issue	Title and ID of the measure		Complementary description	Period of performance / Corresponding plan	Performance monitoring system	Performance indicators	Corrective measures	Responsible managers for implementation
	BioT-Comp-7	Ecological restauration within the limits of the Anse Quitor nature reserve	This measure consists in: • Rebuilding the fence around the Anse Quitor nature reserve, with one that would be similar to the fence around the airport in order to discourage grazing livestock inside the reserve. This measure is a short-term response to the grazing vs. biodiversity issue that has to be solved with the offset measure (BioT-Comp-6: Action plan towards more sustainable agricultural practices for native biodiversity). • Reinforcing native species populations by planting 500 native plant specimens within the Anse Quitor nature reserve buffer area, located besides the future airport boundaries (see map below).	Harvesting (seeds, cuttings) and production must take place well before the works phase as well as the fencing work **Biodiversity management and monitoring plan**	- Check the watering quality of the plants; - Identify, locate and count exotic species and define appropriate control methods against invasive and potentially invasive exotic species; - Quantify the mortality rate and health status of native species. - Establish corrective measures if necessary, in order to always orientate this rehabilitation project in an ecologically correct direction.	- Number of plants planted - Mortality rate (total/species) - Number of placettes - Number of linear metres of fence	Reinforcing measures BioT-Mit-3, BioT-Mit-4	External biodiversity specialists / RRA services Under RRA and ARL's control Potential partners: Wildlife Foundation, Forestry Services
	BioT-Mit-8	Collect arthropods from the Tropiphodora genus before and during earthwork	This measure consists in collecting living individuals of Tropiphodora within the project footprint boundaries. Several campaigns will be conducted before the works phase and during earthwork. Sampling planning will allow the entire project area to be visited in an equivalent manner. If species are more abundant in some areas, these areas will be collected more thoroughly.	Works phase This measure must be implemented before and during the earthwork phase. Several campaigns have to be scheduled. **Biodiversity management and monitoring plan**	Learn how to distinguish the two different species recorded on site	- number of living specimens collected - number of species collected - number of survey campaigns	None	External biodiversity specialists / Contractor Under ARL's control Potential partners: Vincent Florens (Department of Biosciences, University of Mauritius, Réduit, Mauritius)
	BioM-Mit-1	Installation of a floating boom to confine sediments and prevent their resuspension in the marine environment	To contain sediments and prevent their resuspension in the marine environment	Works phase During the construction works **Marine environment monitoring plan**	- Visual surveillance of the floating boom's good hold - Measurement campaign of turbidity and current	- Ensure that the floating boom is properly - Visual monitoring of corals at Pointe Palmiste in relation to the turbid plume - Monitoring turbidity with: Duration over an alert and a stop threshold Number of exceedance over a threshold Maximum concentration tolerated	- Decrease of the released flow - Temporary stop of the sediment discharge - Temporary stop of the dredging	Contractor Under ARL's control Potential partner : Shoals Rodrigues / SEMPA
	BioM-Mit-2	Monitoring for the possible presence of turtles in the project area and egg laying site on Crab Island	To preserve protected species and maintain local biodiversity	Works phase During the construction works Laying period **Marine environment monitoring plan**	Visual surveillance by boat, on foot Laying traces on beaches	GPS location, descriptive and photographic information Continuous consolidation of all published information	Stopping works if marine turtles are present and come to lay eggs on the beaches near the project	Shoals Rodrigues / SEMPA Under ARL's control
	BioM-Av-3	Avoid coral heads located at the edge of the project	To preserve protected species and maintain local biodiversity	Before the construction works	Identify corals in the work area Marking with buoys	Waypoint's position of each type of coral	None	Contractor Under ARL's control

Theme / Issue	Title and ID of the measure		Complementary description	Period of performance / Corresponding plan	Performance monitoring system	Performance indicators	Corrective measures	Responsible managers for implementation
				Marine environment monitoring plan	Check their movements to SEMPA	Conservation status (Before/after the movements)		Potential partner : Shoals Rodrigues / SEMPA
Infrastructures and solid waste management	Inf-Mit-1	Transfer materials out of high traffic periods	To avoid creating traffic jams by adapting the works supply traffic schedules	Works phase **Site and works facilities management and monitoring plan**	Complaint collection	Zero additional traffic jam Zero unaddressed complaint	Re-adapting traffic schedules	To be implemented by the Contractor Under ARL's control Partner: RRA
	Inf-Mit-2	Anticipate and supervise exceptional convoys	To avoid creating traffic jams by adapting the exceptional convoys schedules and the communication before and during their passage	Works phase In case of exceptional convoys / before and during passage **Site and works facilities management and monitoring plan**	Complaint collection	Zero additional traffic jam Zero unaddressed complaint	Re-enforcing communication and exceptional convoys schedule adaptation	To be implemented by the Contractor Under ARL's control Partner: RRA
	Inf-Mit-3	Rehabilitate roads that were used during construction and at the end of works	Rehabilitate the roads that would be spoiled by the trucks traffic	Works phase **Site and works facilities management and monitoring plan**	Roads inspection	Zero road degradation during the works and at the end of the works	Re-enforcing roads inspection and rehabilitation	To be implemented by the Contractor Under ARL's control
	Inf-Mit-4	Adapt the period of work	To avoid traffic jam by adapting the works season, if possible (vacations, low touristic season)	Works phase / to be anticipated during the works' construction planning **Site and works facilities management and monitoring plan**	Complaint collection	Zero additional traffic jam Zero unaddressed complaint	Reinforce Inf-Mit-1	To be implemented by the Contractor Under ARL's control Partner: RRA
	Inf-Mit-5	Use generators	To avoid to create extra burden on the electricity network for works supply	Works phase **Site and works facilities management and monitoring plan**	Complaint collection	Zero deficiency in households' electricity supply	Replace more electricity for works supply with generators	To be implemented by the Contractor Under ARL's control Partner: RRA
	Inf-Mit-6	Recycling and reuse of materials	Sorting and recycling of works' solid waste	Works phase **Site and works facilities management and monitoring plan**	Solid Waste management Plan Environmental site visits and works environment supervision	Recycling objective to be proposed by the detailed design	Improve the sorting system and worker sensibilization	To be implemented by the Contractor Under ARL's control
Air quality	Air-Mit-1	Institute a speed limit on all unpaved roads around the site (max 30 km/h)	-	Works phase **Air quality and noise environment management and monitoring plan**	Air quality management and monitoring plan	air emission standards	-	To be implemented by the Contractor Under ARL's control
	Air-Mit-2	Regularly water the main roads and areas producing dust	-			air emission standards	-	
	Air-Mit-3	Limit the storage and handling of	-			air emission standards	-	

Theme / Issue	Title and ID of the measure		Complementary description	Period of performance / Corresponding plan	Performance monitoring system	Performance indicators	Corrective measures	Responsible managers for implementation
		materials that may create dust						
	Air-Mit-4	Reduce road traffic to a minimum by optimizing the truck loading for the site supply	-			air emission standards	-	
	Air-Mit-5	Minimize on-site travel distances and avoid as far as possible traffic close to inhabited areas	-			air emission standards	-	
Noise environment	Noi-Mit-1	Avoid night work and limit work during evening period	-	Works phase **Air quality and noise environment management and monitoring plan**	Noise environment management and monitoring plan	noise emission standards	-	To be implemented by the Contractor Under ARL's control
	Noi-Mit-2	Choose the least noisy techniques and equipements	-			noise emission standards	-	
Landscape	Land-Mit-1	Limit the vegetation clearing area during construction	-	Preliminary works (clearance and site installation): before site clearance starts and during working period. Preparation period of every subsidiary construction contract. **Landscape management and monitoring plan**	An expert such as an environmentalist or a landscape architect	Visual check-up Pictures in the monthly environmental report	Compensation planting and seeding, site cleaning	Contractor Under ARL's control
	Land-Mit-2	Prevent encroachment of areas outside designated boundaries	-	Any phase of work **Landscape management and monitoring plan**	An expert such as an environmentalist or a landscape architect	Visual check-up Pictures in the monthly environmental report	Compensation planting and seeding, site cleaning	Contractor Under ARL's control
	Land-Mit-3	Minimize the lighting of construction sites	-	Any phase of work **Landscape management and monitoring plan**	An expert such as an environmentalist or a landscape architect	Visual check-up Pictures in the monthly environmental report	Contractor to change the lighting furnitures and orientation on request	Contractor Under ARL's control
	Land-Mit-4	Minimize visual intrusion	-	Prior to construction works, not later than preparation period of main contractor **Landscape management and monitoring plan**	A landscape architect	Preliminary Visual Assessment control and final report	To be defined in the visual assesment report	Detail Design Engineer and Architects ARL Contractor Under ARL's control
	Land-Mit-5	Ensure that platforms and construction work areas are maintained in a	-	Any phase of work **Landscape management and monitoring plan**	An expert such as an environmentalist or a landscape architect	Visual check-up Pictures in the monthly environmental report	Contractor to proceed to cleaning and site management on request	Contractor Under ARL's control

Theme / Issue	Title and ID of the measure		Complementary description	Period of performance / Corresponding plan	Performance monitoring system	Performance indicators	Corrective measures	Responsible managers for implementation
		clean and orderly manner						
	Land-Mit-6	Perform temporary seeding	-	Any phase of work **Landscape management and monitoring plan**	An expert such as an environmentalist or a landscape architect	Regular billing for seeding	Contractor to proceed to seeding on request	Detail Design Engineer and Architects ARL Contractor Under ARL's control
	Land-Mit-7	Temporary fences and earthworks will be arranged to reduce visual intrusion	-	Any phase of work **Site and works facilities management and monitoring plan**	An expert such as an environmentalist or a landscape architect	Visual check-up Pictures in the monthly environmental report	Contractor to adapt fence type and stock piles layout on request	To be implemented by the Contractor Under ARL's control
	Land-Mit-8	Ensure that earth and material storage areas are not located directly on the coast	-	Any phase of work **Site and works facilities management and monitoring plan + Landscape management and monitoring plan**	An expert such as an environmentalist or a landscape architect	Visual check-up Pictures in the monthly environmental report	Contractor to adapt storage and stock piles layout on request	To be implemented by the Contractor / Detail Design Engineer and Architects Contractor Under ARL's control
	Land-Mit-9	Plantings are designed and arranged to form visual screens to mitigate visual impacts	-	As early as possible Prior to construction works **Landscape management and monitoring plan**	A landscape architect	Detailed Impact Assessment on site and report	To be defined in the Detailed Design report	Detail Design Engineer and Architects ARL Contractor Under ARL's control
	Land-Mit-10	Rehabilitate areas that were temporarily used during construction.	-	During preparation period of every subsidiary construction contract **Landscape management and monitoring plan**	A landscape architect	Visual check-up Photo report Compare Site Pictures before / after	To be defined	Detail Design Engineer and Architects ARL Contractor Under ARL's control
	Land-Mit-11	Favor dispersed relocation building in existing communities	-	Prior to agreement with families **Landscape management and monitoring plan**	Relevant government administration	Construction control	None	RRA Under RRA and ARL's control
	Land-Mit-12	Relocate families outside of the Zone of Visual Influence	-	Prior to agreement with families **Landscape management and monitoring plan**	Relevant government administration	Construction control	None	RRA Under RRA and ARL's control
	Land-Mit-13	Community support in construction process	-	**Landscape management and monitoring plan**				RRA Under RRA and ARL's control

Theme / Issue	Title and ID of the measure		Complementary description	Period of performance / Corresponding plan	Performance monitoring system	Performance indicators	Corrective measures	Responsible managers for implementation
	Land-Mit-14	Establishment of an Airport Urban Development Master Plan to monitor and frame urban development related to airport activity and ensure sustainable good living conditions	-	As early as possible Prior to construction works **Landscape management and monitoring plan**	Designer such as a landscape architect, urbanist or architect	Deliver an Urban Development Master Plan based on site study and three scenarios	None	RRA Under RRA and ARL's control
	Land-Mit-15	Airport buildings and infrastructures to reach architectural quality and soundness	-	All Design Phases Architect selection Construction contract selection Contractor selection Any phase of work **Landscape management and monitoring plan**	Architect in chief to be nominated	Rodrigues tourism officials and representatives demands met on visual representation, exhaustiveness of Detailed Design	None	Detail Design Engineer and Architects ARL Under ARL's control
	Land-Mit-16	Touristic infrastructure to respect the scale of Rodrigues' landscape and sense of place	-	All Design Phases Architect selection Construction contract selection Contractor selection Any phase of work **Landscape management and monitoring plan**	Relevant government administration	Rodrigues tourism officials and representatives demands met on visual representation, exhaustiveness of Detailed Design	None	RRA Under RRA and ARL's control
	Land-Mit-17	Urban development to foster the development of public places and public amenities	-	All Design Phases Architect selection Construction contract selection Contractor selection Any phase of work **Landscape management and monitoring plan**	Relevant government administration	Rodrigues tourism officials and representatives demands met on this particular concern	None	RRA Under RRA and ARL's control
	Land-Mit-18	Establishment of local Urban Development Master Plan to monitor urban development related to tourism growth, to value and enhance the local landscape	-	As early as possible Prior to construction works **Landscape management and monitoring plan**	Designer such as a landscape architect, urbanist or architect	Deliver an Urban Development Master Plan based on site study and three scenarios	None	RRA Under RRA and ARL's control

1.6.2 Social Management Plan for the construction phase

Table 14 lists the plans to be developed and then implemented to monitor all the environmental measures in the impact study.

Specific guides for preparing plans are provided in Chapter 9.2.2 of the ESIA.

Table 15 summarizes all the environmental measures in the impact study. The precise description of the measures is given in the impact study, in Chapter 8 of the ESIA.

The estimated cost associated with the social management and monitoring are provided in Chapter 12. The costs are considered indicative at this stage and will be updated during the life cycle of the project.

Table 14: Social Management Plans for Construction Phase

Plan	Measures that the plan must allow to implement and monitor (see description in section 7 and ESMP above)	Person in charge of implementation and control
Base camp and works site social management plan	-	**Contractor + ARL**
Communication plan	SE-Comp-1 SE-Mit-3 SE-Mit-5 SE-Mit-7 SE-Mit-8 SE-Mit-10 SE-Mit-11 SE-Mit-12 SE-Mit-13 SE-Mit-14 SE-Mit-15 (and take into account SE-Mit-16, SE-Mit-18, SE-Mit-19)	- Relocation committee appointed by and in liaison with the Executive Committee of the RRA - ARL - Spokesperson of the village Sainte Marie - Fishing station managers and livestock breeder users of the impacted area - Villagers of Plaine Corail (proposed resettlement location) - Executive Committee of the RRA - ARL - Project managers for the works - Village committees of the airport area (Anse Quitor and Plaine Corail – Cascade Jean Louis) - Local media (radio) - Rodrigues Agriculture Commission - Village Committee (Plaine Corail – Cascade Jean Louis) and non-resident livestock breeders - Possibly a specialised external entity such as an NGO - Optionally an independent external office

Plan	Measures that the plan must allow to implement and monitor (see description in section 7 and ESMP above)	Person in charge of implementation and control
Base camp and works site social management plan	-	**Contractor + ARL**
		- Rodrigues fishing Commission - Rodrigues women and small entrepreneurship Commission To be monitored by: RRA / ARL and the Resettlement Monitoring Committee of Rodrigues Regional Assembly
Complaints management plan	SE-Comp-1 SE-Mit-3 SE-Mit-8 SE-Mit-10 SE-Mit-11 SE-Mit-13	- Relocation committee appointed by and in liaison with the Executive Committee of the RRA - ARL - Spokesperson of the village of Sainte Marie - Fishing station managers and livestock breeder users of the impacted area - Villagers of Plaine Corail (proposed resettlement location) - Executive Committee of the RRA - ARL - Project managers for the works - Village committees of the airport area (Anse Quitor and Plaine Corail – Cascade Jean Louis) - Optionally an independent external office - Rodrigues Agriculture Commission - Villagers and livestock breeders of the resettlement area - Rodrigues fishing Commission To be monitored by: RRA / ARL and the Resettlement Monitoring Committee of Rodrigues Regional Assembly (with the help of an external specialized entity)

Plan	Measures that the plan must allow to implement and monitor (see description in section 7 and ESMP above)	Person in charge of implementation and control
Base camp and works site social management plan	-	**Contractor + ARL**
Action plan for relocation and compensation (including the livelihood restoration plan)	SE-Comp-1 SE-Comp-2 SE-Mit-10 SE-Comp-4 SE-Mit-14	- Relocation committee appointed by and in liaison with the Executive Committee of the Rodrigues Regional Assembly - ARL - Spokesperson of the village of Sainte Marie - Fishing station managers and livestock breeder users of the impacted area - Villagers of Plaine Corail and village committee of Cascade Jean Louis (proposed resettlement towns) - Optionally an independent external office - Rodrigues women and small entrepreneurship Commission - Rodrigues Agriculture Commission - Rodrigues fishing Commission To be monitored by: RRA / Resettlement Monitoring Committee of Rodrigues Regional Assembly
Community development plan	SE-Mit-9 SE-Mit-11 SE-Mit-12 SE-Mit-14	- Relocation committee appointed by and in liaison with the Executive Committee of the RRA - Rodrigues Agriculture Commission - Village committees of the airport area (Anse Quitor, Plaine Corail – Cascade Jean Louis) - Livestock breeders of the relocation area - Rodrigues women and small entrepreneurship Commission - Rodrigues fishing Commission - ARL To be monitored by: RRA / Resettlement Monitoring Committee of Rodrigues

Plan	Measures that the plan must allow to implement and monitor (see description in section 7 and ESMP above)	Person in charge of implementation and control
Base camp and works site social management plan	-	**Contractor + ARL**
		Regional Assembly (with the help of an external specialized entity)
Public health and community safety plan	SE-Mit-16 SE-Mit-17 SE-Mit-18 SE-Mit-19	- ARL - Project managers - Rodrigues health Commission - Rodrigues infrastructure commissions - Village committees of the airport area (Anse Quitor, Plaine Corail – Cascade Jean Louis) - Media (local radio) To be monitored by: RRA / ARL
Occupational health and safety plan	SE-Mit-18 SE-Mit-19	- ARL - Project managers - Rodrigues health Commission - Rodrigues labour Commission - Village committees of the airport area (Anse Quitor, Plaine Corail – Cascade Jean Louis) - Media (local radio) To be monitored by: ARL
Workforce management and training plan / Labour Management Plan	SE-Mit-5 SE-Mit-6 SE-Mit-7 SE-Mit-8 SE-Mit-18 SE-Mit-19	- ARL - Project managers - Rodrigues labour Commission - Executive Committee of the RRA - ARL

Plan	Measures that the plan must allow to implement and monitor (see description in section 7 and ESMP above)	Person in charge of implementation and control
Base camp and works site social management plan	**-**	**Contractor + ARL**
		- Village committees of the airport area (Anse Quitor, Plaine Corail – Cascade Jean Louis) - Local media (radio) Labour management plan to be set up To be monitored by: RRA / ARL

Table 15: Summary of Social Measures and Monitoring for Construction Phase

Theme / Issue : Corresponding plan	Title of the measure concerned	Description	Period of performance	Performance monitoring system	Performance indicators	Corrective measures	Responsible managers for implementation
Communication Ensure a harmonious implementation of the work at all stages of its performance with all the communities directly or indirectly impacted by the project **Communication plan**	**SE-Comp-1**- Implementation of a Resettlement Action Plan (RAP).	The RAP necessarily includes the establishment of communication with the affected communities to provide detailed information on the project, the issues it represents in general for the Rodrigues population and the issues of physical and economic displacement.	The relocation plan must be finalized before the works begin.	To be monitored by: Resettlement Monitoring Committee of Rodrigues Regional Assembly Relocation Plan Report to be submitted by the Relocation Committee at the end of relocation plan and before resettlement.	- Number of communication activities carried out; - Number of communication media produced and distributed; - Number of organized sessions, meetings or information workshops; - Number of information activities organized.	Organise additional communication activities or meeting sessions in case of insufficient communication with involved stakeholders.	- Relocation committee appointed by and in liaison with the Executive Committee of the RRA - Airport of Rodrigues - Spokesperson of the village Sainte Marie - Fishing station managers and livestock breeder users of the impacted area - Villagers of Plaine Corail (proposed resettlement location
	SE-Mit-3- Complaint management and internal support for relocation.	An outcome of the RAP, complaint management is the attentive listening to the affected populations regarding relocation. It must be effective and transparent in order to take into consideration and share all the grievances expressed by the communities in order to define appropriate communication and support strategies.	The complaint management plan covers the entire project: from the implementation of the resettlement plan and throughout the period of adaptation of the displaced communities.	To be monitored by: Resettlement Monitoring Committee of Rodrigues Regional Assembly Quarterly reports to be submitted by the Relocation Committee until full adaptation of resettled population	- Number of registered complaints and reports on actions taken for complaint management.	Ensure that all registered complaints have been satisfactorily treated. If not, complaints not yet treated will have to appear positively handled in following report.	
	SE-Mit-5- Communication plan concerning the integration of external workers.	The project will bring in foreign and specifically qualified labour. It is important to communicate about a considerable and temporary advent of an external population and to ensure transparency concerning the hiring procedures in relation to foreign workers.	This communication plan must begin prior to the arrival of the first workers and continue throughout all of the works phase.	To be monitored by: RRA / ARL Annual reports submitted by the Airport of Rodrigues in collaboration with Rodrigues Regional Assembly that include communication measures taken on the period as well as local surveys on inhabitants as well as external workers.	- Number of communication activities carried out; - Number of communication media produced and distributed; - Number of organized sessions, meetings or information workshops; - Results of carried out surveys; - Number and qualitative details on hired people; - Number of registered complaints and reports on actions taken for complaints management.	- Organise additional communication activities in case of insufficient communication and if required through surveys results. - Ensure that all registered complaints have been satisfactorily treated. If not, complaints not yet treated will have to appear positively handled in following report.	- Executive Committee of the RRA - Airport of Rodrigues - Project managers for the works - Village committees of the airport area (Anse Quitor and Plaine Corail – Cascade Jean Louis) - Local media (radio)
	SE-Mit-7- Communication and hiring management plan **SE-Mit-8-** Communication and complaint management plan connected with employment	Specific communication concerning hiring procedures should be put in place so that impacted communities are informed about job opportunities and other related information.	This communication plan must begin and continue throughout the works phase.				
	SE-Mit-10- RAP follow-up plan	This follow-up plan is a continuation of the RAP communication procedures. It implies a continuous communication strategy aimed at	This follow-up takes place from the construction phase and continues during the period of	To be monitored by: RRA and the Resettlement Monitoring Committee	- Number of registered complaints and reports on actions taken for complaint management,	- Improve communication with local people according to reports' feedback.	- Relocation committee appointed by the Executive Committee of the RRA - Airport of Rodrigues

Theme / Issue : Corresponding plan	Title of the measure concerned	Description	Period of performance	Performance monitoring system	Performance indicators	Corrective measures	Responsible managers for implementation
		maintaining the link with affected communities throughout the adaptation period.	adaptation of the displaced communities.	of Rodrigues Regional Assembly (with the help of an external specialized entity) Bi-annual Relocation Plan Report to be submitted by the Relocation Committee including complaints management and satisfaction surveys.	- Qualitative evaluation according to survey results.	- Ensure that all registered complaints have been satisfactorily treated. If not, complaints not yet treated will have to appear positively handled in following report.	- Spokesperson of the village of Sainte Marie - Fishing station managers and livestock breeder users of the impacted area - Villagers of Plaine Corail (proposed resettlement location) - Optionally an independent external office
	SE-Mit-11- Community consultation plan for monitoring the evolution of the agro-pastoral system. **SE-Mit-12**- Support measures concerning livestock breeding techniques.	These measures relate to the communication procedures to be employed concerning the specific and important subject of adaptation of agricultural and livestock breeding techniques by all communities.	The measures occur from the resettlement of displaced villagers and continue throughout the period of community adaptation.				- Relocation committee appointed by the Executive Committee of the RRA - Rodrigues Agriculture Commission - Village Committee (Plaine Corail – Cascade Jean Louis) and non-resident livestock breeders - Possibly a specialised external entity such as an NGO
	SE-Mit-13 - Support and fishermen's complaint management plan.	These measures relate to the communication procedures to be undertaken with the fishermen's community following relocation.	The measures occur from the resettlement of displaced villagers and continue throughout the period of community adaptation.				- Relocation committee appointed by the Executive Committee of the RRA - Rodrigues fishing Commission - Fishing station managers - Airport of Rodrigues
	SE-Mit-14- Plan for consultation and support of the communities of the area concerning the development of income-generating activities. **SE-Mit-15-** Economic support plan for households.	These measures relate to the communication procedures to be employed with the village communities in the area in order to promote the development of income-generating activities for households by becoming aware of the initiatives that the villages and villagers would like to implement.	These measures are developed from the resettlement of displaced villagers and continue throughout the period of community adaptation.				- Rodrigues women and small entrepreneurship Commission - Rodrigues Agriculture Commission - Rodrigues fishing Commission - Airport of Rodrigues - Village committees of the airport area (Anse Quitor, Plaine Corail – Cascade Jean Louis)
Complaint management Ensure that all complaints from communities or	**SE-Comp-**1- Implementation of a Resettlement Action Plan (RAP).	The RAP necessarily includes the establishment of a complaint management procedure issued by affected communities as part of the resettlement process.	*(before work)*	To be monitored by: Resettlement Monitoring Committee of Rodrigues Regional Assembly	- Number of complaints issued; - Number of complaints satisfactorily resolved.	- Ensure that all registered complaints have been satisfactorily treated. If not, complaints not well	- Relocation committee appointed by and in liaison with the Executive Committee of the RRA - Airport of Rodrigues

Theme / Issue : Corresponding plan	Title of the measure concerned	Description	Period of performance	Performance monitoring system	Performance indicators	Corrective measures	Responsible managers for implementation
individuals affected by the implementation of the project are received, reviewed and that appropriate action is taken within a reasonable time to arrive at a mutually acceptable solution. **Complaints management plan**		It requires an effective and transparent complaint management mechanism so that the first steps are taken to provide a solid foundation for the relocation process.		Relocation Plan Report including complaint management to be submitted by the Relocation Committee at the end of the relocation plan and before resettlement.		treated will have to appear positively handled before works begin.	- Spokesperson of the village of Sainte Marie - Fishing station managers and livestock breeder users of the impacted area - Villagers of Plaine Corail (proposed resettlement location)
	SE-Mit-3- Complaint management and internal support for relocation.	The relocation complaint management process requires careful listening to affected populations. It must be effective and transparent in order to take into consideration and share all the grievances expressed by the communities in order to define appropriate communication and support strategies.	*(entire project)*				
	SE-Mit-8 - Communication and complaint management plan connected with employment	This measure is the implementation of an effective and transparent complaint management mechanism concerning hiring procedures during the construction phase of the project, a period during which there will likely be many employment opportunities. This process helps mitigate some potential job-related frustrations.	This communication plan must begin and continue throughout the works phase.	To be monitored by: RRA / ARL Bi-annual reports submitted by the Airport of Rodrigues in collaboration with Rodrigues Regional Assembly that include communication measures taken on the period as well as local surveys on inhabitants as well as external workers.	- Number of registered complaints and reports on actions taken for complaints management, - Qualitative evaluation according to survey results.	- Improve communication with local people according to reports' feedback. - Ensure that all registered complaints have been satisfactorily treated. If not, complaints not yet treated will have to appear positively handled in following report.	- Executive Committee of the RRA - Airport of Rodrigues - Project managers for the works - Village committees of the airport area (Anse Quitor and Plaine Corail – Cascade Jean Louis)
	SE-Mit-10- RAP follow-up plan	This follow-up plan is a continuation of the RAP procedures. It implies a complaint management strategy concerning the following phases of the project to maintain the link with affected communities throughout the adaptation period.	This follow-up takes place from the construction phase and continues throughout the period of adaptation of the displaced communities.	To be monitored by: Resettlement Monitoring Committee of Rodrigues Regional Assembly (with the help of an external specialized entity) Bi-annual Relocation Plan Report to be submitted by the Relocation Committee including complaint management and satisfaction surveys.			- Relocation committee appointed by the Executive Committee of the Rodrigues Regional Assembly - Airport of Rodrigues - Spokesperson of the village of Sainte Marie - Fishing station managers and livestock breeder users of the impacted area - Villagers of Plaine Corail (proposed resettlement location) - Optionally an independent external office
	SE-Mit-11- Community consultation plan	This measure is the implementation of an effective and transparent complaint	The measures occur from the resettlement of displaced villagers and				- Relocation committee appointed by the Executive

Theme / Issue : Corresponding plan	Title of the measure concerned	Description	Period of performance	Performance monitoring system	Performance indicators	Corrective measures	Responsible managers for implementation
	for monitoring the evolution of the agro-pastoral system.	management mechanism concerning agriculture and livestock breeding. This mechanism makes it possible to become aware of the potential discontent of individuals or communities concerning the evolutionary process of the agro-pastoral system.	continue throughout the period of community adaptation.				Committee of the Rodrigues Regional Assembly - Rodrigues Agriculture Commission - Villagers and livestock breeders of the resettlement area
	SE-Mit-13 – Support and fishermen's complaint management plan.	This plan must implement a complaint management mechanism issued by the fishermen's community following relocation.	The measures occur from the resettlement of displaced villagers and continue throughout the period of community adaptation.				- Relocation committee appointed by the Executive Committee of the Rodrigues Regional Assembly - Rodrigues fishing Commission - Relocated fishing post managers
Resettlement and compensation The set of measures to be taken for the resettlement and compensation of impacted communities must help to limit the socio-economic impacts resulting from the displacement of populations by restoring livelihoods and the standard of living of displaced people. **Action plan for relocation and compensation (including the livelihood restoration plan)**	**SE-Comp**-1- Implementation of a Resettlement Action Plan (RAP).	The RAP implements a procedure to delineate a land area prior to the organisation of the relocation of impacted villagers and compensation for farmland, pastures or even social infrastructure.	The relocation plan must be finalized before the works begin.	To be monitored by: Resettlement Monitoring Committee of Rodrigues Regional Assembly Relocation Plan Report to be submitted by the Relocation Committee at the end of relocation plan and before resettlement.	- Verification that the levels of compensation meet at least the international requirements (IFC standards) on the basis of a price matrix to be established under the RAP. - Results of a questionnaire on the satisfaction rate of displaced and/or compensated people.	- Ensure updating to IFC standards according to the Relocation Plan Report before resettlement, - Provide particular emphasis on unsatisfying elements that have been pointed out with the questionnaire's results.	- Relocation committee appointed by and in liaison with the Executive Committee of the Rodrigues Regional Assembly - Airport of Rodrigues - Spokesperson of the village of Sainte Marie - Fishing station managers and livestock breeder users of the impacted area - Villagers of Plaine Corail (proposed resettlement location)
	SE-Comp-2- Availability of farmland.	This measure incorporates the resettlement procedure for the replacement of farmland lost by impacted communities. This ties in with the livelihood restoration plan.	This measure must be effective before the construction phase begins.				- Relocation committee appointed by and in liaison with the Executive Committee of the Rodrigues Regional Assembly - Spokesperson of the village of Sainte Marie - Livestock breeder users of the impacted area - Villagers of Plaine Corail and village committee of Cascade Jean Louis (proposed resettlement towns)
	SE-Comp-4- Provision of pasture areas and new fishing infrastructures.	This measure incorporates the resettlement procedure for the replacement of grazing areas and fishing infrastructures lost by impacted communities. This ties	This measure must be effective before the construction phase begins.				- Relocation committee appointed by and in liaison with the Executive Committee of the Rodrigues Regional Assembly

Theme / Issue : Corresponding plan	Title of the measure concerned	Description	Period of performance	Performance monitoring system	Performance indicators	Corrective measures	Responsible managers for implementation
		in with the livelihood restoration plan.					- Fishing station managers and livestock breeder users of the impacted area - Villagers of Plaine Corail and village Committee of Cascade Jean Louis (proposed resettlement towns)
	SE-Mit-10- RAP follow-up plan.	This plan is a continuation of the procedures of the RAP to maintain the follow-up procedure by keeping the connection with affected communities throughout the adaptation period.	This follow-up takes place from the construction phase and continues during the period of adaptation of the displaced communities.	To be monitored by: Resettlement Monitoring Committee of Rodrigues Regional Assembly Bi-annual Relocation Plan Report to be submitted by the Relocation Committee including complaint management and satisfaction surveys.		- Improve communication with local people according to reports' feedback. - Ensure that all registered complaints have been satisfactorily treated. If not, complaints not yet treated will have to appear positively handled in following report.	- Relocation committee appointed by the Executive Committee of the RRA - Airport of Rodrigues - Spokesperson of the village of Sainte Marie - Fishing station managers and livestock breeder users of the impacted area - Villagers of Plaine Corail (proposed resettlement location) - Optionally an independent external office
	SE-Mit-14- Plan for consultation and support of the communities of the area concerning the development of income-generating activities.	The goal of this measure is to keep communities on a viable and sustainable socio-economic dynamic by proposing to families that they diversify their economic activities.	This follow-up takes place from the construction phase and continues during the period of adaptation of the displaced communities.	To be monitored by RRA Annual report submitted by the Small Entrepreneurship Commission of Rodrigues Regional Assembly to Airport of Rodrigues and Rodrigues Regional Assembly Executive Committee.	- Quantitative and qualitative evaluation of local development according to survey results. - Number of local set up small activities and businesses.	- Enhance local economic environment through group consultations with specific and relevant themes according to evaluation results.	- Relocation committee appointed by and in liaison with the Executive Committee of the RRA - Rodrigues women and small entrepreneurship Commission - Rodrigues Agriculture Commission - Rodrigues fishing Commission - Airport of Rodrigues - Village committees of the airport area (Anse Quitor, Plaine Corail – Cascade Jean Louis)
Community development Medium-term planning of actions that should be implemented to achieve socio-economic development goals at the local level to trigger a virtuous process of improving living conditions	**SE-Mit-9-** Agricultural technical support plan.	This measure contributes to the consolidation of integration in the community environment through the support of technical services facilitating the adaptation of agricultural models and thereby promoting the viability of production.	These measures occur from the resettlement of displaced villagers and continue throughout the period of community adaptation.	To be monitored by: Resettlement Monitoring Committee of Rodrigues Regional Assembly (with the help of an external specialized entity) Annual report submitted by the Commission of Agriculture dealing with results obtained from	- Number of projects implemented; - Number of direct and indirect beneficiaries; - Geographical coverage of the projects implemented; - Diversity of topics discussed.	Projects reinforcement or implementation according to results obtained from field surveys and farmer consultations.	- Relocation committee appointed by and in liaison with the Executive Committee of the RRA - Rodrigues Agriculture Commission - Village committees of the airport area (Anse Quitor, Plaine Corail – Cascade Jean Louis)
	SE-Mit-11- Community consultation plan	These measures contribute to consolidating the integration of communities through the support	The measures occur from the resettlement of displaced villagers and				- Relocation committee appointed by and in liaison with

Theme / Issue : Corresponding plan	Title of the measure concerned	Description	Period of performance	Performance monitoring system	Performance indicators	Corrective measures	Responsible managers for implementation
Community development plan	for monitoring the evolution of the agro-pastoral system. **SE-Mit-12**- Support plan concerning livestock breeding techniques.	of technical services facilitating the adaptation of farming methods to the new environment and thereby promoting the viability of production.	continue throughout the period of community adaptation.	field surveys and farmer consultations.			the Executive Committee of the RRA - Rodrigues Agriculture Commission - Livestock breeders of the relocation area - Village committees of the airport area (Anse Quitor, Plaine Corail – Cascade Jean Louis)
	SE-Mit-14- Plan for consultation and support of the communities of the area concerning the development of income-generating activities.	The goal of this measure is to keep communities on a viable and sustainable socio-economic dynamic by proposing to families that they diversify their economic activities.	This follow-up takes place from the construction phase and continues during the period of adaptation of the displaced communities.	To be monitored by RRA Annual report submitted by the Small Entrepreneurship Commission of Rodrigues Regional Assembly to Airport of Rodrigues and Rodrigues Regional Assembly Executive Committee.		- Enhance local economic environment through group consultations with specific and relevant themes according to evaluation results.	- Relocation committee appointed by and in liaison with the Executive Committee of the RRA - Rodrigues women and small entrepreneurship Commission - Rodrigues Agriculture Commission - Rodrigues fishing Commission - Airport of Rodrigues - Village committees of the airport area (Anse Quitor, Plaine Corail – Cascade Jean Louis)
Public health and community safety Contribution to the mitigation of adverse impacts concerning the health and safety of local communities. **Public health and community safety plan**	**SE-Mit-16** - Communication plan for the communities and livestock breeders of the area concerning road safety.	• The objective of this measure is the implementation of a public awareness campaign for the population on road safety issues in the vicinity of construction sites.	This measure must take place from one month before the start of the site operations and must be carried out throughout the entire construction phase.	To be monitored by: RRA / ARL Annual reports submitted by the Commission of Public Health and the Commission of Transport of Rodrigues Regional Assembly to the Airport of Rodrigues and Rodrigues Regional Assembly Executive Committee.	- Number of accidents directly related to the activities of the project. - Number of pathologies detected directly related to the activities of the project.	Enhance and/or maintain communication campaigns in case of noticed accidents or detected pathologies.	- ARL - Project managers - Rodrigues health Commission - Village committees of the airport area (Anse Quitor, Plaine Corail – Cascade Jean Louis) - Media (local radio)
	SE-Mit-17- Facilitation of access to protected pedestrian lanes and safety signage management plan.	This measure is to design and construct structural elements for the protection of the public taking into consideration the risks to which they could be exposed in the vicinity of the site areas.	This measure must take place from one month before the start of the site operations and must be carried out throughout the entire construction phase.				- ARL - Project managers - Rodrigues infrastructure commissions - Village committees of the airport area (Anse Quitor, Plaine Corail – Cascade Jean Louis)
	SE-Mit-18- Coordination with the project managers involved in the work sites for the implementation of specific Health-Safety training.	The primary objective of this measure is to assess the health and safety risks and impacts to which affected communities are exposed and to take appropriate preventive measures.		To be monitored by ARL Annual report submitted by the Airport of Rodrigues.	- Number of training and communication activities implemented - Number of accidents directly related to the activities of the project.	Increased numbers of training and communication activities on Health and safety prevention.	- ARL - Project managers - Rodrigues health Commission

Theme / Issue : Corresponding plan	Title of the measure concerned	Description	Period of performance	Performance monitoring system	Performance indicators	Corrective measures	Responsible managers for implementation
	SE-Mit-19- Communication plan for the communities concerning the importance of complying with safety instructions.	The purpose of this measure is to ensure the safety of the project by prohibiting access to sites of unauthorized people and populations through promoting awareness of potential hazards in the work area.			- Number of pathologies detected directly related to the activities of the project.		- ARL - Project managers - Rodrigues health Commission - Village committees of the airport area (Anse Quitor, Plaine Corail – Cascade Jean Louis) - Media (local radio)
Health and safety of workers For the realisation of the project it does not present a nuisance to the health and safety of the workers on the site. **Occupational health and safety plan**	**SE-Mit-18**- Coordination with the project managers involved in the work sites for the implementation of specific health-safety training.	The objective of this measure is to establish a system for the protection of workers from occupational diseases and to establish a training program for workers in the project to ensure that these employees have the necessary skills to manage the risks associated with the position they are assigned to.	This measure must take place throughout the construction phase.	To be monitored by ARL Annual report submitted by Airport of Rodrigues.	- Number of incidents involving injury or mortality; - Number of cases of work-related illnesses.	Increased numbers of training and communication activities on health and safety prevention.	- ARL - Project managers - Rodrigues health Commission - Rodrigues labour Commission
	SE-Mit-19- Communication plan for the communities on the importance of complying with safety instructions on construction sites.	The goal of this plan is to initiate measures to prevent accidents, injuries and illnesses resulting from work by minimizing the causes of these hazards as much as possible.	This measure must take place throughout the construction phase.				- ARL - Project managers - Rodrigues health Commission - Village committees of the airport area (Anse Quitor, Plaine Corail – Cascade Jean Louis) - Media (local radio)
Workforce and training Encouragement to form a more rigorous workforce to improve the skills of local labour leading to economic growth linked to the creation of local jobs. **Workforce management and training plan**	**SE-Mit-5**- Communication plan concerning the integration of external workers.	These measures for the development of a management policy concerning the accommodation of external workers permit the improvement of incomes in the locations.	This measure must take place throughout the construction phase.	To be monitored by: RRA / ARL Annual reports submitted by the Airport of Rodrigues in collaboration with Rodrigues Regional Assembly that include communication measures taken on the period as well as local surveys on inhabitants as well as external workers.	- Number of communication activities carried out; - Number of communication media produced and distributed; - Number of organized sessions, meetings or information workshops; - Results of carried out surveys; - Number and qualitative details on hired people; - Number of registered complaints and reports on actions taken for complaints management, - Qualitative evaluation according to survey results.	- Organise additional communication activities in case of insufficient communication and if required through survey results. - Ensure that all registered complaints have been satisfactorily treated. If not, complaints not yet treated will have to appear positively handled in following report.	- ARL - Project managers - Rodrigues labour Commission - Executive Committee of the RRA - Airport of Rodrigues - Village committees of the airport area (Anse Quitor, Plaine Corail – Cascade Jean Louis) - Local media (radio)
	SE-Mit-6 - Influx management plan						- ARL - Project managers - Rodrigues labour Commission - Village committees of the airport area (Anse Quitor and Plaine Corail – Cascade Jean Louis)

Theme / Issue : Corresponding plan	Title of the measure concerned	Description	Period of performance	Performance monitoring system	Performance indicators	Corrective measures	Responsible managers for implementation
	SE-Mit-7- Communication and hiring management plan **SE-Mit-8** - Communication and complaint management plan connected with employment	This measure is to showcase local skills, job opportunities and associated hiring conditions, and to foster local hiring to provide opportunities to obtain skills. This measure is to implement a worker complaint management process including the development of a labour law awareness and training program.	This measure must take place throughout the construction phase.				- ARL - Project managers - Executive Committee of the RRA - Rodrigues labour Commission - Village committees of the airport area (Anse Quitor and Plaine Corail – Cascade Jean Louis) - Local media (radio)
	SE-Mit-18- Coordination with the contractors involved in the work sites for the implementation of specific Health-Safety training.	This measure allows the provision of a secure work environment and facilitates learning and therefore the gaining of skills.	This measure must take place throughout the construction phase.	To be monitored by ARL Annual report submitted by the Airport of Rodrigues.	- Number of incidents involving injury or mortality; - Number of cases of work-related illnesses.	Increased numbers of training and communication activities on health and safety prevention.	- ARL - Project managers - Rodrigues labour Commission - Rodrigues health Commission
	SE-Mit-19- Communication plan for the communities on the importance of complying with safety instructions on construction sites.	This allows employees to be trained more quickly on safety risk issues and on the procedures applicable to project employees.	This measure must take place throughout the construction phase.				- ARL - Project managers - Rodrigues labour Commission - Rodrigues health Commission - Village committees of the airport area (Anse Quitor, Plaine Corail – Cascade Jean Louis) - Media (local radio)

1.7 Environment and social management plans for operation phase

1.7.1 Environment Management Plan for operation phase

Table 16 lists the plans to be prepared prior to start of operation and then implemented during operation to monitor all the environmental measures in the impact study.

Specific guidelines for preparing plans are provided in Chapter 10.1.2 and 10.1.3. of the ESIA

Table 17 summarizes all the environmental measures in the impact study. The precise description of the measures is given in the impact study, in Chapter 8 of the ESIA.

The estimated cost associated with the environmental management and monitoring are provided in Chapter 12. The costs are considered indicative at this stage and will be updated during the life cycle of the project.

Table 16: Environmental Management Plans for Operation Phase

Plan	Measures that the plan must allow to implement and monitor	Person in charge of implementation and control	Activity / Procedures to include
Surface stormwater run-off, drinking and wastewater management and monitoring plan	Design Phy-Hyd-Mit-2 / 3 / 4 / 6 Phy-Wat-Av-6 Phy-Wat-Mit-7 / 8	To be implemented by ARL or an external specialist/ engineer Under ARL's control	- A water management plan
	Operation monitoring of measures Phy-Hyd-Mit-2 / 3 / 4 / 6 Phy-Wat-Av-6 Phy-Wat-Mit-7 / 8	To be implemented by ARL or an external specialist/ engineer Under ARL's control	- A desalination plant, wastewater treatment plant and storm water management system monitoring - A water quality monitoring plan
Karst monitoring plan	Design – groundwater Phy-Kar-Mit-26	To be implemented by ARL or an external specialist/ engineer Under ARL's control	- Sizing note and plans - A follow-up plan to implement by ARL
	Operation monitoring – groundwater Phy-Kar-Mit-26	To be implemented by ARL or an external specialist/ engineer Under ARL's control	- A monitoring procedure to implement by the person in charge for the monitoring - A follow-up plan to implement by ARL
	Operation monitoring – caves Phy-Kar-Av-22	To be implemented by ARL or an external specialist/ engineer Under ARL's control	

Plan	Measures that the plan must allow to implement and monitor	Person in charge of implementation and control	Activity / Procedures to include
	Phy-Kar-Mit/Comp-23 Phy-Kar-Mit/Comp-24		
Marine biodiversity and habitats monitoring plan	-	To be implemented by ARL or an external specialist/ engineer Under ARL's control	- A monitoring procedure to implement by the person in charge for the monitoring - A follow-up plan to implement by ARL
Infrastructures and access monitoring plan	Design ad post-commissioning monitoring Inf-Mit-7	To be implemented by ARL or an external specialist/ engineer Under ARL's control	- A future roads map and sizing notes - A 1 year post-commissioning monitoring plan
Air quality and noise environment management and monitoring plan	Design Air-Mit-6 to 11 Noi-Mit-3 to 5	To be implemented by ARL or an external specialist/ engineer Under ARL's control	- Air quality management plan - Noise environment management plan
	Operation monitoring Air-Mit-12 / 13 Noi-Mit-7	To be implemented by ARL or an external specialist/ engineer Under ARL's control	- Air quality monitoring plan - Noise environment monitoring plan
Landscape measures follow-up plan	Land-Mit-19 / 20 / 21 / 22 / 23	To be implemented by ARL or an external specialist/ engineer Under ARL's control / RRA	- A management plan to follow the measures to be carried out by RRA on an island scale
Emergencies prevention and management plans	Phy-Mar-Mit-6 / 7 Phy-Hyd-Mit-5 Phy-Kar-Av-25	To be implemented by ARL or an external specialist/ engineer Under ARL's control	- Oil spill prevention and management plan - Fire Emergency plan

Table 17: Summary of Environmental Measures and Monitoring during Operation Phase

Theme / Issue	Title and ID of the measure		Complementary description	Period of performance / Corresponding plan	Performance monitoring system	Performance indicators	Corrective measures	Responsible managers for implementation
Marine environment	Phy-Mar-Mit-6	Prevent spills and accidents: train staff to avoidance of spills.	-	Operational phase **Emergencies prevention and management plans**	Regular checking visits and tests	Zero spill	Improve training	ARL
	Phy-Mar-Mit-7	Implementing methodologies for quick confining and treatment of pollutants and protocol for depollution in case of spill	-	Operational phase In case of a spill **Emergencies prevention and management plans**	Monitoring of turbidity levels. Monitoring of contaminants in the water column.	Compliance to water quality prevailing threshold.	Informing of local authorities. The spill source will be immediately isolated, stopped and contained	ARL
Hydrology - Stormwater management Wastewater management / Water resource and water supply	Phy-Hyd-Mit-5	Treat chronic or accidental sources of pollution	Prevention / management of accidental pollution / water from firefighting Confining any accidental pollution / water from firefighting	Operational phase In case of a spill **Emergencies prevention and management plans**	Monitoring of water quality at stormwater outlet and nearby aquifer (control piezometer)	Compliance with prevailing / target standards.	Information of local authorities and implementation of remedial measures / dedicated pumping for evacuation if deemed necessary.	ARL
	Phy-Hyd-Mit-2 Phy-Hyd-Mit-3 Phy-Hyd-Mit-4 Phy-Hyd-Mit-6	Stormwater network Stormwater ditch located to restore the watershed boundary Climate change adaptation: buffering storage and works facilitating infiltration Vegetation of slopes and ditches and collection of infrastructures runoff	Stormwater management for the runway before discharge at sea: Implementation of oil separator/sedimentation works on outlet	Permanent as from the commissioning of the runway **Surface stormwater run-off, drinking and wastewater management and monitoring plan**	The oil separator on the discharge point at sea will be equipped with an alarm to order a maintenance before leakage; monitoring of water quality at discharge at sea; regular manual sampling/analysis of outlet during discharge at sea and visual control.	Compliance with prevailing / target standards. Submission to local authorities once a month.	Discharge to be stopped if non-compliance. Informing of local authorities and implementation of remedial measures: confining / dedicated pumping for evacuation if deemed necessary.	To be implemented by the Detail Design Engineer Under ARL's control Operation Monitoring: ARL (or external specialist engineer under ARL and RRA's control)
			Stormwater management and collection in a buffer storage pond to reduce peak flows before discharge at sea: Implementation of oil separator/sedimentation works before outlet into the pond. Stormwater collection in a buffer storage pond. Implementation of a water treatment plant within an integrated water management plan including reuse of treated stormwater collected.	Permanent as from the commissioning of the new runway facilities **Surface stormwater run-off, drinking and wastewater management and monitoring plan**	The oil separator on the inlet of the buffer storage pond will be equipped with an alarm to order a maintenance before leakage; monitoring of water quality at discharge at sea, regular manual sampling/analysis of outlet during discharge at sea and visual control.	Compliance with prevailing / target standards. Submission to local authorities once a month.	Discharge / reuse to be stopped if non-compliance. Informing of local authorities and implementation of remedial measures: confining / dedicated pumping for evacuation if deemed necessary.	To be implemented by the Detail Design Engineer Under ARL's control Operation Monitoring: ARL (or external specialist engineer under ARL and RRA's control)
	Phy-Wat-Av-6 Phy-Wat-Mit-7 Phy-Wat-Mit-8	Integrated water management plan Water treatment plant Reuse water plan	Wastewater management for the airport facilities before discharge at sea Wastewater integrated management for the airport facilities =>Implementation of a water treatment plant within an integrated water management plan including reuse of treated wastewater.	Permanent as from the commissioning of the treatment facilities **Surface stormwater run-off, drinking and wastewater management and monitoring plan**	Monitoring of water quality at inlet and outlet of Treatment Plant; monitoring of water quality in industrial water storage and stored water quality is maintained including disinfection; regular manual sampling/analysis (once a week) and visual control; automatic real time monitoring on main	Compliance with prevailing / target standards. Submission to local authorities once a month.	Discharge / reuse to be stopped if non-compliance. Informing of local authorities and implementation of remedial measures: confining / dedicated pumping for evacuation if deemed necessary.	To be implemented by the Detail Design Engineer Under ARL's control Operation Monitoring: ARL (or external specialist engineer under ARL and RRA's control)

Theme / Issue	Title and ID of the measure		Complementary description	Period of performance / Corresponding plan	Performance monitoring system	Performance indicators	Corrective measures	Responsible managers for implementation
					parameters usually monitored.			
			Rainwater integrated management for the airport facilities: Implementation of a water treatment plant within an integrated water management plan including reuse / treatment of rainwater harvested for drinking water production.	Permanent as from the commissioning of the treatment facilities **Surface stormwater run-off, drinking and wastewater management and monitoring plan**	Monitoring of water quality at inlet and outlet of Treatment Plant; monitoring of water quality in rainwater storage and stored water quality is maintained including disinfection; regular manual sampling/analysis (once a week) and visual control; automatic real time monitoring on main parameters usually monitored for drinking water production (at least pH and turbidity)	Compliance with prevailing / target standards. Submission to local authorities once a month.	Reuse to be stopped if non-compliance. Informing of local authorities and implementation of remedial measures: confining / dedicated pumping for evacuation if deemed necessary.	To be implemented by the Detail Design Engineer Under ARL's control Operation Monitoring: ARL (or external specialist engineer under ARL and RRA's control)
			Drinking Water supply integrated management for the airport facilities: Implementation of a water treatment plant within an integrated water management plan including reuse / treatment of rainwater harvested for drinking water production. Reuse and treatment of wastewater / stormwater collected if necessary.	Permanent as from the commissioning of the treatment facilities **Surface stormwater run-off, drinking and wastewater management and monitoring plan**	Monitoring of water quality at inlet and outlet of Treatment Plant; monitoring of water quality in drinking water storage and stored drinking water quality is maintained including disinfection; regular manual sampling/analysis (once a week) and visual control; automatic real time monitoring of main parameters (at least pH, turbidity and residual free chlorine) on distribution line.	Compliance with prevailing / target standards. Submission to local authorities once a month.	Distribution to be stopped if non-compliance. Informing of local authorities and implementation of remedial measures: confining / dedicated pumping to empty drinking water storage if deemed necessary.	To be implemented by the Detail Design Engineer Under ARL's control Operation Monitoring: ARL (or external specialist engineer under ARL and RRA's control)
Karst	Phy-Kar-Av-25	All operations involving hydrocarbons must comply with current standards to prevent spills and, if necessary, implement emergency measures	-	Operational phase **Emergencies prevention and management plans**	Installation of a network of observation wells upstream and downstream of the facilities to allow, on the one hand, sampling and analysis of groundwater to define reference values and, on the other hand, to establish a groundwater quality monitoring program (and levels) during the project development phases (construction and operation phases)	Number and intensity of accidental spills of hydrocarbons and other chemicals	In the event of a surface spill, the environmental response plan must be implemented immediately. In the event that there is a significant change in groundwater quality and/or a contaminant is detected, the environmental management plan will also have to be put in place to contain the contamination.	ARL
	Phy-Kar-Mit-26	Do not allow groundwater use downstream of airport infrastructure	-	Operational phase **Karst monitoring plan**				To be implemented by the Detail Design Engineer Under ARL's control Operation Monitoring: ARL (or external specialist engineer under ARL control)
	Phy-Kar-Av-22	Supplementary geotechnical and geophysical investigations to characterize karstic network (caves and voids)	-	Operational phase **Karst monitoring plan**	Periodic topographic surveys	Non-compliance with the leveling tolerances	Geophysical and/or ground investigation launching	To be implemented by ARL or an external specialist Contractor

Theme / Issue	Title and ID of the measure		Complementary description	Period of performance / Corresponding plan	Performance monitoring system	Performance indicators	Corrective measures	Responsible managers for implementation
	Phy-Kar-Mit/Comp-23	In situ investigation diagnostic of infilled cavities (televisual cavity inspections)	-	Operational phase **Karst monitoring plan**	Geophysical/geotechnical detection of underground cavity(ies)	Borehole log anomaly vertical to a leveling defect	Repair works as cavity filling/grouting	(as part of the 10-year guarantee) Under ARL's control
	Phy-Kar-Mit/Comp-24	Additional laboratory testings (Aggregate testings) to characterize erosive potential of in situ geological formations	-	Operational phase **Karst monitoring plan**	Detection of gully development as part of site visits	Slope instability, defect on drainage device	Slope reconstruction with coarse granular materials/Drainage system improvement works	
Infrastructures and solid waste management	Inf-Mit-7	Restore road connections	To adapt the surrounding airport routes to achieve overall network coherence	Operational phase **Infrastructures and access monitoring plan**	Post-commissioning assessment of persistent traffic problems	Zero additionnal traffic jam	Resizing of road network	To be implemented by the Detail Design Engineer and Contractor (as part of the 10-year guarantee) Under RRA and ARL's control
Air quality	Air-Mit-6	If possible, limit the taxiing distance	-	During operational phase **Air quality and noise environment management and monitoring plan**	Air quality and noise environment Management Plan	air emission standards	-	To be implemented by ARL or external specialist engineer Under ARL and RRA's control
	Air-Mit-7	Opt for technologies that limit aircraft pollutant emissions during taxiing	-		Air quality and noise environment Management Plan	air emission standards	-	
	Air-Mit-8	Encourage pilots to shut down unneeded engines when taxiing	-		Air quality and noise environment Management Plan	air emission standards	-	
	Air-Mit-9	Limit congestion (aircraft queues) by making departures as fluid as possible	-		Air quality and noise environment Management Plan	air emission standards	-	
	Air-Mit-10	Minimize the use of the APU and GPU	-		Air quality and noise environment Management Plan	air emission standards	-	
	Air-Mit-11	Develop and implement procedures to limit the use of the thrust reverser	-		Air quality and noise environment Management Plan	air emission standards	-	
	Air-Mit-12	Make ecological performance a criterion of choice for service vehicles and ground equipment	-	Before operational phase **Air quality and noise environment management and monitoring plan**	Air quality and noise environment Management Plan	air emission standards	-	To be implemented by the Detail Design Engineer Under ARL's control
	Air-Mit-13	Develop an efficient public transport system to limit the use of private vehicles	-		Air quality and noise environment Management Plan	air emission standards	-	
Noise	Noi-Mit-3	Limit air traffic at night and the use of noisy equipement	-	During operational phase **Air quality and noise environment management and monitoring plan**	Air quality and noise environment Management Plan	noise emission standards	-	To be implemented by ARL or external specialist engineer Under ARL and RRA's control
	Noi-Mit-4	Raise the ILS glide slope to reduce noise emissions during landing	-		Air quality and noise environment Management Plan	noise emission standards	-	
	Noi-Mit-5	Adapt departure procedures to minimize noise exposure on the ground during take-off	-		Air quality and noise environment Management Plan	noise emission standards	-	
	Noi-Mit-6	Limit the use of reverse thrust	-		Air quality and noise environment Management Plan	noise emission standards	-	
	Noi-Mit-7	Develop an efficient public transport system to limit the use of private vehicles	-	Before operational phase **Air quality and noise environment**	Air quality and noise environment Management Plan	noise emission standards	-	To be implemented by the Detail Design Engineer

Theme / Issue	Title and ID of the measure		Complementary description	Period of performance / Corresponding plan	Performance monitoring system	Performance indicators	Corrective measures	Responsible managers for implementation
				management and monitoring plan				Under ARL's control
Landscape	Land-Mit-19	Set up of green and blue grids	-	Any time **Landscape measures follow-up plan**	Environmental study	Environmental Assessment, guidelines and final report	None	RRA
	Land-Mit-20	Set up of sustainable and resilient city guidelines and architectural guidelines	-		Designer team: landscape architect, urbanist or architect with environmentalist and sociologist	Site Assessment, guidelines and final report	None	RRA
	Land-Mit-21	Investment in woodland planting to feed the timber industry	-		Private or relevant government administration	Yearly increase in wooded surfaces	None	RRA
	Land-Mit-22	Set up sustainable timber management plan	-		Forestry expert	Timber management assessment and report	None	RRA
	Land-Mit-23	Ravine preservation and sanctuarisation of associated woodlands	-		Relevant government administration	Extent of fence + yearly cost of maintenance	None	RRA

1.7.2 Social Management Plan for the operation phase

Table 18 lists the plans to be developed and then implemented to monitor all the environmental measures in the impact study.

Specific guides for preparing plans are provided in Chapter 10.2.2 of the ESIA.

Table 19 summarizes all the environmental measures in the impact study. The precise description of the measures is given in the impact study, in Chapter 8 of the ESIA.

The estimated cost associated with the social management and monitoring are provided in Chapter 12. The costs are considered indicative at this stage and will be updated during the life cycle of the project

Table 18: Social Management Plan during Operation Phase

Plan	Measures that the plan must allow to implement and monitor (see description in section 7 and ESMP above)	Person in charge of implementation and control
Communication plan	SE-Mit-3 SE-Mit-5 SE-Mit-7 SE-Mit-11 SE-Mit-12 SE-Mit-13 SE-Mit-14 SE-Mit-15	- Executive Committee of the RRA - Relocation committee appointed by the Executive Committee of the Rodrigues Regional Assembly - ARL - Spokesperson of the village of Sainte Marie - Fishing station managers and livestock breeder users of the impacted area - Rodrigues Agriculture Commission - Rodrigues women and small entrepreneurship Commission - Rodrigues fishing Commission - Villagers of Plaine Corail (proposed resettlement location) - Village committees of the airport area (Anse Quitor and Plaine Corail – Cascade Jean Louis) - Local media (radio) - Possibly a specialised external entity such as an NGO To be monitored by: ARL/ RRA and the Resettlement Monitoring Committee of Rodrigues Regional Assembly (with the help of an external specialized entity)

Plan	Measures that the plan must allow to implement and monitor (see description in section 7 and ESMP above)	Person in charge of implementation and control
Complaints management plan	SE-Mit-3 SE-Mit-11 SE-Mit-13	- Relocation committee appointed by and in liaison with the Executive Committee of the RRA - ARL - Spokesperson of the village of Sainte Marie - Fishing station managers and livestock breeder users of the impacted area - Villagers of Plaine Corail (proposed resettlement location) - Relocation committee appointed by the Executive Committee of the Rodrigues Regional Assembly - Rodrigues Agriculture Commission - Villagers and livestock breeders of the resettlement area - Rodrigues fishing Commission - Relocated fishing post managers To be monitored by: Resettlement Monitoring Committee of Rodrigues Regional Assembly (with the help of an external specialized entity)
Community assistance and communication plan for the development of income generating activities	SE-Mit-14	- Relocation committee appointed by and in liaison with the Executive Committee of the RRA - Rodrigues women and small entrepreneurship Commission - Rodrigues Agriculture Commission - Rodrigues fishing Commission - ARL - Village committees of the airport area (Anse Quitor, Plaine Corail – Cascade Jean Louis) To be monitored by RRA
Community development plan	SE-Mit-9 SE-Mit-11 SE-Mit-12	- Relocation committee appointed by and in liaison with the Executive Committee of the RRA

Plan	Measures that the plan must allow to implement and monitor (see description in section 7 and ESMP above)	Person in charge of implementation and control
	SE-Mit-14	- Rodrigues Agriculture Commission - Livestock breeders of the relocation area - Village committees of the airport area (Anse Quitor, Plaine Corail – Cascade Jean Louis) - Rodrigues fishing Commission - Rodrigues women and small entrepreneurship Commission To be monitored by: Resettlement Monitoring Committee of Rodrigues Regional Assembly (with the help of an external specialized entity)
Workforce management and training plan	SE-Mit-5 SE-Mit-7	- ARL - Project managers - Rodrigues labour Commission - Executive Committee of the RRA - Village committees of the airport area (Anse Quitor, Plaine Corail – Cascade Jean Louis) - Local media (radio) To be monitored by: RRA / ARL

Theme / Issue : Corresponding plan	Title of the measure concerned	Description	Period of performance	Performance monitoring system – reports to provide	Performance indicators	Corrective measures	Responsible managers for implementation
Communication Ensure a harmonious implementation of the work at all stages of its performance with all the communities directly or indirectly impacted by the project **Communication plan**	**SE-Mit-3-** Complaint management and internal support for relocation.	An outcome of the RAP, complaint management is the attentive listening to the affected populations regarding relocation. It must be effective and transparent in order to take into consideration and share all the grievances expressed by the communities in order to define appropriate communication and support strategies.	The complaint management plan covers the entire project: from the implementation of the resettlement plan and throughout the period of adaptation of the displaced communities.	To be monitored by: Resettlement Monitoring Committee of Rodrigues Regional Assembly Quarterly reports to be submitted by the Relocation Committee until full adaptation of resettled population	- Number of registered complaints and reports on actions taken for complaint management.	Ensure that all registered complaints have been satisfactorily treated. If not, complaints not yet treated will have to appear positively handled in following report.	- Relocation committee appointed by the Executive Committee of the Rodrigues Regional Assembly - Airport of Rodrigues - Spokesperson of the village of Sainte Marie - Fishing station managers and livestock breeder users of the impacted area - Villagers of Plaine Corail (proposed resettlement location)
	SE-Mit-5- Communication plan concerning the integration of external workers.	The project will bring in foreign and specifically qualified labour. It is important to communicate about a considerable and temporary advent of an external population and to ensure transparency concerning the hiring procedures in relation to foreign workers.	This communication plan must begin prior to the arrival of the first workers and continue throughout all of the works phase.	To be monitored by: RRA / ARL Annual reports submitted by the Airport of Rodrigues in collaboration with Rodrigues Regional Assembly that include communication measures taken on the period as well as local surveys on inhabitants as well as external workers.	- Number of communication activities carried out; - Number of communication media produced and distributed; - Number of organized sessions, meetings or information workshops; - Results of carried out surveys; - Number and qualitative details on hired people; - Number of registered complaints and reports on actions taken for complaints management.	- Organise additional communication activities in case of insufficient communication and if required through surveys results. - Ensure that all registered complaints have been satisfactorily treated. If not, complaints not yet treated will have to appear positively handled in following report.	- Executive Committee of the RRA - Airport of Rodrigues - Village committees of the airport area (Anse Quitor and Plaine Corail – Cascade Jean Louis) - Local media (radio)
	SE-Mit-7- Communication and hiring management plan	Specific communication concerning hiring procedures should be put in place so that impacted communities are informed about job opportunities and other related information.	This communication plan must begin and continue throughout the works phase.				
	SE-Mit-11- Community consultation plan for monitoring the evolution of the agro-pastoral system. **SE-Mit-12**- Support measures concerning livestock breeding techniques.	These measures relate to the communication procedures to be employed concerning the specific and important subject of adaptation of agricultural and livestock breeding techniques by all communities.	The measures occur from the resettlement of displaced villagers and continue throughout the period of community adaptation.	To be monitored by: RRA and the Resettlement Monitoring Committee of Rodrigues Regional Assembly (with the help of an external specialized entity) Bi-annual Relocation Plan Report to be submitted by the Relocation Committee including complaints management and satisfaction surveys.	- Number of registered complaints and reports on actions taken for complaint management, - Qualitative evaluation according to survey results.	- Improve communication with local people according to reports' feedback. - Ensure that all registered complaints have been satisfactorily treated. If not, complaints not yet treated will have to appear positively handled in following report.	- Relocation committee appointed by the Executive Committee of the RRA - Rodrigues Agriculture Commission - Village Committee (Plaine Corail – Cascade Jean Louis) and non-resident livestock breeders - Possibly a specialised external entity such as an NGO
	SE-Mit-13 - Support and fishermen's complaint management plan.	These measures relate to the communication procedures to be undertaken with the fishermen's community following relocation.	The measures occur from the resettlement of displaced villagers and continue throughout the period of community adaptation.				- Relocation committee appointed by the Executive Committee of the RRA - Rodrigues fishing Commission - Fishing station managers - Airport of Rodrigues

Theme / Issue : Corresponding plan	Title of the measure concerned	Description	Period of performance	Performance monitoring system – reports to provide	Performance indicators	Corrective measures	Responsible managers for implementation
	SE-Mit-14- Plan for consultation and support of the communities of the area concerning the development of income-generating activities. **SE-Mit-15-** Economic support plan for households.	These measures relate to the communication procedures to be employed with the village communities in the area in order to promote the development of income-generating activities for households by becoming aware of the initiatives that the villages and villagers would like to implement.	These measures are developed from the resettlement of displaced villagers and continue throughout the period of community adaptation.				- Rodrigues women and small entrepreneurship Commission - Rodrigues Agriculture Commission - Rodrigues fishing Commission - Airport of Rodrigues - Village committees of the airport area (Anse Quitor, Plaine Corail – Cascade Jean Louis)
Complaint management Ensure that all complaints from communities or individuals affected by the implementation of the project are received, reviewed and that appropriate action is taken within a reasonable time to arrive at a mutually acceptable solution. **Complaints management plan**	**SE-Mit-3-** Complaint management and internal support for relocation.	The relocation complaint management process requires careful listening to affected populations. It must be effective and transparent in order to take into consideration and share all the grievances expressed by the communities in order to define appropriate communication and support strategies.	*(entire project)*	To be monitored by: Resettlement Monitoring Committee of Rodrigues Regional Assembly Relocation Plan Report including complaint management to be submitted by the Relocation Committee at the end of the relocation plan and before resettlement.	- Number of complaints issued; - Number of complaints satisfactorily resolved.	- Ensure that all registered complaints have been satisfactorily treated. If not, complaints not well treated will have to appear positively handled before works begin.	- Relocation committee appointed by and in liaison with the Executive Committee of the RRA - Airport of Rodrigues - Spokesperson of the village of Sainte Marie - Fishing station managers and livestock breeder users of the impacted area - Villagers of Plaine Corail (proposed resettlement location)
	SE-Mit-11- Community consultation plan for monitoring the evolution of the agro-pastoral system.	This measure is the implementation of an effective and transparent complaint management mechanism concerning agriculture and livestock breeding. This mechanism makes it possible to become aware of the potential discontent of individuals or communities concerning the evolutionary process of the agro-pastoral system.	The measures occur from the resettlement of displaced villagers and continue throughout the period of community adaptation.	To be monitored by: Resettlement Monitoring Committee of Rodrigues Regional Assembly (with the help of an external specialized entity) Bi-annual Relocation Plan Report to be submitted by the Relocation Committee including complaint management and satisfaction surveys.	- Number of registered complaints and reports on actions taken for complaints management, - Qualitative evaluation according to survey results.	- Improve communication with local people according to reports' feedback. - Ensure that all registered complaints have been satisfactorily treated. If not, complaints not yet treated will have to appear positively handled in following report.	- Relocation committee appointed by the Executive Committee of the Rodrigues Regional Assembly - Rodrigues Agriculture Commission - Villagers and livestock breeders of the resettlement area
	SE-Mit-13 – Support and fishermen's complaint management plan.	This plan must implement a complaint management mechanism issued by the fishermen's community following relocation.	The measures occur from the resettlement of displaced villagers and continue throughout the period of community adaptation.				- Relocation committee appointed by the Executive Committee of the Rodrigues Regional Assembly - Rodrigues fishing Commission - Relocated fishing post managers

Theme / Issue : Corresponding plan	Title of the measure concerned	Description	Period of performance	Performance monitoring system – reports to provide	Performance indicators	Corrective measures	Responsible managers for implementation
Resettlement and compensation The set of measures to be taken for the resettlement and compensation of impacted communities must help to limit the socio-economic impacts resulting from the displacement of populations by restoring livelihoods and the standard of living of displaced people. **Action plan for relocation and compensation (including the livelihood restoration plan)**	**SE-Mit-14-** Plan for consultation and support of the communities of the area concerning the development of income-generating activities.	The goal of this measure is to keep communities on a viable and sustainable socio-economic dynamic by proposing to families that they diversify their economic activities.	This follow-up takes place from the construction phase and continues during the period of adaptation of the displaced communities.	To be monitored by RRA Annual report submitted by the Small Entrepreneurship Commission of Rodrigues Regional Assembly to Airport of Rodrigues and Rodrigues Regional Assembly Executive Committee.	- Quantitative and qualitative evaluation of local development according to survey results. - Number of local set up small activities and businesses.	- Enhance local economic environment through group consultations with specific and relevant themes according to evaluation results.	- Relocation committee appointed by and in liaison with the Executive Committee of the RRA - Rodrigues women and small entrepreneurship Commission - Rodrigues Agriculture Commission - Rodrigues fishing Commission - Airport of Rodrigues - Village committees of the airport area (Anse Quitor, Plaine Corail – Cascade Jean Louis)
Community development Medium-term planning of actions that should be implemented to achieve socio-economic development goals at the local level to trigger a virtuous process of improving living conditions **Community development plan**	**SE-Mit-9-** Agricultural technical support plan.	This measure contributes to the consolidation of integration in the community environment through the support of technical services facilitating the adaptation of agricultural models and thereby promoting the viability of production.	These measures occur from the resettlement of displaced villagers and continue throughout the period of community adaptation.	To be monitored by: Resettlement Monitoring Committee of Rodrigues Regional Assembly (with the help of an external specialized entity) Annual report submitted by the Commission of Agriculture dealing with results obtained from field surveys and farmer consultations.	- Number of projects implemented; - Number of direct and indirect beneficiaries; - Geographical coverage of the projects implemented; - Diversity of topics discussed.	Projects reinforcement or implementation according to results obtained from field surveys and farmer consultations.	- Relocation committee appointed by and in liaison with the Executive Committee of the RRA - Rodrigues Agriculture Commission - Village committees of the airport area (Anse Quitor, Plaine Corail – Cascade Jean Louis)
	SE-Mit-11- Community consultation plan for monitoring the evolution of the agro-pastoral system. **SE-Mit-12**- Support plan concerning livestock breeding techniques.	These measures contribute to consolidating the integration of communities through the support of technical services facilitating the adaptation of farming methods to the new environment and thereby promoting the viability of production.	The measures occur from the resettlement of displaced villagers and continue throughout the period of community adaptation.				- Relocation committee appointed by and in liaison with the Executive Committee of the RRA - Rodrigues Agriculture Commission - Livestock breeders of the relocation area - Village committees of the airport area (Anse Quitor, Plaine Corail – Cascade Jean Louis)

Theme / Issue : Corresponding plan	Title of the measure concerned	Description	Period of performance	Performance monitoring system – reports to provide	Performance indicators	Corrective measures	Responsible managers for implementation
	SE-Mit-14- Plan for consultation and support of the communities of the area concerning the development of income-generating activities.	The goal of this measure is to keep communities on a viable and sustainable socio-economic dynamic by proposing to families that they diversify their economic activities.	This follow-up takes place from the construction phase and continues during the period of adaptation of the displaced communities.	To be monitored by RRA Annual report submitted by the Small Entrepreneurship Commission of Rodrigues Regional Assembly to Airport of Rodrigues and Rodrigues Regional Assembly Executive Committee.		- Enhance local economic environment through group consultations with specific and relevant themes according to evaluation results.	- Relocation committee appointed by and in liaison with the Executive Committee of the RRA - Rodrigues women and small entrepreneurship Commission - Rodrigues Agriculture Commission - Rodrigues fishing Commission - Airport of Rodrigues - Village committees of the airport area (Anse Quitor, Plaine Corail – Cascade Jean Louis)
Workforce and training Encouragement to form a more rigorous workforce to improve the skills of local labour leading to economic growth linked to the creation of local jobs. **Workforce management and training plan**	**SE-Mit-5**- Communication plan concerning the integration of external workers.	These measures for the development of a management policy concerning the accommodation of external workers permit the improvement of incomes in the locations.	This measure must take place throughout the construction phase.	To be monitored by: RRA / ARL Annual reports submitted by the Airport of Rodrigues in collaboration with Rodrigues Regional Assembly that include communication measures taken on the period as well as local surveys on inhabitants as well as external workers.	- Number of communication activities carried out; - Number of communication media produced and distributed; - Number of organized sessions, meetings or information workshops; - Results of carried out surveys; - Number and qualitative details on hired people; - Number of registered complaints and reports on actions taken for complaints management, - Qualitative evaluation according to survey results.	- Organise additional communication activities in case of insufficient communication and if required through survey results. - Ensure that all registered complaints have been satisfactorily treated. If not, complaints not yet treated will have to appear positively handled in following report.	- ARL - Project managers - Rodrigues labour Commission - Executive Committee of the RRA - Airport of Rodrigues - Village committees of the airport area (Anse Quitor, Plaine Corail – Cascade Jean Louis) - Local media (radio)
	SE-Mit-7- Communication and hiring management plan	This measure is to showcase local skills, job opportunities and associated hiring conditions, and to foster local hiring to provide opportunities to obtain skills. This measure is to implement a worker complaint management process including the development of a labour law awareness and training program.	This measure must take place throughout the construction phase.				- ARL - Project managers - Executive Committee of the RRA - Rodrigues labour Commission - Village committees of the airport area (Anse Quitor and Plaine Corail – Cascade Jean Louis) - Local media (radio)

Table 19: Summary of Social Measures and Monitoring during Operation Phase

1.8 Cumulative Impact Assessment

Cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity (collectively referred to in this document as “developments”) when added to other existing, planned, and/or reasonably anticipated future ones. For practical reasons, the identification and management of cumulative impacts are limited to those effects generally recognized as important on the basis of scientific concerns and/or concerns of affected communities.

Multiple and successive environmental and social impacts from existing developments, combined with the potential incremental impacts resulting from proposed and/or anticipated future developments, may result in significant cumulative impacts that would not be expected in the case of a stand-alone development.

The ESIA has already identified the Valued environmental and Social component s (VECs) of concern both during construction and operation phases, inter alia

- Physical Environment
  - Terrestrial geology and geotechnics
  - Marine and shores geology and marine turbidity
  - Hydrology
  - Hydrogeology
  - Water resource and waste water management
- Biological Environment
  - Terrestrial Biological Environment
  - Marine Biological Environment
- Utility and Services
  - Transport network
  - Electricity supply
  - Water supply
  - Wastewater management
  - Solid waste management
- Socio-Economic Environment
  - Land Use Planning
  - Housing
  - Heritage Conservation
  - Education, Health and Community Facilities
  - Employment Uses
  - Agriculture and Fisheries
  - Mineral Resources
  - Tourism

The assessment and/or estimation of the future condition of selected VECs, as the result of the cumulative impacts that the development is expected to have, when combined with those of other reasonably predictable developments as well as those from natural environmental and external social drivers, will be done upon receipt of the final design of the project.

It is however foreseen that the cumulative impact will be significant both at construction and operation stages on the natural and built environment.

1.9 Scope of Studies for the finalisation of the ESIA Report

As part of the finalisation of the ESIA report, all the environmental and social field surveys and studies undertaken in 2018/2019 for the preparation of the ESIA 2019 will have to be updated. These comprise but are not limited to

- terrestrial and marine biodiversity surveys,
- studies of relevant available data gathered during the period,
- further studies/modelling once the detailed design of the Project is received.

Chapter 2 hereafter provides the Terms of Reference & Methodology for Updating the ESIA.

2 Terms of Reference & Methodology for Updating the ESIA

2.1 Terms of Reference for Consultancy Services to Update an Environmental and Social Assessment for the Expansion of the Rodrigues Airport Project.

The terms of Reference below have been prepared by the World Bank and serve to update the existing ESIA prepared in 2018-2019.

2.1.1 Introduction

An ESIA for the expansion of the Rodrigues Airport was prepared in 2019 to meet the requirements of the Government of Mauritius and those of the Agence Française de Développement (AFD) and the European Union (EU).

Airport of Rodrigues Ltd is proposing to seek financing support from the World Bank and is therefore required to update the existing ESIA to meet the requirements of the World Bank Environmental and Social Framework (ESF).

The proposed project is currently classified as a High-risk project under the World Bank Environmental and Social Policy, due to the anticipated long-term and permanent adverse direct, indirect and cumulative impacts. In particular the construction of the new runway will have direct impacts on endangered and critically endangered tree species which will require relocation, furthermore it is anticipated that marine construction activities may have an impact on critically endangered marine turtles and near threatened coral species, which will require further investigation and mitigations as part of the final ESIA. Even though the expansion of the airport may contribute to positive socio-economic benefits of Rodrigues, potential cumulative impacts may negatively impact on scarce natural resources, sense of place, and potential social impacts such as security, loss of land for agriculture etc. The full extent of the potential downstream cumulative impacts will be further assessed as part of the final ESIA.

2.1.2 Objectives of the Assignment

This assignment aims to update the existing ESIA to address the gaps identified to meet the requirements of the World Bank ESF in addition to the legislative requirements of the Republic of Mauritius. The Consultant will further update the ESIA, taking into consideration the design changes and final design considerations. The updated ESIA must aim to identify and assess all positive and negative environmental and social risks and impacts potentially generated by all phases of the Rodrigues Airport expansion project (collectively referred to as the “Project” in this Terms of Reference – ToR) and propose technically feasible mitigation measures to manage the identified environmental and social risks and impacts. The ToR focuses on the ESIA aspects that need to be updated firstly to meet early disclosure requirements. The output of this ToR will be the delivery of an updated “draft” ESIA.

A final version of the ESIA will be prepared and disclosed before project appraisal (preliminarily planned for April 23) based on the additional studies identified in the draft ESIA (this document) and the finalization of the airport design.

Therefore, the updated draft ESIA shall describe the current information gaps and their potential impacts and risks to the project and provide information on how the consultant anticipates collecting information to close the information gap during the finalization of the ESIA. The updated draft ESIA will inform the additional studies and information gathering required to finalization of the ESIA and Environmental and Social Management Plan (ESMP) to meet the requirements of the World Bank ESF.

2.1.3 Relevant Standards and Legal Requirements

The updated draft ESIA and relevant environmental and social studies should take into consideration the following national environmental legal framework, relevant standards and guidelines

- Mauritius environmental legislation
- International Law, including conventions and treaties adopted by Mauritius and applicable to the Rodrigues airport Project;
- World Bank Environmental and Social Framework;
- The World Bank Group General Environmental, Health and Safety Guidelines (EHSG), and;
- The World Bank Group EHSG for Airports projects
- Any other relevant legal requirement

2.1.4 Scope of Work

2.1.4.1 Draft ESIA

The Assignment corresponds to the following task: Update the “draft” ESIA to meet the requirements of the World Bank ESF.

As part of preparing the updated draft ESIA, the Consultant must prepare a chapter that substantiates the current Project information gaps and how they could pose a risk to the Project and identify the scope of work required to fill those gaps. This chapter should provide information on the methodology and parameters, if relevant, that will be followed to fill in the existing gaps and the relevant additional studies required detailing the respective scope of work. The Consultant will further update the ESIA to clarify/amend the information provided in the existing document as stipulated in this ToR.

The above requirements are fulfilled in section 1.2 below.

2.1.4.2 Final ESIA

A final version of the ESIA will be prepared and disclosed before project appraisal (preliminarily planned for April 23) based on the additional studies identified in the draft ESIA (this document) and the finalization of the airport design.

2.2 Methodology for updating the ESIA

As at date, the Detailed Design of the Project is still ongoing by the consultants, with the geotechnical investigations currently underway at Plaine Corail Airport.

The Final alignment of the runway shall be finalised once the geotechnical investigation has been completed and the outcome thereof incorporated into the detailed design.

Hence, as at date, there is no significant information concerning the new design, to the exception of the location of the Air Traffic Control and the Rescue and Fire Fighting Services that have been moved outside the Nature Reserve.

2.2.1 Draft ESIA

The improvements and corrections brought to the existing ESIA (2018) are provided in Table 20 below. Where the required updates cannot be done at this stage, the later has been justified and is moved to the ESIA finalisation stage; the methodology to achieve the update is hence provided.

Table 20: Draft ESIA update - Corrections and Amendments to the existing ESIA

No	GAP ANALYSIS	DRAFT ESIA UPDATE
a	Update the ESIA to reflect the latest version of the project description, including the new location of the Control Tower and the new layout of buildings and infrastructure;	Architectural drawings of the following buildings have been received: ATC, RFFS, incinerator, boat house, met. Services, quarantine, power centre A plan of the repositioning of the ATC and RFFS outside AQNR has been received. This positive aspect is discussed in the present draft ESIA update. It was a recommendation of the initial ESIA 2018. A plan of the possible repositioning of the runway 75m to the east has been received. The client has indicated that same should not be taken into consideration for now There is currently no latest version of the master plan with proper positioning of all buildings and their setbacks to potential environmental sensitive areas. There is no technical data on the incinerator, jetty/slipways, etc enabling a review of the impact assessment The ESIA will be finalised once the project is signed off and necessary data is made available
b	(Introduction - chapter 2): Explain the ESIA update regarding the compliance with the World Bank ESF requirements;	chapter 2 Introduction has been updated accordingly
c	(Introduction - chapter 2): Include and explain the risk rating according to each ESS;	chapter 2 Introduction has been updated accordingly
d	Clarify and harmonize the definitions of the project's areas of influence (eg Anse Quitor Natural Reserve – AQNR, and ending of river's edge should be part of the area of influence) and define criteria for the selection of the areas;	Project area of influence has been partly amended. The area of Influence will be reviewed further, in a manner consistent with the requirements of the ESSs, in the light of the detailed design and technical information gathered on the project on the one hand, and the collection and analysis of environmental and social baseline information and data on the other hand.

		The area of influence and hence studies, reports and maps will be amended during the ESIA finalisation for a complete coverage of the marine and terrestrial environment including riverine land and estuary
e	Climate and disaster risk (section 3.3.1.2): Include analysis on sea level rise, including projections for future rise and on the possible increase in frequency and intensity of tropical cyclones;	The 'update of the nationally determined contribution of the Republic of Mauritius' published on 1 October 2021 and the MMS give some figures which are included in section 3.3.1.2 and 3.3.1.3 A specific section 3.3.1.4 has been created. Hence renumbering of all other sections
f	(section 3.3.1.8): Address the needs of water during construction (including calculations and sources);	Section updated Water requirement during construction is not known at this stage Water source proposed is a temporary desalination plant
g	(section 3.3.1.8): Clarify the dismantling or updating of the existing wastewater treatment system;	Section updated The existing wastewater treatment plant will be dismantled once the new plant is operational.
h	(section 3.3.1.9): Given the lack of information and uncertainty regarding the hydrogeological karstic environment, review the sensitivity of all three receptors;	The sensitivity has been reviewed. Refer section 3.3.1.9; Section 6.3.7.6.3 and Section 6.3.9
i	(section 3.3.2.1): Complete the information on AQNR: aims of the reserve, date of creation, gazetting status	Section 3.3.2.1 updated
j	(section 3.3.2.1 – Table 1): Classify habitats as per ESS6 and update the IUCN status of threatened species	Section 3.3.2.1.1 updated with reference to ESS6. IUCN status updated with latest data available from IUCN Red List of Threatened Species website
k	(section 3.3.2.1.4): Revise the statement that the project avoids impacts on AQNR, considering it is located within the area of influence of the runway;	The statement has been deleted in the present updated 'draft' ESIA. The risk assessment will be reviewed when finalising the ESIA in the light of the detailed design.
l	(section 3.3.2.2.1): Review the IUCN status of Acropora formosa (NT);	IUCN latest update 2008 classified as Near Threatened. No change
m	(section 3.3.3.3): Provide additional information on solid waste management – capacity of the landfill site in Grenade to absorb waste generation during construction and operation; final disposal of hazardous and e-waste during construction and operation	Data received from RRA and included
n	(section 3.3.6.2): Provide additional information, including mapping, of the impacts on fossils and the mitigation proposed;	Information available in the draft ESIA has been included in this section of the executive summary. Should further studies be required, these will be undertaken as part of the ESIA final update A conservation plan will need to be set up
o	(section 3.4.2): Include impacts on Acropora formosa and reconsider the risk rating;	Acropora formosa is included in marine habitat BioM-Hab-W-Temp-1 Risk rating low base on studies undertaken in 2018 A fresh assessment of the marine biodiversity may be required as part of the ESIA final update
p	(section 3.4.2): Identify and assess potential impacts on bat populations in the caves (or other species present at the	Terrestrial and marine fauna and flora have been assessed

	caves), and on coastal habitats, including areas suitable for turtles nesting;	Study on marine turtle will be updated as part of the ESIA final update to include seasonal representativity
q	(section 4.1): Add information on legislation on protected areas, national legislation on environment, health and safety, gender-based violence, land acquisition, compensation, resettlement, cultural heritage; Include a final section on the gap between the applicable ESS and the national legislation;	Section 4.1 updated
r	(section 4.1.2.2): Provide details on the EIA process in Mauritius, including the requirements for consultation	Refer to section 4.1.1 Updated
s	(section 4.3.2): Update the reference to the Kyoto Protocol, no longer effective, and include the Paris agreement	Section 4.3.2 updated
t	(section 4.3.2): Include the ILO Conventions ratified by Mauritius;	Section 4.3.2 updated
u	(section 5.): Provide the demonstration that the project, including infrastructures (eg storm water drainage) are climate resilient;	it is understood that the terms of reference of the design includes resilience to climate change. The consultant shall provide such demonstration at detailed design stage
v	(section 5.2): Update the timeline for the project;	Section 5.2 updated with data from ARL
w	(section 5.3.1.2): Add the capacity of the water tower	Section 5.3.1.2 updated a minimum volume of 30 m^3 as per firefighting guidelines
x	(Figure 21): Adjust the legend	Figure 21 deleted. Figure 13 provides the latest master plan provided by ARL
y	(section 5.3.14.5): Substantiate application of the mitigation hierarchy (avoid discharges in sensitive areas (eg coral, marine habitats);	Section 5.3.14.5 is now 5.3.10.5 in the updated 'draft' ESIA the effects of the discharges will be analysed and avoidance measures will be defined in the marine environment and in particular in the sensitive areas, previously determined by the additional field investigations and the bibliography
z	(section 5.4): Update budget and financing	The financial update will be undertaken in as part of the ESIA final update in the light of the information provided by the client and Main Consultant.
aa	(section 5.6.4.1): Provide details about the workers camp and its location	Details not available. Will be requested for evaluation as part of the ESIA final update
bb	(section 5.6.4.2): Provide details about the desalination plant;	Section 5.6.4.2 updated However these are assumptions/recommendations given that the provision of water will be under the responsibility of the contractor
cc	(section 5.6.4.3): Provide data about the water needs and sources for the concrete and asphalt plants;	Details not available. Will be requested for evaluation as part of the ESIA final update
dd	(section 5.6.4.4): Provide details about the incinerator and its potential environmental impacts;	Section amended and Removed

ee	(section 5.6.4.4): Identify and assess the impacts of the management of the waste during construction, including the transport to Mauritius	Details not available. Will be requested for evaluation as part of the ESIA final update against possibilities in Rodrigues
ff	(section 5.7): Revise definition of "associated facilities" according to the meaning on the ESF;	Section renamed Ancillary facilities
gg	(section 6.3.8.1): Update and revise the table on water supply	Table updated
hh	(section 6.3.9): Revise the sensitivity of water supply	Sensitivity revised to high
ii	(section 6.4.1.2.2): Revise the classification of AQNR as per ESS6;	Same comment as item j above
jj	(6.4.1.5.3): Replace the AFD definition of Critical Habitat with the definition of ESS6	Both definitions are found in section 6.4.1.5.3 AFD and WB. Ref to ESS6 added
kk	(section 7.2.1.1.1.2): Detail the footprint of the shoreline reclaimed, habitat types and area affected	Extent of reclamation will be available at final design stage The assessment will be updated as part of the ESIA final update with assessment of the localised effects on the relevant coastal areas, zones, habitats and species
ll	(section 7.2.1.1.3): Provide detail about disposal of the dredging material, dredging equipment, operation conditions (eg noise), acceptable thresholds for suspended sediments and revise impact analysis and mitigation	No information available to date This major assessment will be undertaken as part of the ESIA final update receipt of design elements. It is necessary to make a multi-criteria study for the dredging techniques, the technology available on the island or the islands around, the zone of deposit of minimum impact according to the risks of habitats and a toxicological analysis of dredging sediments. A hydro-sedimentary model would be interesting to establish the dispersion profile of sediments in the lagoon. Measures can also be applied to reduce the impacts depending on the method (e.g. bubble curtain to limit the sediment transfer and dispersion, and noise reduction). The impact analysis and mitigation measures will be revised, especially for corals
mm	(section 7.2.1.4.5): Provide the identification and assessment of the impacts of the construction and operation of a desalination plant	A preliminary assessment is included as chapter 7.2.1.4.5 (new)
nn	(section 7.2.2.3.1.2): Revise the assessment of the impacts on coral	the assessment of the impacts on coral will be revised in as part of the ESIA final update once the detailed design is complemented, the extent of dredging and reclamation at sea is known and the sediment plume dispersion modelling reviewed
oo	(section 7.2.2.4.2.1): Provide details about the model used for the dispersion of sediment plume	Details are provided in sections 6.3.3.1 and 7.2.1.1.1.1).
pp	(section 7.3.1.2): Assess the risk of leakage to the karstic environment	The risks have already been discussed in the following sections: 7.2.1.3: Geotechnics and Hydrogeology of the karstic system 7.2.1.4: Impact Phy-Wat-W-Temp-2: impact of works on water resource due to impact on karstic groundwater

		7.3.1.3: Geotechnics and Hydrogeology 7.3.1.4: Water resource and wastewater management Also, as discussed in Section 6.3.7.4.2 of the EISA, when the amount of data on karst soils and hydrogeological conditions is sufficient, a vulnerability analysis of the karst aquifer could be developed based on GIS tools and possibly the EPIK method
qq	(section 7.3.2.3.5): Provide details about the mitigation BioT-MIt-8 (eg relocation sites, density/numbers)	Details added in section 6.3.3.1.and already in section 7.3.2.3.2.2 Further details if required will be provided as part of the ESIA final update
rr	(section 7.3.2.4.3): Revise the assessment of the residual impacts; clarify the mitigation measure of coral relocation, not listed in the table, but referred in the text of section 7.3.2.4.1	Rephrased Marine habitat - BioM-Hab-W-Def-1 - Destruction of natural habitats, including areas characterized by presence of Acropora formosa
ss	(section 7.4.4.1): Please elaborate and contextualize the concept of improvement measures	Inadequate translation of 'mesures de bonification' 'Bonus measures' replaced by 'improvement measures' throughout the document
tt	Include a specific chapter on cumulative impact assessment, including a preliminary analysis of indirect impacts during operation (increase of the number of tourists will put additional pressure on water resources, energy demands, etc.).	Given the short timeframe to undertake the draft ESIA update, a specific chapter on cumulative impact assessment has been created yet it contains basic generic items in relation to the World Bank Group IFC Good Practice Handbook. The chapter will be substantiated as part of the ESIA final update

2.2.2 Final ESIA

a) Update the marine fauna baseline study, including marine mammals, turtles, and habitats with seasonal representativity, covering the estuarine area and Crab, Fregate and Destinee islands. This study should include a map of the coral habitat and reassess the technical feasibility of the coral relocation proposed as a mitigation measure based on evidence obtained from other projects where this measure was adopted;

In order to strengthen the elements relating to the description of marine species and habitats it is necessary to carry out two complementary actions:

1) Additional literature review

The available documents and studies concerning marine species date back to several years and are partial in their knowledge of the presence of marine species, such as marine mammals, turtles and habitats, particularly in the project's area of influence.

In order to reinforce the initial state, the local associations in charge of ecological monitoring will be contacted. Possibility to complete some information by additional bibliography or discussions with local associations, Data is certainly available from the association CARET (Comité d'Action Rodriguais d'Etude et de Protection des Tortues Marines), and by undertaking desk research with universities and the IUCN.

2) Marine Field investigation

In order to complete the knowledge, especially over a summer period, including the Crab, Frégate and Destinee Islands, as well as the estuarine zone, hge are of area the sea outfalls and the jetties/slipway, additional underwater investigations are necessary. These investigations will allow on the one hand to specify the map of habitats (corals, sea grass, coralligenous) but also to establish a map of the sensitivity of the habitats allowing to define the various impacts of the project.

These field missions will also aim to reassess the technical feasibility of relocating coral by identifying the corals concerned and the habitats suitable for transplants, and to carry out an assessment with regard to other projects that have required such transplantation measures.

As regards the marine turtles, it is proposed to carry out the field study during the breading season (generally October to March).

As part of the scope an understanding of the seabed type of habitats and conditions and diversity of species in the areas affected by the marine works, particularly the locations of the sensitive receptors (coral reefs, potential nesting sites for the turtles etc.) and the sensitivity of the intertidal zone need to be assessed. Based on the outcomes of the supplementary studies, biodiversity management plans will need to be developed. The ESMP should include a requirement for a Dredging and Reclamation Management Plan to be developed prior to initiating any dredging or reclamation works.

b) Update the terrestrial biodiversity baseline study of the species Pteropus rodricensis to determine the probability of its occurrence in the project's area of influence, and provide additional information on potential forest areas, trees or caves that this specie could potentially utilize as roosting areas that the project activities may impact;

The terrestrial biodiversity baseline study shall be updated with seasonal representativity.

For Pteropus rodricensis, we propose 2 sessions (dry season and wet season to cover the annual cycle) of 2 days with 2 people. We will make focal points of observations at different times of the day (dawn and dusk in particular) to characterize the use of the site: number of individuals, flight paths, resting site, feeding site. Note that this species is generally not cave-dwelling and that specific prospections in lava tunnel are of no interest for this species. However, new ultrasonic recordings can again be implemented at these locations to confirm the absence of microchiroptera in Rodrigues Island.

A terrestrial biodiversity management plan will be included in the ESMP based on the outcome of the updated studies.

c) Update the baseline study of the gastropod Tropidophora articulata, including an assessment of the current population on the island of Rodrigues;

For Tropidophora articulata, we will complete the bibliographic data collected by a survey giving presence absence by cells. Specific research of this species will be organized in the area of influence on a 250m side grid to reveal a potential range and abondance on the area of influence. Coupled with knowledge related to the ecology of tropidophora, we can obtain from this field campaign an approach to suitable habitats

for the species. The campaign will have to take place in the wet season for a better relevance.

A terrestrial biodiversity management plan will be included in the ESMP based on the outcome of the updated studies.

d) Obtain baseline information on the geological and geotechnical characteristics of the project's area of influence, including volcanic activity, voids, groundwater patterns, and vulnerability analysis of the aquifer and undertake a detailed assessment of the geotechnical and hydrogeological risks of building the runway upon a fractured karstic base;

Part 1 – Geological Aspects

The current ESIA report section 6.3.4.1.4: Geology of the restricted area of influence provides details about the geology of the area. That section was largely developed based on the investigations carried out in three stages from January 2017 to September 2018.

The works carried out provided enough information to understand the ground model within that area. The intrusive works show that the area consists of the following

(a) Calcarenites – composed of alternating fine to coarse sands and grained corals, separated by clayey beds (average thickness of 5 m),

(b) Basalts – composed, from top to bottom of Basalt series, of highly to slightly weathered basalts, with high plasticity silty clays with intervals of gravels and cobbles (average thickness of 9.5m),

(c) Breccias – composed of highly weathered breccia, often located beneath Calcarenite deposits up to depths of 10 m, with high plasticity silty clays and medium to fine gravels of weathered basalts (average thickness of 3 m).

Sections drawn across the site shows that the Calcarenites layer varies from the St Marie mount area increases towards the coastline.

Ground penetrating radar (GPR) surveys were carried out over the area and revealed that **541 voids** were determined this way, but more can be found deeper. Over the **541 voids determined with the following distribution:**

- none are found between 0 and 5 m below the surface.
- 11% are found between 5 and 10 m
- 38 % between 10 and 15m,
- 30% between 15 and 20
- 21% beyond 20 m.

Most of voids are thus located between 10 and 20 m below the surface. The effect of karstic dissolution in the formation of the voids identified was not investigated considering the absence of ground water monitoring.

The following works are recommended to be carried out

(a) Further assessment of underground ground features associated with Karstic Action with particular reference to the identified caves.

It is strongly recommended to carry out additional GPR surveys in area adjacent to the ground features to assess the existence of underground ground features. The GPR shall be specified to have an accurate model. For example,with survey lines at centres not less than five metres, characteristics of the voids can be accurately mapped. The findings shall then be used to relate the likelihood of positions of these underground features (voids and tunnels) with the proposed locations of the runway and embankments.

(b) Assess impact of offshore works

Also, along the South East, with the proposed graded area embankment forming the runaway partly built beyond the existing coastline, it is recommended to carry out additional investigations offshore to not only determine the geotechnical design parameters but more importantly extend the ground models in that area. The new structure will have an implication on the coastal geomorphology and therefore must be investigated.

Surveys, assessment, and modelling of metocean, hydrological, sedimentological and coastal geomorphological conditions should be carried out together with an identification of potential adverse impacts on coastal processes such as erosion and accretion, from the placement of new earth retaining structures and land reclamation.

The design, siting considerations and coastal protection measures with particular reference to groynes and proposed seawalls shall be considered to minimize adverse impacts from these structures.

(c) Understand the impact of the land reclamation on the coast processes

As part of a coastal processes monitoring and management plan, projects should conduct a risk assessment of littoral sediment transport, shoreline morphology and erosion patterns and trends, and coastal inundation profiles.

In addition, the source of materials to carry out the land reclamation works shall be identified. Risk assessments shall be carried out to identify potential impact of such works and importing of materials from the source.

Part 2 – Hydrogeology.

As discussed in Section 6.3.7.2 of the ESIA, the implementation of a network of piezometers and monitoring of water levels with automatic loggers on the Plaine Corail Peninsula would help identify the subsurface flow pattern and understand the behaviour of the flow as a function of climatic contingencies. It would then be necessary to install new observation wells upstream of existing and future facilities. A water level monitoring campaign will be required to determine the relationship of groundwater flow in the karst and basaltic aquifer to tidal and climatic events. A water sampling campaign should also be scheduled and an analytical program instituted to determine the variation in groundwater quality over time.

Also, as discussed in Section 6.3.7.4.2 of the ESIA, when the amount of data on karst soils and hydrogeological conditions is sufficient, a vulnerability analysis of the karst aquifer could be developed based on GIS tools and possibly the EPIK method.

e) Prepare or update the biodiversity management plan with additional information obtained from the additional terrestrial and marine baseline studies to be conducted;

The biodiversity management plan shall be updated in the light of the existing and additional surveys and studies to be commissioned for the project

f) Assess the potential risks associated with the construction-induced traffic to transport workers, materials, and equipment from Port Mathurin to the project site and prepare a Traffic Management Plan (including maritime traffic) for the construction and operation phases;

Terrestrial Traffic.

Construction phase. A Traffic Impact Assessment should be carried out for the construction phase with regards to transport of material, labours etc, on the main arteries of the island and in the vicinity of the airport. In this context, the existing baseline infrastructure conditions are to be surveyed, and an analysis undertaken of the project related induced traffic on aspects such as level of service, safety, traffic control and diversions, possible infrastructure upgrade required.

Operation phase. Likewise, a Traffic Impact Assessment should be carried out for the operation phase; based on the expected flight schedules and requirements associated thereto

Marine Traffic

Should marine transport be considered, the analysis of the effects and impacts on the marine environment will be carried out, integrating for example the risks of disturbance or collision with marine fauna, such as turtles.

The analysis of the initial state of the transport network highlights an important modal share of road transport for domestic traffic to ensure the service of the most dispersed towns and hamlets. Because of its island context, airport and maritime traffic are equally important and constitute the backbone of the development of economic activities such as trade, tourism, fishing, and the supply of consumer products to the island, etc.

The ESIA identifies that during the construction phase, the road network will be affected by:

- The circulation of construction machinery around the study area;
- Convoys of construction materials arriving in Port Mathurin by boat which will have to be transferred to Plaine Corail airport.

These factors will increase and slow down road traffic.

About air transport, some of the construction materials could be transported by air, directly to Plaine Corail airport. This should not affect the passenger air traffic; however, the cargo traffic could be increased.

For Maritime routes, as for the air traffic, there should be only minor impact on the port traffic of Rodrigues. The supply of materials will lead to an increase in the volume of goods arriving at the port. However, this will only have a little impact on passenger traffic or other freight

traffic. The impact severity is low. Considering the receptor sensitivity assessed as low, the impact magnitude is low.

Additions will be made during the updating of the ESIA to better identify the risks for workers and local residents as well as road and seaway users, and the sources of danger and conflicts to which they will be exposed. In this regard, ARL will have to indicate the origin of the materials and the locations of the industrial bases and any data likely to be used in this section.

The mitigation measures will include, in addition to the elements in the ESIA, recommendations and guidelines for the contractors, who will be responsible for drawing up a safety and traffic management plan induced by the movement of construction equipment and trucks.

Project activities, as well as the development and use of temporary infrastructure sites (construction sites, storage areas and camps), may impact traffic on public roads. The Traffic and Access Control Management Plan serves as a traffic management plan for the appropriate government authorities and provides guidance to contractors on the minimum requirements to maintain safe work environments and minimize traffic disruptions to the traveling public.

We understand that the plan will include, at a minimum, the requirements that all contractors will be expected to meet in developing traffic management plans for each construction segment and for the operations phase.

Details of the plan include current and forecasted traffic volumes, a description of traffic flows, identification of potential staging storage sites, camps and construction sites, and an assessment of potential impacts and associated mitigation measures for key Project activities and locations.

Contractors will develop complementary traffic detour and management plans for their work areas during final construction planning.

Mitigation measures are site-specific and may include the use of traffic control devices, signalization, and traffic control personnel, as well as measures to minimize local impacts from light, dust, and noise. Project workers will congregate at designated locations and be transported to work sites where possible.

g) Assess the potential risks associated with the project water supply needs (during construction and operation phases) and prepare a Water Management Plan;

Rainwater harvesting – a holistic and endogenous solution: The challenge is to ensure that the increased water needs associated with the project does stress further an already water stressed island. The airport already relies on rainwater harvesting even though it is connected to the public network. Hence, the project will use treated rainwater (from rooftops, run off storm water) and recycled treated wastewater, as a primary source of water instead of the public network which will only be used as backup. All of which will be properly captured, stored and treated.

In particular, the different types of water sources, within the “integrated” water management approach, will be mobilised according to the specific use to be made of. For instance, drinking water needs will be fulfilled mainly by the drinking water network, but all other uses

not necessarily requiring drinking water standards, will be fulfilled with the other water sources, after an adequate level of treatment and water quality monitoring, as proposed

Integrated water management design assumptions: In addition to securing the rainwater as a reliable source, the water management approach adopted in this project is an integrated water management that will be put in place to optimize water usage (domestic, industrial and potable) during all phases.

The water management plan is part of the global integrated water management plan presented in the ESIA. As an overview, the integrated water management will consist namely of:

- The capture and storage of rainwater (from rooftops) and runoff stormwater (from “clean” surfaces) at the time of availability in order to use them whenever required after an adequate treatment and quality monitoring.

- The reuse of the domestic wastewater after an adequate treatment and quality monitoring for industrial and irrigation uses.

- An eventual backup of the drinking water network, if necessary, after an adequate treatment and quality monitoring.

- A zero liquid discharge, as far as possible during normal operating conditions by mobilising the different sources of water available.

The main objective of this integrated management plan is the optimization of the water uses that will lead to a reliable and sustainable water system.

The challenge of designing the different parts of the management plan is the input data of the various water management solutions - actual potable water daily demand, volume of wastewater produced that is expected to increase from the future airport development. For instance, the water consumption is usually at its highest during the month of November and December when Rodriguans visit family at the end of the year. However, this may change with increased tourism travel which may take place at other times of the year. Increased tourism will indeed increase the number of airport employees, passengers and overall general traffic. Hence, water demand and wastewater production are expected to increase proportionally to the total number of people expected to visit or work at the airport. The assumptions used to design the different units will be confirmed at the end of the current detailed design being carried out by the Detailed Design Consultant.

Climate change integration: Finally, it must be noted that any water supply plan that depends on rainfall availability must inevitably be assessed with regards to climate change - it’s impact on the frequency and intensity of the rain events as well on the infrastructure works built. These design considerations (decrease in rainfall quantity, unpredictability of rainfall events, potential drought) must be fully taken into account in the detailed design of the water management of the new airport.

The General Principle proposed for the Integrated Water Management envisaged was presented in Figure 22 of ESIA 2019 (now Figure 21 of the updated ESIA).

The final ESIA will furthermore assess the potential impacts associated with the wastewater treatment plant based on the final design and location. Aspects such as marine outfall and capacity of the receiving body including impacts on the marine biota based on the location of the WWTP will be assessed.

The ESIA will further identify potential areas or sources of soil and ground water pollution within the footprint of the existing airport and assess the likelihood of any existing soil and ground water contamination.

h) Update and provide a detailed assessment of the stormwater drainage project;

The stormwater drainage will be updated and detailed as part of the ESIA final update once the final detailed design will be communicated. It will include:

- The stormwater drainage plan according to the new detailed design,
- The sizing of the stormwater network (pipes, ditch, etc.),
- The sizing of the buffer tanks,
- The sizing of the hydraulic works.

The details of the calculation will be inserted in the final ESIA with the hydrological data taken into consideration and the formulas used for the hydraulic part.

The sizing of the stormwater drainage will take into consideration the evolution of rainfall associated to climate change. Higher intensity of the synthetical events obtained by the current rain data of Rodrigues will be used depending on climate change prediction in the region.

For this part, we will need the final design plans of the study area in DWG, PDF and shapefiles format and the topography of the study area including the project (DEM).

The general concept of the land drainage is to reuse and recycle the water as much as feasible. The overflow at times of heavy rainfall will be channelled to the sea.

Mitigation measures envisaged include but are not limited to

- Ensure the sea outfall(s) is (are) located in least concerned /no concern areas of marine biodiversity,
- Ensure the engineering design of the outfall(s) does not cause further erosion of the coastline than the natural erosion due to natural runoff to the sea.

<u>Marine environment:</u>

The project may increase stormwater runoff and thus increase the discharge rate. The following points should be considered:

- Change from the current state (position and flows)
- If changes exist, then:
    - Is the discharge into the marine environment?
    - Is the discharge likely to impact on marine biodiversity?

If changes to the stormwater discharge may impact marine biodiversity, then numerical modelling of the freshwater plume and turbidity should be undertaken. This will allow the

extent of the freshwater plume to be compared to the current state and thus estimate the impact of the proposed stormwater discharge.

This will require reusing the existing numerical model and incorporating salinity. The simulations will incorporate a heavy rainfall event which will generate a high runoff and therefore a high freshwater input. The parameters modelled will be the salinity of the water as well as the input of suspended sediments if necessary.

The results will lead to a comparative analysis of the areas of the different plumes modelled, which will then be cross-referenced with the identified sensitive areas. These results will be provided in the form of maps and time series at strategic points.

In case of discharge of rainwater and drainage water into the marine environment, depending on the quality of the discharge, flows, etc., the effects and impacts on the marine environment will be assessed and measures to avoid and reduce the effects of the discharge on fauna, flora and the quality of marine waters will be analysed

i) Update the noise baseline and impact assessment modelling, including maximum noise values, sampling points near the airport, identification of landing/takeoff events and aircraft types; consider noise from airport ground equipment and the ambient acoustic baseline;

The noise impact assessment will be updated where necessary.

Relevance of baseline update will be discussed in the light of possible changes in the built environment. Displacement of population do not necessarily warrant a baseline update.

On the other hand, the modelling may be reviewed in the light of design considerations (substantial changes from 2019 concept design) and the impact assessment reviewed in the light of the changes in the built environment.

The final ESIA shall further assess the impacts associated with noise based on the projected activities and propose mitigation measures based on ICAO requirements, and long-term noise monitoring plan. The ESMP will include a requirement for the preparation of a noise monitoring plan to be developed for both construction and operational phases.

j) Prepare a feasibility study for the relocation of water abstraction from Caverne Bouteille;

It will be necessary to specify the needs in drinking water connected to the current water intake of the Bouteille cave. The capacity of the treatment plant is currently about 540 m3/day. The feasibility study will have to evaluate the groundwater resources on the left bank of Anse Quitor. Given the potential impacts of the project, it is not recommended that the new intake be located on the right bank of Anse Quitor.

As part of the ESIA the potential impacts of the abstraction on the ecosystem services and biodiversity features of the Anse Quitor will be assessed as part of the finalization of the ESIA.

Water exploration work will include updating the inventory of existing springs, searching for new springs, and potentially using surface geophysical methods to try to identify preferential flow areas in the basalts and limestones.

All the relevant studies carried out since 2019 will be provided in the final ESIA. Otherwise, similar water exploration will be required for investigation of new ground water resources.

Social aspect. In the site identified for the relocation of water abstraction, the feasibility study will consider the following social variables:

- Presence of houses or other private or public buildings
- Presence of economic activities in the area: crops, grazing areas, fisheries
- Presence of cultural heritage sites
- Catchment of water for domestic, agricultural or other uses

If any of these variables are verified, a degree of social risk will be estimated and will be taken into account in the evaluation of the feasibility of the relocation. In this case, a specific assessment will be carried out.

k) Prepare detailed guidelines for elaborating the Environmental and Social Management Plans (ESMPs) for the construction and operational phases;

The ESMP will be prepared in compliance with the World Bank's Environmental and Social Standards (ESS).

The ESMP identifies environmental and social management measures to be implemented during construction and operational phases of the Project and will be integrated into all contractual and responsible party agreements with partners involved in project implementation.

Besides the legal and institutional requirements for the successful implementation of the relevant management plans, ESMP also determines the roles and responsibilities of the Client, consultants and the contractor / sub-contractors. The main objectives of ESMP are as follows:

• To provide an overview of the environment, health and safety (EHS), socio-economic and cultural heritage policies, standards and legal legislation that the Project is obliged to comply with,

• To provide guidance on how to manage EHS risks in the construction phase of the Project in compliance with ESS, EHS policies, standards and legal regulations and to ensure that Project commitments are fulfilled,

• To determine the roles and responsibilities of the Client and contractors to ensure compliance with EHS requirements during the construction phase of the project,

• To ensure that construction activities are properly checked by the Client and Consultants to ensure that the Project is in compliance with EHS policies, standards and legal regulations;

- Ensure reporting systems are developed and streamlined to deliver EHS compliance performance;
- Enabling ongoing development and EHS compliance coverage

The ESMP shall be in accordance with ESS1—annex 1. Environmental and social assessment – section E: Indicative outline of ESMP. The content of the ESMP will include the following:

a) Mitigation
b) Monitoring
c) Capacity Development and Training
d) Implementation Schedule and Cost Estimates
e) Integration of ESMP with Project

The ESMP to be prepared as part of the final ESIA will set out the need for the preparation of the required management plans, including a waste management plan, water management plan including groundwater monitoring, stormwater management plan, hazardous material management plan, quarry management and rehabilitation plan, among others, to be prepared during implementation.

l) Prepare a Cumulative Impact Assessment (CIA) considering the overall development planned for the Rodrigues Airport (considering the increased pressure on public utilities, such as water supply and sanitation, energy generation and transmission, and to other infrastructure (transportation, for example) and services (health, habitation, among others), increased damages to the natural environment, etc.);

It is proposed to use IFC's Good Practice Handbook - Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets for the preparation of a Cumulative Impact Assessment.

Cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity (collectively referred to in this document as "developments") when added to other existing, planned, and/or reasonably anticipated future ones. For practical reasons, the identification and management of cumulative impacts are limited to those effects generally recognized as important on the basis of scientific concerns and/or concerns of affected communities.

Multiple and successive environmental and social impacts from existing developments, combined with the potential incremental impacts resulting from proposed and/or anticipated future developments, may result in significant cumulative impacts that would not be expected in the case of a stand-alone development.

The expected outcomes of a good Cumulative Impact Assessment can be summarized as follows:

- Identification of all Valued Environmental and Social Components (VEC) that may be affected by the development under evaluation.

- In consultation with stakeholders, agreement on the selected VECs the assessment will focus on.
- Identification of all other existing and reasonably anticipated and/or planned and
- potentially induced developments, as well as natural environmental and external social drivers that could affect the selected VECs.
- Assessment and/or estimation of the future condition of selected VECs, as the result of the cumulative impacts that the development is expected to have, when combined with those of other reasonably predictable developments as well as those from natural environmental and external social drivers.
- Evaluation of the future condition of the VECs relative to established or estimated thresholds of VEC condition or to comparable benchmarks.
- Avoidance and minimization, in accordance with the mitigation hierarchy, of the development's impact on the VECs for the life of the development or for as long as the impacts continue to be present.
- Monitoring and management of risks to VEC viability or sustainability over the life span of either the development or its effects, whichever lasts longer.
- Provision of project-related monitoring data to governments and other stakeholders for the life of the development, and material support for the development of collaborative regional monitoring and resource management initiatives.
- Continuous engagement and participation of the affected communities in the decision-making process, VEC selection, impact identification and mitigation, and monitoring and supervision

Social aspects

The ESIA conducted in 2019 considered only the direct impacts of the Project. In parallel to the realization of the ESIA, a specific study requested by the Rodrigues Regional Assembly, on the cumulative and indirect impacts of the Project on the island. The study was entrusted to KPMG-Deloitte of Mauritius. The study was intended to investigate essentially the socio-economic aspects induced by the improvement of air transport services to Rodrigues (due to the widening of the runway).

The document will be reviewed, and information will be used as part of the CIA during the final ESIA.

The EU supported strategic development plan for Rodrigues should also be considered, if available at the time prior to finalizing the ESIA.

The update of the cumulative and indirect impact study will have to take into account all the variables that could be impacted by the increase in the volume of passengers transported to the island. In particular, it will be necessary to evaluate:

- With regard to the increase in tourist flows
  - The current capacity of tourist reception (number and typology of reception structures: accommodation, catering, transport, services to tourism: leisure, sports, cultural tours, etc.)
  - The economic contribution of tourism through the circuit of reception structures (accommodation, catering, etc.)
  - The number of employments in the sector (by sub-sector of activities)

    - Evaluation of the needs arising from the increase in demand
- About the possible demographic evolutions
    - Migration to Rodrigues of economic operators (which also includes the resettlement or return of Rodrigues inhabitants settled in Mauritius or abroad)
- Assessment of the increase in pressure on the island's resources and services:
    - Assessment of the current state of service provision and evaluation of possible scenarios of increased demand, with respect to:
        - Water supply
        - Food supply, especially for local production (fishing, breeding, market gardening)
        - Transportation
        - Solid waste management
        - Health
- Assessment of the possible increase in pressure on critical habitats
- Evaluation of the institutional framework and the capacities of the regional administration to respond to the increase in demand for goods and services resulting from the increase in flows to the island. The study of the policy orientations of the regional administration in the areas of tourism, housing, environment and basic services will be included.
  The study should also take stock of other major projects underway or in the planning phase in Rodrigues and identify the cumulative effects of the various projects. An inventory of major infrastructure and service strengthening projects is to be drawn up.

  The study will be based on available data and on the collection of primary data from economic operators and service delivery structures. The databases produced in 2019 during the first study will serve as the basis for the work.

  A management plan for the cumulative and indirect impacts of the project will be produced and will contain recommendations on the measures to be adopted to enhance the positive impacts and mitigate the negative impacts.

  Marine environment:

  All cumulative effects will be considered with regard to the project in the construction phase and in the operation phase, including the cumulative effects on the marine environment.

  A newly created public body, namely the Rodrigues Public Utilities Corporation (RPUC), is currently carrying a complete review of the water management in Rodrigues with a view to improve the water production and distribution. This includes the rehabilitation of existing desalination plants but also the optimisation of the use of inland water.

  In order to cater for increased water needs the island may require the installation of additional desalination plants which may depending on its location and treatment, brine (from desalination plants) and wastewater can impact the natural environment. In the event of a discharge into the marine environment, the impact of these discharges on marine biodiversity should be verified.

  If the modification of these discharges can have consequences for marine biodiversity, then numerical modelling of the wastewater and brine discharge should be carried out. This will allow the extent of the different plumes (wastewater and brine) to be compared

to the current state and thus estimate the potential impact of the project on marine biodiversity.

This will involve re-using the existing numerical model and incorporating salinity. The simulations will incorporate the brine and/or wastewater discharge assumptions defined in the project with current oceanic weather conditions. The parameters modelled will be the salinity of the water as well as possible bacterial inputs.

The results will lead to a comparative analysis of the areas of the different plumes modelled, which will then be cross-referenced with the identified sensitive areas. These results will be provided in the form of maps and time series at strategic points.

In the case of a desalination plant, great attention will be paid to the effects of seawater pumping and brine discharge into the marine environment, by providing expertise on avoidance and mitigation measures for the project and related infrastructure.

m) Update the Stakeholder Engagement Plan

A Stakeholders Engagement Plan was produced in 2019 and is an appendix to the ESIA. The following points address the requirements for updating the document.

1. Legislative and regulatory framework

SEP refers to :

- The legislation and guidelines of the Government of Mauritius;
- International standards and guidelines

The international guidelines are to be updated, incorporating the World Bank's ESS 10 as the primary tool for stakeholder engagement planning. A Stakeholder Engagement Plan should be produced, following the requirements listed in sections 13 to 18 of ESS 10, and according to the instructions provided in the ESS 10 guidance notes.

A gap analysis between the national legislation and the EHS 10 will be used to check for consistency and inconsistencies between the two regulatory frameworks.

2. Approach

The SEP approach follows the principles outlined in ESS 10.

However, the following elements need to be updated:

- A description of the project's anticipated environmental and social effects must be included in the
- Concerned area. As the project design and technical options evolve, and as the final footprint and impact area is identified, the size of the stakeholder identification area should be updated
- Engagement activities already carried out. The record of activities should be updated, taking into account the evolution of the Project and the stakeholder engagement activities that have taken place between 2019 and 2022. In particular, take into account the engagement processes that have taken place during the design and implementation of the RAP.
- Methodology and limits. To be updated based on next steps

3. Identification and analysis of the stakeholders

The list of stakeholders should be updated as the project evolves
Above all, the stakeholder analysis must include the identification and consideration of disadvantaged or vulnerable people or groups.

4. Stakeholder consultation: a summary of perceptions of the project

The chapter provides an interesting synthesis and analysis of the positions and views of various stakeholders on key issues.
In order to update the document, new public consultations will be undertaken to update the data and document the evolving views on the Project. It is especially important to update views on involuntary resettlement issues, as the process has clearly evolved since 2019. Issues of communication, project information, and livelihoods will be revisited in public consultations in each affected locality.

5. Stakeholder engagement strategy

The chapter is to be updated, incorporating all of the guidelines in ESS 10. For each stage of the project and for each major issue (e.g., ESIA update, resettlement, implementation of a livelihoods restoration plan, etc.), it is necessary to identify the stakeholders to be engaged, how stakeholders will be notified, methods of engagement, a list of information/documents to be made available, the languages in which this information will be disseminated, the length of the consultation period, and opportunities for comment, as outlined in the ESS 10 Guidance Note.
In the SEP update phase, the framework for NGOs involvement will be reviewed to ensure that the scope and nature of their involvement in stakeholder engagement is well calibrated. NGOs can facilitate all information, consultation and engagement activities. Support in relation to the grievance mechanism can also be provided by specialized stakeholders who should be identified.

6. Complaint and grievance management mechanism

A grievance management mechanism is proposed in the 2019 SEP. In the updating of the document, it is necessary to verify what have been, between 2019 and 2022, the channels and methods of complaint management, and to integrate the current practices into the design of the mechanism.

7. Monitoring and reports of stakeholder's engagement activities

The chapter needs to be updated. It is requested that the following two points be specified:
- Clear indications of the division of responsibilities for implementing mobilization activities. Note that the contact information for the plan leaders should be included in the document.
- Indication of the resources required

Resources required to update the SEP
The resources required to update the Stakeholder Engagement Plan are as follows
- Mobilization of a sociologist expert for 10 to 12 days
- Individual interviews with institutional and political leaders
- Individual interviews with the managers of each component of the Project
- Collective interviews (focus groups) with the impacted communities (according to the definition of the project's area of influence)

- Interviews with other involved informants: local media, civil society organizations

n) Review of the policy framework of the study, Institutional framework and legislative and regulatory framework

In addition to the above, we propose to review the general documentation of the Project made available to the public and provided by the Client, in order to have a preliminary overview of the intervention context, to identify the main issues and problems and to proceed to a first identification of the institutional actors

The following points are proposed:

- Policy framework of the study
  The policy framework underpinning the studies will be analysed and determined, including national policy on environmental and social protection and management.
- Institutional framework
  With regard to the institutional framework, the Consultant will describe the said framework through an inventory of the various ministerial departments, the private sector, the local administrations of the site that will host the project. Their specific activities must also be described in a succinct manner, with emphasis on their relevance to the implementation of the present project.
- Legislative and regulatory framework of the study
  The Consultant will determine the legal framework of the study on the basis of existing documentation, laws and various regulatory texts governing environmental and social protection and safeguarding in force in Mauritius, in particular the environmental code, decrees and application orders.
  In addition to these regulatory texts, there are international and sub-regional conventions signed or ratified by Mauritius and dealing with the environmental and social aspects of this type of project.

- Donor policies and guidelines, including but not limited to
  - World Bank's Environmental and Social Standards (ESS)
  - World Bank EHS Guidelines, general and sectoral

- Comparison of the different standards and their application in the project
  The consultant's comprehensive presentation of all international and national standards will enable him to highlight divergences and convergences. In effect, he will compare the applicable regulations and make recommendations on the policy applicable to the project. This analysis will establish the standards to which the project will have to conform in the construction phase, but also those which the study will have to respect

3 Introduction

3.1 The ESIA 2019

The Project refers to the New runway at Plaine Corail Airport in Rodrigues island, a dependency of the Republic of Mauritius.

With a runway length of 1200 m, the largest aircraft that it can accommodate currently is the ATR 72, which carries passengers only. The number of flights at PCA amounts to three per day during the low season and can rise to a maximum of twelve flights during the peak season which coincides with the Christmas and New Year holidays.

The airport is managed by Airport of Rodrigues Ltd. (ARL), a subsidiary of the Airports of Mauritius Co. Ltd. (AML).

Due to its remote location, 620 kilometres from Mauritius, air transport is vital to the island in every respect and particularly important from a social and economic perspective. Rodrigues Island, through the Rodrigues Regional Assembly, wishes to increase the capacity of its airport in order to accommodate the A321 Neo / B737 aircraft type, which carries up to a maximum of 244 passengers and is capable of transporting cargo.

The objectives of the construction of the new longer runway as well as the associated facilities and amenities, are to:

- provide Rodrigues with an efficient, reliable, safe and affordable air transport facility to improve the national, regional and international connectivity and accessibility of the island and;
- contribute to its social and economic development in key economic sectors such as tourism, agriculture and fishery.

The initial Environmental and Social Impact Assessment report 2019 had two objectives:

- Compliance to the procedure for obtaining the EIA Licence from the Government of Mauritius
- Evaluation of the environmental and social impacts of the project in line with the requirements of the two Funding Agencies: Agence Française de Développement (AFD) and the European Union (EU).

3.2 The ESIA Update 2022/2023

3.2.1 The World Bank Context

ARL is now proposing to seek financing support from the World Bank for the Expansion of the Rodrigues Airport; and is therefore required to update the ESIA to meet the requirements of the World Bank Environmental and Social Framework1 (ESF).

The World Bank Environmental and Social Framework sets out the World Bank's commitment to sustainable development, through a Bank Policy and a set of Environmental and Social Standards that are designed to support Borrowers' projects[2].

The Borrower and the project will need to comply with the ten **Environmental and Social Standards** through the project life cycle, namely:

- Environmental and Social Standard 1: Assessment and Management of Environmental and Social Risks and Impacts;
- Environmental and Social Standard 2: Labor and Working Conditions;
- Environmental and Social Standard 3: Resource Efficiency and Pollution Prevention and Management;
- Environmental and Social Standard 4: Community Health and Safety;
- Environmental and Social Standard 5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement;
- Environmental and Social Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources;
- Environmental and Social Standard 7: Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities;
- Environmental and Social Standard 8: Cultural Heritage;
- Environmental and Social Standard 9: Financial Intermediaries; and
- Environmental and Social Standard 10: Stakeholder Engagement and Information Disclosure.

The Bank will classify all projects (including projects involving Financial Intermediaries (FIs)) into one of four classifications: High Risk, Substantial Risk, Moderate Risk or Low Risk.

The proposed project is currently classified as *a High-risk project* under the World Bank Environmental and Social Policy. In determining the appropriate risk classification, the Bank takes into account relevant issues, such as the type, location, sensitivity, and scale of the project; the nature and magnitude of the potential environmental and social risks and impacts; and the capacity and commitment of the Borrower (including any other entity responsible for the implementation of the project) to manage the environmental and social risks and impacts in a manner consistent with the ESSs.

As per the Works Bank's Terms of Reference, 'This assignment aims to update the existing ESIA to address the gaps identified to meet the requirements of the World Bank ESF in addition to the legislative requirements of the Republic of Mauritius. The Consultant will further update and finalise the ESIA, taking into consideration the design changes and final design considerations. The updated ESIA must aim to identify and assess all positive and negative environmental and social risks and impacts potentially generated by all phases of the Rodrigues Airport expansion project (collectively referred to as the "Project" in this Terms of Reference – ToR) and propose technically feasible mitigation measures to manage the identified environmental and social risks and impacts'.

A final version of the ESIA will be prepared and disclosed before project appraisal (preliminarily planned for April 23) based on the additional studies identified in the draft ESIA (this document) and the finalization of the airport design.

[2] The World Bank Environmental and Social Framework, The World Bank – IBRD – IDA – World Bank Group, 2017

3.2.2 The Project Status

As at date, the Detailed Design of the Project is still ongoing by GIBB (Mauritius) Ltd, with the geotechnical investigations currently underway at Plaine Corail Airport.

The Final alignment of the runway shall be finalised once the geotechnical investigation has been completed and the outcome thereof incorporated into the detailed design.

Hence, as at date, there is no new information concerning the new design, to the exception of the location of the Air Traffic Control and the Rescue and Fire Fighting Services that have been moved outside the Nature Reserve.

The ESIA will be updated and finalised, taking into consideration the design changes and final design considerations, which hare expected by April 2022.

3.3 Environmental and Social Standards applicable to the project

- The following Environmental and Social Standards of the World Bank Environmental and Social Framework are regarded as relevant to the project at this stage namely:
-
- ESS 1: Assessment and Management of Environmental and Social Risks and Impacts.
- ESS 2: Labor and working conditions
- ESS 3: Resource Efficiency and Pollution Prevention and Management.
- ESS 4: Community Health and Safety.
- ESS 5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement.
- ESS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources.
- ESS 8: Cultural Heritage.
- ESS: 10: Stakeholder Engagement and Information Disclosure.

-
- It should be noted that the following two standards are not considered relevant namely:
- ESS 7: Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities. The standard is not considered to be relevant because in Rodrigues no historical or social situation corresponds to the cases considered by the standard
- ESS 9: Financial Intermediaries. This standard is not considered to be relevant as no FIs are engaged

4 Legal and institutional framework

4.1 National legal requirements

4.1.1 The Environment Protection Act 2002

The Environment Protection Act 2002 (EPA2002), as amended, provides for the protection and management of the environmental assets of Mauritius so that their capacity to sustain the society and its development remains unimpaired and to foster harmony between quality of life, environmental protection and sustainable development for the present and future generations. More specifically, it is designed to provide for the legal framework and the mechanism to protect the natural environment, to plan for environmental management, to co-ordinate the inter-relations of environmental issues, and to ensure the proper implementation of governmental policies and enforcement provisions necessary for the protection of human health and the environment of Mauritius.

Part IV of the EPA2002 sets out the legal framework for the Environmental Impact Assessment, a tool for sound decision-making and a formal process for ensuring that potential environmental impacts are considered in approval of major projects.

The Environment Protection (amendment of Schedule) Regulations 2006, includes “Undertakings Requiring a Preliminary Environmental Report” (Part A) and “Undertakings Requiring an Environmental Impact Assessment” (Part B).

The construction of a new runway is listed among the undertakings requiring an Environment Impact Assessment (item 6).

The Environment Protection (Amendment of Schedule) Regulations 2022 (Government Notice No. 252 of 2022) amends the Fifth Schedule as follows:

3. The Fifth Schedule to the Act is amended, in Part B, by deleting items 6, 7 and 21 and replacing them by the following items –

6. Construction of airports and runways, except for the construction of runways in the Island of Agaléga and the Island of Rodrigues

7. Construction of breakwaters, groins, jetties, revetments and seawalls, except for the construction of –

(a) jetties in the Island of Agaléga; and

(b) the jetty associated with the new runway at Plaine Corail Airport in the Island of Rodrigues

21. Incineration of municipal solid waste, quarantine waste, medical and clinical wastes, except for the construction of incinerators, for quarantine and medical waste, at the Plaine Corail Airport in the Island of Rodrigues

4. These regulations shall come into operation on 17 September 2022.

4.1.1.1 Main regulations under the Environment Protection Act 2002

Regulations, promulgated under the EPA2002 (as amended), deemed applicable to the proposed project include, but are not limited to, the following:

4.1.1.1.1 Air pollution

Standards are set under the Environment Protection (Standards for Air) Regulations 1998 (Government Notice No. 105 of 1998).

4.1.1.1.2 Noise pollution

Standards are set under the Environment Protection (Environmental Standards for Noise) Regulations 1997 (Government Notice No. 17 of 1997). Control of Noise is regulated by the Environment Protection (Control of Noise) Regulations 2008 (Government Notice No. 114 of 2008).

4.1.1.1.3 Water pollution (effluent discharge)

Standards for discharge on land/underground and to surface water courses are set under the Environment Protection (Standards for effluent discharge) Regulations 2003.

The water treatment plant proposed for the project complies with the Environmental Guideline No. 16 for Wastewater Treatment Plant published by the Ministry of Environment.

4.1.1.2 The requirements for Environmental Impact Assessment (EIA)

The requirements for environmental impact assessments are outlined in Section IV of the Environment Protection Act 2002, as amended. It sets the conditions for the realization of a Preliminary Environmental Report and for an Environmental Impact Assessment.

Section 18 of the EPA, in particular, sets out the contents of an EIA. Here are the main points that must appear in the report:

- the precise location and surroundings of the undertaking, the zoning of the site and the number of similar undertakings in the area;
- the principle, concept and purpose of the undertaking;
- the direct or indirect effects that the undertaking is likely to have on the environment;
- such data as may be necessary to identify and assess the effects that climate change may have on the undertaking; [Inserted 11/2020 (cio 22/4/021).]
- the measures which the proponent proposes in order to mitigate the adverse effects that climate change may have on the project; [Inserted 11/2020 (cio 22/4/021).]
- any action or measure that the proponent proposes to promote the use of alternatives, best available techniques and environmental practices to minimise the use, release and emission of hazardous substances, including mercury; [Inserted 11/2020 (cio 22/4/021).]
- an assessment of the social, economic and cultural effects which the undertaking is likely to have on the people and society;
- any action or measure which the proponent proposes to take to avoid, prevent, change, mitigate or remedy, as far as possible, the likely effects of the undertaking on the environment;
- an assessment of the inevitable adverse environmental effects that the undertaking is likely to have on the environment, people and society, where it is implemented in the manner proposed by the proponent;
- an accurate assessment of the irreversible and irretrievable commitment of resources which will be involved in the undertaking, where it is implemented in the manner proposed by the proponent;
- any alternative manner or process in which the undertaking may be carried out so as to cause less harm to the environment;
- an environmental monitoring plan;

- information pertaining to the decommissioning of the project at the end of its life cycle and associated impacts, proposed measures to return the site as far as possible to its former state, or rehabilitation measures;
- in the case of a new infrastructure proposal, an environmental management plan to be implemented during the construction phase; [Amended 11/2020 (cio 22/4/2021).]
- information on eco-friendly practices to promote sustainable development such as waste minimization, reuse, recycling, composting, energy efficiency, renewable energy supply, green building practices, water conservation and management, rainwater harvesting and recycling of waste water; and [Inserted 11/2020 (cio 22/4/2021).]
- such other information as may be necessary for a proper assessment and review of the potential impact of the undertaking on the environment, people and society.

The proponent may, where applicable, be required to include, in the EIA report:

- an ecological assessment of the site;
- a vulnerability assessment and proposed adaptation measures with respect to climate change;
- an estimation of greenhouse gas emission attributed to the undertaking, and associated activities within the physical boundary of the undertaking, over its life cycle. [Added 11/2020 (cio 22/4/021).] [S. 18 amended by s. 30 of Act 11 of 2020 w.e.f. 22 April 2021].

From the previous points it appears that the national legal requirements in relation to the realization of the EIA have evolved, integrating new requirements in 2021.

It is therefore necessary to integrate an analysis of the compliance or possible gaps between the national requirements (also taking into account the updates of 2021) and the international standards.

4.1.1.3 Requirements on public consultations and disclosure

Paragraph 92 of the Environment Protection Act establishes the specific regulations for Rodrigues: the Regional Assembly may, after consultation with the Rodrigues Environment Committee, make regulations applicable to the island of Rodrigues. These include projects requiring preliminary environmental reports and environmental impact assessment licences.

With respect to the consultations, the Environment Protection Act, in paragraph 19, establishes that the environmental impact assessment should defer the details of any public consultation held in the project area. The act therefore contains a very clear indication that any environmental impact assessment process should include a stakeholder consultation approach.

The guidelines for the environmental impact assessment, published in 2004 by the Environment Department of the Ministry of the environment of Mauritius, provide specific guidance on the requirement and nature of the reporting of consultations to be carried out within the framework of the EIA. It indicated that the engagement documentation should include :

- Statutory bodies, environmental and accreditation groups and local residents likely to be affected by the proposals;
- The means to contact and advertise the project (leaflets, public postings, questionnaires, letters, etc.);
- A brief summary of their responses detailing the emphasized issues of concern and their contribution to the EIA.

For any development project namely the construction of hotels, golf courses, piers, etc. in the coastal area, the developer must consult the fishermen in the area to explain their project. The consultation is under the aegis of the ministry of fishing

4.1.2 Legislation on land acquisition, compensation, resettlement

According to Section 54 of the Rodrigues Regional Assembly Act 2001, any land or other property which was formerly under the jurisdiction of the Government of Mauritius (post Autonomy of Rodrigues) is, under the State Lands Act, transferred to the RRA.

90% of the land in Rodrigues is State land against 10% which is private land. As it is the domain under the management of the State, leases are issued for residential, commercial/industrial or agricultural use. The duration of a residential lease only is 60 years and in return the person pays an annuity to the ARR varying from Rs 100 to Rs 1000 on average per year (depending on the salary of the beneficiary). The land remains the property of the RRA but any property on the land belongs to the beneficiary of the lease. Once the 60-year term of the lease has passed, the lease is usually renewed if the person is still alive. Otherwise, the lease is transferred to the name of an heir or spouse.

For agricultural uses (livestock and plantations), the RRA issues the beneficiary an agricultural permit for a period of 5 years, renewable, thus giving the holder the right to exploit the land during this period.

According to the Land Acquisition Act - Act 54 of 1973, provision is made for the possibility of Compulsory Acquisition" by the State of any land under its governance. its governance. Although this type of acquisition also gives rise to the payment of compensation from those affected by the project, the person whose lease is to be requisitioned is to be requisitioned by the State, is not entitled to have a choice or even to refuse the refuse the State's offer even if the offer does not suit him.

It should be noted that the option of "Compulsory Acquisition" and expropriation of land was not the one chosen by the RRA in the case of the present Project. A gap analysis with regard to World Bank standards, and in particular against ESS 5, is required. Compliance with the ESS 5 indications is to be adopted.

4.1.2.1 The different policies involved in this project of population displacement Project

4.1.2.1.1 Social housing construction policy

The RRA has a social housing policy aimed at low-income families that allows them to have access to a suitable house in return for a minimal contribution to the total cost of the construction of the house. In fact, this house construction project is carried out in collaboration with local banks where the RRA contributes the majority of the cost of the house, i.e. 80%. The construction work is undertaken by a contractor from a list of contractors registered with the Construction Industry Development Board (CIDB).

4.1.2.1.2 Marine Park Protection Policy

The provisions of the South East Marine Protected Area (SEMPA) Regulations 2011 have to be taken into account in the selection of sites identified by those with fishing activities - given that several categories of areas exist in SEMPA, including in-take and in-take" and "no-take"

areas and the same law also stipulates the activities that are also stipulates the activities that are permitted in these zones

4.1.3 Other main applicable legislation

4.1.3.1 The Climate Change Act 2020

An Act to establish a legal framework towards making Mauritius a climate-change resilient, and low emission, country.

Part V – Climate Change Measures include in Sub-Part A the formulation of

- the National Climate Change Adaptation Strategy and Action Plan,
- the National Climate Change Mitigation Strategy and Action Plan and
- the National Inventory Report.

4.1.3.2 The Fisheries and Marine Resources Act 2007

This Act amends and consolidates the law relating to the management, conservation, protection of fisheries and marine resources, and protection of marine ecosystems.

The Protection of the aquatic ecosystem is regulated by Section 69 of the Fisheries and Marine Resources Act 200, as follows:

- No person shall place, throw, discharge or cause to be placed, thrown or discharged into the maritime zones or into a river, lake, pond, canal, stream, tributary or wetland any poisonous substance,
- No person shall – except with the written approval of the Permanent Secretary - cut, take, remove or damage a mangrove plant,
- No person shall place, construct or cause to be placed or constructed any structure within the territorial sea or internal waters, as defined in the Maritime Zones Act 2005, except with the written authorization of the Permanent Secretary,
- The Permanent Secretary may, on granting an approval under the paragraph above, impose such terms and conditions as he may deem fit.
-

4.1.3.3 The Forest and Reserves Act 1983

An Act to amend and consolidate the law relating to forests, reserves and related matters.

As per the Second Schedule (section 2), Anse Quitor is a declared Nature Reserve.

As per the Fourth Schedule (section 2), Riviere Anse Quitor is a declared river. Where there is no escarpment, the river reserve means the land extending from the edge of the river to a distance of 16 metres measures on the horizontal plane; where there is an escarpment the river reserve means the land extending from the edge of the river to the top of the escarpment.

4.1.3.4 The Wildlife and National Parks Act 1993

An Act to amend and consolidate the law relating to the conservation and management of wildlife and to provide for the preservation of National Parks.

Part IV of the Act refers to ‘National Parks and Other Reserves’ and applies to Anse Quuitor Nature Reserve

Part V of the Act refers to ‘Protection of Fauna and Flora’ and applies to protected wildlife.

4.1.3.5 The Rivers and Canals Act 1863

As per the Act, “rivers and streams” includes all natural rivers of water and watercourses, but does not include any artificial watercourse; all rivers and streams are public property (du domaine public).

4.1.3.6 The National Heritage Fund Act 2003

An Act to provide for the establishment and management of the National Heritage Fund and for matters relating to national heritage.

Section 12 of the Act reads

Designation of national heritage

The Minister may, on recommendation of the Board, designate by regulations -

(a) any monument;

(b) any object or site of cultural significance;

(c) any intangible heritage;

(d) any natural feature consisting of physical and biological formation or group of such formations which are of outstanding value; and

(e) any geological and physiographical formation or precisely delineated area which constitute the habitat of animals and plants of outstanding value, in Mauritius to be a national heritage.

Schedule 2 of the Act lists the six declared National Heritage of Rodrigues; none of which being located in the project area of influence.

4.1.3.7 The Beach Authority Act

The Authority shall, in respect of the management of public beaches, have such functions as are necessary to further most effectively its object, and in particular, shall regulate activities on public beaches and ensure the security and safety of users of public beaches (section 5.(b)).

4.1.3.8 The Occupational Safety and Health Act, 2005

OSHA is the main legal instrument governing occupational health and safety issues. Among the obligations established by the act, we mention:

- General duties of employers
- Special duties of employers
- Special duty of employers using machinery
- Prohibitions regarding young persons
- Duties of employer regarding Safety and Health Officers
- Risk assessment by employer
- Record of risk assessments
- Duties of Safety and Health officers
- Establishment of Safety and Health Committees
- Functions of the Safety and Health Committee
- Meetings of Safety and Health Committees

An analysis must be made to verify the possible gaps in relation to the World Bank's ESS 2

4.1.3.9 The National Development Strategy 2003 and Planning Policy Guidance 2004

The National Development Strategy was developed in 2003 in replacement of the 1993/1994 National Physical Development Plan.

The National Development Strategy, Ministry of Housing and Land, seeks to improve the environment by adapting the following measures:

- To safeguard valued elements of the natural and built environments
- To use natural resources in a sensitive and sustainable manner
- To promote land and property development and management practices which will benefit the environment and all Mauritians, and
- To ensure that development makes a positive contribution to the environment

4.1.3.10 The Rodrigues Outline Planning Scheme

The Outline Planning Scheme of Rodrigues 2001 was prepared under the requirement of the Town and Country Planning Act 1954. The Outline Scheme covers the main island of Rodrigues as well as the islets surrounding it.

4.1.4 Legal requirements about gender and gender-based violence[3]

4.1.4.1 National Policies

The National Gender Policy Framework, adopted in 2008, was designed as a fundamental framework that sets out guiding principles, broad operational strategies and institutional arrangements for gender equality at the national level. The NGPF calls for a strategic partnership between the government, the media, private institutions and civil society organizations to achieve gender equality and equity in a comprehensive manner.

According to the national policy, ministries are responsible for developing gender-sensitive policies, programs and budgets within their scope. They are also responsible for producing sex-disaggregated administrative data for the planning, implementation and monitoring of their interventions from a gender perspective. Also, gender focal points (GFPs) are identified at the administrative and technical levels within each within each organization.

4.1.4.2 Institutional framework

The Minister of Gender Equality, Child Development and Family Welfare is responsible for the design and implementation of social policies and programs that promote women's empowerment, child development, family well-being, and community well-being. Among the objectives of the Ministry:

- Promote and defend women's rights as human rights, work for the elimination of all forms of discrimination against women and ensure that legal measures are taken to promote equality between men and women.

- Implement gender-sensitive macroeconomic policies and strategies, including those related to poverty reduction.

Within the framework of the Project, it remains to be verified which are the legal measures and the specific policies taken by each Ministry as regards :

- gender equity in access to employment

[3] Source: Profil Genre Maurice, 2016, AFD (Profil-Genre-Maurice.pdf (plateforme-elsa.org)

- specific vulnerability issues in environmental and social impact assessments
- specific measures regarding women and vulnerable people in resettlement processes

4.2 Rodrigues Sustainable Integrated Development Plan

The Sustainable Integrated Development Plan for Rodrigues (SIDPR) was prepared by KPMG in 2009.

The Terms of Reference where prepared by the United Nations Development Programme, a key extract of which is provided hereafter: 'The SIDPR is a project which uses the Millennium Development Goals (MDGs) as the basis for the formulation of the island's long term sustainable development plan … The SIDPR will be a showcase for the relevance of MDGs at sub-national level."

This SIDPR is presented in terms of the three constituent parts of sustainable development, namely environmental, economic, and social sustainability. How to move towards achieving sustainability is presented in five distinct parts:

- Part I: Awakening and Envisioning;
- Part II: Getting the basics right (Kick-starting the process of Sustainable Development);
- Part III: Ensuring environmental sustainability;
- Part IV: Promoting economic sustainability; and
- Part V: Strengthening the 'soft infrastructure' for a thriving Rodriguan community.

A Short-Term Action Plan that accompanies this long-term strategy document contains a route map for the next 1-5 years as well as a set of objectives and key performance indicators that need to be attained. As far as possible, the use of logical framework matrices is preferred but flexibility is maintained in the design of the Action Plans.

The update of the 'Sustainable Integrated Development Plan for Rodrigues' is a request from the European Union (EU) in the context of the airport development project.

4.3 Water Development Strategies

A consultancy for the Development of Rodrigues Water Resources Strategy and the Definition of Priority Action Plan was commissioned and the revised version was issued in May 2022.

The main objective expressed by the Rodrigues Regional Assembly is to 'Secure a regular access for all at least one day out of the week', and also to 'Ensure and secure the quality of the water distributed to the consumers'.

4.4 International standards

4.4.1 International Guidelines for Environment and Social Standards

Also carried out in order to obtain approval of the project by international lenders, this impact assessment is carried out in accordance with the international requirements and guidelines:

- World Bank's "Environmental and Social Framework"
- World Bank Group's Environmental, Health and Safety (EHS) guidelines
- World Bank Group's General EHS Guidelines (v) Industry sector Guidelines
- World Bank Group's EHS Guidelines for Airports

- World Bank Groups' EHS guidelines for Construction Material Extraction
- World Bank Group EHS guidelines for Waste Management Facilities
- Relevant ICAO standards and guidelines

It should be noted that a full gap analysis between Mauritian legislation, Rodrigues' specific regulations and World Bank standards will be undertaken as part of the final ESIA. The most stringent requirements will be applicable to the project. Where gaps between the legislation and World Bank Standards exists, the ESIA will indicate actions taken to ensure that the gaps have been adequately addressed.

4.4.2 International Conventions and Treaties

Mauritius is signatory of a number of multilateral conventions/treaties signed/ratified/acceded to after independence.

Most relevant conventions/treaties to the project are provided in the Table below.

-

Table 21: Most Relevant conventions/treaties

Environmental Aspects	
Convention on International Trade in endangered species of Wild Flora and Fauna (CITES)	Ratified on 28.04.75
United Nations Framework Convention on Climate Change	Ratified on 17.8.92
Convention on Biological Diversity	Ratified on 17.8.92
Vienna Convention for the Protection of the Ozone Layer	Acceded on 18.08.92
Montreal Protocol on Substances that Deplete the Ozone Layer	Acceded on 18.08.92
London Amendment to the Montreal Protocol (1990)	Acceded on 20.10.92
Bamako Convention on the Ban of the Import into Africa and the Control of Transboundary movement of Hazardous Wastes within Africa	Ratified on 29.10.92
Basel Convention on the Control of Transboundary movement of Hazardous Wastes	Ratified on 24.11.92
Copenhagen Amendment to the Montreal Protocol (1992)	Ratified on 30.93
International Convention to Combat Drought and Desertification	Acceded on 11.01.96
Convention for the Protection, Management and Development of the Marine and Coastal Environment in the Eastern African Region and Related Protocols (Nairobi Convention)	Acceded on 10.07.2000
1992 Civil Liability Convention CLC and Fund Convention	Acceded on 06.12.2000
Paris Agreement on Climate Change	Ratified on 22.04.16
The Stockholm Convention on Persistent Organic Pollutants	Ratified on 05.07.04
Ramsar Convention on Wetlands of International Importance (Ramsar)	Ratified on 25.05.01
Cartagena Protocol on Biosafety	Ratified on 09.05.01

Montreal (1997) and Beijing (1999) Amendments to the Montreal Protocol	Accepted on 03.03.03
Marine Pollution	
International Convention for the Prevention of Pollution from Ships (MARPOL), 1973 as amended by the Protocol, 1978	Acceded on 06.04.1995
International Convention on Oil Pollution Preparedness, Responses ans Cooperation (OPRC) 1990	Acceded on 03.02.2000
The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972 (London Convention)	1972
Labour Aspects	
Occupational Safety and Health Convention, 1981 (ILO No. 155)	Ratified on 25.07.2014
Promotional Framework for Occupational Safety and Health Convention, 2006 (ILO No. 187)	Ratified on 19.11.2012
C100 - Equal Remuneration Convention, 1951 (ILO No. 100)	Ratified on 18.12.2002
Discrimination (Employment and Occupation) Convention, 1958 (ILO No. 111)	Ratified on 18.12.2002
Violence and Harassment Convention, 2019 (ILO No. 190)	Ratified on 01.07.2021

5 Project description and justification

5.1 Introduction to the project and background information

5.1.1 Project objective

Rodrigues Island is a territory of the Republic of Mauritius, autonomous since October 2012, located about 650 km east of the other two Mascarene Islands: Mauritius and Reunion. The island, small in size (110 km²), however, is tasked with the development of its economy while preserving cultural values strongly linked to the sectors of agriculture, fishing and tourism. The latter sector has the support of local authorities as part of a sustainable development policy that seeks to grow the reputation of the island both in terms of environmental protection and as an exemplary destination for ecotourism.

Rodrigues, due in particular to its small size, relies upon an economy which remains fragile. The island remains dependent on regular imports by sea, with only a very small proportion of imports arriving by air. As such, the Rodrigues Plaine Corail Airport is currently equipped with a fairly small landing strip of 1,200 m long, which can accommodate aircraft of type ATR 72. Operational and technical issues related to the length of the runway mean that the airport cannot operate at full capacity. This situation inexorably leads to some pressure on the carriers during peak periods, a higher cost rate application for airline tickets, and an inability to develop a viable air cargo sector.

In response to this situation, the government has expressed the wish for the construction of a new runway which will boost the economic and social development of the island. The new runway will be approximately 2,100 m in length x 45 m wide. This new infrastructure would support larger aircraft like the A321 Neo/B737, which carries up to a maximum of 244 passengers and is capable of transporting cargo. With this new configuration, the potential of operating new regional routes will be feasible, which may further enhance the economic growth of the island.

The airport is managed by Airport of Rodrigues Ltd. (ARL), a fully-owned subsidiary of Airports of Mauritius Ltd. (AML). It should be noted that the project to equip Rodrigues with a new and longer airstrip stems from a political will shared by the Rodrigues Regional Assembly (RRA) and the Government of Mauritius to consolidate the economy of Rodrigues in order to facilitate the island's socio-economic development. The goal is to foster economic development while taking steps to ensure that Rodrigues is an exemplary island in terms of sustainability and sustained management of its scarce resources.

This environmental and social impact study concerns the project to build a new runway to accommodate larger aircraft, as well as the construction of associated equipment.

5.1.2 Brief history of the project

The following section provides a brief history of the New Runway project for Rodrigues. Chapter 7 details the steps involved in selecting a preferred alternative for the project after giving due consideration to several development options.

April 2016, GIBB (Mauritius) Ltd. (GIBB) was commissioned by the Rodrigues Regional Assembly to develop the design for the extension of the runway into the sea to the west of the

existing airport, based on the 2011 feasibility study (Ecorys Report). The commission also included assessment of all the other airport facilities together with a masterplan for the future development of the airport for a planning horizon that extends to 2040.

As a result of the discovery of deeper bedrock than expected, the expected impacts in regard to fill material needed to compensate the deepness, and expected technical challenges and high costs associated with the runway extension into the sea, the RRA decided to amend the Consultant's Terms of Reference to prepare the Preliminary Design for a new Land-Based Runway. The Preliminary Design consists of the design of a new 2,100m long eastward runway with connecting taxiways and apron expansion suitable for Airbus A321 series.

In December 2017, GIBB submitted the "New Runway Options Report", which presents the different new runway alignment options and the required associated facilities, including budget estimates, to RRA. The Consultant recommended Option C, with a budget estimate of MUR 3.6 B, as being the most appropriate siting for the new runway according to the environmental, risk and cost analyses.

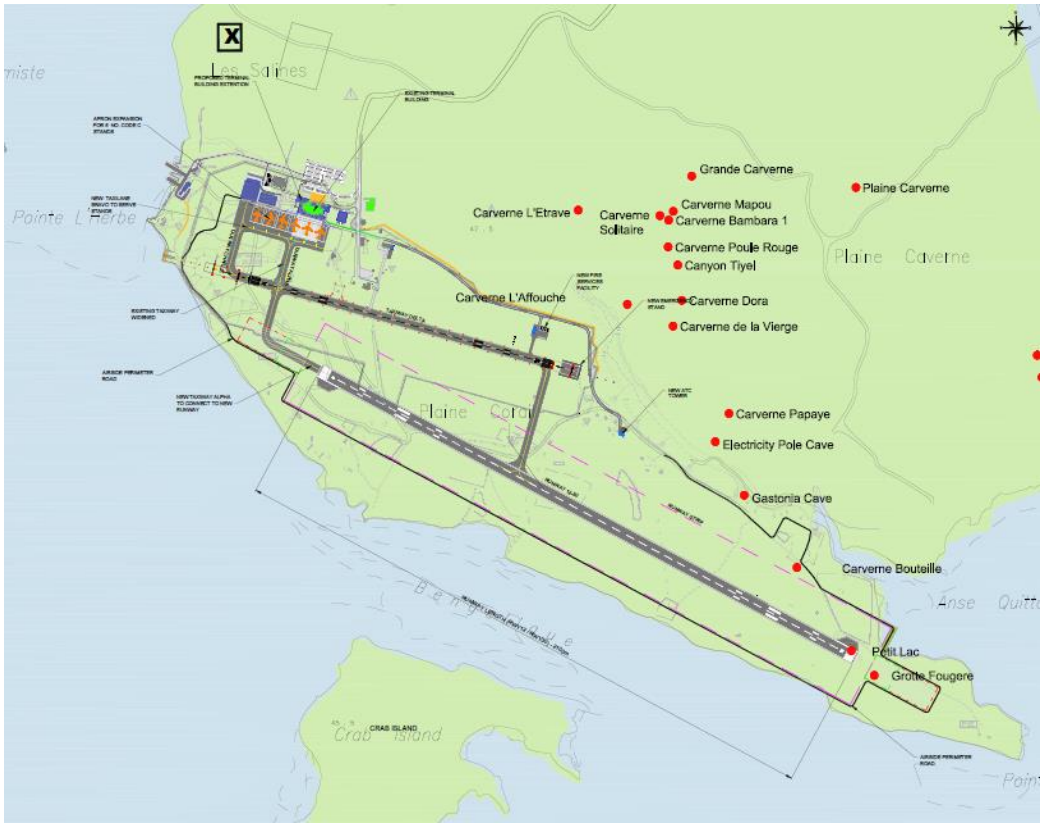


Figure 11: Alignment of Option C (Dec 2017)

In November 2018, GIBB submitted the Preliminary Design **based on option C but with a new runway alignment based on maximising its siting on the existing land with minimal maritime works, as well as avoiding the existing caves Petit Lac and Grotte Fougère**. This was made possible by finally a little bit more marine work than option C.

The preliminary design report as updated prepared by GIBB (Mauritius) still serves as basis for the ESIA update. The final ESIA shall be reviewed in the light of the Detailed Design scheduled for April 2023.

It is understood that the terms of reference of the design includes resilience to climate change. The consultant shall provide such demonstration at detailed design stage.

In February 2018, the Ministry of Finance and Economic Development (MOFED) submitted a request for the financing of the project to the Agence Française de Development (AFD) in the form of a loan and a grant from the European Union (EU).

Subsequently, a policy decision was made for the Airport of Rodrigues (ARL) to become a fully-owned subsidiary of Airport of Mauritius ltd (AML). Discussions were underway for AML to be the bearer of the loan / grant for the financing of the Rodrigues runway project. The change in ownership went into effect in March/April 2018. The decision was also made for AML to take over the lead for the new runway project, with any necessary support provided ARL.

5.1.3 Studies received since ESIA 2019

The following studies have been received with reference to the project at hand

- Strategy and Action Plan for the protection and preservation of native and endemic plants that will be affected by the Airport Development Project at Plaine Corail, Rodrigues, Republic of Mauritius, Mauritian Wildlife Foundation, Rodrigues, 28 October 2021
- Projet de Construction d'une Nouvelle Piste d'atterrissage a l'aéroport de Plaine Corail Rodrigues, Plan d'action de Réinstallation des Résidents et Non-Résidents du Village de Sainte Marie, Bangelique et Pointe Corail, Bureau du Chef Commissaire, Assemblee Régionale De Rodrigues, 2021
- Status on Airport Development Project, Relocation of Households (Plan d'Action de Réinstallation) - the implementation status of the Resettlement Action Plan (RAP) and Livelihood Restauration Plan (LRP), 10 December 2022
- Review of the New Runway of Plaine Corail Airport Environmental and Social Impact Assessment Report As part of Gap Analysis to Suit the new requirements – **Geological Aspects**, B. Dabee, 19 December 2022

-
- The studies have not been incorporated in the present ESIA draft update but have served to measure the progress.
-
- It is understood that the following study has also been completed, but not received:
  - Socio-Economic impact of the runway for Rodrigues - A general study on the socio-economic aspects generated by the airport project on the whole of Rodrigues Island, KPMG-Deloitte

Information from the recently completed and ongoing studies will serve to update the plans and programmes during the finalization of the ESIA.

5.1.4 Studies under-way and way forward for the project

The following studies are still ongoing:

- Geotechnical and geophysical investigation and reporting. The study is expected to be completed by February 2023
- The consultancy for the 'Detailed Design, Tender Documents and Construction Supervision of a New Runway at Plaine Corail Airport' was entrusted to GIBB (Mauritius) Ltd. The study is expected to be completed by April 2023,

5.2 Project Time Line and Milestones

Project Time Line and Milestones have been updated worked out as follows by ARL/AML:

- Appointment of Consultant for Detailed Design & Construction Supervision
- Award of Contract : End June 2019
- Detailed Design Report & Bid Doc : April 2023
-
- Pre-construction and Construction:
- Floating of tenders for works : July/August 2023
- Award of Construction works : October 2023
- Construction start : October /November 2023 (27 months duration)
-
- Completion of works/ start operation: early 2026
-

5.3 Description of the projected infrastructures and airport management

5.3.1 Scope of works

The construction works include the following:

Infrastructure works:

- New Runway 2100 m* 45 m
- Taxiway and Aprons
- Isolated Apron
- Airfield Ground Lighting
- Approach Lights
- Flood Light Masts
- PAPIs
- CNS equipment and Landing Procedures
- Landside Car Park
- Stormwater Network
- Potable Water Network
- Sewerage Network
- Sewerage Treatment Plant
- Maritime Rock Revetment Works
- Desalination plant

Buildings

- Air Traffic Control Tower
- Airport Rescue and Fire Fighting Station
- Meteo building
- Quarantine building
- Incinerator and associated building
- Boat House for the National Coast Guard
- Power Centre
- Cold Storage Building

Infrastructure and buildings to be constructed under phase 1 (this project) and 2 (future development) are specified in Figure 12 hereafter.

Design parameters

1. Design to ICAO Annex 14 Regulations
2. New Runway -Code 4C, instrument
3. Runway -45m wide with 2.5m shoulders (Total 50m) -140m Runway strip
4. Existing Runway to be downgraded to Taxiway
5. Taxiways 15m wide with 5m shoulders
6. Design Aircraft A321 neo
7. Apron designed to 30 year life, Runway to 15 years
8. Taxiway provided
9. Apron to accommodate 3No. A321 Neo type aircraft
10. Portable Ground Power units to be provided
11. New ATC (with 3 Operator positions), ARFFS Building + Sea Rescue Facility
12. Fire Rescue vehicles to have maximum 3 minutes response time
13. Navaids –NDB and DVOR DME

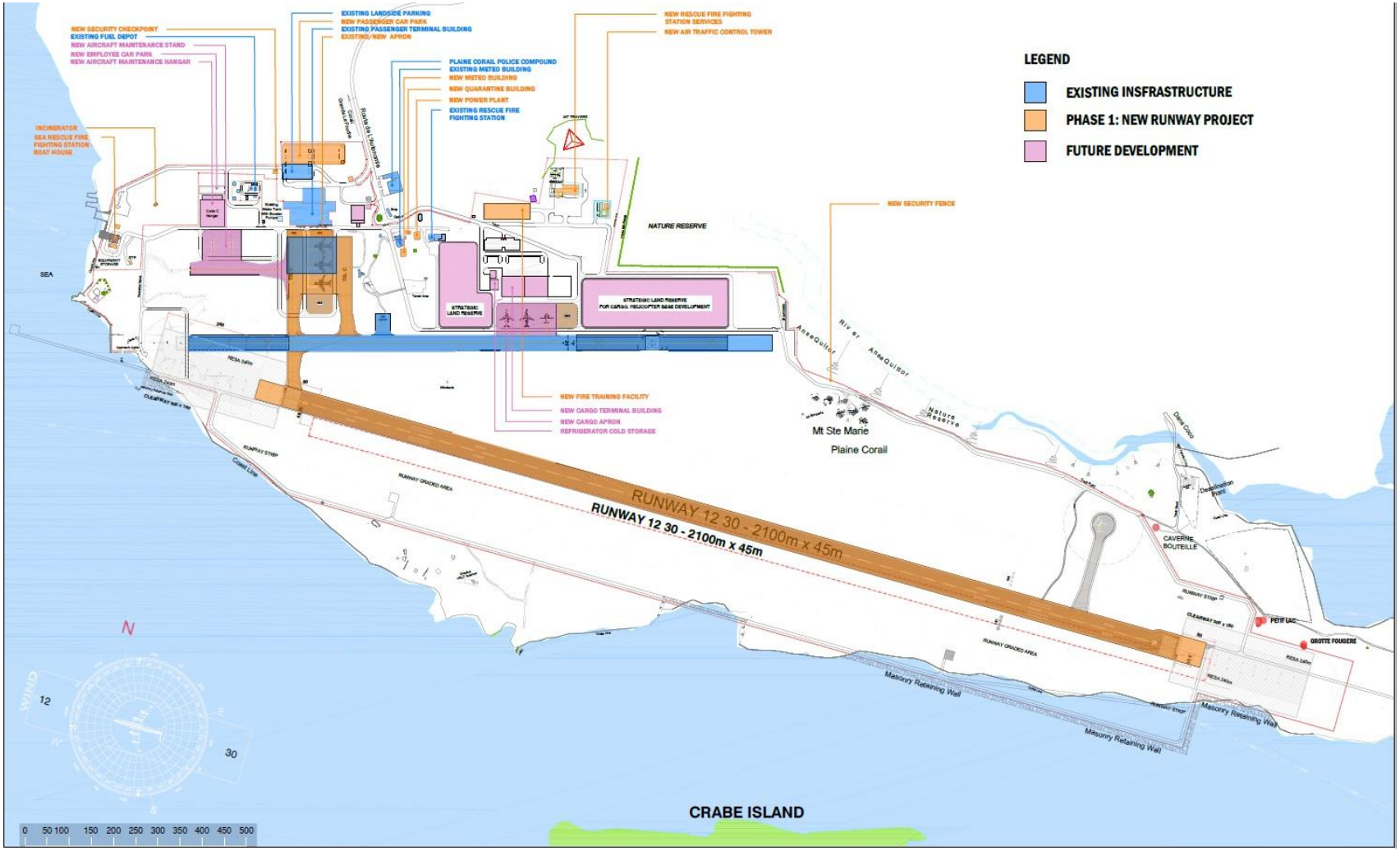


Figure 12: Updated Master Plan (ARL, Nov. 2022)

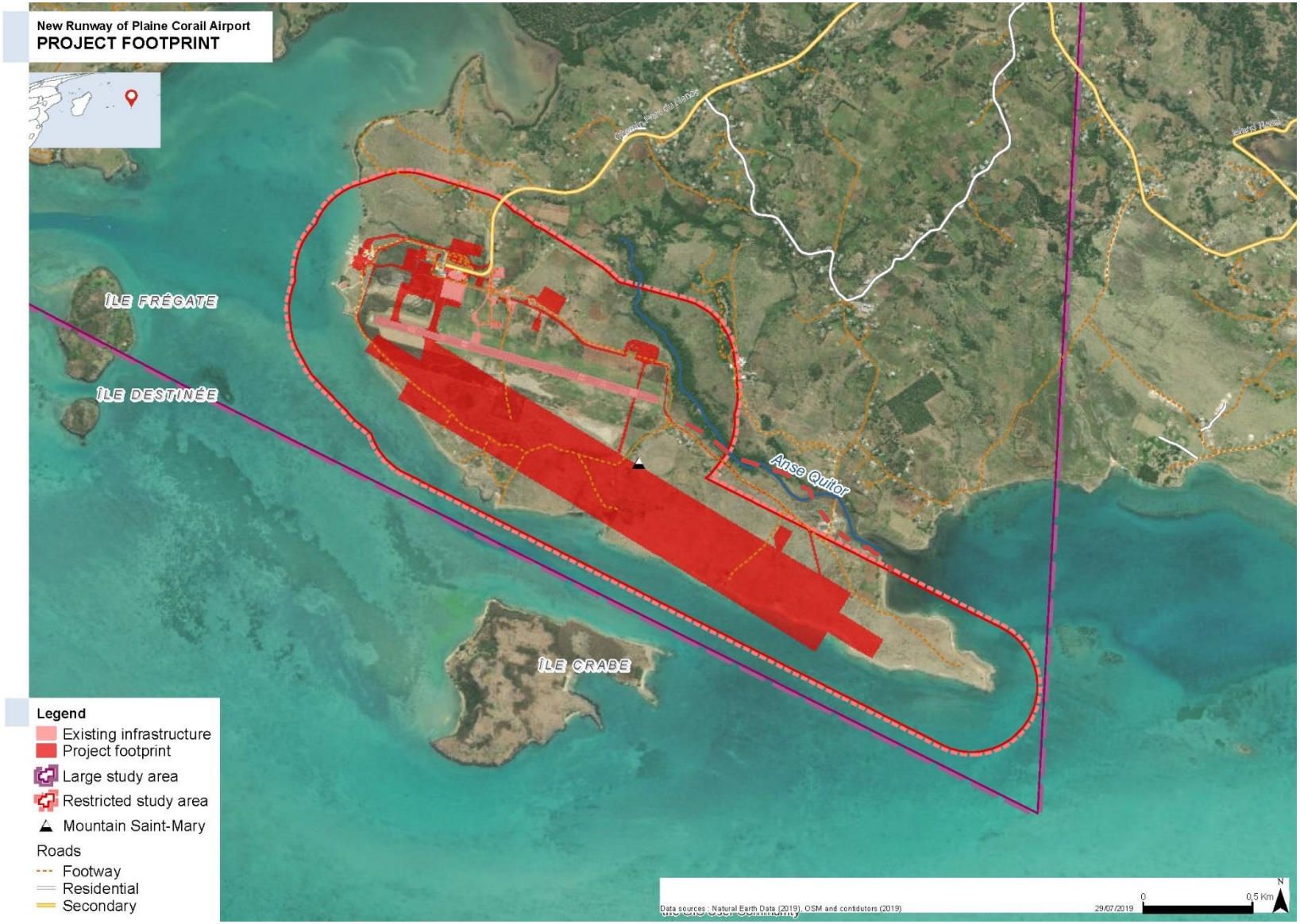


Figure 13: Existing infrastructures and projected facilities (to include the river and estuary)

5.3.2 Runway

5.3.2.1 New runway footprint and geometry

The existing runway at 30m wide x 1280m long (with a declared runway distance of 1,217m) does allow for the safe operation of the ATR72 type of aircraft. In order to replace ATR72s by the larger A319 type aircraft, which will significantly increase the number of passengers per flight, the length, the width and the strength of the pavement have to be adapted.

The Preliminary Design was mandated to design a new runway with a **length of 2,100m and a width of 45 m** as per ICAO requirements, including Turn Pads for the A321 Neo type aircraft, and taking into account a Runway End Safety Area (RESA) on both ends of the runway.

This defines the Aerodrome Reference Code as per ICAO Annex 14 as 'Code Number 4'. Furthermore, the design aircraft is the A321 which is categorised as 'Code C'. Therefore, the new Runway is classified as '4C'.

The **orientation** of the new runway is aligned in respect to the primary wind direction: the geometric orientation of the new runway aligns with its designation as 12-30 on the island geographical grid.

NB: Although the existing runway is designated as 12-30, its actual orientation relating to the geographical grid of the island is 11-29. It is not unusual for runway designations to be different from the geographical grid. However in this study, as in the Preliminary Design Report, the existing runway designation will be considered as 11-29 as this correlates to its geographical grid.

A **45m wide** runway that caters up to a Code C aircraft does not require any **shoulders** under ICAO Annex 14. However, the design includes 2.5m-wide shoulders on each side of the runway rather than a grass surfaced strip to increase the runway edge lights conspicuity.
The primary landing will be on Runway 12 and aircrafts will therefore need to complete a 180 degrees turn before taxiing along the Runway towards the apron. Accordingly, a **runway turn pad** has been provided to facilitate a 180 degree turn at Runway 30 for the A321.

A **Runway End Safety Area (RESA)** has been provided on both ends of the new Runway in accordance with ICAO Annex 14. The RESA provided is of a recommended length of 240m beyond the Runway Strip and 90m wide.

A **Runway Strip** of 2,220m by 300m (length by width), which includes the Runway and a Clear and Graded Areas, has been provided in accordance with ICAO Annex 14. This provides a 150m strip on either side of the runway centreline and the 60m length of strip beyond both ends of the Runway.

The **runway vertical** profile is continuous cross fall and its levels are tied in to existing at 20% gradient beyond the Clear and Graded Areas of the Runway Strip.

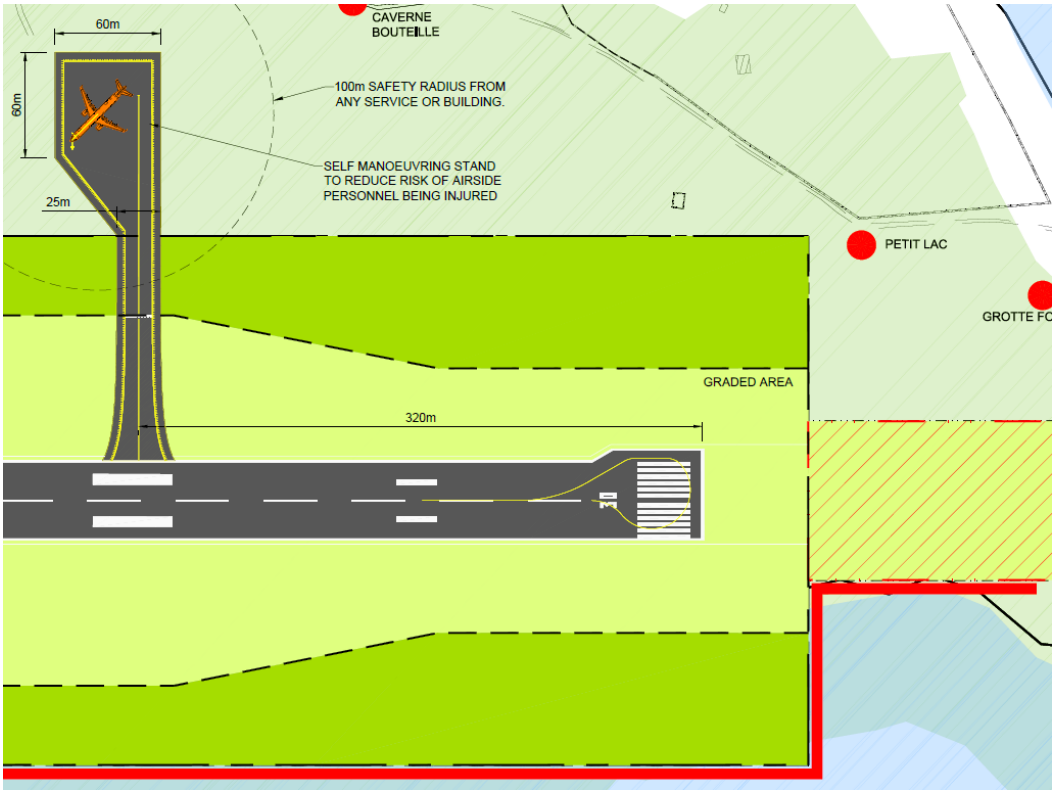


Figure 14: Turn pad on the 30 end of the runway – to be updated based on final design

The new inland runway alignment will entail massive earthworks to be able to connect to the existing taxiway pavement and parking on the extended apron. To minimize the need to import fill from the other quarry sites, the earthworks in the Preliminary Design has been optimised and will involve the cutting of the Sainte Marie Hill and surrounding area including the Bangelique reservoir.

Suggestions for improvement in Detailed Design
The Preliminary Design study confirmed the new runway orientation (12- 30) as the optimal alignment. However, to optimize the design, building closer to the two caves, Grotte Petit Lac and Grotte Fougère, could drastically reduce marine works and consequently would have a reducing impact on the project cost. The possibility of building closer than the 50 m buffer zone provided in the PDR will depend on the ESIA conclusion about critical sensitivity level of the caves and on the technical feasibility determined by the detailed design studies.
Also, the detailed design will work to meet the objective to optimise the earthwork and achieve a balance in the cut and fill volumes.

5.3.2.2 Pavement for the new runway

The structural pavement consists of four layers above the upper part of the earthwork:

- Marshall Asphalt Surface Course (50mm)
- Marshall Asphalt Binder Course (75mm for the runway, 50mm for the shoulders)
- Cement Bound Granular Base (140mm for the runway and no granular base for the shoulders)
- Crushed Aggregate Base (150mm for the runway and 315mm for the shoulders)

- Select Fill (400mm)

5.3.2.3 AGL, Navaids and illuminated signage for the new runway

All AGL, Navaids and illuminated signage will be compliant with the ICAO Annex 14. All circuits shall be run in underground sleeves. All light fittings shall be inset (except for elevated approach lights) LED type, mounted on deep FAA compliant transformer cans.

The AGL system will consist of new circuits powered from new constant current regulators (CCRs) which will be located at the CCR room of the new Power Centre.

The runway lighting circuits will have a minimum brilliancy control of 100%, 30% and 10%.
The new runway AGL includes:

- AGL;
- High intensity PAPIs;
- Illuminated signs;
- Illuminated Windsocks;
- Runway Threshold Identification Lights (RTILs) flashing white lights with a frequency between 60 and 120 per minute;
- Runway Guard Lights are a visual aid intended to caution pilots that they are about to enter an active runway. These lights shall be provided on all taxiways/runway intersections and flash unidirectional yellow light;
- Runway Approach Lights.

5.3.2.4 Dismantling of the existing runway

The existing runway shall be decommissioned without necessarily demolishing the pavement structure. Part of the existing runway shall be converted into a taxiway to connect to the new runway, this will be subject to the detailed design.

5.3.3 Taxiways

The Preliminary Design was mandated to design and provide:

- Construction of 15 m-wide new Code C taxiways with shoulders to link the existing runway or apron to the new runway;
- Construction of a new taxilane to provide flexibility of connections from the apron to the new runway;
- Full assessment of the existing taxiway and upgrade to suit the operational requirements of A321 series and similar aircraft types: rehabilitation, strengthening, and widening of pavement of existing taxiway;
- Rehabilitation and strengthening of a part of the existing runway to be used as a taxiway;
- Surface markings and illuminated signage to the runways, taxiways and apron.

5.3.3.1 Taxiways footprint and geometry

The taxiways have been designated starting from west to east. Therefore, the new taxiway designations will be as follows:

- Taxiway Alpha - New taxiway which links the apron expansion to the existing runway 11-29.
- Taxilane Bravo - New taxilane behind the expanded apron to serve the aircraft parking stands
- Taxiway Charlie - Existing taxiway A. This taxiway will need to be widened and strengthened. Furthermore, the taxiway connecting existing runway 11-29 and new

runway 12-30 will be an extension to the taxiway Charlie and therefore will also be known as 'Taxiway Charlie'
- Taxiway Echo – New taxiway connecting the new runway to the isolated pad.
- (These names refer to the preliminary design and may evolve in the detailed design, in particular due to changes concerning the taxiway D. Please report to 8.5.2.2 Taxiway or access road for fire fighting).

The width of the new taxiways must meet the requirement for the design aircraft of A321 that is 15.0m minimum.

Moreover, the design of the taxiway fillets should allow for a minimum of 3.0m clearance from the outer edge of the aircraft main gear to the edge of the taxiway in accordance with Clause 3.9.3 of ICAO Annex 14. Thus, the width of the taxiway shoulders is 5 m on either side of the taxiway.

Therefore, a 26 m-wide taxiway strip on either side from the taxiway centreline has been designed.

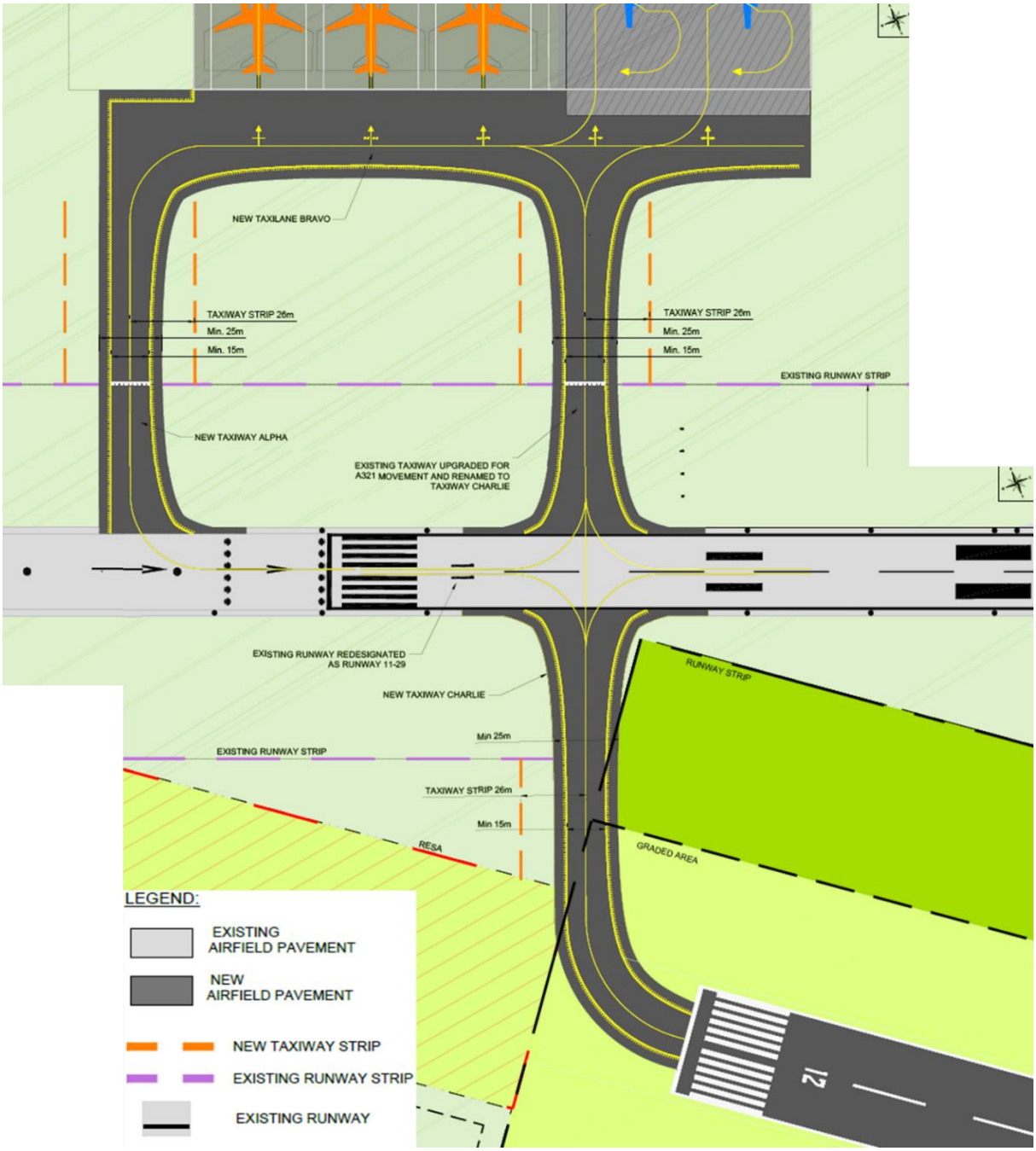
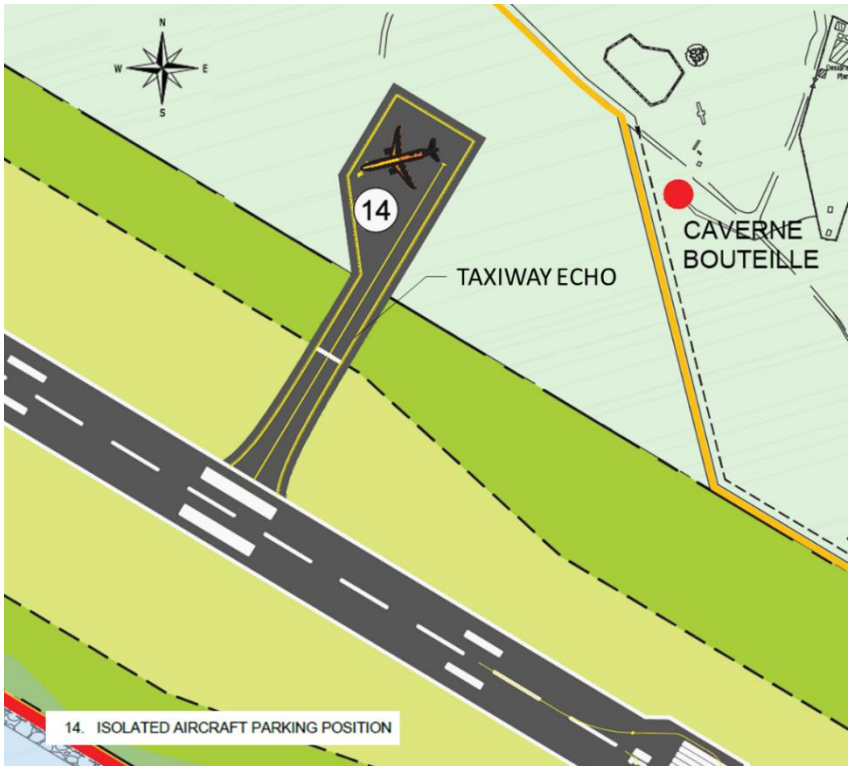


Figure 15: Taxiways Alpha, Bravo and Charlie (Preliminary Design Report) – to be updated based on final design



14 : isolated aircraft parking position

Figure 16: Taxiway Echo (Preliminary Design) – to be updated based on final design

5.3.3.2 Pavement for the taxiways

The proposed taxiway system serving the new runway utilises parts of the existing runway and the existing apron access taxiway. These pavements were constructed/upgraded in 2003 and designed to cater to the ATR 72 aircraft. Consequently the proposed use by A321 neo size aircraft requires significant strengthening of the existing flexible (asphalt) pavements. The rigid (concrete) pavement of the existing parking apron was designed to cater for larger aircraft and thus its life whilst catering to the forecast traffic must be evaluated as it is impractical to strengthen by simple overlay.

Three new taxiways are to be developed: new Alpha, Bravo and south part of Charlie.

The existing taxiway Alpha (redesignated as Charlie - north part - in the project) has to be strengthened, as well as the existing runway located between new taxiways Alpha and Charlie, which will be used as a taxiway in the project.

5.3.3.2.1 New taxiways

The new taxiways Alpha and Bravo, and the south part of the new taxiway Charlie will be constructed on fill. The structural pavement consists of five layers:

- Marshall Asphalt Surface Course (50mm)
- Marshall Asphalt Binder Course (75mm)
- Cement Bound Granular Base (140mm)
- Crushed Aggregate Base (150mm)
- Select Fill (400 mm)

5.3.3.2.2 Existing taxiways

For the existing runway between taxiways Alpha and Charlie, an overlay will be put above the existing materials. The pavement is structured as follows:

- Material for overlay (total thickness 200 mm)
- Marshall Asphalt Surface Course Overlay (50mm)
- Marshall Asphalt Binder Course Overlay (65mm)
- Marshall Asphalt Binder Course Overlay (75mm)
- Existing materials (240 mm)
- Existing Marshall Asphalt Surfacing (90mm)
- Existing Crushed Aggregate Base (150mm)

Thus, the total pavement thickness will be 440 mm.

In the same way, for the existing taxiway Alpha redesignated Charlie (north part), an overlay will be put on the existing materials. The pavement is structured as follows:

- Material for overlay (total thickness 200 mm)
- Marshall Asphalt Surface Course Overlay (50mm)
- Marshall Asphalt Binder Course Overlay (65mm)
- Marshall Asphalt Binder Course Overlay (75mm)
- Existing materials (240 mm)
- Existing Marshall Asphalt Surfacing (90mm)
- Existing Crushed Aggregate Base (150mm)

Thus, the total pavement thickness will be 440 mm.

5.3.3.3 AGL, Navaids, and illuminated signage for the taxiways

As for the new runway, the taxiway AGL design is compliant with the ICAO Annex 14. All light will be of LED type and all instruments will be powered from the new power centre through circuits run in underground sleeves.

The AGL and navaids for the taxiway will include direction signs and edge lighting consisting of blue omnidirectional LED.

5.3.4 Apron

5.3.4.1 Main apron

The existing apron has two stands which can support an ATR72. It requires enlargement to accommodate an A321 aircraft and a number of larger aircraft stands needs to be provided.

The Preliminary Design mandated the design of an extension to the existing apron including a fuel hydrant system, floodlighting and ground power, and the ability to accommodate the operations of a minimum of three parking stands for the A321 and two stands for the ATR72.

The table below highlights the design parameters for the new stands (A321 type). The stands will be designated as Stand 1 to 5 starting from the west and heading east.

Table 4-2: Aircraft Stands Design Parameters

Design Parameters	Distance (m)
Length of Stand	62.0
Width of Stand	38.0
Wingtip Clearance to Edge of Stand	1.0
Head of Stand to A321 Nose	10.5
A321 Tail to Back of Stand	4.5
Back of Stand to Taxilane Bravo Centreline	22.5

The 3 new stands designed for A321 aircrafts will be operating as nose-in and pushback. Existing stands, designed for the ATR72, will be operated in autonomy.

Static ground power units shall be provided to the aircraft parking stands. Two 90 KVA units capable of feeding full load 400 Hz power will be provided at each stand.

A new hydrant refuelling system will have to be provided to serve all the new aircraft parking stands. A complete loop will start and end at the new pump house that will have to be located within the fuel depot. The pumping system will be designed to fuel or de-fuel one aircraft at a time. A control room will also be provided within the fuel depot which will have to be equipped with all the appropriate telemetry and controls to facilitate the operation, control and monitoring of the system.

We also can note the existence of an air-conditioned system.

5.3.4.2 Isolated apron

The Isolated Aircraft Parking Position (Isolation pad) is planned to be located such that an emergency incident does not stop operations at the airport and that any potential threat does not cause damage to critical buildings, equipment or facilities.

The Isolated Aircraft Parking Position has been located towards the end of Runway 12 approximately 320m from Threshold 30. This location has been determined to ensure a landing aircraft will be able to evacuate the Runway as soon as possible.

Furthermore, the location is such that the Isolated Aircraft Parking Position is far away from any other airport service including the Terminal Building and the Apron.

The Isolated Aircraft Parking Position is operated as a self-manoeuvring stand, so the aircraft will be able to complete a 180 degree turn on the pad before taxiing back to the Runway.

The dimensions of the Isolated Aircraft Parking Position are 60m x 60m plus a 25m wide access Taxiway including shoulders, to allow for all Code C aircraft including both the A321 and the ATR72. The length of the Taxiway leading up to the Isolation Pad will be 180m.

In normal circumstances, this stand could be utilised to park any long layover flight or to use as a remote stand should it become necessary.

5.3.4.3 Pavement for the apron

5.3.4.3.1 New apron

The extension to the parking apron is to be constructed with Pavement Quality Concrete (PQC) slabs as the existing apron.

Three courses of material will be used:

- PQC (375 mm)
- Cement Bound Granular Base (150 mm)
- Crushed Aggregate Base (150 mm)

5.3.4.3.2 Existing apron

The apron pavement consists of 266No 5m x 5m x 350mm thick concrete slabs. No further strengthening is considered necessary.

5.3.4.4 AGL, Navaids, and illuminated signage for the apron

As for the new runway, the apron AGL design is compliant with the ICAO Annex 14. All light will be of LED type, and all instruments will be powered by the new power centre through circuits run in underground sleeves.

The AGL and navaids for the apron will include:

- AGL:
- Edge lighting consisting of blue omnidirectional LED;
- Flood lighting: the height of these masts has been determined so as not to penetrate the OLS. Apron floodlighting shall be provided by 18m high steel masts supporting LED floodlights;
- VDGS (Visual Docking Guidance System);
- Constant Current Regulators (CCRs).

5.3.5 Air Traffic Control Tower and facility (updated 2022)

The ATC facility is currently only an advisory service with all operations based upon visual decisions by the pilots. A new control tower is required to be compliant with the new runway and with the A321 type of aircraft.

Considering the sighting requirements, the most suitable location identified for the new ATC tower is due east of the existing location.

The Preliminary Design located the new control tower east of the airport, close to the Anse Quitor River, i.e. within the limits of the critical habitat.

The intial ESIA 2019 recommended the relocation of the ATC tower outside the Reserve.

The latest design received confirms the relocation of the ATC tower outside the environmental sensitive area. Hence the risk rating will be amended accordingly.

The specific components of the ATC include

- A control cab
- A tower shaft and
- A base building

The first component of ATC tower is the **Control Cab**. It provides the best unobstructed view for air traffic controllers. Size depends on the level of airport activity and the number of operating personnel required.

To avoid an obstructed view, construction is by a steel structure so that the structural loading is minimum. The perimeter glazing is fully covered by inclined 15 degrees glasses to avoid glare/reflections.

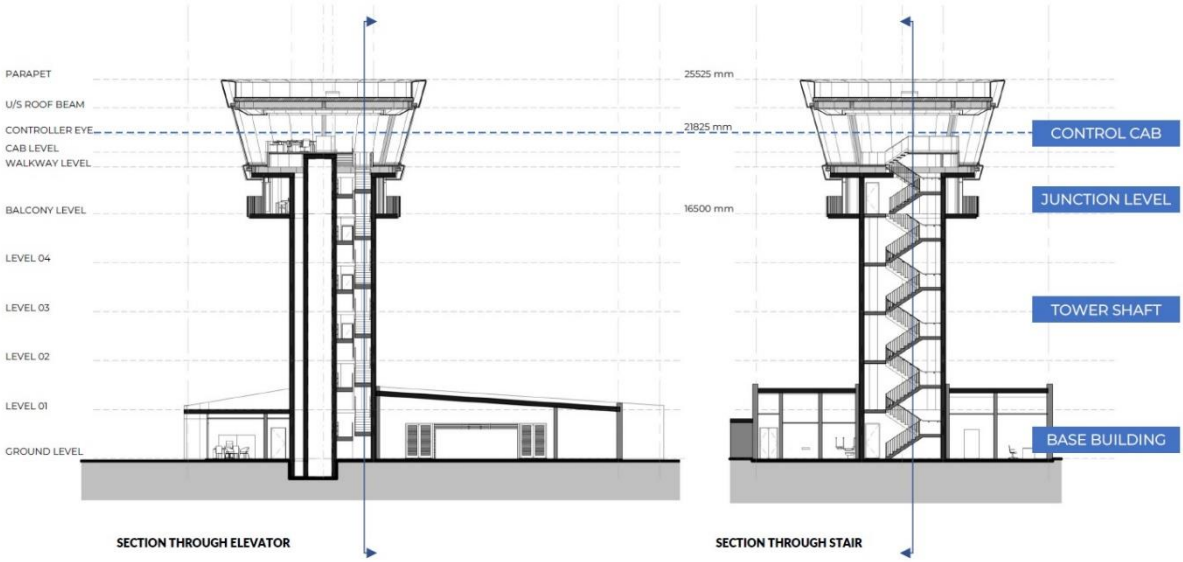
The operating level height or optimum visual surveillance is obtained from the OLS.

The second component of ATC tower is the **Tower Shaft**. The main function of this shaft is to provide the required height for the tower determined by the operating level or optimum visual surveillance for the control cab. It encompasses an elevator/s and a stair/s for access.
There is a junction level between the Tower Shaft and Control Cab that provides space for Mechanical & Electrical equipment together with a break out space and a lavatory.

The last component of ATC tower is the **Base Building**. Here, training, conference & telecommunication rooms, radar & communication and equipment rooms are located. It could be located included within the ATC tower or as a separate component building itself. Combinations could be:

1. Separate (entirely separated away from tower)
2. Base (horizontally at the base of the tower)
3. Stacked (Vertically around the tower)
4. Stacked Split (Attached to the tower yet)

4.8 Latitudinal & Longitudinal Sections



4.2 Ground (Base Building) Plan

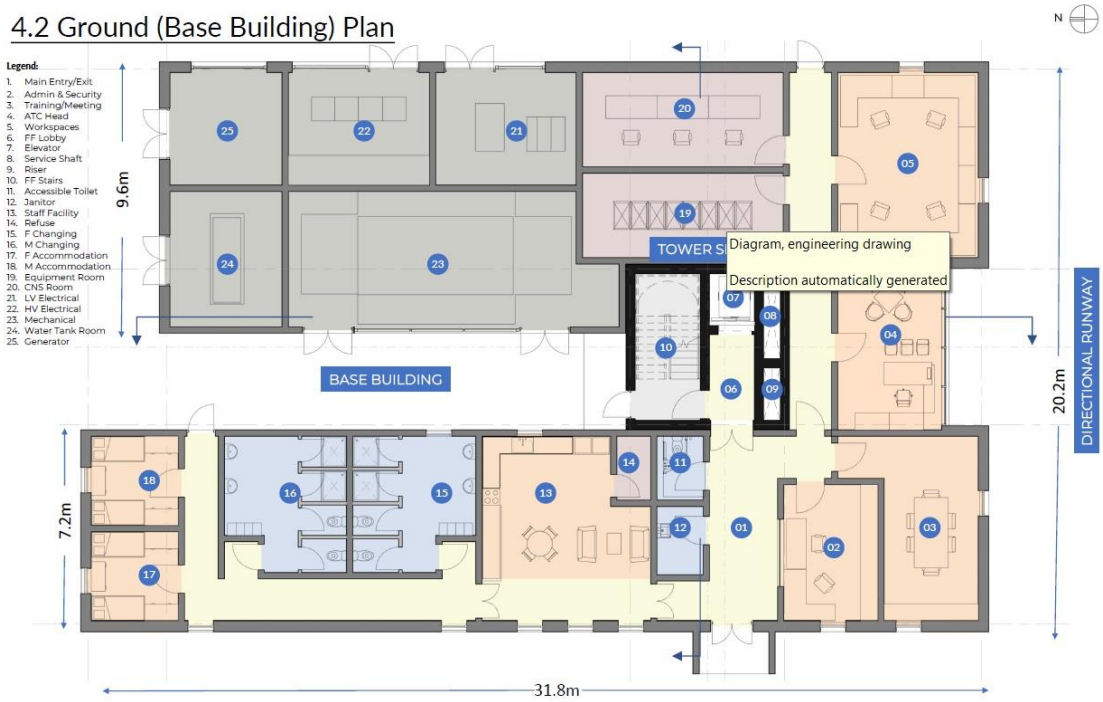


Figure 17: Updated Architectural Drawings of the ATC (Preliminary Design)

5.3.6 Rescue and Fire Fighting Services (updated 2022)

5.3.6.1 Fire station

The current CAT5 provision with swift and direct access to the runway is adequate for the safe operation of the ATR72 type aircraft. To cater to A321 aircraft type, the Preliminary Design was mandated to propose a location and sizing for new rescue and fire fighting services (RFFS) of type CAT7.

Due to its location, the travel time between the current fire station and both ends of the new runway is not compliant with the ICAO regulations. Thus, a new location had to be proposed. Following the Feasibility Studies, it was decided to integrate the new RFFS with the new control tower.

The new Fire Station will need to provide all the necessary facilities to comply with ICAO Airport Services Manual Part 1 including accommodation for staff and vehicles, administrative and support requirements and a watch room.

Four fire vehicles can be parked with allowance made for servicing.

New water storage tanks will need to be provided near the fire station to safeguard water supplies during emergency situations. The capacity of the new water storage tanks will need to cater to the enhanced service requirements.

The Preliminary Design located the new RFFS together with the ATC east of the airport, close to the Anse Quitor River, i.e., within the limits of the critical habitat.

The initial ESIA 2019 recommended the relocation of the ATC and RFFS outside the Reserve.

The latest design received confirms the relocation of the ATC tower & RFFS outside the environmental sensitive area. Hence the risk rating will be amended accordingly.

The current architectural drawing received show a G+2 building

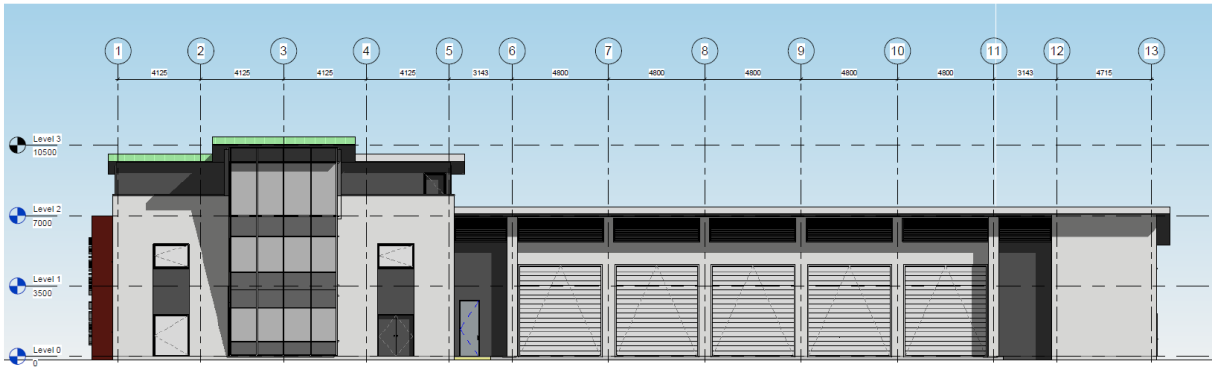


Figure 18: Rescue and Fire Fighting Services – South Elevation (updated 2022)

5.3.6.2 Fire training facility

A fire training facility pad is projected along the perimeter road between the airport terminal and the new control tower.

Limitation

There is currently no information on the new fire training facility. However should fire exercise be considered at the facility same should be assessed in as much as air pollution (from burning) and ground/underground pollution (from run off of water/foam dispersion from firefighting) are concerned.

Impacts associated with the fire fighting and training facility will be further assessed during the finalization of the ESIA.

5.3.6.3 Sea rescue facility

The airport is on the coast and aircraft will be passing over the lagoon at a low-level. The RFFS should be able to react to any incident adjacent to the airport and so the provision of a fast rescue boat is recommended. It should be equipped to provide an initial response and to undertake routine patrols of the immediate area.

Thus, the Preliminary Design projected the construction of a boat house and jetty facilities. The boat house will be located on the coast, west of the airport building, linked to it by a 7 m wide driveway.

The boat house will be equipped for two jetties. A specific car park will be associated.

Limitation:

The current design of the sea rescue facility comprises of a set of drawings of the building. There are no details on the siting of the facility, on the slipe way etc to enable an assessment of the potential impact(s) of the facility on the environment (coastal environment predominantly). However, impacts can be anticipated on the coastal and marine environment.

Potential impacts associated with the construction and operations of the sea rescue centre will be assessed as part of the finalization of the ESIA.

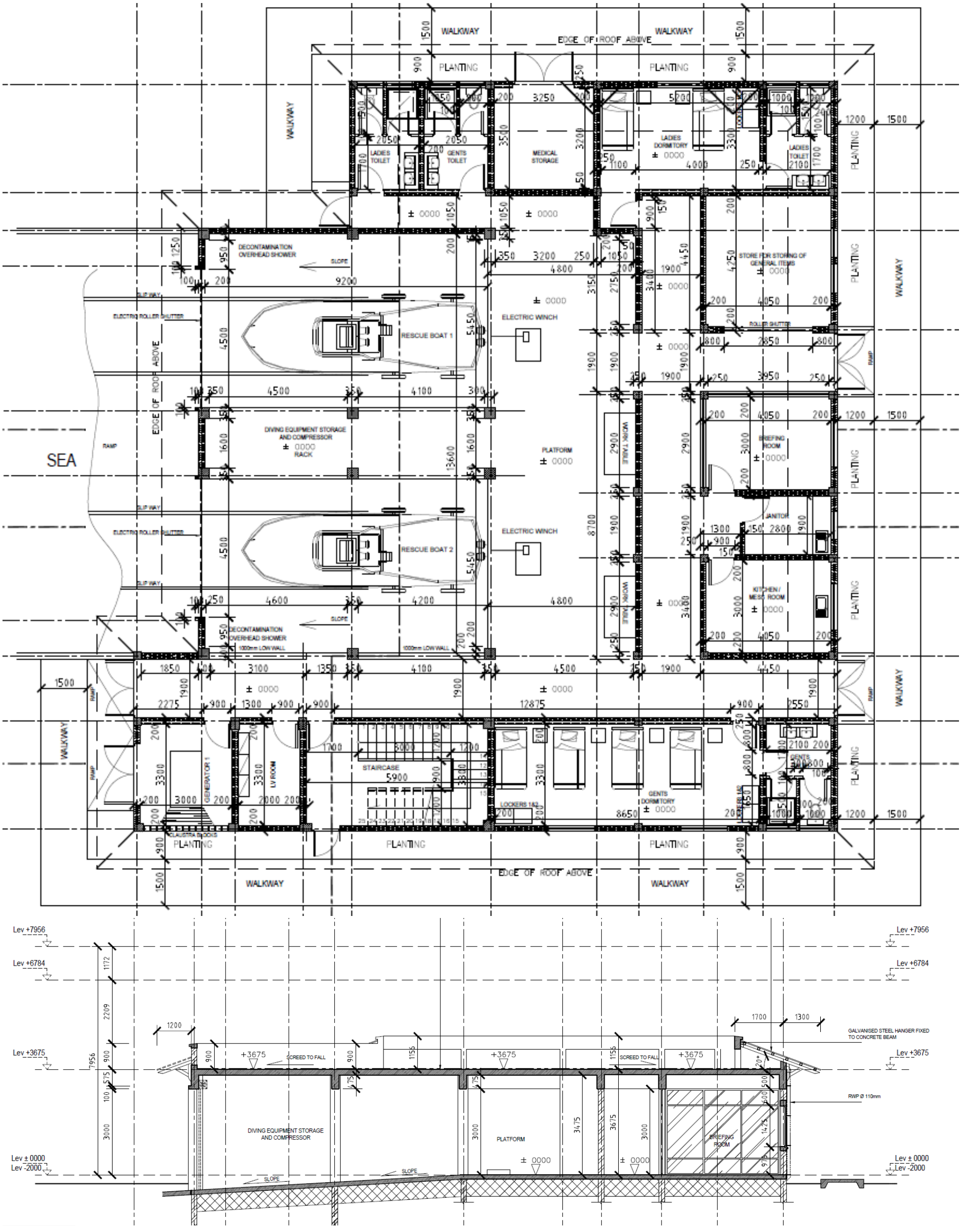


Figure 19: Sea Rescue Facility – GF plan and Section A-A (updated 2022)

5.3.7 Ancillary Facilities within the Scope of Phase 1 Airport Expansion

Refer to Figure 13 as updated for siting of the ancillary facilities.

5.3.7.1 Fuel farm

To be compliant with larger aircraft operating on new (and longer) routes, a full re-fuelling service is required. Fuel is currently delivered to the island's main port and is transferred to the airport by road tanker. The nature of the roads on the island means that only small capacity tankers can be used. The required on-site storage capacity of an extended fuel farm cannot be determined at this stage as it will depend not only on the weekly demand but also the frequency and volume of the bulk deliveries. The impact of an increase in the road haulage of fuel across the island will be assessed as part of the finalization of the ESIA .

5.3.7.2 Power Centre

A new Power Centre consisting of a GF only, 272m2 building is scheduled and will encompass amongst others the following rooms: metering, LV, Transformer and HV, CCR, control, workshop, store, kitchen, mess, toilets, together with a generator room with Nos 2 stand by generators.

5.3.7.3 Quarantine Building

A quarantine consisting of GF only 454m2 building is scheduled and will encompass amongst others the following rooms: consultation, nursing, donning, treatment, quarantine (high Risk), quarantine (low Risk), waiting, sanity facilities, etc. The waste management will be determined and assessed as part of the final ESIA.

5.3.7.4 Meteorological Building

A new meteorological facility of G+1 208m2 building is scheduled and will encompass amongst others the following offices, dormitories, observation room at First Floor, sanity facilities, etc

5.3.7.5 Solid Waste Management Facility / Incinerator

An incinerator is projected. From information gathered at concept stage, it is oil fired and capable of handling a range of general waste, hazardous waste, animal carcasses and medical waste.

It will have the lowest emissions possible by controlling the rate of combustion in a three chambers process and by capturing particulate matter in a settling chamber resulting in industry leading low emissions.

The capacity is:

- General waste: 50 kg/h - Medical waste: 33 kg/h	- Animal carcass: 30 kg/h - Plastic: 28 kg/h.

The impacts associated with the incinerator will be assessed as part of the finalization of the ESIA once more details are known.

5.3.7.6 New perimeter road

The new perimeter road will reuse the existing track which leads to the mouth of the Anse Quitor river. It is planned to widen it and make it passable for all types of vehicles.

The impacts associated with the perimeter road will be assessed as part of the finalization of the ESIA once more details are known.

5.3.7.7 Other facilities

The following additional facilities are planned:

- New security checkpoint
- New passenger car park

Limitation:

- There is no technical data available on the ancillary facilities to enable an assessment of the potential impact(s) of the facilities on the environment.
- Potential impacts associated with the construction and operations of these facilities will be assessed as part of the finalization of the ESIA

5.3.8 Ancillary Facilities within the Scope of Phase 2 Airport Expansion

Refer to Figure 13 as updated for siting of the ancillary facilities.

Strategic land has already been earmarked and reserved for the future development under phase 2 expansion:

Facilities to be located adjacent (north) of to the existing runway

- New cargo terminal building
- New cargo apron
- Refrigerator cold storage
- Cargo, helicopter base development

Facilities to be located west of existing passenger terminal

- New aircraft maintenance stand
- New aircraft maintenance hangar
- New employee car park

Limitation:

- There is no technical data available on the ancillary facilities to enable an assessment of the potential impact(s) of the facilities on the environment.
- Phase 2 expansion is excluded from the scope of the present ESIA. Hence, potential impacts associated with the phase 2 of the airport expansion will not be assessed as part of the finalization of the ESIA

5.3.9 Water tower

New water storage will need to be provided near the fire station to safeguard water supplies during emergency situations. The water will be supplied from the integrated water system proposed and detailed in section 5.3.10. The capacity of the new water storage tanks will need to cater for the enhanced service requirements and it will be determined in the detailed design phase. For fighting purposes, the water tower will need to have a minimum volume of 30 m3 as per firefighting guideline.

5.3.10 Stormwater drainage and domestic wastewater management facilities

The project includes an appropriate **stormwater drainage network** ensuring that stormwater is adequately captured and disposed of in an environmentally safe manner. The possibility of reuse of stormwater in an effective manner has been considered in an "integrated" water management scheme.

The project includes a **new sewer network with an associated wastewater treatment plant** to cater for the new control tower and Rescue and Fire Fighting Station, together with the existing passenger terminal building.

5.3.10.1 Main Concept Design considerations

The general principle proposed is presented in the figures hereinafter, based on the following concept design considerations:

Stormwater drainage and management

- Collection, pre-treatment and disposal or reuse.
- Use of the stormwater drainage facilities to confine the effluents generated by chronic pollution and any eventual firefighting on the runway and preserve the environment, in particular the 2 caverns (Caverne Petit Lac and Grotte Fougère) near Anse Quitor, but also potentially Caverne Bouteille in the same zone where drinking water is being produced by desalination.
- Use the opportunity of gravity stormwater drainage for stormwater harvesting to reuse it after treatment for the water supply requirements of the airport.
- Assess on the one hand the water needs for the airport, and on the other hand assess the volume of wastewater to be produced and the volume of stormwater to be collected in order to determine the zones of the airport that can be drained effectively towards the buffer storage pond and the Water Treatment Plant for reuse. This is to relax as far as possible the constraints induced by the topographical characteristics of the new runway which tends to slope down towards Anse Quitor.
- The stormwater harvesting on the impermeable zones (namely taxiways, aprons, roads) will come in addition to the rainwater harvesting from the roofs of the passenger terminal building for reuse.
- The stormwater drainage network needs to be non-infiltrating to convey the first runoff flow with the highest pollutant loadings to the buffer storage through an oil separator / primary sedimentation equipment.
- The stormwater management including a buffering storage and / or works facilitating infiltration and reducing soil erosion enables to address climate change adaptation for disaster risk reduction. In fact, reduction of peak flows, run off and soil erosion lead to reduced sedimentation of water bodies including lagoons, thus protecting biodiversity, corals and white sandy beaches.
- However, according to the recommendations of Gregory MIDDLETON in his email dated 10th April 2019 to Aurele Anquetil ANDRE, "The stormwater drainage system must be properly constructed to carry water far away from the runway, as excessive infiltration of concentrated runoff from infrastructure has been identified as a major cause of sinkhole collapse in the young limestones of Florida. Water and sewer systems in karst areas are prone to failure caused by small leaks that create minor subsidence, which then leads to major pipe failure".
- The buffer storage pond for reuse, which is envisaged in open air, is to be emptied within a small lapse of time so as to be made available for the next eventual rain event. A visual monitoring is to be carried out for maintenance purposes.

- A sea outfall is to be implemented for discharging at sea the excess water that cannot be reused. The sea outfall for excess stormwater is to be implemented tentatively in the zone of the existing boat house and new sea rescue facility, in common with the sea outfall of the Waste Water Treatment Plant.
- The water to be reused is to be conveyed by pumping towards the Water Treatment Plant (WTP 1 on the General Principle diagram figure 20, consisting tentatively of a sand filtration, activated carbon and ozonation) before being stored in an industrial water storage tank after proper treatment and adequate treated water quality monitoring.
- An industrial water storage is envisaged with a capacity of 400 m^3 to reuse treated waste water or treated stormwater. This capacity can be backed up if required by rainwater harvesting from roofs of buildings.
-

Domestic wastewater management

- Having a new Waste Water Treatment Plant on site gives the opportunity to implement an “Integrated” Water Management associating both stormwater and sewage water as sources of raw water for the common uses of the airport, after an adequate treatment.
- The considered sewage water has to be strictly domestic wastewater. Any non-domestic wastewater shall be evacuated specifically by pumping via a dedicated carrier. In fact, domestic wastewater is generally free of pollutants like heavy metals and therefore can be treated using biological techniques with regard to toxicity towards bio-organisms.
- The Wastewater Treatment Plant shall be of modular type to cater for future extensions if required and of “package plant” type, including UV disinfection and water quality monitoring at the outlet. A dedicated inlet lift pumping station shall be implemented at the inlet of the Water Treatment Plant.
- The sludge produced shall be reused in agriculture and therefore shall require a minimum level of dryness.
- A sea outfall is to be implemented for discharging at sea the excess treated water that cannot be reused, even if the objective is zero discharge as far as wastewater is concerned.
- This sea outfall is to be implemented tentatively in the zone of the existing boat house and new sea rescue facility, in common with the sea outfall of the buffer storage tank described above.
- The gravity sewer networks to be implemented to convey the domestic wastewater to the Water Treatment Plant shall be of uPVC type, with intermediate lift pumping stations if required. The pumping networks shall be of HDPE type.
- The treated wastewater will be stored in a dedicated 400 m^3 water tank; note that this figure may be reviewed at detailed design stage.

Water supply

- The Integrated Water Management gives the opportunity to have enough raw water for reuse after an adequate treatment and water quality monitoring.
- The treated water from the outlet of the water treatment plant will be reused for drinking water purposes provided the level of treatment can be made compliant with the drinking water standards and correctly monitored at the outlet of the treatment. Only the fraction dedicated to drinking water purposes has to be disinfected thoroughly. The treatment will be ensured by a specific Reverse Osmosis treatment stage (WTP 2 on the General Principle diagram Figure 20).
- The water to be reused is to be conveyed by pumping from the Water Treatment Plant outlet towards the corresponding storage tank after adequate water quality monitoring.

- it is proposed that this storage tank be the existing storage capacity of 400 m^3 since it is already connected to the distribution network and to the drinking water supply from the public network, to be maintained as back-up. The existing rainwater harvesting will be disconnected from the storage tank and connected to a new storage of 400 m^3 to be implemented and dedicated to rainwater storage. In fact, at the moment, the drinking water from the public network is connected to the same storage tank used for rainwater harvesting from the roofs of the passenger terminal building. The drinking water is thus contaminated on the bacteriological point of view. It is therefore proposed to have a storage dedicated to drinking water uses at the airport.
- The specific storage tank for drinking water purposes shall be equipped with a disinfection facility using controlled chlorination towards the passenger terminal building.
-

Determination of the storage capacity for treated water to be potentially reused

- The storage capacity determined for rainwater, industrial water and drinking water is based on a compromise considering namely:
- a water demand of around 21 m^3/d
- a storage of 1 month considering a period of no rain for around 21 days
- the existing storage capacity of 400 m^3 taking into account an existing volume reserved for fire fighting (volume considered of 120 m^3).
- A dedicated separate storage tank for rainwater harvesting, industrial water and drinking water for distribution, is proposed with a capacity of 400 m^3 each.
- In fact, the new capacity envisaged is arbitrarily fixed for the moment to 400 m^3 like the existing water storage on site

Determination of treatment capacity for reuse

- WTP to produce industrial water = around 21 m^3/d (estimated water demand)
- Rainwater to produce drinking water (WTP 2) = around 21 m^3/d (estimated water demand)
- Stormwater to produce industrial water (WTP 1) = up to 100 m^3/d (estimated stormwater collected during the month of least rainfall forecast: October)

Estimate of the total footprint for the whole water treatment plant

- Approximate total surface area (including land area, building footprint, road access, industrial water buffer storage) = 850 m^2
- Approximate height of buildings = 5 m

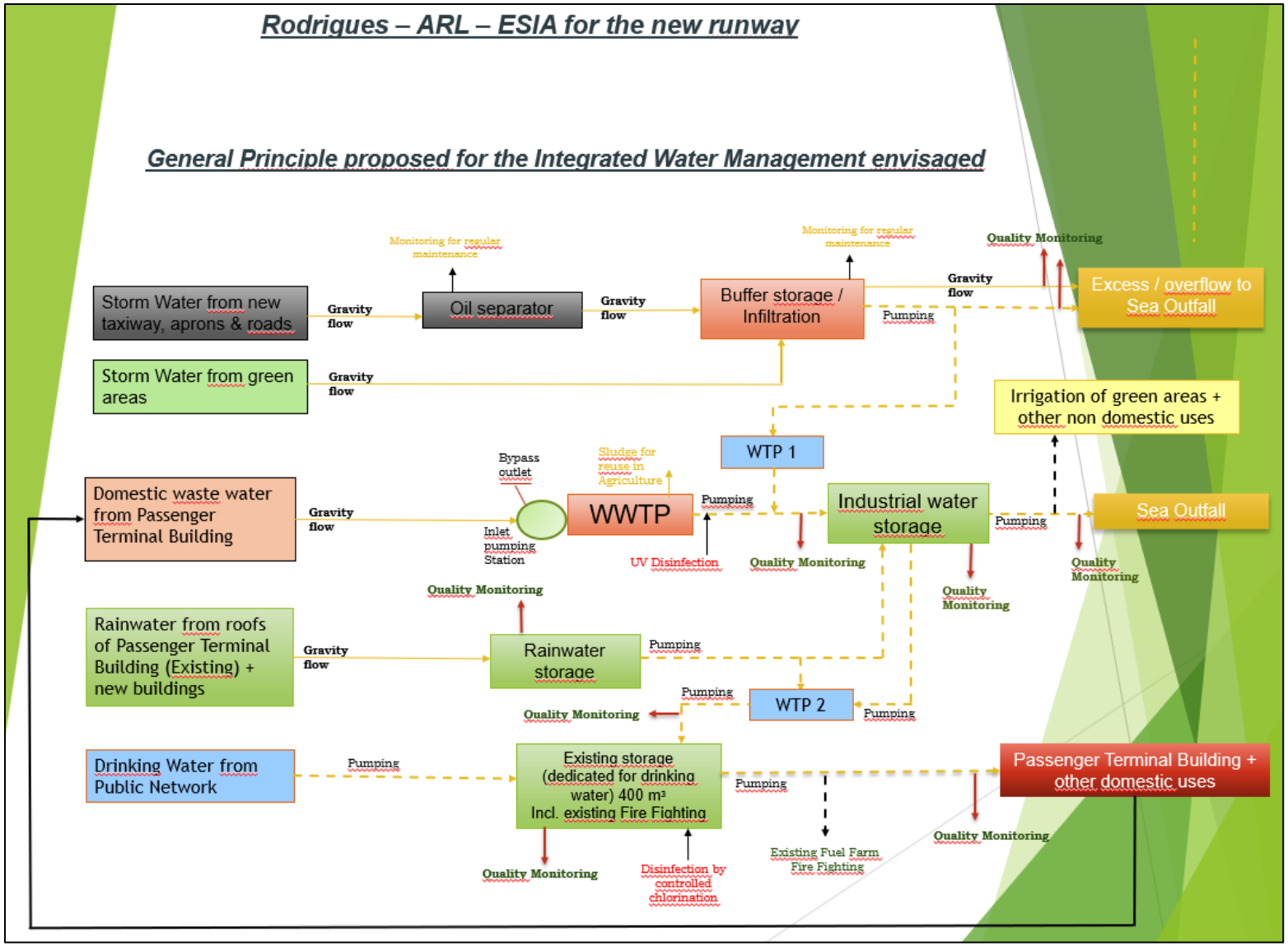


Figure 20: General principle proposed for the integrated water management envisaged

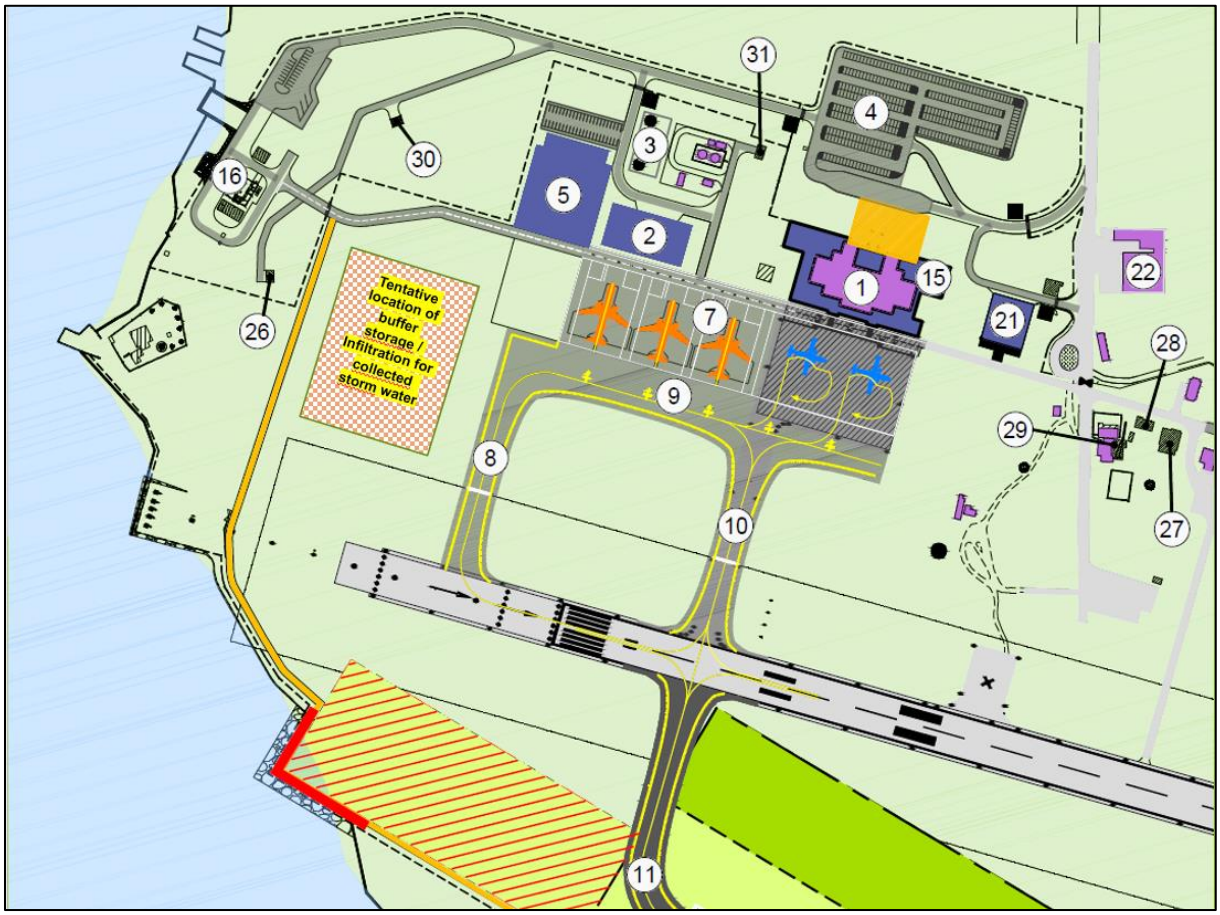


Figure 21: Tentative location of the buffer storage envisaged for the stormwater management

KEY:

1. EXISTING TERMINAL BUILDING
2. NEW CARGO FACILITY
3. UPGRADED FUEL FARM
4. UPGRADED TERMINAL CAR PARK
5. NEW AIRCRAFT HANGER
6. NEW ATC
7. APRON EXPANSION
8. NEW TAXIWAY ALPHA
9. NEW TAXILANE BRAVO
10. EXISTING TAXIWAY CHARLIE TO BE UPGRADED
11. NEW TAXIWAY CHARLIE
12. NEW TAXIWAY DELTA
13. NEW RUNWAY
14. ISOLATED AIRCRAFT PARKING POSITION
15. TERMINAL BUILDING EXTENSION
16. NEW SEA RESCUE FACILITY
17. UPGRADED PERIMETER ROAD
18. NEW AIRSIDE PERIMETER ROAD
19. RUNWAY STRIP
20. EXISTING RUNWAY
21. VIP TERMINAL
22. POLICE STATION
23. NEW RFFS
24. FIRE TRAINING FACILITY
25. RELOCATED HELIPAD
26. SEWER TREATMENT PLANT
27. POWER CENTRE
28. QUARANTINE
29. METEO OFFICE
30. INCINERATOR
31. COLD STORAGE
32. WATER TOWER

The location of the buffer storage envisaged, as indicated in the figure above, has been chosen in order to benefit from the existing topography in this specific zone and be able to reach the permeable soil layer for partial / natural infiltration of the pre-treated stormwater. The implementation in this zone also makes it less risky in terms of bird attraction with regard to safety restrictions of aviation.

Moreover, the location of the new Wastewater Treatment Plant (in the Preliminary Design) (location 26 in Figure 21 above) and the location of the existing water facilities for reuse in the passenger terminal building (zone between locations 1 and 5 in Figure 21 above), make it easier to handle the water transfer among the corresponding water facilities and for easy access for maintenance purposes as well.

5.3.10.2 Main Concept Design numerical assumptions and applicable standards

The main assumptions made at this prior stage are namely:

Air passenger volume projected / year :	100 000
Air passenger volume projected / day :	274
Number of employees projected :	170
Ratio L / employee per day :*	75
Ratio L / passenger from terminal per day :*	30
* source : INFRATA June 2014	
Ratio L / passenger from planes per day	2

The flow of wastewater produced at this prior stage is thus estimated to:

	Number	Ratio L/d	Volume (m3/d)
Passengers	274	30	8.2
Employees	170	75	12.8
Passengers from planes	274	2	0.5
Total			**21.5**

According to EPA Guidelines, the design assumptions are the following:

Parameters	Units	Design
Hydraulic flows		
Average flows	*m3/d*	21.5
Peak flows	*m3/h*	5.8
Pollution Flows		
BOD5	*kg/d*	5.4
COD	*kg/d*	8.6
Total Suspended Solids (TSS)	*kg/d*	6.5
NK	*kg/d*	2.2
Pt	*kg/d*	0.4
Bacteriological proprieties		
Faecal coliforms	*U/100mL*	1.00E+05
Physico-chemical proprieties		
Wastewater temperature	*°C*	20
pH range		7 to 8
Minimum hardness		5
Minimum K Acid buffer capacity	*mmol/L*	8

The standards proposed to be complied with are the following, regarding both wastewater treatment and treated wastewater discharge at sea. Drinking water standards, for reuse as such, if applicable, are given hereinafter.

A comparison of the 3 most common international standards is the following for a discharge at sea:

	Local standards	European standards				US standards	
	EPA and National WW guidelines	British Standards		French standards DERU 1991 + 07/21/2015 regulation			
		Concentration	Minimum % of reduction	Concentration	Minimum % of reduction	Concentration	Minimum % of reduction
BOD_5	20 mg/L	25 mg/L	70-90%	25 mg/L (>2000pe)	80%	45 mg/L (daily max)	
TSS	30 mg/L	-	-	35 mg/L (>2000pe)	90%	45 mg/L (daily max)	
COD	50 mg/L	125 mg/L	75%	125 mg/L (>2000pe)	75%	-	
NH_4 (Ammonium Nitrogen)	10 mg/L	-	-	-	-	-	
NO_3 (nitrates as N)	15 mg/L	-	-	-	-	-	
Total Nitrogen		< 15 mg/L (10 000 – 100 000 pe)	70%	< 15 mg/L (10 000 – 100 000 pe)	70%	10 mg/L	
Ptotal	10 mg/L (orthophosphate)	2 mg/L (10 000 – 100 000 pe)	80%	2 mg/L (10 000 – 100 000 pe)	80%	-	
E.coli	1 org/100mL	-	-	-	-	-	
Faecal coliforms	100 org/100mL	-	-	-	-	-	

It is proposed that the following performance standards be considered **for a discharge at sea** i.e. local standard as per comparative standards shown above (local, Europoean and American) :

	Concentration	Minimum percentage of reduction
BOD_5	20 mg/L	70-90%
TSS	30 mg/L	90%
COD	50 mg/L	75%
NH_4 (Ammonium Nitrogen)	10 mg/L	-
NO_3 (nitrates as N)	15 mg/L	-
Total Nitrogen sum of total Kjeldahl-nitrogen (organic N + NH_3), nitrate (NO_3)-nitrogen and nitrite (NO_2)-nitrogen	< 15 mg/L (10 000 – 100 000 pe)	70%
Ptotal	2 mg/L (10 000 – 100 000 pe)	80%
E.coli	1 org/100mL	-
Faecal coliforms	100 org/100mL	-

In the Final ESIA, the discharge limits will also include reference to the WBG EHS discharge limits, namely the following table extracted from the General EHS Guidelines: Environmental Wastewater and Ambient Water Quality.

Table 1.3.1 Indicative Values for Treated Sanitary Sewage Discharges[a]

Pollutants	Units	Guideline Value
pH	pH	6 – 9
BOD	mg/l	30
COD	mg/l	125
Total nitrogen	mg/l	10
Total phosphorus	mg/l	2
Oil and grease	mg/l	10
Total suspended solids	mg/l	50
Total coliform bacteria	MPN[b] / 100 ml	400[a]

Notes:
[a] Not applicable to centralized, municipal, wastewater treatment systems which are included in EHS Guidelines for Water and Sanitation.
[b] MPN = Most Probable Number

However, for reuse, we propose the following standards according to local (Mauritian) wastewater regulations:

Parameter	Unit	Land/ Underground	Surface water courses	REUSE in irrigtion
Total coliforms	MPN per 100 ml	-	400	-
Faecal coliforms	MPN per 100 ml	-	-	1000
E. Coli	MPN per 100 ml	<1000	<200	-
Free Chlorine	mg/l	-	0.5	-
Total Suspended Solids (TSS)	mg/l	45	35	45
Total Dissolved Solids	mg/l	-	-	2000
Sodium Adsorption Ratio (SAR)	-	-	-	<6
Reactive Phosphorus	mg/l	10	1	-
Color	-	Not objectionable	Not objectionable	Not objectionable
Temperature	degree C	40	40	-
pH	-	5 - 9	5 - 9	5 - 9
Chemical Oxygen Demand (COD)	mg/l	120	120	120
Biochemical Oxygen Demand (BOD5)	mg/l	40	40	40
Chloride	mg/l	750	750	250
Sulphate	mg/l	750	750	500
Sulphide	mg/l	0.002	0.002	-
Ammoniacal Nitrogen	mg/l	1	1	-
Nitrate as N	mg/l	10	10	20
Total Kjeldahl Nitrogen (TKN)	mg/l	25	25	-
Nitrite as N	mg/l	1	1	-
Aluminium	mg/l	5	5	5
Arsenic	mg/l	0.1	0.1	0.1
Beryllium	mg/l	0.1	0.1	0.1
Boron	mg/l	0.75	0.75	0.75
Cadmium	mg/l	0.01	0.01	0.01
Cobalt	mg/l	0.05	0.05	0.05
Copper	mg/l	0.5	0.5	0.2
Chromate chromium	mg/l	-	-	0.1
Fluorine	mg/l	-	-	1
Iron	mg/l	2	2	-
Lead	mg/l	0.05	0.05	2
Lithium	mg/l	2.5	2.5	2.5
Manganese	mg/l	0.2	0.2	0.2
Mercury	mg/l	0.005	0.005	0.02
Molybdenum	mg/l	0.01	0.01	0.01
Nickel	mg/l	0.1	0.1	0.2
Selenium	mg/l	0.02	0.02	0.02
Sodium	mg/l	200	200	-
Total Chromium	mg/l	0.05	0.05	-
Vanadium	mg/l	0.1	0.1	0.1
Zinc	mg/l	2	2	2
Oil & Grease	mg/l	10	10	10
Total Pesticides	mg/l	0.025	0.025	0.025
Total organic halides	mg/l	1	1	-
Cyanide (as CN -) or Free cyanide	mg/l	0.1	0.1	-
Phenols	mg/l	0.5	0.5	-
Detergents (as LAS*) * Linear Alkylate Sulphonate	mg/l	15	15	-
Detergents	mg/l	-	-	5
Intestinal nematodes	Arithmetic mean no. of eggs per litre	-	-	<1

For drinking water uses, the following local (Mauritian) standards are commonly used. However, the Treated Water shall be monitored in compliance with the EC Drinking Water

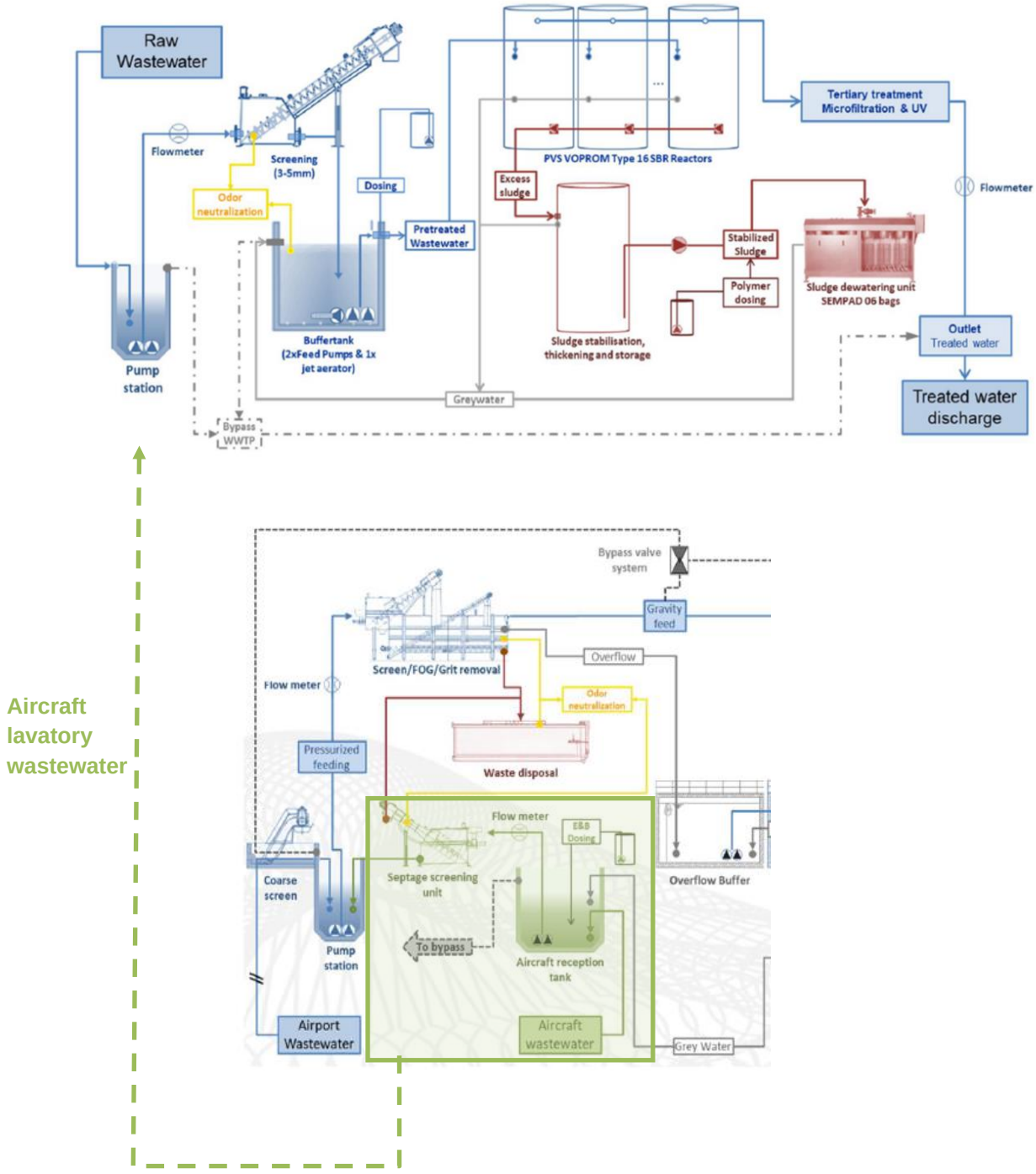
Directive 98/83/EC and the Drinking Water Standards (GN n°55 of 1996 below), whichever is stricter.

Parameter	*Standards*
Microbial	
E. *coli*	must not be detectable in any 100ml sample
Coliform Organisms	0 in 95% of samples examined throughout the year. In the case of quantities of water needed for distribution throughout the year, when not less than 50 samples are examined for each period of 30 days, 3 in an occasional sample , but not in consecutive samples
Physico-chemical	
pH	6.5-8.5
Total dissolved solids	1000 mg/l
Turbidity	5 NTU
Organoleptic	
Colour	20 Pt-Co
Taste and Odour	not objectionable
Trace metals	
Aluminium	0.2 mg/l
Arsenic	0.01 mg/l
Cadmium	0.003 mg/l
Copper	1 mg/l
Lead	0.01mg/l
Mercury	0.001 mg/l
Total chromium	0.05 mg/l
Zinc	3.0 mg/l
Nickel	0.02 mg/l
Anions	
Chloride	250mg/l
Fluoride	1.5 mg/l
Sulphate	250 mg/l
Nitrate	50 mg/l (as NO_3)
Nitrite	3 mg/l (as NO_2)
Pesticides	
Aldrin and dieldrin	0.03 microgram/l
DDT	2 microgram/l
Lindane	2 microgram/l
HCB	1 microgram/l
Methoxychlor	20 microgram/l
Heptachlor and Heptachlor oxide	0.03 microgram/l

5.3.10.3 Main Concept Design working principle (Wastewater Treatment for discharge or reuse)

The figure below illustrates the general working principle envisaged and proposed for the Waste Water Treatment Plant.

Figure 22: General principle proposed for the water treatment plant



5.3.10.3.1 Pre-treatment of the wastewater from the Aircraft infrastructures

The wastewater from the aircrafts will first enter a receiving tank with a storage capacity of 2 days. This receiving tank will be equipped with special aerators and a dosing station which will add specific reagents in order to render the aircraft wastewater treatable.

A pair of clog free pumps will enable to feed the pre-treatment unit.

A flowmeter will count the flow of aircraft wastewater sent to the pre-treatment unit.

A special pre-treatment unit, developed and engineered in order to handle septic and highly concentrated wastewater from aircrafts will press and remove the suspended solids and sediment in order to obtain a wastewater quality adapted to the domestic wastewater flows coming from the airport infrastructures.

The pre-treated aircraft wastewater will be added to the general inlet pump station of the WWTP.

5.3.10.3.2 Pre-treatment of the domestic wastewater from the Airport infrastructures

The water will be lifted up by the pump station and the incoming flows counted with a flowmeter.

In addition, the pump station will be equipped with an overflow/bypass system. But this is to be used in a very exceptional situation.

The lifting station will send the wastewater to a screening unit in order to remove a maximum of suspended solids.

The waste removed by this primary step will be stored in dedicated waste disposal containers.

The primary treatment unit and the waste containers will be treated by an activated carbon for odour removal in order to avoid the spreading of unwanted gases.

In addition, the primary treatment will be equipped with an overflow sending the wastewaters to a buffer tank and a by-pass system in order to be able to by-pass the biological treatment for maintenance purposes.

After pre-treatment, the wastewater will be sent by gravity to a buffer tank.

5.3.10.3.3 Buffering of the screened wastewater

The wastewater will enter a buffer tank. This receiving tank will be equipped with jet mixing aerator and a dosing station which will add specific reagents depending on the quality of the wastewater.

A pair of clog free pumps will enable to feed the pre-treatment unit.

A flowmeter will count the flow sent to the SBR Cells.

The buffer tank will be designed in order to handle the overflows and return of greywaters.

5.3.10.3.4 Biological treatment with treatment modules.

After buffering, the waste water will be sent to the biological reactors. There will be unit reactor cells and 1 stabilisation cell with a modular scalability. This means that each cell can be activated, put on hold or completely off-line from the process.

Therefore, the plant will be capable of adapting the treatment in regard to the influent loads giving the possibility to start with smaller amounts of wastewater and grow in regard to the airport growth itself.

The process is designed here in order to handle 15 to 20 m³/d of wastewater per reactor cell. It includes carbon, nitrogen and phosphorus treatment.

The biological system is also paired with the buffer tank, designed to handle all overflows from the reactors.

The excess sludge will be sent to an aerated stabilization sludge storage.

The treated water will be sent by gravity to a tertiary disinfection unit before sea outfall pumping via a specific pumping station.

5.3.10.3.5 Sludge treatment: stabilization, thickening, storage and dehydration

The generated excess sludge coming from the biological reactors will be treated within a dedicated sludge stabilization tank. This reactor will have following properties:

- Aerated storage of the sludge in order to avoid fermentation and odours
- Thickening of the sludge up to five times higher than in the biological SBR reactors
- Storage of the sludge in a liquid form

The stabilized sludge will be pumped out and sent to a sludge dehydration unit with capacity of 70% dry content. In order to reach this high dryness, the unit used will be the filtration bag technology. The sludge will enter the unit, the bags will hold up the sludge and the water will pass through the bags. Once the bags are full, they will be stored outside in order to dry out up to 70% of dryness.

The filtration bag technology is the best known on the market in order to reach high dryness capabilities and is suitable for installations handling up to 200 m³/d of domestic wastewater. An illustration is given below.

Figure 23: Example of the filtration bag technology proposed for the sludge treatment on site

5.3.10.3.6 Tertiary treatment of treated water

The treated effluents from the biological reactors will be polished with a microfilter unit in order to remove the last suspended particulate matter. This prior step is important in order to provide high efficiency for the bacterial removal.

After microfiltration the effluents will pass through a UV disinfection system in order to destroy bacteria, eggs and viruses.

Once the water is disinfected, it can be released to the sea according to the local regulations or reused as proposed either as industrial water or, if really necessary, to produce drinking water through the specific Reverse Osmosis treatment units.

The industrial water storage envisaged is of 400 m^3.

5.3.10.4 Main Concept Design working principle (Rainwater/Stormwater Treatment for reuse or discharge)

The stormwater to be treated and reused will be collected from the zones illustrated below, which exclude the new runway due to topographical constraints.

In accordance with the General Principle diagram (Figure 20), rainwater harvested from the roofs of buildings will be treated for reuse in priority to produce drinking water for the airport. This rainwater will be supported by the stormwater collected in the buffer storage pond for the drinking water production.

For the drinking water production, it is envisaged the implementation of 2 reverse osmosis units after an adequate pre-treatment consisting of at least a drum filtration and a sand filtration.

The drinking water produced will be stored in the existing storage of 400 m^3 already connected to the water distribution facilities of the passenger terminal building.

The stormwater collected in the buffer storage pond will top up the rainwater harvested, if necessary, for drinking water production. Otherwise, it will be used for industrial water production. The excess will be discharged at sea.

The rainwater storage envisaged is of 400 m^3 (refer to the General Principle diagram - Figure 20).

Figure 24 below shows the catchment areas according to the topography.

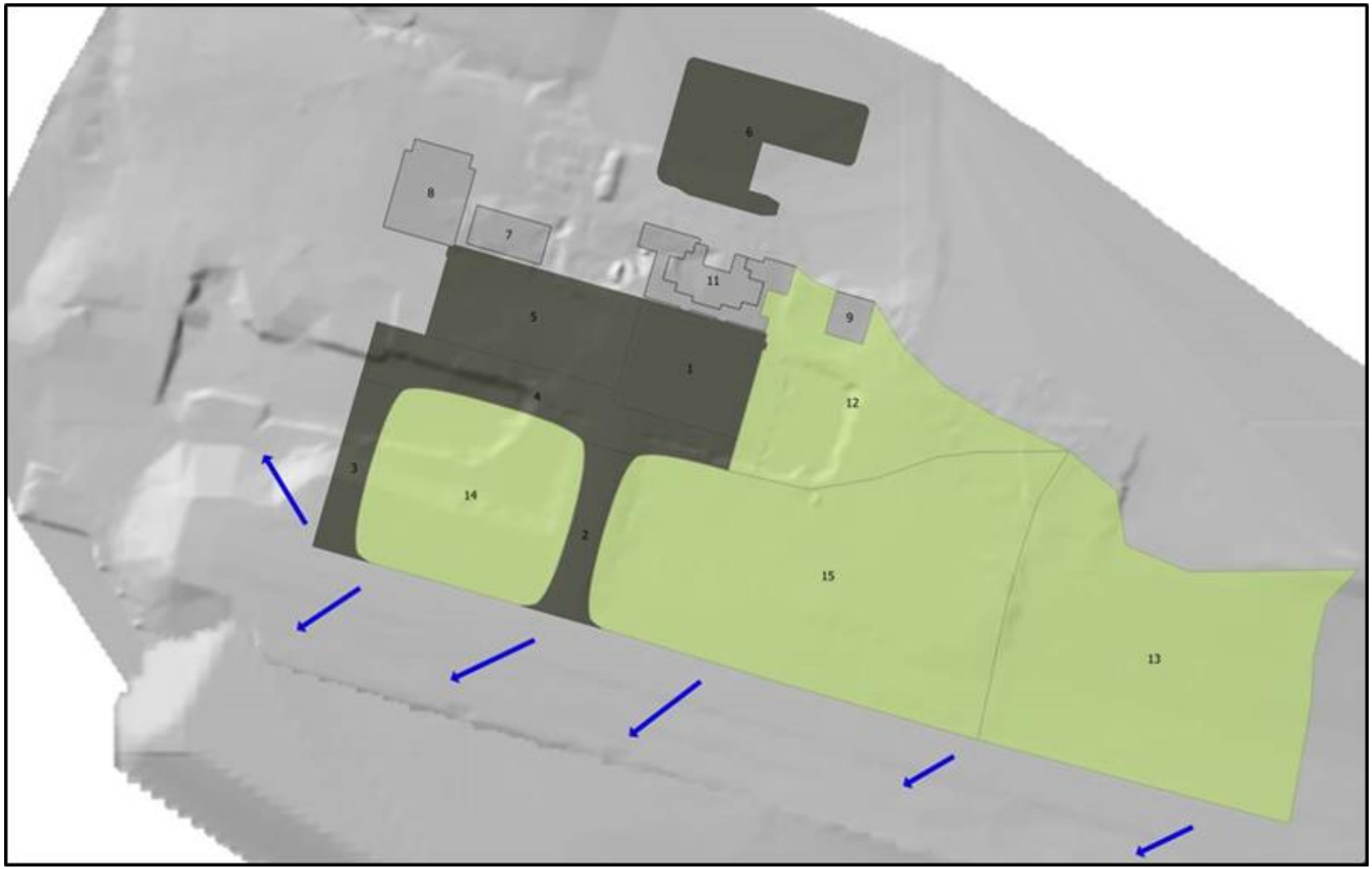


Figure 24: Zones for rainwater/stormwater collection for treatment and reuse

5.3.10.5 Main Concept Design assumptions and characteristics for the stormwater drainage management on the new runway towards Anse Quitor

The drainage system defined in the impact study replaces those proposed in the preliminary design in order to better take into account the issues associated with potential impacts on the natural environment and the reuse water network.

The design of the stormwater drainage system covers both quantitative (flows and volumes of water flowing on site and discharged to the natural environment) and qualitative (quality of water discharged to the natural environment) aspects.

On the quantitative side, the main issue is to protect the facilities against flooding. Since runoff is ultimately discharged into the ocean, and in the absence of issues vulnerable to downstream flooding, reducing the volumes of discharged water is not that essential. However, a particular attention is paid to the choice of final outlets in order to limit the concentration of the volumes of discharged water and to keep them away from sensitive sites, particularly the identified caves.

The main issue is therefore based on the quality of the discharged water, which is likely to have a strong impact on the end receiving environment (the lagoon). The aim is to treat chronic or accidental sources of pollution and to limit the supply of materials resulting from the erosion of drained catchment areas.

The stormwater drainage system is to be divided into two distinct sub-networks due to the general topography of the project:

- the first one, to the South, is to manage stormwater from the new runway and its surroundings, with gravity outflows to the lagoon south of the runway and Anse Quitor,
- the second one, to the North, is to manage rainwater from buildings, stormwater from car parks, taxiways and their surroundings, with a natural outlet to the west, towards the existing boat house. This drainage system will feed the water re-use process as indicated in the above scheme.

5.3.10.5.1 Stormwater drainage of the airport installation, to the North of the new runway

To the North of the future runway, stormwater from the airport facilities (including collecting roofs, roads, parkings, taxiways and part of the existing runway and the natural watersheds overhanging) is collected to a retention basin to buffer peak flows and supply the stormwater reuse network.

The outlet of the roads, parkings and taxiways stormwater network will be equipped with an oil separator designed to collect and treat upt to 20% of the flow generated by a 2-year return period rainfall. The outlet of this network is also equipped with a first storage works associated with a valve to isolate the flow from the natural environment in the event of a pollution (leakage of polluting liquids, water from fire fighting, etc.).

As no risk of flooding associated with rainwater discharge has been identified, the main objective of the buffer tank is to reduce pollution and sedimentation to the lagoon, thus protecting biodiversity, corals and white sandy beaches.

The buffer tank is therefore to be sized to contain a 2-year return period rainfall with a leakage rate of 10L/s/ha of drainage area. If the soil allows it, infiltration will be preferred. A sea outfall

is to be implemented for discharging at sea the excess water that cannot be reused. The sea outfall for excess stormwater is to be implemented tentatively in the zone of the existing boat house and new sea rescue facility, in common with the sea outfall of the Waste Water Treatment Plant.

However, the sizing of the collect system and of the buffer tank will have to take into account the evolution of rainfalls associated with the climate change. A higher intensity of the 2-year event obtained by the current rain data of Rodrigues will be considered in the detail design phase depending on the climate change prediction in the region.

5.3.10.5.2 Stormwater drainage of the **new runway** and associated taxiways

The stormwater drainage of the **new runway** and associated taxiways is to be designed to collect the first flows of runoff loaded with potential pollutants in a watertight network, connected with oil separators and sedimentation works. The outlet of this network is also to be equipped with a storage capacity associated with a valve to isolate the flow from the natural environment in the event of a pollution (leakage of polluting liquids, water from firefighting, etc.). All these structures will be designed to collect and treat up to 20% of the flow generated by a 2-year return period rainfall.

Over and above these first flows, the water is to be evacuated away from the runway to avoid any risk of flooding.

To the North of the runway, a large ditch will collect its flows. It will also collect runoff from the excavated hillside created by the project that could flow to the runway in the absence of such existing works (cut-off drain). The ditch will be vegetated, wide and shallow, in order to reduce flow velocities and spread water; this will allow to:

- facilitate the natural infiltration of water if the soil allows it,
- reduce transfer times to the natural outlet,
- reduce the risk of erosion and the transfer of materials to the lagoon.

This ditch will be divided into several linear sections to create different evacuation points to the ocean, to the South of the runway, via structures passing under the runway. All these works will be sized at least for a 50 year return period rain event.

The sizing of the leak-tight collectors could be increased over 20% of the 2-year event rainfall if necessary in the detailed design phase in order to limit the use of the infiltration system which can be subject to failures and sinkhole collapse if used too frequently. Indeed, water and sewer systems in karst areas are prone to failure caused by small leaks that create minor subsidence, which then leads to major drainage system failure.

Moreover, as for the stormwater drainage of the airport installation, the sizing of the collect system and of the buffer tank will have to take into account the evolution of rainfall associated with the climate change. A higher intensity of the synthetical rainfall events obtained by the current rain data of Rodrigues will be considered in the detail design phase depending on the climate change prediction in the region.

On the southern part of the runway, flows will be in free runoff over the grassed shoulders and will flow to the ocean.

The project has been designed to evacuate the stormwater avoiding the sensitive points of caves, and favours multiple discharge points to the ocean to avoid concentration effects in the

receiving environment. In addition, the first runoff is collected in leak-tight collectors and treated before discharge. However, we do not know the sensitivity of the receiving environments and do not have the means to quantify the impacts.

These principles are presented on the illustrating figures hereinafter.

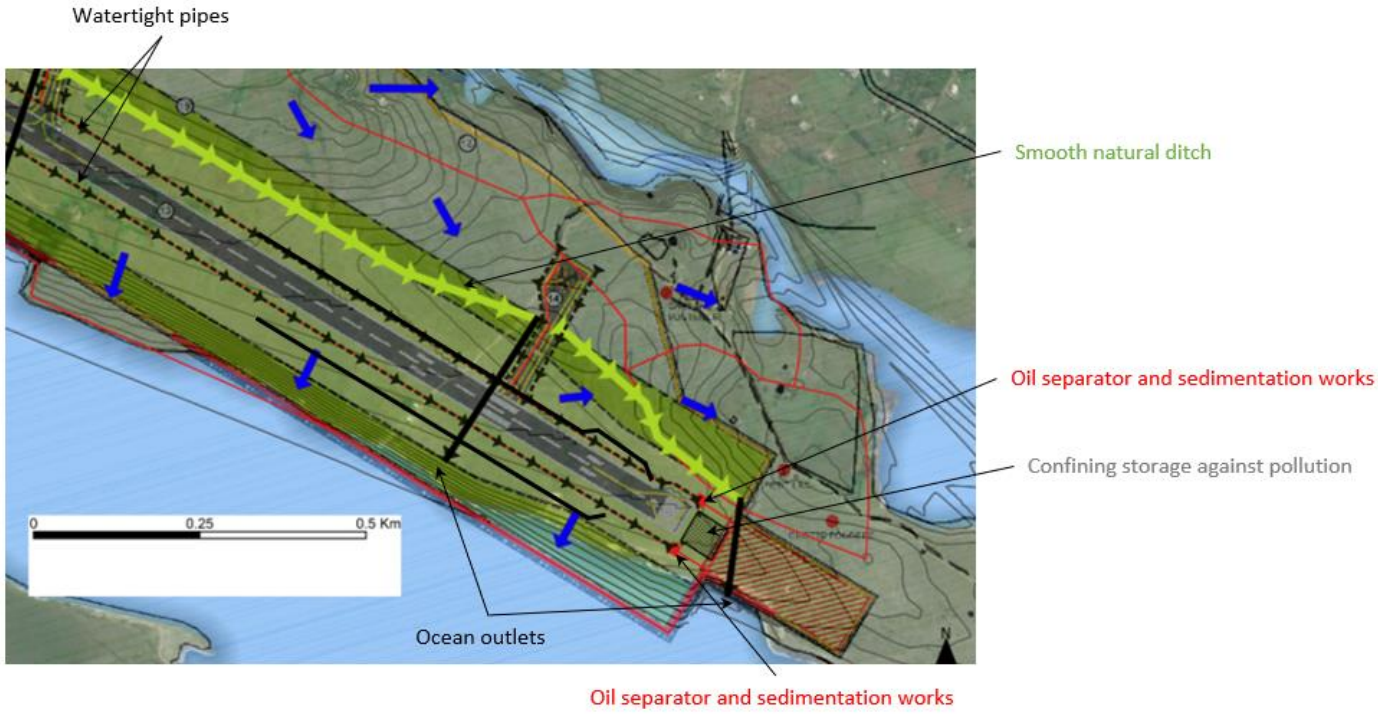
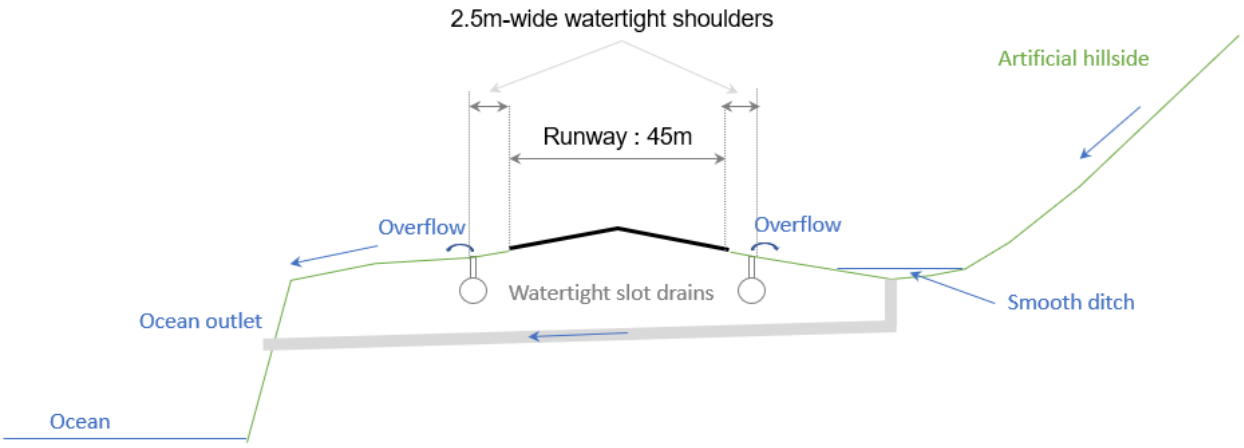


Figure 25: Schematic diagram of the stormwater network



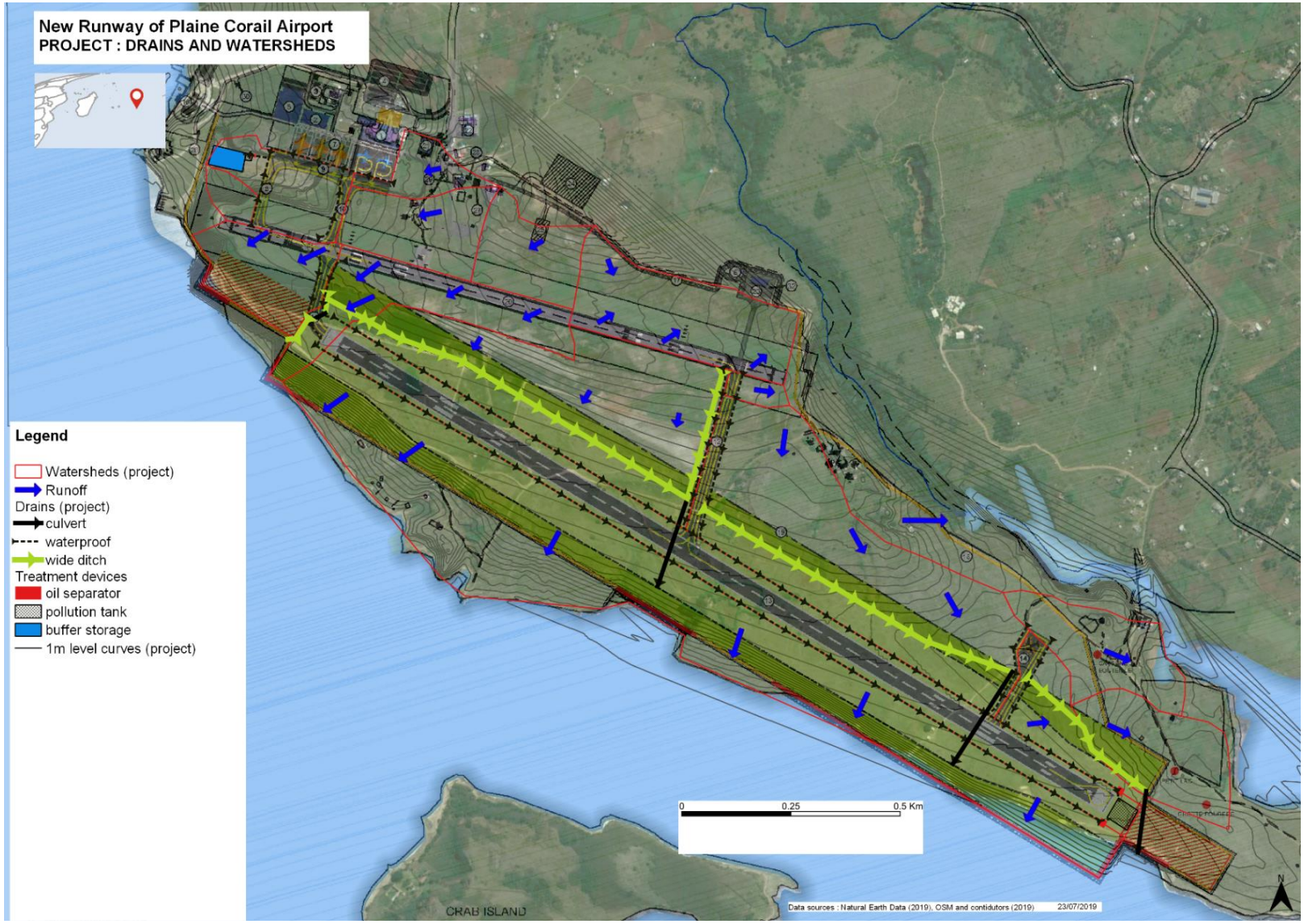


Figure 26: Projected watershed and stormwater network

5.4 Cost and investment

The project's preliminary cost estimated as per Design of 2019 is **MUR 3,923,013,815.00:**

Description	Amount (MUR)
Preliminary and general itms (20%)	**622,700,604**
Airport Aairside Infrastructure and Facilities	**2,764,082,809**
Including Earthwork	
Pavement	
Drainage	
Markings and AGL, Floodlighting, Control Systems	
Permeter, Service Roads, Gate Post and Fencing	
Lanscaping works	
Building works	**152,340,840**
Including Meteo	
Boat haouse and facilities	
Fire station	
Quarantine,	
Power center	
Cold storage building	
Incinerator	
Control Tower building	
Civil and utility works	**57,531,602**
Including new access road	
Car Park	
Power supply system	
Water supply system	
Sewer system	
Air Navigation Facilities	**129,867,770**
DayWorks	**9,680,000**
Contingency sum (5%)	**186,810,190**
TOTAL	**3,923,013,815**

The financial update will be undertaken in the light of the information provided by the client and Main Consultant.

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5.5 Projected traffic

5.5.1 Passengers traffic

The feasibility report prepared by Ecorys in 2011 contained forecasts for future passenger traffic over the period 2011-2031. These forecasts were based on a range of economic considerations and tourist segments and thus annual growth rates vary during the forecast period as different segments of the market are forecast to develop at varying rates.

Considering a new 2,100 m long runway and international routes to be developed, it was forecast that the passenger arrivals (and hence departures) would grow from approximately 61,000 (consisting of approximately 54,000 by air and 6,600 by sea) in 2010, to 137,500 in 2031, an annualised compound growth rate of 3.95%.

However, passenger arrivals by air over the period 2010 - 2017 are shown below, and it can be seen that these have increased faster than expected.

Table 22: Statistic passenger arrivals

Year	2010	2011	2012	2013	2014	2015	2016	2017
Passenger arrivals	54,017	59,456	62,114	63,543	66,196	80,463	91,004	96,812
Annual growth		10.07%	4.47%	2.30%	4.18%	21.55%	15.00%	8,69%

Among the 96,000 passengers arriving per year, there are currently 78,000 tourists, and thus 18,000 Rodriguese passengers.

It is unlikely that air passenger traffic will continue to increase indefinitely but rather that it will be constrained by the size of the population, available resources and the capacity of the island's infrastructure, improved as necessary, to support tourist activities.

This point was encapsulated in the 2009 Sustainable Integrated Development Plan for Rodrigues (SIDPR) Report where, in section 16.4, it was noted that "*the exact number (of tourists) that Rodrigues could welcome would ultimately become a policy trade off (balancing economic and social sustainability against environmental sustainability)*".

The objective of RRA is to host 100,000 tourists per year in 2025. It is expected that the Rodriguese passengers will see a very small increase by this time.

It is therefore considered that for the purpose of airport planning, the number of arriving air passengers forecast by Ecorys for 2031, 137,500, should be maintained with the growth rate between the actual passenger arrivals in 2017 and the forecast numbers for 2031 adjusted to achieve this. The consequent adjusted annual compound growth rate is 2.54%.

The resultant forecast passenger arrivals are shown below and are compliant with the RRA tourism objectives.

Table 23: Forecast of passenger arrivals

Year	Actual Passenger Arrivals	Forecasted Arriving Passengers
2010	54017	
2011	59456	
2012	62114	
2013	63543	
2014	66196	
2015	80463	
2016	92530	
2017	96812	
2018		99271
2019		101793
2020		104378
2021		107029
2022		109748
2023		112535
2024		115394
2025		**118325**
2026		121330
2027		124412
2028		127572
2029		130812
2030		134135
2031		137542

5.5.2 Air traffic

The Preliminary Design Terms of Reference required the facilities to be designed to cater to A320 neo/A321 neo and B737-800 aircraft. Air Mauritius currently operates the A319-100 variant of the A320 aircraft and is planning to operate either the A320neo or the A321neo in the near future, whilst the B737-800 is, or is expected to be, operated by other airlines in the region.

Based on the assumption that 80% of all departures will be carried out by A321 neo and 20% by B737-800 aircraft and that the growth rate in aircraft departures will mirror that in passenger departures, i.e. 2.54%, the number of aircraft departures to be catered to at the pavement design horizons are set out below:

Table 24: Forecast aircraft departures

Design year	Cumulative total of forecasted aircraft departures		
	A321 neo	B737-800	Total Departures
Inauguration + 15	9,352	2,683	12,035
Inauguration + 20	13,337	3,827	17,163
Inauguration + 30	22,975	6,592	29,568

Airline flight schedules are typically based on two seasons per year, April – October and November – March, with additional flights to cater to expected peaks. The monthly passenger movements, as a percentage of the annual total, derived from analysis of the actual arrivals/departures for 2010-2016 is shown below:

Table 25: Average percentage of annual passenger departures per Month

Month	Average percentage of annual passenger departures
January	9.48 %
February	5.05 %
March	6.09 %
April	9.06 %
May	6.86 %
June	5.31 %
July	8.91 %
August	9.07 %
September	5.78 %
October	8.20 %
November	10.46 %
December	15.73 %

As can be seen there are significant variations in the monthly departures within the typical airline schedule periods, ex. December departures being three times those of February.

5.5.3 Cargo

An A321 aircraft can take about 4 tons of cargo on board.

Cargo projected traffic is not available yet.

For the time being, it is planned to use the transport capacity of passenger aircraft and not to charter aircraft specifically for air freight.

Table 26: Forecast Aircraft Departures for 2021 – passenger traffic

Aircraft Type				A321 neo			B737-800			Forecast Weekly Flights for Mixed Fleet*
Month	Average Percent of Annual Departures	Monthly Pax Departures	Average Weekly Departures	Weekly Flights Required (90%)	Forecast Weekly Flights	Forecast Monthly Flights	Weekly Flights Required (90%)	Forecast Weekly Flights	Forecast Monthly Flights	
January	9.40%	10,059	2271	13.64	14	62	15.77	16	71	14
February	5.05%	5,409	1352	8.12	8	32	9.39	9	36	8
March	6.08%	6,508	1469	8.83	9	40	10.20	10	44	9
April	9.07%	9,711	2266	13.61	14	60	15.74	16	69	14
May	6.84%	7,322	1653	9.93	10	44	11.48	12	53	10
June	5.28%	5,656	1320	7.93	8	34	9.16	9	39	8
July	8.98%	9,608	2169	13.03	13	58	15.07	15	66	13
August	9.11%	9,748	2201	13.22	13	58	15.29	15	66	13
September	5.82%	6,232	1454	8.73	9	39	10.10	11	47	9
October	8.12%	8,693	1963	11.79	12	53	13.63	14	62	12
November	10.58%	11,323	2642	15.87	16	69	18.35	18	77	16
December	15.66%	16,761	3785	22.73	23	102	26.28	26	115	24

„* Mixed Fleet is 80% A321 neo + 20% B737-800

5.6 Construction Activities

As the project is only at the Preliminary Design stage, the construction phase has not been described yet. Only some principles are known.

Precise methods, phases and organizations will be described in the Detailed Design, following the recommendations of the Environmental and Social Management Plan provided as a last chapter of this ESIA.

5.6.1 Earthworks and construction above voids

The existing voids located in the runway and project footprint need to be filled prior to proceeding to the earthwork and infrastructures construction.

Voids of less than 1 meter wide could be compacted instead of filled with concrete, in order to avoid risks of polluting the karstic system with liquid concrete spills.

The Sainte-Marie Hill could be demolished using dynamite except if environmental issues are raised against the method.

Earthmoving methods and their relevance to the different locations on the site are described in Chapter 7.2.1.3.1 (Earthworks in the new proposed runway area).

The earthworks and their predicted impacts and associated measures are described in the following sections of Chapter 7.2.1.3, and then in Chapter 7.3.1.3.

5.6.2 Demolitions

Buildings must be demolished for project purposes. These are the buildings located within the project footprint:

- Dwellings,
- Agricultural buildings,
- Fisheries buildings.
- Different demolition techniques could be used:
-
- Manual demolition using picks, weights and pneumatic hammers. This method is accompanied by significant nuisances, however, since the site is far from inhabited areas and demolitions concern specific buildings, this method could be acceptable for part of the demolitions.
-
- Demolition with mechanical mini engines. Made from excavators equipped with a bucket or a rock breaker, this technique is suitable for low-rise buildings, type R + 1. The vibrations generated are potentially higher.

5.6.3 Marine works

The current design requires approximately 2.7 ha of land to be reclaimed. The current reclamation approach considered the construction of a marine rock revetment wall. The details of the marine works are yet to be finalized.

5.6.4 Works main facilities

5.6.4.1 Worker's installation

As about 400 workers will be needed for the works and a part of them will come from Mauritius or other countries, a **workers' camp** will be erected for the workers.

The location of the site establishment and workers' camp is not known to date. The impact assessment of such facilities will be discussed with the Consultant responsible for drafting the Terms of Reference for the Tender for construction.

5.6.4.2 Work site supply

The work site will be supplied by sea, arriving in Port Mathurin and then by road from there to the airport. Because of the shallowness of the lagoon's seabed, direct supply by sea is not an option.

The road used will be the coastal one, which directly arrives on the projected runway site and Sainte-Marie Hill. The section of this road crossing Anse Quitor and arriving to Saint-Marie will have to be resized and strengthened to make the circulation of trucks possible.

Electricity supply will be provided by the same electrical centre supplying the airport.

Water supply, estimated to be around 40 m^3 per day, might not be possible from the public reservoir if the works' needs are too important. Therefore, the Terms of Reference for the contractor will include the provision of a desalination plant and minimum measures that will need to be complied with will be stipulated in the final ESIA and ESMP.

The following assumptions are made regarding the anticipated temporary desalination plant that is required during the construction phase:

The water desalination plant will be a pre-fabricated and pre-tested reverse osmosis unit designed to produce 20 m^3/day. To date, assumptions have been made on the water characteristics which will be confirmed at the end of the detailed design. The desalination plant may be constituted of:

- A prefiltration system equipped with:
  - a pump
  - a sand filter to remove particles up to 80 µm.
  - a microfiltration system to remove particles up to 5 µm
  - an anti-fouling dosing to prevent co-precipitation on the membrane surfaces
- A reverse osmosis system equipped with an energy recovery system with pressure exchanger that does not require any electric energy, working at an efficiency of about 95 percent and practically maintenance free.

A 35 percent recovery rate is expected.

Special attention will be put on the brine discharge and disposal. One recommendation in the Terms of Reference for the provision of the desalination plant could be a zero liquid discharge of the brine, which will potentially allow for the production of salt on site. As such brine could be treated through an evapo-concentrator-condenser-crystallizer instead of being diluted and rejected in the natural environment.

This is fully in line with the integrated management plan that aims at optimizing the different water uses.

The potential impacts associated with the desalination plant and potential mitigation and management measures will be further assessed as part of the final ESIA and ESMP

5.6.4.3 Works plants and buildings

It is assumed that the construction works will require an in-situ asphalt plant and a concrete batching plant rather than transporting the material from an off-site plant.

However, no information is available to date and hence the assessment will be done once the design is more advanced and tender requirement are worked out.

Likewise, it is assumed that basic workshops will be required for the maintenance of equipment.

The siting/parking of plants and equipment will have to be validated upon receipt of the contractor's site establishment layout plan.

The final ESIA and ESMP will include the relevant management requirements to assess and mitigate anticipated impacts associated with the infrastructure required for construction purposes.

5.6.4.4 Construction waste and solid waste management

Construction waste such as cement, blocks, etc is usually used as backfilling material for construction, if found suitable.

Other construction waste such as metal scrap, plastic, glass, paper, wood, etc sill be sorted and carted away/treated in line with available solid waste management in Rodrigues.

Export of waste to Mauritius for recycling may be considered.

5.7 Ancillary facilities

5.7.1 Ground service equipment

The currently operating ATR72s power-in & power-out from the stand and have their own in-built passenger steps. Luggage is man-handled from ground level. The requirement for GSE is limited therefore to ground generation. Refuelling tankers are rarely used as most of the current flights carry sufficient fuel for the return trip.

To comply with larger aircraft starting up operations, aircraft tugs / access steps / fuel bowsers / baggage conveyors and hoists are then required. All this GSE will require garaging and servicing, normally provided by a dedicated GSE building.

This increased activity is planned to be housed in the new airport's buildings and facilities, and no specific construction is planned.

5.7.2 Security

The current low level of operations and little numbers of staff and visitors on the site result in a self-secure operation in the sense that most individuals are recognised or categorised. There is a CCTV security system installed and the perimeter fence is regularly checked with repair / replacement undertaken immediately. The proposed increase in activity at the airport will

increase the risk of a security breach and so an extension of the current CCTV coverage and an increase in security patrols is recommended.

6 Environmental and social baseline conditions

6.1 Scoping and methodology

6.1.1 Scoping

The ESIA has been carried out in accordance with the Mauritius Environmental Protection Act 2002 and with the requirements of the World Bank Environmental and social Framework .

The purpose of the ESIA is to identify the environmental issues which could have been directly or indirectly impacted by the project. In order to highlight the main themes to be studied, some experts have been consulted. This methodology allows the study to focus on the effective potential impacts of such an airport project and helps to determinate the level of the investigations to carry out on the different subjects.

The following tasks have been undertaken:

- Desk review of available data,
- Site investigations,
- Consultations with interested parties,
- Consultations with specialists.

The project is an existing airport extension, thus the project area already is an airport site. The environment is open, very sparsely populated, and essentially used for extensive agriculture and fishing. There are no forests nor swamps in the area.

The specific issues related to the type of project are air quality and noise, terrestrial flora and fauna, including birds, topography and landscape, and displaced populations.

The island and coastal context of the project also requires a specific focus on the natural and hydro-sedimentary marine environment and meteorological conditions.

Finally, the original geological and hydrogeological context linked to the presence of a karst sedimentary formation above a volcanic basement means that particular attention must also be paid to the risks associated with ground movements and groundwater resources.

In addition, the following subjects were the subject of campaigns to recognize the existing system:

- Terrestrial natural environment (field investigation carried out in April 2019)
- Marine natural environment (field investigation to be carried out in May-June 2019)
- Hydro-sedimentary context (field investigation to be carried out in May-June 2019)
- Hydrology and water management (field surveys to be carried out in May 2019)
- Socio-economic context (field survey carried out in April 2019)

As the geotechnical context has been recently investigated, no complementary field investigations were carried out.

6.1.2 Baseline issues assessment methodology (receptor sensitivity)

The first step is a presentation of the general state of the island of Rodrigues. This global presentation aims to define the current state (baseline) of the island, before the potential implementation of the project. It is therefore a description that takes into account several themes (physical context elements, natural context elements...).

The final objective of this exercise is to highlight all the "receptors" which could be affected, directly or indirectly, by the implementation of the project.

For each of these receptors, sensitivity was assessed according to the importance of the issue and its vulnerability.

In the context of this social impact assessment, and in order to adapt as precisely as possible to the local context of Rodrigues Island, the sensitivity of the receptor was judged in particular on the basis of the results of consultation meetings with local stakeholders, taking into account the importance given to them by local communities and authorities.

Thus, at the end of each section of the initial state, the issues are listed and their sensitivity is assessed and rated using the following methodology: 1 "low", 2 "medium", 3 "high" or 4 "major". To make reading easier, a gradient of blue is associated with each score to make the report more readable.

The higher the importance of the issue, the more intense the shade of blue.

Table 27: Receptor sensitivity

Receptor sensitivity	Low	Medium	High	Major

6.2 Area of Influence

Several areas of influence (AoI) have been defined to establish the baseline of the project's site. Each component of the environment is contextualized at the scale of the Island or the Indian Ocean according to the themes, then examined at the scale of a "large area of influence" and finally, if necessary, at the scale of a "restricted area of influence".

The "large area" includes the airport and its remote surroundings, which are known to be influenced by the direct and indirect impacts of the airport. The "restricted area" is the project footprint's direct surroundings, which are considered potentially directly impacted by the project.

The project's footprint is included in the restricted area.

Specific areas of influence had to be defined for some of the baseline components:

- the areas of influence for the terrestrial and marine natural environment are designed to adapt to the targeted species and ecosystems,
- the socio-economic area of influence is designed to adapt to the boundaries of the villages and areas used by the affected inhabitants or for the resettlement of displaced populations.

At the beginning of each section, the area of influence applied is specified.

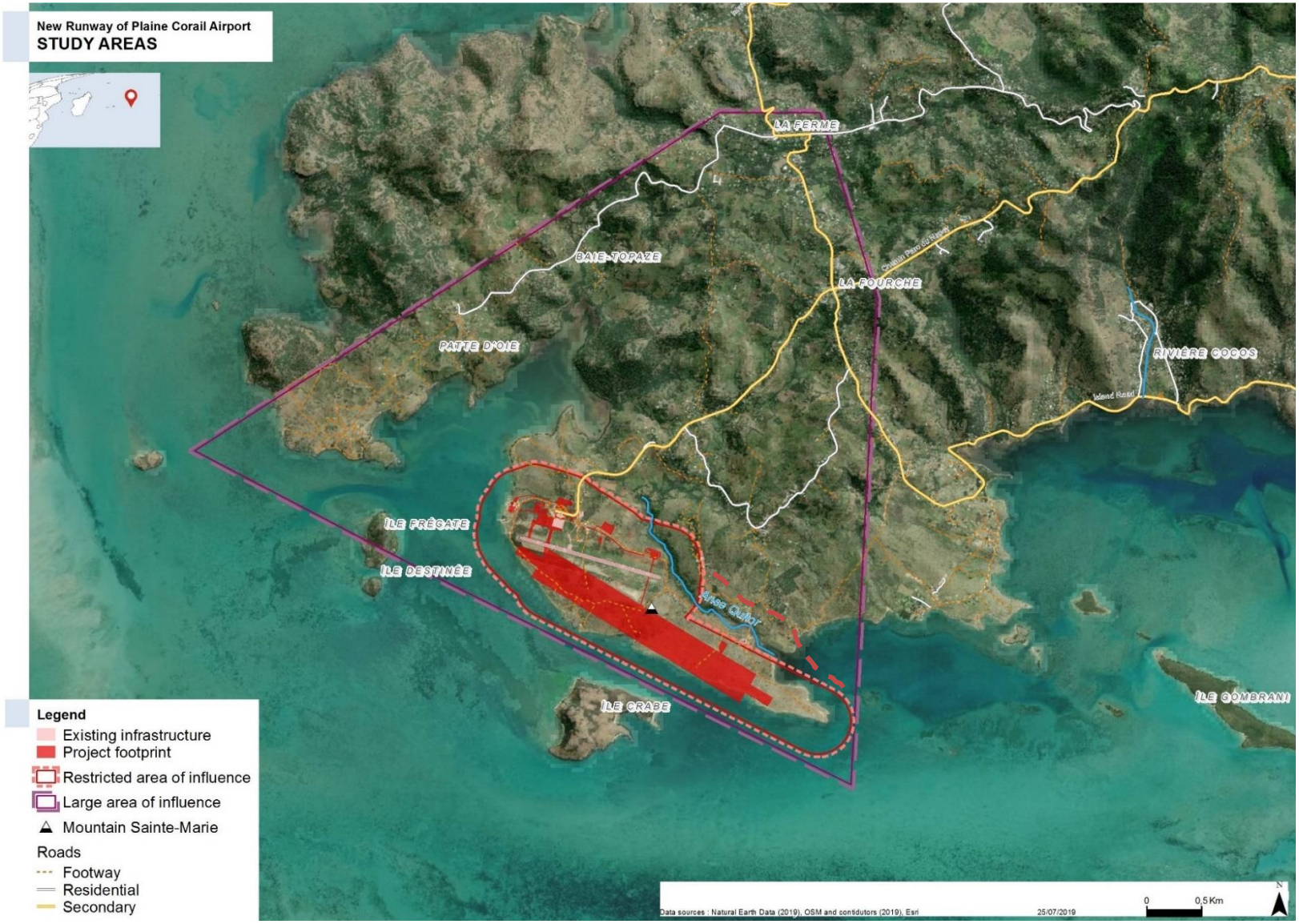


Figure 27: Area of influence (to be updated at final ESIA stage)

6.3 Physical environment

6.3.1 Area of influence

The area of influence for physical context is mapped in Figure 27. The terms large and restricted area of influences discussed previously are used.

6.3.2 Geographical overview

Rodrigues, like Mauritius or La Réunion, is an island of volcanic origin belonging to the Mascarene Islands. Located in the South Western Indian Ocean near the southern end of the Mascarene Ridge, it is 18 km long, 6.5 km wide and covers a surface area of 108 km².

Rodrigues' capital city is Port Mathurin, located at the opposite corner of the island from Plaine Corail, in the northeast.

Rodrigues Island strikes E-W. Although of modest elevation (the highest peak, Mount Limon, rises to 398 metres), the island has a general mountainous topography. This mountain separates alluvial plains to the north and south. The island is organized around a central ridge in a west-southwest direction, from which steep ravines radiate. The valley bottoms usually remain dry and are only affected by torrential flows during heavy cyclonic rains.

However, the southwestern part of the island is dominated by a karst plain of coral sandstone over an area of about 10 km².

The island is surrounded by a large coral reef, located between 50 m and 8 km from the coastline. This immense lagoon is generally shallow. It is dotted with several islets which emerge from it.

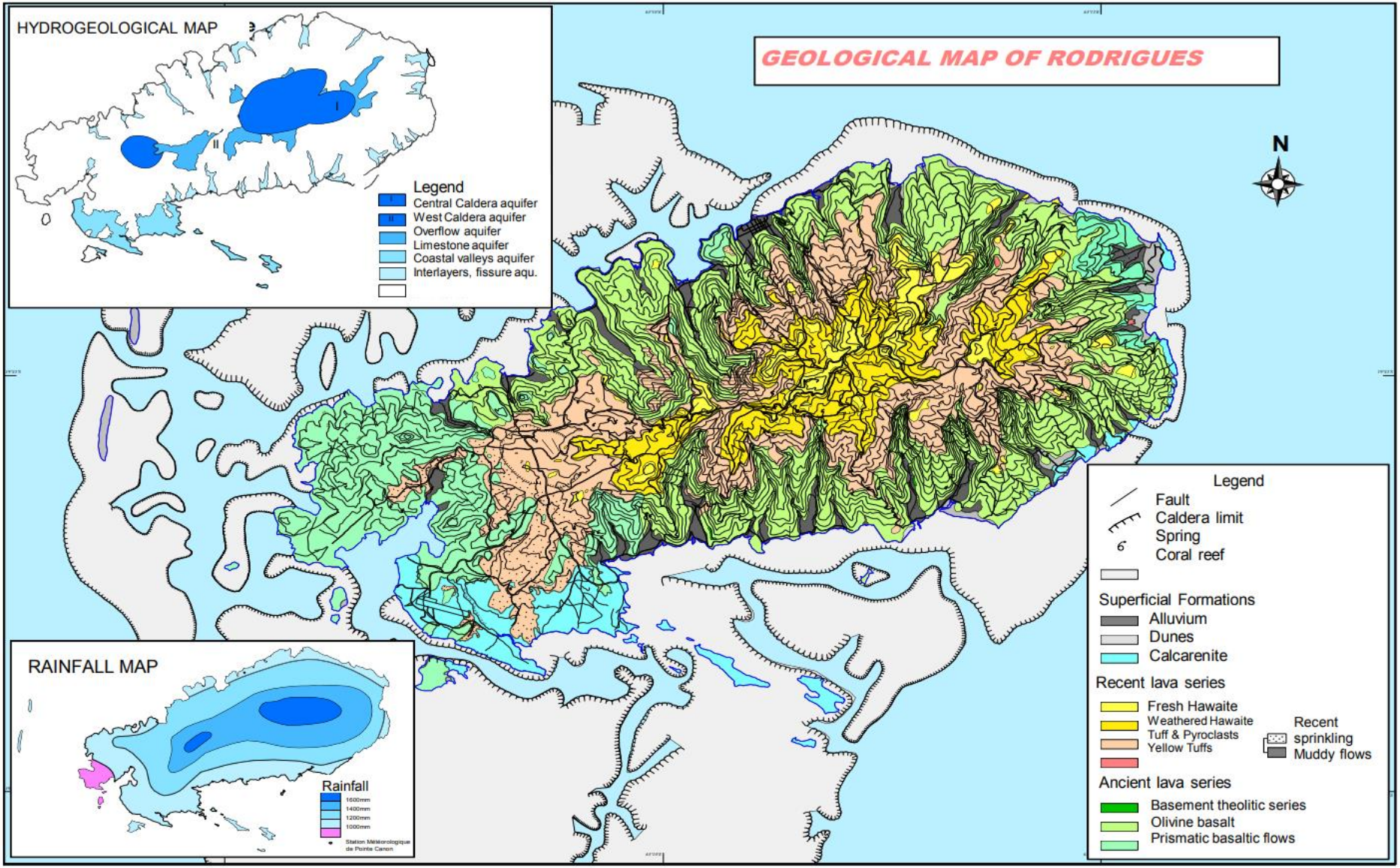


Figure 28: Geographical overview of Rodrigues Island

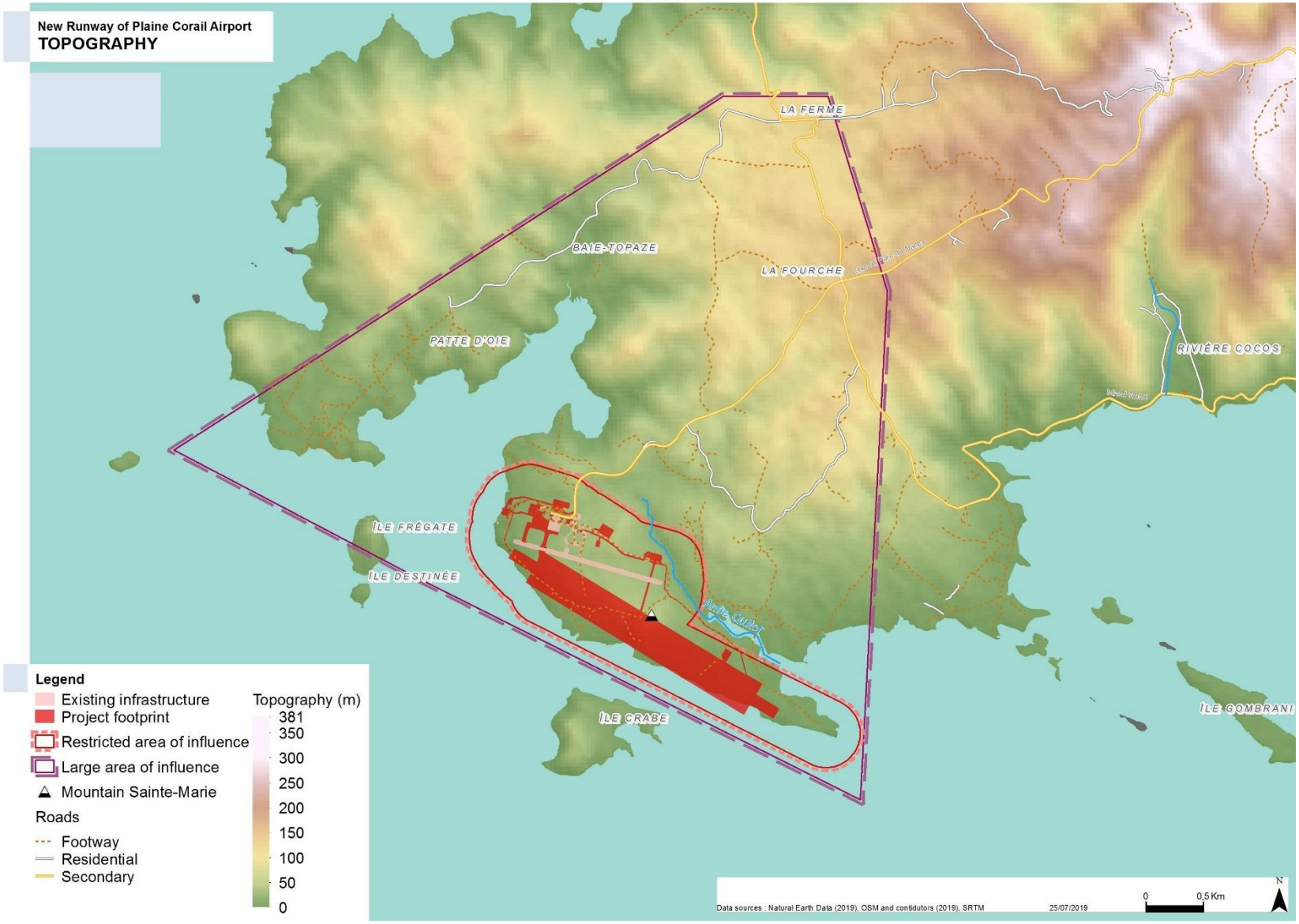


Figure 29: Topography of the area of influence

6.3.3 Climate and marine and terrestrial meteorological conditions

The purpose of this chapter is to present, in a traditional way, the particular climatic and meteorological conditions of the Island of Rodrigues linked to its geographical location. However, its purpose is also to present precisely the wind, current, swell, waves, and water level conditions, as well as the situation in terms of extreme events.

Indeed, since the project involves significant earthworks and a modification of the shoreline, it is important to be able to analyse its impacts on marine currents and sedimentation, as it may have impacts on the marine life of the reef and the balance of erosion phenomena.

This baseline is an input for the hydro-sedimentological modelling planned for impact analysis.

It is also important to analyse the risks associated with the arrival of large aircrafts on this island, which is sometimes subject to extreme weather conditions.

A numerical coupled wave–current–sediment transport model (horizontal two-dimensional approach, 2DH) is built and exploited in order to simulate flows, waves, sediment transport, winds and their mutual interaction with the reef; simulations are performed during its current state, considered as the baseline conditions.

6.3.3.1 Numerical hydrodynamic modelling

6.3.3.1.1 Hydrofynamic software

Delft3D suite is used to model hydrodynamics. Delft3D suite is a fully integrated computer software suite for a multi-disciplinary approach and 3D computations for coastal, river and estuarine areas. It can carry out simulations of flows, sediment transports, waves, water quality, morphological developments and ecology. It has been designed for experts and non-experts alike. The Delft3D suite is composed of several modules, grouped around a mutual interface, while being capable to interact with one another. Following molules are used in this study:

- Delft3D-FLOW: multi-dimensional (2D or 3D) hydrodynamic (and transport) simulation program which calculates non-steady flow and transport phenomena that result from tidal and meteorological forcing;
- Delft3D-WAVE: wave module of Delft3D computes wave propagation, wave generation by wind, non-linear wave-wave interactions and dissipation, for a given bottom topography, wind field, water level and current field in waters of deep, intermediate and finite depth.
- Delft3D-MORPHOOLOGY: sediment transport and morphology module supports both bedload and suspended load transport of non-cohesive sediments and suspended load of cohesive sediments due to waves and currents;
- D-Water Quality: this module simulates the far- and mid-field water and sediment quality due to a variety of transport and water quality processes.

6.3.3.1.2 Data input

The oceanographic data used in the DELFT-3D model is summarized as follows:

- The large-scale model bathymetry data would be forced from the General Bathymetric Chart of the Oceans (GEBCO) with 0.5° resolution, approximately 430m. Closer to Rodrigues, the GEBCO bathymetry would be supplemented by a thinner data set, approximately 200m, close to the coast and inside the lagoon furnished by the RRA.

- The LEGOS4 produced a global finite element solutions (FES) tidal atlases computed from the tidal hydrodynamic equations and data assimilation. Harmonic constants, amplitude and phase, are extracted in the surroundings of the island
- An analysis was performed by MeteOcean to characterize the meteo-oceanic conditions in the vicinity of Rodrigues. Waves, winds, water height, salinity and temperature statistics are available at a deep water point (2989m from the MSL) located at -63°12'E 20°S, in the South of the island.

-

6.3.3.1.3 Simulations carried out

In order to point out the impact of the structure, two types of simulation are carried out:

- The reference simulation. This is the current situation with no extension of the runway onto the ocean.
- The construction phase simulation. The runway is under construction hence the modified topography; turbid flumes are propagated during the construction work.

-

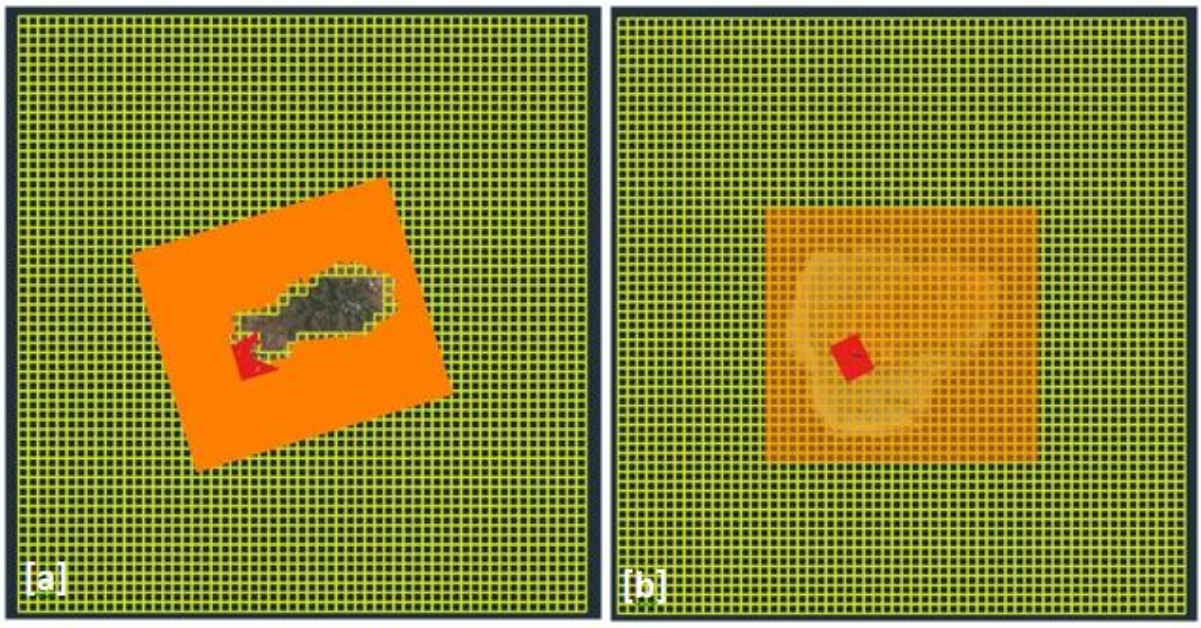


Figure 30: Flow [a] and Wave [b] computational grids

The computational domain of the model is about 42 km wide and 45km long centered on the coral reef fringing Rodrigues. The flow model consists of a 3 levels nested grid of 1000m, 50m and 10m resolution and the wave model is composed of another 3 levels nested grid of 1000m, 250m and 50m resolution.

6.3.3.2 General geographical and climatic considerations

Rodrigues, one of the three Mascarene Islands (the two others are Mauritius and La Réunion), lies near the edge of the southern tropical belt and is free from the influence of large land masses or continents. The climatological regime of the island, characterized as mild tropical maritime, is determined by the alternation of the two seasons: winter from May to October and summer from November to April.

Summer is the rainier and warmer season, during which tropical cyclones occur. February is the wettest month. Winter is cooler and relatively drier. October is the driest month.

[4] Laboratoire d'Etude en Géophysique et Océanographie spatiales

The average annual rainfall over Rodrigues is 1348 mm, which is equivalent to about 150 Mm^3/year for the whole island.

The rainfall increases from 800 mm on the coast to more than 1,600 mm on the summits.

The most frequent natural disasters faced by Rodrigues are cyclones and high intensity rainfall over short periods of time which lead to flash floods or water accumulation.

6.3.3.3 Winds

6.3.3.3.1 Wind pattern in the vicinity of the Mascarene Islands

The wave pattern on the coast of Rodrigues is influenced year-round by two types of persistent winds: south-easterly trade winds and Austral westerly ones; which is caused by the geographical location of the island being near to the Inter Tropical Convergence Zone (ITCZ). There are seasonal variations. The summer season experiences weaker trade winds when the subtropical anticyclones become less intense and migrate towards the pole. In winter, when strong anticyclones pass to the South and close to the Mascarene Islands, trades are stronger and more persistent as they are migrating equatorward and then moving eastwards along the southern high latitudes.

6.3.3.3.2 Wind statistics around Rodrigues

The following distribution rose chart shows the joint probability distribution of wind (magnitude and direction).

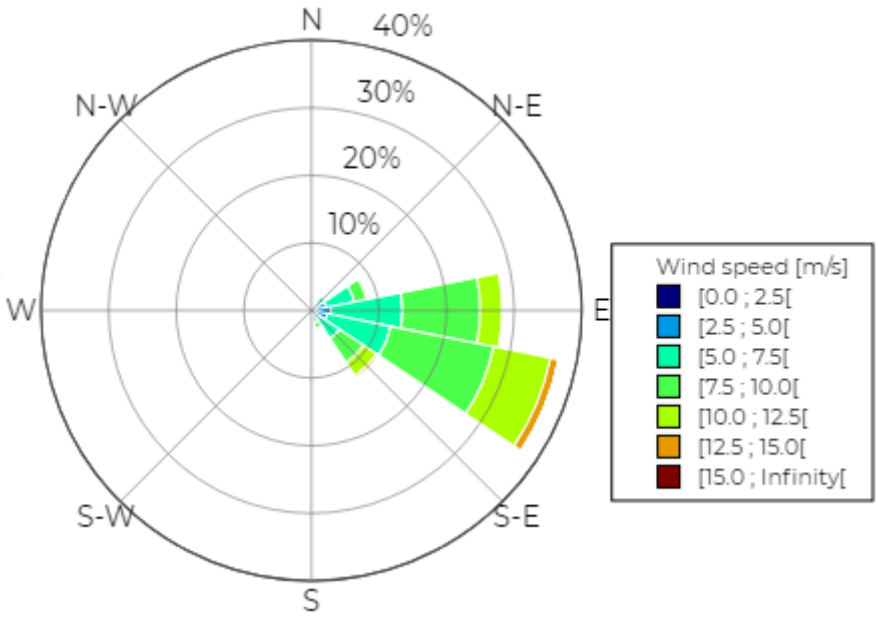


Figure 31: Wind distribution rose (coming from direction) at 10m at point (-63°12'E 20°S)

Most of the wind is coming from the East and South-Southeast directional sector with a mean velocity of 7.68 m/s. During extreme events, such as cyclones, wind gusts can reach a speed of up to 44.03m/s.

Plaine Corail's south side is sheltered from the dominant winds by its coast.

6.3.3.4 Current

6.3.3.4.1 Deep water offshore current

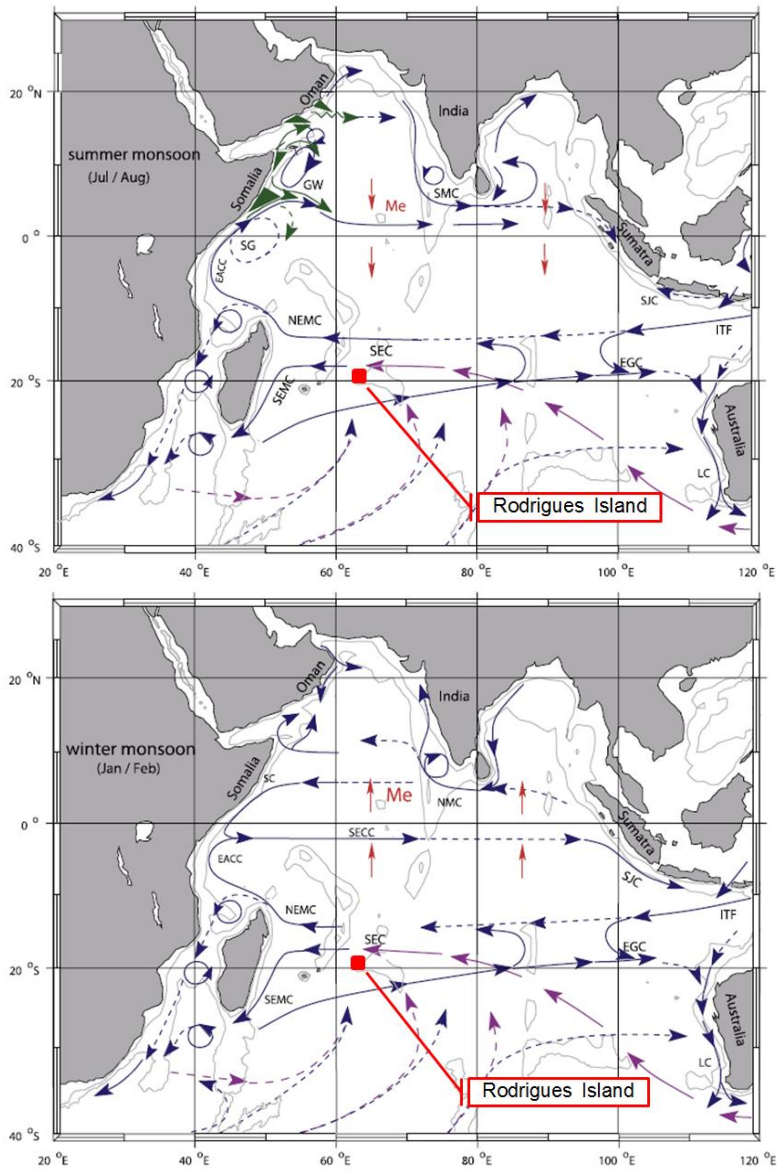


Figure 32: Schematic representations of identified current branches during summer and winter monsoons

The anticyclone winds influence the coastal hydrodynamics and offshore current systems of the island. The strong prevailing South Easterly trade winds increase the current magnitude of the South Equatorial Current (SEC) flowing from West to East throughout the duration of the year and fluctuate between 10 and 20°S in the Indian Ocean (see Figure 32). The speeds of the current increase as it passes through the channels situated within the Mascarene Plateau resulting in the formation of strong gyres on the leeward side. It splits when it reaches Madagascar: one part goes to the North to feed the current in the Mozambique Channel and the East Africa current as the other part flows southwards along the Madagascan coast.

6.3.3.4.2 Current near Rodrigues in deep water

The following distribution rose chart shows the joint probability distribution of the surface current (magnitude and direction).

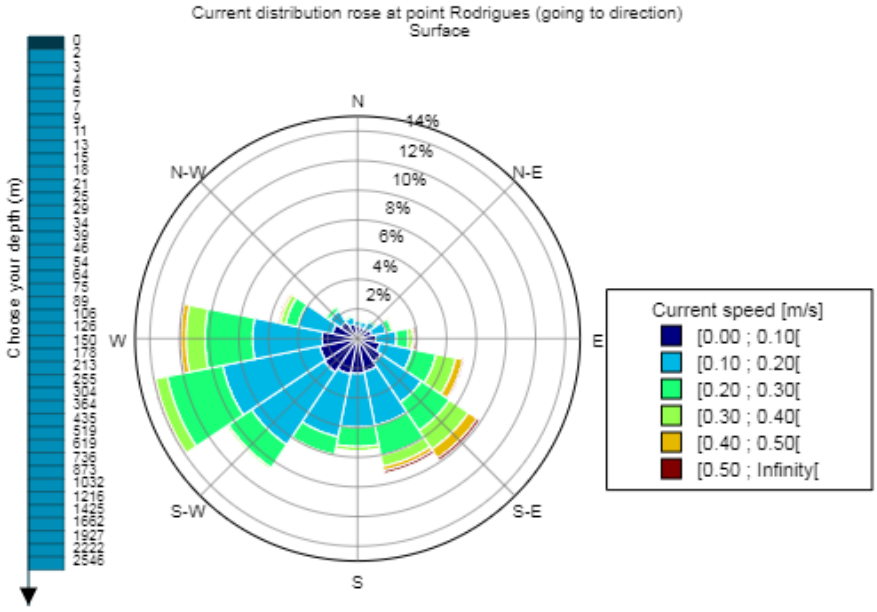


Figure 33: Annual current distribution rose (going to direction) in surface

The mean magnitude of current is 0.17 m/s and varies from 0 to 1.02 m/s. Currents of less than 0.3m/s are the most likely (89% frequency). Most of the magnitude is inferior to 0.3 m/s, 89%. The directional spreading is significant. Directions vary with a predominance of South West – North East currents.

6.3.3.4.3 Current inside the lagoon

The hydrodynamics of the reef lagoon are complex as it is exposed to a broad range of physical events such as tides, waves, winds, river discharge, rainfall, and evaporation.

Density-driven currents have been observed between the lagoon and ocean. Circulation patterns in a lagoon are mainly driven by spatiotemporal variations of hydrodynamic parameters: waves, winds and tides. Bathymetry pass dimensions and lagoonal width to length to depth ratios, as well as the reef structure (size, roughness), also have to be considered.

Tidal cycles have a direct effect on the lagoon water: the lagoon fills during the flow and empties during the ebb, inducing so called “tidal ellipses” (periodically rotating currents). This basic scheme can be significantly complicated by the presence of complex lagoon bathymetry with multiple openings and passages towards the open ocean and neighbouring lagoons. Around Rodrigues, at least three lagoonal passes can be identified in the fringing reef, none of them in front of Plaine Corail.

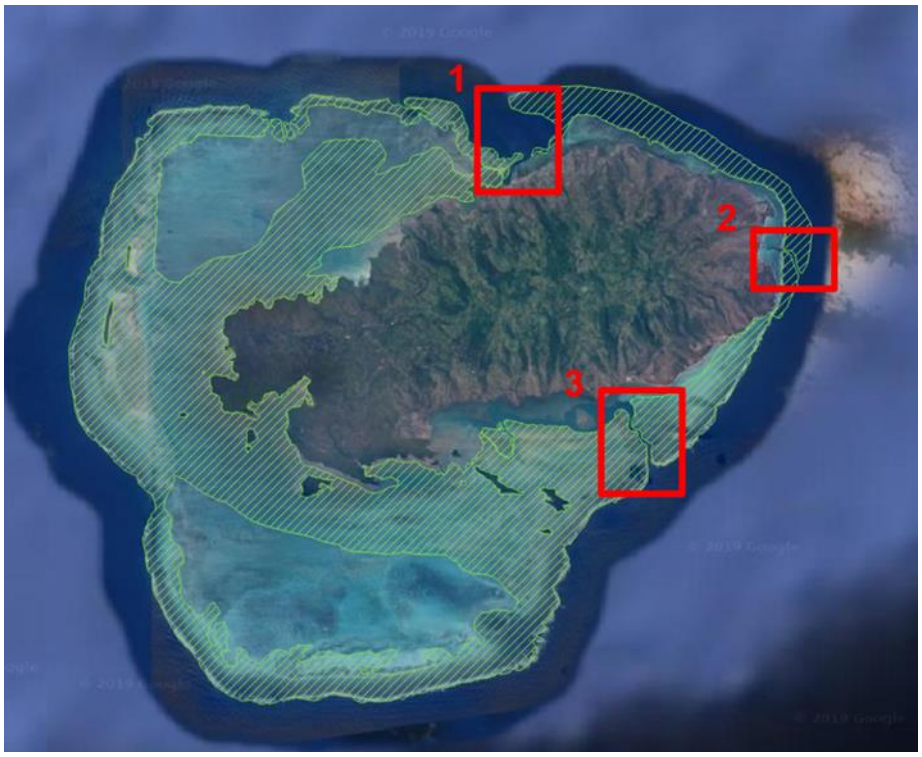


Figure 34: Passes and fringing reef enclosing Rodrigues

The flushing of the lagoon takes place in the pass n°3 causing high magnitude flow, up to 1.0 m/s, oriented to outside the coral reef. Bathymetry varies from 20 cm depth to 26.40 m and connects Anse Grand Var to the Ocean.

Another passe is located in the western part of the reef and participates, to a smaller extent, to the flushing of the lagoon.

Current magnitudes are under the influence of tidal cycles. The gravitational effects of the moon and the sun affect the Earth's tides on a monthly basis and are expressed under two configurations:

- When the sun, moon, and Earth are in alignment, the solar tide has an additive effect on the lunar tide, enhancing the tidal signal and generating extra-high high tides and very low low tides – known as spring tides.
- When the sun and moon are at a right angle to each other, the solar tide partially cancels out the lunar tide and produces moderate tides – known as neap tides.
- During each lunar month, two sets of spring tides and two sets of neap tides occur.

Spring currents exhibit the strongest velocities (see table below).

6.3.3.4.4 Current between Topaze Bay and Anse Quitor

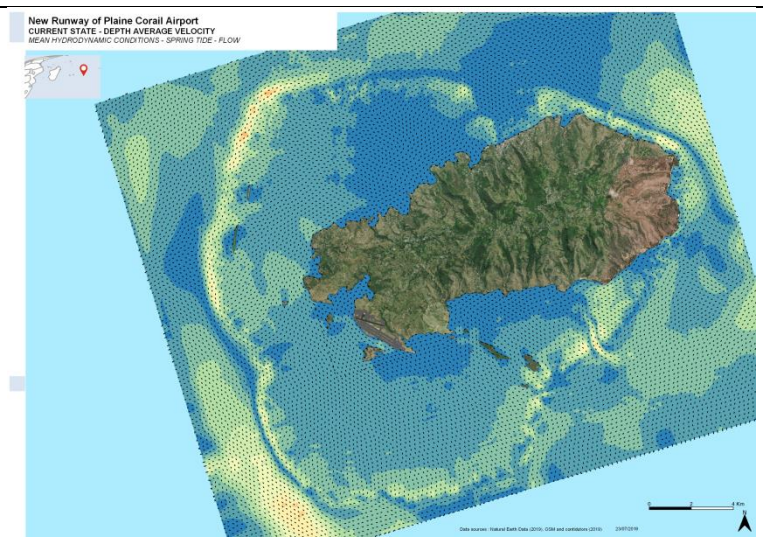
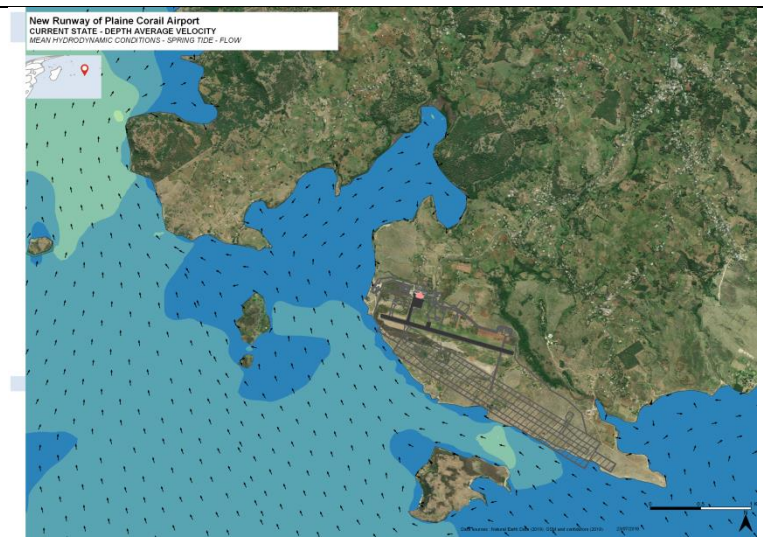
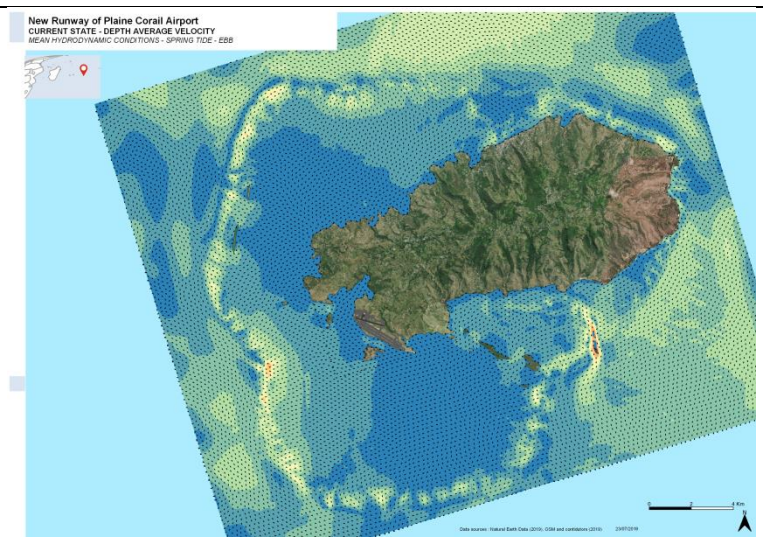
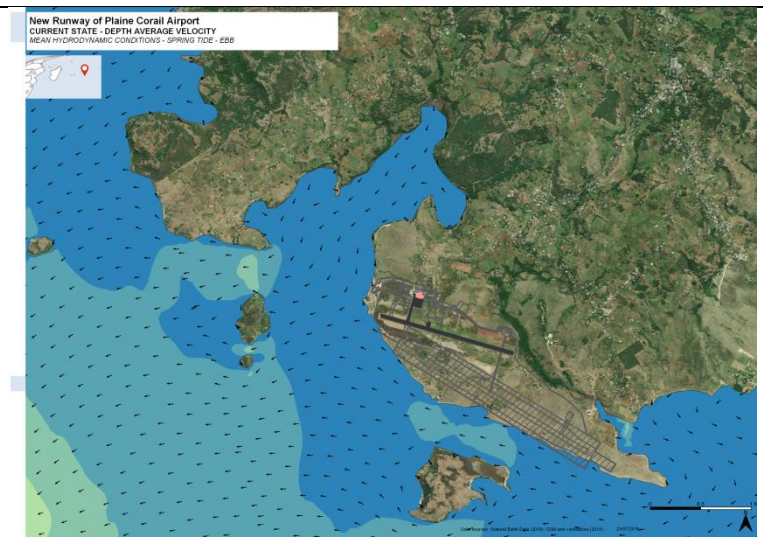
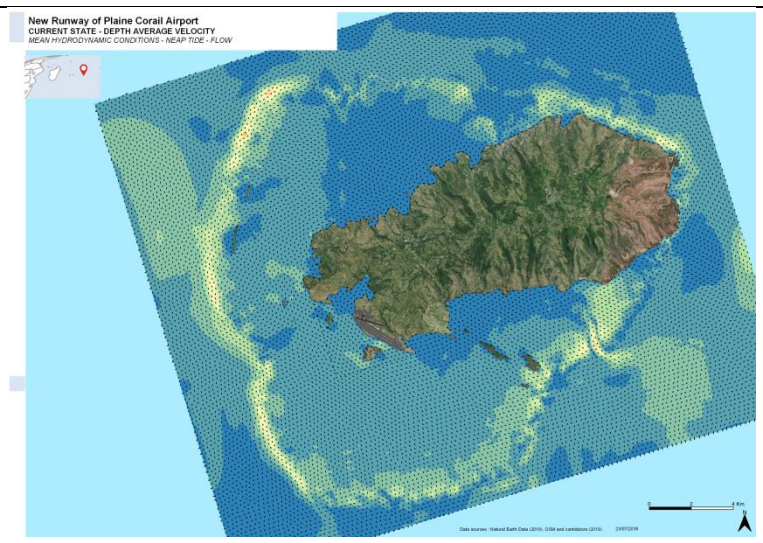
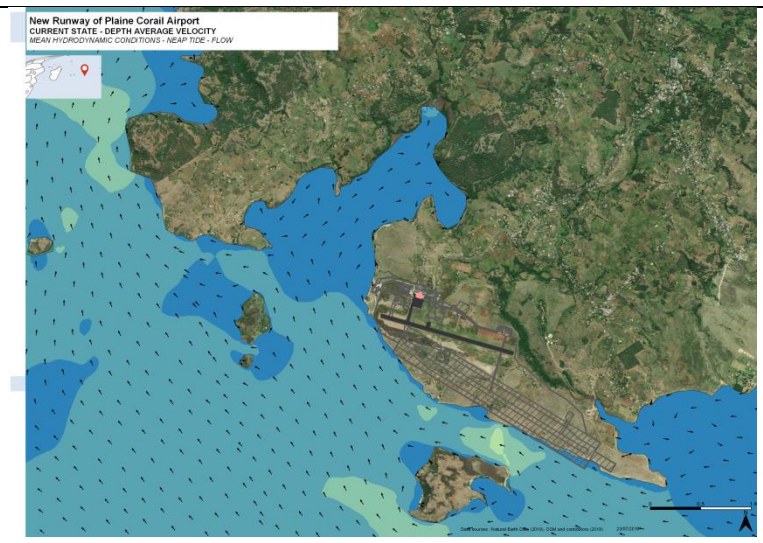
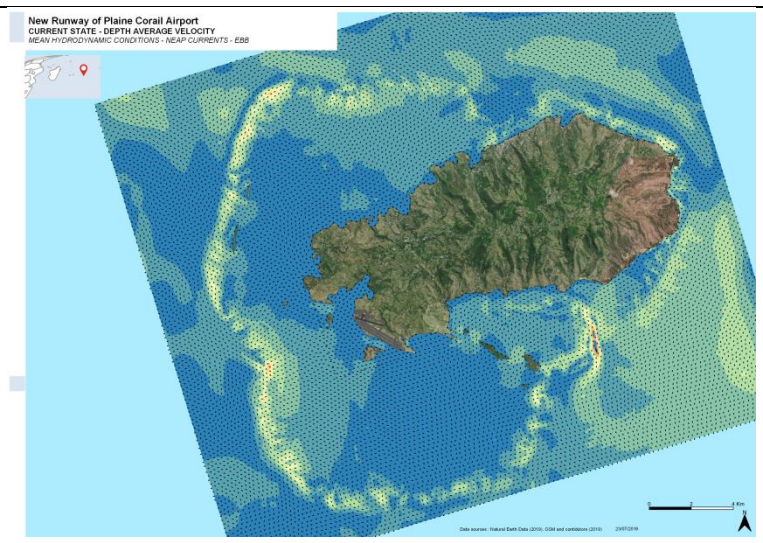
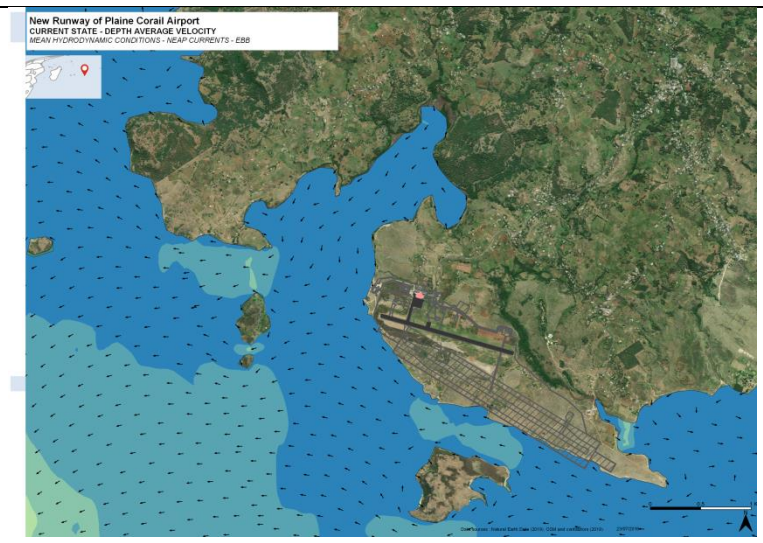
The channels between Crab Island and Plaine Corail, Fregate Island and Destinee Island, Fregate Island and the mainland are a bottle-neck for current: the magnitude increases in this area.

Alongside the runway, currents are flowing from South-East to North-West throughout the duration of the year and fluctuate from almost no magnitude to 0.5 m/s with ebb and flow tide currents. They are tide generated, the wave height inside the laggon being very small. During light wind and strong tide coefficient the current can briefly reverse.

Topaze Bay is away from the main Northwestern current and relatively current free.

Northwesten currents split when they reach Crab Island, its western front constitutes a calm sheltered area.

Table 28: Circulation pattern in the lagoon and at Plaine Corail

	RODRIGUES	PLAINE CORAIL
Spring tide – FLOW **Legend** Project runway,taxiway Existing apron, taxiway, runway Terminal Velocity < 0.1m/s 0.1 - 0.2m/s 0.2 - 0.3m/s 0.3 - 0.4m/s 0.4 - 0.5m/s 0.5 - 0.6m/s 0.6 - 0.7m/s 0.7 - 0.8m/s 0.8 - 0.9m/s 0.9 - 1.0m/s 1.0 - 1.2m/s > 1.5 m/s		
Spring tide - EBB **Legend** Project runway,taxiway Existing apron, taxiway, runway Terminal Velocity < 0.1m/s 0.1 - 0.2m/s 0.2 - 0.3m/s 0.3 - 0.4m/s 0.4 - 0.5m/s 0.5 - 0.6m/s 0.6 - 0.7m/s 0.7 - 0.8m/s 0.8 - 0.9m/s 0.9 - 1.0m/s 1.0 - 1.2m/s > 1.5 m/s		
Neap tide - FLOW **Legend** Project runway,taxiway Existing apron, taxiway, runway Terminal Velocity < 0.1m/s 0.1 - 0.2m/s 0.2 - 0.3m/s 0.3 - 0.4m/s 0.4 - 0.5m/s 0.5 - 0.6m/s 0.6 - 0.7m/s 0.7 - 0.8m/s 0.8 - 0.9m/s 0.9 - 1.0m/s 1.0 - 1.2m/s > 1.5 m/s		
Neap tide - EBB **Legend** Project runway,taxiway Existing apron, taxiway, runway Terminal Velocity < 0.1m/s 0.1 - 0.2m/s 0.2 - 0.3m/s 0.3 - 0.4m/s 0.4 - 0.5m/s 0.5 - 0.6m/s 0.6 - 0.7m/s 0.7 - 0.8m/s 0.8 - 0.9m/s 0.9 - 1.0m/s 1.0 - 1.2m/s > 1.5 m/s		

6.3.3.5 Waves

6.3.3.5.1 General information

Deep sea waves affecting Rodrigues's shores can be generated by the following three meteorological phenomena:

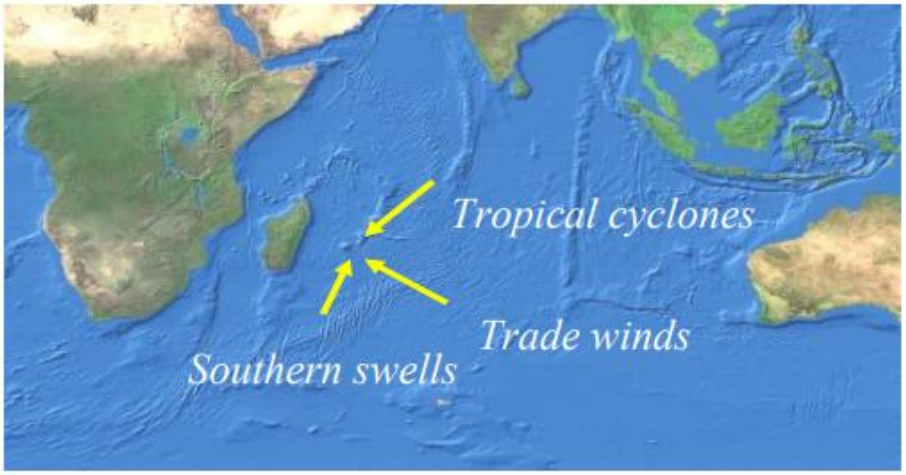


Figure 35: Type of Wave Generation Mechanisms in Mauritius and Rodrigues

- Local Generated Waves: waves generated by the south-eastern trade winds in the vicinity of Rodrigues, generally from the East to the South-east direction;
- Southern Hemisphere Swells: waves generated by distant storms, as extra-tropical cyclones, that can propagate thousands of kilometres across the ocean with little loss of energy. The swells typically approach Rodrigues from the southwest;
- Tropical Cyclones: waves due to tropical cyclones generated in the South Western part of the Indian Ocean. Tropical cyclones can have very high wind speeds and the waves generated can be extremely large. Their characteristics vary for each cyclone (wind speed and track). In general these waves approach the country predominantly from East to North. Also, the high wind speeds and low central depression of a tropical cyclone can induce large surges in coastal regions.

The following distribution rose chart shows the joint probability distribution of waves (magnitude and direction).

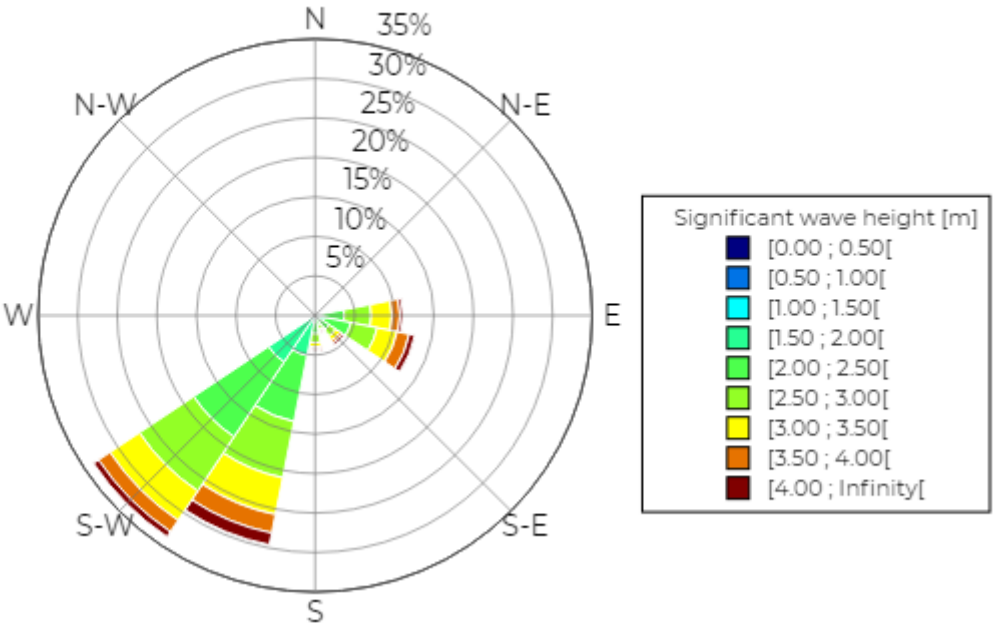


Figure 36: Annual wave distribution rose (peak direction) coming from direction at point (-63°12'E, 20°S)

Statistics computed during the period 10/01/1979 to 31/01/2019 show that the mean significant wave height is 2.66m and varies from 1.02 m to 12.95m. Most of them are coming from two directions:

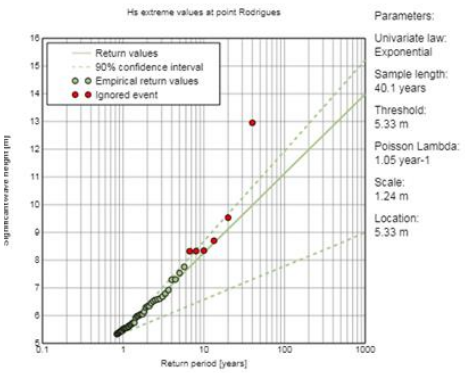
- 63.3% from the SW and SSW: these are the Southern swells;
- 25% from the E and ESE: these are waves generated by trade winds.

Wave spectral peak periods range between 6 and 22s, and the majority is included between 9 and 15.75s.

- Hydrodynamic mean annual conditions present the following wave characteristics:
- Trade winds (from East): Hs = 2.75m, Tp = 9.25s, Direction = 105°

Southern swells (from SW): Hs = 2.25m,Tp = 14.5s, Direction = 215°

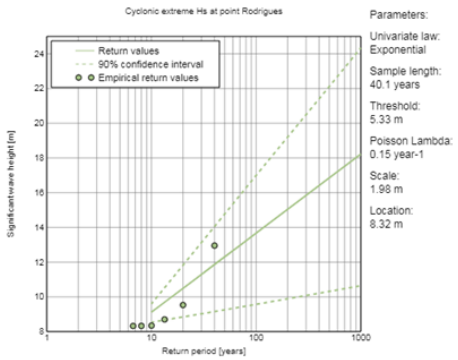
Extreme values are based on an Extreme Values Analysis, which uses probabilistic laws to predict extreme events over large return periods that usually exceed the duration of the data. Wave height extreme values in Rodrigues, for regular and for cyclonic waves, are the following:



Hs extreme values at point Rodrigues

Return period [years]	Hs [m]	Hs lower [m]	Hs upper [m]
1	5.39	5.37	5.41
5	7.39	6.21	7.69
10	8.26	6.57	8.69
50	10.26	7.43	10.96
100	11.12	7.79	11.92
500	13.12	8.61	14.23
1000	13.99	9.01	15.22

Figure 37: Hs extreme values at point (-63°12'E, 20°S)



Cyclonic extreme Hs at point Rodrigues

Return period [years]	Hs [m]	Hs lower [m]	Hs upper [m]
10	9.12	8.54	9.59
50	12.30	9.25	14.76
100	13.67	9.57	17.01
500	16.85	10.31	22.11
1000	18.22	10.64	24.34

Figure 38: Cyclonic extreme Hs values at point (-63°12'E, 20°S)

6.3.3.5.2 Inside the lagoon

The coral reef fringing Rodrigues serves as a natural barrier that protects adjacent shorelines from offshore coastal hazards such as storms surges and waves. As waves propagate towards Rodrigues, an important amount of energy is dissipated on the reef when the abrupt change of bathymetry causes a first depth limited wave breaking.

Waves breaking on the fringing reef create a radiation stress gradient that drives wave-induced current and wave set-up. Depending on the incident wave characteristics, the strongest generated current remains in the surrounding of the reef boundaries. The wave-induced velocity is less than 0.1m/s in the further area. In particular, Plaine Corail is well protected from extreme waves due to the reef, which is up to 8.3 km wide in this region, and Crab Island, which is located south of the area and can protect it from southwestern dominant waves.

The main physical processes during the wave propagation into the lagoon toward the shore include refraction, reflection and shoaling on the outside reef slope, bathymetric breaking occurring generally before the reef top, harmonic transfers toward infragravity (IG) waves, dissipation by friction, and interaction with co- or counter-currents. The relative importance of each process is controlled by the offshore wave features, the bathymetry, the mean water level and slope, and the reef roughness.

6.3.3.5.3 Between Topaze Bay and Anse Quitor

As most of the swell has broken on the reef or has been transformed during the propagation trough the lagoon, the most significant waves reaching the area of interest are wind waves. i.e waves generated and influenced by the local wind field.

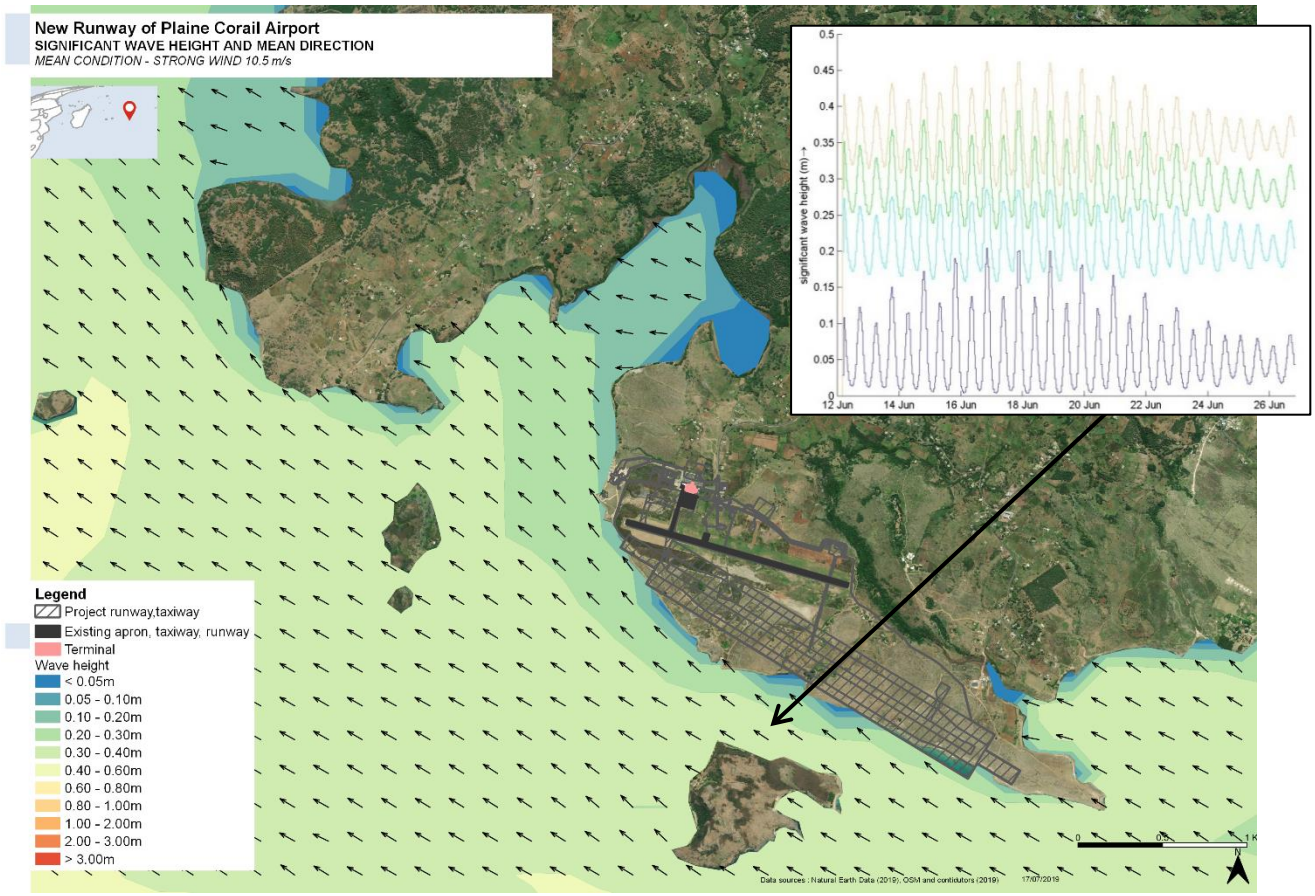


Figure 39: Significant height and mean direction under mean hydrodynamic conditions and wave significant height for nul (dark blue), light (blue), mean (green) and strong (yellow) wind

The comparison of nul, light, means and strong wind shows the impact of wind onto wave height: the stronger the wind is, the higher is the wave.

In the canal between Crab Island and the runway, significant height reaches 45 cm when eastern wind blows with 10.5 m/s velocity (highest 10%) and 20 cm without wind.

6.3.3.6 Water level

6.3.3.6.1 General information

Tides are generated by the effect on the Earth's oceans of gravitational forces between the Earth, the Moon and the Sun, of centrifugal forces due to the Earth's rotation, and of centrifugal forces due to the Earth's solar orbit.

The tides with the largest range are called spring tides, and occur at a new moon and at a full moon. The tides with the smallest range are called neap tides, and occur at intermediate phases of the Moon, at seven and a quarter days after the new or full moon, in the first and last quarters.

6.3.3.6.2 Port Mathurin tide gauge

A tide gauge has been located at Port Mathurin since 1987.

Table 29: Characteristics of Rodrigues' tide gauge

Station Name	Port Mathurin, Rodrigues (Indian Ocean)
Gloss Station Number	19 (Operational since 1987)
Latitude	19°41'S
Longitude	63°25'E
Local Time	GMT + 4 hours
Type	Leupold and Steven's float/Stilling well
New Gauge	Real Time Satellite transmission
Authority Responsible	Mauritius Meteorological Services
Benchmarks	A bolt at the edge of the wharf of the tide gauge. Zero of tide staff tied to benchmark which is a point on beam adjacent to tide gauge station.
Auxiliary Benchmarks:	(a) Brass tube fixed on a wall in the marine services area about 200m from tide gauge. (b) One benchmark located near entrance of the Port
Tide predictions	Performed by the University of Hawaii
Data sent to	Permanent Service for Mean Sea Level (PSMSL), Hawaii
Other data available in vicinity	Sea Level Pressure, rainfall, winds

The maximum tidal range is approximately 1.90 m, and since the average water depth in the lagoon is less than 2 m, some areas are exposed during spring tides. Rodrigues' tides can be classified as meso-tidal due a tidal range inferior to 2 m.

The tide signal can be decomposed as elementary harmonic constants; the main ones are the following:

Table 30: Port Mathurin, Inner Harbour, Admiralty Tide Tables harmonic amplitudes and phases (2002 analyses)

Symbol	Constituent Name	Amplitude (cm)	Phase (°)
M2	Principal Lunar Semidiurnal	40.1	256.1
S2	Principal Solar Semidiurnal	25.55	282.0
K1	Luni-solar declinational diurnal	5.55	95.3

It is broadly representative of natural open-ocean as a consequence of the islands' limited continental shelf width.

The statistics of the sea level height are collected from the University of Hawaii Sea Level Center, computed from the period 09/11/1986 to 31/12/2018 and referred to as the zero point assigned to the tide gauge. The empirical probability distribution of total surface height at Port Mathurin is the following:

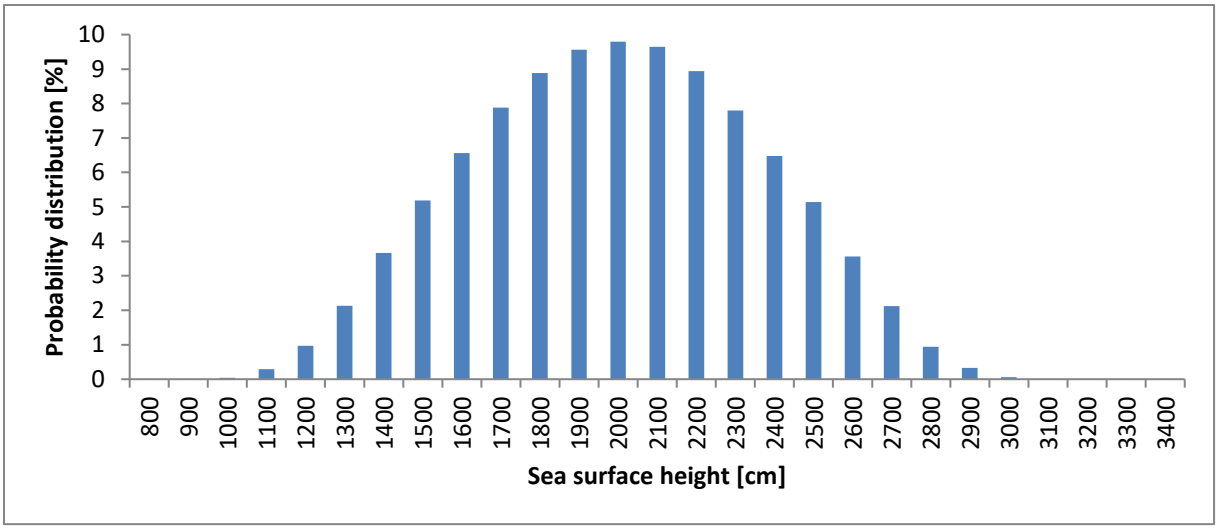


Figure 40: Empirical probability distribution of total sea surface height at Port Mathurin

Rodrigues is one of the islands being impacted by global climate change. From 1986 to 2003, sea level has decreased at a rate of -0.32 mm/year whereas between 2003 and 2009 an accelerated rise at a rate of 1.2 to 3 mm/year was observed.

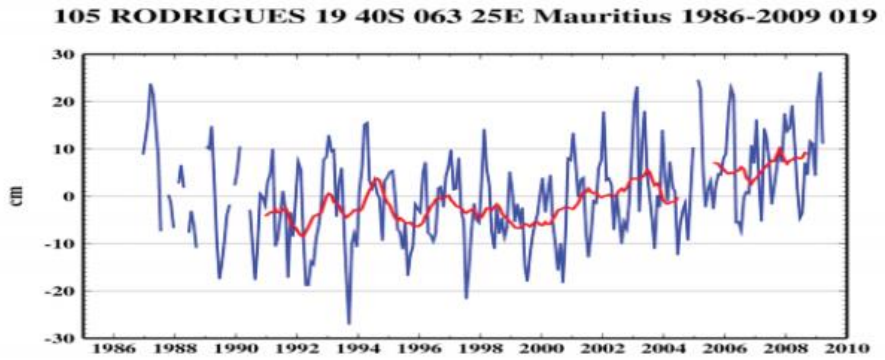


Figure 41: Sea level trend at Port Mathurin, Rodrigues [1986-2009]

According to the Acclimate study, sea level has already risen by 6.7 cm in Rodrigues between 1950 and 2001 representing an average +1.34 mm per year. Therefore, surveys showed occurrences of severe bleaching leading to the mortality of up to 75% of corals in some sites. The North and West of the island are particularly vulnerable.

6.3.3.6.3 Inside the lagoon

Of the processes linked to extreme sea levels in reef lagoon environments, wave setup has been found to be the largest component of extreme water levels for other island case studies with fringing reef morphology (e.g. Hoeke et al. 2015). Set-up at coasts has been regarded approximately as 10 to 20% of deep water wave height (e.g. WMO 1998; Holden 2008), with reefs potentially forcing higher set-up values, of up to a third of incident wave height (Munk and Sargent 1948; Hoeke et al. 2013).

The impacts of the reef on the still water level will be included in the model amongst others on the elevation caused by extreme wave breaking. Indeed, when waves are strong, water enters the lagoon faster than it can be flushed through reef passes. The sea level difference generates an elevation of the lagoon level and amplifies ebb tidal current.

Two different lagoon natural flushing processes are possible in lagoons exposed to wave and ocean tides. Their relative importance depends on the bathymetry of the lagoon and the local hydrodynamic climate. After studying the local bathymetry of the lagoon, it would be possible to determine the flushing process of Rodrigues.

The sea surface height alongside Plaine Corail could be impacted by this elevation and therefore is different from Port Mathurin's.

6.3.3.7 Tropical cyclones

As it is located in the cyclone belt, Rodrigues can be affected by hurricanes from the east from November to April. On average, ten named tropical depressions are tracked in the South-West Indian Ocean and of these, three reach tropical cyclone intensity.

These winds blow clockwise around the centre and generate very high waves. The cyclones often re-curve to the South and East prior to reaching the island of Rodrigues and the cyclone intensity typically diminishes with latitude.

Tropical disturbances are ranked according to their maximum of average sustained wind speed and which tropical cyclone basin they belong to. The Meteo France's Reunion Tropical Centre monitors the cyclonic activity of the South-West Indian Ocean, the basin where Rodrigues is located, and uses the following terminology to classify them:

Table 31: Tropical cyclone naming in the SW Indian Ocean (Mauritius Meteorological Service and Meteo France)

Tropical Disturbance Classification	Maximum of average 10-minute sustained wind speed		Beaufort Scale
	kt	km/h	
Very Intense Tropical Cyclone	> 115	> 212	Force 12 and +
Intense Tropical Cyclone	90 – 115	166 – 212	
Tropical Cyclone	64 – 89	118 – 165	
Severe Tropical Storm	48 – 63	89 – 165	Force 10 – 11
Moderate Tropical Storm	34 – 47	63 – 88	Force 8 – 9
Tropical Depression	28 - 33	51 – 62	Force 7
Tropical Disturbance	< 28	< 50	Force 0 – 6

Since the early 60's, 74 tropical disturbances have occurred in the vicinity of Rodrigues (refer table 32) which represent in average of 1.3 events per year. Most of them are qualified as Tropical Storm or Severe Tropical Storm. They usually present the same characteristics: they form in the eastern part of the Indian Ocean and migrate to the southwest following a parabolic trajectory. In the past few years, Hansella (1996), Kalunde (2003), Amara (2014), Bansi (2015) and Gelena (2019) were the most damaging cyclones. Cyclone Kalunde brought 3.4 million euros in damage to Rodrigues Island.

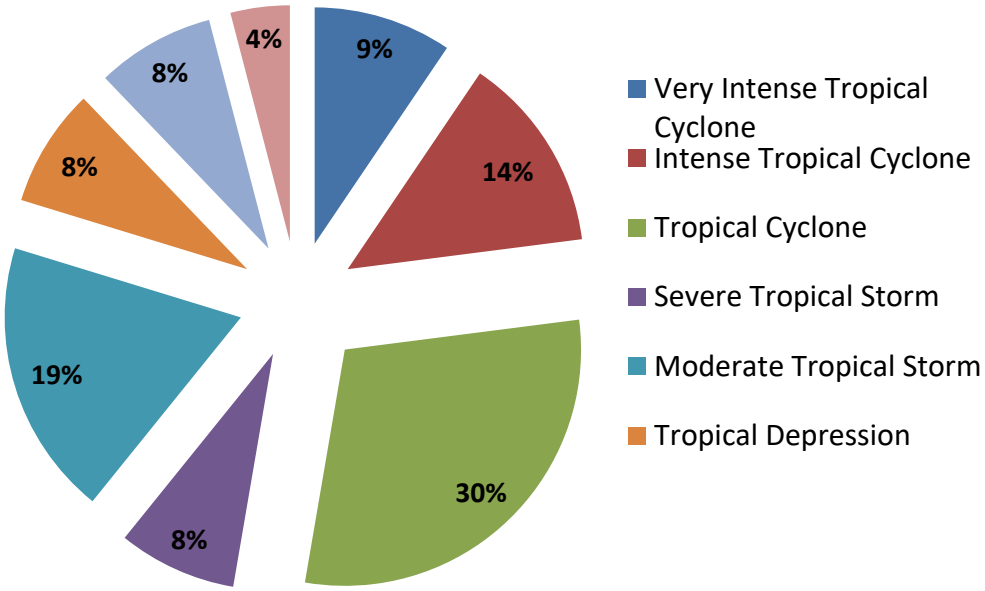


Figure 42: Distribution of Cyclone Types since 1962

The Cyclone Warning System of Mauritius and Rodrigues issues warnings to the population before a cyclonic disturbance is likely to affect its coast. Warning is ranked in 4 classes according to the remaining time before a 120 km/h gust hits:

- Class I: Issued 36 to 48 hours before Rodrigues is likely to be affected by gusts reaching 120 km/h;
- Class II: Issued so as to allow, as far as practicable, 12 hours of daylight before the occurrence of gusts of 120 km/h;
- Class III: Issued so as to allow, as far as practicable, 6 hours of daylight before the occurrence of gusts of 120 km/h;
- Class IV: Issued when gusts of 120 km/h have been recorded in some places and are expected to continue.

6.3.3.8 Tsunami

Minor floods were experienced as a result of the 26 December 2004 tsunami. So far there is no record of any significant tsunami that has affected Rodrigues but there is a possibility that a tsunami generated from either the Sumatra or the Makran source could affect the coasts of Rodrigues. The Tsunami Warning System of Mauritius considers a lead-time of 5-7 hours for a tsunami wave from Sumatra to reach its coast.

Table 32: Tropical disturbance events in the vicinity of Rodrigues Island [1962 - 2019]

Cyclone Season	Approaching date (UTC)	TC Name	Type	Intensity (kts) at nearest distance from Rodrigues Airport	Maximum intensity (kts) of the TC	Minimum sea level pressure (mb)	Code JTWC (Join Typhoon Warning Center)	Nearest distance form Rodrigues Airport	Wind speed at Plaine Corail (kts)	Direction in the vicinity of Rodrigues	Data Source	Cyclone Warning System (Mauritius Meteorological Services)
1962	06/04/1962	MAUD	Tropical Cyclone	64	-	-	-	-	_	Parabolic NE to SW	IBTrACS-NOAA	-
1963	19/02/1963	GRACE	Severe Tropical Storm	62	-	-	-	-	_	Parabolic NE to SW	IBTrACS-NOAA	-
1964	11/12/1963	AMANDA	Severe Tropical Storm	63	-	-	-	-	_	Parabolic NE to SW	IBTrACS-NOAA	-
1965	08/01/1965	FREDA	Tropical Cyclone	65	-	-	-	-	_	Parabolic NE to SW	IBTrACS-NOAA	-
1967	12/02/1967	HUGUETTE	Moderate Tropical Storm	35	-	-	-	-	-	NNW to SSE then E	IBTrACS-NOAA	-
1968	23/12/1967	CARMEN	Tropical Cyclone	70	-	-	-	-	-	N to S	IBTrACS-NOAA	-
1968	21/01/1968	HENRIETTE	Tropical Cyclone	80	-	-	-	-	_	NNE to SSW	IBTrACS-NOAA	-
1968	29/03/1968 00:00	MONIQUE	Tropical Cyclone	64	-	-	-	-	_	Parabolic NE to SW	Cycloneoi.com (NOAA, UNISYS, C.PEGOUD)	-
1970	19/02/1970 12:00	JANE	Very Intense Tropical Cyclone	140	-	900	-	305 km N		Parabolic NE to SW	FIRINGA/ - SA	-
1970	30/03/1970 00:00	LOUISE	Tropical Cyclone	80	-	910	-	210 km N	_	Atypical track	Cycloneoi.com (NOAA, UNISYS, C.PEGOUD)	-
1971	12/11/1970 00:00	CLAUDINE	Tropical Cyclone	70	-	970	-	160 km North	_	E to W	Cycloneoi.com (NOAA, UNISYS, C.PEGOUD)	-
1971	27/01/1971 00:00	GINETTE	Tropical Cyclone	81	-	938	-	55 km SE	_	-	Cycloneoi.com (NOAA, UNISYS, C.PEGOUD)	-
1971	26/02/1971 00:00	LISE/YVONNE	Tropical Cyclone	80	-	-	-	80 km	_	E to W then S	Cycloneoi.com (NOAA, UNISYS, C.PEGOUD)	-
1972	05/01/1972 00:00	BELLE	Moderate Tropical Storm	46	-	-	-	-	_	-	Cycloneoi.com (NOAA, UNISYS, C.PEGOUD)	-
1972	20/02/1972 00:00	FABIENNE	Very Intense Tropical Cyclone	135	-	-	-	120km W	_	From E	Cycloneoi.com (NOAA, UNISYS, C.PEGOUD)	-
1977	08/02/1977 09:00	GILDA	Moderate Tropical Storm	45	-	-	-	230 km	_	From E; Then N to S	FIRINGA	-
1977	24/02/1977 22:00	IO/JACK	-	-	-	-	-	300 km	_	-	FIRINGA/NOAA	-
1979	09/02/1979 00:00	CELINE	Very Intense Tropical Cyclone	116	-	-	-	-	_	-	FIRINGA/NOAA	-
1979	14/02/1979 11:00	ESTELLE	-	-	-	988	-	200 km W	_	Atypical track	FIRINGA/NOAA	-
1980	03/02/1980 16:00	JACINTHE	Tropical Cyclone	65	-	-	-	160 km NW	_	-	FIRINGA/NOAA	-
1982	31/01/1981 03:32	HEYLETTE	-	-	-	-	-	100 km N	_	-	FIRINGIA	-
1982	16/01/1982 12:00	DAMIA	Tropical Cyclone	80	120	-	TC 08S 1982	Over Rodrigues	_	-	JTWC	-
1984	22/01/1984 18:00	EDOARA	Tropical Depression	30	35	-	TC 15S 1984	40 km S	_	-	JTWC	-

1984	16/02/1984 06:00	HAJA	Tropical Depression	30	45	-	TC 20S 1984	155km S	_	-	JTWC	-
1985	02/12/1984 06:00	BOBALAHY	Tropical Disturbance	20	55	-	TC 02S 1985	130 km SE	_	From NE to SW	JTWC	-
1985	26/01/1985 00:00	DITRA	Tropical Cyclone	65	70	-	TC 16S 185	< 10km S	_	N the S	JTWC	-
1985	10/04/1985 12:00	HELISAONINA	Intense Tropical Cyclone	100	110	-	TC 33S 1985	110 km N	_	Loop. From N to W.	JTWC	-
1986	14/01/1986 06:00	COSTA	Tropical Cyclone	70	70	-	TC 06S 1986	130 km NE	-	NW to SE	JTWC	-
1987	06/02/1987 03:00	BEMAVAZA	Moderate Tropical Storm	35	-	-	-	-	-	-	FIRINGA	-
1989	05/04/1989 12:00	KRISSY	Tropical Cyclone	65	105	-	TC21S 1989	120km NW	-	NE to SW	JTWC	-
1989	22/03/1989 12:00	JINABO	Tropical Disturbance	25	65	-	TC19S 1989	190 km N		E to W and S	JTWC	-
1990	06/03/1990 00:00	EDISOANA	Intense Tropical Cyclone	95	100	-	TC18S 1990	210 km W	-	N to S	JTWC	-
1991	31/01/1991 06:00	BELLA	Intense Tropical Cyclone	100	130	-	TC08S 1991	25 km W	-	E to W and then to S	JTWC	Warning class IV (max)
1992	10/02/1992 00:00	CELESTA	Tropical Disturbance	25	45	-	TC 15S 1992	75 km N	-	NNW to SE	JTWC	-
1992	01/03/1992 00:00	GERDA	Tropical Depression	30	35	-	TC 24S 1192	150km NNW	-	-	JTWC	-
1994	15/02/1994 12:00	IVY	Severe Tropical Storm	50	100	-	TC 16S 1994	100 km W	-	NE to S	JTWC	-
1994	12/04/1994 12:00	ODILLE	Intense Tropical Cyclone	95	105	-	TC 26S 1994	150 km SW	-	NNW to SSE	JTWC	-
1995	30/11/1994 06:00	ALBERTINE	Tropical Cyclone	70	115	-	TC 02S 1995	105 km NW	-	NNE to SSW	JTWC	-
1995	27/01/1995 00:00	DORINA	Moderate Tropical Storm	45	100	-	TC08S 1995	150 km SE	-	ENE to WSW	JTWC	-
1995	09/02/1995 00:00	GAIL	Tropical Cyclone	70	75	-	TC 10S 1995	35 km NNW	-	NE to SW	JTWC	-
1996	24/02/1996 12:00	EDWIDGE	Tropical Depression	30	95	-	TC 16S 1996	15 km SW	-	SE to NW	JTWC	-
1996	29/02/1996 18:00	FLOSSY	Intense Tropical Cyclone	100	115	-	TC 17S 1996	100km NNW	-	NE to SW	JTWC	-
1996	06/04/1996 06:00	HANSELLA	Intense Tropical Cyclone	95	95	-	TC 24S 1996	30km NE	90	N to S	JTWC	Warning class IV (max)
1996	08/04/1996 18:00	HANSELLA	Severe Tropical Storm	60	95	-	TC 24S 1996	70km SW	-	E to W	JTWC	Warning class IV (max)
1997	21/02/1997 18:00	KARLETTE	Tropical Cyclone	65	65	-	TC 25S 1997	50 km S	-	NE to SW	JTWC	-
1999	03/02/1999 06:00	CHIKITA	Moderate Tropical Storm	35	40	-	TC 17S 1999	50 NE	-	ESE to WNW	JTWC	-
1999	08/03/1999 18:00	DAVINA	Intense Tropical Cyclone	100	110	-	TC 25S 1999	150 km N	-	NE to SW	JTWC	-
1999	07/04/1999 06:00	EVRINA /FREDERIC	Tropical Depression	30	140	-	TC 31 S 1999	30 km N	-	E to W	JTWC	-
2001	15/01/2001 18:00	BINDU	Moderate Tropical Storm	45	100	-	TC05S 2001	130 km SE	-	NE to SW	JTWC	-
2001	07/04/2001 00:00	EVARISTE	Severe Tropical Storm	55	75	-	TC 18S 2001	180 km W	-	NNW to SSE	JTWC	-
2002	20/01/2002 18:00	DI NA	Very Intense Tropical Cyclone	130	130	910	TC 10S 2002	180km NNW	-	ENE to WSW	JTWC	Warning class III

2003	12/03/2003 18:00	KALUNDE	Intense Tropical Cyclone	90	140	954	TC 23S 2003	60km SE	114	N to S	JTWC	Warning class IV
2005	02/02/2005 06:00	GERARD	Tropical Disturbance	15	60	1006	TC 14S 2005	30 km SE	-	NE to SW	JTWC	None
2005	10/04/2005 12:00	JULIET/ADELINE	Very Intense Tropical Cyclone	120	125	992	TC 26S 2005	130 km SE	-	NE to SSW	JTWC	Warning class III
2006	29/12/2005 00:00	-	Tropical Disturbance	25	35	1002	TC 04S 2006	200km NW	-	NE to SW	JTWC	-
2007	10/02/2007 18:00	ENOK	Moderate Tropical Storm	40	55	993	TC13S 2007	Over Rodrigues	-	NNW to SSE	JTWC	Warning class IV (max)
2007	15/02/2007 12:00	FAVIO	Moderate Tropical Storm	40	120	994	TC14S 2007	150 km NW	-	NE to SSW	JTWC	-
2007	06/02/2007 12:00	DORA	Severe Tropical Storm	50	115	985	TC10S 2007	130 km SE	-	NNE to SW	JTWC	Warning class II
2008	17/12/2007 06:00	CELINA	Moderate Tropical Storm	35	40	996	TC06S 2008	150 km WNW	-	NNE to SSW	JTWC	None
2008	19/02/2008 18:00	HONDO	Tropical Disturbance	25	130	1004	TC16S 2008	60 km N	-	E to NW	JTWC	None
2010	20/02/2010 18:00	GELANE	Tropical Cyclone	65	125	974	TC 16S 2010	180km W	-	N to S	JTWC	Warning class II
2011	19/03/2011 21:00	CHERONO	Moderate Tropical Storm	35	45	998	TC18S 2011	30 km S	-	E to SW	JTWC	Warning class I
2012	20/01/2012 18:00	ETHEL	Tropical Cyclone	70	70	970	TC07S 2012	90 km E	-	N to S	JTWC	Warning class IV
2012	21/02/2012 12:00	HILWA	Moderate Tropical Storm	40	40	993	TC13S 2012	75km ESE	-	NE to S	JTWC	None
2013	15/04/2013 12:00	IMELDA	Tropical Cyclone	70	85	970	TC21S 2013	110 km W	-	NE to SW then E	JTWC	Warning class IV
2014	21/12/2013 00:00	AMARA	Very Intense Tropical Cyclone	125	130	929	TC03S 2014	80 km E	73	Parabolic NE to SW	JTWC	Warning class IV (14h)
2015	09/01/2015 06:00	BANSI	Very Intense Tropical Cyclone	120	140	933	TC05S 2015	110 km NE	67	NE to SW	JTWC	Warning class IV (12h10)
2016	13/12/2015 00:00	BOHALE	Moderate Tropical Storm	35	35	996	TC 05S 2016	440 km E	-	NE to S	JTWC	
2017	12/03/2017 00:00	FERNANDO/ELEVEEN	Tropical Depression	30	45	1000	TC 11S 2017	100 km S	-	NE to WSW	JTWC	None
2018	13/01/2018 22:00	BERGUITTA	Moderate Tropical Storm	40	95	940	-	155 km N	-	E to W then SW	FIRINGA/MeteoFrance	Warning class III
2019	23/12/2018 07:00	CILIDA	Tropical Cyclone	85	95	945	-	310 km SW	-	NW to SE	FIRINGA/MeteoFrance	Warning class I
2019	06/02/2019 23:00	FUNI	Tropical Cyclone	85	100	940	-	220 km ENE	-	NNW to SSE	FIRINGA/MeteoFrance	Warning class II
2019	09/02/2019 23:00	GELENA	Intense Tropical Cyclone	95	100	942	-	50 kmSW	82	WNW to ESE	FIRINGA/MeteoFrance	Warning class IV (27 hours)
2019	26/03/2019 01:00	JOANINHA	Intense Tropical Cyclone	100	100	939	-	80 km NNE	96 (gusts > 54 kts during 33 hours)	-	FIRINGA/MeteoFrance	Warning class IV

Table 33: Sea level at Port Mathurin for the major cyclones impacting Rodrigues

Approaching date (UTC)	Name	Relative Sea Level [m]	Sea Level measured at Port Mathurin [cm]	Wind Speed at Plaine Corail
1/2/1991 6:00	BELLA	-0.37	1700	-
6/4/1996 6:00	HANSELLA	-0.10	1880	166 km/h (90kts)
8/4/1996 16:00	HANSELLA	-0.37	1549	-
12/3/2003 18:00	KALUNDE	0.21	2181	212 km/h (114kts)
15/4/2013 12:00	IMELDA	0.51	2428	-
21/12/2013 0:00	AMARA	0.51	2735	135 km/h (73kts)
9/1/2015 6:00	BANSI	-0.39	1878	124 km/h (67 kts)
13/1/2018 22:00	BERGUITTA	0.12	2373	-
23/12/2018 07:00	CILIDA	0.44	2629	-
06/02/2019 23:00	FUNANI	0.65	3150	-
09/02/2019 23:00	GELENA	1.04	3520	-
26/03/2019 01:00	JOANINHA	0.7	3030	178 km/h (gusts > 100 km/h during 33hours) (96 kts) (54kts)

6.3.4 Climate Change Projections

6.3.4.1 Sea Level Rise

Sea level have started to rise under the impact of climate change. This increase is estimated by the IPCC for different parts of the world. For the South Indian Ocean, the estimates are as follows compared to the period 1995-2014 according to 2 scenarios:

Period	Sea level rises	
	Scenario SSP2-4.5 *(middle-of-the-road development)*	Scenario SSP5-8.5 *(Fossil-fuelled development)*
Near term (2021-2040)	+0,1m	+0,1m
Medium Term (2041-2060)	+0,2m	+0,3m
Long Term (2081-2100)	+0,6m	+0,7m

6.3.4.2 Tropical Cyclones

IPCC projections show medium confidence in evolution of tropical cyclones according to document: Climate Change 2021: The Physical Science Basis.

Projections for Madagascar (no projections for Indian Ocean) show medium confidence of decrease in frequency and increase in intensity. Cyclones will potentially be less numerous with more intense winds and rainfall. Lower minimum pressure and stronger winds may generate more significant surges. According to IPCC, "*The increase in global TC* [Tropical Storm] *maximum surface wind speeds is about 5% for a 2°C global warming across a number of high-resolution multi-decadal studies (Knutson et al., 2020)*" and "*A projected increase in global average TC* [Tropical Storm] *rain rates of about 12% for a 2°C global warming* […] *(Knutson et al., 2020)".*

6.3.5 Terrestrial geology and geotechnics

The purpose of this section is to describe the geology of the Island and the geological and geotechnical characteristics of the area of influence. The sector of Plain Corail has an exceptional geology as it is characterized by a karst formation above a volcanic basement. In order to better scope relevant information regarding geological history, including karstic development, a brief summary of its regional geodynamics and main geological units is provided below. Then the geotechnical conditions are described.

The objective is to make it possible to assess the risks in constructing such an infrastructure above a geotechnically fragile structure: risks of infrastructure collapse and plane crash, but above all, environmental risks due to consolidation techniques during the work.

The impacts of the project earthwork on erosion and their consequences on the risks of ground movements around the infrastructure will also be assessed knowing the geological and geotechnical context.

6.3.5.1 Geodynamical and geological settings of Rodrigues Island

6.3.5.1.1 Geodynamics of Rodrigues

Rodrigues Island is located on the eastern part of a roughly E-W trending fracture zone (RFZ - Rodrigues Fracture Zone), east of the Mascarene Plateau, supporting the Mauritius and La Réunion islands. This Plateau is drifting in a NE direction (24 mm/y) (see figure below).

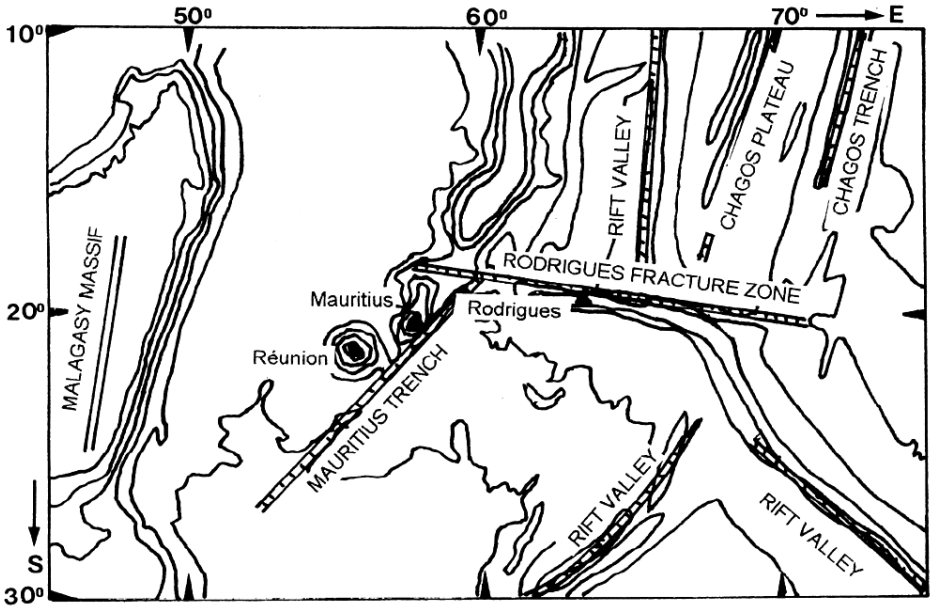


Figure 43: Geodynamic sketch map of the Mauritius-Rodrigues region

6.3.5.1.2 Hot Spot Volcanic Setting

The geological history of Rodrigues Island is marked by three separate volcanic activity periods. The first period led to the production of a basalt basement, followed by a non-activity period. The second period began with the formation of a central cone, made up of aerial and subaerial lava, slags and cinders. Then, hydrothermal activity took place on the centre of the cone, followed by an explosive episode. A volcanic plug of hawaiites and basalts filled the depression.

The restricted area of influence of Plaine Corail is composed of this basalt and hawaiite basement, weathered through time.

6.3.5.1.3 Geology of Plaine Corail

Plaine Corail area is located on the southwestern side of Rodrigues Island (see figure below).

Local topography ranges from 5 m to 39 m above mean sea level (AMSL). The natural terrain slopes gently downwards from the present-day airport's south boundary towards the coastline, from north to south. The highest point near Plaine Corail is the Mount Sainte Marie, where ancient lava outcrops occur.

The Southern part of Rodrigues Island (La Fourche, Petite Butte, and Plaine Corail sites) is characterized by the following geological categories:

- ***calcarenites*** composed of corals and sands deposits (formations A – in yellow and A5 – in blue), some areas being affected by depressions in the calcarenites (formation A4 – in hatched light green) and which can potentially be affected by karstic evolution, including the formation of voids and caverns;
- unweathered ***massive basalts***, partially covered by clayey soils (formations D2 and D4 - in salmon and orange);
- thick ferralitic soils overlaying ***weathered basalts*** and volcanic ***ash*** (formations E1 to E4 - shaded in purple); and,
- ***weathered basalts*** observed at ground surface (formation E5 - in light red), some being observed in the restricted area of influence (as for example Mount Sainte-Marie), North and South close to Plaine Corail Airport's (also known as Sir Gaetan Duval Airport's) footprint.

The airport footprint (hatched grey area) is supposed to be supported by calcarenite formations (A1), except a small part on the North Eastern part where weathered basalt formations (A5) are assumedly found at ground level (Mount Sainte Marie).

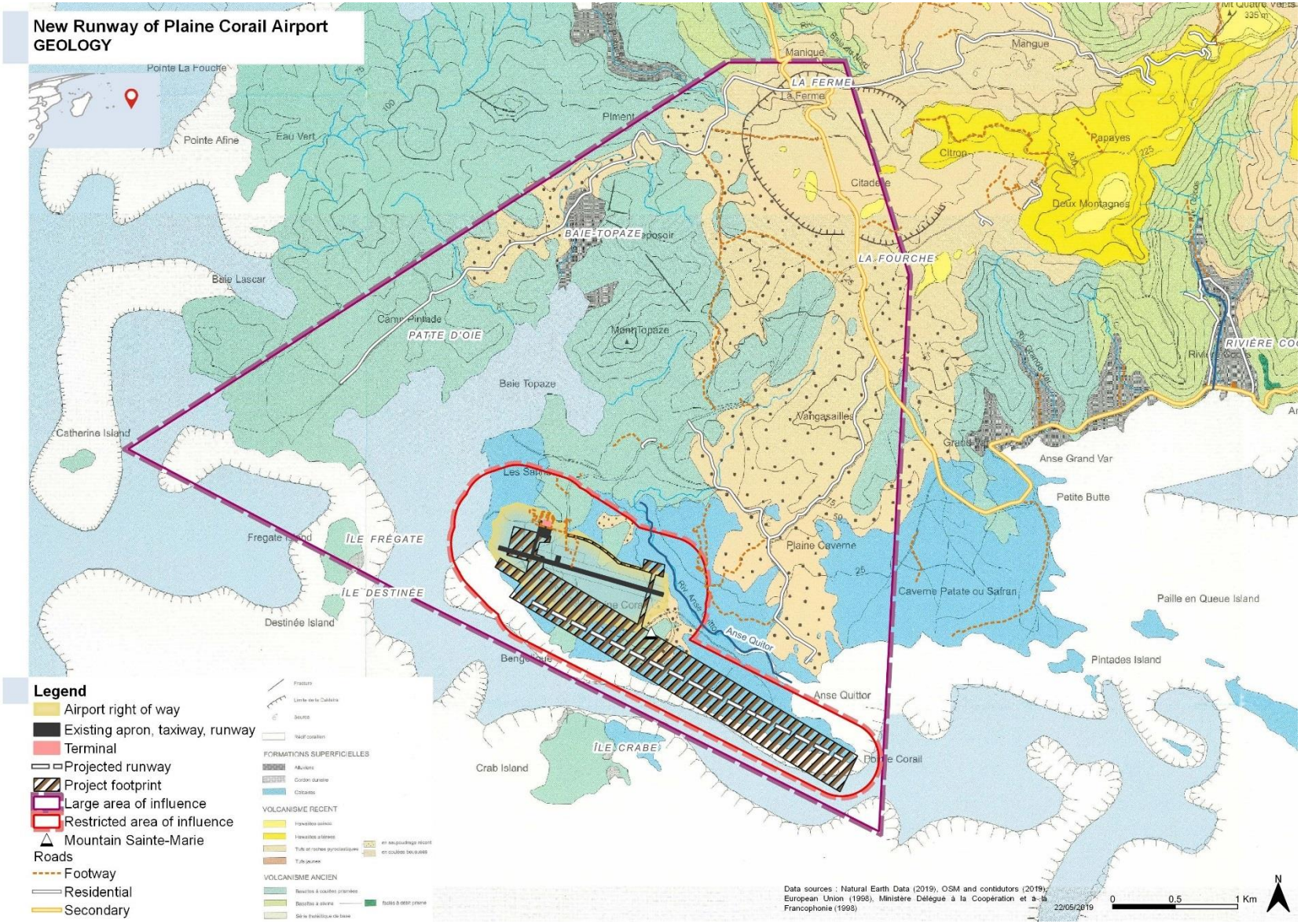


Figure 44: Geological map of Rodrigues

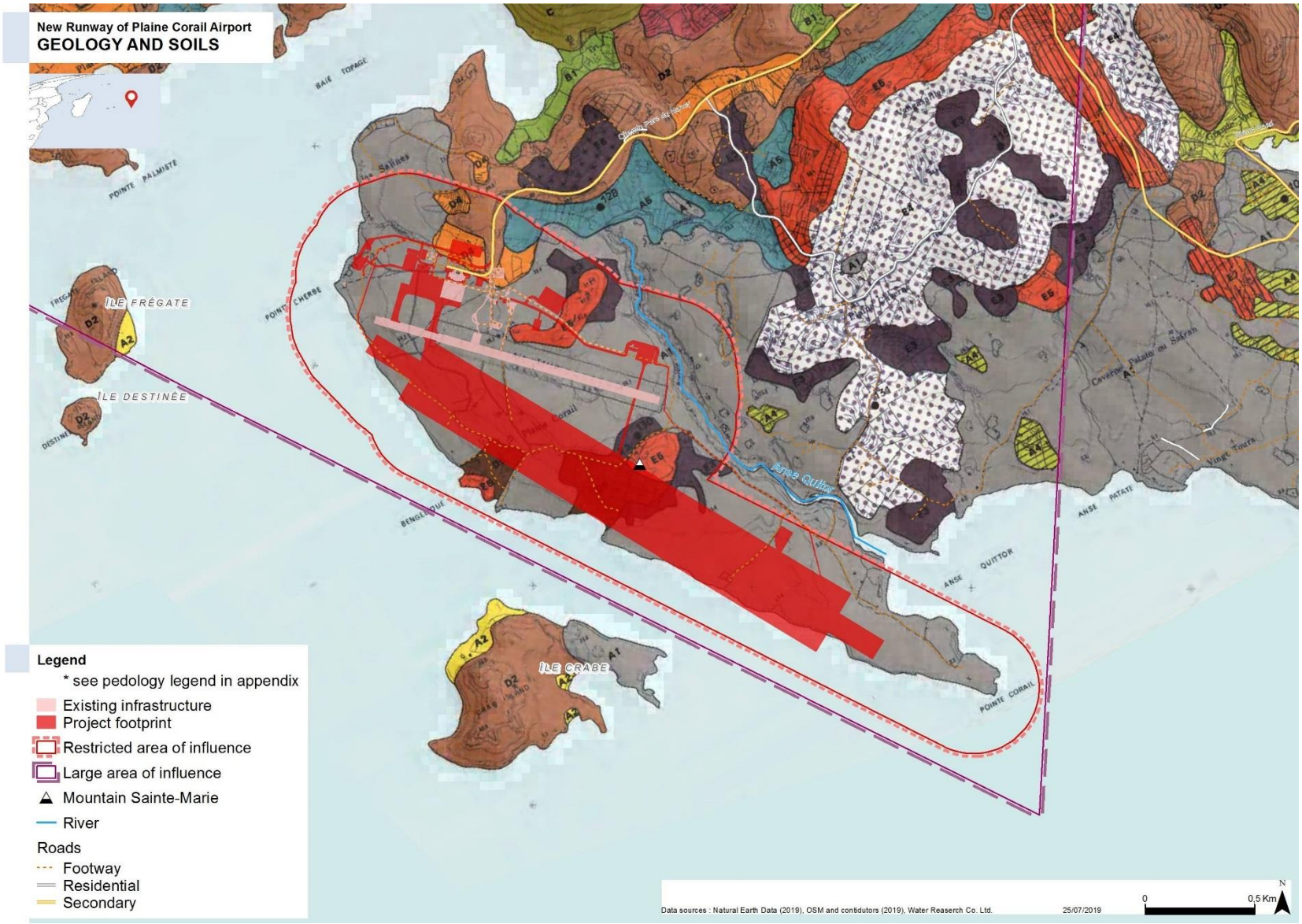


Figure 45: Geology and soils in the area of influence (legend next page)

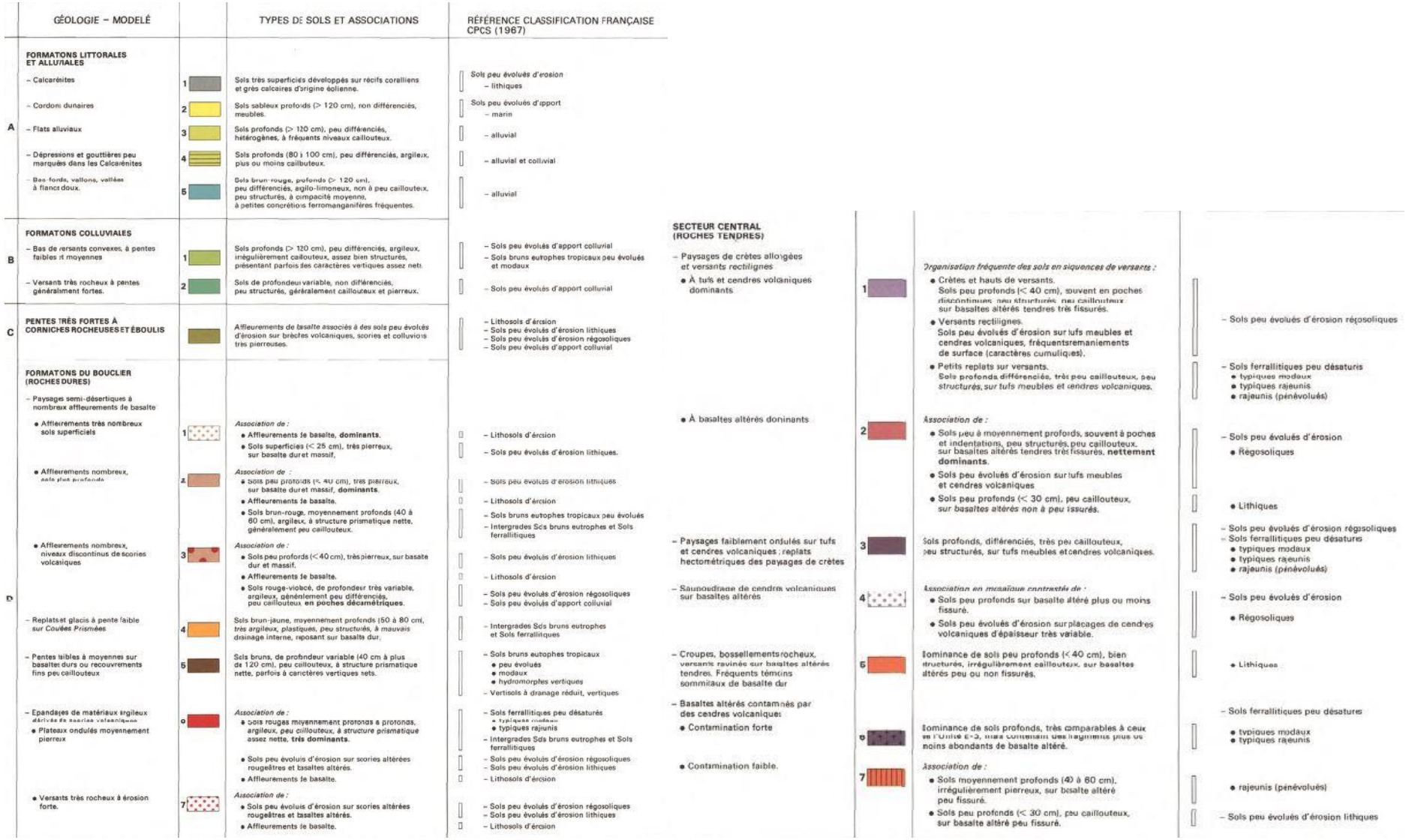


Figure 46: Legend of the geology and soils map of southern pat of Rodrigues Island, near Plaine Corail and in the area of influence

6.3.5.1.4 Geology of the restricted area of influence

6.3.5.1.4.1 Ground investigations carried out

Different ground investigations were led by GIBBS, in accordance with British Standard BS 5930 -2015, in the project runway area (dashed white line) and focused on characterization of the ground conditions (nature and mechanical properties of soils) and the determination of voids/caverns in relation to karstic phenomenon in the area.

These investigations were performed in three steps (Phase A, Phase B and Phase C) from January 2017 to September 2018. Phase A was led to identify the main suitable borrow areas, and to characterize the main geological strata of the entire area. Phase B and Phase C were led to obtain detailed geotechnical data in the vicinity of the projected runway area, south of the present-day Plaine Corail Airport runway.

64 No. rotary core boreholes were drilled during Phase B geotechnical campaign, from September to November 2017. Supplementary 47 No. rotary core boreholes were drilled during Phase C geotechnical campaign, from May to August 2018, completed with 9 No. additional trial pits located in the northwestern part of the Rodrigues Airport area, close to the northern part of the existing runway (refer to Figure 47).

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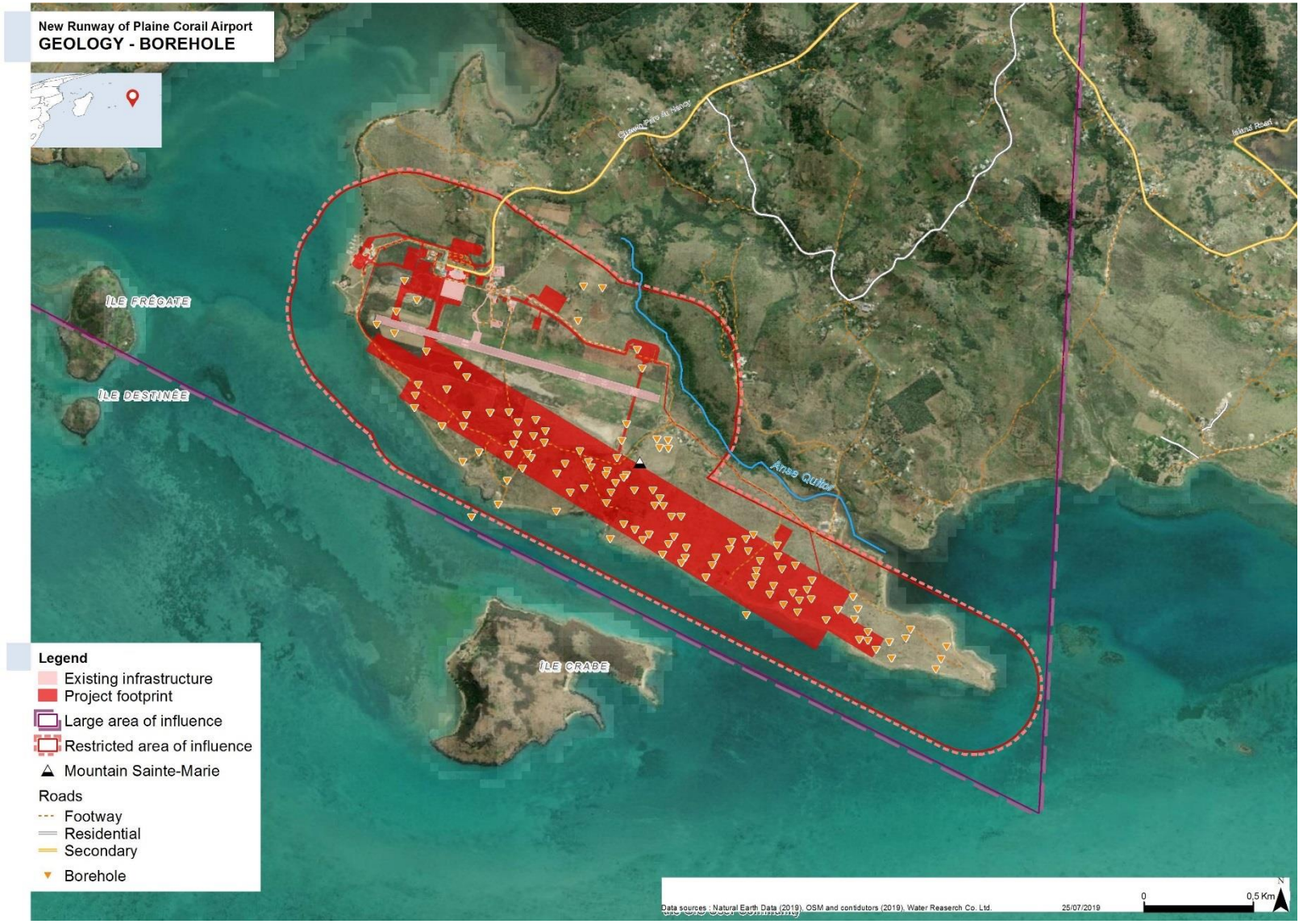


Figure 47: All ground investigations from Phase B (2017) and Phase C (2018) geotechnical campaign of the restricted area of influence at Plaine Corail (Preliminary Design, 2017)

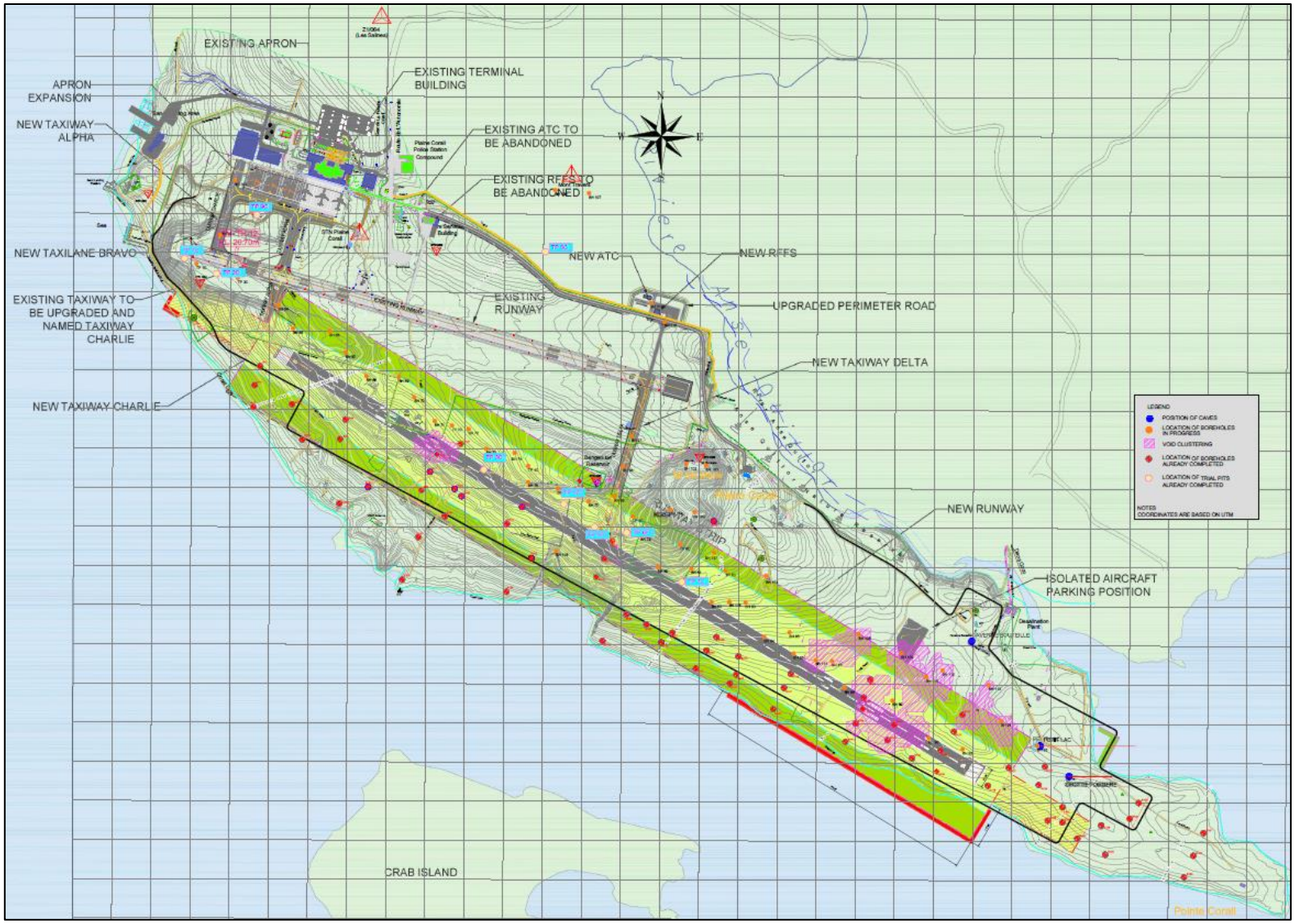


Figure 48: All ground investigations from Phase B (2017) and Phase C (2018) geotechnical campaign of the restricted area of influence at Plaine Corail (Preliminary Design, 2017)

6.3.5.1.4.2 Description of the geology of the restricted area

Based on the results of the in situ ground investigations, the general geological profile on site of the new project runway is the following:

- **Calcarenites** – composed of alternating fine to coarse sands and grained corals, separated by clayey beds (average thickness of 5 m),
- **Basalts** – composed, from top to bottom of Basalt serie, of highly to slightly weathered basalts, with high plasticity silty clays with intervals of gravels and cobbles (average thickness of 9.5m),
- **Breccias** – composed of highly weathered breccia, often located beneath Calcarenite deposits up to depths of 10 m, with high plasticity silty clays and medium to fine gravels of weathered basalts (average thickness of 3 m).

No groundwater monitoring devices were installed from 2017 to 2018. In situ groundwater levels have been recorded in all rotary core boreholes from 2017 Phase B geotechnical campaign. No groundwater level has been recorded in the Phase C rotary core boreholes.

Ground penetrating radar (GPR) surveys were carried out over the area and revealed that 541 voids were determined this way, but more can be found deeper. Over the 541 voids determined with the following distribution:

- none are found between 0 and 5 m below the surface.
- 11% are found between 5 and 10 m
- 38 % between 10 and 15m,
- 30% between 15 and 20
- 21% beyond 20 m.

Most of voids are thus located between 10 and 20 m below the surface. The effect of karstic dissolution in the formation of the voids identified was not investigated considering the absence of ground water monitoring.

In addition, 38 drilling anomalies have been encountered in rotary core boreholes. These cavities have a 50 cm diameter spacing in average (see Figure 48).

Available laboratory test results collected from samples extracted from both Phase B and Phase C have been summarized in Table 34.

As a comment, one can observe that lab tests performed are mostly focused on soil-derived facies, whereas behavioural parameters of unweathered rocky facies are poor, especially for basalts.

Additional 3 geological long sections have been performed to highlight the geometry at depth of the encountered geological formations at ground surface.

These long sections are located in Figure 50 and focus on the northern, centre and southern parts of the new projected area (Figure 51, Figure 52).

All long sections show longitudinal variations of the thickness of the calcarenite unit, this unit being missing in the centre of the project, at Saint Marie mount area. Toward the northern and southern part of the mount Saint Marie, the thickness of the calcarenite increases, but is still limited in the northern part, due to Basalt rock basement present at lower depth.

Figure 53 shows the spatial distribution of each geological formation based on the borehole and trial pit ground investigations. It highlights that ground investigations confirm at depth the geological formations present at ground level. A color bar has been applied to all ground investigations to show the thickness of each geological unit.

Table 34: Summary of In situ and Laboratory Data of Calcarenites, Breccias and Basalts Formations

Parameters	**Geological Formation**			**Calcarenites**	**Breccias**	**Basalts**
Classification	***Bulk density (Mg/m³)***			1.9	2.3	-
	Porosity (%)			23.2	12.9	-
	Carbonate Content of SOIL, CO2 (%)			37.9	0.4	-
	Atterberg Tests	Plastic Limit (%)		-	40	30
		Liquid Limit (%)		-	78	53
		Plasticity Index (%)		-	38	23
Intrinsic parameters / Soil Strength	***Standard Penetration Test (SPT)***			30	23	22
	Shear box	***c' (kPa)***		81	107	5
		φ' (°)		27	31	42
	Undrained Shear Strength	Direct Shear Strength	***Su*** (kPa)	209	247	219
Compressibility and Consolidation	***Consolidation (Odeometer Test)***	Consolidation, m_v (m^2/MN)		1.68	1.38	0.37
		Consolidation, c_v (m2/y)		1.85E-02	4.62E-03	7.12E-03
		Void ratio, e_0 (-)		0.53	0.72	0.44
Compaction	***Compaction, maximum dry density - MDD (Mg/m3)***			1.82	1.39	1.65
	Compaction, maximum dry density - MDD (Mg/m3)			12.30	30.65	22.1
Bearing Capacity	***California Bearing Ratio (5.0mm plunger load) - CBR (%)***			31	7.8	6.3
Rock parameters	***Uniaxial Compressive strength (N/mm2)***			9.4	27.4	-
	Los Angeles Coefficient			65.5	-	-
	Slake Durability Index 2	Durability Class		Medium – High	-	-
		2nd cycle		89.8	-	-

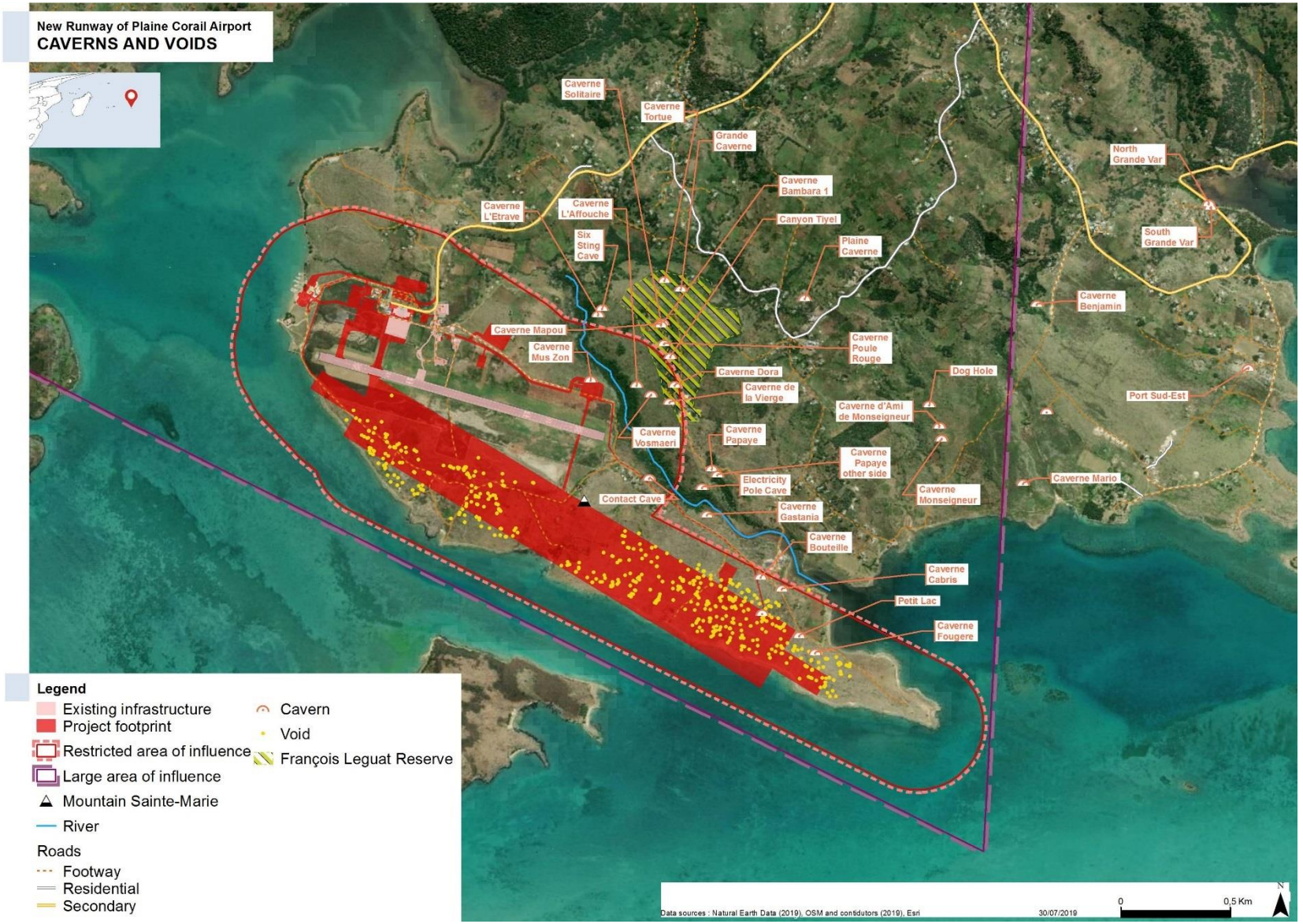


Figure 49: Voids and cavities identified in the restricted area of influence at Plaine Corail

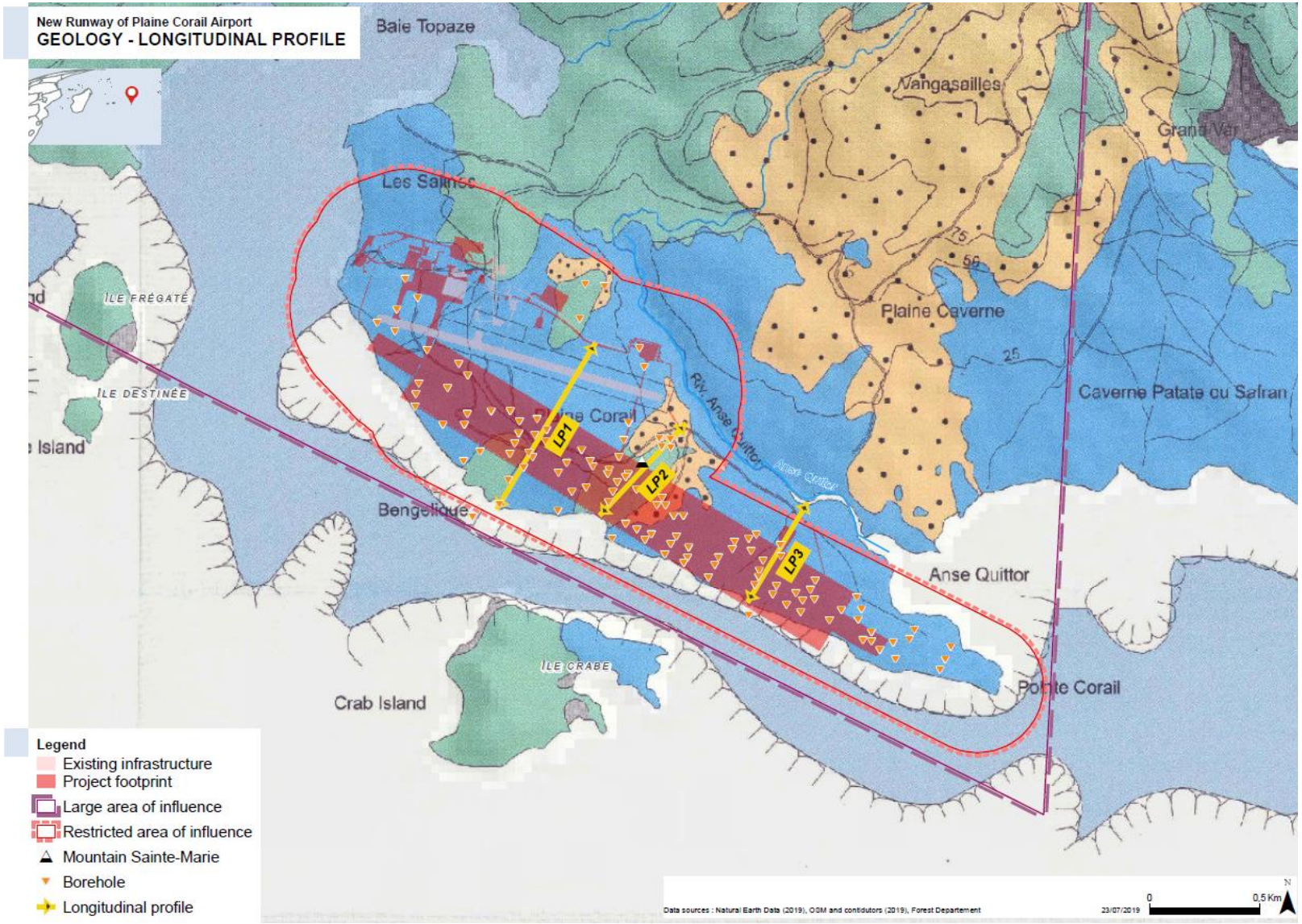


Figure 50: Geological long sections through the restricted area of influence at Plaine Corail

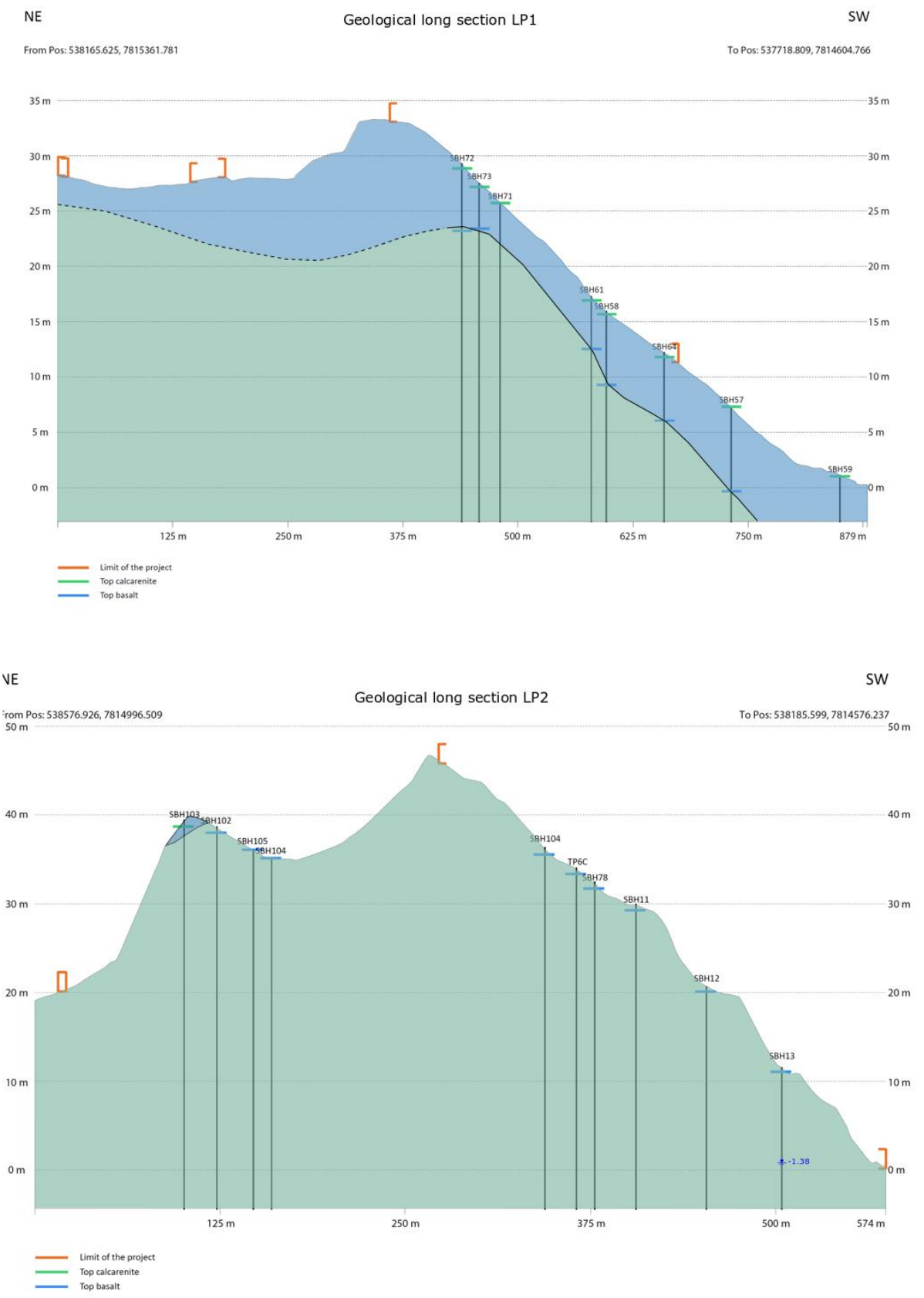


Figure 51: Geological long sections LP1 to LP2

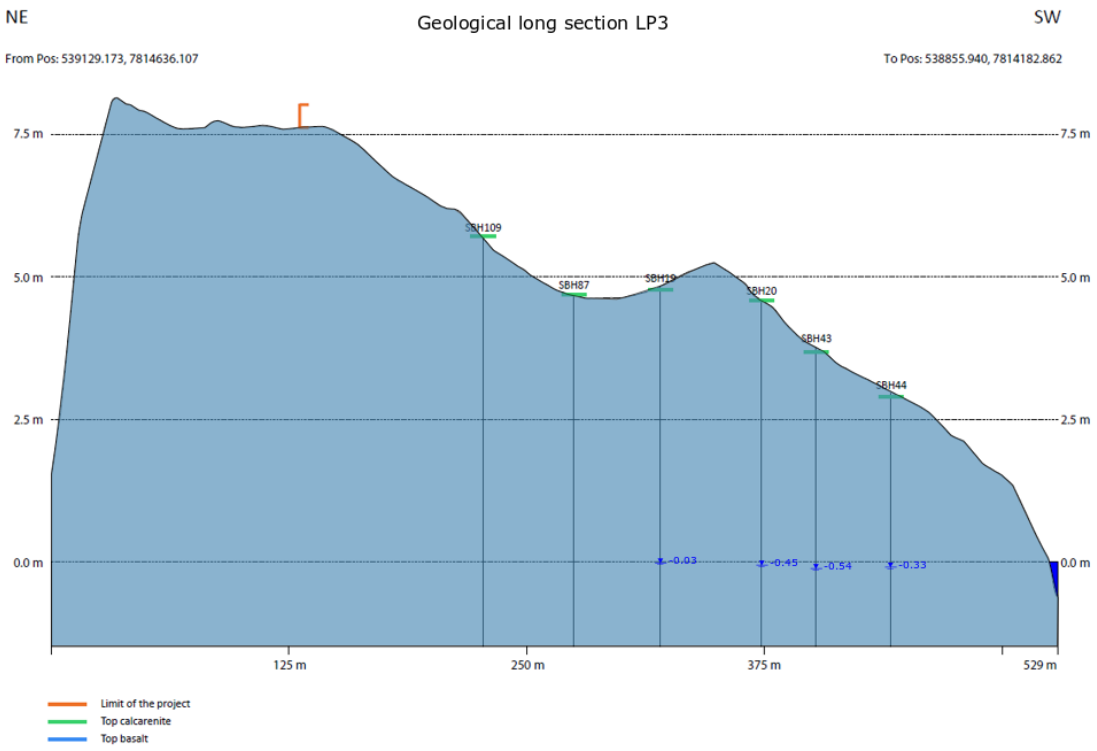


Figure 52: Geological long sections LP3

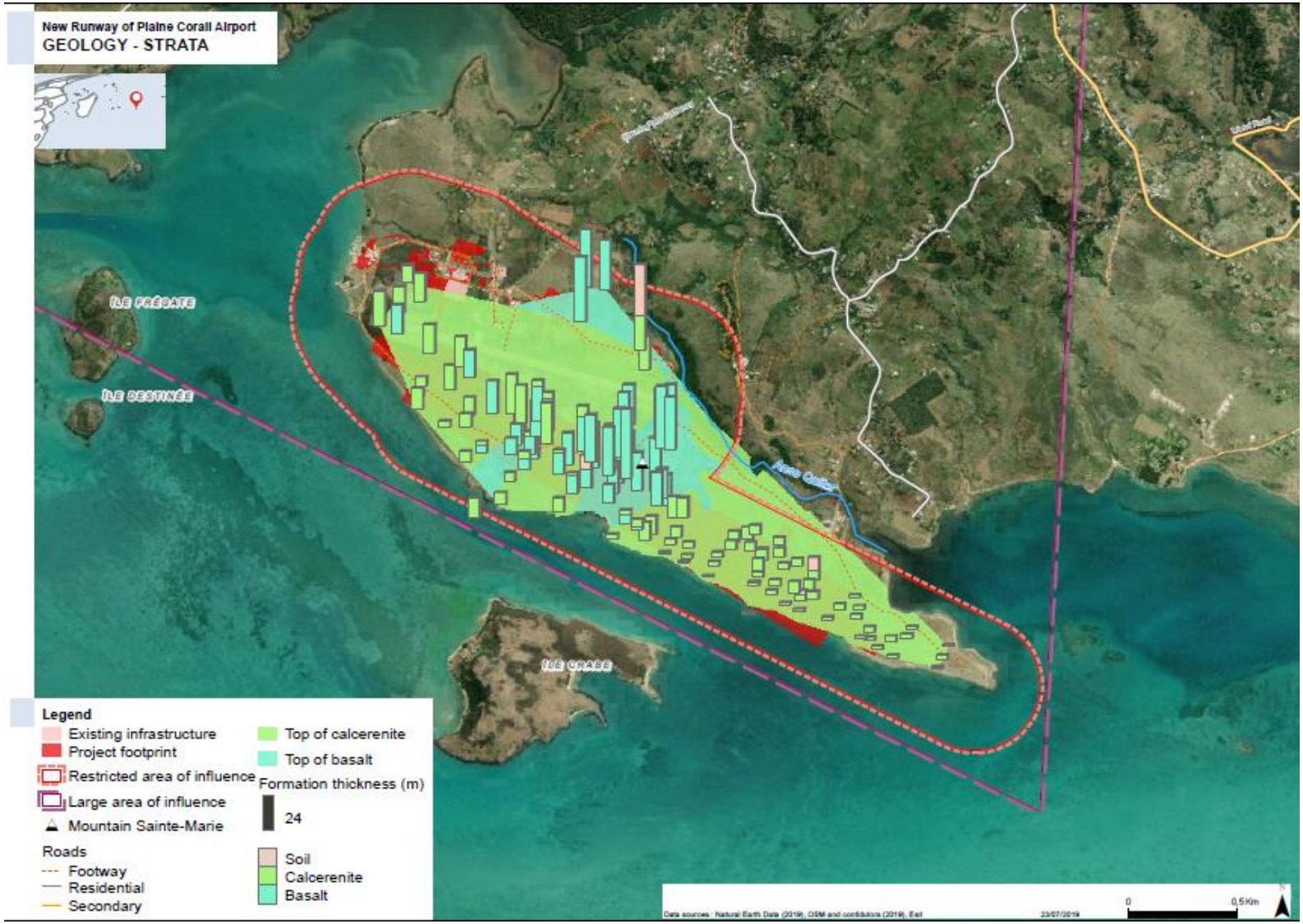


Figure 53: Spatial distribution and thickness of the main geological formations based on the geological formations encountered in boreholes ground investigations

6.3.5.1.5 Synthesis and uncertainties

It has to be stressed that no additional geophysical ground investigations were performed in the area of the present-day Plaine Corail Airport since Phase B ground investigations campaign.

Numerous voids identified from geophysical survey and borehole investigations have been located in the proposed runway area. The number of voids clearly shows that the Eolian Calcarenite Formation is a geological unit affected by karstic dissolution. But uncertainties remain with regard to relationships between geophysical/drilling anomalies attributed to karstic features and the known caverns located along the western flank of Anse Quitor. Additional geophysical surveys coupled with control boreholes shall therefore be carried out in this area by the consultant in charge of the detailed design, in order to clearly understand the 3D expression of the underground karstic features directly below the new runway footprint, and appreciate associated geotechnical hazards.

For more information on the karst formation in the restricted area of influence and the assessment of project impact on the groundwater, please refer to section 5.3.7.

6.3.5.2 Soils and erosion

Land uses may be grouped into Agriculture and Grazing Lands; Forestry and Forest Biodiversity; Management of Caves; Botanical Gardens; and Built up areas (SIDPR classification). Poor land management is considered a concern on the Island, which has resulted in soil erosion. Soil erosion is a result of several factors, including:

- bad agricultural and grazing practices;
- past deforestation;
- poor building practices (especially the dispersed nature of settlements);
- steep topography; and
- high intensity rainfall.

The SIDPR reports a lack of an endorsed framework for land planning and land use. Soil erosion results in a number of knock effects, including land degradation that affects agricultural productivity and is therefore a major factor in food security and poverty. It also affects rivers and dams as well as the lagoons and coral reefs, contributing to environmental degradation of the aquatic and marine environment. The anticipated secondary effects of the development of a new runway, i.e. the development of the tourism industry and demand for new services and goods, may have important implications on land use in terms of land use planning (i.e. appropriate zoning of new developments) and in terms of encouraging unsustainable land use practices such as agriculture to provide goods to the tourist industry, if not managed appropriately.

6.3.6 Marine and shores geology and marine turbidity

This chapter is the marine counterpart to the previous one, and is meant to base the assessment of the risks of impacts related to earthwork and shoreline work during the construction and then the consequences of the topography and shoreline modification.

6.3.6.1 Description of Rodrigues and Plaine Corail shorelines and reef

The coastal zone is mostly surrounded by fringing coral reef enclosing a shallow lagoon area – 0.5 to 3m – with deeper channels (to 40m in front of Port South-East). A shallow channel also separates the location of the future airport runway from Crab Island. The width of lagoons varies from place to place; along the West coast the reef lies 4-8km from the shore (4,6km from the airport runway). The reef platform and shallow lagoon around the island are more than twice the island's area. The bottom of the lagoon is composed of silty sand, the amount of silt being dependent on the distance from (temporary) rivulets. In general, the vast lagoon between the coastline and the reef is shallow, with sandbanks appearing at low tide and some deeper channels. At spring low tides, the intertidal zone locally extends several hundred meters.

Rodrigues Island was formed some ten million years ago from a crater of a sea-mount and consisted of theolitic lavas which have been observed as far as the eastern coast of the island. Subsequently, other eruptions consisting of pyroclasts and lavas (prismatic, hawaiites, etc.) contributed to the geomorphological features of the island.

The coastline is about 67 km long and is composed of different shore types: rocky stretches (especially at the headlands) alternating with sandy beaches (mainly in the bays) and smaller stretches of rock boulders and pebble shores. Locally, small (undercut) cliff walls (2–3 m high) occur, composed of eroded fossil coral reefs. In front of (temporary) rivulets, silty-sandy areas develop. Plaine Corail's shore is mostly rocky.

Because of late volcanic eruptions that occurred 1.3 to 1.5 million years ago, most of the shoreline is made of rocks and only 9% of the coastline are sandy beaches. Most are pocket beaches or small crescentic ones. They range from 2 to 25 m wide, some being very narrow as a consequence of the receding shoreline.

Table 35: General characteristics of beaches in Rodrigues

Island	Coastline (km)	Sandy coastline (km)	Number of beaches	Beaches seriously eroded
Rodrigues	67	6 (9%)	8	3

The eastern side of the island experiences greater exposure to the open ocean and prevailing wind and wave regime.

The southwestern area of Rodrigues Island is composed of thick eolian calcarenite deposits which contain a rich variety of limestone caves (Caverne Patate) and many karst features.

Plaine Corail, located in the South West, is an extensive area of low and flat land made of limestone, made up of solidified wind-blown sand.

Crab Island, which is southwest of mainland Rodrigues, is 1.1 km long in the east-west axis and 0.8 km wide in the north-south axis and lies some 350 m offshore of Plaine Corail at its nearest point to the mainland. The greater part of Crab Island consists of basaltic rock formed by volcanic activity probably over 1.3 million years ago (Upton et al., 1967). The summit of the islet rises to 45.5m above sea level at the highest point. The land slopes down rather steeply beyond the plateau except towards the NE where the gradient is much gentler. The islet has a rather open and shallow bay to the SW, fringed at places with some remnants of calcarenitic rocks consisting of wind-blown coralline sand probably deposited during the Pleistocene and thereafter cemented together (Mc Dougall et al., 1965). A more extensive calcarenitic area occurs along the Southern coast of the peninsula. The islet has three beaches of coralline sand: one in the southwest, and two on the eastern side, the larger of which occurs in the northeast portion of Crab Island. There is no river or fresh water body on Crab Island that could generate turbidity.

6.3.6.2 Marine sediment transport

The western coastal area of Rodrigues' lagoon is characterized by significant medium sand and mud.

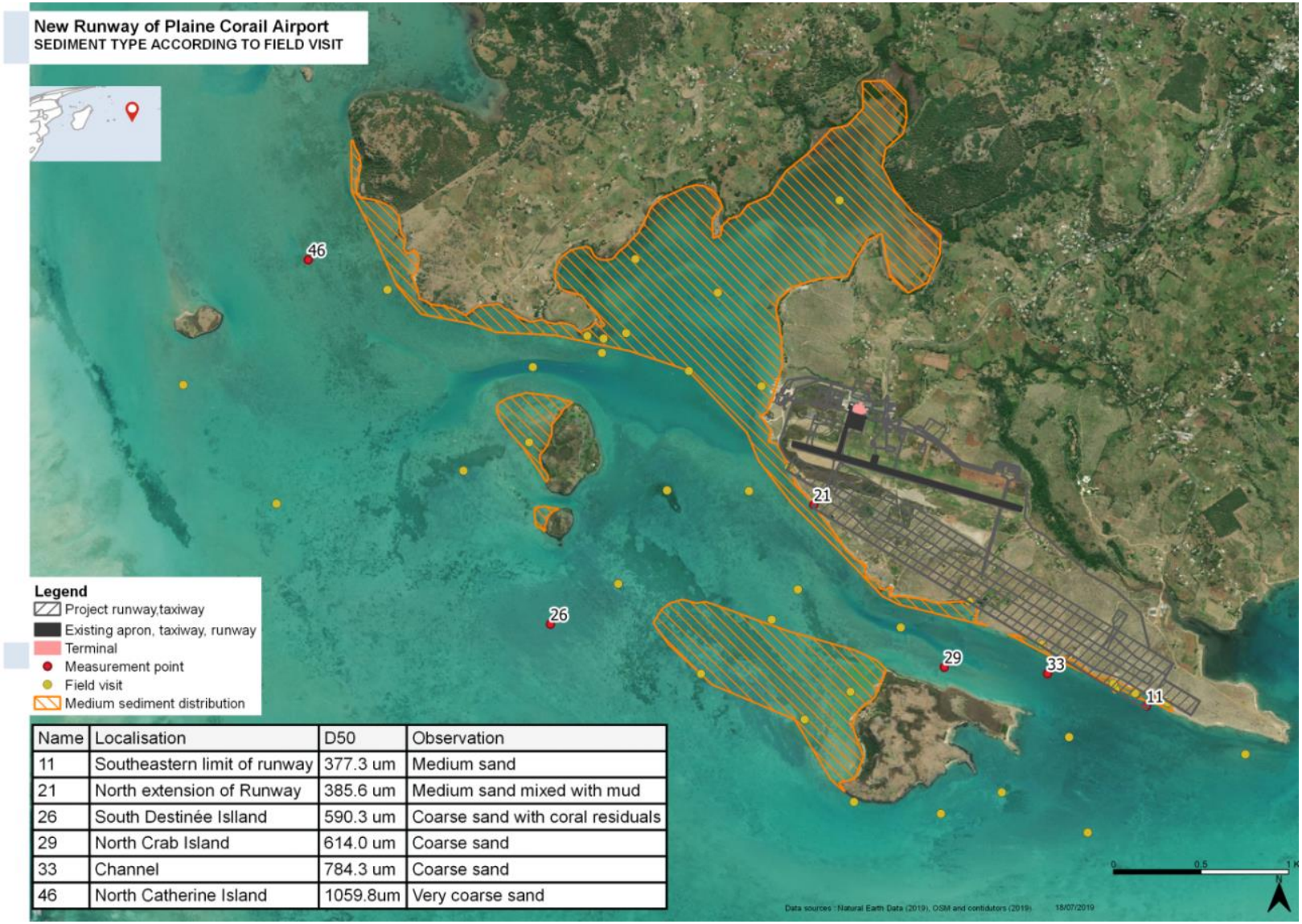
The grain size distribution of superficial distribution was conducted in July 2019. It shows sand is a more important component than silt and clays in the 6 samples collected and analysed (see figure below). These measurements showed a predominance of sand with a median diameter (d50) of 350 to 1060 µm.

Coarse sand stock exists in the inner part of the channel between Crab Island and the mainland, whereas finer sediments are located near the shore and in Topaze bay where current is weaker or almost non-existant. There, the portion of silt and clays is significant[5] (AFD, 2016).

The Northern part of the bay is composed of mud due to the very weak current and the important water runoff during heavy rains.

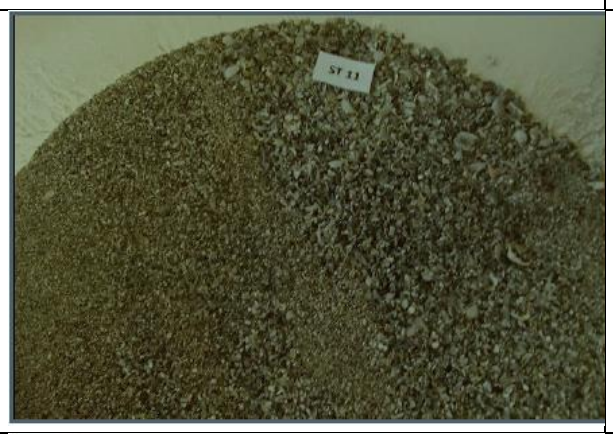
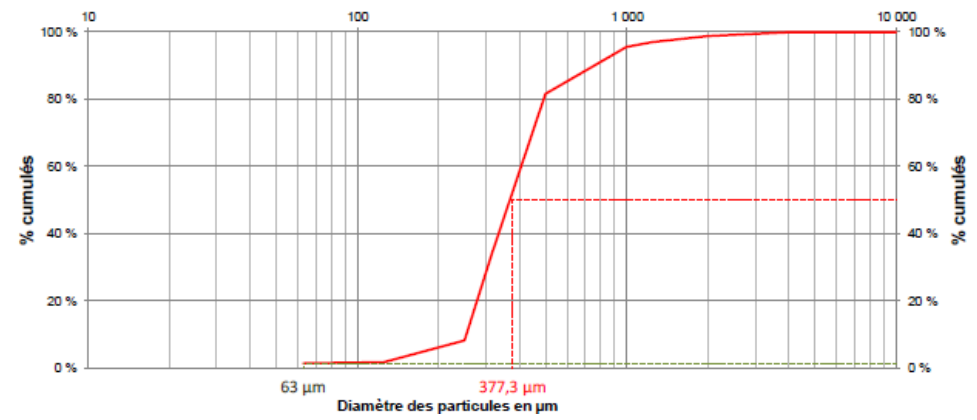
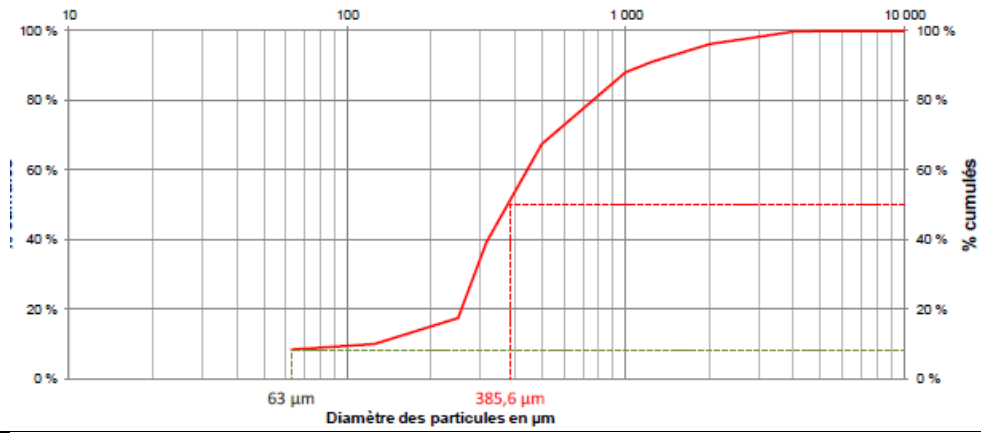
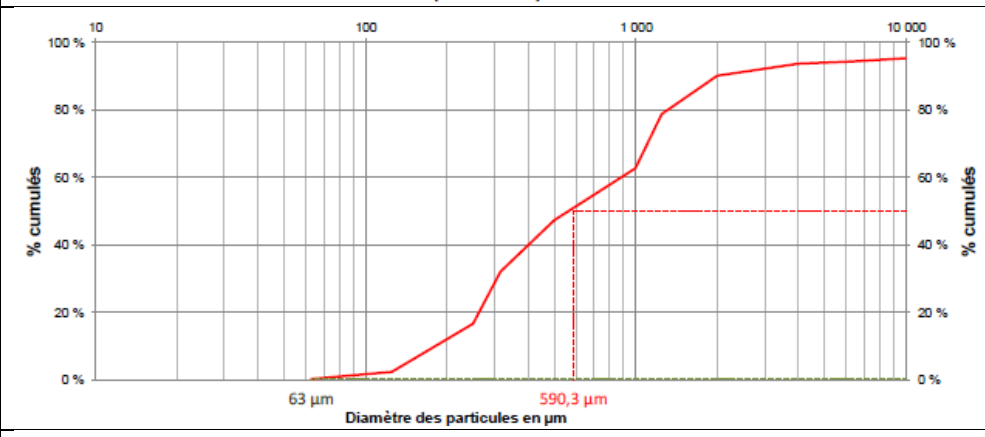
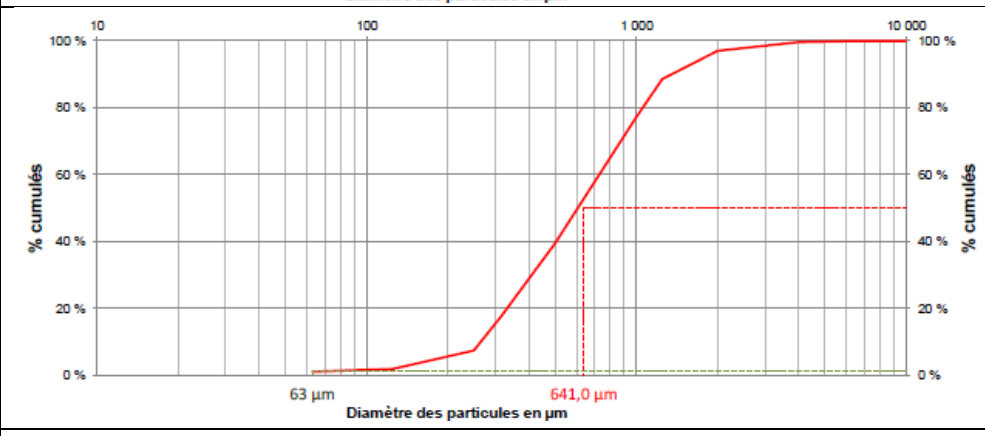
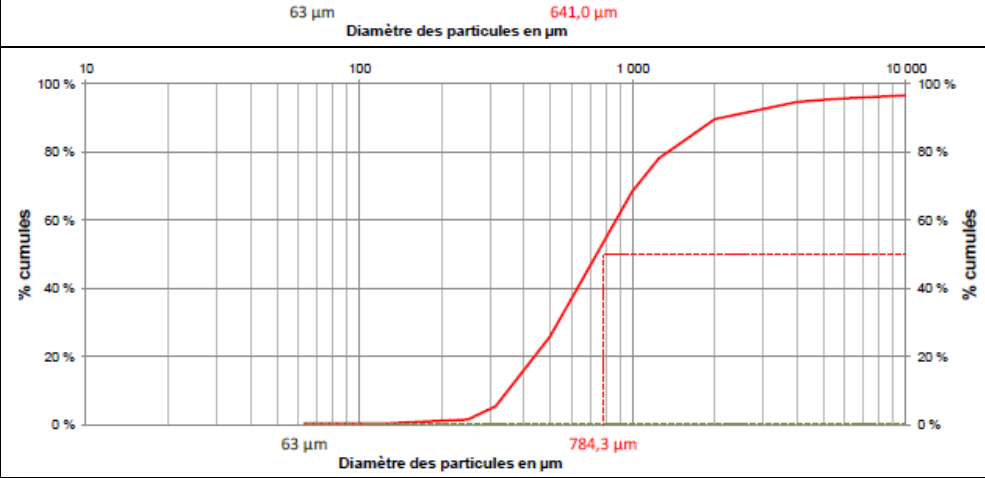
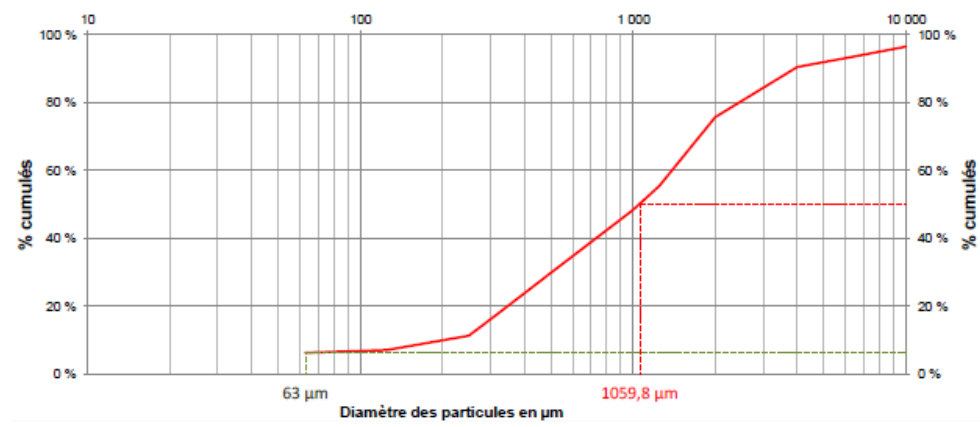
Bed load and resuspension occurs within the lagoon during each tidal cycle. Sediment transport under the influence of the flow is mainly from South-East to North-West. Resuspension is stronger when the current magnitude is important, the maximum is observed with ebb and flow current.

[5] AGENCE FRANCAISE DE DEVELOPPEMENT – Projet d'extension de l'aéroport de Rodrigues (Maurice): réalisation d'un diagnostic écologique / PHASE 1. BIOTOPE – Version finale - Juin 2016



Name	Localisation	D50	Observation
11	Southeastern limit of runway	377.3 um	Medium sand
21	North extension of Runway	385.6 um	Medium sand mixed with mud
26	South Destinée Island	590.3 um	Coarse sand with coral residuals
29	North Crab Island	614.0 um	Coarse sand
33	Channel	784.3 um	Coarse sand
46	North Catherine Island	1059.8um	Very coarse sand

Figure 54: Marine sediment field measurement and grain size distribution.

SAMPLE	PHOTO	GRAIN SIZE DISTRIBUTION
11 Clean medium sand		
21 Silted medium sand		
26 Very coarse sand with coral residuals		
29 Coarse sand		
33 Coarse sand		
46 Very coarse sand		

6.3.6.3 Seawater turbidity

The sea water around Rodrigues is usually very clear. However, during heavy rain, along the North-Western and Western coasts, rivers carry large amounts of debris and soil into the lagoons, increasing the sea water turbidity. In some places, mangroves have been planted to stabilize the sediments and prevent the turbidity spreading into the lagoon.

In the northern area of Plaine Corail Airport, in Baie Topaze, natural turbid plume was identified in the past, see figure below.

Figure 55: Natural turbid plume in Baie Topaze (Google Earth, 25-05-2017)

Under common hydrodynamic conditions[6], inorganic matter levels are usually inferior to 20mg/L, rarely exceeding 30 mg/L in the Topaze bay. Turbidity is higher in the intertidal zone. The turbidity is homogenous in the water columns. Stronger winds increase sediment suspension, inorganic matter levels of 40-50 mg/L can be reached.

6.3.6.4 Marine environment issues

The studied area is characterized by a mild tropical maritime climate and influenced by south-easterly trade winds and Austral westerly ones. The coral reef fringing Rodrigues serves as a natural barrier that protects adjacent shorelines from offshore coastal hazards such as tropical cyclones approaching from the Northeast, southern hemisphere swells and local generated waves.

[6] Appendix Bc Consultation File (DCE) – Projet d'extension de l'aéroport de Rodrigues (Maurice) – Réalisation d'un diagnostic écologique – Phase 1 – Bibliographie, Agence Francaise de Développement (AFD), juin 2016

The coastal zone is surrounded by a shallow lagoon composed of silty sand and deeper channels. Usually crystal clear, the sea water around Plaine Corail can be very turbid after heavy rain.

Based on the description of the existing environment, the key marine receptors of concerns are the following:

- Marine receptor 1: Marine sediment quality: contamination of marine sediments.
- Marine receptor 2: Marine sediment dynamics: physical disturbance of marine sediments.
- Marine receptor 3: Seawater quality: temperature, salinity, concentration of contaminant.
- Marine receptor 4: Physical coastal processes: shoreline, morphology, wave, currents.

Even if the extension will change the shape of the island the area gained on the sea is minimal relative to the size of the channel between Crabe Island and Rodrigues, it would not change the wave dynamic. The receptor “Physical coastal processes” is therefore considered to be of low sensitivity.

“Seawater quality” is categorized as high because the project is located in a rather shallow area and pre-stresses. Natural turbid plumes have been identified in the past after heavy rain events.

The “Marine sediment quality” and “Marine sediment dynamic” receptors are considered to be of medium sensitivity because of the poor knowledge of sediment thickness and local granulometry, due to a lack of in situ data, as well as their temporal evolution.

6.3.7 Hydrology

This chapter aims at describing the rivers and surface water characteristics and how storm water behaves in the project area, depending on the geology, soil properties, and topography. The goal is to base the assessment of the project and earthwork impact on the river flows and floods on it.

It is also aimed at providing input data to base the conception stormwater management system of the project on.

6.3.7.1 Water catchment physical characteristics

The Island of Rodrigues is divided into 38 major river basins. Their catchment areas vary between 0.35 Km^2 and 7.02 Km^2 as shown in the figure below.

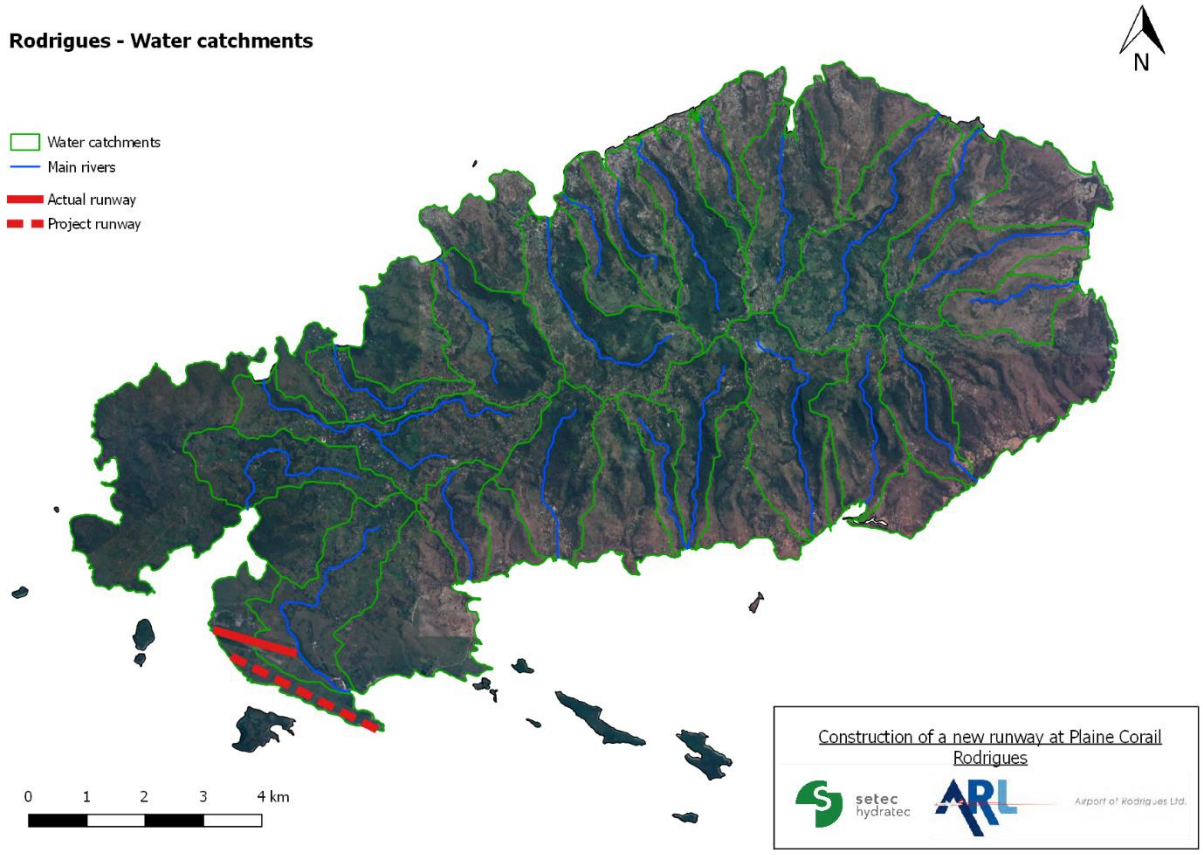


Figure 56: Water catchments

In most water basins, the low permeability of soils generated by alteration of basalt suggests a generally low infiltration capacity, which is sometimes increased locally by the presence of fracture zones.

As for most volcanic islands of comparable geological structure and topography, a proportion of the amount of water infiltrated during rainy episodes is returned to the sea. This part can represent a significant fraction of the water balance of a watershed.

The rivers that lead to the North, East and South coasts of the island have watersheds of similar morphology. Watershed heads are characterized by soft-shaped hills (slopes of 10 to 20%). Further downstream, the rivers have cut into very small valleys. The slopes that generate

the flow are then very steep (30 to 100%), with frequent waterfalls in the beds and cliffs on the top of the slopes. Transfer times of the flow generating zones are very short as a result.

Therefore, although the main watersheds are usually relatively elongated, their concentration times are very short: around 15 to 30 minutes at their mouth into the sea, for the most abundant. Response times are extremely short and hydrological regimes are a succession of fast and short-lived floods separated by dry periods of varying lengths.

The deep cut valleys with steep gradients and the absence of impounding reservoirs in Rodrigues result in most of the rainfall over the island being lost to the sea as high velocity runoff. Due to negligible infiltration to groundwater, base flow of rivers is very low. The flows range from 1.4 l/s in Riv. Grenade to 56.9 l/s in Riv. Baie aux Huîtres.

6.3.7.2 Rainfall analysis

The definition of the hydrology scope depends upon territorial and climatic data, including rainfall data. Rainfall is the main input data for flood estimations (with sea level when it comes to coastal area), due to the availability of historical records and the presence of measuring stations throughout the island.

The main issue for rainfall assessment is the definition of statistical intensities and their spatial repartition on the territory for intense events, which can generate flood events. Indeed, a geographical gradient is observed for the annual rainfall between coastal areas (less than 1,000 mm) and the central plateau (over 1,600 mm).

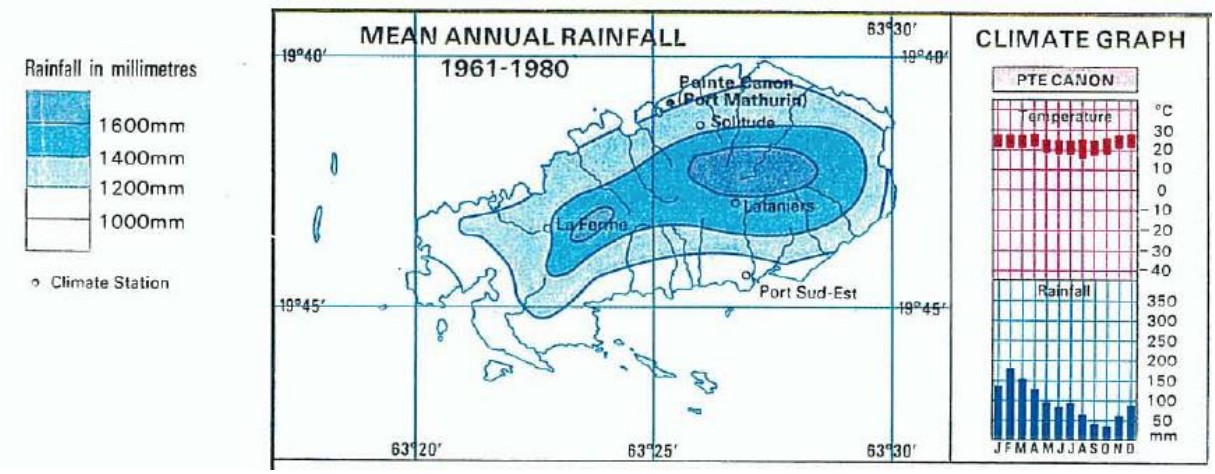


Figure 57: Mean annual rainfall – Rodrigues ("Etude d'un programme de lutte contre l'érosion à Rodrigues", BRGM, ONF, Impact, December 1996)

6.3.7.2.1 Rainfall stations, available data

Mauritius Meteorological Services (MMS) is collecting data from its own recording systems, and from private ones. The existing rainfall stations network (the only automatic weather stations) for Rodrigues Island is shown on the map below.

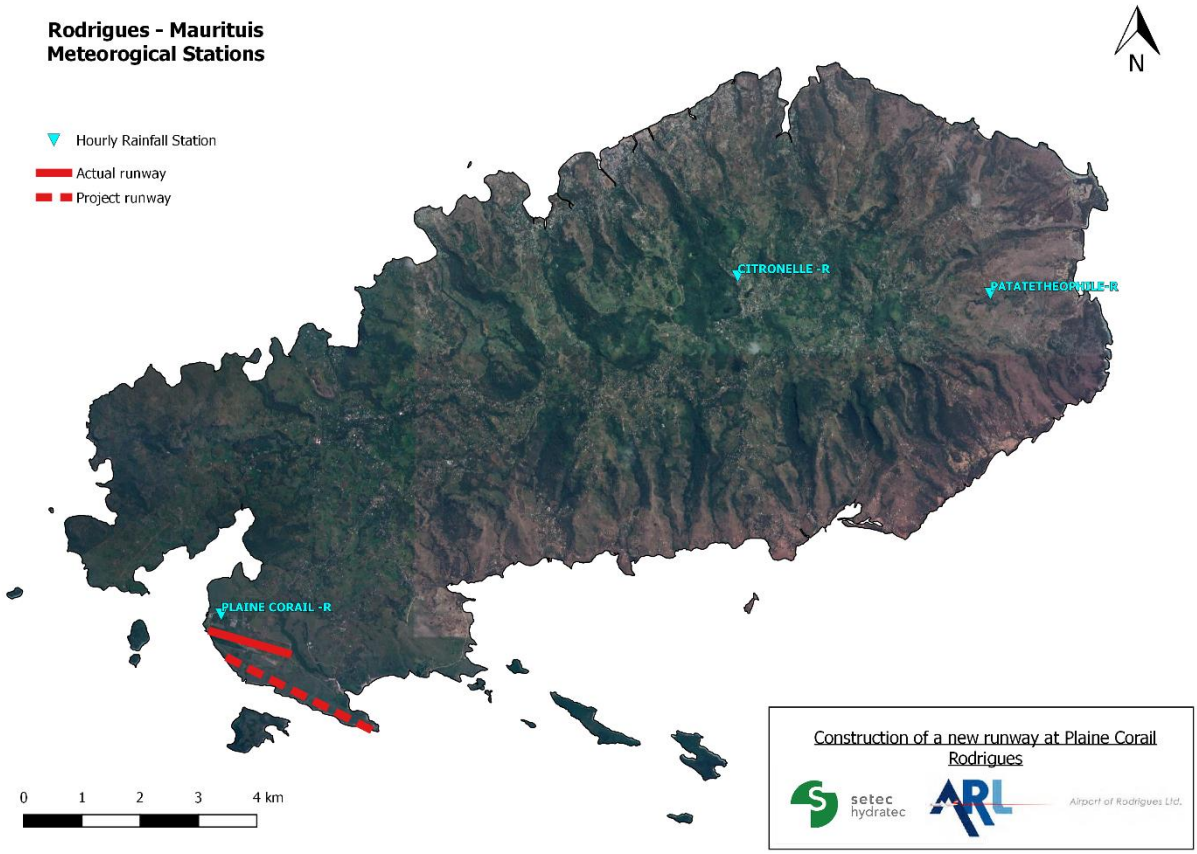


Figure 58: Rainfall stations. Note: The station "Plaine Corail – R" corresponds to the study area

6.3.7.2.2 Statistical analysis

Rainfall statistical analysis can be synthetized in Intensity – Duration – Frequency (IDF) curves.

Hydrological studies for statistical discharge estimation are based on IDF curves established from storm rainfall data across the island.

Note: Rainfall data specific to the Rodrigues Airport platform is not available since they do not exist. Therefore, as in the Preliminary Design, the rainfall data to be considered is the one used for Mauritius and based on the same IDF curves as Mauritius.

6.3.7.3 Runoff, rivers and flooding

The airport is located near the Anse Quitor River. The river is quite deep near the actual airport runway, and there is no potential flooding expected as a result.

The illustration below shows the Digital Elevation Model (DEM) of Rodrigues. This DEM was made from level curves of 10 m. The next figure shows a zoomed-in view of the DEM on the project area with level curves and flood areas for a 100-year return period.

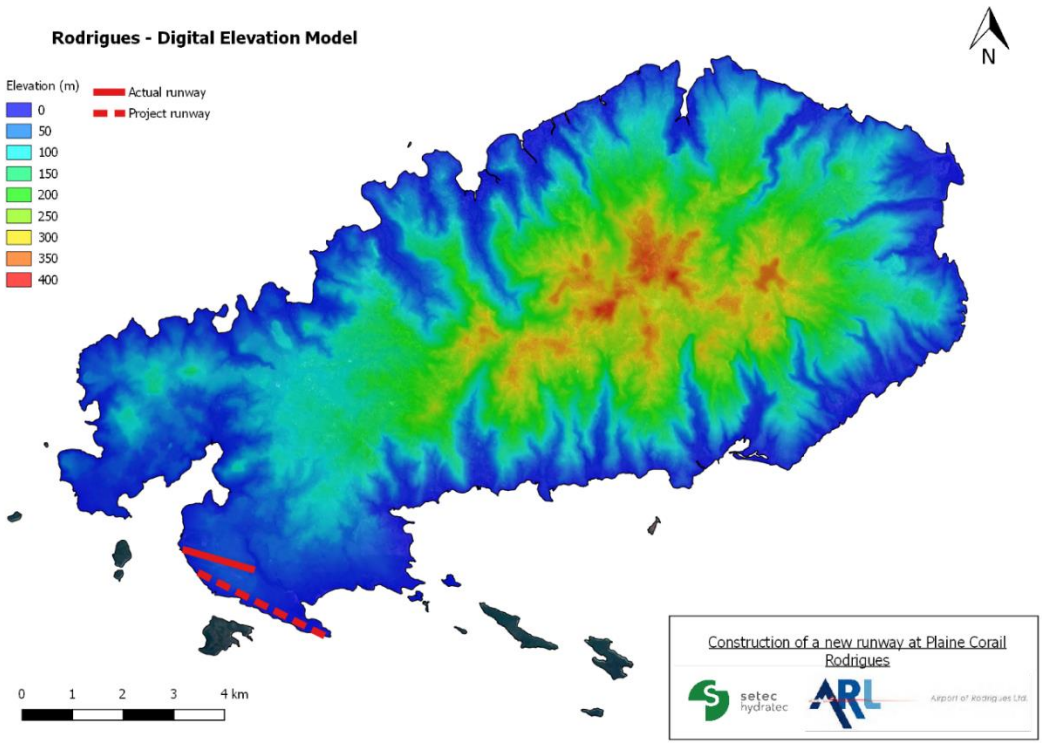


Figure 59: DEM of Rodrigues

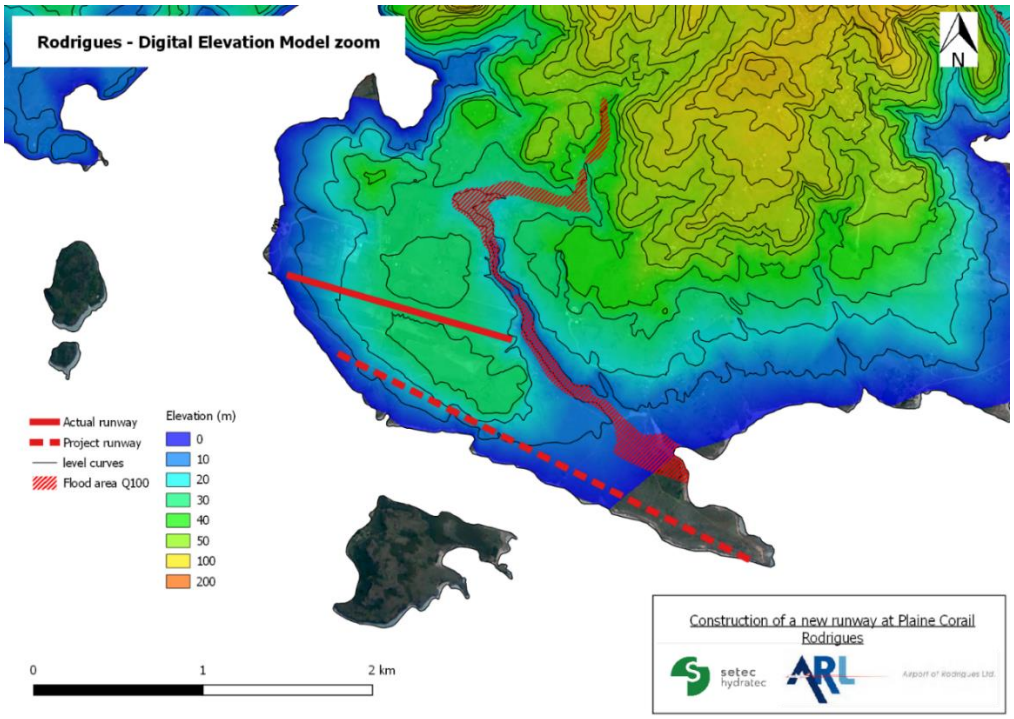


Figure 60: DEM of Rodrigues (zoom) and flood area for Q100

The map below shows a detailed view of the topography of the site from a 2m planimetric resolution point seedling.

On the basis of this topographical data, existing maps and observations made on site during the first field visit carried out at the beginning of April 2019, the sub-watersheds as well as the main runoff and rainwater drains could be specified:

- Artificial ditches. During the second site visit carried out with ARL at the beginning of May 2019, a drain was observed only around the existing apron and along the taxiway in front of the passenger terminal building, which passes under the existing taxiway and discharges the stormwater into the natural environment nearby as illustrated hereinafter.
- Natural low points of runoff concentration; however, no ditches are marked.

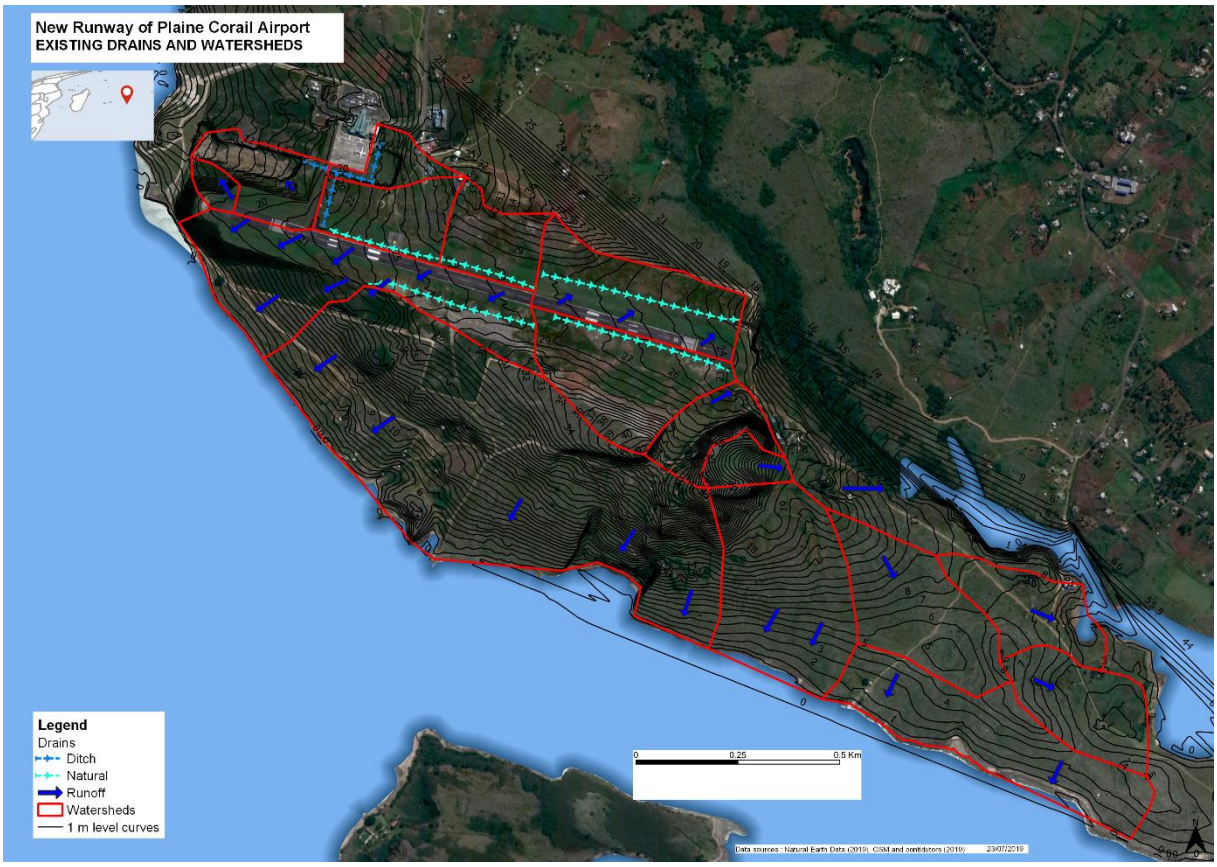


Figure 61: Detailed view of the watersheds and drains of the existing site (topography 2 m planimetric resolution)

Runoff from the current runway flows diffusely to the shoulders and into the natural drains. These runoffs are thus directly discharged into the natural environment.
The topography of the current track makes it possible to manage current rains without damage:

- slightly elevated topography compared to the low drainage points of natural watersheds,
- slight lateral slope allowing a regular drainage of water to the shoulders.

Figure 62: View south / north of the current runway – April 2019 field visit

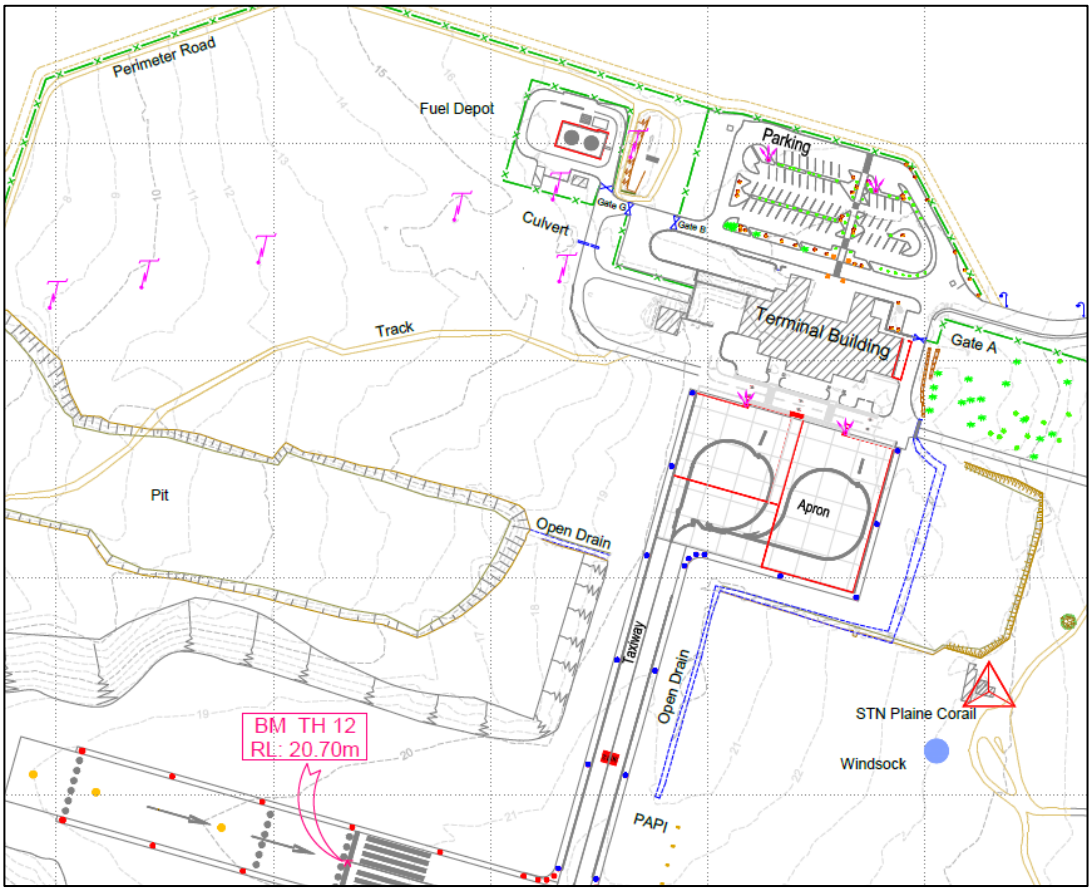


Figure 63: Extract of the general layout drawing showing the existing drains observed around the apron in front of the passenger terminal building

Figure 64: View of the existing drains observed around the apron in front of the passenger terminal building

Figure 65: View of the existing drains observed around the apron in front of the passenger terminal building

An uncertainty still remains on the accuracy of the flood zone observed on the previous map, particularly at the mouth of the Anse Quitor River illustrated below:

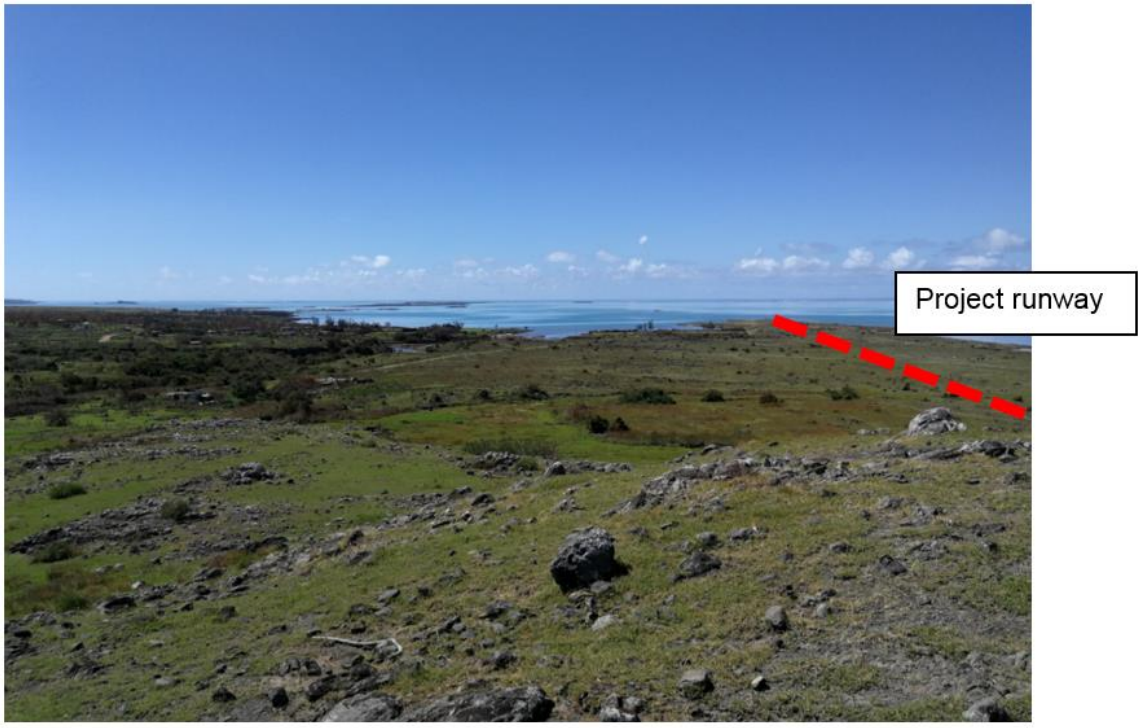


Figure 66: View north/south of the site of the project runway – April 2019 field visit

The first field visit highlighted a flat outlet of the Anse Quitor River, which is probably a flood-prone area.

Even if the boundaries of the project runway are probably in the flood area, the installations on fill above the original ground level will not be concerned by flooding and run-off.

The position on a watershed with no other built-up issues also limits the risks associated with stormwater run-off.

Thus, in light of the above, we can observe that the problem of stormwater run-off only concerns the drainage of the various platforms that will be managed and equipped with drains. In case of extreme events and overflowing of the drainage systems, stormwater will be discharged to the sea in gullies without impacting issues.

6.3.7.4 Hydrology issues

6.3.7.4.1 Stormwater management

Stormwater management is an issue regarding the new runway and its proper drainage is therefore important in order not to disturb the operation of the runway during landing and take-off of airplanes. Furthermore, its proper pre-treatment, with respect to oil, grease and suspended solids in our case, is also important before its discharge in the environment or at sea.

This issue sensitivity is of a major level.

6.3.7.4.2 Flooding of issues downstream of facilities

The development is likely to change the downstream flows. As no watercourses cross the project and all stormwater runoff discharges flow directly to the sea, no built environment issues are likely to be affected by this risk.

This issue sensitivity is of a low level.

6.3.7.4.3 Transfer of pollution to the natural environment

Transfer of possible pollution from the runway by stormwater runoff directly to the natural environment, including effluents generated by a fire fighting operation on the runway.

This issue sensitivity is of a major level.

6.3.7.4.4 Transfer of sediments to the lagoon

Stormwater management including a buffering storage and / or other works facilitating infiltration and reducing soil erosion enables to address climate change adaptation for disaster risk reduction. In fact, reduction of peak flows, run off and soil erosion leads to reduced sedimentation of water bodies including lagoons, thus protecting biodiversity, corals and white sandy beaches. The buffering storage offers an opportunity of confining any pollution generated by an eventual firefighting on the runway.

This issue sensitivity is of a major level.

6.3.8 Hydrogeology

This chapter focuses on the karstic calcarenites formation on the restricted area of influence. It aims to describe how ground water flows in this formation and to analyse the current quality of groundwater.

It also seeks to identify the points of vulnerability and contamination of groundwater, as well as the current use of groundwater.

The goal is to base the project impact assessment on the groundwater: risks of chronic or accidental pollution, flow modification and supply to wells, boreholes or springs due to karstic voids consolidation or filling in the project footprint area.

This subject is particularly sensitive on an island such as Rodrigues where fresh water is a scarce resource.

6.3.8.1 Hydrogeological setting

6.3.8.1.1 General considerations and definitions

The hydrogeological context is closely linked to geology. The hydrogeological units of the Rodrigues Islands are formed mainly by volcanic rocks and by a minority (in terms of coverage) of limestone (called calcarenite hereby) on the coast. The reader is asked to refer to the chapter on geology for more details.

The Figure 67 below shows the main hydrogeological units on Rodrigues Island.

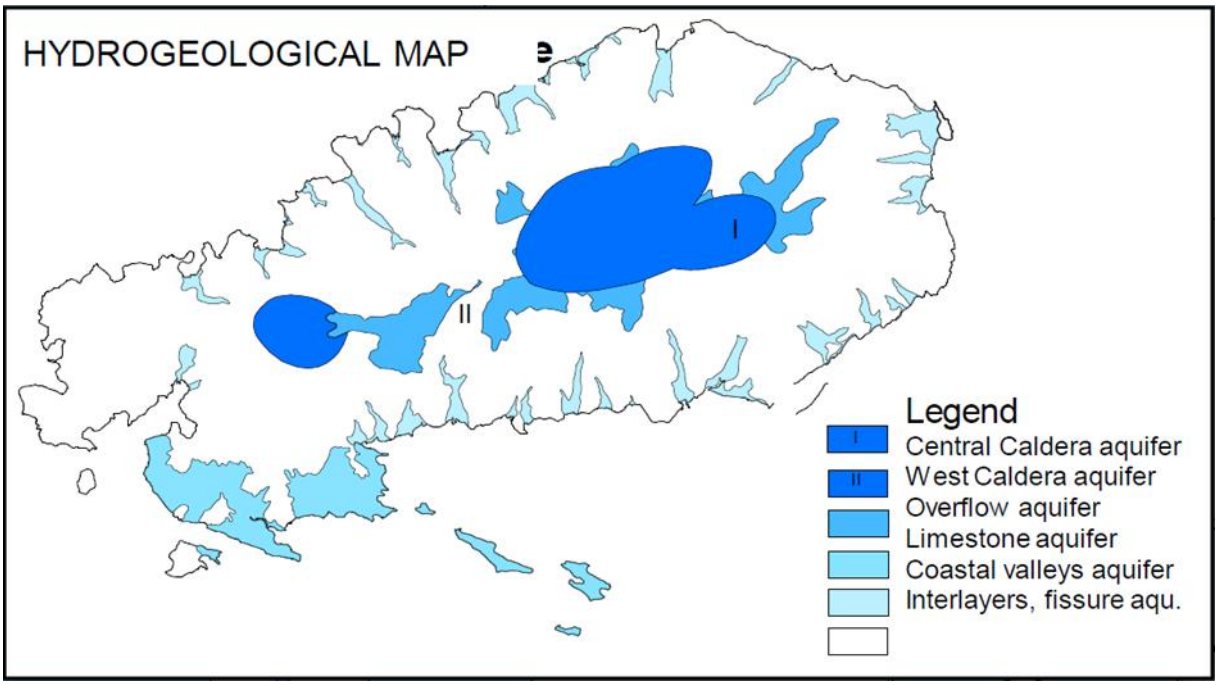


Figure 67: Hydrogeological map (from WRU of Mauritius)

According to surface observations and the interpretation of borehole data, Plaine Corail is characterized by two types of potentially aquiferous formation: basalts and karst calcarenites.

The basalts identified in the project area are weak, altered, and are defined as a fractured aquifer with double porosity: the matrix and the fracture porosity.

These two types of porosities define the aquifer properties and contribute to groundwater flow.

Karst calacarenites represent very complex aquifers since they combine three types of porosities that contribute to groundwater flow: the matrix, fracture and karst network porosities.

6.3.8.1.2 Particularities of karst carbonate aquifers

The restricted study area has elements typical of karst landforms: caves, doline, karren, lapiaz, sink holes, pinnacle, etc. closely linked to groundwater flow paths.

Karst aquifers are the most heterogenic and anisotropic type of aquifer. The secondary porosity, as fracture in fractured aquifer, comes from dissolution conduct networks (sometimes also called tertiary porosity).

This section aims to help with the understanding of groundwater movement in carbonate aquifer with well developed karstic network.

Figure 68 below shows a general conceptual model of a karst system called "double continuum", where water flows into voids (fast flow) and through porosity of the rock (slow flow).

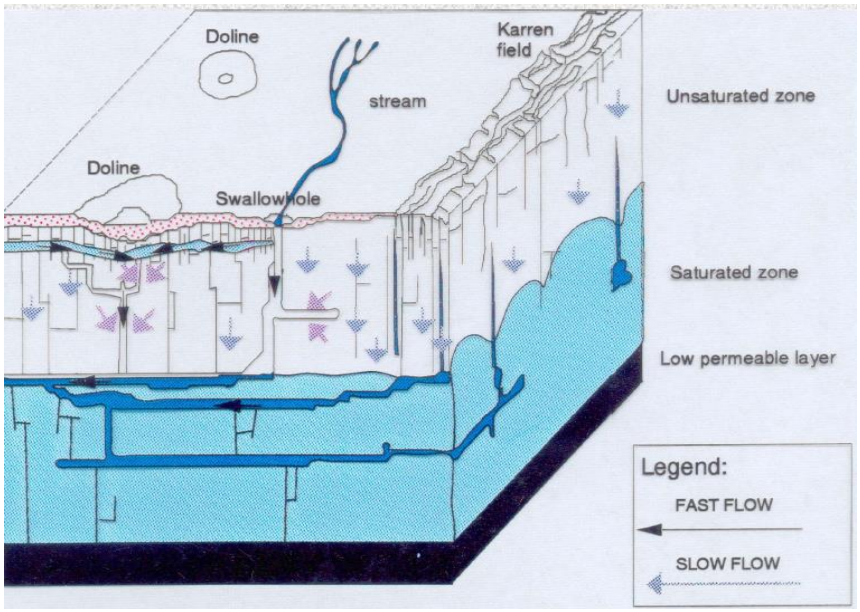


Figure 68: Karstic system conceptual model (modified from M. Bakalowicz, hydrosciences Montpellier 2002)

Hydrodynamically speaking (rapid variation in water conditions over time), the karst network is the most influential because it has a high capacity to transmit water between infiltration and discharge. A well developed karst network will react very quickly to precipitation, resulting in a sudden and significant variation in the groundwater flow regime.

The result of this particularity is that the aquifer reacts quickly to heavy precipitation and the direction of flow may be totally erratic. That is, groundwater flow does not correspond to a conventional pattern related to topography and geological structure. This makes it very difficult to develop a groundwater flow map that is representative of a seasonal period.

The epikarst, the upper part of the karst in which water is stored before it percolates to underlying aquifers, has a considerable importance to karst hydrogeology. The conceptual model above graphically shows how surface water from a stream flows, or direct infiltration from rain reaches first the unsaturated zone and then the saturated zone.

The concept of “elementary representative volume” is important in karst hydrogeology because local and regional groundwater flows can have very different behaviours and directions. The phreatic surface can be extremely variable in karst, due to high permeability contrasts.

6.3.8.1.3 Local considerations

6.3.8.1.3.1 Recharge process

The epikarst in the project area is partially represented by sinkholes when visible but also by numerous non-observable dissolution structures below the soil deposit. The process of recharge can occur by different mechanisms:

- Direct infiltration through the soil;
- Streambed infiltration (sinking stream);
- Lateral recharge from basaltic material.

In terms of volume, usually, sinking streams represent the one mode of recharge for the underlying karst aquifers. Floods may temporarily create an inflow to the cave network through riverbeds like the Anse Quitor River or through the large number of cave collapse sinkholes. In some areas, such as the Grande Caverne cave system’s Canyon Tiyel section, the presence of an elongated collapsed depression could also act as preferential inflow during rain to the underground network. A considerable amount of water can circulate in the karstic network during rainstorms.

Basaltic outcrops are present in the new runway area indicating the presence of a potential basaltic fractured aquifer. This aquifer is probably in relation to the overall phreatic water in the Pointe Corail peninsula.

6.3.8.1.3.2 Hydraulic properties

There is not sufficient information to provide hydraulic properties of the potential basaltic or karstic aquifer. Due to the high hydraulic anisotropy of the Karst aquifer, for the local scale of Plaine Corail, there is no practical reason to provide any range of permeability or transmissivity value. This agrees with the elementary representative volume concept discussed in the previous section. Indeed, the volume represented by the Plaine Coral Peninsula is too small to identify a flow pattern with certainty. Therefore, only an estimate based on a few observations will allow a conceptual model of groundwater flow to be presented in the following section.

6.3.8.2 Groundwater flow

Geotechnical investigations for the new runway extension highlighted groundwater level in 55 rotary coring boreholes out of 111 in total. Water level depths were converted to water elevation using borehole’s ground elevation references. The groundwater level in Phase B boreholes (south of the projected runway) is between 1.2 and 12.8 m deep below the ground surface.

Figure 69 below shows the groundwater elevation curves (isopiestic line) and the arrows indicate the hypothetical groundwater flow direction. Natural groundwater flow is relatively consistent with topography, but saturated karst features probably disturb the local groundwater flow. At this time, the only information about groundwater level mapping could be interpreted as above the level of tide influence. The groundwater level between 3 and 13 m AMSL on the map is consistent with topographic elevation in the area.

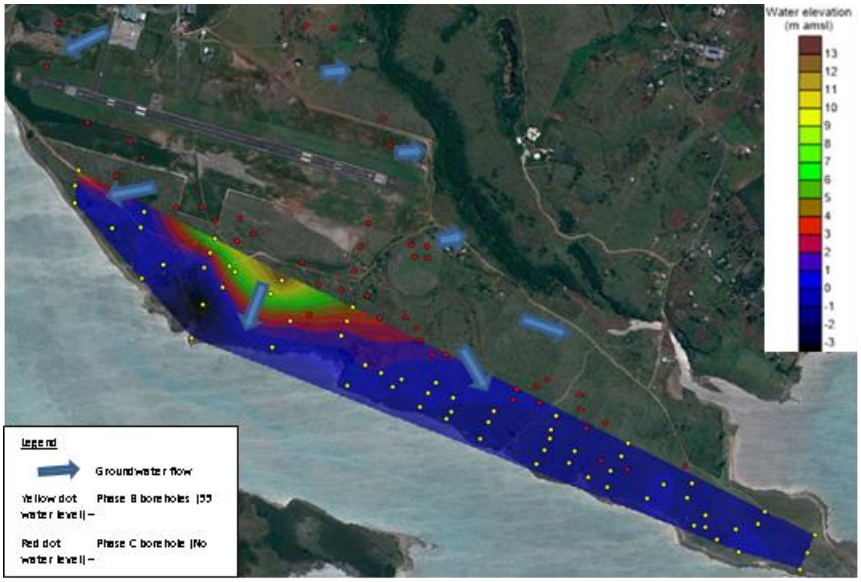


Figure 69: Location of two drilling campaign data sets and groundwater map contour

Negative groundwater elevation seems not to have any coherent signification. Tidal influence may affect consistence between values, as expressed in the geotechnical report. For example, based on the tidal prediction chart of May and June in 2016 (information on hand), the highest tide was 2.77 m. Spatial distribution of groundwater level is therefore probably not representative of a specific time. Unless a groundwater monitoring program with a datalogger is performed, no realistic groundwater level could be graphically produced at an exact representative time.

In the second geotechnical drilling campaign (Phase C), no groundwater was encountered in any boreholes. The red dots in Figure 69 show the locations of the phase C borehole campaign, while the yellow dots indicate the locations of the first (Phase B) borehole drilling campaign. The groundwater level from the Phase C geotechnical investigations does not appear to be reliable because the bottoms of 11 of the 47 boreholes drilled during phase C of the field work are under the sea level, with no groundwater level report. So the dry conditions of these boreholes are incoherent.

Figure 70 below shows a vertical profile of ground surface and groundwater levels (isopiestic lines in previous figure) from a section (red line) on both levels data. The solid blue line represents the measured water level and the dashed blue line represents the projected water level.

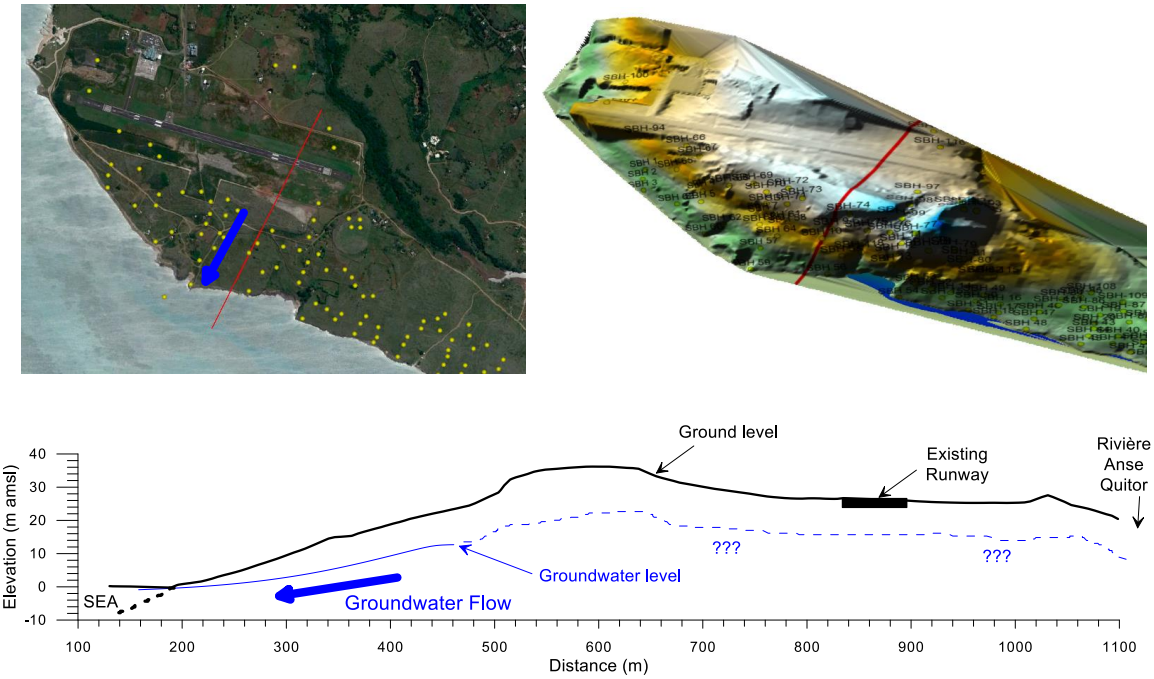


Figure 70: Vertical section of topographic and groundwater level

In conventional porous medium, groundwater is naturally flowing from a high land elevation to the sea, relatively associated to the landform. In a karstic medium, flow path is probably completely disturbed by saturated or partially saturated karstic networks and flow direction is probably not landform dependent.

Apparently, there are springs in the lower topographic part of the airport area because groundwater elevation is already close to sea level below the inland. There is not enough information to identify local groundwater patterns associated with all caves already identified in the airport area.

6.3.8.3 Hydrogeological receptors identification

The three receiving environments identified in the project area that are related to the hydrogeological context are as follows:

- Receptor #1: Carbonate Karstic aquifer
- Receptor #2: Basaltic aquifer
- Receptor #3: Caves

6.3.8.3.1 Carbonate Karstic aquifer

The carbonate eolian calcarenites aquifer on the left side of the Rivière Anse Quitor (northern side) has a consistent karst developed area with numerous opened caves and gallery connections. The calcarenites in Plaine Corail are probably affected as well by karstic development and numerous entries of caves as identified.

There is calcarenites outcrop in most of Plaine Corail site but it is also covered by mainly topsoil in the western part of the area. The geotechnical description of the topsoil is a very weak orangish cream coral with frequent seams of black silt and frequent rootlets. The average thickness of the topsoil in the area of borehole investigation is about 0.3 m and up to a maximum of 1 meter. This material does not represent an aquifer in the footprint area. A hydraulic permeability test will have to be performed in further investigations.

Based on the geotechnical and geophysical investigations, cavities appear to be scattered in calcarenite formation all over the study area, except in areas where the basaltic substratum outcrops to the surface. The cavities are mainly located below a 10 m depth. No cavity has been identified at 0 to 5m deep and laboratory tests indicate an average porosity of 33.8% for the weathered calcarenite in the first 5m of depth. This material seems to be relatively permeable (hydrogeologically speaking) and is probably part of the epikarst that contributes to surface water infiltration into the weathered and non-weathered calcarenite aquifer. The numerous cavities identified in the calcarenite below 5m depth consist of the karstic network up and below the groundwater level.

6.3.8.3.2 Basaltic aquifer

The basaltic aquifer represents a small part of the geological material in the project area because it is mostly covered by calcarenite materials. The MontSainte-Marie is the main outcrop of the basalt and no information on the groundwater level is available but probably lower than the deepest borehole, that is to say 25 m deep. Weathered basalt has usually high permeability compared to unweathered basalt. Geotechnical investigations identified mostly weathered basalt in most of the boreholes.

6.3.8.3.3 Caves

In the project area, caves are karst features expression as a disolution of carbonate rock. Based on the observations of the Riviere Anse Quitor's left bank, there are large caves and well-developed galleries of pluri-metric size and up to 500m (Grande Caverne) and 1 km long. (i.e. Caverne Patate in the vicinity of the project: Plaine Caverne). Several speleological and karst studies have identified interconnections between caves.

The right bank of Rivière Anse Quitor did not benefit from as many studies and galleries development and interconnections are only considered as a similar development. However, there are a few visible caves or sinkholes in Plaine Corail calcarenite that confirm the presence of potential large-scale karstic development. Geotechnical investigations also identified over 500 cavities (or drilling anomalies) in around 140 boreholes located mainly in the footprint of the projected runway.

Three caves are located near Plaine Corail village, around the end of the footprint of the projected runway (Figure 71). Evidence of paleontological materials were identified in one of them.

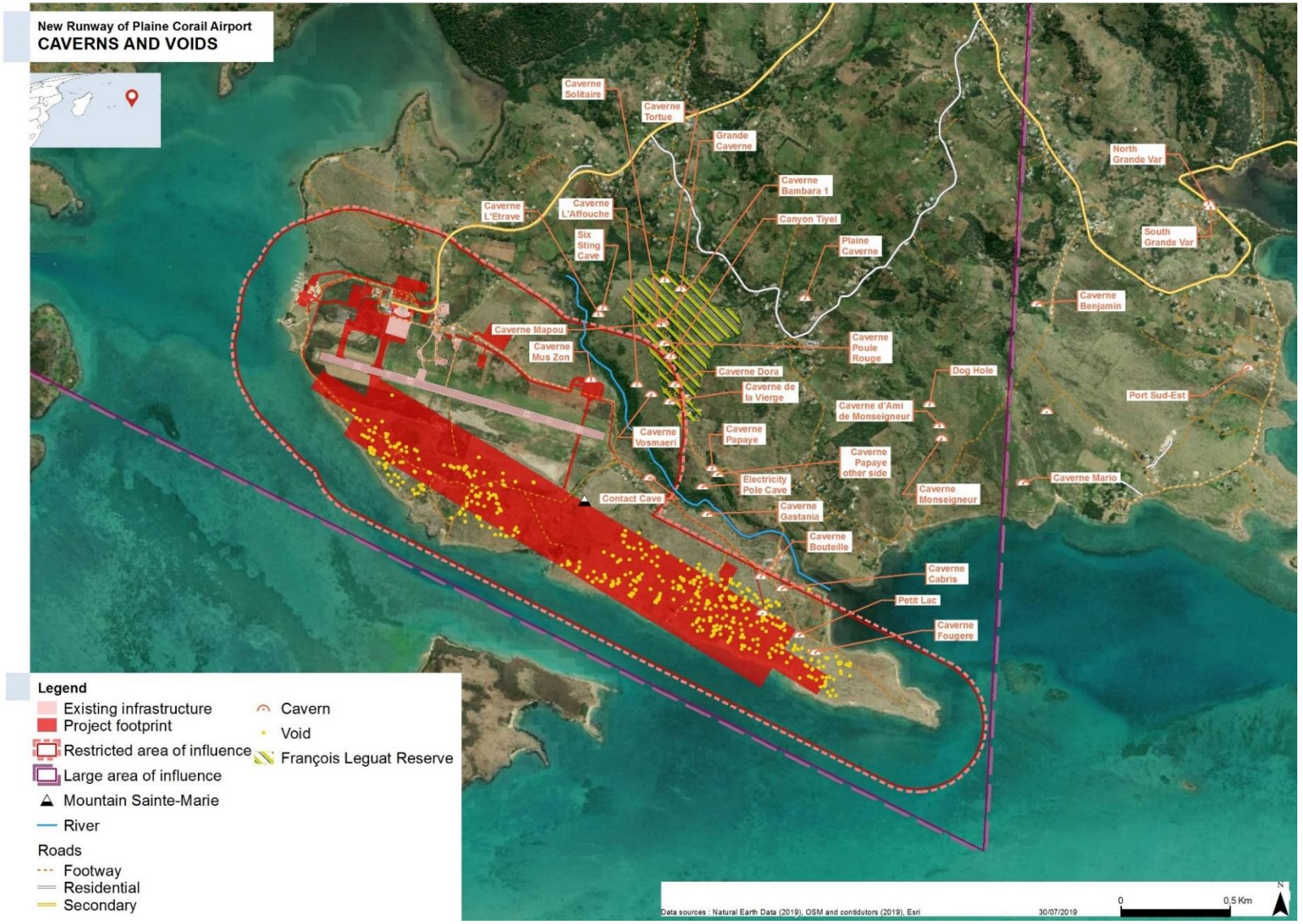


Figure 71: Caves location of the Plaine Corail area

- **Caverne Bouteille** is a small opening that gives access to a water filled chamber that is used for pumping water for the desalination plant. Groundwater quality is brackish probably mixed with fresh groundwater. Information on the quality of the water pumped to the Bottle Cave suggests that the supply of fresh water is significant. Indeed, the average electrical conductivity and salinity of the pumped water are respectively 25 000 us/cm and 15.4 ppt. However, the average conductivity and salinity values of seawater are respectively 55000 us/cm and 35 ppt. As the value of these upstream groundwater parameters is unknown, the ratio of fresh water to seawater cannot be determined, but according to standard values for groundwater, this should be close to 1/1 for the current operating flow rate. Any change in the operating rate may affect this ratio in the same location of extraction. Caverne Bouteille has galleries that reach a maximum length of 25m, a maximum depth of 8.5m. The small underground lake that occupies part of the cave reaches 2.5m in depth. Figure 72 shows Caverne Bouteille abstraction.

Figure 72: Caverne Bouteille orifice and abstraction

- **Caverne Petit Lac** is a small pond in a natural depression in the surficial calcarenite. This pond contains no significant sediment accumulation (Figure 73).

Figure 73: The pound of Caverne Petit-Lac

- **Grotte Fougère** is a collapse feature (sinkhole) with an anchialine pond (a landlocked body of water with a subterranean connection to the ocean that is also under slight tidal influence) as it shows variations over 30 cm during the tidal cycle. Fine organic sediment has accumulated inside the small cave. The sediments contain over 3000 years of well preserved bones, terrestrial and freshwater gastropod shells, and microfossils that include pollen, spores, and algal skeletons. For scientists and cave specialists, Caverne Fougère sediments represent an important paleoenvironmental site to preserve on the island. However, the fossiliferous sediments are probably already affected by sheep excrements and need immediate protection. Figure 74 shows the sinkhole – Caverne Fougère – and the presence of livestock (sheep).

Burney et al (2015) mapped the Grotte Fougère, which is estimated to have a development of about 25m. Figure 74 shows the topography of the Grotte Fougère

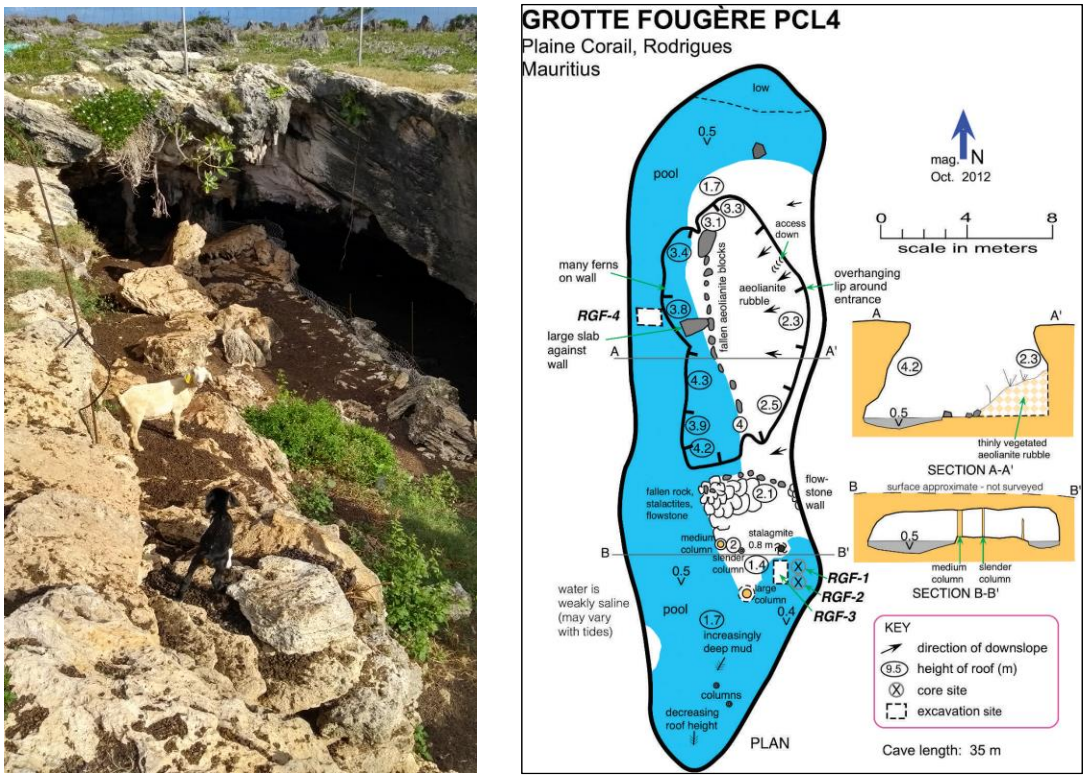


Figure 74: Grotte Fougère sinkhole view (left picture) and topography (right picture) from Burney and al. (2015)

Two other caverns also situated on the Rivière Anse Quitor's right bank and close to the project, include Caverne Gastonia and Caverne Cabris:

- Caverne Gastonia has an explored length of 142m. Its floor varies between 8 to 12 m AMSL. The larger cavities may have headroom of 12 m. Caverne Gastonia contains an underground lake in which there are several large cones composed of white calcite flakes. This phenomenon is rare in the world and may be the only occurrence in the southern hemisphere.
- Caverne Cabris runs over 68m of galleries. There is no more available information about this cavern.
-

6.3.8.4 Water quality, vulnerability and contamination

6.3.8.4.1 Water quality

There is no information about groundwater quality in the area of the airport. Water in the caves close to sea level is probably salted, at least in the tidal influence area. Salted intrusions in

land are not documented in Rodrigues (so far, the information where collected). Stagnant freshwater ponds inside the caves are usually quickly invaded by biological elements and quickly become inappropriate for human consumption. Water inflow from storms probably "flush" or dilute the stagnant water in the cave's pond changing the water quality for a relatively short term.

The water pumped into Caverne Bouteille is brackish and probably results from a mixture of tide influenced seawater and fresh water from the karst aquifer.

6.3.8.4.2 Vulnerability

Generally, when there is groundwater use for drinking water, the vulnerability of an aquifer becomes a main issue.

The concept of vulnerability is strong considering the nature of the superficial material as a "first barrier" to a potential contamination event from the surface. Topsoil has been encountered in most exploratory holes with an average thickness of 0.25m and it was generally described as gravelled, low plasticity sandy silt with roots (from Geotechnical investigation report phase C). This description of topsoil corresponds to a thin layer of non-impermeable material.

However, most of the material will probably be removed for the new airport infrastructure development. Vulnerability analysis on existing conditions will not reflect the vulnerability of the groundwater after the new installations are built.

Nevertheless, the information available on soil type and rock formation characteristics would indicate that the aquifers identified so far on the coral plain site would be highly vulnerable.

Future investigations should provide more information and, if necessary, develop a detailed vulnerability map.

6.3.8.4.3 Potential sources of contamination

Potential sources of groundwater contamination must be identified in the airport area. The usual contaminant vectors in the airport are:

- Fuel storage and operation (Kerosene, diesel and gas)
- Firefighting foam
- Industrial waste water
- Sanitary waste water
- Any chemical liquid or highly soluble material
- Contact rainwater, runoff water and infiltration

To our knowledge, there is no groundwater monitoring history at Plaine Corail Airport.

6.3.8.5 Groundwater uses in the Island

In 2009, KMPG indicated about 62% of water is captured by surfaces and 38% by boreholes. In 2009 the groundwater extraction from the boreholes was about 3780 and 2670 m^3/d respectively during the wet and dry season. It is to be noted that all boreholes are persistently over-utilized. The limit for borehole water has long been reached. Production is at maximum capacity and falling year after year. Based on the existing information review, no borehole is extracting groundwater in the vicinity of the airport.

The extraction of brackish water from Caverne Bouteille is not really considered a groundwater use in the same way as inland drilling. Nevertheless, the dissolution of seawater in Caverne Bouteille is indeed provided by a groundwater supply of karstic origin.

6.3.8.6 Hydrogeological receptors sensitivity

The hydrogeological issues mainly concern change in groundwater quality and quantity, no matter the nature of the aquifer. The change in water quality infiltrating the environment can then affect the physicochemical processes that naturally occur in the saturated or unsaturated levels of aquifer formations.

Caves are particular receptors that may or may not be part of the aquifer system. A karst network that is no longer active nevertheless plays a decisive role, especially during heavy precipitation. The interconnection of the cavities then transforms the underground regime for more or less short periods of time. Changing the recharge of these cavities or networks will therefore influence the natural temporary or permanent groundwater flow.

6.3.8.6.1 Carbonate aquifer

The hydraulic conductivity of karst aquifers is mainly ensured by the saturated or unsaturated gallery network. Aquifer recharge can be achieved both by infiltration through the ground and the epikarst and laterally by depending on the connectivity of the karst network.

Implementing an impermeable layer over the surface can therefore affect the recharge rate and therefore the groundwater flow regime. This aquifer is therefore considered sensitive to surface changes.

On the other hand, in Plaine Corail, the only use of groundwater from these cavities has been identified at Caverne Bouteille.

6.3.8.6.2 Basalt aquifer

There are groundwater users from this formation on the left bank (north) of the Anse Quitor River but no users have been identified in the Plaine Corail area. According to available information, there are no groundwater quality references for this formation on Plaine Corail.

6.3.8.6.3 Caves

Caves are partially part of carbonate aquifers when they contribute temporarily or permanently to the control of groundwater flow.

The sensitivity of caves is mainly associated with their palaeontological content present in sediments accumulated at the bottom of the caves for nearly 3000 years. The interest is therefore mainly scientific knowledge rather than environmental concern since some of these caves have already been affected by the presence of humans and livestock.

Table 36: Hydrogeological receptors sensitivity

Receptors identification	Receptors description	Sensitivity	Justification
Hydrogeology 1	Carbonate Karstic aquifer	High	Only one catchment structure has been identified in the nearby area (Caverne Bouteille). The water collected is already unsuitable for consumption due to its high salinity. Nevertheless, a change in water quality could lead to changes in the karst dissolution regime and affect the structure of the underground cavity network.
Hydrogeology 2	Basaltic aquifer	Medium	There are no catchment points in this aquifer on the Coral Plain. There are no water quality references. The basaltic formation outcrops on two areas that are precisely on the path of the new track.
Hydrogeology 3	Caves (Plaine Corail)	Major	Some caves (Caverne Fougère and Caverne Cabris) represent a fairly considerable scientific interest for the paleoenvironmental material in the sediments.

6.3.9 Water resource and waste water management

6.3.9.1 Water supply in Rodrigues

6.3.9.1.1.1 Current water supply

As Rodrigues is a small island, fresh water is a scarce resource. It comes from dams built on rivers, but also many boreholes and springs that are typical of karst areas.

The daily **water demand** for Rodrigues is estimated to be 11.000 to 12.000 m³/day.

This demand is satisfied by rainwater harvested by private individuals in private reservoirs and by water provided by the public services.

The production of water varies depending on rainfall intensity and frequency. The daily fresh water production is provided by surface water harvesting, boreholes, and desalination of marine water, in the following proportions:

Table 37: Water production for 2017/ 2022

Serial No.	Sources	2017	2019	2020	2021	2022
1	Surface water	1273	3000	3404	3033	2887
2	Boreholes	2529	3148	3510	1899	1878
3	Desalination	628	1200	1677	1805	1135
	Total	**4430**	**7348**	**8591**	**6737**	**5900**

Two desalination plants are already operational in Rodrigues:

- Songe, with a capacity of 500 m³/day;
- Caverne Bouteille, partially powered by solar energy and located close to the project area, with a capacity of .
    - Solar hybrid plant : 240 m³/day of potable water
    - Electricity plant : 300 m³/day of potable water
    - A project is currently under consideration to rise the capacity of the electric plant up to 1000 m3/ day.
- Caverne Bouteille plant'spotable water is distributed to about 1 500 families in :
    - Vangassailles
    - Anse Quitor/Corail
    - Cascade Jean Louis
    - Petite Butte
    - Grand Var
    - Plaine Corail/Airport
    - Grand La Fouche Corail
    - Mt Cabris
    - Camp Pintade
    - Citadelle
    - Pistaches
    - Piment/ Reposoire
    - Baie Topaze
    - La Ferme.
- The capacity of extraction of salty water is about 3 200 m³/day.

Here are the water quality results according to analysis carried out in Caverne Bouteille intake:

1.0 Intake Borehole water (before treatment)
2.0

Frequency	Parameters	Range of results
Daily	pH	6.2 – 8.4
	Cond	20100 - 29900
	TDS	10300 - 17900
	Salinity	12.2 - 18.6
Monthly	Chloride	10997 - 12876
	Sulphate	1602 - 2370
	Potassium	152.77 – 234.61
	Sodium	5119 - 6485
	Nitrate	<0.04

2.0 Desalinated Water (after treatment)

Frequency	Parameter	Range of results
Daily	pH	6.52 - 8.45
	Conductivity	119 - 550
	TDS	59 - 280
	Salinity	0.06 - 0.26
Monthly	pH	6.5 – 6.9
	Conductivity	511 - 561
	TDS	343 - 389
	Salinity	0
	Hardness	42 - 59
	CaCO3(alkalinity)	16.9 – 19.8
	Chloride	209 - 232
	Sulphate	9.67 – 12.89

Water distribution is managed by the water resources, water is collected from dams, boreholes and desalination plants, pumped uphill for storage into reservoirs prior to distribution by gravity on the network.

Water is treated prior to distribution on the network, the water from boreholes is not necessarily treated prior to storage into distribution reservoirs.

The map below shows the water network in Rodrigues.
A reservoir is located in the project area, named Bangelique reservoir, but it's not used anymore. A spring used for fresh water is located north of the project area, very close to the restricted area.

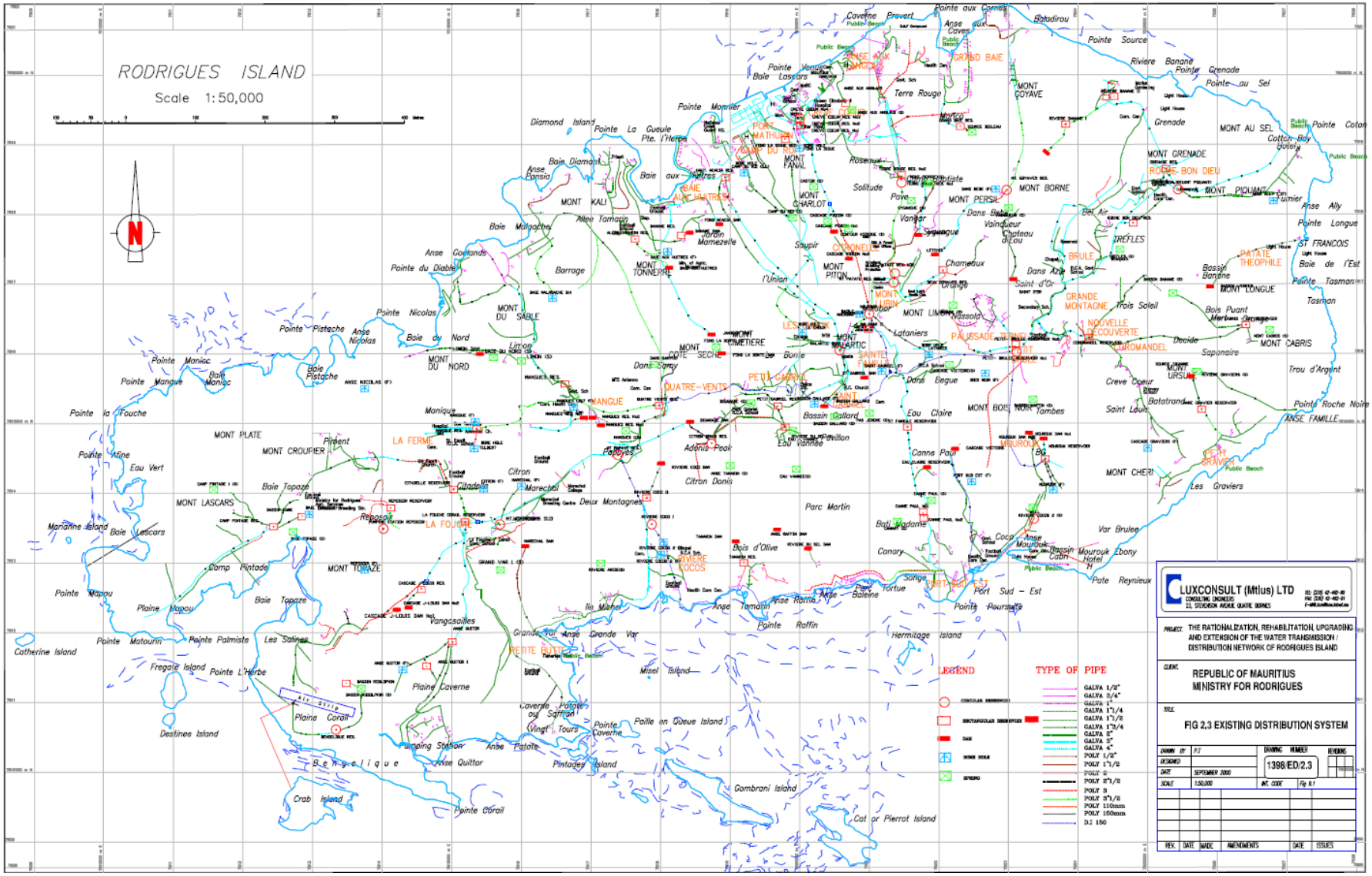


Figure 75: Water network of the island

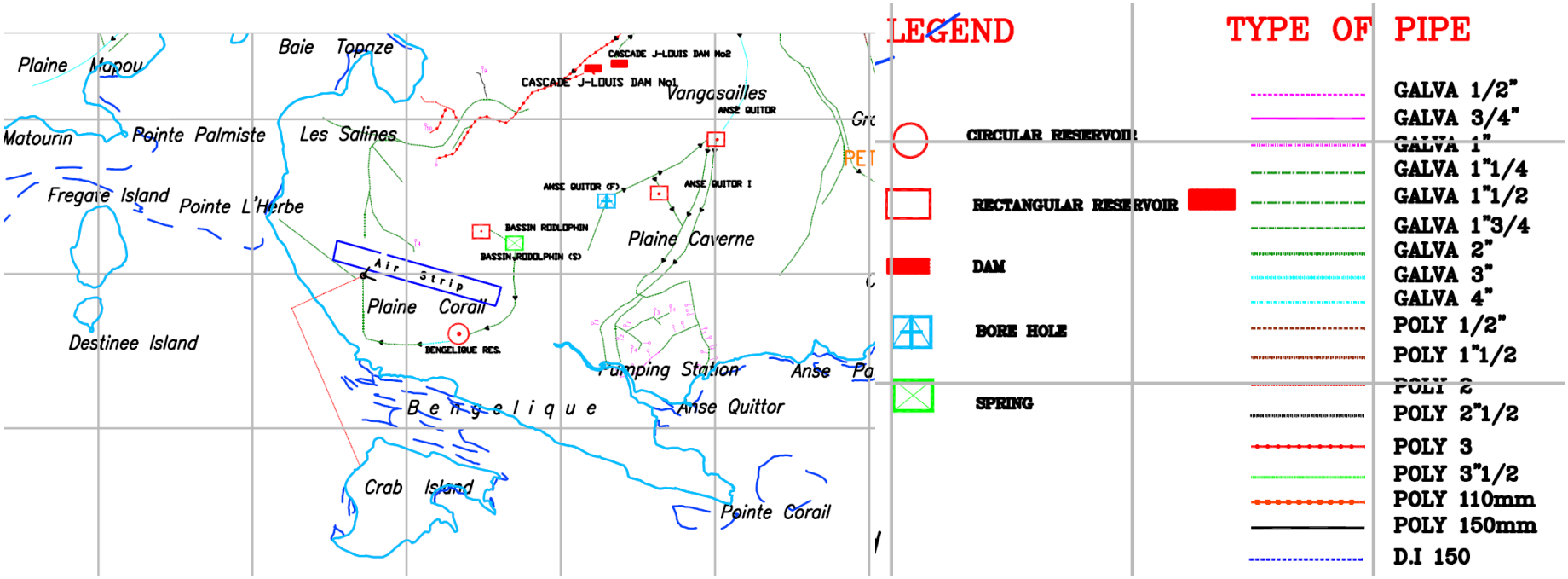


Figure 76: Water network in Plain Corail and the restricted area

6.3.9.1.1.2 Project for increasing water production

Two new desalination plants are to be commissioned:

- Pointe cotton;
- Baie malgache.

There is also a project of construction of a dam at Pave la Bonte or Anse Baleine, still under study. New boreholes could be projected, not precisely defined.

There is currently no master plan available for the water development at the commission for water resources. A consultation with the Government of India is currently ongoing to master and control the development of Rodrigues up to 2045.

6.3.9.1.2 Water supply and consumption in Plaine Corail Airport

The airport platform is connected to the public water supply distribution network. However, due to the erratic water supply from the public water network, the airport of Rodrigues relies mainly on rainwater harvesting to meet its daily water requirements.

The water collected from the roof of the terminal building is not treated and is used mainly for sanitary purposes and general maintenance and cleaning of the facilities at the passenger terminal building at Plaine Corail Airport.

The airport has a total storage capacity of 400 m^3 plus 2 additional individual tanks for rainwater harvesting. The main storage of 400 m^3, comprising 2 compartments in connection with each other (isolation of any one compartment possible) caters for a reserved volume for firefighting. The storage is also supplied by drinking water from the public water network. The water is used at the passenger terminal building and for firefighting (fuel depot) purposes using booster pumps installed in a room behind the storage concrete tank, as illustrated below.

Figure 77: Water storage and distribution facilities at the airport passenger terminal building

The graph below, provided by ARL, shows the water consumption of the airport for the year 2017. It can be observed that the water demand is highest during the months of October, November and December, which corresponds to Rodrigues' highest passenger traffic period, coinciding with school holidays in the Mauritius and Rodrigues Islands. During this period, the average daily water consumption reaches an average of 12.5 m^3 per day. For the rest of the

year when traffic is at its lowest, the minimum average daily water consumption is 3.6 m^3 per day. The average daily water consumption is estimated to 5.6 m^3 per day irrespective of the time of the year. This amount is expected to increase proportionally with the increase in passenger traffic at Plaine Corail Airport.

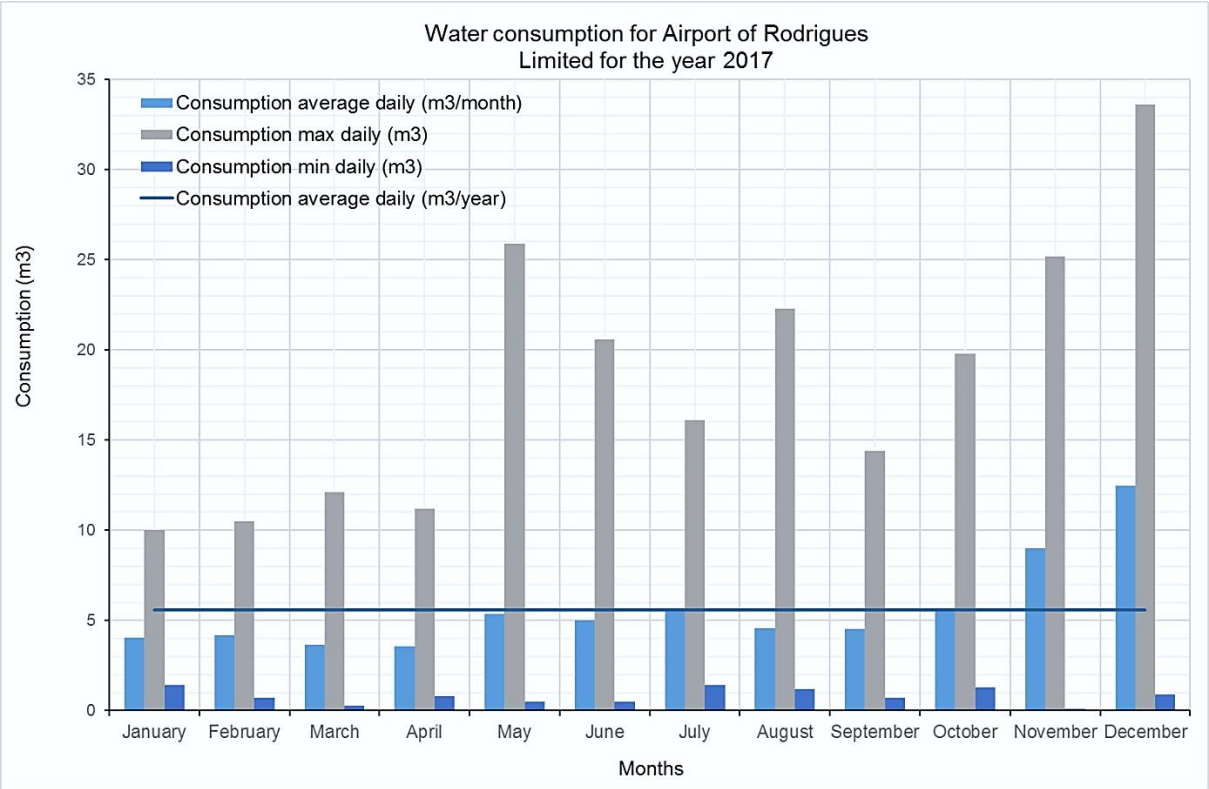


Figure 78: Graph of the water consumption for Airport of Rodrigues Limited for the year 2017

Table 38: Data table of the water consumption for Airport of Rodrigues Limited for the year 2017

Months	**January**	**February**	**March**	**April**	**May**	**June**
Consumption average daily (m3/month)	4.0	4.2	3.6	3.6	5.4	5.0
Consumption max daily (m3)	10.0	10.5	12.1	11.2	25.9	20.6
Consumption min daily (m3)	1.4	0.7	0.3	0.8	0.5	0.5
Months	**July**	**August**	**September**	**October**	**November**	**December**
Consumption average daily (m3/month)	5.5	4.6	4.5	5.5	9.0	12.5
Consumption max daily (m3)	16.1	22.3	14.4	19.8	25.2	33.6
Consumption min daily (m3)	1.4	1.2	0.7	1.3	0.1	0.9

The figure below illustrates an extract of the existing rainwater harvesting network from the roof of the passenger terminal building to the dedicated storage site.

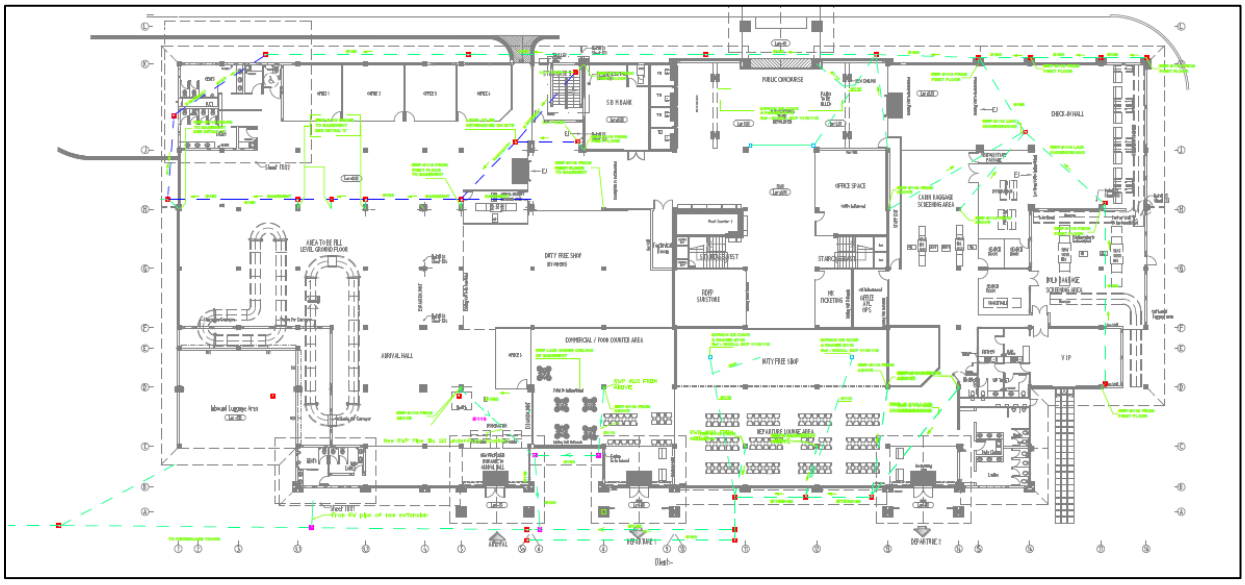


Figure 79: Extract of the existing rainwater harvesting network

Note: This principle will be included in the "integrated" water management plan, potentially envisaged at this stage, together with the overall wastewater and stormwater management of the whole airport platform.

6.3.9.2 Waste water management

6.3.9.2.1 Waste water management in Rodrigues Island

Rainwater is collected into drains and discharged into the sea.

There is no network of wastewater treatment on the island; most buildings have pit latrines. The existing airport has its own treatment system. Over 90% of households are owners of their dwellings, of these, 94% had access to sanitation facilities in 2000 (either flush toilets or pit latrines) (KPMG, July 2009). The existing airport has its own treatment system.

There is an underway water management plan for Rodrigues

6.3.9.2.2 Waste water management in Plaine Corail airport

The airport is currently equipped with a leaching field instead of the usual infiltration field. The leaching dates back to 2003, coinciding with the construction of the passenger terminal building and has been selected due the impermeability of the coral substrate at the airport.

The wastewater produced by the airport is directed to its own on-site wastewater treatment system consisting of a sceptic tank and a leaching field; which corresponds roughly to a primary treatment. The overflow from the septic tank is released to a leaching field. However, currently regular pumping of the overflow from the septic tank is done because the system does not work properly and the leaching field is not permeable enough. This pre-treated wastewater is carted away to the municipal wastewater treatment plant of Grenade.

The aircraft lavatory wastewater is not unloaded from the plane and is taken to Mauritius for disposal. No facilities are currently available in Rodrigues to handle it.

No heavy maintenance/repair activities are carried out on site at the moment. However, small maintenance operations can be done if necessary. The real extent of this activity cannot currently be estimated.

Note: In the framework of the “integrated” water management plan potentially envisaged, the specific effluents generated by maintenance/repair operations must be specifically collected and evacuated separately.

The figure below illustrates an extract of the sewerage network from the different collection points of the passenger terminal building to the dedicated septic tank.

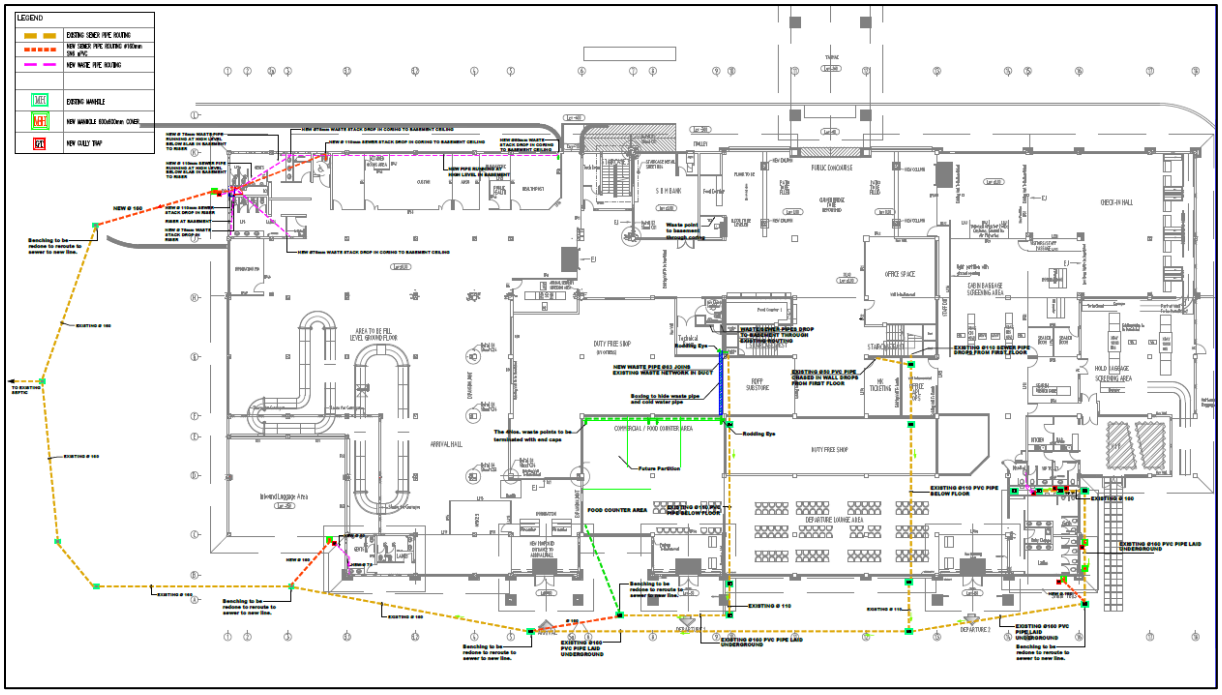


Figure 80: Extract of the existing wastewater network provided

6.3.9.3 Stormwater

As described above, only natural drains enable the stormwater drainage on the site, in addition to the natural slope of the existing runway which helps to drain the stormwater towards the sea, without any specific pre-treatment such as an oil and grease separator. An existing natural drain can be observed only around the apron and along the taxiway in front of the passenger terminal building, which passes under the taxiway and discharges the stormwater into the natural environment nearby.

The fuel depot is equipped with a retention capacity (equipped with a disconnection valve) to collect stormwater generated therein. Collected stormwater is then pumped for evacuation by dedicated wastewater tankers. The loading / unloading platform is equipped with a disconnecting valve in order to direct the stormwater from the platform towards an open-air oil separator (visual control for maintenance) during “off duty” periods and to isolate the platform during fuel loading / unloading operations. However, the disconnection valves are rusty and therefore show that they have not been used for a long time and further need a replacement, as illustrated below, as observed during our last site visit in May 2019.

Note: As indicated in the Preliminary Design Study, the new runway will be equipped with stormwater drains and oil and grease separators for pre-treatment purposes. However, due to the impermeability of the coral substratum, unlike what is mentioned in the Preliminary Design Study, infiltration will be difficult unless the infiltration drains and trenches are deep enough to go beyond the coral layer.
Anyway, in order to collect the storm water and pre-treat it on oil separators, the drains have to be impermeable to convey all the stormwater to be pre-treated. Therefore, it is expected that the stormwater be collected, pre-treated and managed within the framework of the "integrated" water management plan envisaged away from the runway. The impermeable drains are further required to collect and confine effluents generated by an eventual fire fighting operation on the runway.

Figure 81: View of the Fuel depot and associated facilities to prevent environmental accidental pollution

6.3.9.4 Water resource and waste water issues

6.3.9.4.1 Domestic wastewater management

Domestic wastewater management is an issue regarding the preservation of the surrounding receiving environment with the increasing number of passengers. Its proper treatment / management is therefore important before discharge in the environment or at sea.

This issue sensitivity is of a high level.

6.3.9.4.2 Water supply management

Water supply management is an issue regarding the sufficiency and availability of water at the airport for the different basic uses. Drinking water supply is very irregular and therefore alternatives have to be implemented. An integrated water management combining reuse of treated wastewater and stormwater, together with rainwater harvesting, is thus important and necessary. This can reduce the burden on the existing public water supply network. Given the island context and the limitation of freshwater resources and the potential relocation of one of the supply sources (Caverne Bouteille), the sensitivity of the drinking water supply is considered high.

This issue sensitivity is of a high level.

6.3.10 Summary: Physical environment sensitivity

Table 39: Physical environment sensitivity

Theme	Sub-theme	Receptor	Sensitivity
Physical environment	Marine and shores geology and marine turbidity	Marine sediment quality: contamination of marine sediments	Medium
		Marine sediment dynamics: physical disturbance of marine sediments	Medium
		Seawater quality: temperature, salinity, concentration of contaminant	High
		Physical coastal processes: shoreline, morphology, wave, currents	Medium
	Hydrology	Stormwater management	Major
		Flooding of issues downstream of facilities	Low
		Transfer of pollution to the natural environment	Major
		Transfer of sediments to the lagoon	Major
	Terrestrial geology and geotechnics and Hydrogeology Karstic environment	Carbonate Karstic aquifer	High
		Basaltic aquifer	Medium
		Caves (Plaine Corail)	Major
	Water resource and wastewater management	Domestic wastewater management	High
		Water supply management	High