Working towards NNL of Biodiversity and Beyond

Ambatovy, Madagascar – A Case Study (2014)

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The Ambatovy Joint Venture is operated by Sherritt International Corporation. The joint venture partners include Sherritt International Corporation (40%), Korea Resources Corporation (27.5%), Sumitomo Corporation (27.5%), and SNC-Lavalin Incorporated (5%). In Madagascar, Ambatovy operates through two companies: Ambatovy Minerals, S.A. (AMSA) for the mine site and pipeline, and Dynatec Madagascar, S.A. (DMSA) for the metals refining facility. For the purpose of this case study, the Ambatovy Joint Venture is referred to as "Ambatovy" or "the company".

Available from http://www.forest-trends.org/documents/ambatovy_2014

About this Document

Ambatovy joined the Business and Biodiversity Offsets Programme (BBOP) in 2006 as a pilot project. In 2009, Ambatovy, together with BBOP, published a case study on the company's biodiversity management and offset work up to that point (available at http://www.forest-trends.org/documents/files/doc_3118.pdf). The present document serves as an update on Ambatovy's progress achieved since then and following a second-party evaluation (pre-audit) against the BBOP Standard on Biodiversity Offsets (BBOP, 2012) and the International Finance Corporation's Performance Standard 6 (IFC, 2012). For more detail and a history of the company's work in applying the mitigation hierarchy and biodiversity offsetting, it is useful also to refer back to the 2009 original case study.

With the publication of this update, Sherritt International Corporation, Forest Trends, and Wildlife Conservation Society (WCS) hope to contribute to the knowledge on biodiversity management and offsetting, to stimulate discussion, and possibly to assist others in understanding certain technical aspects of offset design and implementation, as well as some of the challenges that may be encountered and solutions that may be available.

It is important to recognize that biodiversity management is a 'work in progress' and that experience on good practice offsetting continues to provide lessons, and that the practice, the relevant Standards and societal expectations in terms of biodiversity management keep evolving.

With the publication of this update, Solid Energy and Forest Trends hope to further the state of knowledge on biodiversity management and offsetting, stimulate discussion, and share information on technical aspects of offset design and implementation, including some of the challenges that may be encountered and solutions that may be available.

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Executive Summary

Executive Summary

Ambatovy is a large-scale nickel and cobalt mining enterprise in Madagascar, comprised of a lateritic mine near Moramanga, a central-eastern town, and a processing plant in Toamasina, a city located on the east coast. The two sites are linked by a pipeline of approximately 220 km in length.

Project construction began in 2007 and was completed in 2012. In January 2014, Ambatovy met the requirements for commercial production.[1] This achievement represents an important milestone in the operational ramp-up of the Ambatovy facilities to full production capacity. The estimated life of the operation is approximately 29 years.

Madagascar is a global hotspot for biodiversity, with exceptionally high degrees of endemism, and, at the same time, a high level of threat. Following extensive deforestation, only about 10% of the original forest cover remains. The Ambatovy mine lies in a high-biodiversity region at the southern tip of a large section of remnant eastern rainforest corridor. To the north-east of the mine lies the Ankeniheny-Zahamena forest corridor (CAZ), while to the east lie the Torotorofotsy wetland (a Ramsar[2] site) and the Mantadia National Park. Connecting the mine forests to the CAZ and Mantadia is an area of intact forest known as the Analamay-Mantadia forest corridor (CFAM). These forests are known to support 14 species of lemurs, 32 other mammals, 122 birds, almost 200 reptiles and amphibians, 50 fish (including 25 endemic species) and over 1,580 plants (including 250 orchids), representing more than 10% of Madagascar's known flora.

Ambatovy's mission is to be a leader in the sustainable production of high-quality nickel and cobalt for the global market. Ambatovy's vision is to deliver world-class results in safety, environmental stewardship, social performance, product quality, production, and cost efficiency through a committed and engaged workforce. Guided by Sherritt's commitment to demonstrating environmental responsibility, Ambatovy aims to meet or exceed all its environmental obligations and to deliver no net loss, and preferably a net gain, of biodiversity and no net harm to Madagascar's ecosystems. Ambatovy joined the Business and Biodiversity Offsets Programme (BBOP) as a pilot project in 2006, with the intention of benefiting from and contributing to best practice in achieving its biodiversity goals.

The company's biodiversity management strategy is based on application of the mitigation hierarchy with an objective of no net loss (NNL), or preferably a net gain (NG), of biodiversity. In this regard, Ambatovy primarily follows two standards – the Biodiversity Offset Standard (BBOP, 2012) and the IFC Performance Standards on Environmental & Social Sustainability (IFC, 2012). Both standards require adherence to the first three

[1] Commercial production is defined as 70% of ore throughput of nameplate capacity in the pressure acid leach circuit, averaged over a 30-day period.

[2] The Convention on Wetlands of International Importance, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for action and international cooperation and wise use of wetlands and their resources. For more information, visit: http://www.ramsar.org

steps of the mitigation hierarchy (avoidance, minimisation, restoration of impacts) before considering the implementation of offsets to compensate for any residual loss of biodiversity. Offsets are then designed and implemented in accordance with the principles of the Biodiversity Offset Standard.

Avoidance measures were primarily defined at the project design stage, including keeping the footprint area to an absolute minimum for mine operations, establishing two azonal forest set-asides of 306 ha overlying the ore body, constructing sediment dams to avoid impacts in downstream water catchments, routing the pipeline to avoid sensitive areas such as forest fragments and locating the processing plant on degraded coastal lands rather than close to the mine.

Minimisation measures are based around a paced, directional forest-clearing process, whereby forest clearance is conducted by lots in a planned manner, using labour-intensive non-mechanised methods, clearing slowly out from the center to the footprint periphery, thereby allowing the more mobile wildlife to escape into the surrounding 3,500 ha of conservation forests which have been secured by Ambatovy through a 50-year surface lease. Minimisation for each forest lot follows a coordinated process in three phases - pre-clearing, clearing, and post clearing. Prior to clearing, inventories of flora and fauna are conducted, plant species of concern are flagged for salvage while trees with nesting birds or mammals are marked for preservation until fledging or rescue. A mitigation plan is developed by the environmental and operations teams. During clearing, the salvage and rescue of priority species of plants (known as ‘Species of Concern’ or SOCs, including all orchids), mammals, birds, reptiles, and amphibians is undertaken. Following clearing and grubbing, timber is removed for distribution to local communities, brushwood is collected for mulching and top soil is removed and stored for restoration purposes.

Ambatovy is committed to the restoration of the mine site, using a continuous restoration approach starting in 2015. The restoration vision as originally formulated was to generate, over 35 years, multiple-use replacement forests coherent with the surrounding forest matrix. The ambition is to make restoration contribute explicitly to the goal of no net biodiversity loss, particularly by aiming to restore critical ecological values (e.g., populations of endangered species) where feasible and maintaining the values and functions of ecosystem services affected by the project. Trials are being conducted to assess a variety of restoration methods. Saplings are grown in production nurseries, while rare and recalcitrant species are being grown from tissue culture in a laboratory at the University of Antananarivo.

To compensate for the operation’s residual losses of biodiversity, Ambatovy has developed a multi-faceted offset programme. In this, the company has been guided by the materials and tools published by BBOP, as well as by processes such as regular compliance audits conducted by third-party experts who report to the lenders.

Ambatovy is in the process of completing its offset design, while implementation of offset activities is already underway at a suite of sites. In the case of Ambatovy, ‘averted loss’ offsetting aimed at protecting biodiversity that would otherwise be lost, is widely regarded by stakeholders as the most suitable mechanism. This is supported by high observed levels of deforestation in Madagascar and in the context of exceptionally limited funding for existing Protected Areas and large forest areas identified for protection across the country as part of the ‘Durban Vision’ but without funding committed to implement this expanded Protected Area network.

Key steps in offset design included:[3]

1. Reviewing the development project's scope and activities
2. Reviewing the legal framework and/or policy context for a biodiversity offset
3. Initiating the stakeholder participation process
4. Determining the need for and feasibility of an offset based on residual impacts on biodiversity
5. Choosing methods to calculate loss/gain and quantifying residual losses
6. Reviewing potential offset locations and activities and assessing the biodiversity gains which could be achieved at each
7. Calculating offset gains and selecting appropriate offset locations and activities
8. Recording the offset design and entering the offset implementation process.

The present document focuses on technical aspects (i.e., Steps 5-7) of this process, specifically on the choice of methods to quantify biodiversity losses and gains and initial calculations undertaken for forests affected at the mine site and upper pipeline. More detailed assessment that includes aquatic biodiversity and priority species is still underway.

Based on a review process involving desk-top research and intensive field surveys, five sites were selected as part of the current composite offset programme. These sites were identified based on various criteria, the most important being: the comparable (like-for-like) nature of their biodiversity (priority species and affected forest types) and the potential for achieving significant additional biodiversity 'gains' through long-term protection measures (i.e., gains in the form of averted loss of forest and priority species over and above what would have happened under a 'business as usual' scenario of on-going deforestation).

The offset sites are:

- Two patches of azonal forest (306 ha) in the mining concession;
- The 'Conservation Zone': a large area (3,338 ha) of mostly zonal forest within the mining concession;
- Ankerana (5,715 ha), an area of azonal and zonal forest situated approximately 70 km to the north of the mine site and forming part of the very extensive CAZ;
- A part of the CFAM (7,269 ha) covering mostly zonal forest and connecting the mine 'Conservation Zone' to Mantadia National Park
- The forests (3,876 ha) surrounding the Torotorofotsy wetlands to the south-east of the mine.

Initial loss/gain calculations have been undertaken to assess the potential for long-term protection of these sites to contribute towards reaching no net loss of forest relative to the residual impacts caused by Ambatovy. A 'habitat hectares' or 'area x condition'-type of currency that combines a measure of forest condition and extent was chosen as the basis for determining losses and gains. This in line with best available practice, as 'area x condition' currencies offer important advances over previously frequently used 'area-only' based

[3] BBOP (2009) and Ambatovy-BBOP case study (2009)

Table 1. Summary Statistics of Forest Losses due the Mine - and Four Different Scenarios of Potential Averted Losses (and Gains due to Offsetting) by 2040 across All Offset Sites

Forest type	Loss (hh)	Averted Loss by 2040 (in habitat hectares, hh)				Potential to achieve NNL by 2040
		Scenario 1	Scenario 2	Scenario 3	Scenario 4	
Azonal forest	- 740.03	50.84	89.19	125.30	163.65	No scenario achieves NNL for azonal habitat
Transitional forest	- 175.01	93.43	109.94	259.03	274.94	Scenarios 3 & 4 achieve NNL for transitional forest
Zonal forest	- 534.38	1,663.11	2,033.21	4,381.07	4,752.84	All scenarios achieve NNL for zonal forest
Total	-1,467.05	1,807.38	2,231.74	4,765.40	5,191.43	All scenarios achieve NNL/NG for forest (types aggregated)
Net Forest Gain*		+ 340.33	+ 764.69	+ 3,298.25	+ 4,294.0	

*See Figure 1.

currencies. In terms of losses, a total of 2,065 ha of forest are predicted to be residually impacted at the mine and upper pipeline, of which 50% is azonal, 23% transitional, and 27% zonal forest. The respective precise figures in habitat hectares are given in the table below.

Potential ‘gains’ (averted forest loss) from protecting the selected offset sites were assessed against a baseline or ‘business as usual’ scenario of background deforestation in the applicable regions (Brickaville and Moramanga). The chosen timeframe for projecting averted losses was from three years after implementation of the first full conservation interventions at each offset site (between 2014 and 2017) and up to the year 2040.

Four cenarios were established to project the potential for averted losses. These scenarios represent a range of possible outcomes and are based on deforestation rates measured across three timeframes over the past 20 years. These deforestation rates are available both for areas surrounding protected areas and inside existing protected areas. The former rates (which ranged from 0.3-1.31% per annum) were used as an indicator of likely future background deforestation (‘without protection’) while the latter rates (ranging between 0.02 and 0.31% p.a.) were used to indicate the possible ‘with protection’ (and conservation success) situation. Mangerivola National Park, Andasibe-Mantadia National Park, and Analamazoatra Special Reserve were used as representative protected areas.

The four scenarios that were therefore used to report the potential for averted losses at each offset site are as follows:

1. Low baseline deforestation rate in the region (based on the lowest observed background deforestation rate since 1990) and limited conservation success at the offset site (based on the highest deforestation rate observed since 1990 in the relevant proxy Protected Area, PA): the least extreme averted loss scenario.

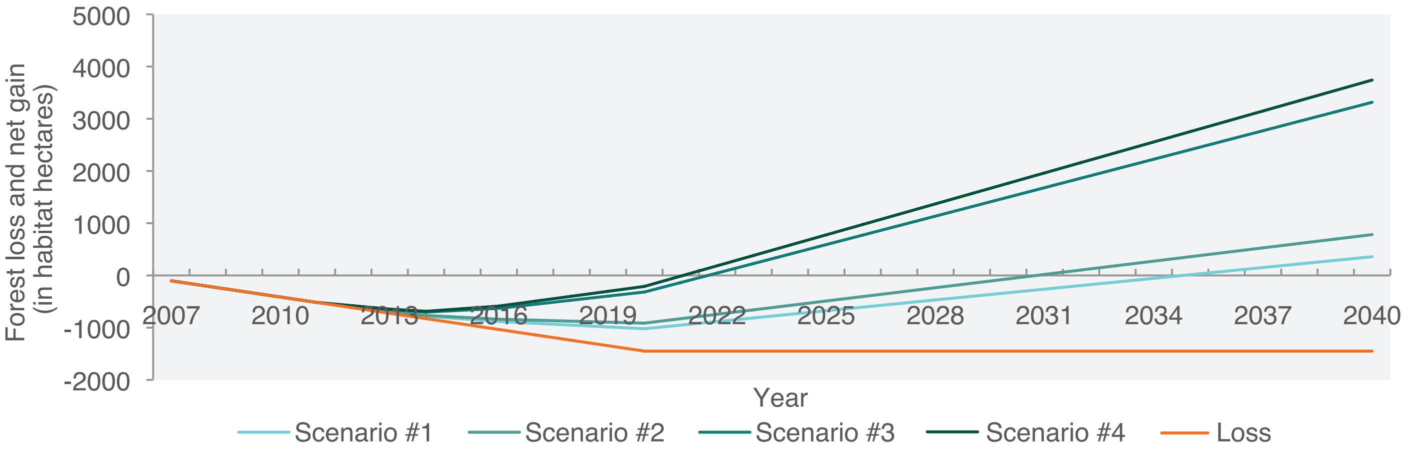
2. Low baseline deforestation rate and high conservation success (the latter based on the lowest deforestation rate observed for the relevant PA).
3. High baseline rate (based on the highest background deforestation rate observed in the relevant region since 1990) and limited conservation success.
4. High baseline deforestation rate and high conservation success: the most extreme averted loss scenario.

The findings of the initial loss/gain calculations are summarized in Table 1 and Figure 1 below.

The results show the marked influence of deforestation rates and associated scenarios on forecasting potential offset 'gains' (averted losses). As expected, there are very large differences between the scenarios. This highlights the importance of examining (and retaining as part of the projections) a range of possible outcomes, thereby catering for some of the significant uncertainty associated with such projections. Based on the current understanding of land use pressures and on the effectiveness of conservation measures, the most credible forecast would seem to lie between the extremes, thus between Scenario 2 and 3. Both scenarios predict No Net Loss or possibly a Net Gain in habitat hectares of forest (not differentiating between forest types) and across all sites within the 2040 timeframe.

However, when forest types are analysed separately, NNL/NG for azonal forest is not achievable within the next thirty or so years under any of the scenarios (Table 1). This is due to the large area of azonal forest affected by the mine relative to the more limited extent of azonal forest in the offset areas (Ankerana and within the mine concession). The loss/gain balance through averted loss offsetting for azonal forest specifically could only be reached much later than 2040, if at all. This is assuming an unrestricted timeframe for the achievement of NNL/NG.[4] Important to note, however, is the high degree of similarity with regards to the species composition (fauna and flora) in azonal, zonal, and transitional forest. This applies particularly where these occur in close proximity at a given site (e.g., azonal patches and conservation forests within

Figure 1. Projected losses due to Ambatovy's Operations and the Potential Net Gains in Forest (in habitat hectares) according to Four 'Averted Loss' Scenarios and across all Offset Sites



Note: Forest types are aggregated here and that based on these projections, NNL/NG of aggregated forest types could be achieved sometime between 2022 and 2035.

the mine concession area). The main compositional differences are found with respect to the flora at quite distant sites (e.g., Ankerana and Ambatovy share only about 50% of the flora), even though there is significant overlap with respect to most of the faunal taxa, especially the mobile taxa. For instance, all of the potentially affected lemur species at the mine site occur at Ankerana.

The following observations from the first loss/gain projections are pertinent:

- While the results are a first estimation, and are incomplete (e.g., species-specific and aquatic components are still to be incorporated), they provide a valuable framework for proceeding with the offset work across the five sites.
- NNL/NG for overall forest (see note on azonal forest above) affected by the operations appears feasible over the next 20-30 years. This is given the current scale of the offset programme and the fact that implementation is underway at several sites prior to the accumulation of maximum losses.
- The scope of the offset programme may appear extensive, but is based on a precautionary approach and addresses a range of risks and uncertainty. As it stands, the programme a) allows for flexibility in terms of prioritising actions and refining outcomes over time, depending on what is most effective and efficient, b) caters for uncertainty, e.g. fluctuating levels of conservation success, varying background deforestation rates and other factors that are mostly beyond the control of the company, and c) covers as well as possible the wide range of different biodiversity components impacted by the operations (i.e., forest types, priority species, and other components).
- In this context, it is also important to note that the loss/gain calculations exclude any form of discounting, i.e., the underlying assumption is of a zero discount rate. If a positive discount rate were applied, this would reduce the rate of loss and thus the potential gains. Agreement on how to determine a meaningful and defensible discount rate for biodiversity offset calculations is still outstanding.[5]
- The loss/gain calculations assume that 100% of additional conservation outcomes can be ascribed to Ambatovy for all sites, whereas adjustment may need to be made to reflect the contributions of other stakeholders at certain sites (notably the Torotorofotsy wetland).
- The loss/gain calculations do not yet take account of the minor losses to biodiversity in modified, non-critical habitats caused by the lower part of the pipeline, plant site, and tailings facility.
- Future refinement of the calculations given additional data (e.g., on priority species distributions) and monitoring of deforestation rates and conservation success will allow for any necessary changes and adaptive management of the offset programme over time.

The offset programme is in the early stages of implementation. While intensive conservation work in the mine Conservation Zone (including the azonal patches) has been on-going for several years and activities are similarly quite advanced at Ankerana, more detailed offset planning is underway for CFAM and Torotorofotsy.

[4] Clear restrictions on the timeframe for achieving NNL are rarely available, although a generational timespan of ~30 years has been proposed by some as representing a ‘reasonable timeframe’. There is however no consensus as yet on this issue.

[5] A variety of rates and approaches for determining these have been proposed to date and are debated in offsetting circles (e.g., Denne & Bond-Smith, 2012; Evans et al., 2013). Similarly there is an as yet unresolved debate around discounting in relation to ecosystem services and natural resource accounting.

This is outlined in the full report below. Arrangements regarding long-term governance and management (e.g., through outsourcing arrangements) and financing (beyond funding offset activities from operations budgets) for all of the sites are in progress, as is the process for finalising the legal protection status of the land. These arrangements, along with a summary of the offset design process, will be consolidated in a Biodiversity Offset Management Plan. Finalising this Plan, and implementing it as part of the Ambatovy Biodiversity Management System, is one of the key priorities identified for the Environment Department by the pre-audit team as part of conformance actions required to meet IFC PS6 and the Biodiversity Offset Standard over the medium term.

In conclusion: Experience has shown that offsetting of residual biodiversity impacts must be seen as an integral part of the mitigation hierarchy, involving first and foremost the design and implementation of rigorous, defensible, and realistic avoidance, minimisation, and restoration measures. Furthermore, putting in place an adaptive management approach to reconcile the assumptions upon which the mitigation measures were based with empirical evidence of their results is essential. These elements of best practice are fundamental to the approach taken by Ambatovy in order to support the company's efforts to fulfil its commitment to no net loss of biodiversity in line with international standards and evolving best practice.

A number of technical and practical challenges are involved in working towards the goal of no net loss. These have included aspects such as defining appropriate biodiversity metrics, collecting the data required for analyzing and monitoring biodiversity across a range of sites, and developing and retaining the expertise required to support this work. It is not easy, perhaps especially in a situation characterised by high levels of biodiversity, to move beyond the most basic metrics (such as habitat hectares) to include priority species or to develop practical monitoring systems to provide independently verifiable information. Guidance from external specialists has been essential, yet the available pool of skills in this area of expertise is still quite limited. Furthermore, the implementation of effective and lasting biodiversity conservation measures is not a trivial task in a context such as presented by Madagascar.

These challenges should not, however, be allowed to delay measures to address the complex social and economic challenges that need to be addressed to develop appropriate and adequate biodiversity offsets. The Biodiversity Offset Standard, in particular, is helpful in highlighting the key principles and requirements for making offsets a defensible and lasting component of the mitigation hierarchy. Overall, the combination of IFC performance standards PS6 and PS1 and the Biodiversity Offset Standard provides a clear and coherent framework for achieving no net loss or a net gain for biodiversity and this has been indispensable in guiding Ambatovy's biodiversity management and conservation programme.

1

The Project and Regional/National Context

1. The Project and Regional/National Context

Ambatovy[6] is a large-tonnage nickel and cobalt mining, processing, and refining operation located in eastern Madagascar. Cumulative expenditures up to and including December 31, 2013 were US$7.2 billion (100% basis), including financing charges and foreign exchange, making it the largest commercial investment in Madagascar's history. The mining project received a national environmental permit in December 2006, following the completion of a comprehensive Environmental and Social Impact Assessment (ESIA) in January 2006, and construction began in 2007. The project became operational in the latter half of 2013 and commercial production was reached in January 2014.[7] The anticipated life of the mine is around 29 years. Ambatovy is owned by four shareholders: Sherritt International Incorporated (40%) as the main operating partner, Sumitomo (27.5%), KORES (27.5%) and SNC-Lavalin, the construction partner (5%). Ambatovy has received US$2.1 billion in loans from 14 lenders.[8]

Figure 2. Aerial View of the Mine Site

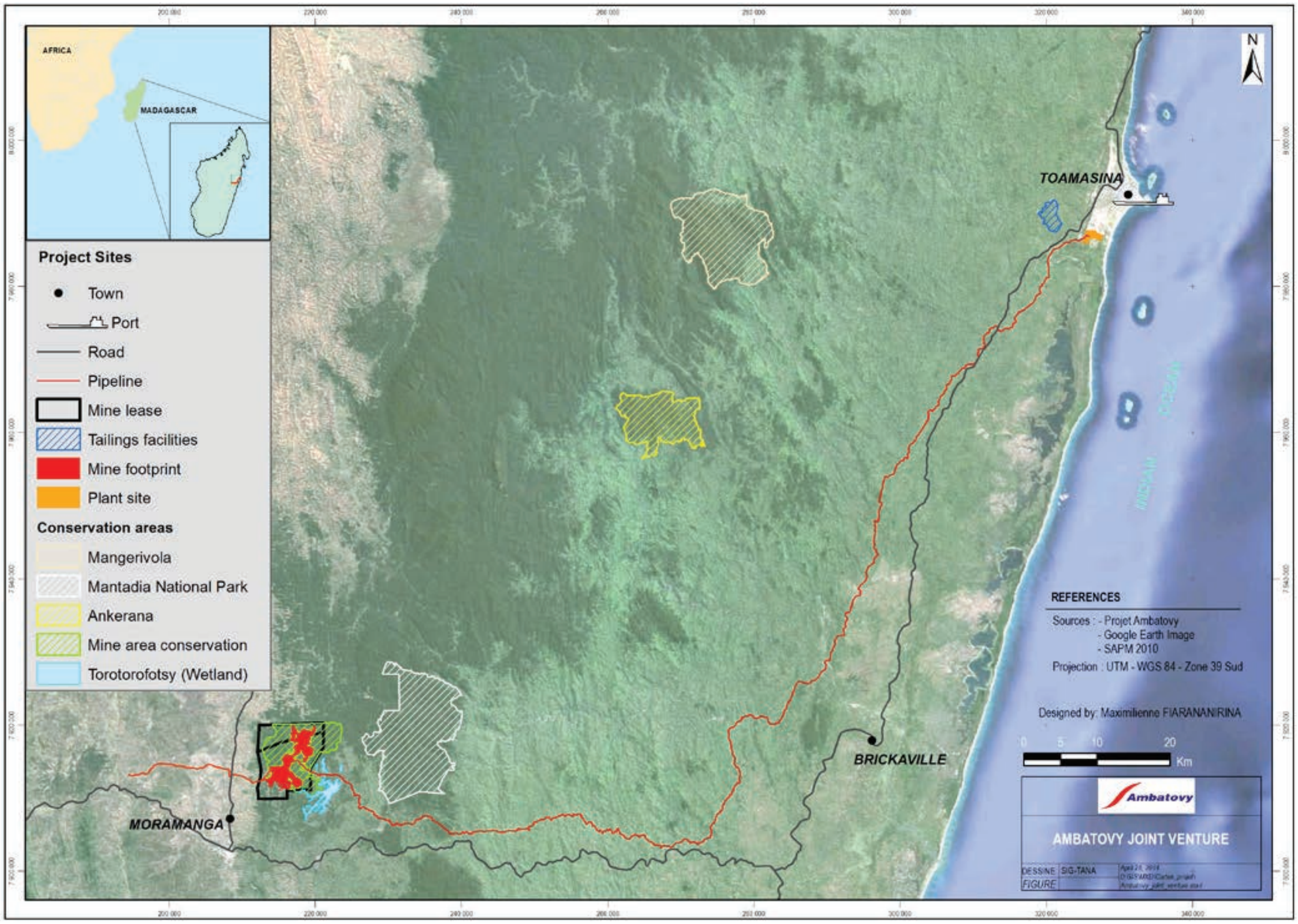
Photo credit: Rafaely Miantsoarivo

[6] Ambatovy consists of two companies, Ambatovy Minerals SA (AMSA) and Dynatec Madagascar SA (DMSA), both of which are referred to as 'Ambatovy' in this report.

[7] http://www.miningweekly.com/article/sherritt-international-declares-commercial-production-at-madagascar-operation-2014-01-25.

[8] This consortium of lenders includes government-sponsored export credit agencies and international development banks including African Development Bank, European Investment Bank, Export Development Canada, Export-Import Bank of Korea, and Japan Bank for International Cooperation) and others (http://www.ambatovy.com/docs/?p=179).

Figure 3. Site Map of Ambatovy's Operations in Madagascar



The operation extends across two of the country's twenty-two regions, Alaotra-Mangoro and Antsinanana, and comprises of a mine site, an approximately 220-km slurry pipeline and a processing plant at the coastal city of Toamasina (Fig. 2).

Mine site: The mine (Fig. 3) is located near the town of Moramanga in the Alaotra-Mangoro region, 80 km east of Madagascar's capital, Antananarivo. The mine's footprint of 1,800 ha consists of two ore deposits (the southern deposit Ambatovy and the northern deposit Analamay), an ore processing plant (OPP), and supporting infrastructure. The site is situated at ca. 1000 m a.s.l (metres at sea level) within the mid-altitude forests at the southern end of the eastern rainforest corridor known as the Ankeniheny-Zahamena corridor (CAZ). Ambatovy manages the forests surrounding the mine footprint as a conservation area. These forests were previously exposed to considerable human-induced pressures from hunting, selective logging, slash and burn (tavy) agriculture, and bush fires.

Slurry pipeline: Slurry produced at the mine site is transported to the coastal processing plant via a gravity pipeline that is approximately 220 km in length. The pipeline is predominantly buried and the selected route made significant deviations, including tunnelling, to avoid affecting forest fragments, cultural sites, and local habitations. It thus mostly traverses degraded areas of secondary vegetation. While the pipeline crosses the

Torotorofotsy Ramsar site, it was designed to avoid sensitive wetland areas within the site by following an old railroad spur and was deviated to avoid breeding habitat of the critically endangered golden Mantella frog (Mantella aurantiaca).

Plant site: The plant site (Fig. 4) is an industrial complex of 320 hectares (ha) located near the town of Toamasina on the east coast of Madagascar. Prior to construction, the land where the processing plant now sits was already highly degraded with residual impacts on biodiversity considered not significant in the ESIA (Ambatovy Project, 2006).

Port expansion: Due to the large quantity and specialized nature of imported raw materials necessary for production, Ambatovy upgraded the port of Toamasina. This involved the extension of Pier B (a breakwater protecting the harbour) and the installation of equipment to handle the unloading and conveyance of bulk materials to waiting trains for transfer to the processing plant along a new 'port-to-plant' rail corridor.

The most significant impacts on biodiversity will occur at the mine site and along the upper section of the pipeline. The biodiversity impacts caused by the company's other key components are limited as these components are located in areas of degraded natural or modified, non-critical, habitats.

The principal biodiversity impacts resulting from Ambatovy's mine operations are the loss of forest habitat, mainly through the phased clearing of mid-altitude forest at the mine site and the degradation of freshwater systems due to mining activities and the upper pipeline's multiple river crossings. The total footprint of the mining area defined for management purposes is ca. 2,154 hectares, of which 1,800 ha represents actual clearance of forest, bush, and other habitats. Of these, 978 ha of forest to be cleared has been defined as 'good quality, quasi-pristine forest.' In addition, streams in two catchments, the Mangoro system to the west and the Rianila system to the east, will be impacted specifically by the mine.

Figure 4. Aerial View of the Processing Plant Site at Toamasina

Photo credit: Rafaely Miantsoarivo

Figure 5a. Diademed Sifaka Propithecus diadema (IUCN CR) with Radio Collar for Long -Term Monitoring as Part of the Lemur Management Plan

Photo credit: Ambatovy

Figure 5b. Golden Mantella Frog Mantella Aurantiaca (IUCN CR)

Photo credit: Ambatovy

The affected terrestrial and freshwater systems harbour a large number of species of conservation concern, including species listed as 'threatened' on the IUCN Red List as well as range-restricted/endemic species and fish ESUs (evolutionary significant units). Based on intensive surveys undertaken by the company over the past years on the mine footprint and surrounding conservation zone, 201 'priority species' have been identified (153 flora species and 48 fauna species)[9] several of which will be impacted by the project's activities in the mine area. Although mitigation measures are implemented for all fauna species, priority species for which specific conservation programs have been developed include but are not limited to Propithecus diadema (IUCN CR,[10] Fig. 5a), Indri indri (IUCN CR), Mantella aurantiaca (IUCN CR, Fig. 5b), and five endemic fish ESUs and are being developed for about 10 plant species of concern ('SOCs').

1.1 Regional and National Context

The island of Madagascar (587,040 km2) is renowned for its unique biodiversity, which is characterised by exceptional levels of endemism at family and genus level[11] and high species richness. The country has been referred to as a "global biodiversity hotspot" (Myers et al., 2000).

Madagascar is home to some 11-12,000 vascular plant species, 82% of which occur nowhere else on Earth (Callmander et al., 2011), 346 reptile species, of which 91% are endemic to Madagascar, including more than

[9] 'Priority species' are selected on multiple criteria (endemism, restricted range, IUCN threatened or uncertain status (CR, EN, VU, DD), national protected legal status and listing in CITES appendices).

[10] The IUCN Red List identifies the following categories and criteria: CR – Critically Endangered; EN – Endangered; VU- Vulnerable; DD - Data Deficient. IUCN Red List Categories and Criteria (2012). Version 3.1. Second edition. Gland, Switzerland and Cambridge, UK: IUCN. Available at http://www.iucnredlist.org/

[11] Eight plant, 4 bird, and 5 primate families are unique to Madagascar and its island neighbours (http://www. conservation.org/where/priority_areas/hotspots/africa/Madagascar_and_the_Indian_Ocean_Islands/Pages/default.aspx).

Figure 6. Slash and Burn Agriculture Causing Forest Loss

Photo credit: Ambinintsoa Samoelina

half the world's chameleon species (Raxworthy, 2003), and over 200 amphibian species, of which 99% are endemic to Madagascar (Glaw and Vences 2003).

Madagascar is one of the 'Least Developed Countries' with a large and rural population reliant mostly on subsistence agriculture (UN, 2011). A range of past and present land use practices – including 'slash and burn' agriculture – has led to a rapid decline in the country's native biodiversity: e.g., between 1990 and 2000 an estimated 8.6 % of forest cover was lost across the island (Harper et al., 2007). And, while Madagascar has pledged to expand the current system of protected areas to cover at least 10% of the country's total area, funding for this is inadequate in the short and long-term (Carret and Loyer, 2003). Further, conventional protected areas also do not necessarily prevent deforestation (Ingram and Dawson, 2005) – for example, if local communities are not involved or compensated.

More than two-thirds of the population lives on less than US$ 1.25 per day and living standards have deteriorated over the last 40 years as the economy has grown more slowly than the population (African Economic Outlook: Madagascar, 2011), estimated at approximately 23 million.

2

Corporate Vision and Commitments

2. Corporate Vision and Commitments

The mission of Ambatovy is to be a leader in the sustainable production of high-quality nickel and cobalt for the global market. Ambatovy's vision is: 'Through a committed and engaged workforce, we will deliver world-class results in safety, environmental stewardship, social performance, product quality, production and cost efficiency'. Ambatovy's core values include respect for people, responsibility, integrity, and excellence. Ambatovy's environmental strategy is aligned with the mission, vision, and values and aims at:

- Ensuring full regulatory compliance and conformity with national regulations and international loan agreements;
- Minimising residual impacts through the stringent application of the mitigation hierarchy;
- Reducing environmental risks through dynamic management guided by Malagasy know-how and stakeholder consultation; and
- Producing positive conservation outcomes on biodiversity through the mitigation programme that aims at achieving no net loss of biodiversity, and possibly net gain, in order to sustain 'a good citizen project' status in a host country recognised as constituting a biodiversity hotspot.

Article 10 of the Environment Charter of 1990 provided that all investment projects in Madagascar should be the subject of an environmental impact evaluation. In application of this law, the MECIE (Mise en Compatibilité des Investissements avec l'Environnement) decree N° 2004-167 lays down the procedure for environmental impact evaluation. The MECIE decree is enforced by the environmental regulator, ONE (Office National de l'Environnement). While the terms of reference for an ESIA typically require attenuation of environmental impacts and implementation of a social development plan, biodiversity offsets are not required.

However, given the ecologically sensitive location and the operation's residual impacts on the region's biodiversity, Ambatovy committed early on to establishing biodiversity management and conservation programme, including a biodiversity offset. The company's biodiversity policy accordingly set out to:

- '...cause no net harm to biological diversity where we operate, to mitigate unavoidable impacts, and to practice responsible closure procedures;'
- '...assure the conservation of habitats, flora and fauna, using all reasonable actions and technologies;'

[3] The pilot project was conceived as a retrospective offset, with impacts having occurred prior to offset design being initiated.

[4] The residual impacts anticipated from newly initiated mining have not yet been assessed or documented by Solid Energy.

[5] This was based on best available existing datasets (e.g., in the case of the flora) and data from the Strongman biological monitoring programme, which included sampling of periphyton, aquatic invertebrates and fish between 2003 and 2007, as verified by independent surveys (e.g., Olsen, 2007, Harding, and Niyogi, 2008: See SENZ, 2009).

- '...ensure responsible attention to the maintenance and, where possible, enhancement of biodiversity in the best interest of our business, the communities in which we operate, and the world at large.'

To help fulfil these important commitments the company joined the Business and Biodiversity Offsets Programme (BBOP) as a pilot project in 2006. This was partly to seek guidance for its own operations and, more broadly, to help pioneer and improve best practice in biodiversity offset design in the context of the mitigation hierarchy and implementation based on practical experience. As a BBOP member, Ambatovy thus subscribes to and supports the ten principles on biodiversity offset best practice (see Box 1). In addition, the company has made a voluntary commitment to meeting the 2012 BBOP Biodiversity Offset Standard, and in 2013 completed its first second-party[13] pre-audit against this Standard.

Textbox 1. The Ten BBOP Principles (2009)

The ten Principles on Biodiversity Offsets were developed by members of the BBOP Advisory Group, who support them and recommend them as the basis for the design and implementation of high-quality biodiversity offsets. The Principles also provide the structure for the international Biodiversity Offset Standard, released in 2012 by BBOP.

1. Adherence to the mitigation hierarchy
2. Limits to what can be offset
3. Landscape context

Ambatovy, through agreements with its principal lenders, committed in 2007 to conforming to the International Finance Corporation's (IFC) Environmental and Social Performance Standards (PS, at that time the 2006 version). The PS were revised in 2012. Ambatovy intends meeting the updated PS, in particular PS6 relating to Biodiversity Conservation and Sustainable Management of Living Natural Resources. The second-party audit of Ambatovy's compliance with IFC PS6 and the Biodiversity Offset Standard noted close alignment between BBOP and IFC PS6 on many biodiversity related matters (Appendix 1, Fig. A.1).

This means, amongst other things, closely adhering to the impact mitigation hierarchy (to avoid, minimise, restore impacts on biodiversity and ecosystem services, and to offset residual biodiversity impacts) with the goal of achieving measurable conservation outcomes that deliver at least No Net Loss (NNL), and preferably a Net Gain (NG) of biodiversity for the entire operation.

2.1 The Policy Context for No Net Loss at Ambatovy

Madagascar was the first country in Africa to have a World Bank-sponsored environmental action plan, initiated in 1990, which has since run through three successive seven-year implementation programmes (EP1, EP2, and EP3). ESIA legislation was introduced in the early 90s. Shortly after 2000, during EP2, the forests directorate declared a 'zero tolerance policy' to any further logging of natural forest in Madagascar. In

[13] A second-party audit is performed by an independent contractor hired by the company to perform an internal audit (see http://elsmar.com/Forums/showthread.php?t=21819).

September 2003, President Ravalomanana made an international declaration at the World Parks Congress in Durban that Madagascar would triple the area of protected forests in Madagascar from 2 to 6 million hectares, or 10% of Madagascar's land surface (referred to as the 'Durban Initiative').

In this context, Ambatovy moved towards its development phase and carried out its social and environmental studies for the ESIA in 2005-2006. The Ambatovy concession lies within a region of high biodiversity importance, flanked by the Torotorofotsy wetland, Mantadia, and Andasibe national parks and the surviving forest corridor to the north (now protected as the 'CAZ' corridor). Ambatovy therefore made a 'no net loss' commitment based on an innovative combination of intensive mitigation efforts to minimize impacts and the establishment of one or more offset sites as compensation for residual biodiversity losses caused by the mine.

Ambatovy's approach has been influential on national and corporate policy. In 2006, the development of a policy on biodiversity offsets was identified as a specific activity within the Madagascar Action Plan or 'MAP' of President Ravolomanana (Government of Madagascar, 2006). During 2013 and 2014, Sherritt International Corporation, the project operator of Ambatovy, has been developing a new sustainability policy which includes a commitment to no net loss of biodiversity.

Compliance with Ambatovy's commitments on biodiversity is evaluated by the national regulator through site visits and review of the company's annual reporting on biodiversity, an independent Scientific Consultative Committee (SCC) which meets annually, quarterly visits of the Independent Engineers on behalf of Ambatovy's lenders, and recently through a second-party audit in 2012/13 by Golder Associates and Forest Trends.

3

Guidelines Followed and Application of the Standard

3. Guidelines Followed and Application of the Standard

Ambatovy's biodiversity management programme, including the offset component, has been developed iteratively, benefitting from a range of different sources of guidance. Here, BBOP has played a central role through facilitating the sharing of experience and expertise amongst members and with the broader community of practice. BBOP has developed and published key best practice guidance documents which Ambatovy has both contributed to and applied. These documents include the ten Principles on Offset Design and Implementation (BBOP, 2009), several handbooks and resource papers (e.g., BBOP, 2009a) and b) and, most recently, the Biodiversity Offset Standard (BBOP, 2012). Together, these materials have provided useful practical information and step-wise guidance to the company in an area where guidance had been previously limited. These resources have enabled the company to tackle a rapidly evolving and often complex area of work. Important additional and complementary guidance has come from the IFC's revised PS6 and associated Guidance Note (IFC, 2012) as well as from other publications[14] and discussions during the annual Scientific Consultative Committee meeting with experts in the field.

Owing to the evolving nature of the work and practice in biodiversity management and offsetting, Ambatovy has also had the opportunity to make substantial contributions to furthering knowledge and methodologies in the field of mitigation and offsetting. This includes developing and implementing the paced and directional forest clearing method to minimize impact on mobile fauna species by slowly moving them out of the footprint into the surrounding conservation zone forests. This method has been particularly successful for lemurs. Manual salvaging and captive breeding of a critically endangered frog species has increased knowledge of its habitat requirements that can be used to restore and enrich natural ponds to augment the wild population while developing local capacity in amphibian husbandry techniques. New methods on mitigating endemic fish Evolutionary Significant Units (ESUs) have also been developed that are based on conducting extent of occurrence (EOO) surveys, aquatic habitat restoration, and exotic species eradication in order to focus on in situ conservation methods. Details about biodiversity inventories and mitigation work have been compiled and made available in a special edition of the peer-reviewed journal Malagasy Nature (Goodman & Mass, 2010).

[14] For example: Good Practice Guidance for Mining and Biodiversity (International Council on Mining and Metals 2006), Planning for Integrated Mine Closure: Toolkit (International Council on Mining and Metals 2008).

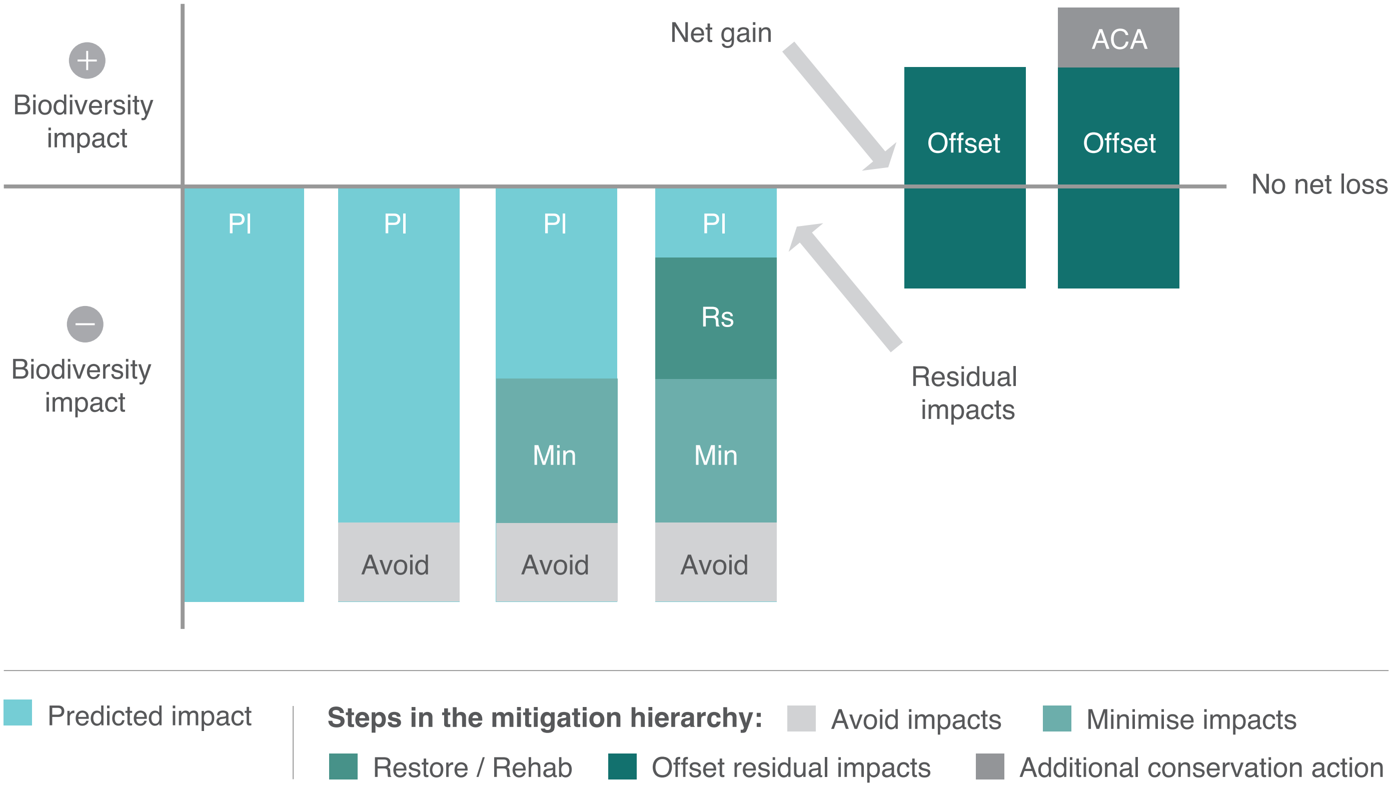
4

Mitigation Hierarchy and Offset Design

4. Mitigation Hierarchy and Offset Design

A fundamental premise emphasized throughout the BBOP materials and by other guidance documents is the importance of rigorously following the mitigation hierarchy and considering offsets only as a last resort once prior steps in the mitigation hierarchy have been exhausted (see Principle 1 of the BBOP Standard, IFC PS6, 2012). The mitigation hierarchy (Figure 7) is a tool or framework commonly used to anticipate and manage biodiversity risks and opportunities relating to a specific development project and to assist with designing appropriate responses to achieving NNL/NPI (net positive impact.

Figure 7. Diagram of the Mitigation Hierarchy (to Avoid, Minimise, Restore Impacts and Offset Residual Impacts to Achieve No Net Loss or a Net Gain)



(Diagram adapted by Rivolala Andriamparany.)

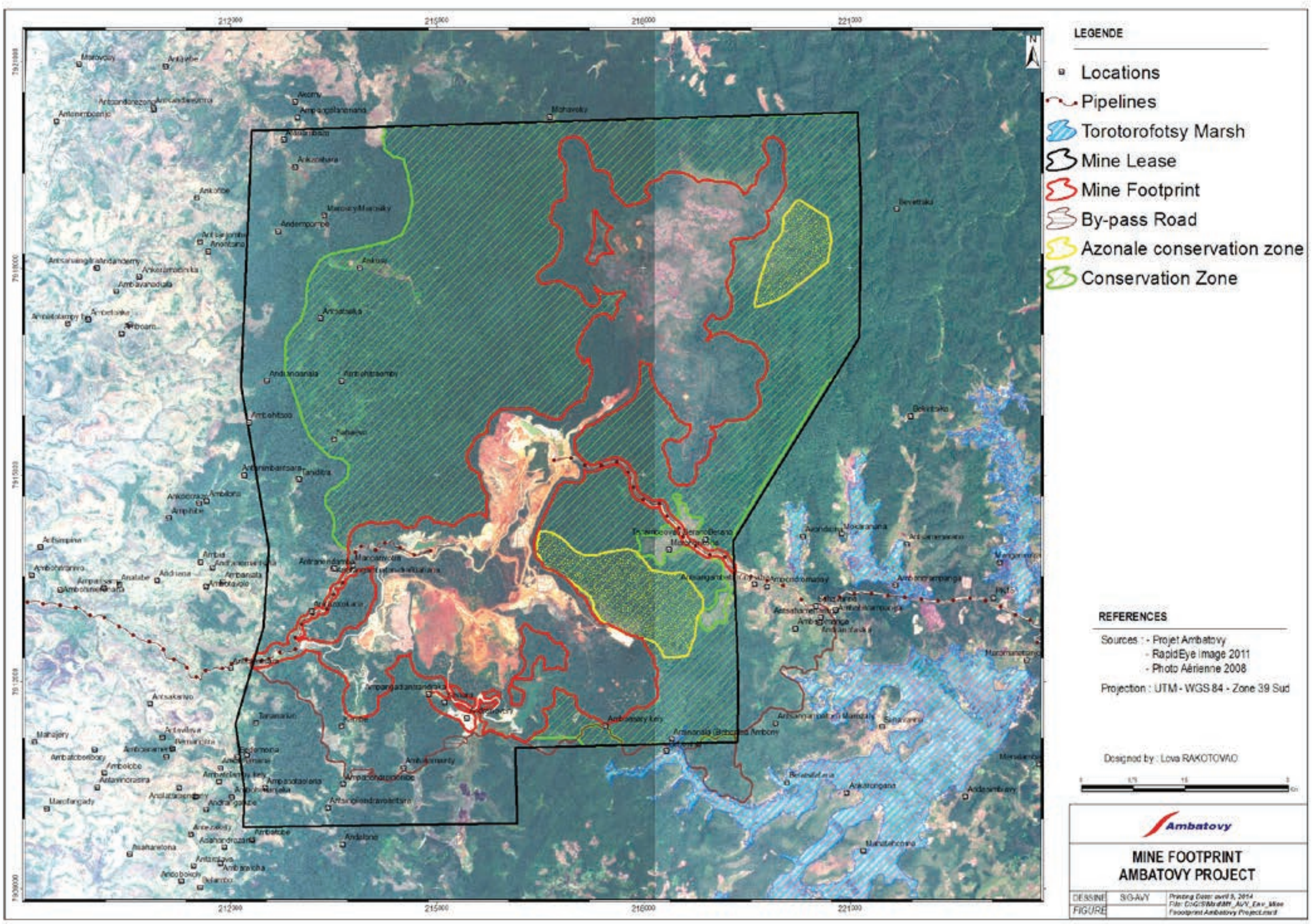
Ambatovy's Biodiversity Management Programme is built to give effect to each of the steps in the mitigation hierarchy, i.e., avoidance, minimisation, restoration, and offsetting. The activities that are being undertaken as part of each step and across the entire operation are manifold and often interlinked. In practice, the mitigation hierarchy is a continuum of interrelated measures, the combined impact of which is planned to achieve no net loss or net gain. The summary illustrates the main ways in which Ambatovy is applying the mitigation hierarchy:

1. Avoidance

Avoidance measures are aimed at preventing biodiversity impacts from occurring in the first place, e.g. though outright prevention of a damaging action, or by repositioning a project component so that the associated impact becomes negligible. This is particularly important for biodiversity components of high irreplaceability and/or vulnerability to ensure that the risk of loss of these components is minimized.

- The most important avoidance measure by Ambatovy is to forego mining an area of 306 ha which overlays a part of the main ore body (Figure 8). This area of azonal forest has been integrated into a larger area of 'on-site' conservation forests, currently being actively managed by the company. The aim is to secure their long-term formal protection, initially as part of Ambatovy's conservation forests and eventually as part of the national Protected Area Network.

Figure 8. The Mine Concession Area, Footprint, and Conservation Forests Surrounding the Mine, as well as Torotorofotsy Wetlands Lying to the South East of the Mine



- Another substantial avoidance measure was to reroute the pipeline at significant cost to the company so as not to impact several forest fragments. In the case of the Vohimana forest concession, the pipeline was tunnelled under the mountain in order to avoid impacting the forest, at considerable cost. In another example, the pipeline was diverted during construction around a newly discovered breeding pond of the critically endangered golden mantella frog Mantella aurantiaca (IUCN CR) in the Torotorofotsy Ramsar site, at a cost of over $1 million.

2. Minimisation

Activities grouped under the term 'minimisation' reduce the magnitude, likelihood, or severity of biodiversity impacts as far as possible, though they cannot completely prevent these impacts. It can be difficult to differentiate between certain avoidance and minimisation measures, as there is not always a clear-cut line and/or it can be a matter of perspective (e.g., limiting impacts by reducing the size of footprint could be considered avoidance of certain impacts or minimisation).

From the start of the project (i.e., pre-construction phase) and as part of its biodiversity management programme Ambatovy has been implementing a range of minimisation measures, including:[15]

- Manual paced and directional forest clearance to allow for the retreat of mobile terrestrial fauna into the surrounding conservation forests and limit direct losses of fauna and priority flora species. Clearance procedures are provided to the forest-clearing team manager as part of Standard Operating Procedures. In addition, clearance of each forest block is the subject of a specific 'Job Environmental Analysis' (JEA) negotiated between the clearance manager and the Environment department and details all the environmental measures to be respected as clearance proceeds. The proper implementation of forest clearance actions are monitored by the mine environment department, and any deviations are reported for immediate corrective action.
- Repetition of biological surveys in the clearing areas prior to any forest clearance in order to inventory flora and fauna taxa present, particularly priority species (IUCN Endangered, EN, and Critically Endangered, CR, categories) but also to mark occupied nests (birds and lemurs) and tree holes (lemurs) which are monitored during the clearing process. The surveys have served to facilitate the development of taxa-specific mitigation measures. For example, a representative sample of individuals of five lemur species from both the mine footprint and surrounding conservation zone are captured and fitted with radio collars and subcutaneous microchips in order to monitor their ability to migrate from an area as it is cleared and the receiving populations' behaviour on arrival of displaced groups in their territory.
- For plants, a list of species of concern (SOC) was drawn up during ESIA baseline studies in collaboration with Ambatovy's botanical expert partner, Missouri Botanical Garden, and classified into SOC1, 2 or 3 according to their known occurrence at one (mine area only), two, or three sites in Madagascar. The list of SOCs and the related management actions are continuously being refined and updated as new data become available. Initially, pre-clearance work involved identifying the presence of any SOC and marking it for rescue and removal, identifying associated flora, taking soil samples, and collecting seeds and tissue for in vitro propagation. Since 2010, plant rescue has focused on SOC1F plants (those known so far only from the footprint) and plant species listed

[15] This work is on-going, but see also see also Ambatovy Project, 2009.

by IUCN as EN or CR. In parallel, offsite searching for SOCs in protected areas has progressively reduced the number of SOCs (from an initial 300 to about 100 today), allowing conservation efforts to be focused increasingly on the rare species for which conservation plans will be developed.

- For fish in streams impacted by the mine, sub-regional spatial surveys (with genetic sampling) were conducted initially to determine whether the species were footprint endemics, resulting in the provisional identification of five Evolutionary Significant Units (ESUs) which were treated as endangered and whose populations have been monitored annually in the mine impact zone. Pending genetic analysis, assurance populations from the two ESUs at highest risk were recovered and maintained in aquaculture systems. Genetic results confirmed the initial risk assessment and relevance of the plans for a sanctuary in the conservation zone and dams to allow eradication and prevent further introduction of exotic species. Regional-scale Extent of Occurrence (EOO) surveys are planned for each ESU while taxonomic work will establish the identity of the ESUs. In situ mitigation has evolved throughout, and currently emphasizes minimizing impacts on aquatic habitats in situ (e.g., by maintaining forest bands along water courses) while establishing small, temporary assurance populations in case in situ measures fail.

- Fauna are monitored during and after clearance. For example, lemur spatial dispersion is monitored during forest clearance to assess their capacity to (a) migrate (avoid immediate impacts); (b) settle in their new home range (a medium-term impact) and (c) reproduce and maintain population viability (a long-term impact). Integrated biomedical and spatial monitoring facilitates the analysis of trends within impacted lemur populations.

- Salvaging activities have focused on fauna likely to require human aid to migrate towards refuge areas (the conservation zones shown in green on Figure 8). A crew of 60 technical agents has been trained to identify and salvage herpetofauna found in clearing areas. Systematic salvage of these species has been undertaken for all mine, pipeline, and plant site clearings, under the supervision of external experts and the Ambatovy biodiversity team. Taxa have been recorded and individuals are relocated to refuge areas. Flora salvaging is conducted (e.g., of all orchids, high-category SOCs, and IUCN CR or EN species). In addition, ex situ conservation measures are implemented for selected SOCs, including some plant, fish, and frog species. In these cases, individuals are trans-located to a dedicated on-site area while searches for the SOC in areas outside the footprint are being completed.[16] Tissue from these SOC has been collected for micro-propagation and cryopreservation as a 'back-up' conservation strategy.

3. Restoration and Rehabilitation

Rehabilitation and restoration are undertaken once a damaging activity has ceased in order to repair or replace the affected ecosystem and biodiversity. Rehabilitation and restoration are related terms but differ in their goals and strategies. Ecological restoration usually aims to re-establish a damaged ecosystem's composition, structure, and function so as to bring it back to its pre-disturbance state. Rehabilitation, while sharing the focus on historical ecosystems as models or reference points, emphasizes returning

[16] To date, all SOC surveys have led to the identification of off-site viable populations; Ambatovy and its botanical partners remain confident that this will be the case for all remaining SOCs. In the event that SOCs are not found, then the aforementioned mitigation will be applied.

ecosystem processes, productivity, and services (e.g., to ensure erosion control) but does not necessarily aim to re-establish pre-existing biotic integrity in terms of species composition or community structure. Thus, rehabilitation tends to involve the preparation of stable landforms on disturbed sites and revegetation.

To date, Ambatovy has taken the following steps as part of its progressive rehabilitation and restoration planning:

- Rehabilitation of 50 km of exploration roads and platforms in the mine area (2004/5);
- Developing an overarching Restoration strategy;
- Developing a first 'Reclamation Plan' (Ambatovy, 2009) for the operation, from construction phase onwards, including:
  - Broadly sketching out a vision of outcomes until the year 2045 and mapping out feasible and desired end land uses across the extent of the operations; and
  - Setting out the current and proposed reclamation, rehabilitation, and restoration measures for different sectors at the mine site and its periphery up to the year 2020, including progressive rehabilitation of parts of the mining footprint, as well as restoration of certain areas with the goal of creating replacement forests with reinstated biodiversity values;
- Establishing research and production plant nurseries at the mine site; and
- Undertaking first limited rehabilitation/restoration trials at a few locations on the mine site.

These measures are predominantly in the planning phase and further refinement and consolidation of the restoration programme are being undertaken. This is important so that more specific and feasible goals for ecological outcomes can be defined and the detailed restoration strategy continuously updated based on sound field research and trials. Given the uncertainty at present as to the level of restoration success[17] that will be achieved, Ambatovy is taking a precautionary approach and is excluding altogether any predicted biodiversity gains due to restoration from loss/gain calculations and from contributing towards the NNL goal.[18]

The biodiversity commitments of Ambatovy are currently addressed through the application of the Biodiversity Management Plan (BMP), which was based on a Biodiversity Action Plan (BAP). The BAP was initially developed based on the Ambatovy Environmental and Social Impact Assessment and is essentially a list of actions aimed at mitigating impacts on biodiversity associated with the Ambatovy investment. Recently, the initial BAP was updated to highlight links between actions and international and national commitments. In addition, current biodiversity management has also been guided by compliance to IFC PS6 (2006 and 2012), the Company's offset strategy, and various other documents including recently developed SOP manuals for biodiversity, forest management, restoration, and biosecurity.

[17] Either with regards to replacing the specific forest types naturally occurring on the Ambatovy footprint or for creating a functionally coherent but compositionally different replacement ecosystem.
[18] Nevertheless, restoration is considered a vital component of the overall mitigation strategy, not least since the ecological functionality of restored habitats will be crucial for the long-term integrity of the mine conservation forests as part of maintaining landscape-scale connectivity for the area's remaining habitats. Furthermore, demonstrating successful ecological restoration would significantly reduce the residual impacts due to the operation and thus the gains required for achieving NNL.

Currently Ambatovy is developing a comprehensive Biodiversity Management System (ABMS) which has, in part, been driven by company-wide standardization and quality improvement initiatives in line with established quality standards, most notably ISO 9001. The objective of the ABMS is to provide a quality assurance adaptive management framework for biodiversity through the design, implementation, control, and tracking of relevant strategies and plans in order to ensure compliance with Ambatovy's biodiversity commitments (international, national, and internal).

4. Offsetting

Offsetting is the last step in the mitigation hierarchy specifically to address the significant residual impacts that remain once efforts to avoid, minimise, and restore impacts have been exhausted. The ultimate goal is for these measures together to achieve no net loss or a net gain of biodiversity relative to the impacts caused by a development project. The importance of avoiding impacts needs to be highlighted, especially as there are limits to what can be offset. Certain impacts are clearly not capable of being offset, an extreme example being the extinction of a species. To prevent impacts that cannot be offset, and which compromise achieving no net loss, it is essential early on to perform a thorough risk assessment and take appropriate steps to manage any risks (see Ambatovy Project, 2009; see Textbox 2).

Offsets are designed with reference to the given landscape context, and they may be located at some distance from the impact areas. There are two main ways to deliver biodiversity gains as part of an offset, and they are not mutually exclusive. One option is to reduce pressures on and protect and manage priority biodiversity that would otherwise be lost. This is referred to as an 'averted loss' offset and is often suitable where background trends of biodiversity loss are high (e.g., high deforestation rates). Another option is to improve the condition or state of biodiversity through restoration or enhancement of degraded ecosystems and of species' habitats and secure these areas for conservation.

To fulfil its commitment to achieving no net loss of and no net harm to biodiversity, in 2007,[19] Ambatovy undertook to design and implement a high-quality biodiversity offset to address the operation's significant residual impacts identified as part of the ESIA (Ambatovy Project, 2006). In line with BBOP guidance, which supports either single or composite offsets to compensate fully for the entire suite of residual impacts, Ambatovy has developed a multi-faceted offset programme comprising several sites and associated activities. The development of a multi-faceted program was considered necessary given the large scope of the operation, part of which (principally the mining and upper pipeline areas) falls within in a sensitive high-biodiversity area.

The principal areas of focus for the offset have been the mine conservation forests, the Corridor Forestier Analamay-Mantadia (CFAM, a forest corridor linking the mine conservation forests with the Corridor Ankeniheny-Zahamena – CAZ), and the Ankerana massif (an area of ca. 6800 ha situated roughly 70 km to the north of the mine site and forming part of the CAZ). Additional areas are currently being investigated to determine their suitability in terms of complementing the offset portfolio. The offset design is in the process of being finalized, incorporating data from biodiversity assessments at selected additional offset sites.

[19] The need for an offset became apparent in the ESIA screening phase, based on the significance of the predicted residual impacts (Ambatovy Project, 2006).

Textbox 2. Ensuring the 'Offsetability' of Residual Impacts

Risks and indicated limits to what can be offset have been taken into consideration in Ambatovy's biodiversity management program, particularly in terms of informing the avoidance and minimisation measures and as part of adaptive management.

Prior to forest clearance, exhaustive surveys were conducted of the mine footprint habitats to identify any potentially range-restricted species (i.e., species that may be restricted to the mine footprint). Survey results indicated the presence of several high-priority species including a critically endangered frog (Mantella aurantiaca), five fish ESUs, endangered lemurs, and several plant species of special conservation concern. Wider-ranging, regional and Extent of Occurrence surveys have been conducted to determine the distributions of high-priority species distributions and whether these species are well-represented beyond the footprint, particularly whether they could be conserved within the mine's broader concession area (and proposed conservation zones), in other protected areas, and at potential offset sites.

As new data arise, Ambatovy has continually refined the mapping of critical habitats in areas impacted by the project. To date, the studies have resulted in the 'downgrading' of some areas of habitat from critical to natural or modified, but in no case in an upgrade of habitats to critical, suggesting that the original surveys were indeed exhaustive while the habitat classifications have been conservative.

A forest management plan and species-specific management plans have been developed and are being implemented to protect the extensive conservation forests as well as priority taxa within the mining concession. For several high-priority taxa, additional conservation programmes are being undertaken to minimize the risk of significant net population reduction. These measures include micro-propagation and cryopreservation for plant species of concern, manual salvaging and captive breeding programs of fish ESUs and Mantella to augment natural populations (with high success rates,) and a multi-faceted lemur spatial and biomedical monitoring programme.

Finally, the set-aside areas of azonal forest were in part intended to avoid the extinction of any as yet undiscovered species, particularly of microfauna that could not be considered in the ESIA surveys. Long-term studies of these forest patches will determine over time the presence of any further restricted range species.

Note: Also see Ambatovy Project, 2009.

To begin the process of independent verification of its biodiversity management and offset programme, the company in 2013 underwent a second-party pre-audit against IFC PS6 and the BBOP Biodiversity Offset Standard (BBOP, 2012). The aim of the pre-audit was to assess the status of the offset work and to identify gaps and priority actions required as part of moving towards meeting the Standard and the NNL goal.

Textbox 3. Key Offset Design Steps (BBOP, 2009)

1. Reviewing the development project's scope and activities
2. Reviewing the legal framework and/or policy context for a biodiversity offset
3. Initiating the stakeholder participation process
4. Determining the need for and feasibility of an offset based on residual impacts on biodiversity
5. Choosing methods to calculate loss/gain and quantifying residual losses
6. Reviewing potential offset locations and activities, and assessing the biodiversity gains which could be achieved at each
7. Calculating offset gains and selecting appropriate offset locations and activities
8. Recording the offset design and entering the offset implementation process

4.1 Developing the Biodiversity Offset

Ambatovy developed the offset for its residual impacts as an integral part of the company's biodiversity management and conservation programme, and according to the guidance set out in various BBOP materials (BBOP, 2009a, b, 2012).[20] Textbox 3 summarises the key steps followed as part of the offset design process.

The sections below briefly describe how Ambatovy approached key technical aspects of offset design,[21] including:

- Choosing methods to quantify biodiversity losses and gains (i.e., which biodiversity components to assess, which metrics to use, choice of scenarios for projecting gains – baseline and conservation scenarios);
- Selecting suitable offset sites and activities;
- Calculating losses due to the operation and predicted gains from the composite offset.

The focus here is on terrestrial biodiversity because the surveys and methods (particularly with respect to offsetting) are most advanced in this regard, although aquatic biodiversity is also being addressed through the extensive sampling, assessment, and mitigation programmes being undertaken by Ambatovy (e.g., see Section 4 above).

4.1.1 Choice of Biodiversity Components and Metrics to Quantify Losses and Gains

A fundamental decision in biodiversity management and offset design is which biodiversity components to consider.[22] In the case of Ambatovy, this process was supported by the construction of a Key Biodiversity Components Matrix (KBCM). This matrix serves to organize a long list of affected biodiversity components

[20] These steps are not necessarily sequential. Often they overlap as part of an iterative approach.
[21] The 2009 Ambatovy BBOP case study by Berner et al. (Ambatovy Project, 2009) outlines how Ambatovy assessed the likely impacts on biodiversity; prepared a Key Biodiversity Components Matrix (KBCM); applied the mitigation hierarchy; determined residual impacts; and checked whether these residual impacts could be offset.

(e.g., species and their habitats, assemblages, ecosystems, and processes) according to their intrinsic, use, and cultural values.[23]

In line with international best practice and BBOP guidance, it was decided to measure losses and gains for the following biodiversity components:

- Vegetation types/habitats (divided into 'azonal', 'zonal', and 'transitional' vegetation) and
- Selected species (of conservation concern)[24]

It was also decided to use an 'area x condition' currency as the unit of measurement for vegetation. Currencies that integrate data on the extent or area (i.e., quantity) and condition (i.e., quality) of affected biodiversity have variously been termed 'habitat hectares' (developed in the State of Victoria, Parkes et al., 2003), 'condition hectares' or 'quality hectares' – all of which are variations on a theme.[25] In recent years, these currencies have become more widely used and accepted as a basic metric for determining offset requirements. While no currency is perfect and continuous improvement and evolution is necessary in the types of currencies used, the combination of quantity and quality offers a significant improvement over 'area-only' currencies. In addition, it is possible to capture many different biodiversity components (habitats, vegetation, species) and values in terms of a unit that combines condition and amount of biodiversity.

Expressing vegetation in terms of habitat hectares at Ambatovy involved the following steps. First, the extent of different affected forest types was mapped (i.e., azonal, zonal and transitional) and second, a range of structural and compositional attributes[26] was measured at plots and transects in these forest types at the impact and proposed offset sites to determine current condition relative to a set of 'best possible or best observed' benchmark values for these attributes. Reference values were established based on measurements at suitable benchmark sites and available literature/existing datasets. The comprehensive sampling approach for specific forest types and condition measurements is further detailed elsewhere (e.g., ESIA – Ambatovy Project, 2006; Ambatovy Project, 2009; WCS, 2014).

4.1.2 Quantifying Residual Losses

Residual losses due to Ambatovy's mining and associated activities were predicted to accumulate progressively over the timeframe from 2007 to 2022. Losses were not determined in the context of background

[22] This is especially important as the basis for calculating biodiversity losses and gains, ensuring their equivalence (like for like) and selecting appropriate offset sites, determining appropriate offset activities for delivering no net loss or a net gain, and for monitoring. No single component can adequately capture the complexity of biodiversity, and there is no single unit of measurement. Thus, an important step was to identify a subset of biodiversity components (and a way of measuring these) recognized as being characteristic or representative of affected biodiversity overall and/or as having particular importance or value to stakeholders (e.g., due to being of use or cultural value, or under threat).

[23] The KBCM is useful in offset design, as it can help with assessing limits to what can be offset, informing biodiversity management and monitoring, determining like-for-like exchanges, and providing a basis from which to select components that could be adequately measured and quantified as part of the loss/gain calculations.

[24] Losses and gains have so far only been quantified in terms of forest habitat hectares. Species-specific and aquatic habitat calculations are still pending.

[25] These currencies are units of measurement which combine the area affected and the quality or condition of impacted biodiversity. Condition for habitat or vegetation is assessed using a range of attributes that relate to the structure, composition, and function of that habitat). The habitat hectares metric was originally developed in Victoria, Australia to focus on vegetation structure in particular as a proxy for composition and function. It has since been adapted by BBOP and others to cover aspects of composition and function.

[26] See Ambatovy BBOP Case Study, 2009. These included stems (number/ha), tree species (species/ha), canopy height (m), and basal area (m^2/ha).

deforestation, but rather as an 'absolute' loss at a specific point in time determined by the affected forest's present extent and condition. This means that background (regional) deforestation rates, while they are used to assess potential gains (i.e., averted losses) for the proposed offsets, were not used to adjust biodiversity losses due to the mining project even though these losses occur in stages over time.

Table 2 shows the losses due to the mining project for the three forest types that were mapped. The losses are reported in extent (area in hectares) and habitat hectares with the same units/currency being applied to the gains (see Section 4.1.3 below) to ensure that losses and gains are comparable.

Note that residual impacts on aquatic biodiversity and species-specific impacts are not yet explicitly taken into account here as work on these is in progress. Nevertheless, significant mitigation measures are in place to address and limit impacts on key biodiversity components of conservation concern, including affected freshwater streams and fish, flora, and fauna (e.g., lemurs, frogs, reptiles, birds, and small mammals) as outlined in the sections above.

Table 2. Summary of the Residual Forest Losses due to Ambatovy's Operations

Forest type	Directly and indirectly affected area (hectares)	Losses in habitat hectares
Azonal forest	1,077.1 ha	-740.03 hh
Transitional forest	462.4 ha	- 175.01 hh
Zonal forest	526.2 ha	- 534.38 hh
Total	2064.7	- 1,467.05 hh

4.1.3 Reviewing Potential Offset Locations and Activities

Preliminary surveys were undertaken in 2005 to identify potential offset sites that would satisfy the 'like for like' concept and provide adequate gains to balance out the operation's residual losses. The criteria used to guide the selection of candidate sites included landscape context, geology, soils, topography and altitude, forest structure, and likely species composition. The need for protection and chance of achieving additional gains were also key considerations. The approach involved the following (see also the Ambatovy Project, 2009):

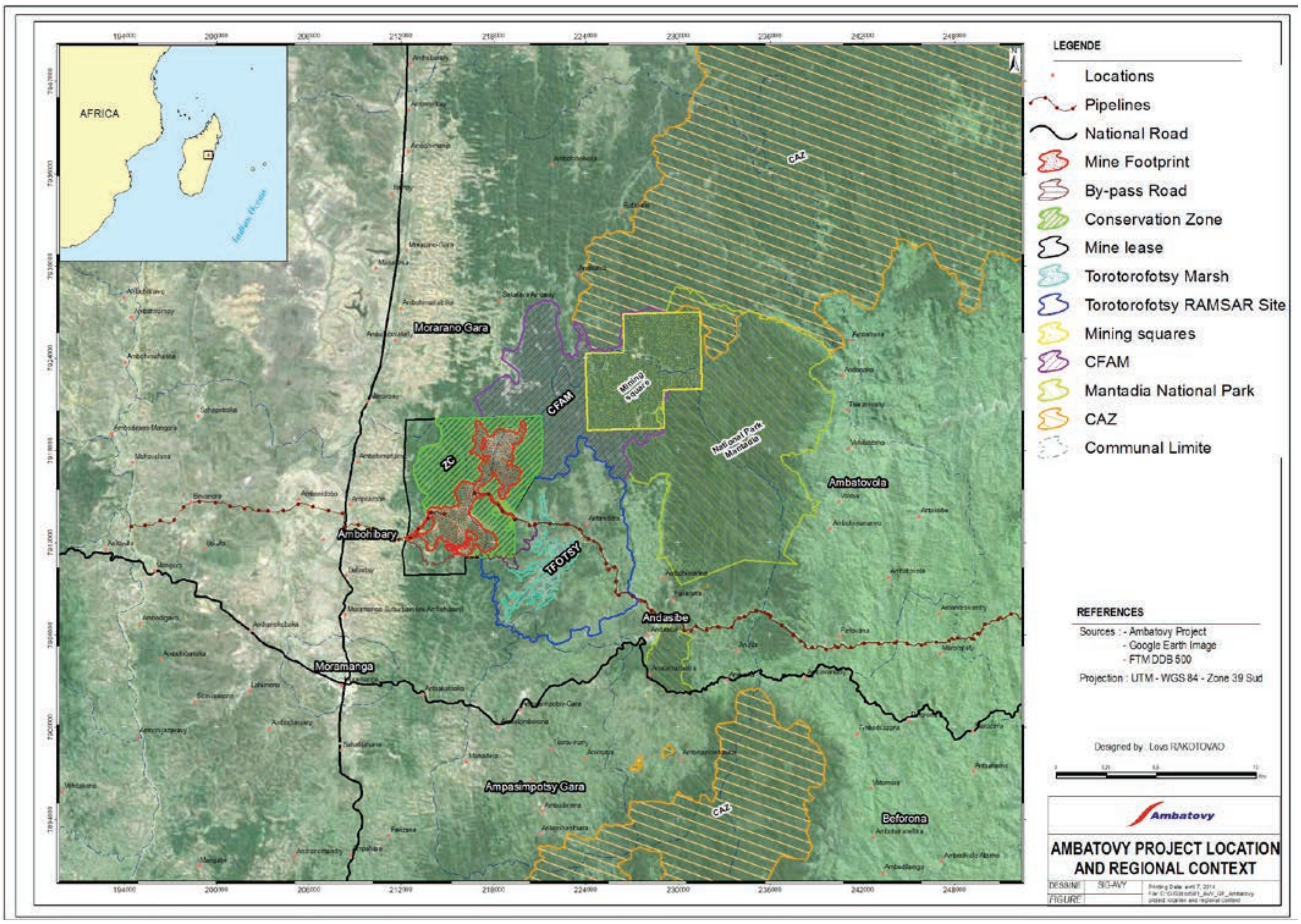
- A desk-top study of satellite images and other spatial data to identify sites that might be suitable as offset sites was conducted. Fourteen potential sites were identified based on the presence of ultramafic outcrops and remaining forest cover.
- An aerial reconnaissance survey to confirm the presence of forest cover and undertake a rapid visual integrity assessment was conducted. Two potential candidate sites (Vohimenakely and Ankerana) were selected, partly based on the quite unusual ultramafic geology of these sites that were expected to support similar 'azonal' vegetation comparable to parts of the mine concession.
- Following aerial (helicopter) and subsequent field surveys of the two potential candidate sites,[27] Ankerana was chosen as the most appropriate potential offset site, given its large size and

[27] Vohimenakely, NW of Zahamena National Park, appeared to have the right characteristics, but the remaining natural vegetation was found to include only a very small highly disturbed 'azonal' forest patch (<10 ha). [28] Losses and gains have so far only been quantified in terms of forest habitat hectares. Species-specific and aquatic habitat calculations are still pending.

connectedness with other intact forest areas (as part of the CAZ), the presence of ultramafic geology with predicted associated ‘azonal’ vegetation, and limited signs of disturbance. The site is however surrounded by subsistence agricultural fields and a number of villages. It is also temporarily legally protected as a part of the CAZ ‘new protected area’ (although unfunded) in Madagascar’s ‘Durban Vision.’

- Biodiversity field surveys were undertaken as part of several scientific expeditions to Ankerana (2011-2014). Compositional and structural data, as well as data on underlying geology, were collected for assessment of similarity to Ambatovy and for first iteration of loss/gain calculations.[28]

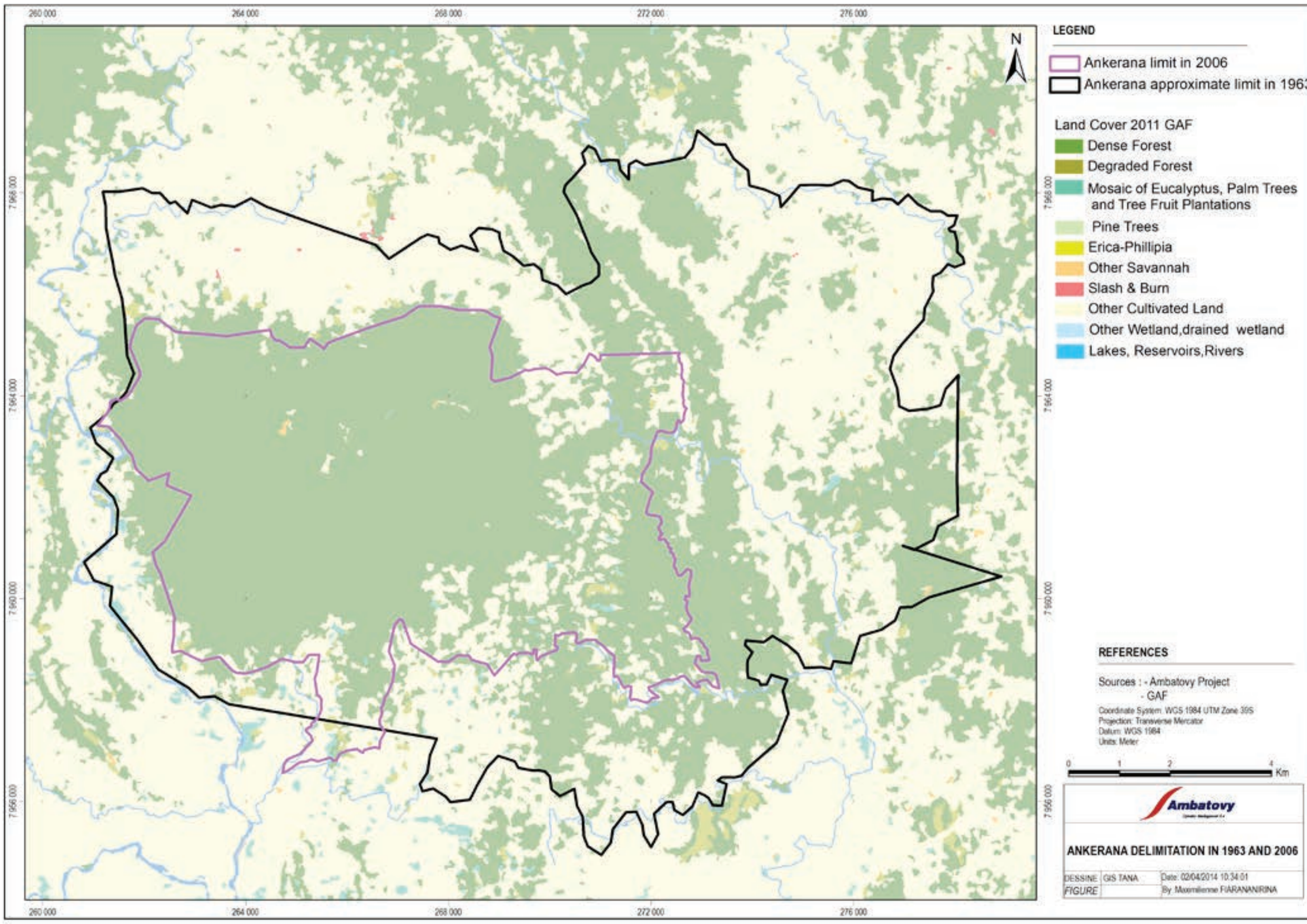
Figure 9. Regional Context of the Ambatovy Mine and Offset Portfolio



Note that the Ankerana site is further to the North, as shown in Figure 2 and Figure 10 below.

[25] Ankerana had previously and independently been identified by the Missouri Botanical Garden – Madagascar (a project partner) as a potential conservation area based on its floral assemblages. The work identified many similarities in the physical, climatic, and biological characteristics compared to Ambatovy/Analamay, although also highlighted considerable differences in floral composition and the presence of low-altitude forest. Overall, the data supported the hypothesis that Ankerana could be considered as sufficiently comparable to the forests at Ambatovy to qualify as a like-for-like offset.

Figure 10. Map of Ankerana Classified Forest, Indicating Loss of Approximately 50% since Gazetted in 1963



- Based on these initial data analyses and loss/gain projections, numerous sites were reviewed for consideration as part of the offset portfolio. This was done to complement biodiversity gains anticipated from protecting Ankerana. Two additional sites, CFAM and Torotorofotsy, were selected as options based on specialist advice and further desktop and ground-level assessments. These areas presented significant opportunities for achieving important conservation outcomes (e.g., protecting flagship species such as Prolemur simus, and maintaining regional forest connectivity).

4.1.4 Assessing Potential Gains

In the case of Ambatovy, the basis for achieving biodiversity gains is principally through 'averted loss' or 'averted deforestation' offsetting. This involves conserving priority forest habitat that is demonstrably under threat of being cleared (either immediately or over time). In Madagascar, where land use pressures are leading to the rapid and on-going decline in biodiversity, the long-term protection of the island's remaining biodiversity is widely regarded by conservation stakeholders as a crucial and additional conservation action. This also applies to the landscapes surrounding Ambatovy's operations and offset sites. One of the greatest pressures on the remaining forests is slash-and-burn agriculture (tavy) by rural communities for the cultivation of rice and other crops. Due to the extensive nature of this practice it contributes significantly to the background deforestation rate in the regions and districts where Ambatovy operates.

Assessing the potential for 'averted losses' due to conservation measures at various offset sites involved the following steps: The first was to establish an appropriate baseline or counterfactual scenario/s (see Ferraro and Pattanayak, 2008). This indicates what is likely to happen in the absence of protection measures, with the best available proxy in this case being data on past background deforestation rates (e.g., at regional/district-level). The next step was to determine the potential for reducing deforestation rates at an offset site through protection measures. The difference between the reduced deforestation and the baseline deforestation rates over time essentially constitutes the 'averted loss' which constitutes a real conservation outcome (measured in terms of forest habitat saved due to the offset). A last step to enable quantifying the biodiversity 'gains' at each offset site was to evaluate the contribution of each site in terms of habitat hectares (i.e., the same 'area x condition' of forest currency as used for the losses).

To complete the first step, various sources[29] were reviewed to obtain relatively reliable and consistent data on land-use change and deforestation trends in the regions where Ambatovy operates. The most recent Madagascar-wide study by ONE, Conservation International, and other partners, released in 2013, was selected as the most suitable reference. This study is based on Landsat data, provides average deforestation rates at District and Region level, as well as for Protected Areas, and usefully reports rates for the periods 1990-2000, 2000-2005 and 2005-2010 based on a consistent methodology.

The Ambatovy mining concession and conservation forests, Corridor Forestier Analamay Mandadia (CFAM), and Torotorofotsy fall mostly within the District of Moramanga. Ankerana is located within the Brickaville District. Table 3a provides the highest and lowest background deforestation rates recorded for these districts between 1990 and 2010 (ONE et al., 2013). For Brickaville, for instance, the annual deforestation rate ranges between 0.3% (2000-2005, 2005- 2010) and 0.43% (1990-2000).These data were used to construct two baseline scenarios per site: one based on the highest and the other on the lowest observed deforestation rates respectively. Reporting trends and forecasted loss/gain results within this kind of range provides a 'margin of error' that is more realistic than would be the case if a single rate for projecting averted losses were used. It may also cater for some of the uncertainty associated with fluctuating background deforestation rates and using these to make future predictions.

The second step was to predict potential 'averted losses' due to offset interventions in the context of the baseline deforestation rates. To obtain a reasonable estimate of the reduction in deforestation rates that could be achieved due to Ambatovy's conservation (offset) management, deforestation rates recorded for existing Protected Areas were used as a proxy. As for the baseline, the highest and lowest rates given for the period 1990-2010 were used. Andasibe-Mantadia National Park and Analamazoatra Special Reserve (in close proximity to the mine conservation forests, CFAM and Torotorofotsy) and Mangerivola National Park (close to Ankerana) were chosen as reference sites (Table 3a). The assumption here is that conservation management by Ambatovy would be able to replicate the reductions in forest loss rates achieved by the Protected Areas administration.[30] The year of Ambatovy's first conservation intervention at each site is given

[29] This included, amongst others, Harper et al., 2007 ; Horning, 2000; studies by Conservation International, USAID and government partners published in 2009 and in 2013.

[30] While there is some support for this based on initial results from a high resolution land use change analysis (GAF, 2012), a thorough leakage assessment has yet to be done, and data over a longer timespan would be needed to determine outcomes more reliably.

in Table 3a. However, due to the likelihood of a lag period between first interventions and any outcomes (i.e., forest loss being reduced) potential 'averted losses' were only counted after at least three years of action, so as not to overestimate conservation success in the initial years. In addition, likely conservation success was integrated as a precautionary measure to adjust potential averted losses in the projections (see Table 3a).

Table 3a. Selected Statistics for Sites in the Current Offset Portfolio

Offset Site	Area with forest cover (ha)	Baseline rates (1) based on regional annual background deforestation rates (%)	Estimated annual deforestation rate (2) achievable at offset site when under conservation management	Timeframe over which rates were measured by ONE et al. 2013	Starting date of Ambatovy conservation management and in (..) the year when gains first counted	Indicated probability of conservation success
Mine Conservation Forests ('ZC')	3338	0.53-1.31%	0.02 - 0.12	1990-2010	Jan 2009, (2012)	75%
Azonal 'set asides'	305	0.53-1.31%	0.02 - 0.12	1990-2010	Jan 2009, (2012)	75%
('Deux Blocs')	5715	0.3 - 0.43%	0.05 - 0.31	1990-2010	Jan 2011, (2014)	60%
CFAM	7269	0.53-1.31%	0.02 - 0.12	1990-2010	Jan 2013, (2016)	50%
Torotorofotsy ('TTFotsy')	3876[31]	0.53-1.31%	0.02 - 0.12	1990-2010	Jan 2014, (2017)	50%

Note: Deforestation data are based on data from ONE, DGF, FTM, MNP & CI (2013) Evolution de la couverture de forêts naturelles à Madagascar 2005-2010, Antananarivo. The table shows background deforestation rates, predicted rates under conservation management, and predicted annual biodiversity gains relative to deforestation rates with and without protection are shown

(1) The rates observed in the Moramanga District (Alaotra Mangoro Region) were used for the mine conservation forests, azonal patches, CFAM and Torotorofotsy while rates given for Brickaville District (Atsinanana Region) were used for Ankerana (2) The observed deforestation rates for the closest-lying Protected Areas were used for this estimate. These are Andasibe-Mantadia & Analamazaotra for the mine forests and azonal patches, CFAM and Torotorofotsy, and Mangerivola for Ankerana.

A third step was to assess the proposed offsets for their habitat composition, using the forest classes developed for the Ambatovy footprint forests. The figures in Table 3b highlight the significance of the azonal set asides and Ankerana for the presence of azonal forest, while the mine conservation forests and the two azonal parcels are important for the presence of transitional forest. CFAM and Torotorofotsy, on the other hand, are significant in terms of containing relatively large areas of zonal forests.

Based on the previous three steps and inputs summarised in Table 3a, four scenarios of averted loss projection are presented for Ambatovy. The projections are presented for the offset portfolio outlined in the company's draft strategy for achieving NNL/Net Gain (Ambatovy, 2013, and Table 4) and represent a first estimation. This will be refined over time, based on monitoring and better data becoming available.

[29] The proposed Torotorofotsy offset (3878 ha) comprises only the forested parts of the Ramsar site (10023 ha).

Complementary assessments for aquatic biodiversity and selected species are also still to be done. For the time being, potential averted forest losses are reported for each site according to the following four scenarios:

1. Low baseline deforestation rate in the respective region (based on the lowest observed background deforestation rate since 1990) and limited conservation success at the offset site (based on the highest deforestation rate observed since 1990 in the relevant proxy Protected Area, PA): the least extreme averted loss scenario.
2. Low baseline deforestation rate and high conservation success (the latter based on the lowest deforestation rate observed for the relevant PA).
3. High baseline rate (based on the highest background deforestation rate observed in the relevant region since 1990) and limited conservation success.
4. High baseline deforestation rate and high conservation success: the most extreme averted loss scenario.

Table 3b. Break-Down of Different Forest Types (in ha) in the Offset Sites Chosen by Ambatovy

	Area in hectares		
Offset site	Azonal	Transitional	Zonal
Mine Conservation (ZC)	109	739.8	2,427.6
Azonal forests (Deux Blocs)	162.2	128	15.8
Ankerana	836	0	1,043 (mid-altitude) & 3,836 (low altitude forest)
CFAM	0	0	7,269
Torotorofotsy	0	0	3,876

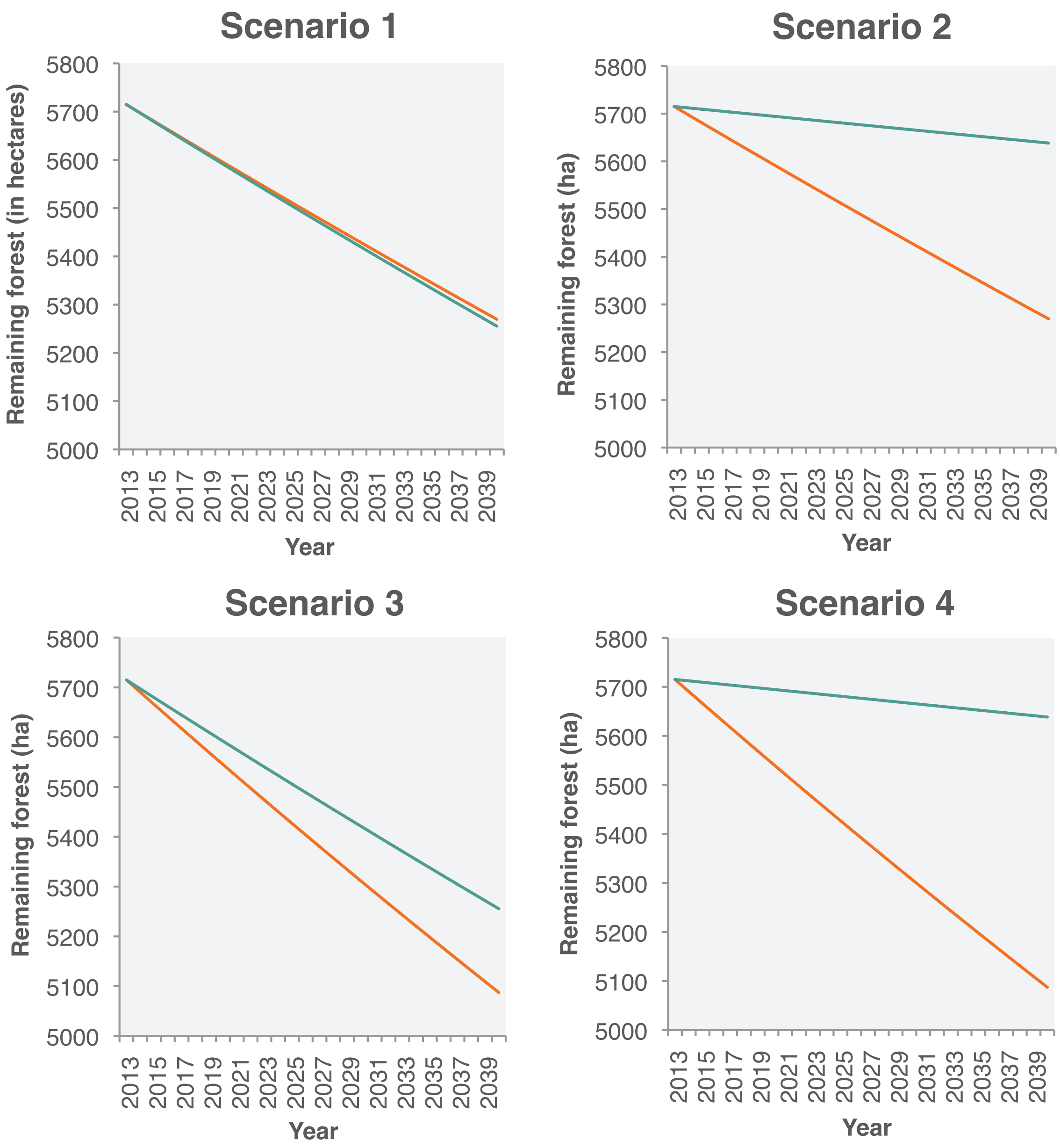
Textbox 4. Monitoring Deforestation Using High-Resolution Satellite Imagery

A study was conducted by GAF AG in 2012 to assess land-use change and deforestation between 2006 and 2011 for eight areas of interest relating to the Ambatovy operations. The study was commissioned by the European Investment Bank (EIB) in support of a commitment by Ambatovy to establish earth observation methodologies for monitoring forest changes in Ambatovy's impact sites and offsets. Given the use of different (much higher-resolution) imagery and methodologies compared with the ONE et al. (2013) study, resulting in high spatial and temporal variation, the decision was taken to use the significantly more conservative statistics (i.e., lower deforestation reflected) of the ONE et al. (2013) report for the present baseline scenarios and gains projections for Ambatovy. Efforts continue, however, with the use of high-resolution imagery with a national earth observation partner (IOGA) since this has greater utility for site management, being able to detect small forest clearings and other earlier indications of incursions and for the accurate measurement of 'leakage' (displaced deforestation pressure in the periphery of the offset).

4.1.5 First Results and Interpretation

The deforestation trends underpinning the four averted loss scenarios up to 2040 are graphically presented in Figure 11 for one of the sites, Ankerana. Indicative forecasts of potential averted losses from Ambatovy's offset programme, taking all sites into account, are presented in Figure 12 and Table 4 according to the four chosen scenarios.

Figure 11. The Four Chosen Scenariosfor One of the Offset Sites



Note: Baseline deforestation rates (anticipated background or 'business-as-usual' deforestation and no protection afforded to the site) are shown in red, while the predicted deforestation rate under conservation management (i.e., reduced to equate to the rates observed in protected areas) are shown in green (see Table 3a).

The graphs in Figure 11 show the marked influence of deforestation rates and associated scenarios on the forecasting of offset 'gains' (averted losses). As expected, there are very large differences between the scenarios. Scenario 1 forecasts the least accumulation of averted forest losses: in fact, no averted losses are predicted for Ankerana, given that the deforestation rate with protection in this scenario is set slightly above the background rate of loss (0.31% versus 0.3%). Scenario 4, on the other hand, forecasts the accumulation of substantial averted losses. These trends, shown here for Ankerana only, mirror the predictions for the other sites (Table 4) although the specifics differ somewhat according to the inputs used (given in Table 3a). These projections highlight the importance of presenting a range of scenarios and related outcomes rather than a single forecasted value. The data presented in Table 4 and Figure 12 for all sites further emphasize this observation.

Judging by data on past trends in Madagascar (ONE, 2013) it appears unlikely for deforestation in protected areas to be higher than in the surrounding areas over the same period of time. While this implies that Scenario 1 in the case of Ankerana is quite unlikely, Scenario 1 and 3 nevertheless serve as useful illustrations of less 'extreme' scenarios regarding the potential for accumulating averted losses, and – by extension – for achieving potential 'gains' in forest cover. Scenarios 4 and to a lesser degree 2 represent the opposite end of the scale, where significant averted loss – and potential for achieving gains - is predicted (see Table 4).

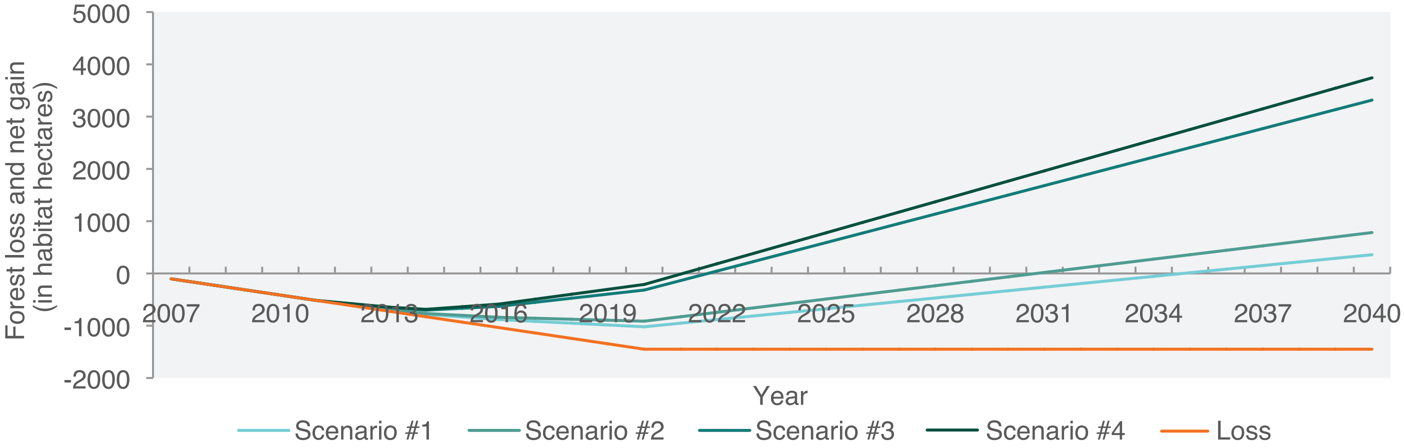
Table 4. Summary Statistics of Forest Losses due the Mine - and Four Different Scenarios of Potential Averted Losses (and Gains due to Offsetting) by 2040 across All Offset Sites

Forest type	Loss (hh)	Averted Loss by 2040 (in habitat hectares, hh)				Potential to achieve NNL by 2040
		Scenario 1	Scenario 2	Scenario 3	Scenario 4	
Azonal forest	- 740.03	50.84	89.19	125.30	163.65	No scenario achieves NNL for azonal habitat
Transitional forest	- 175.01	93.43	109.94	259.03	274.94	Scenarios 3 & 4 achieve NNL for transitional forest
Zonal forest	- 534.38	1,663.11	2,033.21	4,381.07	4,752.84	All scenarios achieve NNL for zonal forest
Total	-1,467.05	1,807.38	2,231.74	4,765.40	5,191.43	All scenarios achieve NNL/NG for forest (types aggregated)
Net Forest Gain*		+ 340.33	+ 764.69	+ 3,298.25	+ 4,294.0	

*Also see Figure 1.

Figure 12 illustrates the projected net gains over time, across all offset sites and for aggregated forest types (in habitat hectares) for the four chosen scenarios. The graph also shows the existing and expected future forest loss (in habitat hectares) due to Ambatovy's operations. This is a preliminary estimate.

Figure 12. Projected Losses and Four 'Averted Losses' Scenarios (Indicating Potential Gains in habitat hectares) across all Offset Sites



Note: Based on these projections, NNL/NG of aggregated forest types could be achieved sometime between 2022 and 2035.

Based on current understanding of land-use pressures and the effect that sound conservation measures can have on reducing deforestation rates, the most credible forecast probably lies between the extremes, thus between Scenario 2 and 3. Both scenarios predict no net loss or possibly a net gain in habitat hectares of forest (i.e., aggregating forest types) and across all sites within the next 20 years. This prediction fits in between the 2022 milestone (predicted under Scenario 4) and the 2035 milestone (for Scenario 1 – all sites, forest types aggregated, see Table 4 and Figure 12).

Given the very large area of forest included in the offset portfolio relative to the extent of impacted forest (see Table 2 and 3a), it is perhaps not surprising that NNL/NG appears achievable under any of the scenarios and within a relatively short timeframe (i.e., sooner than 2040). However, it is crucial to note, first, that these forecasts apply to forest overall, i.e. when different types of forest are aggregated and not assessed separately. Secondly, the offset portfolio is dominated by zonal forest, as opposed to azonal or transitional forest (Table 3b).

The detailed results in Table 4 show that when forest types are analysed separately, NNL/NG for azonal forest is not achievable within the next thirty or so years under any of the scenarios. Underlying this is the more limited extent of this forest type in the offset areas (Table 3b) relative to the high proportion of azonal forest in the mine-impacted areas (Table 2). This means that for azonal forest specifically, the loss/gain balance could only be reached much later than 2040. This is assuming an unrestricted timeframe for the achievement of NNL/NG.[32] This emphasises again the vital contribution made to the offset by Ankerana and the azonal forest areas within the mining concession: Azonal forest is only found at these sites, one of the main reasons why they were chosen early on as a core part of the offset (Ambatovy Project, 2009).

However, it is also important to note that a high degree of similarity has been found in the species composition (fauna and flora) of azonal, zonal, and transitional forest. This applies particularly where these forest types occur in close proximity or as a mosaic at a given site (e.g., as in the conservation forests in the mine

[32] Clear restrictions on the timeframe for achieving NNL are rarely available.

concession). The main compositional differences are found with respect to the flora at quite distant sites (e.g., Ankerana and Ambatovy share only about 50% of the flora). The same does not necessarily apply to the fauna: for example, all of the potentially affected lemur species occur at Ankerana and the level of overlap is also high for most other faunal taxa.[33]

To conclude:

- The results currently are a first estimation but provide a valuable framework for proceeding with offset work.
- NNL/NG for overall forest (see note on azonal forest above) affected by the operations appears feasible over the next several years. This is given the current scale of the offset programme and the fact that implementation is underway at several of the sites, prior to the accumulation of maximum losses and according to the potential averted loss scenarios outlined above.
- While the current scope of offset portfolio/programme may appear extensive, this is based a precautionary approach and addresses a range of risks and uncertainty. As it stands, the offset programme a) allows for flexibility in terms of prioritising actions and refining outcomes depending on what – over time – turns out to be most effective and efficient (and cost-efficient), b) caters for uncertainty, e.g., fluctuating levels of conservation success, varying background deforestation rates, and other factors that are mostly beyond the control of the company, c) covers as well as possible the wide range of different biodiversity components impacted by the operations (i.e., forest types, individual species – yet to be fully analysed, and other components).
- In this context, it is also important to note that the loss/gain calculations exclude any form of discounting, i.e., the underlying assumption is of a zero discount rate. If a positive discount rate were applied, this would reduce the rate of loss and thus the potential gains. Agreement on how to determine a meaningful and defensible discount rate for biodiversity offset calculations is still outstanding.[34]
- Future refinement of the calculations given additional data (e.g., on priority species distributions) and monitoring of deforestation rates and conservation success will allow for any necessary changes and adaptive management relating to the offset programme over time.

[33] The results of comparative species composition have not yet been fully analysed for all sites and forest types, as new data are still being collected at the offset sites.

[34] A variety of rates and approaches for determining these have been proposed to date and are debated in offsetting circles (e.g., Denne & Bond-Smith, 2012; Evans et al., 2013). Similarly there is an as yet unresolved debate around discounting in relation to ecosystem services and natural resource accounting.

5

Offset Implementation and Governance

5. Offset Implementation and Governance

The full biodiversity offset programme for Ambatovy is in the early stages of implementation. The stage of management planning and implementation varies among the sites comprising the composite offset (Table 3a). However, currently all are under some form of active conservation management supported by Ambatovy. Long-term arrangements to secure formal protected area status are in process for Ankerana, CFAM, and the mine conservation forests (including the azonal areas), whilst a co-management agreement is pending for the forests of Torotorofotsy.

The precise scope (i.e., of the precise spatial extent and nature of development and conservation interventions) of the offset programme over the medium- to long-term awaits completion and long-term financial and management arrangements are still pending. The main offset design features and full implementation plans (i.e., details regarding management, legal and financial arrangements, and monitoring and evaluation) are still to be set out in a comprehensive Biodiversity Offset Management Plan (BOMP). However, the key characteristics of the sites, as they currently stand, are summarised below:

1) The mine conservation forests, including azonal areas: This involves the formal protection and conservation management of 'zonal' and 'transitional' forests (3,338 ha) and two patches of 'azonal' forest (306 ha) within the mining concession. The biodiversity value of these forests is high and the area is of particular ecological significance amongst the offset sites given its similarity to (like for like), and continuity with, the forest habitat affected by Ambatovy's mining activities. At a landscape scale, the location of the mine forests adjacent to the CFAM complex is important for greater connectivity with CFAM and the southern end of the CAZ and as a buffer between the more developed areas around Moramanga and the CFAM forests. In the long-term, this connectivity should also facilitate sound outcomes from the minimisation and restoration measures being undertaken on the mining concession.

Currently, the management of the mine conservation forests is being undertaken by Ambatovy. Essentially, this entails various activities including developing community forest management zones adjacent to the conservation forests, community awareness and education, developing alternative livelihood programs, ecological monitoring by communities, and conducting regular forest patrols. In addition the company has a comprehensive biodiversity monitoring programme that aims to detect any changes in species population viability over time (e.g., for lemurs, birds, amphibians etc). Targeted habitat restoration measures are also undertaken to facilitate in situ conservation of priority species, such as Mantella aurantiaca and fish ESUs. At present, this is being financed from the company's operating budget, and comprises about a quarter (25%) of the overall annual expenditure on the mitigation (and offsetting) programme.

Along the periphery of the mine conservation forests, community-based forest management transfers have been set up to help buffer mine-adjacent offset sites from habitat loss and degradation. These transfers comprise a further 2,555 ha of natural habitats which may also be included in the future averted loss projections.

2) Ankerana: This involves the protection of a 5,715 ha block of forest that forms part of the Ankerana massif, located roughly 70 km to the north of the mine site. The forest cover is of the same 'dense, humid evergreen' forest type as the mine site, and there are good examples of a similar short stature 'azonal' forest structurally comparable to that present at the mine site. As noted previously, this site was identified very early on as one of two potential offset sites with similar underlying ultramafic geology to that of Ambatovy.

Based on the data collected during several expeditions undertaken to the site so far, the degree of equivalence (like for like) between the mine site habitats and Ankerana is not as well defined as originally anticipated, although for example at least 60% of all fauna species found on the mine footprint are present at Ankerana. Indeed, all of the lemur species are represented at Ankerana, and it hosts significant densities of Varecia variegata and Indri indri (both with IUCN CR status). The conservation importance of Ankerana cannot be disputed and therefore it forms a crucial component of the offset portfolio. In fact, a large portion of Ankerana would be considered of higher conservation priority than the mid- to high-altitude evergreen Ambatovy forests, given that very few low-lying humid evergreen forests remain across the country.

Figure 13. View across the Ankerana Massif and Vohimana Peak.

Photo credit: Ambatovy

Ambatovy has invested significantly in Ankerana and its immediate surroundings over the past few years, including in conservation and research efforts, environmental education, and alternative livelihood development. To date this work has included extensive engagement with community leaders, the establishment of park infrastructure, forest patrols by dedicated conservation agents, irrigation dams and training for more efficient rice production, the cultivation of alternative cash crops, and the establishment of woodlots for fuel production. A large-scale socio-economic baseline study and studies on bushmeat consumption and trade have been conducted. Ambatovy aims to establish permanent mechanisms for community engagement and natural resources governance.

Ankerana first received official status as a classified forest in 1963 at which time it covered an area of at least 19,000 ha. In 2005, Ankerana was included as a parcel of the CAZ which was given temporary protected area status as part of implementing the Durban Vision. Ambatovy has long-standing MOUs with the regional forest authorities and with Conservation International (CI) for cooperation in relation to Ankerana. In 2011, CI was designated by the central government as the official manager of the entire CAZ. Ambatovy is currently discussing sub-delegation arrangements with CI for Ankerana.

At present, Ankerana is directly managed by Ambatovy, and conservation activities at the site are entirely financed by Ambatovy through a dedicated offset budget.

3) CFAM: The Analamay-Mantadia Forest Corridor includes around 7,269 ha of forest within a wider area of 14,027 ha and provides a pivotal link between the mine conservation forests, the Andasibe-Mantadia National Park, the CAZ and Torotorofotsy. CFAM is currently an unprotected area of forest with high-biodiversity value and containing most of the priority species found in the mining concession. Two scientific expeditions have been undertaken to complete inventories of the fauna and flora; Ambatovy has also supported surveys of the greater bamboo lemur Prolemur simus (IUCN CR and one of the 25 most endangered primates in the world) of which CFAM harbours one of Madagascar's largest populations.

Conservation actions currently being implemented by Ambatovy in CFAM focus on joint patrols with the regional forest authorities to ensure forestry laws are observed in the area while formal legal protection is pending. Ambatovy has supported the process for formal legal protection, including regional consultations with surrounding communities and the preparation of a formal submission to the government for inclusion of CFAM in the protected areas system (SAPM). The full legal protection of the land has been held up by the presence of graphite mining concessions in a part of the area. These need to be cancelled if the affected lands are to become part of the new protected area. While awaiting resolution of these issues, Ambatovy collaborates with the local forest authorities and the graphite mine owners to enforce the application of forest protection laws in the area to avoid deforestation.

4) Torotorofotsy: Torotorofotsy is a Ramsar site designated by Madagascar for its important wetlands in 2004 and declared as a temporary protected area in 2010. The site covers 10,023 ha of wetlands and surrounding forested catchments of which 1,669 ha (mainly forest) overlap with the mining concession. While the Ramsar designation was made in 2004, the site was legally established as a temporary protected area in 2010, following the award of the mining concession in October 2007.

To date Ambatovy's efforts have focused on research, inventories, and additional conservation actions such as developing (with others) a wetland management plan for the entire site, undertaking hydrological studies and modelling and supporting a community consultation process to halt further conversion of wetlands into rice paddies. In collaboration with Sherritt International Corporation, the project operator, Ambatovy has supported studies by the Asity NGO (BirdLife International partner designate for Madagascar) for bird monitoring and conservation.

Ambatovy is currently engaged in a partnership initiative with the local forest authorities and Mitsinjo, the NGO manager of Torotorofotsy, to secure the long-term conservation and management of the site. This includes the catchment forests (3,878 ha) surrounding the wetlands which would contribute to the company's offset commitments. Note that, the focus of Ambatovy's support thus far has been on the wetland component (and thus not directly contributing to the offset as such), the most comparable biodiversity to that affected by the company lies within the forests surrounding the wetland. A governance structure is needed which allocates responsibility for supporting forest conservation to Ambatovy.

6

Evaluation and Lessons Learned

6. Evaluation and Lessons Learned

In 2012, Ambatovy commissioned a second-party to conduct a pre-audit against the Biodiversity Offset Standard (BBOP, 2012) and the IFC's PS6 (IFC, 2012).

The key objectives of the pre-audit were to:

- Help Ambatovy identify how best to focus its efforts toward meeting its various biodiversity-related goals and commitments to achieving best practice, including the NNL/NG goal
- Capture any lessons learned and possible improvements in relation to applying the Biodiversity Offset Standard.

The pre-audit comprised four main steps:

1. Clarification of the auditing framework to be used based on IFC PS6 and the Biodiversity Offset Standard, including of overlaps and differences (see Appendix 1);
2. Collection and consolidation of and familiarisation with available, relevant information;
3. Evaluation and verification of the information, including through site visits, interviews, review of data and;
4. Formulation of results and recommendations.

In summary, the findings from the pre-audit were as follows:

- With respect to the biodiversity management and conservation/offset programme: Ambatovy has made substantial and measurable progress to date on the path towards conformance with the Biodiversity Offset Standard and PS6 requirements. Full conformance was regarded by the assessors as a realistically attainable goal for the company.
- In line with the pre-audit's first objective, a number of risks and key gaps were identified along with the actions required to fill these gaps and limit the risks. The company is actively pursuing these actions in anticipation of the lenders' completion audit and as part of its programmes to fulfil its environmental and social commitments.
- The highest priority action overall was determined to be finalising the biodiversity offset strategy for achieving NNL/NG (i.e., setting out the final design and implementation planning details) and the biodiversity offset management plan for the offset sites (i.e., detailing implementation-related aspects, such as all the parties' specific management roles, responsibilities as well as legal and financing arrangements for the sites). This would then implicitly address other key conformance areas noted, provided they are implemented with care to follow best-practice guidelines and based on a dynamic expert reference/support mechanism.

Key lessons and challenges identified included:

- Fully integrating offsetting into the mitigation hierarchy, particularly emphasising the importance of appropriate avoidance, minimisation and restoration measures, and their influence on limiting residual impacts and on offset feasibility, and achieving a common understanding of this within the company and stakeholders is essential for the efficient design and implementation of an offset.
- Early engagement with stakeholders and the development of partnerships are critical for the success of a high-quality biodiversity management and offsetting programme. This applies especially in a challenging context such as that presented by Madagascar and covers a wide range of activities and partnerships (e.g., with national authorities, international and national NGOs, research institutions, community-based organisations, and independent experts).
- The additionality of conservation actions needs to be robustly interpreted within the context of the particular country and region in question. Thus, while most remaining forest areas in Madagascar carry at least temporary legal protected status, the reality is that few of these areas have any significant funding for proper long-term protection measures.
- High-quality data and defensible mitigation design are an important foundation for sound biodiversity management and decision-making aimed at achieving NNL. However, some of the most significant challenges lie with the implementation of these measures, including offsetting. Therefore, it is wise to prioritise planning for implementation as early as possible.
- Significant planning, documentation, and appropriate systems for managing and updating information are essential to support (often rapid) decision-making and enable adaptive management. This is also essential for transparency, communication, and facilitates auditing.
- Uncertainty, data limitations, and diverse opinions are a common feature of biodiversity management for a large project operating in a biodiversity hotspot. This demands a resourceful and flexible approach to accommodate these challenges.

Specifically with respect to the Biodiversity Offset Standard (BBOP, 2012):

- Developing a sound biodiversity management and offsetting programme is a critical yet complex task for a large operation with significant residual impacts. The experience of Ambatovy to date has shown the value of following a clear Standard or Standards such as those published by IFC and BBOP for guiding biodiversity management and offsetting.
- The Biodiversity Offset Standard in particular is helpful as it has a detailed Principles, Criteria, and Indicators (PCI) structure which facilitates auditing on the one hand, and implementation of appropriate activities on the other hand, as well as comprehensive supporting guidance notes.
- The Biodiversity Offset and IFC Standards are complementary, although for the most part follozing the former should result in alignment with IFC PS6, given the comprehensive scope of the Biodiversity Offset Standard. IFC PS6 does, however, impose a few additional specific requirements (see Figure in the Appendix).

7

Conclusion and Next Steps

7. Conclusion and Next Steps

In 2006, at the time that Ambatovy secured its environmental permit, knowledge regarding the means for achieving no net loss or net gains was at a preliminary stage. Sufficient data were also not yet available to make a complete assessment of the feasibility of such a goal. The establishment of the Business and Biodiversity Offset Programme provided a recognised approach to follow and Ambatovy accordingly became a pilot project of BBOP. This enabled the company's offset strategy to co-evolve with the development of the Biodiversity Offset Standard (BBOP, 2012).

Rigorous application of the mitigation hierarchy – a fundamental feature of both the IFC PS and the Biodiversity Offset Standard – is the foundation of the approach taken by Ambatovy to achieving no net loss. Many aspects of impact mitigation to date have meant working in 'uncharted territory' and developing innovative approaches to avoidance, minimisation, restoration, and offsetting itself. Offsetting in particular has been an entirely new and complex area to navigate, requiring a precautionary, adaptive approach.

Demonstrating no net loss of biodiversity involves a number of technical and scientific challenges in the quantification of biodiversity, finding the appropriate metrics and appropriately accounting for risk and uncertainty, while providing a robust offset design capable of delivering adequate 'gains' within the project lifetime. Ambatovy's offset design, which encompasses a composite offset based on a landscape approach, has evolved in line with these requirements. Some of the remaining aspects being tackled by the company include the development of complementary metrics to account for species and aquatic habitats.

Ensuring the successful implementation of the offset involves further practical challenges, such as securing the full legal protection of the suite of sites, developing the right governance structures, building community support and sustainable livelihoods in the offset peripheries, and long-term financing. Three of the four offset sites now enjoy at least temporary protected legal status, possess established governance structures and benefit from a variety of programmes that closely involve local communities. All of the sites require continuing investment to ensure the necessary sustainability.

Overall, the combination of IFC PS6 and the Biodiversity Offset standard provide a coherent and comprehensive framework for biodiversity mitigation and offsetting. For such a complex and rapidly evolving area, the continuous use of external expertise, independent evaluation, and the sharing and exchanging of experience are key to success. Despite the challenges encountered as part of the process, the Ambatovy experience demonstrates that a meticulous and rigorous approach to the mitigation hierarchy, and a willingness on the part of the project developer to make the necessary investment in conservation, allows even complex projects to be planned for no net loss or even a net gain of biodiversity. Mechanisms can be developed and put in place to ensure that once no net loss is achieved, it is maintained over the long term. Ambatovy remains fully committed to implementing the full suite of appropriate and adequate mitigation measures in pursuit of the goal of no net loss and indeed a net gain of biodiversity.

Ambatovy, in collaboration with its stakeholders, intends to undertake a series of further steps over the short to medium term. These next steps respond to the recommendations of the pre-audit and include the following:

- Finalise offset design, including:
    - Complete species-focused critical habitat assessment to inform loss/gain calculations for selected priority species;
    - Complete leakage assessments for all offset sites;
    - Analyse the social cost-benefit assessments undertaken at Ankerana and around the mine concession area and conservation sites;
    - Develop monitoring indicators and system for assessing and evaluating conservation success at offset sites. This will be aligned with the overarching Biodiversity Monitoring and Evaluation Plan; and
    - Complete endemic fish EOO surveys to refine mitigation strategy and inform design of offset and/or compensation measures for aquatic habitats, as required.
- Confirm the full area of the CFAM to be under Ambatovy responsibility and the means for linking CFAM to the rest of CAZ.
- Develop a comprehensive Biodiversity Offset Management Plan for the offset sites.
- Secure definitive permanent legal status and management arrangements for all offset sites.
- Continue programs stakeholder engagement, governance structure development, and livelihoods reinforcement to secure community support for the offsets.
- Continue developing a long-term sustainable financing strategy for offset sites to assure funding for the offset programme beyond operational budgets.

8

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9

Appendices

9. Appendices

Appendix 1

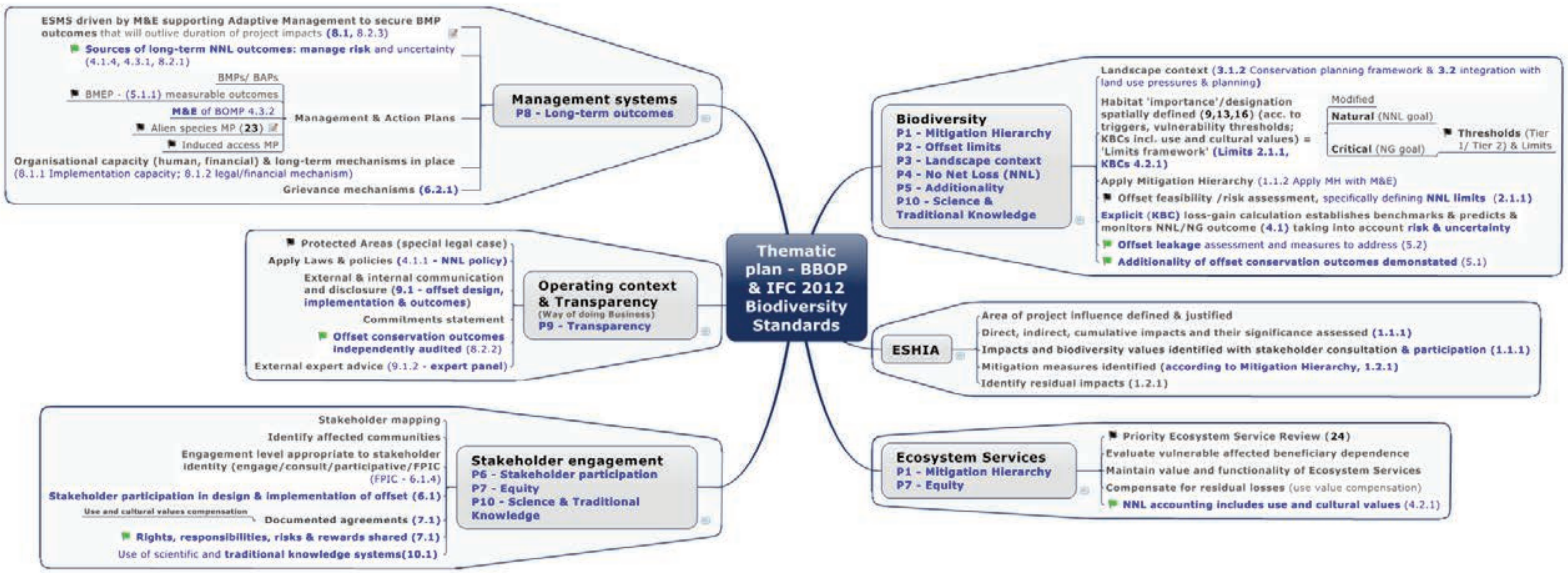
Comparative Mapping of BBOP & IFC Standards by Themes

Figure A.1 summarises and maps the key requirements of IFC PS6 (and supporting aspects of PS1) and the BBOP Standard according to six themes with sub-headings. The diagram provides a framework for comparing the Standards, presenting their significant overlap and complementarity, as well as those requirements that are not shared. The thematic diagram was used as an audit support and results communication tool. Some points to emphasise:

The high degree of overlap between the IFC & BBOP Standard effectively means that the BBOP Principles, Criteria, and Indicators (PCI)-based framework can be used by proponents to ensure meeting IFC PS6, with some caveats (noted below **). This is attractive because the BBOP Standard has well-developed guidance documentation and an auditing framework, while the IFC PS lack the latter.

- **IFC-PS specific requirements that may not necessarily be satisfied by adherence to the BBOP Standard are: 1. Specific requirements (e.g. how to apply the mitigation hierarchy) as they are defined in relation to the IFC's habitat designations of Modified, Natural and Critical Habitat; 2. preparation of an Invasive Species Management Plan; 3. specific provisions relating to legally Protected Areas; 4. explicit definition of the area of project influence; 5. full Ecosystem Services Review.
- The significant developments in the 2012 versus 2006 PS6 are denoted by black flag icons in Figure A.1. These items are not entirely new requirements, but develop pre-existing themes in PS6 2006. The 2012 PS6 tends to provide greater clarity regarding the expectations that the IFC has of applicable projects.
- While the BBOP Standard does not explicitly cover all IFC PS6 requirements, it goes further in guiding projects to ensure that the requisite planning and management structures are implemented to maximise the likelihood of achieving NNL for a particular project (Green flag items in Figure A.1 show the important elements of the strategy to ensure NNL that conformance with the BBOP Standard explicitly requires in addition to PS6 requirements).

Figure A.1. Thematic Mapping of IFC and BBOP 2012 Standards' Key Biodiversity Requirements



Legend

Black header text	Derived unifying themes	**NNL**	No Net Loss	**ESMS**	Environmental & Management System
Grey text	IFC PS1/6 Standard main clause excerpt	**NG**	Net Gain	**BMEP**	Biodiversity Monitoring & Evaluation Programme
Blue text	BBOP Standard reference	**M&E**	Monitoring & Evaluation	**BOMP**	Biodiversity Offset Management Plan
(black flag)	New aspect to IFC Standard for 2012	**BMP**	Biodiversity Management Plan	**FPIC**	Free, Prior & Informed Consent
(green flag)	BBOP aspect not explicitly required in IFC Standard	**BAP**	Biodiversity Action Plan	**ESHIA**	Environmental, Social & Health Impact Assessment

This thematic diagram was created as an audit support and results communication tool (Golder and Forest Trends, 2013). Its main aim was to provide a simplified rapid understanding of the two Standards' requirements, and areas of complementarity and difference. The annotation of new aspects of IFC PS6 arising with the 2012 version (black flag icons) was done after a full comparative review of the 2006 and 2012 IFC biodiversity requirements, in the context of Ambatovy.

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