NEHO
Nouvelle Energie Hydroélectrique de l'Onive

Sahofika Hydropower Plant

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Biodiversity Action Plan-Final Draft

biotope Madagasikara

biotope

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Project Owner	NEHO, Nouvelle Énergie hydroélectrique de l'Onive	
Contact Person	E&S Manager THEMIS Energy Meryem Lakhssassi	Contact Person
Authorized Representative	Biotope	
Biotope, Project Lead	Anna Deffner	Biotope, Project Lead
Biotope, Director of Studies	Fabien Quétier	Biotope, Director of Studies

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ERAA	Ecologically Relevant Analysis Area
AfDB	African Development Bank
BBOP	Business Biodiversity Offsets Program
CEM	Malagasy Environmental Charter
CEPF	Critical Ecosystem Partnership Fund
CGF	Contractual Forest Management
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CLP	Local Park Committees
CoAP	Protected Areas Code
CTE	Ad Hoc Technical Evaluation Committee
DMP	Development and Management Plan
DREEF	Regional Environment, Ecology and Forestry Department
EIES	Environmental and Social Impact Assessment
ES	Ecosystem Services
FDHMA	Dense humid evergreen forest
GSPM	Madagascar Plant Specialists Group
HIER	Hydro Ingénierie Etudes et Réalisations
IFC	International Finance Corporation
IUCN	International Union for Conservation of Nature
LW	Lichen Woodland
MECIE	Environmental Investment Compliance
MEEF / MEDD	Ministry of the Environment, Ecology and Forestry, recently renamed Ministry of the Environment and Sustainable Development (MEDD)
MEH	Ministry of Energy and Hydrocarbons
MH	Modified Habitat as defined by the IFC
MNP	Madagascar National Parks
NH	Natural Habitat as defined by the IFC
NPA	New Protected Area
ONE	National Environment Office
OS	Operational Safeguard
PNAM	Madagascar National Park
PREE	Environmental Commitment Program
PS	Performance Standard

TCC	Short Circuited Section. Corresponds to the Onive River between the dam and the water discharge point at the main hydropower plant.

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Abstract

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The Sahofika Hydropower Plant project, to be built on the Onive River, is located approximately 100 km as the crow flies southeast of the capital and 62 km east of Antanifotsy. This project nestles in the midst of a woodland that is typical of eastern Madagascar.

As one of the potential hydropower sites pre-identified by the Government, the Sahofika project will increase the country's electricity production capacity by around 300 MW, with 190 MW "guaranteed" production during low-water periods, to address the chronic deficit on the Antananarivo interconnected grid (70 MW at peak) and increased demand.

The Project Proponent is a four-company consortium including Eiffage, Eranove, Themis and HIER. Below is a brief description of the four companies:

- **Eiffage**: a French company operating in France and around the world in the areas of construction, infrastructure, energy and concessions;
- **Eranove**: a leading industrial group operating in the management of public services and the production of electricity and drinking water in Africa;
- **Neo Themis**: a project developer and investor with an exclusive focus on clean and renewable energy generation assets in Sub-Saharan Africa;
- **HIER (Hydro Ingénierie Études et Réalisations):** a Malagasy company specialized in hydropower plant projects.

An Environmental and Social Impact Assessment (ESIA) consistent with the requirements of Madagascar's national legislation and biodiversity standards laid down in PS6 of the IFC and OS3 of the AfDB was conducted in 2018 and 2019. This Biodiversity Action Plan follows on from the biodiversity component of the ESIA and includes the following:

- An assessment of critical habitats in accordance with Performance Standard No. 6 of the IFC,
- An assessment of residual impacts on species of conservation concern and critical habitats,
- A compensation strategy addressing these residual impacts, in accordance with the IFC's PS6 on biodiversity and with the objective of achieving a NET GAIN of biodiversity on the components concerned,
- A presentation of all mitigation measures to be implemented in order to reduce impacts on biodiversity and ecosystem services, which the BAP describes in a clear and practical manner by means of data sheets (**Annexes 1 to 6**).

Project Impacts

The Project comprises a 60 m high main dam standing on the Onive River and forming a 140 hm^3 reservoir (8.9 km^2), an underground gallery (headrace tunnel 4.2 km long) followed by a penstock (of 2 km in length) down to the hydropower plant located 6.5 km further downstream (13 km along the Onive River bed). The dam foundation level will be at an altitude of 1,328 m above sea level, while the hydropower plant will stand at 610 m. Therefore, the total height of the fall will be approximately 700 m.

According to a 2003 World Bank benchmark study[1] covering several hydropower projects around the world (Figure 1), the Sahofika dam project is one of the most efficient projects, based on the ratio between the number of flooded hectares versus the number of MW installed. The project has a ratio of less than 10 flooded hectares per installed MW, with a calculated ratio of around 4.5 ha / installed MW. This is relatively low in comparison with the other hydropower projects analyzed

[1] *World Bank, 2003. Environmental Criteria for Site Selection of hydroelectric Projects*

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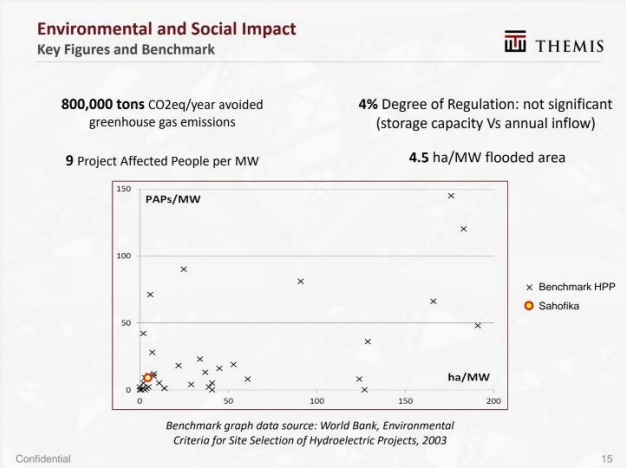

Figure 1. Comparison of several hydropower projects around the world based on the ratio of the number of flooded Ha and displaced populations versus installed MW (World Bank, 2003)

The project will also entail several types of impacts on biodiversity (detailed in the ESIA and Section 4.1 of the BAP), and the following in particular:

- In the reservoir upstream from the future dam, an alteration of the hydromorphology of the river and, therefore, of the aquatic fauna and flora habitat. Various river flow patterns will be replaced by a variable water body. This morphological change will be accompanied by physico-chemical modifications described in Chapter 5.8 of the ESIA (Version D, 2019).
- The rise in water levels will result in the submergence of approximately 144 ha of watercourses (Onive and tributaries).
- Downstream from the reservoir, there will be physico-chemical alterations with also a different sediment regime, caused by a different hydrological system.
- Habitat loss/degradation/disturbance related to the water reservoir, the project's infrastructure (temporary and permanent) as well as access tracks and the installation of the HV transmission line. These include in particular the track linking the dam and the plant as it crosses the forest corridor, which includes a number of priority biodiversity issues.
- Rising water levels, project emissions (noise, dust), construction activities followed by operation activities will lead to changes in the functional structure of certain habitats.
- The opening of access roads (towards the dam and between the dam and the plant) is likely to lead to population growth in the area, with the arrival of project personnel and migrants. This poses threats to fauna and flora (deforestation, poaching).

The natural habitats impacted by the project are home to considerable biodiversity, and are confirmed or potential critical habitats for nearly forty rare and/or threatened endemic species, including the fiollowing:

- the Onive river from the rapids area (Faravohitra waterfall, plant) confluence with the right bank Nosivolo tributary, integrating all the tributaries of the catchment area of the Manogoro and Nosivolo rivers - which is critical for the protection of *Rheocles wrightae* (EN) and *Rheocles sp. Ambatovy*;
- the rainforests of the Central Domain in the Mangoro catchment area, which are sensitive natural habitats due to the presence of about 80 threatened (CR, EN, VU, NT) or limited range fauna and flora species;
- the lichen woodland;

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- 9 plants: *Dypsis lutea (EN), Malagasia aff. Alticola (Capuron) L.A.S. Johnson & B.G. Briggs* (EN in the TROPICOS database), *Podocarpus rostratus (EN), Ravenea lakatra (CR), Aeranthes nidus* (EN in GSPM), *Angraecum viguieri* (EN in GSPM), *Dypsis decipiens (VU), Dypsis louvelii (VU), Peperomia hildebrandtii (VU);*
- 2 crayfish species: *Astacoïdes caldwelli, Astacoïdes madagascariensis;*
- 2 fish species: *Rheocles wrightae* (EN), *Rheocles sp. Ambatovy* (DD);
- 17 amphibians: *Boophis boehmei (EN), Boophis rhodoscelis (EN), Boophis rufioculis (NT), Gephyromantis blanci (NT), Gephyromantis cornutus (VU), Gephyromantis eiselti (EN), Gephyromantis thelenae (EN), Gephyromantis spiniferus (VU), Mantella cowani (EN), Mantella madagascariensis (VU), Mantidactylus albofrenatus (EN), Mantidactylus madecassus (EN), Anodonthyla boulengeri (NT), Plethodontohyla brevipes (VU), Plethodontohyla tuberata (NT), Stumpffia kibomena (Rhombophryne kibomena) (EN), Anodonthyla moramora (EN);*
- 2 chameleons: *Calumma hilleniusi (EN), Calumma oshaughnessyi (VU);*
- 1 snake: *Pseudoxyrhopus oblectator VU);*
- 4 lemurs: *Cheirogaleus sibreei (CR), Lepilemur betsileo (EN), Propithecus diadema (CR), Microcebus lehilahytsara (VU);*
- 1 Web-footed tenrec: *Limnogale mergulus (VU)*

Absence of significant impacts on critical habitats

The project impacts ~216 hectares of natural forest habitat, which are accounted for in the project's residual impacts. This ~216-hectare footprint corresponds to approximately 0.2% of the cumulative ecologically relevant areas of analysis used for the assessment of critical habitat in dense rainforests (north and south of the Onive River). This forest cover is negligible compared to the overall national forest cover, estimated at 8.9 Mha in 2014[2].

Residual Impacts of the Project

The project will result in significant residual impacts (including a permanent ~216-hectare footprint on forest habitats) on several groups of species for which some critical habitats have been identified (natural forests in particular), but also on the full range of associated forest species (lemurs, amphibians, reptiles). In accordance with IFC Performance Standard No. 6, these residual impacts will be offset by an ambitious "ecological compensation" strategy.

Key BAP Measures

The BAP features a total of 31 measures, including 5 environmental measures, 15 mitigation measures targeting terrestrial species and habitats, 5 mitigation measures targeting aquatic species and habitats, 7 support measures, including some providing alternative sources of income for the local population, and finally a project management assistance measure designed to ensure that BAP measures are implemented. The BAP proposes 4 compensation measures (one of which is a conditional measure) aimed at achieving a net gain in biodiversity, taking into consideration residual impacts on critical habitats:

- Preparation and implementation of a program to restore degraded areas in forests adjacent to the main forest corridor – BAP 21

[2] *Vieilledent, 2018. Combining global tree cover loss data with historical national forest cover maps to look at six decades of deforestation and forest fragmentation in Madagascar. Biological conservation 222. 189-197*

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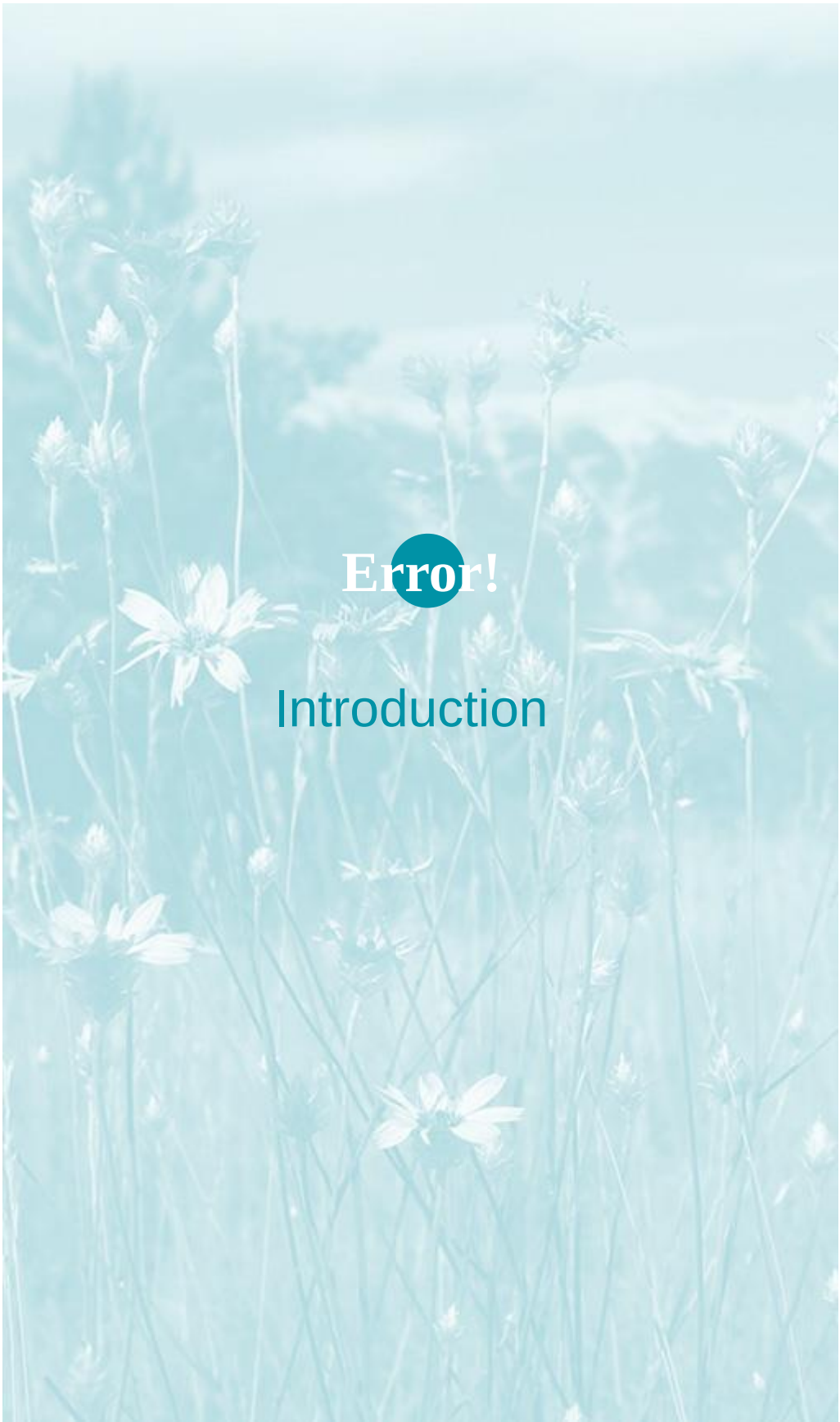
- Contribution to the creation of the Tsinjoarivo NPA for the conservation and restoration of natural forests – BAP 22
- Support for the conservation of natural forests in the Marolambo National Park – BAP 23



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Introduction

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1 Study Background

The Sahofika Hydropower Plant project, built on the Onive River, is located approximately 100 km as the crow flies southeast of the capital and 62 km east of Antanifotsy. This project nestles in the midst of a woodland that is typical of the eastern Madagascar region.

This project is part of a series of reforms introduced by the Republic of Madagascar in order to improve electricity supply in the country. To this effect, the Ministry of Water, Energy and Hydrocarbons (MEEH) declared, on June 17, 2016, the Eiffage, Eranove, Themis and HIER Consortium (hereinafter the "Proponent") as provisional contractor for the Project and signed, on December 2, 2016, an agreement for the construction of the Sahofika Hydropower Plant.

This consortium shall be responsible for designing, financing, building, operating and maintaining the Sahofika Hydropower Plant under a concession contract to be entered into with the Government of Madagascar, via a Malagasy company currently being established called Nouvelle Energie Hydroélectrique de l'Onive ("NEHO" or the "Concessionaire)

Upon completion, the project will have an installed capacity of 192 MW at the delivery point, 130 MW of which will be 99% guaranteed. The Project's objective is to provide low-cost, renewable base-load energy to the Antsirabé-Antananarivo interconnected grid. The average annual production will be 1,570 GWh. Considering its size, the facility will also contribute to the stability of the interconnected grid.

An Environmental and Social Impact Assessment (ESIA) of the project has been prepared to ensure compliance with Madagascar's national legislation, the performance standards of the International Finance Corporation (IFC) and the operational safeguards of the African Development Bank (AfDB) currently under review.

This document, which complements the ESIA, is the **Biodiversity Action Plan report for the Sahofika Hydropower Project in accordance with national** (**MECIE**) **and international standards**, those of the African Development Bank (OS3-AfDB) and the International Finance Corporation (IFC PS6) more specifically.

This report includes an updated assessment of the potential critical habitat triggers described in the ESIA, the presentation of the detailed technical sheets of the measures outlined in the Biodiversity Action Plan, in accordance with the requirements of the IFC and the African Development Bank.

This study was conducted using data already available in the current drafts of the ESIA, RAP and associated studies, based on additional literature reviews, a fact-finding field mission (July 2019) and consultations with stakeholders

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2 Biodiversity-related Due Diligence

Table 1. Summary of all Biodiversity-related Due Diligence Activities Performed in Connection with the Sahofika Hydropower Project

E&S safeguard document	Diligence conducted and objective	Conducted through	Conducted by	Date / Period	Location
Environmental Scoping	• The project was subject to an **initial environmental scoping mission** carried out from October 2017 to March 2018 by Biotope, Zina (a local NGO) and their partners. This scoping mission focused on the biodiversity and natural resources component, which made it possible to establish the specifications for the elaboration of the project's Environmental and Social Impact Assessment (ESIA).	• Field visits	• BIOTOPE • Zina and partners focusing on the biodiversity and natural resources component	• October 2017	• Project area (dam + plant site)
ESIA	• Within the framework of the ESIA, and in accordance with the national and international regulatory framework governing the project, two field surveys on the biological component were thus conducted by the Biotope SAS and Biotope Madagascar teams: one in March-April 2018 (rainy season) and another one in September-October 2018 (dry season), reinforced by experts from the University of Antananarivo, in order to cover potential seasonal effects and ensure the inventories and collection of baseline data are as comprehensive and reliable as possible.	• Two biodiversity inventory sessions (dry and wet seasons)	• BIOTOPE SAS • BIOTOPE Madagascar • Experts of the University of Antananarivo • Sourcing of national experts (Vahatra for fauna and GSPM for flora). •	• March-April 2018 (rainy season) • September-October 2018 (dry season)	• Project area (dam + plant site)
	• As part of geotechnical surveys conducted for the project's engineering purposes, and the construction of the penstock in particular, an additional field survey was conducted to ensure geotechnical activities carried out in July 2018 were completed in accordance with the required standards. This	• Field visits	• BIOTOPE Madagascar	• July 2018 • October 2018	• Project area

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E&S safeguard document	Diligence conducted and objective	Conducted through	Conducted by	Date / Period	Location
	was supplemented by a second interim control survey conducted in October 2018.				
	• Fauna and flora inventories along the route of the power transmission line to Antananarivo and the integration of associated impacts into the ESMP were carried out in March 2019, along the corridor selected for the construction of the high-voltage (HV) power line.	• Inventory	• BIOTOPE Madagascar	• March 2019	• Along the corridor selected for the installation of the HV power line.
	• Zina's experts, who were responsible for studying the project's impacts on conservation and/or renewable natural resource management areas, visited the field during the second half of 2018. Their meeting with stakeholders took place in Fandriana, Antsirabe, Moramanga and Antananarivo.	• Consultations with stakeholders	• Zina experts	• Second half of 2018	• Fandriana, • Antsirabe, • Moramanga and Antananarivo.
	• Public consultation phase as part of the ESIA process (see details in the ESIA report).	• Consultations with stakeholders	• NEHO	• June 2019	• Fokontany of Sahofika, Antenina, Fisoronana, and Befotaka. • Commune of Tsinjoarivo • Commune of Belanitra • Alaotra Mangoro and Vakinankaratra regions • Asity Madagasikara • Sadabe NGO • Antananarivo, with

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E&S safeguard document	Diligence conducted and objective	Conducted through	Conducted by	Date / Period	Location
					institutional partners • Antananarivo, with NGOs
BAP	• E&S safeguard document	• Diligence conducted and objective	• Conducted through	• Conducted by	• Project area (dam + plant site)
	• To justify and explore the content of the BAP measures with the stakeholders concerned by their implementation, the managers and developers of the protected areas concerned, renowned scientific organizations or experts, or civil society organizations involved in biodiversity conservation in Madagascar, an exchange visit to Antananarivo was conducted after the field visit.	• Consultation with Rainforest Trust & SADABE • Report in Annex 8	• BIOTOPE SAS	• From July 29 to August 2, 2019	• Antananarivo
	• A workshop was organized with SADABE, Rainforest Trust and MAVOA to study the list of conservation concern species to be included in the BAP and the various ERC measures proposed.	• Workshop • Report in Annex 8	• BIOTOPE SAS	• August 13, 2019	• Antananarivo (at Biotope Madagascar's office)

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3 Presentation of the Project

The Sahofika Hydropower project is located on the Onive River. Upon completion, the plant is expected to have a delivery point capacity of 192 MW, with a production capacity of approximately 1,500 GWh per year. The Project consists of the construction and operation of a hydropower plant on the Onive River in Sahofika. The main components of the Project are as follows:

Permanent Footprints:

- The dam on the Onive River, which consists of a 60 m high main structure and a 35 m high saddle dike, as well as a watertight buried separation;
- **The reservoir or submerged area** upstream from the dam. Once the dam is in operation the reservoir will have a volume of 140 hm^3 and a surface area of 8.9 km^2;
- The **river and its various facilities**: the entrance bays and the headrace, the diversion structure, the surge tank, the gate house, and the penstocks to the plant;
- The **powerplant or hydropower plant** (on the surface) itself, including buildings and ancillary production and discharge management equipment;
- The switchyard, the transmission line and substation down to the dam;
- The 220-kV double-circuit **power transmission line** to Antanifotsy from the dam; The power discharge line to Antanifotsy from the dam;
- **Access**: rehabilitation of existing tracks and construction of new access roads to the project site (from RN7 to the dam and between the dam and the plant following the route validated with the consortium based on a multi-criteria analysis of environmental and social issues);
- **The bridge** over the Onive River downstream from the dam at the start of the track leading to the plant;
- The **operation buildings** including: the operation city on the right bank and the dam operation building on a site on the left bank downstream from the dam. The plant's operation building;
- The social measures to support the populations and in particular **the site for the resettlement of displaced populations** and associated compensation areas (agriculture, housing) as well as the rural electrification project, the content of which is currently unknown;
- Ecological compensation areas.

Construction site footprints:

- **The quarries dedicated to the project and their access roads**: the operation mode planned is by open-cast mining with explosives;
- **Industrial site facilities**: concrete mixing plants, metal reinforcement units, storage areas for machinery and equipment, excavated materials, etc. (still to be defined, with a principle of maximum mutualization in the final areas);
- **The construction site base camps** providing accommodation and work areas for contractors, the project owner and their advisers, located in areas yet to be defined, to be mutualized as much as possible with the final footprints (impact not assessable at this stage);
- **Reconnaissance drilling footprints**, part of which could be analyzed during the ESIA field work phase and whose monitoring is yet to be finalized.
- **Construction site accesses**, defined in the preliminary design or yet to be defined and facilitating construction works.
- **Temporary diversion structures**, as defined in the preliminary design agreement and enabling the phased construction of permanent structures on the river.

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Duration of construction works and operating procedures:

The construction of the project is scheduled to be completed in 56 months. The operation of the facility is subject to discussions between the designer-builder and the operator, based on a functional description of the facility and on the specifications laid down by the authorities for production facilities connected to the grid being installed. The exact date is therefore not known with precision. However, the power purchase contract, which is currently being finalized, provides for a high load factor for the facility (baseload operation).

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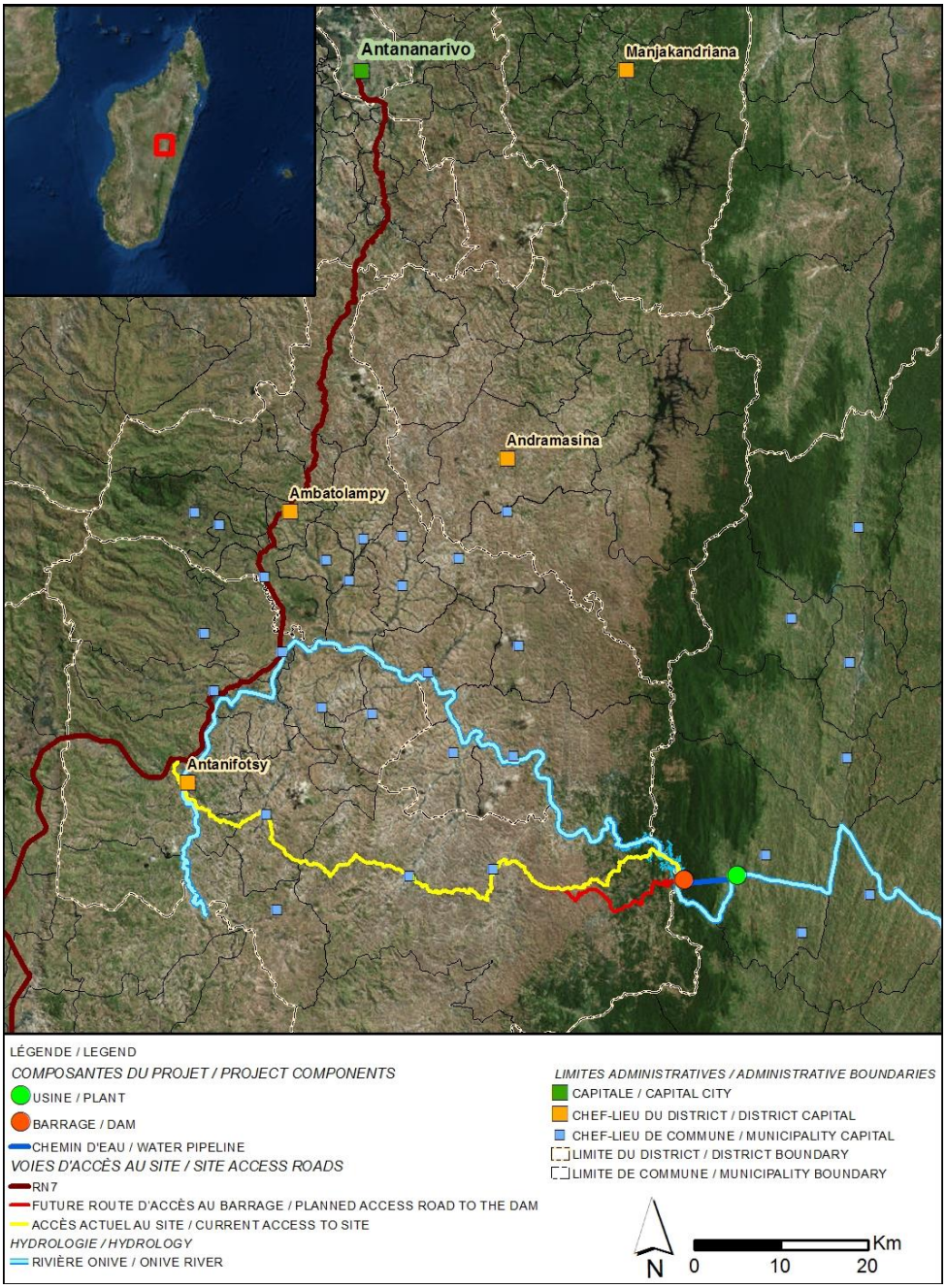
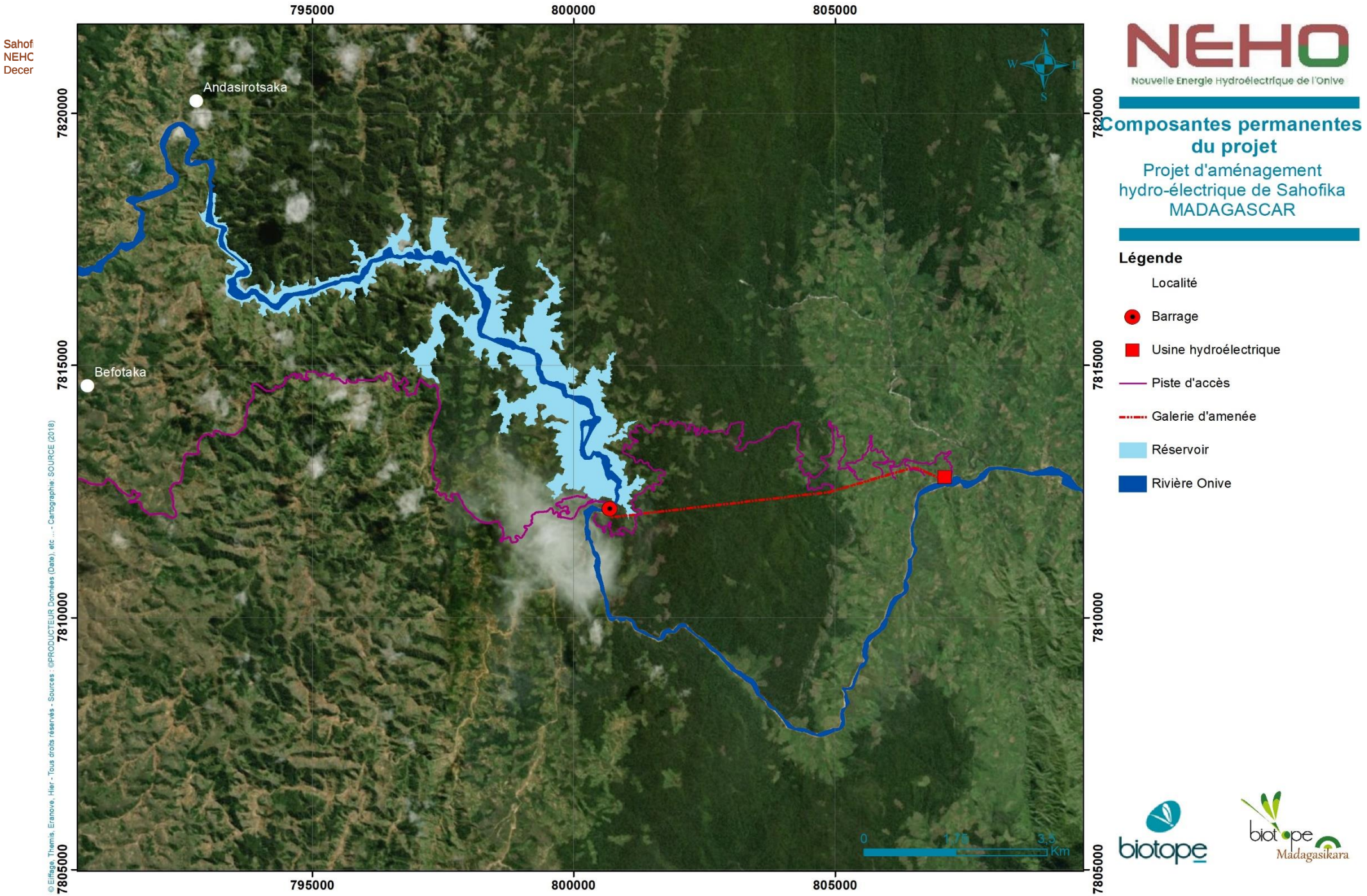


Map 1. Location of the Sahofika Powerplant Project (Source: ESIA Report – version D, 2019)



Carte 2. Permanent Project Components (ESIA Report, 2019)

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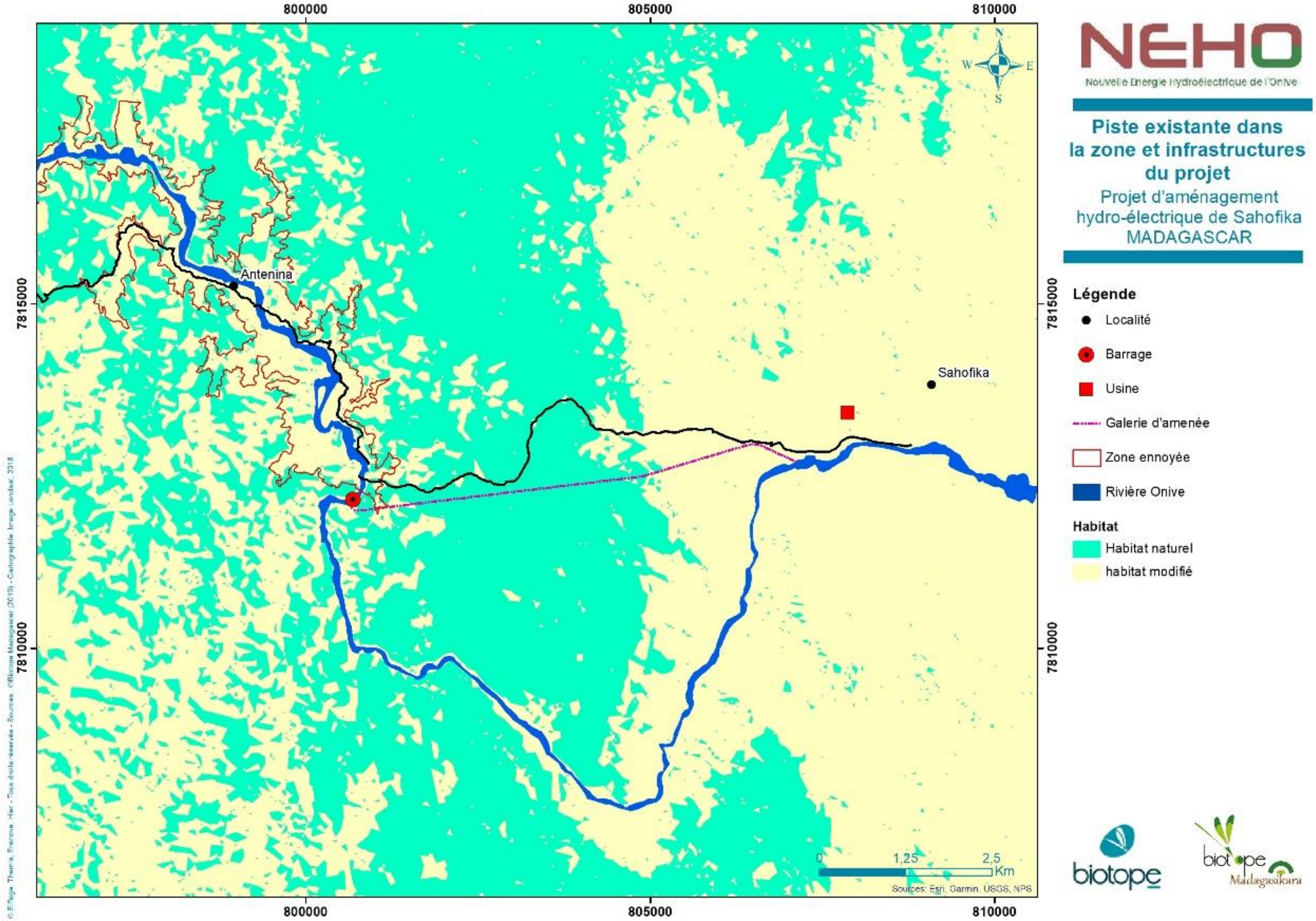

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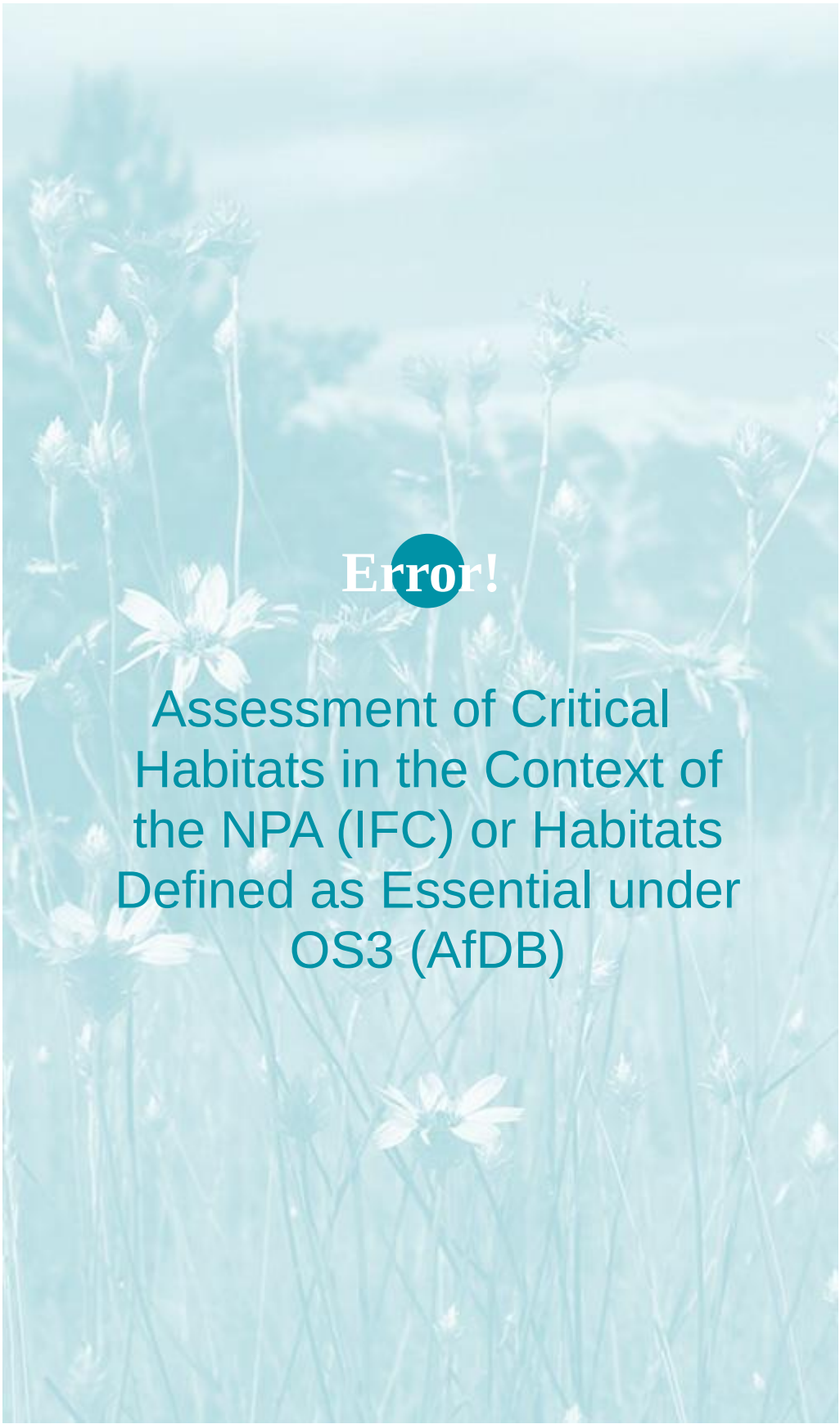
Carte 3. Permanent Project Components – Modified/Natural Habitats (Biotope, 2019)



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Assessment of Critical Habitats in the Context of the NPA (IFC) or Habitats Defined as Essential under OS3 (AfDB)

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1 Overview of the PS6 (IFC) and OS3 (AfDB) Criteria

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1.1 PS6 - OS3 and the Mitigation Hierarchy

1.1.1 Performance Standard 6 (PS6 – IFC, 2012)

Performance Standard 6 (IFC, 2012), along with its guidance note updated in June 2019, is now a benchmark shared by numerous financial institutions. The standard specifically addresses issues related to **biodiversity, natural environments and natural resources (including ecosystem services)**, and is actually one of **8 performance standards** that provide a framework for good practice for all issues related to a development project's implementation and operation phases: Assessment and Management of Environmental and Social Risks and Impacts (PS1), Labor and Working Conditions (PS2), Resource Efficiency and Pollution Prevention (PS3), Community Health, Safety, and Security (PS4), Land Acquisition and Involuntary Resettlement (PS5), Consideration of Indigenous Communities (PS7), and Cultural Heritage (PS8).

Overall, PS6 has three objectives: (1) **protect and conserve biodiversity**, (2) **maintain the benefits of ecosystem service**s, and (3) **promote the sustainable management of living natural resources through** the adoption of practices that integrate conservation needs and development priorities.

To achieve these objectives, PS6 recommends the application of the **mitigation hierarchy** and requires a "no-net-loss" and/or "net-gain" outcome for biodiversity. This requires project proponents to demonstrate that their project **avoids** damage to biodiversity and its services, or **reduces** the extent of such damage, and, finally, that it compensates for damage that could not be prevented or reduced. **This means that losses attributable to impacts that could not have been avoided or reduced must be quantified, and must be equal to or less than the "gains" attributable to compensatory measures.**

There are a number of key issues and questions that need to be addressed to structure the correct definition of the mitigation hierarchy to achieve the "net no loss" or "net gain" objective.

There are a number of key issues to be addressed and questions to be asked in order to structure a correct definition of the mitigation hierarchy to be implemented before the "no net loss" or "net gain" goal can be achieved.

1) **The timeframe**

It is important to be clear about the timeframe or deadline for achieving the objectives.

2) **The spatial framework / scale**

The spatial scale at which the measures put in place to achieve the objectives should be precisely defined: local (site scale), regional (landscape scale), etc. The spatial scale of the measures put in place to achieve the objectives should be defined with precision.

3) **The initial or zero status**

It is crucial that the baseline biodiversity situation against which results will be measured be defined properly. This can be the current situation, a past situation or a future situation.

4) **The measurement unit or "metrics".**

This is the precise definition of the indicators and their measurement unit to be used to measure and evaluate the success of the measures that form the mitigation hierarchy.

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5) **The views of actors/stakeholders.**
6) **Transparency of the approach**

Are working assumptions, choices made and data sources clearly and openly documented and publicly shared?

1.1.2 Operational Safeguard 3 of the AfDB

This Operational Safeguard 3 "Biodiversity, Renewable Resources and Ecosystem Services" sets the objectives for conserving biological diversity and promoting a sustainable use of natural resources. It also captures the commitments contained in the Bank's Integrated Water Resources Management policy and operational requirements. The specific objectives of this OS are as follows:

- Preservation of biological diversity and ecosystem integrity by reducing and minimizing, if not avoiding, potentially negative impacts on biodiversity;
- Restoration or rehabilitation of biodiversity, including in cases where certain impacts are unavoidable, the implementation of biodiversity compensation measures to ensure that there is "no net loss of biodiversity, but a "net gain instead;
- Protection of natural, modified and habitats;
- Maintenance of the availability and productivity of priority ecosystem services in order to maintain benefits to affected communities and the performance of projects.

The requirements of the AfDB's OS3 on critical habitat that the project must comply with are as follows:

- Determination of the nature of the habitat (natural or modified) in consultation with recognized institutions and habitat and biodiversity experts, taking into account designations by national and local authorities;
- Integration of the best available scientific data and involvement of internationally biodiversity experts in the conduct of impact assessments and the development and implementation of mitigation and management strategies for projects built in natural habitats, high conservation value modified habitats, critical habitats or legally protected areas;
- Assessment of potential risks and impacts that may occur at the landscape level if the project takes place in or near a natural or critical habitat, or near a legally protected or internationally recognized area;
- Minimization of any further degradation or conversion of modified habitats;
- Promotion of conservation activities in high biodiversity and conservation value areas within the project's area of influence through appropriate indicators and monitoring;
- Absence of significant changes to natural habitats caused by the project unless:
  - There are no technically and economically viable alternatives to implementing the project in a natural habitat;
  - The biodiversity mitigation hierarchy is properly implemented and appropriate mitigation measures are designed; and
  - The views and concerns of affected communities, as identified through the consultation process, are addressed in the design of mitigation measures.
- Integration and implementation of mitigation measures such as ecological restoration of habitats, measures aimed at reducing fragmentation and restoration of the ecosystems' functioning if projects are to be developed in natural habitats, or will have potential negative impacts on natural habitats further downstream, to achieve either a net gain or no net loss of biodiversity;
- Absence of adverse impacts (direct, indirect or cumulative) associated with project activities on the critical habitat designation criteria;
- Implementation of the mitigation hierarchy in critical habitats;

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- Search for improvement in critical habitat, and positive preservation outcome for the project's activities` improvement in critical habitat, and positive preservation outcome for the project's activities;
- Compliance with national and local regulations on appropriate environmental management where national regulations allow projects to encroach on legally protected or internationally recognized areas, or areas proposed for protection or international recognition;
- Consultation with stakeholders in the preparation of management and mitigation measures.

The AfDB recommends that clients avoid impacts on biodiversity and ecosystem services. Where direct and indirect impacts are unavoidable, they must implement measures to minimize impacts and restore biodiversity and ecosystem services. In this respect, the project is committed to assessing all impacts on biodiversity in order to:

- define modified, natural and critical habitats;
- prioritize mitigation measures, including compensation measures; and
- consider impacts on ecosystem services.

The various areas that the AfDB considers important for projects to address in order to meet requirements in terms of conservation and sustainable management of the ecosystem service (protection of ecosystems, habitats and species) are as follows:

- Protected and internationally recognized areas;
- Genetically modified organisms;
- Exotic invasive species;
- Environmental discharges;
- Renewable natural resources;
- Value chains;

Management of ecosystem services

1.1.3 PS6 and OS3 and Critical/Essential Habitat Triggers

Table 2. Type of Habitat Impacted and Associated PS6 Biodiversity Performance Requirements

Habitat Type as Defined under PS6	PS6 Requirements and Expected Performance		AfDB Habitat Type as classified by OS3
Under PS6, 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. PS6 provides an initial classification of biodiversity according to the habitats affected by the project. It distinguishes and considers 3 main habitat types, which can be considered modified or natural. Some of these habitat types are critical from a biodiversity perspective (whether modified or natural). These various types of habitat create contrasting levels of requirements.			OS3 also classifies biodiversity according to the habitats affected by the project. It distinguishes and considers **3 main types of habitats**, which can be considered as **modified** or **natural.** Some of them are **essential** from the point of view of biodiversity (whether modified or natural).
Modified Habitats These are areas of high biological richness that may harbor a large proportion of exotic animal and/or plant species and/or **whose primary ecological functions and species composition have been significantly altered by human activity.** Examples: areas developed for agricultural purposes, forest plantations, coastal areas reclaimed from the sea, and areas reclaimed from wetlands and marshes. They are sometimes identified and defined at the national level.	• Limit impacts on biodiversity; • Implement appropriate mitigation measures.	**Mitigation**	Modified habitats: Habitats whose primary ecological functions have been altered by human activities and whose original species composition, richness and abundance are reduced, with evidence of colonization by non-native fauna and flora species.

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Natural Habitats Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition. These natural habitats may require human management and are sometimes identified and defined at the national level.	Within this type of habitat, PS6 recommends: • No conversion; • No degradation. EXCEPT if the following conditions are met: • There are no other viable alternatives in the region for the development of the project in modified habitat areas; • Consultation with stakeholders, including affected communities, took into account their views on the extent of conversion and degradation to be allowed; • Any conversion or degradation is mitigated in accordance with the mitigation hierarchy (including any necessary compensation measures). The project developer must then be able to demonstrate that the project meets all of these requirements. In natural habitat areas, mitigation measures will aim to ensure no net loss of biodiversity where feasible, and may include appropriate actions consisting of the following: • **Avoiding** impacts on biodiversity through the identification and protection of set-aside areas; • Implementing measures to **limit** habitat **fragmentation**, such as creating biological corridors; • **Restoring habitats** during operations and/or after operations; and	**No Net Loss**	Natural Habitats Habitats harboring endemic fauna and flora populations whose species composition, richness and abundance have not been altered by human activities.

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	• Implementing biodiversity loss **compensation** measures.		
Critical (Modified or Natural) or Essential Habitats Critical habitats are areas with a high biodiversity value in particular based on the following 5 criteriaaa[3]: • C1) Areas of critical importance for Critically Endangered (CR) and/or Endangered (EN) species; • C2) Areas of high importance for endemic and/or limited distribution species; • (C3) Areas of high importance hosting significant international concentrations of migratory and/or gregarious species; • C4) Critically threatened and/or unique ecosystems; and • C5) Areas that are associated with key evolutionary processes.	Do not implement the project EXCEPT IF: • There are no other viable options in the region for implementing the project in modified or natural habitats that are not critical; • The project will have no measurable adverse impacts on the value of the biodiversity for which the critical habitat has been identified or on the ecological processes supporting the value of that biodiversity; • The project will not result in a net reduction in the international and/or national/regional population of critically endangered and/or endangered species, for a reasonable period of time; • A robust and well-designed long-term biodiversity monitoring program is integrated into the client's program. In cases where a client has the capacity to meet the requirements defined in the previous paragraph, the mitigation strategy should be described in a **Biodiversity Action Plan** (BAP). This Plan must aim to achieve net gains in those	**Net gain**	Critical Habitats - these are natural or modified habitats that have high biodiversity value and include: • Important habitats for species at risk of extinction or affected by numbers (**C1 of PS6**); • Habitats of significant importance for endemic or restricted species and subspecies (**C2 of PS6**); • Globally significant habitats with considerable concentrations of migratory or gregarious species (**C3 of PS6**); • Ecosystems that are regionally significant or highly threatened or unique (**C4 of PS6**); • Areas associated with major evolutionary processes (**C5 of PS6**); • Important areas for species that are vital to ecosystems, such as key species (**additional AfDB criterion**); and • Areas that feed into ecological networks (**additional criterion AfDB**). Critical habitats may include areas that are not protected or managed, and may be outside legally protected and reserved areas. Habitats may be considered critical where the ecosystem functions of habitats or species rely on or provide connectivity with other critical habitats, including legally protected critical habitat areas. The Bank will not finance projects in critical habitats that have been decommissioned for the sole purpose of enabling the projects to proceed.

[3] Quantitative critical habitat trigger levels are defined in **Table 3** below

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	biological resources for which critical habitat has been designated.		

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Table 3. Quantitative Thresholds Triggering Critical Habitat under PS6 (updated on June 27, 2019)

Criteria	Thresholds	Observations	BAP Selection
1: Critically Endangered (CR) and/or Endangered (EN) species	(a) Areas that overall support significant concentrations of a species classified as EN or CR in the IUCN Red List **(≥0.5%** of the world population AND **≥5** breeding pairs of the CR or EN species).	Species with CR/EN classes at national and regional levels should be determined on a project-by-project basis with competent professionals.	In accordance with the recommendations, species classified as CR or EN by the GSPM have been incorporated into the list of critical habitat trigger species (ESIA, BAP).
	(b) Areas that globally contain significant concentrations of species classified as Vulnerable (VU) on the IUCN Red List, the destruction of which could lead to a change in the IUCN status of the species from VU to EN or CR, as well as meeting the thresholds in GN72(a).		
	(c) Where appropriate, areas with significant concentrations of species classified as EN or CR on national and international Red Lists.		
2: Endemic and/or limited range species	(a) Areas that regularly support **≥10%** of the world population AND **≥10** breeding pairs of a species	**Vertebrates and terrestrial plants:** EOO is < 50,000 km² (20,000 km² for aquatic species at the time of the ESIA) **Marine species:** EOO is <100,000 km². **Coastal, shoreline and aquatic species:** where habitats are <200 km wide at each point, EOO is <500 km long.	In the particular context of the level of endemicity of the species on the island of Madagascar, the "Endemic" species without restricted distribution as defined in C2 but threatened (VU or NT) were selected, but endemic species without restricted distribution and of LC status were not selected.
3: Migratory and/or gregarious species	(a) Areas known to support, on a regular or cyclical basis, **≥1%** of the world population of a migratory species at any point in its life cycle.	**Migratory:** when a significant proportion of the population moves cyclically and predictably from one geographical point to another. **Gregarious:** when individuals group together in large groups on a regular/cyclical and/or predictable basis.	**No specific additions/analyses in the ESIA and BAP**
	(b) Areas that predictably support **≥10%** of the population of a species during periods of environmental stress.		
4: Critically Endangered and/or Unique Ecosystems	(a) Areas that represent **≥5%** of the global distribution of an ecosystem meeting the IUCN CR and EN criteria.	Where IUCN evaluation does not exist, systemic methods at regional and national levels, implemented by governmental, academic or NGO institutions, should be used.	**No specific additions/analyses in the ESIA and BAP**
	(b) Other areas that have not yet been evaluated by the IUCN but which represent an important regional or national conservation priority.		
5: Key evolutionary processes	• Landscapes with great spatial heterogeneity • Environmental gradients • Edaphic interfaces • Connectivity between habitats • Sites of demonstrated importance for climate change adaptation	The importance of structural attributes determined on a case-by-case basis in a landscape, and the determination of critical habitat will have to be based largely on scientific knowledge. In the majority of cases, the criterion will apply in areas that have already been studied and are known or suspected to be associated with key evolutionary processes.	**No specific additions/analyses in the ESIA and BAP**

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1.2 Critical/Essential Habitat Determination Methodology

Based on the criteria and thresholds presented above, the next step will be to propose a step-by-step demonstration of the proven presence of critical habitats within the project study area.

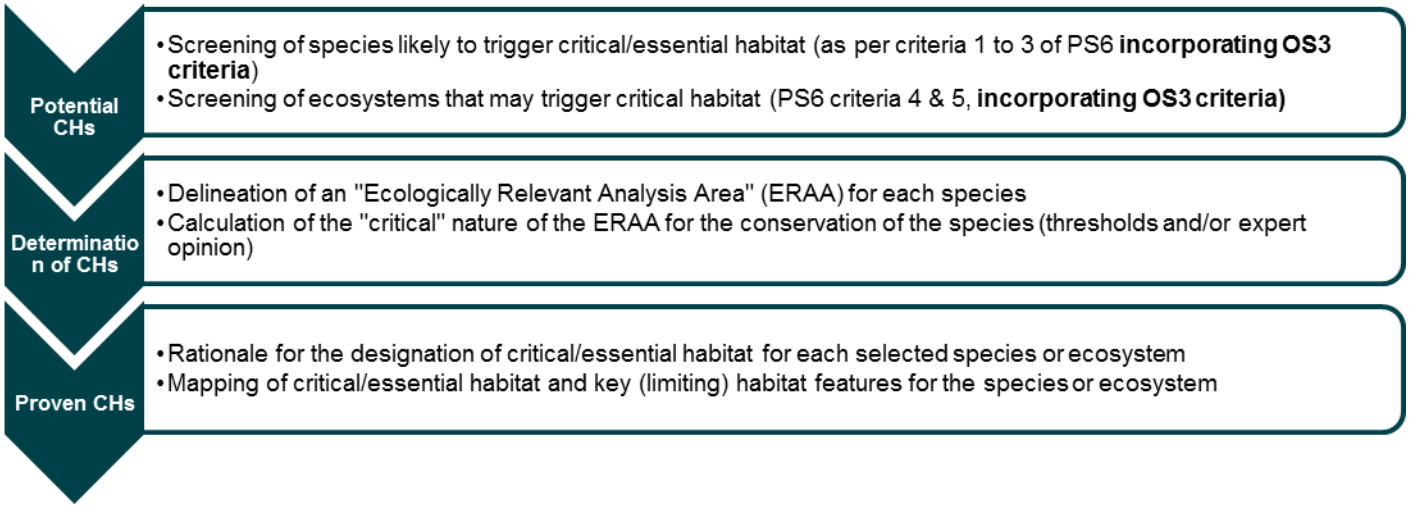

Figure 2. Comprehensive Methodological Framework for the Determination of Critical Habitats (CHs).

2 Identification and Assessment of Critical/Essential Habitats

2.1 Analysis of Species Likely to Trigger Critical Habitat (Screening)

A database of present and potential species was compiled by the project team and analyzed in order to prioritize the highest conservation concern species, based on the **critical/essential habitat** trigger criteria and their proven or very likely presence in the project area.

2.1.1 Criterion 1: Critically Endangered (CR) and/or Globally Endangered (EN) Species

After screening this initial list of species against criteria 1 to 3 of PS6, 23 species whose presence in the study area is proven or probable and meeting criterion C1 - CR-EN were listed:

- **5 plants:** *Dypsis lutea, Khaya madagascariensis, Malagasia aff. Alticola (Capuron) L.A.S. Johnson & B.G. Briggs (EN* in the TROPICOS database), Podocarpus *rostratus, Ravenea lakatra, Aeranthes nidus (EN* in GSPM), *Angraecum viguieri (EN* in GSPM),
- **1 fish species:** *Rheocles wrightae*
- **9 amphibians:** *Anodonthyla moramora, Boophis boehmei, Boophis rhodoscelis, Gephyromantis eiselti, Gephyromantis thelenae, Mantella cowani, Mantidactylus* albofrenatus*, Mantidactylus madecassus, Stumpffia kibomena (Rhombophryne kibomena)*
- **1 chameleon:** Calumma *hilleniusi*

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- **4 lemurs:** *Cheirogaleus sibreei, Daubentonia madagascariensis, Lepilemur betsileo, Propithecus diadema*
- **2 birds:** *Anas melleri, Tachybaptus pelzelnii*

It should be noted that the workshop held on August 13, 2019 with project stakeholders (SADABE, Rainforest Trust and MAVOA) added **3 species whose presence is proven by SADABE** to the list of "critical" species in the ESIA. These species were not mentioned during the various initial status consultations and have only recently been identified within the framework of the field works carried out by SADABE. There are two amphibians (*Rhombophryne kibomena, Anodonthyla moramora)* and one bird (*Anas melleri)* (see **Table 4**).

2.1.2 Criterion 2: Endemic and/or Limited Distribution Species

One listed species (*Cheirogaleus sibreei*) is locally endemic and another 70 species have a limited distribution. This list includes all proven or potential species with restricted distribution < 50,000 km^2 and all VU or NT endemic species. Other species are excluded from those that may trigger critical habitat within the study area, despite their national or regional endemicity status based on existing data.

There are:

- **10 plants:** *Dalbergia chapelieri Baill, Dalbergia orientalis, Dypsis decipiens, Dypsis louvelii, Dypsis lutea, Dypsis procumbens, Peperomia hildebrandtii, Podocarpus madagascariensis, Podocarpus rostratus*
- **Two *fish* species:** *Rheocles wrightae, Rheocles sp. ambatovy*
- **2 crayfish species:** *Astacoids caldwelli, Astacoids madagascariensis*
- **17 *Amphibians*:** *Anodonthyla boulengeri, Anodonthyla moramora, Boophis boehmei, Boophis rhodoscelis, Boophis rufioculis, Bleached Gephyromantis, Gephyromantis cornutus, Gephyromantis eiselti, Gephyromantis spiniferus, Gephyromantis thelenae, Mantella cowani, Mantella madagascariensis, Mantidactylus albofrenatus, Mantidactylus madecassus, Plethodontohyla brevipes, Plethodontohyla tuberata*
- **7 *reptiles*:** *Calumma hilleniusi, Calumma oshaughnessyi, Calumma parsonii, Lygodactylus bivittis, Pseudoxyrhopus imerinae, Pseudoxyrhopus oblectator, Trachylepis boettgeri,*
- **9 *lemurs*:** *Avahi laniger, Cheirogaleus sibreei, Eulemur fulvus, Eulemur rubriventer, Hapalemur griseus, Lepilemur betsileo, Lepilemur mustelinus, Microcebus lehilahytsara, Propithecus diadema*
- **3 bats:** *Eidolon dupreanum, Hipposideros commersoni, Rousettus madagascariensis*
- **1 Web-footed tenrec:** *Limnogale mergulus*
- **3 euplerids:** *Cryptoprocta ferox, Eupleres goudotii, Fossa fossana, Galidictis fasciata*
- **14 birds:** *Accipiter henstii, Accipiter madagascariensis, Anas melleri, Atelornis crossleyi, Brachypteracias leptosomus, Crossleyia xanthophrys, Glareola ocularis, Hartertula flavoviridis, Lophotibis cristata, Mesitornis unicolor, Neodrepanis hypoxantha, Tachybaptus pelzelnii, Xanthomixis cinereiceps, Xenopirostris polleni*

It should be noted that the workshop held on August 13, 2019 with the project stakeholders (SADABE, Forest Trust and MAVOA) resulted in the addition of 2 species to this list: 2 **amphibians**: *Rhombophryne kibomena, Anodonthyla moramora (*see **Table 4**).

2.1.3 Criterion 3: Migratory Species and/or High Concentration Species

Criterion 3 applies to migratory species a significant proportion of whose members move cyclically and predictably from one geographical area to another (e.g. migratory birds moving between temperate and tropical zones) or from one ecosystem to another (e.g. migratory amphihaline fish). The list of species whose presence in the study are is proven or probable includes 15 migratory species, with 4 species of fish (see Migratory Species-Aquatic Fauna section) and 11 species of birds (see Migratory Species-Terrestrial Fauna section).

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None of these migratory species, whether aquatic or terrestrial, exhibit either of the two levels of criticality defined in the chapter entitled Response Methodology/Identification of Potential Critical Habitat Triggers.

2.1.4 Tracked Changes in the Species List between the ESIA and the BAP

Table 4.Tracked Changes on the Species List between the ESIA and the BAP

Taxonomic groups	Species removed from the critical / essential habitat screening	Species added to the critical / essential habitat screening
Amphibians	• *Boophis brachychir (VU)* • *Gephyromantis leucocephalus (VU)* These species have not been observed in the project area (neither by BIOTOPE nor by SADABE) and their presence is considered very unlikely considering their respective ranges.	• *Anodonthyla moramora* • *Stumpffia kibomena (Rhombophryne kibomena)* The presence of these two species is proven by SADABE
Crayfish		• *Astacoids madagascariensis* LC species but with restricted distribution
Mammals	• *Microcebus rufus (VU)* Considering the species' range, its presence in the Project's area of influence is highly unlikely. • *Propithecus edwarsi (EN)* Considering the species' range, its presence in the Project's area of influence is highly unlikely.	/
Web-footed tenrecs	• *Voalavoantsahabensis* (EN, restricted distribution) This species has not been observed in the project area and its presence is considered very unlikely considering its range.	/
Reptiles	• *Brookesia dentata* (EN, restricted) This species is found in low altitude forests in the northwestern part of Madagascar and has a very limited distribution. A publication mentions the presence of this species in the Fandriana Vondrozo Corridor (south of the area), but considering what is known of the ecology of this species, its presence in the study area is considered very unlikely. • *Uroplatus ebenaui* (VU, restricted) This species has not been observed in the project area and its presence is considered very unlikely considering its range	/
Birds	• *Sarothrura watersi* (EN, restricted) This species has not been observed in the project	• *Anas melleri* (EN, not restricted) The presence of this species is proven by

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Taxonomic groups	Species removed from the critical / essential habitat screening	Species added to the critical / essential habitat screening
	area and its presence is considered unlikely considering its range.	SADABE

2.2 Analysis of Habitats Likely to Trigger Critical / Essential Habitat (Screening)

2.2.1 Criterion 4: Severely Threatened and/or Unique Ecosyste

Due to their rich flora and fauna biodiversity and the alarming rate of deforestation they are subject to as reported by the PERR-FH Consortium (2014), the eastern rainforests of Madagascar are among its most threatened ecosystems. In 2007, the eastern rainforests were included in the UNESCO World Heritage List. In addition, the eastern forest areas are included in the Zero Extinction Alliance zones as part of the ecosystem profiling of the Madagascar and Indian Ocean islands hotspot by the Critical Ecosystem Partnership Fund (CEPF).

In addition to the plant and animal species identified during surveys, other threatened species mentioned in the bibliography are present inside the forest corridor and remnants of natural forests in the surrounding area. These forest habitats play a vital ecological role in maintaining the survival of these species.

Considering the pace at which deforestation is taking place in the Study Area (see **Map 6**), the risk of the forest corridor shrinking and fragmenting and its biodiversity value decreasing, the natural habitats in the project's footprint formed largely by **dense eastern rainforest are identified as threatened, regardless of the project's impact on these forests, and thus as critical habitats under PS6 and as essential habitats under OS3.**

Furthermore, according to PS6, areas with high biodiversity value recognized at the national and/or international levels should be treated as critical habitats. These Key Biodiversity Areas (KBAs) include RAMSAR sites, Important Bird Areas (IBAs), Important Plant Areas (IPAs), Zero Extinction Alliance (ZEA) areas, etc. The project's area of influence includes several national and international protected areas:

In the south of the Onive:

- The **Marolambo National Park** and the three areas under management transfer (VOI) in the Commune of Belanitra (Antenina, Fisoronana and Befotaka) located in its protected area (buffer zone surrounding the core area).

The Marolambo National Park is also internationally designated as a **ZEA (Forest Corridor Fandriana-Marolambo NPA, COFAM)**, which covers the heart of the park and its protected area. The designation of this ZEA was justified in particular by the presence of two restricted-range lemur species, i.e. *Lepilemur betsileo* (EN) and *Avahi betsileo* (EN) known to occur only in the Marolambo Park and not present north of the Onive River. **It should be noted that the ESIA stipulates that the project's area of influence (in particular the access road to the dam) is located in the PNM protection zone, and not in the core area of the park where the park's high conservation concern species (the two species of lemurs that justified the ZEA designation: *Lepilemur betsileo* and *Avahi betsileo*) are located. Furthermore, the project is committed to supporting the PNM and is an opportunity for the PNM teams to develop and improve their actions in the North of the park (surveillance, anti-poaching, etc.) as part of the implementation of surveillance and anti-poaching actions.**

In the North of the Onive

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The Tsinjoarivo – Ambalaomby NPA in the process of being created. This project which is about creating a protected area is today led by NGO SADABE, based in Tsinjoarivo, Ambatolampy district. SADABE has been conducting research and support activities for local development in the Commune of Tsinjoarivo for about ten years. The forest massif of Tsinjoarivo-Ambalaomby is a forest corridor linking the National Park of Marolambo in the South, separated by the river Onive, and the forest of the rural Commune of Antandrokomby in the North. This year (2019), the Tsinjoarivo NPA proponent, SADABE, has received support from an international NGO, the Rainforest Trust, to fund the establishment of the NPA. The NGO's website reports that more than $1 million was raised. The Tsinjoarivo-Ambalaomby NPA's overall management scheme proposes category VI of the IUCN, referred to in the protected area code as a "Natural Resource Reserve" as an appropriate category for the NPA, taking into account planning and management objectives: to protect species and biodiversity, maintain ecological functions and connectivity and ensure human well-being (see **Map 4**; **Map 5** below). **The project will contribute to the creation of the NPA (access and various infrastructure for management, technical support etc.) and to forest management and restoration measures over the life of the project (35 years) - see BAP 21 and BAP 22.**

The **Important Bird and Biodiversity Area (IBA) of the "Onive classified forest**" which covers the Tsinjoarivo NPA and extends from north to south over 75 km (see **Map 4**; **Map 5** below). It is bordered by the Onive River in the southern part of the site. It was established in 2001, based on data collected in 1998, and is supported by NGO Asity Madagascar, an affiliate of Birdlife International. The IBA is home to bird species that are characteristic of mid-altitude rainforests, many of which are endemic to Madagascar. Apart from endangered mammal species (*Eulemur rubriventer, Varecia variegata variegata, Propithecus diadema, Fossa fossana, Cryptoprocta ferox*), this area is home to 5 threatened bird species, including 1 vulnerable species (*Brachypteracias leptosomus*) and 4 near-threatened species (*Accipiter henstii, Atelornis crossleyi, Crossleyia xanthophrys, Xanthomixis cinereiceps*). It should be noted, however, that this IBA has not been designated following the KBA standards *(IUCN, 2016. A Global Standard for identification of Key Biodiversity Areas*). The list of species warranting designation as IBAs (presented in Table 65 of the ESIA) is now obsolete. **Since its establishment, the IBA has not been subject to any inventory updates (carried out more than 20 years ago), research, protection or conservation work. NGO Asity Madagascar, which is the reference entity for the IBA, considers that an update of the IBA file (list of bird species, conservation issues) is currently necessary, and is a prerequisite for any reflection on conservation actions to be carried out in the IBA. To avoid increasing disparities between the Project's ornithological data and ONIVE's Classified Forest IBA data, the project will contribute to the updating of IBA data, through the IBA's reference NGO, i.e. Asity Madagascar- see BAP 25.**

- No World Heritage sites are found within the project's area of influence

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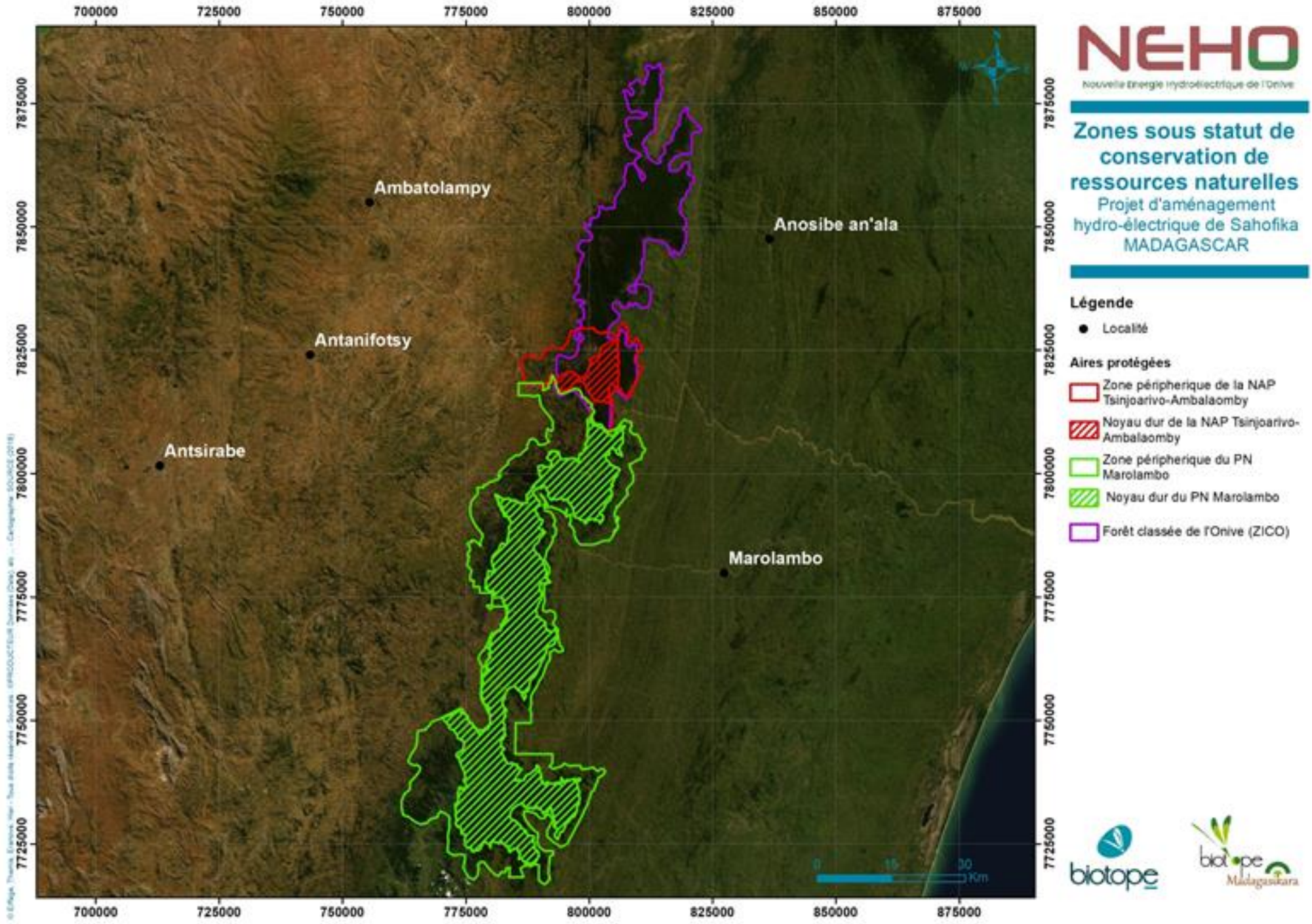

Map 4. Protected Areas Adjacent to the Project Area (Source: Biotope, 2019)

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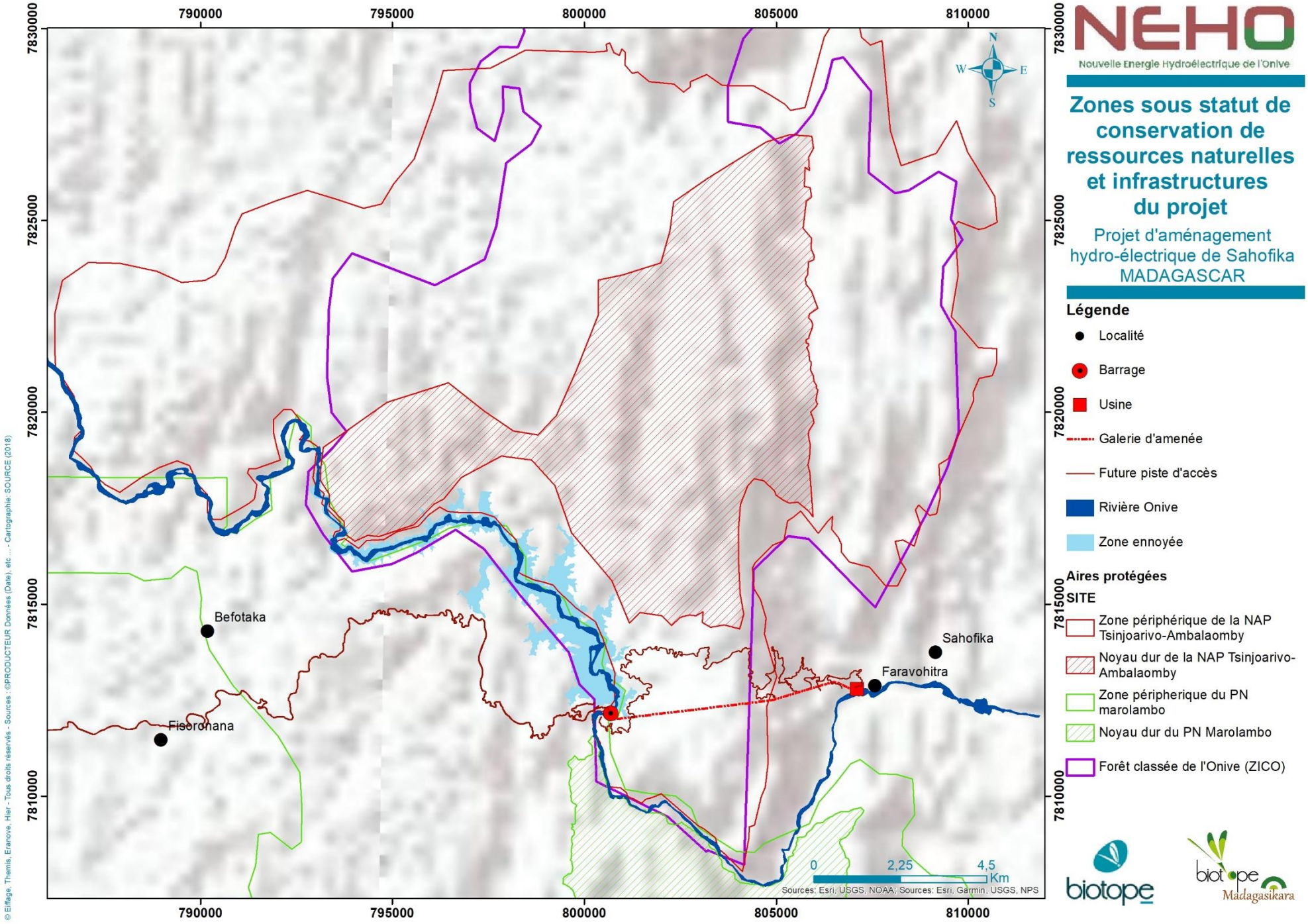

NEHO
Nouvelle Energie Hydroélectrique de l'Onive

Zones sous statut de conservation de ressources naturelles et infrastructures du projet

Projet d'aménagement hydro-électrique de Sahofika
MADAGASCAR

Légende

- Localité
- Barrage
- Usine
- Galerie d'amenée
- Future piste d'accès
- Rivière Onive
- Zone ennoyée

Aires protégées

SITE

- Zone périphérique de la NAP Tsinjoarivo-Ambalaomby
- Noyau dur de la NAP Tsinjoarivo-Ambalaomby
- Zone péripherique du PN marolambo
- Noyau dur du PN Marolambo
- Forêt classée de l'Onive (ZICO)

biotope

biotope Madagasikara

Map 5. Protected Areas Adjacent to the Project Area – Zoom (Source: Biotope, 2019)

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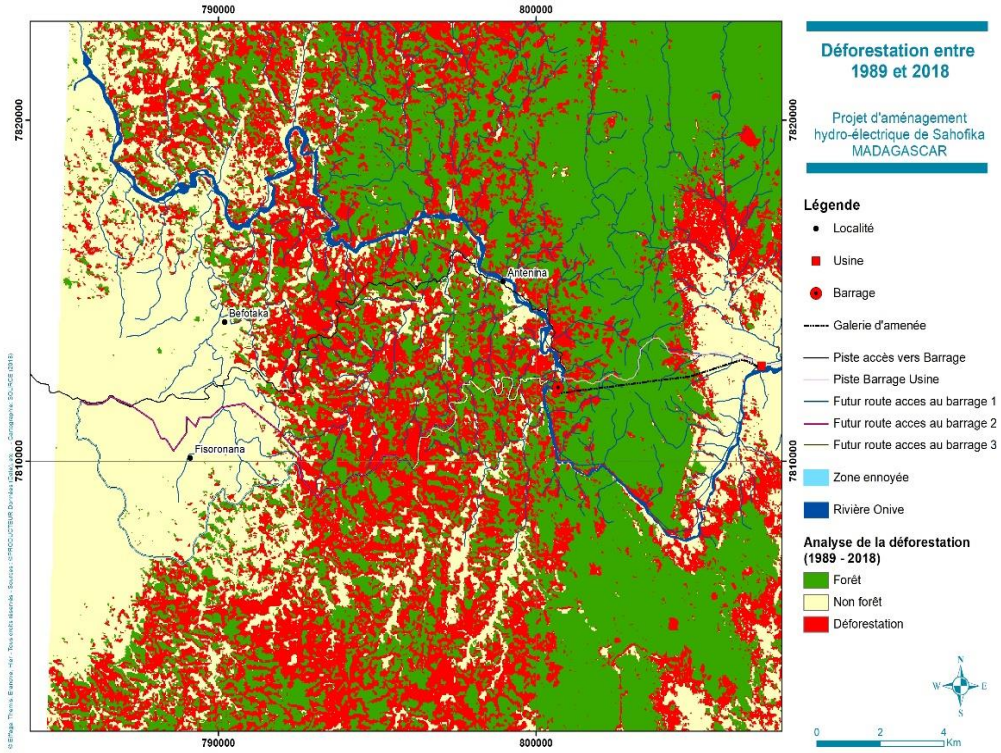
2.2.2 Criterion 5: Areas Associated with Key Evolutionary Processes

Biological corridors are among the types of spatial features associated with evolutionary processes in the IFC PS6 Guidance Note. They are responsible for species migration and gene flow.

The Onive River makes the connectivity of aquatic fauna stands possible by promoting exchanges between upstream and downstream ichthyofauna populations and freshwater and marine ecosystems. This is the case in particular for the migratory fish inventoried in the study area (4 species out of the 20 fish species inventoried).

The Onive River plays an important role in the genetic and migratory flows of fish such as eels (*Anguilla marmorata* and *A. mossambica*). These species are also subject to fishing for supplementary food by the local populations, but not to commercial fishing. However, based on **current scientific knowledge, one cannot assert that there is a particular gene flow for these species**. Therefore, considering existing (relatively complete) knowledge about the study area on the one hand, and scientific knowledge on the issue of gene flows (which is incomplete) on the other hand, **it is not possible to describe the study area as an area associated with key evolutionary processes.**

The pace at which deforestation is occurring makes the eastern rainforests an important shelter for wildlife. The forest in the project's footprint is therefore of particular interest for the evolutionary process of certain species of fauna, but is also of paramount importance for maintenance and genetic exchanges between and within populations, especially fauna and flora populations**.**



Map 6. Beforestation between 1989 and 2018

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2.3 Determination of "Ecologically Relevant Analysis Areas" (ERAs) for Critical Habitats

For Criteria 1 to 4, the project must determine a boundary defining the areas of habitat to be considered in the critical habitat assessment. These are called **"Ecologically Relevant Analysis Areas" (ERAAs)**, formerly known as Discrete Management Units (DMU). These should be defined in accordance with the characteristics (structures, functions, processes) important to the species or ecosystems for which the habitat is designated as critical.

An ecologically relevant area of analysis may or may not have an actual management boundary (e.g., legally protected areas, World Heritage sites, community reserves, etc.), but may also be defined by another ecologically relevant boundary such as, for example, a watershed, an interfluvial zone, a patch of intact forest within a modified habitat, grasslands, coral reefs, or deep-sea upwelling area, etc. Several analysis areas were selected for the species present in the project's area of influence.

2.3.1 Natural Forest Habitat Analysis Areas

Forest habitats in the project's footprint are formed by the forest corridor linking the Marolambo National Park with the New Ambalaomby Protected Area, as well as relics of natural forests located in the Mangoro watershed. These forest habitats are located at the eastern edge of the central region, and belong to the *Domaine du Centre* (Humbert, 1955) whose vegetation is characterized by **a dense humid mid-altitude (800-1200 m) forest of** the ***Tambourissa* and *Weinmannia* series with herbaceous undergrowth** and **lichen woodlands.** These forest habitats are home to a large number of terrestrial and aquatic flora and fauna species (including *Astacoides caldwelli and A. madagascariensis*) that are threatened (CR, EN and VU) or of limited distribution (see 2.2.1 - Analysis of Species Likely to Trigger Critical Habitat).

To conduct a relevant assessment for the project and the BAP, we have chosen a natural forest habitat analysis area limited to protected areas adjacent to and ecologically connected with the Project area. Besides, to take into account the capacity of species present in forests to cross or not cross the Onive River (some lemurs cannot cross the Onive and are confined to a single bank of the river), three forest ERAAs must be considered:

- ERAA 1: North of the Onive River (left bank), natural forest habitats in the entire Important Bird and Biodiversity Area (IBA) of the classified Onive forest - **64,476 ha**;
- ERAA 2: South of the Onive River (right bank), natural habitats in the Marolambo National Park - **115 934 ha;**
- ERAA 3: North of the Onive River (left bank), all natural habitats between 1,450 and1,800 m above sea level in the IBA of the classified forest of the Onive River, potentially corresponding to the lichen woodland **– 26,431 ha.**

ERAA 1 - Natural Forest Habitats North of the Onive River (Left Bank)

This analysis area includes all natural forests within the boundaries of the Onive classified forest IBA (mid-altitude dense humid forest and lichen woodland). This ERAA covers in total **64,476 ha of natural habitats** and forms a continuous set of forests, separated from the other forest areas by the Onive River in the south and by an interruption of the forest corridor in the north (**Map 7**). It is relevant for assessing the criticality of natural forests for the entire range of priority forest species previously identified (see 2.2.1), especially for several threatened lemurs species whose range is restricted to the North of the Onive and cannot cross the river (natural barrier): *Propithecus diadema Microcebus lehilahytsara, Cheirogaleus sibreei.*

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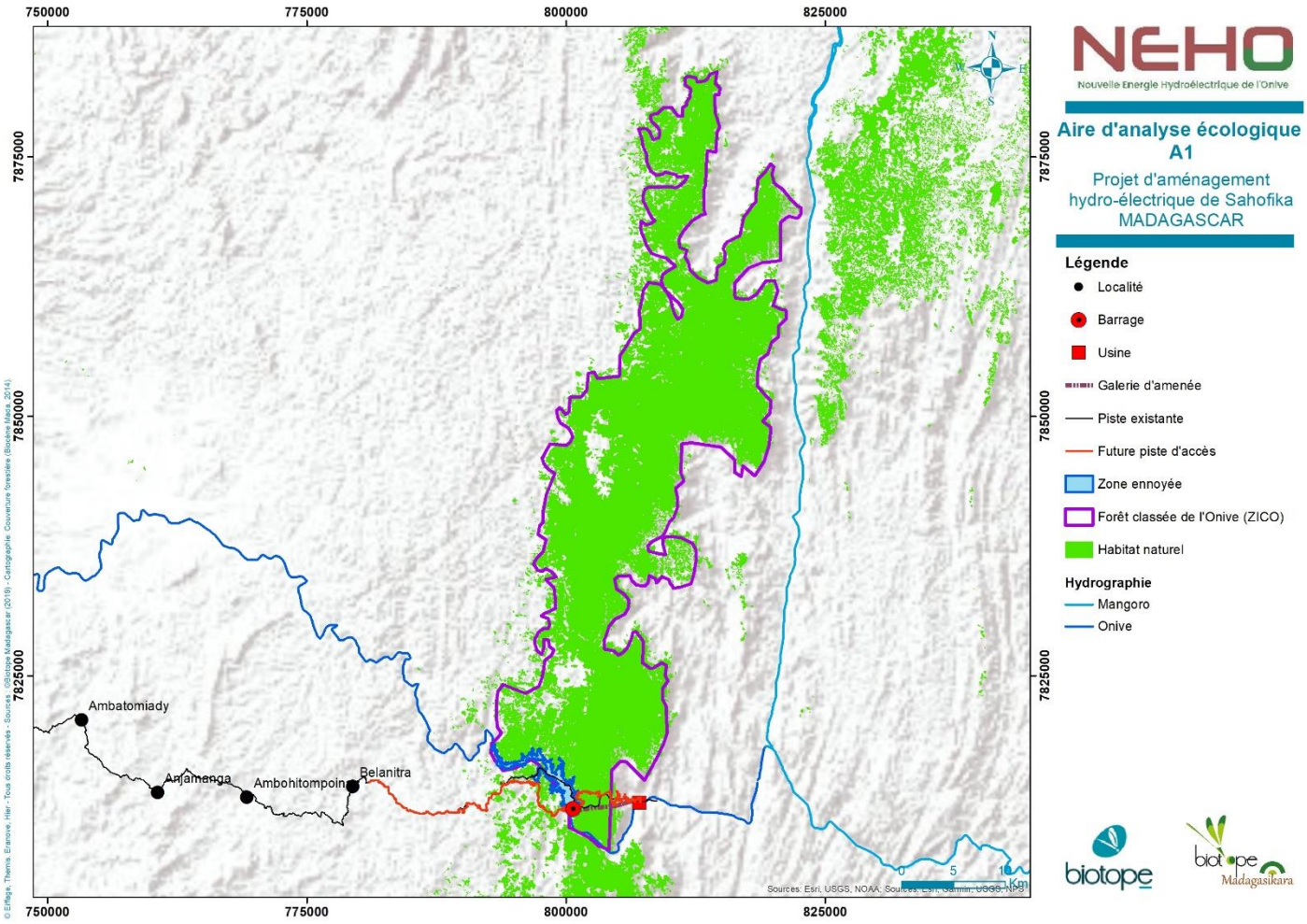
ERAA 1 also hosts two aquatic species that may trigger critical habitat *(Astacoides caldwelli and A. madagascariensis)*. The baseline survey made it possible to indicate that these two crayfish species are present in the immediate study area only in temporary or permanent streams and wetlands of forested tributaries and that they are absent from the Onive River. Based on current knowledge, there is no detailed mapping of their range (as is the case for some lemurs, for example). Their area of analysis is therefore **assimilated to the natural habitats of the dense evergreen rainforest at mid-altitude and to the lichen woodland**

Species concerned by ERAA 1 are presented in chapter 3.



Map 7. ERAA 1 - Natural Forest Habitats North of the Onive River (IBA) (Source: Biotope, 2019)

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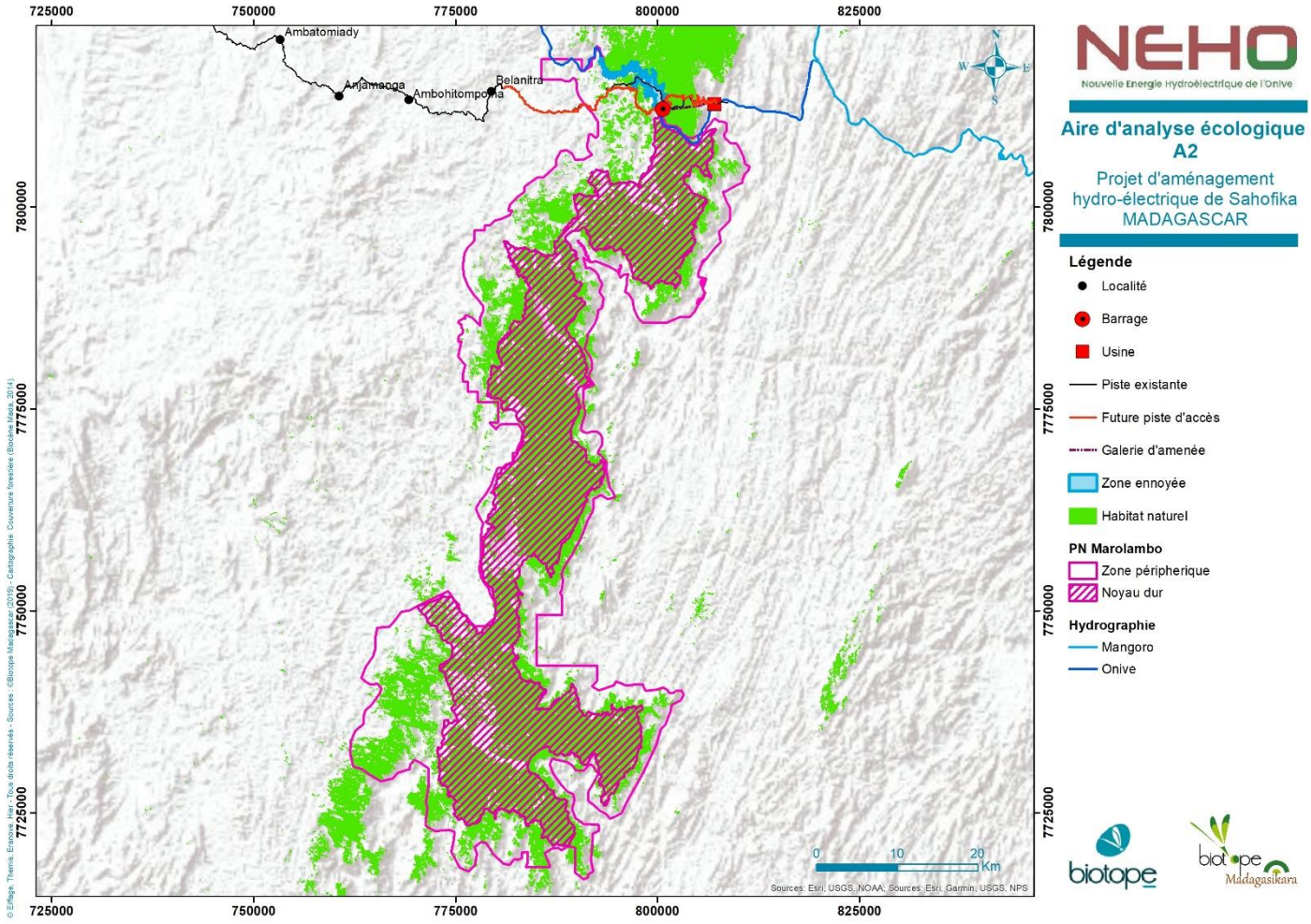
ERAA 2 – Natural Terrestrial Habitats South of the Onive River

It is also relevant to consider a second ERAA south of the Onive River (right bank) that includes all **the natural forest**s within the boundaries of the Marolambo National Park (periphery + core). This ERAA covers a total of **115,934 ha of natural habitats** (Map 8). It should be noted that in the project area, there are very few patches of natural forest on this bank of the Onive, which is largely dominated by modified habitats that consist largely of croplands and residential areas.

Species concerned by ERAA 2 are presented in Chapter 3.



Map 8. ERAA 2 - Natural Habitats South of the Onive River - Marolambo National Park (Source: Biotope, 2019)

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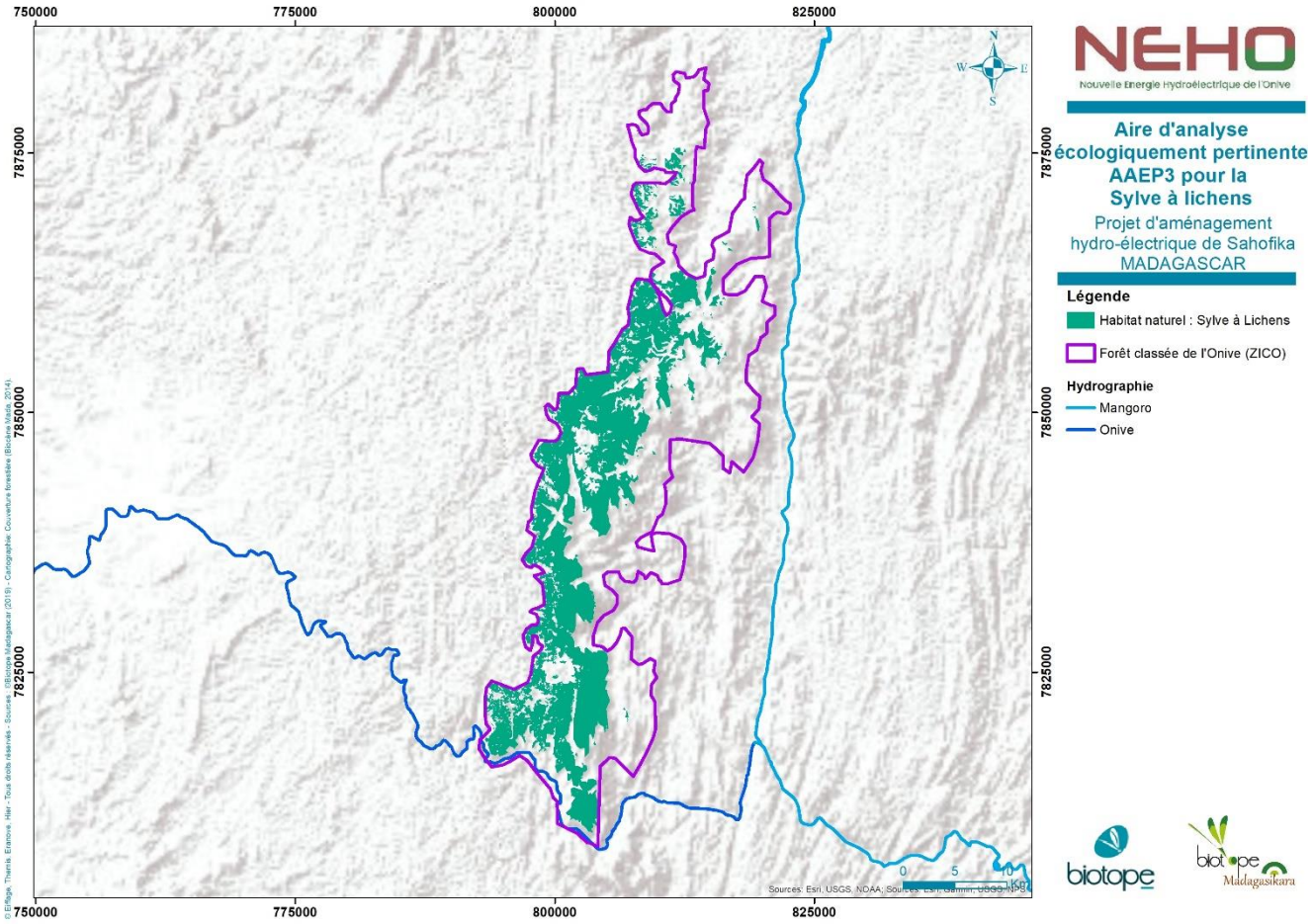
ERAA 3 - Lichen Woodlands North of the Onive River

This ERAA corresponds to natural forest habitats restricted to lichen woodlands that are particularly important for certain threatened flora species such as *Malagasia aff. Alticola* (Capuron) L.A.S. Johnson & B.G. Briggs, threatened orchids *Aeranthes nidus* (EN, GSPM) and *Angraecum viguieri* (EN, GSPM) that are particularly abundant in the lichen woodland, two species of Amaphibian *Mantidactylus madecassus (*EN, IUCN*) and Plethodontohyla tuberata (VU IUN)* known to occur only at altitudes above 1,500 m (based on current knowledge of the species). This ERAA is calculated by taking into account natural habitats located between 1,450 and 1,800m of altitude within the IBA and potentially corresponding to the lichen woodland. This ERAA covers a total of 26,431 ha of potential lichen woodlands (**Map 9**).



Map 9. ERAA 3 - Natural habitats between 1,400 and 1,800m above sea level within the IBA, potentially corresponding to the lichen wooldand

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2.3.2 Analysis Areas for Aquatic Habitats

ERAA4 - Aquatic Habitats Suitable for Rheocles wrightae and R. sp. Ambatovy

According to surveys and observations, *Rheocles wrightae* is mainly present in lenticular areas which seems to be a trait of the Bedotiidae family. However, it is not possible to disregard lotic areas (moderate to high current velocity) from the ERAA due to a lack of data on the ecology of the species. **Despite this lack of data, it was noted during field surveys that the species preferred uncommon but not stagnant areas with a gravelly substrate that was not or only slightly clogged.**

The ecological characteristics of these species presents similarities (observation of the 2 species during inventories on the same stations). Therefore, the bioassessment and criticality analysis elements proposed for Rheocles wrightae will also be used for Rheocles sp. Ambatovy, along with the same avoidance, reduction and compensation measures. Consequently, the Rheocles wrightae ERAA can be considered as the same for Rheocles sp. Ambatovy.

Figure 3. Habitat Suitable for Rheocles Wrightae (left) and example of suitable granilometry for the species (right)

ERAA 4, which corresponds to habitats that are suitable for Rheocles therefore includes the following:

- **The Onive River and its tributaries downstream from the rapids to the confluence with the Mangoro River** (about 19 km on the Onive)

The Onive River upstream from the rapids and falls (a few hundred meters upstream from the plant) is excluded from the analysis area because Rheocles, a non-migratory species, is most likely incapable of moving up the rapids on the Onive River (see **Figure 4**). It should be noted that no Rheocles individuals were observed upstream from the falls (3 field missions and 5 weeks on site). Surveys have shown that the populations upstream from the falls are not familiar with Rheocles and the literature review does not mention Rheocles so far upstream and at such a high altitude. Nevertheless, the workshop with SADABE (August 13, 2019) highlighted a new observation of *Rheocles wrightae* by SADABE on the Andranotsimizaka site (coordinates: S19, 7133652 and E47, 8819968) between 1,300 and 1500 m in the tributary of the Onive River flowing near the plant. This new observation does not call into question the absence of Rheocles upstream from the Onive Falls (see **Map 11**) but provides interesting information on the use *of the* tributaries of the Onive by *R. wrightae*.

- **The Mangoro and its tributaries upstream from the confluence with the Onive River.** In the absence of more precise information, the entire catchment area is included, bearing in mind that the species was found in the Moramanga district (around 900-1000 m above sea level), during inventories carried out for the Ambatovy mining project;
- The Mangoro and its tributaries downstream from the confluence with the Onive to the confluence with the right bank of the Nosivolo (including about 70 km only for the

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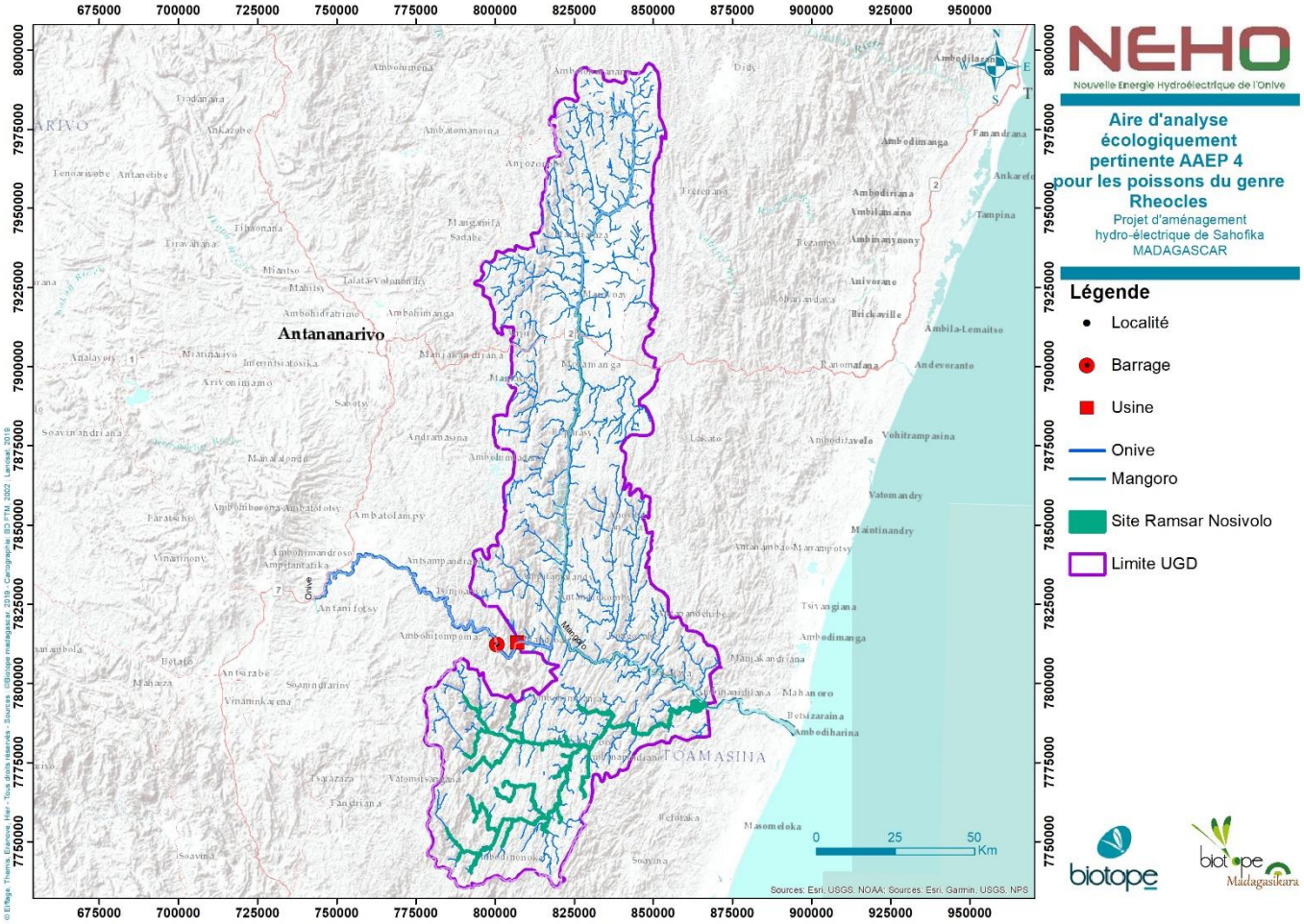
Mangoro). The species is not known to occur in the lower part of the river, downstream from the confluence with the Nosivolo, although it is known to occur in the upstream parts of the Nosivolo catchment area.

ERAA 4 totals approximately 1,232,000 ha, which is of the same order of magnitude as the known range of *Rheocles wrightae* (733,500 ha according to the IUCN). It should be noted, however, that this range is both poorly documented and unreliable.

In ERAA 4, there are approximately 940 hectares of aquatic environments (estimated cumulative total of the main rivers and tributaries present within the watersheds) and a cumulative distance of permanent watercourses flowing over nearly 3,130 km.



Map 10. ERAA 4 – Aquatic Habitats Suitable for Rheocles wrightae (Source: Biotope, 2019)

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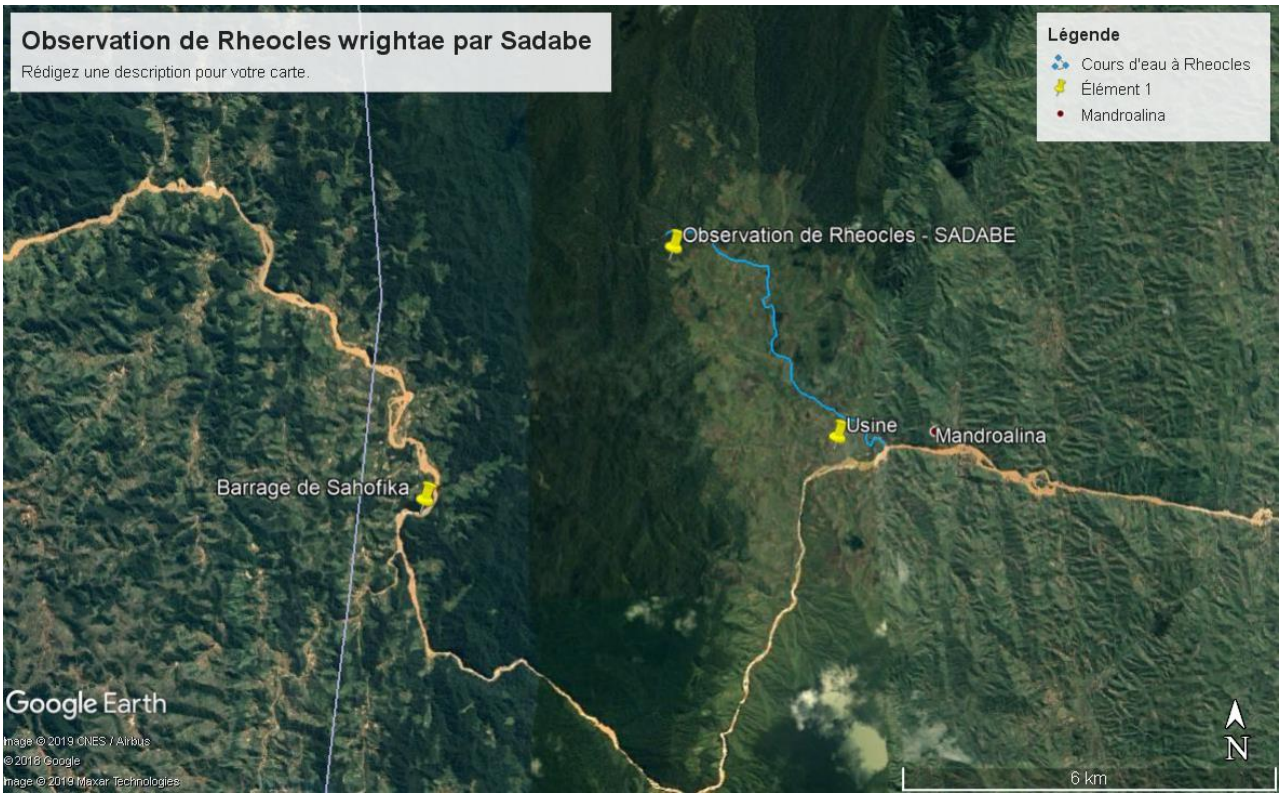

Map 11. Location of the area where SADABE observed *Rheocles wrightae*.

Figure 4. Section of the Onive that is impassable by R. *Wrightae* between the plant and the dam. Left: Helicopter view of the Faravohitra waterfall (just upstream from the plant); Right: Helicopter view of a second area of rapids upstream from the Faravohitra waterfall.

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3 Summary of the Project's Critical/Essential Habitats

- Critical/essential habitat confirmed - Validated C1 or C2 thresholds
- Potential critical/critical habitat - C1 and C2 validated but the species was not observed
- Critical/essential habitat Unconfirmed - C1 and C2 not validated

Table 5. Summary of Species Triggering Critical Habitats

Class	Family	Scientific Name	IUCN Status	Presence BIOTOPE	Presence SADABE	ERAA	Range (EOO)	# of known sites	Critical Habitat Justification	Critical Habitat
Amphibians	**Mantellidae**	*Boophis boehmei*	EN	Not observed but likely	**Proven**	**A1, A2**	Restricted 2,490 km^2	3	*Boophis boehmei* is a frog species endemic to the North and South of the Onive River with only 3 locations in Eastern Madagascar (Andasibe zone, RS Analamazaotra, and RS Ambohitantely). In the project area, it was observed by SADABE on the Andranomandry, Besoamamy, and Andranotsimizaka sites. This is a species with a severely fragmented population. The combined A1 and A2 analysis area corresponds to 72% of the species' area of occurrence. Criteria C1a and C2A are therefore considered as met. **The natural forest is therefore a confirmed critical habitat for this species.**	**Confirmed**
Amphibians	**Mantellidae**	*Boophis rhodoscelis*	EN	Not observed but likely	Probable	**A1, A2**	Restricted (1,637 km²)	4	*Boophis rhodoscelis* is an endemic frog species, with a restricted range estimated at 1,637 km^2. It has not been observed in the project area but its presence there is probable. It is known to occur in 1 to 4 locations, including the Ranomafana and Antoetra sites. It has not been observed at the site but its presence there is probable. It is a rare species in terms of its range. Its population is estimated to be declining due to current deforestation activities. It is present north and south of the Onive River. The combined A1 and A2 analysis area is greater than the area of occurrence of the species (110%). Criteria C1a and C2a are therefore considered as validated. **The natural forest is therefore a potential critical habitat for this species.**	**Potential**
Amphibians	**Mantellidae**	*Boophis rufioculis*	NT	**Proven**	Probable	**A1, A2**	Restricted (22, 394 km^2)	–	*Boophis rufioculis* is present in the North and South areas of the Onive River. It is known to occur in the central part of the rainforest of eastern Madagascar. The combined A1 and A2 analysis area represents about 9% of the EOO for the species. It is therefore considered that threshold C2a can be met for this species. **The natural forest is therefore a confirmed critical habitat for this species.**	**Confirmed**
Amphibians	**Mantellidae**	*Bleached Gephyromantis*	NT	**Proven**	**Proven**	**A1, A2**	Restricted (24 088 km²)	–	*Gephyromantis blanci* was observed in the project area. It is known to occur only in the South area of the Onive, from Ranomafana, the Andringitra mountains to the Anosyenne ranges. The exact number of locations of the species is un known. The combined A1 and A2 analysis area corresponds to about 7% of the EOO for the species. Criterion C2a can be met. **The natural forest is therefore a confirmed critical habitat for this species.**	**Confirmed**

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Class	Family	Scientific Name	IUCN Status	Presence BIOTOPE	Presence SADABE	ERAA	Range (EOO)	# of known sites	Critical Habitat Justification	Critical Habitat
Amphibians	**Mantellidae**	*Gephyromantis cornutus*	VU	Not observed but likely	**Proven**	**A1**	Restricted (6, 857 km²)	9	*Gephyromantis cornutus* was observed in the project area by SADABE. It is known to occur only in the North of the Onive at 9 locations in total, in the Center-East (Andasibe, Vohimana, Vohidrazana, Mandraka, and Anjozorobe). Area A1 corresponds to about 75% of the known EOO for this species. Criteria C1a, C2A are considered as validated. **The natural forest is therefore a confirmed critical habitat for this species**.	**Confirmed**
Amphibians	**Mantellidae**	*Gephyromantis eiselti*	EN	Not observed but likely	**Proven**	**A1**	Restricted (795 km²)	4	*Gephyromantis eiselti* was observed in the project area by SADABE. It is known to occur at only 4 locations in the North of the Onive (Andasibe, PN Mantadia, and RS Analamazaotra). The A1 area corresponds to almost 81% of the known EOO for this (poorly known) species. Criteria C1a and C2a are therefore considered as validated. **The natural forest is therefore a confirmed critical habitat for this species.**	**Confirmed**
Amphibians	**Mantellidae**	*Gephyromantis spiniferus*	VU	**Proven**	Probable	**A1, A2**	Restricted (16, 404 km²)	10	*Gephyromantis spiniferus* was observed in the project area. It is now known to occur in the South of the Onive at 10 locations in total. The combined A1 and A2 analysis area corresponds to about 10% of the known EOO for this species. Criteria C1a and C2a are therefore considered as validated. **The natural forest is therefore a confirmed critical habitat for this species.**	**Confirmed**
Amphibians	**Mantellidae**	*Gephyromantis thelenae*	EN	**Proven**	Probable	**A1**	Restricted (795 km²)	4	*Gephyromantis thelenae* was observed in the project area. It is known to occur in Andasibe and Mantadia at 4 locations in total. The A1 area accounts for about 80% of the known EOO for the species. Criteria C1a and C2a are considered as validated. **The natural forest is therefore a confirmed critical habitat for this species.**	**Confirmed**
Amphibians	**Mantellidae**	*Mantella cowani*	EN	Not observed but likely	Probable	**A1, A2**	Restricted (253 km²)	3	*Mantella cowani* has not been observed in the project area but its presence is likely. It is known to occur in the North and South of the Onive, at only 3 sites in the Central Eastern Highlands (Antakasina, Antoetra, and Itremo). The project site would therefore represent 1/4 of the known locations for the species and the combined A1 and A2 analysis area corresponds to more than 7 times the known EOO for this species. Criteria C1a and C2a are considered as validated. **The natural forest is therefore a potential critical habitat for this species.**	**Potential**
Amphibians	**Mantellidae**	*Mantella madagascariensis*	VU	Not observed but likely	Probable	**A1, A2**	Restricted (9,434 km²)	9	*Mantella madagascariensis* has not been observed in the project area. However, its presence is likely, and it occurs in the North and South of the Onive River, in the central-eastern area of Madagascar (Niagarakely south of Ranomafana) at 9 locations in total. The combined A1 and A2 analysis area represents about 20% of the known EOO for this species. Criterion C2a is therefore considered as validated. **The natural forest is therefore a potential critical habitat for this species.**	**Potential**
Amphibians	**Mantellidae**	*Mantidactylus albofrenatus*	EN	Not observed but likely	Probable	**A1**	Restricted (1, 851 km²)	2	*Mantidactylus albofrenatus* has not been observed in the project area. However, its presence is probable, and it is present in the north of the Onive River, at only 2 locations. Area A1 represents about 75% of the known EOO for this species. Criteria C1a and C2a are therefore considered as validated. **The natural forest is therefore a potential critical habitat for this species**.	**Potential**
Amphibians	**Mantellidae**	*Mantidactylus madecassus*	EN	Not observed but likely	Probable	**A1, A2**	Restricted (1,290 km²)	10	*Mantidactylus madecassus* has not been observed in the project area but its presence is considered probable. Today it is known to occur at 10 locations south of the Onive River. Area A2 corresponds to about 90% of the known EOO for the species. Criteria C1a and C2a are considered as validated. **The natural forest is therefore a potential critical habitat for this species.**	**Potential**

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Class	Family	Scientific Name	IUCN Status	Presence BIOTOPE	Presence SADABE	ERAA	Range (EOO)	# of known sites	Critical Habitat Justification	Critical Habitat
Amphibians	**Microhylidae**	*Anodonthyla boulengeri*	NT	Not observed but likely	**Proven**	**A1, A2**	Restricted (24,370 km^2)	3;4	*Anodonthyla boulengeri* is an endemic frog species with a restricted range estimated at 24,370 km^2. The species is known to occur in only 3 to 4 locations in eastern Madagascar. It is present in the North and South of the Onive River. The combined A1 and A2 analysis area corresponds to about 7% of its EOO, but to 1/4 of the where it is known to occur. Criterion C2a is considered to be met. **The natural forest is therefore a confirmed critical habitat for this species.**	**Confirmed**
Amphibians	**Microhylidae**	*Anodonthyla moramora*	EN	Not observed but likely	**Proven**	**A1, A2**	Restricted 685 km^2	2	*Anodonthyla moramora* is an endemic frog species with a very restricted range estimated at 685 km2. It is known to occur only in the south of the project area in Ranomanfana NP (from Ranomafana village to Vohipararar), and only 2 locations are known in total. It is considered as a regional endemic species. However, it js known to be present in the project area by Sadabe, which would significantly extend the EOO for the species. All of the project's analysis areas are above the known EOO for the species. Criteria C1a and C2a can be considered to be met. **The natural forest is therefore a potential critical habitat for this species.**	**Potential**
Amphibians	**Microhylidae**	*Plethodontohyla brevipes*	VU	**Proven**	Probable	**A1, A2**	Restricted (6,510 km²)	2	*Plethodontohyla brevipes* was observed in the project area. It is known to occur at only 2 locations south of the Onive River, including Ranomafana NP (the only verified site to date). The combined A1 and A2 analysis area represents about 30% of the known EOO for the species and the project area 1/3 of the known locations of the species. Criterion C2a is therefore considered to be validated. **The natural forest is therefore a confirmed critical habitat for this species.**	**Confirmed**
Amphibians	**Microhylidae**	*Plethodontohyla tuberata*	NT	Not observed but likely	Probable	**A1, A2**	Restricted (22,539 km²)	-	*Plethodontohyla tuberata* has not been observed in the project area but its presence is considered probable. It is known to occur in the North and South of the Onive, in the center of Madagascar. The combined A1 and A2 analysis area represents about 8% of the known EOO for this species. Criterion C2a is considered as validated. **The natural forest is therefore a critical habitat for this species.**	**Potential**
Amphibians	**Microhylidae**	*Stumpffia kibomena (Rhombophryne kibomena)*	EN	Not observed	**Proven**	**A1**	Restricted (to be checked)		*Rhombophryne kibomena* was observed in the project area by SADABE. It is currently known to occur at only 2 locations, in the North East of Antananarivo. Area A1 represents about 60% of the known EOO for the species. Criteria C1a, C2a are validated. **The natural forest is therefore a confirmed critical habitat for this species.**	**Confirmed**
Crayfish	**Parastacidae**	*Astacoides caldwelli*	VU	**Proven**	_	**A1, A2**	Restricted (11,930 km²)	8	*Astacoides caldwelli* is an endemic species with a restricted range estimated at 11,930 km^2. The species is known to occur in central-eastern Madagascar at 8 locations (North and South of the project area). The latest studies show that *Astocoides caldwelli* could be the rarest of all Malagasy crayfish sampled (*A. granumilanus, A. crosnieri, A. betsileoensis and A. caldwelli*). At none of the sampling locations was the species found to be abundant. The combined A1 and A2 analysis area represents about 15% of the species' area of occurrence. Taking into account the rarity of the species, it can be considered that criterion C2a is met (> 10% of the population). **The natural forest is therefore a confirmed critical habitat for this species.**	**Confirmed**
Crayfish	**Parastacidae**	*Astacoids madagascariensis*	LC	**Proven**	_	**A1**	Restricted (11,7465 km²)	Not documented	*Astacoides madagascariensis* is an endemic species that has been found in the provinces of Toamasina (Andasibe, and Amboasary gara) and Antananarivo (Anjozorobe, Mantasoa, Fenoarivo, and Behenjy). The species is present north of the Onive River. As the A1 area represents about 25% of the species' range of occurrence, it can be estimated that criterion C2a is completed (> 10% of the population).	**Confirmed**

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Class	Family	Scientific Name	IUCN Status	Presence BIOTOPE	Presence SADABE	ERAA	Range (EOO)	# of known sites	Critical Habitat Justification	Critical Habitat
Mammals	**Cheirogaleidae**	*Cheirogaleus sibreei*	CR	**Proven**	**Proven**	**A1**	Restricted (50 - 2,500 km²) and with an occupancy area < 10 km²	Not documented	*Cheirogaleus sibreei* is an endemic lemur species with a very restricted distribution. The species is now known to occur only in two sites, i.e. Ranomafana National Park and Tsinjoarivo. In Tsinjoarivo, C. sibreei can be restricted by the Onive and Mangoro rivers, Anjozorobe, and by the corridor leading to the western half of the Tsinjoarivo forest at an altitude of over 1,400 m. The area of occurrence of the species is currently estimated at between 50 and 2,500 km², with an area of occupancy of less than 10 km². The A1 analysis area is 179 km² larger than the species' area of occupancy. Criteria C1a and C2a are considered met. **The natural forest is therefore a confirmed critical habitat for this species.**	**Confirmed**
Mammals	**Cheirogaleidae**	*Microcebus lehilahytsara*	VU	**Proven**	**Proven**	**A1**	Restricted (8,350 km²)	Not documented	*Microcebus lehilahytsara* is a restricted-range lemur species with an estimated EOO of 8,350 km². The species is known to occur in Andasibe, Maromizaha, R.S. Analamazaotra, PN Mantadia, and Tsinjoarivo. The species occurs only north of the Onive River. Area A1 represents about 8% of the known EOO for the species. Criterion C2a is considered to be met. **The natural forest is therefore a confirmed critical habitat for this species.**	**Confirmed**
Mammals	**Daubentoniidae**	*Daubentonia madagascariensis*	EN	**Proven**	**Proven**	**A1, A2**	Not restricted	Not documented	*Daubentonia madagascariensis* is an unrestricted species. The combined A1 and A2 analysis area represents less than 0.5% of the area of occurrence of this species in Madagascar. Criteria C1a and C2a are considered as not validated. **The natural forest is therefore not a confirmed critical habitat for this species.**	**Unconfirmed**
Mammals	**Eupleridae**	*Cryptoprocta ferox*	VU	Not observed but likely	_	**A1, A2**	Not restricted		*Cryptoprocta ferox* is widely distributed (from east to west) but is rare in the central highlands and southern spiny forests. The species is present north and south of the Onive River. The The combined A1 and A2 analysis area represents less than 0.5% of the species' area of occurrence. Criteria C1a and C2a are considered as not validated. **The natural forest is therefore not a confirmed critical habitat for this species.**	**Unconfirmed**
Mammals	**Eupleridae**	*Eupleres goudotii*	VU	Not observed but likely	_	**A1, A2**	Not restricted	Not documented	*Eupleres goudotii* is a species with an unrestricted distribution, known to occur in the eastern rainforest, from the Amber Mountain (north) to the Mandrare River (south). The species is therefore present north and south of the Onive River. The combined A1 and A2 analysis area represents less than 10% of the known range of occurrence of the species. Criterion C2a is considered not to have been met. **The natural forest is therefore not a confirmed critical habitat for this species.**	**Unconfirmed**
Mammals	**Eupleridae**	*Fossa fossana*	VU	Not observed but likely	_	**A1, A2**	Not restricted	Not documented	*Fossa fossana is* a species with an unrestricted distribution, known to occur in the rainforest (Sambirano region to the northwest), from PN Montagne d'Ambre to PN Andohahela on the eastern part. The species is therefore present north and south of the Onive River. The combined A1 and A2 analysis area represents less than 10% of the known range of occurrence of the species. Criterion C2a is considered as not validated. **The natural forest is therefore not a confirmed critical habitat for this species.**	**Unconfirmed**
Mammals	**Eupleridae**	*Galidictis fasciata*	VU	Not observed but likely	_	**A1, A2**	Not restricted	Not documented	*Galidictis fasciata* is an unrestricted species known to occur in the eastern rainforest (from PN Marojejy to Andohahela). The species is therefore present north and south of the Onive River. The combined A1 and A2 analysis area represents less than 10% of the known range of occurrence of the species. Criterion C2a is considered as not validated. **The natural forest is therefore not a confirmed critical habitat for this species**.	**Unconfirmed**

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Class	Family	Scientific Name	IUCN Status	Presence BIOTOPE	Presence SADABE	ERAA	Range (EOO)	# of known sites	Critical Habitat Justification	Critical Habitat
Mammals	**Indriidae**	*Avahi laniger*	VU	**Proven**	_	**A1**	Not restricted	Not documented	*Avahi laniger* is an endemic lemur species with an unrestricted distribution. The species has been observed between the Bemarivo River in the North and Nesivolo / Mangoro in the South, and in the sites of Mananara - North, Mantadia, Marojejy, Zahamena, Betampona, Ambatovaky, Ambohitantely, Analamazaotra, Anjanaharibe-Sud, Mangerivola, Makiracon known at occur only two sites, in Ranomafana National Park and Tsinjoarivo. The species is therefore present north and south of the Onive River. The combined A1 and A2 analysis area represents less than 10% of the EOO for the species. Criterion C2a can be considered as not met. **The natural forest is therefore not a confirmed critical habitat for this species.**	**Unconfirmed**
Mammals	**Indriidae**	Propithecus diadema	CR	**Proven**	**Proven**	**A1**	Restricted (44 292 km²)	Not documented	*Propithecus diadema* occurs in eastern and northeastern Madagascar. Although the precise limits of its range are not known, this species is believed to be one of the most widespread sifakas. It is present in all the tropical forests of eastern Madagascar, north of the Mangoro and Onive rivers up to the Mananara River. Historically, its range extended from north to south of the Antainambalana River, but in recent years it has not been observed in fairly extensive surveys in this region (Mittermeier et al. 2013). Its area of occurrence is now estimated at 44,292 km^2. This species is rare, with a low density estimated at 7 individuals per km^2 in areas of continuous forest in good conservation status, such as the Tsinjoarivo site (in the project area). The population of this species is declining, as it is threatened by habitat loss and hunting. Analysis area A1 of 179 km^2 therefore potentially corresponds to 1,250 individuals, probably > 5 breeding pairs. Criteria C1a and C2a are considered met. **The natural forest is therefore not a confirmed critical habitat for this species.**	**Proven**
Mammals	**Lemuridae**	Eulemur fulvus	NT	**Proven**	_	**A1**	Not restricted	Not documented	*Eulemur fulvus* is a species with an unrestricted distribution, with 3 known populations: 1) one in the west north of the Betsiboka River, 2) another in eastern Madagascar from north of the Mangoro River to the Onive River and an isolated population in the Ambohitantely Reserve. The species occurs only north of the Onive River, and the A1 analysis area corresponds to less than 10% of the known range of occurrence of the species. Criterion C2a is considered as not validated. **The natural forest is therefore not a confirmed critical habitat for this species.**	**Unconfirmed**
Mammals	**Lemuridae**	Eulemur rubriventer	VU	**Proven**	_	**A1, A2**	Not restricted	Not documented	*Eulemur rubriventer* is a species with an unrestricted distribution, known to occur in the Tsaratanana massif to the Ivohibe Peak and the Manampatrana River. The species is therefore present north and south of the Onive River. The combined A1 and A2 analysis area represents less than 10% of the known range of occurrence of the species. Criterion C2a is not validated and critical habitat is not confirmed.	**Not confirmed**
Mammals	**Lemuridae**	Grey Hapalemur	VU	**Proven**	_	**A1, A2**	Not restricted	Not documented	*Hapalemur griseus* is a restricted-range species, known to occur in the eastern part of Madagascar. The species occurs north and south of the Onive River. The combined A1 and A2 analysis area represents less than 10% of the known EOO for the species. Criteria C1a and C2a are considered as not validated. **The natural forest is therefore not a confirmed critical habitat for this species.**	**Not confirmed**
Mammals	**Lepilemuridae**	Lepilemur betsileo	EN	Not observed but likely	_	**A2**	Restricted (3000 km2)	Not documented	*Lepilemur betsileo* is a species with a very restricted distribution, estimated at less than 3000 km2. The species is known to occur only in the Fandriana region in central-eastern Madagascar, south of the Onive River. The species occurs north and south of the Onive River. The cumulation of areas A1 and A2 represents about 40% of the known EOO for the species. Criteria C1a and C2a are considered as validated. **The natural forest is therefore a**	**Potential**

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Class	Family	Scientific Name	IUCN Status	Presence BIOTOPE	Presence SADABE	ERAA	Range (EOO)	# of known sites	Critical Habitat Justification	Critical Habitat
									potential critical habitat for this species.	
Mammals	**Lepilemuridae**	Lepilemur mustelinus	NT	**Proven**	**Proven**	**A1**	Restricted (37 559 km²)	Not documented	*Lepilemur mustelinus* is a species with a restricted range estimated at 37,559 km2. The species is known to occur in the Eastern Forest (between the Onive and Mangoro Rivers (south) to the Maningory River (north). The species occurs only north of the Onive River. Area A1 represents less than 10% of the known EOO for the species. Criterion C2a is considered as not validated. **The natural forest is therefore a potential critical habitat for this species.**	**Not confirmed**
Mammals	**Tenrecidae**	Limnogale mergulus	VU	Not observed but likely	Probable	**A1, A2**	Restricted (2000 km²)	10	*Limnogale mergulus* is a restricted species with an estimated EOO for 37,559 km2. The species is known to occur in 10 sites: Antsampandrano Forest Station, Ankaratra Massif, Antanifotsy village (Andringitra), Andekaleka, Ranomafana, Antsirabe. The species occurs only north and south of the Onive River. The combined A1 and A2 analysis area represents nearly 90% of the known EOO for the species and the project concerns 1 site out of 10 known locations. Criterion C2a is considered as validated. **The natural forest is therefore a potential critical habitat for this species.**	**Potential**
Mammals (bats)	**Hipposideridae**	*Hipposideros commersoni*	NT	Not observed but highly probable	_	**A1, A2**	Not restricted	Not documented	*Hipposideros commersoni* is a widespread species in Madagascar, known to occur in Tsingy de Bemaraha, Isalo, Ankarafantsika, Namoroka, Tsimanampetsotsa, Ankarana, Analamerana, Montagne d'Ambre, Kirindy-Mite. The species occurs south and north of the Onive River. The combined A1 and A2 analysis area represents less than 10% of the known EOO for the species. Criterion C2a is considered as not validated. **The natural forest is therefore not a confirmed critical habitat for this species.**	**Not confirmed**
Mammals (bats)	**Pteropodidae**	*Eidolon dupreanum*	VU	Not observed but likely	_	**A1, A2**	Not restricted	Not documented	*Eidolon dupreanum* is a widespread species in Madagascar, found up to high altitude regions. The species occurs south and north of the Onive River. The combined A1 and A2 analysis area represents less than 10% of the known EOO for the species. Criterion C2a is considered as not validated. **The natural forest is therefore not a confirmed critical habitat for this species.**	**Not confirmed**
Mammals (bats)	**Pteropodidae**	*Rousettus madagascariensis*	NT	Not observed but highly probable	_	**A1, A2**	Not restricted	Not documented	*Rousettus madagascariensis* is a widespread species in Madagascar. The species occurs south and north of the Onive River. The combined A1 and A2 analysis area represents less than 10% of the known EOO for the species. Criterion C2a is considered as not validated. **The natural forest is therefore not a confirmed critical habitat for this species.**	**Not confirmed**
Birds	**Accipitridae**	*Accipiter henstii*	NT	**Proven**	_	**A1, A2**	Not restricted	Not documented	*Accipiter henstii* is a widespread species in Madagascar, in many forest areas except in the southwest. The species occurs south and north of the Onive River. The combined A1 and A2 analysis area represents less than 10% of the known EOO for the species. Criterion C2a is considered as not validated. **The natural forest is therefore not a confirmed critical habitat for this species.**	**Not confirmed**
Birds	**Accipitridae**	*Accipiter madagascariensis*	NT	**Proven**	_	**A1, A2**	Not restricted	Not documented	*Accipiter madagascariensis* is a species widely distributed in Madagascar in primary forests. The species occurs south and north of the Onive River. The combined A1 and A2 analysis area represents less than 10% of the known EOO for the species. Criterion C2a is considered as not validated. **The natural forest is therefore not a confirmed critical habitat for this species.**	**Not confirmed**

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Class	Family	Scientific Name	IUCN Status	Presence BIOTOPE	Presence SADABE	ERAA	Range (EOO)	# of known sites	Critical Habitat Justification	Critical Habitat
Birds	**Anatidae**	*Anas melleri*	EN	Not observed but likely	**Proven**	**A1, A2**	Not restricted (261,000 km2)	100	*Anas melleri* is an endemic bird species with an unrestricted distribution estimated at 261,000 km^2. The species is known to breed in at least 7 protected areas in Madagascar and is known to breed in 14 Important Bird Areas (IBAs). No regular breeding sites are known. The species occurs south and north of the Onive River. The combined A1 and A2 analysis area represents less than 10% of the known EOO for the species. Criterion C2a is considered as not validated. **The natural forest is therefore not a confirmed critical habitat for this species.**	**Not confirmed**
Birds	**Bernieridae**	*Crossleyia xanthophrys*	NT	Not observed but likely	_	**A1, A2**	Not restricted	Not documented	*Crossleyia xanthophrys* is an endemic bird species with an unrestricted distribution, known to occur in the eastern rainforest (from Tsaratanana in the north to Andohahela in the south). The species occurs south and north of the Onive River. The combined A1 and A2 analysis area represents less than 10% of the known EOO for the species. Criterion C2a is considered as not validated. **The natural forest** is therefore not a confirmed critical habitat for this species.	**Not confirmed**
Birds	**Bernieridae**	*Hartertula flavoviridis*	NT	**Proven**	_	**A1, A2**	Not restricted	Not documented	*Hartertula flavoviridis* is an endemic bird species with an unrestricted distribution, known to occur in the rainforest (Manongarivo in the northwest to Andohahela in the south). The species is therefore present south and north of the Onive River. The combined A1 and A2 analysis area represents less than 10% of the known EOO for the species. Criterion C2a is considered as not validated. **The natural forest is therefore not a confirmed critical habitat for this species.**	**Not confirmed**
Birds	**Bernieridae**	*Xanthomixis cinereiceps*	NT	Not observed but highly probable	_	**A1, A2**	Not restricted	Not documented	*Xanthomixis cinereiceps* is an endemic species with unrestricted distribution along the entire length of the rainforest corridor of eastern Madagascar. It is a rare or completely absent species below 800 m above sea level (IBAI 1999). It is common in its high-altitude habitat (IBA 1999). The species probably has a relatively small population, given its restricted distribution. The species occurs south and north of the Onive River. The combined A1 and A2 analysis area represents less than 10% of the known EOO for the species. Criterion C2a is considered as not validated. **The natural forest is therefore not a confirmed critical habitat for this species.**	**Not confirmed**
Birds	**Brachypteraciidae**	*Atelornais crossleyi*	NT	**Proven**	_	**A1, A2**	Not restricted	Not documented	*Atelornais crossleyi* is an endemic bird species with an unrestricted distribution (165,000 km^2), known to occur in Tsaratanana to Andohahela, between 800 and 200 m above sea level. The species occurs south and north of the Onive River. The combined A1 and A2 analysis area represents less than 10% of the known EOO for the species. Criterion C2a is considered as not validated. **The natural forest is therefore not a confirmed critical habitat for this species.**	**Not confirmed**
Birds	**Brachypteraciidae**	*Brachypteracias leptosomus*	VU	Not observed but highly probable	_	**A1, A2**	Not restricted	100	*Brachypteracias leptosomus* is an endemic bird species with an unrestricted distribution, known to occur in the low and medium altitude eastern rainforest (from Daraina to Andohahela in the south). The species occurs south and north of the Onive River. The combined A1 and A2 analysis area represents less than 10% of the known EOO for the species. Criterion C2a is considered as not validated**. The natural forest is therefore not a confirmed critical habitat for this species.**	**Not confirmed**

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Class	Family	Scientific Name	IUCN Status	Presence BIOTOPE	Presence SADABE	ERAA	Range (EOO)	# of known sites	Critical Habitat Justification	Critical Habitat
Birds	**Glareolidae**	*Glareola ocularis*	VU	**Proven**	_	**A1, A2**	Not restricted	Not documented	*Glareola ocularis* is an endemic migratory bird species, whose unrestricted breeding area covers almost the entire Malagasy territory, south and north of the Onive River. The combined A1 and A2 analysis areas represent less than 10% of the known breeding range of the species. Criterion C2a is considered as not validated. **The natural forest is therefore not a confirmed critical habitat for this species.**	**Not confirmed**
Birds	**Mesitornithidae**	*Mesitornis unicolor*	VU	**Proven**	_	**A1, A2**	Not restricted	100	*Mesitornis unicolor* is an endemic species with an unrestricted and uneven distribution within the rainforest of eastern Madagascar. The species occurs south and north of the Onive River. The combined A1 and A2 analysis area represents less than 10% of the known EOO for the species. Criterion C2a is considered as not validated. **The natural forest is therefore not a confirmed critical habitat for this species.**	**Not confirmed**
Birds	**Philepittidae**	*Neodrepanis hypoxantha*	VU	**Proven**	_	**A1, A2**	Not restricted	100	*Neodrepanis hypoxantha* is an endemic species with an unrestricted distribution, known to occur in the high-altitude regions of eastern Madagascar, from the massifs of Marojejy and Anjanaharibe-Sud in the north to the Andohahela massif in the south. The species is therefore present south and north of the Onive River. The combined A1 and A2 analysis area represents less than 10% of the known EOO for the species. Criterion C2a is considered as not validated. **The natural forest is therefore not a confirmed critical habitat for this species.**	**Not confirmed**
Birds	**Podicipedidae**	*Tachybaptus pelzelnii*	EN	**Proven**	Probable	**A1, A2**	Not restricted	100	*Tachybaptus pelzelnii* is an endemic species with an unrestricted distribution which is common in western and central Madagascar. The species occurs south and north of the Onive River. The combined A1 and A2 analysis area represents less than 0.5% of the known EOO for the species. Criterion C1a is considered as not validated. **The natural forest is therefore not a confirmed critical habitat for this species.**	**Not confirmed**
Birds	**Threskiornithidae**	*Lophotibis cristata*	NT	Not observed but highly probable	_	**A1, A2**	Not restricted	Not documented	*Lophotibis cristata* is an endemic bird species with an unrestricted distribution which is widely present throughout the island of Madgascar. The species occurs south and north of the Onive River. The combined A1 and A2 analysis area represents less than 10% of the known EOO for the species. Criterion C2a is considered as not validated. **The natural forest is therefore not a confirmed critical habitat for this species.**	**Not confirmed**
Birds	**Vangidae**	*Xenopirostris polleni*	NT	**Proven**	_	**A1, A2**	Not restricted	Not documented	*Xenopirostris polleni* is an endemic species with an unrestricted distribution throughout eastern Madagascar, between 0 and 1,950 m above sea level, between Andohahela and Ranomafana. The species occurs south and north of the Onive River. The combined A1 and A2 analysis area represents less than 10% of the known EOO for the species. Criterion C2a is considered as not validated. **The natural forest is therefore not a confirmed critical habitat for this species.**	**Not confirmed**
Plants	**Arecaceae**	*Dypsis decipiens*	VU	**Proven**	_	**A1, A2**	Restricted (42846 km²)	8	*Dypsis decipiens* is an endemic plant with a restricted range estimated at 42,846 km^2, between 1,200 and 1,700 m above sea level. It is known to occur in the sites of Ambohitantely Itremo/Ambatofinandrahana, Kalambatritra, Ranomafana. The species occurs south and north of the Onive River. The combined A1 and A2 analysis area represents less than 10% of the known EOO for the species but the area of influence of the project affects 1 site out of 8 the sites where it is known to occur. Criterion C2a is therefore considered as validated. **The natural forest is a confirmed critical habitat for this species.**	**Proven**

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Class	Family	Scientific Name	IUCN Status	Presence BIOTOPE	Presence SADABE	ERAA	Range (EOO)	# of known sites	Critical Habitat Justification	Critical Habitat
Plants	**Arecaceae**	*She-wolf dypsis*	VU	**Proven**	_	**A1, A2**	Restricted (8884 km²)	8	*Dypsis louvelii* is an endemic plant with restricted distribution, estimated at 8,884 km^2. It is known to occur in the sites of Mantadia, Analamazaotra, Corridor Ankeniheny Zahamena, Mantadia. The species occurs south and north of the Onive River. The combined A1 and A2 analysis area represents 20% of the known EOO for the species and the project's area of influence affects 1 site out of 8 the sites where it is known to occur. Criterion C2a is therefore considered as validated. **The natural forest is a confirmed critical habitat for this species.**	**Proven**
Plants	**Arecaceae**	*Dypsis lutea*	EN	**Proven**	_	**A1, A2**	Restricted (1435 km²)	4	*Dypsis louvelii* is an endemic plant with a restricted range estimated at 1,435 km2. It is known to occur in the sites of Masoala, Mananara Nord, Ambatovaky, Zahamena, Mantadia. The species occurs south and north of the Onive River. The combined A1 and A2 analysis area is greater than the known EOO for the species and the project's area of influence affects 1 out of 4 the sites where it is known to occur. Criteria C1a and C2a are therefore considered as validated. **The natural forest is a confirmed critical habitat for this species.**	**Proven**
Plants	**Arecaceae**	*Dypsis procumbens*	NT	**Proven**	_	**A1, A2**	Not restricted	32	*Dypsis procumbens* is an endemic plant with unrestricted distribution, estimated at 16,1478 km^2. It is known to occur in the sites of Manongarivo, Marojejy, Makira, Zahamena, Mantadia, Ranomafana, Midongy Atsimo, Andohahela Ambatovaky, Andohahela, Befotaka - South Midongy, Kalambatritra, Lokobe, Makira, North Mananara, Manongarivo, Mantadia, Ranomafana, Zahamena. The species occurs south and north of the Onive River. The combined A1 and A2 analysis area represents less than 10% of the known EOO for the species and the project's area of influence affects 1 site out of 32 the sites where it is known to occur. Criterion C2a is therefore considered as not validated. **The natural forest is therefore not a confirmed critical habitat for this species.**	**Not confirmed**
Plants	**Arecaceae**	*Ravenea lakatra*	CR	**Proven**	_	**A1, A2**	Not restricted	8	*Ravenea lakatra* is an endemic plant with an unrestricted distribution area (58,423km^2). However, on each of the known sites, there are only a few individuals (Ambatovaky, Ambohijanahary, Befotaka - South Midongy, Bemaraha, Betampona, Lokobe, Loky-Manambato, Makira, North Mananara, Manombo, Manongarivo, Marojejy, Masoala, Ranomafana, Tsaratanana, and Zahamena). The population is estimated at less than 30 mature trees and is declining. The combined A1 and A3 analysis area represents only 3% of the species' area of occurrence. However, considering the great rarity of the species, criterion C1a can be considered as met (at least 3% of the total impacted population). **The natural forest is a confirmed critical habitat for this species.**	**proved**
Plants	**Fabaceae**	*Dalbergia chapelieri Baill.*	NT	**Proven**	_	**A1, A2**	Not restricted	25	*Dalbergia chapelieri Baill.* is an endemic plant with unrestricted distribution, estimated at 150,000 km^2. It is known to occur in 25 sites: Agnalazaha (Mahabo), Analalava, Analamazaotra, Andohahela, Andringitra, Befotaka - South Midongy, Betampona, Ivohibe, Manombo, Masoala, Ranomafana. The species occurs south and north of the Onive River. The combined A1 and A2 analysis area represents less than 10% of the known EOO for the species. Criterion C2a is considered as not validated. **The natural forest is therefore not a confirmed critical habitat for this species.**	**Not confirmed**
Plants	**Fabaceae**	*Dalbergia orientalis*	VU	**Proven**	_	**A1, A2**	Restricted (unknown)	Not documented	*Dalbergia orientalis* is an endemic plant with a distribution so far unknown. It is known to occur in the East of Madagascar in particular at the sites of Fort-Carnot, Betampona, Zahamena, Masoala, and Analamazaotra. The species occurs south and north of the Onive River. The combined A1 and A2 analysis area represents less than 10% of the known EOO for the species. Criterion C2a is considered as not validated. **The natural forest is therefore not a**	**Not confirmed**

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Class	Family	Scientific Name	IUCN Status	Presence BIOTOPE	Presence SADABE	ERAA	Range (EOO)	# of known sites	Critical Habitat Justification	Critical Habitat
									confirmed critical habitat for this species.	
Plants	**Meliaceae**	*Khaya madagascariensis*	EN	**Proven**	_	**A1, A2**	Not restricted	Not documented	*Khaya madagascariensis* is an endemic plant with unrestricted distribution. It is known to occur in the sites of Ambatovy, Bemarivo, Analalava, Analamazaotra, Amber Mountain, Ampasindava, Manongarivo, Tsaratanana, Zahamena, Mananara Nord, Masoala, Marojejy, and the Ankeniheny-Zahamena Corridor. The species occurs south and north of the Onive River. The combined A1 and A2 analysis area represents less than 10% of the known EOO for the species and the area of influence of the project affects 1 site out of the 32 sites where it is known to occur. Criterion C2a is therefore considered as not validated. **The natural forest is therefore not a confirmed critical habitat for this species**.	**Not confirmed**
Plants	**Orchidaceae**	*Aeranthus nidus*	EN (GSPM)	**Proven**	_	A3 (SL)	unknown	Not documented	*Aeranthes nidus* is an endemic orchid with an unknown distribution today, known to occur in Mount Tsaratanàna. The species is listed in Appendix II of the CITES and assessed as Endangered in the GSPM Red List. It is an epiphyte on mosses and lichens, found between 1,000 - 2,000 m above sea level. **Considering the threatened status of this species, natural forest can be considered as potential critical habitat.**	**Potential**
Plants	**Orchidaceae**	*Angraecum viguieri*	EN (GSPM)	**Proven**	_	A3 (SL)	unknown	Not documented	*Angraecum viguieris* is an endemic orchid with a so far unknown distribution which is known to occur in the central-eastern part (Moramanga and Perinet) of Madagascar. The species is listed in Appendix II of the CITES and assessed as Endangered in the GSPM Red List. It is a rainforest epiphyte. **Considering the threat status of this species, natural forest can be considered as potential critical habitat.**	**Potential**
Plants	**Piperaceae**	*Peperomia hildebrandtii*	VU	**Proven**	_		Restricted (1,633 km²)	Not documented	*Peperomia hildebrandtii* is an endemic plant with restricted distribution, estimated at 1633 km2. It is known to occur in the provinces of Fianarantsoa, Toamasina and Toliara. The species occurs south and north of the Onive River. The combined A1 and A2 analysis area is greater than the known EOO for the species. Criterion C2a is therefore considered as not validated. **The natural forest is not a confirmed critical habitat for this species.**	**Proven**
Plants	**Podocarpaceae**	*Podocarpus madagascariensis*	NT	**Proven**	_	**A1, A2**	Not restricted	Not documented	*Podocarpus madagascariensis* is an endemic plant with unrestricted distribution, estimated at 100,000 km^2. It is known to occur in the sites of Ambatovy, Ambohitantely, Analamazaotra, Andringitra, South Anjanaharibe, Forest Corridor Marojejy- South Anjanaharibe - North Tsaratanana, Galoko Kalobinono, Itremo/Ambatofinandrahana, Kalambatritra, Loky-Manambato, Manongarivo, Marojejy, Masoala, Tsaratanana, Zahamena. The species occurs south and north of the Onive River. The combined A1 and A2 analysis area is greater than the known EOO for the species. Criterion C2a is therefore considered as not validated. **The natural forest is not a confirmed critical habitat for this species.**	**Not confirmed**
Plants	**Podocarpaceae**	*Podocarpus rostratus*	EN	**Proven**	_		Restricted (21,229 km²)	3	*Podocarpus rostratus* is an endemic plant with restricted distribution, estimated at 21,229 km^2. It is known to occur in the sites of Andringitra, Marojejy- South Anjanaharibe Forest Corridor-North Tsaratanana, Tsaratanana. The species occurs south and north of the Onive River. The combined A1 and A2 analysis area is greater than the known EOO for the species. Criterion C2a is therefore considered to be met**. The natural forest is a confirmed critical habitat for**	**Proven**

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Class	Family	Scientific Name	IUCN Status	Presence BIOTOPE	Presence SADABE	ERAA	Range (EOO)	# of known sites	Critical Habitat Justification	Critical Habitat
									this species.	
Plants	**Proteaceae**	*Malagasia* aff. *Alticola*	IN (TROPICOS)	**Proven**	_	A3 (SL)	restricted		The cumulative areas of A1 and A2 are greater than the area of occurrence of the species.	**Proven**
Fish	**Bedotiidae**	*Rheocles sp. Ambatovy*	DD	**Proven**	_	A4 (Onive downstream)	Restricted (unknown)		Ecology similar to *Rheocles wrightae*. **Aquatic habitats included in Analysis Area 4 are therefore considered as confirmed critical habitat for this species.**	**Proven**
Fish	**Bedotiidae**	*Rheocles wrightae*	EN	Proven	Proven	A4 (Onive downstream)	Restricted (7,335 km²)		*Rheocles wrightae* is a fish species proven to be endangered in the project area, endemic to the Mangaro. It is a non-migratory species whose known area of occurrence is restricted (7,335 km²) in the eastern sector of Madagascar (7,335 km²), in the Mangoro watershed (Máiz-Tomé et al., 2018). This declining species is threatened by deforestation, clogging of fine sediments, and the presence of invasive alien species. The A4 analysis area corresponds to about 2.7% of the area of occurrence of this species, which is rarer in the upper part of the Mangoro watershed. **Aquatic habitats included in Analysis Area 4 are therefore considered as confirmed critical habitat for this species.**	**Proven**
Reptiles	**Chamaeleonidae**	*Calumma hilleniusi*	EN	Not observed but likely	Probable	**A1, A2**	Restricted (820 km²)	3	*Calumma hilleniusi* is an endemic chameleon with a restricted range estimated at 1,300 km². The species has not been observed in the project area. It is known to occur in 3 locations north and south of the Onive River on the sites of Ankaratra, Andringitra, Ivohibe, and Ambohijanahary. The combined A1 and A2 analysis area corresponds to more than double the known EOO for the species. Criteria C1a and C2a are validated. **The natural forest is therefore a potential critical habitat for this species**.	**Potential**
Reptiles	**Chamaeleonidae**	*Calumma oshaughnessyi*	VU	**Proven**	**Proven**	**A1, A2**	Restricted (18,000 km²)	10;15	*Calumma oshaughnessyi* is an endemic chameleon with a restricted range estimated at 18,000 km². The *species* has been observed in the project area. It is present in the North and South of the Onive River and is known to occur at 10 to 15 locations in many areas of the high plateaus (Tsinjoarivo, Antoetra, Andringitra, Andohahela, Kalambatritra, and Ranomafana). The combined A1 and A2 analysis area represents about 11% of the known EOO for this species. Criterion C2a is validated. **The natural forest is therefore a confirmed critical habitat for this species.**	**Confirmed**
Reptiles	**Chamaeleonidae**	*Calumma parsonii*	NT	Not observed but highly probable	**Proven**	**A1, A2**	Restricted (39,800 km²)	_	*Calumma parsonii is an endemic chameleon with a restricted range estimated at 39,800 km². The species* was observed in the project area by SADABE. It is present north and south of the Onive River in many localities in the eastern rainforest (Ranomafana, Southern Anjanaharibe, Masoala Peninsula, Manongarivo, and Nosy Boraha). The combined A1 and A2 analysis area represents 5% of the known EOO for this species. Criterion C2a is not validated. **The natural forest is therefore not a confirmed critical habitat for this species.**	**Not confirmed**

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Class	Family	Scientific Name	IUCN Status	Presence BIOTOPE	Presence SADABE	ERAA	Range (EOO)	# of known sites	Critical Habitat Justification	Critical Habitat
Reptiles	**Gekkonidae**	*Lygodactylus bivittis*	VU	**Proven**	Probable	**A1**	Restricted (17,767 km²)	_	*Lygodactylus bivittis* was observed in the project area. This species is known to occur in the rainforest between Marojejy and Andasibe, north of Antananarivo. The combined A1 and A2 analysis area represents 4% of the known EOO for this species. Criterion C2a is not validated. **The natural forest** is therefore not a confirmed critical habitat for this species**. The natural forest is therefore not a confirmed critical habitat for this species.**	**Not confirmed**
Reptiles	**Lamprophiidae**	*Pseudoxyrhopus imerinae*	NT	Not observed but likely	_	**A3 (SL)**	Restricted (20000 km²)	Not documented	*Pseudoxyrhopus imerinae* is an endemic species with a restricted range estimated at 20,000 km². This snake has not been observed in the project area but its presence is likely. The species is indeed known to occur in the central highlands of Madagascar (Ranomafana, Anjozorobe, and Ambatovy) and a site at the southern end of the island. The species is known to occur at high altitudes (individuals found at 2,200 m). Its area of analysis therefore corresponds to A3 (lichen woodlands). Area A3 represents less than 10% of the known EOO for the species. Criterion C2a is not validated. **The natural forest is therefore a potential critical habitat for this species.**	**Potential**
Reptiles	**Lamprophiidae**	*Pseudoxyrhopus oblectator*	VU	Not observed but highly probable	Probable	**A1, A2**	Restricted (17434 km²)	Not documented	*Pseudoxyrhopus oblectator* is a species with a restricted range estimated at 17,434 km². It has not been observed in the project area, but its presence is probable in the project area. The species is known to occur in the Ranomafana forest, the new reserve of Anjozorobe, and from Ambatovy, at an altitude of between 700 and 900 m. The species is therefore present north and south of the Onive River. The combined A1 and A2 analysis area represents about 10% of the known EOO for the species. Criterion C2a is validated. **The natural forest is therefore a potential critical habitat for this species.**	**Confirmed**
Reptiles	**Scincidae**	*Trachylepis boettgeri*	LC	Not observed but likely	_	**A1, A2**	Restricted (42891 km²)		*Trachylepis boettgeri* is an endemic species with a restricted range estimated at 42,891 km². This reptile has not been observed in the project area but its presence is probable. The species is known to occur in many localities in the central highlands: Betafo, Antananarivo, Ankaratra, Andringitra, Angavo-Anjozorobe, Kalambatitra. The reptile is thus present north and south of the Onive River. The combined A1 and A2 analysis area represents less than 10% of the known EOO for the species. Criterion C2a is not validated. **The natural forest is therefore not a confirmed critical habitat for this species.**	**Not confirmed**

Legend: Critically Endangered, EN - Endangered, VU - Vulnerable, NT - Near Threatened, DD - Not Assessed

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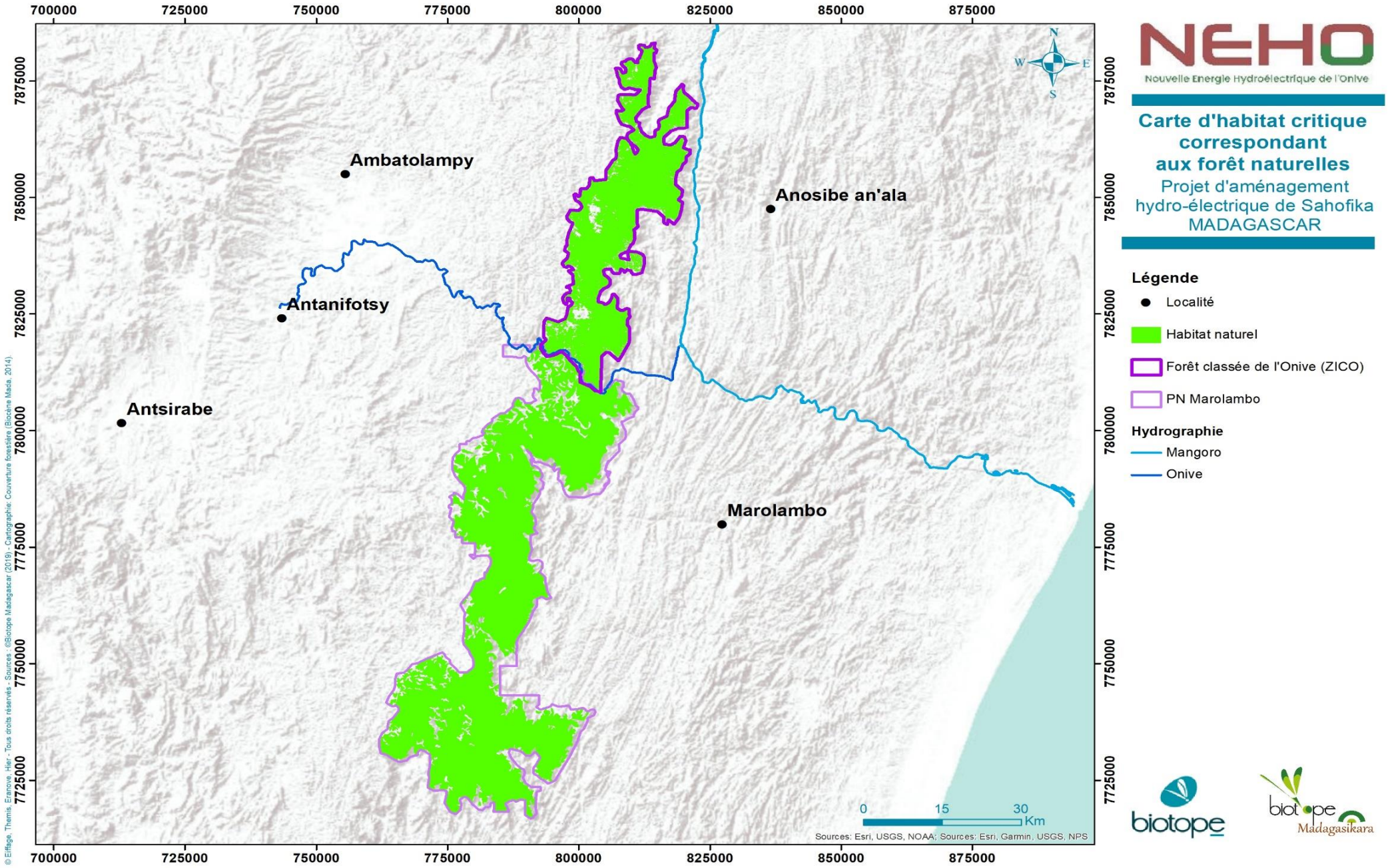
4 Conclusion on Critical Habitats

Based on the IFC PS6 and AfDB OS3 criteria, the Sahofika hydropower project site has two main habitat types identified as critical and essential habitats that deserve special attention during the implementation of the Project:

- **ERAA 1 and ERAA 2** corresponding to the central domain humid forests in the Mangoro catchment area, which are sensitive natural habitats due to the presence of nearly 80 threatened (CR, EN, VU, NT) or limited-range fauna and flora species. *Area = 64,476 ha +115,934 ha*
- **ERAA 3** of the lichen woodland. *Area = 26,431 ha*

  ERAA 4 including the Onive River from the rapids area (Faravohitra waterfall, plant) to the confluence with the right bank tributary of the Nosivolo, integrating all the tributaries of the Manogoro and Nosivolo catchment area - critical for the protection of *Rheocles wrightae* (EN) and *Rheocles sp. Ambatovy*. Area = *940 hectares of aquatic environments (estimate of the cumulative total of the main rivers and tributaries within the watersheds) and a cumulative line of permanent watercourses of nearly 3,130 km.*



Map 12. Critical Habitat Map Corresponding to Natural Dense Rainforests. (Source: Biotope, 2019)

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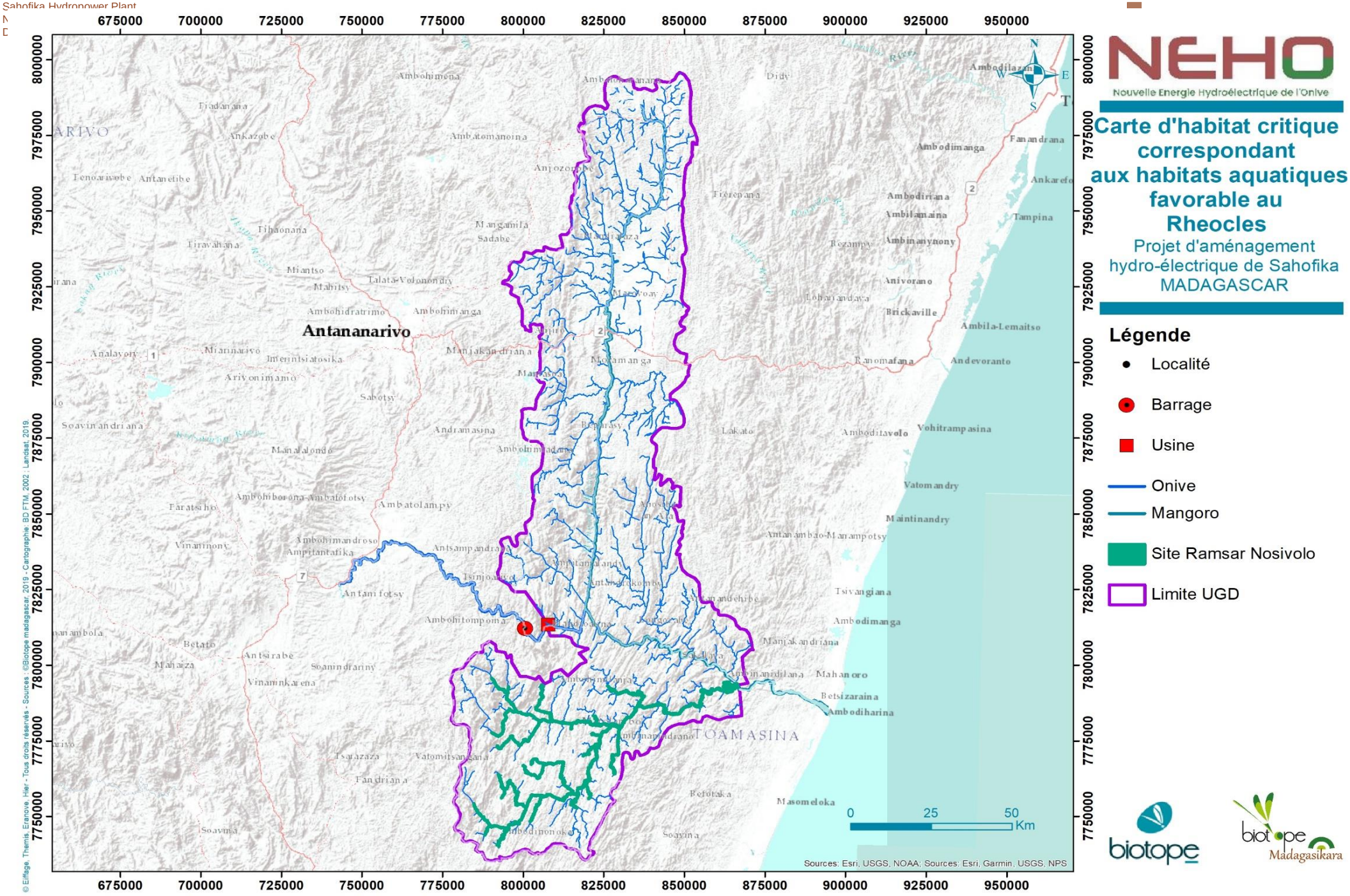
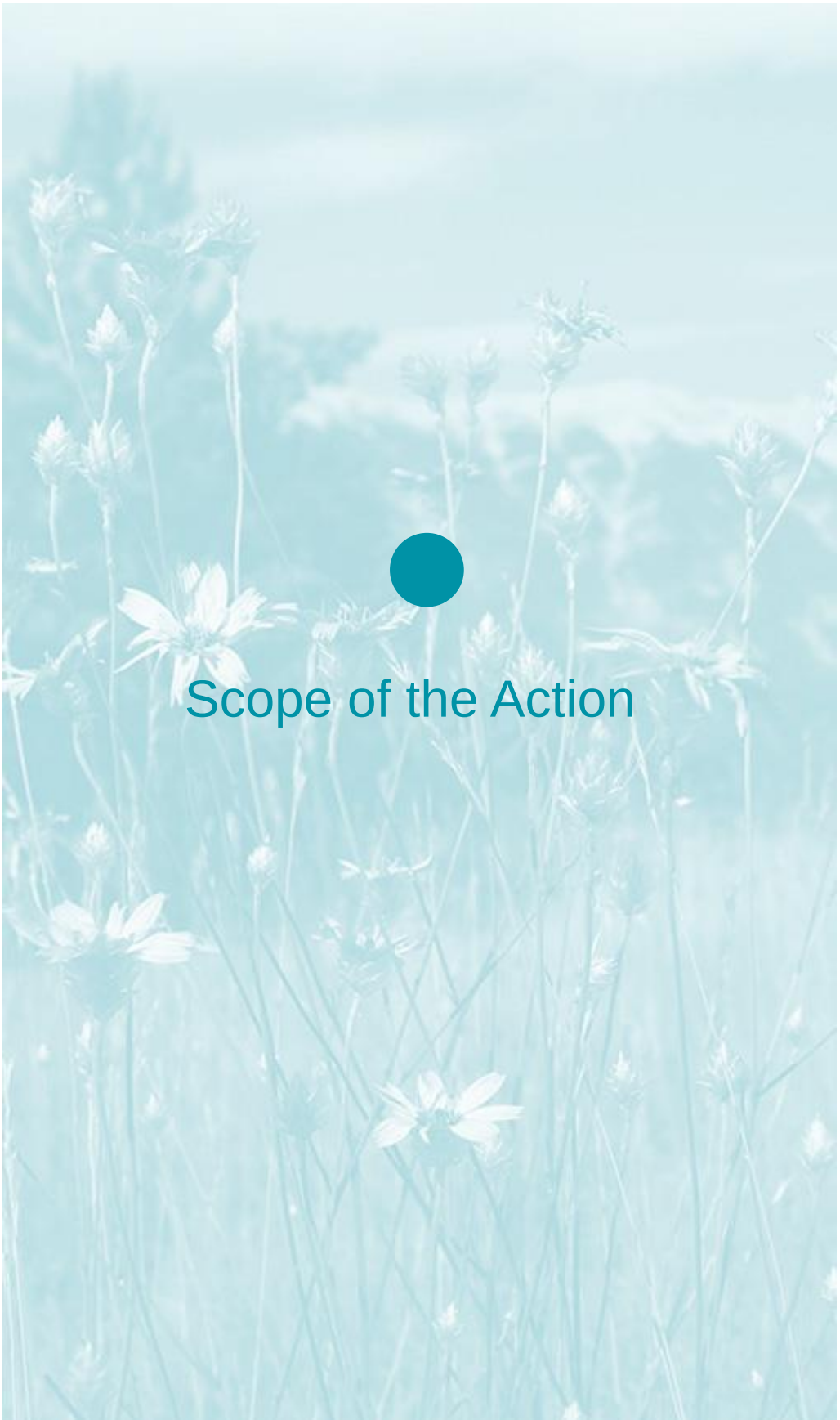
Sahofika Hydropower Plant



Map 13. Critical Habitat Map Corresponding to Aquatic Habitats Suitable for Rheocles wrightae



Scope of the Action

The Biodiversity Action Plan aims to provide the necessary additions to the biodiversity component of the Environmental and Social Impact Assessment, by setting out, in a concrete and practical manner (description, timetable, budget, distribution of tasks between stakeholders) the measures outlined in the plan, possibly complementing them with other measures to resolve the biodiversity issues identified.

This work was carried out using data already available in the ESIA and related studies and through additional research, field visits and stakeholder consultations. These efforts have made it possible to:

- update the critical habitat assessment;
- propose appropriate and proportionate mitigation and compensation measures to achieve the PS6 and OS3 objectives.

This action plan covers the aquatic area affected by the project, as well as the terrestrial environments directly or indirectly impacted (permanent footprint of the hydropower project or associated transmission line, temporary occupation sites and their areas of influence).

There are several objectives being pursued in accordance with PS6 and OS3:

- Protect and preserve terrestrial and aquatic biodiversity (fauna, flora, and natural habitats);
- Comply with the mitigation hierarchy (avoid - reduce - compensate) by aiming for no net loss of biodiversity or even a net gain;
- Cover the construction, reservoir impoundment and operation phases of the project

1 Impacts of the Project

1.1 Impacts on Terrestrial Habitats

1.1.1 Habitat Loss/Degradation/Disturbance

This type of impact concerns all habitats that will host or be close to the Project's infrastructure.

Between the hydropower plant and the dam

The access road and transmission line between the dam and the plant, including access to the surge tank, have a footprint on forest blocks that are considered critical habitats because (i) they are home to ecologically sensitive species, and (ii) they are already threatened due to deforestation activities and overexploitation of natural resources. The works will result in further losses in this habitat.

Around the plant and the dam, the most important footprint is that of the reservoir and the facilities that will be temporarily or permanently built for the Project.

Between the dam and the exit of Marolambo Park

The access tracks and the transmission line between the dam and the exit of the Marolambo Park cross various plant formations within the protection zone (= buffer zone) of the Marolambo Park. The route initially planned was 10.1 km long and crossed the site under management transfer from Fisoronana

From the Exit of Marolambo Park to Antanifotsy

The transmission line only crosses modified habitats in this area. These include eucalyptus or pine plantations used by the residents as wood sources.

Summary of project-impacted surface areas

As a precautionary principle regarding the components of the project still to be detailed, a 20% increase factor has been randomly applied to terrestrial habitats (see Table 6). **It should also be noted that the surface areas of the footprints impacted are likely to vary depending on the results of the technical studies.**

Table 6. Current Total Area of the Various Habitats Impacted by the Project. Source: ESIA, 2019 (Version D)

TOTAL		**Footprint (ha) increased for terrestrial habitats**	
			%
Natural Habitats (critical)	Medium-altitude dense humid forest	**213**	**16%**
	Lichen woodlands	**3**	**0%**
Modified Habitats	Crops	174	13%
	Secondary forest	752	56%
	Degraded formation	57	4%
Water (modified habitat)		144	11%
TOTAL		1,343	100%

1.1.2 Habitat Type Alteration

Rising water levels, project emissions (noise, dust), construction and then operation activities will lead to a change in the functional structure of certain habitats, and therefore to a change in their attractiveness to the fauna and flora species currently using them.

1.1.3 Diversification and Intensification of Threats to Fauna and Flora

The construction of access roads (to the dam and between the dam and the plant), population growth due to the arrival of project staff and migrants will be sources of threats to the fauna and flora. There is a real risk of increased demand for natural resources by residents and of a lack of consideration for the ecological integrity of the ecosystem and biodiversity by the people who will use the access roads opened by the project.

1.1.4 Fire Hazards

There are numerous possible causes of fires inherent to the works. However, the main source is related to the storage and use of hydrocarbon products needed to operate vehicles, machines and portable equipment on the construction site. The various types of habitats present in the area are susceptible to burning, especially in the dry season

Beyond these risks, it is important to bear in mind that the forest habitats present in the project area are subject to significant anthropogenic pressures linked to the practice of tavy, slash-and-

burn agriculture. Anthropogenic fires are sometimes poorly controlled, turning into fires that accelerate the degradation and destruction of the forest corridor.

1.1.5 Erosion Risks

Erosion risks are described in Chapter 5.2.1 of the ESIA (Version D, 2019) as physical impacts. Erosion can lead to lost habitats for flora and fauna, disturbance or degradation of habitats due to siltation and pollution of the aquatic environment.

1.1.6 Light Nuisances

Continuous nocturnal lighting during the construction and operation phases is a potential source of nuisance for certain day and night fauna species (insects, reptiles, bats, etc.). Light sources and continuous lighting can disrupt the lifestyle of these species, or kill them.

1.1.7 Destruction of Fauna and Flora Individuals

During the works (construction, development, track rehabilitation, deforestation), vehicles will be used to transport materials; machinery will be mobilized for earthmoving and other construction activities. The destruction of flora and fauna of conservation interest during this work is a risk.

1.1.8 Wildlife Migration

The disturbances caused by the Project (physical impacts) in the natural environment could harm certain species of wildlife and will therefore encourage migration. Sensitive species could be forced to leave their usual locations because of the nuisance generated by the project. In addition, project activities may disrupt the reproductive cycle and behaviors of certain groups of animals due to changes in home range or even diet.

1.1.9 Introduction and Spread of Invasive Alien Species

All activities contributing to the change or transformation of land use by the project are likely to facilitate the introduction and growth of invasive alien species in the area. Construction materials transportation and vehicle movements are among the causes of their introduction into the area. Since invasive species are already present in the area, their spread may be facilitated by infrastructure development works if appropriate control measures are not taken into account by the project. These species are harmful to biodiversity and the ecosystem and are difficult to control, especially in an ecoregion such as the Project's footprint.

1.1.10 Risk of Collision of Avian Species along the Power Line

The risk of electrocution or collision with power lines is a major cause of bird mortality. With a 220-kV line, the length of the insulators (typically 2.50 m or more) and, more generally, the distances between metal parts subjected to various voltage levels, are such that the risk of electrocution is equal to zero.

However, the risk of a collision is real, especially for birds in conditions of low visibility (night, fog) or moving at high speed. The overhead earth wire generates the greatest risk because of its small diameter which makes it less visible and its position above the other cables.

In the absence of large migratory birds in the Malagasy territory and considering the results of bird inventories in the project's footprint area, the bird species likely to be impacted by electrocution and collisions are as follows:

- Between the start of the power line at the hydropower plant and Belanitra, forest habitat raptor species including *Accipiter francesiae, A. henstii, A. madagascariensis, Buteo brachypterus, Aviceda madagascariensis,* and *Polyboroides radiatus*;
- Between Belanitra and Antanifotsy, raptor species adapted to open environments (savannahs, pseudo-steppe, plantations, etc.) including *Falco newtoni, F. eleonorae, Milvus* aegyptius.

With the exception of the Henst's Goshawk *(Accipiter henstii)*, which is endemic to Madagascar and has near-threatened status-NT, these species have no special conservation status and do not trigger the "critical habitat" criteria.

1.2 Impacts on Aquatic Environments

The physical impact of the project on the aquatic environment is summarized in Table 15 below.

Table 7.Impact of the Project on Aquatic Environments during the Operation Phase

Hydrographic Sector	Impact of the Project on Aquatic Environments	
	Watercourse distance in km	Surface area (ha)
ONIVE + impacted tributaries upstream from the dam (flooded area)	32	144
ONIVE, bypassed section	14	84
ONIVE downstream from the plant up to the confluence with the Mangoro River.	19	190

1.2.1 Aquatic Habitat Alteration

Upstream from the dam (reservoir)

In the reservoir upstream from the future dam, the Project will lead to a alteration of the hydromorphology of the river and therefore of the aquatic fauna and flora habitat. The various river flow facies will be replaced by a variable water body. This morphological change will be accompanied by the physico-chemical alterations described in Chapter 5.8 of the ESIA (Version D, 2019).

These physico-chemical alterations will add up to those already existing in the Onive as a result of deforestation and gold panning activities.

The rise in water level will cause the flooding of an area of about 144 ha of watercourses (Onive and tributaries).

Downstream from the reservoir

Scope of the Action Plan

The physico-chemical alterations will be reflected downstream from the reservoir, also with a different sedimentary regime, caused by a different hydraulic regime.

1.2.2 Obstacle to Ecological Continuity

The presence of the dam will form an impassable obstacle to ecological continuity. Migratory species capable of crossing the Onive Falls will no longer be able to access the areas upstream from the dam. Based on inventories and surveys across the study area, a maximum of four (4) species are concerned, including three probably upstream from the dam; these are two species of Anguillidae (*Anguilla marmorata and Anguilla mossambica)* and two species of Gobiidae (*Sicyopterus franouxi* and *Awaous aeneofuscus*). There are still questions as to how eels reach the upper reaches of the Onive River basin: either by following its main course (which would require eels to travel several kilometers over very steep areas) or by using adjacent basins and less steep tributaries (in which case the dam would not necessarily be an obstacle). There are moderate concerns associated with these species. Although no species is threatened according to IUCN, their conservation is largely an issue for those who fish for them (see Chapter 4.2.10.5 on fishing in the ESIA, Version D, 2019). At the population level, the construction of the dam is not likely to put these species at risk. However, it will be an additional potential factor of habitat fragmentation and population decline.

Non-migratory species and conservation concern endangered species such as *Rheocles wrightae, Astacoides caldwelli and A. madagascariensis* are not concerned by this issue. In fact, they are not migratory and will be able to complete their entire life cycle downstream from the dam for *Rheocles wrightae* and on the tributaries of the Onive for *Astacoides caldwelli* and *Astacoides madagascariensis.*

1.2.3 Obstacle to Sediment Continuity

The dam will be an obstacle to sediment continuity over the long term and will lead to an accumulation of sediment upstream from the reservoir (especially fine sediment) and a deficit downstream. However, this phenomenon is not permanent, since the sediments may pass through as floods occur and as soon as the normal retention level is reached and the inflow exceeds the outflow of the equipment.

1.2.4 Reduced Flow and Habitat in the Bypassed Reach.

During the dry season, a significant portion of the flow will be captured at the dam and will feed the turbines placed in the plant. The bypassed reach (BR) created between these two points has a stream of about 14 km and an estimated area of about 80 ha.

The reduced flow will be noticeable in the dry season, when only the instream flow (5.7 m^3/s) will be discharged into the bypassed reach. The reduced flow will result in reduced aquatic habitat on the section concerned. However, high conservation concern, threatened species can only frequent the extreme downstream part of the bypassed reach concerned, i.e., the 1.5-km-long

section upstream from the hydropower plant, because they cannot cross the falls. As regards Rheocles, the 1.5 km of river potentially impacted is considered negligible compared to the cumulative river stream line within the ecologically relevant analysis area (ERAA 4) of Rheocles (corresponding to the catchment area of the Mangoro River), i.e. nearly 3,130 km cumulatively (see ERAA 4 definition).

1.2.5 Alteration of the Hydrological Regime Downstream from the Dam

Between the dam and the plant

In the dry season, water flow through the BR will be greater than or equal to the instream flow, set at this stage at 5.7 m^3/s, and supplemented by a few insignificant lateral inflows from tributaries (a few dozens of m^3/s). During high water periods, the impoundment of the upstream reservoir will delay the flood at the end of the dry season. This delay and therefore potential impact will depend on the minimum level reached by the reservoir and the time it takes for it to fill depending on rainfall in the upstream watershed.

Downstream from the plant

During low-water periods, the water flow downstream from the plant will be most often close to 40.7. m^3/s (instream flow plus a 35 m^3/s turbine flow), excluding marginal lateral inflows between the dam and the plant. The low-water flows will therefore be increased ("low-water support"), while floods will be delayed in the high-water season since the flood wave can only propagate once the reservoir is actually filled.

In addition, the facility will operate below capacity only in the following circumstances:

- during the maintenance of one of the turbines (stable turbine flow reduced to 30 m^3/s);
- in very dry periods (on average 1 year out of 7, according to the modelling carried out); in which case, if the reservoir reaches its minimum level during the dry season, the turbine flow may only reach 35 m^3/s for part of the day (peak-hour production).

This operation in a very dry year (1 year out of 7) will result in rapid and frequent (daily) variations in the flow rate and, therefore, in variations in the water level downstream from the plant. The hydraulic studies carried out show that these water and level variations will impact the Onive as far away as the confluence with the Mangoro River (along a distance of about 19 km downstream from the plant).

- This can lead to trapping of aquatic fauna in water pockets during low-water periods.

1.2.6 Proliferation of Aquatic Invasive Alien Species

The transition from a mosaic of relatively diverse aquatic habitats in terms of flow facies to a uniform lentic zone in the reservoir will be more beneficial to the least demanding species with rapid development capacities, and in particular invasive alien species such as carp *Cyprinus carpio* or *Channa maculate;* and predators such as *Rheocles wrightae*. These species have already been present in the Onive and its tributaries for many years. It was noted, however, that these species are more abundant in upstream areas than in downstream areas, the latter being those hosting threatened rainbow fish.

In addition, native crayfish populations are declining nationally, due to habitat degradation and the introduction of invasive alien species and their capture for consumption and sale. These last two limiting factors may be boosted by population displacements during the construction and operation of the hydropower project. It should also be noted that, in the Mangoro basin near Moramanga, the invasive alien species *Procambarus virginalis* has been present for several years.

1.2.7 Mortality of and Injuries to Aquatic Wildlife caused by the Facilities

The dam's water intake is likely to push fish towards the penstock and then towards the turbines, which leads to inevitable death due to the drop height, regardless of the size or stage of development of the fish.

The turbining of the instream flow at the dam in anticipation of local electrification is also likely to push fish towards the turbine, causing variable degrees of mortality and injury.

However, this impact should be qualified and put into perspective with the fact that these 2 water intakes are planned 33 m below the normal level of the reservoir (at the Feasibility Study stage). As a result, fish will only move in close proximity and could only be drawn into the water path of the turbines in very dry years.

There are also no species of conservation concern in the Onive River upstream from the dam, and the downstream transit of introduced invasive species could be reduced.

2 Impacts of the Project in Relation to Nearby Protected Area

Table 8. Impacts of the Project in Relation to Nearby Protected Area

Protected Areas	Impacts of the Project	Specific BAP Measures
Marolambo National Park and the three areas under management transfer (VOI) in the Commune of Belanitra (Antenina, Fisoronana and Befotaka)	***Low direct impacts:*** the project's area of influence (especially the access road to the dam) is located in the MNP protection zone, not the core area where the park's high conservation concern species are present. ***Moderate indirect impacts*** related to population influx on the periphery of the MNP due to the presence of the Project (increased pressure on natural resources).	The project is committed to supporting the MNP and is an opportunity for the MNP teams to develop and improve their efforts to implement surveillance and anti-poaching actions - see BAP 11 and BAP 23 in particular.
ZEA (NPA Forest Corridor, COFAM) which covers the heart of the Marolambo National Park and its protection zone.	***Low direct impacts:*** the project's area of influence (in particular the access road to the dam) is located in the MNP protection zone, and not its core area, where the presence of two species of lemurs justified the designation of the ZEA: *Lepilemur betsileo* and *Avahi betsileo*. ***Moderate indirect impacts*** related to the population influxes on the periphery of the MNP due to the presence of the Project (increased pressure on natural resources).	The project is committed to supporting the MNP and is an opportunity for the MNP teams to develop and improve their efforts to implement surveillance and anti-poaching actions - see BAP 11 and BAP 23 in particular.
NPA of Tsinjoarivo - Ambalaomby in the process of being created	***Moderate direct impacts:*** Part of the project's area of influence is located in the peripheral area of the NPA. The access road between the dam and the plant and the installation of the HV line impacts high conservation concern forest habitats and species, which are the conservation priority of the protected area. These impacts are accounted for among the residual impacts of the project.	The project will implement a series of impact mitigation measures in the forest corridor - see BAP 3 and BAP 5 to 15 in particular. The project will also contribute to the creation of the NPA (access and various management infrastructure, technical support etc.) and to forest management and restoration measures over the life of the project (35 years) - see BAP 21 and BAP 22 in particular.
Important Bird Area (IBA) in the Onive "gazetted forest"	***Low direct impacts:*** The direct footprint of the project impacts only the southern end of the IBA. The project footprint is estimated at ~216 hectares, representing 3% of the total area of the IBA estimated at 75 km^2.	Since its establishment, the IBA has not been subject to any inventory updates (carried out more than 20 years ago), research, protection or conservation work. NGO Asity Madagascar, which is the reference entity for the IBA, considers that an update of the IBA file (list of bird species, conservation issues) is currently necessary, and is a

Protected Areas	Impacts of the Project	Specific BAP Measures
	Furthermore, the project's impacts on avifauna (related to the risk of collision with the HV line in particular) are assessed as low and limited considering the characteristics of the HV line, the installation of bird-diverters and the absence of high conservation concern species (triggering critical habitat) - see 1.1.10.	prerequisite for any reflection on conservation actions to be carried out in the IBA. To avoid increasing disparities between the Project's ornithological data and the Onive gazetted forest IBA data, the project will contribute to updating IBA data through the IBA's reference NGO, i.e. Asity Madagascar - see BAP 25.

3 Analysis of Residual Impacts by Species or Taxon

The project's residual impacts (construction + operation) are presented in the table below, which also features the mitigation measures (including avoidance, reduction, restoration and support) to be implemented BEFORE COMPENSATION. Detailed descriptions of the mitigation measures are presented in **Appendices 1, 2, 3 and 6** to the report.

Table 9. Summary of Residual Impacts on Species that Have Triggered Critical Habitat Designation

Species Concerned	Associated Natural Habitat	Gross Impacts in the Construction and Operation Phase	ESIA Mitigation Measures and BAP Additions (avoidance / reduction / restoration)	Residual Impact	BAP Objective
Analysis of Residual Impacts for Terrestrial Species					
MAMMALS **Lemurs**	Medium-altitude dense humid forest + Lichen woodland **CRITICAL HABITAT** Analysis Areas *ERAA1 = 645 km²* *ERAA2 = 1159 km²*	• Loss of critical habitat due to the destruction of natural forests by the project's temporary and permanent infrastructure (~216 hectares of permanent footprint over the natural forest); • Fragmentation of natural habitats due to the presence of the access road between the dam and the plant (lack of connectivity, traffic) during the construction and operation phases; • Increased poaching due to population influx into the project area; • Loss of fruit trees for consumption (during deforestation); • Risk of species hibernating in the ground being crushed by construction machines (deforestation);	Main mitigation measures for lemurs: ➔ Traffic management on the road between the dam and the plant to minimize the risk of crushing wildlife and disturbing night lemurs (reduced speed, night traffic ban) ➔ See **BAP 5 Reduction_preservation_continuum** ➔ The implementation of an anti-poaching plan with the local populations and employees integrating high conservation concern lemur species, through monitoring and awareness-raising visits (mechanism to impart sanctions to employees). ➔ See **BAP11.reduce_population_ influx_poaching** ➔ An employee awareness program for the recognition of lemur species and the consideration of lemurs at all stages of the construction works and in the operation phase. ➔ *See* **BAP 26. Support_ environmental_awareness-raising**	MODERATE • Loss of ~216 hectares of natural forest, i.e. 0.3% of ERAA1 and 0.2% of ERAA1 and ERAA2 cumulatively. • Risks related to population influx • Fragmentation of the forest corridor	**NET GAIN**

Species Concerned	Associated Natural Habitat	Gross Impacts in the Construction and Operation Phase	ESIA Mitigation Measures and BAP Additions (avoidance / reduction / restoration)	Residual Impact	BAP Objective
		• Noise and light pollution during construction and operation;	➔ Ban on consuming or bringing bushmeat into the site and living areas ➔ See **BAP 11. Reduction_population_influx_poaching** ➔ Regulation of access to project access roads ➔ See **BAP 11. Reduction_population_influx_poaching** ***Additional BAP measures:*** ➔ ***Observance of the species' reproduction and hibernation period*** ➔ *See* **BAP 6. Reduction_Works_Planning** ➔ ***Installation of walled bridges on the portion of the road crossing the heart of the corridor between the dam and the plant (their exact location will have to be defined).*** ➔ **See BAP 5 Reduction_preservation_continuum** ➔ ***Controlled access to the road between the dam and the plant (vehicle and traffic control)*** ➔ ***Establishment of guard posts at the boundaries of protected areas (MNP/DGEF and Proponent of the future NPA/NEHO) for the control of vehicles crossing the Onive River.*** ➔ ***Implementation of a control/monitoring system on the reservoir (monitoring crossings from one bank to the other of the Onive and activities around the lake) - monthly visit by the team in charge of water quality monitoring.*** ➔ *See* **BAP 11. Reduction_population_influx_poaching** ➔ ***Lemur-related actions in the awareness program for site personnel (species recognition, monitoring of individuals seen in the work area, on access roads, etc.).***		

Species Concerned	Associated Natural Habitat	Gross Impacts in the Construction and Operation Phase	ESIA Mitigation Measures and BAP Additions (avoidance / reduction / restoration)	Residual Impact	BAP Objective
			➔ *See* **BAP 26. Support_ environmental_awareness-raising** • ***Establishment of procedures for wildlife flight prior to any deforestation action.*** ➔ *See* **BAP 7: Sensible_deforestation**		
MAMMALS **Hedgehog *(Limnogale mergulus, VU)***	Medium-altitude dense humid forest + Lichen woodland **CRITICAL HABITAT** Analysis Areas *ERAA1 = 645 km²* *ERAA2 = 1159 km²*	*Limnogale mergulus* (VU) is a semi-aquatic carnivorous species (a kind of hedgehog) whose diet consists of freshwater crayfish, aquatic insect larvae and small crustaceans: • Overall, loss of critical habitat due to the destruction of natural forests by the project's temporary and permanent infrastructure (~216 hectares of permanent footprint over the natural forest); • Degradation of forest watercourses at the access road crossing areas between the dam and the plant (spillage of materials, pollutants, fuels, erosion risks) impacting the species' habitat and food sources; • Disruption of ecological connectivity at small forest stream crossings; • Risks of crushing on the ground by construction machines (deforestation, machine traffic on the access road between the dam and the plant); • Collateral victim of increased fishing pressure in forest streams (eel traps)	Key mitigation measures for *Limnogale mergulus* (ESIA): • Reduction of the risks of erosion, especially on the access road between the dam and the plant, in order to minimize the risks of degradation of the forest watercourses crossed. ➔ *See* **ME3. Reduction_erosion_risk** • Implementation of suitable crossings on crossed forest watercourses. ➔ *See* **BAP 19. Reduction_crossings_tributaries** • Traffic management on the access road between the dam and the plant to minimize the risk of wild animals being run over. ➔ *See* **BAP 5: Reduction_preservation_continuum** ***Additional BAP measures:*** • ***Establishment of wildlife crossing structures at forest watercourse crossing structures (conservation of bank continuity)*** ➔ *See* **BAP 19. Reduction_crossings_tributaries**	WEAK • Loss of natural habitats (~216 hectares), i.e. 0.3% of ERAA1 and 0.2% of the cumulative total of ERAA1 and ERAA2 • 10 watercourses crossed along the access road between the dam and the Onive River	**NET GAIN**

Species Concerned	Associated Natural Habitat	Gross Impacts in the Construction and Operation Phase	ESIA Mitigation Measures and BAP Additions (avoidance / reduction / restoration)	Residual Impact	BAP Objective
MAMMALS **Small carnivores (Epleridae)**	Medium-altitude dense humid forest + Lichen woodland **CRITICAL HABITAT** Areas of analysis *ERAA1 = 645 km²* *ERAA2 = 1159 km²*	• Loss of critical habitat due to the destruction of natural forest by the project's temporary and permanent infrastructure (~216 hectares of permanent footprint over the natural forest); • Fragmentation of natural habitats due to the access road between the dam and the plant (lack of connectivity, traffic) during the construction and operation phases; • Risk of wild animals being run over by vehicles on the access road to the dam and plant; • Risk of poisoning due to the presence of waste in the work area; • Risks of individuals being destroyed during the work phases (deforestation, passage of machinery); • Increased poaching due to population influx into the project area.	Key mitigation measures for small carnivores: • Observance of the species' sensitive period (breeding) ➔ *See* **BAP 6. Reduction_works_planning** • Traffic management on the road between the dam and the plant to minimise the risk of wild animals being run over (reduced speed, no night traffic) ➔ *See* **BAP 5: Reduction_preservation_continuum** • An employee awareness program for the recognition of Eupleridae and the consideration of lemurs at all stages of the works. ➔ *See* **BAP 26. Support_ environmental_awareness-raising** • Impose a ban on consuming or bringing bushmeat into the site and living areas • Regulation of access to project access roads ➔ *See* **BAP 11. Reduction_population_influx_poaching** ***Additional BAP measures:*** • ***Establishment of guard posts at the boundaries of protected areas (MNP/DGEF and Proponent of the future NPA/NEHO) for the control of vehicles crossing the Onive River.*** • ***Installation of a control/monitoring system on the reservoir*** ➔ *See* **BAP 11. Reduction_population_influx_poaching**	MODERATE • Loss of natural habitats (~216 hectares), i.e. 0.3% of ERAA1 and 0.2% of the cumulative total of ERAA1 and ERAA2 • Risks related to population influx • Fragmentation of the forest corridor	NET GAIN
	Medium-altitude dense rainforest +	• Loss of critical habitat due to the destruction of natural forest by the project's temporary and permanent infrastructure (~216 hectares	No bat-focused measures in the ESIA		

Species Concerned	Associated Natural Habitat	Gross Impacts in the Construction and Operation Phase	ESIA Mitigation Measures and BAP Additions (avoidance / reduction / restoration)	Residual Impact	BAP Objective
MAMMALS Bat	Lichen woodland (hunting) including cavernous habitats (breeding) **NON-CRITICAL HABITAT** Areas of analysis *ERAA1 = 645 km²* *ERAA2 = 1159 km²*	of permanent footprint over the natural forest).	***Additional BAP measures:*** • ***Active search for bat roosting sites and the presence of colonies (caves, cracks) prior to exploitation of the project's quarries (by a team of chiropractors).***	WEAK	NO NET LOSS
AMPHIBIANS **Arboreal Amphibians**	Medium-altitude dense forest + Lichen Woodland **CRITICAL HABITAT** Areas of analysis *ERAA1 = 645 km²* *ERAA2 = 1159 km²*	• Loss of critical habitat due to the destruction of natural forests by the project's temporary and permanent infrastructure (~216 hectares of permanent footprint over the natural forest); • Risks of individuals being destroyed during the work phases (deforestation, passage of machinery); • Disruption of ecological connectivity at small forest stream crossing structures;	<u>Key Mitigation Measures for Arboreal Amphibians (ESIA):</u> • Traffic management on the road between the dam and the plant to minimise the risk of wild animals being run over (reduced speed, no night traffic) ➔ *See* **BAP 5: Reduction_preservation_continuum.** • The first trip in the morning is carried out by the E&S team. • Implementation of suitable crossing structures on forest watercourses crossed by the access road between the dam and the plant breeding habitats for certain species of arboreal amphibians ➔ *See* **BAP 19. Reduction_crossings_tributaries** ***<u>Additional BAP measures:</u>*** • ***Observance of the breeding season for amphibians*** ➔ *See* **BAP 6. Reduction_works_planning**	MODERATE • Loss of natural habitats (~216 hectares), i.e. 0.3% of ERAA1 and 0.2% of the cumulative total of ERAA1 and ERAA2 • Fragmentation of the forest corridor	NET GAIN

Species Concerned	Associated Natural Habitat	Gross Impacts in the Construction and Operation Phase	ESIA Mitigation Measures and BAP Additions (avoidance / reduction / restoration)	Residual Impact	BAP Objective
			• ***Minimization of the risks of amphibians being crushed with the passage of a team of herpetologists before any deforestation, delimitation in particular of areas suitable for breeding and therefore sensitive (ponds and small watercourses, trunk cavities for certain species of tree frogs). It should be noted that the breeding period for amphibians is normally avoided with the implementation of BAP 6.*** ➔ *See* **BAP 7: Sensible_Deforestation**		
AMPHIBIANS **Terrestrial Amphibians**	Medium-altitude dense humid forest + Lichen woodland **CRITICAL HABITAT** Areas of analysis *ERAA1 = 645 km²* *ERAA2 = 1159 km²*	• Loss of critical habitat due to the destruction of natural forest by the project's temporary and permanent infrastructure (~216 hectares of permanent footprint over the natural forest); • Risks of individuals being destroyed during the work phases (deforestation, passage of machinery); • The risks of flooding when impounding the reservoir in areas with a low slope (impoundment speed greater than 2 km/h) and on islands that may form inside the reservoir during impoundment.	Key Mitigation Measures for Terrestrial Amphibians (ESIA): ➔ Traffic management on the road between the dam and the plant to minimize the risk of wild animals being run over (reduced speed, no night traffic) ➔ See **BAP 5: Reduction_preservation_continuum** ➔ Installation of suitable crossing structures on forest watercourses crossed by the access road between the dam and the plant to preserve aquatic environments, breeding habitats for certain species of terrestrial amphibians. ➔ *See* **BAP 19. Reduction_crossings_tributaries** ***Additional BAP measures:*** ➔ ***Observance of the amphibians' sensitive period (hibernation, breeding)*** ➔ ***See* BAP 6. Reduction_works_planning** ➔ ***Minimization of the risks of amphibians being crushed with the passage of a team of herpetologists before any deforestation (identification of breeding sites)*** ➔ *See* **BAP 7: Sensible_Deforestation**	MODERATE • Loss of natural habitats (~216 hectares), i.e. 0.3% of ERAA1 and 0.2% of the cumulative total of ERAA1 and ERAA2 • Fragmentation of the forest corridor	NET GAIN

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Species Concerned	Associated Natural Habitat	Gross Impacts in the Construction and Operation Phase	ESIA Mitigation Measures and BAP Additions (avoidance / reduction / restoration)	Residual Impact	BAP Objective
REPTILES	Medium-altitude dense humid forest + Lichen woodland **CRITICAL HABITAT** Areas of analysis *ERAA1 = 645 km²* *ERAA2 = 1159 km²*	• Loss of critical habitat due to the destruction of natural forest by the project's temporary and permanent infrastructure (~216 hectares of permanent footprint over the natural forest); • Risks of individuals being destroyed during the work phases (deforestation, passage of machinery). • The risks of flooding when impounding the reservoir in areas with a low slope (impoundment speed greater than 2 km/h) and in islands that may form inside the reservoir during impoundment. • Increased poaching activities due to the population influx in the project area (especially for chameleon populations).	Key Reptile Mitigation Measures (ESIA): ➔ Regulation of access to project access roads ➔ *See* **BAP 11. Reduction_population_influx_poaching** ➔ An employee awareness program to recognize and consider reptiles at all stages of work. ➔ *See* **BAP 26. Support_environmental_awareness-raising** ***Additional BAP measures:*** • ***Observance of the sensitive period for reptiles (breeding)*** ➔ *See* **BAP 6. Reduction_works_planning** • ***Minimisation of the risk of reptile crushing with the passage of a team of herpetologists before any deforestation (identification of sensitive areas, collection and protection of individuals).*** ➔ *See* **BAP 7: Sensible_Deforestation** • ***Minimization of the risk of reptiles being submerged during impoundment of the reservoir by 1) clearing the submerged areas before impoundment, 2) respecting a maximum impoundment speed of 2 km/h and 3) setting up a mission to rescue small wildlife during impoundment, carried out by a team of herpetologists and targeted on low-slope areas where submergence will be faster and where islands form in the reservoir.*** ➔ *See* **BAP16. Reduction_impoundment_reservoir** • ***Raising awareness among the population and employees not to collect protected and endangered chameleons*** ➔ *See* **BAP 11. Reduction_population_influx_poaching**	MODERATE • Loss of natural habitats (~216 hectares), i.e. 0.3% of ERAA1 and 0.2% of the cumulative total of ERAA1 and ERAA2 • Risks related to population influxs • Fragmentation of the forest corridor	**NET GAIN**

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Species Concerned	Associated Natural Habitat	Gross Impacts in the Construction and Operation Phase	ESIA Mitigation Measures and BAP Additions (avoidance / reduction / restoration)	Residual Impact	BAP Objective
BIRDS ***Anas melleri (EN), Tachybaptus pelzelnii (EN)***	Mid-altitude dense humid forest wetlands **CRITICAL HABITAT**	• Loss of critical habitat due to the destruction of natural forest by the project's temporary and permanent infrastructure (~216 hectares of permanent footprint over the natural forest); • Risk of collision of avifauna along the power line	Key bird mitigation measures (ESIA): • Between the plant and the dam, installation of three-dimensional "bird diverters" on the ground wires, only in the corridor. ➔ *See* **BAP 13. Reduction_collision_risk** • Support for the updating of the IBA data of the Onive gazetted forest, in collaboration with the reference NGO. ➔ *See* **BAP 25. Support_inventories_IBA** ***Additional BAP measures:*** • ***For the remainder of the HV line, consider lakes/other bodies of water that may support potentially sensitive waterfowl (LC) species (duck flights) when selecting portions of the HV line requiring bird diverters.*** ➔ *See* **BAP 13. Reduction_collision_risk**	WEAK • Loss of natural habitats (~216 hectares), i.e. 0.3% of ERAA1 and 0.2% of the cumulative total of ERAA1 and ERAA2	**NET GAIN**
PLANTS	Medium-altitude dense humid forest + Lichen woodland **CRITICAL HABITAT** Areas of analysis *ERAA1 = 645 km²* *ERAA2 = 1159 km²*	• Loss of critical habitat due to the destruction of natural forest by the project's temporary and permanent infrastructure (~216 hectares of permanent footprint over the natural forest); • Increased collection due to population influx in the project area. • Fire risks related to the project (works and operation phase) • Risks related to the introduction of IAS of flora	Key Flora Mitigation Measures (ESIA): • The identification, marking and precise location of the critical habitat triggering flora species listed in the ESIA for avoidance during the exact siting of infrastructure in forest areas; • Adaptation of footprints and impacting activities to the maximum extent possible or relocation of the specimens concerned to avoid damaging them. • Follow-up of actions to protect threatened plants by the EPC and in the operation phase • Combating the introduction and spread of invasive alien plant species	MODERATE • Loss of natural habitats (~216 hectares), i.e. 0.3% of • ERAA1 and 0.2% of the cumulative total of ERAA1 and ERAA2 • Population influxes • Fragmentation of the forest	

Species Concerned	Associated Natural Habitat	Gross Impacts in the Construction and Operation Phase	ESIA Mitigation Measures and BAP Additions (avoidance / reduction / restoration)	Residual Impact	BAP Objective
			Additional BAP measures: • Collection and removal of species (whose removal is controlled) meeting critical habitat criteria prior to clearing and works; • Breeding in nurseries of certain high conservation concern species where possible; • Introduction of a system of sanctions by the EPC against employees in the event of non-compliance with the works footprint.	corridor	
Analysis of residual impacts on aquatic species					
FISH ***(Rheocles wrightae*, EN)**	Onive downstream from the Onive + Mangoro and Nosivolo catchment area **CRITICAL HABITAT**	Considering the limited knowledge of the ecology of Rheocles species, the impacts of the project are difficult to assess. The knowledge acquisition study, to be started at the beginning of the works, will provide additional information and assess the potential impacts of the project on the species. At this point, we can conclude that: • *Rheocles wrightae* is not impacted by the ecological connectivity disruption associated with the dam. As a matter of fact, Rheocles is not a migratory species and can complete its entire life cycle downstream from the dam. • It is very unlikely that *Rheocles wrightae will be* able to move up into the Bypassed Reach (BR) due to the characteristics of the species and the intensity of rapids in this	Key Mitigation Measures for Rheocles (ESIA): • When impounding the reservoir for the first time, schedule a test of at least 16 hours with only the instream flow applied; • Visual observations on the bypassed reach and downstream from the plant (before and after 4 p.m.) to check continuity of the flow and identify any singularities that may appear; • During this test, ichthyologists will be involved, in order to exactly evaluate the possible impact of different environmental variations and conditions on the habitat of aquatic species in the Onive, or even on the species themselves (observation in particular downstream concerning the habitats suitable for Rheocles); • A study to deepen knowledge about *Rheocles wrightae* and *Rheocles sp. Ambatovy* will begin as soon as the works begin; • Raising the local populations' awareness with respect to targeting Invasive alien species (IAS) rather than endangered species (R. wrightae) and native crayfish.	To be confirmed	To be confirmed

Species Concerned	Associated Natural Habitat	Gross Impacts in the Construction and Operation Phase	ESIA Mitigation Measures and BAP Additions (avoidance / reduction / restoration)	Residual Impact	BAP Objective
		section of the Oniveles Rapids (Faravohitra Falls and upstream rapids areas) - see definition in ERAA 4 of Rheocles • The habitats suitable for *Rheocles* downstream from the dam may be modified (positively or negatively) by the dam: loss of suitable habitats due to changes in the sedimentary regime of the river Onive (sediment scouring downstream), increase in suitable habitats. • The transition from a relatively diverse mosaic of aquatic habitats (flow facies) to a uniform lentic area will primarily benefit the least demanding species with rapid development capacities, in particular invasive alien species such as carps *Cyprinus carpio* or *Channa maculate* and predators such as *Rheocles wrightae*.	***Additional BAP measures:*** • Monitoring of the evolution of the sedimentary regime downstream from the dam to be included in the study of Rheocles.		
MIGRATORY FISH	**NON-CRITICAL HABITAT**	• Based on inventories and surveys across the study area, a maximum of four (4) species are concerned, including three probably upstream from the dam; these are two species of Anguillidae (*Anguilla marmorata and Anguilla mossambica)* and two species of Gobiidae (*Sicyopterus franouxi* and *Awaous aeneofuscus*). There are moderate concerns associated with these species. Although no species is threatened according to IUCN, their conservation is largely an issue for those who fish for them (representing only an occasional supplement for the people who fish for them - see ESIA).	Key Mitigation Measures for Aquatic Migratory Species (ESIA): • Instream flow is maintained at all times in the bypassed reach (5.7 m^3/s).	WEAK • Connectivity failure	/

Species Concerned	Associated Natural Habitat	Gross Impacts in the Construction and Operation Phase	ESIA Mitigation Measures and BAP Additions (avoidance / reduction / restoration)	Residual Impact	BAP Objective
		• The presence of the dam will constitute an impassable obstacle to ecological continuity. Migratory species in particular will no longer be able to access areas upstream from the dam.			
CRAYFISH ***(Astacoides caldwelli; Astacoides madagascariensis)***	Medium-altitude dense humid forest + Lichen woodland **CRITICAL HABITAT** Areas of analysis *ERAA1 = 645 km²* *ERAA2 = 1159 km²*	• Loss of critical habitat due to the destruction of natural forest by the project's temporary and permanent infrastructure (~216 hectares of permanent footprint over the natural forest); • Risks of watercourse degradation during the construction of the access road between the dam and the plant • Erosion risks that could alter the quality of watercourses in the forest corridor.	Key Mitigation Measures for Astacoids (ESIA): • Installation of crossing structures on all watercourses to be crossed by vehicles or construction equipment; • Raising the local populations' awareness with respect to targeting Invasive alien species (IAS) rather than endangered species (R. wrightae) and native crayfish. ***Additional BAP measures:*** • ***Safeguard fishing during the construction of crossing structures, in watercourses where relevant.*** • ***In the event of an accidental spill (materials, fuels, etc.) into one of the watercourses to be crossed (Astacoid watercourse), appropriate clean-up (repair) measures must be put in place.***	MODERATE • Loss of natural habitats (~216 hectares), i.e. 0.3% of ERAA1 and 0.2% of the cumulative total of ERAA1 and ERAA2 • Accidents on watercourses during construction works	**CRAYFISH** ***(Astacoides caldwelli; Astacoides madagascariensis)***

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4 Compensation Strategy

4.1 Proposed Compensation Measures

The IFC and AfDB performance standards require that the project does not cause a net loss of biodiversity (natural habitats) and generates a net gain for species and habitats considered "critical". As a result of these requirements, and considering the residual impacts of the project after the avoidance and risk reduction measures have been implemented (see Analysis of residual impacts by species), compensatory measures for terrestrial biodiversity are required.

Compensation is intended to offset, through positive actions, any residual negative effects that are not avoided by the project design or are insufficiently mitigated by the implementation of mitigation measures. The aim is to implement compensatory measures close to the impacted environments in order to guarantee their functionality on a permanent basis. In other words, compensation must make it possible to conserve overall and, in the case of the Sahofika project (because of the critical nature of the impacted habitats) improve the quality of the environments.

In view of these residual impacts on natural forests, the compensation strategy proposed in this BAP focuses on three main measures: **forest restoration, creation of the Tsinjoarivo NPA and Support for the Marolambo National Park.**

4.1.1 Forest Restoration

See Annex 3– BAP 21. Compensation_Forest_Restoration

This forest restoration activity will aim, on the one hand, to "restore" a forest area at least equal to the area directly destroyed as a result of the project (double the area was proposed in the ESIA). The aim is to compensate for the loss of critical forest habitats and ultimately to return to the structure, diversity and dynamics of the original ecosystem by restoring its essential functions (primary production, resilience, protection) and enabling local populations to benefit from some of its multiple ecosystem services.

Furthermore, this forest restoration program should benefit local communities, which should be closely involved in its design and implementation, and contribute to Madagascar's "reforestation" objectives, with a view to mitigating climate change and strengthening the adaptation of populations to extreme weather events (cyclones and droughts).

It will take several years for the restored land to begin to regain functionality close to that of a native forest. It should be noted, however, that restoration is being implemented here in addition to a contribution to the creation of the NPA in Tsinjoarivo and thus to the conservation of most of the impacted forest massif. Furthermore, the proximity to this still largely intact massif should ensure that restoration efforts are more effective.

The restoration program may be based on two restoration modalities:

- **Active restoration** (involving native species planting and effective defense against cutting, grazing and fire) of degraded areas in forests adjacent to the main forest corridor.
- **Natural restoration** without initial planting work, allowing vegetation to naturally redevelop by following the known plant succession in this sector (secondary formations).

This forest restoration program will be conducted with the following goals in mind:

- Ensure or restore connectivity between remaining forest patches.
- Identify sites to be restored in cooperation with the MNP and the NPA of Tsinjoarivo - Ambalaomby, targeting sites within areas managed and preferably protected by these entities or in management transfer zones.
- In the formerly cleared areas upstream from the dam, in order to optimize the protection of the dam against silting and the protection of the tributaries feeding the Onive, coming from the NPA in creation of Tsinjoarivo - Ambalaomby.

The restoration process recommended in this project must involve:

- A detailed ecological analysis of the state of forest degradation: a summary observation during the field work showed that the quality of the forest ecosystem in the area is very heterogeneous, with a high degree of fragmentation and only small trees overall;
- A commitment from a set of actors and medium and long-term objectives: the presence of VOIs and protected area managers, who manage these forest resources, is an asset for the implementation of forest restoration;

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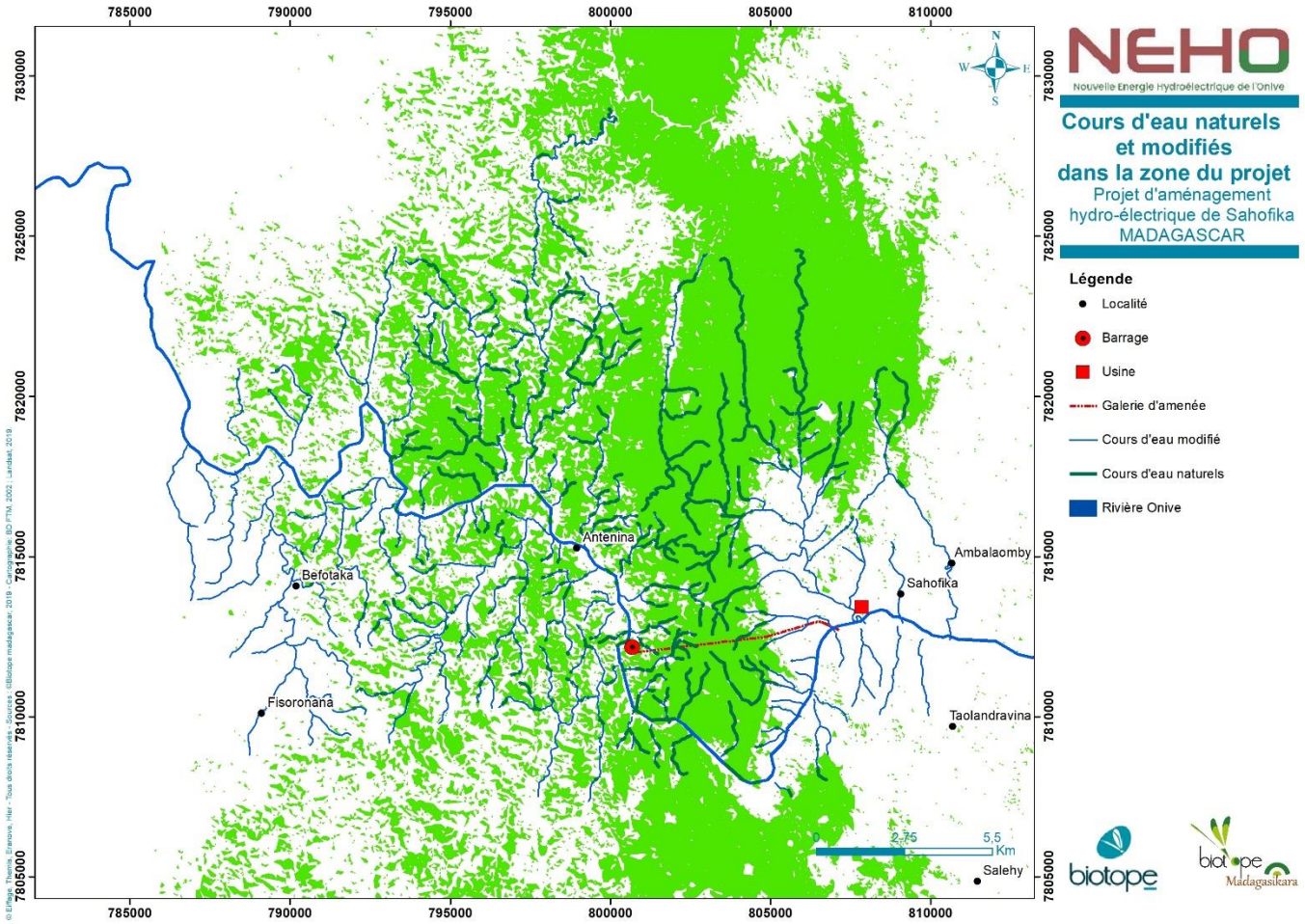
- A call for various forestry techniques: setting up of defenses or producing native plants in nurseries. Forest restoration seedlings will be provided by the project (which may have its own nursery).
- The restored land will have to be subject to an effective and sustainable protection status, within the framework of the governance of natural resources to be set up within the project perimeter and in the vicinity of existing protected areas.

The analysis of the equivalence between losses/gains is described below (Additionality of the forest restoration program). This analysis takes into account the rate of natural regeneration (the time required for the environment to return to its initial state, i.e. recreate a forest habitat “close” to the original one).

It should be noted that to integrate *Astacoides caldwelli* and *Astacoides madagascariensis*, forest restoration will include a component related to the restoration of modified streams. The line of modified and natural rivers among the tributaries of the Onive has been estimated (see **Table 10** below). A watercourse is considered modified when it is surrounded by modified habitats or its bed has been altered by human activities. Similarly a watercourse is considered natural when it is surrounded by natural (forest) habitats.

Table 10. Length of Modified and Natural Water Courses Among the Tributaries of the Onive River

Unit in m	Length of watercourses modified (m)	Length of natural watercourses (m)	Total (in m)
Onive River tributary	283,504	170;222	453,726



Map 14. Map of the Onive’s Modified/Natural Watercourses

4.1.2 Contribution to the Creation of the Tsinjoarivo NPA for Natural Forest Conservation

See Annex 2 – BAP 22 - Compensation_Creation_Tsinjoarivo_NPA

NEHO is a partner of the NPA and is committed to achieving a goal of zero deforestation in the NPA over the life of the project. The project's commitment to the proponent of the future NPA is therefore a performance contract aimed at stopping deforestation and restoring the forest (monitoring in hectares of natural forest conserved and restored).

Contribution of the Project to the Creation of the NPA

The project will contribute to the creation of the NPA incidentally through the construction of access roads and in a proactive way through traffic regulation, sharing of inventory data, installation of guard posts, reception of the NPA proponent's agents in the project base camps.

The project will cover all additional costs generated by the project (administrative procedures, time etc.) for the NPA. On the other hand, the project will not ask for a financial contribution from the NPA for the use of its infrastructure which is essential for the proper management of the NPA (access roads, bridge over the Onive River, access to the operator's city).

Contribution of the project to the NPA's strategic objectives (over 35 years)

In partnership with the proponent of the future NPA and the various stakeholders (including the relevant public authorities), the project will contribute to the overall strategic objectives of the NPA for 35 years:

- **Slowing down and then stopping deforestation:** surveillance of deforested hectares, arresting offenders by strengthening surveillance capacities (material and human resources), strengthening forest control with the DGEF;
- **Restoring the forest:** through natural and proactive restoration actions;
- **Provide social and economic opportunities:** improved road access, rural electrification, basic infrastructure linked to community development, revenue alternatives (***Annex 3-Support_measures_income_generating_activity***), including the development of eco-tourism;
- **Generate scientific knowledge on fauna and flora:** monitoring of endangered species, monitoring of ecological restoration efficiency, accommodating students and contributing to the country's scientific and technical capacity building;
- **Support the operation of the NPA** after the temporary protection period (material and human resources): guard posts, offices, jobs, equipment (electric ATVs, etc.).

Table 11. Rationale for the Participation of the NEHO Project in the Creation of the NPA

	With NEHO	Without NEHO	Summary
Initiation of the NPA project	Yes	Yes	/
Cost of the creation process	Complements	Rainforest	+
Additional costs related to the presence of NEHO	Yes	No	-
Inventory data	Complements	Rainforest	+
Infrastructure: base camp with electricity etc.	Yes	No	++
Access road	Yes	No	+++
Access control / regulation	Support		-

Technical support of the project to the proponent of the NPA:

- Prepare the NPA's Development and Management Plan;
- Support the preparation of the NPA ESIA, integrating issues related to the populations' user rights (authorized clearings in the peripheral zone etc.), performance objectives related to the well-being of the populations (social actions of the NPA, etc.).

Memorandum of Understanding between NEHO and the Proponent of the future NPA

Consultations with Sadabe and Rainforest Trust, the two key actors involved in the creation of the NPA these days, have clarified the possible content of the Memorandum of Understanding that will govern the partnership between NEHO and the Proponent of the future NPA. This Memorandum of Understanding should include at least:

- A shared vision;
- Short-term collaborative activities on the preparation of each party's BAP and GAP and other regulatory documents/tools - including information sharing;
- Medium- and long-term coordination for adaptive management): governance[4] mechanism to be put in place, reciprocal commitments;
- The principle of a monitoring and transparency plan on the effectiveness of the measures implemented under the Memorandum of Understanding;
- The budget (at least for short-term collaboration): NEHO will have to cover the extra costs related to the presence of the dam, coordination with NEHO and successive revisions of the documents to adapt them to the decisions of the parties, including for the benefit of the local associations involved in the management of the NPA (transfer of management);
- Interlocutors and their mode of appointment / renewal;
- Coordination of activities on the social component of the NPA.

The shared vision would include:

- The BAP's net biodiversity gain target;
- The objective of conserving natural habitats in the core NPA;
- The objective of restoring degraded natural habitats in the core and buffer zone;
- The objective of restoring the buffer zone and the catchment area of the dam, reasoning in terms of ecosystem services to people and biodiversity objectives (this goes beyond the only legal obligation);
- The objective of integrating forest and agricultural management into the management of the dam's watershed;
- The objective of providing alternatives to the populations concerned within the framework of the project and NPA commitments;
- The objective of supporting local civil society (associations involved in management transfers) and local employment in the implementation of actions;
- The objective of not expropriating populations within the framework of the creation of the NPA;
- The objective of ensuring sustainable funding (e.g. through the Rainforest Trust or another trust fund: a dedicated agreement will be required

It should be noted that a Memorandum of Understanding will be signed between NEHO and the Proponent of the future NAP before, during and after the temporary protection measures.

4.1.3 Support for the Marolambo National Park

See Annex 4 – BAP 23 - Compensation_Support_Marolambo_NP

- The project will contribute to a significant reduction in the rate of deforestation by also supporting the Marolambo National Park through capacity building for the monitoring and control of illegal activities, deforestation and poaching, etc. The project will contribute to reducing deforestation by supporting the development of the Marolambo National Park.

The Marolambo National Park support strategy was subject to a dedicated interview with the Park Director, Juliette Raharivololona - see report in Annex 12.

[4] *This is about the governance of collaboration between NEHO and SADABE; the tools (BAP, GAP, etc.) put in place by the parties, and the measures or activities provided for in these tools will naturally have their own governance system.*

The consultation carried out by Biotope with the Marolambo Park, through its director, Juliette Rabarivololona, identified several possible ways in which the Project could support the management of the MNP. In priority order:

Support for MNP monitoring activities

- The current monitoring program is planned on a bi-monthly basis and is implemented by the local committees. The project could help the MNP strengthen its monitoring activities and move to monthly campaigns in the north of the park.
- **Support for joint actions with the gendarmerie.** At the moment, the gendarmes are only mobilized on an ad hoc basis when offences are observed, to assist PNM officers during arrests. They are understaffed and difficult to move from Ambohitompoina. The project (in particular the rehabilitation and construction of the access road to the dam and population resettlement in Fisoronana) is likely to increase anthropogenic pressures in the north of the park. The regular presence of the gendarmerie would serve as a deterrent. The Project could support the monthly missions of the gendarmes in the northern area of the MNP.
- **Funding for a guard post at the park's boundary (MNP/DGEF):** This guard post would directly benefit the MNP teams by providing a permanent presence in the northern area of the park. At the moment the MNP sector chief can only travel once every two months to this sector. This guard post would also provide control over the removal of timber or poaching of endangered species from the project area. This post will have to be managed in partnership with the gendarmes (see with the DREDD).
- **Support to the forest administration:** Support by the project would facilitate the movements of forest administration agents to control timber loading areas (marking of authorized products) rather than control at the exit of communes (often mixtures of timber and wood from natural forests).
- **Material support to be discussed:** e.g. GPS (purchase in progress), monitoring is conducted on foot (provide bicycles if possible).

Support for the extension of the Fisoronana management transfer area

- The PAPs transferred to Fisoronana will increase the need for natural resources in this sector. The MNP proposes to extend the Fisoronana management transfer area to so far unmanaged forests, in particular the Manaripatsa forest in the extreme northeast of the commune of Belanitra, bordering the territory of the District of Marolambo.
- The Project could support the MNP in the VOI extension process: initial assessment, field inventories, consultations, organization, elaboration of forest management plans. The process of extending the VOI of Fisoronana could start as soon as the Project starts (resource inventories, organisation etc.) and validation could be done once the population is settled on the new resettlement site. Discussions are under way with the DREDD responsible for the process of evaluating and contracting the management transfer zones.

Support for restoration actions

- In line with the objectives of reforesting protected areas in Madagascar, the MNP has been conducting forest restoration actions for several years. In the north of the park, these actions have now stopped due to lack of operating resources. Synergies could, however, be found with the installation of local nurseries (in Fisoronana in particular) planned within the framework of the reforestation and restoration actions of the project and the actions of the MNP;
- The rehabilitation of the access road to the project could also facilitate travel by conservation NGOs and facilitate MNP restoration projects in the northern sector. For example: collaboration with the association Graine de vie (https://grainedevie.org/fr/index.php), which works with the PNM but in areas that are less isolated than the Fisoronana region.

Raising awareness among the local populations

- Awareness-raising actions are cross-cutting and important. However, the MNP's resources only allow officers to come into contact with the local population once every two months. The project could support the MNP to carry out monthly awareness campaigns among local populations.

MNP Communication

- The MNP management plan was updated in 2019. The Project could support the MNP in the implementation of the process of validating the updated GAP with the local populations and more widely of the actions of communication / dissemination of the GAP to the local populations.

Ecological monitoring

- Currently, no ecological monitoring is being carried out in the northern area of the MNP. Synergies would thus have to be found between the participatory monitoring actions planned within the framework of the Project's ESMP and the monitoring needs of the MNP, in particular through the establishment of joint local committees.

4.1.4 Socio-economic Support Measures

See Annex 6 – BAP 27 and 28 measures

Compensation measures must be backed up by support measures allowing the development of sustainable livelihood activities in order to support economic diversification for the local populations, provide them with income alternatives and thus reduce pressure on forests.

Type of development projects planned (in the RAP):

- Establishment of a community development cooperative that will largely take charge of improving farming and livestock practices for all the displaced persons, but also for all the populations in the project's impact area, while ensuring essential tasks for the implementation of the project's socio-economic mitigation measures;
- Agroforestry projects: plantation/conservation of fertilizer trees (leguminous) in crops;
- Income-generating projects: technical support for agricultural production (agro-ecological techniques, agro-forestry, etc.), support for agricultural development (market gardening), support for equipment purchases, support for the development of small-scale livestock farming, support for the development of commodity chains (equipment for the processing and marketing of products) - promising agricultural commodity chains to be determined;
- Development of ecotourism activities: increased potential due to the accessibility of the NPA after rehabilitation and construction of access roads to the dam, consideration of local employment opportunities common to the project and potential ecotourism activities: recycling local jobs from the project into the ecotourism project (cooks, camp leaders, guides, etc.).

Further, to avoid pressure on natural forests in areas under protection status and on land targeted for forest restoration, it is recommended that a reforestation program using fast-growing species be developed during the construction phase.

Several reforestation programs are to be initiated within the framework of the BAP:

- To limit deforestation operations near the resettlement site in the West area of the forest corridor (within the green belt of the MNP) in partnership also with the MNP and the 3 VOIs concerned (Fisoronana, Befotaka, Antenina), in particular the Fisoronana VOI closest to the MNP and including the resettlement site - see reforestation project included in the RAP
- To limit pressure on the NPA east of the forest corridor in partnership with the Proponent of the future NPA and the future VOIs of Ambalaomby and Sahofika

4.2 Consideration of the Temporal Nature of Forest Restoration in the Calculation of the Compensation Ratio

4.2.1 Principle

There are so-called intermediate losses of biodiversity and/or services, which occur between the time the damage occurs (destruction of natural forest) and the time when restoration allows the environment to return to its original state (forest habitat "close" to destroyed natural habitats).

There are also so-called intermediate gains in biodiversity and/or services, which occur between the start of restoration actions and the moment when the environment has returned to its initial state (at least a forest habitat "close" to the natural habitats destroyed).

Scope of the Action Plan

Biodiversity losses (including intermediate losses) and biodiversity gains (including intermediate gains) from the restoration program should be equal (see **Figure 5**)

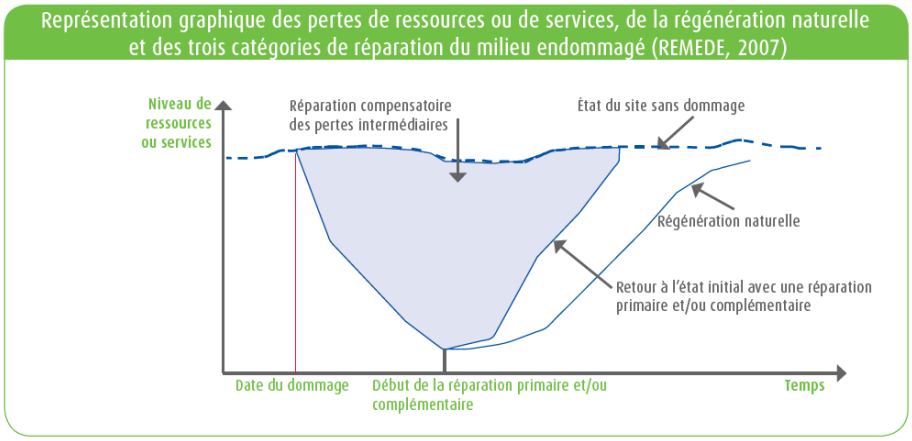


Figure 5. Comparison of the Evolution of Losses and Gains Over Time. Source: CGDD, 2012..

4.2.2 Rate of Natural Forest Regeneration in the Local Area

Forest restoration follows a natural regeneration rhythm, which can be more or less accelerated by initial planting actions with fast-growing native species (this is called active restoration). Natural vegetation succession from a brownfield site is well known and has been described by Razanadravao (1997):

After the second year of cultivation, the farmers abandon their plot of land and look for another plot (natural forest or older secondary formation), more suitable for agriculture, to practice Tavy. This abandoned plot is successively colonized by different types of formations, characterized by their floristic compositions and physiognomy. These various stages of evolution are as follows:

- 0 to 1 year after the abandonment of the cultivation plots, the environment is covered by low, discontinuous vegetation, dominated by pioneer, ruderal and invasive species. The most frequent and abundant include: *Solanum* spp. (Solanaceae), *Ageratum conizoides, Bidens pilosa (*Asteraceae), *Lantana camara (*Lamiaceae), and grasses.
- 1 to 3 years later, the vegetation evolves and becomes denser, reaching 2 m in height and is dominated by shrubs such as *Harungana madagascariensis (*Hypericaceae), *Trema orientalis (*Cannabaceae), *Afromomum angustifolium (*Zingiberaceae), *Psiadia altissima* (Asteraceae);
- 3 to 4 years: A shrub formation of 6 to 8 m occupies the environments. The physionomic and floristic characteristics of the formation vary according to the environmental conditions and the quality of the soil, especially its fertility. The formation is dense and closed with an initial of stratification that starts to individualize itself.
- 6 to 7 years later and without the slightest disturbance such as clearing or fire, the Savoka formation can reach a height of 10 m. It is rich in woody material, especially in rich soil formations where organic matter is not eroded by runoff. The formations standing on degraded soils have a slower evolution and do not allow the presence and abundance of woody plants and evolve into a Savoka with *Ravenala madagascariensis* (Strelitzeaceae) and *Sticherus flagellaris* (Gleicheniaceae) after 10 or 15 years.

After 25 years of evolution, the Savoka with *Harungana madagascariensis* (Hypericaceae) can become a 12-14 m high tree formation, classified as old Savoka by Razanadravao (1997) or old forest fallow by Rasoanaivo *et al.* (2015). The formation has a well-defined

Scope of the Action Plan

physiognomic structure, composed of three strata (herbaceous, shrubby and woody), dominated by indigenous and native forest woody species, a large part of which is endemic to Madagascar.

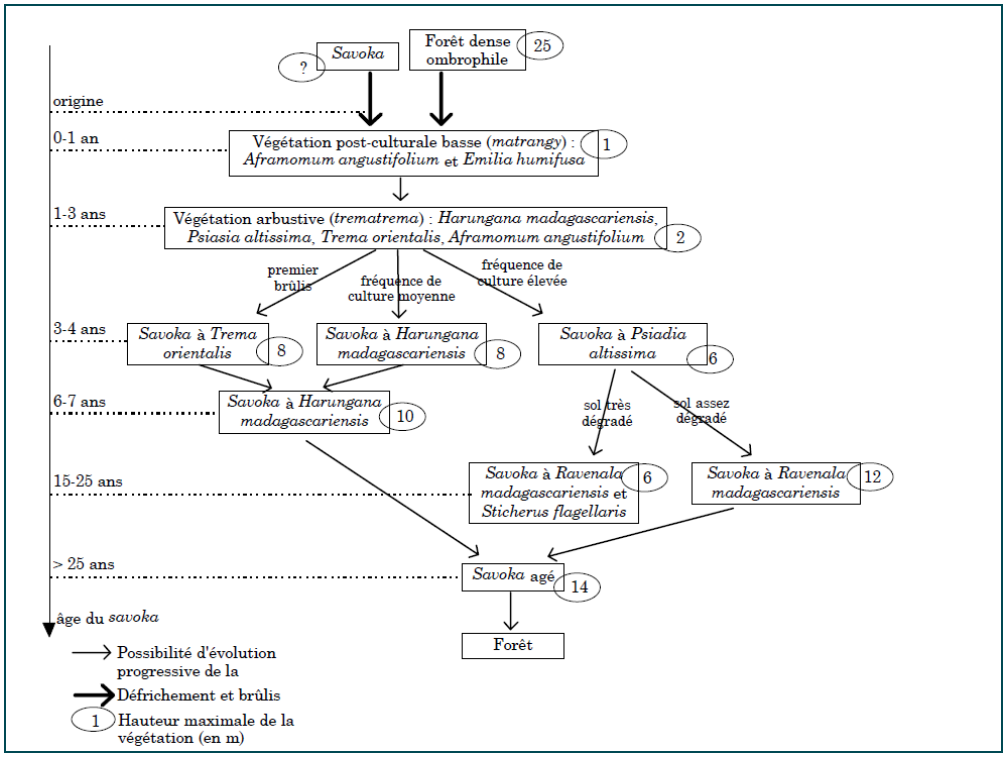


Figure 6. Secondary Post-Cropping Formation over a period of 25 Years

In 25 years of natural regeneration, we can therefore hope to reach a habitat equivalent to an old Savoka, still very far from the original natural forest, especially in terms of biodiversity / functionalities / services.

4.2.3 40-year Loss/Gain Scenarios for Forest Restoration

Working Assumptions

- An initial loss of forest estimated at ~216 Ha of natural forest. It should be noted that a precautionary principle with regard to the elements of the project still to be detailed has been followed by applying a 20% increase coefficient to terrestrial habitats. The areas of the footprints impacted are likely to vary depending on the results of the technical studies;
- An analysis on a 40-year time step corresponding to the project time step (construction + operation);
- Taking into account the accumulation of intermediate losses over 40 years, between the time when the damage occurs (destruction of the natural forest) and the time when restoration allows the environment to return to its initial state (forest habitat "close" to the destroyed natural habitats);
- Taking into account the accumulation of intermediate gains over 40 years, between the start of restoration actions and the moment when the environment has returned to its initial state (at the very least, a forest habitat "close" to the natural habitats destroyed);
- Habitats are qualified by a level of biodiversity and/or services rated from 1 to 10;
- The natural habitats destroyed by the project all go from a quality of 9/10 to a quality of 0/10, permanently;
- The modified habitats "to be restored" all have a quality of 1/10 at the outset (corresponding to one year's agricultural wasteland). After 40 years they all recover a quality equal to 2/3 of the initial quality, i.e. 7/10, because it is considered that forest habitats can only recover a quality equivalent to the initial quality (corresponding to old forests) after a hundred years;
- Gains from two types of restoration are tested and compared:
  - ✓ on the one hand, natural regeneration, which does not involve any initial intervention such as sowing or planting, but which must always be accompanied by protection and management measures to limit pressure on the restored forest (clearing, fires, collection, grazing, etc.).
  - ✓ On the other hand, so-called "active" or "assisted" restoration, which involves more or less heavy human intervention, such as sowing, planting or enrichment actions, actions to control competitive non-timber species (etc.), also reinforced by protection and management actions.

  Our hypothesis is that active restoration accelerates forest regeneration but does not achieve a level of habitat quality higher than 7/10 (i.e. 2/3 of the maximum habitat quality) after 40 years. It is estimated that revegetation in active restoration is faster. The results of "active" or "assisted" natural restoration are usually visible within the first three years[5].
- A capitalization rate is always applied to the calculation of interim gains and losses (in accordance with existing methods). Several capitalization rates are tested here: 1.5%, 5% and 7.5%, the capitalization rate applied at the national level in Madagascar being 5%.

Modelling of restoration losses and gains over 40 years

The figures below provide modelling data for one unit of forest area (e.g. one hectare): the 40-year project losses **(Figure 7)**, the intermediate gains from natural regeneration actions **(Figure 8)** and the intermediate gains from active restoration actions **(Figure 9)**.

[5] FAO, 2019. Restoring forest landscapes through assisted naturel regeneration (ANR) – A practical manual. Bangkok. 52 pp

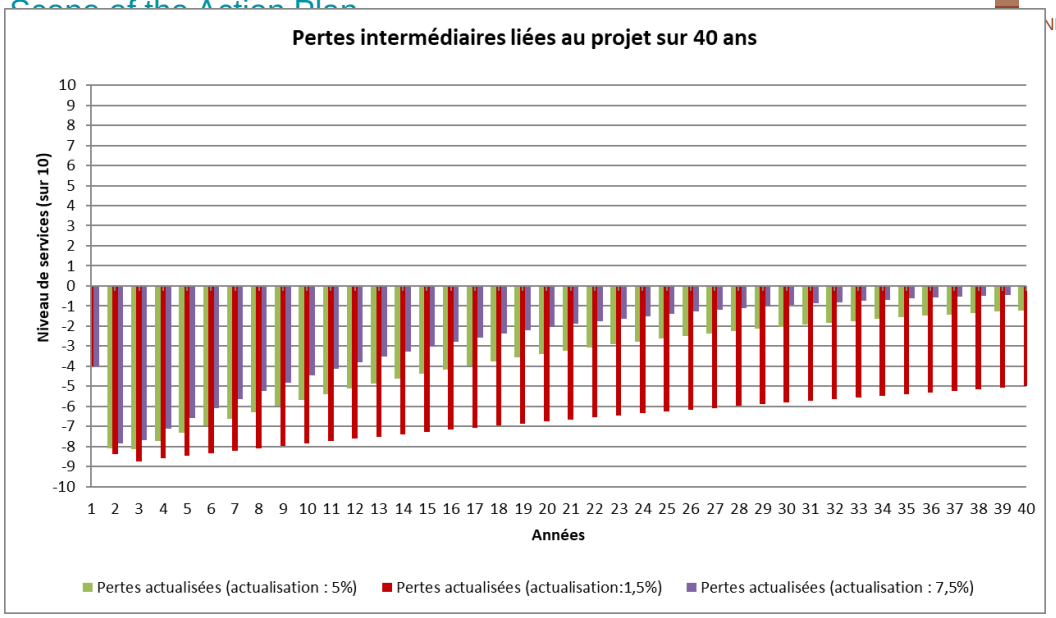


Figure 7. Modelling of Project-related Losses over 40 Years for a Forest Area Unit (Source: Biotope, 2019)

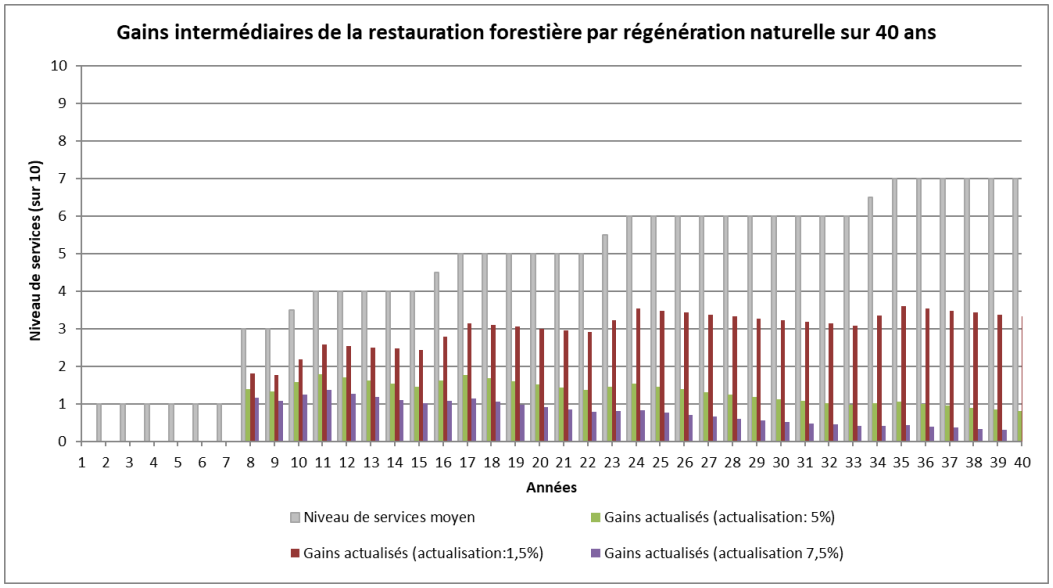
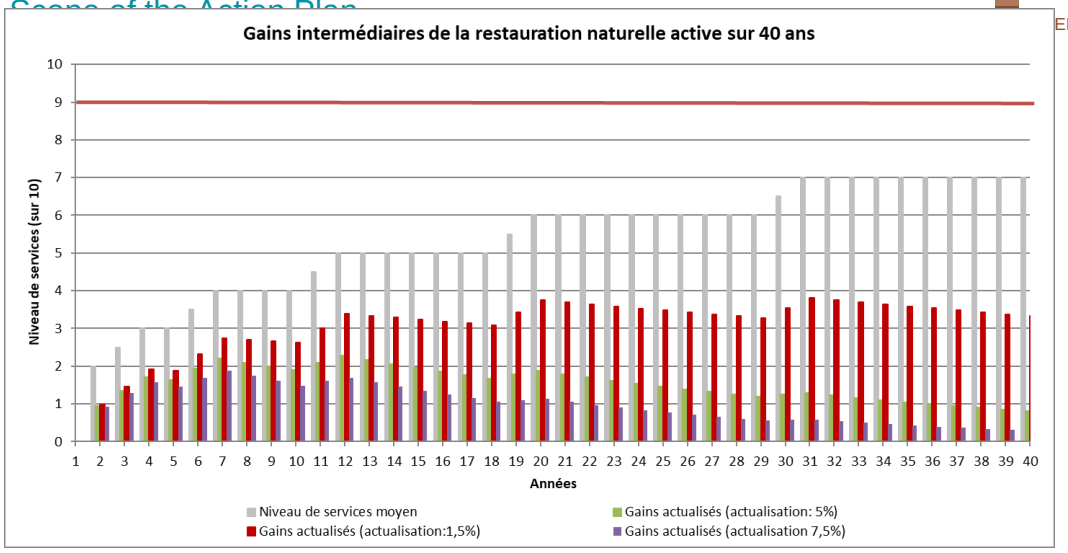


Figure 8. Modelling of Project-related Losses over 40 Years for a Forest Area Unit (Source: Biotope, 2019)



The ration between intermediate losses and gains corresponds to the ratio to be applied for the compensation measure de compensation.

Figure 9. Modelling of Intermediate Gains from Active Forest Restoration over 40 Years for a Habitat Unit Area (Source: Biotope, 2019)

4.2.4 Loss-Gain Balance and Search for an Offsetting Ratio to be Applied

Table 12 compares the total intermediate gains related to natural regeneration actions with the total intermediate losses over the 40-year life of the project. Total gains and losses are expressed in terms of level of service (rated from 1 to 10) for a unit area. The ratio of Total Gains to Total Losses over 40 years is equivalent to the offsetting ratio to be applied. This ratio is calculated for several capitalization rates (1.5%; 5%, and 7.5%).

Table 13 compares the total intermediate gains related to "active" natural restoration actions with the total intermediate losses over the 40-year life of the project. Total gains and losses are expressed in terms of level of service (rated from 1 to 10) for a unit area. The ratio of Total Gains to Total Losses over 40 years is equivalent to the offsetting ratio to be applied. This ratio is calculated for several capitalization rates (1.5%; 5%, 7.5%).

Table 12. Loss-Gain Balance for Natural Regeneration Actions over 40 Years and Calculation of the Ratio to be Applied

	Total gains over 40 years through natural regeneration			**Total losses over 40 years through natural regeneration**		
	Capitalization rate of	*Capitalization rate of 5%*	*Capitalization rate of*	*Capitalization rate of*	*Capitalization rate of 5%.*	*Capitalization rate of*
Total gains or losses expressed in level of services, for a unit area (ha)	99,5	43,7	25,5	-267	-151	-109
Equivalent in ha, level of services (~216 hectares actually destroyed)				-57,610	-32,701	-23,594

	Capitalization rate of 1.5%	Capitalization rate of 5%	Capitalization rate of 7.5%
Compensation ratios to be applied in the case of restoration via natural regeneration -Total gains/Total losses" ratio	**2.7**	**3.5**	**4.3 (Max ratio)**
Equivalent in hectares to be restored (for ~216 hectares effectively destroyed by the Project)	591 ha	756 ha	929 ha

Table 13. Loss-Gain Balance for Active Restoration Actions over 40 Years and Calculation of the Ratio to be Applied

	Total gains over 40 years through active restoration			Total losses over 40 years through restoration		
	Capitalization rate of 1.5%	*Capitalization rate of 5%*	*Capitalization rate of 1.5%*	*Capitalization rate of 5%*	*Capitalization rate of 1.5%*	*Capitalization rate of 5%*
Total gains or losses expressed in terms of level of service for one unit of area (ha)	122.7	60.1	38.8	-267	-151	-109
Equivalent in ha, level of services (for ~216 hectares effectively destroyed)				-57,610	-32,701	-23,594

	Capitalization rate of 1.5%	*Capitalization rate of 5%*	*Capitalization rate of 7.5%*
Compensation ratios to be applied in the case of active restoration - "Total gains / Total losses" ratio	**2.2 (Ratio min)**	**2.5**	**2.8**
Equivalent in hectares to be restored (for ~216 hectares effectively destroyed by the project)	475 ha	540 ha	605 ha

This analysis leads to the conclusion that there are several possible compensation ratios depending on the restoration choices and the capitalization rate actually applied to the project (taking into account the uncertainties related to the local socio-economic context). The project could restore a maximum of 756 ha (applying a ratio of 3.5) through natural regeneration or a minimum of 475 ha (applying a ratio of 2.2).

It is likely that the final restoration package will incorporate both types of restoration. Therefore, a ratio of 3.5 should be applied to all natural restoration plots and a ratio of 2.5 to all active restoration plots.

4.2.5 Potential Areas for Restoration

At this stage several sectors suitable for restoration have been identified and will have to be validated after consultation with SADABE:

- ✓ **Sector 1 - PRIORITY:** Area of the restoration program considered for the Sahofika BAP, on the left bank of the Onive River. Following the completion of the works and due to population movement to the resettlement site, this area should no longer be inhabited. This is a good

opportunity to initiate forest restoration actions. These sectors are located between the Ambalaomby Forest and the main forest corridor. Reconnecting these two forest massifs would constitute a significant ecological added value for the NPA and these conservation objectives.

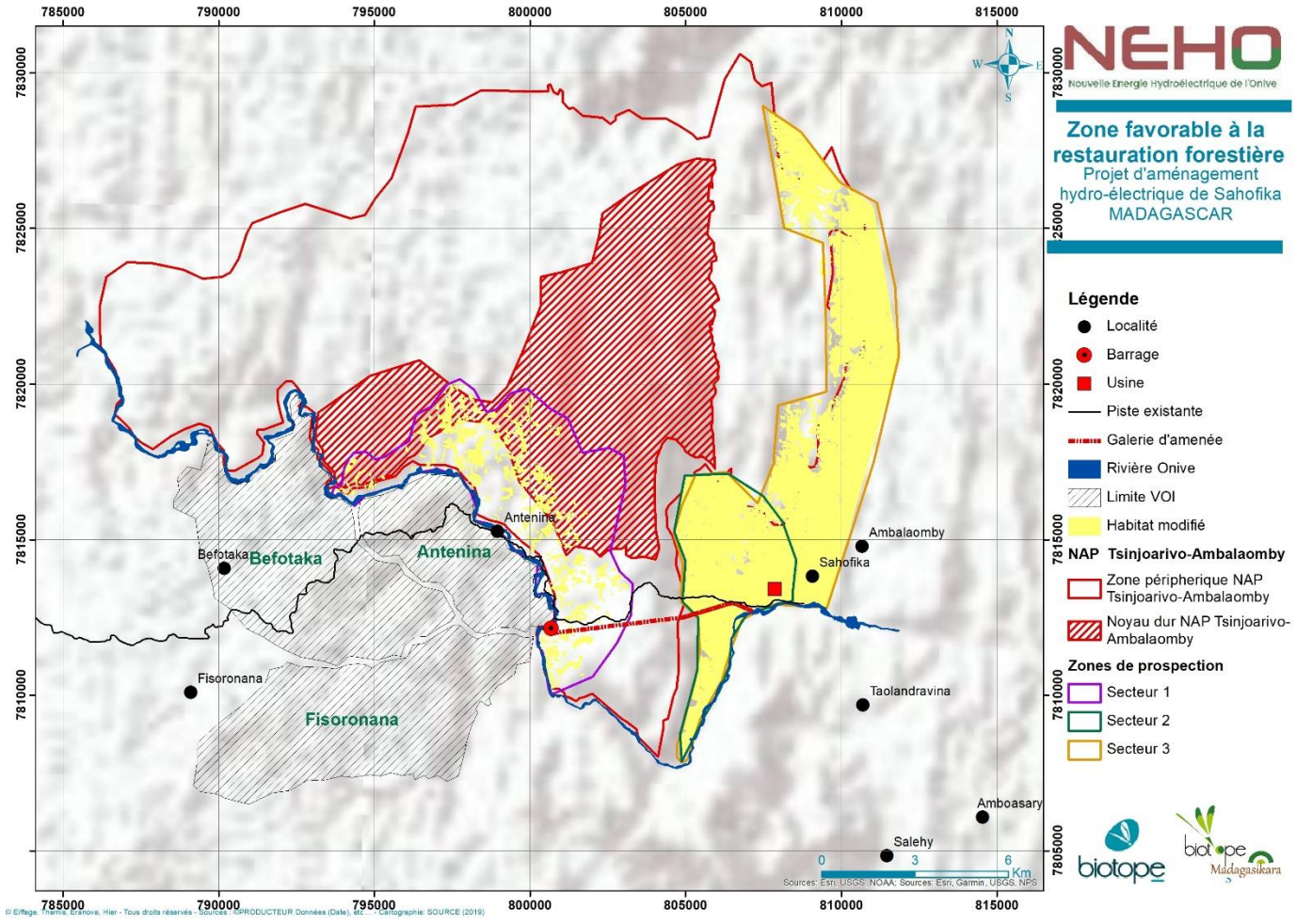
- ✓ **Sector 2:** This sector near the NPA peripheral zone (East side) is preferred by SADABE for reforestation actions (usage forests), in partnership with the Sahofika VOI. The possibility of restoration actions can also be analyzed in degraded habitats adjacent to the forest corridor in consultation with local communities (Faravohitra in particular).
- ✓ **Sector 3:** This sector is preferred by SADABE for reforestation actions for the benefit of the communities and for the management of watercourses for Rheocles (Ambalaomby VOI).

Table 14. Potential Surface Area for Restoration

Sectors	Type of Habitat	In the NPA Core Area (in ha)	Outside the NPA Core Area (in ha)
Sector 1 PRIORITY	**Natural Habitats**	1,426	1,146
	Modified Habitats	274 ha	503
Sector 3	**Natural Habitats**	0	61
	Modified Habitats	0	1,734
Sector 2	**Natural Habitats**	0	578
	Modified Habitats	0	2,973

Table 15. Size of Forest Blocks to be Restored in Sector 1

In sector 1 - Blocks to be restored	In the NPA Core Area	Outside the NPA Core Area
Blocks of less than 1 ha	• 21.02 ha • 107 blocks	• 19.57 ha • 80 blocks
Blocks of more than 1 ha and less than 10 ha	• 100.45 ha • 29 blocks	• 79.18 ha • 24 blocks
Blocks of more than 10 ha	• 152.48 ha • 6 blocks	• 404.58 ha • 10 blocks



Map 15. Areas Suitable for Restoration (Source: Biotope, 2019)

4.3 Analysis of Avoided Losses Related to the Creation of the NPA

4.3.1 Ecoregion-level Deforestation Data

Deforestation is a major issue in Madagascar, especially in terms of biodiversity conservation and ecosystem protection.

It has multiple anthropogenic causes that have been analyzed and described by several authors. Some of the causes are described as follows:

- The practice of Tavy is a cultivation method for rice production that contributes to a subsistence economy. This practice has become a tradition especially for eastern forest farmers (Vicariot et al., 1970);
- In rural and landlocked areas, deforestation is a system used by farmers to acquire lands. It is practice closely linked to the land context and customary law (Freudenberger, 1998; Muttenzer, 2010; Tahinarivony et al., 2015);
- The environmental conditions imposed by uneven topography, very narrow valleys and a small area of irrigated zones force farmers, who do not have adequate means and techniques, to practice agriculture on slopes across the Tavy (Barrett, 1999; Tahinarivony et al., 2015);
- The inability of the various institutions to implement the country's array of regulatory instruments for forest protection encourages destructive practices (Razafy Fara, 2012).

Several initiatives have been taken to try to halt deforestation over the past decades, the most important of which being the creation of new protected areas and the expansion of existing protected areas, which are considered a priority to achieve the goal of the Durban vision[6].

In Madagascar, the ecosystem most affected by deforestation is the dense humid forest in the eastern area (low and medium altitude). A study was recently conducted on the humid ecoregion of Madagascar and demonstrated an increased deforestation rate from 2005 to 2013 (Rakotomalala *et al.,* 2015). **This was a 0.5% annual rate between 2005 and 2010 which increased to 0.94% per year between 2010 and 2013**. Detailed data on deforestation rates for this ecoregion are presented in Table 16. Deforestation Rate in the Wet Ecoregion of Madagascar (Rakotomalala *et al.*, 2015) below. The study areas (enlarged and brought close together) are part of this ecoregion and are not exempt from the Tavy issue and its impact on the conservation and protection of biodiversity.

Table 16. Deforestation Rates in the Wet Ecoregion of Madagascar (Rakotomalala et al., 2015)

	Area of Forest Cover (thousands of hectares)			Deforestation Rate (% per year)	
	2005	2010	2013	2005 - 2010	2010 - 2013
Entire ecoregion	4,556	4,457	4,345	0,5	0,94
Below 800 m above sea level	1,712	1,666	1,616	0,6	1,15
Above 800 m above sea level	2,844	2,790	2,729	0,44	0,82

[6] In 2003, in Durban, South Africa, the Government of Madagascar announced a vision for the country by tripling the area of protected areas from 1.7 million hectares to 6 million hectares

In addition, Forest Trends (Forest Trends, 2014) developed several deforestation scenarios in Madagascar in 2014 using differentiated deforestation rates between forests outside protected areas and forests inside protected areas:

- Deforestation rates between 0.3 and 1.31% per year in **"unprotected" areas**;
- Rates between 0.02 and 0.31% per year for **"protected" areas.**

4.3.2 Local-level Deforestation Data

As part of this study, an analysis of deforestation data between 1989 and 2018 was carried out for the study area.

Landsat images from 2000, 2006 and 2011 were processed and analyzed to study changes in Antenina's forest cover. The results of this analysis show an annual deforestation rate of **0.33% between 2000 and 2006** and **1.41% between 2006 and 2011** (higher than the average deforestation rate in the ecoregion).

The results of these analyses show that the changes or transformation of the landscape are characterized by the following (see Map 6. Deforestation between 1989 and 2018):

- Considerable losses of forest cover in the study area;
- The change in forest cover starts from a specific point, which may be a residential area, valleys or riverbanks;
- The areas most affected by deforestation during the last 30 years are the western parts of the corridor (Andasirotsaka, Befotaka, Antenina) and the western and southwestern part of Manaripatsa;
- Deforestation in the eastern part of the country has reached the foot of the East or Angavo cliff.

The "Non-Forestry" class on the map groups together different classes of secondary formations. These formations are described with their physiognomic and floristic characteristics (described in the ESIA).

4.3.3 Calcul des scénarios de pertes évitées à horizon 2059

Table 17. Area and Proportion of Natural Habitats (Forests) within the NPA Boundaries

Surface	NAP (source: Landsat 2018)		
	Peripheral zone (PZ)	Core area (CA)	PZ+CA
Natural habitat (ha)	9,979	6,338	16,317

Modified habitat (ha)	9,252	901	10,153
Surface TOTAL	**19,198**	**7,227**	**26,425**
% natural habitats	52%	88%	62%

We propose here a scenario for avoided losses in relation to the creation of the NPA by 2059 with the following assumptions:

- The year 2059 corresponding to the time span of the Sahofika project (4 years for construction and 35 years for the life of the project);
- A 5-year implementation of the NPA is therefore considered to be operational only from 2024. The NPA is considered fully operational between 2025 and 2059;
- The basic deforestation rates applied without any protection are: 1.1%, corresponding to the national average (Vieilledent, 2019), and 1.41% (calculated by Biotope, EIES 2019);
- The deforestation rate applied in the core section of the NPA when the NPA is fully operational is 0.31%, which corresponds to the maximum rate of deforestation under protection used by Forest Trends (Forest Trends, 2014). This low ratio implies a high efficiency of the NPA and therefore an exemplary operation;
- On the periphery of the NPA, it is considered that the operation of the NPA should reduce the rate of deforestation towards an average value between the rate applied in the core area of the NPA (i.e. 0.31%) and the deforestation rates applied outside the NPA (i.e. 1.1% for the MIN scenario and 1.41% for the MAX scenario of avoided losses);
- An efficiency differential is thus applied over time and within the NPA zoning (periphery versus core area);
- The deforestation rates applied are assumed to be constant until 2040 (possible changes due to national policies or one-off events involving curve breaks are not taken into account).

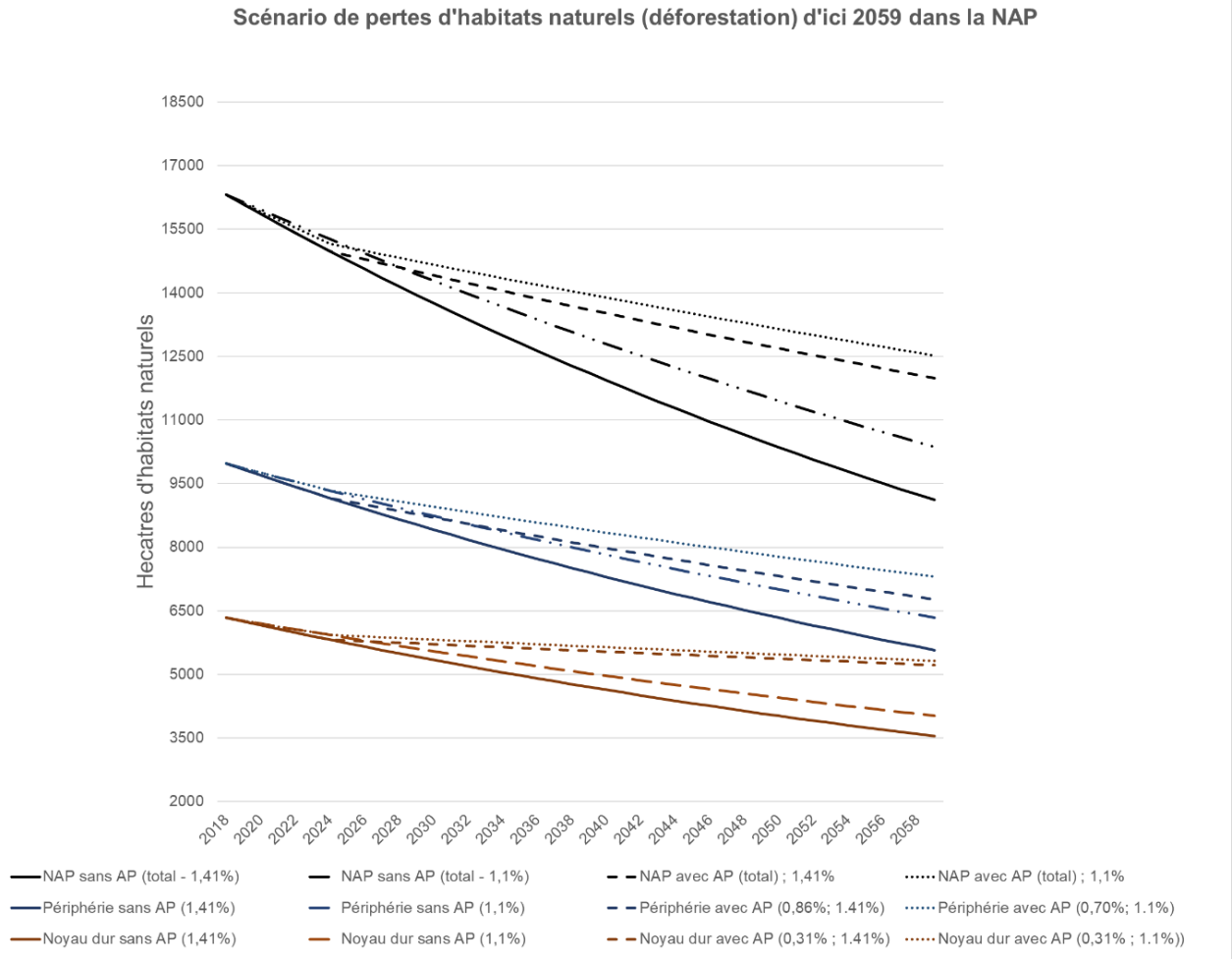


Figure 10. Scenarios of Losses Avoided by the NPA by 2059

Table 18. Losses Avoided by 2059

By 2059	MAXIMUM (ha) with a rate of 1.41%	MINIMUM (ha) with a rate of 1.1%
Losses avoided in the NPA periphery (ha) by 2059	1,198 ha	962 ha
Losses avoided in the NPA core area (ha) by 2059	1,680 ha	1,293 ha
TOTAL avoided losses in the NPA (ha) by 2059	**2,878 ha**	**2,155 ha**

4.3.4 Conclusion

Deforestation losses avoided in the NPA (core + periphery) are believed to range between 2,150 and 2,900 ha by 2059 (40 years).

5 Summary of Achieved Net Loss and Net Gain Objectives

Table 19. Summary of Achieved No Net Loss and Net Gain Objectives for BAP Habitats and Species

Habitat concerned	Estimated residual impact	Residual impact of the project after implementing mitigation measures	Proposed compensation measures	Possible support measures	Achievement of the no net loss or net gain objective
Achievement of NNL or NG habitat objectives					
Medium-altitude dense humid forest	MODERE	213 ha of natural forest permanently destroyed and fragmentation of the corridor	• Contribution to the creation of the Tsinjoarivo NPA for the conservation and restoration of natural forests - BAP 22 • Preparation and implementation of a program to restore degraded areas in forests adjacent to the main forest corridor within the NPA - BAP 21. • Support for the Marolambo National Park - BAP 23	• Development of income-generating activities (agriculture and other sectors) - BAP 28 • VOI Support Program: Reforestation in management transfer areas and preservation of ecosystem services - BAP 27	**NET GAIN (in ha of natural forest)** • **Restoration** - ratios of 2.5 for the active restoration and 3.5 for natural restoration with an estimate of 540 ha to 756 ha to be restored for ~216 ha of permanently destroyed forest. • **Conservation** - The project's contribution to the creation of the Tsinjoarivo NPA will guarantee the best conservation of about 6,340 hectares of forest (core area) and better management of 890 hectares of forest in the peripheral zone. • **Avoided losses** – Besides, taking into account deforestation activities in the local area, it is estimated that the NPA will help avoid the loss of
Lichen woodland	MODERE	3 ha of lichen stands permanently destroyed and fragmentation of the corridor			

Scope of the Action Plan

Habitat concerned	Estimated residual impact	Residual impact of the project after implementing mitigation measures	Proposed compensation measures	Possible support measures	Achievement of the no net loss or net gain objective
					2,150 to 2,900 ha by 2059 (40 years).
Aquatic Habitats (ERAA 4 - Rheocles)	The residual impacts of the Project on Rheocles will be assessed at the start of the Project via support measure BAP 30 aimed at acquiring knowledge on this species.			**Precautionary measure for Rheocles:** • Deepening of knowledge on Rheocles wrightae and Rheocles sp. Ambatovy - BAP 29 • Raising the local populations' awareness with respect to targeting Invasive alien species (IAS) rather than endangered species (R. wrightae) and native crayfish - BAP 30	If the results of BAP 30 confirm the residual negative impacts of the Project on Rheocles, the NET Gain will be sought through **support to the management of the NPA of Nosivolo,** targeted on conservation/restoration actions of habitats suitable for Rheocles in the catchment area of the Nosivolo river (with an objective of achieving results on the demographics of Rheocles).
Achievement of NNL or NG objectives for terrestrial species					
MAMMALS **Lemurs**	MODERATE	• Loss of ~216 hectares of natural forest, i.e. 0.3% of ERAA1 and 0.2% of ERAA1 and ERAA2	• Contribution to the creation of the Tsinjoarivo NPA for the conservation and restoration of natural forests - BAP 22 • Preparation and implementation of a	• Development of income-generating activities (agriculture and other sectors) - BAP 28 • VOI Support Program: Reforestation in management transfer areas and preservation of ecosystem	**NET GAIN (in ha of natural forest)** • **Restoration** - ratios of 2.5 for active restoration and 3.5 for natural restoration with an estimate of 540 ha to 756 ha to be restored for ~216 ha of permanently destroyed forest. • **Conservation** - The project's contribution to the creation of the Tsinjoarivo NPA will guarantee the

Scope of the Action Plan

Habitat concerned	Estimated residual impact	Residual impact of the project after implementing mitigation measures	Proposed compensation measures	Possible support measures	Achievement of the no net loss or net gain objective
		combined. • Risks related to population influx • Forest corridor fragmentation	program to restore degraded areas in forests adjacent to the main forest corridor within the NPA - BAP 21. • Support for Marolambo National Park - BAP 23	services - BAP 27	best conservation of about 6340 hectares of forest (core) and better management of 890 hectares of forest in the peripheral zone. • **Avoided losses** - Besides, taking into account deforestation activities in the local area, it is estimated that the NPA will help avoid the loss of 2,150 to 2,900 ha by 2059 (40 years).
MAMMALS **Hedgehog *(Limnogale mergulus, VU)***	MODERATE	• Loss of ~216 hectares of natural forest, i.e. 0.3% of ERAA1 and 0.2% of ERAA1 and ERAA2 combined. • 10 watercourses crossed along the access road between the dam and the Onive River	• Contribution to the creation of the Tsinjoarivo NPA for the conservation and restoration of natural forests - BAP 22 • Preparation and implementation of a program to restore degraded areas in forests adjacent to the main forest corridor within the NPA - BAP 21. • Support for Marolambo National Park - BAP 23	• Development of income-generating activities (agriculture and other sectors) - BAP 28 • VOI Support Program: Reforestation in management transfer areas and preservation of ecosystem services - BAP 27	**NET GAIN (in ha of natural forest)** • **Restoration** - ratios of 2.5 for active restoration and 3.5 for natural restoration with an estimate of 540 ha to 756 ha to be restored for ~216 ha of permanently destroyed forest. • **Conservation** - The project's contribution to the creation of the Tsinjoarivo NPA will guarantee the best conservation of about 6,340 hectares of forest (core area) and better management of 890 hectares of forest in the peripheral zone. • **Avoided losses** - Besides, taking into account deforestation activities in the local area, it is estimated that the NPA will help avoid the loss of 2,150 to 2,900 ha by 2059 (40 years).

Scope of the Action Plan

Habitat concerned	Estimated residual impact	Residual impact of the project after implementing mitigation measures	Proposed compensation measures	Possible support measures	Achievement of the no net loss or net gain objective
MAMMALS **Small carnivores (Epleridae)**	MODERATE	• Loss of ~ 216 hectares of natural forest, i.e. 0.3% of ERAA1 and 0.2% of ERAA1 and ERAA2 cumulatively • Forest corridor fragmentation	• Contribution to the creation of the Tsinjoarivo NPA for the conservation and restoration of natural forests - BAP 22 • Preparation and implementation of a program to restore degraded areas in forests adjacent to the main forest corridor within the NPA - BAP 21. • Support for Marolambo National Park - BAP 23	• Development of income-generating activities (agriculture and other sectors) - BAP 28 • VOI Support Program: Reforestation in management transfer areas and preservation of ecosystem services - BAP 27	**NET GAIN (in ha of natural forest)** • **Restoration** - ratios of 2.5 for active restoration and 3.5 for natural restoration with an estimate of 540 ha to 756 ha to be restored for ~216 ha of permanently destroyed forest. • **Conservation** - The project's contribution to the creation of the Tsinjoarivo NPA will guarantee the best conservation of about 6,340 hectares of forest (core area) and better management of 890 hectares of forest in the peripheral zone. • **Avoided losses** - Besides, taking into account deforestation activities in the local area, it is estimated that the NPA will help avoid the loss of 2,150 to 2,900 ha by 2059 (40 years).
MAMMALS **Bat**	WEAK	NONE	/	• Development of income-generating activities (agriculture and other sectors) - BAP 28 • VOI Support Program: Reforestation in management transfer areas and preservation of ecosystem services - BAP 27	/

Scope of the Action Plan

Habitat concerned	Estimated residual impact	Residual impact of the project after implementing mitigation measures	Proposed compensation measures	Possible support measures	Achievement of the no net loss or net gain objective
AMPHIBIANS **Arboreal Amphibians**	MODERATE	• Loss of ~216 hectares of natural forest, i.e. 0.3% of ERAA1 and 0.2% of ERAA1 and ERAA2 combined.	• Contribution to the creation of the Tsinjoarivo NPA for the conservation and restoration of natural forests - BAP 22 • Preparation and implementation of a program to restore degraded areas in forests adjacent to the main forest corridor within the NPA - BAP 21. • Support for Marolambo National Park - BAP 23	• Development of income-generating activities (agriculture and other sectors) - BAP 28 • VOI Support Program: Reforestation in management transfer areas and preservation of ecosystem services - BAP 27	**NET GAIN (in ha of natural forest)** • **Restoration** - ratios of 2.5 for active restoration and 3.5 for natural restoration with an estimate of 540 ha to 756 ha to be restored for ~216 ha of permanently destroyed forest. • **Conservation** - The project's contribution to the creation of the Tsinjoarivo NPA will guarantee the best conservation of about 6,340 hectares of forest (core) and better management of 890 hectares of forest in the peripheral zone. • **Avoided losses** - Besides, taking into account the local context related to deforestation, it is estimated that the NPA will help avoid the loss of 2,150 to 2,900 ha by 2059 (40 years).
AMPHIBIANS **Terrestrial Amphibians**	MODERATE	• Loss of ~216 hectares of natural forest, i.e. 0.3% of ERAA1 and 0.2% of ERAA1 and ERAA2 combined.			
REPTILES	MODERATE	• Loss of ~216 hectares of natural forest, i.e. 0.3% of ERAA1 and 0.2% of ERAA1 and ERAA2 combined.			

Scope of the Action Plan

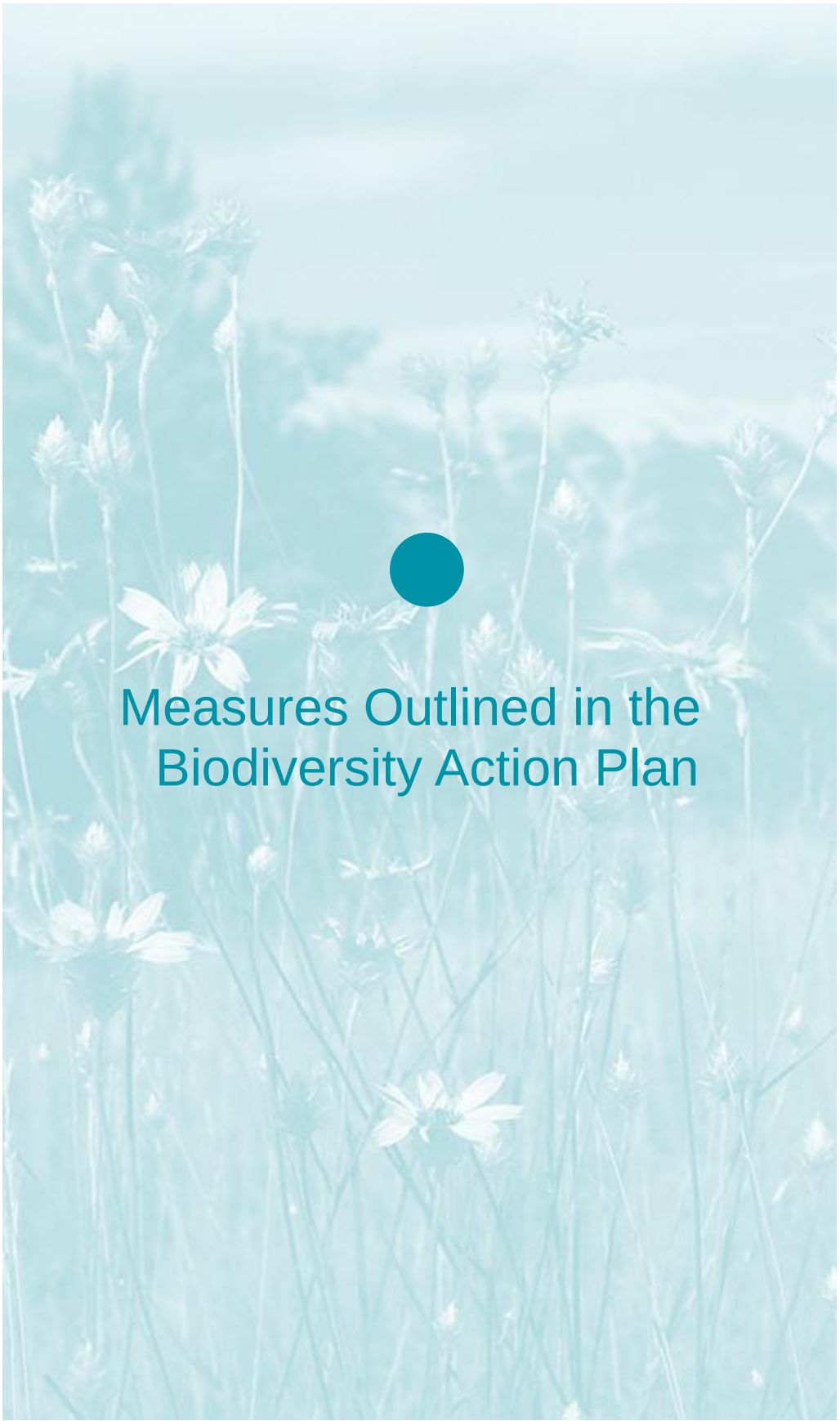
Habitat concerned	Estimated residual impact	Residual impact of the project after implementing mitigation measures	Proposed compensation measures	Possible support measures	Achievement of the no net loss or net gain objective
BIRDS ***Anas melleri (EN), Tachybaptus pelzelnii (EN)***	WEAK	NONE		• Support in updating the data of the IBA of the Onive classified forest, in collaboration with the reference NGO - BAP 25	
FLORA	MODERATE	Loss of ~216 hectares of natural forest, i.e. 0.3% of ERAA1 and 0.2% of ERAA1 and ERAA2 combined.			**NET GAIN (in ha of natural forest)** • **Restoration** - ratios of 2.5 for active restoration and 3.5 for natural restoration with an estimate of 540 ha to 756 ha to be restored for ~216 ha of permanently destroyed forest. • **Conservation** - The project's contribution to the creation of the Tsinjoarivo NPA will guarantee the best conservation of about 6,340 hectares of forest (core) and better management of 890 hectares of forest in the peripheral zone. • **Avoided losses -** Besides**,** taking into account deforestation activities in the local area, it is estimated that the NPA will help avoid the loss of 2,150 to 2,900 ha by 2059 (40 years).
Achievement of NNL or NG objectives for aquatic species					

Scope of the Action Plan

Habitat concerned	Estimated residual impact	Residual impact of the project after implementing mitigation measures	Proposed compensation measures	Possible support measures	Achievement of the no net loss or net gain objective
FISH ***(Rheocles wrightae*, EN)**	To be confirmed by follow-up studies	To be confirmed by follow-up studies		**Precautionary measure for Rheocles** • Deepening of knowledge on Rheocles wrightae and Rheocles sp. Ambatovy - BAP 29 • Raising the local populations' awareness with respect to targeting Invasive alien species (IAS) rather than endangered species (R. wrightae) and native crayfish - BAP 30	NO OBJECTIVE FOR THE MOMENT
MIGRATORY FISH	WEAK	NONE		• Raising the local populations' awareness with respect to targeting Invasive alien species (IAS) rather than endangered species (R. wrightae) and native crayfish - BAP 30	NO OBJECTIVE
CRAYFISH ***(Astacoides caldwelli; Astacoides madagascariensis)***	MODERATE	Loss of ~216 hectares of natural forest, i.e. 0.3% of ERAA1 and 0.2% of ERAA1 and ERAA2 combined.	• Contribution to the creation of the Tsinjoarivo NPA for the conservation and restoration of natural forests - BAP 22 • Preparation and implementation of a program to restore degraded areas in	• Raising the local populations' awareness with respect to targeting Invasive alien species (IAS) rather than endangered species (R. wrightae) and native crayfish - BAP 30	**NET GAIN (in ha of natural forest)** • **Restoration** - ratios of 2.5 for active restoration and 3.5 for natural restoration with an estimate of 540 ha to 756 ha to be restored for ~216 ha of permanently destroyed forest. • **Conservation** - The project's contribution to the creation of the Tsinjoarivo NPA will guarantee the best conservation of about 6,340 hectares of forest

Scope of the Action Plan

Habitat concerned	Estimated residual impact	Residual impact of the project after implementing mitigation measures	Proposed compensation measures	Possible support measures	Achievement of the no net loss or net gain objective
			forests adjacent to the main forest corridor within the NPA - BAP 21.		(core) and better management of 890 hectares of forest in the peripheral zone. • **Avoided losses -** Besides, taking into account deforestation activities in the local area, it is estimated that the NPA will help avoid the loss of 2,150 to 2,900 ha by 2059 (40 years).



Measures Outlined in the Biodiversity Action Plan

SUPPLIED TO MARY BOOMGARD, OVERSEAS PRIVATE INVESTMENT CORPORATION ON 10 JAN 20 01:31:23 GMT

Scope of the Action Plan

1 Environmental Measures Outlined in the BAP

Table 20 below lists all the environmental measures to be put in place during the project's construction and operation phases. These measures are not reduced to biodiversity issues. They also affect other components of the environment (water quality, air quality, noise, soil, pollution, etc.). These measures are included in the BAP but, since they are detailed in the ESIA, they are not developed in this report.

Table 20. Correspondence between the Environmental Measures Outlined in the BAP and the Measures Indicated in the ESIA

BAP Code	BAP Measure	ESIA Code	Description of Measures in the ESIA	Implementation Phase	Managed by
ME1 REDUCTION_ DUST	**Reduce dust emissions, which are a source of nuisance for wildlife**	**Atmo 01, Atmo 02**	• Regular watering in the dry season. Set up a follow-up system for dust-related complaints and take steps to limit impacts; • Limiting the speed of construction vehicles to 40 km/h on tracks and 15 km/h on working platforms or in facilities	Construction	EPC
ME2 REDUCTION_RISKS_OF_EMISSION	**Reduce the risk of accidental pollution and maintain water quality**	**Poll 01, Poll 02, Poll 03, Poll 04, Poll 05**	• Preparation and implementation of a pollution and spill management plan for the construction phase, taking into account the principles set out in the ESIA. • As part of an initial and subsequent training program, training of workers in the prevention and management of pollutant spills. • Designing (i) the operator's installations supporting hydromechanical and electromechanical equipment, and (ii) storage sites for oils and other petrochemical or chemical products, so that direct leakage to the environment without retention is impossible. Where this is not possible, plan to use biodegradable oil. • Construction for the operator of maintenance and refueling facilities for project vehicles to contain accidental leaks and maintenance products. • Use of biodegradable oil for hydromechanical and electromechanical equipment presenting a risk of uncontrolled leakage into the environment, in particular for all parts in direct contact with water.	Construction Construction Study and Construction Study and construction Operation	EPC EPC EPC EPC NEHO
		Ero01, Ero02,	• Preparation of an earthworks/overburden/embankment management and erosion prevention plan submitted to NEHO for approval and incorporating the principles of	Pre-construction	EPC

BAP Code	BAP Measure	ESIA Code	Description of Measures in the ESIA	Implementation Phase	Managed by
ME3 REDUCTION_EROSION_RISK	**Minimize erosion risk**	**Ero03, Ero04**	Chapter 5.2.1.2 of the ESIA. • Assignment in the EPC team of the "Erosion Control" function and implementation of the plan prepared within the framework of the Ero01 action. • Installation of crossing structures on all watercourses to be crossed by vehicles or construction machinery. • Shaping of final disposal areas for surplus materials in order to facilitate their integration into the landscape.	& Construction	
ME4 REDUCTION_WASTE	**Collecting, treating and managing waste**	**Dech 01, Dech 02, Dech 03, Dech 04**	• Preparation and implementation of a plan for the collection, treatment and management of liquid and solid waste for the construction phase, taking into account the three principles set out in the ESIA (avoiding the uncontrolled spread of pollutants, compliance with Malagasy standards, compliance with IFC recommendations). • As part of an initial and subsequent training program, educate workers on solid and liquid waste management. • Internal control of waste collection (record keeping) and effluent quality.	Construction	EPC
ME5 REDUCTION_NOISE_POLLUTION	**Definition and implementation of a procedure for noise pollution**	**Atmo 02, Atmo 03,**	• Limiting the speed of construction vehicles to 40 km/h on the tracks and 15 km/h on the working platforms or in the facilities. • Ban on the use of explosives from 9pm to 7am for surface works (allowed underground).	Construction	EPC

2 Avoidance and Reduction Measures Outlined in the BAP

2.1 Measures Regarding Terrestrial Habitats and Species

Table 21. Areas of Correspondence between ESIA and BAP Measures for Terrestrial Environments

BAP CODE	BAP Measure	ESIA Code	ESIA Measures and Additional BAP Measures	Phase	Managed by
BAP 1 **AVOIDANCE_NATURAL_HABITATS_BEFORE_BELANITRA**	**Maximum avoidance of natural and critical habitats during the final implementation of the project between Antanifotsy and Belanitra.**	**BioT04, Opti02**	Implementation of linear infrastructure between Antanifotsy and Belanitra: • Avoid wooded areas as much as possible to minimize deforestation (use recent aerial/satellite imagery and field visits to identify wooded/deforested areas). • Make maximum use of existing trails, rehabilitating them where necessary rather than creating new ones.	**Design & Construction**	**EPC**
BAP 2 **AVOIDANCE_NATURAL_HABITATS_BELANITRA_DAM**	**Maximum avoidance of natural and critical habitats during the final implementation of the project between Belanitra and the dam (construction of the access road and HV line).**	**BioT05**	Between Belanitra and the dam: • Adopt a layout and design of the line and road that avoids wooded areas as much as technically possible; • Consult VOI for approval of affected wooded areas.	**Design & Construction**	**EPC** **NEHO**
BAP 3 **AVOIDANCE_NATURAL_HABITATS_DAM_PLANT**	**Maximum avoidance of natural and critical habitats during the final implementation of the project between the dam and the plant (access road and power line).**	**BioT06, Opti03**	Between the dam and the hydropower plant: • Run the service line and communication networks through the waterway gallery, buried along the road or placed overhead with the existing line (insulated ground wire). For road and line drawing: • Recognize and make maximum use of areas already impacted as described in the ESIA. • Bury the transmission line for 1.6 km where the selected route crosses the greatest forest width.	**Design & Construction**	**EPC**

BAP CODE	BAP Measure	ESIA Code	ESIA Measures and Additional BAP Measures	Phase	Managed by
			• Limit the width of the tracks (rolling strip) to 5 m in wooded areas (excluding bends and crossing areas). Have the implantations validated by NEHO.		
BAP 4 **AVOIDANCE_NATURAL_HABITATS_TEMPORARY_INFRA**	**Maximum avoidance of natural and critical habitats during the final installation of the project in relation to or permanent infrastructure.**	**BioT07, Opti04**	• Use the future reservoir's footprint as much as possible for temporary infrastructure and extraction sites (without exposing the sites to flooding from the Onive River); • At the dam, outside the reservoir area: (i) Implement temporary infrastructure on the right bank of the Onive (west) rather than on the left bank to minimize risks to the new protected area and (ii) Avoid natural habitats and agricultural areas to limit the volume of compensation or economic displacement. • Plant level: Avoid agricultural areas to limit the amount of compensation or economic displacements. ***Additional actions in the BAP:*** • Extend good avoidance practices to all sensitive natural habitats as identified by a qualified ecologist, (including for example natural forest habitats but also habitats suitable for bats (some caves), endangered birds (some wetlands), natural forests).	**Design & Construction**	**EPC**
BAP 5 **REDUCTION_PRESERVATION_CONTINUUM**	**Measures to preserve the ecological continuum for wildlife**	**BioT09, Bio T 010**	• Night traffic (between 8:00 p.m. and 6:00 a.m.) between the dam and the plant will be prohibited for scheduled or regular site activities, and will be reserved for emergencies and exceptional circumstances approved by NEHO. • Setting up barriers and guard posts at the extremities of the forest. • Night traffic (between 7pm and 7am) between the dam and the plant will be prohibited for scheduled or regular operation activities, and will be reserved for emergencies and exceptional circumstances. • Setting up barriers and guard posts at the extremities of the forest (see map presented in measure BAP 5 in **Appendix 2**), through coordinated management with the proponent / NPA manager.	**Construction**	**EPC**

BAP CODE	BAP Measure	ESIA Code	ESIA Measures and Additional BAP Measures	Phase	Managed by
			Additional actions in the BAP: • The limitation of night traffic only concerns the area between the guard posts at the extremities of the forest, and also concerns construction activities in this area. • Installation of walled bridges on the access road between the dam and the plant (in the section crossing the forest corridor where the HV line will be buried, with the most impact on the forest continuum)		
BAP 6 **REDUCTION_PLANNING ON_WORKS**	**Performing works outside the sensitive periods of conservation concern species**	**ADDITIONAL BAP MEASURE** **See the timetable given in the BAP 6 measure sheet in Annex 2**		Construction	EPC
BAP 7 **REDUCTION_SENSIBLE_DEFORESTATION**	**Reduction of habitat loss and the destruction of individuals (flora and fauna) through the implementation of rational deforestation.**	**BioT11, BioT12, BioT13, BioT14**	**Protection of endangered flora (between the dam and the plant):** • The identification, marking and precise location of the critical habitat triggering flora species listed in the ESIA for avoidance during the exact siting of infrastructure in forest areas; • Adaptation of footprints and impacting activities to the maximum extent possible or relocation of the specimens concerned to avoid damaging them. • Follow-up of actions to protect threatened flora. **Protection of endangered wildlife (between the dam and the plant):** • Large trees identified as food sources (frugivorous species) and lemur sleeping areas should be avoided as much as possible. These trees will be easily recognizable by the abundance of seedlings and the presence of excrement; • Sequenced deforestation after the definitive establishment of infrastructure crossing forest areas, in order to scare away wild animals: ✓ Felling of trees, then (ii) Leaving 24 hours for the residual fauna to	**Design and construction** **Design and construction** **Operation** **Design and construction** **Design and construction**	**NEHO** **EPC** **NEHO** **NEHO** **NEHO**

BAP CODE	BAP Measure	ESIA Code	ESIA Measures and Additional BAP Measures	Phase	Managed by
			move away (especially reptiles, chameleons, entomofauna), then (iii) Finalization of deforestation and cleaning of the area with storage of the vegetation collected on the edges of the footprints for crushing or composting (no burning). • Minimization of the risk of wild animal being run over: (i) Driver awareness and training in the removal of wildlife species from the roadways, and (ii) 40 km/h speed limit between the dam and the plant. • Follow-up of actions to protect endangered wildlife. ***<u>Additional actions in the BAP</u>*** • Note: It is specified that the potentially impacting actions are 1) deforestation then 2) earthworks (deforestation and earthworks will be simultaneous). • Timing of deforestation followed by earthworks (peak hibernation periods for species and/or bat/bird/lemur nesting); • Integration of deforestation and timber cutting management in authorized work footprints; • Controlled procedure for the recovery of wood from community deforestation actions; • Good practices for maintenance actions under the HV line between the dam and the plant (NEHO with Jirama) then from the dam to Antanifotsy (good practices to be shared with Jirama, the company responsible for the maintenance of the HV line); • Introduction of a system of penalties by the EPC for employees in the event of non-compliance with work footprints; • Protocol for planning deforestation and earthworks before the passage of machines (see BAP 6 Reduction_Planning_Works)	**Design and construction** **Operation**	**EPC** **NEHO**
BAP 8 **REDUCTION_CRUSHING_ WILDLIFE**		**BioT15**	• Regulation of traffic between the dam and the plant in coordination with the proponent of the future NPA and with consultation of the population	**Operation**	**NEHO**

BAP CODE	BAP Measure	ESIA Code	ESIA Measures and Additional BAP Measures	Phase	Managed by
	Minimizing the risk of wild animals being crushed		(the road is not free of access to all). • Driver awareness and training in the removal of wildlife species from traffic lanes, • Restrictions on night traffic (see map presented in measure BAP 8 in **Annex 2**), • Speed limited to 40 km/h between the dam and the plant, • Monitoring and georeferencing of points where wildlife specimens have been crushed. ***Additional actions in the BAP:*** • Note: The limitation of night traffic only concerns the area between the guard posts at the extremities of the forest, and also concerns construction activities in this area (see map presented in measure BAP 8 in Annex 2); • ***Active search for amphibians and reptiles and re-establishment before deforestation/grazing carried out outside the hibernation period (by a team of herpetologists);*** • ***Awareness and training sessions for employees (drivers and others) for reporting and removal of high conservation concern species before gear passage;*** • ***Planning of work outside of periods when wildlife is sensitive to the issues at stake (breeding, hibernation).***		
BAP 9 REDUCTION_IAS-TERRESTRIAL_FLORA_CONTROL	**Addressing the introduction and spread of invasive alien flora species**	**BioT16**	• Identify the invasive species present in the construction site and its surroundings before the works are carried out; • Manually or mechanically remove shrub or tree IAS by ensuring that the root system is removed; • Eradicate these species through appropriate measures, without the use of pesticides (on-site disposal and incineration of plant debris); • Carry out a preliminary study of material supply sites (quarries, others).	**Design and construction**	**EPC**

Scope of the Action Plan

BAP CODE	BAP Measure	ESIA Code	ESIA Measures and Additional BAP Measures	Phase	Managed by
BAP 10 **REDUCTION_FIRE_HAZARDS**	**Reducing fire risks**	**BioT17**	• Open fires are prohibited during the entire construction period, • Equip workstations/sites where flammable products are used with fire extinguishers, • Train staff in the use of fire extinguishers • Remind of basic rules regarding the use of flammable products.	**Construction**	**EPC**
BAP 11 **REDUCTION_ POPULATION_INFLUX_POACHING**	**Reduce negative impacts on biodiversity associated with the influx of populations into protected areas**	**BioT18, Affl 09 BioT21 Seco05 Seco06**	• Support to managers of areas under conservation status for the protection of biodiversity. • Preparation and implementation of a program for the protection of CITES species and the fight against illegal trade and poaching defined with the managers and proponents of protected areas within the framework of actions already planned to regulate traffic and strengthen the control and protection of biodiversity. ***Additional actions in the BAP:*** • Inclusion of small carnivore and bat high conservation concern species in the list of species targeted by the anti-poaching program; • ***Implementation of a control/monitoring system on the reservoir (monitoring crossings from one bank to the other of the Onive and activities around the reservoir) with a monthly visit by the team in charge of water quality monitoring;*** • ***Regulation of road access (vehicle control) at the entry/exit of the project area;*** • ***Establishment of a sanction regime coupled with an awareness program for the poaching of protected species***.	**Construction and operation**	**NEHO**
BAP 12 **REDUCTION_LIGHT_POLLUTION**	**Minimisation of light pollution (nocturnal species)**	**BioT19, Bio T20**	• Avoid void continuous lighting and use presence detector activation for comfortable outdoor lighting. Safety during night works requires powerful and permanent lighting. The recommendations therefore apply during the construction phase only to base camps and office buildings.	**Construction**	**EPC**

BAP CODE	BAP Measure	ESIA Code	ESIA Measures and Additional BAP Measures	Phase	Managed by
			• Use lower brightness bulbs or use floor directed lighting for outdoor lighting.	**Operation**	**NEHO**
BAP 13 **REDUCTION_ _COLLISION_RISKS**	**Reducing the risk of collision with the power line**	**BioT27**	• Between the plant and the dam, setting up three-dimensional "bird diverters" on ground wires, only in the corridor **<u>Additional actions of the BAP</u>**: • On the rest of the HT line, check for potential issues in lakes / other water bodies related to the presence of waterbirds (LC) (e.g. duck flights). Bird diverter requirements will be refined for certain sections of the HV line.	**Construction** **Construction**	**EPC** **NEHO**
BAP 14 **REDUCTION_LOCAL_RESOURCES**	**Avoiding or reducing the use of local natural resources as much as possible**	**ADDITIONAL BAP MEASURE**		**Design and construction**	**EPC**
BAP 15 **RESTORATION_Re-vegetation**	**Revegetation after construction works**	**ADDITIONAL MEASURE OF BAP** (in connection with erosion control measures) ***Additional BAP actions:*** • Zoning of revegetation actions according to the functions sought (control of erosion on slopes, soil maintenance, restoration of plant biodiversity) depending on the altitude of the restoration areas (selection of the most suitable species), the location of the areas to be restored in relation to the heart of the forest corridor. • ***The EPC will be able to purchase the seedlings needed for revegetation actions from existing nurseries, giving preference to the purchase of native plants (present in the forest corridor) and not fast-growing exotic plants such as eucalyptus.***		**Construction**	**EPC**

2.2 Measures Regarding Aquatic Habitats and Species

Table 22. Correspondence Between the Avoidance, Reduction, and Restoration Measures Outlined in the BAP and the Measures Mentioned in the ESIA

BAP Code	BAP Measure	ESIA Code	Titles of Measures in the ESIA	Implementation phase	Managed by
BAP 16 REDUCTION_ ENVIRONMENTAL _IMPOUNDMENT_ RESERVOIR	**Environmental impoundment of the reservoir**	**BioA01 Downstream03**	• When impounding the reservoir for the first time, schedule a test of at least 16 hours with only the instream flow applied; • Visual observations on the bypassed reach and downstream from the plant (before and after 4 p.m.) to check the continuity of the flow and identify any singularities that may appear; • During this test, ichthyologists will be involved, in order to evaluate exactly the possible impact of the various environmental variations and conditions on the habitat of aquatic species in the Onive, or even on the species themselves (observation in particular downstream concerning the habitats suitable for *Rheocles*). ***Additional actions in the BAP:*** • Deforestation of the flooded area before impounding the reservoir to allow wildlife to move away; • ***In sensitive low-slope areas, where the impoundment speed exceeds 2km/ha horizontally, collection of small fauna by the herpetologist teams (reptiles, amphibians).*** • ***Capture of species trapped on islands (or submerged high points) formed by the reservoir (mapping of islands created by the reservoir to be created)***	Impounding the reservoir	NEHO - EPC
BAP 17 REDUCTION_INSTREAM_FLOW	**Maintaining an instream flow**	**BioA02, BioA03, Downstream 01**	• Instream flow is maintained at all times in the bypassed reach (5.7 m^3/s). 7) ***Additional actions in the BAP***	Construction Operation	EPC NEHO

BAP Code	BAP Measure	ESIA Code	Titles of Measures in the ESIA	Implementation phase	Managed by
			• ***Campaign to identify and verify alternative routes for eels;*** • ***Monitoring of sediment inflow downstream from the plant and development of restoration and/or compensation actions depending on the monitoring results (e.g. sediment input by erosion, compensation actions of Rheocles in the NPA of Nosivolo).***		
BAP 18 REDUCTION_AQUATIC_IAS_CONTROL	**Targeted and suitable control of aquatic invasive alien species (IAS) and *Channa maculata* in particular**	**BioA06**	• Targeted and suitable control of aquatic invasive alien species	Operation	NEHO
BAP 19 REDUCTION_CROSSING_TRIBUTARIES	**Installation of out-of-water crossing structures (nozzles, scuppers, culverts) on tributaries and with safeguard fishing measures**	**Ero03**	• Installation of crossing structures on all watercourses to be crossed by vehicles or construction equipment; ***Additional actions in the BAP*** • Safeguard fishing during the construction of crossing structures, in watercourses where relevant. • ***Wildlife crossings at Onive tributary crossing infrastructure for aquatic and semi-aquatic species to maintain in-stream and bank connectivity.*** • ***In the event of an accidental spill (materials, fuels, etc.) into one of the watercourses to be crossed (Astacoid watercourse), implement clean-up (repair) measures.***	Construction	EPC
BAP 20 REDUCTION_WORKS_PLANNING	**Performing works outside the sensitive periods of conservation concern species**	**ADDITIONAL BAP MEASURE** **See timetable in the BAP 6 measure sheet in Annex 2.**		Construction	EPC

3 Compensation Measures

In view of the residual impacts identified for the Sahofika project (Part 4.2), the compensation measures provided for under the BAP concern only terrestrial habitats and species

Table 23. Compensation Measures in the BAP Targeting Terrestrial Habitats and Species

BAP Code	BAP Measure	ESIA Code	Title in the ESIA	Phase	Managed by
BAP 21 COMPENSATION_FOREST_RESTORATION	**Preparation and implementation of a program to restore degraded areas in forests adjacent to the main forest corridor**	**BioT22**	• Preparation and implementation of a program to restore degraded areas in forests adjacent to the forest corridor (final surface area equal to twice the surface area of lost wooded areas). ***Additional actions in the BAP:*** • Integration of an objective of restoring forest watercourses degraded by human activities (clearing, agriculture etc.), by restoring a forest area with a density of watercourses equivalent to the area impacted by the project (target species: Astacoids***).***	**Construction and Operation**	**NEHO**
BAP 22 COMPENSATION_CREATION_TSINJOARIVO_NPA	**Support for the conservation of the natural forests of the Tsinjoarivo NPA**	**BioT23**	➢ Support for the conservation of the natural forests of Tsinjoarivo NPA and Marolambo National Park ***Additional PAO actions (from consultations with the NPA proponent):*** ➢ Affirmation of an outcome objective related to the NPA: ○ ***NEHO becomes a partner of the NPA and commits to a goal of zero deforestation in the NPA over the life of the project;*** ○ ***Contribution of the project to the creation of the NPA (justification of the contribution of the project to the creation of the NPA).***	**Construction and Operation**	**NEHO**

BAP Code	BAP Measure	ESIA Code	Title in the ESIA	Phase	Managed by
			➢ ***Coverage of all additional costs directly generated by the project in relation to the conservation objectives of the NPA (administrative procedures, etc.).*** ○ ***The project's commitment to the Proponent of the future NPA is a performance contract aimed at reducing the rate of deforestation and forest restoration (monitoring in hectares of natural forest conserved and restored).*** ○ ***Contribution of the project to the NPA's strategic objectives (over 35 years):*** ○ ***Slowing down and then stopping deforestation: monitoring, apprehension of offenders by strengthening monitoring capacities (material and human resources) and strengthening forest law enforcement with the DGEF;*** ○ ***Restoring a defined area of forest: natural restoration, proactive restoration (see Compensation Strategy)*** ○ ***Provide social and economic opportunities: improved road access, rural electrification, basic infrastructure for community development, income alternatives, development of eco-tourism.*** ○ ***Generate scientific knowledge on fauna and flora: monitoring endangered species, monitoring ecological restoration efficiency, accommodating students and contributing to the country's scientific and technical capacity building.*** ○ ***Technical support of the project to the proponent of the NPA:*** ○ ***Prepare the NPA Development and Management Plan;*** ➢ ***Support the preparation of the NPA ESIA, integrating issues related to the populations' user rights (authorized clearings in the peripheral zone etc.), performance objectives related to the well-being of the populations (social actions of the NPA, etc.)***		

BAP Code	BAP Measure	ESIA Code	Title in the ESIA	Phase	Managed by
BAP 23 COMPENSATION_SUPPORT_MAROLAMBO_NP	**Support for the conservation of natural forests in the Marolambo National Park**	**BioT23**	• Support for the conservation of the natural forests of Tsinjoarivo NPA and Marolambo National Park ***Additional BAP actions (proposals resulting from consultation with the MNP)*** • Support for MNP monitoring activities • Support for the extension of the Fisoronana management transfer area • Support for forest restoration actions • Raising the awareness of local populations	**Construction and Operation**	**NEHO**

4 Support Measures

4.1 Measures Regarding Terrestrial Habitats and Species

Table 24. Support Measure in the BAP Targeting Terrestrial Habitats and Species

BAP CODE	BAP Measure	ESIA Code	Title in the ESIA	Phase	Managed by
BAP24 SUPPORT_ECOLOGICAL_MONITORING_PLAN	**Implementation of targeted monitoring of biodiversity (flora and fauna species triggering critical habitat) over the long term**	**BioT26**	• Preparation and implementation of a monitoring program for a number of fauna and flora target species that triggered critical habitat analyses. This program will be undertaken with protected area managers and proponents.	**Construction and Operation**	**NEHO**
BAP25 SUPPORT_INVENTORIES_IBA_BIRDS	**Updating IBA inventories with the relevant entity**	**BioT28**	• Support for the updating of the IBA data of the Onive gazetted forest, in collaboration with the reference NGO.	**Construction and Operation**	**NEHO**

Scope of the Action Plan

BAP CODE	BAP Measure	ESIA Code	Title in the ESIA	Phase	Managed by
BAP26 SUPPORT_ ENVIRONMENTAL_ AWARENESS-RAISING	**Public and employee information and awareness program**	**BioT01, BioT02**	• Raising awareness and informing the population concerned about the Project and measures to protect biodiversity. • Information sharing, training and capacity building of NEHO employees on environmental measures taken by the project. ***Additional actions in the BAP:*** Integration of all wildlife species triggering critical habitat (small carnivores, lemurs, amphibians, reptiles) into the project's environmental awareness program.	**Pre-construction & Construction & Operation**	**NEHO**
BAP27 SUPPORT_REFORESTATION	**Support program for VOI: reforestation in management transfer areas and preservation of ecosystem services.**	**BioT24**	Support program for VOI: reforestation in management transfer areas and preservation of ecosystem services.	**Construction and Operation**	**NEHO**
BAP28 SUPPORT_INCOME-GENERATING_ACTIVITIES	**Support for the development of income-generating activities (agriculture and other sectors)**	**BY**	**ADDITIONAL BAP MEASURE** *(IN CONNECTION WITH ACTIONS OUTLINED IN THE RAP)* ***Additional actions in the BAP:*** • Support for the development of ecotourism activities in the project area: increased potential due to the accessibility of the NPA after rehabilitation and construction of access roads to the dam. • ***Taking into account local employment opportunities common to the project and potential ecotourism activities: recycling local jobs from the project into the ecotourism project (cooks, camp leaders, guides, etc.).*** • ***Support for the capacity building program in the tourism sector (e.g. training in tourist reception).***	**Construction and Operation**	**NEHO**

4.2 Measures Regarding Aquatic Habitats and Species

Table 25. Support Measures in the BAP Targeting Aquatic Habitats and Species

BAP CODE	BAP Measure	ESIA Code	Title in the ESIA	Phase	Managed by
BAP 29 **SUPPORT_KNOWLEDGE_RHEOCLES**	**Deepening of knowledge about Rheocles wrightae and Rheocles sp. Ambatovy**	**BioA04** **Sedi01**	• Deepening of knowledge about *Rheocles wrightae* and Rheocles sp. Ambatovy already during the construction phase • Monitoring of the evolution of sand banks OVER the 3 km strip downstream from the hydropower plant (visual monitoring during the dry season) ***Additional actions in the BAP*** • Integration of monitoring of abundance indicators and recruitment rates in the Rhoecles wrighta study It should also be noted that as a precautionary measure for Rheocles, and depending on the results of the monitoring, NEHO is considering a follow-up measure on sedimentary input downstream from the plant and the development of restoration and/or compensation actions (e.g. sedimentary input by erosion, compensation actions for Rheocles in the Nosivolo NPA).	**Operation**	**NEHO**
BAP 30 **SUPPORT_Awareness_Raising_Local_Fisheries**	**Raising awareness of local populations to target the capture of invasive alien species (IAS) rather than endangered species (R. wrightae) and native crayfish.**	**BioA07**	• Raising awareness of local populations to target the capture of invasive alien species (IAS) rather than endangered species (R. wrightae) and native crayfish. ***Additional actions in the BAP*** • Awareness-raising actions on local fisheries (monitoring of changes in fishing practices by local people)	**Operation**	**NEHO**

Follow-up and Monitoring

Scope of the Action Plan

To the extent possible, all monitoring and follow-up actions will be performed with the direct involvement of the populations (participatory monitoring principle).

Table 26. Assessment of the BAP Follow-up Measures

Code	Title of the Measure	Monitoring arrangements	Measure effectiveness indicators	Monitoring frequency	Monitored by
ENVIRONMENTAL MEASURES					
ME1 - DUST_REDUCTION	**Reduce dust emissions, which are a source of nuisance for wildlife**	• Control of road traffic (vehicle speed) during the works and in the operation phase by recording (GPS or tachometer) and checking the speed.	• Good visibility for drivers following another vehicle	Daily and ongoing	Construction: EPC Operation: NEHO
ME2 - REDUCTION_POLLUTION_RISKS	**Reduce risks of accidental pollution and maintain water quality**	• Water quality control (biological and physico-chemical) in the peripheral areas of the construction site (receiving environment of runoff water)	• Location of points of release into the environment (GPS coordinates) and associated measure points • Compliance with international water quality standards	Monthly during the works and regularly during the operation phase	Construction: EPC Operation: NEHO
ME3 - REDUCTION_EROSION_RISKS	**Minimize erosion risks**	• Visual inspection and in-situ measures	• Area of eroded habitats (not revegetated and prone to erosion with loaded runoff)	Monthly during construction	Construction: EPC Operation: NEHO
ME 4 - REDUCTION_WASTE	**Collecting, treating and managing waste**	• Tracking the amount of waste generated • Monitoring the quantity of waste treated	• Quantity of waste treated/waste generated by type of waste	Monthly	Construction: EPC Operation: NEHO
ME 5 - REDUCTION_NOISE_POLLUTION	**Definition and implementation of a procedure for noise pollution**	• Monitoring compliance with noise regulations	• Compliance with noise abatement measures	Ongoing	EPC (Environmental Coordinator)
MITIGATION MEASURES AIMED AT HABITATS AND LAND SPECIES					
BAP 1 - AVOIDANCE_NATURAL_HABITATS_BEFORE_BELANITRA	**Maximum avoidance of natural and critical habitats during the final implementation of the project between Antanifotsy and Belanitra**	• Monitoring of the accumulated area of impacted afforestation	• Afforestation area (pine, eucalyptus)	Monthly, for the duration of the workss	EPC (Environmental Coordinator)

Scope of the Action Plan

Code	Title of the Measure	Monitoring arrangements	Measure effectiveness indicators	Monitoring frequency	Monitored by
BAP 2 - AVOIDANCE_NATURAL_HABITATS_BELANITRA_DAM	**Maximum avoidance of natural and critical habitats during the final implementation of the project between Belanitra and the dam (construction of the access road and HV line)**	• Follow-up of surfaces cleared during the works	• Area of natural forests cleared	Monthly, for the duration of the workss	EPC (Environmental Coordinator)
BAP 3 - AVOIDANCE_NATURAL_HABITATS_DAM_Plant	**Maximum avoidance of natural and critical habitats during the final implementation of the project between the dam and the plant (access road and power line)**	• Follow-up of surfaces cleared during the works	• Area of natural forests cleared	Monthly, for the duration of the workss	EPC (Environmental Coordinator)
BAP 4 - AVOIDANCE_NATURAL_HABITATS_INFRA_TEMPORAIRES	**Maximum avoidance of natural and critical habitats during the final installation of the project in relation to or permanent infrastructure**	• Follow-up of surfaces cleared during the works	• Area of natural forests cleared	Monthly, for the duration of the workss	EPC (Environmental Coordinator)
BAP 5 - REDUCTION_PRESERVATION_CONTINUUM	**Measures designed to preserve the ecological continuum for wildlife**	• Roadside checks at night	• Number of vehicles crossing the corridor at night	Daily	Construction: EPC Operation: NEHO
BAP 6 - REDUCTION_WORKS_PLANNING	**Conducting the works outside the sensitive periods of the high conservation concern species**	• When deforestation occurs, dates are recorded and compared to periods of sensitivity to deforestation. • Follow-up of actions to maintain unsuitable conditions between the deforestation and earthwork phases.	• Number of individuals (small fauna + lemurs) destroyed during deforestation; • Number of individuals resettled (small fauna + lemurs) on the deforested and cleared areas before earthworks.	Monthly during deforestation and earthwork phases	EPC (Environmental Coordinator)
BAP 7 - REDUCTION_DEBOISEMENT_RAISONNE	**Reduction of habitat loss and the destruction of individuals (flora and fauna) through the implementation of rational deforestation.**	• Follow-up of the major stages of deforestation (identification of conservation concern flora/fauna species, deforestation, clearing before earthworks, etc.). •	• Deforested area in ha	Every week for the entire duration deforestation period	EPC during the construction phase
BAP 8 - REDUCTION_CRUSHING_WILDLIFE	**Minimizing the risk of wild animals being crushed**	• Tracking and georeferencing of areas where animals were crushed	• Number of vertebrates crushed by construction machines or other vehicles and identification of species	Ongoing	NEHO

Scope of the Action Plan

Code	Title of the Measure	Monitoring arrangements	Measure effectiveness indicators	Monitoring frequency	Monitored by
BAP 9 - IAS-TERRESTRIAL_FLORA_CONTROL	**Addressing the introduction and spread of invasive alien flora species**	• During site maintenance operations, carry out estimates of invasive plant cover (field observations by an experienced botanist).	• Area invaded by IAS as a percentage of the area modified by the Project	Monthly during the construction phase and then annually during the operation phase.	Construction: EPC Operation: NEHO
BAP 10 - REDUCTION_FIRE_HAZARDS	**Reducing fire risks**	• Recording and tracking of reported fires within the EPC area (and their cause)	• Area and type of vegetation cover burned as a result of project activities	Daily and ongoing	Construction: EPC Operation: NEHO
BAP 11 - REDUCTION_POPULATION_INFLUX_POACHING	**Reduce the negative impacts on biodiversity linked to the influx of population into protected areas (Marolambo Park and Tsinjoarivo NPA), especially through the support and guidance of the managers of areas under conservation status**	• Checking workers and drivers entering and leaving the project area for weapons, traps, hunting equipment, and bushmeat.	• Number of checks and proportion of checks	Ongoing	NEHO in the construction and operation phases
BAP 12 - REDUCTION_LIGHT_POLLUTION	**Minimization of light pollution (nocturnal species)**	• Monitoring of light sources installed on the construction site and operating areas	• Number of light sources that are not up to standard	Ongoing	Construction: EPC Operation: NEHO
BAP 13 - REDUCTION_COLLISION_RISKS	**Reducing the risk of collision with the power line**	• Checking the installation of bird diverters	• Number of bird diverters installed	Before transfer to Jirama	NEHO
BAP 14 - REDUCTION_LOCAL_RESOURCES	**Avoiding or reducing the use of local natural resources as much as possible**	• Tracking and tracing of materials used in construction	• To be determined based on requirements in materials	Monthly during construction	EPC (Environmental Coordinator)
BAP 15 - REDUCTION_RE-VEGETATION	**Revegetation after construction works**	• Monitoring the evolution of vegetation in planted areas (field observations by an experienced botanist)	• Area of eroded habitats (not revegetated and prone to erosion with heavy runoff) - idem ME3 • Absence of invasive alien species	Monthly for 5 years and then annually for the entire duration of the project's operation phase	NEHO
MITIGATION MEASURES FOR AQUATIC HABITATS AND SPECIES					**MITIGAT**

Scope of the Action Plan

Code	Title of the Measure	Monitoring arrangements	Measure effectiveness indicators	Monitoring frequency	Monitored by
BAP 16 - REDUCTION_ ENVIRONMENTAL_IMPOUND MENT_RESERVOIR	**Environmental impoundment of the reservoir**	• Documentation of species caught and areas deforested	• Safeguard catches and deforestation performed	Daily for the duration of the impoundment process	NEHO in coordination with EPC
BAP 17 - REDUCTION_ INSTREAM_FLOW	**Maintaining an instream flow**	• Continuous measurement of the flow discharged from the dam.	• Flow rate always higher than the minimum allowed value	Ongoing	During construction and impoundmen t: EPC During the operation phase: NEHO
BAP 18 - REDUCTION_AQUATIC_IAS_C ONTROL	**Targeted and suitable control of aquatic invasive alien species (IAS) and *Channa maculata* in particular**	• Fish inventories • Surveys of fishermen and local populations	• % of threatened species among species caught	Quarterly for the first 5 years of control, then annually.	NEHO
BAP 19 - REDUCTION_CROSSING_TRIB UTARIES	**Implementation of out-of-water structures (nozzles, gutters, and culverts) on the tributaries by conducting works in waterless conditions (diversion) and with safeguard fishing measures**	• Monitoring the ecological quality of watercourses with crossing structures	• Proportion of watercourses crossed in water-less conditions	Monthly, for the duration of the works	EPC (Environmental Coordinator)
BAP 20 - REDUCTION_WORKS_PLANNI NG	**Performing works outside the sensitive periods of conservation concern species**	• Environmental coordination of the construction site	• Share of deforestation works and earthworks carried out in accordance with BAP6	Continues during construction	EPC (Environmental Coordinator)
COMPENSATION MEASURES FOR TERRESTRIAL HABITATS AND SPECIES					**COMPEN**
BAP 21 - COMPENSATION_FOREST_RE STORATION	**Preparation and implementation of a program to restore degraded areas in forests adjacent to the main forest corridor**	• Monitoring the evolution of the vegetation of sites under restoration (satellite images and field observations by an experienced botanist)	• Area and state of conservation of restoration sites (after 10 years of restoration)	Annually throughout the term of the concession	NEHO
BAP 22 - COMPENSATION_SUPPORT_T SINJOARIVO_NPA	**Support for the conservation of the natural forests of the Tsinjoarivo NPA**	• Satellite image analysis	• Monitoring deforestation in the NPA	Annual	NEHO

Scope of the Action Plan

Code	Title of the Measure	Monitoring arrangements	Measure effectiveness indicators	Monitoring frequency	Monitored by
BAP 23 - COMPENSATION_SUPPORT_MAROLAMBO_NP	**Support for the conservation of natural forests in the Marolambo National Park**	• Satellite image analysis	• Monitoring deforestation in the northern zone of the MNP	Annual	NEHO
SUPPORT MEASURES FOR AQUATIC HABITATS AND SPECIES					
BAP 24 – SUPPORT_ECOLOGICAL_MONITORING_PLAN	**Implementation of targeted monitoring of biodiversity (flora and fauna species triggering critical habitat)**	• Annual report shared on the NEHO website	• Follow-up and publication on the website	Annually (at least two monitoring periods, in dry and rainy season)	NEHO
BAP 25 – SUPPORT_INVENTORIES_IBA_BIRDS	**Updating IBA inventories with the relevant entity**	• Follow-up of the completion of the new inventory	• IBA inventory updated and submitted to Birdlife for publication	At the end of the inventory	NEHO
BAP 26 - SUPPORT_ENVIRONMENTAL_AWARENESS-RAISING	**Public and employee information and awareness program**	• Checking employee certificates (or attendance sheets of people who have gone through training/awareness-raising on good environmental practices on the worksite)	• Percentage of employees who have gone through training/awareness raising on good environmental practices on the worksite • Number of consultations with the population	Monthly	EPC (for employees and other persons under the responsibility of the EPC)
BAP 27 - SUPPORT_REFORESTATION	**Support program for VOI: reforestation in management transfer areas and preservation of ecosystem services.**	• Follow-up of reforestation actions in VOIs	• Reforested area against the defined objectives • Number of trees planted	Annual	NEHO and VOI members affected by a reforestation program
BAP 28 – SUPPORT_INCOME-GENERATING ACTIVITIES	**Support for the development of income-generating activities (agriculture and other sectors)**	• Follow-up on measures taken to support the development of IGAs	• Number of planned support measures carried out	Semi-annual	NEHO
SUPPORT MEASURES FOR AQUATIC HABITATS AND SPECIES					
BAP 29 - SUPPORT_KNOWLEDGE_RHEOCLES	**Deepening of knowledge of *Rheocles wrightae* and *Rheocles sp. Ambatovy***	• Effective increase of the understanding of the ecology of Rheocles sp..	• Acquired knowledge of the ecology of the species required for the Project	At the end of the phase	NEHO

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Code	Title of the Measure	Monitoring arrangements	Measure effectiveness indicators	Monitoring frequency	Monitored by
BAP 30 – SUPPORT_AWARENESS-RAISING_LOCAL_FISHING	**Raising awareness among local populations to target the capture of invasive alien species (IAS) rather than threatened species (R. wrightae) and native crayfish.**	• Surveys of fishermen and local populations	• % of surveyed fishermen who changed their fishing practices	Quarterly	NEHO

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Timeline

SUPPLIED TO MARY BOOMGARD, OVERSEAS PRIVATE INVESTMENT CORPORATION ON 10 JAN 20 01:31:23 GMT

Scope of the Action Plan

Table 27. Bap Timeline

Scope of the Action Plan

Code		Year																																		
		1	2	3	4	5	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
	pre	Construction				water	Operation																															
ME1 - DUST_REDUCTION		x	x	x	x																																	
ME2 - REDUCTION_POLLUTION_RISKS		x	x	x	x																																	
ME3 - REDUCTION_EROSION_RISKS		x	x	x	x																																	
ME4 - REDUCTION_WASTE		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
ME5 - REDUCTION_NOISE_POLLUTION																																								
BAP 1 - AVOIDANCE_NATURAL_HABITATS_BEFORE_BELANITRA	x																																							
BAP 2 - AVOIDANCE_NATURAL_HABITATS_BELANITRA_DAM	x																																							
BAP 3 - AVOIDANCE_NATURAL_HABITATS_DAM_Plant	x																																							
BAP 4 -	x																																							

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Code		Year																																		
		1	2	3	4	5	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
	pre	Construction				water	Operation																															
AVOIDANCE_NATURAL_HABITATS_INFRA_TEMPORAIRES																																								
BAP 5 - REDUCTION_PRESERVATION_CONTINUUM		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
BAP 6 - REDUCTION_WORKS_PLANNING	x																																							
BAP 7 - REDUCTION_SENSIBLE_DE-FORESTATION		x	x	x	x																																			
BAP 8 - REDUCTION_CRUSHING_WILDLIFE		x	x	x	x																																			
BAP 9 - REDUCTION_IAS-TERRESTRIAL_FLORA_CONTROL		x	x	x	x																																			
BAP 10 - REDUCTION_FIRE_HAZARDS		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
BAP 11 - REDUCTION_POPULATION_INFLUX_POACHING		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
BAP 12 - REDUCTION_LIGHT_P		x	x	x	x																																			

Scope of the Action Pla

Code		Year																																		
		1	2	3	4	5	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
	pre	Construction				water	Operation																															
OLLUTION																																								
BAP 13 - REDUCTION_COLLISION_RISKS	x																																							
BAP 14 - REDUCTION_LOCAL_RESOURCES		x	x	x	x																																			
BAP 15 - REDUCTION_RE-VEGETATION				x	x	x																																		
BAP 16 - REDUCTION_IMPOUNDMENT_RESERVOIR						x																																		
BAP 17 - REDUCTION_INSTREAM_FLOW		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
BAP 18 - COMPENSATION_REDUCTION_AQUATIC_IAS_CONTROL							x	x	x	x	x	x	x	x	x	x																								
BAP 19 - AVOIDANCE_CROSSING_TRIBUTARIES		x	x	x	x																																			
BAP 20- REDUCTION_WORKS_PLANNING	x																																							
BAP 21 - COMPENSATION_FOR		x	x	x	x	x	x	x	x	x	x		x		x		x		x		x		x		x		x		x		x		x		x		x		x

Scope of the Action Pla

Code	Year																																			
		1	2	3	4	5	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
	pre	Construction				water	Operation																															
EST_RESTORATION																																								
BAP 22 - COMPENSATION_CREATION_TSINJOARIVO_NPA	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
BAP 23 - COMPENSATION_SUPPORT_MAROLAMBO_NP	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
BAP 24 - SUPPORT_ECOLOGICAL_MONITORING_PLAN	x	x	x	x	x	x																																		
BAP 25 - SUPPORT_INVENTORIES_IBA_BIRDS	x	x	x	x	x	x																																		
BAP 26 - SUPPORT_ENVIRONMENTAL_AWARENESS-RAISING	x	x	x	x	x	x																																		
BAP 27 - SUPPORT_REFORESTATION	x	x	x	x	x		x		x		x		x		x																										x
BAP 28 - SUPPORT_INCOME-GENERATING_ACTIVITIES	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
BAP 29 - SUPPORT_KNOWLED		x	x	x	x	x	x	x	x	x	x																													

Scope of the Action Pla

Code		Year																																		
		1	2	3	4	5	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
	pre	Construction				water	Operation																																
GE_RHEOCLES																																								
BAP 30 - SUPPORT_AWARENESS-RAISING_LOCAL_FISHERIES							x	x	x	x	x																														

Budget

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Table 28. Estimated BAP Measures Implementation Budget

Measure number	Title of the measure	Estimated overall budget (euros-€)	Budget details
ENVIRONMENTAL MEASURES			
ME1	**Reduce dust emissions, which are a source of nuisance for wildlife**	**-**	• No additional cost for the BAP; included in the project design
ME2	**Reducing the risk of accidental pollution and maintaining water quality**	**-**	• No additional cost for the BAP; included in the project design
ME3	**Minimize erosion risk**	**-**	• No additional cost for the BAP; included in the project design
ME 4	**Collecting, treating and managing waste**	**-**	• No additional cost for the BAP; included in the project design
ME 5	**Definition and implementation of a procedure for noise pollution**	**-**	• No additional cost for the BAP; included in the project design
MITIGATION MEASURES TARGETING TERRESTRIAL HABITATS AND SPECIES			**MITIGATI**
BAP 1	**Maximum avoidance of natural and critical habitats during the final implementation of the project between Antanifotsy and Belanitra.**	**-**	• No additional cost for the BAP; included in the project design
BAP 2	**Maximum avoidance of natural and critical habitats during the final implementation of the project between Belanitra and the dam (construction of the access road and HV line).**	**-**	• No additional cost for the BAP; included in the project design
BAP 3	**Maximum avoidance of natural**		

Measure number	Title of the measure	Estimated overall budget (euros-€)	Budget details
	and critical habitats during the final implementation of the project between the dam and the plant (access road and power line).	-	• No additional cost for the BAP; included in the project design
BAP 4	**Maximum avoidance of natural and critical habitats during the final installation of the project in relation to or permanent infrastructure.**	-	• No additional cost for the BAP; included in the project design
BAP 5	**Measures to preserve the ecological continuum for wildlife**	-	• No additional cost for the BAP; included in the project design
BAP 6	**Performing works outside sensitive periods of conservation concern species**	-	• No additional cost for the BAP; included in the project design
BAP 7	**Reduction of habitat loss and the destruction of individuals (flora and fauna) through the implementation of rational deforestation.**	-	• No additional cost for the BAP; included in the project design
BAP 8	**Minimizing the risk of wild animals being crushed**	-	• No additional cost for the BAP; included in the project design
BAP 9	**Addressing the introduction and spread of invasive alien flora species**	-	• No additional cost for the BAP; included in the project design
BAP 10	**Reducing fire risks**	-	• No additional cost for the BAP; included in the project design
BAP 11	**Reduce negative impacts on**	To be determined	• To be determined according to the control and monitoring procedures applied (plan for a minimum budget): ✓ 2 full-time guard posts (24/7) throughout the entire

Measure number	Title of the measure	Estimated overall budget (euros-€)	Budget details
	biodiversity associated with the influx of populations into protected areas		duration of the works and continuously during the operation phase to control project area entrances/exits ✓ Construction of two gatehouses/barriers
BAP 12	**Minimization of light pollution (nocturnal species, etc.)**	**-**	• No additional cost for the BAP; included in the project design
BAP 13	**Reducing the risk of collision with the power line**	**-**	• No additional cost for the BAP; included in the project design
BAP 14	**Avoiding or reducing the use of local natural resources as much as possible**	**-**	• No additional cost for the BAP; included in the project design
BAP 15	**Revegetation after construction works**	***To be determined***	• Implementation budget to be determined according to the restoration methods chosen and the surface area of the work areas to be revegetated (plan for a minimum budget): ✓ Purchase of seedlings by the EPC from local nurseries ✓ Then plan between 250 to 640 euros / ha for revegetation actions; • Follow-up budget: ✓ Monthly visits (by a botanist) for 5 years to evaluate the effectiveness of re-vegetation measures (use of native species, good recovery of vegetation, absence of invasive alien species).
MITIGATION MEASURES FOR AQUATIC HABITATS AND SPECIES			
BAP 16	**Environmental impoundment of the reservoir**	**-**	• No additional cost for the BAP; included in the project design
BAP 17	**Maintaining an instream flow**	**-**	• No additional cost for the BAP; included in the project design
BAP 18	**Targeted and suitable control of aquatic invasive alien species (IAS) and *Channa maculata* in particular**	***To be determined***	• Implementation budget to be determined according to the control methods chosen (plan for a minimum budget): ✓ staff dedicated to IAS control (mobilization of a team of fishermen) for 35 years; ✓ 4 sessions of fish inventories in the reservoir per year (mobilization of a team of fishermen + experts) - during the first 5 years;

Measure number	Title of the measure	Estimated overall budget (euros-€)	Budget details
			✓ 4 sessions of local population surveys per year - for the first 5 years.
BAP 19	**Installation of out-of-water crossing structures (nozzles, scuppers, culverts) on tributaries and with safeguard fishing measures**	-	• No additional cost for the BAP; included in the project design
BAP 20	**Performing works outside sensitive periods of conservation concern species**	-	• No additional cost for the BAP; included in the project design
COMPENSATION MEASURES			
BAP 21	**Preparation and implementation of a program to restore degraded areas in forests adjacent to the main forest corridor**	***To be determined***	• Implementation budget to be determined according to the restoration choices applied √ Estimation of fixed costs (plantations, nurseries): between Ar. 1 032 300 and Ar.2 640 200 or between **250 and 640 euros per hectare** (Conservation International, 2011), estimate of 400 euros / ha for reforestation over 20 years (GIZ, 2016); √ Estimated additional costs (studies, maintenance): between Ar. 103,500 and Ar. 287,700 per hectare, i.e. between 25 and 70 euros per hectare per year. • Floow up: √ Annual visits (by a botanist) to restoration sites to monitor the effectiveness of the measures; ✓ Conducting annual satellite image analyses to assess the rate of reforestation (to be coupled with the analysis of the deforestation rate in the NPA) during the life of the project.
BAP 22	**Support for the conservation of the natural forests of the Tsinjoarivo NPA**	***To be determined***	• Implementation: The indicative budget is to be secured with the NPA proponent. However, an estimate of $130,000 to $264,000/year is put forward for the operation of the NPA. • Monitoring: budget for annual analysis of satellite imagery to assess the overall effectiveness of NPA in combating deforestation (annual calculation of reforestation/deforestation rate) over the life of the project.
BAP 23	**Support for the conservation of natural forests in the Marolambo National Park**	***To be determined***	• Implementation: the indicative budget is to be secured with the Marolambo National Park, focusing in priority on support for surveillance activities of the MNP in the northern sector (support for joint actions with the gendarmerie, guard posts, travel of forest administration agents, material support to be estimated). • Monitoring: budget for annual analysis of satellite imagery to assess the overall effectiveness of the NPA in combating deforestation (annual calculation of reforestation/deforestation

Measure number	Title of the measure	Estimated overall budget (euros-€)	Budget details	
			rate) over the life of the project.	
SUPPORT MEASURES FOR TERRESTRIAL HABITATS AND SPECIES				**ACCOMP**
BAP 24	**Implementation of targeted monitoring of biodiversity (flora and fauna species triggering critical habitat) over the long term**	***To be determined***	• Budget to be determined	
BAP 25	**Updating IBA inventories with the relevant entity**	***To be determined***	• Implementation: the indicative budget must be secured with Asity (managing association of the IBA). • A first indicative budget of €14,500 is being studied with Asity, the IBA management association. • Follow-up: no extra cost for BAP	
BAP 26	**Public and employee information and awareness program**	**-**	• No additional cost for the BAP; included in the project design	
BAP 27	**Support program for VOI: reforestation in management transfer areas and preservation of ecosystem services.**	**-**	• No additional cost for the BAP; included in the project Resettlement Action Plan (RAP) - to be determined according to the area to be reforested	
BAP 28	**Support for the development of income-generating activities (agriculture and other sectors)**	**-**	• No additional cost for the BAP; included in the project Resettlement Action Plan (RAP)	
SUPPORT MEASURES FOR AQUATIC HABITATS AND SPECIES				
BAP 29	**Deepening of knowledge about *Rheocles wrightae* and *Rheocles sp.*** **Ambatovy**	***To be determined***	• Implementation: ✓ Budget for a genetic study (including field inventories and a laboratory analysis phase) ✓ Budget for field inventory sessions (ADNe + fish inventories) downstream from the dam to study habitats suitable for the species (including significant logistical costs due to difficulties of access to sectors downstream from the dam) ✓ Budget for the drafting of a study report • Follow-up: no additional cost for the BAP.	

Measure number	Title of the measure	Estimated overall budget (euros-€)	Budget details
BAP 30	**Raising awareness of local populations to target the capture of invasive alien species (IAS) rather than endangered species (R. wrightae) and native crayfish.**	***To be determined***	• Implementation: √ Organization of three awareness campaigns per year among the local population (fishermen), throughout the life of the project. √ Indicative budget of € 10000 / year for 35 years • Follow-up: no extra cost for the BAP

Annexes

Annex 1 – Environmental Measures

1 ME1 - Reduction_Dust_Emission

PURPOSE OF MEASURE	
Measure code	REDUCTION_DUST_EMISSION
Title	**Reduce dust emissions, which are a source of nuisance for wildlife**
Type of Measure	Reduction
Critical habitat	YES: Dense humid forest (ERAA1 - 2 - 3)
Activities (impact source)	**During the construction phase:** Construction of access roads, dam, penstock, surge tank, plant and power line installation **<u>During the operation phase</u>:** Infrastructure maintenance work and circulation of transport vehicles (personnel and materials)
Key impacts and risks	**Type:** Indirect **Degree:** MODERATE Indirect impact related to the disturbance and degradation of habitats and wildlife - MODERATE Air pollution will result from the use of hydrocarbon products by project vehicles and from dust emissions along the access roads. This type of impact can affect the biological environment by causing nuisances, especially for wildlife.

IMPLEMENTATION OF THE MEASURE	
Project phase	Construction / Operation
Duration of the measure	Throughout the works and then throughout the operation phase.
Objective	NO NET LOSS
Description of the measure	Watering of tracks and restricting vehicle speed in sensitive areas.

Action plan	During the dry season, tracks and work platforms or facilities (all activity areas with bare ground) will be regularly watered to limit dust emissions. The speed of construction vehicles will be limited to 40km/h on tracks and 15km/h on platforms and installations.
Other related measures	NONE
Implementation constraints	NO
Implementer	During the construction phase: EPC During the operation phase: NEHO
Stakeholders	NONE
Institutional or technical support	NONE
Sustainability guarantee (governance)	NA

MONITORING OF THE MEASURE	
Monitoring arrangements	Road traffic control (vehicle speed) during the works and in the operation phase Visual inspection of dust emissions
Implementation indicators	Recording (GPS or tachometer) and checking speed Record of trail watering activities
Effectiveness indicators	Good visibility for drivers following another vehicle
Monitoring frequency	Daily and ongoing
Monitored by	During the construction phase: EPC During the operation phase: NEHO

ESTIMATED BUDGET	
Cost in euros	No extra cost for the BAP - technical option included in the project design budget

2 ME2 - Reduction_Pollution_Risks

PURPOSE OF THE MEASURE	
Measure code	REDUCTION_POLLUTION_RISKS
Measure title	**Reducing the risk of accidental pollution and maintaining water quality**
Masure type	Reduction
Critical habitat	YES, Dense humid forest (ERAA1 - 2 - 3)
Activities (impact source)	Construction of the access roads, dam, penstock, surge tank and plant Construction activities (concreting, structural work, site water management) Infrastructure maintenance work and circulation of transport vehicles (personnel and materials) Crossing of tributaries encountered by machines in the close study area
Key impacts and risks	**Type:** Direct Indirect impact related to stormwater runoff in construction areas (blockades, site facilities, etc.) - LOW Direct impact related to soil pollution due to machine maintenance activities - LOW Direct impact related to accidental pollutant spills during maintenance activities - STRONG Direct impact linked to the pollution of aquatic environments by the crossing of tributaries encountered by machines - MODERATE

IMPLEMENTATION OF THE MEASURE	
Project phase	Construction / Operation
Duration of the measure	During the construction phase and for the duration of the project (35 years)
Objective	NO NET LOSS

Description of the measure	This measure aims to limit as far as possible the risks or consequences of accidental pollution and degradation of water quality during the construction and operation phases, in particular by setting up risk prevention and rainwater management systems and good site practices.

Action plan	**Before starting works**: Develop a pollutant and spill management plan, taking into account the principles set out in the ESIA - EPC / NEHO **During the construction phase:** Reduce the overall risk of environmental pollution. The site installations will therefore be located outside sensitive areas (flood-prone areas in particular) - EPC Carry out maintenance and refueling of machines in suitable areas to avoid spillage into waterways - EPC As part of initial and subsequent training, train workers in the prevention and management of pollutant spills - EPC Sizing installations supporting hydromechanical and electromechanical equipment to limit the risk of accidents -EPC Sizing storage sites for oil and other petrochemical or chemical products so that direct leakage to the environment without retention is impossible - EPC Construct maintenance and fueling facilities for project vehicles to allow for the containment of accidental leaks and maintenance products. For equipment to be supplied on site, provide the necessary equipment to prevent any hydrocarbon leakage, and train employees in its use -EPC Collecting, evacuating and monitoring hazardous products (drains, etc.); Measures for the treatment of waste water from the base camp **Concerning stormwater (SW) and construction site water management:** Treat stripped soils (caterpillar tracks, creation of furrows, etc.) and protect them as soon as possible (mulch, geotextile, etc.) - EPC; Set up a site sanitation (track, facilities, storage areas). Water collection ditches and merlons will slow down and direct the water to properly sized and regularly maintained treatment and settling devices - EPC; Recover water from washing tools or equipment that have been in contact with concrete or similar products in watertight recovery pits (concrete pits) - EPC; Recover wastewater from site facilities in regularly maintained, watertight settling pits - EPC. **During the operation phase:** Use biodegradable oil for hydromechanical and electromechanical equipment with a risk of uncontrolled leakage into the environment, especially for all parts in direct contact with water.
Other related measures	SUPPORT_ ENVIRONMENTAL_AWARENESS-RAISING
Implementation constraints	NA
Implementer	Construction: EPC Operation: NEHO

Stakeholders	NA
Institutional or technical support	NA
Sustainability guarantee (governance)	NA

MONITORING OF THE MEASURE	
Monitoring arrangements	Water quality control (biological and physico-chemical) in the peripheral areas of the construction site (receiving environment of runoff water)
Implementation indicators	Implementation of pollution risk prevention facilities and rainwater and wastewater treatment facilities in all discharge and risk areas Conducting water quality monitoring measures (volume sampled, equipment used, reference standards, measuring station, frequency etc.).
Effectiveness indicators	Location of points of discharge into the environment (GPS coordinates) and associated measurement points. Compliance with the limit values in the IFC HSE guidelines for water quality discharged into surface waters
Monitoring frequency	Monthly, for the duration of the works Regularly during the operation phase
Monitored by	Construction: EPC Operation: NEHO

ESTIMATED BUDGET	
Cost in euros	No additional cost for the BAP; included in the project design

3 ME3 - Reduction_Erosion_Risks

PURPOSE OF THE MEASURE	
Measure code	REDUCTION_EROSION_RISKS
Measure title	**Minimize erosion risks**
Measure type	**Reduction**
Critical habitat	YES, Onive downstream from the dam (ERAA 4), dense rainforest (ERAA 1 - 2 - 3)
Activities (source impact)	Construction works or installation of infrastructure (roads, base camps, pipeline, etc.): part of the infrastructure (e.g. access roads) crosses areas prone to erosion. The transformation or degradation of the vegetation cover at the building site level Areas left bare after the construction of the infrastructure will be exposed to these erosion risks. Transportation of construction and other materials by project vehicles and machinery: the risks are compounded by increased road traffic flow and climatic risks. The tidal range of the reservoir. Possibly inadequate maintenance of sewerage and drainage networks
Key impacts and risks	**Type:** Direct **Degree:** MODERATE Direct impact related to Habitat loss/degradation/disturbance due to erosion (siltation, pollution) - MODERATE Direct impact related to the disturbance and degradation of habitats, fauna and flora - STRONG; Direct impact related to erosion risks - STRONG The project's footprint has a humid tropical climate characterized by abundant rainfall. In this type of environment, the work to be carried out and the selection of site location can destructure or degrade habitats by generating erosion phenomena. In the event of uncontrolled erosion, especially in a natural habitat, losses of individuals or populations of fauna and flora species will be highly probable.

IMPLEMENTATION OF THE MEASURE	
Project phase	Construction / Operation

Duration of the measure	During the construction phase and for the duration of the project (35 years)
Objective	NO NET LOSS
Description of the measure	This measure aims to limit erosion as much as possible, especially in sensitive environments (steeply sloping environments, river or stream banks) during construction works and vehicle traffic (construction and operation).
Action plan	**Before the works begin**: Submit an earthworks/overburden/embankment management and erosion prevention plan to NEHO for approval, incorporating the principles of ESIA Chapter 5.2.1.2; The responsibility for "Erosion Control" will be assigned to the relevant persons in the EPC team and the plan prepared under the Ero01 action will have to be implemented. **During the works** Areas left bare and susceptible to erosion will have to be gradually restored by means of soil-fixing plants, in the farm site and its surroundings (revegetation of the slopes of access roads, geotextile-type stabilization system, etc.) - see measure BAP 15 - REDUCTION_RE-VEGETATION Slopes (lower and upper) of excavated areas (temporary or permanent) or material disposal sites, if made of materials subject to erosion, shall be constructed with slopes not exceeding 3:2 (H:V). The slopes of the embankments will be interrupted every 4 m high by a berm at least 2 m wide with a peripheral drainage ditch. The circulation of machinery must be minimized by the implementation of a traffic plan limiting the linear extent of the access roads to the works; Install settling ponds for suspended solids in runoff water and filtration modules in runoff water collection networks before discharging water into the natural environment; Minimize cut / fill volumes and distances between borrow areas and the work area (to limit transport-related impacts); Ensure that the geotechnical structure of the access roads is adapted to the weight of the construction machines in order to avoid track deterioration and the associated risks of soil erosion (especially in the rainy season); Erosion prevention devices will be designed and constructed in erosion-sensitive areas (steep slope areas, especially on the access road between the dam and the plant). They include lightweight retaining devices, the sewerage system, or the installation of retaining walls in the most sensitive areas. **During the construction and operation phases:** Dry crossings on all watercourses will have to be set up for the passage of construction vehicles or equipment; Areas for the final disposal of surplus materials in order to facilitate their integration into the landscape will need to be properly shaped.
Other related measures	

	SUPPORT_ENVIRONMENTAL_AWARENESS-RAISING
Implementation constraints	NA
Implementer	Construction: EPC Operation: NEHO
Stakeholders	NA
Institutional or technical support	NA
Sustainability guarantee (governance)	NA

MONITORING OF THE MEASURE	
Monitoring arrangements	Visual inspection and in-situ measures
Implementation indicators	Implementation of actions indicated in the erosion risk management plan Number of control points and frequency of monitoring
Effectiveness indicators	Area of eroded habitats (not revegetated and prone to erosion with loaded runoff)
Monitoring frequency	Monthly during construction
Monitored by	Construction: EPC Operation: NEHO

ESTIMATED BUDGET	
Cost in euros	No additional cost for the BAP; included in the project design

4 ME4 - Waste_Reduction

PURPOSE OF THE MEASURE	
Measure code	WASTE_REDUCTION
Title	**Collecting, treating and managing waste**
Measure type	**Reduction**
Critical habitat	YES, dense rainforests
Activities (impact source)	**During the construction phase;** All project construction activities All activities related to construction works: machinery maintenance, temporary or permanent storage of equipment or materials, workers' camps, construction site areas, etc. **During the operation phase;** The presence of personnel and operating activities.
Key impacts and risks	**Type:** Direct **Degree:** MODERATE Direct impact related to the disturbance and degradation of habitats, fauna and flora - MODERATE **During the construction phase;** Waste will be generated during the works. This waste may be solid, liquid or gaseous. Solid waste is the household waste generated by project personnel or workers, residues of materials used and others. Liquid waste includes waste water, waste oil and hydrocarbons, while gaseous waste is waste emitted by the machinery, vehicles and equipment used by the project. This waste is harmful to fauna and flora and will contribute significantly to the degradation of the quality or integrity of essential and critical natural habitats. **During the operation phase;** All kinds of waste will be produced during the operation phase. This includes household waste produced in the base camps and by project staff and waste due to production work and infrastructure maintenance. The uncontrolled generation and release of such waste into the natural environment would contribute to the degradation of the natural environment and could affect the health of fauna and flora species, including endangered species.

IMPLEMENTATION OF THE MEASURE	
Project phase	Construction / operation
Duration of the measure	During the construction phase and for the duration of the project (35 years)
Objective	NO NET LOSS
Description of the measure	
Action plan	**<u>During the construction phase;</u>** A plan for the collection, treatment and management of liquid and solid waste will be developed and implemented, taking into account the three principles set out in the ESIA (avoiding the uncontrolled spread of pollutants, compliance with Malagasy standards, compliance with IFC recommendations). During initial and further training, workers will be made aware of solid and liquid waste management. Waste collection (record keeping) and effluent quality will be subject to internal monitoring. **<u>During the operation phase;</u>** A waste management plan will be developed and implemented, taking into account the waste management hierarchy (reduce, recycle, compost, landfill), and distinguishing between: Domestic waste from the operating city and staff. Organic waste (floating wood, water hyacinths). Industrial waste resulting from operation and maintenance activities.
Other related measures	SUPPORT_ ENVIRONMENTAL_AWARENESS-RAISING
Implementation constraints	Accessibility of the site
Implementer	Construction: EPC Operation: NEHO
Stakeholders	NONE
Institutional or technical support	NA
Sustainability guarantee (governance)	NA
Illustration	NO

MONITORING OF THE MEASURE	
Monitoring arrangements	Monitoring of the quantity of waste generated / treated
Implementation indicators	Waste management plan operational, approved and implemented.
Effectiveness indicators	Quantity of waste treated / waste generated by type of waste
Monitoring frequency	Monthly
Monitored by	EPC construction Operation: NEHO

ESTIMATED BUDGET	
Cost in euros	No additional cost for the BAP; included in the project design

5 ME5 - Reduction_Noise_Pollution

PURPOSE OF THE MEASURE	
Measure code	REDUCTION_NOISE_POLLUTION
Measure title	**Definition and implementation of a procedure for noise pollution**
Measure type	Reduction
Critical habitat	YES, dense humid forest
Activities (source impact)	**During the construction phase**: All construction-related activities requiring noisy equipment or noisy techniques. **During the operation phase**: Activity at the production plants or in base camps and vehicle traffic.
Key impacts and risks	**Type**: Direct **Degree**: LOW Direct impact related to disturbance of wildlife by noise - LOW

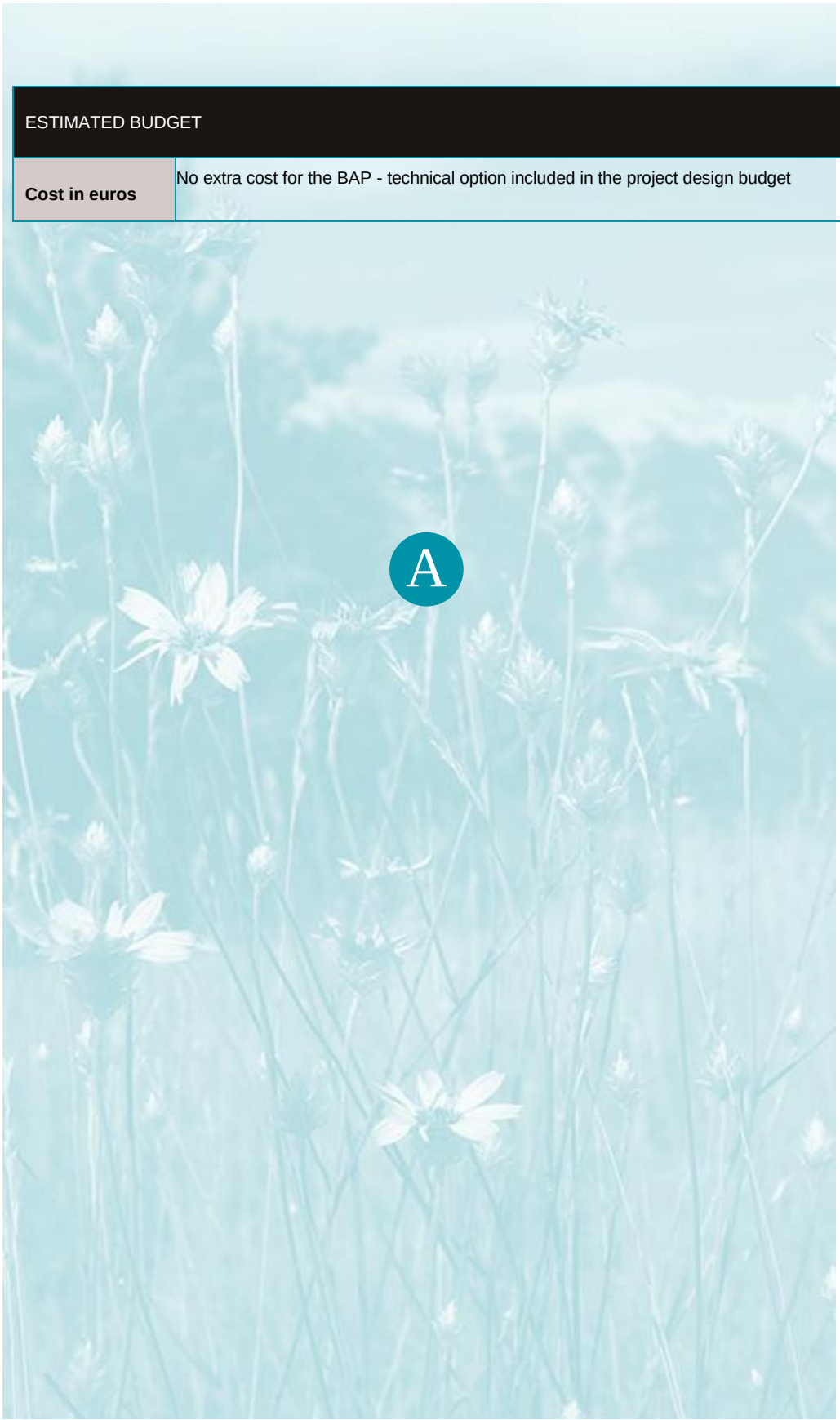
IMPLEMENTATION OF THE MEASURE	
Project phase	Construction
Duration of the measure	During the construction phase (5 years)
Objective	NO NET LOSS
Description of the measure	The objective of the measure is to limit noise in the area of the forest corridor that is most sensitive (between the construction site dam/upstream portal and the surge tank construction site).
Action plan	Do not use explosives in open areas at night (the use of explosives at night in the tunnel is permitted). Limit the speed of the machines to 15km/h as much as possible on the working platforms or in the installations and 40km/h on the tracks during the day. Do not travel at night (from 8:00 p.m. to 6:00 a.m.) in the forest corridor (between the construction site dam/upstream portal and the surge tank construction site).
Other related measures	REDUCTION_PRESERVATION_CONTINUUM (road traffic control on the road between the dam and the plant)
Implementation constraints	NONE
Implementer	EPC (environmental coordinator)
Stakeholders	NONE
Institutional or technical support	NONE
Sustainability guarantee (governance)	NA

MEASURE MONITORING	
Monitoring arrangement	Monitoring compliance with noise regulations
Implementation indicators	Compliance with noise abatement measures
Effectiveness	Compliance with noise abatement measures
Monitoring frequency	Ongoing
Monitored by	EPC (environmental coordinator)

Indicative budget of € 10000 / year for 35 years

Assessment of Critical Habi

ESTIMATED BUDGET	
Cost in euros	No extra cost for the BAP - technical option included in the project design budget



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Annex 2- Mitigation Measures Targeting Terrestrial Habitats and Species

BAP 1 - Avoidance_Natural_Habitats_Before_Belanitra

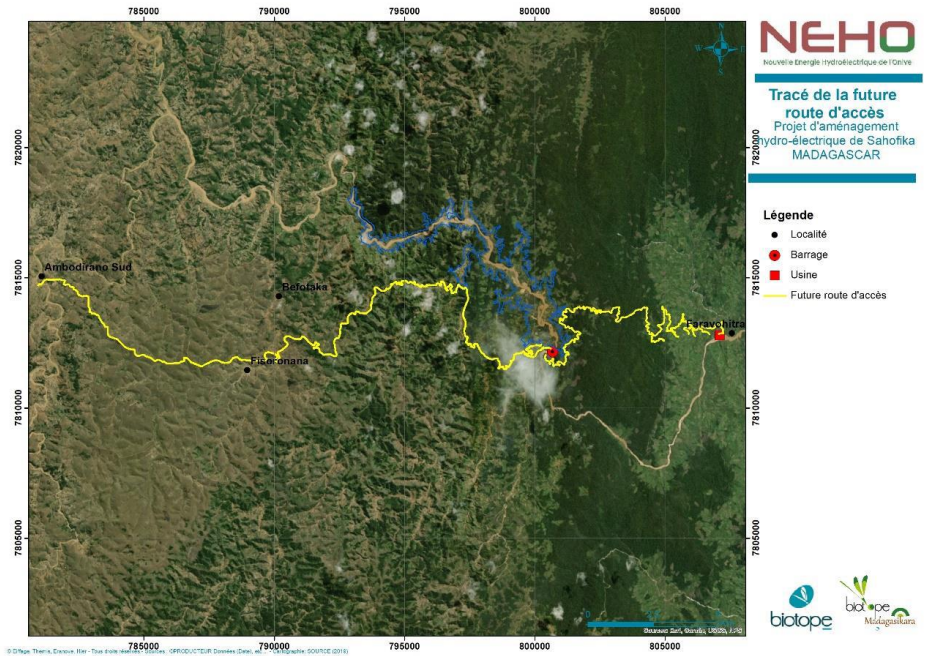
Measure code	AVOIDANCE_NATURAL_HABITATS_BEFORE_BELANITRA
Measure title	**Maximum avoidance of natural and critical habitats during the final implementation of the project between Antanifotsy and Belanitra.**
Measure type	Avoidance
Species concerned	No critical species impacted by the project
Critical habitat	NONE
Activities (impact source)	• Construction of the access roads to the surge tank and the plant and the power line
Key impacts and risks	• **Type:** Direct • **Degree:** LOW There are no protected areas or natural habitats in this area. However, there are erosion issues. • Direct impact related to the disturbance and degradation of habitats, fauna and flora - LOW; • Direct impact related to erosion risks - STRONG

Project phase	

Annex 2- Mitigation Measures Targeting Terrestrial Habitats and Species

	Construction
Duration of the measure	During the entire construction period of the access road and the HV line
Objective	NO NET LOSS
Description of the measure	Concerning roads (main roads or access roads to pylon construction points), in order to avoid the creation of new tracks in this area, the decision was taken to use existing tracks to the maximum, rehabilitating them where necessary. Limitation of the project's footprint on community afforestation and erosion.
Geographical area	• Project section between Antanifotsy and Belanitra (access road and HV line)
Action plan	• Avoid eucalyptus and pine plantations used by the populations. • Use existing roads (main or access roads to tower construction points) as much as possible by rehabilitating them.
Other associated measures	• Feasibility mission for the track Belanitra-Dam-plant & installation sites, BIOTOPE MG December 2019
Implementation constraints	NONE
Implementer	• EPC (environmental coordinator)
Stakeholders	NONE
Institutional or technical support	NA
Sustainability guarantee (governance)	NA

Annex 2- Mitigation Measures Targeting Terrestrial Habitats and Species

Illustration	

Monitoring arrangements	• Monitoring of the cumulative area of impacted afforestation
Implementation indicators	• Observance of the implementation of infrastructure to avoid afforestation areas
Effectiveness indicators	• Afforestation area (pine, eucalyptus)
Monitoring frequency	• Monthly, for the duration of the works
Monitored by	• EPC (Environmental Coordinator)

Cost in euros	• No additional cost for the BAP; included in the project design

BAP 2 - Avoidance_Natural_Habitats_Belanitra_Dam

Annex 2- Mitigation Measures Targeting Terrestrial Habitats and Species

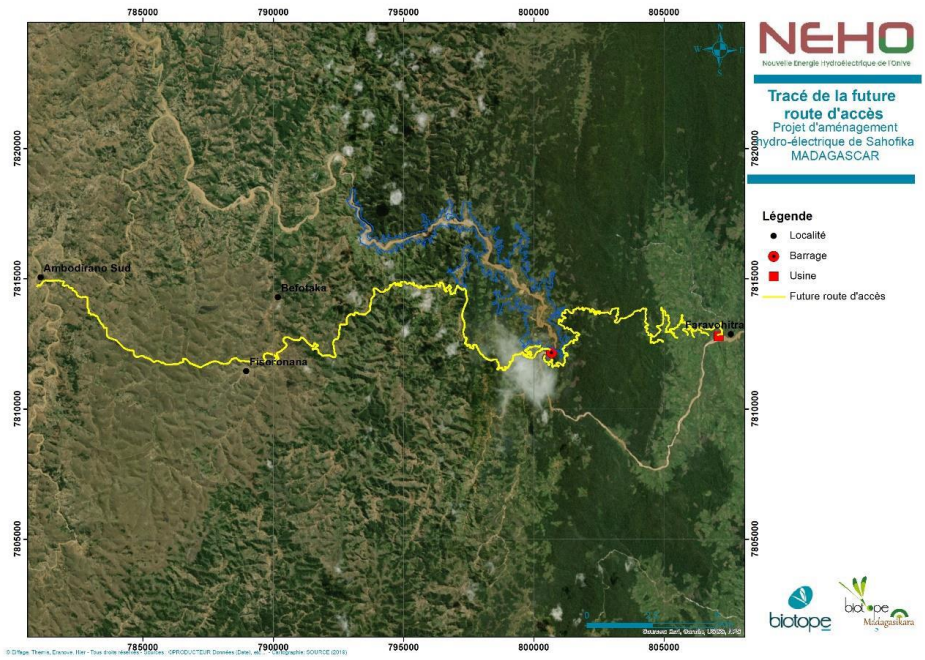
Measure code	AVOIDANCE_NATURAL_HABITATS_BELANITRA_DAM
Measure title	**Maximum avoidance of natural and critical habitats during the final implementation of the project between Belanitra and the dam (construction of the access road and HV line).**
Measure type	Avoidance
Critical habitat	YES, natural forest fragments
Activities (impact source)	• The Project will build the transmission line, but also an access road to the dam, since there is no passable track here.
Key impacts and risks	• **Type:** Direct • *Degree:* • Direct impact related to habitat loss/degradation/disturbance The access road crosses the protection zone (buffer zone) of the Marolambo Park. It is sparsely populated, but there are natural wooded areas (their number increases towards the east, as it approaches the forest corridor) and the forested areas managed by the populations.

Project phase	Construction
Duration of the measure	During the entire construction period of the access road and the HV line
Objective	NO NET LOSS
Description of the measure	The principle adopted for this area is to adopt a layout and design of the line and road that avoids wooded areas as far as technically possible, with the involvement of the VOI. This measure should ensure compliance with the regulations governing the footprint of work areas (temporary infrastructure, material storage areas, cut and fill areas, but also storage areas for wood obtained through deforestation).

Annex 2- Mitigation Measures Targeting Terrestrial Habitats and Species

Geographical area	• Project area between Belanitra and the dam (access road and HV line)
Action plan	• Adopt a layout and design of the line and the road that avoids wooded areas as much as technically possible, with the involvement of the VOI; • The Onive River crossing structure at the main dam will be a permanent bridge (the crest of the dam is not intended to be used as a traffic lane); • Introduction of a system of penalties by the EPC for employees who do not observe the footprints (destruction of natural forest beyond the ~216 hectares planned).
Other associated measures	• Feasibility mission for the track between Belanitra-Dam-plant & installation sites, BIOTOPE MG December 2019 • COMPENSATION_SUPPORT_MAROLAMBO_NPA • SUPPORT_ ENVIRONMENTAL_AWARENESS-RAISING
Implementation constraints	NONE
Implementer	• The EPC (Environmental Coordinator) is responsible for the correct implementation of the avoidance measure. • The interface with the various stakeholders such as the VOIs concerned and the Marolambo park, on the other hand, is provided by NEHO.
Stakeholders	• Involvement of VOIs for the avoidance of natural afforestation: the VOI of Fisoronana in particular • Marolambo National Park (crossing the buffer zone of the park) for the management of impacts linked to population influxes (increased land clearing) - see COMPENSATION SUPPORT_PN_MAROLAMBO
Institutional or technical support	• Ecological expert for site monitoring
Sustainability guarantee (governance)	NA

Annex 2- Mitigation Measures Targeting Terrestrial Habitats and Species

Illustration	

Monitoring arrangements	• Follow-up of surfaces cleared during the works
Implementation indicators	• Observance of the chosen route (with maximum avoidance of wooded areas and natural habitats)
Effectiveness indicators	• Area of natural forest cleared
Monitoring frequency	• Monthly, for the duration of the works
Audit	**NO**
Monitored by	• EPC (Environmental Coordinator)

Cost in euros	• No additional cost for the BAP; included in the project design

BAP 3 - Avoidance_Natural_Habitats_Dam_Plant

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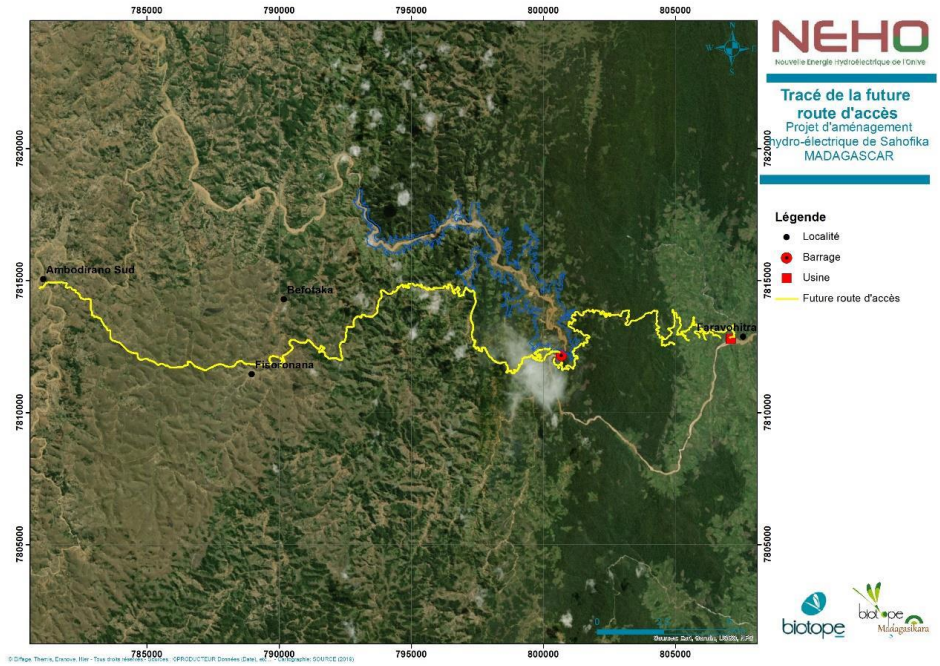
Measure code	AVOIDANCE_NATURAL_HABITATS_DAM_PLANT
Measure title	**Maximum avoidance of natural and critical habitats during the final implementation of the project between the dam and the plant (access road and power line).**
Measure type	Avoidance
Critical habitat	YES, dense humid forest
Activities (impact source)	The Project will build the transmission line and an access road from the hydropower plant to the dam in this area, since only pedestrian access is currently available. This area crosses the forest corridor, which is very rich in biodiversity. It is almost unpopulated and is mostly covered with forests that are home to species of flora and fauna of great interest.
Key impacts and risks	• **Type:** Direct • **Degree:** HIGH • Direct impact related to the disturbance and degradation of habitats, fauna and flora - STRONG; • Direct impact linked to erosion risks - STRONG linked to the crossing of 10 tributaries of the Onive in the heart and periphery of the forest massif. • Direct impact (footprint) on forested terrestrial natural habitats

Project phase	Construction
Duration of the measure	During the entire construction period for the access road and the HV line
Objective	NO NET LOSS
Description of the measure	This measure aims to adopt a layout and design of the transmission line and the access road between the dam and the plant that avoids natural habitats as far as technically possible, in particular by maximizing the use of areas already deforested.
Geographical area	• Project area between the dam and the plant (access road and HV line) passing through

	the forest corridor (critical habitats)
Action plan	The principles retained for this area are as follows: • The service line and communication networks will be in a position to use the waterway gallery and therefore both infrastructure will be able to avoid impacts; • The selected route is the one that minimizes environmental impacts by using the areas already impacted and avoiding the creation of a new access roads in addition to the existing footpath (see the multi-criteria analysis of route options between the plant and the dam presented in the ESIA); • The selected route is 21 km long. The access road will reach an altitude of up to 1,500 m altitude with a 4 km section between 1,400 and 1,500m. The selected route presents, as it stands, certain steeply sloping sectors that may present risks of erosion. These erosion-sensitive sectors will need to be subject to erosion risk prevention and specific control measures (see measure ME2 - Reduction_risk_erosion); • With this option the transmission line will be buried for 1.6 km, where the selected route crosses the widest part of the forest.
Other associated measures	• Feasibility mission for the track route between Belanitra-Dam-plant & installation sites, BIOTOPE MG December 2019 • AVOIDANCE_OF_TRIBUTARY_FRONTS • REDUCTION_EROSION_RISKS
Implementation constraints	• The selected route presents a road safety issue (due to the long descent from the top of the escarpment to the plant). • This route presents major problems related to the soil and the risk of erosion due to escarpment (shorter and steeper route) and the passage of tributaries (approximately 10 tributaries of the Onive River crossed in the heart and periphery of the forest massif). It will be necessary to ensure the correct application of the ME3 measures - Reduction_erosion_risks and BAP 19 • -Tributary_Franking_Reductions
Implementer	• EPC (Environmental Coordinator)
Stakeholders	• The proponent of the future NPA, consulted on the selection of the final route
Institutional or technical support	• Ecological expert for site monitoring
Sustainability guarantee (governance)	NA

This route presents major problems related to the soil and the risk of erosion due to escarpment (shorter and steeper route) and the passage of tributaries (approximately 10 tributaries in the Onive River crossed in the heart and

Illustration	

Monitoring arrangements	• Monitoring of surfaces cleared during the works
Implementation indicators	• Compliance with the route chosen for the access road between the dam and the plant
Effectiveness indicators	• Area of natural forest cleared
Monitoring frequency	• Monthly, for the duration of the works
Monitored by	• EPC (Environmental Coordinator)

Cost in euros	• No additional cost for the BAP; included in the project design

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BAP 4 - Avoidance_Natural_Habitats_temporary_Infrastructure

PURPOSE OF MEASURE	
Measure code	AVOIDANCE_NATURAL_HABITATS_TEMPORARY_INFRASTRUCTURE
Measure title	**Maximum avoidance of natural and critical habitats during the final installation of the project in relation to or permanent infrastructure.**
Measure type	Avoidance
Critical habitat	YES, fragments of natural forests
Activities (impact source)	• Temporary infrastructure: main infrastructure located near the village of Faravohitra, offices and base camp, supply platform, temporary platform at the dam (BCR manufacturing plant, concrete plant), access to the construction site, borrow and excavation area;
Key impacts and risks	• **Type:** Direct • **Degree:** LOW • Habitat loss/degradation/disturbance • The footprint of temporary and permanent infrastructure outside the reservoir is not known (ESIA).

Project phase	Construction
Duration of the measure	During the entire construction period of the access road and the HV line
Objective	NO NET LOSS
Description of the measure	To minimize impacts on natural habitats, as well as resettlement requirements, most temporary infrastructure, especially borrow sites, will be located within the future flooded area or on already degraded footprints (avoid natural habitats and farmlands under cultivation, give preference to bare lands, savannahs or fallow areas).
Geographical area	• Temporary work areas located in the forest corridor (critical habitats)

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Action plan	• Use the future reservoir's footprint as much as possible for temporary infrastructure and extraction sites (without exposing the sites to flooding from the Onive River); • **At the dam, outside the reservoir area**:
Other associated measures	• REDUCTION_EROSION_RISKS • REDUCTION_RE-VEGETATION
Implementation constraints	NA
Implementer	• The correct application of the avoidance measure is the responsibility of the EPC (Environmental Coordinator). • The interface with the NPA manager is managed by NEHO.
Stakeholders	• Sponsor or manager of the future NPA
Institutional or technical support	• Ecological expert for site monitoring
Sustainability guarantee (governance)	• For the implementation of temporary or permanent infrastructure not yet defined, select the sites by associating environmental and social experts. • Raising staff awareness
Illustration	**TEMPORARY INFRASTRUCTURE LOCATION MAP (see feasibility mission for the track route between Belanitra-Dam-plant & installation sites, BIOTOPE MG December 2019)**

Monitoring arrangements	• Monitoring of areas cleared during the works
Implementation indicators	• Observance of the location of temporary work areas
Effectiveness indicators	• Area of natural forest cleared
Monitoring frequency	• Monthly, for the duration of the works
Monitored by	• EPC (Environmental Coordinator)

Cost in euros	• No additional cost for the BAP; included in the project design

BAP 5 - Reduction_Preservation_Continuum

Measure code	REDUCTION_PRESERVATION_CONTINUUM
Measure title	**Measures to preserve the ecological continuum for wildlife**
Measure type	Reduction
Critical habitat	YES, dense humid forest
Activities (impact source)	• Construction of linear infrastructure (power line and access road) between the dam and the plant • Deforestation, land use change and vehicle noise
Key impacts and risks	• **Type:** Direct • **Degree***:* • Fragmentation of the forest corridor and disruption of the ecological continuum

Project phase	Construction / Operation
Duration of the measure	Throughout the works and then throughout the operation phase.
Objective	NO NET LOSS
Description of the measure	Linear infrastructure (access line and track) between the dam and the plant may alter genetic connectivity for fauna and flora. This risk is highly variable depending on the species and their ecology and depends on several factors such as the physical interruption of the forest continuum caused by deforestation, changes in land use, or vehicle noise. This risk has already been reduced by the decision to locate the linear infrastructure in the the most impacted, deforested and frequented part of the forest corridor. Complementary measures are adopted to best address the fragmentation of the forest corridor within the framework of the Project.

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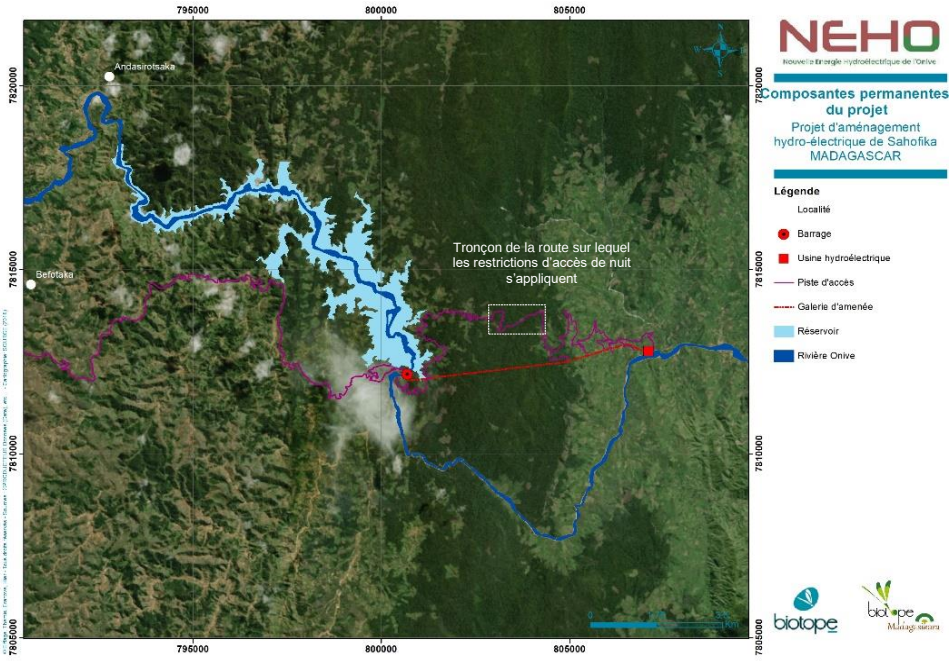
Geographical area	• Forest corridor
Action plan	***In the construction and operation phases:*** • Night traffic (between 8:00 p.m. and 6:00 a.m. during the construction phase, between 7:00 p.m. and 7:00 a.m. during the operation phase) in the forest corridor (between the construction site dam/upstream portal and the surge tank construction site) will be prohibited for scheduled or regular construction site activities, and will be reserved for emergencies and exceptional circumstances approved by NEHO (traffic between the surge tank construction site and the hydropower plant construction site will be permitted). • Barriers and guard posts will be set up at the ends of the forest area where traffic is prohibited.  ***Location of infrastructure:*** • The transmission line will be buried over 1.6 km, where the selected route crosses the largest width of forest (exact positioning to be confirmed in the detailed study phase); • The width of the tracks (rolling strip) will be limited to 5 m in wooded areas (excluding bends and crossing areas); • Fencing of construction areas will be limited to what is strictly necessary. ***Installation of walled bridges in the section of the road crossing the forest corridor*** • To preserve ecological connectivity on both sides of the access road between the dam and the plant (in the section crossing the heart of the forest corridor), it is proposed to install bridges at the walls (see feedback from the Ambatovy project, 2011 on two types of bridges)

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	 *Propihtecus diadema* crossing pipeline - Right-of-Way type bridge (Mass et al., 2011)  *Eulemur fulvus* crossing mine area type bridge. (Mass et al., 2011) ***Source**: Mass, V., Rakotomanga, B., Rakotondratsimba, G., Razafindramisa, S., Andrianaivomahefa, P., Dickinson, S., ... & Cooke, A. (2011). Lemur bridges provide crossing structures over roads within a forested mining concession near Moramanga, Toamasina Province, Madagascar. Conservation Evidence, 8, 11-18.*
Other associated measures	• AVOIDANCE_NATURAL_HABITATS_DAM_Plant
Implementation constraints	
Implementer	• Construction: EPC • Operation: NEHO
Stakeholders	• The proponent of the future NPA
Institutional or technical support	NO
Sustainability guarantee (governance)	• Coordinated management with the proponent of the future NPA

MEASURE IMPLEMENTATION MONITORING	
Monitoring arrangements	• Road checks at night
Implementation	• Implementation of the access control system (in the forest corridor)

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indicators	
Effectiveness indicators	• Number of vehicles crossing the corridor at night
Monitoring frequency	• Daily
Monitored by	• Construction: EPC • Operation: NEHO

ESTIMATED BUDGET	
Cost in euros	• Cost of setting up lemur bridges and trap cameras

BAP 6 - Reduction_Works_Planning

PURPOSE OF MEASURE	
Measure code	REDUCTION_WORKS_PLANNING
Measure title	**Performing works outside the sensitive periods of conservation concern species**
Measure type	Reduction
Critical habitat	YES, dense humid forest
Activities (impact source)	• Construction of linear infrastructure (power line and access road) between the dam and the plant • Deforestation and earthworks for the surge tank and the plant
Key impacts and risks	• **Type:** Direct • **Degree:** HIGH • Direct impact related to the disturbance and degradation of habitats, fauna and flora • The risk of mortality of conservation concern wildlife species through the destruction of nests or hibernating specimens.

Project phase	Construction
Duration of the measure	During the construction phase (5 years)
Objective	NO NET LOSS
Description of the measure	To reduce the risks of destruction and disturbance of individuals of certain species of fauna, it is advisable to carry out clearing and earthworks within the forest corridor (dense rainforest identified as critical habitat for the project) outside the sensitive periods of high conservation concern terrestrial species: Amphibians, reptiles, lemurs (in particular dwarf lemurs hibernating on the ground or in tree cavities). The schedule (**Table 29 - below**) shows the sensitive periods of the high conservation

	concern species for the project and the deforestation and earthworks strategy to be adopted accordingly by the builder.
Geographical area	• Applicable in particular for work in the forest corridor
Action plan	✓ With regard to the species sensitivity timeline, the strategy of actions to be adopted by the manufacturer for deforestation and earthmoving activities is as follows: • Carry out deforestation actions between March and May (see timeline presented in Table 29 below) following the good deforestation practices presented in measure BAP 7 - Sensible_Deforestation • In deforested areas, pendings earthworks, it is advisable to maintain activities that generate unsuitable conditions for the high conservation concern species (amphibians, reptiles, lemurs) in order to avoid their installation for hibernation prior to the works. ✓ Limiting vegetation as much as possible by gentle clearing actions on sectors suitable for amphibians and reptiles (always towards the outside of the plot to allow fauna to move way). ✓ Removing all residues (stumps, trunks, crushed plant material) that can be used as a refuge by small wildlife. Ongoing maintenance of earthwork areas by brushcutting if the earthworks cannot be carried out immediately after the first brushcutting.
Other associated measures	• BAP 19 - AVOIDANCE_CROSSING_TRIBUTARIES;
Implementation constraints	
Implementer	• EPC (Environmental Coordinator)
Stakeholders	NA
Institutional or technical support	NA
Sustainability guarantee (governance)	NA

MEASURE IMPLEMENTATION MONITORING	
Monitoring arrangements	• Environmental site coordination and monitoring of the deforestation schedule before excavation: during deforestation, the dates are recorded and compared with the periods of sensitivity to deforestation. • Follow-up of actions to maintain unsuitable conditions between deforestation and earthworks
Implementation indicators	• All deforestation works on the site are carried out between March and May (the least sensitive period for wildlife).
Effectiveness indicators	• Number of individuals (small fauna + lemurs) destroyed during deforestation phases • Number of individuals resettled (small fauna + lemurs) on the deforested and cleared areas before earthworks
Monitoring	

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frequency	Monthly during deforestation and earthwork phases
Monitored by	EPC (Environmental Coordinator)

ESTIMATED BUDGET	
Cost in euros	• No extra cost for the BAP - technical option included in the project design budget

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Table 29. Sensitivity Timeline for Conservation Concern Species

High conservation concern species group	Period	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
		RAINY SEASON				DRY SEASON						RAINS	
Lemurs	**Breeding**							SENSITIVITY PEAK					
	Hibernation *Known phenomenon for the dwarf lemurs of the Cheirogaleidae genus (fat storage in the tail, which can hibernate for several months without food supply).*												
Eupleridae	**Breeding**												
Amphibians	**Breeding**												
Reptiles	**Breeding**												
Birds	**Breeding** *Highly varied breeding season for species triggering critical habitat*												
STRATEGY FOR WORK PLANNING IN THE FOREST CORRIDOR													
COUPE DES ARBRES (sur la partie boisée du corridor forestier)													
MAINTIEN DES CONDITIONS DÉFAVORABLES AU RETOUR DES ESPECES HIBERNANTES OU NICHEUSES AVANT TERRASSEMENT **MAINTENANCE OF CONDITIONS THAT ARE UNSUITABLE FOR THE RETURN OF HIBERNATING OR NESTING SPECIES BEFORE EARTHWORKS**													

Legend:

Sensitivity peak; Sensitive period of the species (breeding, hibernation)

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BAP 7 - Reduction_Sensible_Deforestation

PURPOSE OF MEASURE	
Measure code	REDUCTION_SENSIBLE_DEFORESTATION
Measure title	**Reduction of habitat loss and the destruction of individuals (flora and fauna) through the implementation of rational land clearing**
Measure type	**Reduction**
Critical habitat	YES, dense humid forest
Activities (impact source)	• Construction and operation of the access roads, dam, penstock pipe, surge tank, and plant
Key impacts and risks	• **Type:** Direct • *Degree:* • Direct impact related to the destruction of individuals of fauna and flora - STRONG • Direct impact related to wildlife emigration - STRONG **Flora:** Several endangered plant species found in the extended study area may be found on the sites of access and/or location of infrastructure and associated activities. Land clearing may result in the disappearance of individuals or a population of these threatened species. **Wildlife:** Clearing vegetation could kill animals with limited mobility (small mammals, chameleons, lizards, amphibians), juveniles (chicks) or animals with restricted home ranges.

Project phase	Construction
Duration of the measure	During the construction phase (5 years)
Objective	NO NET LOSS
Description of	This measure aims to minimize as much as possible the project's deforestation

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the measure	requirements (total footprint of the areas to be deforested) and to minimize impacts on flora and fauna, through the application of good practices at each stage of deforestation.
Geographical area	Forest Corridor
Action plan	**<u>Minimization of land clearing footprint</u>** • Minimize land clearing and minimize the project's footprint • Avoid fragmentation of forest fragments to maintain ecosystem balance and respect the ecological integrity of protected species. • Where land clearing cannot be avoided or reduced, put in place measures to ensure conservation of fauna and flora species. • Integrate deforestation and the management of timber cut in footprints with authorized works; • Provide for a controlled procedure for the recovery of wood from deforestation actions for the benefit of the communities; • Introduction, by the EPC, of a system of penalties for employees in the event of failure to observe the footprint; **<u>Concerning plants</u>** • Precise identification of high conservation concern plant species prior to any work and their precise location by a botanist before any clearing. • Adaptation of footprints and impacting activities to the maximum extent possible or relocation of the specimens concerned to avoid damaging them. • Prior to any deforestation and work, implement actions to protect threatened flora (meeting critical habitat criteria), distinguishing between species: ✓ that should be **avoided** as much as possible (marking of plants to be avoided); ✓ that can be **collected and moved** (for species whose movement is controlled); ✓ that can reproduce in the **nursery;** • The project's environmental coordination system will have to provide for regular procedures for monitoring compliance with footprints and a system of sanctions by the EPC in the event of non-compliance with avoidance measures by employees; **<u>Concerning wildlife</u>** • Comply with the implementation schedule for deforestation and then earthworks (peak hibernation periods for species and/or bat/bird/lemur nesting) - see BAP 6 - reduction_works_planning; • Plan a prior active research of conservation concern fauna before any clearing with a team of herpetologists for amphibians and reptiles; • Collect and relocate small conservation concern fauna species (amphibians / reptiles) before clearing any land; • Large trees identified as food supports (frugivorous species) and lemur dormitories should not be cut down. These trees will be easily recognizable by the abundance of seedlings and the presence of excrement, and must therefore be spotted when linear infrastructure is installed; • Avoid clearing land with active nests of high conservation concern birds. Establish a procedure for sequenced deforestation prior to the final implementation of

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	infrastructure crossing the forest corridor and provide for a prior scaring procedure to allow wildlife to flee and holding down of cuts to give wildlife time to retreat: (i) felling trees, then (ii) leaving 24 hours for the residual fauna to flee (especially reptiles, such as chameleons, entomofauna), then (iii) Finalization of the deforestation operation and cleaning of the area with storage of the vegetation collected on the edges of the footprints for crushing or composting (no burning). **<u>Good practices during maintenance operations under the HV line</u>** • Implement good practices for maintenance actions under the HV line between the dam and the plant -(NEHO/Jirama) Share these good practices with Jirama, the company responsible for the maintenance of the HV line on the section of the dam up to Antanifotsy.
Other associated measures	• NO
Implementation constraints	NONE
Implementer	• EPC during the construction phase
Stakeholders	NONE
Institutional or technical support	• Ecological experts for the visit prior to deforestation or earthworks (a botanist, a wild life expert)
Sustainability guarantee (governance)	NA

Monitoring arrangements	• Monitoring of the major stages of deforestation (identification of conservation concern flora/fauna, deforestation, clearing before earthworks, etc.). • Monitoring of cleared footprints
Implementation indicators	• The dates of the major stages of deforestation (identification of species, deforestation, management of cut wood, clearing of areas for earthworks, etc.) are recorded. • During deforestation, dates are recorded and compared to periods of deforestation sensitivity.
Effectiveness indicators	• Deforested areas
Monitoring frequency	• Weekly for the duration of the deforestation operations

Monitored by	• EPC during the construction phase

Cost in euros	• No additional cost for the BAP; included in the project design

BAP 8 - Reduction_Crushing_Wildlife

Measure code	REDUCTION_CRUSHING_WILDLIFE
Measure title	**Minimizing the risk of wild animals being crushed**
Measure type	Reduction
Critical habitat	YES, dense humid forest
Activities (impact source)	• Vehicle traffic between the dam and the plant
Key impacts and risks	• Impacts on wildlife species of conservation concern between the dam and the plant

Project phase	Construction / Operation
Duration of the measure	During the construction phase and for the duration of the project (35 years)
Objective	NO NET LOSS

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Description of the measure	This measure is intended to minimize the risk of wild animals being crushed during the entire construction and operation phase of the project (35 years).
Action plan	• Plan an active search for amphibians and reptiles and re-establishment before deforestation/grazing carried out outside the hibernation period (by a team of herpetologists). **Regulation / control of traffic on the construction site** • Regulate traffic between the dam and the plant in coordination with the proponent of the future NPA and after consultation with the local population (the road is not open to all); • Restrict nighttime traffic to limit disturbance to nocturnal species. *The limitation of night traffic during the construction phase only concerns the section of the road crossing the forest corridor (see map below), and also concerns construction activities in this area. Access to the surge tank can be done at night.* • Apply a speed limit of 40 km/h between the dam and the plant; • Sensitize and train drivers in the removal of wildlife species from traffic lanes. • Plan work outside sensitive periods for conservation status wildlife (breeding, hibernation).
Other associated measures	• BAP 5 - REDUCTION_PRESERVATION_CONTINUUM • BAP 6 – REDUCTION_WORKS_PLANNING
Implementation constraints	NON
Implementer	• NEHO
Stakeholders	NONE
Institutional or technical support	NONE
Sustainability guarantee (governance)	• Consultation with the manager of the future NAP and the populations (the road is not open to all)

MEASURE IMPLEMENTATION MONITORING	
Monitoring arrangements	• Tracking and georeferencing of areas where animals were crushed (training/raising awareness of drivers)
Implementation indicators	• Monitoring compliance with traffic restrictions on the construction site (compliance with speed limits and night traffic restrictions in the corridor)
Effectiveness indicators	• Number of vertebrates crushed by construction machines or other vehicles and identification of species
Monitoring frequency	**Daily**
Monitored by	

	NEHO

ESTIMATED BUDGET	
Cost in euros	• No additional cost for the BAP; included in the project design

BAP 9 - IAS-Terrestrial_Flora_Control

Measure code	IAS-TERRESTRIAL_FLORA_CONTROL
Measure title	**Addressing the introduction and spread of invasive alien flora species**
Measure type	Reduction
Critical habitat	YES, dense humid forest
Activities (impact source)	• Construction of access roads, dam, penstock, surge tank, plant and power line installation • Soil exposure, land clearing, soil stripping, fire, transportation and transfer of material, tools and vehicles
Key impacts and risks	• **Type**: direct • **Degree**: MODERATE • Direct impact related to the introduction and proliferation of IAS (terrestrial flora) - MODERATE

•	
Project phase	Construction / Operation
Duration of the measure	During the entire construction and operation phases (35 years)

Annex 2- Mitigation Measures Targeting Terrestrial Habitats and Species

Objective	NO NET LOSS
Description of the measure	• Monitoring and management of IAS is important because the development of these species can limit the development of native species. The project must provide for the development and implementation of a program to combat the introduction and/or spread of invasive species. Particular attention should be paid to all imported and stored materials.
Geographical area	Over the entire work area
Action plan	**<u>Prior to conducting plot cleaning, stripping and earthwork activities</u>**: • The identification of the IAS present in the construction site and its surroundings before the work is carried out and the conduct of a preliminary study on the materials supply sites (quarries, others); • Implementation of measures to eradicate invasive species inventoried in the project footprint and material supply areas (where applicable), through manual or mechanical removal of shrubby or tree-dwelling IAS by ensuring that the root system is removed; • Eradication of species through appropriate measures (on-site incineration of plant debris, disinfection and cleaning in situ, systematic hunting and trapping, destruction of nests, hiding places and sleeping areas, etc.). **<u>During the entire duration of the work and also during the operation phase</u>**: • Cleaning of vehicles at the entrance to the Project area when they first arrive (risks of contamination) - putting in place procedures to reduce the risks of IAS spread that are especially strict for equipment imported from abroad (outside the island of Madagascar); • If IAS are known to be present in the areas being used, set up a systematic vehicle cleaning system at the exit of invaded areas; • Implement measures (tarpaulins) on the most volatile materials to avoid losses during transport; • Identification and implementation of a waste management plan to limit the proliferation or arrival of invasive animal species; • Monitoring to eradicate or limit the spread of invasive alien species • Maintaining the system to combat the introduction of these harmful species, which has been in operation since the “construction site” phase, in the operation phase.
Other associated measures	• REDUCTION_RE-VEGETATION; • SUPPORT_ ENVIRONMENTAL_AWARENESS-RAISING
Implementation constraints	NONE
Implementer	• During the construction phase: EPC • During the operation phase: NEHO
Stakeholders	NONE
Institutional or technical	• Experienced botanist

support	
Sustainability guarantee (governance)	• Good information, awareness-raising and training of personnel working on the site and then in the operating phase (elements of good practice). • Ensuring that the IAS management plan is consistent with the actions to revegetate the work areas.
Illustration	• NO

Monitoring arrangements	• During site maintenance operations, carry out estimates of invasive plant cover (field observations by an experienced botanist).
Implementation indicators	• Adoption and implementation of an approved IAS Management Plan
Effectiveness indicators	• Area invaded by IAS as a percentage of the area modified by the Project
Monitoring frequency	• Monthly during the construction phase and then annually during the operation phase.
Audit	**NO**
Monitored by	• During the construction phase: EPC • During the operation phase: NEHO

Cost in euros	• No additional cost for the BAP; included in the project design

BAP 10 - Reduction_Fire_Hazards

Measure code	REDUCTION_FIRE_HAZARDS
Measure title	**Reducing fire hazards**
Measure type	**Reduction**
Critical habitat	YES, dense humid forest
Activities (impact source)	Construction phase: • Construction activities for the access roads, the dam, the penstock, the surge pipe, the surge tank and the plant • Storage of hydrocarbon products necessary for the mobilization of vehicles and construction equipment Operation phase: • Use of flammable products such as hydrocarbons for vehicles and machines, • Short-circuit accidents • Maintenance works on infrastructure located in open air nature (transformers, power lines, etc.)
Key impacts and risks	• **Type:** Direct • **Degree:** HIGH • Direct impact related to fire hazards - STRONG

Project phase	Construction / Operation
Duration of the measure	Throughout the works and then throughout the operation phase

Annex 2- Mitigation Measures Targeting Terrestrial Habitats and Species

Objective	NO NET LOSS
Description of the measure	This measure is intended to limit the risk of fire related to EPC activities in the EPC area only. The purpose of this measure is not to reduce the risk of fire related to anthropogenic activities in the project area. These risks are limited by other mitigation measures limiting access to the project area (e.g. BAP 11).
Action plan	• Open fires will be prohibited during the entire construction and operation periods. • Equip fire extinguishers at workstations/sites where flammable products are used. The installation of fire protection devices is also recommended for depots where flammable materials and products are stored. They will limit the spread of fires and reduce the risk of fires in critical habitats -EPC / NEHO; • Train personnel in the use of fire extinguishers and more generally in the basic rules concerning the use of flammable products, fire risk prevention measures and accident response protocol - EPC /NEHO
Other associated measures	• BAP 26 - SUPPORT_ENVIRONMENTAL_AWARENESS_RAISING
Implementation constraints	NA
Implementer	• Construction: EPC • Operation: NEHO
Stakeholders	NA
Institutional or technical support	NA
Sustainability guarantee (governance)	NA

Monitoring arrangements	• Recording and tracking of reported fires within the EPC zone (and their cause)
Implementation indicators	• Development of a fire risk management plan
Effectiveness indicators	• Area and type of vegetation cover burned as a result of the project's activities
Monitoring frequency	Daily and ongoing

Annex 2- Mitigation Measures Targeting Terrestrial Habitats and Species

Monitored by	• Construction: EPC • Operation: NEHO

Cost in euros	• No additional cost for the BAP; included in the project design

BAP 11 - Reduction_Population_Influx_Poaching

Measure code	REDUCTION_POPULATION_INFLUX_POACHING
Measure title	**Reduce negative impacts on biodiversity associated with population influxes into protected areas (Marolambo Park and Tsinjoarivo NPA), especially through support and guidance to managers of areas under conservation status for the protection of CITES species and anti-poaching actions.**
Measure type	Reduction
Critical habitat	YES, dense humid forest (A2)
Activities (impact source)	• Construction of access roads, improvement of access to the project area
Key impacts and risks	• **Type:** Induced • *Degree:* • Increasing pressures on natural resources in status areas • Increased impacts on protected areas due to population influxes

Annex 2- Mitigation Measures Targeting Terrestrial Habitats and Species

Project phase	Construction
Duration of the measure	Starts during the construction phase and continues throughout the operation phase of the project (35 years).
Objective	NO NET LOSS
Description of the measure	The construction and operation phases will last several years and will result in population movements in the area. The capacities of the managers of areas under conservation status must be strengthened so that they can best ensure compliance with the regulations governing the areas and can contribute to the protection of biodiversity.
Action plan	**Regulation of access to project access roads:** • Control vehicles entering / leaving the project area with the proponents/protected area managers. On the road between Belanitra and the Dam (public road): • During the construction phase, see the traffic regulation measures provided for in the ESIA. • During the operation phase, set up a traffic mechanism to open up the hydropower plant area, while minimizing the risk of accidents or use of the track for activities impacting protected areas; • Set up a regulated circulation, with the support of NEHO in coordination with MNP managers; • Set up barriers and guard posts at the ends of the forest On the road between the dam and the plant (project road): • Regulate access to the road (vehicle control) when entering / leaving the project area Proponent of the future NPA **Reservoir control/monitoring:** • Set up a control/monitoring system on the reservoir (monitoring crossings from one bank of the Onive to the other and activities around the reservoir) with a monthly visit by the team in charge of water quality monitoring; **In partnership with protected area managers (NPAs, MNPs):** • Establishment of guard posts at the boundaries of protected areas (MNP/DGEF and Proponent of the future NPA/NEHO) for the control of vehicles crossing the Onive River. • Material assistance for better protection - see compensation measures BAP 22 and BAP 23. **Construction phase**: • Make workers aware of conservation issues in the Project area - see BAP 26 - by including all high conservation concern species (including small carnivores and bats) in the list of species targeted by the anti-poaching program;

Annex 2- Mitigation Measures Targeting Terrestrial Habitats and Species

	• Formally prohibit in the internal regulations of the construction site the possession of weapons, traps and hunting equipment as well as the consumption or introduction of bushmeat within the work camp, in the living areas and on the construction sites and provide for adequate signage; • Limit poaching in and around the site and put in place a sanctions regime coupled with an anti-poaching awareness program for protected species; • Promote hiring among local populations and get the families of employees (or beneficiaries) to join the fight against poaching (signed commitment that the person and his/her family will promote the fight against poaching); • Have all persons working on the site sign a commitment; • Raise awareness and involve site workers in the fight against poaching; • Control workers and drivers at the entrances and exits of the camp; • Supply the site canteens with meat free of charge (e.g. project-related livestock farms, see measure on Livestock / hunting ecosystem service) to avoid bushmeat consumption including during holidays or to enable workers to return home via free shuttle buses. **<u>During the operation phase:</u>** • A program for the protection of CITES species and the fight against illegal trade and poaching will be defined and then implemented with the managers and proponents of protected areas within the framework of the actions already planned to regulate traffic and strengthen the control and protection of biodiversity
Other associated measures	• BAP 27 - SUPPORT_REFORESTATION • BAP 22 - COMPENSATION_SUPPORT_TSINJOARIVO_NPA • BAP 23 - COMPENSATION_SUPPORT_MAROLAMBO_NP
Implementation constraints	• Acceptabilité des contraintes d'accès aux pistes d'accès du Projet par les populations locales
Implementer	• NEHO
Stakeholders	• Promoteur de la future NAP de Tsinjoarivo; • MNP, en tant que gestionnaire du Parc de Marolambo • Les VOI concernés
Institutional or technical support	AUCUN
Sustainability guarantee (governance)	• Collaboration with PA managers and DGEF officers in the application of national regulations on protected species

Monitoring arrangements	• Checking workers and drivers entering and leaving the project area for weapons, traps, hunting equipment, and bushmeat.
Implementation indicators	• Development and implementation of strict internal regulations concerning anti-poaching (posters, training, and staff awareness) • Conducting regular checks (guard posts, dedicated staff) and applying the penalty regime where appropriate

Effectiveness indicators	• Number of checks and proportion of checks
Monitoring frequency	• Continuous, during the entire construction period and during the operating phase • Regularly during the operation phase
Monitored by	• **NEHO**

Cost breakdown	• Implementation: To be determined in accordance with the control and monitoring arrangements applied, at least: ✓ 2 full-time guard posts (24/7) during the entire duration of the works and continuously during the operation phase to control the entrances/exits of the project area ✓ The construction of two gatehouses/barriers • Follow-up: no extra cost for the BAP.
Cost in euros	• To be determined

BAP 12 - Reduction_Light_Pollution

Measure code	REDUCTION_LIGHT_POLLUTION
Measure title	**Minimization of light pollution (nocturnal species)**
Measure type	**Reduction**
Critical habitat	YES, dense rainforest
Activities (impact source)	• During the construction phase, lighting during the construction of the access roads, improving access to the Project area • During the operation phase, lighting of the infrastructure

Annex 2- Mitigation Measures Targeting Terrestrial Habitats and Species

Key impacts and risks	• **Type:** Direct • *Degree:* • During the construction phase, direct impact related to the disturbance of nocturnal species by project lighting - LOW • In the operation phase, direct impact linked to the disturbance of nocturnal species by the project's lighting - MODERATE

Project phase	Construction / Operation
Duration of the measure	Throughout the works and then throughout the operation phase.
Objective	NO NET LOSS
Description of the measure	Construction and operating sites will be designed and managed to minimize the impact of light pollution.
Action plan	• Avoid continuous lighting and use presence detector activation for comfortable outdoor lighting. The safety of night work requires powerful and permanent lighting. The recommendations therefore apply during the construction phase only to base camps and offices. • Use low-brightness bulbs or use floor-oriented lighting for outdoor lighting.
Other associated measures	NO
Implementation constraints	NO
Implementer	• **During the construction phase: EPC** • **During the operation phase: NEHO**
Stakeholders	NO
Institutional or technical support	NO
Sustainability guarantee (governance)	NA

MEASURE IMPLEMENTATION MONITORING	
Monitoring arrangements	• Monitoring of light sources installed on the construction site and operating areas

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Implementation indicators	• The installed light sources comply with environmental regulations (low intensity, directed towards the ground, with motion trigger for comfort sources).
Effectiveness indicators	• Number of non-compliant light sources
Monitoring frequency	Continuous during construction and operation phase
Monitored by	• **During the construction phase: EPC** • **During the operation phase: NEHO**

ESTIMATED BUDGET	
Cost in euros	No extra cost for the BAP - technical option included in the project design budget

BAP 13 - Reduction_Collision_Risks

PURPOSE OF MEASURE	
Measure code	REDUCTION_COLLISION_RISKS
Measure title	**Reducing the risk of collision with the power line**
Measure type	Reduction
Species concerned	• Birds: no critical species
Critical habitat	NO
Activities (impact source)	• Installation of the high-voltage line between the start of the power line at Sahofika and Belanitra and then between Belanitra and Antanifotsy
Key impacts and risks	• **Type:** Direct • **Degree:** MODERATE The risk of collision mainly concerns birds of prey and the ground wire, during the phases of diving towards prey detected on the ground, i.e. during high-speed flight from the air onto the ground. The risk of collision may also occur near bodies of water (lake, ponds) on the route of the HV line to Antanifotsy. Waterbirds can potentially stay there and be potentially affected by

	the risk of collisions, especially during their flight (e.g. duck flights). This concerns the crossing of the Onive river, and the proximity (less than 200m) of the reservoir that will be created by the project.

Project phase	Operation
Duration of the measure	The entire operational life of the project (35 years)
Objective	NO NET LOSS
Description of the measure	This measure is aimed at installing 3D bird-diverters on ground wires.
Action plan	• In the forest corridor where the greatest number of potentially affected species is present, three-dimensional "bird diverters" (e.g. Preformed Line Products' "BIRD-FLIGHT Diverter" model, or an equivalent product with a long life span; not two-dimensional bird diverters hanging below the rope) will be placed on the ground wires. • On the rest of the HV line, potential issues related to the presence of waterbirds (LC) (e.g. duck flights) in lakes / other water bodies will have to be assessed. The need for bird diverters will be refined on certain sections of the HV line.
Other associated measures	• NO
Implementation constraints	NA
Implementer	• EPC before transfer to Jirama
Stakeholders	NA
Institutional or technical support	NA
Sustainability guarantee (governance)	NA

MEASURE IMPLEMENTATION MONITORING

In the forest corridor where the greatest number of potentially affected species is present, three-dimensional "bird diverters" (e.g. Preformed Line Products' "BIRD- FLIGHT Diverter" model, or an equivalent product with a long life span; not two-

Monitoring arrangements	• Checking the installation of bird diverters
Implementation indicators	• Installation of bird diverters on the HV line (corridor and proximity to water bodies if applicable)
Effectiveness indicators	• Number of bird diverters installed and their location
Monitoring frequency	Before transfer to Jirama
Monitored by	NEHO

ESTIMATED BUDGET	
Cost in euros	No additional cost for the BAP; included in the project design

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BAP 14 - Reduction_Local_Resources

PURPOSE OF MEASURE	
Measure code	REDUCTION_LOCAL_RESOURCES
Measure title	**Avoiding or reducing the use of local natural resources as much as possible**
Measure type	**Avoidance**
Species concerned	• Flora: X
Critical habitat	YES, Dense humid forest
Activities (impact source)	• Construction and infrastructure development work requires the use of local materials such as wood, water, gravel and others. Excessive, unsustainable demand by the project will lead to overexploitation of these resources and become a threat to the ecosystem and biodiversity.
Key impacts and risks	• **Type:** Direct • **Grade:** Strong

Project phase	Construction
Duration of the measure	For the duration of the construction phase (5 years)
Objective	NO NET LOSS
Description of the measure	This measure aims to avoid or reduce the use of local natural resources as much as possible.
Action plan	• Quantify accurately and in advance the quantity of materials needed for the constructions. • Identify where these products are collected from or taken to in order to reduce impacts on the degradation of ecosystems (forest, aquatic) and ecosystem services. • Organize its supply chain in a way to avoid impacts on existing wooded areas in the vicinity of the Project.

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	The wood used in constructions must come from entities that have a cutting and/or sales authorization from the competent services, in the case where the supply is made in Madagascar.
Other associated measures	NA
Implementation constraints	• Difficulty of access to the project area
Implementer	• EPC
Stakeholders	NA
Institutional or technical support	NA
Sustainability guarantee (governance)	•

MEASURE IMPLEMENTATION MONITORING	
Monitoring arrangements	• Tracking and tracing of materials used in construction
Implementation indicators	• To be determined based on requirements in materials
Effectiveness indicators	• To be determined based on requirements in materials
Monitoring frequency	• Monthly during construction
Monitored by	• EPC

ESTIMATED BUDGET	
Cost in euros	• No additional cost for the BAP; included in the project design

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BAP 15 - Restoration_Re-vegetation

PURPOSE OF MEASURE	
Measure code	RESTORATION_Re-vegetation
Measure title	**Revegetation after construction works**
Measure type	**Reduction**
Critical habitat	YES, Dense humid forest
Activities (impact source)	• Construction of the access roads, dam, penstock, surge tank and plant
Key impacts and risks	• **Type**: • **Degree:** • Habitat loss/degradation/disturbance • Erosion risks

Project phase	Construction / Operation
Duration of the measure	Implementation of the measure from the pre-construction period, during the entire operation period (35 years).
Objective	NO NET LOSS
Description of the measure	The vast majority of temporary work zones will be located within the flooded area or on existing footprints (see measure TEMPORARY_INFRA_NATURAL_HABITATES). Nevertheless, all work areas left bare after the works, suitable for revegetation and located outside the reservoir or existing footprints must be subject to a re-vegetation plan, with actions to revegetate or maintain developed areas, limit the risk of erosion (see measure REDUCTION_EROSION_RISKS). This will help limit soil erosion, restore the landscape and control the establishment and spread of invasive alien species.

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Geographical area	Temporary work area left bare
Action plan	• Zoning of the revegetation area • A zoning of revegetation actions will have to be produced according to the functions required (erosion control on slopes, soil maintenance, restoration of plant biodiversity), according to the altitude of the restoration areas (selection of the most suitable species), the location of the areas to be restored in relation to the heart of the forest corridor. **Definition of a protocol for revegetation after works** • Gradual revegetation to secure erosion-prone areas (slopes) and preserve biodiversity (areas to be restored); • Reconstitute and cover with native plants adapted to the environmental conditions the areas left bare after uprooting invasive plants. This will reduce impacts such as erosion or the proliferation of unwanted vegetation. The species to prioritize are those that have: ✓ Ecophysiological characteristics and requirements adapted to the environmental conditions; ✓ Soil-fixing characteristics that are not invasive or preferably indigenous; ✓ Values in terms of conservation or for ecosystem services (species for food, heating, pharmacopoeia, etc.). • Shredding and storage of deforestation/land clearing products for re-use in soil revegetation; • Recover and store topsoil, in heaps less than 2 m high, limiting the risk of erosion, and reuse it as quickly as possible (avoid storing the soil for more than two years without use) for soil revegetation. This involves implementing a progressive rehabilitation plan. • Put in topsoil and mulch, and revegetate with local species or authorized and approved non-invasive species selected by an experienced botanist. **Setting up nurseries** • The EPC will be able to purchase the plants needed for revegetation actions from existing nurseries. • The EPC should favour the purchase of **native plants**, which can restore natural vegetation, rather than fast-growing exotic plants such as eucalyptus.
Other associated measures	• REDUCTION_EROSION_RISKS
Implementation constraints	• It is important to specify that revegetation actions should target the restoration of the native plant cover (indigenous plants), which will make it possible to recreate natural habitats, outside reforestation areas, for social use. • Considering the duration of the dam's construction (5 years), this action must begin as early as the pre-construction phase.
Implementer	• NEHO
Stakeholders	• VOI from Fisoronana, Befotaka, Antenina, Ambalomby, Sahofika • Local populations (Fisoronana nurseries, faravohitra, restoration actions etc.).
Institutional or technical support	• The specificity of the use of native species will be ensured by dedicated supervision.
Sustainability guarantee (governance)	• Involve local populations in the implementation of revegetation actions setting up of local nurseries, selection species, planting and monitoring)

Annex 2- Mitigation Measures Targeting Terrestrial Habitats and Species

Illustration	**TEMPORARY INFRASTRUCTURE LOCATION MAP (see Feasibility missions for the track route between Belanitra-Dam-plant & installation sites, BIOTOPE MG December 2019)**

MEASURE IMPLEMENTATION MONITORING	
Monitoring arrangements	• Monitoring of the progress of vegetation recovery in the planted areas (field observations by an experienced botanist)
Implementation indicators	• All temporary work areas (excluding the reservoir and existing footprints) and erosion-sensitive areas are being restored.
Effectiveness indicators	• Area of eroded habitats (not revegetated and prone to erosion with heavy runoff) - ditto ME3 • Absence of invasive alien species
Monitoring frequency	• Monthly for 5 years and then annually for the entire duration of the project's operation
Monitored by	• NEHO

ESTIMATED BUDGET	
Cost breakdown	• <u>Implementation:</u> ✓ The purchase of seedlings by the EPC from local nurseries ✓ Depending on the areas to be restored in the context of temporary work zones and areas at risk of erosion (area not determined at present); the cost of restoration can vary between **250 and 640 euros per hectare.** • Monitoring: Monthly visits (by a botanist) for 5 years to evaluate the effectiveness of the re-vegetation measures (use of native species, good recovery of vegetation, absence of invasive alien species).
Cost in euros	To be determined

Annex 3 - Mitigation Measures for Aquatic Habitats and Species

BAP 16 - Reduction_ Environmental_Impoundment_Reservoir

PURPOSE OF MEASURE	
Measure code	REDUCTION_ ENVIRONMENTAL_IMPOUNDMENT_RESERVOIR
Measure title	**Environmental impoundment of the reservoir**
Measure type	Reduction
Species concerned	Aquatic fauna Small slow-moving terrestrial fauna (reptiles, amphibians)
Critical habitat	YES, Onive downstream from the plant + tributary
Activities (impact source)	• Commissioning of the works • Filling and permanent presence of the reservoir
Key impacts and risks	• Impact of the modified hydrological regime on habitats downstream from the dam and plant • Destruction of small fauna during impoundment of the reservoir (impoundment rate greater than 2km/h in areas with a low slope and trapping of small fauna in the islands formed in the reservoir).

Project phase	Operation
Duration of the measure	The first time the reservoir is impounded
Objective	NO NET LOSS
Description of the measure	The actual duration of the impoundment will depend on the natural flow of the Onive at the

	time the impoundment begins and on the technical constraints applicable to the first impoundment (verification of the stability of the structure and the reservoir). Considering the natural flow of the Onive, this impoundment will last between one week (hypothesis of rapid impoundment in the flood season) and two months (slow impoundment in the dry season). The measure aims to limit the mortality of small terrestrial and aquatic fauna during the impoundment of the reservoir. It enables slow impoundment (maximum speed < 2km/h on the ground), safeguard activities in the sensitive areas of the reservoir (islands, low-slope areas with a rapid rise in water level, or islands) and conduct flow tests in the bypassed reach. When the reservoir is first filled, a test of at least 16 hours is planned with only the instream flow applied. During this test, visual observations will be made on the bypassed reach and downstream from the plant (before and after 4 p.m.) to check flow continuity and identify singularities likely to appear. Ichthyologists will be associated with this test, in order to accurately assess the possible impact of different environmental variations and conditions on the habitat of aquatic species in the Onive and even on the species themselves
Geographical area	Reservoir
Action plan	***Tests during impoundment*** • When impounding the reservoir for the first time, schedule a test of at least 16 hours with only the instream flow applied; • Visual observations on the bypassed reach and downstream from the plant (before and after 4 p.m.) to check the continuity of the flow and identify any singularities that may appear; • During this test, ichthyologists will be involved, in order to evaluate exactly the possible impact of the different environmental variations and conditions on the habitat of aquatic species in the Onive, or even on the species themselves (observation in particular downstream concerning the habitats suitable for the *Rheocles*). ***Maximum impoundment speed*** • Maximum impoundment speed of the reservoir allowing wildlife to flee (2km/h - one man on foot). This “horizontal” rate of water rise varies with the topography inside the reservoir. • Modeling the topography within the reservoir would allow the evaluation of (low-slope) areas where the impoundment could exceed the maximum speed of 2 km/h, or the identification of islands. In these sensitive areas, the project should include species conservation teams - see below. ***Safeguarding of small fauna in the reservoir when impounding the reservoir*** • Clearing of the flooded area before impounding the reservoir to allow wildlife to escape; • In the sensitive areas with a low slope, where the impoundment speed exceeds 2km/h horizontally, teams of herpetologists will be in charge of collecting and safeguarding the small fauna (reptiles, amphibians) and capturing the species trapped on the islands formed by the reservoir (mapping of the islands created by the reservoir).
Other associated measures	NA
Implementation constraints	

	NA
Implementer	• NEHO in coordination with EPC
Stakeholders	NA
Institutional or technical support	• Team of ichthyologists: MZBA-MAVOA
Sustainability guarantee (governance)	NA

MEASURE IMPLEMENTATION MONITORING	
Monitoring arrangements	• The parameters recorded could be water variations rise and isolated high points likely to turn into an island and then be submerged.
Implementation indicators	• Documentation of species caught and areas deforested
Effectiveness indicators	• Safeguard catches and deforestation performed
Monitoring frequency	• Daily for the duration of the impoundment process
Monitored by	NEHO in coordination with EPC

ESTIMATED BUDGET	
Cost breakdown	• Implementation: cost of temporary recruitment of observers (fish scientists) during the test phase. • Follow-up: 0
Cost in euros	**To be determined**

BAP 17 - Reduction_Instream_Flow

PURPOSE OF MEASURE	
Measure code	REDUCTION_ INSTREAM_FLOW
Measure title	**Maintaining an instream flow**

Measure type	Reduction
Species concerned	• Aquatic fauna: X
Critical habitat	NO
Activities (impact source)	• Creation of a bypassed reach (BR) between the dam and the plant
Key impacts and risks	• Type: Direct • Degree: • During the construction of the Sahofika hydropower plant, the only activity likely to temporarily modify the flow of the Onive River is the passage from the first to the second phase of the diversion. • Flow reduction, temperature increase, habitat reduction in the BR

IMPLEMENTATION OF THE MEASURE	
Project phase	Construction / Operation
Duration of the measure	The entire duration of the construction and operation phase (35 years)
Objective	NO NET LOSS
Description of the measure	At all stages of construction and testing, an instream flow of 5.7 m3/s will be maintained at all times downstream from the dam, including when the river is closed for dam construction purposes. During operation, an instream flow will be maintained permanently downstream from the dam. The proposed instream flow of 5.7 m3/s probably allows the essential functions of the Onive River to be maintained in the bypassed reach: this will have to be confirmed by the Project follow-up, especially with regard to *Rheocles wrightae* and also to ensure that the bed is not easily crossed on foot anywhere.
Geographical area	Dam
Action plan	**Maintaining a minimum start:** Construction phase: • Detailed studies and work planning to ensure continuity of flow downstream and, in all cases, a flow downstream from the development always equal to or greater than the

	instream flow (5.7 m3/s). Filling: • Ensure that the flow downstream from the development is always equal to or greater than the instream flow (5.7 m3/s) during the first filling of the impoundment. Exploitation: • A minimum flow of 5.7 m3/s will be discharged permanently from the dam to the bypassed reach, regardless of hydrological conditions or the operating status of the hydropower project. **Conducting a campaign to identify and verify alternative routes for eels**
Other associated measures	• REDUCTION_IMPOUNDMENT_RESERVOIR
Implementation constraints	NONE
Implementer	• During construction and impoundment: EPC • During the operation phase: NEHO
Stakeholders	NONE
Institutional or technical support	NA
Sustainability guarantee (governance)	NA

MEASURE IMPLEMENTATION MONITORING	
Monitoring arrangements	• Continuous measurement of the flow discharged from the dam.
Implementation indicators	• Continuous measurement of the flow discharged from the dam
Effectiveness indicators	• Flow rate always higher than the minimum allowed value
Monitoring frequency	Ongoing
Monitored by	• During construction and impoundment: EPC • During the operation phase: NEHO

Annex 3 - Mitigation Measures for Aquatic Habitats and Species

ESTIMATED BUDGET	
Cost in euros	• No additional cost for the BAP; included in the project design

BAP 18 - Reduction_Aquatic_IAS_Control

PURPOSE OF MEASURE	
Measure code	COMPENSATION_REDUCTION_AQUATIC_IAS_CONTROL
Measure title	**Targeted and suitable control of aquatic invasive alien species (IAS) and *Channa maculata* in particular**
Measure type	Reduction
Species concerned	• Aquatic fauna: *X Astacoides caldwelli, Rheocles wrightae*
Critical habitat	YES, Onive downstream from the plant and its tributary
Activities (impact source)	• Presence of restraint
Key impacts and risks	• Type: Indirect • Degree: HIGH The transition from a mosaic of relatively diverse aquatic habitats in terms of flow facies upstream from the reservoir to a uniform lentic area will favour the least demanding species with rapid development capacities such as invasive alien species: carp *Cyprinus carpio* or *Channa maculata* , predators of Rheocles in particular. • Indirect impact related to the proliferation of aquatic alien invasive species to the detriment of native species - STRONG

IMPLEMENTATION OF THE MEASURE	
Project phase	Operation
Duration of the measure	During the entire operation phase of the project (35 years)
Objective	NET GAIN

Description of the measure	The aim of this measure is to introduce targeted and appropriate measures to combat aquatic invasive alien species, in particular the carp *Cyprinus carpio* or *Channa maculata* , a predator of *Rheocles* in particular.
Geographical area	On the reservoir
Action plan	• Conduct before hand a literature search on the various existing and internationally implemented management measures for the targeted species. The most realistic modes of intervention, considering the context of the study area and the means that can be mobilized, will be selected. • Based on the literature review, develop a plan to address aquatic invasive alien species • This fight will necessarily be coupled with the measure that allows the local population to be involved in the problem of aquatic IAS - see BAP 30.
Other associated measures	• BAP 30 - SUPPORT_AWARENESS-RAISING_LOCAL_FISHING
Implementation constraints	• To be determined
Implementer	• NEHO
Stakeholders	• Local people
Institutional or technical support	• Experienced Ichtyologist
Sustainability guarantee (governance)	• Ensuring the involvement of local fishermen

Monitoring arrangements	• Fish inventories • Surveys of fishermen and local populations
Implementation indicators and target	• Adoption and implementation of an aquatic IAS control plan
Effectiveness indicators and target	• % endangered species in species fished
Monitoring frequency	• Quarterly for the first 5 years of control, then annually.
Monitored by	• NEHO

ESTIMATED BUDGET

Cost breakdown	• To be determined according to the control methods chosen: provide at least a minimum: ✓ Staff dedicated to the fight against IAS (mobilization of a team of fishermen) for 35 years; ✓ 4 sessions of fish inventories in the reservoir per year (mobilization of a team of fishermen + experts) - during the first 5 years; ✓ 4 sessions of local population surveys per year - for the first 5 years4 sessions of local population surveys per year - for the first 5 years4 sessions of local population surveys per year - for the first 5 years
Cost in euros	• To be determined

BAP 19 - Reduction_Crossing_Tributaries

PURPOSE OF MEASURE	
Measure code	REDUCTION_CROSSING_TRIBUTARIES
Measure title	**Installation of out-of-water crossing structures (nozzles, scuppers, culverts) on tributaries and with safeguard fishing measures**
Measure type	Avoidance
Species concerned	• *Astacoids caldwelli* and *Limnogale mergulus*
Critical habitat	• YES, tributaries of the Onive assimilated to the critical habitat of dense rainforest
Activities (impact source)	• Construction of crossing structures for tributaries encountered by machines during the construction of access roads; • Approximately 10 tributaries will be crossed by the access road between the dam and the plant, following the selected route.
Key impacts and risks	• Type: Indirect • Degree: MODERATE • Indirect impact related to the reduction and degradation of aquatic habitats by the crossing of tributaries encountered by machines - MODERATE • Direct impact related to the pollution of aquatic environments by the crossing of tributaries encountered by machines - MODERATE

IMPLEMENTATION OF THE MEASURE

Annex 3 - Mitigation Measures for Aquatic Habitats and Species

Project phase	Construction
Duration of the measure	During the construction phase (5 ans)
Objective	NO NET LOSS
Description of the measure	The purpose of this measure is to put in place watercourse crossing structures adapted to limit the degradation of aquatic environments during the passage of machinery in the forest corridor.
Geographical area	• All watercourses impacted by the project and in particular sensitive watercourses located within the forest corridor (impacted by the access road between the dam and the plant) for the safeguard fisheries and the wildlife crossing facility.
Action plan	• Overall, implement crossing structures on all watercourses that must be crossed by vehicles or construction equipment in order to minimize impacts on aquatic environments; • Knowing that the implementation of crossing structures remains however globally impacting on the aquatic environment and the communities in place, avoid as much as possible the interception of watercourses; • Conduct safeguard fisheries during the construction of crossings in sensitive watercourses within the forest corridor. Fish / crayfish trapped in the residual pits in the work area will be caught and moved to an area not impacted by the work; • Provide wildlife crossings at the Onive tributary crossing infrastructure (within the forest corridor) for aquatic and semi-aquatic species in order to maintain connectivity in the watercourse and on the banks; • In the event of an accidental spill (materials, fuels, etc.) in one of the tributaries of the Onive (*Astacoid* watercourse), implement clean-up (repair) measures.
Other associated measures	• ME3 - REDUCTION_EROSION_RISKS
Implementation constraints	NA
Implementer	• EPC (Environmental Coordinator)
Stakeholders	NONE
Institutional or technical support	Expert site supervision
Sustainability guarantee (governance)	NA

MEASURE IMPLEMENTATION MONITORING	
Monitoring arrangements	• Monitoring the ecological quality of watercourses with crossings
Implementation	• Verification of the implementation of watercourse crossings and compliance with

indicators	diversion procedures, safeguard fisheries and installation of wildlife crossings in watercourses in the forest corridor.
Effectiveness indicators	• Proportion of watercourses crossed in water-less conditions
Monitoring frequency	Monthly, for the duration of the works
Monitored by	• EPC (Environmental Coordinator)

ESTIMATED BUDGET	
Cost in euros	• No additional cost for the BAP; included in the project design

BAP 20 – Works Planning

Voir BAP 6

Annex 4 – Compensation Measures for Terrestrial Habitats and Species

BAP 21 - Compensation_Forest_Restoration

PURPOSE OF MEASURE	
Measure code	COMPENSATION_FOREST_RESTORATION
Measure title	**Preparation and implementation of a program to restore degraded areas in forests adjacent to the main forest corridor**
Measure type	**Compensation**
Critical habitat	YES, Dense humid forest
Activities (impact source)	• Construction of the access roads, dam, penstock, surge tank and plant
Key impacts and risks	• **Type:** Direct • **Degree:** HIGH • Direct impact related to the destruction of natural forests linked to infrastructure and the dam - FORT • ~216 hectares of natural forest impacted in total by the project

IMPLEMENTATION OF THE MEASURE	
Project phase	Construction / exploitation
Duration of the measure	Starts during the construction phase (5 years) and continues throughout the operation phase of the project (35 years).
Measure definition method	Species conservation • Additionality: added value linked to forest restoration actions on restored modified

	habitats, and additionality to ongoing conservation actions as restoration actions will be prioritised outside the NPA. • Sustainability: restoration actions over 35 years, in partnership with local structures (VOI) and the Proponent of the future NPA. • Ecological equivalence: forest restoration to compensate for residual impacts on dense rainforest habitats • Geographical proximity: Within the project area.
Objective	NET GAIN
Description of the measure	The planned reforestation effort will eventually concern an area equal to **2.5 times the impacted area for active restoration and 3.5 for natural restoration** with an estimate of **540 ha to 756 ha to** be restored for ~216 hectares of permanently destroyed forests. The objective is to combat forest corridor fragmentation and maintain ecological connectivity by reconnecting fragments of natural forests using native species. The restoration actions of the project will have to be discussed with the Proponent of the future NPA in coherence with the set restoration objectives (COMPENSATION_APPUI_NPA_TSINJOARIVO). Restoration actions will also have to be thought out in coherence with the socio-economic context of the local populations, which is why they will be accompanied: • An agricultural income improvement program to improve household food security and offset income from the exploitation of forest resources, thus reducing dependence on natural resources and limiting pressures. on landscape forester: GENERATING_ACTIVITIES_INCOME_ACCOMPANY • A reforestation program (planting of fast-growing exotic species, eucalyptus) to meet the wood energy needs of local communities: REDUCTION_ACTIONS_REFORESTING
Geographical area	Perimeter of the forest corridor in the project's area of influence (see sectors suitable for restoration)
Action plan	**Prerequisite for any restoration initiative in the project area:** The definition of a strategy and action plan for forest restoration in the project area, in partnership with the local communities and the VOIs concerned (VOI, traditional authorities, MNP, NPA, etc.): • Identify sites to be restored in cooperation with stakeholders and NPA. At this stage the areas formerly cleared upstream from the dam are to be favoured, to optimise the protection of the dam against silting and the protection of the tributaries feeding the Onive, in order of priority: ➢ **Sector 1 - PRIORITY:** Area of the restoration program envisaged for the Sahofika BAP, **on** the left bank of the Onive. At the end of the work and the movement of people to the resettlement site, this area should no longer be inhabited (see RAP results). This is a good opportunity to initiate forest restoration actions. These sectors are positioned between the Ambalaomby Forest and the main forest corridor. Reconnecting these two forest massifs would constitute a significant ecological added value for the NPA and these conservation objectives. ➢ **Sector 2:** This sector, close to the NPA peripheral zone (east side), is a privileged sector for reforestation activities by the proponent of the future NPA, in partnership with VOI Sahofika. The possibility of restoration actions can also be studied in degraded habitats adjacent to the forest corridor in consultation with local communities

Sector 2: This sector, close to the NPA peripheral zone (east side), is a privileged sector for reforestation activities by the proponent of the future NPA, in partnership with VOI Sahofika. The possibility of restoration actions can also be studied in

(Faravohitra in particular).

- **Sector 3:** This sector is an area to be favoured by the proponent of the future NPA for reforestation for the benefit of the communities and for the management of watercourses for the Rheocles (VOI Ambalaomby).

Sector	Habitat type	*In the NPA Core Area*	*Outside the NPA Core Area*
Sector 1 PRIORITY	**Natural habitat**	1426.34 ha	1145.76 ha
	Modified habitat	273.96 ha	503.34 ha
Sector 3	**Natural habitat**		61.19 ha
	Modified habitat		1734.11 ha
Secteur 2	**Natural habitat**		577.59 ha
	Modified habitat		2972.84 ha

In sector 1 - Blocks to be restored	In the NPA Core Area	Outside the NPA Core Area
Blocks of less than 1 ha	• 21.02 ha • 107 blocks	• 19.57 ha • 80 blocks
Blocks of more than 1 ha and less than 10 ha	• 100,45 • 29 blocks	• 79.18 ha • 24 blocks
Blocks of more than 10 ha	• 152.48 ha • 6 blocks	• 404.58 ha • 10 blocks

- Determination of restoration modalities:
  - On some lands, actively restore: planting and reforestation using native species with effective defenses against cutting, grazing and fire) of degraded areas in forests adjacent to the main corridor.
  - On other lands, apply natural (passive) restoration
- Define field tactics: field team, logistics and equipment, tests and pilot restoration sites;
- Size the project team: appoint community liaison officers (Faravohitra, Antenina), project leader, restoration officer, consultants/trainers, support from an international expert in forest restoration;
- Resolve land conflicts through the project.

<u>Implementation of forest restoration:</u>

- Set up a network of local nurseries as soon as work begins to produce native tree seedlings to restore natural forests. It is proposed to create two community nurseries away from the forest corridor (Faravohitra and Fisoronana) in order to relocate economic interests outside the forest corridor.
- The most efficient method of producing seedlings is the collection of wildfowl in the forest. The young plants are taken from the forest and then transplanted in the nursery for 3-6 months before being replanted.
- Other techniques exist and can be tested (germination in the nursery, direct sowing of

	seed, pre-germination, cuttings, etc.). Nurseries should be located as close as possible to the restoration sites and close to a water source • Selection species: priritize pioneer and heliophilic species adapted to degraded fallow land, with rapid growth. • Selection of technical restoration routes: passive restoration (defensive measures, creation of firebreaks and cleaning of ferns and weeds) or active restoration (plantations, etc.). • Set up tests on pilot restoration sites; **Capacity building:** • Realization of training and awareness-raising activities for VOIs concerned by the restoration actions; • Organize training and exchange workshops.
Other associated measures	• COMPENSATION_SUPPORT_TSINJOARIVO_NPA; • SUPPORT_REFORESTATION • SUPPORT_INCOME-GENERATING_ACTIVITIES
Implementation constraints	• Considering the time it takes for vegetation to recover, this action must begin as early as the pre-construction phase; • The question of the future of the Antenina VOI after the resettlement of part of the inhabitants of Antenina is crucial for the success of the restoration actions in sector 1. **It is necessary to determine which VOI will be in charge of the restoration actions in this sector: it can be the Antenina VOI or the Ambalaomby VOI (to be created).** • Many hamlets are located close to the forest corridor, which can make reforestation difficult: the restored land will have to be subject to an effective and sustainable protection status, within the framework of the governance of natural resources to be set up within the project perimeter and in the vicinity of existing protected areas.
Implementer	• NEHO
Stakeholders	• Proponent of the future NPA • Local people • VOI: Antenina (if maintained after resettlement), Ambalaomby, Sahofika, Fisoronana, Befotaka
Institutional or technical support	• The specificity of the use of native species will be ensured by dedicated supervision.
Sustainability guarantee (governance)	• Involve local populations in the implementation of revegetation actions setting up local nurseries, choice of species, planting and monitoring • Ensuring an effective and sustainable protection status for restored sites • Support a plan to invest in alternative agricultural practices to meet the needs of local people and reduce pressure on the forest. • Supporting reforestation programs to meet fuelwood needs

MEASURE IMPLEMENTATION MONITORING	
Monitoring arrangements	• Monitoring the evolution of the vegetation of sites under restoration (satellite images and field observations by an experienced botanist)

Estimation of fixed costs (plantations, nurseries): between Ar. 1 032 300 and Ar.2 640 200 or between 250 and 640 euros per hectare (Conservation International, 2011), estimation of 400 € / ha for reforestation over 20 years (GIZ, 2016)

Implementation indicators	• Development and implementation of a restoration plan
Effectiveness indicators	• Area and state of conservation of restoration sites (after 10 years of restoration)
Monitoring frequency	Annually throughout the term of the concession
Monitored by	• NEHO

ESTIMATED BUDGET	
Cost breakdown	**Implementation:** • Estimation of fixed costs (plantations, nurseries): between Ar. 1 032 300 and Ar.2 640 200 or between **250 and 640 euros per hectare** (Conservation International, 2011), estimation of 400 € / ha for reforestation over 20 years (GIZ, 2016) • Estimated additional costs (studies, maintenance): between Ar. 103 500 and Ar. 287 700 per hectare, i.e. between EUR 25 and 70 per hectare per year. **Floow up:** • Annual visits (by a botanist) to the restoration sites to monitor the effectiveness of the measures. • Conducting annual analyses of satellite images to assess the rate of reforestation (to be coupled with the analysis of the deforestation rate in the NPA)
Cost in euros	• To be determined

References:

- *GIZ, 2016. Restoration des Paysages Forestiers – Evlaution des potentialités dans le contexte des engagements de Bonn 2.0 et de la Déclaration de New York sur les forêts. Méthodologie et résultats pour Madagascar.*
- *WWF, 2010. Restoration des paysages forestiers – Cinq ans de réalisation à Fandriana-Marolambo (Madagascar)*
- *Conservation International, 2011. Forest Restoration à Madagascar: Document de capitalisation des expériences en vue de l'élaboration d'un Plan d'Action de Restoration*
- *UICN et WRI (2014). A Guide to the Restoration Opportunities Assessment Methdology (ROAM) Online:* http://cmsdata.iucn.org/downloads/roam_handbook_lowres_web.pdf
- *Andiramanantsehheno C., Richter F.& SeppS.2013. Standards et principes du „reboisement villageois individuel"-Reboisement énergétique sur terrains dénudés. ECO-Consulting Group. Online:* http://www.eco-consult.com/fileadmin/user_upload/pdf/downloads/RVI_standards_et_principes.pdf

Annex 4 – Compensation Measures for Terrestrial Habitats and Species

BAP 22 - Compensation_Creation_Tsinjoarivo_NPA

PURPOSE OF MEASURE	
Measure code	COMPENSATION_CREATION_TSINJOARIVO_NPA
Measure title	**Contribution to the establishment of the Tsinjoarivo NPA for the conservation and restoration of natural forests**
Measure type	Compensation
Critical habitat	YES, Dense humid forest
Activities (impact source)	• Construction and operation of the access roads, dam, penstock, surge pipe, balancing shaft and plant
Key impacts and risks	• **Type:** Direct • **Degree:** HIGH • Direct impact related to the destruction of individuals of fauna and flora - STRONG • Direct impact related to increased pressure on natural resources in status areas • Increased impact on protected areas due to population influxes

IMPLEMENTATION OF THE MEASURE	
Project phase	Construction / operation
Duration of the measure	Starts during the construction phase and continues throughout the operation phase of the project (35 years).
Measure definition method	Species conservation

Annex 4 – Compensation Measures for Terrestrial Habitats and Species

	• Additionality: see analysis of avoided losses • Life span: 35 years Ecological equivalence: this measure is aimed at conserving the same natural habitats (dense rainforest and lichen woodland) triggering the critical habitat and impacted by the project and therefore concerns the same range of associated species. This measure therefore complies with the qualitative ecological equivalence required for compensation Conservation des espèces • Geographical proximity: this measure targets natural forest habitats in functional proximity to the project area (see **Map 5**).
Objective	NET GAIN (in hectares of natural forest) - NEHO becomes a partner of the NPA and commits to a goal of zero deforestation in the future protected area during the life of the project.
Description of the measure	The Sahofika project is committed to contribute to the creation of the Tsinjoarivo NPA, to significantly reduce the rate of deforestation affecting this protected area by strengthening the capacity to monitor and control illegal activities such as clearing, poaching, etc., and to strengthen forest restoration actions. The project's commitment to the Proponent of the future NPA is a **performance contract** aimed at reducing the rate of deforestation and forest restoration (monitoring in hectares of natural forest conserved and restored).
Geographical area	NPA Tsinjoarivo (core zone + periphery)
Action plan	• Signature of a Memorandum of Understanding between the Proponent of the future NPA and the Sahofika project specifying the terms of the partnership between the two parties - including a **performance contract** concerning the reduction of the deforestation rate; ***Contribution to the creation of the NPA*** • Access road and traffic regulation, inventory data, installation of a guard post, reception of the NPA proponent's agents in the project's bases • Coverage of all additional costs generated by the project (administrative procedures, time etc.) ***Contribution of the project to NPA's strategic objectives (over 35 years)*** • Slowing down and then stopping deforestation: monitoring of deforested hectares, apprehension of offenders by strengthening monitoring capacities (material and human resources), strengthening forest control with the DGEF; • Restoring forest areas: through natural restoration and proactive restoration actions. • Providing social and economic opportunities: improving road access, rural electrification, basic infrastructure linked to community development, income alternatives (BAP 28), including the development of eco-tourism. • Generate scientific knowledge on fauna and flora: monitoring endangered species, monitoring ecological restoration efficiency, accommodating students and contributing to the country's scientific and technical capacity building. Support the operation of the NPA after the period of temporary protection (material, human resources): guard posts, offices, jobs, equipment (electric ATVs, etc.).

Annex 4 – Compensation Measures for Terrestrial Habitats and Species

	Technical support of the project to the proponent of the NPA: • Prepare the NPA Development and Management Plan; • Support the preparation of the NPA ESIA, integrating issues related to the populations' user rights (authorized clearings in the peripheral zone etc.), performance objectives related to the well-being of the populations (social actions of the NPA, etc.).
Other associated measures	• REDUCTION_IMPACTS_POPULATION_INFLUX ; • COMPENSATION_FOREST_RESTORATION
Implementation constraints	
Implementer	• NEHO
Stakeholders –	• Proponent of the future NPA
Institutional or technical support	
Sustainability guarantee (governance)	• Signing of a Memorandum of Understanding with relevant stakeholders

MEASURE IMPLEMENTATION MONITORING	
Monitoring arrangements	• Analysis of satellite images to monitor the rate of deforestation within the NPA
Implementation indicators and target	• Annual activity report including the results of an analysis of the deforestation rate over the year. • Objectives of the performance contract
Effectiveness indicators and target	• Monitoring deforestation in the NPA • Achievement of the objectives of the performance contract
Monitoring frequency	**Annual Review**
Monitored by	**NEHO**

ESTIMATED BUDGET	
Cost breakdown	**Implementation:** • Indicative budget (operation of a protected area) to be secured with the NPA proponent; • A recent study (Lindsey et al, 2018) reports a minimum of $500/km2 per year and an average of $1,000/km2 per year for protected area management in Africa. The maximum given at more than 1800$/km2/year;

As the NPA area is 264 km2 , the overall estimate of the cost of managing the NPA would therefore be between $130,000 / year and $264,000 / year. This figure is indicative and will need to be refined with the NPA proponent, consistent with the

	• As the NPA area is 264 km2 , the overall estimate of the cost of managing the NPA would therefore be between $130,000 / year and $264,000 / year. This figure is indicative and will need to be refined with the NPA proponent, consistent with the conservation objectives of the NPA. **Floow up:** • Budget for annual analyses of satellite images to assess the overall effectiveness of the NPA in combating deforestation (annual calculation of the rate of reforestation/deforestation) over the life of the project.
Cost in euros	• To be determined

References:

- Lindsey, P. A., Miller, J. R., Petracca, L. S., Coad, L., Dickman, A. J., Fitzgerald, K. H.,& Knights, K. (2018). More than $1 billion needed annually to secure Africa's protected areas with lions. *Proceedings of the National Academy of Sciences*, *115*(45), E10788-E10796. https://www.pnas.org/content/115/45/E10788.short

BAP 23 - Compensation_Support_Marolambo_NP

PURPOSE OF MEASURE	
Measure code	COMPENSATION_SUPPORT_MAROLAMBO_NP
Measure title	***Support for the conservation of natural forests in the Marolambo National Park***
Measure type	Compensation
Critical habitat	YES, Dense humid forest
Activities (impact source)	• Construction of the transmission line, but also of an access road to the dam between Belanitra and the dam, as there is no passable track here.
Key impacts and risks	• **Type:** Direct • Degree*:* • Direct impact related to the destruction of natural forests in the infrastructure footprint between Belanitra and the dam.

The ongoing monitoring program is planned on a bi-monthly basis and is carried out by the local committees. The project could support the MNP to strengthen its monitoring activities and move to monthly campaigns in the north of the park.

Project phase	Construction / operation
Duration of the measure	Starts during the construction phase and continues throughout the operation phase of the project (35 years).
Objective	NET GAIN
Description of the measure	The main aim of this measure is to contribute to a significant reduction in the rate of deforestation in the MNP by strengthening the capacity to monitor and control illegal clearing and poaching activities.
Geographical area	Northern Zone of Marolambo National Park
Action plan	Support tracks for the MNP: ***Support for MNP monitoring activities*** • The ongoing monitoring program is planned on a bi-monthly basis and is carried out by the local committees. The project could support the MNP to strengthen its monitoring activities and move to monthly campaigns in the north of the park. • **Support for joint actions with the gendarmerie.** Today, the gendarmes are only mobilized on an ad hoc basis when offences are observed, to assist PNM officers during arrests. They are understaffed and difficult to move from Ambohitompoina. The project (in particular the rehabilitation and construction of the access road to the dam and the resettlement of the population in Fisoronana) is likely to increase anthropogenic pressures in the north of the park. The regular presence of the gendarmerie would serve as a deterrent. The Project could support the monthly missions of the gendarmes still in the northern zone of the MNP. • **Funding for a guard post at the park boundary (MNP/DGEF):** This guard post will directly benefit MNP teams by providing a permanent presence in the northern zone of the park. Currently the MNP sector chief can only travel once every two months to this sector. This guard post will also make it possible to control the removal of timber or poaching of endangered species outside the project area. This post will have to be managed in partnership with the gendarmes (see with the DREDD). • **Support to the forest administration:** Project support will facilitate the movements of forest administration agents to control timber loading areas (hammering of authorized products) rather than control at the exit of communes (often mixtures of timber and wood from natural forests). • **Material support to be discussed:** e.g. GPS (purchase in progress), monitoring is done on foot (if possible a bicycle allowance). **<u>Support for the extension of the Fisoronana management transfer area</u>** • The PAPs transferred to Fisoronana will increase the need for natural resources in this sector. The MNP proposes to extend the management transfer area of Fisoronana to as yet unmanaged forests, in particular the Manaripatsa forest in the extreme northeast of

	the commune of Belanitra, bordering the territory of the District of Marolambo. The Project could support the MNP in the VOI extension process: initial assessment, field inventories, consultations, organization, elaboration of forest management plans. The process of extending the VOI of Fisoronana could start as soon as the Project starts (resource inventories, organisation etc.) and validation could be done once the population has settled on the new site of relocation. Discussions are under way with the DREDD responsible for the process of evaluating and contracting the management transfer zones. **Support for restoration actions** • In line with the objectives of reforestation of protected areas in Madagascar, the MNP has been conducting forest restoration actions for several years. In the north of the park, these actions are now stopped due to lack of means. Synergies could however be found with the installation of local nurseries (in Fisoronana in particular) planned within the framework of the reforestation and restoration actions of the project and the actions of the MNP; • The rehabilitation of the access road to the project could also facilitate the travel of conservation NGOs and facilitate MNP restoration projects in the northern sector. For example: collaboration with associations working with the MNP (e.g. Graine de Vie) but in areas that are less isolated than the Fisoronana region. **Raising the awareness of local populations** • Awareness-raising actions are cross-cutting and important. However, the MNP's resources only allow officers to come into contact with the local population once every two months. The project could support the MNP to carry out monthly awareness campaigns among local populations. **MNP Communication** • The MNP management plan was updated in 2019. The Project could support the MNP in the implementation of the process of validation of the updated MAP with the local populations and more widely of the actions of communication / diffusion of the MAP to the local populations. **Ecological monitoring** • Currently, no ecological monitoring is being carried out in the northern zone of the MNP. Synergies would thus have to be found between the participatory monitoring actions planned within the framework of the Project's ESMP and the monitoring needs of the MNP, in particular through the setting up of joint local committees
Other associated measures	• BAP 21 - COMPENSATION_FOREST_RESTORATION
Implementation constraints	
Implementer	• NEHO
Stakeholders –	• PNM
Institutional or technical support	• DGEF (supervisory actions)
Sustainability	• Memorandum of Understanding between the project and the MNP

guarantee (governance)	

MEASURE IMPLEMENTATION MONITORING	
Monitoring arrangements	• Satellite image analysis
Implementation indicators	• Monitoring deforestation in the northern zone of the MNP
Effectiveness indicators	• Monitoring deforestation in the northern zone of the MNP
Monitoring frequency	• Annual Review
Monitored by	**NEHO**

ESTIMATED BUDGET	
Cost breakdown	• Implementation: the indicative budget is to be secured with the Marolambo National Park, focusing in priority on support for surveillance activities of the MNP in the northern sector (support for joint actions with the gendarmerie, guard posts, travel of forest administration agents, material support to be estimated). • Monitoring: budget for annual analysis of satellite imagery to assess the overall effectiveness of NPA in combating deforestation (annual calculation of reforestation/deforestation rate) over the life of the project.
Cost in euros	• To be determined

Annex 5 – Support Measures Targeting Terrestrial Habitats

BAP 24 – Support_Ecological_Monitoring_Plan

PURPOSE OF MEASURE	
Measure code	SUPPORT_ECOLOGICAL_MONITORING_PLAN
Measure title	**Implementation of targeted monitoring of biodiversity (flora and fauna species triggering critical habitat) over the long term**
Measure type	**Support**
Critical habitat	YES, Dense humid forest and Onive downstream from the plant
Activities (impact source)	• Any type of activity
Key impacts and risks	• Any type of impact

IMPLEMENTATION OF THE MEASURE	
Project phase	Construction / Operation
Duration of the measure	During the construction phase and for the duration of the project (35 years)
Objective	NO OBJECTIVE
Description of the measure	The construction and installation of the infrastructure will last several years and will result in the destruction and/or degradation of some habitats. For these reasons, ecological monitoring will have to be carried out to study the evolution of habitats and remarkable fauna and flora.

	As far as possible, all monitoring and follow-up actions that allow this will be carried out with the direct involvement of the populations (principle of participatory monitoring).
Geographical area	Forest Corridor
Action plan	**<u>Ecological monitoring of habitats</u>** This monitoring will concern all forested areas and wildlife and plant species with high ecological stakes (triggering critical habitat). An initial status will be carried out beforehand and then periodic follow-ups will be recommended during and at the end of the installation phase. The process consists of: • Establish permanent monitoring plots before, during and after the works in order to assess the conservation status of the habitats and the associated remarkable species; • Carry out regular population monitoring of species of conservation concern; • Analyze the observed information on the changes generated by the project; • Identify and implement adjustment measures if necessary. **<u>Ecological monitoring of target species and adaptation</u>** A monitoring program for a number of target species, fauna and flora and triggered critical habitat analyses will be undertaken with protected area managers and proponents, with the aim of • Verify in the long term that there is no net loss of biodiversity, • Identify possible adaptive measures to be implemented, • To improve knowledge of these species and thus contribute to their protection.
Other associated measures	• BAP 29 - SUPPORT_KNOWLEDGE_RHEOCLES
Implementation constraints	• Involve local populations directly in ecological monitoring (dedicated training and local employment opportunities)
Implementer	• NEHO
Stakeholders –	• Proponent of the future NPA • Marolambo National Park • Representatives of the Fokhontany concerned for the involvement of the local population in the implementation of the ecological monitoring of the project.
Institutional or technical support	• Scientific bodies to be identified (e.g. MBG on floristic aspects)
Sustainability guarantee (governance)	• Dedicated and secured funds for conducting inventories

MEASURE IMPLEMENTATION MONITORING	
Monitoring arrangements	• Annual report published on the NEHO website
Implementation indicators	• Conducting annual monitoring inventories, as planned in the monitoring protocol (at least two monitoring periods, in the dry and rainy seasons). • Local hiring for follow-up implementation (if relevant)
Effectiveness indicators	• Follow-up and publication on the website
Monitoring frequency	Annual (with at least two inventory periods in the dry and wet seasons)
Monitored by	• **NEHO**

Cost breakdown	• Implementation: to be determined • Follow-up: no extra cost for the BAP.
Cost in euros	• To be determined

BAP 25 – Support_Inventories_IBA_Birds

Measure code	SUPPORT_INVENTORIES_IBA_BIRDS
Measure title	**Updating IBA inventories with the relevant entity**
Measure type	**Support**
Critical habitat	YES, Dense humid forest and Onive downstream from the plant

Activities (impact source)	• Installation of the high-voltage line between the start of the power line at Sahofika and Belanitra and then between Belanitra and Antanifotsy
Key impacts and risks	• **Type:** Direct • **Degree:** MODERATE • The risk of collision mainly concerns birds of prey and more especially the ground wire, during the phases of diving towards prey identified on the ground, i.e. during high-speed flight from top to bottom. • The risk of collision may also occur near bodies of water (lake, ponds) on the route of the HV line to Antanifotsy. Waterbirds can potentially stay there and be potentially affected by the risk of collisions, especially during their flight (e.g. duck flights).

Project phase	Construction / Operation
Duration of the measure	During the construction phase and for the duration of the project (35 years)
Objective	NA
Description of the measure	To avoid increasing disparities between the Project's ornithological data and ONIVE's Gazetted forest IBA data, the project will contribute to updating IBA data through the IBA's reference NGO, namely Asity Madagascar. The precise modalities of this support remain to be defined, and may be extended to other more specific bird conservation activities under the Biodiversity Action Plan.
Geographical area	The IBA (especially the southern sector in the vicinity of the project)
Action plan	• Follow-up protocol to be determined with the entity responsible for the IBA - Asity Madagascar
Other associated measures	• All BAP measures
Implementation constraints	NONE
Implementer	• Before construction starts, during construction and operation: NEHO • Before and During the construction phase: EPC
Stakeholders –	• Asity Madagascar

Institutional or technical support	NO
Sustainability guarantee (governance)	NA

MEASURE IMPLEMENTATION MONITORING	
Monitoring arrangements	• Follow-up on the completion of the new inventory
Implementation indicators	• IBA inventory updated and submitted to Birdlife for publication
Effectiveness indicators	• IBA inventory updated and submitted to Birdlife for publication
Monitoring frequency	At the end of the inventory
Monitored by	• **NEHO**

ESTIMATED BUDGET	
Cost breakdown	• Implementation: the indicative budget must be secured with Asity (managing association of the IBA). ✓ A first indicative budget of 14500 € is being studied with Asity. • Follow-up: no extra cost for BAP
Cost in euros	• To be determined

BAP 26 - Support_ Environmental_Awareness-Raising

PURPOSE OF MEASURE	
Measure code	SUPPORT_ ENVIRONMENTAL_AWARENESS-RAISING
Measure title	**Public and employee information and awareness program**
Measure type	**Support**
Critical habitat	YES, Dense humid forest and Onive downstream from the plant
Activities (impact source)	• Construction of the access roads, dam, penstock, surge tank and plant
Key impacts and risks	• **Type:** Direct • **Degree:** • direct impact related to waste pollution - MODERATE • Direct impact related to fire hazards - STRONG

IMPLEMENTATION OF THE MEASURE	
Project phase	During the construction and operation phases
Duration of the measure	During the construction phase and for the duration of the project (35 years)
Objective	NA
Description of the measure	Prior to start-up and during construction, the Project will implement a program to inform and sensitize the population and workers on the risks to fauna and flora in the Project area, the benefits of a protected natural environment and rich biodiversity, and the measures

	implemented by the Project in this regard:
Action plan	• Awareness-raising and information activities for the population concerned about the Project and the associated biodiversity protection measures; • Information sharing, training and capacity building of project staff on environmental measures taken by the Project; • Prohibiting access by persons other than project personnel to construction sites and prohibiting project employees from travelling to unauthorized areas, including ecologically sensitive habitats; • Ongoing evaluation of the effectiveness of the measures taken in order to correct or adjust them if necessary; • Employee training and awareness campaigns to monitor the presence of high conservation concern species on the site prior to the work (clearing of land, passage of machinery, etc.). All species triggering critical habitat must be targeted by these training and awareness actions; • A training program for drivers on the removal of wildlife species from roadways; • A driver training program, covering the basic rules (observing speed limits, wearing seat belts, vehicle condition). • A mechanism put in place by the EPC for sanctioning employees in case of non-compliance with the BAP requirements by these employees: destruction of natural forest beyond the ~216 hectare anticipated by the project, poaching of protected and endangered species (triggering critical habitat), accidental spills into watercourses not repaired, etc.
Other associated measures	• All BAP measures
Implementation constraints	NONE
Implementer	• Before construction starts, during construction and operation: NEHO • Before and During the construction phase: EPC
Stakeholders –	• Representatives of the Fokhontany concerned
Institutional or technical support	NO
Sustainability guarantee (governance)	NA

MEASURE IMPLEMENTATION MONITORING	
Monitoring arrangements	• Checking employee certificates (or attendance sheets of people who have gone through training/awareness raising on good environmental practices on the worksite)
Implementation	• Number of consultations with the population

indicators	
Effectiveness indicators	• Percentage of employees who have gone through training/awareness raising on good environmental practices on the worksite
Monitoring frequency	**Monthly**
Monitored by	• EPC (for employees and other persons under the responsibility of the EPC) • NEHO (for the population) •

Cost in euros	• No additional cost for the BAP; included in the project design

BAP 27 - Support_Reforestation

PURPOSE OF MEASURE	
Measure code	SUPPORT_REFORESTATION
Measure title	**Support program for VOI: reforestation in management transfer areas and preservation of ecosystem services.**
Measure type	Reduction
Critical habitat	No critical habitat affected
Activities (impact source)	• Construction of access roads, improvement of access to the Project area • Inflow of newcomers
Key impacts and risks	• **Type:** Induced • **Degree:** MODERATE • Increasing pressures on natural resources in status areas

IMPLEMENTATION OF THE MEASURE

Project phase	Construction / Operation
Duration of the measure	Starts during the construction phase and continues throughout the operation phase of the project (35 years).
Objective	NA, Supporting ERC measures
Description of the measure	To avoid pressure on natural forests in status areas and on land targeted for forest restoration, it is recommended that the following be developed as early as the construction phase: • Building a reforestation program with fast-growing species. Several reforestation programs are to be initiated within the framework of the BAP: • Limit deforestation near the resettlement site in the West of the forest corridor (within the green belt of the MNP) in partnership also with the MNP and the 3 VOIs concerned (Fisoronana, Befotaka, Antenina), in particular the Fisoronana VOI closest to the MNP and including the resettlement site - see reforestation project included in the RAP • Limit pressures on the NPA east of the forest corridor in partnership with the Proponent of the future NPA and the future VOIs of Ambalaomby and Sahofika
Geographical area	Reforestation on the Fisoronana site (relocation) and at Faravohitra
Action plan	• Identify sites suitable for reforestation with the VOIs concerned. • Set up local nurseries: VOI support for the purchase of seedlings, and seedling management: it is envisaged to set up two community nurseries in conjunction with the ecological restoration actions targeted by the compensation and revegetation measures. The two sites are located on the site of Fisoronana and the other near the village of Faravohitra. • Establish plantations of fast-growing species, such as eucalyptus, that can produce quality barrels that can be used for lumber and service; • Planting is carried out on acid soil (old tavy or old forest soils) but with a minimum of maintenance, silvicultural care and protection (especially against fire). Silvicultural care to be applied: ✓ Thinning (from 1000 individuals at planting to 500 individuals per hectare from the 5th year. Thinning is an operation consisting of removing a certain number of trees from a plot of land in favour of those left in place. ✓ Pruning at the end of year 2 and the end of year 4. Pruning is a technique consisting in regularly lifting the crown of trees intended for timber production, in order to limit the development of knots, by regularly cutting the branches; • VOI support for fire protection: firewalls, security. It should be noted that for a first 5-year production cycle, the average diameter obtained is 35 cm. For one hectare of 5-year reforestation, we will have 500 individuals representing 187 m3.
Other associated measures	• BAP 23 - COMPENSATION_SUPPORT_MAROLAMBO_NP • BAP 22 - COMPENSATION_SUPPORT_TSINJOARIVO_NPA • BAP 21 - COMPENSATION_FOREST_RESTORATION
Implementation constraints	To be determined

Implementer	• VOI involved in reforestation programs
Stakeholders	• Proponent of the future NPA - consistent with the reforestation programs under the NPA MAP; • VOI of Fisoronana - maintenance of the nursery and implementation of the reforestation program at the resettlement site; • VOI of Sahofika and Ambalaomby - maintenance of the nursery and implementation of reforestation programs in support of the protection of the NPA in conjunction with the Proponent of the future NPA; • Antenina VOI (depending on the future of this VOI) and Befotaka VOI - implementation of reforestation programs in support of the natural forest restoration measures provided for under the compensation measure COMPENSATION_FOREST_RESTORATION
Institutional or technical support	• NGO specialized in reforestation programs
Sustainability guarantee (governance)	• Involvement of VOIs in the choice of reforestation sites and involvement of local populations in the implementation (choice of species to be planted, management of nurseries and plantations)

MEASURE IMPLEMENTATION MONITORING	
Monitoring arrangements	• Monitoring reforestation actions in VOIs
Implementation indicators and target	• Status of reforestation - nurseries, plantations, management
Effectiveness indicators and target	• Area reforested and number of trees planted
Monitoring frequency	• Annual
Monitored by	• NEHO and VOI members involved in a reforestation program

ESTIMATED BUDGET	
Cost breakdown	• To be determined according to the area to be reforested: average fixed costs of 400€/hectares reforested (GIZ, 2016).
Cost in euros	• No additional cost for the PAO included in the Project Relocation Plan (PRP)

References:

- *GIZ, 2016. Restoration des Paysages Forestiers – Evlaution des potentialités dans le contexte des engagements de Bonn 2.0 et de la Déclaration de New York sur les forêts. Méthodologie et résultats pour Madagascar.*
- *WWF, 2010. Restoration des paysages forestiers – Cinq ans de réalisation à Fandriana-Marolambo (Madagascar)*
- *Conservation International, 2011. Forest Restoration à Madagascar: Document de capitalisation des expériences en vue de l'élaboration d'un Plan d'Action de Restoration*

Implementation: the indicative budget is to be secured with the Marolambo National Park, focusing in priority on support for surveillance activities of the MNP in the northern sector (support for joint actions with the gendarmerie, guard posts, travel

- *UICN et WRI (2014). A Guide to the Restoration Opportunities Assessment Methdology (ROAM) Online:* http://cmsdata.iucn.org/downloads/roam_handbook_lowres_web.pdf
- *Andiramanantsehheno C., Richter F.& SeppS.2013. Standards et principes du „reboisement villageois individuel"-Reboisement énergétique sur terrains dénudés. ECO-Consulting Group. Online:* http://www.eco-consult.com/fileadmin/user_upload/pdf/downloads/RVI_standards_et_principes.pdf

Implementation: the indicative budget is to be secured with the Marolambo National Park, focusing in priority on support for surveillance activities of the MNP in the northern sector (support for joint actions with the gendarmerie, guard posts, travel

BAP 28 - Support_Income_Generating_Activities

PURPOSE OF MEASURE	
Measure code	SUPPORT_INCOME_GENERATING_ACTIVITIES
Measure title	**Support for the development of income-generating activities (agriculture and other sectors)**
Measure type	Support
Critical habitat	NA, no critical habitat directly targeted
Activities (impact source)	• Construction of access roads, improvement of access to the Project area • Inflow of newcomers
Key impacts and risks	• **Type:** Induced - Increasing pressure on natural resources in status areas

Project phase	Construction / Operation
Duration of the measure	Starts during the construction phase and continues throughout the operation phase of the project (35 years).
Objective	NA, support ERC measures
Description of the measure	Forest restoration projects most often include sustainable livelihood activities to support the economic diversification of local populations, provide income alternatives and thus reduce pressures on forests. • Actions related to the improvement of the agricultural income of the households concerned: increasing production and/or income is one of the key principles to reduce the pressure on the forest landscape, while improving the well-being of the population.
Action plan	• Define the modalities of support to the communities

Implementation: the indicative budget is to be secured with the Marolambo National Park, focusing in priority on support for surveillance activities of the MNP in the northern sector (support for joint actions with the gendarmerie, guard posts, travel

	• Doing technical and socio-organizational capacity building • Provide materials and equipment • Provide administrative support for activities Type of development projects envisaged (in the RAP): Establishment of a community development cooperative that will largely take charge of improving farming and livestock practices for all displaced persons, but also for the entire population of the project's impact area while ensuring essential tasks for the implementation of socio-economic mitigation measures of the project; • Agroforestry projects: plantation/conservation of fertilizer trees (legumes) in crops • Income-generating projects: technical support for agricultural production (agro-ecological techniques, agro-forestry, etc.), support for agricultural development (market gardening), support for the purchase of equipment, support for the development of small-scale livestock farming, support for the development of commodity chains (equipment for the processing and marketing of products) - promising agricultural commodity chains to be determined. • Support for reconversion (crafts, trade, ecotourism) • Support for the development of ecotourism activities: increased potential due to the accessibility of the NPA after rehabilitation and construction of access roads to the dam, consideration of local employment opportunities common to the project and potential ecotourism activities: recycling local jobs from the project into the ecotourism project (cooks, camp leaders, guides, etc.).
Other associated measures	• BAP 27 - SUPPORT_REFORESTATION • BAP 21 - COMPENSATION_FOREST_RESTORATION
Implementation constraints	• Imbalance between project supply and demand from target groups • Incorrect identification of promising sectors (no prior market study) • Weak ownership by beneficiaries leading to dependency on allocated funds
Implementer	• NEHO
Stakeholders –	• Local communities affected by restoration actions • Proponent of the future NPA • Village representatives: Antenina, Faravohitra • VOI in the buffer zones of the NPA and near the project area: Ambalaomby and Sahofika (under creation) and the 3 VOI on the right bank (Fisoronana, Befotaka, Antenina).
Institutional or technical support	• Agricultural development NGO
Sustainability guarantee (governance)	• To be determined

MEASURE IMPLEMENTATION MONITORING	
Monitoring arrangements	• Follow-up on measures taken to support the development of IGAs
Implementation indicators	• Status of programs and projects implemented

Effectiveness indicators	• Number of planned support measures carried out
Monitoring frequency	**At the end of the project**
Monitored by	• NEHO

ESTIMATED BUDGET	
Cost breakdown	• Implementation: to be determined based on actions anticipated in the RAP. • Follow-up: to be determined, in relation to the actions foreseen in the RAP.
Cost in euros	• No additional cost for the PAO included in the Project Relocation Plan (PRP)

Annex 6 – Support Measures for Aquatic Habitats and Species

BAP 29 - Support_Knowledge_Rheocles

PURPOSE OF MEASURE	
Measure code	SUPPORT_KNOWLEDGE_RHEOCLES
Measure title	**Reinforcing knowledge on Rheocles wrightae and Rheocles sp. Ambatovy**
Measure type	**Support**
Species concerned	• *Rheocles wrightae and Rheocles sp. Ambatovy*
Critical habitat	YES, Onive downstream from the plant + tributary
Activities (impact source)	• Construction of the access roads, dam, penstock, surge tank and plant • Operation of the hydropower project
Key impacts and risks	• Unproven but potential impacts related to the operation of the hydropower project: changes in the hydrological regime, water quality and sediment regime (altered habitat modification).

Project phase	Construction / Operation
Duration of the measure	Starts in the work phase and continues for several years (follow-up time to be determined)
Objective	Acquisition of knowledge
Description of the measure	This measure is a prerequisite for any eventual restoration project for the species. Indeed, the literature review highlighted the gaps in knowledge about these species.
Geographical area	The study area for this measure could be the study area close to the project downstream from the plant, i.e., the watershed of the Onive River and its tributaries from downstream from the rapids in the lower part of the short-circuited section to the confluence with the Mangoro River.
Action plan	The two components of this measure will focus on: • Genetic sequencing of the species with a view to deploying environmental DNA (eDNA) techniques for the search for the species; • A finer description of the species' habitat via a prospecting effort coupled with eDNA in a first step in order to target the areas where the species is present (hydrographic section scale), then by a traditional piscicultural inventory in a second step (electric fishing, fishing gear) on the sections that have revealed the presence of the species, in order to describe the species' habitat more precisely (temperature and physico-chemistry in situ, flow velocities, depths, flow facies, substrate, clogging, etc.). • Improved knowledge of the ecology of the species: breeding and feeding patterns, seasonal migrations and preferred habitats. • This measure will be coupled with the inventory data from the reservoir filling tests (BAP 16), which will provide the basis for longer-term monitoring and the first knowledge base on these species in terms of distribution and habitat. Considering the high rate of endemism in the *Rheocles* genus, this measure will also make it possible to verify whether there is not a subspecies specific to the study area.
Other associated measures	• BAP 16 - REDUCTION_IMPOUNDMENT_RESERVOIR
Implementation constraints	NPA
Implementer	• NEHO
Stakeholders	• Proponent of the future NPA, consulted for the elaboration of the study specifications, in coherence with the objectives of the NPA MAP in relation to the conservation of Rheocles species and suitable habitats.

Institutional or technical support	• MAVOA and MZBA for conventional ichthyological inventories (electric fishing, fishing gear) • Ichtyologist trained in eDNA analysis
Sustainability guarantee (governance)	No particular constraints

MEASURE IMPLEMENTATION MONITORING	
Monitoring arrangements	• Effective increase of the understanding of the ecology of Rheocles sp..
Implementation indicators	• Drafting of the study specifications (inventory schedule, sampling, eDNA) • Study Status
Effectiveness indicators	•
Monitoring frequency	**To be determined**
Monitored by	**NEHO**

ESTIMATED BUDGET	
Cost breakdown	• <u>Implementation:</u> ✓ Budget for a genetic study (including field inventories and a laboratory analysis phase) ✓ Budget for field inventory sessions (ADNe + fish inventories) downstream from the dam to study habitats suitable for the species (including significant logistical costs due to difficulties of access to sectors downstream from the dam) ✓ Budget for the drafting of a study report • Follow-up: no extra cost for the BAP.
Cost in euros	• To be determined

BAP 30 - Support_Awareness-Raising_Local_Fisheries

Measure code	SUPPORT_AWARENESS-RAISING_LOCAL_FISHERIES
Measure title	**Raising awareness of local populations to target the capture of invasive alien species (IAS) rather than endangered species (R. wrightae) and native crayfish.**

Implementation: the indicative budget is to be secured with the Marolambo National Park, focusing in priority on support for surveillance activities of the MNP in the northern sector (support for joint actions with the gendarmerie, guard posts, travel

Measure type	**Support**
Species concerned	• Aquatic fauna: X,
Critical habitat	YES, Onive downstream from the plant + tributary
Activities (impact source)	• Presence of restraint
Key impacts and risks	• **Type:** Direct • **Degree:** HIGH The transition from a mosaic of relatively diverse aquatic habitats in terms of flow facies upstream from the reservoir to a uniform lentic area will favor the least demanding species with rapid development capacities such as invasive alien species: carp Cyprinus carpio or *Channa maculata* , predators of Rheocles in particular. • Indirect impact related to the proliferation of aquatic alien invasive species to the detriment of native species - STRONG

• **IMPLEMENTATION OF THE MEASURE**	
Project phase	Operation
Duration of the measure	During the entire operation phase of the project (35 years)
Objective	NA, Support
Description of the measure	Surveys have confirmed that some rare or endangered species are under fishing pressure. This is notably the case of Rheocles (“zono” in Malagasy) but also of crayfish (“orana” in Malagasy). This measure aims to achieve
Geographical area	Upstream area of the dam - fishing activities on the reservoir and tributaries of the Onive River
Action plan	• To set up awareness-raising activities on the use of certain traditional fishing techniques (angling or fishing with gill nets or large trunk gill nets) that make it possible to target less demanding and less heritage species such as Rheocles and native crayfish.
Other associated measures	• COMPENSATION_REDUCTION_AQUATIC_IAS_CONTROL

Implementation constraints	Receptiveness of the populations concerned
Implementer	• NEHO
Stakeholders –	NGO specialized in ichthyology and public awareness
Institutional or technical support	To be determined
Sustainability guarantee (governance)	• Ensuring the involvement of local fishermen

MEASURE IMPLEMENTATION MONITORING	
Monitoring arrangements	• Surveys of fishermen and local populations
Implementation indicators and target	• Number of awareness-raising sessions conducted with fishermen and local populations
Effectiveness indicators and target	• % of surveyed fishermen who changed their fishing practices
Monitoring frequency	**Quarterly**
Audit	**NO**
Monitored by	• NEHO

ESTIMATED BUDGET	
Cost breakdown	• Implementation: ✓ Organization of three awareness campaigns per year among the local population (fishermen), throughout the life of the project. ✓ Indicative budget of € 10000 / year for 35 years • Follow-up: no extra cost for BAP
Cost in euros	To be determined

Implementation: the indicative budget is to be secured with the Marolambo National Park, focusing in priority on support for surveillance activities of the MNP in the northern sector (support for joint actions with the gendarmerie, guard posts, travel

Annex 6 – Support Measures for Aquatic Habitats and Species

Annex 7 - Species Data Sheets

Poissons – *Rheocles wrightae; R. sp. ambatovy*

Family			Scientific Name	IUCN Status	Presence	Range	Sites where it is known to occur	Area of analysis	Critical habitat
Bedotiidae			*Rheocles wrightae*	EN	Proven	Restricted (7,335 km²)	Mangoro basin downstream from the plant	ERAA4	**Confirmed**
Bedotiidae			*Rheocles sp. Ambatovy*	DD	Proven	Restricted (unknown)	Ambatovy - Mangoro basin downstream from the plant	ERAA 4	**Confirmed**

Rheocles sp. Ambatovy

Rheocles wrightae

ECOLOGY OF THE SPECIES	
Species description and eco-ethology	Stiassny & Reinthal (1992) and Stiassny & Rodriguez (2001) state that the majority of species of the Rheocles genus are from central eastern Madagascar. More specifically, several species of the Rheocles genus, including R. wrightae, are recorded in the Mangoro watershed. This species has therefore been observed throughout its known range.
Habitats	This species is mainly present in the lentic areas according to surveys and observations, which seems to be a trait of the Bedotiidae family. However, it is not possible to eliminate lotic areas (at moderate to high current velocities).
Ecologically relevant area of analysis	A1, Onive downstream from the plant and its tributary
Potential use or associated	

ecosystem service	The species is subject to a fishing practice identified during surveys among the inhabitants of the villages around the future plant. However, this fishing activity is opportunistic.
Threats	• This species is sensitive to deforestation and the associated consequences of habitat and water quality degradation (increased turbidity, water temperature and riverbed clogging). • This species can also be indirectly impacted (predation by alien species, etc.). • O. mykiss and especially *Channa maculata*).

SENSITIVITY AND ASSOCIATED MEASURES	
Sensitivity in relation to the project:	• Direct impacts of the dam on the habitat and water quality (clogging, turbidity) of the Onive (already largely impacted on these parameters), but also on its hydrology (possible impact of a sluice operation); • But also indirectly with the spread of these exotic species already present essentially upstream from the future dam and on the BR, upstream from the rapids. *Channa maculata* is a calm water species. The creation of a reservoir can therefore potentially facilitate its development.
Key associated measures	• REDUCTION_AQUATIC_IAS_CONTROL: Targeted and adapted control of aquatic invasive alien species (IAS) and *Channa maculata* in particular • REDUCTION_EROSION_RISKS: Reduce erosion risks as much as possible • SUPPORT_KNOWLEDGE_RHEOCLES: Reinforce knowledge on Rheocles wrightae and Rheocles sp. Ambatovy • SUPPORT_AWARENESS-RAISING_LOCAL_FISHERIES: Raising awareness among local populations to target the capture of invasive alien species (IAS) rather than threatened species (R. wrightae) and native crayfish

Écrevisses – *Astacoides caldwelli; A.madagascariensis*

Family	Scientific Name	IUCN Status	Presence	Range	Sites where it is known to occur	Area of analysis	Critical habitat
Parastacidae	*Astacoides caldwelli*	**VU**	Proven	Restricted (11,930 km²)	• Central-Eastern Madagascar • north and south of the Onive River	ERAA 1 and ERAA2	**Confirmed**
Parastacidae	*Astacoides madagascariensis*	LC	Proven	Restricted (11 7,465km²)	• provinces of Toamasina (Andasibe, Amboasary gara) and Antananarivo (Anjozorobe, Mantasoa, Fenoarivo, Behenjy) • The species is present north of the Onive River.	ERAA 1	**Confirmed**

Astacoides caldwelli (Biotope, 2018)

ECOLOGY OF THE SPECIES

Species description and ecoethology	In Madagascar, freshwater decapods have a richer species diversity and a higher rate of endemism than comparable countries in the Afrotropical region. Recent exploration and new taxonomic studies have shown that Madagascar has 17 species of freshwater crabs (Potamonautidae), seven species of crayfish (Parastacidae) and 40 species of freshwater shrimp (Atyidae and Palaemonidae), most of which are endemic. These numbers are expected to increase as exploration continues. *Astacoides caldwelli* is a species of freshwater crayfish endemic to the highlands of eastern Madagascar. Its ecology is still very little known. It breeds once a year with a clear peak (synchrony) in the number of females bearing eggs between July and October. The eggs are carried for about 4 months and hatch between October and November. All juveniles are independent at the end of January (Jones J.PG. et al, 2007).

Habitats	There is very little information on Astacoid habitats. The literature concludes that species of the Astcoides genus are restricted to streams in the upper reaches or are abundant upstream in faster streams flowing through the forests. Furthermore, the initial status has made it possible to specify that it is present in the immediate study area only on wooded tributaries and that it is absent from the Onive River.
Area of analysis	A2, tributaries in good condition in the dense rainforest
Potential use or associated ecosystem service	The species can be collected by local people for subsistence needs or small-scale trade (Jones et al., 2006) (Jones et al., 2006).
Threats	• The main threats to Madagascar's freshwater decapod fauna result from high human population density, increasingly disturbed habitats, extreme fragmentation, and poor land-use practices. • There is also the threat of the freshwater fish *Channa maculata ,* an invasive alien species that feeds on young crayfish.

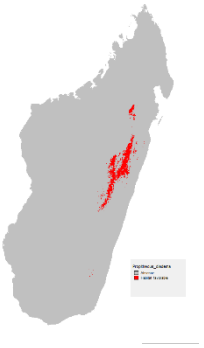
SENSITIVITY AND ASSOCIATED MEASURES

Sensitivity in relation to the project	• Risk of pollution and degradation of the aquatic habitat of the tributaries of the Onive River • Crossings to be expected
Key associated measures	• COMPENSATION_REDUCTION_AQUATIC_IAS_CONTROL: Targeted and adapted control of aquatic invasive alien species (IAS) and Channa maculata in particular • REDUCTION_EROSION_RISKS: Réduire autant que possible les risques liés à l'érosion • SUPPORT_AWARENESS-RAISING_LOCAL_FISHERIES: Raising awareness among local populations to target the capture of invasive alien species (IAS) rather than threatened species (R. wrightae) and native crayfish • AVOIDANCE_CROSSING_TRIBUTARIES: Installation out-of-water crossing structures (nozzles, gutters, and culverts) on the tributaries by conducting works in waterless conditions (diversion) and with safeguard fishing measures

Bibliographic References

- Hobbs Jr, H. H. (1987). A review of the crayfish genus Astacoides (Decapoda: Parastacidae). Smithsonian Contributions to Zoology.
- Cumberlidge, N., Rasamy Razanabolana, J., Ranaivoson, C. H., Randrianasolo, H. H., Sayer, M., Máiz-Tomé, L., ... & Darwall, W. R. (2017). Updated extinction risk assessments of Madagascar's freshwater decapod crustaceans reveal fewer threatened species but more Data Deficient species.

Diademed sifaka - *Propithecus diadema* - CR

Propithecus diadema		
Classe, Family	Mammal, Indriidae	
IUCN Status	**CR**	
Presence in the Area of analysis	Proven	
Occurrence	**Restricted (44292 km²)** Sites where it is known to occur: Mananara-Nord, Mantadia, Zahamena, Betampona, Ambatovaky, Mangerivola, Marotandrano, Andriantantely, Tsinjoarivo, Marokitay, Anosibe an'ala, Anjozorobe, Didy, Iofa, Maromizaha, Sandranantitra	
Critical habitat	Yes, according to PS6 C1, C2 criteria	

ECOLOGY OF THE SPECIES	
Species description and ecoethology	*Propithecus diadema* is a species of eastern moist forest **Diademed sifaka**. This species persists in some smaller forest fragments (up to about 30 ha). Its diet consists mainly of ripe fruit, seeds, flowers and young leaves, with their respective proportions varying according to seasonal abundance.
Habitats	This species is associated with primary rainforest habitats,
Area of analysis	ERAA1

Potential use or associated ecosystem service	It is a species hunted for food, which is a definite threat to its conservation.
Threats	• Continued destruction of rainforest habitat in eastern Madagascar due to slash-and-burn farming techniques and expansion of sugar cane cultivation land for Tsinjoarivo • Selective logging of trees used for *Propithecus diadema* (Irwin and Ravelomanantsoa 2004) • Hunting for food

SENSITIVITY AND ASSOCIATED MEASURES	
Sensitivity in relation to the project	• Risks of habitat loss through fire and erosion • Increased hunting
Key associated measures	• BAP 1 - AVOIDANCE_NATURAL_HABITATS_BELANITRA_DAM • BAP 2 - AVOIDANCE_NATURAL_HABITATS_DAM_PLANT • BAP 5 - REDUCTION_PRESERVATION_CONTINUUM • BAP7 - REDUCTION_SENSIBLE_CLEARING • BAP 11 - REDUCTION_POPULATION_INFLUX_POACHING • BAP 21 - COMPENSATION_FOREST_RESTORATION • BAP 22 - COMPENSATION_SUPPORT_TSINJOARIVO_NPA • BAP 23 - COMPENSATION_SUPPORT_MAROLAMBO_NP

Bibliographic References

- Irwin MT. 2008a. Diademed sifaka (*Propithecus diadema*) ranging and habitat use in continuous and fragmented forest: Higher density but lower viability in fragments? . *Biotropica* 40(2): 231-240.
- Irwin MT. 2008b. Feeding ecology of diademed sifakas (*Propithecus diadema*) in forest fragments and continuous forest. *Int J Primatol* 29(1): 95-115.
- Irwin, M. T. and Ravelomanantsoa, H. V. 2004. Illegal rum production threatens health of lemur populations at Tsinjoarivo, eastern central Madagascar: brief report and request for information. *Lemur News* 9: 16–17.
- Irwin MT, Raharison J-L, and Wright PC. 2009. Spatial and temporal variability in predation on rainforest primates: Do forest fragmentation and predation act synergistically? . *Anim Conserv* 12(3): 220-230.
- UICN. 2014. The IUCN Red List of Threatened Species. Version 2014.1. Available at: www.iucnredlist.org. (Accessed: 12 June 2014).
- Mayor, M. I., Sommer, J. A., Houck, M. L., Zaonarivelo, J. R., Wright, P. C., Ingram, C., Engel, S. R. and Louis, E. E. 2004. Specific status of *Propithecus* spp. *International Journal of Primatology* 25: 875-900.
- Mittermeier, R.A., Louis Jr., E.E., Richardson, M., Schwitzer, C., Langrand, O., Rylands, A.B., Hawkins, F., Rajaobelina, S., Ratsimbazafy, J., Rasoloarison, R., Roos, C., Kappeler, P.M. and MacKinnon, J. 2010. *Lemurs of Madagascar. 3rd edition*. Conservation International, Arlington, VA.
- Mittermeier, R.A., Rylands, A.B. and Wilson D.E. 2013. *Handbook of the Mammals of the World: Volume 3 Primates*. Lynx Edicions, Barcelona.
- Powzyk JA. 1997. The socio-ecology of two sympatric indriids: Propithecus diadema diadema and Indri indri, a comparison of feeding strategies and their possible repercussions on species-specific behaviors . Durham, NC: Duke University.

Sibree's dwarf lemur - *Cheirogaleus sibreei* - CR

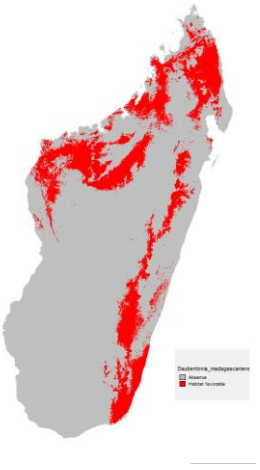
Cheirogaleus sibreei		
Classe, Family	Mammal, Cheirogaleidae	
IUCN Status	**CR**	
Presence in the Area of analysis	Proven	
Occurrence	**Very restricted (100 km²)** *Cheirogaleus sibreei is known to occur only in Ranomafana National Park and Tsinjoarivo (Madagascar). At Tsinjoarivo, C. sibreei can be bounded by the Onive and Mangoro rivers, Anjozorobe, and by the corridor leading to the western half of the Tsinjoarivo forest at an altitude of over 1,400 m. The area of occurrence of the species is currently estimated to be between 50 and 2,500 km2 with an area of occupancy of less than 10 km2. Known sites: Tsinjoarivo, locally endemic.*	
Critical habitat	Yes, according to PS6 criteria: C1, C2	

ECOLOGY OF THE SPECIES	
Species description and ecoethology	Cheirogaleus sibreei is a species of Sibree's dwarf lemur. Dwarf lemurs are the only type of primate known to undergo prolonged periods of torpor (= hibernation). This is assumed to be a response to food scarcity during the dry southern winter (Petter et al., 1977, Hladik et al., 1980, Petter-Rousseaux, 1980, Wright and Martin, 1995, Fietz and Ganzhorn, 1999, Dausmann et al., 2000, 2004). The body mass of these animals therefore shows marked seasonal changes.
Habitats	This species is associated exclusively with primary dense rainforest habitats,
Area of analysis	ERAA2
Potential use or associated ecosystem	This species is hunted for food, which is a definite threat to its conservation.

service	
Threats	• Loss and degradation of rainforests in eastern Madagascar due to agricultural expansion, selective logging and hunting. • Hunting

SENSITIVITY AND ASSOCIATED MEASURES	
Sensitivity in relation to the project	• Destruction of individuals caused by clearing activities • Risks of habitat loss through fire and erosion • Increased hunting
Key associated measures	• BAP 1 - AVOIDANCE_NATURAL_HABITATS_BELANITRA_DAM • BAP 2 - AVOIDANCE_NATURAL_HABITATS_DAM_PLANT • BAP 5 - REDUCTION_PRESERVATION_CONTINUUM • BAP7 - REDUCTION_SENSIBLE_CLEARING • BAP 11 - REDUCTION_POPULATION_INFLUX_POACHING • BAP 21 - COMPENSATION_FOREST_RESTORATION • BAP 22 - COMPENSATION_SUPPORT_TSINJOARIVO_NPA • BAP 23 - COMPENSATION_SUPPORT_MAROLAMBO_NP

Sibree's dwarf lemur - *Daubentonia madagascariensis* - EN

Daubentonia madagascariensis		
Classe, Family	Mammal, Daubentoniidae	
IUCN Status	EN	
Presence in the Area of analysis	Proven	
Occurrence	Unrestricted Known sites: Andohahela, Andringitra, Mananara-North, Mantadia, Marojejy, Masoala, South Midongy, Amber Mountain, Ranomafana, Sahamalaza-Iles Radama, Tsingy de Bemaraha, Tsingy de Namoroka, and Zahamena, Betampona, Tsaratanana, Makira, Farankaraina, Itampolo, Tsingy	 ***REBIOMA database, 2019***
Critical habitat	Yes, according to the PS6 criteria: C1	

ECOLOGY OF THE SPECIES	
Species description and ecoethology	*Daubentonia madagascariensis* is a species of Sibree's dwarf lemur. *Daubentonia madagascariensis* is a nesting species, which nests on the forks of trees or in a tangle of branches, with a single juvenile every two to three years (Petter & Peyrieras, 1970). Males have larger territories than females. It has a diversified diet: Canarium and Terminalia catappa seeds, Orania trispatha, beetle and butterfly larvae, Ravenala nectar, cultivated plants (coconut, lychees, mangoes, etc.).
Habitats	This species can adapt to different types of habitats: primary rainforest, deciduous forest,

	secondary forest, cultivated areas, dry thickets, coconut palms, mangroves (Harcourt & Thornback, 1990; Ancrenaz et al, 1994; Andriamasimanana, 1994).
Area of analysis	A2 + secondary forests
Potential use or associated ecosystem service	• This species is hunted for food in certain regions of Madagascar. • It is also a species often perceived as harmful to crops or symbolically unappreciated, hunted for that reason.
Threats	• Loss and destruction of habitat due to agricultural expansion, selective logging (*Intsia bijuga and Canarium madagascariensis*) and hunting (as a symbol of misfortune and pest for some places, and food for others - Makira). • Hunting

SENSITIVITY AND ASSOCIATED MEASURES	
Sensitivity in relation to the project	• Risks of habitat loss through fire and erosion • Increased hunting
Key associated measures	• BAP 1 - AVOIDANCE_NATURAL_HABITATS_BELANITRA_DAM • BAP 2 - AVOIDANCE_NATURAL_HABITATS_DAM_Plant • BAP 5 - REDUCTION_PRESERVATION_CONTINUUM • BAP7 - REDUCTION_SENSIBLE_CLEARING • BAP 11 - REDUCTION_POPULATION_INFLUX_POACHING • BAP 21 - COMPENSATION_FOREST_RESTORATION • BAP 22 - COMPENSATION_SUPPORT_TSINJOARIVO_NPA • BAP 23 - COMPENSATION_SUPPORT_MAROLAMBO_NP

Bibliographic References

- Petter J.-J & Peyrieras A. 1970. Nouvelle contribution à l'étude d'un lémurien malgache, le aye-aye (Daubentonia madagascariensis E. Geoffroy), Mammalia 34 (2): 167-193.
- Harcourt, C., & Thornback, J. (1990). Lemurs of Madagascar and the Comoros: The IUCN red data book. Gland, Switzerland and Cambridge, UK: IUCN - The World Conservation Union.
- Ancrenaz M, Lackman-Ancrenaz I & Mundy N. 1994. Field observations of aye-ayes (Daubentonia madagascariensis) in Madagascar. Folia Primatologica 62 (1-3): 22-36.
- Andriamasimanana M. 1994. Ecoethological study of free-ranging aye-aye (Daubentonia madagascariensis) in Madagascar. Folia Primatologica 62 (1-3): 37-45
- ISIS. 2009. International Species Information System. Apple Valley, MN Available at: www.isis.org. (Accessed: 01.01.2009).
- IUCN. 2014. The IUCN Red List of Threatened Species. Version 2014.1. Available at: www.iucnredlist.org. (Accessed: 12 June 2014).
- Iwano, T. and Iwakawa, C. 1988. Feeding behavior of the aye-aye (*Daubentonia madagascariensis*) on nuts of ramy (*Canarium madagascariensis*). *Folia Primatologica* 50: 136-142.
- Mittermeier, R., Louis, E., Hawkins, F., Langrand, O., Ganzhorn, J., Konstant, W., Rasoloarison, R., Rajaobelina, S. and Richardson, M. 2008. Lemurs of Madagascar, 3rd edition. Conservation International.

- Sterling, E.J. 1993. Patterns of range use and social organization in aye-ayes (Daubentonia madagascariensis) on Nosy Mangabe. In: Kappeler, P.M. and Ganzhorn, J.U. (eds), Lemur Social Systems and their Ecological Basis, pp. 1-10. Plenum Press, New York.
- Sterling, E. J. and Richard, A. F. 1995. Social organization in the aye-aye (Daubentonia madagascariensis) and the perceived distinctiveness of nocturnal primates. In: L. Alterman, G. A. Doyle and M. K. Izard (eds), Creatures of the Dark: The Nocturnal Prosimians, pp. 439–451. Plenum Press, New York, USA.

Sibree's dwarf lemur - *Microcebus lehilahytsara* - VU

Microcebus lehilahytsara	
Classe, Family	Mammal, Cheirogaleidae
IUCN Status	**VU**
Presence in the Area of analysis	Proven
Occurrence	**Restricted (8,350 km²)** Sites where it is known to occur: Andasibe, Maromizaha, RS Analamazaotra, Mantadia NP, Tsinjoarivo gazetted forest
Critical habitat	Yes, according to the PS6 criteria: **C2**

REBIOMA database, 2019

ECOLOGY OF THE SPECIES	
Species description and ecoethology	This species is associated with primary rainforest habitats but can be observed in eucalyptus plantations as they move.
Habitats	ERAA1
Area of analysis	This species is hunted for food.

Potential use or associated ecosystem service	• Loss and degradation of habitat due to agricultural expansion, selective logging, etc. Hunting
Threats	• This species is associated with primary rainforest habitats but can be observed in eucalyptus plantations as they move.

SENSITIVITY AND ASSOCIATED MEASURES	
Sensitivity in relation to the project	• Destruction of individuals due to land clearing • Risks of habitat loss caused by fire and erosion • Increased hunting pressure
Key associated measures	• BAP 1 - AVOIDANCE_NATURAL_HABITATS_BELANITRA_DAM • BAP 2 - AVOIDANCE_NATURAL_HABITATS_DAM_Plant • BAP 5 - REDUCTION_PRESERVATION_CONTINUUM • BAP7 - REDUCTION_SENSIBLE_CLEARING • BAP 11 - REDUCTION_POPULATION_INFLUX_POACHING • BAP 21 - COMPENSATION_FOREST_RESTORATION • BAP 22 - COMPENSATION_SUPPORT_TSINJOARIVO_NPA • BAP 23 - COMPENSATION_SUPPORT_MAROLAMBO_NP

Bibliographic References

- Ganzhorn, J.U. 1987. A possible role of plantations for primate conservation in Madagascar. American Journal of Primatology 12(2): 205-215.
- Ganzhorn, J. U. 1988. Food partitioning among Malagasy primates. Oecologia 75: 436–450.
- Ganzhorn, J.U. 1989. Niche separation of seven lemur species in the eastern rainforest of Madagascar. Oecologia 79(2): 279-286.
- IUCN. 2014. The IUCN Red List of Threatened Species. Version 2014.1. Available at: www.iucnredlist.org. (Accessed: 12 June 2014).
- Kappeler, P. M., Raoloaraison, R. M., Razafimanantsoa, L., Walter, L. and Roos, C. 2005. Morphology, behaviour and molecular evolution of giant mouse lemurs (Mirza spp.) Gray, 1870, with description of a new species. Primate Report 71: 3–26.
- Radespiel, U., Ratsimbazafy, J.H., Rasoloharijaona, S., Raveloson, H., Andriaholinirina, N., Rakotondravony, R., Randrianarison, R.M. and Randrianambinina, B. 2012. First indications of a highland specialist among mouse lemurs (Microcebus spp.) and evidence for a new mouse lemur species from eastern Madagascar . Primates 53(2): 157-170. doi:10.1007/s10329-011-0290-2.
- Roos, C. and Kappeler, P. 2006. Distribution and Conservation Status of Two Newly Described Cheirogaleid Species, Mirza zaza and Microcebus lehilahytsara. Primate Conservation 21: 51-53.

Betsileo sportive lemur - *Lepilemur betsileo* - EN

Lepilemur betsileo	

Classe, Family	Mammal, Lepilemuridae	
IUCN Status	EN	
Presence in the Area of analysis	Probable	
Occurrence	Restricted (3000 km²) Sites where it is known to occur: only the Fandriana region in the central-eastern part of madagascar, south of the Onive river	 ***REBIOMA database, 2019***
Critical habitat	Yes, according to the PS6 criteria: C1 et C2	

ECOLOGY OF THE SPECIES	
Species description and ecoethology	*Lepilemur mustelinus* is a species of nocturnal and arboreal Betsileo sportive lemur. Very little information exists on the ecology of this species.
Habitats	It is associated with the primary rainforest of eastern Madagascar.
Area of analysis	ERAA 2
Potential use or associated ecosystem service	This species is hunted for food.
Threats	• Habitat loss and degradation • Hunting

SENSITIVITY AND ASSOCIATED MEASURES	
Sensitivity in relation to the project	• Risks of habitat loss caused by fire and erosion • Increased hunting pressure

Implementation: the indicative budget is to be secured with the Marolambo National Park, focusing in priority on support for surveillance activities of the MNP in the northern sector (support for joint patrols with the gendarmerie, guard posts, travel

Key associated measures	• BAP 1 - AVOIDANCE_NATURAL_HABITATS_BELANITRA_DAM • BAP 2 - AVOIDANCE_NATURAL_HABITATS_DAM_Plant • BAP 5 - REDUCTION_PRESERVATION_CONTINUUM • BAP7 - REDUCTION_SENSIBLE_CLEARING • BAP 11 - REDUCTION_POPULATION_INFLUX_POACHING • BAP 21 - COMPENSATION_FOREST_RESTORATION • BAP 22 - COMPENSATION_SUPPORT_TSINJOARIVO_NPA • BAP 23 - COMPENSATION_SUPPORT_MAROLAMBO_NP

Implementation: the indicative budget is to be secured with the Marolambo National Park, focusing in priority on support for surveillance activities of the MNP in the northern sector (support for joint patrols with the gendarmerie, guard posts, travel

Lemurs

Family	Scientific Name	Statut IUCN	Presence	Range	Sites where it is known to occur	Area of analysis	Aquatic habitat criteria
Lemuridae	*Eulemur fulvus*	NT	Proven	Unrestricted	• 3 known populations: 1) there in the west north of the Betsiboka River, 2) in the east of Madagascar from north of the Mangoro River to the Onive River and an isolated population in the Ambohitantely Reserve. • The species is only present in the North of the Onive River.	ERAA 1	**Not confirmed**
Lemuridae	*Eulemur rubriventer*	VU	Proven	Unrestricted	• Andringitra, Mantadia, Marojejy, Ranomafana, Zahamena, • Tsaratanana, Ambatovaky, Analamazaotra, Anjanaharibe-South, Mangerivola, Marotandrano, Pic d' Ivohibe	ERAA 1 and ERAA 2	**Unconfirmed**
Lemuridae	Hapalemur griseus	VU	Proven	Unrestricted	• eastern part of Madagascar. • The species is present north and south of the Onive River.	ERAA 1 and ERAA 2	**Not Confirmed**
Lepilemuridae	*Lepilemur mustelinus*	NT	Proven	Restricted (37,559 km²)	• Eastern forest (between the Onive and Mangoro Rivers (south) to the Maningory River (north). • The species is only present north of the Onive River.	ERAA 1 and ERAA 2	**Not Confirmed**

Eulemur fulvus, © anthony_m CC BY-NC-ND, IUCN

Eulemur rubriventer , © J. Ralison, Biotope

Hapalemur griseus, © J. Ralison, Biotope

Lepilemur mustelinus, © J. Ralison, Biotope

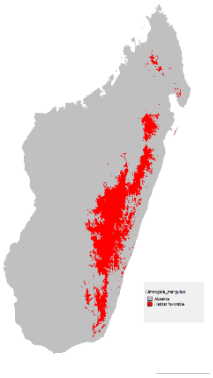
Annex 7 - Species Data Sheets

ECOLOGY OF THE SPECIES	
Species description and eco-ethology	
Habitats	
Area of analysis	
Potential use or associated ecosystem service	
Threats	•

Sensitivity in relation to the project	• Risks of habitat loss caused by fire and erosion • Increased hunting pressure
Key associated measures	• BAP 1 - AVOIDANCE_NATURAL_HABITATS_BELANITRA_DAM • BAP 2 - AVOIDANCE_NATURAL_HABITATS_DAM_Plant • BAP 5 - REDUCTION_PRESERVATION_CONTINUUM • BAP7 - REDUCTION_SENSIBLE_CLEARING

	• BAP 11 - REDUCTION_POPULATION_INFLUX_POACHING • BAP 21 - COMPENSATION_FOREST_RESTORATION • BAP 22 - COMPENSATION_SUPPORT_TSINJOARIVO_NPA • BAP 23 - COMPENSATION_SUPPORT_MAROLAMBO_NP

Micro-mammal - *Limnogale mergulus* - VU

Limnogale mergulus		
Classe, Family	Mammals, Tenrecidae	
IUCN Status	VU	
Presence in the Area of analysis	Not observed but likely	
Occurrence	Restricted (2000 km²) Known sites: Antsampandrano Forest Station, Ankaratra Massif, Andringitra, Andekaleka, Ranomafana East	 ***REBIOMA database, 2019***
Critical habitat	Yes, according to the PS6 criteria C2	

ECOLOGY OF THE SPECIES	
Species description and ecoethology	Limnogale mergulus is a semi-aquatic carnivorous species that feeds on freshwater crayfish, aquatic insect larvae and small crustaceans.
Habitats	This species can be found along streams and rivers (permanent, clean and fast water).
Area of analysis	A2 (forest tributaries)
Potential use or associated ecosystem	NONE

service	
Threats	• Habitat degradation due to siltation and soil erosion caused by deforestation, population decline due to drowning in eel traps

SENSITIVITY AND ASSOCIATED MEASURES	
Sensitivity in relation to the project	• 1_Risks of habitat change through modification of the water regime • 2_Risk of water pollution
Key associated measures	• REDUCTION_EROSION_RISKS • SUPPORT_AWARENESS-RAISING_LOCAL_FISHERIES • AVOIDANCE_CROSSING_TRIBUTARIES

Bibliographic References

Small carnivores

Family	Scientific Name	Statut IUCN	Presence	Range	Sites where it is known to occur	Aquatic habitat criteria	Area of analysis
Eupleridae	*Eupleres goudotii*	VU	Not observed but likely	Unrestricted	• Humid forests in the East, from the Amber Mountain in the North to Andohahela and along the Mandrare river	C1	**ERAA 2**
Eupleridae	*Fossa fossana*	VU	Not observed but likely	Unrestricted	• Endemic to the forests of eastern Madagascar and the Sambirano region in the northwest. • Amber Mountain, Ankarana, Masoala, Makira, Ambatovaky, Zahamena, Ranomafana, Andohahela	C1	**ERAA 2**
Eupleridae	*Galidictis fasciata*	VU	Not observed but likely	Unrestricted	• Widely dispersed from north to south through the forests of eastern Madagascar • Marojejy, Masoala, Zahamena, Ranomafana	C1	**ERAA 2**
Eupleridae	*Cryptoprocta ferox*	VU	Not observed but likely	Unrestricted	• Wide distribution, • Inhabits the western and eastern forests of the island. • Sometimes rare in some areas (central plateau forests and southern spiny forests) • Present in many protected areas (Kirindy, Ranomafana, Masoala, Ankarafantsika, Andringitra, etc.).	C1	**ERAA 2**

Eupleres goudotii *Fossa fossana* *Galidictis fasciata* *Cryptoprocta ferox*




ECOLOGY OF THE SPECIES	
Species description and eco-ethology	• These are nocturnal species that exclusively or almost exclusively solitary (except during the nursing period when a female and her calf can be encountered). • They feed on soft-bodied invertebrates (earthworms, slugs, molluscs), insects, small vertebrates (frogs, chameleons) or small mammals.
Habitats	These species are associated with tropical rainforests, with limited tolerance for degraded habitats (secondary forests). • Other species show some tolerance to forest degradation and can be found in secondary forests (even bamboo forests): *Anodonthyla moramora, Anodonthyla boulengeri*.
Ecologically relevant area of analysis	• **ERAA 1**
Potential use or associated ecosystem service	None, a priori
Threats	• Habitat loss due to deforestation and forest degradation • Hunting for meat in certain localities • Competition with the introduced civet species (*Viverricula indica*) • Dog predation

SENSITIVITY AND ASSOCIATED MEASURES	
Sensitivity in relation to the project	• Risks of habitat loss caused by fire and erosion • Increased hunting pressure
Key associated measures	• AVOIDANCE_NATURAL_HABITATS_BELANITRA_DAM • AVOIDANCE_NATURAL_HABITATS_DAM_Plant • AVOIDANCE_NATURAL_HABITATS_INFRA_TEMPORAIRES • SUPPORT_ ENVIRONMENTAL_AWARENESS-RAISING • REDUCTION_PRESERVATION_CONTINUUM

	• REDUCTION_SENSIBLE_CLEARING • REDUCTION_POPULATION_INFLUX_POACHING • OMPENSATION_RESTORATION_FORESTIERE • COMPENSATION_SUPPORT_TSINJOARIVO_NPA

Chauves-souris

Family	Scientific Name	Statut IUCN	Presence	Distribution	Sites where it is known to occur	Critical habitat	Area of analysis
Pteropodidae	Eidolon dupreanum	VU	Probable	Unrestricted	• Widespread in Madagascar, found all the way up to high altitude regions. The species is present south and north of the Onive River.		
Pteropodidae	*Hipposideros commersoni*	NT	Probable	Unrestricted			
Hipposideridae	Rousettus madagascariensis	NT	Probable	Unrestricted			

Eidolon dupreanum
©V.Simenovski

Hipposideros commersoni
©wikipedia

Rousettus madagascariensis,
©V.Simenovski

ECOLOGY OF THE SPECIES

Species description and eco-ethology	• *Rousettus madagascariensis and Eidelon dupreanum* are endemic species of madagascar. They are frugivorous species (fruits). *Eidelon dupreanum* feeds on e.g. plants with pulpy fruits (eucalyptus pollens, ficus fruits), pollens and nectars of plants growing in the immediate vicinity or at least 2 km from its home. • *Hipposideros commersoni,* on the other hand, is the largest Malagasy insectivorous bat, feeding mainly on beetles and hemiptera.
Habitats	• *Rousettus madagascariensis* nests in caves and cliff cracks. A colony usually consists of several hundred individuals. The species is associated with forests, forest edges and caves, below 950 m above sea level. • *Eidelon dupreanum* is also known to nest in caves and rock crevices. But some individuals can nest in trees. The species is inferred from rocky environments within different forest types (humid, dry, deciduous and thorny forests), up to 1200 m above sea level. • *Hipposideros commersoni can nest in trees, buildings and caves. This species* is related to different habitat types, deciduous dry forest, gallery or coastal forests, up to 1350 m above sea level.
Ecologically relevant area of analysis	• These three species are widely distributed on the island of Madagascar, north and south of the Onive River. Their area of analysis is AEEP1 and AAEP2.
Potential use or associated ecosystem service	• These 3 species are hunted for food.
Threats	• Hunting (important hunting of *Hipposideros commersoni* in the southwest of Madagascar due to famine) • Anthropic disturbance (caves, other lodgings) • *Rousettus madagascariensis* is persecuted because of its role as a “pest” for *Litchi chinensis and Dimocarpus longan* crops.

SENSITIVITY AND ASSOCIATED MEASURES	
Sensitivity in relation to the project	• Destruction of individuals due to land clearing; • Risks of habitat loss caused by fire and erosion; • Increased hunting pressure;
Key associated measures	

Arboreal amphibians

Family	Scientific Name	Statut IUCN	Presence	Distribution	Sites where it is known to occur	Area of analysis	Critical habitat
Microhylidae	*Anodonthyla boulengeri*	NT	Not observed but likely	Restricted (24,370 km^2)	• Know to occur at 3 to 4 locations	**ERAA 1 and ERAA 2**	Confirmed
Microhylidae	*Anodonthyla moramora*	EN	Proven (SADABE)	Restricted 685 km^2	• Ranomanfana NP (from Ranomafana village to Vohiparara	**ERAA 1 and ERAA 2**	Potential
Mantellidae	*Boophis boehmei*	EN	Not observed but likely	Restricted (unknown)	• East	**ERAA 1 and ERAA 2**	Confirmed
Mantellidae	*Boophis rufioculis*	NT	**Proven**	Restricted (22,394 km²)	• Central part of the Eastern Rainforest	**ERAA 1 and ERAA 2**	Confirmed
Mantellidae	*Boophis rhodoscelis*	EN	/	Restricted (1,637 km²)	• Ranomafana, Antoetra	**ERAA 1 and ERAA 2**	Potential

Anodonthyla boulengeri

Anodonthyla moramora

Boophis boehmei

Boophis rhodoscelis

Boophis rufioculis

ECOLOGY OF THE SPECIES

Species description and eco-ethology	This group includes the species of arboreal amphibians that live in trees (usually trunk cavities) more or less in height. Depending on their mode of breeding, these species (for those whose breeding has been studied) are more or less associated with aquatic environments. There are: • *Species that reproduce in water-filled cavities in tree trunks: Anodonthyla boulengeri* (breeding not especially seasonal), *Anodonthyla boulengeri* • Species that breed in aquatic environments for the development of larvae: *Boophis boehmei, Boophis rufioculis, Boophis rhodoscelis* (breeding of species of the genus Boophis is characterized by the deposition of eggs directly in watercourses).
Habitats	Most of these species are associated with primary wet forest habitats in good conservation status. • Some species are associated exclusively with dense rainforest habitats. "primary": *Boophis boehmei, Boophis rufioculis, Boophis rhodoscelis*

	• Other species show some tolerance to forest degradation and can be found in secondary forests (even bamboo forests): *Anodonthyla moramora, Anodonthyla boulengeri*..
Ecologically relevant area of analysis	• **ERAA 2**
Potential use or associated ecosystem service	A priori none
Threats	• Decline in forest habitat due to subsistence agriculture, timber extraction, charcoal making, invasive spread of eucalyptus, livestock grazing and expansion of human settlements. • Decline in the extent and quality of forest habitat due to subsistence agriculture, • Burning to maintain pastures and expanding human settlements.

SENSITIVITY AND ASSOCIATED MEASURES	
Sensitivity in relation to the project	• Proliferation of invasive and predatory species • Loss of habitat due to land clearing • Fire hazards
Key associated measures	• AVOIDANCE_NATURAL_HABITATS_BELANITRA_DAM • AVOIDANCE_NATURAL_HABITATS_DAM_Plant • REDUCTION_WORKS_PLANNING • REDUCTION_SENSIBLE_CLEARING • REDUCTION_FIRE_HAZARDS • COMPENSATION_FOREST_RESTORATION

Bibliographic References

- Vallan, D., Andreone, F., Raherisoa, V., & Dolch, R. (2004). Does selective wood exploitation affect amphibian diversity? The case of An'Ala, a tropical rainforest in eastern Madagascar. Oryx, 38(4), 410-417. doi:10.1017/S003060530400078X
- Hutter, C. R., Lambert, S. M., Andriampenomanana, Z. F., Glaw, F., & Vences, M. (2018). Molecular phylogeny and diversification of Malagasy bright-eyed tree frogs (Mantellidae: Boophis). Molecular phylogenetics and evolution, 127, 568-578.
- Vences, M., Glaw, F., Köhler, J., & Wollenberg, K. C. (2010). Molecular phylogeny, morphology and bioacoustics reveal five additional species of arboreal microhylid frogs of the genus Anodonthyla from Madagascar, Contributions to Zoology, 79(1), 1-32. doi: https://doi.org/10.1163/18759866-07901001
- Katharina C. etal. 2010. First assessment of the male territoril vocal behaviour of a Malagasy leaf litter frog (Gephyromantis thelenae). Herportology Notes, volume 3: 141-150
- Hutter, C. R., Lambert, S. M., Andriampenomanana, Z. F., Glaw, F., & Vences, M. (2018). Molecular phylogeny and diversification of Malagasy bright-eyed tree frogs (Mantellidae: Boophis). Molecular phylogenetics and evolution, 127, 568-578.

Implementation: the indicative budget is to be secured with the Marolambo National Park, focusing in priority on support for surveillance activities of the MNP in the northern sector (support for joint patrols with the gendarmerie, guard posts, travel

Amphibians terrestres

Family	Scientific Name	Statut IUCN	Presence	Range	Sites where it is known to occur	Area of analysis	Critical habitat
Mantellidae	*Mantella cowani*	EN	Not observed but likely	Unknown	Upland and mid-east	**ERAA 2**	**Potential**
Mantellidae	*Gephyromantis eiselti*	EN	Proven (SADABE)	Restricted (795 km²)	Andasibe	**ERAA 2**	**Confirmed**
Mantellidae	*Gephyromantis thelenae*	EN	Proven	Restricted (795 km²)	Andasibe, Mantadia	**ERAA 2**	**Confirmed**
Mantellidae	*Gephyromantis blanci*	NT	Proven	Restricted (24,088 km²)	Ranomafana, Andringitra Mountains to the Anosyenne Ranges	**ERAA 2**	**Confirmed**
Mantellidae	*Gephyromantis spiniferus*	VU	Proven	Restricted (16 404 km²)	Southeast (Andringitra to Andohahela)	**ERAA 2**	**Confirmed**
Mantellidae	*Gephyromantis cornutus*	VU	Proven (SADABE)	Restricted (6 857 km²)	Centre-East (Andasibe, Vohimana, Vohidrazana, Mandraka, Anjozorobe)	**ERAA 2**	**Confirmed**
Mantellidae	*Mantidactylus albofrenatus*	EN	Not observed but likely	Restricted (1 851 km)	Andasibe, Anosibe An'ala	**ERAA 2**	**Potential**
Mantellidae	*Mantidactylus madecassus*	EN	Not observed but likely	Restricted (1290 km²)	Andringitra massif	**ERAA 2**	**Potential**
Mantellidae	*Mantella madagascariensis*	VU	Not observed but likely	Restricted (9434 km²)	Central East (Niagarakely south of Ranomafana)	**ERAA 2**	**Potential**
Microhylidae	*Plethodontohyla brevipes*	VU	Proven	Restricted (6509 km²)	PN Ranomafana	**ERAA 2**	**Confirmed**
Microhylidae	*Plethodontohyla tuberata*	NT	Not observed but likely	Restricted (22,539 km²)	Centre (Antoetra, Ankaratra, Angavokely)	**ERAA 2**	**Potential**
Microhylidae	*Stumpffia kibomena* (précédemment connu en tant que *Rhombophryne kibomena)*	EN	Proven (SADABE)	Restricted (1,051 km²)	Andranomandry, Besoamamy, Andranotsimizaka	**ERAA 2**	**Confirmed**

Mantella madagascariensis *Mantella cowani* *Gephyromantis eiselti*

Implementation: the indicative budget is to be secured with the Marolambo National Park, focusing in priority on support for surveillance activities of the MNP in the northern sector (support for joint patrols with the gendarmerie, guard posts, travel

Stumpffia kibomena

Gephyromantis thelenae

ECOLOGY OF THE SPECIES	
Species description and eco-ethology	This group includes terrestrial Amaphibian species of conservation concern. Some of these species are burrowers and live or reproduce in the soil: *Plethodontohyla brevipes, Plethodontohyla tuberata* Depending on their mode of breeding, these species (for those whose breeding has been studied) are more or less associated with aquatic environments. You can tell the difference: • *Directly* developing species (without aquatic larval stage), which are not associated with freshwater aquatic habitats and may be found quite far from watercourses: *Gephyromantis eiselti, Gephyromantis blanci, Gephyromantis spiniferus, Gephyromantis thelenae (reproductive mode to be confirmed)* • Species that reproduce near aquatic environments for larval development: *Mantidactylus albofrenatus, Mantidactylus madecassus, Mantella madagascariensis, Mantella cowani.* • Species for which larvae develop underground: *Plethodontohyla brevipes (*possibly but to be verified*), Plethodontohyla tuberata*
Habitats	• The majority of these species (6 species) are associated with dense natural rainforest habitats but also show some tolerance to forest degradation and can be found in secondary forests (some even eucalyptus forests): *Gephyromantis eiselti, Gephyromantis thelenae, Gephyromantis blanci, Mantidactylus madecassus, Stumpffia kibomena, Plethodontohyla tuberata, Mantidactylus madecassus.* • 5 these species are associated exclusively with habitats of “primary” dense rainforest in good conservation status: *Gephyromantis spiniferus, Gephyromantis cornutus Mantella madagascariensis Mantidactylus albofrenatus, Plethodontohyla brevipes.* • One species is not associated with dense rainforest habitats, but with open habitats that are regularly burned: *Mantella cowani.*
Ecologically relevant area of analysis	• **A2 exclusive:** *Gephyromantis spiniferus, Gephyromantis cornutus Mantella madagascariensis Mantidactylus albofrenatus, Plethodontohyla brevipes,* • **A2 + Secondary forests/woodland***:* Gephyromantis eiselti, Gephyromantis thelenae, Whitened Gephyromantis, Mantidactylus madecassus, Stumpffia kibomena, *Plethodontohyla tuberata*

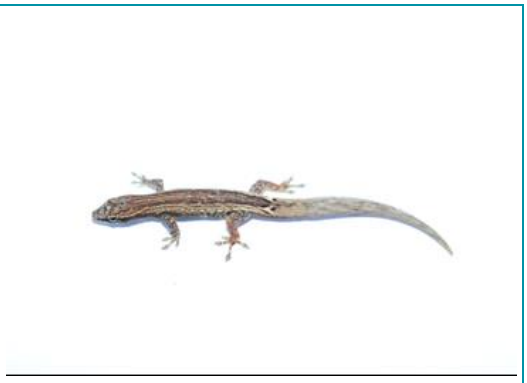
	• **Other:** Mantella cowani
Potential use or associated ecosystem service	• No known use except for international trade of *M. madagascariensis*.
Threats	• Reduction of forest habitat due to human activities (farming system, fires, artisanal exploitation, wood extraction, charcoal making), and degradation of its habitat due to livestock grazing. • Trade of *M. madagascariensis* , population reduction due to increased exploitation for international trade • Degradation of mountain habitats in the highlands (overgrazing, frequent fires) • Vulnerability to aquatic fungi Chytrides (recently become invasive) which are parasites of amphibians

SENSITIVITY AND ASSOCIATED MEASURES	
Sensitivity in relation to the project	• Proliferation of invasive and predatory species • Loss of habitat due to land clearing • Fire hazards
Key associated measures	• AVOIDANCE_NATURAL_HABITATS_DAM_Plant: Maximum avoidance of natural and critical habitats during the final implementation of the project between the dam and the plant • REDUCTION_WORKS_PLANNING: Conducting works in the dry season • REDUCTION_SENSIBLE_CLEARING: Reduction of habitat loss and the destruction of individuals (flora and fauna) through the implementation of sensible land clearing • REDUCTION_FIRE_HAZARDS: Reduce fire hazards • COMPENSATION_FOREST_RESTORATION: Preparation and implementation of a program to restore degraded areas in forests adjacent to the main forest corridor • REDUCTION_CRUSHING_WILDLIFE: Minimizing the risk of wildlife being crushed

Bibliographic References

- Vallan, D., Andreone, F., Raherisoa, V., & Dolch, R. (2004). Does selective wood exploitation affect amphibian diversity? The case of An'Ala, a tropical rainforest in eastern Madagascar. Oryx, 38(4), 410-417. doi:10.1017/S003060530400078X
- Katharina C. etal. 2010. First assessment of the male territorial vocal behaviour of a Malagasy leaf litter frog (Gephyromantis thelenae). Herportology Notes, volume 3: 141-150
- Andreone, F., Cadle, J. E., Cox, N., Glaw, F., Nussbaum, R. A., Raxworthy, C. J., ... & Vences, M. (2005). Species review of amphibian extinction risks in Madagascar: conclusions from the Global Amphibian Assessment. Conservation Biology, 19(6), 1790-1802.
- https://www.sciencedirect.com/science/article/pii/S105579030400332X?via%3Dihub
- Bellati A, Scherz MD, Megson S, Hyde Roberts S, Andreone F, Rosa GM, Noël J, Randrianirina JE, Fasola M, Glaw F, Crottini A (2018) Resurrection and re-description of Plethodontohyla laevis (Boettger, 1913) and transfer of Rhombophryne alluaudi (Mocquard, 1901) to the genus Plethodontohyla (Amphibia, Microhylidae, Cophylinae). Zoosystematics and Evolution 94(1): 109-135. https://doi.org/10.3897/zse.94.14698

Geko - *Lygodactylus bivittis - VU*

Lygodactylus bivittis		
Classe, Family	Reptile, Gekkonidae	
IUCN Status	**VU**	
Presence in the Area of analysis	Proven	
Occurrence	**Restricted (17,767 km²)** Sites where it is known to occur: humid forest between Marojejy and Andasibe	
Critical habitat	Yes, according to the PS6 criteria **C2**	

ECOLOGY OF THE SPECIES	
Species description and ecoethology	*Lygodactylus bivittis* is a species of terrestrial Tiny Dwarf Gecko.
Habitats	This species is observed in or near intact primary forest. It seems to be absent from degraded areas
Area of analysis	**A2 exclusively**
Potential use or associated ecosystem service	NONE

Threats	• Loss and degradation of rainforests in eastern Madagascar due to agricultural expansion, logging and fires.

SENSITIVITY AND ASSOCIATED MEASURES	
Sensitivity in relation to the project	• Loss of habitat due to land clearing • Fire hazards
Key associated measures	• AVOIDANCE_NATURAL_HABITATS_DAM_PLANT • REDUCTION_SENSIBLE_CLEARING

Bibliographic References

- Glaw, F. and Vences, M. 2007. A Fieldguide to the Amphibians and Reptiles of Madagascar. Third Edition. Vences & Glaw Verlag, Cologne.
- IUCN. 2011. IUCN Red List of Threatened Species (ver. 2011.2). Available at: http://www.iucnredlist.org. (Accessed: 10 November 2011).

Snake- Pseudoxyrhopus oblectator - VU

Pseudoxyrhopus oblectator	
Classe, Family	Reptile, Lamprophiidae
IUCN Status	VU
Presence in the Area of analysis	Not observed but highly probable
Occurrence	Restricted (17 434km²) Sites where it is known to occur: Ranomafana, Anjozorobe, Ambatovy and other sites of the Central Escarpment
Critical habitat	Yes, according to the PS6 criteria: C2

Species description and ecoethology	Terrestrial species
Habitats	Nocturnal species living in the rainforest
Area of analysis	A2
Potential use or associated ecosystem service	NO
Threats	• Small-scale livestock grazing, charcoal production and logging..

SENSITIVITY AND ASSOCIATED MEASURES	
Sensitivity in relation to the project	• Proliferation of invasive and predatory species • Loss of habitat due to land clearing • Fire hazards

Key associated measures	• AVOIDANCE_NATURAL_HABITATS_DAM_Plant • REDUCTION_SENSIBLE_CLEARING

Chamelons

Family	Scientific Name	Statut IUCN	Presence	Range	Sites where it is known to occur	Critical habitat
Chamaeleonidae	*Calumma hilleniusi*	EN	Not observed but likely	Restricted (820 km²)	• Ankaratra, Andringitra, Ivohibe, Ambohijanahary, Ibity, Itremo,	Confirmed
Chamaeleonidae	*Calumma oshaughnessyi*	VU	Proven	Restricted (18,000 km²)	• Numerous areas in the high plateaus (Tsinjoarivo, Antoetra, Andringitra, Andohahela, Kalambatritra, Ranomafana)	Confirmed
Chamaeleonidae	*Calumma parsonii*	NT	Not observed but highly probable	Restricted (39800 km²)	• Eastern rainforest (Ranomafana, Southern Anjanaharibe, Masoala Peninsula,	Confirmed

Calumma oshaughnessyi_Madagascar Voakajy

Species description and eco-ethology	Terrestrial species

Habitats	At the edge of the Ankaratra mountain rainforest and also in secondary habitats and transitional rainforests
Area of analysis	A2
Potential use or associated ecosystem service	
Threats	Although no signs of collection were observed during the mission, the presence of reptile species (Calumma, Furcifer, Phelsuma) known on international markets and collection authorized by CITES for commercial purposes could be of interest to the operators. In addition, guides have reported hunting large snakes of the genus Sanzinia for consumption, as reported by Rakotondravony & Rakotondrasoa (2011).

SENSITIVITY AND ASSOCIATED MEASURES

Sensitivity in relation to the project	• Loss of habitat due to land clearing • Fire hazards
Key associated measures	• **BAP 2 -** AVOIDANCE_NATURAL_HABITATS_DAM_Plant • **BAP 6 -** REDUCTION_WORKS_PLANNING • **BAP 7 -** REDUCTION_DEBOISEMENT_RAISONNE • **BAP 8 -** REDUCTION_CRUSHING_WILDLIFE • **BAP 10 -** REDUCTION_FIRE_HAZARDS • **BAP 21 -** COMPENSATION_FOREST_RESTORATION

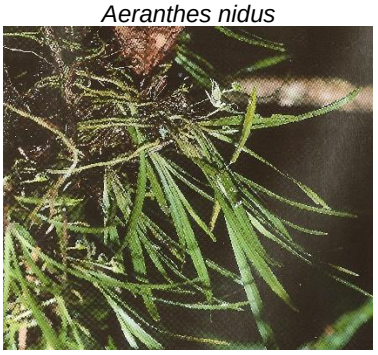
Flora

Conservation concern orchids

Family	Scientific Name	Statut IUCN	Presence	Distribution	Sites where it is known to occur	Area of analysis	Critical habitat
Orchidaceae	*Aeranthes nidus*	EN (GSPM)	Proven	Unknown	Unknown		Confirmed
Orchidaceae	*Angraecum viguieri*	EN (GSPM)	Proven	Unknown	Unknown		Confirmed

Angraecum viguieri

Aeranthes nidus



Source: Frederic Melki

ECOLOGY OF THE SPECIES

Species description and eco-ethology	These species are listed in CITES Appendix II and assessed as endangered in the GSPM Red List.
Habitats	Orchid species are abundant in the lichen forests of the forest corridor.
Ecologically relevant area of analysis	A2
Potential use or associated ecosystem service	Ornamental
Threats	• Logging • Illicit export

SENSITIVITY AND ASSOCIATED MEASURES

Sensitivity in relation to the project	• Introduction and spread of invasive alien species • Destruction of individuals due to land clearing • Fire hazards • Risk of erosion • Increased collection by the populations
Key associated measures	• AVOIDANCE_NATURAL_HABITATS_DAM_Plant • AVOIDANCE_NATURAL_HABITATS_INFRA_TEMPORAIRES • IAS-TERRESTRIAL_FLORA_CONTROL • REDUCTION_FIRE_HAZARDS • REDUCTION_IMPACTS_POPULATION_INFLUX • COMPENSATION_FOREST_RESTORATION

Bibliographic References:

Conservation status palm trees

Family	Scientific Name	Statut IUCN	Presence	Distribution	Sites where it is known to occur	Critical habitat
Arecaceae	*Dypsis lutea*	EN	**Proven**	Restricted (1,435 km²)	Masoala, Mananara Nord, Ambatovaky, Zahamena, Mantadia	C2
Arecaceae	*Dypsis decipiens*	VU	**Proven**	Restricted (42,846 km²)	Ambohitantely Itremo/Ambatofinandrahana, Kalambatritra, Ranomafana	C1, C2
Arecaceae	*Dypsis louvelii*	VU	**Proven**	Restricted (8,884 km²)	Mantadia, Analamazaotra, Corridor Ankeniheny Zahamena, Mantadia	C2
Arecaceae	*Ravenea lakatra*	CR	**Proven**	Unrestricted	Ambatovaky, Ambohijanahary, Befotaka - Midongy du Sud, Bemaraha, Betampona, Lokobe, Loky-Manambato, Makira, Mananara Nord, Manombo, Manongarivo, Marojejy, Masoala, Ranomafana, Tsaratanana, Zahamena	C2

ECOLOGY OF THE SPECIES	
Species description and	In 2010, only 4 sub-populations were observed and a strong decrease in the area of

eco-ethology	occupation of the species is predicted to occur by 2020 (Mandimbizaka, 2010). Relatively slow-growing species growing in sunny, drought-resistant environments but prefer well-drained environments - Listed on CITES Appendix I
Habitats	Palms (Ravenea and Dypsis (Arecaceae)) have a fairly wide distribution in dense humid forest but do not tolerate the rocky substrates of the banks of the Onive;
Ecologically relevant area of analysis	A2
Potential use or associated ecosystem service	• Construction of hunting tools and equipment • Gold panning (supply line)
Threats	• The habitat of these species is very fragile and is threatened by fire. These species are victims of selective logging, slash and burn (tavy) cultivation, and the manufacture of huts in the forest. The socio-economic uses of the species studied also worsen the threats of extinction. As a result, the D. lutea and Ravenea madagascariensis species are reassessed ENDANGERED (EN) and CRITICAL (CR). In terms of percentage of forest cover, these palms are still under threat and considered to have a very critical future. To address these constraints, a conservation strategy must combine in situ conservation, ex situ conservation and the improvement of the living conditions of local farmers.

SENSITIVITY AND ASSOCIATED MEASURES	
Sensitivity in relation to the project	• 1_Introduction and spread of invasive alien species • 2_Destruction of individuals due to land clearing • 3_ Fire hazards • 4_Risk of erosioin • 5_Increased collection by the populations
Key associated measures	• AVOIDANCE_NATURAL_HABITATS_DAM_Plant • AVOIDANCE_NATURAL_HABITATS_DAM_Plant • AVOIDANCE_NATURAL_HABITATS_INFRA_TEMPORAIRES • IAS-TERRESTRIAL_FLORA_CONTROL • REDUCTION_FIRE_HAZARDS: • REDUCTION_IMPACTS_POPULATION_INFLUX: COMPENSATION_FOREST_RESTORATION:

Bibliographic References

• MANDIMBIZAKA J. 2010. Etude de quatre espèces de palmiers spécifiques et menacées de la nouvelle aire protégée Fandriana-Marolambo en vue de leur conservation: Dypsis baronii, D. lutea, D. nodifera et Ravenea madagascariensis

Implementation: the indicative budget is to be secured with the Marolambo National Park, focusing in priority on support for surveillance activities of the MNP in the northern sector (support for joint patrols with the gendarmerie, guard posts, travel

Annex 7 - Species Data Sheets

Annex 8 – List of Invasive Flora Species Inventoried at The Site

L'anthropisation des habitats favorise l'installation, le développement et la propagation des espèces invasives dans le milieu naturel. Elles sont surtout rencontrées dans les habitats de type « non-forêt » ou modifiés au sens de la PS6, dont les jeunes formations post-culturales. Au total 20 espèces sont inventoriées dans la zone (**Table 30**) dont quatre sont qualifiées de néfastes par l'UICN (*Lantana camara*, *Clidemia hirta*, *Psidium guayava* et P. *cattleianum*).

The enthronization of habitats facilitates the installation, development and propagation of invasive species in the natural environment. These species are mostly found in "non-forest" or modified habitats as defined in PS6, including young post-cultural formations. A total of 20 species are inventoried in the area (**Table 30**), four of which are classified as harmful by the IUCN (*Lantana camara*, *Clidemia hirta*, *Psidium guayava* and P. *cattleianum*).

Table 30. List of Invasive Species Surveyed

N°	FAMILY	TAXA
1	ACANTHACEAE	*Stachytarpheta jamaicensis* (L.) Vahl
2	ASTERACEAE	*Ageratum conyzoides* L.
3	ASTERACEAE	*Bidens pilosa* L.
4	ASTERACEAE	*Solanummauritianum* Scop.
5	EUPHORBIACEAE	*Ricinus communis* L.
6	FABACEAE	*Albizia lebbeck* (L.) Benth.
7	FABACEAE	*Desmodium incanum* (Sw.) DC.
8	FABACEAE	*Mimosa pudica* L.
9	GLEICHENIACEAE	*Dicranopteris linearis* (Burm. f.) Underw.
10	LAMIACEAE	*Lantana camara* L.
11	MELASTOMATACEAE	*Clidemia hirta* (L.) D. Don
12	MYRTACEAE	*Eucalyptus robusta* Sm
13	MYRTACEAE	*Psidium cattleyanum* Sabine
14	MYRTACEAE	*Psidium guajava* L.
15	POACEAE	*Imperata cylindrica* (L.) Raeusch.
16	PROTEACAE	*Grevillea banksii* R. Br.
17	PTERIDACEAE	*Dicranopteris linearis* (Burm. f.) Underw.
18	ZINGIBERACEAE	*Aframomum angustifolium* (Sonn.) K. Schum.
19	ZINGIBERACEAE	*Hedychium coronarium* J. Koenig
20	MYRTACEAE	*Melaleuca quinquenervia* (Cav.) S.T. Blake

Annex 9 – List of Indigenous Species of Interest for Lemur Feeding

This species list can be used for two purposes:

- Firstly, during the preliminary identification of the conservation plant species before any land clearing / works, to make it possible to target large fruit trees probably used for food by lemurs, and need to be avoided and preserved as much as possible;
- Secondly, for all revegetation actions (site)/forest restoration (compensation) as a tool for the selection of species to be planted that are suitable for lemurs.

Legende

*	Yes
**	Probable

Hemingway, C.A. & Overdorff, D.J. 1999. Sampling effects on food availability estimates: phenological method, sample size, and species composition. Biotropica 31(2): 354-364
Irwin, M.T. 2008. Feeding ecology of Propithecus diadema in forest fragments and continuous forest. International Journal of Primatology, 29: 95-115.
Ganzhorn, J.U. 1988. Food partitioning among Malagasy primates. Oecologia 75: 436-450

Table 31. List of Indigenous Species of Definite or Probable Interest for Lemur Feeding

N°	FAMILY	SPECIES	*Propithecus diadema*	*Eulemur fulvus*	*Avahi laniger*	*Hapalemur griseus*	*Cheirogaleus major*
1	ACANTHACEAE	*Mendoncia cowanii* (S. Moore) Benoist		**			**
2	ACANTHACEAE	*Mendoncia flagellaris* (Baker) Benoist		**			**
3	ANACARDIACEAE	*Micronychia madagascariensis* Oliv.	**				
4	ANACARDIACEAE	*Micronychia minutiflora* (H. Perrier) Randrian. & Lowry	**				
5	APHLOIACEAE	*Aphloia theiformis* (Vahl) Benn.		*			
6	APOCYNACEAE	*Carissa spinarum* L.		**			
7	APOCYNACEAE	*Mascarenhasia arborescens* A. DC.	*				
8	APOCYNACEAE	*Mascarenhasia lisianthiflora* A. DC.	**				
9	AQUIFOLIACEAE	*Ilex mitis* (L.) Radlk.		*			
10	ARALIACEAE	*Polyscias amplifolia* (Baker) Harms	**	**			
11	ARALIACEAE	*Polyscias briquetiana* (Bernardi) Lowry & G.M. Plunkett	**	**			
12	ARALIACEAE	*Polyscias carolorum* Bernardi	**	**			
13	ARALIACEAE	*Polyscias madagascariensis* (Seem.) Harms	**	**			
14	ARALIACEAE	*Polyscias multibracteata* (Baker) Harms	**	**			
15	ASTERACEAE	*Apodocephala angustifolia* Humbert					*

Implementation: the indicative budget is to be secured with the Marolambo National Park, focusing in priority on support for surveillance activities of the MNP in the northern sector (support for joint patrols with the gendarmerie, guard posts, travel

Annex 9 – List of Indigenous Species of Interest for Lemur Feeding

N°	FAMILY	SPECIES	*Propithecus diadema*	*Eulemur fulvus*	*Avahi laniger*	*Hapalemur griseus*	*Cheirogaleus major*
16	ASTERACEAE	*Solanum mauritianum* Scop.	*				
17	BALSAMINACEAE	*Impatiens* sp1	**				
18	BALSAMINACEAE	*Impatiens* sp2	**				
19	BALSAMINACEAE	*Impatiens* sp3	**				
20	BALSAMINACEAE	*Impatiens* sp4	**				
21	BALSAMINACEAE	*Impatiens* sp5	**				
22	BIGNONIACEAE	*Phyllarthron bojeranum* DC.					**
23	BLECHNACEAE	*Stenochlaena tenuifolia* (Desv.) T. Moore					**
24	BURSERACEAE	*Canarium madagascariense* Engl.	*				
25	CALOPHYLLACEAE	*Mammea bongo* (R. Vig. & Humbert) Kosterm.	**				
26	CANELLACEAE	*Cinnamosma madagascariensis* Danguy	**				
27	CELASTRACEAE	*Salacia madagascariensis* (Lam.) DC.	*				
28	CLUSIACEAE	*Garcinia mangorensis* (R. Vig. & Humbert) P. Sweeney & Z.S. Rogers	**		**		
29	CLUSIACEAE	*Garcinia pauciflora* Baker	**		**		
30	CLUSIACEAE	*Garcinia verrucosa* Jum. & H. Perrier	**		*		
31	CLUSIACEAE	*Symphonia eugenioides* Baker	**				
32	CLUSIACEAE	*Symphonia gymnoclada* (Planch. & Triana) Benth. & Hook. f. ex Vesque	**				
33	CLUSIACEAE	*Symphonia louvelii* Jum. & H. Perrier	*				
34	CLUSIACEAE	*Symphonia microphylla* (Hils. & Bojer ex Cambess.) Benth. & Hook. f. ex Vesque	**				
35	CLUSIACEAE	*Symphonia pauciflora* Baker	**				
36	CLUSIACEAE	*Symphonia* aff. *tanalensis* Jum. & H. Perrier	**				
37	CLUSIACEAE	*Symphonia* sp	**				
38	CLUSIACEAE	*Symphonia urophylla* (Decne. ex Planch. & Triana) Benth. & Hook. f. ex Vesque	**				
39	CUNONIACEAE	*Weinmannia minutiflora* Baker		**			
40	CUNONIACEAE	*Weinmannia rutenbergii* Engl.		**			
41	CUNONIACEAE	*Weinmannia bojeriana* Tul.		*			

Implementation: the indicative budget is to be secured with the Marolambo National Park, focusing in priority on support for surveillance activities of the MNP in the northern sector (support for joint patrols with the gendarmerie, guard posts, travel

Annex 9 – List of Indigenous Species of Interest for Lemur Feeding

N°	FAMILY	SPECIES	*Propithecus diadema*	*Eulemur fulvus*	*Avahi laniger*	*Hapalemur griseus*	*Cheirogaleus major*
42	CUNONIACEAE	*Weinmannia commersonii* Bernardi		**			
43	CUNONIACEAE	*Weinmannia eriocarpa* Tul.		**			
44	CUNONIACEAE	*Weinmannia hildebrandtii* Baill.		**			
45	CUNONIACEAE	*Weinmannia humblotii* Baill.		**			
46	EBENACEAE	*Diospyros gracilipes* Hiern	*	**			
47	EBENACEAE	*Diospyros haplostylis* Boivin ex Hiern	**	**			
48	EBENACEAE	*Diospyros myriophylla* (H. Perrier) G.E. Schatz & Lowry	**	**			
49	EBENACEAE	*Diospyros parvifolia* Hiern	**	**			
50	EBENACEAE	*Diospyros* sp1	**	**			
51	EBENACEAE	*Diospyros* sp2	**	**			
52	EBENACEAE	*Diospyros sphaerosepala* Baker	**	**			
53	ERYTHROXYLACEAE	*Erythroxylum corymbosum* Boivin ex Baill.	**	**	**		
54	ERYTHROXYLACEAE	*Erythroxylum ferrugineum* Cav.	**	**	**		
55	ERYTHROXYLACEAE	*Erythroxylum nitidulum* Baker	**	**	**		
56	EUPHORBIACEAE	*Drypetes madagascariensis* (Lam.) Humbert & Leandri	**				
57	EUPHORBIACEAE	*Macaranga alnifolia* Baker	**				
58	EUPHORBIACEAE	*Macaranga boutonioides* Baill.	**				
59	EUPHORBIACEAE	*Macaranga echinocarpa* Baker	**				
60	EUPHORBIACEAE	*Macaranga oblongifolia* Baill.	**				
61	EUPHORBIACEAE	*Macaranga sphaerophylla* Baker	**				
62	EUPHORBIACEAE	*Suregada boiviniana* Baill.		**			
63	FABACEAE	*Albizia adianthifolia* (Schumach.) W. Wight	**				
64	FABACEAE	*Albizia gummifera* (J.F. Gmel.) C.A. Sm.	*				
65	FABACEAE	*Albizia lebbeck* (L.) Benth.	**				
66	FABACEAE	*Phylloxylon xylophylloides* (Baker) Du Puy, Labat & Schrire					**
67	FABACEAE	*Senna septemtrionalis* (Viv.) H.S. Irwin & Barneby					**
68	FABACEAE	*Viguieranthus kony* (R. Vig.) Villiers					**
69	HYPERICACEAE	*Harungana madagascariensis* Lam. ex Poir.			*		

Implementation: the indicative budget is to be secured with the Marolambo National Park, focusing in priority on support for surveillance activities of the MNP in the northern sector (support for joint patrols with the gendarmerie, guard posts, travel

Annex 9 – List of Indigenous Species of Interest for Lemur Feeding

N°	FAMILY	SPECIES	*Propithecus diadema*	*Eulemur fulvus*	*Avahi laniger*	*Hapalemur griseus*	*Cheirogaleus major*
70	LAMIACEAE	*Clerodendrum arenarium* Baker	**				
71	LAMIACEAE	*Clerodendrum chartaceum* Moldenke	**				
72	LAMIACEAE	*Clerodendrum hircinum* Schauer	**				
73	LAMIACEAE	*Clerodendrum petunioides* Baker	**				
74	LAURACEAE	*Cryptocarya crassifolia* Baker	**				
75	LAURACEAE	*Cryptocarya ovalifolia* (Danguy) van der Werff	**				
76	LAURACEAE	*Cryptocarya pervillei* Baill.	**				
77	LAURACEAE	*Cryptocarya polyneura* (Kosterm.) van der Werff Search in The Plant List	**				
78	LAURACEAE	*Cryptocarya rigidifolia* van der Werff	**				
79	LAURACEAE	*Ocotea auriculiformis* Kosterm.	**		**		
80	LAURACEAE	*Ocotea cymosa* (Nees) Palacky	**		**		
81	LAURACEAE	*Ocotea racemosa* (Danguy) Kosterm.	**		**		
82	LAURACEAE	*Ocotea sessiliflora* Kosterm.	**		**		
83	LAURACEAE	*Ocotea thouvenotii* (Danguy) Kosterm.	**		**		
84	LAURACEAE	*Ravensara floribunda* Baill.		**	**		
85	LORANTHACEAE	*Bakerella clavata* (Desr.) Balle	*				
86	LORANTHACEAE	*Bakerella grisea* (Scott Elliot) Balle	**				
87	LORANTHACEAE	*Bakerella hoyifolia* (Baker) Balle	**				
88	MALVACEAE	*Dombeya dichotomopsis* Hochr.	**				
89	MALVACEAE	*Dombeya dolichophyllla* Arènes	**				
90	MALVACEAE	*Dombeya megaphylla* Baker	**				
91	MALVACEAE	*Dombeya spectabilis* Bojer	**				
92	MALVACEAE	*Urena lobata* L.					**
93	MELASTOMATACEAE	*Clidemia hirta* (L.) D. Don					**
94	MELASTOMATACEAE	*Dichaetanthera cordifolia* Baker		**	**		**
95	MELASTOMATACEAE	*Dichaetanthera oblongifolia* Baker		*	*		**
96	MELASTOMATACEAE	*Lijndenia danguyana* (H. Perrier) Jacq.-Fél.					**
97	MELASTOMATACEAE	*Memecylon louvelianum* H. Perrier	*	**	**		**
98	MELASTOMATACEAE	*Memecylon* sp1	**	**	**		**

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Annex 9 – List of Indigenous Species of Interest for Lemur Feeding

N°	FAMILY	SPECIES	*Propithecus diadema*	*Eulemur fulvus*	*Avahi laniger*	*Hapalemur griseus*	*Cheirogaleus major*
99	MELASTOMATACEAE	*Memecylon* sp2	**	**	**		**
100	MELASTOMATACEAE	*Memecylon* sp3	**	**	**		**
101	MELASTOMATACEAE	*Memecylon* sp4	**	**	**		**
102	MORACEAE	*Ficus botryoides* Baker	**			**	
103	MORACEAE	*Ficus brachyclada* Baker	**			**	
104	MORACEAE	*Ficus lutea* Vahl	**			**	
105	MORACEAE	*Ficus politoria* Lam.	**			**	
106	MORACEAE	*Ficus reflexa* Thunb. subsp. *reflexa*	**			**	
107	MORACEAE	*Ficus tiliifolia* Baker	**			**	
108	MORACEAE	*Streblus dimepate* (Bureau) C.C. Berg			**		
109	MYRTACEAE	*Eugenia alaotrensis* H. Perrier		**	**		
110	MYRTACEAE	*Eugenia goviala* H. Perrier		**	**		
111	MYRTACEAE	*Eugenia hazompasika* H. Perrier		**	**		
112	MYRTACEAE	*Eugenia iantarensis* N. Snow		**	**		
113	MYRTACEAE	*Syzygium bernieri* (Drake) Labat & G.E. Schatz	**				
114	MYRTACEAE	*Syzygium emirnense* (Baker) Labat & G.E. Schatz	**				
115	MYRTACEAE	*Syzygium micropodum* (Baker) Labat & G.E. Schatz	**				
116	MYRTACEAE	*Syzygium parkeri* (Baker) Labat & G.E. Schatz	**				
117	OLEACEAE	*Noronhia decaryana* H. Perrier		**			
118	OLEACEAE	*Noronhia linocerioides* H. Perrier		**			
119	OLEACEAE	*Noronhia verticillata* H. Perrier		**			
120	ORCHIDACEAE	*Bulbophyllum bryophilum* Hermans					*
121	ORCHIDACEAE	*Bulbophyllum coriophorum* Ridl.					**
122	ORCHIDACEAE	*Bulbophyllum kainochiloides* H. Perrier					*
123	PHYLLANTHACEAE	*Antidesma madagascariense* Lam. var. *madagascariense*			**		
124	PHYLLANTHACEAE	*Bridelia tulasneana* Baill.					**
125	PHYLLANTHACEAE	*Margaritaria rhomboidalis* (Baill.) G.L. Webster					**
126	PHYLLANTHACEAE	*Phyllanthus casticum* P. Willemet					**

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N°	FAMILY	SPECIES	*Propithecus diadema*	*Eulemur fulvus*	*Avahi laniger*	*Hapalemur griseus*	*Cheirogaleus major*
127	PHYLLANTHACEAE	*Phyllanthus fuscoluridus* Müll. Arg.					**
128	PHYLLANTHACEAE	*Phyllanthus matitanensis* Leandri					**
129	PHYLLANTHACEAE	*Phyllanthus nummulariifolius* Poir.					**
130	PHYLLANTHACEAE	*Uapaca densifolia* Baker	*		*		
131	PHYLLANTHACEAE	*Uapaca ferruginea* Baill.	*				
132	PITTOSPORACEAE	*Pittosporum ochrosiifolium* Bojer	**		**		
133	PITTOSPORACEAE	*Pittosporum verticillatum* Bojer	**		**		
134	POACEAE	*Bambusa multiplex* (Lour.) Raeusch. ex Schult. & Schult. f.				**	
135	POACEAE	*Bambusa vulgaris* Schrad. ex J.C. Wendl.				**	
136	PRIMULACEAE	*Embelia madagascariensis* A. DC.	**				
137	PRIMULACEAE	*Maesa lanceolata*Forssk.	*				
138	PRIMULACEAE	*Oncostemum arboreum*H. Perrier	**	**	**		
139	PRIMULACEAE	*Oncostemum filicinum* Mez	**	**	**		
140	PRIMULACEAE	*Oncostemum laurifolium* (Bojer ex A. DC.) Mez	**	**	**		
141	PRIMULACEAE	*Oncostemum lucens* H. Perrier	**	**	**		
142	PRIMULACEAE	*Oncostemum nitidulum* (Baker) Mez	**	**	**		
143	PRIMULACEAE	*Oncostemum oliganthum* (Baker) Mez	**	**	**		
144	RHIZOPHORACEAE	*Carallia brachiata* (Lour.) Merr.		*	*		
145	RUBIACEAE	*Danais fragrans* (Comm. ex Lam.) Pers.		**			
146	RUBIACEAE	*Danais ligustrifolia* Baker		**			
147	RUBIACEAE	*Danais longipedunculata* Homolle		**			
148	RUBIACEAE	*Danais pubescens* Baker		**			
149	RUBIACEAE	*Danais rhamnifolia* Baker		**			
150	RUBIACEAE	*Gaertnera darcyana* Malcomber & A.P. Davis			**		
151	RUBIACEAE	*Gaertnera macrostipula* Baker			**		
152	RUBIACEAE	*Gaertnera madagascariensis* (Hook. f.) Malcomber & A.P. Davis			**		
153	RUBIACEAE	*Gaertnera obovata* var. *sphaerocarpa* (Baker) Malcomber			**		
154	RUBIACEAE	*Gaertnera phanerophlebia* Baker			**		

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Annex 9 – List of Indigenous Species of Interest for Lemur Feeding

N°	FAMILY	SPECIES	*Propithecus diadema*	*Eulemur fulvus*	*Avahi laniger*	*Hapalemur griseus*	*Cheirogaleus major*
155	RUBIACEAE	*Gaertnera phyllostachya* Baker			**		
156	RUBIACEAE	*Gaertnera rubra* C.M. Taylor			**		
157	SALICACEAE	*Ludia madagascariensis* Clos		**			**
158	SALICACEAE	*Ludia pinnatinervia* (H. Perrier) Capuron & Sleumer		**			**
159	SALICACEAE	*Ludia scolopioides* Capuron & Sleumer		**			**
160	SALICACEAE	*Scolopia hazomby* H. Perrier					**
161	SALICACEAE	*Scolopia madagascariensis* Sleumer					*
162	SAPINDACEAE	*Allophylus arboreus* Choux	**		**		**
163	SAPINDACEAE	*Allophylus trichodesmus* Radlk.	**		**		**
164	SAPINDACEAE	*Deinbollia macrocarpa* Capuron					**
165	SAPINDACEAE	*Filicium decipiens* (Wight & Arn.) Thwaites					**
166	SAPINDACEAE	*Plagioscyphus jumellei* (Choux) Capuron			*		
167	SAPINDACEAE	*Plagioscyphus louvelii* Danguy & Choux			**		
168	SAPOTACEAE	*Chrysophyllum boivinianum* (Pierre) Baehni	*				
169	SAPOTACEAE	*Chrysophyllum lanceolatum* (Blume) A. DC.	**				
170	SARCOLAENACEAE	*Sarcolaena multiflora* Thouars					**
171	SARCOLAENACEAE	*Leptolaena gautieri* G.E. Schatz & Lowry					*
172	SARCOLAENACEAE	*Leptolaena multiflora* Thouars					**
173	SARCOLAENACEAE	*Schizolaena exinvolucrata* Baker					**
174	ERICACEAE	*Erica goudotiana* (Klotzsch) Dorr & E.G.H. Oliv.					**
175	ERICACEAE	*Erica imerinensis* (H. Perrier) Dorr & E.G.H. Oliv.					**
176	ERICACEAE	*Vaccinium madagascariense* (Thouars ex Poir.) Sleumer					**

Implementation: the indicative budget is to be secured with the Marolambo National Park, focusing in priority on support for surveillance activities of the MNP in the northern sector (support for joint patrols with the gendarmerie, guard costs, travel

Annex 10 – Minutes of the Meeting Held on August 1, 2019 between Biotope, Sadabé and the Rainforest Trust

The meeting was held at the Gassy Country House in Ivato, on the sidelines of the ATBC conference.

Participants

- Rina MANDIMBINIAINA, Rainforest Trust
- Mitch IRWIN, Sadabe
- Fabien QUETIER, Biotope France
- Andriatiana RAKOTOARIMALALA, Sadabe
- Jose-Myriel RALISON, Biotope Madagascar

Excused: Jean Luc RAHARISON, Sadabe, and Anna DEFFNER, Biotope France

Initial Discussion on the Project

We first mentioned the project, its schedule, and the previous meetings between Sadabe and the Sahofika Hydropower Project Consortium.

Biotope has been mandated to prepare a Biodiversity Action Plan (BAP) in line with the requirements of the financial institutions with which the consortium is in discussion. It was mentioned that the BAP must be sufficiently precise and that it could be legally binding (via the Environmental Management Plan of the project, for which ONE is responsible for ensuring that the Environmental Permit Holder complies with a set of specifications).

It is estimated that the creation of the new protected area will take at least 3 years. The authorities have to revise the temporary status decree, and Sadabe will then have to prepare the EIA (ongoing), the social and environmental safeguard plan and the MAP for the protected area[7]. Various validations by the national authorities are then required before a final document can be submitted to obtain official protected area status. The target status is “IUCN Category V, Protected Landscape/Seascape ”.

The implementation of the studies planned for the creation of the protected area are affected by the dam project:

- Which studies are no longer necessary?
- What unplanned studies have become necessary?

It was agreed with NEHO that any additional costs could be borne by the Consortium. With the dam, they need to review the cost incurred in conducting their ESIA.

It was also mentioned that NEHO could provide information (data, measures, etc.) to Sadabe for their activities. Conversely, Sadabe’s MAP may feed into NEHO’s updated BAP.

With regard to the core area limit, reference was made to the costs of updating the MAP by Sadabe (consultation, regulatory files, etc.) if this limit were to be changed again.

Decisions

Several were made at the meeting:

- Signing of a Memorandum of Understanding between NEHO and Sadabe
- Sadabe’s contributions to the preparation of the project’s BAP: content of measures, governance, etc.

[7] *The NPA management tools include the MAP, the EHSP and and the ESMP.*

Annex 10 – Minutes of the Meeting Held on August 1, 2019 between Biotope, Sadabé and the Rainforest Trust

Memorandum of Understanding

This memorandum of understanding shall include:

- A shared vision
- Short-term collaborative activities on the preparation of the BAP and MAP and other regulatory documents/tools of each party - including information sharing!
- Medium- and long-term coordination (adaptive management): governance[8] to be put in place and reciprocal commitments + principle of a monitoring and transparency plan on effectiveness.
- Budget (at least for short-term collaboration): the agreement between Sadabe and the Rainforest Trust clearly specifies the expected cost for the creation of the PA, and NEHO will have to cover the extra costs related to the presence of the dam: coordination with NEHO and successive revisions of the documents to adapt them to the decisions of the parties, including for the benefit of the local associations involved in the management of the NPA (management transfer).
- It is necessary to identify interlocutors and their mode of appointment / renewal
- Coordination must also cover the social dimension

The shared vision would include:

- The BAP's net biodiversity gain target!
- The goal of conserving core natural habitats
- The objective of restoring degraded natural habitats in the core and buffer areas
- The objective of reforesting the buffer zone and the dam catchment area, thinking in terms of ecosystem services to people and biodiversity objectives (this goes beyond legal obligations).
- The objective of integrating forest and agricultural management into the management of the Dam watershed
- The objective of ensuring alternatives for the populations concerned within the framework of the project and NPA commitments
- The objective is to support local civil society (associations involved in management transfers) and local employment in activity implementation
- The objective of not expropriating populations as part of the creation of the NPA
- The objective of ensuring sustainability of funding (e.g. through the Rainforest Trust or another trust fund: a dedicated agreement will then be required)

☞ Biotope / NEHO will propose a first draft of this agreement and send it to Sadabe at the beginning of the week of August 12. Feedback is expected within 10 days, so the agreement can be signed in early September.

Co-construction of BAP measures for the hydropower project

Considering the timetline for the preparation of the BAP, it was suggested that rapid progress be made in sharing information and knowledge on the fauna, flora and habitats targeted by the BAP. The procedure adopted is to process the species via “sheets” that Biotope has planned to prepare for NEHO.

The following timetable has been agreed:

- Sending the Species Data Sheets & priority habitats list on August 5, 2019 and request a response to the partners: Sadabe & Asity.
- Species Data Sheets & priority habitats draft sent out August 09, 2019
- Workshop on the Species Data Sheets and priority habitats, August 13, 2019 (1/2 day), at Biotope's office.

[8] This concerns the governance of collaboration between NEHO and Sadabé; the tools (BAP, MAP, etc.) put in place by the parties, and the measures or activities provided for in these tools will of course have their own governance structure.

☞ Biotope will take care of logistics and invitations for the August 13 mini-workshop.

Annex 11 - Minutes of the August 13, 2019 Workshop

Date:	13/08/2019
Start time	10h15
End of the workshop	17h22
Location:	Biotope Madagascar Office
Participants:	Stakeholders: • Rina MANDIMBINIAINA (Rainforest trust) • Jean Luc Fanomezantsoa RAHARISON (SADABE) • Andry (SADABE) • Alain RAKOTONDRINA - Madagasikara Voakajy • Raphali ANDRIANTSIMANARILAFY - Madagasikara Voakajy • José RALISON - Biotope Mada • Hamy RAHARINAIVO - Biotope Mada
Background:	• EIA conducted between the end of 2017-2019 by Biotope • Drafting of the BAP since July 2019 • There has already been an Excel file (inventory of critical species) that Biotope has distributed to the stakeholders to ensure threatened species are not forgotten (MAVOA has already carried out inventories on their side). **Data in the Excel table: Critical species** **Three species of animals were proposed by SADABE (*Anodonthyla moramora*-Amphibians, *Rhombophryne kibomena*-*Amphibians*, *Anas melleri*- *Birds*) and were included in the analysis of critical habitats due to the following:** • Criterion 1 (CR-EN) for the three species mentioned • Criterion 2 (limited/endemic distribution) for *Anodonthyla moramora, Rhombophryne kibomena* **Two other species were proposed by MAVOA (*Boophis andohahela, Brachypteracias leptosomus*) but were not included in the list of species triggering critical habitat for the following reasons:** • *Boophis* sp. *andohahela:* a doubt on the species observed because the photo does not

	show the true morphological features of *Boophis andohahela.* MAVOA did note that it is *Boophis rappiodes* (LC) instead. *Brachypteracias leptosomus*, VU species with a wide geographical distribution (203,000 km^2) The 40 species mentioned on the data sheet are derived from the analysis of the IFC (threatened species triggering critical habitats) and AfDB (critical habitats) criteria. • The analysis was carried out in the Tsinjoarivo/Ambalaomby area, adjacent forests and watershed; • The NEHO project follows IFC Performance Standard No. 6 • Goal: Protection of Malagasy biodiversity in the action plan that we are going to highlight • All species that trigger critical habitats are subject to an action plan
Agenda:	• Responding to the expectations of the various stakeholders in the elaboration of the BAP through this workshop • Input from stakeholders as their knowledge of the area is a major asset in the drafting of the BAP.
Issues discussed: **(Morning)**	• Reminder of the project and the purpose of the meeting by José • Presentation of the Excel sheet by José (through various parameters): ✓ Group, species, habitats, presence of the species in the study area, rationale for critical habitat designation, area of analysis; ✓ Conservation expectations; ✓ Expectations for follow-up The table is the outcome of a summary of bibliographical work, inventory data and consultation with Vahatra-GSPM. The inventory focused more on terrestrial than aquatic species VOAKAJY covered the other terrestrial fauna species SADABE covered the lemurs
	• Species No. 01: Rheocles wrightae This species was seen by the MAVOA hydrobiologist on one of the tributaries north of the site at an altitude of 1300 to 1500 m. A species that indicates the natural state of an environment Species #02: Rheocles ambatovy Discovered by the Biotope team, supported by the MZBA Tsilavina expert (Biotope consultant in aquatic fauna) noted that this species is similar to the one he discovered in Ambatovy **Rina:** We'll present the conservation measures later **José:** This species cannot survive in a high-turbidity river (which is the case of the Onive where the species was not observed). SADABE's inputs in terms of management/conservation and monitoring Increased sampling in the area (CONSERVATION) because an adequate forest conservation system must be considered. This will preserve water quality. Possibility of undertaking ex-situ breeding of species but preferably preserving their habitat **José:** ACTOR: Which entity could undertake this task? Maybe MZBA (former DBA) **Jose:** The BAP should be consistent with the conservation process considered by SADABE (proponent of the New Protected Area) => consultation between NEHO-SADABE, especially during the construction phase **SADABE:** to add three species according to their studies carried out within the framework of the inventories (EIA for the establishment of the NPA). **José:** Each species mentioned must have adequate actions for its conservation, considering the pressures generated by the project => the lenders would like to know the action plan for each species before providing funding. **Note:** the difference between the BAP (for a project) and the action plan on conservation

targets (creation of protected areas) must be clearly established.
For the BAP: each species triggering critical habitat must be subject to tangible actions for its conservation;
For the Biodiversity Management Plan (BP), conservation targets are sometimes grouped (integrated target) according to pressures. There is a difference with the requirements for the creation of protected areas

- There is a difference with the requirements for the creation of protected areas.
- PA creation = conservation targets less than 10
- However, the pressures on each major group must be taken int account

Actor identified for the Rheocles BAP

Actor identified	Conservation	Follow-up
MAVOA Sadabe	• In-depth knowledge of the species (per inventory) • Development of the conservation strategy for the species • Implementation of measures • Management of water quality maintenance at the tributary level=> watershed management (reforestation forest adjacent to water, ??? • Identification of pressures on the water environment	• Increase the number of sampling sites in the focus area through extensive surveys • Monitoring

Rina: Which one of us will do the costing?
José: We will see this after validation of the actions by NEHO (the draft or plan proposal will be sent by Friday).
Rina: What is the level of detail for watersheds, for example?
Jean Luc: Construction of the dam over 3 years => During the meeting with CB Moramanga, Anosibe An'Ala, there was a discussion on the population's request to settle in Andranotsimizaka as well as in Fisoronana (1st choice) and Soamanandrariny (2nd choice) => within as part human resettlement operations.
José: In social resettlement, the consent of the PAPs is not always the same. There will always be people protesting. The settlement of the population in the natural environment after the creation of the PA is illegal.
Rina: Repression is not a solution, but it is a case of force majeure. There would always be discussions and awareness-raising as well.
State 0 may or may not be good.
Raphali: The first challenge is to maintain State 0 or higher. *Example:* 10 trees but then restoration to obtain 15 trees.
José: There will be residual impacts that the project must compensate => ecological gain. *Example:* Ecological density of 10 species of Rheocles per m^3 of water but after mitigation and compensation 20 species per m^3, resulting in an ecological gain.
Rina: Therefore, State 0 should be defined for all species on the list. So are there particular strategies for other species, because deforestation and *tavy* are common pressures for all species? In terms of compensation, the requirements of each species must be taken into account. (*Example:* arboreal and terrestrial species of frog) and of the case of the project (at such action for such phase: as land stripping).
José: The aquatic species mentioned are not directly affected by the project as they are found in the tributaries downstream from the dam. On the other hand, there would be an influx of population that would cause pollution to these tributaries after the project is implemented (induced impacts).
Raphali: We are currently developing a conservation strategy for each species, so why don't we identify the sources of impact on the species in order to draw up the conservation strategy?
Andry (Sadabe): The outcome of this workshop will be a tool for NEHO and NPA.

José: We include each species in the table because each one has its criticality value.

1 action plan for 1 species

Requirement of lenders => Obligation

Jean Luc: The place we are talking about will be a future core area. Why not strengthen the **preservation of the core area**? Generalized case
José: No, because we won't get **a net gain for the critical species.**
Rina: You should focus on about ten species if it's in the context of a project. We have this PCD which is our asset. This BAP would improve the conservation of the species near the dam site as part of a biodiversity compensation program. Need for monitoring to combat species decline.
Insertion of the dam in the PA.
José: PA management tool? The PA could not follow this tool because it goes into too many details. In general, there are 7 threats in a PA that are general to all species. On the other hand, each species can have its own pressure (*Example:* bubble passage).
Jean Luc: Is the conservation concern biodiversity in the implementation of access roads known?
José: Mitigation measures such as re-routing are proposed if conservation concern biodiversity is present => minimization of cleared areas on the selected route (the highest route). *Example:* avoidance of threatened frog nesting sites. So during the construction phase, there should have been *Mantella* followed by MZBA and MAVOA.
Raphali: All species will be disturbed during the construction phase. We need to know impacts on the species and we will find the measures.
José: If a project infrastructure passes through a watercourse (not avoidable) and if there is a risk of a landslide => vegetarian planting.
Raphali: That's kind of what it is.
Jose: Literature searches and stakeholder data were useful in confirming the species analysis. Ecological compensations are not limited to project sites only, hence the analysis of information from other areas or even BV.
Raphali: The species conservation strategy should be an activity different from this tool that we are building together?

(Après-midi)

- Species No. 3: *Astacoid (*Crayfish)

Same conservation method but for the actors: MZBA is not an actor. For plant species: We won't discuss them now (see with MBG)

- Species: Anodonthyla boulengeri (Amphibians)

Actor identified	Conservation	Follow-up
MAVOA Sadabe	• Inventory (knowledge of population status) • Definition of the habitat • Reforestation/Restoration • Identification of pressures • Translocation of affected individuals within the area to be cleared	• Increase the number of sampling sites in the focus area through extensive surveys • Monitoring

- Species: Anodonthyla moramora (Amphibians)

Actor identified	Conservation	Follow-up
MAVOA Sadabe	• Inventory (knowledge of population status) • Definition of the habitat • Reforestation/Restoration	• Increase the number of sampling sites in the focus area through extensive surveys

		• Identification of pressures on habitats • Translocation of affected individuals within the area to be cleared • Refinement of the strategy	• Monitoring

- Species: g. *Calumna* (Reptiles)

Same as with the amphibians

- Species: Pseudoxyrhopus oblectator
- Species: Lygodactylus bivitis (Gecko)

MAVOA, Sadabe	• Inventory (knowledge of population status) • Identification of pressures on habitats • Translocation of affected individuals within the area to be cleared (pour reptiles et gecko) • Refinement of the strategy	• Increase the number of sampling sites in the focus area through extensive surveys • Suivi périodique

- Species: Cheirogaleus sibreei
- Lepilemur mustelinus
- Daubentonia madagascariensis

Sadabe, GERP	• Inventory (knowledge of population status) • Identification of pressures on habitats • Translocation of affected individuals within the area to be cleared (cas de *Cheirogaleus, Lepilemur*) • Refinement of the strategy	•

- Species: Limnogale mergulus

MZBA Sadabe	• Inventory (knowledge of population status) • Refinement of the strategy	•

- Sarothura watersi (ornitho)
- Tachybaptus pelzelnii
- Anas melleri

Asity	• Inventory (knowledge of population status) • Identification of pressures on habitats • Refinement of the strategy	• Increase the number of sampling sites in the focus area through extensive surveys • Suivi périodique

José: Are there any other ideas for improvement before sending the draft on Friday August 16

NONE

	• LUTTE ANTI-BRACONNAGE: PROTECTION OF CITES SPECIES AND COMBATING POACHING

Poaching control	**José**: systematic monitoring of anti-poaching activities **Jean Luc**: destruction of traps by *polisin'ala,* arrest of poachers in the core area.
Protection of CITES species	**Raphali**: Implementation of zoning for anthropic activities in order to control the collection of CITES species. The easier and more public the access route, the more species are exposed to illegal collection

- Reduction of the impacts of population influxes:

Jean Luc: Raising awareness and informing the relevant authorities

- **Support of area managers:** Support to the VOIs of Sahofika and Ambalaomby for implementation of the PAGs (simplified development and management plan of two VOIs (Ambalaomby and Sahofika) => for their management transfer zones. The VOIs have their own DINAs and patrols.
- Contents of the PAGs: patrols, implementation of DINAs, awareness-raising, alternative AGR and reforestation, PTAs

Rina: We supported Sadabe financially for the PA process only. NEHO BAP is only one part of the PA Biodiversity Conservation Plan. NEHO could launch its funding through Rainforest Trust (discussion with Fabien in Ivato). Does Sadabe have a source of funding for the management of the PA?

- First the important activities to be done should be identified and then funding should be raised.
- NEHO could carry out its support on the communities directly affected by the project (therefore not on the 7 VOIs created under the PA).

- **Jean Luc:** We are preparing for the creation of the PA. There will probably be co-management with the 7 VOIs

Rina: Need to consider MAP without project and MAP with project. It would be necessary to look at the optimization of the collaboration between the manager and NEHO because the installation of the dam could bring many negative impacts (increase of insecurity, ...).

Jean Luc: The viability of the 2 VOIs is assured if Sadabe obtains the requested title. However, with the support of NEHO, Sadabe can optimize co-management with the other 5 VOIs.

Jose: The manager of the entire PA is responsible for all VOIs. VOIs are starting to be viewed negatively in Madagascar. We should look at the general PA MAP.

Jean Luc: Support for the implementation of the population influx management mentioned in the MAP.

3- Compensation_Forestry_RESTORATION

- Preparation and implementation of a program to restore degraded areas in forests adjacent to the main forest corridor.

Jose: The zoning units of the project will be impacted differently. Reforested area = right bank area. NEHO has to compensate for the surface losses generated by the route between Ambatotsipihina and Sahofika => Need for reforestation and forest restoration in

	terms of compensation Right bank => Marolambo Park part, this is more or less solved, with the discussion with the three VOI during the Biotope mission last July. The impacts on the right and left banks are not equal. Are there any restoration programs on the left bank? **Jean Luc:** Not yet because the MAP has not yet been defined. PAGs is not yet defined either. **Raphali:** Priority must be given to identifying the restoration area (PREPARATION). **Jean Luc:** Forest restoration should be carried out in the raised area (by native species). **José:** Who will be responsible for the catering? Implementation will focus on identifying the restoration area with the responsible VOIs. **Jean Luc:** It will be the VOI of Ambalanomby because it is its terroir. **5- COMPENSATION SUPPOR NPA TSINJOARIVO: SUPPORT FOR THE CONSERVATION OF NATURAL FORESTS IN THE MAROLAMBO NATIONAL PARK** • MAP support but focuses on species management plan • Supporting the implementation of the Biodiversity Management Plan included in the PA MAP. **6- REDUCTION REFORESTATION MEASURES: SUPPORT PROGRAM FOR ROADS: REFORESTATION IN AREAS WHERE MANAGEMENT HAS BEEN TRANSFERRED AND SERVICES PRESERVED** • *Actors:* VOI Ambalanomby and Sahofika • *Zone:* In Ambalanomby and Sahofika • Preservation ecosystem service: reforestation => preserves water quality Jean Luc: For the VOI, reforestation is important because it represents another alternative to AGRs, because in Ambalanomby, there is still a strong dependence on forest resources.
Other points	**Rina:** We have proposed a lot of actions on the various species. It would be better to ensure these actions are coherent when prersented to the lenders (IFC, AfDB). **José:** Yes, because lenders closely monitor action plans. This is why we check the list of species with you (stakeholders). **Rina:** Would it be possible to get the draft version of the BAP? **José:** We should to ask Fabien QUETIER

Annex 12 – Report on Consultation with Marolambo National Park

Participants

-Anna Deffner, Biotope

- Juliette RAHARIVOLOLONA, Director of Marolambo National Park, juliette_dpMRL@mnparks.mg / rjuliette_elisa@yahoo.fr

Not attending: José-Myriel Ralison, Guillaume Crépin, Vonjisoa Rasoloarison

Purpose of the meeting: identification and discussion of the various opportunities for support for the Marolambo National Park within the framework of the biodiversity action plan of the Sahofika project.

By priority order:

Support for MNP monitoring activities in the northern zone (core + periphery)

Ongoing program support

- Ongoing bimonthly monitoring program by local committees - currently the MNP does not have the resources to conduct monthly monitoring.
- Request for support to conduct monthly monitoring in the north of the park
- Estimated cost: 120 000 Ariary / month - to compensate the surveillance teams (2 persons - 6 days per month)

Joint action with the gendarmerie

- Today the gendarmes are only mobilized occasionally when offences are observed, to assist PNM officers during arrests - insufficient numbers and difficult travel from Ambohitompoina.
- The project (access road and resettlement of the population in Fisoronana) may increase pressure in the north of the park.
- The regular presence of the gendarmerie would serve as deterrence - discussion under way with the Brigade Commander.
- Possibility of supporting monthly gendarmerie missions in the northern zone of the PNM
- Estimated cost - for a presence of the gendarmes every two weeks (mobile in the forest, heart of the PNM and community forests) - an allowance of 30,000 to 36,000 Ariary per person per day + travel expenses (motorbikes) must be taken into account.

Financing of a guard post in Belanitra

- Would directly benefit the MNP - ensure a regular/permanent presence in the North zone - the sector chief can only travel today on a bi-monthly basis
- The project could fund a local permanent job (MNP cannot fund this position).
- This would ensure control over the removal of timber or poaching of endangered species from the project area.
- This officer must also be supported by the constables (see with the DREDD, Regional Constabulary District on an unannounced basis).

Support to the forest administration

- Support from the project would facilitate the movements of forest administration agents to control timber loading areas (hammering of authorized products) rather than control at the exit of communes (often mixtures of timber and wood from natural forests).

Material support to be discussed

- e.g. GPS (purchase in progress)
- surveillance is done on foot (if possible a bicycle allowance)

Support for the extension of the Fisoronana management transfer area

- The PAPs transferred to Fisoronana will increase the need for natural resources in this sector.
- Proposal to carry out an extension of management transfers to the portions of forest where there is no management - targeted forest = Manaripatsa at the extreme north-east of the Belanitra commune, bordering the territory of the District of Marolambo)
- Request for support for the extension of the VOI of Fisoronana - the whole process (assessment, inventories, consultations, organization, forest management plans)
- The Fisoronana MAP was updated in 2017.
- The process of extending the VOI can start now (resource inventories, organization etc.).
- Validation can take place once the population has settled in the new resettlement site.
- Ongoing discussion with the DREDD responsible for the process of evaluation and contractualisation of management transfer zones.
- Cost of the process to be discussed with the DESD

Support for restoration actions

- Past collaboration between nurserymen and the MNP in the north of the park - stopped due to lack of funds;
- Old nursery in Fisoronana and in another voluntary village having already shown its interest/motivation for nurseries/reforestation, benefits from the fish farming activity of an association in the Fokontany Ankadivory of the Commune of Belanitra but also to strengthen the restoration of the Park;
- The aim would be to revitalize local nurseries - a major reforestation program.
- Synergies to be found between the installation of local nurseries (in Fisoronana in particular) and the restoration actions of the project and the MNP
- Estimated cost for 1 nursery and transplanting: local labor + small materials + supervision = 10 Million ariary per year (annual production of 10,000 plants).
- The MNP has an ongoing collaboration with the University of Antananarivo for a restoration program in the center of the Marolambo Park (10,000 plants annually) - university researchers are support the nurserymen for the production of plants - planting of Rosewood in progress.
- Past collaboration with the association Graine de vie https://grainedevie.org/fr/index.php - but travel from Tana is too difficult - the PNM still works with Graine de vie but in regions less isolated than Fisoronana.
- The rehabilitation of the road by the project could facilitate movements by this NGO and facilitate the support to local nurseries?

Raising the awareness of local populations

- Important cross-cutting actions
- Opportunity to support special missions of the MNP team in the North to establish more contact with local populations.
- Today the contact with the populations happens every two months --> moving on to monthly contacts?

MNP communication

- No need to update the MAP (finalized in 2019 for the management through to 2021) - not

good timing but can , if possible, support the project from 2021 for a 2022-2027 MAP.

- Need for support for the organization of stakeholder consultations for the evaluation of the implementation of the previous PAG and the validation of the updated PAG; Estimated costs: 2 Million Ar x 6 for the evaluation in the 6 Districts of the Park + 5 Million Ar x 4 for the regional validations in the 4 Regions concerned and 6 Million Ar for the national validation.
- But possible support for the dissemination/communication of the MAP from 2020 onwards
- For communication on the MAP

Ecological monitoring

- No ecological monitoring in progress in the north of the park.
- Establishment of participatory monitoring with local committees

Estimated cost of 60 000 Ariary / month (if possible with support for moving by bicycle for example)

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Siège social :
22 boulevard Maréchal Foch - BP58 - F-34140 Mèze
Tél. : +33(0)4 67 18 46 20 - Fax : +33(0)4 67 18 65 38 - **www.biotope.fr**

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