Liberia Western Range Iron Ore
Phase 1 Direct Shipping Ore

Addendum to Environmental and Social Impact Assessment: Additional Zoological Studies, Main Report

December 2011

Prepared for

ArcelorMittal

Revision Schedule

Addendum to ESIA: Additional Zoological Studies

December 2011

Rev	Date	Details	Prepared by	Reviewed by	Approved by
01	Dec 2011	Final	**Ben Phalan** Zoologist	**Tanya Romanenko** Project Coordinator	**Gareth Hearn** Project Director

URS Scott Wilson
Scott House
Alencon Link
Basingstoke
Hampshire
RG21 7PP

Tel: +44 (0)1256 310 200
Fax: +44(0)1256 310 201

Report Structure of Environmental and Social Impact Assessment (ESIA)

Section	Report Title
Main Report	Addendum to Environmental and Social Impact Assessment for Phase 1. Additional Zoological Studies
Annex 1	Survey of Dragonflies and Damselflies (Odonata) in Nimba County, Liberia. Dijkstra, K.-D.B
Annex 2	Conservation Status of Bats (Chiroptera) Within the ArcelorMittal Liberia Concession, with Special Emphasis on the Phase 1 Footprint. Monadjem, A.
Annex 3	Nimba Toad Survey (*Nimbaphrynoides occidentalis liberiensis*) Within the ArcelorMittal Liberia Concession Sandberger, L. & Loua, N.S.
Annex 4	Herpetological Survey of the ArcelorMittal Concession, Yekepa, Liberia. Penner, J.
Annex 5	Reptile Survey Report – Baseline Data with Additional Observations on the Amphibian Fauna. Phase 1 DSO Mining Project, Nimba County, Liberia. Branch, W R

Limitations

URS Scott Wilson Ltd ("URS Scott Wilson") has prepared this Report for the sole use of **ArcelorMittal Liberia Ltd** ("Client") in accordance with Addendum No.1 to the Agreement under which our services were performed dated 06 September 2010. No other warranty, expressed or implied, is made as to the professional advice included in this Report or any other services provided by URS Scott Wilson. This Report is confidential and may not be disclosed by the Client nor relied upon by any other party without the prior and express written agreement of URS Scott Wilson.

The conclusions and recommendations contained in this Report are based upon information provided by others and upon the assumption that all relevant information has been provided by those parties from whom it has been requested and that such information is accurate. Information obtained by URS Scott Wilson has not been independently verified by URS Scott Wilson, unless otherwise stated in the Report.

The methodology adopted and the sources of information used by URS Scott Wilson in providing its services are outlined in this Report. The work described in this Report was undertaken between 27 September 2010 and 22 March 2011 and is based on the conditions encountered and the information available during the said period of time. The scope of this Report and the services are accordingly factually limited by these circumstances.

Where assessments of works or costs identified in this Report are made, such assessments are based upon the information available at the time and where appropriate are subject to further investigations or information which may become available.

URS Scott Wilson disclaim any undertaking or obligation to advise any person of any change in any matter affecting the Report, which may come or be brought to URS Scott Wilson's attention after the date of the Report.

Certain statements made in the Report that are not historical facts may constitute estimates, projections or other forward-looking statements and even though they are based on reasonable assumptions as of the date of the Report, such forward-looking statements by their nature involve risks and uncertainties that could cause actual results to differ materially from the results predicted. URS Scott Wilson specifically does not guarantee or warrant any estimate or projections contained in this Report.

Unless otherwise stated in this Report, the assessments made assume that the sites and facilities will continue to be used for their current purpose without significant changes.

Where field investigations are carried out, these have been restricted to a level of detail required to meet the stated objectives of the services. The results of any measurements taken may vary spatially or with time and further confirmatory measurements should be made after any significant delay in issuing this Report.

Copyright

Table of Contents

Abbreviations and acronyms

ACB	Action pour la Conservation de la Biodiversité en Côte d'Ivoire
CI	Conservation International
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
DSO	Direct shipping ore
ENNR	East Nimba Nature Reserve
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
IUCN	International Union for Conservation of Nature
km	kilometre(s)
LAMCO	Liberian American Swedish Mining Company
m	metre(s)
TMF	Tailings Management Facility
UN	United Nations
WCF	Wild Chimpanzee Foundation

1 Executive Summary

ArcelorMittal Liberia commissioned a set of additional zoological studies in 2010/2011 to fill gaps identified in the Phase 1 ESIA. Findings from those surveys are summarised here. The additional surveys covered the following taxa:

- Dragonflies and damselflies
- Bats: additional surveys including adit surveys
- Amphibians: specific surveys for Nimba Toad and other species
- Reptiles
- Large mammals: further camera trapping

In addition to these surveys, studies were conducted by Conservation International (CI), the Wild Chimpanzee Foundation (WCF), Action pour la Conservation de la Biodiversité en Côte d'Ivoire (ACB) and Sylvatrop on mammals, using a transect-based "biomonitoring" programme and a bushmeat study. These are reported separately in the CI's reports but, where relevant, their findings are briefly discussed here.

Further information on occurrence of threatened and endemic species was collected, including several new records for Liberia. The key additional findings of greatest relevance for the project environmental management and mitigation were:

1. The discovery of a site of particularly high importance for dragonflies, including species new to science, at the "ladder falls" at Tokadeh. This site, with an appropriate buffer zone of forest habitat, will need to be protected from damage or development.

2. The finding that at least 2000 bats of six species, including two globally threatened species, roost in old mine adits at Mts. Gangra, Yuelliton and Tokadeh, some of which are scheduled to be destroyed during Phase 1 mining. Where possible, those adits should be protected. Where this is not possible, construction of alternative roost sites, and translocation of bats, will be required to compensate for the loss of habitat.

3. Confirmation beyond reasonable doubt that Nimba Toad does not occur in the proposed mining areas at Mts. Tokadeh, Gangra and Yuelliton.

4. Observations of a rare rock-living gecko, which may be a new species endemic to the Nimba Range, in adits at Mt. Gangra: further evidence of the biological value of these artificial caves.

5. Observations (from Biomonitoring studies by CI, WCF and ACB) of two concentrations of chimpanzee activity in West Nimba, one overlapping the proposed layouts for Phase 1 at Mts. Gangra and Yuelliton.

New and revised recommendations arising from these and other findings are outlined.

2 Field surveys

2.1 Introduction

This report is an addendum to the Main Environmental and Social Impact Assessment (ESIA) for the Western Range DSO Iron Ore Project (Phase 1) proposed by ArcelorMittal Liberia. In order to fill gaps identified in the baseline surveys for the ESIA, additional zoological surveys were commissioned by ArcelorMittal Liberia in 2010/2011. This report summarises the principal findings of those field surveys (in Section 2), and the recommendations arising from them (in Section 3). The specialist reports themselves are provided as Annexes 1 – 5.

2.2 Dragonflies and Damselflies

Dragonflies and damselflies (Odonata) are the only insect order in West Africa for which a full regional Red List assessment has been carried out. They were surveyed at the end of the rainy season, from 27 September to 14 October 2010, in the peak of the dry season, from 27 December 2010 to 14 January 2011, and at the start of the rains, from 18 to 22 March 2011. The surveys were undertaken by Dr KD Dijkstra (Annex 1).

The most important findings from these surveys were as follows:

- A total of 145 species were found within the ArcelorMittal concession area, and at least 20 more are expected to occur. To put this in context, there are around 120 species in all of Europe (Dijkstra & Lewington 2006).
- At least 20 of the taxa in Liberian Nimba are of conservation interest, being regionally endemic, threatened, rare or insufficiently known (and therefore, potentially threatened).
- Twenty-six species were found in Liberia for the first time, indicating that knowledge of dragonfly faunas in this part of Liberia is still far from complete. These included two species new to science.
- Three sites of particular importance for dragonflies and damselflies were identified: Yehwah stream at Gangra-Yuelliton (Figure 1), the “ladder falls” at Mt. Tokadeh and a rocky stream at Mt. Tokadeh (Figure 2).

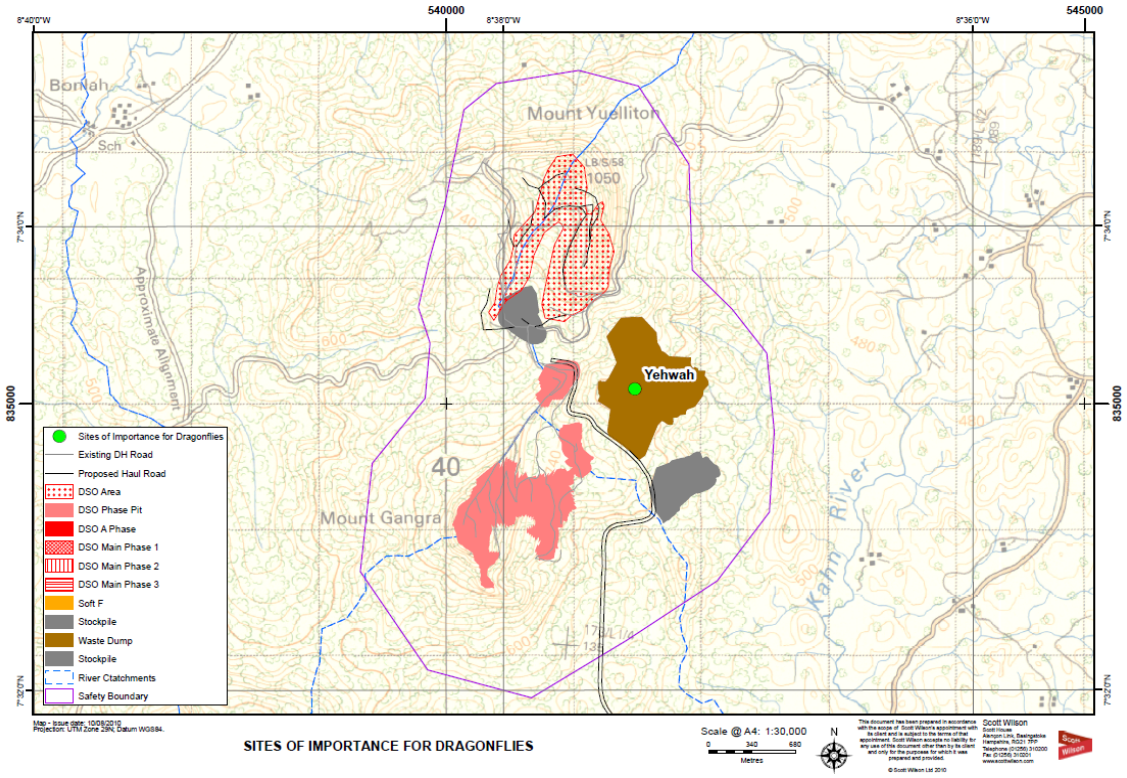

Figure 1. Site of most importance for dragonflies at Gangra/Yuelliton: Yehwah. This site had a high "jewelwing index" of 5.5, indicating a natural and structurally complex habitat, with high water quality and biotic integrity. The waste dump planned for this site should be relocated as per the constraints map.

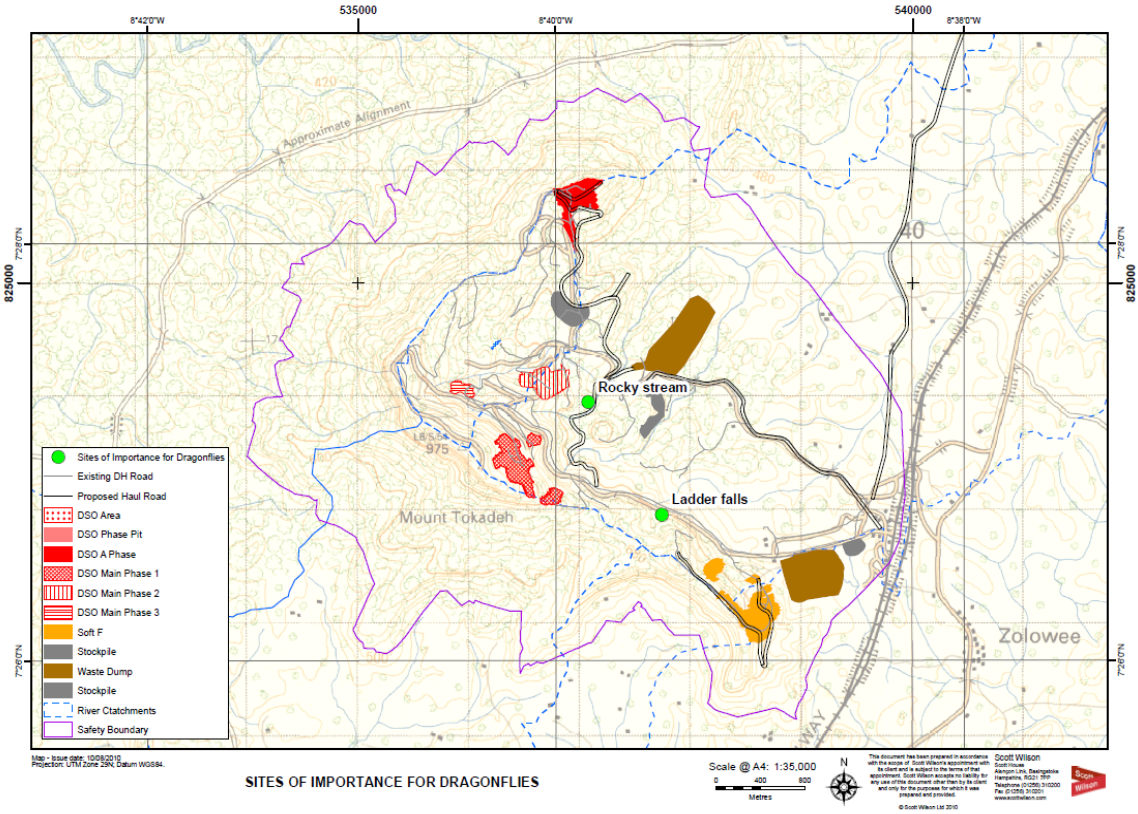

Figure 2. Sites of most importance for dragonflies at Tokadeh. The "ladder falls" supports undescribed species and other species of high conservation value. The "rocky stream" had an exceptional "jewelwing index" value (9.5) and is a prime example of a forested fast-flowing stream, hardly silted by run-off from the old mine. Management here should aim to control erosion upstream and conserve a strip of forest along the stream.

2.3 Small Mammals: Bats

A survey of bats was carried out between 13 December 2010 and 4 January 2011 (Annex 2). The surveys were undertaken by Prof Ara Monadjem. The prior baseline survey of bats by Kouame et al in 2009 did not record many of the species thought likely to be present, and included some misidentifications. Also, it did not assess the importance of adits (mining tunnels) as roost sites for bats.

The most notable findings of 2010/ 2011 survey were as follows:

- A total of 31 species of bats were recorded, bringing the total known species list for the ArcelorMittal concession area to 41 species.

- At least eight species of bats occurring in the ArcelorMittal concession area are listed by the IUCN as being of global conservation concern, including Aellen's Roundleaf Bat *Hipposideros marisae* (Vulnerable), Pohle's Fruit Bat *Scotonycteris ophiodon* (Near Threatened), Schreiber's Bent-winged Bat *Miniopterus schreibersii villiersi* (Near Threatened) and Upland Horseshoe Bat *Rhinolophus hillorum* (Near Threatened).

- Over 2000 individual bats of six species utilise the old mine adits at Mts. Gangra, Yuelliton and Tokadeh as day roosts, including the threatened Aellen's Roundleaf Bat and Upland Horseshoe Bat (Figure 3, Figure 4). Bats were found in all 11 adits surveyed.

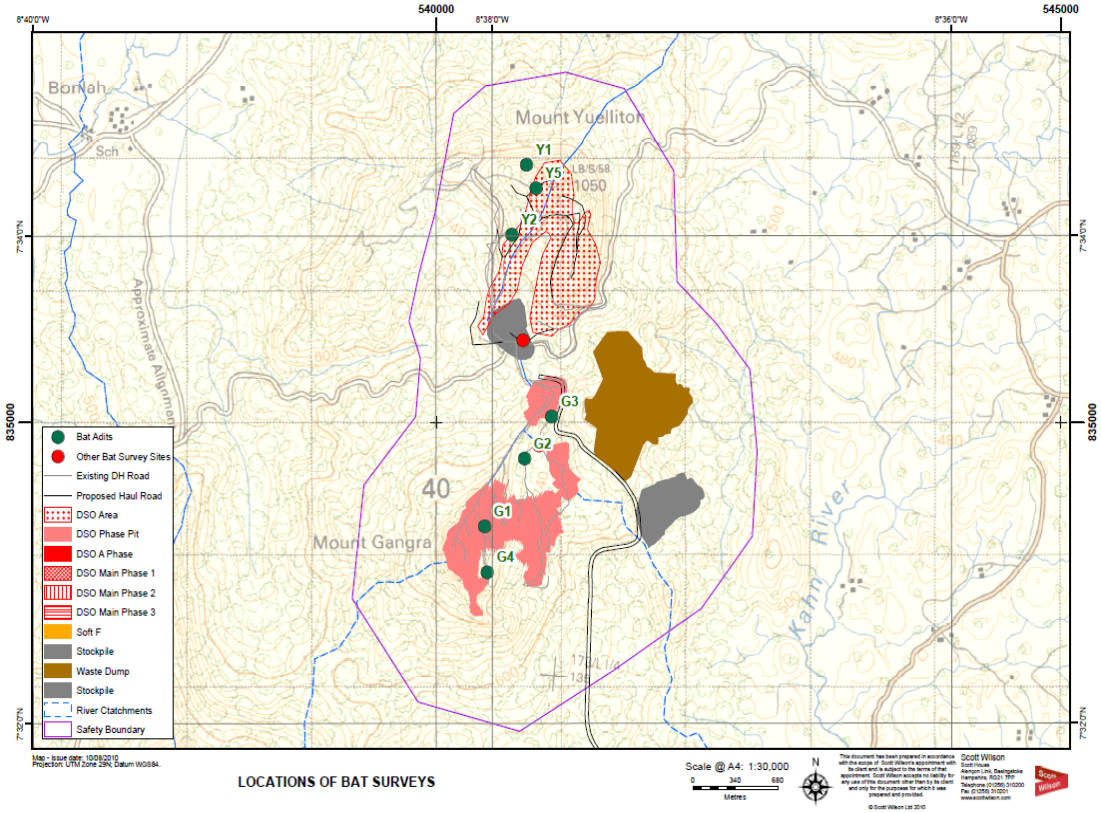

Figure 3. Adits with bats at Gangra/Yuelliton. The globally Vulnerable Aellen's Roundleaf Bat was found in adits G1 and G3. The Near Threatened Schreiber's Bent-winged Bat was found in adits G1 and Y1.

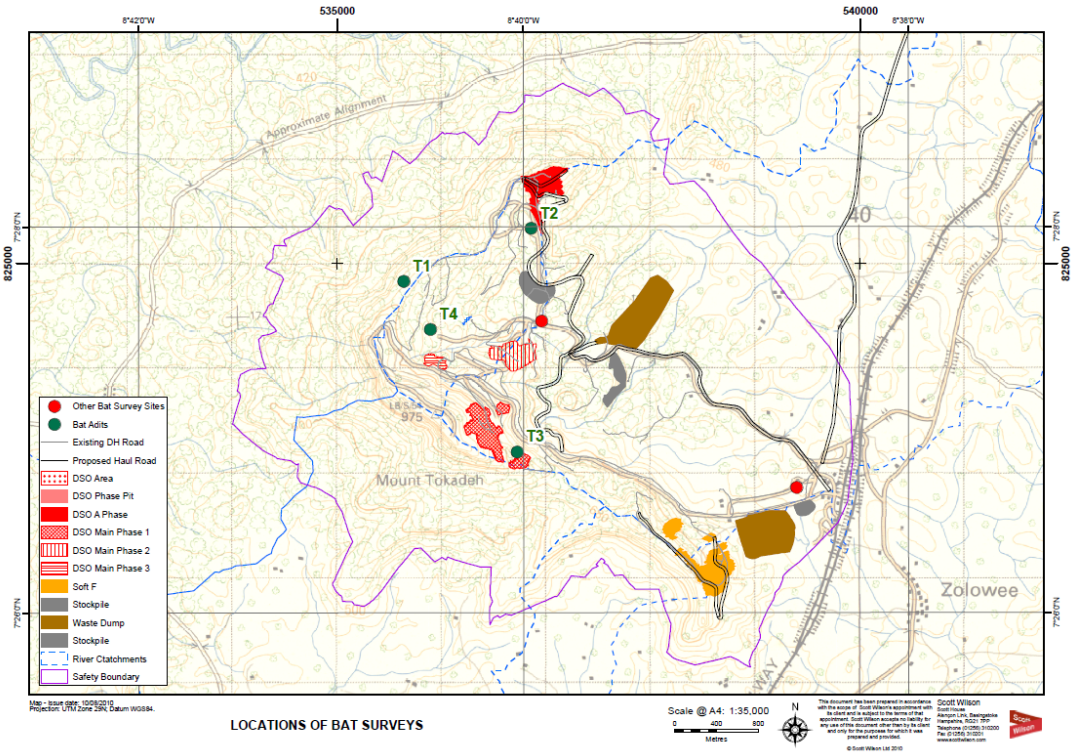

Figure 4. Adits with bats at Tokadeh. The globally Near Threatened Upland Horseshoe Bat was found in adit T1. A particularly large roost of ±500 bats was found in adit T2.

2.4 Amphibians: Nimba Toad

The Nimba Toad *Nimbaphrynoides occidentalis* is a Mt. Nimba endemic, and is assessed as globally Critically Endangered by IUCN (Sandberger *et al.* 2010). Previous surveys found it only above 1200 m, so it was considered unlikely to occur within the proposed Phase 1 mining footprint. However, the baseline surveys could not confirm its absence as they had not included thorough searches during the correct season, so additional targeted surveys were conducted (Annex 3).

No Nimba Toads were found at Mts. Gangra, Yuelliton or Tokadeh. Targeted searches were carried out from 10 to 15 October 2010 by experts familiar with the species. The surveys were led by L Sandberger and NS Loua. This period was towards the end of the best period to survey Nimba Toads (the rainy season), but surveys in known habitat within the ENNR confirmed that the species was still active and that the survey technique was appropriate. Based on these findings, it seems reasonable to conclude that the Nimba Toad does not occur within the proposed Phase 1 mining footprint.

The subspecies of Nimba Toad *N. o. liberiensis* is found only on Liberian Mt. Nimba, where a tiny population persists in high altitude grassland habitat extensively damaged by past LAMCO mining activities. Possible management interventions that might help ensure the persistence of this taxon include fire and vegetation management, adding material to increase the altitude of the ridge, provision of loose stones and rocky areas with many small holes, loosening compacted soil, and combating erosion/mass wasting (Annex 3). However, there is still an insufficient knowledge base from which to determine which of these activities would be

effective, and most of them could have as many negative as positive impacts on the toad population (Annex 3).

2.5 Amphibians: Other Species

Additional observations of amphibians were collected in 2010–2011 during surveys for Nimba Toad by the URS Scott Wilson team comprising L Sandberger and NS Loua, and other herpetological surveys led by J Penner (Annex 4) and W Branch (Annex 5). Herpetologists were requested to pay particular attention to globally-threatened species, including *Arthroleptis crusculum* and *Phrynobatrachus annulatus* (both Endangered). During these surveys in 2010 and 2011, seven more species were added to the species list for the ArcelorMittal concession area (including Liberian Mt. Nimba), bringing the total to 57 amphibian species listed in Table A.1 of Annex 5.

Other than these additional species, the most notable findings in 2010 were as follows:

- The presence of the squeaker *Arthroleptis crusculum* (Endangered and endemic to Mt. Nimba) at a small marsh in secondary forest east of Mt. Yuelliton (Annex 5) and possibly recorded acoustically but not confirmed at Tokadeh (Annex 3). It also occurs in the ENNR.

- The discovery of the rocket frog *Ptychadena stenocephala*, a West African species previously unrecorded from Liberia, in the ENNR (Annex 5).

These observations are consistent with previous assessments that concluded that forest and wetland habitats within the ArcelorMittal concession are of considerable importance for amphibians. These habitats (and high altitude grasslands) are particularly important within the ENNR, but species of global conservation concern are found also within the proposed mining footprint.

2.6 Reptiles

Reptiles were not assessed during the baseline surveys, except through a limited number of casual observations (Bangoura *et al.* 2009; Phalan 2010). To address this gap, two additional surveys were carried out focusing on reptiles, from 8 November – 5 December 2010 by J Penner (Annex 4) and from 23 January – 21 February 2011 by W Branch (Annex 5). These surveys added two new species to the Liberian list (*Cnemaspis occidentalis* and *Cophoscincopus greeri*). The total reptile species list for the Mt. Nimba area now stands at 84 (Annex 5).

Key findings from the additional surveys were as follows:

- Observations of the rock-living gecko *Cnemaspis occidentalis* in two adits (G3 and presumably G2, see Figure 3) on Mt. Gangra. This species has otherwise only been recorded twice since its description and was known from only eight specimens (Annex 5). Given taxonomic uncertainty, W Branch recommends treating it as a likely Mt. Nimba endemic.

- Further confirmation from local reports (though no direct observations) that African Dwarf Crocodile *Osteolaemus tetraspis* (Vulnerable) occurs at Tokadeh (Annex 4). Waterbodies in the vicinity of Mt. Tokadeh, including within the proposed Phase 1 footprint, appear to constitute important habitat for this globally-threatened species.

- Slender-snouted Crocodile *Mecistops cataphractus* (data deficient) does not appear to occur within the proposed Phase 1 footprint and, within the ArcelorMittal concession area, is only likely to occur in West Nimba (Annex 4).

- Several species sensitive to over-exploitation in the skin and pet trade, and listed on CITES Appendix II (CITES 2011) occur in the ArcelorMittal concession area, including the crocodiles, African Rock Python *Python sebae*, Ornate Monitor *Varanus ornatus*, Graceful Chameleon *Chamaeleo gracilis*, and Forest Hingeback Tortoise *Kinixys erosa* (Annex 5). All of these species could be subject to increased levels of exploitation as a result of increases in road access, economic activity and human population in the ArcelorMittal concession area.

2.7 Mammals: Camera Trapping

The Zoological Assessment of the Phase 1 ESIA reported some initial findings of camera trapping. Complete details from subsequent camera trapping in West Nimba and other locations will be presented in the Phase 2 ESIA report. Presented here is preliminary information on 377 trap-nights at Gangra/Yuelliton, 539 trap-nights at Tokadeh and 170 trap-nights in the East Nimba Nature Reserve. Cameras were deployed for a further 611 trap-nights at Tokadeh and 406 trap-nights in the ENNR, but unfortunately no images were obtained from those deployments because of camera failures. The cameras used (mostly Moultrie units) are now several years old and those which are still operational may be near the end of their useful life.

Table 1. Encounter rates (number of observations per 100 trap-nights) of mammals recorded using camera traps during 377 trap-nights at Gangra/Yuelliton, 539 trap-nights at Tokadeh, and 170 trap-nights in the East Nimba Nature Reserve (ENNR), between 27 April and 15 September 2010. Global Red List status for each species (subspecies) is given in red (NT = Near Threatened, VU = Vulnerable). An observation is an independent photo (> 30 mins from other photos) of an individual or group. A '-' indicates no observations of that species at that site.

Species	Gangra	Tokadeh	ENNR	Overall
Sooty Mangabey *Cercocebus atys* VU (NT)	-	0.6	-	0.3
Thomas's Galago *Galago thomasi*	0.3	-	-	0.1
Fire-footed Rope Squirrel *Funisciurus pyrropus*	-	0.6	-	0.3
Brush-tailed Porcupine *Atherurus africanus*	1.3	0.9	-	0.9
Giant Pouched Rat *Cricetomys* sp.	0.5	1.1	-	0.7
Honey Badger *Mellivora capensis*	-	0.2	-	0.1
Common Cusimanse *Crossarchus obscurus*	0.8	-	-	0.3
Genet *Genetta* sp. NT	0.3	-	0.6	0.2
African Palm Civet *Nandinia binotata*	-	0.2	-	0.1
African White-bellied Pangolin *Phataginus tricuspis* NT	0.3	-	-	0.1
Bay Duiker *Cephalophus dorsalis*	0.8	0.2	-	0.4
Brooke's Duiker *Cephalophus ogilbyi brookei*? (VU)	-	-	0.6	0.1
Maxwell's Duiker *Philantomba maxwellii*	0.3	0.6	-	0.4
Unidentified mammal*	1.3	0.6	1.2	0.9
Total mammals	5.8	4.8	2.4	3.9

** Unidentified mammals were small rodents (4), a bat (1), and unknown/blurry (3).*

(a) Brush-tailed Porcupine, Tokadeh

(b) Honey Badger, Tokadeh

(c) Genet, possibly Bourlon's Genet, ENNR

(d) Bay Duiker, Gangra

(e) Duiker, possibly Brooke's Duiker, ENNR

(f) Maxwell's Duiker, Tokadeh

Figure 5. Some mammals photographed using camera traps in 2010.

The most noteworthy findings from camera trapping were:

- Multiple observations (three) of groups of Sooty Mangabey *Cercocebus atys* (globally Vulnerable) in forest at Tokadeh, including in the proposed location of the Tokadeh area A waste dump.

- Occurrence of one or two globally Near Threatened mammals on Mt. Yuelliton (African White-bellied Pangolin *Phataginus tricuspis*, possibly Bourlon's Genet *Genetta bourloni*), within the proposed DSO area.

- Possible records of Bourlon's Genet and Brooke's Duiker *Cephalophus ogilbyi brookei* (a Vulnerable subspecies of Ogilby's Duiker) in the ENNR.

The camera traps thus recorded up to two of the eight large mammal species which were suspected but not confirmed during baseline surveys (Brooke's Duiker and Bourlon's Genet, Figure 5). However, because the relevant photos did not capture important identification features, particularly the heads of the animals, positive identification was not possible. Further camera trapping effort, using cameras with faster response times, should help to clarify the status of these and other large mammals within the ArcelorMittal concession area.

2.8 Mammals: Biomonitoring and Bushmeat Reports

ArcelorMittal commissioned a team organised by CI, WCF and ACB to conduct transect surveys for mammals in the Gangra/Yuelliton, Tokadeh and West Nimba areas from May 2010. Two phases of surveys were carried out, in 2010 and in 2011 (CI/WCF/ACB 2011). This work adds greatly to understanding of mammal distribution within the ArcelorMittal concession area. The most important findings in relation to management and mitigation of Phase 1 DSO mining were:

- The presence of two consistent areas where the globally Endangered West African Chimpanzee *Pan troglodytes verus* was present in the Gba Community Forest, one extending into proposed mining footprint at Mts. Gangra/Yuelliton, and the other mainly northwest of the proposed mining areas at Mt. Tokadeh (see Figure 11 in the CI Draft Report on Biomonitoring. The chimpanzee population in West Nimba was estimated at 10-67 individuals (best estimate 26).

- The highest density of observations of other primates in West Nimba was in the vicinity of Mts. Gangra and Yuelliton, indicating the high importance of this area for monkey species.

- Further information on local distributions of the globally Endangered Nimba Otter Shrew *Micropotamogale lamottei* from trapping and interviews will presumably be provided in final version of the Biomonitoring report. According to farmers, the species occurs in swamp habitat towards the South East of the Tokadeh site. The species was previously trapped in a wetland at Mt. Tokadeh during baseline surveys led by Dr B Phalan as part of Phase 1 ESIA zoological team. These new reports underline the importance of minimising damage to wetland habitats such as swamps within the ArcelorMittal concession area, particularly through sensitive sitting of waste dumps and stockpiles and through the control of runoff from mine surfaces and drainage.

Bushmeat surveys by CI and Sylvatrop confirmed that hunting pressure is considerable, and that there is some take of globally threatened primate species and other species protected by Liberian law, as well as hunting within the ENNR (Bene & Dufour 2011). In the absence of well-planned and culturally appropriate measures to reduce hunting and consumption of bushmeat, development of mining is likely to exacerbate hunting pressure by increasing local populations and by making forest areas more accessible.

3 Recommendations for mitigation

3.1 Summary of Recommendations

Most of the recommendations arising from the additional surveys duplicate and confirm those made in the original Phase 1 ESIA, and those are not repeated here. However, in the light of the new information collected, it is possible to include some more detail regarding specific features of importance within the ArcelorMittal concession. The most important new recommendations are as follows:

- Where possible, adits important for bats should be retained, and grilles fitted to prevent human disturbance. At least during Phase 1 mining, retention should be feasible for at least half of the adits. For adits where retention is not possible, suitable replacement "adits" should be constructed to compensate for their loss, with translocations to be carried out in the period August–October.

- Protection of the "ladder falls" site at Tokadeh, plus surrounding forest within a large buffer (of the order of 500 m, to protect the water supply to the site). This site is of exceptional importance for dragonflies, and has up to three species new to science as well as other species of conservation importance. Although it is an artificial feature, any development of the reservoir must be undertaken with great care to minimise loss of its ecological value

- Revision of mine layouts to take account of the revised constraints map (in Section 3.2).

Other recommendations, which added some detail or emphasis to those made in the original Zoological Assessment of the ESIA/ ESMP for Phase I, but which were essentially consistent with the recommendations of that document. They are as follows:

- A management plan for biodiversity within the entire ArcelorMittal concession should be developed, to define specific actions to avoid, reduce and mitigate negative impacts, and the management and monitoring structures should be such to ensure that these actions are delivered and that their delivery is documented.

- Every provision should be made to avoid further destruction of forest habitat, and to minimise the size of the mining footprint. Particular attention should be paid to preserving forest on upper slopes, and in broad buffer zones along watercourses and wetlands.

- Every provision should be made to protect wetlands and watercourses from mine runoff, erosion, landslides and other forms of sediment and chemical pollution. The additional surveys of amphibians, reptiles and dragonflies have underlined the global importance of wetland habitats such as streams within the ArcelorMittal concession. Sediment inputs into watercourses to be controlled through measures such as re-use of water, settling ponds and construction of sediment traps during road construction and mine operation. Water quality to be assessed with frequent monitoring.

- The siting of mine components and infrastructure should be undertaken in collaboration and communication with environmental specialists to minimise potential environmental impacts. Dumping of waste in the Yehwah valley east of Gangra, and in the forested rocky stream at Tokadeh (Figure 2) should be avoided.

- Support should be provided for the sensitive management of the newly established Gba Community Forest in West Nimba. The management plan for the Community Forest will need to address threats such as logging and hunting as well as farming, through full

involvement of stakeholders, implementation of environmental education, and arrangements for alternative sources of income. Protection of habitats in West Nimba may serve as an offset for unavoidable residual impacts of mining.

- In addition to other support to the ENNR, resources should be provided for a field ranger to locate, monitor and control access to bat roost sites.
- Recommendation to continue the established biomonitoring programme, involving local staff of the ENNR and people in communities surrounding the Gba Community Forest in West Nimba.
- In the short-term, monitoring of fauna during the construction and operational phases of the mine will be required.
- The increasing isolation of ENNR and West Nimba should be addressed in medium to long term plans for the ArcelorMittal concession, by improving ecological connectivity between these areas.
- Ensure that swamp habitats where local reports indicate the occurrence of the Endangered and endemic Nimba Otter Shrew are protected from damage.
- Assessment of the impacts of burning on vegetation succession within the ENNR is needed, to inform the development of management options.
- ArcelorMittal should use its influence to encourage the local UN deployment to show leadership by respecting the boundary of the ENNR, and not using it for wood extraction and target practice.
- An environmental education programme should be developed for ArcelorMittal staff and local communities. This should focus initially on bushmeat. Culturally appropriate company policies should be developed, such as a prohibition on the purchase or sale of any legally protected species within the ArcelorMittal concession area or by ArcelorMittal staff. All staff (not just management staff) should be educated as to the legal status of fauna protected under Liberian law.

In addition to the above, recommendations for environmental management made in the Phase 1 ESIA should be fully implemented.

3.2 Ecological Constraints Map

The Ecological Constraints Map has been refined using data collected during additional surveys.

How to use this map

This map shows areas of priority for biodiversity around Mts. Gangra/Yuelliton and Mt. Tokadeh. Layouts should be designed so as to avoid overlaps with priority 1 constraints (black) as far as is feasible, and to minimise their area of overlap with priority 2 (dark grey) and priority 3 (light grey) constraints. Where point constraints cannot be avoided (e.g., adit G1 on Mt. Gangra), provision of alternative sites will need to occur before they are destroyed.

Main implications of constraints map for mine development, relative to Feasibility Study layouts

Provision of alternative roost sites for bats will need to occur before adits are destroyed.

Plans for most waste dumps and stockpiles will need some modification, as previously advised:

- At Gangra/Yuelliton, the least damaging location for the large waste dump may be to the northeast of the site (east side of Mt. Yuelliton) or immediately to the south of Mt. Gangra
- At Gangra, the stockpile should be shifted a short distance southwest to minimise forest loss
- At Tokadeh, the waste dump and stockpile east of DSO area F (south of the plant) should be relocated to the north of area F (north of the road, northwest of the plant)
- At Tokadeh, the waste dump east of DSO area A should be relocated a short distance southwards or eastwards to avoid contiguous forest
- At Tokadeh, the stockpile south of area A should be relocated to avoid disruption to the wetland, which is a habitat for the globally Endangered Nimba Otter Shrew and also important in controlling storm flows
- Other parts of the layout should be modified as appropriate to minimise impacts on the mapped constraints.

All crossings of rivers and streams will need renewed care in planning and design to avoid erosion and sediment inputs into watercourses, already noted as a problem during Phase 1 startup.

Description

Constraints maps were developed for the ESIA to guide the siting of mine components and infrastructure, such as waste dumps and haul roads. These constraints were based on the principle that “good” forest and *Raphia* swamps should be protected, and that vegetation buffers of at least 30 m should be left uncleared along all watercourses, including swamps and small streams. These constraints remain relatively unchanged as they already incorporate most of the forest and wetland habitats identified as important in the additional surveys.

Development of site plans should take account of these constraints maps, and should incorporate direct liaison with ecological specialists to ensure that mine layout plans are designed to minimise negative ecological impact. Where constraints cannot be avoided, effort should be made to minimise the area affected. Avoidance of the mapped constraints will not ensure no impact on biodiversity, but it will help to minimise the harm to species and habitats of highest conservation concern which remain in the area of the mine sites. Residual impacts will be compensated for to the degree possible by a programme of biodiversity offsets under development by the Company.

In response to a request from the Company for a more detailed map of constraints according to their level of priority, and making use of information from additional surveys in 2010 and 2011, constraints have been disaggregated and mapped according to priority (Figures 1-3). The constraints have been developed only for the area within a 2 km buffer of the proposed Phase 1 footprint, which includes all land within the safety boundaries and the haul road corridor. Priority is assigned as follows:

Priority 1. Internationally important

A very high priority is to preserve the large contiguous areas of moist tropical forest which occur close to both Tokadeh and Gangra/Yuelliton. To exclude small fragments, all forest areas, as mapped in the Phase 1 ESIA, were buffered internally by 250 m, to identify core areas less affected by edge effects. These core areas were rebuffered by 250 m to produce a map of the largest blocks of remaining forest in the project area. This approach results in a minimum constraint as it does not include long thin extensions of forest from the edges of larger blocks, but only compact parts of larger forest blocks. Recognising that some very small overlaps with DSO areas are inevitable at the edges of these areas, such overlaps with DSO areas were excluded from the constraint.

An area of priority 1 forest is mapped in the planned location of the TMF (Phase 2). Using a precautionary approach, based on observations of globally threatened species in all suitable habitats surveyed so far, all large areas of good forest (as identified from orthophotos by W. Hawthorne for the Phase 1 ESIA and minimised as described in the previous paragraph) are included as priority 1. Further survey will provide information on whether the forest patch in the TMF area merits lower priority.

Also of very high priority are the three adits supporting roosts of globally threatened bat species (adits G1, G3 and T1). If these adits cannot be retained intact, then compensatory roost sites should be constructed and bats successfully translocated before the adits are destroyed.

The “ladder falls” at Tokadeh was the site with the greatest number of dragonfly species of conservation concern (8) in the concession area. Because the hydrological integrity of this site will be affected by loss of forest within its small catchment area, a forest buffer of 500 m above the site has been included in this constraint. Any dredging should leave at least half of the swampy perimeter intact and allow regrowth; replacement of the reservoir by a concrete tank or basin would be detrimental to the present fauna.

Damage to habitats occupied by the globally Endangered and endemic Nimba Otter Shrew should be avoided. These include wetlands at Tokadeh, plus buffer zones around them: a minimum buffer distance of 30 m is mapped, but buffers should be wider where possible.

Priority 2. Nationally or regionally important

A high priority, both for on-site biodiversity and to protect downstream water supplies, is to retain buffer zones of vegetation along all watercourses, including streams and swamps. A minimum buffer distance of 30 m should be adopted (with 50 m or larger buffers where possible:

see priority 3), to protect water quality. It is recognised that some loss of streams and their buffers within mined areas is likely, but these losses should be kept to a minimum, and mitigation measures to capture and control runoff should be strengthened. Where haul roads cross streams, bridges or culverts should be sufficiently large so as not to become blocked and cause ponding. The Gangra-Tokadeh haul road should be planned to minimise incursion on vegetation buffers. Mitigation measures such as diversion berms, check dams, rip rap, silt fences and sediment traps should be put in place where appropriate to minimise any sediment runoff into streams at crossing places.

In order to contain mining impacts to as few catchments as possible, the sub-catchment towards the SE of Tokadeh, which supports Nimba Otter Shrew, should be avoided. The planned waste dump and stockpile in that sub-catchment should be relocated. Tokadeh DSO Area F overlaps with this sub-catchment, and the resource pit should be designed so that runoff is directed northwards into a catchment already affected by mining.

All adits supporting roosts of bats are of high importance. Where these adits cannot be retained intact, compensatory roost sites should be constructed and bats successfully translocated before the adits are destroyed.

The biological value of priority 1 forest areas will diminish over time if they become too isolated from other areas of forest, so connecting habitats should be maintained between them. Connecting forests have been mapped as priority 2, by identifying forest cover which directly connects adjacent areas of priority 1 forest.

Priority 3. Locally important

Smaller fragments of good quality forest support some globally threatened and endemic species, and should be protected where possible. It is recognised that loss of some such areas will be unavoidable, but the area affected should be kept as small as possible. Where feasible, minimum buffers of 50 m should be protected along streams and swamps: these are mapped in addition to the 30 m buffers. Two sites important for dragonflies (Yehwah stream and an unnamed stream at Tokadeh, both with very high ‘jewelwing index’ values) are mapped as priority 3.

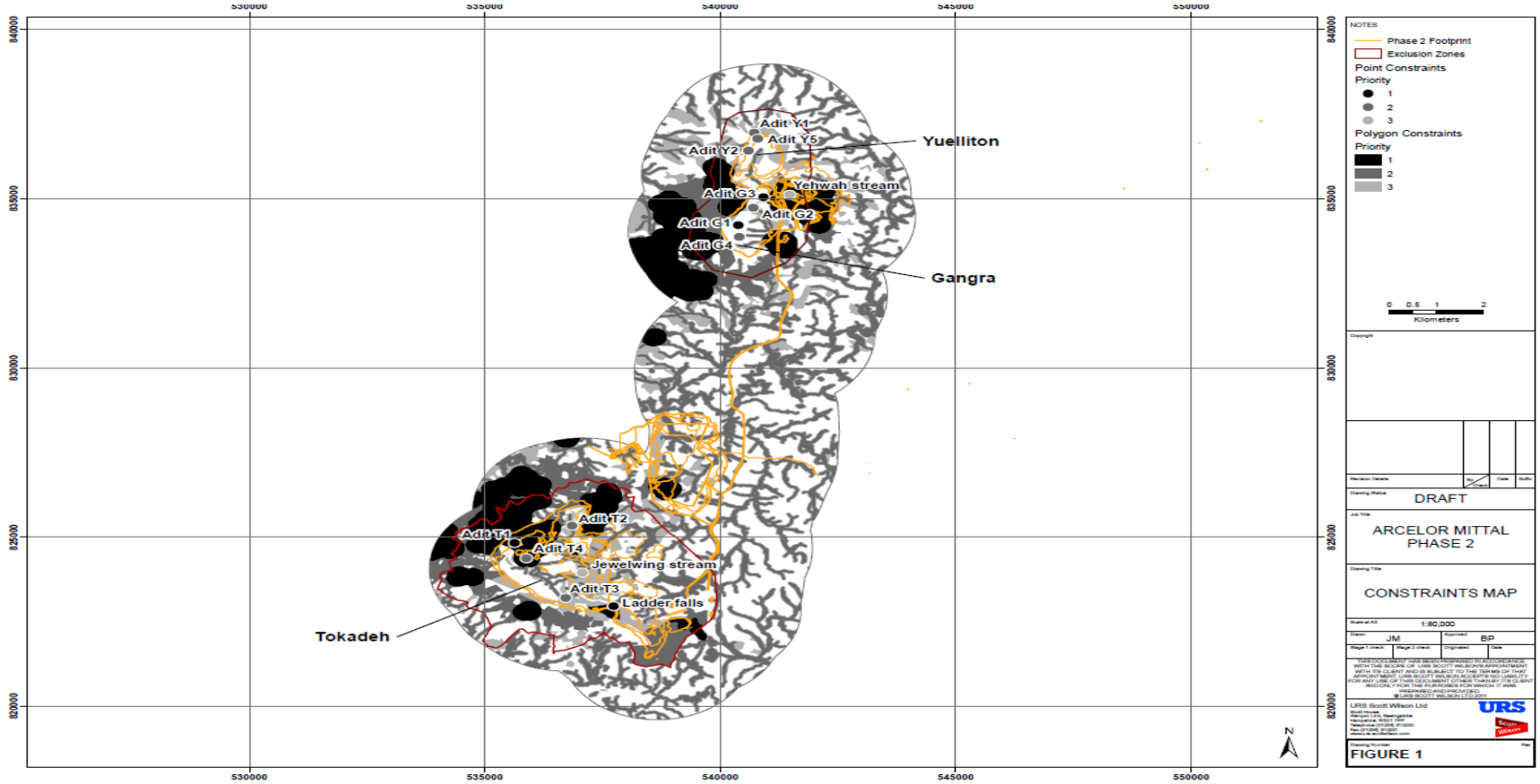

Figure 6. Updated constraints map, with shaded areas and points denoting constraints. Constraints are mapped only within a 2 km buffer around Phase 1 footprint and haul road. Priority 1: black; priority 2: dark grey; priority 3: light grey.

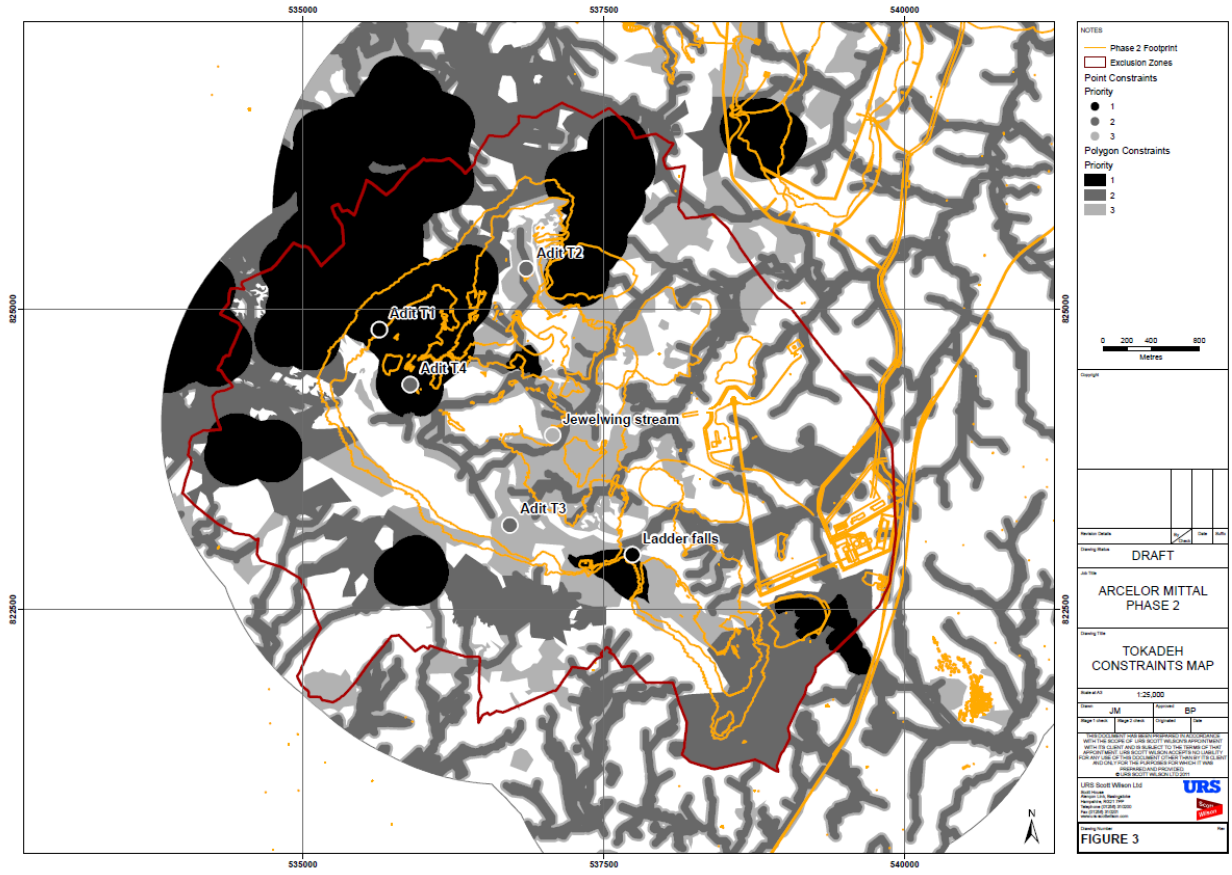

Figure 7. Updated constraints map for Gangra/Yuelliton, with shaded areas and points denoting constraints. Priority 1: black; priority 2: dark grey; priority 3: light grey.

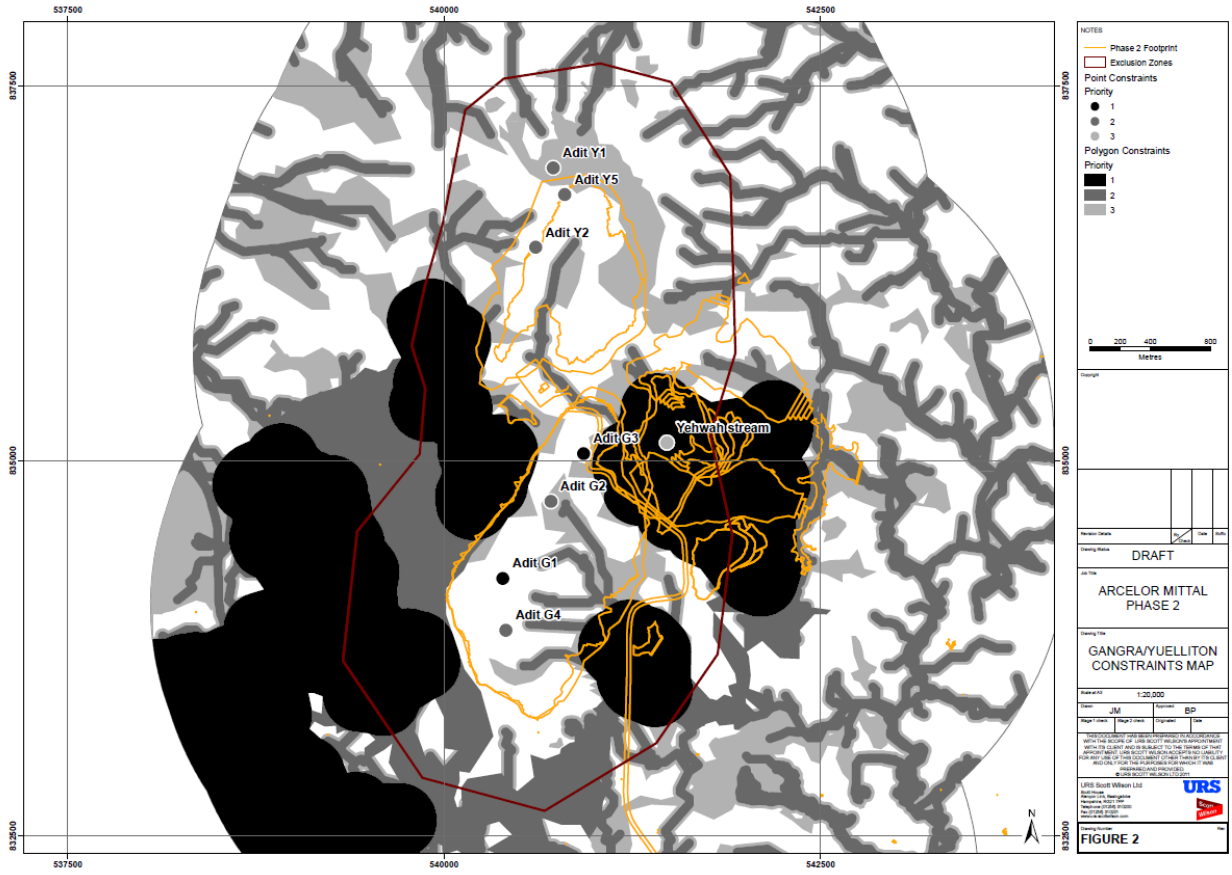

Figure 8. Updated constraints map for Tokadeh, with shaded areas and points denoting constraints. Priority 1: black; priority 2: dark grey; priority 3: light grey.

4 References

Bangoura, M.A., Doumbia, J., Johnson, A.T. & Camara, K. (2009) Preliminary Survey of the Herpetofauna of the Tokadeh and Gangra Areas and the East Nimba Nature Reserve, Nimba Mountains, Liberia. *Western Area Deposits, Environmental Studies. Nimba County (Liberia) Biodiversity Preliminary Assessment – BIOPA June 2008 and January 2009. Final Report* (eds F. Lauginie & G. Rondeau), pp. 126-141. W. S. Atkins/ArcelorMittal.

Bene, J.-C.K. & Dufour, S. (2011) *Bushmeat Survey in the Northern Nimba County Liberia. Draft Report to ArcelorMittal*. Conservation International / Sylvatrop.

CI/WCF/ACB. (2011) *Biomonitoring Program and Additional Faunal Studies in Arcelor Mittal Liberia (AML) Concessions: Consolidated Report from the First and Second Phases. Draft Report to ArcelorMittal*. Conservation International / Wild Chimpanzee Foundation / Action pour la Conservation de la Biodiversité en Côte d'Ivoire.

CITES. (2011) Appendices I, II and III, http://www.cites.org/eng/app/appendices.shtml

Dijkstra, K.-D.B & Lewington, R. (2006) *Field Guide to the Dragonflies of Britain and Europe*. British Wildlife Publishing.

Kouamé, B.A., Gbeintor, E., Mory, D. & Kabi, M. (2009) Preliminary Survey of the Small Mammals Communities of the Tokadeh and Gangra Areas and the East Nimba Nature Reserve, Nimba Mountains, Liberia. *Western Area Deposits, Environmental Studies - BIOPA Studies. Nimba County (Liberia) Biodiversity Preliminary Assessment – BIOPA, June 2008 and January 2009. Final Report (Wet and Dry seasons surveys)* pp. 20-30.

Scott Wilson (2010) *Western Range DSO Iron Ore Project. Volume 4, Part 1: Zoological Assessment*. Scott Wilson for ArcelorMittal. B Phalan

Sandberger, L., Hillers, A., Doumbia, J., Loua, N.-S., Brede, C. & Rödel, M.-O. (2010) Rediscovery of the Liberian Nimba Toad, *Nimbaphrynoides liberiensis* (Xavier, 1978) (Amphibia: Anura: Bufonidae), and Reassessment of Its Taxonomic Status. *Zootaxa*, **2355**, 56-68.