



Reforestation in grassland areas of Uchindile,
Kilombero, Tanzania & Mapanda, Mufindi, Tanzania

Biodiversity Monitoring Results

1st January 1997 to 1st September 2012

Document overview

Green Resources has developed a biodiversity monitoring plan to monitor and assess the impacts, both positive and negative, of its “Reforestation In Grassland Areas Of Uchindile, Kilombero, Tanzania & Mapanda, Mufindi, Tanzania” project in terms of biodiversity. This monitoring plan is presented as part of the verification process under the Climate, Community and Biodiversity Alliance (CCBA), but also builds on current monitoring systems Green Resources has in place for other monitoring commitments, such as for the Forest Stewardship Council® (FSC).

Since the development of such a comprehensive monitoring plan was elaborated after project start it has meant that some of the monitoring parameters have not been monitored from the beginning of the project – this is explained in more detail further in the monitoring plan. However, all parameters will be monitored through subsequent monitoring periods. Each monitoring section within this monitoring plan describes the process of how each section’s indicators are assessed and what data will be recorded as the output.

The first verification event for the project under the CCBA using this monitoring plan, version 1, is planned for December 2012 and will cover the monitoring period from the 1st January 1997 until the 1st September 2012. As the project develops and undergoes future verifications, the monitoring plan will be adapted to ensure that any new impacts and/ or required indicators are monitored.

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A. General data

At each verification under CCBA (at least every 5 years), the areas (in ha) of the different land classes within the project will be measured and summarised. The following is a list of the different strata that will be covered – this is not exhaustive and new strata may be included if found within the project:

- Area of pine forest plantation
- Area of eucalyptus forest plantation
- Area of grassland
- Area of riverine vegetation
- Area of natural forest
- Area of planted indigenous species
- Area of water bodies

At this monitoring stage the total areas for the two parcels of land are 6,647 ha and 6,258 ha for Uchindile and Mapanda, respectively. Areas of different land classes are as shown in Table 1 and 2 below.

Table 1: Land class stratification of Uchindile Forest Project

Land class	Area (Ha)
Pine forest plantation	1675
Eucalyptus forest plantation	1531
Trial plantations (native and non-native species)	25
Grassland	800
Riverine vegetation	811
Natural forest	15
Valley bottoms	1924
Water bodies	109
Gullies	73
Fire belt	113
Total	7,076 ha
% of total area planted with Pine and Euc	45%

Table 2: Land class stratification of Mapanda Forest Project

Land class	Area (Ha)
Pine forest plantation	2502
Eucalyptus forest plantation	510
Grassland	1100
Riverine vegetation	1126
Natural forest	n/a
Valley bottoms	707
Water bodies	88
Gullies	14
Fire belt	288
Total	6,258 ha
% of total area planted with Pine and Euc	48%

Uchindile Forest Plantation Land Use and Species Distribution

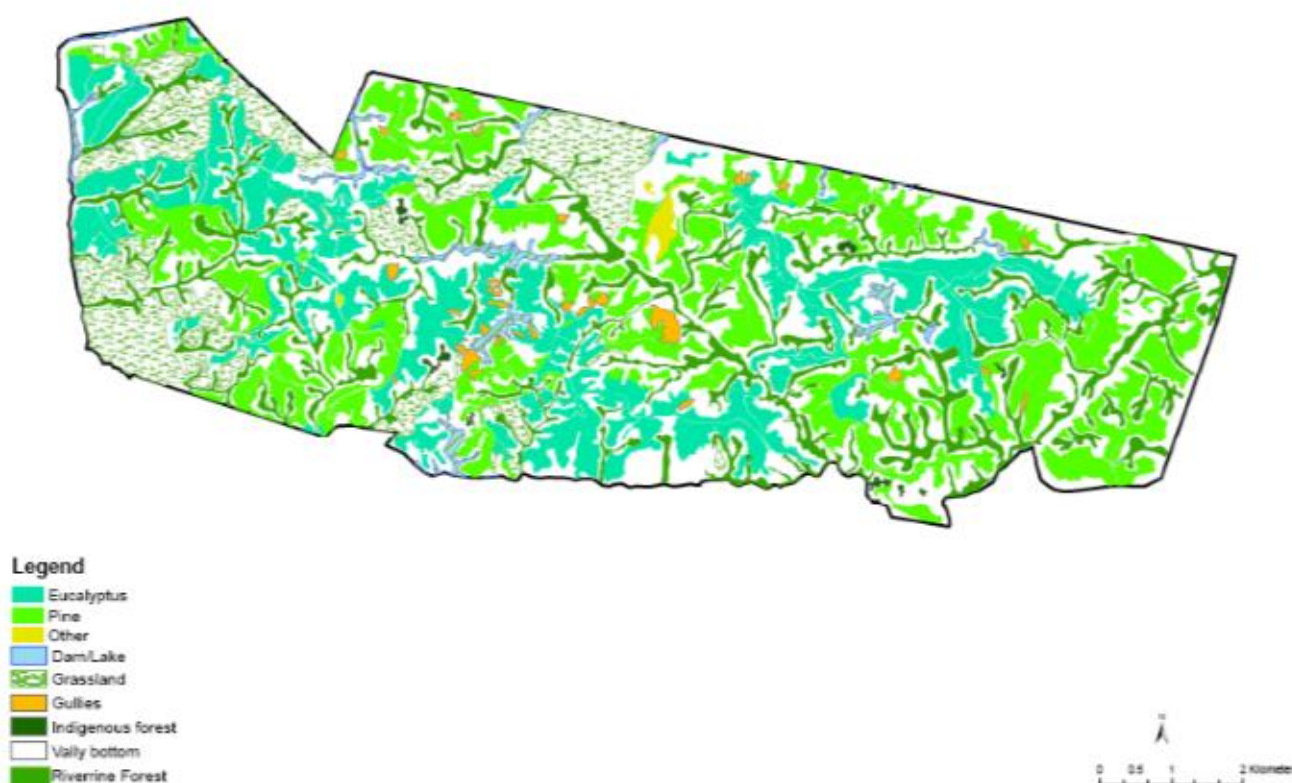


Figure 1. Land use map of Uchindile Forest Project

Mapanda Forest Plantation Land use and Species Distribution

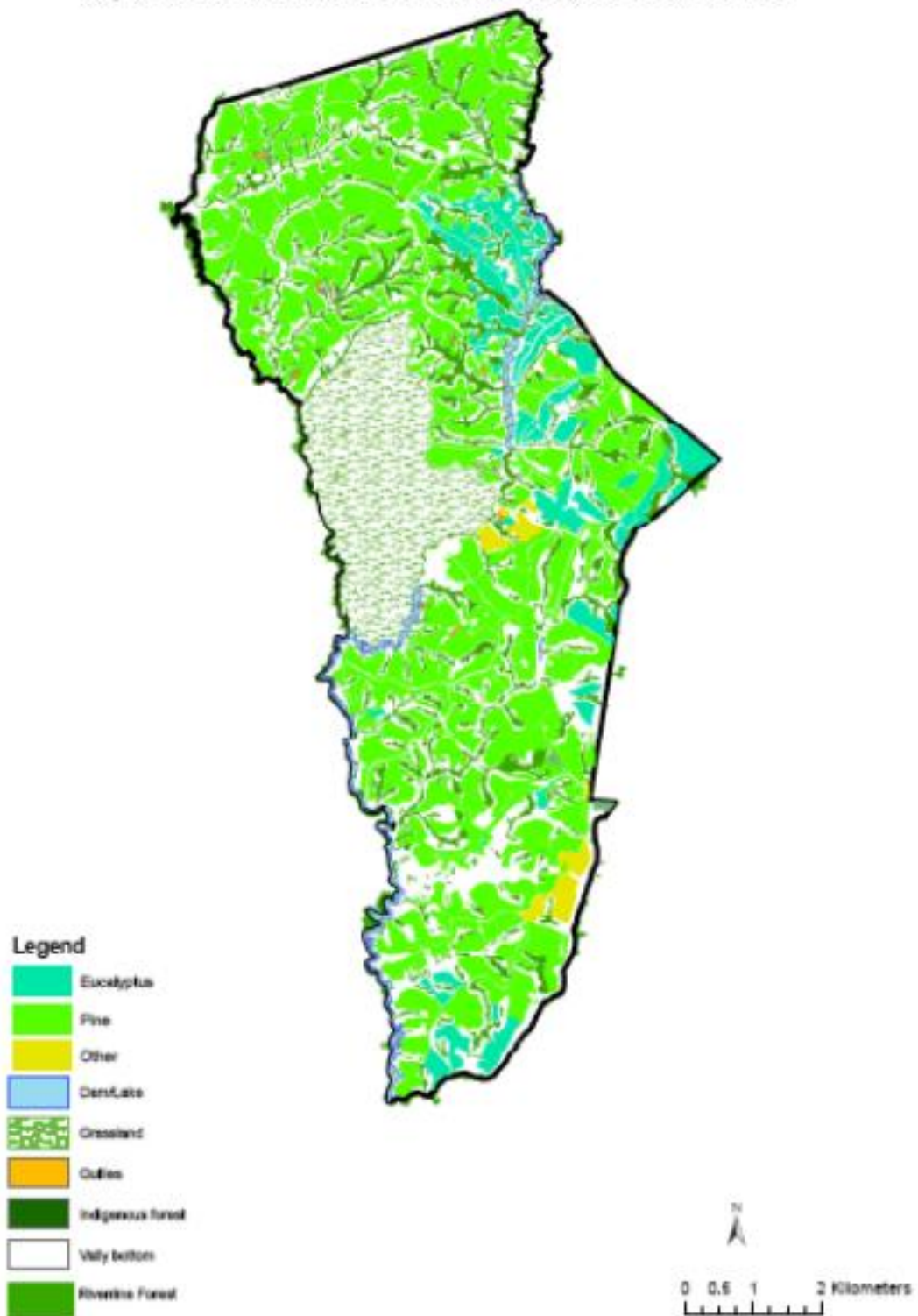


Figure 2. Land use map of Mapanda Forest Project

B. Maintenance of conservation areas

The conservation areas at Uchindile and Mapanda related to biodiversity¹ are as follows:

- *Blue swallow grassland*
- *Riverine forest – including wetlands*
- *Natural forest*
- *Water bodies*

The following are summaries of each of the conservation area assessments through a combination of high resolution satellite image analysis (comparing changes between 2005 and 2010) and ground truthing:

Blue swallow grassland

Blue swallow (*Hirundo atrocaerulea*) bird species were first identified in 2008 at Uchindile project site during an ecological survey by an external consultant, the Wildlife Conservation Society of Tanzania (WCST) to GRL. The habitat requirements for the bird species include highland grasslands interspersed with drainage lines in gullies and valleys with riverine forests. GRL has demarcated and maintained conservation areas specifically for the blue swallow as shown in figures 3 and 4 below. The conservation areas have been kept to their original conditions.

¹ Graves and ritual sites are also conserved but are covered in the community monitoring plans

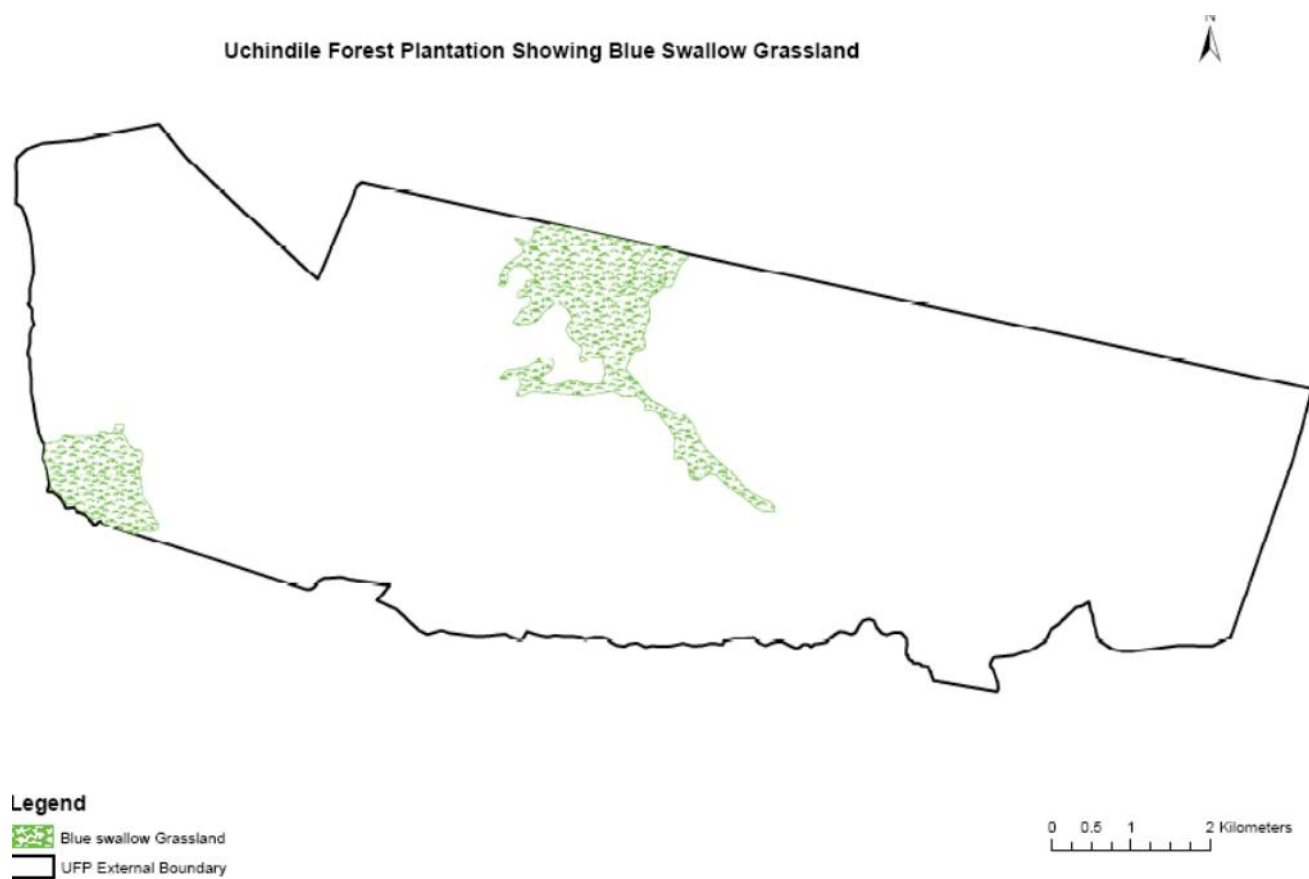


Figure 3. Blue swallow grassland areas at Uchindile Forest Project

Mapanda Forest Plantation Showing Blue Swallow Grassland



Figure 4. Blue swallow grassland areas at Mapanda Forest Project

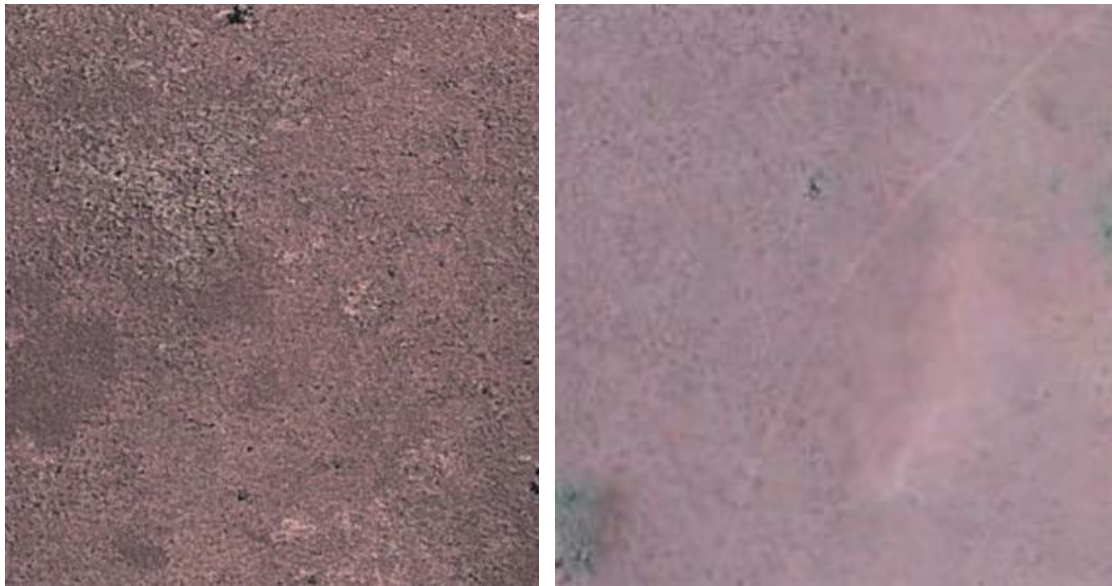


Figure 5. Examples of blue swallow grasslands at Uchindile (left) and Mapanda (right)

Management practises that are being undertaken in these areas include application of prescribed burning in some areas. This represents the baseline scenario where annual fire is common practice. It was required as a management practice to maintain grass and miombo woodlands and thus maintaining the ecological niche. Burning was done very carefully to avoid spread of fire into other areas than those that it was intended to, and minimise emissions. Sample plots, termed Natural Permanent Sample Plots (Natural PSPs) were also installed to record species abundance, diversity and increment in areas containing native vegetations. High resolution imagery were used to check landscape change prior to and at verification stage. These will be purchased at least every verification event (5 years), and more likely every 3 years, moving forward. The conservation areas within the project boundary have been stratified as follows:

For the first monitoring event, high resolution images from 2010 have been analyzed for both Uchindile and Mapanda. High resolution image from 2005 available were compared to the 2010 image to act as a baseline comparison (this is the earliest available high resolution satellite imagery). A selection of snapshots is presented in annex 1. A summary of results are as shown in table 3 below.

Table 3: Comparison of Blue swallow area for 2005 and 2010

Project	<i>Blue swallow grassland</i>	
	2005	2010
Uchindile	- Blue swallow area was not established. It was established in 2007. - Planting was not done in this, or its surrounding areas	-Criteria for conservation of blue swallow were identified as an area of land that is 330ha or more consisting riverine forest, protea tree species, grassland and wetlands. Such area will not be subjected to planting with exotic species, only restoration with native species where needed. - Surrounding areas are planted, and only conservation is left unplanted - The blue swallow grassland area in Uchindile is 440 ha
Mapanda	- Blue swallow area was not established. The blue swallow area was established in 2007. - Planting was not done in this, or its surrounding areas	- Criteria for conservation of blue swallow were identified as an area of land that is 330 ha or more consisting riverine forest, protea tree species, grassland and wetlands. Such area will not be subjected to planting with exotic species, only restoration with native species where needed. -Surrounding areas are planted, and only conservation is left unplanted - The blue swallow grassland area in Mapanda is 731 ha



Figures 6 and 7. Photos showing conservation areas at Mapanda and Uchindile forest plantations, respectively.

Some eucalyptus and bamboos were monitored in the conservation area in UFP during the ongoing monitoring. Since these are non-native species, they were removed to restore the natural value of the conservation area. The geographical coordinates of these clusters were taken and recorded, as well as photographs to document monitoring of exotic species outside plantation areas (figures 8, 9 and 10).



Figure 8 and 9. Satellite image and photo showing eucalyptus identified and felling



Figure 10. Photo showing bamboo cut

Riverine forest

Figure 11 and 12 below show the riverine forest areas that have been identified and demarcated at Uchindile and Mapanda, respectively.

Uchindile Forest Plantation Showing Riverrine Forest



Figure 11. Riverine forest at Uchindile Forest Plantation

Mapanda Forest Plantation Showing Riverrine Forest

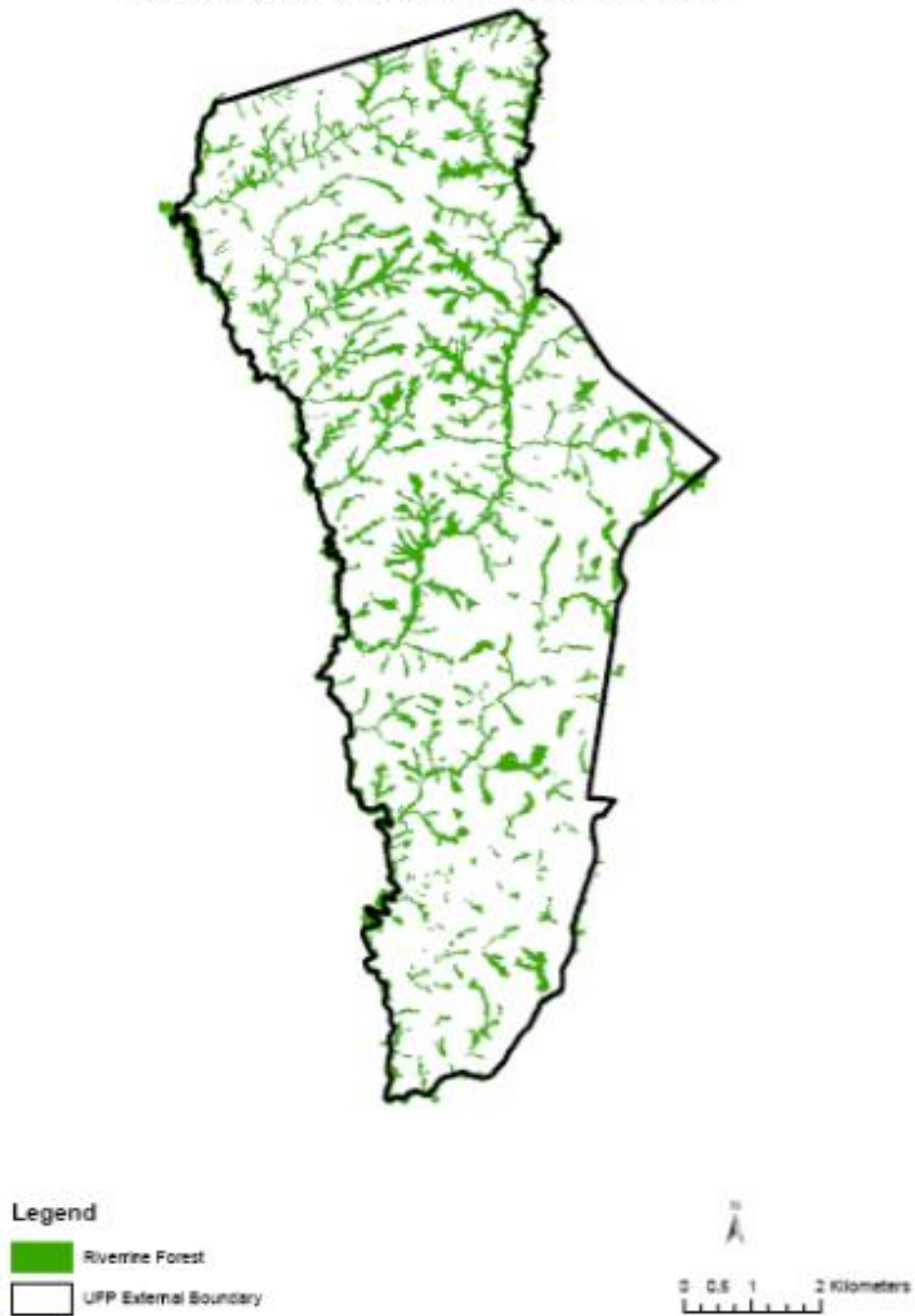
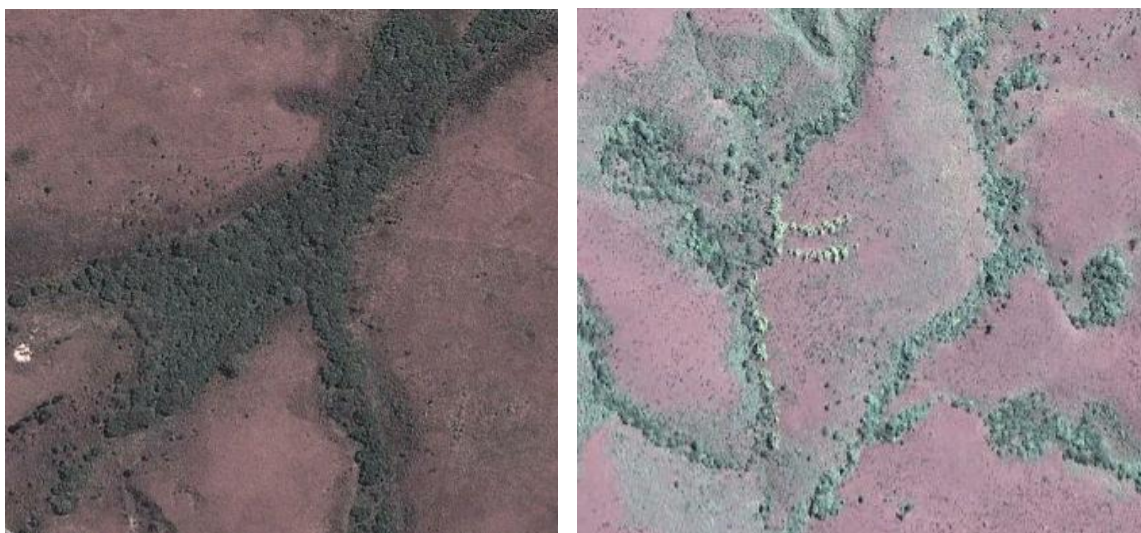


Figure 12. Riverine forest at Mapanda Forest Plantation



Figures 13 and 14. Example of riverine vegetation at Uchindile (left) and Mapanda (right)

For the riverine vegetation, a sampling methodology is adopted to carry out the analysis of this stratum. This is done due to this stratum being the largest, and significantly larger than any of the other strata. Sample plots of 5 ha will be randomly located within the stratum; 15 plots at each project location. Analysis of the sample plots is carried out through remote sensing with visual inspection to determine whether there have been any disturbances as well as whether the buffer zones have been adhered to. The sample plots will be compared to the previous assessment of the same sample plots to determine whether there has been change – either positive or negative – compared to the previous monitoring. At the first monitoring event, a comparison between 2005 and 2010 has been carried out for Uchindile and just a 2010 assessment for Mapanda (2005 satellite image was not available).

Table 4. Interpretation of Satellite Image of Riverine Forest

Project/Aspect	Monitoring Year		Evidence
	2005	2010	
Uchindile FP			
Buffer zones	At a distance of 30 meters from all water bodies, valleys and native forests	A distance of 60 meters for plantings after 2005 and 30 meters before 2005, maintained	Annex 3
Mapanda FP	2010		
Buffer zones	A distance of 60 meters for plantings after 2005 and 30 meters before 2005, maintained		Annex 3

Buffer zones where no planting takes place are implemented 30 and 60 meters² around conservation areas, such as, river courses, valley bottoms or riverine forests as well as pockets of native forests and 10 meters from grave yard/ritual sites; these areas are not planted with exotic tree species, and thus are left intact. During this monitoring period, monitoring of such areas has included uprooting any invasive or exotic species which might have germinated in the conservation areas. Satellite images have been used to see changes that have occurred to these areas comparing 2005 and 2010. This method will be applied at each verification.

Natural forest

Each parcel is monitored at each verification event as follows to show that it has been maintained and whether there have been any positive or negative impacts:

Natural forest was identified in the PDD in 8 different small discrete parcels at Uchindile. No forest remnants were found within Mapanda, except for the riverine vegetation, which has been identified as a separate stratum. Therefore the monitoring of natural forest vegetation is only carried out at Uchindile. All 8 pockets of forest are assessed at each monitoring event, or earlier if a high resolution image is available prior to the monitoring event. The pockets of forest are monitored to see if the trees are still standing or whether there has been degradation. In addition, monitoring of the buffer zones is carried out around the natural forest remnants. The areas will be compared to the previous assessment of the same area to determine whether there has been a change – either positive or negative – compared to the previous monitoring. At the first monitoring event, a comparison between 2005 and 2010 is made for Uchindile. Snapshots of each of the 8 parcels of forest were taken and are presented in annex 1.

² In 2005 the National Environmental Management Act was introduced which made it mandatory to have buffer zones around wetlands of 60m; prior to this, the buffer zone requirements were 30m

Uchindile Forest Plantation Showing Indigenous Forest

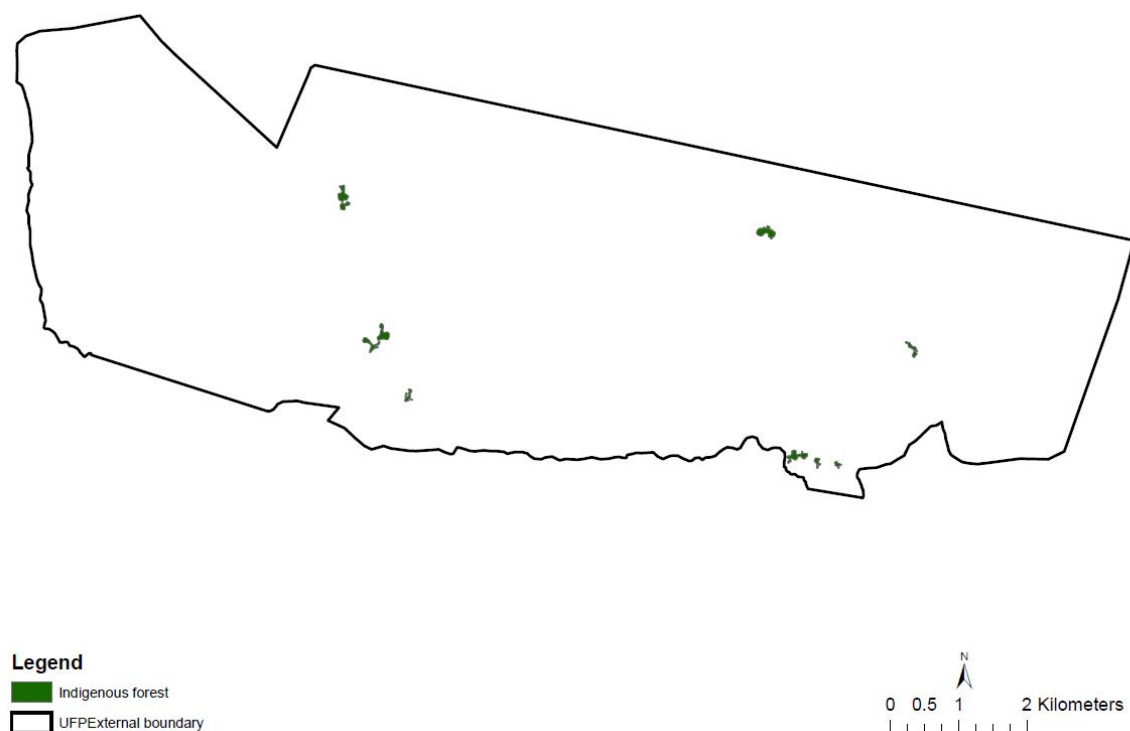


Figure 15. Areas of natural forest at Uchindile Forest Project

Table 4. Satellite Images and their interpretation at Uchindile Forest Project

Natural Forest ID	Change between 2005 and 2010	Evidence
1	None	The forest cover seems to have increased in 2010.
2	None	The forest cover seems to have increased in 2010. Gullies and landslides seem to have increased for reasons unknown, and therefore are subject to further monitoring.
4	None	No difference can be seen between the two images
21	None	No difference can be seen between the two images
31, 32, 33	None	No difference can be seen between the two images
35	None	No difference can be seen between the two images Images: Annex 1

Remote sensing data found that the native forests have not been affected by project implementation during this monitoring period. These features were being protected by ensuring no activity is undertaken, and by respecting the buffer zones.

Water bodies

There are 5 water bodies found at Uchindile, which are shown in the CCBA PDD. Mapanda does not have any water bodies other than streams. Similarly to the natural forest, water bodies are assessed at each monitoring event, or earlier if a high resolution image is available prior to this. The water bodies are stored in a GIS database with their size and will be monitored to see if the size of the water body has changed at all – seasonal variations will also be considered when carrying out the analysis – as well as monitoring of the buffer zones around the water body. The areas will be compared to the previous assessment of the same area to determine whether there has been change – either positive or negative – compared to the previous monitoring. At the first monitoring event, a comparison between 2005 and 2010 will be done for Uchindile. Selected snapshots for 2005 and 2010 are shown in annex 3 and their interpretation is included in table 5 below. No changes have so far been recorded.

Table 5. Interpretation of satellite Images of water bodies at Uchindile Forest Project

Water Body ID	<i>Change between 2005 and 2010</i>	<i>Evidence</i>
4	No	No difference can be seen between the two images
11	No	No difference can be seen between the two images
12	No	No difference can be seen between the two images
14	No	No difference can be seen between the two images
17	No	No difference can be seen between the two images

C. Ecological surveys

Ecological surveys are carried out at the project to monitor the impact that the project is having on fauna and flora and more generally to the ecosystems within the project area. The survey involves a combination of methods of assessing the fauna and flora of the different ecosystems, including line transects and sample plots, as well as interviews with key stakeholders who know the history of the areas. Management prescriptions are also provided to ensure that any issues that are highlighted are incorporated into management plans. A combination of in-house capacity and external capacity is used to carry out the ecological surveys: every five years an external ecological survey will be carried

out and every three years an internal ecological survey. For the first monitoring period that will be assessed under the CCBA, ecological surveys from 2006, 2007, 2008 and 2009 have been carried out. A number of frequent ecological surveys were carried out between 2006 and 2009 as it was found that further assessments were necessary to include species that hadn't previously been identified. The reason why ecological surveys are now planned after three to five years is that there haven't been any significant changes in terms of species composition and abundance in the previous studies.

The main ecological surveys contain an array of assessments of the different fauna and flora found within the different strata within the project boundary. In addition, they look at rare, threatened and endangered species, as well as invasive species. RTE species and invasive species are, however, covered in separate sections of this monitoring report. The table below summarises the findings of all studies that have been undertaken.

Table 6: Summaries of the past ecological surveys

Study 1	
Report date	February 2006
Field work date	20 – 26 July 2005
Study conducted by	Tanzania Tree Seed Agency (TTSA)
Full reference	GRL Report on Botanical Survey
Plantations covered	Uchindile, Mapanda, Idete
Methods	PSPs, 20m transects with 10m ² quadrants
Strata	
Key findings	<i>Prunus africana</i> (red stinkwood) and <i>Osyris lanceolata</i> (African sandalwood) were found in PSPs implemented at Mkungwe River (eastern and western side); the GPS coordinates are 0797932, 9065102 and 0796918, 9063758, respectively.
RTE species	<i>Prunus africana</i> (red stinkwood) and <i>Osyris lanceolata</i> (African sandalwood)
Conclusions	During the survey a total of 88 species were found across all three projects. The threatened RTE species listed above should be conserved.
Study 2	

Report Date	June 2006							
Field work date	June 2006							
Study conducted by	P.K.T Munishi							
Full Reference	Munish, P.K.T., 2006. Ecological Survey in the Kilombero Forest Project at Uchindile Kilombero District Tanzania							
Plantations covered	Uchindile							
Strata Found	Three strata namely patches of natural vegetation (grassland), valley bottom wetlands/ riverine vegetation and plantations. Plantations re-stratified by age and species of eucalyptus and pine.							
Methods	Field Observations and Indigenous knowledge. Field surveys done in the three types of ecosystem. The study employed transects method in field surveys. Transects of 4 meter wide and 0.5km long were established in each strata in predetermined direction and extended into the strata to cover as much variations as possible. Information collected included all plant and animal species encountered. Observations were made to identify signs that indicate presence of wildlife. Plants were identified by botanical names and indigenous knowledge							
Key findings	Different vegetation types have different species richness, each one representing unique habitats. In valley bottoms more than 80 plant species and 22 bird species were observed. Between 20 and 40 plant species were identified in natural grasslands. Approximately 31 bird species were reported to have been observed by the local people in different parts of the plantations. Full list of birds is given in the table below. <table><tr><td>Field Observation</td><td>Local people reports</td></tr><tr><td>Black kite</td><td>Martial eagle</td></tr><tr><td>Village indigobird</td><td>Black kite</td></tr></table>		Field Observation	Local people reports	Black kite	Martial eagle	Village indigobird	Black kite
Field Observation	Local people reports							
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	Village (black-faced) weavers	Hammerkop	
	Speckled mousebird	Bateuler eagle	
	White browed coucal	Frankolin	
	Tropical boubou	Green pigeon	
	Willow warber	Tambourine dove	
	Black- roughwing swallow	Helmeted guinea fowl	
	Chin –spot batis	Button quail	
	Variable sunbird	Grey –go-away bird	
	Pied crow	Cape eagle fowl	
	Common stonechat	Kingfisher	
	Little greenbul	Scimitabill	
	Blue spotted wood dove	Sunbird	
	Cardinal woodpecker	White stock	
	Yellow fronted citril	Wholly-necked stork	
	Widow bird	Abdim's stork	
	African firefinch	Yellow-vented bulbul	
	Black faced waxbill	Speckled mousebird	
	Dusky flycatcher	White browed robin coucal	
	Yellow vented bulbul	Pied crow	
	Red caped crombec	White crowned robin chat	
	Yellow crowned bishop	Paradise flycatcher	
	Eurasian bee eater	Yellow white eye	
	Singing cisticola	Tchagra?	
	Pigmy falcon	Ox-pecker	
	Purple grenadier	Drongo	
	Drongo	Black faced waxbill	

	White browed Scrub Robin	Pin tailed whydah
	Red-eyed dove	Widow bird
	Having identified 32, 23 and 17 species respectively from year 1, 4 and 8 stands of pine, as well as 29, 22 and 29 species respectively from year 1, 4 and 8 stands of eucalyptus; the study could not determine a significant difference in plant species composition between the different plantation ages and species. In addition, there was not a significant difference in terms of species composition between the natural vegetation (grasslands) and the plantations. The valley bottom wetlands had the most species identified.	
RTE Species	Not found	
Conclusions	The valley bottom is the most diverse stratum. The valley bottom is the most important habitat for enhancing biodiversity and water ecosystems. These should thus be left undisturbed. Most of the natural vegetation is influenced by fire, which is a major driver of the current biodiversity of the area. However, if excessively applied it may degrade the biodiversity by suppressing most of the herbaceous plants.	
Study 3		
Report Date	July, 2007	
Field work date	July, 2007	
Study conducted by	P.K.T Munishi & J. Wambura	
Full Reference	Munishi, P.K.T & Wambura, J., 2007. Munishi & Wambura, 2007. Ecological Survey in the Mufindi and Kilombero Forest Projects at Mapanda and Uchindile Tanzania	
Plantations covered	Uchindile and Mapanda	
Strata Found	Three strata namely patches of natural vegetation (grassland), valley bottoms wetlands/riverine ecosystem and plantations. Plantations re-stratified through a combination of age and species resulting in a total of 9 different strata.	

Methods	Field Observations and Indigenous knowledge. Field surveys done in the three types of ecosystem. The study employed transects method in field surveys. Transects of 4 meter wide and 0.5km long were established in each strata in predetermined direction and extended into the strata to cover as much variations as possible. Information collected included all plant and animal species encountered. Observations were made to identify signs that indicate presence of wildlife. Plants were identified by botanical names and indigenous knowledge																								
Key findings	The different vegetation types have different species richness each one representing a unique habitat that requires conservation. The valley-bottom wetlands/riverine ecosystems are the most diverse and with highest species richness. On average between 30 and 80 plant species were identified in the different bottomland /wetland sites of the plantations which make them a good repository of plant biodiversity. 24 and 20 species of mammals were observed/ reported at Uchindile and Mapanda respectively. These included: Uchindile mammal observations <table border="1"> <thead> <tr> <th>Common name</th><th>Scientific name</th></tr> </thead> <tbody> <tr> <td>bush pig</td><td><i>Potamochoerus porcus</i></td></tr> <tr> <td>Red duiker</td><td><i>Cephalophus natalensis</i></td></tr> <tr> <td>Grey duiker</td><td><i>Cephalophus grimmia</i></td></tr> <tr> <td>Suguya</td><td><i>Madoqua kirkii</i></td></tr> <tr> <td>Bush Buck</td><td><i>Tragelaphus scriptus</i></td></tr> <tr> <td>Bohor Reedbuck</td><td><i>Redunca redunca</i></td></tr> <tr> <td>Rock Hyrax</td><td><i>Heterohyrax brucei</i></td></tr> <tr> <td>Giant Gambian Rat</td><td><i>Cricetomys gombianus</i></td></tr> <tr> <td>House rat/</td><td><i>Rattus rattus</i></td></tr> <tr> <td>Cane Rat</td><td><i>Thryonomys swinderianus</i></td></tr> <tr> <td>Hare</td><td><i>Lepus capensis</i></td></tr> </tbody> </table>	Common name	Scientific name	bush pig	<i>Potamochoerus porcus</i>	Red duiker	<i>Cephalophus natalensis</i>	Grey duiker	<i>Cephalophus grimmia</i>	Suguya	<i>Madoqua kirkii</i>	Bush Buck	<i>Tragelaphus scriptus</i>	Bohor Reedbuck	<i>Redunca redunca</i>	Rock Hyrax	<i>Heterohyrax brucei</i>	Giant Gambian Rat	<i>Cricetomys gombianus</i>	House rat/	<i>Rattus rattus</i>	Cane Rat	<i>Thryonomys swinderianus</i>	Hare	<i>Lepus capensis</i>
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	Small spotted	<i>Genetta genetta</i>	
	Banded Mangose	<i>Mungos mungo</i>	
	Yellow Baboon	<i>Papio cynocephalus</i>	
	Vervet Monkey	<i>Cercopithecus aethiops</i>	
	African Buffalo	<i>Syncerus caffer</i>	
	Black Rhinoceros	<i>Diceros bicornis</i>	
	African Elephant	<i>Loxodonta africana</i>	
	Leopard	<i>Panthera pardus</i>	
	Hippo	<i>Hippopotamus amphibius</i>	
	Mapanda mammal observations		
	Common name	Scientific name	
	Bush pig	<i>Potamochoerus porcus</i>	
	Red Duiker	<i>Cephalophus natalensis</i>	
	Common Duiker	<i>Cephalophus grimmia</i>	
	Kirk's Dikdik	<i>Madoqua kirkii</i>	
	Bush Buck	<i>Tragelaphus scriptus</i>	
	Bohor Reedbuck	<i>Redunca reducta</i>	
	Cricot Gambia Rat	<i>Cricetomys gambianus</i>	
	Mole Rat	<i>Rattus rattus</i>	
	Cant Rate	<i>Thyonomys swinderianus</i>	
	Cape hare	<i>Lepus capensis</i>	
	Banded Mongosse	<i>Mungos mungo</i>	
	Senter Mangosese	<i>Herpestes sanguineus</i>	
	Acindvashe	<i>Orycteropus afer</i>	
	Black – backed Jackal	<i>Canis mesomelas</i>	

	But – reed Fox	<i>Otooyon megalotis</i>
	Honey badger	<i>Mellivora capensis</i>
	Common Genet	<i>Genetha genetho</i>
	Yellow Baboon	<i>Papio cynocephalus</i>
	Vervet Monkey	<i>Cercopithecus aethiops</i>
	Fonr-toed Hedgehog	<i>Erinacus albiventus</i>
	African Crested Porcupire	<i>Hystrix africae</i>
	Wast Hog	<i>Phacochoenus aethipicus</i>
	African civet	<i>Viverra civetta</i>

Approximately 28 bird species were observed at Mapanda and 30 species at Uchindile. Further, 7 and 9 species of reptiles were observed at Mapanda and Uchindile respectively. There was a higher richness of both taxa in the valley-bottom wetlands/ riverine ecosystems. Full list of birds that were identified is given in the table below.

Some Birds observed at Uchindile

Common name	Scientific name
Red-eyed dove	<i>Streptopelia semitoguata</i>
Emerald-spothed Wood Dove	<i>Turtur chalcospilas</i>
White-browed Crucal	<i>Centropus superciliosus</i>
Cardinal woodpecker	<i>Campethera fuscescens</i>
African (Grassland) pipit	<i>Anthus cinzamomeus</i>
Speckled Mousebird	<i>Colins striatus</i>
Dark-capped Balbal	<i>Pycnonotus tricolor</i>
While browed scrub Robin	<i>Cercotrichas leucophrys</i>

	Nightingale	<i>Luscinia megarhynchos</i> (NM)
	Stonechat	<i>Saxicola torquata</i> (NM)
	Rueppell's Robin Chat	<i>Cossypha seminota</i>
	Miombo Rock Thrush	<i>Monticola angolensis</i>
	Grey – Backed Camaroptera	<i>Camaroptera brachyuran</i>
	Trilling Cisticola	<i>Cisticola woosnami</i> (AM)
	Twany – flanked prinia	<i>Prinia subflava</i>
	Rufous chatterer	<i>Turdoides rubiginosus</i>
	Variable sunbird	<i>Nectarinia venusta</i>
	Tropical Boubau	<i>Laniarius aethiopicus</i>
	Pied crow	<i>Cornus albus</i> (AM)
	Baglafaecht Wearer	<i>Ploceus baglafaecit</i>
	Marsh Widowbird	<i>Euplectes hartlambi</i>
	Yellow – Moulded Widowbird	<i>Euplectes macrourus</i>
	Pin-tailed whydah	<i>Vidua macroura</i>
	Common waabill	<i>Estrilda astrild</i>
	Atock – crowned weabill	<i>Estrilda nonnula</i>
	African firefinch	<i>Lagonosticta rubricate</i>
	Green – Backed Twinspot	<i>Mandigoa nitidula</i>
	Southern Cordonbleu	<i>Uraeginthus angolensis</i>
	Bronze Mannikin	<i>Lonchura cucullata</i>
	East African Citril	<i>Serinus hypostictus</i>
	Some Birds observed at Mapanda	

	Species Name		Family	Habitat
	English/Local	Scientific		
	Angus Buzzard	<i>Buteo augur</i>	Acciptridae	Sky
	Harlequin Quail	<i>Coturnix delegorguei</i>	Phasianidae	Grassland
	Red-necked Spurfowl	<i>Francolinus levaillantii</i>		
	Red-eyed Dove	<i>Streptopelia semitorquata</i>	Columbidae	Riparian, plantation
	Green Pigeon	<i>Teron calva</i>		
	White-browed Conical	<i>Centropus superciliosus</i>	Centropidae	Riparian
	Speckled Monsebird	<i>Calus striatus</i>	Coliidae	Riparian
	Little Bee-Cater	<i>Merops pusillus</i>	Meropidae	Riparian
	Wire-tailed Swallow Black-Roughwing	<i>Himantopus smithii</i> (AM) <i>Psittodoprocne holomelas</i> (NM)	Himantodidae	Riparia/Grasslands /Plantation
	African (Grassland) pipit	<i>Anthus cinnamomeus</i>	Motacillidae	Grassland
	Golden pipit	<i>Troglodytes tenuis</i>		
	Yellow-throated Longclaw	<i>Macropygia croceus</i>		
	Dark-capped Bulbul	<i>Pycnonotus tricola</i>	Pycnonotidae	Riparian
	White-browed Scrub Robin	<i>Certhiopsis leucophrys</i> (NM)	Turdidae	Riparian, Common
	Stone Chat	<i>Saxicola torquata</i> (AM)		resident Grassland
	Sedge Warbler	<i>Acrocephalus schoenobaenus</i> (NM)	Sylviidae	Grassland
	Twany-flanked primia	<i>Prinia subflava</i> (AM)		
	Sooty Flycatcher	<i>Muscicapa infusate</i>	Muscicapidae	Riparian
	Dusky Flycatcher	<i>Muscicapa adusta</i>		
	Paradise Flycatcher	<i>Terpisphe viridis</i>	Monarchidae	Common resident
	Variable Sunbird	<i>Nectarinia venusta</i> <i>Nectarinis senegalensis</i>	Nectarinidae	Riparian, Plantation, Grassland
	Tropical Bonbon	<i>Laniarius aethiopsians</i>	Malaconotidae	Riparian
	Fork – tailed Drongo	<i>Dicrurus adsimilis</i>	Dicruidae	Riparian
	Pied crow	<i>Corvus albus</i> (AM)	Corvide	Grassland, Riparia, Plantation
	Yellow Bishop	<i>Euplectes capensis</i>	Ploceidae	Grassland/Plantations
	Brimstone Canary	<i>Serinus sulphuratus</i>	Fringillidae	Riparian
RTE species	Although the report did not state that any RTE species were found; the species <i>Prunus africana</i> and <i>Osyris lanceolata</i> were identified and these are classed as RTEs			
Conclusions	The project area still harbours an appreciable richness in terms of wildlife with the majority of species being found in the valley bottom/ riverine stratum.			
Study 4				
Report Date	March 2008			
Field work date	February to March, 2008			
Study conducted by	L. Melamari, S. Mbwana, E. Pius & B. Emidi (WCS Tanzania)			
Full Reference	WCST, 2008. Consultancy Report on Ecological Survey of Uchindile and Mapanda Reforestation Projects in the Southern Highlands-Tanzania			

Plantations covered	Kilombero (Uchindile) and Mafinga (Mapanda)																				
Strata Found	Stratification based on vegetation zones, two vegetation zones were found, that is, valley bottoms and wooded grasslands																				
Methods	Point count survey, vegetation plot, track signs and transects. Night drive and opportunistic survey were also applied. Interviews with local people. Remote sensing, land cover interpretation.																				
Key findings	Although the area is rich in biodiversity, the area has suffered a lot of loss of mammals due to uncontrolled harvests and change in habitats because of uncontrolled fires. Reptiles are fewer than expected or this may be due to the herbaceous ground cover. Old plantations have shown signs of suppressing herbaceous undergrowth. Blue swallow, an intra-African migratory bird species, which is vulnerable under the IUCN and endangered to East Africa was spotted and protection recommendations were given. Setting aside an area for blue swallow conservation was advised. Several species were identified as important species that needed special management. Such species included <i>Szygium guneense</i> and <i>Szygium codotum</i> – which are water conserving species, <i>Osyris lanceolata</i> and <i>Catha edulis</i> and Orchids. The most applicable conservation strategy for all these species was <i>in situ</i> conservation where the trees are left to grow naturally in the habitats, supported where feasible with enrichment planting. Bird species were also identified that were of conservation concern. These are shown in the table below. <i>Sightings of the birds of conservation concerns</i> <table><tr><td>Bird spp</td><td colspan="2">GPS Coordinates</td></tr><tr><td>Uhehe Fiscal</td><td>795738</td><td>9063683</td></tr><tr><td>European Bee-eater</td><td>795738</td><td>9063683</td></tr><tr><td>Churring Cisticola</td><td>771160</td><td>9038531</td></tr><tr><td>Blue Swallow</td><td>766834</td><td>9035504</td></tr><tr><td>Blue Swallow</td><td>768348</td><td>9036788</td></tr></table>			Bird spp	GPS Coordinates		Uhehe Fiscal	795738	9063683	European Bee-eater	795738	9063683	Churring Cisticola	771160	9038531	Blue Swallow	766834	9035504	Blue Swallow	768348	9036788
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	Eurasian Hobby	768348	9036788
	Fulleborn's Black Boubou	771413	9038561
	Coppery-tailed Coucal	768888	903822
	Short-tailed Pipit	771835	9039435
RTE spp	<i>Osyris lanceolata</i> , <i>Orchids</i> , Blue swallow (<i>Hirundo atrocaerulea</i>) <i>Poeoptera kenricki</i> (East African endemic) and Uhehe Fiscal (endemic to Iringa)		
Invasive spp	<i>Acacia mearnsii</i> , <i>Rubus spp</i> , <i>Bambusa balcoae</i> , <i>Psidium guajava</i> , <i>Lantana camara</i> and <i>Cleteric centata</i> with <i>Rubus spp</i> being the most common.		
Conclusions	Conserve some areas; leave them intact and in pristine conditions. Although the study did not see that invasive species would be a big threat, it recommended that they should be uprooted. Grassland area should be set aside for protection of blue swallow.		
Study 5			
Report Date	March 2010		
Field work dates	From April 2009 – March 2010		
Study conducted by	P.K.T Munishi, D. Shirima & J. Wambura		
Full Reference	Munishi, P.K.T. & Shirima, D. 2010. Annual Ecological Survey and Monitoring in GRL Afforestation Projects in Idete, Mapanda and Uchindile		
Plantations covered	Uchindile, Mapanda & Idete		
Strata Found	At Uchindile and Mapanda four strata were identified including valley bottom wetland/riverine vegetation, natural grassland, wooded grassland and plantations. The number of plant species varied between vegetation types with the most plant species found in the valley bottom/ riverine vegetation (95 species). A range of plant species from 51 to 81 was found in the grassland areas (the lower range found in wooded grasslands). A significant number of plant species were found in the plantation stands, being		

	87 and 89 in pine and eucalyptus stands at Uchindile. Species composition in different age classes differed in abundance but not in a particular pattern, in pine stands for example 9, 5, 7, 15, 14 and 16 native plant species were encountered in stands of 1997, 2002, 2003, 2005, 2006/2007 plantings respectively. A total of 44 birds were found, two of which were migratory. 20 mammals were also found.
Methods	Line transects, point count, interviews
Key findings	The vegetation zones contain various species and life forms, each one representing unique habitats that require a unique management and conservation approach. There was no clear trend of species composition in relation to age of stands of different stands of eucs and pines.
RTE species	<i>Osyris lanceolata</i> and <i>Prunus africana</i> identified as threatened. Uhehe Fiscal and Iringa Akalat (threatened endemic species) were also identified.
Invasive spp	<i>Acacia mearnsii</i> , <i>Conyza bonariensis</i> , <i>Mangifera indica</i> , <i>Manihot glaziovii</i> , <i>Passiflora edulis</i> , <i>Physalis peruviana</i> , <i>Psidium guajava</i> , <i>Tagetes minuta</i> , <i>Bidens pilosa</i> , <i>Smithia elliotii</i> , <i>Rubus pinnatus</i> ; <i>Agave sisalan</i> , <i>Galinsoga parviflor</i> , <i>Ilex mitis</i> , <i>Manihot esculenta</i> , <i>Oxalis latifolia</i> , <i>Physalis peruviana</i>
Management Prescriptions for different ecosystems	Grasslands: Maintain as much as possible of this ecosystem as an example of a natural ecosystem in the area Prevent from fire and if necessary establish a prescribed fire regime that restores and maintains the ecological functions of naturally occurring grasslands in conservation areas e.g. application of early burning at a minimum Burning should take into account creations of mosaic of burned and non burned patches. Furthermore, when burning fire should be applied from the center of the patches designated for burning. Valley bottom grasslands should be maintained in the plantation For the purpose of future reference and research a small parcel of land say 30 - 50 ha of pure grassland (a true representative of the planted area) can be set aside for conservation irrespective of where it is located Valley bottoms and wetlands: Leave the areas completely undisturbed and as intact as possible

	Enhance their conservation through restoration where necessary. Exclude fire and exotic alien invasive species completely Catchment management on riparian zones including vigorous application of measures to avoid soil erosion, Maintain a buffer of natural vegetation of about 60 m of riparian vegetation from major water sources and restore with indigenous vegetation where necessary Areas with high concentration or abundance of rare or endangered species should be set aside and conserved Maintain other areas where blue swallows and African black duck were observed. Where possible maintain a continuous habitat of this type. Monitor whether they are breeding or on transit Plantations: All forest management operations will adhere to the silvicultural prescriptions outlined by the Forest and Beekeeping Division At time of clear cutting the clear cut size should be kept low to avoid abrupt opening of large areas that may have negative implications on the biodiversity and ecological functioning Thinning in areas that have high conservation values should be carried out when the stand has achieved merchantable age in order to avoid frequent disturbances. Planting at wider spacing
Conclusions	The study found eight plant growth forms which were unevenly distributed with herbs being most dominant. Others included trees, grasses and shrubs. Grasses were an important component of the system as most of the area composed of grasslands which make habitats for birds and other fauna like mammals. More species were recorded in this study than the previous ones. There were more species identified in grasslands as research is undertaken across the year The study could not find change differences between old stands of eucalyptus and pine and unplanted grasslands in terms of species abundance and diversity.
Study 6	

Report Date	September 2012
Field work dates	10 to 20 th September 2012
Study conducted by	P. Mussami, V. Kimey
Full Reference	Biodiversity Monitoring Report – Mapanda and Uchindile Forest Plantations, September 2012, Green Resources
Plantations covered	Mapanda and Uchindile
Strata Found	Grassland conservation area, valley bottom, wooded grassland and plantation areas
Methods	Plot quadrant count (plants and birds) of 11 x 11m for trees and 1 x 1m for the herbaceous layer; transect of 200 to 500m (mammals).
Key findings	
RTE species	Some RTE species were recorded, namely, <i>Osyris lanceolata</i> and <i>Anas sparsa</i> at Uchindile and <i>Aloe sp</i> , <i>Prunus Africana</i> , <i>Iringa akalat</i> and <i>Uhehe fiscal</i> at Mapanda.
Invasive spp	No records
Management Prescriptions for different ecosystems	Not applicable
Conclusions	Confirmation that GRL plantation activities still provide diverse habitats for flora and fauna species and that these biodiversity rich habitats (grassland, valley bottom and natural forest) are being conserved.

Overall the ecological surveys demonstrate that the richest land class stratum is the riverine vegetation; the grassland area harbours less biodiversity than the riverine forest but still contains a significant value – mainly in regard to herbaceous species and due to the blue swallow also relying on this habitat. Some of the surveys have assessed biodiversity within the planted pine and eucalyptus

stands and have shown that there is significant biodiversity – a number of mainly herbaceous species as well as birds that were spotted – however, the project is conservatively not including any such benefits in the biodiversity results.

D. HCVF

HCVF areas have been identified at UMFP due to RTE species being present, or likely to be present, in certain habitats found with the project zone. RTE species are monitored every three years through internal ecological surveys and will also be incorporated into any future external ecological surveys as well. Since many of the RTE species are, by the very nature of their status, likely to be difficult to monitor, indicators will be used act as a proxy to determine habitat health and suitability of the conservation areas for the RTE species that depend on them. For the riverine forest stratum, where RTE species of both flora and fauna are found, a combination of natural permanent sample plots and line transects will be implemented to identify species. For the blue swallow conservation areas, line transect will be carried out and point counts of birds taken.

Figure 16 and 17 show the HCVF areas defined in the Uchindile site and as sample plots that have been implemented to monitor species and habitat health in these areas, respectively. The biodiversity monitoring plan only covers the monitoring of the riverine forest and blue swallow grassland area within the HCVF areas – the grave and ritual sites are assessed in the community monitoring results. Figure 17 and 18 show the respective maps for the Mapanda site.

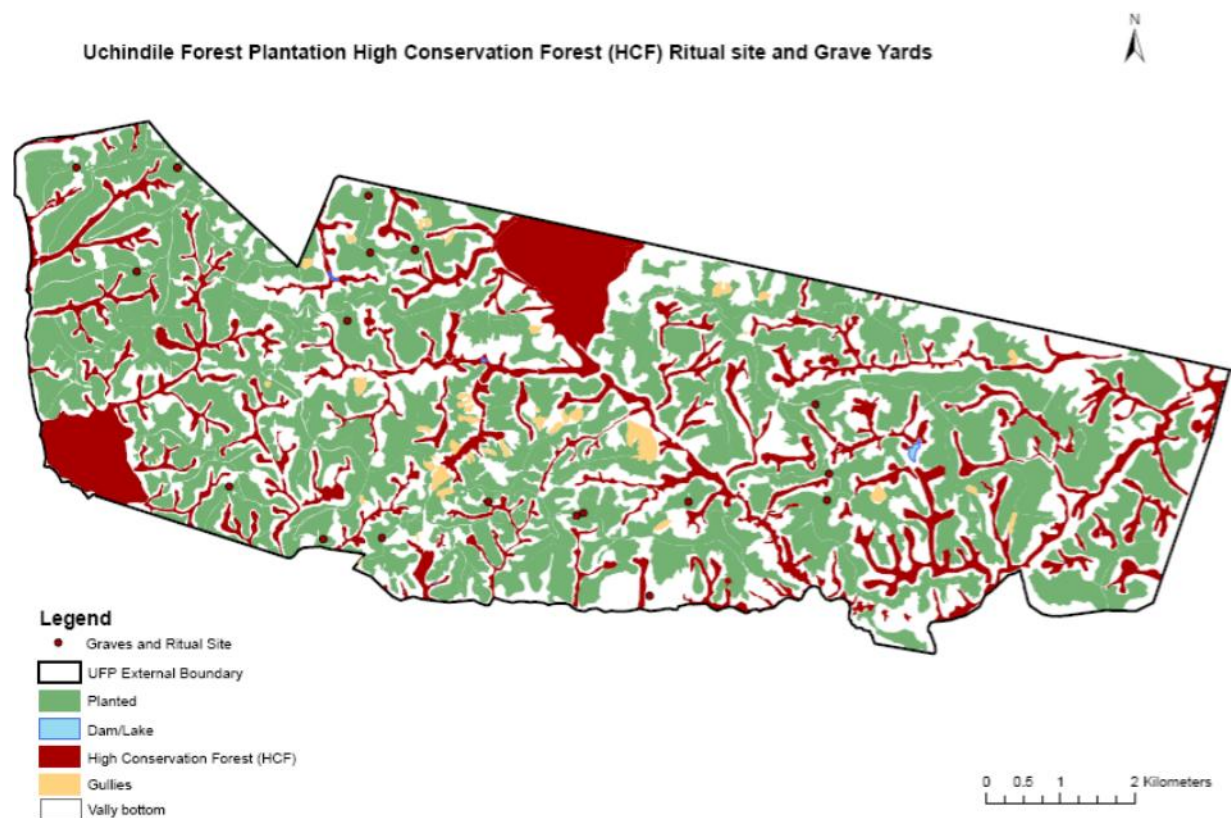


Figure 16. HCVF and graves/ritual sites identified at Uchindile Forest Project

Uchindile Forest Plantation Land Use Monitoring Point And PSP's

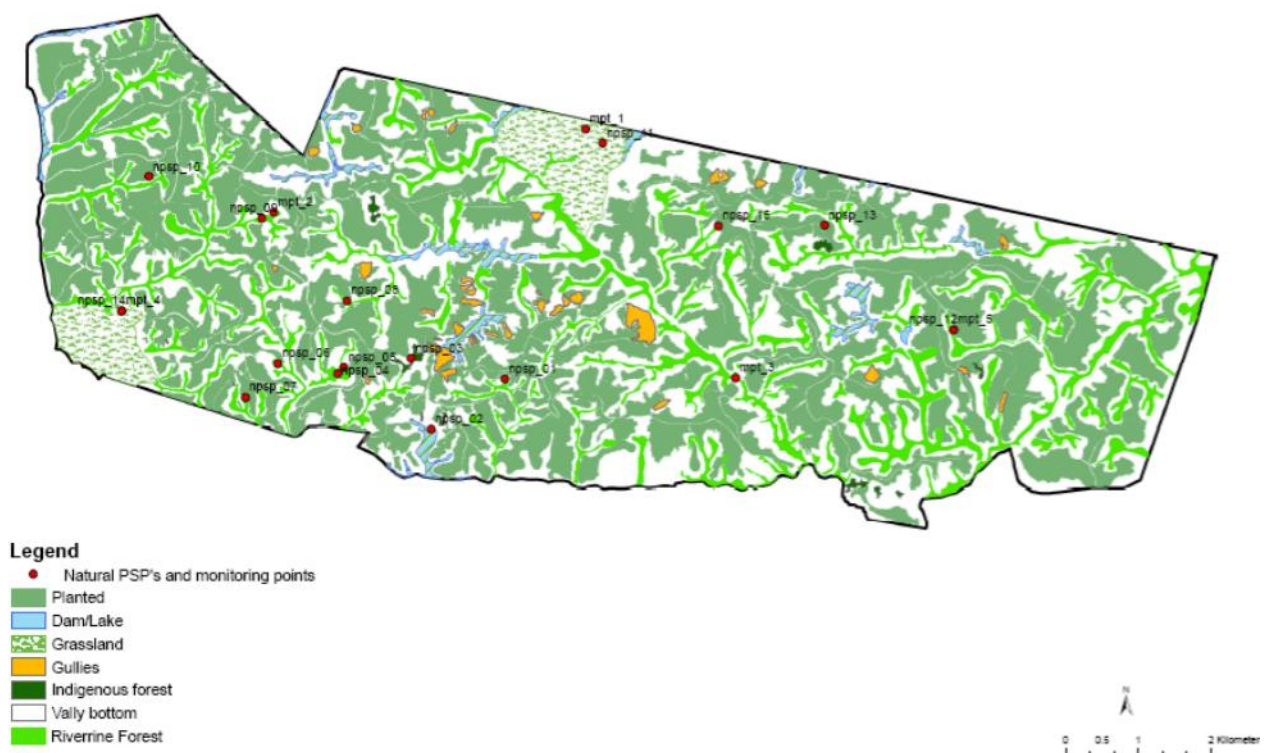


Figure 17. Land use map with natural PSPs and monitoring points at Uchindile Forest Project

Mapanda Forest Plantation High Conservation Forest (HCF) Ritual site and Grave Yard

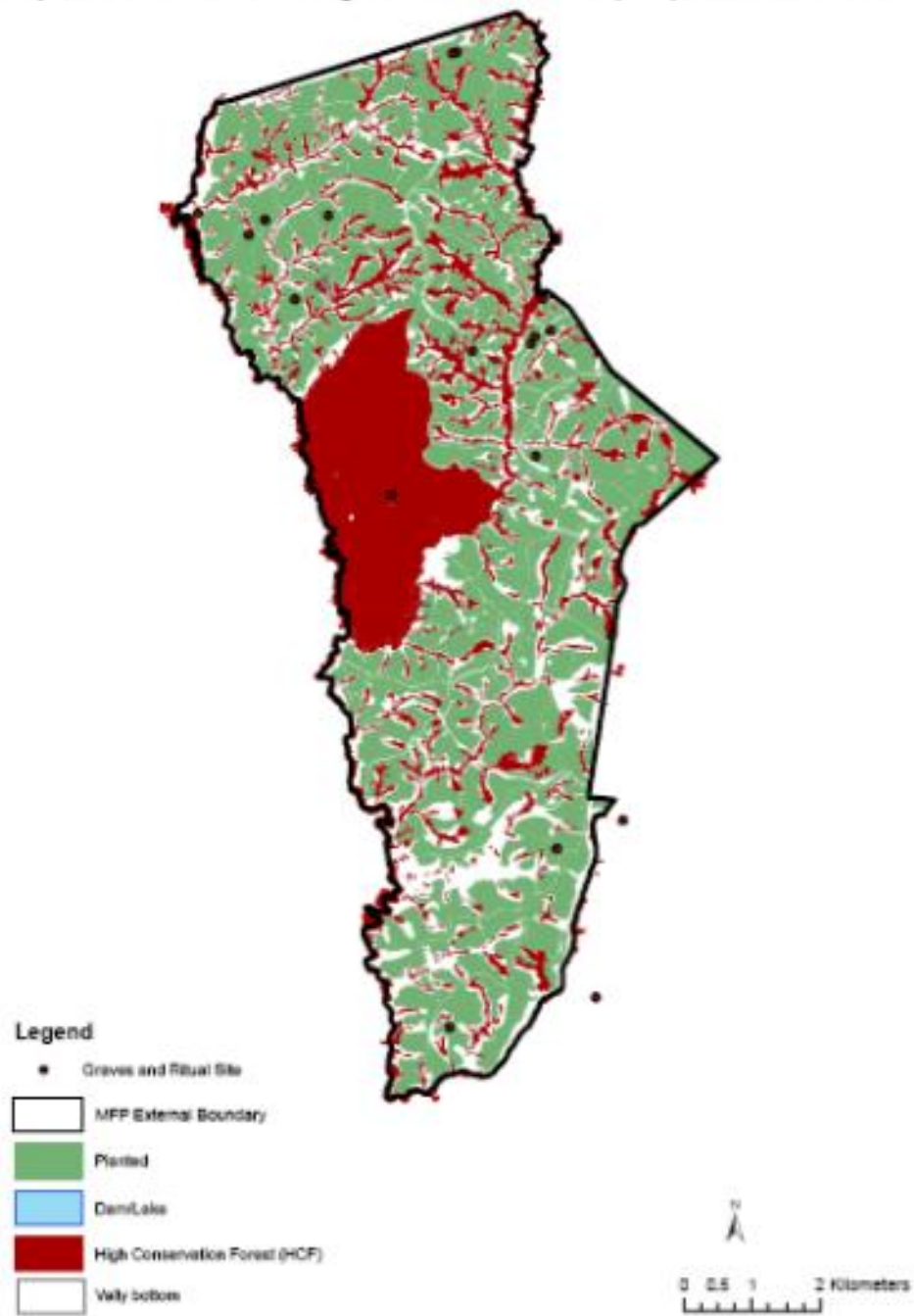


Figure 18. HCVF and graves/ritual sites identified at Mapanda Forest Project

Mapanda Forest Plantation Land Use Monitoring Points and Natural PSP's

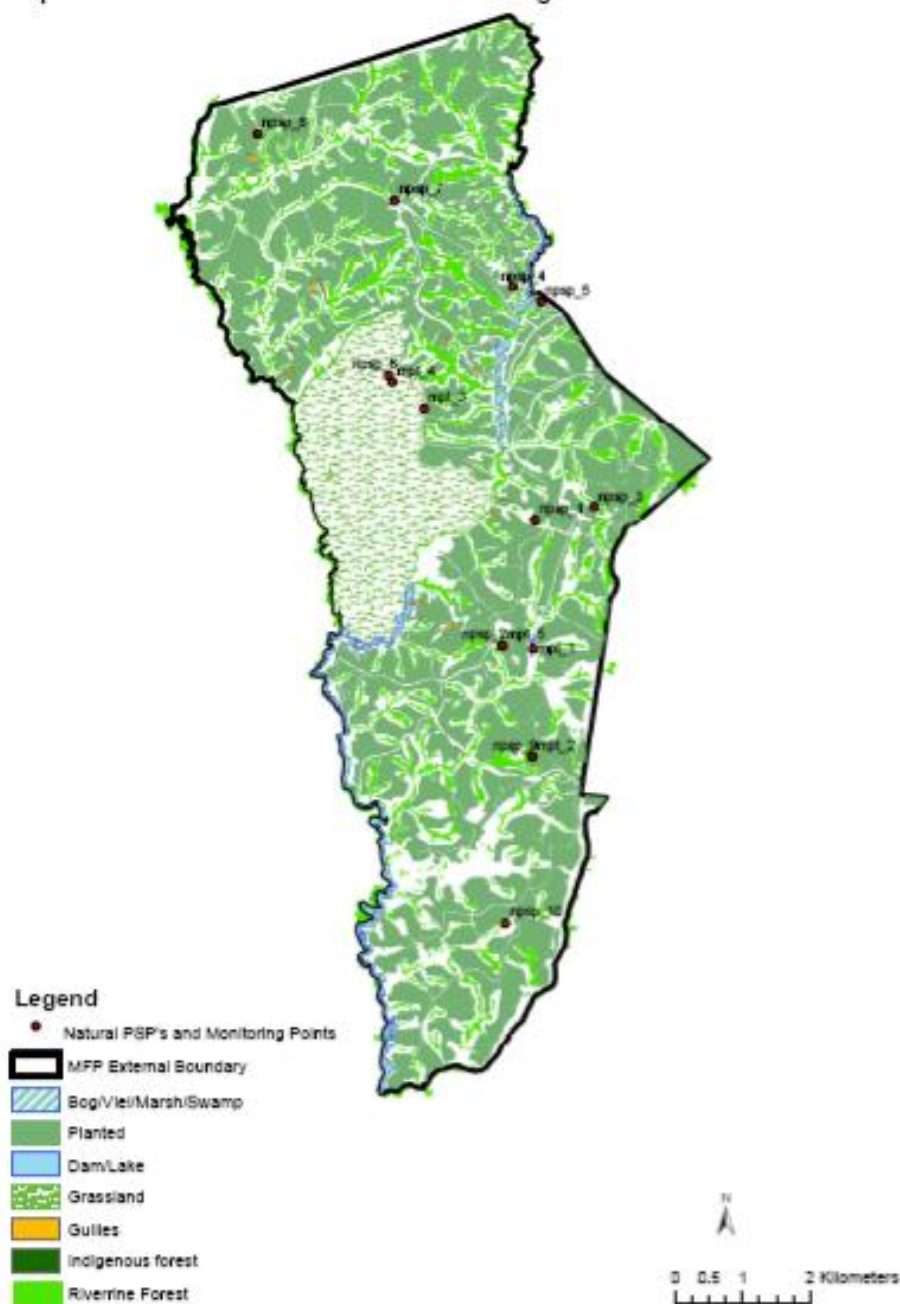


Figure 19. Land use map with natural PSPs and monitoring points at Mapanda Forest Project

Riverine Forest – including wetlands

The latest ecological survey, “Biodiversity Monitoring Report, Mapanda and Uchindile Forest Plantations, September 2012” found more than 30 plant species at Uchindile and 40 at Mapanda in the riverine forest during the survey. The riverine forest is dominated by tree species like *Syzgium cordatum*, *Bridelia micrantha* and *Rauvolfia caffra*, which help to protect and conserve water for biodiversity. These species indicate that this land class stratum is in good health. The results also

show that species like *Acrostichum aureum*, *Seratic serata*, and *Clutia abyssinica* are the most dominant herbs/shrubs species in the area. The grass cover was observed to be less than 30% in valley bottom due to the effects of shading and water logging.



Figure 20. *Acrostichum aureum* observed in valley bottom (Uchindile)

Previous surveys identified *Osyris lanceolata* and *Prunus africana* which occur in low abundance in both plantation and natural vegetation as the only threatened plant species at Uchindile. This survey found *Osyris lanceolata* in one sample plot. At Mapanda the past ecological surveys reported the presence of RTE species such as orchid species and *Cynthea thomiini* – none of these species were identified in the latest Ecological Survey, but that would not necessarily be expected due to the scarcity of such species. However, aloe species were observed in three locations (points 1, 2, 4) and *Prunus africana* recorded at points 1 and 2. These results prove that the RTE species are present in only small numbers and scattered in the riverine forest of the project; hence by protecting this land class stratum as HCVF, GRL is protecting the Rare, Threatened and Endangered species (RTEs) that depend upon it. The points where the RTE species have been found have been recorded and will be re-monitored in the next ecological survey to compare the abundance and growth.

Table 7. RTE plant species found in valley bottoms at both plantation sites.

Bird species		Valley bottom / wetland (number of count)	
Local name	Scientific name	Uchindile	Mapanda
Mwembe vidunda	<i>Osyris lanceolata</i>	5	0

Mwiluti	<i>Prunus africana</i>	0	9
Litembwe	Aloe species	0	3



Figure 21. *Prunus africana* at NPSP 2 (Mapanda)



Figure 22. *Osyris lanceolata* observed at NPSP 2 (Uchindile)

According to ecological survey there are no records of Rare, Threatened or Endangered species of mammals at Uchinidle and Mapanda forest plantations. However the precautionary principle has been applied by GRL and as such all habitats of these RTE mammals will be conserved to ensure that such biodiversity is not negatively impacted by the project. Abbott's Duiker (*Cephalophus spadix*) is

one such species – it is classed as endangered – and would be suited to the riverine forest vegetation as its habitat.

Although mammals and avian species are among the wildlife resources that have been reported to occur at these areas, during the 2012 survey the team did not spot any mammal species. However, whilst carrying out the transect lines, different signs were observed indicating that wild life animals are still present in the forest plantation. The animals signs observed during the survey were animal footpath, animal droppings, and burrows/holes, digging and feeding signs. According to the local people the signs prove the presence of animals like bush pig, bush buck, antelope, banded mongoose, hare and giant Gambian rat. Most of the signs were observed at valley bottoms. Although only these signs were observed during transect line survey at selected points it still indicates the richness of animal species in the project area, and as such that the riverine forest is still a healthy ecosystem for the fauna and flora that depend on it.



Figure 23 and 24. Signs of animal digging and antler thrashing (Bush pig and banded mongoose)

Birds being good biological indicators of human activity reflect the health of natural ecosystem and give early warning of harmful changes. These are being used for conservation and environmental impact assessment of sites. More than 16 species of birds at Uchindile and 14 at Mapanda were recorded during the survey. The number of species is lower compared to the previous ecological surveys but this is likely to be due to the different season of monitoring, with some species having migrated to other areas. This survey will be repeated in rainy season to which the data will be compared.

Table 8: Bird species recorded during at different vegetation type

Bird species		Bottom Valley (number of count)	Grassland (number of count)
Local name	Scientific name		
Kinyanyambo	-	6	0
Mbayuwayu	Hirundo rustica	0	20
Mwalunuinui	Nectariniakilimensis	12	2
Ngurukiru	Pycnonotus tricolor	3	0
Nyangavava	Lanius marwiti	1	5
Mwakapinda	-	0	1
Kikula	Serinus canicollis	2	
Kisweswe	Iringa alkat	4	0
litoloma	Citril Serinus	3	0
Lufyasi	Melocichla mentalis	4	0
Nyova/kwale	francolinus afer	1	6
Msolwa	Acrocephalus	1	0
kimnono	Prinia subflava	3	1
Chwario	Tauraco	2	0

The results show that most of the bird species were observed in the riverine forest stratum. This confirms once again that riverine forest is the richest stratum in the plantation area.



Figure 25. Bird nest observed at the buffer zone area near NPSP 2 (Mapanda)

According to the previous surveys at Uchindile two bird species of ecological concern, a rare species, African black duck - *Anas sparsa* and the vulnerable, Blue Swallow - *Hirundo atrocaerulea* were recorded. While for Mapanda two species were recorded as endemic species which are Iringa akalat (*Sheppardia lowei*) considered vulnerable and Uhehe fiscal (*Lanius marwitsi*) and one species recorded as endangered which is the blue swallow (*Hirundo Atrocaerulea*). This survey, however, only observed African black duck at a marsh/lake area in Uchindile and the two species Iringa akalat and Uhehe Fiscal in different locations of Mapanda project area. This provides the evidence that protecting wetlands provides habitat for several species including the species of special concern like Blue swallow.

Table 8. RTE bird species found in Uchindile and Mapanda project areas by strata

Bird species		Valley bottom / wetland (number of count)		Grassland (number of count)	
Local name	Scientific name	Uchindile	Mapanda	Uchindile	Mapanda
Nyangavava	<i>Lanius marwitsi</i>	0	1	0	5
Kisweswe	<i>Iringa akalat</i>	0	4	0	0

Grassland

The grasslands in this area have been described as edaphic fire climax grasslands as well as headwater valley grasslands and occupy about 90% of the area; grass species are dominant in this stratum covering more than 50%, followed by shrubs/ herbs such as *Dolichos sericus* and *Dodonea viscosa* with around 40% cover and a few trees such as *Parinari curatelifolia*, *Markhamia obtusifolia* and Protea species.

Table 9 shows the dominant grass species and percentage cover.

Table 9. Grass species composition in grassland stratum

	Uchindile	Mapanda
Cymbopogon species	> 80%	> 70%
<i>Hyparrhenia cymabarica</i>	> 10%	> 20%
<i>Fadogia odorata</i>	< 5%	< 5%



Figure 26 and 27. Grassland conservation area



Figure 28. Bird known as “Mwakapinda” observed at grassland conservation area (Mapanda)

Although more bird species were observed in the riverine forest stratum, still a significant number of birds were spotted in the grassland, indicating that the grasslands are being conserved affectively. It is therefore assumed that the blue swallow has sufficient suitable habitat within the project so that it is not negatively impacted.

E. Invasive species

As shown in table 6 of section C of this document, six invasive species were identified during the ecological study at Uchindile and Mapanda by WCST in 2008. These species included *Acacia mearnsii*, *Rubus spp*, *Bambusa balcoae*, *Psidium guajava*, *Lantana camara* and *Cleteric cantata*. Out of these, the first two were common. Since only a few species were spotted, the study could not see that presence of such invasive species had impacts to the native species at this time. However, to control them, it was recommended that such species should be uprooted wherever found in the project areas. GRL makes use of the fire patrol men and planting crew to uproot invasive species. There are employees that are trained to identify such IAS and each time they spot any such species, they organise the uprooting of them. Because there are not many IAS in the plantation, trained patrol men can easily identify and uproot them during their daily routine as they patrol the plantation. If found they then record the activity which is booked in the register and kept at the plantation office. This is what is being used in the assessment for the first verification under CCBA. However, moving forward, the project will carry out monitoring of invasive species every three years. The methodology for monitoring the invasive species will be through sample plots/ line transects in each stratum.

See Annex 5 for the Invasive Species Monitoring guideline.

F. Water Monitoring: Quality and Quantity

Water Quality

Water quality monitoring has been done twice a year in this monitoring period. Permanent water sampling points were installed at rivers that flow crossing the plantation. Figure 29 and 30 below show the location of the sampling points as well as key rivers within the plantations and the surrounding villages.

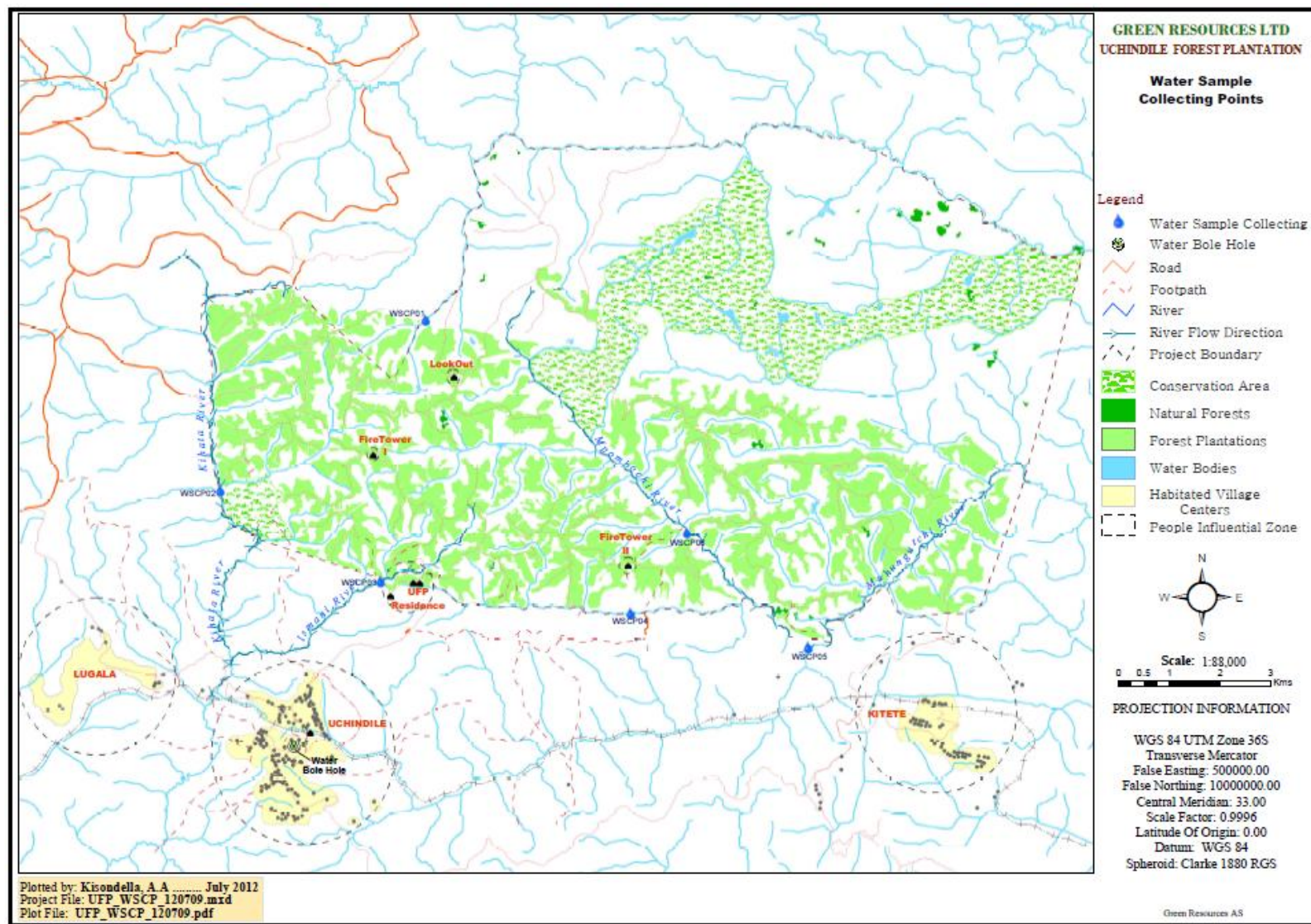


Figure 29. Uchindile water sampling points

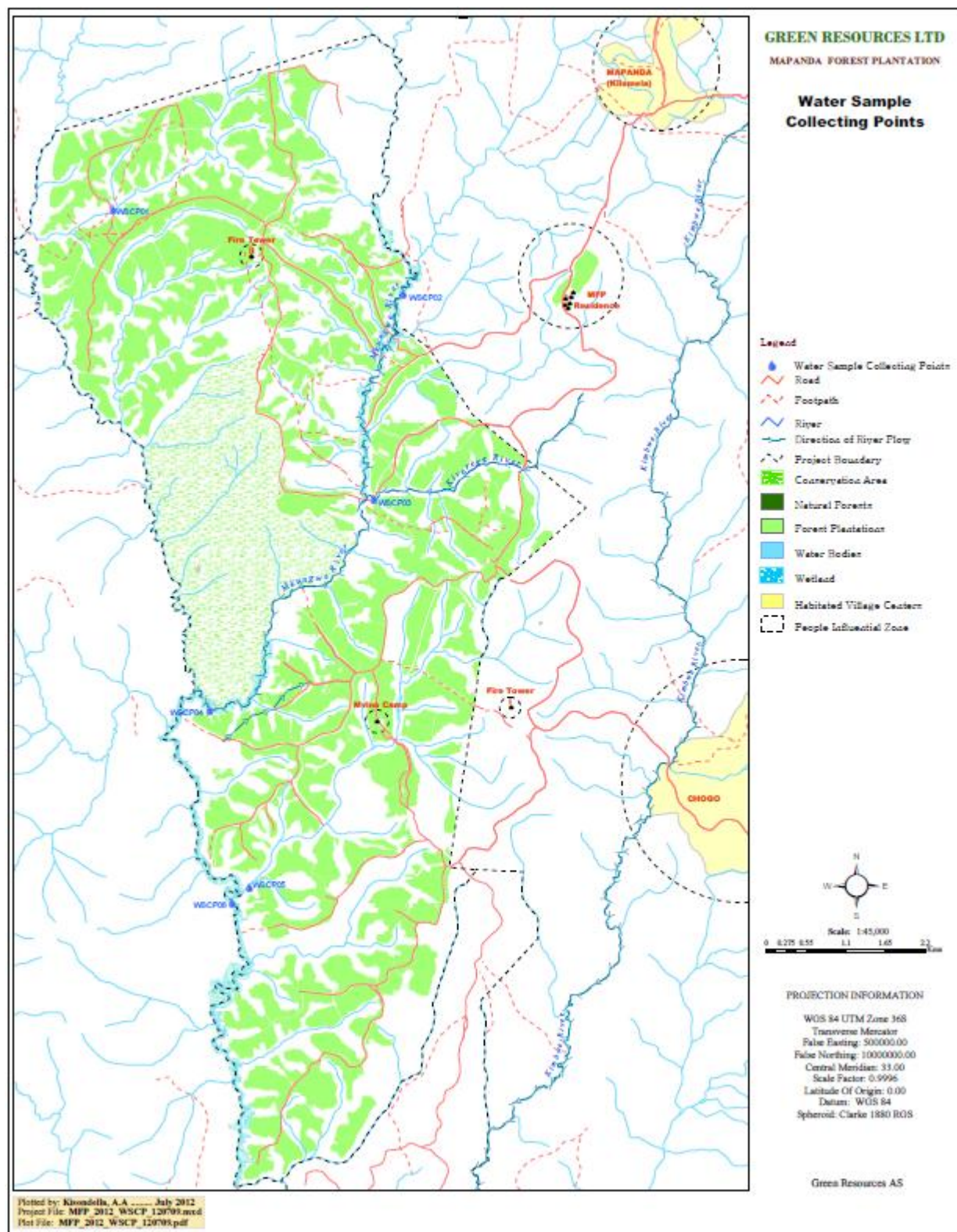


Figure 30. Mapanda water sampling points

The samples that are collected were analysed at the laboratory at Rufiji water office in Iringa. The results from the sampling have shown that there are no direct negative impacts from the project. Below is a summary of results of the last two water quality assessments of dry season 2011 and wet season 2012 (full information including monitored data from 2007 onwards can be found in annex 5):

- o All water samples were found to range from acidic to alkaline with the pH between 6.4-7.79 which are within the allowable limit. This range of pH is within the range of 6.5–8.5 stipulated for drinking and domestic purposes (WHO, 1993).
- o Water sources indicated very clear that the level of transparency was greater than 90% during dry season. The sediments level for all water sources within the forest projects found to be less than 0.1 ml/l.
- o All water samples found to be fresh water with total dissolved solid less than 40 and 500mg/l for the dry season 2011 and wet season 2012 respectively.
- o There were very low levels of nutrient species such as NH_3 , NO_3 , NO_2 and orthophosphate which signifies an absence of contamination from fertilizers, sewage and decayed matters.
- o The amount of dissolved oxygen were found to range from 6.63 mg/l to 8.16 mg/l in all water sources which meets the requirements for both domestic uses as well as supporting aquatic life in water; with the exception of Selasini stream which has low dissolved oxygen of 3.13mg/l in wet season 2012
- o The level of turbidity in some water sources are within the allowable limit to fit all water uses, with an exception of Selasini stream, Kihata, Isimani stream and Mgelela river which found to be turbid to very turbid water.

The only result which was found to be outside of the acceptable range set by the WHO (0 counts/100ml) was the level of faecal coliform; this WHO limit is for drinking water:

- o Faecal coli form was found in all samples ranging from 5-160 count/100ml with Mwenga river and Mhunguchi river having the highest values

Such bacteria have been monitored at the project since 2010 and although the levels are all greater than the WHO limit, this is not necessarily related to the project. However, GRL is aware that this is an issue that needs to be looked into further since such levels could be having a negative impact on communities, and the project could be contributing to the levels, directly or indirectly. GRL has carried out further research into the issue to better understand it – see faecal coliform section below.

From these findings it has been recommended that, since the parameters tested for (both physical and chemical) indicated to be within the allowable standard limits for water to be used for several

purposes hence the optimal management should be maintained. The level of high turbid water found in most sources might have been caused by soil erosion which runs from forest catchments hence should be managed. The low level of dissolved oxygen in Selasini stream should be avoided by bush clearing around the source to allow water aeration.

The results show that with the exception of the bacterial tests, there has been no contamination of the water sources caused by project activities. However, it was not possible to determine a clear cause for faecal coli forms results. Furthermore, since the bacterial tests show that the water is contaminated with faecal coli forms and as such it's not suitable for human consumption, GRL will continue to build awareness among its workers and the communities surrounding the project to take appropriate measures like boiling water before it is used for drinking.

An Additional Study on Faecal Coliform

Since faecal coliforms were found in all points where the water was collected for analysis and it was unclear what caused this in GRL's Uchindile and Mapanda plantations – whether these were baseline levels in the region or whether the project or local communities have influenced affected the levels - a separate study³ on the causes of this coliform and whether communities are aware or are taking the required measures was undertaken to understand the situation on the ground. Participatory methods were employed in this study where interviews focussed group discussions were conducted with workers and community members in the village. Observations were also done of the sources of water used for domestic purposes and GPS coordinates and photos taken.

The results show that workers are well sensitised and are regularly supplied with water guard at their camps, thus the majority of the workers at the plantation frequently take water that is either applied with water guard or boiled. This is due to sensitization carried out with all workers at the project sites. Workers are also not allowed to collect water in rivers and are advised not to drink, wash or bath at the source – the project supplies water to each of the worker sites within the project, with all drinking water treated with water guard. In the villages it was found that the level of awareness was either low or villagers themselves had not accepted the fact that water in their sources is contaminated. Sources of water in the villages are locally made wells, streams or bore holes. Although the water sources in the villages were not analysed regarding water quality, it is likely that the bore holes have safer water than the well or stream water due to the fact that no visible water

³ GRL Faecal Coliform Survey Report for Uchindile, Mapanda and Idete plantations (Mtupile, E & Msilu, S. 2012)

pollution was observed in this source. Water pollution was observed at the streams and wells where villagers clean and wash at the source, the same water that is used for domestic purposes, and sometimes drunk without being boiled. An assessment of toilet facilities was also carried out both in the plantations and the villages to assess whether this is a likely reason for such high levels of faecal coliform. Unlike the plantation sites where each house or dormitory has toilets which are in use and in good conditions, the use of toilets is not so common in the villages. Nevertheless, the study found that nurses were playing a greater role in raising awareness in the villages, as reported by the nurse and confirmed by villagers themselves. However, further sensitisation is required to ensure a higher uptake in water purification methods, as interviews revealed that some villagers were not willing to drink boiled or water guard treated water due to the water tasting different, and thinking this was not so good for them. This study concluded that awareness needs to stay at the forefront of GRL's community campaigns on health initiatives. Therefore, since this is the start of faecal coliform studies it will be treated as baseline and will thus be monitored moving forward. More water sampling points will be taken within the plantations and at the villages to broadly understand the extent of the problem such that communities and workers are well advised on remedial measures.

Water Quantity

Monitoring water quantity is essential in the plantation to see effects of exotic tree planting on water resources. It is from this point of view that permanent water gauging stations were installed on each river flowing across Uchindile and Mapanda forest plantations. Therefore, water quantity monitoring at GRL involves recording water levels and measuring water flow and volumes on the rivers.

While the last two are done once in a year, the water level measurement is a daily activity. Readings are taken twice a day, one in the morning and the other in the afternoon/evening. The readings are then summed up to make monthly reports that are compiled into annual water monitoring reports. One person is chosen at the project site to undertake this exercise. On the other hand water flow and volume monitoring is done through an external agent the Rufiji Basin Water Office staffs that are stationed in Iringa. This team uses current meters and other tools to measure water flow, gauge height, size of the place where water flow measurements are conducted. Several measurements are normally taken and then averaged. Due to increased need to understand water flow levels and speed across the year this kind of measurement is being planned for more than once in a year in all GRL projects.



Figure 31 and 32: Water resource monitoring include measuring the flow/volume of water; Water gauges have been installed on all rivers flowing in the plantation for monitoring depth of rivers

Water quantity monitoring has been done in all the four rivers that flow across the Uchindile plantation: Kihata, Mgelela, Mpombochi and Selasini. Water level started in 2003 for Kihata and 2006 for the other rivers, while gauging stations for flow measurements were only installed in 2007.

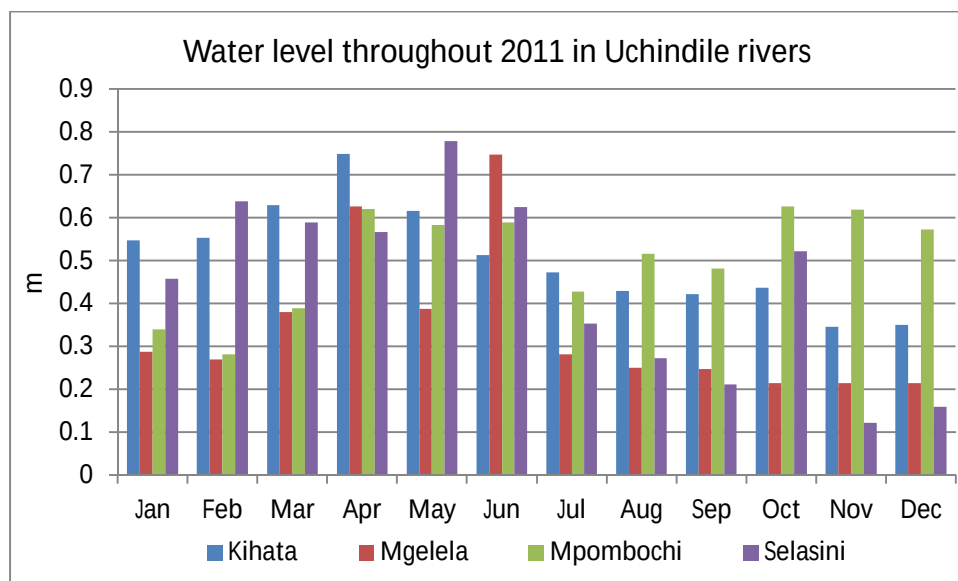


Figure 29. Water level monthly records in Uchindile rivers (2011)

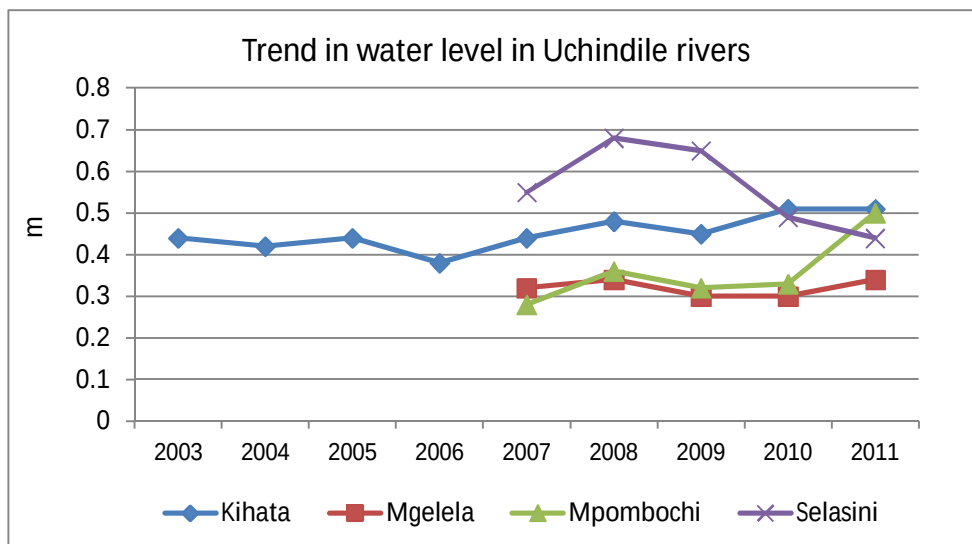


Figure 30. Trend in water level since the start of monitoring (2003) in Uchindile rivers

The water levels in Selasini and Kihata Rivers were higher during the first six months of the year than the other two rivers this is because those two rivers are near the Mufindi Escarpment where there is more rain than in other places in this area. The water levels decrease in the dry period of the year (figure 31) as there is little or no rain. Looking at the data presented in figure 30 and 33 it is still soon to establish a trend in water level except for Kihata river that seems overall unaffected by project activities.

Water levels and discharge measurements in Mapanda started in 2008 after installation of the gauging stations on four rivers in 2008. The rivers installed with gauging stations are Mwenga, Mkungwe, Mvino and Kiverege. Water level measurement has been done since then.

River Mwenga has the highest water level; in fact several rivers flow into Mwenga including Mkungwe and Mvino. River Kiverege flows into Mkungwe. Water quantity monitoring for Mapanda rivers is still at an early stage, as more data is collected and monitoring frequency is increased GRL expects to be able to understand if and how its activities are impacting river quantity.

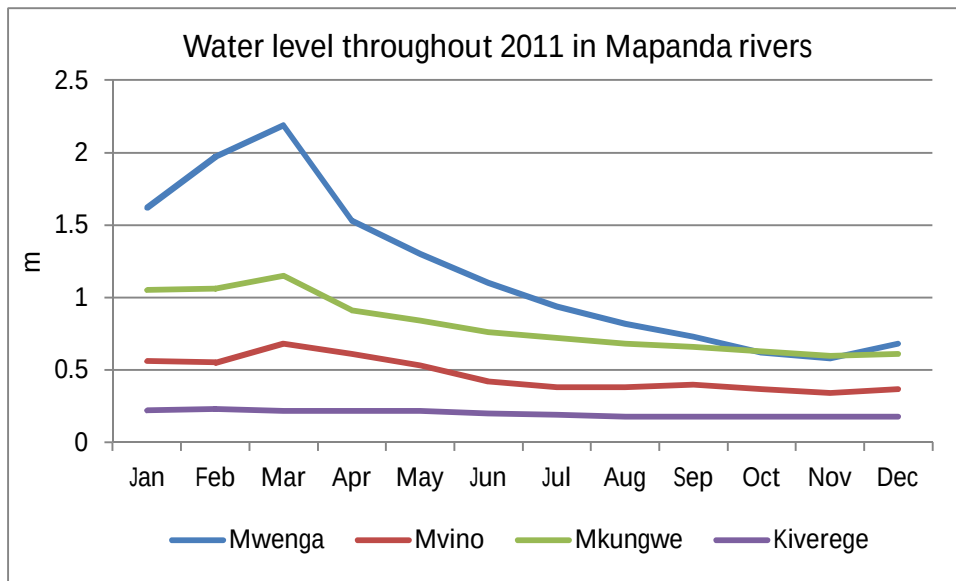


Figure 31. Water level monthly records in Uchindile rivers (2011)

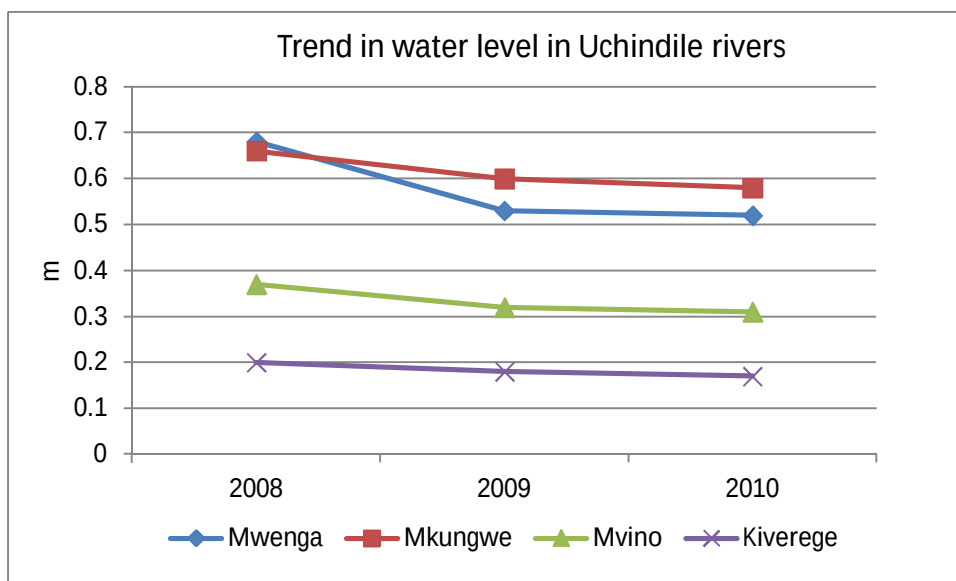


Figure 32. Trend in water level since the start of monitoring (2008) in Mapanda rivers

In addition, climate data is collected from weather stations at each plantation to better understand the impacts forest plantations might have on water quantity. Two parameters, temperature and rainfall have been monitored in this monitoring period. Weather is recorded starting in November of one year until October of the next year. In Uchindile a weather station was installed in Fire Tower No. 1 and data collection started in April 2002. However in 2011 there were some problems with the weather station and as such rainfall is underestimated for that year. In Mapanda the weather station was installed in February 2008, but data for 2008 and 2009 is incomplete due to failures in the

station. Therefore and considering the shorter period of data collection, weather information for Mapanda is not presented, but can be seen in the activities monitoring reports for 2010 and 2011.

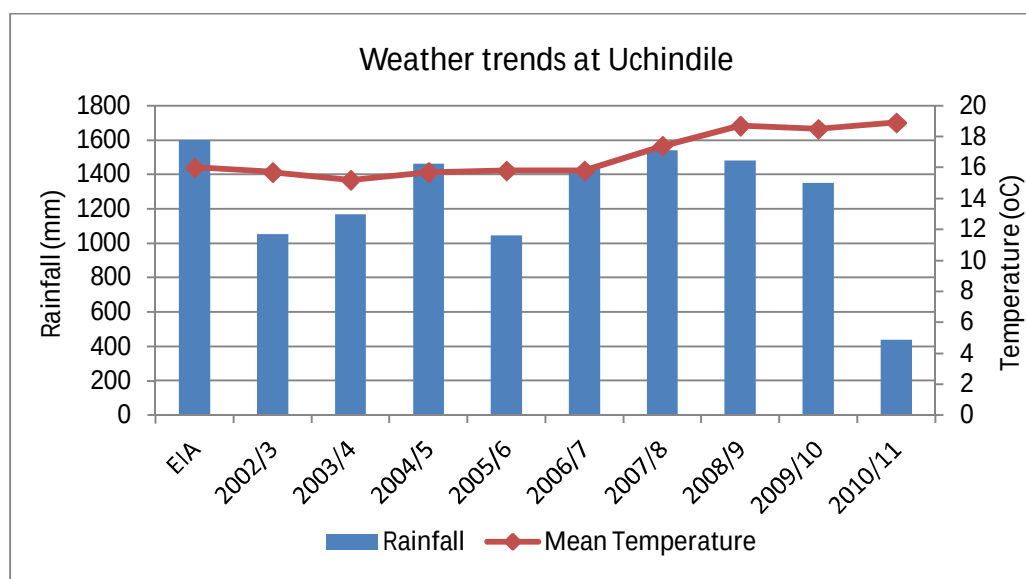


Figure 33: Climate trends at Uchindile Forest Plantations (1999-2011)
Source: GRL Activities Monitoring Report, 2011

Figure 33 shows that mean temperature has been fluctuating slightly around 16 degrees and has increased in the last four years reaching a maximum of 18.9 in 2011. Rainfall has also been fluctuating during this period with 2003 and 2006 registering the lowest rainfall, 1054.4 and 1046.5 mm, respectively and 1999 (EIA) and 2008 registering the highest, 1600 and 1540.6 mm, respectively.

G. Soil Quality Monitoring

Soil analysis was first carried out at the project in 2001 and was then subsequently monitored from 2005 every year until 2008. Following the 2008 results of the soil monitoring it was decided that the analysis did not need to be carried out every year since the meaningful data cannot be interpreted in such a small timeframe. It was, therefore, decided to monitor soils on a five year basis from 2008. This means that the next soil monitoring event will take place in 2013. The results of soil data collected since start of the project are shown in the table below.

Table 10: Results of analysed soil parameters at Uchindile forest project

Aspect/Year	EIA Y 2000	Y 2003	Y 2005	Y 2007	Y 2008	Remarks
pH: H ₂ O	5.40 - 6.30	4.96 - 5.40	3.47 - 5.48	4.09 - 5.71	4.82 - 5.48	Increase
EC	0.01 – 0.03	0.01 – 0.04	0.01 – 0.12	0.01 – 0.09	0.01 – 0.04	Increase
CEC	7.0 – 24.6	0.56 - 11.53	0.35 – 27.2	4.2 – 25.2	6.8 – 47.4	Decrease
Total N %	0.05 – 0.23	0.04 – 0.16	0.03 – 5.15	0.01 – 0.17	0.05 – 0.18	Decrease
Organic C %	0.66 – 2.83	0.02 – 1.82	0.19 – 4.43	0.42 – 2.53	0.49 – 2.77	Increase
Available P	2.13 – 4.98	0.77 – 9.82	0.15 – 22.0	0.01 – 4.63	0.32 – 24.49	Decrease
PSD: Clay (%)	62.3	66.4	62.2	64.2	58.6	Increase
Silt (%)	8.0	7.6	6.5	7.6	10.0	Increase
Sand (%)	29.7	26.0	31.3	28.2	31.4	Decrease
Text. Class	Sandy clay to heavy clay	Clay	Mostly Clay	Clay	Clay	
Ca ⁺⁺ c/mol/kg	4.0 – 9.9			0.04 – 1.9	0.18 – 7.84	Decrease
K ⁺ c/mol/kg	0.01 – 0.06			0.01 – 1.5	0.03 – 0.24	Increase
Mg ⁺⁺ c/mol/kg	2.2 – 5.1			0.01 – 0.11	0.01 – 1.08	Decrease
Na ⁺ c/mol/kg	0.03 – 0.11			0.10 – 0.2	0.03 – 1.57	Increase

Table 11. Results of analysed soil parameters at Mapanda forest project

Aspect/Year	Y 2001	Y 2005	Y 2006	Y 2007	Y 2008	Remarks
pH: H ₂ O	5.34 - 6.02	5.23 – 6.53	4.37 - 7.18	4.05 - 6.40	5.32 - 6.47	Decrease
EC		0.02 – 0.39	0.01 – 0.11	0.01 – 0.08	0.01 – 0.06	Decreased
CEC		3.40 - 8.60	3.0 – 7.400	3.6 – 22.0	8.0 – 47.4	Increased
PSD: Clay (%)		45.6	44.2	52.6	40.0	Decreased
Silt (%)		6.8	8.8	7.8	10.7	Increased

Sand (%)		47.6	47.0	39.6	49.3	Decreased
Text. Class	Sandy clay	Sandy clay	Clay	Sandy clay	Sandy clay	
Total N %		0.04 – 0.11	0.01 – 0.11	0.01 - 0.32	0.05 – 0.33	Increased
Organic C %	0.08 - 1.41	0.12 – 1.59	0.08 – 2.05	0.27 – 3.91	0.16 – 5.66	Increased
Available P		23.6 – 55.6	0.09 – 14.6	0.06 – 1.91	0.97 – 9.34	Decreased

From these results, no significant change is shown, rather minor increases and decreases in the soil parameters over time. Such minor changes are not expected to produce significant impacts to performance of trees in the plantation.

H. Awareness campaigns and capacity building

All awareness campaigns and capacity building sessions with employees and local communities related to the biodiversity sections will be monitored. At the present monitoring event a number of awareness and capacity building events have been carried out with the local community and GRL workers. The different awareness and training programmes that have been implemented are presented in Table 12 below. All capacity building has been documented, however, since little monitoring and recording was carried out in the first few years of the project. Moving forward, all capacity building sessions will be documented and updated into database on annual basis.

Table 12. Awareness campaigns and capacity building

Training/sensitization	Name of Training, Facilitator and training date	Location	Who attended	No. of people attended	Evidence
FSC	Community consultation on FSC (Kimey, Majaliwa, Samson 2008)	Villages	Open to all community members and employees	Not recorded	Report
	Training On Certification Awareness (Dr. P. M. Mussami, Castor Makeula, Wilfred Pima, Simon Kizza, Zawjia Omari, Mapanda-January 2010 and Uchindilw-February, 2010)	Plantation site	Patrolmen, fire crew	-	Report
Carbon certification	Community consultation on carbon (Kimey, Majaliwa, Samson 2008).	Classrooms, on open grounds, community halls	To all	Not recorded	Reports
	Community consultation and training on carbon for Uchindile and Mapanda villages (Ngegba, Malinga, Elly and Vailet, June 2011),	Open areas	Open to all community members	-	Reports, photos, attendance
Tree Growers Associations	TGA Formulation (Malinga and Vailet, Sept 2010).	Classrooms, on open grounds, community halls, on woodlot sites	TGA members only	-	Photos and reports, attendance
	Training on Constitution development (Malinga and vailet; march, 2011)	Classrooms, on open grounds, community halls, on woodlot sites	TGA members only	-	Photos and reports, attendance, constitutions
Training on Community Woodlots	Nursery establishment (Malinga and Vailet, Sept 2010),	Classrooms, on open grounds, community halls, on woodlot sites	TGA members only	-	Photos and reports, attendance

	Woodlot establishment (Malinga and Vailet, Jan 2011),	Classrooms, on open grounds, community halls, on woodlot sites	TGA members only	-	Photos and reports, attendance
	Training on woodlot measurement and mapping (Malinga, Vailet and Elly, September 2011).	Classrooms, on open grounds, community halls, on woodlot sites	Representatives from all sub-villages, in each village	-	Reports, photos, attendance
	Biodiversity Conservation (Malinga & Vailet, June 2011)	Classrooms, on open grounds, community halls, on woodlot sites	TGA members only	-	Report, training manuals and attendances
	Woodlot management (Malinga and Vailet, March, April, May 2011)	Classrooms, on open grounds, community halls, on woodlot sites	TGA members only	-	Manual, reports, photos
Fire control	Training on fire protection (fire brigade June, 2006-2011)	Open grounds	Employees. Fire crews	-	Report
	Fire fighting refresher training at GRL forest plantation (Bariki Temu, Kimey, M. Njowu, August, 2011)	Open grounds	Community/Employees. Fire crews	-	Reports
	Fire training during plantation ceremonies at Mapanda and Uchindile project areas (Malinga, 2008, 2009, 2010).	Open grounds	Open to all Community members	Approx. Over 300 in each seminar.	Reports
	Video shows on fire campaigns in villages surrounding the Uchindile and Mapanda plantations. Mbeya forest publicity, (2008-11),	Open grounds	Open to all Community members	Not counted	The videos and films belongs to the forestry division publicity department, Mbeya zone
	Red Cross fire Training (September, 2011)	Saohil office	Green Resources management, plantation 57representative for community training	24 from Saohil and Green Resources	Minutes, invitation letter

	Fire training during plantation ceremony (Malinga, 2008, 2009, 2010).	Mapanda and Uchindile Project sites	Open to all Community members	Not counted	Report, photos
	Video shows on fire campaigns (Mbeya forest publicity, 2008-11)	Villages surrounding Uchindile an Mapanda Project	Open to all village members	Not counted	ToRs, Invitation letters?
	Fire training campaign by Malinga (Ministry of Natural Resources and Tourism August 2009)	Mapanda and Idete	villagers and workers	-	Reports
	Workshop on integrated fire management, Forestry and bee keeping (MNRT), 1-3 September 2011	Morogoro	H. Malinga (CD & PR Manager)		Reports
Biodiversity Conservation and Environmental management	Training on tree diseases and poisonous mushroom (11 th -12 th January, 5 th February 2010 respectively) Dr Musami, Kizza, Zawjia, Pima	Mapanda and Uchindile project sites	patrolmen, fire crews and supervisors	-	Reports
	Training on RTE species, invasive species, HCV Forest and FSC/CDM, Dr. Musami, Nambombe and Zawjia, (4 th -5 th November, 12 December 2008). Mussami,	Uchindile and Mapanda Respectively	Patrolmen, fire crewmen, supervisors and some staffs	-	Reports
	Training on FSC awareness, RTE species, invasive species, tree diseases and HCV forests (Dr Mussami and V Kimey, February 2011)	Plantation offices	Firecrew, patrolmen, plantation, supervisors and managers	-	Reports
	Biodiversity conservation (Malinga and Vailet, June 2011).	Open	all		Reports

Plantation Management	Project Planning and Management course,MS-TCDC,4 th -15 th May 2009	Arusha	Samson Msilu (CDO)	-	Certificate
	Certificate of Attendance on training on the Application of community Monitoring Guidelines for Green Resources, Raymond Mariki, October 2010	GRL,Mafinga	CDOs,	-	Certificate
	National Social Security Funds training (Christel, July 2011)	Mapanda and Uchindile Project sites and surrounding villages	Both permanent and casual	-	Reports, photos
	Occupational Health and Safety training (Peter Maganga, Nov. 2009)	Mapanda FP	Fire crew	-	Report

Annex 1: Images of Natural Forest at Uchindile Forest Project

Situation in 2005	Situation in 2010
 NATF01	 NATF01
NATF01	
 NATF02	 NATF02
NATF02 Forest cover increased, gullies increased	



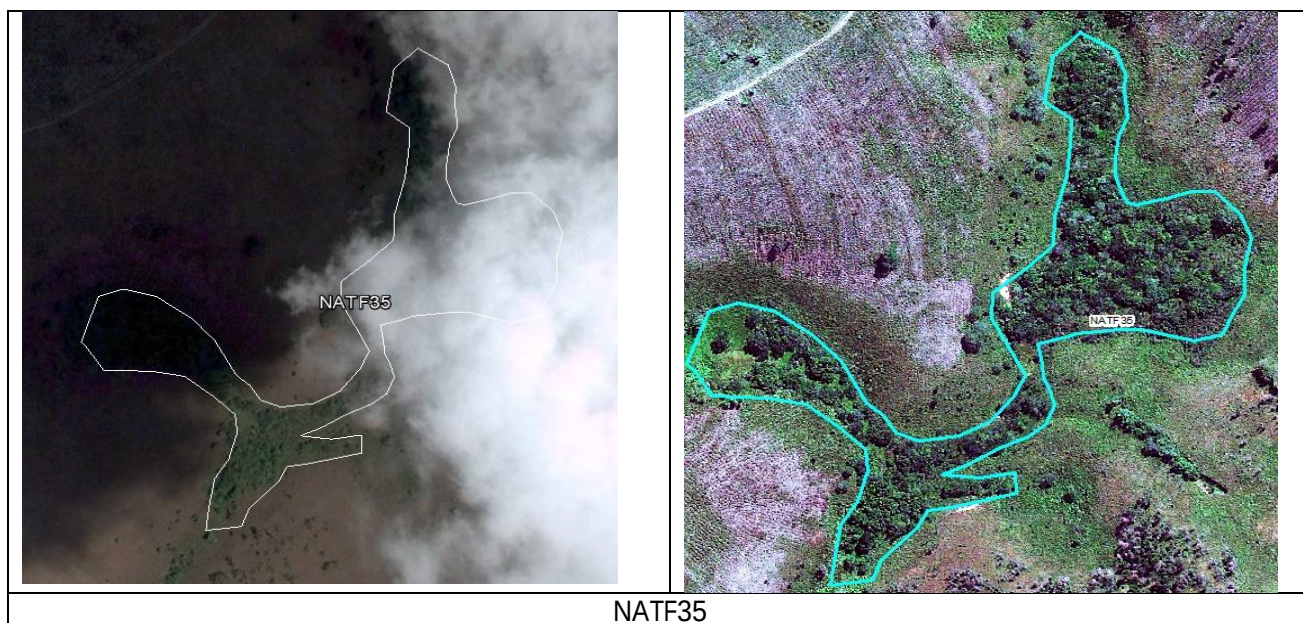
NATF04



NATF21 – forest cover slightly increased



NATF31, 32, 33



NATF35

nnex 2: Snapshots of various riverine forest in the plantation

Uchindile

2005 Google Image



2010 GeoEye Image



Mapanda

2010

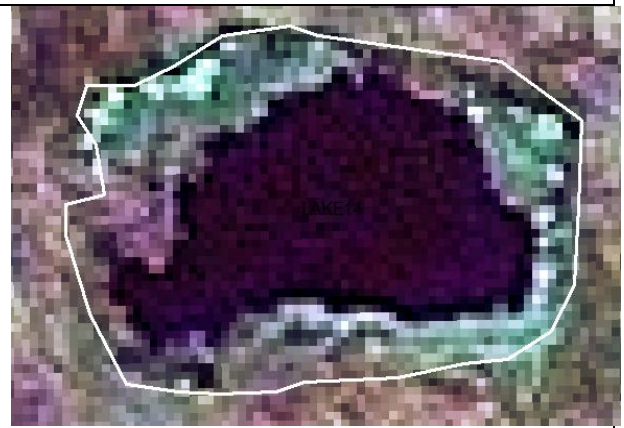


Annex 3: Assessment of Lakes in Uchindile Plantation

Situation in 2005	Situation in 2010
 A satellite image of LAKE04 in 2005. The lake is dark and irregularly shaped, surrounded by a mix of green vegetation and brownish soil. A white outline traces the lake's perimeter. Text at the bottom reads: "Image © 2011 DigitalGlobe" and "© 2011 Google".	 A satellite image of LAKE04 in 2010. The lake is dark and irregularly shaped, surrounded by a mix of green vegetation and brownish soil. A white outline traces the lake's perimeter.
LAKE04	
 A satellite image of LAKE11 in 2005. The lake is dark and irregularly shaped, surrounded by a mix of green vegetation and brownish soil. A white outline traces the lake's perimeter.	 A satellite image of LAKE11 in 2010. The lake is dark and irregularly shaped, surrounded by a mix of green vegetation and brownish soil. A white outline traces the lake's perimeter. Text in the top right corner reads: "Wetland18".
LAKE11	



LAKE12



LAKE14



LAKE17

Annex 4. Water quality monitoring results

Water Quality Monitoring in Uchindile Rivers

Table 7. Water Quality Analysis Result 2012

UCHINDILE FOREST PROJECT (June 2012)							
Parameters	Unit	Sampling Points , LabID and Coordinates					
		Mhunguchi river	Selasini stream	Kihata river	Mgelela river	Mpombochi river	Isimani stream
Lab ID		108/12	104/12	103/12	105/12	106/12	107/12
Coordinates		S08° 45' 06.8''	S08° 41' 39.2''	S08° 44' 08.9''	S08° 43' 27.4''	S08° 43' 54.2''	S08° 44' 27.0''
		E035° 30' 06.1''	E035° 25' 51.7''	E035° 16' 17.7''	E035° 23' 39.8''	E035° 28' 41.3''	E035° 25' 24.3''
pH		6.46	6.40	6.57	6.72	6.57	6.22
Temperature	°C	17.0	16.3	16.1	16.3	16.0	16,5
Turbidity	NTU	35.9	49.7	25.6	19.6	17.7	27.4
Conductivity	µs/cm	26.1	53.4	23.5	26.0	26.1	23.8
TDS	mg/l	12.0	25.0	10.7	11.9	12.1	10.9
Colour		62	21	89	43	81	60
Transparency	%	93.0	95.0	93.0	97.0	96.0	95
Bicarbonates	mg/l	26	18.0	14.0	22.0	22.0	10
Ammonia	mg/l	0.16	0.10	0.14	0.15	0.19	0.28

Nitrate	mg/l	0.0	0.1	0.0	0.0	0.0	0.0
Nitrite	mg/l	0.0	0.002	0.0	0.002	0.0	0.0
Orthophosphate	mg/l	0.04	0.14	0.17	0.10	0.10	0.02
Dissolved O ₂	mg/l	8.17	3.13	8.17	7.74	6.96	9.03
Feacal Coliform	No/100mls	160	8	15	90	45	21

Source: GRL Water Quality Analysis Report June, 2012

b). Water Quality Monitoring in Mapanda Rivers

MAPANDA FOREST PROJECT (June 2012)						
Sampling Points, Lab ID and Coordinates						
Parameter	Unit	Mwenga river	Mvino river	Igomaenze river	Kiverige river	Mkungwe upriver Mkungwe downriver
Lab ID		97/12	98/12	102/12	101/12	100/12 99/12
Coordinates		S08° 31' 14.0''	S08° 31' 17.6''	S08° 26' 02.2''	S08° 28' 11.6''	S08° 43' 31.6'' S08° 29' 45.4''
		E035° 40' 48.1'	E035° 40' 55.2''	E035° 39' 51.7''	E035° 41' 50.6''	E035° 42' 08.3'' E035° 40' 34.2''
pH		7.79	7.45	7.36	7.47	7.55 7.50
Temperature	°C	14.5	15.1	15.1	15.4	13.4 15.2
Turbidity	NTU	15.3	5.8	3.62	3.07	12.2 11.4

Conductivity	µs/cm	48.4	27.4	36.2	27.8	50.3	48.5
TDS	mg/l	22.7	12.6	16.8	12.8	23.7	22.7
Colour		19	2	1	1	15	23
Transparency	%	96.0	97.0	98.0	98.0	96.0	95.0
Bicarbonates	mg/l	26.0	26.0	24.0	22.0	30	30
Ammonia	mg/l	0.13	0.08	0.09	0.09	0.09	0.13
Nitrate	mg/l	0.0	0.2	1.0	1.5	0.8	1.0
Nitrite	mg/l	0.002	0.0	0.0	0.0	0.0	0.006
Orthophosphate	mg/l	0.19	0.17	0.05	0.07	0.16	0.11
Dissolved O ₂	mg/l	5.38	7.28	9.11	8.87	7.31	8.65
E Coliform	No/100 ml	148	60	15	6	32	52

Source: GRL Water Quality Analysis Report June, 2012

Water quality monitoring results since project start at Uchindile rivers

Kihata River

Parameters/ season	96 Dry	07 Wet	07 Dry	08 Wet	08 Dry	09 Wet	09 Dry	010 Wet	010 Dry	011 Wet	011 Dry	WHO 1994
Nitrites (ppm)	0.003	0.008	0.007	0.004	0.01	0.007	0.006	0.013	0.001	0	0.003	NS
Ammonium (ppm)	0.22	0.56	0.22	0.36	0.01	0.39	0.16	0.55	0.1	0.31	0.16	0.5
Phosphates (ppm)	0.22	0.27	0.24	0.09	0.01	0.19	0.09	0.24	0.24	0.38	0.4	NS
Sediments(ppm)	0	0	0	0	0	0	0	0	<0.1	<0.1	<0.1	0
Nitrates (ppm)	0.9	0.07	0.5	0.3	1	0.9	1.7	4.1	0.14	2.2	0.4	30
Alkalinity (ppm)	18	20	10	34	16	10	8	16	22	12	16	5500
Salinity(TDS)	12.1	18.7	9.5	40	11.4	9	12.8	17.7	8	9.9	9.6	NS
BOD ₅ /DO (ppm)	3	4	6	6	6.1	6.1	6.1		9.2	5.5	5.3	10
pH	8	6.2	8	6.3	6.73	7.23	6.6	7.01	6.95	6.63	6.61	6.5-8.5
Temperature °C	22.9	22.1	23.6	19.8	24.7	24.4	23.1	22.5	23.3	21.4	24.1	NS
Transparency %	95	95	97	96	98	99	94	92	99	95	96	90 - 100
Ecoliform (parts/100ml)									236	20	14	0

Source: GRL Annual Activity Monitoring Report, 2011

Mpombochi River

Parameters/ season	96 Dry	07 Wet	07 Dry	08 Wet	08 Dry	09 Wet	09 Dry	10 Wet	10 Dry	11 Wet	11 Dry	WHO 1994
Nitrites (ppm)	0.005	0.009	0.003	0.002	0.01	0.006	0.004	0.009	0.01	0	0.02	NS
Ammonium (ppm)	0.14	0.35	0.21	0.21	0.12	0.25	0.08	0.28	0.27	0.24	0.04	0.5
Phosphates (ppm)	0.14	0.21	0.23	0	0.09	0.01	0.09	0.13	0.27	0.23	0.5	NA
Sediments (ppm)	0	0	0	0	0	0	0	0	<0.1	<0.1	<0.1	0
Nitrates (ppm)	0.9	0.05	0.4	0.3	0.6	1	1.5	2.6	0.049	0.5	0.3	30
Alkalinity (ppm)	16	20	14	12	14	14	12	18	26	14	18	5500
BOD ₅ /DO	4	3	6.2	6	6.2	6	6.1		9.7	5.3	5.2	10
Salinity(TDS)	16.2	25.6	13	15.6	15	12	16.6	21.1	12.3	13.1	11.2	NS
pH	7.5	6.2	7.5	7.1	6.61	7.54	6.7	7.34	7.18	6.61	6.98	6.5-8.5
Temperature °C	22.8	22.1	23.6	19.9	26.4	24.4	23.2	22.8	23.3	21.3	24	NS
Transparency %	98	95	98	98	98	83	94	93	98	94	97	90 - 100
Ecoliform (parts/100ml)									37	150	72	0

Source: GRL Annual Activity Monitoring Report, 2011

Mgelela River

Parameters/ season	96 Dry	07 Wet	07 Dry	08 Wet	08 Dry	09 Wet	09 Dry	010 Wet	010 Dry	011 Wet	011 Dry	WHO 1994
Nitrites (ppm)		0.01	0.014	0.003	0.01	0.01	0.006	0.012	0.001	0	0.02	NS
Ammonium (ppm)		0.32	0.11	0.16	0.11	0.19	0.09	0.34	0.01	0.28	0.58	0.5
Phosphates (ppm)		0.11	0.24	0.01	0.03	0.04	0.19	0.16	0.02	0.73	0.05	NA
Sediments (ppm)		0	0	0	0	0	0	0	<0.1	<0.1	<0.1	0
Nitrates (ppm)		0.05	0.4	0.5	0.7	1.8	2.2	3	0.034	1.8	1.8	30
Alkalinity (ppm)		18	18	18	16	19	10	18	22	18	16	5500
Salinity(TDS)		18.2	17	15.6	18.6	18.9	17.6	20	13.1	12.9	17.6	NS
BOD ₅ /DO (ppm)		4	6.4	6.2	6.3	6.3	6.2		8.9	5.93	6.01	10
pH		6.3	7.6	7.5	6.65	7.56	6.7	7.5	7.15	6.62	6.37	6.5-8.5
Temperature °C		22.3	23.6	19.8	27.6	24.6	23.1	23.5	23.3	21.4	24.1	NS
Transparency %		96	95	96	97	85	93	91	94	94	96	90 -100
E coliform (parts/100ml)									44	120	78	

Source: GRL Annual Activity Monitoring Report, 2011

Selasini River

Parameters	96 Dry	07 Wet	07 Dry	08 Wet	08 Dry	09 Wet	09 Dry	10 Wet	10 Dry	11 Wet	11 Dry	WHO 1994
Nitrites (ppm)		0.007	0.004	0.002	0.01	0.005	0.004	0.004	0.001	0	0.006	NS
Ammonium (ppm)		0.33	0.17	0.21	0.12	0.17	0.02	0.02	0.05	0.34	0.15	0.5
Phosphates (ppm)		0.17	0.11	0	0.01	0.03	0.01	0.11	0.24	0.77	0.2	NA
Sediments (ppm)		<0.1	<0.1	0	0	<0.1	0.1	0	<0.1	0	0	0
Nitrates (ppm)		0.06	0.3	0.2	0.4	1.2	0.2	0.7	0.36	0.7	1.2	30
Alkalinity (ppm)		10	26	12	12	12	12.2	14	26	22	12	5500
Salinity(TDS)		16.8	11.2	12.6	13.8	10.8	12.9	17.3	8.1	25.6	7.7	NS
BOD ₅ /DO (ppm)		5	6	6.2	6.1	6.2	6.1		9.8	5.64	5.5	10
pH		6.2	7.2	6.6	6.8	7.12	6.5	7.22	6.48	6.27	6.34	6.5-8.5
Temperature °C		22	23.6	19.9	25.8	24.3	23.2	21.5	23.3	21.3	24.2	NS
Transparency %		85	99	97	99	89	97	98	94	96	95	90 - 100
E coliform (parts/100ml)									33	10	23	

Source: GRL Annual Activity Monitoring Report, 2011

Water quality monitoring results since project start at Mapanda rivers

Mkungwe River

Parameters	07 Wet	07 Dry	08 Wet	08 Dry	09 Wet	09 Dry	10 Wet	10 Dry	11 Wet	11 Dry	WHO 1994
Nitrites(ppm)	0.002	0.016	0.044	0.003	0.005	0.003	0.002	0.001	0	0.1	NS
Phosphates(ppm)	0.2	0.2	0.25	0.47	0.13	0.41	0.24	0.29	0.56	0.2	NS
Ammonium(ppm)	0.01	0.05	0.18	0.06	0.17	0.05	0.12	0.05	0.29	0.11	0.5
Sediments (ppm)	>0.1	0	0	0	0	0	0	<0.1	<0.1	<0.1	0
Nitrates(ppm)	1.4	1.5	0.06	0.01	1.2	1.5	1.2	0.08	0.1	1	30
Alkalinity(ppm)	32.4	32	22	18	36	36	14	30	28	4	5500
Salinity(ppm)	26	38.1	25.8	18.8	13.9	36.4	16.1	29.7	24.5	37.2	NS
BOD ₅ /DO (ppm)	6	6.2	6	6.2	6.1	6.2	6.2	7.26	7.57	7.5	10
pH	7.25	7.2	6.85	7.1	6.8	7.27	6.88	7.49	7.1	7.33	6.5-8.5
Temperature °C	21.7	24.1	23.6	25	21.7	22.3	23.5	24.2	18.7	24	NS
Transparency%	98	98	98	98	97	99	96	98	95	98	90-100
Ecoli Form								71	121	76	0

Source: GRL Annual Activity Monitoring Report, 2011

Mwenga River

Parameters	07 Wet	07 Dry	08 Wet	08 Dry	09 Wet	09 Dry	010 Wet	010 Dry	011 Wet	011 Dry	WHO 1994
Nitrites (ppm)	0.006	0.014	0.006	0.004	0.006	0.005	0.008	0.02	0	0.017	NS
Ammonium (ppm)	0.01	0.05	0.18	0.06	0.34	0.09	0.19	0.15	0.15	0.14	0.5
Phosphates (ppm)	0.23	0.24	0.25	0.47	0.28	0.26	0.3	0.31	0.94	0.07	NA
Sediments (ppm)	0	0	0	<0.1	0	0	0	>0.1	<0.1	<0.1	0
Nitrates (ppm)	1.3	1.6	0.04	0.2	0.26	0.17	2.4	0.17	0.8	1.1	30
Alkalinity (ppm)	28.7	26	32	28	44	34	14	30	24	26	5500
Salinity (ppm)	24	38.4	37.8	29.4	19.9	31.9	17.8	47.4	22.5	28.6	NS
BOD ₅ /DO (ppm)	8	6	6.2	6	6.1	6.1	6.2	7.44	8.2	7.1	10
pH	7.01	7.22	6.61	6.61	6.61	7.28	6.95	7.51	6.97	6.72	6.5-8.5
Temperature °C	21.4	24.1	25.6	25.6	21.6	22.5	23.5	24.3	18.5	22.2	NS
Transparency %	96	97	98	97	97	97	95	98	95	96	90-100
E coliform (parts/100ml)								69	128	56	0

Source: GRL Annual Activity Monitoring Report, 2011

Mvino River

Parameters	07 Wet	07 Dry	08 Wet	08 Dry	09 Wet	09 Dry	010 Wet	010 Dry	011 Wet	011 Dry	WHO 1994
Nitrites(ppm)	0.001	0	0.007	0.007	0.004	0.002	0.01	0.003	0	0.01	NS
Ammonium(ppm)	0.06	0.01	0.08	0.08	0.16	0.06	0.06	0.08	0.06	0.07	0.5
Phosphates(ppm)	0.18	0.18	0.29	0.08	0.06	0.28	0.12	0.18	0.99	2.4	NA
Sediments(ppm)	<0.1	0	0	0	0	0	0	>0.1	<0.1	<0.1	0
Nitrates (ppm)	0.9	1	0.03	0.4	2.8	0.6	1.4	0.313	0	1.2	30
Alkalinity(ppm)	15.4	28	14	14	32	16	16	18	24	18	5500
Salinity(ppm)	18	38.3	12	15	11.4	18	12.9	13.9	12.5	14.3	NS
BOD ₅ /DO(ppm)	6	7.9	7.5	6.2	7	6.8	6.6	7.44	8.22	6.97	10
pH	6.85	7.32	6.94	6.87	7.1	7.17	6.79	7.6	6.51	6.59	6.5-8.5
Temperature °C	21.6	24.2	25.6	25.6	21.7	22.3	23	24.1	18.5	22.2	NS
Transparency %	96	96	97	98	97	99	98	97	98	97	90 - 100
Ecoli Form								51	20	11	0

Source: GRL Annual Activity Monitoring Report, 2011

Kiverege Stream

Parameters	07 Wet	07 Dry	08 Wet	08 Dry	09 Wet	09 Dry	010 Wet	010 Dry	011 Wet	011 Dry	WHO 1994
Nitrites (ppm)	0.001	0.016	0.006	0.004	0.006	0.018	0.001	0.001	0	0.013	NS
Ammonium (ppm)	0.05	0	0.1	0.04	0.16	0.02	0.07	0.04	0.04	0.1	0.5
Phosphates (ppm)	0.06	0.1	0.2	0.04	0.04	1.35	0.22	0.2	0.67	0.74	NA
Sediments (ppm)	0	0	0	0	0	0	0	>0.1	<0.1	<0.1	0
Nitrates (ppm)	1	1	0.03	0.04	1.6	1.3	1	0.1	0	0.6	30
Alkalinity (ppm)	14.4	26	16	26	36	20	20	24	20	22	5500
Salinity (ppm)	16	12.9	14	30	13.1	18.7	23.5	14.3	12.9	14.7	NS
BOD ₅ /DO (ppm)	6	6.2	6.1	6.2	6.1	6.1	6.1	7.44	7.3	6.16	10
pH	6.9	7.37	6.89	6.88	7.1	7.17	6.69	7.86	6.73	6.69	6.5-8.5
Temperature°C	21.4	24.1	24.9	24.9	21.6	22.4	23.2	24.4	18.7	22.2	NS
Transparency %	98	98	98	98	96	98	95	98	99	99	90-100
Ecoli Form								55	105	34	0

Source: GRL Annual Activity Monitoring Report, 2011

Annex 5 – Invasive Species Monitoring

GUIDELINES FOR MONITORING OF INVASIVE TREE SPECIES

(Revised Version)

Introduction

Invasive alien species have been described as non-native species capable of displacing native species within particular area. These can originate from other countries or other region within the country. They can be brought by human beings for certain uses (ornamental, crop) or by accident through wind, water or wild animals. These guidelines are aimed at outlining methods for remedial actions and monitoring of the invasive species. In GRL projects only six were encountered by WCS in the two project areas. They include *Acacia meansii*, *Lantana camara*, *Rubus spp*, *Bambusa balcoae*, *Psidium guajava* and *Celeteric centata* with *Rubus spp* being the most common. The FSC audit team encountered two other IAS species namely *Mauritius thorn* and *Mexican sunflower*. According to WCST assessment the IAS is not yet a big threat to the ecosystem. It is recommended to uproot all visible IAS and people made aware of the potential dangers of Invasive Species and their control methods. More IAS were identified in the annual ecological survey covering different vegetation zones conducted by SUA researchers as recommended before and they include *Ilex mitis*, *Mangifera indica* and *Manihot esculenta*. These have also been added to the list.

Although the survey by WCST concluded that IAS are not yet a serious problem it is recommended as follows:

- All IAS weeds and invaders should be uprooted any time they are spotted in the GRL areas of jurisdiction including in the buffer zones. Patrol men will form team of the monitoring crew.
- Local communities should be informed about the problems of IAS and their control methods.
- The use of chemicals in the control of IAS should be discouraged due to possible environmental effects.
- An annual monitoring programme covering the different vegetation zones is recommended. This will enable us to identify and exhaust the IAS species and look for methods for remedial measures and monitoring.

The invasive species identified in the forest projects include the following:

SN.	Scientific Names	Common Names
1	<i>Acacia mearnsii</i>	Muwati

2	Acasia melanoxyton	Australian black wood
3	Lantana camara	Lantana
4	Rubus spp	Lumwino
5	Psidium guajava	Mpera
6	Caesalpinia decapetala	Mexican sunflower
7		Mauritius thorn
8	Agave sisalana	Mkonge(Katani)
9		Passion fruits
10	Celeteric cerrata	
11	Bambusa balcoae	Bamboo tree
12	Glycine wightii	Perennial soybean
13	Ilex mitis	
14	Mangifera indica	Muembe
15	Manihot esculenta	Cassava

Photos/ images of invasive species:



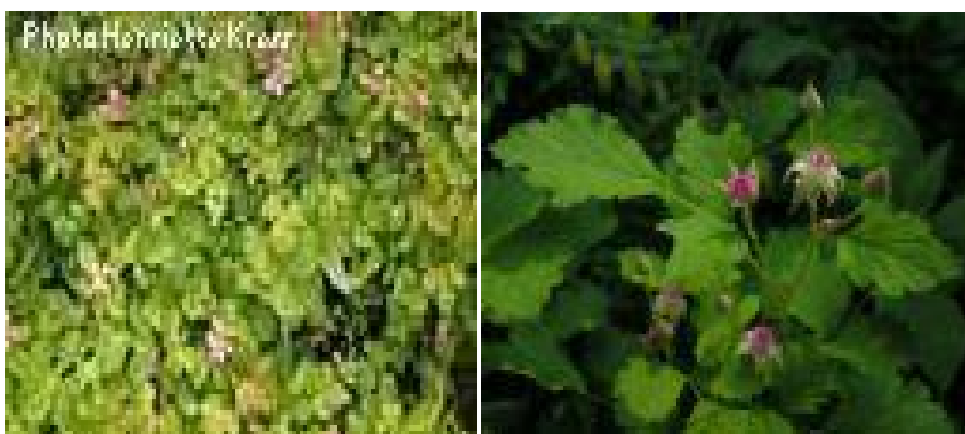
1. ACASIA MEARNSII



2. ACASIA MELANOXYLON



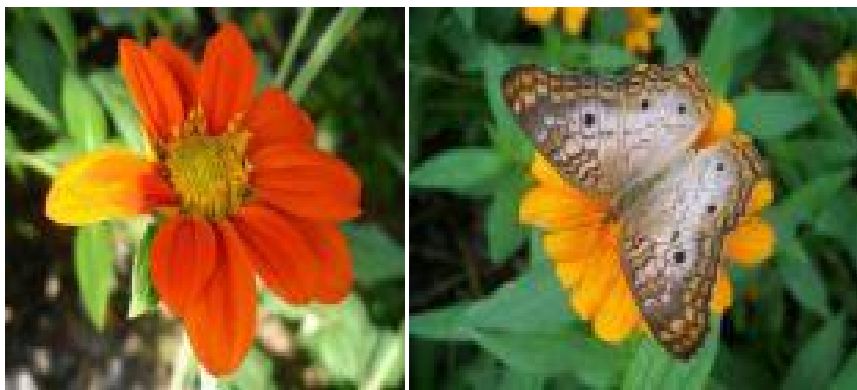
3. LANTANA CAMARA



4. RUBUS SPECIES



5. PSIDIUM GUAJAVA - MPERA



6. MEXICAN SUNFLOWER



7. MAURITIUS THORN (*Caesalpinia decapetala*)



8. SISAL (MKONGE AU KATANI) *Agave sisalana*



9. PASSION FRUITS



10. CELETERIC SERRATA



11. BAMBUSA BALCOAE



12. GLYCENE WIGHTII



13. ILEX MITIS



14. MANGIFERA INDICA



15. MANIHOT ESCULENTA

There are also invasive species either grass or herbs that can be eliminated through weeding, herbicide spraying and may disappear naturally when the trees close the canopy. Such species include *Oxalis latifolia* (wood sorrel), *Physalis peruviana* (Poha, ground cherry), *Conyza bonariensis* (Hairy fleabane), *Galioga parviflora* (Mashona nguo), *Tagetes minuta* (Marigold), *Bidens pilosa* (Black jack, broomstick) and *Smithia elliottii* (Mlenda). More IAS will be identified through ecological surveys from time to time.

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