



Prioritisation of biodiversity for management actions

E. Tatum-Hume, A. Serckx, S. Livingstone, J. Pilgrim

Key findings inside:

- *Three habitats, four species and one protected area are highest priority for targeted mitigation measures*
- *Although impacts may occur to other habitats and species, the consequence of an impact is lower and can be mitigated through general mitigation measures*

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Table of contents

1	Executive summary	4
2	Introduction.....	6
3	Approach.....	7
4	Results	8
5	References.....	45
Appendix 1	Biodiversity identified by the Critical Habitat Assessment (CHA)	47

1 Executive summary

The Critical Habitat Assessment (CHA) (TBC 2017) undertaken for the Joule Africa Bumbuna Phase II Project (the Project) in Sierra Leone identified the Project's priority biodiversity (see [Appendix 1](#)). This includes both species/subspecies and habitats. To align with IFC PS6, the Project will be required to achieve a Net Gain for biodiversity that qualifies the Project area for Critical Habitat, and No Net Loss for Natural Habitat.

1. Although a number of biodiversity features qualify for Critical Habitat in the Project area of influence, there is variability in the likelihood that they will be impacted by the Project and the consequence of any impact for their conservation status. Therefore, not all features are equal priorities for Project management actions. The prioritisation process described in this report applies a risk-based approach to identify an appropriate level of management effort and actions for each biodiversity feature (

[ifTable 1](#)).

Four species/subspecies and three habitats are classed as highest priority for habitat mitigation and/or species-specific actions (Action Category 1). These are: the freshwater plant *Ledermanniella yiben*; Western Chimpanzee (*Pan troglodytes verus*); the freshwater fish *Enteromius* sp. aff. *trispilos* and *Chiloglanis* sp. OTU3, freshwater habitat; gallery forest habitat; and hillslope forest habitat. One species of frog (*Ptychadena* cf. *submascareniensis* 2) is also provisionally placed in Action Category 1, pending the results of genetic analysis. This species will be re-assessed once genetic analysis is completed. For all seven of the confirmed highest priority features, specific avoidance and minimisation measures will be required and a robust monitoring program to ensure Net Gain is achieved.

The results of the prioritisation exercise are used as a basis to appropriately target mitigation actions and ensure the Project can achieve required Net Gain/No Net Loss outcomes. The Project's mitigation actions are defined in the Biodiversity Action Plan (BAP) (Seli Hydropower 2019a).

ifTable 1: Results of the prioritisation process for priority biodiversity

Action Category (AC)	Group	Biodiversity feature	Mitigation and monitoring approach
AC 1 High priority for habitat mitigation and/or species-specific measures	Mammals	Western Chimpanzee (<i>Pan troglodytes verus</i>)	Highest priority for both species-specific and habitat-focused mitigation and offset actions in order to achieve net gain
	Freshwater plants	<i>Ledermaniella yiben</i>	
	Amphibians	<i>Ptychadena cf. submascareniensis 2*</i>	
	Freshwater fish	<i>Enteromius sp. aff. trispilos</i> , <i>Chiloglanis sp.</i> OTU3	
	Natural Habitats	Galley forest, hillslope forest and freshwater habitat	
	Protected Areas & Internationally-Recognized Areas	Bumbuna Conservation Area	
AC 2 Contingency planning	Mammals	Ziama Horseshoe Bat (<i>Rhinolophus ziama</i>)	No significant impacts likely but would be significant if they occur. Implement good-practice mitigation at a broad level. Elevate to Category 1 and develop species-specific measures if impacts are detected.
	Reptiles	Slender-snouted Crocodile (<i>Mecistops cataphractus</i>)	
AC 3 General habitat mitigation measures	Mammals	Western Black-and-White Colobus (<i>Colobus polykomos</i>) and Pygmy Hippopotamus (<i>Choeropsis liberiensis</i>)	Non-significant impacts anticipated. Implement good-practice, tailored habitat mitigation. Use habitat or, if necessary, species-specific monitoring to check scale of impact. Elevate to Category 1 if monitoring suggests significant impacts likely.
	Birds	White-backed Vulture (<i>Gyps africanus</i>) and Hooded Vulture (<i>Necrosyrtes monachus</i>)	
	Amphibians	Freetown Long-fingered Frog (<i>Arthroleptis aureoli</i>), <i>Ptychadena submascareniensis</i> and Cameroon Grassland Frog (<i>Ptychadena retropunctata</i>)	
	Freshwater fish	<i>Marcusenius meronai</i> , <i>Scriptaphyosemion cf. chaytori</i> , <i>Epiplatys sp. aff. njalaensis</i> , <i>Epiplatys sp.</i> , <i>Archiaphyosemion cf. guineense</i> , <i>Scriptaphyosemion wieseae</i> , <i>Amphilius cf. platyichir</i> OTU2, <i>Amphilius sp. aff. rheophilus</i> , <i>Chiloglanis sp.</i> OTU2, <i>Rhexipanchax kabae</i> and <i>Raiamas scarciensis</i>	
	Plants	<i>Ledermanniella aloides</i> and <i>Vepris felicis</i>	
	Natural Habitats	Natural savannah / woodland, inselberg, and river channel community	
	Protected Areas & Internationally-Recognized Areas	Lake Sonfon and environs Important Bird Area and proposed National Park	
AC 4 Remain aware	Mammals	Diana Monkey (<i>Cercopithecus diana</i>) and Western Red Colobus (<i>Piliocolobus badius</i>)	No significant impacts likely. Implement good-practice mitigation at a broad level. Use habitat monitoring as a proxy to check scale of impact.
	Freshwater fish	<i>Enteromius liberiensis</i> , <i>Epiplatys lokoensis</i> and <i>Synodontis tourei</i>	
	Dragonflies	Yellow-fronted Threadtail (<i>Elatoneura dorsalis</i>)	
	Natural Habitats	Swamp & seasonally inundated grasslands	
	Protected areas	Farangbaia Forest Reserve	

* pending the results of genetic analysis

2 Introduction

The Project's Critical Habitat Assessment (CHA) identified the biodiversity features (habitats and species) that qualify for Critical Habitat following the International Finance Corporation Performance Standard 6 (IFC PS6) (TBC 2017). A summary list of these and the results of the CHA is presented in [Appendix 1](#).

The biodiversity identified in the CHA varies in ecology (e.g., habitat specialists versus generalists, restricted versus wide-ranging species), threat level and level of scientific understanding. The appropriate project response for mitigating impacts is therefore also variable. PS6 requires a Net Gain for species that qualify the Project area for Critical Habitat. The presence of Critical Habitat qualifying species does not, however, necessarily mean that the Project will impact them. Several scenarios are possible - from impacts that are negligible, readily avoided or temporary; to those that are significant, long-term and challenging to mitigate.

To help the Project identify appropriate mitigation responses and allocate effort accordingly, a risk-based approach was used to prioritise biodiversity features identified in the CHA (TBC 2017). The process:

1. Considered the *likelihood* and *consequence* of potential Project impacts on each feature;
2. Evaluated the potential risk given the screening of impacts; and
3. Assigned each feature to an appropriate mitigation 'Action Category'.

The prioritization process is not a full impact assessment but a qualitative risk screening process to facilitate appropriate management responses to potential biodiversity risks. It is an iterative process that should be repeated if significant new information is uncovered about a feature, e.g. if a species' global conservation status is up- or down-graded or if further locations are found that broaden the species' distribution ([Figure 1](#)). The results of the prioritisation exercise are used to develop mitigation actions in the Biodiversity Action Plan (Seli Hydropower 2019a), to identify accounting lines for biodiversity losses in the residual impact assessment (Seli Hydropower 2019b) and to appropriately focus offset site selection and offset actions (Seli Hydropower 2019c).



Figure 1: The prioritisation process

3 Approach

Prioritisation is a risk screening exercise that evaluates each priority biodiversity feature for (i) impact likelihood and (ii) consequence of impact (see [Table 2](#) and [Table 3](#) for descriptors). Consequences of impact are judged prior to mitigation. The results determine which Action Category each priority biodiversity feature is placed into for mitigation, management and monitoring actions ([Figure 2](#)).

Habitats were prioritised based on their importance for supporting priority biodiversity and, like species, were assigned an Action Category for biodiversity management and monitoring purposes.

Taxonomic experts were engaged to provide feedback to the prioritisation process. The experts involved include: Dr Jörg Freyhof, Rainer Sonnenberg and Gina Walsh (fish); Dr Annika Hillers (amphibians and Pygmy Hippopotamus); and Dr Genevieve Campbell (primates).

To date the prioritisation process has been applied twice to the Project's priority biodiversity:

1. Following the Project's CHA to identify which priority biodiversity required further field work (during 2017 and 2018) to improve understanding of impact risks and consequences;
2. Following the field work (undertaken in 2017 and 2018) to determine management actions to support the Project's Biodiversity Action Plan (BAP).

This report compiles the results of both processes into one report.

Table 2: Likelihood descriptors

Almost Certain	Likely	Unlikely/Rare
Degradation/loss of some/all of biodiversity feature will occur as it is known to be present/use habitat under the infrastructure footprint and/or will be affected by indirect impacts	Degradation/loss of some of the biodiversity feature may occur as it is known to use habitat/be present near to the infrastructure footprint and/or potential indirect impacts	Degradation/loss of some/all of biodiversity feature is not anticipated as it is not known to be present in/associate with habitat near to the infrastructure footprint or in the area of influence of indirect impacts

Table 3: Consequence descriptors

Critical	Major	Moderate	Low
Regional viability/function may be lost and/or global viability could be reduced or lost	Regional viability/function is likely to be reduced and/or global viability or function may be affected	Local viability/function may be lost and/or regional viability may be affected	Local viability/function of the feature may be reduced but regional viability is unlikely to be affected

		Likelihood of impact			
		Almost certain	Likely	Unlikely	Rare
Consequence of impact	Critical	High priority for habitat and/or species mitigation (1)		Contingency planning (2)	
	Major	General mitigation measures (3)		Remain aware (4)	
	Moderate				
	Low				

Figure 2: Risk-based prioritisation matrix

4 Results

The risk screening for each priority species and the justification for the results is provided in [Table 4](#). The results of the prioritisation of Natural Habitat is provided in [Table 5](#) and internationally-recognised areas in [Table 6](#).

Four species/subspecies and three habitats are classed as highest priority for habitat mitigation and/or species-specific actions (Action Category 1). These are: the freshwater plant *Ledermaniella yiben*; Western Chimpanzee (*Pan troglodytes verus*); the freshwater fish species *Enteromius* sp. aff.

trispilos and the freshwater fish *Chiloglanis* sp. OTU3; freshwater habitat; gallery forest; and hillslope forest. For all seven of these highest priority features, specific avoidance and minimisation measures will be required and a robust monitoring program to ensure Net Gain is achieved.

One additional amphibian species, *Ptychadena* cf. *submascareniensis* 2, is currently included into Action Category 1 as a precautionary measure and pending the results of genetic analysis. The species will therefore be re-assessed once genetic analysis has been undertaken.

Table 4: Prioritisation results

Group	Species/ subspecies	Action Category	Summary justification for categorisation	
Mammal	Western Chimpanzee (<i>Pan troglodytes verus</i>)	1	<p>Ecology and distribution: Chimpanzees live in groups. They are territorial and will defend their home range (territory) against neighbouring groups (Boesch <i>et al.</i> 2008; Mitani <i>et al.</i> 2010). Chimpanzee group home range size varies according to the habitat type, food availability and group size. Home range size can reach 60 km² in a dry environment with groups of up to 35 chimpanzees (Pruetz & Bertolani 2007), but is likely to be smaller in the Project area as the number of individuals in a group are comparatively small (e.g. the group associated with the Bumbuna Conservation Area (BCA) has a minimum size of 10 individuals, based on the non-invasive genetic analysis). The home range comprises of a core area, (which is the area used most often within the home range and usually includes a high concentration of nesting sites (Kouakou <i>et al.</i> 2011)), and foraging areas. In the Project area, the core areas tend to be within gallery forest habitat and hillslope forest habitat (Ganas-Swaray <i>et al.</i> 2018). Chimpanzees will forage around core areas, investigating different habitats depending on food availability, so home range use varies over time.</p>	
			Likelihood: Almost certain	Consequence: Moderate

Group	Species/ subspecies	Action Category	Summary justification for categorisation
			<p>Likelihood of impacts: The subspecies is present within the Project area at an estimated density of 0.13 [0.05-0.32] individuals/km²¹. Two groups recorded in the Yiben reservoir footprint will be permanently impacted by the Project, and four additional groups have been recorded in the surroundings of the reservoir (Ganas-Swaray <i>et al.</i> 2018). The creation of the reservoir will displace animals, which may result in inter-group conflict and will fragment chimpanzee habitat. The group inhabiting the Bumbuna Conservation Area may also be directly impacted by construction activities for the Bumbuna extension. Six additional groups might be indirectly impacted in the Yiben landscape if mitigation measures are not effective.</p> <p>Consequence of impacts: Direct impacts will affect the local viability of the subspecies. Regional viability may be reduced if mitigation measures to avoid conversion and degradation of Important Sites for Biodiversity are not effective and if habitat connectivity between important areas of habitat in the Yiben landscape is not maintained. This is because groups in the Project area may become genetically isolated from one another and from wider populations.</p> <p>Note: The species qualifies for Action Category 3 as the consequence of impact is moderate (regional viability may be affected but is unlikely to be significantly reduced). It has however been promoted to AC1 as the Western Chimpanzee is Critically Endangered Great Ape with a lot of stakeholder interest. Whilst the Project impacts represent a comparatively small loss to the total estimated population in Sierra Leone, chimpanzee populations are threatened by habitat loss and, in some areas, by hunting. Project impacts are therefore an additional pressure on an already threatened population and are therefore treated as a priority species.</p>

¹ In comparison, in Outamba Kilimi National Park – a similar area of wooded savanna habitat in the North of Sierra Leone – the 2010 national chimpanzee census recorded 0.27 individuals/km² in the Kilimi section of the Park and 1.21 individuals/km² in the Outamba section (Brncic *et al.* 2010).

Group	Species/ subspecies	Action Category	Summary justification for categorisation	
Plant	<i>Ledermanniella yiben</i>	1	<p>Ecology and distribution: This freshwater plant is currently only known from one location in the River Seli, from a fast-flowing section of the river with rapids. Project surveys have recorded it growing perennially in the river channel, where it is permanently covered with water, and annually on rocks within the river that are left exposed when the water level drops. Perennial plants living within the river channel only flower and seed if the water level drops low enough to expose them. Annual plants located on rocks in higher areas of the river channel flower, seed and die as the water level drops during the dry season. The seeds of these plants then germinate when the water level rises – and flower, seed and die again the following year when the water level drops (Lebbie 2018).</p>	
			<p>Likelihood: Almost certain</p>	<p>Consequence: Critical</p>
			<p>Likelihood of impact: This is a newly discovered species, recorded by Kew Gardens during baseline surveys in 2016. It is currently only known from one site which will be permanently flooded by the Yiben reservoir.</p> <p>Consequence of impact: The impact would be critical for this species if further populations, outside of the project footprint, cannot be found and if other mitigation measures (including translocation, ex-situ propagation and further searches for natural populations) are not effective.</p>	
Freshwater fish	<i>Enteromius sp. aff. trispilos</i>	1	<p>Ecology and distribution: This undescribed species is found in moderate and larger tributaries and in the main stem of the river. It prefers fast flowing water and deeper flowing water systems. It is endemic to the section of Seli River catchment upstream of Bumbuna Falls; it has only been recorded in the Mawaloko River, and in the Seli River (within the Yiben reservoir footprint and upstream of the Yiben reservoir) (Sonnenberg & Walsh 2018).</p>	

Group	Species/ subspecies	Action Category	Summary justification for categorisation	
			Likelihood: Likely	Consequence: Potentially major
			<p>Likelihood of Impact: The species is associated with fast-flowing water; flooding of the reservoir will have a direct impact on the individuals present, permanently altering the preferred habitat. As the species prefers fast-flowing rivers, it is unlikely to survive in a lacustrine environment (lake conditions).</p> <p>Consequence of Impact: <i>E. sp. aff. trispilos</i> appears to be endemic to the Seli Catchment (above the Bumbuna I reservoir). The population inhabiting the main river and tributaries within the Yiben reservoir will be lost as a result of the Project (approximately 25% of its known range). The reservoir may also act as a barrier between populations in the Mawaloko River and populations upstream of the Yiben reservoir – as a result, populations may become isolated, reducing the regional viability of the species. Global viability should not be affected as a large stretch of river with multiple tributaries will remain upstream of the Yiben reservoir where a viable population is predicted to remain.</p>	
Freshwater fish	<i>Chiloglanis sp.</i> OTU3	1	<p><i>Chiloglanis sp.</i> OTU3 is a newly identified species as a result of genetic analysis undertaken by the Project. The genetic analysis revealed that specimens originally believed to be <i>Chiloglanis sp. aff. occidentalis</i> potentially represent 3 species: <i>Chiloglanis sp.</i> OTU1, <i>Chiloglanis sp.</i> OTU2 and <i>Chiloglanis sp.</i> OTU3. <i>Chiloglanis sp.</i> OTU1 is only present in Sewa catchment and is therefore not impacted by the Project (and not further referred to). <i>Chiloglanis sp.</i> OTU2 is found in several catchments including Seli catchment and is classified as AC3 (see below). So far only one specimen of <i>Chiloglanis sp.</i> OTU3 has been genetically analysed and it was a specimen collected in the Seli catchment; it is therefore possible that this species is endemic to the Upper Seli catchment. Further genetic analysis and potentially surveys is required to confirm the species is endemic to the Seli catchment.</p>	

Group	Species/ subspecies	Action Category	Summary justification for categorisation	
			<p>Ecology and distribution: Although the ecology of this species has not yet been studied it is likely to be similar to other <i>Chiloglanis</i> sp. It is therefore likely to be a rheophilic species, preferring fast-flowing water of various depths with low turbidity and a rocky substrate. The genetically analysed specimen was found in the Seli catchment, in a tributary flowing to the Mawaloko River but the species is also likely to be found in the main stem and the tributaries of the Seli and the Mawaloko Rivers, upstream of the Bumbuna falls (Sonnenberg & Walsh 2018).</p>	
			Likelihood: Almost certain	Consequence: Potentially major
			<p>Likelihood of Impact: Individuals living in the footprint of the reservoir will be lost as they are unlikely to survive in slow-flowing water or water with a high sedimentation rate leading to muddy or sandy substrate.</p> <p>Consequence of Impact: As only one specimen of this species has been genetically sequenced, the species distribution is not currently known but based on expert opinion it is likely to be present in the mean stem and tributaries of Seli River as well as tributaries of Mawaloko River. It may also be present in adjacent catchments but this is not confirmed and experts consider this species to be rare and potentially endemic to the Upper Seli river. The population inhabiting the main river and tributaries within the Yiben reservoir will be lost as a result of the Project and the reservoir may also act as a barrier between populations in the Mawaloko River and populations upstream of the Yiben reservoir. If the species is endemic to the Upper Seli approximately 25% of its range would be lost which would reduce the regional viability of the species, global viability should not be affected as a large stretch of river with multiple tributaries will remain upstream of the Yiben reservoir where a viable population is predicted to remain.</p> <p>Pending a better understanding of the species distribution, the species is classified as AC1.</p>	

Group	Species/ subspecies	Action Category	Summary justification for categorisation	
Amphibian	<i>Ptychadena</i> cf. <i>submascareniensis</i> 2 ²	1	<p>This species was previously referred to as <i>Ptychadena</i> sp. 1 in Project documents (ERM 2017); genetic analysis now confirms <i>Ptychadena</i> sp. 1 to be two species: One is this species, <i>Ptychadena</i> cf. <i>submascareniensis</i> 2 (a species new to science), the other is <i>Ptychadena submascareniensis</i>, a DD species, classified as AC3 (see below).</p> <p>Ecology and distribution: In 2017, the species was recorded in a disturbed habitat (cultivated swamps) outside (but close to) the direct footprint of the Project (Aruna 2017). Due to confusion over the identification of the species, its distribution is poorly understood. Experts from the Leibniz Institute for Evolution and Biodiversity Science (Germany) think they might hold specimens of this species, collected in the Loma mountains, but genetic analysis is required to confirm this.</p>	
			<p>Likelihood: Likely</p>	<p>Consequence: Potentially major</p>
			<p>Likelihood of impact: This species is associated with swampy areas of habitat. Flooding of such habitats by the reservoir would have a direct impact on those individuals present.</p> <p>Consequence of impact: Direct impacts to this species would affect the local population, but it would persist within the wider Project area. However, as this species is currently only confirmed from the Project area, impacts would potentially have a regional and even global consequence for the population of this species. Genetic analysis of the specimens held in the Leibniz Institute for</p>	

² The species is placed in AC1 pending genetic analysis. It will be moved to AC3 if genetic analysis confirms that the specimens collected in the Loma mountains are from the same species.

Group	Species/ subspecies	Action Category	Summary justification for categorisation		
			<p>Evolution and Biodiversity Science would confirm if they are <i>Ptychadena</i> cf. <i>submascareniensis</i> 2 and therefore how likely it is that the species is more widespread than currently known.</p> <p>This species is precautionarily placed in Category 1 until genetic analysis has been undertaken. If the specimens at Loma is confirmed to be this species, it would be placed in Action Category 3 (because impacts would no longer be considered to have a regional consequence, as the species would be known to be significantly more widespread).</p>		
Mammal	Horseshoe bat (<i>Rhinolophus</i> <i>ziama</i>)	2	<p>Ecology and distribution: Ziama Horseshoe Bat is an Endangered species associated with both montane and lowland tropical moist habitat, using caves as roosting sites. IUCN Red List records are from Guinea and Liberia and from less than five locations in a relatively small area (5,000 km²) (Fahr 2008). The record from Bumbuna increases the known distribution of this species, and the number of locations to six, suggesting that the species is likely to be more widely distributed than previously thought.</p> <table border="1" data-bbox="667 868 2056 983"> <tr> <td>Likelihood: Unlikely</td> <td>Consequence: Potentially major</td> </tr> </table> <p>Likelihood of impact: This species was recorded near the Bumbuna dam in 2006 and in 2013 in the Yiben area. Baseline surveys checked caves in the Yiben reservoir footprint for potential for roosting signs in 2016 but none were found. As roosting sites are unlikely to be impacted by the Project, there is not a high impact risk for this species.</p> <p>Consequence of impact: According to the IUCN Red List, the species is known from only a small area in SE Guinea and NW Liberia. The records from Bumbuna suggest that the species' range is likely to be significantly greater than currently known. If an impact were to occur, it would be precautionary to consider that the regional and/or global viability of the species might be</p>	Likelihood: Unlikely	Consequence: Potentially major
Likelihood: Unlikely	Consequence: Potentially major				

Group	Species/ subspecies	Action Category	Summary justification for categorisation		
			affected. However, the records from Bumbuna suggest that – if further surveys were undertaken in suitable habitat – further locations of the species may be found, thereby reducing the significance of any impact.		
Reptile	Slender-snouted Crocodile (<i>Mecistops cataphractus</i>)	2	<p>Ecology and distribution: The Slender-snouted Crocodile is a shy species susceptible to human disturbance. The species was classified as Critically Endangered in 2014, due to a huge population decline across its range: the populations in West and Central Africa are now totally isolated. The decline is close to 70-90% for West Africa over the past 75 years, and there is no reason to expect the decline to slow. Main threats are hunting pressure and habitat loss. The species is associated with forested rivers and densely vegetated bodies of water including lakes (Shirley 2014). It is projected that this species will likely be lost from more marginally forested areas (i.e., the wooded, gallery savanna areas in the north) of its West African range in the next 10–20 years, if it currently still exists in these northern extremes. In the Project area, it was recorded from a tributary of the Mawaloko River (in 2013), despite searches, it has not been recorded in subsequent surveys.</p> <table border="1" data-bbox="667 858 2058 975"> <tr> <td>Likelihood: Unlikely</td> <td>Consequence: Potentially major</td> </tr> </table> <p>Likelihood of impact: This species has not been recorded in the Project area since 2013. Targeted surveys undertaken in 2016 did not re-record its presence and no signs were seen during 2018 surveys (which targeted fish and Pygmy Hippo but looked for signs of crocodiles). These results suggest this species has either disappeared or is very low numbers, therefore current information does not indicate an impact risk for this species.</p> <p>Consequence of impact: This species of crocodile is reported to be rapidly declining in numbers and in range and is classed as CR on the IUCN Red List. Any impacts to the species would affect the local and potentially regional viability of the population as all populations of this species are important for the species survival.</p>	Likelihood: Unlikely	Consequence: Potentially major
Likelihood: Unlikely	Consequence: Potentially major				

Group	Species/ subspecies	Action Category	Summary justification for categorisation	
Mammal	Western Black-and-white Colobus (<i>Colobus polykomos</i>)	3	<p>Ecology and distribution: The species prefers primary forest habitats (rainforest and gallery forest), and is only sometimes found in secondary forests. Until recently this species was widespread, but is likely to have undergone a decline exceeding 30% over the past 30 years due to habitat degradation and intensive hunting across its range (Oates <i>et al.</i> 2008b). In the Project area, the species was observed twice during reconnaissance surveys in 2017-2018, once inside the Yiben reservoir footprint and once approximately 10 km north of the Yiben reservoir. Based on information from local communities and observations during field surveys, up to 10 individuals might still be present in the Project area (Ganas-Swaray <i>et al.</i> 2018).</p>	
			Likelihood: Likely	Consequence: Low
			<p>Likelihood of impact: The species is still present in the Project area but at a very low density. We estimate that up to four individuals are present in the area of the Yiben reservoir footprint and approximately six individuals in the wider area of influence. Colobus in the reservoir footprint are likely to be lost (as forest habitats are fragmented and any individuals present may not be able to escape) and individuals in the wider landscape may be indirectly impacted if mitigation measures are not effective.</p> <p>Consequence of impact: The species is restricted to fragmented forest patches and groups are already isolated from one another and from wider populations. Therefore, impacts are considered to only affect the local viability of populations.</p>	
Mammal	Pygmy Hippo (<i>Choeropsis liberiensis</i>)	3	<p>Ecology and distribution: The Pygmy Hippo is a solitary animal (except when a female is accompanied by her young) associated with primary and secondary forests close to rivers, streams and swamps (Ransom <i>et al.</i> 2015). Within the Project area, the species has been recorded along the Seli River - within the future Yiben reservoir footprint and upstream of the Yiben reservoir - in the Mameli River (Ganas-Swaray <i>et al.</i> 2018). Populations of Pygmy Hippo are reported to be rapidly declining and are increasingly</p>	

Group	Species/ subspecies	Action Category	Summary justification for categorisation		
			<p>fragmented due to loss of habitat and hunting pressures (Ransom <i>et al.</i> 2015). Baseline survey information indicates that the species is present at a very low density in the Project area.</p>		
			<table border="1"> <tr> <td>Likelihood: Likely</td> <td>Consequence: Low</td> </tr> </table>	Likelihood: Likely	Consequence: Low
Likelihood: Likely	Consequence: Low				
			<p>Likelihood of impact: The species is present in the Project area and within the direct footprint of the reservoir, but at a very low density. Flooding of the habitat of the Pygmy Hippo will likely lead to the loss of those individuals present if there is not suitable habitat and conditions for their survival to move into.</p> <p>Consequence of impact: The species is restricted to few areas along the Seli River in the Project area. Local viability might be affected by the Project but the area around Yiben and Bumbuna is not considered a priority area for hippo conservation in Sierra Leone or within the region (Mallon <i>et al.</i> 2011), and so the regional viability of the species is unlikely to be affected.</p>		
Bird	White-backed Vulture (<i>Gyps africanus</i>)	3	<p>Ecology and distribution: The species is associated with wooded savanna, requiring tall trees for nesting. It is a gregarious species, congregating at carcasses, in thermals and at roost sites, and nesting in loose colonies. <i>Gyps africanus</i> is the most widespread and common species of vulture in Africa, but the population is undergoing a rapid decline that is expected to continue, so the species was recently upgraded to Critically Endangered. The decline is due to habitat loss and conversion to agro-pastoral systems, declines in wild ungulate populations, hunting for trade, persecution, collisions and poisoning (vultures are a heavily persecuted group) (BirdLife International 2017a).</p>		
			<table border="1"> <tr> <td>Likelihood: Likely</td> <td>Consequence: Moderate</td> </tr> </table>	Likelihood: Likely	Consequence: Moderate
Likelihood: Likely	Consequence: Moderate				

Group	Species/ subspecies	Action Category	Summary justification for categorisation		
			<p>Likelihood of impact: The Hooded Vulture has not yet been recorded in the Project area but is known from the Loma mountains and is therefore likely to be present in the wider area, including the Project area. Impacts may occur via electrocution from the powerline infrastructure, loss of potential foraging or nesting habitat under the Yiben reservoir footprint (nesting sites have not yet been recorded), or indirectly as a result of persecution by staff, contractors or local people. Impact risk can be reduced through mitigation, e.g. insulation on powerlines and staff and community awareness raising.</p> <p>Consequence of impact: Although this is a widespread and adaptable species, it is reported to be rapidly declining and is classified as Critically Endangered by the IUCN Red List. Project impacts may affect the local viability of the species.</p>		
Bird	Hooded Vulture (<i>Necrosyrtes monachus</i>)	3	<p>Ecology and distribution: The species is often associated with human settlements but is also found in open grassland, forest edge, wooded savanna, desert and along coasts. It tends to occur at higher densities where populations of larger <i>Gyps</i> vultures are low or non-existent. It nests in tall trees. Hooded Vulture is widespread in sub-Saharan Africa but the population is undergoing a rapid decline, so it has recently been upgraded to Critically Endangered. Recently published evidence suggests the population is experiencing an extremely rapid decline owing to indiscriminate poisoning, trade for traditional medicine, hunting, persecution and electrocution, and habitat loss and degradation (BirdLife International 2017b). Hooded Vulture has been recorded in Loma, and frequently in the Yiben area.</p>		
			<table border="1"> <tr> <td>Likelihood: Likely</td> <td>Consequence: Moderate</td> </tr> </table>	Likelihood: Likely	Consequence: Moderate
Likelihood: Likely	Consequence: Moderate				
			<p>Likelihood of impact: Hooded Vulture has been recorded frequently in the Yiben area. Impacts may occur via electrocution from the powerline infrastructure, loss of potential nesting habitat under the Yiben reservoir footprint (nesting sites have not yet been</p>		

Group	Species/ subspecies	Action Category	Summary justification for categorisation		
			<p>recorded), or indirectly as a result of persecution by staff, contractors or local people. Impact risk can be reduced through mitigation, e.g. insulation on powerlines and staff and community awareness raising.</p> <p>Consequence of impact: Although this is a widespread and adaptable species, it is reported to be rapidly declining and is classified as Critically Endangered by the IUCN Red List. Project impacts may affect the local viability of the species.</p>		
Amphibian	<i>Arthroleptis aureoli</i>	3	<p>Ecology and distribution: The Freetown Long-fingered Frog is associated with forest habitat and forest streams. Recent records suggest the species will survive in degraded habitats. According to the IUCN Red List, this species is only known from the Freetown peninsula (Schjøtz & Rodel 2004). However, the assessment is from 2004 and subsequent surveys have found new locations for the species as far afield as Guinea. Surveys undertaken by this Project increase the number of known locations in Sierra Leone (to include Bumbuna, Yiben and the Loma mountains) (Aruna 2017).</p> <table border="1" data-bbox="667 868 2054 983"> <tr> <td>Likelihood: Almost certain</td> <td>Consequence: Low to moderate</td> </tr> </table> <p>Likelihood of impact: This species has been recorded both under the direct footprint of project infrastructure and from surrounding areas (both in the Yiben and Bumbuna areas); those individuals are likely to be lost.</p> <p>Consequence of impact: The IUCN Red List assessment is now out of date and the species is known to have a far larger distribution and to live in disturbed habitats. Impacts arising from the Project may affect local viability but are unlikely to affect regional viability.</p>	Likelihood: Almost certain	Consequence: Low to moderate
Likelihood: Almost certain	Consequence: Low to moderate				

Group	Species/ subspecies	Action Category	Summary justification for categorisation		
Amphibian	<i>Ptychadena submascareniensis</i>	3	<p>This species was previously referred to as <i>Ptychadena</i> sp. 1 in project documents (ERM 2017), but genetic analysis now confirms <i>Ptychadena</i> sp. 1 to be two species: One is <i>Ptychadena</i> cf. <i>submascareniensis</i> 2 (a species new to science), classified as AC1 (see above); the other is <i>Ptychadena submascareniensis</i>, a DD species.</p> <p>Ecology and distribution: Based on the IUCN Red List, <i>Ptychadena submascareniensis</i> is known from Loma Mountains and Mount Nimba and may be present on other mountains of West Africa (IUCN SSC Amphibian Specialist Group 2014). Project surveys have extended the number of known locations for this species and shown that the species is not restricted to mountain areas. In the Project area, the species was recorded in both natural and disturbed habitat (including grassy areas in wooded savanna, disturbed areas of forest, and cultivated swamps) (Aruna 2017). It is therefore likely that the species is far more widespread than currently known.</p>		
			<table border="1"> <tr> <td>Likelihood: Likely</td> <td>Consequence: Low</td> </tr> </table>	Likelihood: Likely	Consequence: Low
Likelihood: Likely	Consequence: Low				
			<p>Likelihood of impact: In the Project area, this species was particularly associated with swampy areas; flooding by the reservoir would have result in loss of those individuals present.</p> <p>Consequence of impact: This species was previously only known from the Loma Mountains and Mount Nimba (Guinea, Liberia and Côte d'Ivoire), the record from the Project survey significantly extends the known range for this species and encounters of the species in many different types of habitat suggests that it is more widely distributed than previously understood. Impacts to the species in the Project area are therefore only considered to affect local species viability and not regional or global viability.</p>		

Group	Species/ subspecies	Action Category	Summary justification for categorisation	
Amphibian	Cameroon Grassland Frog (<i>Ptychadena retropunctata</i>) ³	3	<p>Ecology and distribution: The species is associated with savanna, humid grassland and gallery forest habitats. Breeding probably takes place in shallow puddles. The species was known from the Loma Mountains and Mount Nimba and was presumed to be present on other mountains of West Africa (Rödel & Schiøtz 2004). The Project's amphibian expert has confirmed that the species has recently been observed in the Nimini Mountains. During Project surveys, the species was observed in five locations in and around the Yiben reservoir footprint (as well as close to Loma mountains) (Aruna 2017).</p> <p>Genetic analysis confirms that all specimens collected are of <i>Ptychadena retropunctata</i> and colour variations noted on the back legs of some specimens during early Project survey work are not reflective of any taxonomic difference.</p>	
			Likelihood: Likely	Consequence: Low
			<p>Likelihood of impact: It has been recorded in areas inside and outside of the Yiben reservoir footprint and impacts are therefore likely to occur.</p>	

³ The records of this species from Bumbuna extend the known range and habitat preference for this species significantly. The species is unlikely to be restricted to grasslands in highlands/mountainous areas as it was recorded in humid grasslands at lower altitudes (including modified habitats such as quarries). As the species is likely to be more widely distributed than previously thought, it may not qualify the area as Critical Habitat under Criterion 2.

Group	Species/ subspecies	Action Category	Summary justification for categorisation	
			Consequence of impact: Project surveys demonstrate that this species is not restricted to mountain areas in West Africa and is found in a variety of habitats, including gallery forest. Impacts to the species in the Project area are therefore only considered to affect local species viability and not regional or global viability.	
Plant	<i>Ledermanniella aloides</i>	3	Ecology and distribution: <i>Ledermanniella aloides</i> is a small tropical herb that grows on rocks in river rapids. It has a large area of distribution (from Sierra Leone to Central Africa) but records of the species to date are limited to five or six sites (Diop 2010). In part, however, the limited records are likely due to limited surveys for aquatic plants throughout the region and the species is likely to be found at further locations if surveys are undertaken. The Project has recorded the species in the Seli River, the Makerikeri River and the Gbondorlor tributary (of the river Seli), which increases the number of sites the species is known from.	
			Likelihood: Almost certain	Consequence: Low
			<p>Likelihood of impact: This species has been recorded in areas that will be flooded by the Yiben reservoir and so will be impacted by the project.</p> <p>Consequence of impact: This species has a wide distribution in West Africa (Sierra Leone, Nigeria, Angola and the Central African Republic). It was previously only known from one other site in Sierra Leone but surveys for <i>L. yiben</i> have encountered further populations of this species. Impacts to the Yiben population would therefore only affect the local viability of the species.</p>	

Group	Species/ subspecies	Action Category	Summary justification for categorisation	
Plant	<i>Vepris felicitis</i>	3	<p>Ecology and distribution: <i>Vepris felicitis</i> is a small species of tree found in lowland forests. The species is not considered to be restricted range (Stewart, Missouri Botanical Garden, <i>in litt.</i> 2015) and is “common” in the Yiben reservoir footprint and outside (ERM 2017).</p>	
			<p>Likelihood: Almost certain</p>	<p>Consequence: Low</p>
			<p>Likelihood of impact: This species has been recorded multiple times in areas that will be flooded by the Yiben reservoir.</p> <p>Consequence of impact: This species is known from Guinea, Sierra Leone, Liberia and Ivory Coast, although in low numbers at each known location. Impacts to populations in the Yiben reservoir footprint would affect the numbers of individuals present in the Yiben area and therefore may affect the local viability of the species.</p>	
Freshwater Fish	<i>Marcusenius meronai</i>	3	<p>Ecology and distribution: This species is currently only found in main rivers, preferring fast and deep waters. Preliminary data on fish habitat preferences indicate that <i>M. meronai</i> favors cobble substrate. The species inhabits water near banks with vegetation or crevices and uses low velocity habitat as recovery areas. Low velocity habitat is also a refugia for juveniles. The species is endemic to Sierra Leone, where it is found in the Seli Catchment upstream and downstream of Bumbuna falls (within the Yiben reservoir footprint and upstream of the Yiben reservoir, in the Mawaloko river, and below the Bumbuna falls), as well as in the Sewa catchment (Sonnenberg & Walsh 2018).</p>	

Group	Species/ subspecies	Action Category	Summary justification for categorisation	
			Likelihood: Almost certain	Consequence: Moderate
			<p>Likelihood of Impact: This Endangered species is currently only found in the main rivers, in deeper water and fast-flowing waters. Individuals in the Yiben reservoir footprint will be lost as a result of the Project as the species is unlikely to survive in a lacustrine environment due to changes in flow and higher sedimentation rates. Individuals present downstream of Bumbuna Falls may be affected as there will be less seasonal variation in river flow and a more constant year-round flow. As low velocity conditions are required as refugia for juveniles, the steady year-round flow may mean that less low velocity habitat is available affecting the reproductive success of the species.</p> <p>Consequence of Impact: The species is known from several locations within the Seli catchment and in the Sewa catchment. The species is considered to be relatively rare and was only collected at a few sites. Any impact may therefore lead to a reduction in local viability and might affect the regional viability of the species.</p>	
Freshwater fish	<i>Scriptaphyosemion</i> cf. <i>chaytori</i>	3	<p>Ecology and distribution: This species is a small tributary specialist, preferring slow-flowing and shallow waterbodies. It attaches eggs to submerged vegetation and roots, and requires canopy cover above the water as its main food source is arthropods that fall in off vegetation. The species is found in the Seli River upstream of Bumbuna falls - in the Mawaloko River, above the top of the Bumbuna I reservoir and in the Yiben reservoir footprint - and in the Little Scarcies catchment (Sonnenberg & Walsh 2018).</p>	

Group	Species/ subspecies	Action Category	Summary justification for categorisation	
			Likelihood: Almost certain	Consequence: Moderate
			<p>Likelihood of Impact: This species is a small tributary specialist, unlikely to survive in lacustrine conditions without canopy cover. Individuals present under the project footprint (in the Yiben reservoir footprint and where Bumbuna I reservoir will extent) are likely to be lost as a result of the Project. Changes in water levels might also impact recruitment of the species, if eggs are exposed to air when the water level in the reservoir goes down.</p> <p>Consequence of Impact: This species is endemic to Sierra Leone, where it is currently known from two catchments. Local viability of the species within the Seli catchment will be reduced as only the Mawaloko population will to survive. Regional viability may be reduced if the Mawaloko population is affected by Project indirect impacts.</p>	
Freshwater fish	<i>Epiplatys</i> sp. aff. <i>njalaensis</i>	3	<p>Ecology and distribution: This species is a small tributary specialist mostly found in clean, clear streams with good canopy cover and lower water temperatures. It prefers slow and shallow waterbodies with a muddy substrate. It lays eggs on submerged vegetation and roots. The species is benthopelagic (they live and feed near the bottom) and non-migratory. It requires canopy cover above the water as its main food source is arthropods that fall in from surrounding vegetation. The species is found upstream of Bumbuna falls (in the Mawaloko River and in the section of the Seli River between the top of the Bumbuna I reservoir and the future Yiben reservoir; it has never been reported in the Yiben reservoir footprint or upstream of it) and in the Little Scarcies catchment (Sonnenberg & Walsh 2018).</p>	

Group	Species/ subspecies	Action Category	Summary justification for categorisation	
			Likelihood: Almost certain	Consequence: Moderate
			<p>Likelihood of Impact: This species is a small tributary specialist, unlikely to survive in lacustrine conditions with no canopy cover. Individuals present in the section of the Seli River between the Yiben dam and the current top of the Bumbuna I reservoir, i.e. the area where the Bumbuna I reservoir will extend, are likely to be impacted by the Project. Changes in water levels in the reservoir will also impact the recruitment of the species if eggs are exposed to air when the water level in the reservoir goes down. Loss of riparian vegetation at the banks of the reservoir will also reduce areas where the species can attach its eggs.</p> <p>Consequence of Impact: This species is endemic to the north-eastern part of Sierra Leone, where it is found in two catchments. Local viability of the species within the Seli catchment will be reduced as only the Mawaloko population will survive. Regional viability may be reduced if the Mawaloko population is affected by Project indirect impacts.</p>	
Freshwater fish	<i>Epiplatys</i> sp.	3	<p>Ecology and distribution: This species is a small tributary specialist mostly found in clean, clear streams with good canopy cover and lower water temperatures. It prefers slow and shallow waterbodies. It deposits eggs on submerged vegetation and roots, and requires canopy cover above the water as its main food source is arthropods that fall in off surrounding vegetation. The species is found upstream of Bumbuna falls (in the Mawaloko River, in the Yiben reservoir footprint and upstream of the Yiben reservoir) and in other catchments (Sewa and Pampana) (Sonnenberg & Walsh 2018).</p>	

Group	Species/ subspecies	Action Category	Summary justification for categorisation	
			Likelihood: Almost certain	Consequence: Low
			<p>Likelihood of Impact: This species is a small tributary specialist, unlikely to survive in lacustrine conditions with no canopy cover. Individuals present in the Yiben reservoir footprint are likely to be lost as a result of the Project. Changes in water levels in the reservoir will also impact the recruitment of the species if eggs are exposed to air when the water level in the reservoir goes down. Loss of riparian vegetation at the banks of the reservoir will also reduce areas where the species can attach its eggs.</p> <p>Consequence of Impact: This species is endemic to Sierra Leone, where it is currently known from three catchments. Local viability of the species within the Seli catchment may be reduced and the population living upstream of the Yiben reservoir footprint and the Mawaloko population will be isolated from one another, because of the Yiben reservoir. Regional and global viability is unlikely to be affected as the species is known from two other catchments.</p>	
Freshwater fish	<i>Archiaphyosemion</i> cf. <i>guineense</i>	3	<p>Ecology and distribution: The species is a small tributary specialist, preferring slow-flowing and shallow waterbodies. It uses submerged roots, plants and overhanging vegetation as cover and attaches sticky eggs to submerged roots and plants. Its reproduction is probably influenced by the onset of the rainy season. It requires canopy cover above the water as its main food source is arthropods that fall in off surrounding vegetation. The species is found upstream of Bumbuna falls (in the Mawaloko River, and above the Bumbuna I reservoir to the headwater of the Seli River) and in other catchments (Sewa and Little Scarcies). The species was often recorded during the 2018 survey, suggesting that it is common (Sonnenberg & Walsh 2018).</p>	

Group	Species/ subspecies	Action Category	Summary justification for categorisation	
			Likelihood: Almost certain	Consequence: Low
			<p>Likelihood of Impact: This species is a small tributary specialist, unlikely to survive in lacustrine conditions with no canopy cover. Individuals present in the Yiben reservoir footprint and between the Bumbuna I reservoir and the future Yiben reservoir are likely to be lost as a result of the Project.</p> <p>Consequence of Impact: This species is endemic to Sierra Leone, where it is currently known from three catchments. Local viability of the species within the Seli catchment may be reduced and the population living upstream of the Yiben reservoir and the Mawaloko population will be isolated from one another, because of the Yiben reservoir. Regional and global viability is unlikely to be affected as the species was recorded in several locations in other catchments.</p>	
Freshwater fish	<i>Scriptaphyosemion wieseae</i>	3	<p>Ecology and distribution: The species is a small tributary specialist, preferring slow-flowing and shallow waterbodies. It is found in places with overhanging vegetation and submerged roots or plants, attaching eggs to submerged roots or plants. Reproduction likely begins at the start of the wet season. It requires canopy cover above the water as its main food source is arthropods that fall in off surrounding vegetation. The species is found upstream of Bumbuna falls (in the Mawaloko River, in the Yiben reservoir footprint and upstream of the Yiben reservoir) and in other catchments (Sewa, Pampana and Little Scarcies) (Sonnenberg & Walsh 2018).</p>	

Group	Species/ subspecies	Action Category	Summary justification for categorisation	
			Likelihood: Almost certain	Consequence: Low
			<p>Likelihood of Impact: This species is a small tributary specialist, unlikely to survive in lacustrine conditions with no canopy cover. Individuals present in the Yiben reservoir footprint are likely to be lost as a result of the Project.</p> <p>Consequence of Impact: This species is endemic to Sierra Leone, where it is currently known from four catchments. Local viability of the species within the Seli catchment may be reduced and the population living upstream of the Yiben reservoir and the Mawaloko population will be isolated from one another, because of the Yiben reservoir. Regional and global viability is unlikely to be affected as the species was recorded in several locations in other catchments.</p>	
Freshwater Fish	<i>Amphilius</i> cf. <i>platyichir</i> OTU2	3	<p>The species <i>Amphilius platyichir</i>, according to the IUCN Red List, is present in several African countries, but experts highlighted that it is likely to be a complex of species. Genetic analysis undertaken by the Project has shown that specimens collected as <i>Amphilius</i> cf. <i>platyichir</i> represent 2 species; <i>Amphilius</i> cf. <i>platyichir</i> OTU1 and <i>Amphilius</i> cf. <i>platyichir</i> OTU2. <i>Amphilius</i> cf. <i>platyichir</i> OTU1 is only present in Sewa catchment and not impacted by the Project (and therefore not further considered further by the Project). The species <i>Amphilius</i> cf. <i>platyichir</i> OTU2 is found in several catchments including Seli catchment.</p> <p>Ecology and distribution: This species is found in both main rivers and tributaries, with a preference for moderately sized tributaries to large rivers. It is possible that it uses smaller tributaries for spawning. It is a rheophilic species, preferring faster flowing water at various depths. The species is found upstream of Bumbuna falls (in the Mawaloko River, in the Yiben reservoir</p>	

Group	Species/ subspecies	Action Category	Summary justification for categorisation		
			<p>footprint and upstream of the Yiben reservoir) and in other catchments (Sewa, and Little Scarcies) (Sonnenberg & Walsh 2018). This species is likely to represent <i>Amphilius platychir</i>, i.e. the species that has previously been described by scientists.</p> <table border="1"> <tr> <td>Likelihood: Almost certain</td> <td>Consequence: Low</td> </tr> </table> <p>Likelihood of Impact: The species is rheophilic and therefore requires flowing water for survival. Individuals present in the planned reservoir will be lost as a result of the Project.</p> <p>Consequence of Impact: The Project will affect the local viability of the species in the Seli catchment, through loss of the individuals living in the area that will be flooded by the Yiben reservoir. The populations living upstream of the Yiben reservoir and the Mawaloko population will be isolated from one another, as a result of the Yiben reservoir. Regional and global viability is unlikely to be affected as the species is known from at least two other catchments and has been recorded at multiple locations within the other catchments.</p>	Likelihood: Almost certain	Consequence: Low
Likelihood: Almost certain	Consequence: Low				
Freshwater fish	<i>Amphilius</i> sp. aff. <i>rheophilus</i>	3	<p>Ecology and distribution: The species is a rheophilic species, preferring fast-flowing water in deep and moderately deep rivers and tributaries. Preferred habitats include substrates with cobbles and sand. In the Seli catchment, the species is found only upstream of Bumbuna falls where it has been recorded in the Yiben reservoir footprint, upstream of the Yiben reservoir and in the Mawaloko River. Specimens were also recorded in the Sewa and Little Scarcies catchments. Genetic analysis has confirmed that the specimens collected in different catchments are all the same species.</p>		

Group	Species/ subspecies	Action Category	Summary justification for categorisation	
			Likelihood: Likely	Consequence: Low
			<p>Likelihood of Impact: Flooding of the reservoir will have a direct impact of the individuals present since the species is unlikely to survive in a lacustrine environment and in lentic conditions.</p> <p>Consequence of Impact: The Project will affect the local viability of the species in the Seli catchment, through loss of the individuals living in the area that will be flooded by the Yiben reservoir. The populations living upstream of the Yiben reservoir and the Mawaloko population will be isolated from one another, as a result of the Yiben reservoir. Regional and global viability is unlikely to be affected as the species is known from at least two other catchments and has been recorded at multiple locations within the other catchments.</p>	
Freshwater fish	<i>Chiloglanis</i> sp. OTU2 (probably represents <i>Chiloglanis</i> <i>kabaensis</i>)	3	<p>Ecology and distribution: The species is a rheophilic species, preferring fast-flowing water of various depths. It also prefers waters with low turbidity and a rocky substrate. From baseline surveys, adults are usually found in moderately-sized tributaries and in main river channels, juveniles are found in shallow, small tributaries and half-grown juveniles in smaller to moderate tributaries. These survey results indicate that the species may make spawning movements from the main river channel into tributaries for reproduction. In the Seli catchment, the species is found only upstream of Bumbuna falls where it has been recorded in the Yiben reservoir footprint, and upstream of the Yiben reservoir (it has not been recorded in the Mawaloko River). Specimens were also recorded in the Little Scarcies catchment.</p>	
			Likelihood: Likely	Consequence: Low

Group	Species/ subspecies	Action Category	Summary justification for categorisation		
			<p>Likelihood of Impact: Individuals living in the footprint of the reservoir will be lost as they are unlikely to survive in slow-flowing water or water with a high sedimentation rate leading to muddy or sandy substrate.</p> <p>Consequence of Impact: The Project will affect the local viability of the species in the Seli catchment, through loss of the individuals living in the area that will be flooded by the Yiben reservoir. Regional and global viability is unlikely to be affected as the species was also recorded in another catchment.</p>		
Freshwater Fish	<i>Rhexipanchax kabaie</i>	3	<p>Ecology and distribution: The species prefers moderately sized tributaries with moderate flows. This species is usually absent in very slow-flowing, standing water or polluted water. It is benthopelagic (i.e. they live and feed near the bottom) and occur in small groups. It uses submersed plant roots or vegetation as spawning substrate and attaches eggs to roots, branches or leaves. Before Project surveys, the species was known from two catchments, but is now known from five catchments: the Seli catchment – upstream of Bumbuna falls (in the Yiben reservoir footprint and in tributaries upstream of the Yiben reservoir), three other catchments in Sierra Leone (Sewa, Little Scarcies and Pampana) and one catchment in Guinea (Sonnenberg & Walsh 2018).</p> <table border="1" data-bbox="667 979 2056 1134"> <tr> <td>Likelihood: Likely</td> <td>Consequence: Low</td> </tr> </table> <p>Likelihood of Impact: This species is usually absent in very slow-flowing or standing water but experts suggest that it might be able to survive in certain parts of a lacustrine environment if the water quality and oxygen level are sufficient. Individuals present in the Yiben reservoir footprint might be impacted by the Project if water quality decreases. Changes in water levels in the</p>	Likelihood: Likely	Consequence: Low
Likelihood: Likely	Consequence: Low				

Group	Species/ subspecies	Action Category	Summary justification for categorisation		
			<p>reservoir will also impact the recruitment of the species if eggs are exposed to air when the water level in the reservoir goes down. Loss of riparian vegetation at the banks of the reservoir will also reduce areas where the species can attach its eggs.</p> <p>Consequence of Impact: The species is currently known from five catchments and was recorded in many locations during the surveys. The project might affect the local viability of the species in the Yiben reservoir footprint, but the species is unlikely to be impacted regionally or globally.</p>		
Freshwater Fish	<i>Raiamas scarciensis</i>	3	<p>Ecology and distribution: This species is a large river specialist and is not observed in small to moderate tributaries. It is benthopelagic (i.e. they live and feed near the bottom) and is found in deep waters. The species uses fast-flowing water to feed and breed, but also needs slow-flowing water to rest. The species is endemic to Sierra Leone where it is found in three catchments: the Seli, Sewa and Little Scarcies. In the Rokel/Seli catchment, it is found in the coastal area and below the Bumbuna falls. Above the falls, it is currently only known from the Yiben reservoir footprint, but fish experts think that the species might have a wider distribution and could be found further upstream than previously assumed, it has likely not been collected as it is rare (Sonnenberg & Walsh 2018).</p> <table border="1" data-bbox="667 991 2054 1125"> <tr> <td>Likelihood: Likely</td> <td>Consequence: Low</td> </tr> </table> <p>Likelihood of Impact: The species is semi-rheophilic (i.e. preferring fast-flowing waters) suggesting it and is unlikely to survive under lacustrine conditions due to the increased water temperatures and lower oxygen. Individuals present in the Yiben reservoir footprint will likely be lost as a result of the Project. Some specimens were recorded in Bumbuna I reservoir in 2010 and 2013, suggesting that some individuals can survive, experts consider that the species cannot persist in the long-term in a lacustrine</p>	Likelihood: Likely	Consequence: Low
Likelihood: Likely	Consequence: Low				

Group	Species/ subspecies	Action Category	Summary justification for categorisation		
			<p>environment. Therefore, this species will likely be impacted by the flooding of the Yiben reservoir. Downstream of Bumbuna Falls impacts are unlikely to be significant as the river will remain fast-flowing.</p> <p>Consequence of Impact: The species is found in several locations within Seli catchment and in other catchments of Sierra Leone. The species was relatively rare during collection surveys. Therefore, any impact might lead to a loss in local viability but the regional viability is unlikely to be impacted.</p>		
Mammal	Western Red Colobus, (<i>Ptilocolobus badius</i>)	4	<p>Ecology and distribution: The species prefers primary or mature old growth moist forest. Its global range overlaps with the Project area and the area contains some areas of suitable habitat for the species. Despite targeted surveys, this species was not recorded during baseline surveys. Its presence was reported by local communities in four areas (all outside the Yiben reservoir footprint), two of these areas were investigated, but the species' presence was not confirmed (Ganas-Swaray <i>et al.</i> 2018). It is threatened by habitat loss and hunting throughout its range and only occurs as fragmented populations in Sierra Leone (Oates <i>et al.</i> 2008c).</p> <table border="1" data-bbox="667 949 2056 1082"> <tr> <td>Likelihood: Unlikely</td> <td>Consequence: Low</td> </tr> </table> <p>Likelihood of impact: If the species is still present in the Project area, it is outside of the direct footprint of the Project. Indirect impacts are possible but considered unlikely as the species is either very rare or no longer present in the area.</p> <p>Consequence of impact: If present, the species is restricted to fragmented forest patches in very low numbers. Any groups would already be isolated from one another and therefore only local viability might be affected by indirect impacts.</p>	Likelihood: Unlikely	Consequence: Low
Likelihood: Unlikely	Consequence: Low				

Group	Species/ subspecies	Action Category	Summary justification for categorisation	
Mammal	Diana Monkey, (<i>Cercopithecus diana</i>)	4	<p>Ecology and distribution: This is a mostly arboreal species living in the canopy of primary and old secondary lowland moist forest, and riverine and gallery forests. It is rarely found in degraded forest. Large-scale deforestation in the region, through logging, conversion to agricultural land and charcoal production, continues to reduce the habitat available to this species (Oates <i>et al.</i> 2008a). Its global range overlaps with the Project area and the area contains some suitable habitat for the species. However, the species has not been recorded during baseline surveys and communities do not report its presence either (Ganas-Swaray <i>et al.</i> 2018).</p>	
			Likelihood: Unlikely	Consequence: Low
			<p>Likelihood of impact: The species is unlikely to be present in the Project area and therefore an impact is unlikely.</p> <p>Consequence of impact: If the species is found to be present, it would be restricted to fragmented forest patches in very low numbers. Any groups would already be isolated from one another and therefore only local viability might be affected by indirect impacts.</p>	
Dragonfly	<i>Elatoneura dorsalis</i>	4	<p>Ecology and distribution: This species is endemic to Sierra Leone, where it has been recorded from four locations. It is associated with forest streams in lowland forest (Dijkstra 2010).</p>	
			Likelihood: Unlikely	Consequence: Low

Group	Species/ subspecies	Action Category	Summary justification for categorisation		
			<p>Likelihood of impact: The Project is located within the distribution range of the species according to the IUCN Red List (Dijkstra 2010), but, it has not yet been recorded in the Project area. Very little is known about the ecology of this species, but based on current information an impact is considered unlikely.</p> <p>Consequence of impact: Although the species is known from only four locations in Sierra Leone, it is associated with a widespread habitat type and does not appear to have any specialist habitat requirements.</p>		
Freshwater fish	<i>Enteromius liberiensis</i>	4	<p>Ecology and distribution: This is an Endangered species, living in both stream and lake conditions (Entsua-Mensah 2010a). According to R. Sonnenberg (<i>in litt.</i> 2017), the identification of <i>E. liberiensis</i> within the Project area is likely to be a misidentification during field surveys (the species collected being most probably the newly-described species, <i>E. trispilos</i>, - see above -). <i>E. liberiensis</i> has a coastal plain distribution and is known from two further catchments in Sierra Leone and Liberia (Sonnenberg & Walsh 2018).</p>		
			<table border="1"> <tr> <td>Likelihood: Unlikely</td> <td>Consequence: Low</td> </tr> </table>	Likelihood: Unlikely	Consequence: Low
Likelihood: Unlikely	Consequence: Low				
			<p>Likelihood of Impact: The species is reported to live in both stream and lake conditions in coastal plains. Therefore, only downstream impacts (change in water flow) might affect the species, as the species can survive in variable flow conditions and if found in coastal plains along way downstream from the Project, an impact is considered unlikely.</p> <p>Consequence of Impact: The species occurs in several catchments. Therefore, only local viability could be impacted by the Project.</p>		

Group	Species/ subspecies	Action Category	Summary justification for categorisation	
Freshwater fish	<i>Epiplatys lokoensis</i>	4	Ecology and distribution: this is an Endangered species of fish known only from swampy areas and small rivers on the coastal plains of the Port Loko area of Sierra Leone (Laleye 2010).	
			Likelihood: Unlikely	Consequence: Low
			<p>Likelihood of Impact: Due to the distance downstream from the Project and the fact that the species is associated with small rivers and swamps away from the main Rokel stream, it is unlikely that the Project will significantly impact this species.</p> <p>Consequence of Impact: If an impact did occur to the Rokel river, there could be a loss in the local viability of the population.</p>	
Freshwater Fish	<i>Synodontis tourei</i>	4	Ecology and distribution: This is a Near Threatened species that has a very restricted distribution and is only known from an inland wetland in Guinea (Entsua-Mensah 2010b). Project surveys in 2010 recorded the species above and below the Bumbuna falls and within the Bumbuna I reservoir. However, fish experts undertaking surveys in 2018 believe that the previous records of the species within the Project area were misidentifications and that the species is not present in the Project area (there are no pictures from previous records and further investigations are therefore not possible) (Sonnenberg & Walsh 2018).	
			Likelihood: Unlikely	Consequence: Low

Group	Species/ subspecies	Action Category	Summary justification for categorisation
			<p>Likelihood of Impact: Specimens identified as <i>S. tourei</i> are unlikely to be from this species, and the species is unlikely to be found in the Project area according to fish experts. Therefore, the Project will not impact the species. (If the species was present it would likely survive in the reservoir as it's a wetland specialist species).</p> <p>Consequence of Impact: If the species was present in the Project area the population would likely survive in reservoir conditions and therefore there may be a reduction in local viability only.</p>

Table 5: Prioritisation of Natural Habitats (Note all three Action Category 1 habitats are considered to be Critical Habitat – Gallery forest, hillslope forest and freshwater habitat)

Natural Habitat (NH)	Action Category	# of Priority species/ subspecies associated with the NH	Justification for categorisation
Gallery forest ⁴	1	7 species/subspecies (Western Chimpanzee, (Diana Monkey),	Gallery forest is found typically in 50 m wide strips along rivers and streams. It consists of closed-canopy rainforest with trees up to 25 m high. It is an important habitat for many priority biodiversity species as well

⁴ Lowland forest was identified as an additional forest type in the Project area in the habitat map (Space Intelligence Ltd 2018), but has been incorporated here into Gallery forest. Gallery forests were identified, in the habitat map, as forest pixels located at less than 100 m from a river or a tributary. However, it is likely that locations of all tributaries were unknown and, therefore, that some forest pixels were inappropriately assigned to lowland forest (defined as forest pixels with slope lower than 7 degrees and located at more than 100 m from a river or a stream). Indeed, lowland forest is not a vegetation type identified as present in the Project area (Royal Botanic Gardens, Kew 2016).

Natural Habitat (NH)	Action Category	# of Priority species/ subspecies associated with the NH	Justification for categorisation
		Western Black-and-white Colobus, Western Red Colobus, Pygmy Hippo, Ziama Horseshoe Bat, <i>Vepris felicis</i>)	as for biodiversity more broadly. Gallery forest will be directly and indirectly impacted by the Project which will affect the species that are dependent on it, it is therefore considered to be a priority habitat for Project mitigation actions.
Hillslope forest	1	4 species/subspecies (Western Chimpanzee, (Diana Monkey), Western Black-and-white Colobus, Western Red Colobus)	Hillslope forest is a closed-canopy forest found on hill slopes and summits away from streams. Trees grow to approximately 35 m high and the understory tends to be rich in woody species. Only patches are reported to remain in the Project area, and these are badly damaged by fire and encroached by adjacent farmland (Royal Botanic Gardens, Kew 2016). It is an important habitat for priority biodiversity including Western Chimpanzee and other primates. Hillslope forest will be directly and indirectly impacted by the Project which will affect the species that are dependent on it, it is therefore considered to be a priority habitat for Project mitigation actions.
Freshwater habitats⁵	1	18 species (1 dragonfly, 16 fish species, 2 freshwater plants)	Freshwater habitat refers to the main river and tributaries of the Seli/Rokel river catchment. This catchment is one of the best surveyed for fish species in West Africa and freshwater habitats are known to support many priority freshwater fish species. Flooding of the Yiben reservoir will directly impact freshwater habitat and fragment freshwater habitat in the Upper river Seli, it is therefore considered to be a priority habitat for Project mitigation actions.
Natural savannah/ woodland (Trees taller than 10 m – no human influence)	3	1 subspecies (Western Chimpanzee)	Savannah typically occurs on well-drained soils. Woodlands have a >40% canopy cover and often form a mosaic with wooded grasslands. Grasslands have typically <10% tree canopy cover. In both, trees are taller than 10 m. The only priority species associated with this habitat type are chimpanzees, although it is a less

⁵ This habitat is referred as 'River channel' in the habitat map.

Natural Habitat (NH)	Action Category	# of Priority species/ subspecies associated with the NH	Justification for categorisation
			important habitat than gallery or hillslope forests (Ganas-Swaray <i>et al.</i> 2018) . Whilst impacts will occur, they are not considered to be significant for priority species and therefore savannah is not a priority habitat for the Project, it is considered as a Natural Habitat for mitigation actions.
Inselberg	3	None ⁶	A few granite inselbergs occur in the Project area. They have a characteristic mat of Cyperaceae on the surface and sometimes trees (SAR Sense Ltd. 2017). At least one inselberg will be used as a quarry for construction of the Yiben dam and others will be directly impacted by the flooding of the reservoir. The only priority species that are could be associated with this habitat are plants but surveys to date have not observed any priority species associated with inselberg habitats, a final survey will be carried out once the quarry site has been chosen. Whilst impacts will occur, they are not considered to be significant for priority species and therefore inselberg habitat is not a priority habitat for the Project, it is considered as a Natural Habitat for mitigation actions.
River channel community	3	2 species (<i>Ledermanniella aloides</i> and <i>Ledermanniella yiben</i>)	This habitat is identified as a separate habitat type to freshwater habitat or gallery forest as it is a niche habitat type occurring in short stretches of river where there are sections of rocky bedrock, usually with fast flowing water. This habitat type is known to support plant species that root on or between the rocks (rheophytic plants). Two Critical Habitat-qualifying species are associated with this habitat type in the Project area - <i>Ledermanniella aloides</i> and the new species <i>Ledermanniella yiben</i> . Whilst impacts will occur to this habitat type, the Project has developed species-specific mitigation measures to manage impacts. No further management actions are therefore required for this habitat type.

⁶ Further surveys will be undertaken of the inselbergs that will be used as quarries to check for species that may qualify for Critical Habitat and undertake appropriate mitigation measures if found (Seli Hydropower 2019a)

Natural Habitat (NH)	Action Category	# of Priority species/ subspecies associated with the NH	Justification for categorisation
Swamp & seasonally inundated grasslands	4	Potentially Pygmy Hippo	Inland valley swamps develop in river and stream valleys on sandy or muddy soils that are flooded during the wet season. There are only small areas of this habitat type found in the Project area (24 ha in Yiben reservoir footprint) as it is mostly hilly. Swamps that do exist are usually cultivated for rice, some maintained artificially through dykes and therefore modified habitats.

Table 6: Protected Areas & Internationally-Recognised Areas

Protected areas & Internationally-recognised areas	Action Category	Justification for categorisation
Bumbuna Conservation Area	1	In 2008, the Bumbuna Watershed Management Authority (BWMA) and the Bumbuna Conservation Area (BCA) Act was legally established as part of an offset program for Bumbuna I to conserve chimpanzees. Since its establishment the BCA has been impacted by encroachment from local communities (TBC 2019) which has converted habitats that are important for chimpanzees into farmland. A small group of chimpanzees remains present in the area. The Project will impact the area with the Phase II extension infrastructure and as the BCA is a legally protected area it is a priority for the Project to continue conservation measures in the BCA.
Lake Sonfon	2	Lake Sonfon is an Important Bird Area that has been proposed as a national park. The area is threatened by deforestation for agriculture, high hunting pressure and gold mining near the lake. No recent surveys have been undertaken in the area, so the presence of priority biodiversity cannot be confirmed but it is likely to be present (e.g. primate experts indicated that chimpanzees have been reported close to the lake). The Project will not directly impact the area and indirect impacts are also unlikely as the area is far from towns that are likely to attract economic migrants.
Farangbaia Forest Reserve	4	Farangbaia is in the Dansogoia Chiefdom of the Tonkolili District, approximately 10 km south-east of Bumbuna town. It was designated as a 'Production and Protection' Forestry Reserve in 1945. The limited information available on the condition of this reserve, reveals that, after the 1991 civil war, much of the area has become farmland and bush forest with some sawmills in operation (SAR Sense Ltd. 2017).

		<p>Most of this reserve is therefore likely to be modified habitat now. The Project will not directly impact this area and any indirect impacts would not be significant given the area is likely to be highly degraded.</p>
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Appendix 1 Biodiversity identified by the Critical Habitat Assessment (CHA)

Table 7: Summary of Project Critical Habitat-qualifying species under Criteria 1-3. Tier 1 species are marked with * IUCN Red List Categories: CR= Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Near Threatened, NE = Not Evaluated, DD = Data Deficient. Species are coloured to indicate the Action Category (AC): AC 1 = red, AC 2 = orange, AC 3 = yellow, and AC 4 = green.

Group	English name	Scientific name	IUCN status	Confirmed in DMU?	Restricted range?	Critical Habitat criteria	Tier 1 or 2
Mammals	Diana Monkey	<i>Cercopithecus diana</i>	VU	N	N	1d	2
	Pygmy Hippo	<i>Choeropsis liberiensis</i>	EN	Y	N	n/a - stakeholder	n/a
	Western Black-and-White Colobus	<i>Cobus polykomos</i>	VU	Y	N	1d	2
	Western Chimpanzee	<i>Pan troglodytes verus</i>	CR	Y	N	1c	2
	Western Red Colobus	<i>Piliocolobus badius</i>	EN	N	N	1d	2
	Ziama Horseshoe Bat*	<i>Rhinolophus ziama*</i>	EN	Y		1b, 2b	1
Birds	Hooded Vulture	<i>Necrosyrtes monachus</i>	CR	Y	N	1c	2
	White-backed Vulture	<i>Gyps africanus</i>	CR	N	N	1c	2
Amphibians	Cameroon Grassland Frog	<i>Ptychadena retropunctata</i>	DD	Y	Y	Possible 2b	2
	Freetown Long-fingered Frog	<i>Arthroleptis aureoli</i>	EN	Y	N	1d	2
	n/a	<i>Ptychadena submascareniensis</i> ¹	NE	Y	Y	Possible 2b	2
	n/a	<i>Ptychadena cf. submascareniensis</i> ^{2 1}	NE	Y	Y	Possible 2b	2
Reptiles	Slender-snouted Crocodile	<i>Mecistops cataphractus</i>	CR	Y	N	1c	2
Dragonflies	Yellow-fronted Threadtail	<i>Elatoneura dorsalis</i>	VU	N	Y	2b	2
Freshwater fish	n/a	<i>Amphilius platyichir</i> OTU2 ²	NE	Y	Y	Possible 2b	2
	n/a	<i>Amphilius</i> sp. aff. <i>rheophilus</i>	NE	Y	Y	Possible 2b	2
	n/a	<i>Archiaphyosemion</i> cf. <i>guineense</i>	NE	Y	Y	Possible 2b	2
	n/a	<i>Barbus/Enteromius liberiensis*</i>	EN	Y	N	1a	1
	n/a	<i>Chiloglanis</i> sp. OTU2 ³	NE	Y	Y	Possible 2b	2
	n/a	<i>Chiloglanis</i> sp. OTU3 ³	NE	Y	Y	Possible 2b	2
	n/a	<i>Enteromius</i> sp. aff. <i>trispilos</i>	NE	Y	Y	Possible 2b	1
	n/a	<i>Epiplatys lokoensis*</i>	EN	Y	Y	1a, 2b	1

	n/a	<i>Epiplatys sp.</i>	NE	Y	Y	2b	2
	n/a	<i>Epiplatys sp. aff. njalaensis*</i>	NE	Y	Y	2a	1
	n/a	<i>Marcusenius meronai*</i>	EN	Y	Y	1a, 2b	1
	n/a	<i>Raiamas scarciensis</i>	DD	Y	Y	<i>Possible 2b</i>	2
	n/a	<i>Rhexipanchax kabae</i>	VU	Y	Y	2b	2
	n/a	<i>Scriptaphyosemion cf. chaytori*</i>	NE	Y	Y	2a	1
	n/a	<i>Scriptaphyosemion wieseae</i>	NE	Y	Y	<i>Possible 2b</i>	2
	n/a	<i>Synodontis tourei</i>	NT	Y	Y	2b	2
Freshwater plants	n/a	<i>Ledermanniella aloides</i>	VU (RBG Kew = EN)	Y	N	1d	2
	n/a	<i>Ledermanniella yiben*</i>	NE	Y	Y	1a, 2a	1
Terrestrial plants	n/a	<i>Vepris felis</i>	NE (RBG Kew = EN)	Y	N	1d	2

Ptychadena sp. 2 was identified as a potential Critical Habitat-qualifying species in the CHA. Genetic analysis has highlighted that specimens are from the species *Ptychadena superciliaris*. This Near Threatened does not qualify for Critical Habitat and was therefore removed from the list of biodiversity values of the Project.

¹ Both species were identified as *Ptychadena* sp. 1 in the CHA.

² The species was identified as *Amphilius cf. platyichir* in the CHA.

³ Both species were identified as *Chiloglanis* sp. aff. *occidentalis* in the CHA.