Harvesting Management Plan

Buchanan Renewables Fuel
CONGO TOWN, TUBMAN BOULEVARD
MONROVIA, LIBERIA

PREPARED FOR:
Buchanan Renewables Fuel
Harvesting Program in Liberia

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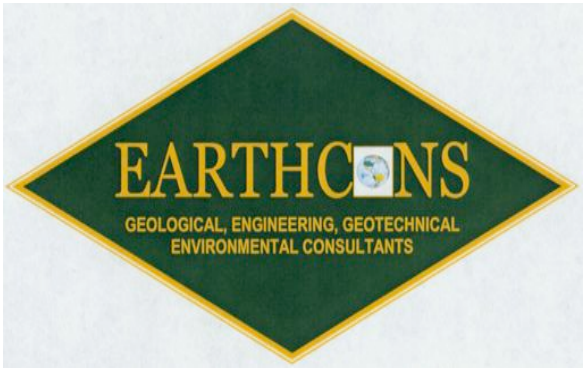

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Overview

This Harvesting Management Plan outlines a system to facilitate and regulate the sustainable harvesting of redundant *rubber trees,* Hevea brasiliensis, in Liberia by Buchanan Renewables Fuel Inc (BR Fuel). Conditions of this plan are consistent with the long term conservation of *rubber plantations in Liberia.*

This Harvesting Management Plan has been prepared by EarthCons Inc, a Liberian Environmental, Geological, Mining, Petroleum & Geo-technical consultancy firm, in consultation with Mr. Emmanuel Weill-Hallé, an International Environmental Consultant, and BR Fuel, to meet the requirements of the Environmental Protection Agency of Liberia and the Environmental Protection and Management Law, approved in 2002 as well as Best Management Practices in keeping with the IFC Guidelines for forest harvesting.

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I.0 INTRODUCTION

Hevea brasiliensis (rubber tree) is a common and widely distributed plantation crop found in Liberia. It was firstly introduced by Firestone Plantations, Company formerly Bridgestone, in 1906. Since that time, rubber plantations owned by multi-million dollar companies and small farm holders have spread throughout the length and breadth of the country, with large plantation concentrated in Margibi, Grand Bassa, Bong and Nimba Counties. Thus, Liberia was once regarded as the largest producer of natural rubber in the world at some point in time. Up to 1990, rubber accounted for a significant portion of Liberia's export earnings (62-705 metric tons valued at $53.2 million)[1], serving as the backbone of the country's economy by providing jobs and economic activities for thousands.

However, during the 15 year old Liberian civil war, many of Liberia's booming rubber plantations were destroyed due to mismanagement, while a significant portion of the plantations became redundant due to decline in their productive lifespan and absence of a cogent replanting program. With the advent of the crisis, it has become a necessity from a socio-economic stand point to rehabilitate the country's rubber sector in order to provide jobs and reinvigorate export earnings to pre-war status.

Buchanan Renewables B.V., a Dutch company, recognizing this need and based on its desire to contribute to the post-war socio-economic development of Liberia, has earmarked a multi million dollars investment with enormous potential for the Liberian rubber industry. Buchanan Renewables has established Buchanan Renewables Fuel (BRF) to superintend the investment of rejuvenating existing rubber plantations in the country by entering into commercial agreements with small and large farm holders for the purchase of redundant rubber plantations, which will pave the way for BRF to up-root non-productive rubber trees to be processed into rubber chips for export. The company has projected around 300,000 tons of chips annually. As part of the commercial agreement between BRF and farm holders, the Company will cultivate lands from which redundant rubber trees are harvested and replant economically viable plantations as a way of boosting the country's gradually collapsing rubber industry.

BRF is currently involved with rubber plantations and farmers in Grand Bassa and Margibi Counties. However, plans are underway for expansion into different parts of the country under the same program.

As a way of adding value to output from the rubber sector and minimizing waste from its operations, Buchanan Renewables Fuel and Buchanan Renewables Power are initializing plans to utilize the waste generated from uprooted rubber trees to produce bio-mass fuel and provide sustainable energy for the development of the country.

BRF has developed this Harvest Management Plan ("HMP") to manifest its commitment to sustainable forestry practices in compliance with Best Management Practices (BMP)

[1] Liberia National Biodiversity Strategy & Action Plan (LNBSAP)-2.2.2 Economy of the country-Rubber (2003)

and the EPAL guidelines. The sustainable forestry mandates outlined in this document will be implemented by BRF throughout the term of the contract entered with farmers/landowners. The goal of the activities at BRF will be to acquire biomass fuels using sustainable forest management practices and guidelines in order to conserve biological diversity, productive plantation capacity, and to promote forest ecosystem health. BRF will work closely with landowners/farmers, regulators, and the community to ensure that the plantation harvesting and replanting programs are managed in a sustainable manner, thereby providing environmental and financial viability to the plantation for future generations.

This Harvesting Management Plan currently covers about 23 redundant plantations, out of which 149.2 acres, representing 11 plantations, have been harvested and replanted in Compound #3, Grand Bassa County. The rest are pending harvest and replanting. Henceforth, BRF will be required to prepare individual harvest plans for each new parcel where harvesting will take place. The harvest plan template, which is included in Appendix A, has the following general sections to be filled out by landowner/farmer and BRF for each parcel of land to be harvested:

- Name
- Address
- Acreage
- Estimated volume to be harvested
- Anticipated harvest date(s), etc.

1. Map
    - Total area of the property
    - Area to be harvested
    - Topography
    - Skid road layout
    - Locations of all streams, wetlands and water bodies, and vegetation type designation
    - Use of adjacent land
2. Landowner objectives
3. Potential ecological and cultural impacts (water quality, wildlife, aesthetics, recreation, cultural heritage features)
4. Baseline environmental data
5. Agricultural and silvicultural techniques and best management practices to be implemented.

Each site-specific harvesting plan will form part of the overall harvesting strategy, which is currently focused in Grand Bass, but which will evolve as more data on plantation locations and characteristics become available.

The General Harvesting Management policy sets forth the following principles, goals and objectives that will be maintained in the sourcing of biomass fuel for BRF from the plantation harvesting program:

1. Minimize environmental impacts of the biomass fuel sourcing activities on the surrounding forest resources by promoting good agricultural and silvicultural practices which enhance the value of the plantation.

2. Develop long-term relationships with small and large farm holders in the surrounding communities.

3. Provide assistance to farm holders in the implementation of required forestry and agricultural guidelines and regulations as they apply to whole tree harvesting.

4. Promote the adoption of agricultural and silvicultural best management practices

To accommodate compliance monitoring and oversight, BRF commits to:

1. Make provisions for the monitoring and periodic inspections of harvesting operations by state authorities or approved non-governmental bodies to ensure that harvest operations conform to the HMP standards.

2. Keep a copy of all harvest plans to facilitate periodic inspections.

1.1 Date of Plan

The Harvesting Management Plan was developed in January 2009 to guide the operation of Buchanan Renewables Fuel harvesting operation in Liberia

1.2 Landowners' and BR Fuel's Objectives

BR Fuel does not own land. It works directly with farmers, mostly smallholders, to harvest and replant existing rubber plantations. In undertaking these activities, BR Fuel's main objectives are to:

1. Develop a viable, environmentally and socially responsible business model that can be replicated in other areas, countries and regions
2. Develop a sustainable, local supply of biomass from rubber woodchips (an agricultural by-product) for affordable, reliable and environmentally responsible electricity generation in Liberia.
3. Support Liberia's export economy by creating an international market for rubber woodchips
4. Rejuvenate the rubber industry in Liberia
5. Contribute to job creation and training in Liberia
6. Contribute to economic and community development in Liberia

The general objectives of plantation owners gathered from pre-harvesting plan consultation are as follows:

1. Timely payment of just remuneration for trees harvested from plantation

2. Harvesting should be carried out in a form that will not affect the growth of the new plantation

3. Number of trees replanted should be equal to or more than number of trees harvested with a maximum replanting density of 500 trees per hectare.

4. BRF carries out replanting within six months from the time of harvest and manage the farm up to its productive stage (7 years), before transfer to the land owner

5. BRF provides farm management training to support land owners capacity to adequately manage the plantations

6. That BRF provides logistical/material support (cups, knives, wires, acid etc) to farmers to enable them to manage the farms after turn over, based on a new agreement under which BRF deducts the cost of materials supplied to landowners from any future payments due.

1.3 General Property Descriptions

The properties comprise of scattered blocks of small plantation farms owned by small farm holders. Most of the farms have exceeded their productive lifespan, aging between 20-25 years, with evidence of mismanagement.

As the project progresses, BR Fuel intends to work with a large number of smallholders, as well as a number of the larger rubber plantation owners, particularly in Grand Bass and Margibi Counties (see Section 11 for the Harvesting Expansion Plan).

1.4 List of Known Threatened and Endangered species

There was no evidence of species which could be classified as rare, endangered or protected under Liberia or International Law.

1.5 Cultural and Natural Heritage Sites

There was no evidence of cultural or natural heritage features of significance on the harvesting sites.

1.6 Past and Current use of The Land

Information gathered that the project lands were previously covered by primary and secondary tropical forests, which were used for harvesting fuel wood and construction materials. These were later cut down for agricultural purposes including livestock grazing, and subsequently converted into rubber plantation lands, which is the current land use.

1.7 Use of Adjacent Land

The majority of the land adjacent to the rubber tree plantations on which BR Fuel is operating, consists of open areas covered in natural bush or old, unproductive rubber trees. In some instances, they are located near secondary growth wetland areas.

1.8 Soils Information

The different blocks of the properties can be classified as lateritic soils, reddish brown in color and quite hard; regosols (sandy soils) that consist of coarse and fine sand which contain a small amount of clay, and swamp soils:

In terms of physical description, the soils consist of:

- Upland soils: These soils are gently sloping and deep, with moderate to well drainage. They have a moderate to high water availability and permeability
- Lowland soils: These are composed of nearly, deep, very poorly drained soil found in depressions and drainage ways. They have very high water availability and slow to moderate permeability. These soils are typically saturated or ponded throughout the rainy season and early dry season. The major limitations hazards are due to minimal rooting depth for trees and equipment accessibility from wet soils. Equipment usage should be limited to periods of the dry season. See Appendix B for sample laboratory analyses of baseline soil conditions and water quality data.

1.9 Locations of the Properties

The current operations are located within Compound #3, Grand Bassa County (see Map 1 of Liberia in Appendix C); however, as the project progresses, BR Fuel plans to extend into Margibi, Montserrado and Bong Counties, and potentially others (see Section 11 for the Harvesting Expansion Plan).

1.10 Road Conditions on and around the Properties

The majority of the plantations that are currently being felled and replanted are along laterite rural roads. Most of the plantations are accessible from the road; however, some are reached using smaller laterite access roads. Many of the main roads are un-kept and uneven with holes and washboard surfaces. In order to facilitate the transport of woodchips too and from sites, many roads need to be properly graded, shaped and maintained, particularly after the rainy season. The plantations, however, are along or accessible off of a limited number of roads. Thus, rehabilitation and/or maintenance of a single road enables BR Fuel to access a large number of plantations.

Some of the smaller roads are also overgrown and must be cleared and graded to facilitate the transport of woodchips and heavy equipment to and from the site. Preliminary expeditions and maps suggest that the conditions of roads in new operational

areas will be consistent with the conditions described above (see Map 2 of the future harvesting area, Totota, in Appendix C). No new roads will be required.

1.11 Aims of this management plan

The aims of this Management Plan are to:

- Facilitate the sustainable harvesting of rubber trees from redundant rubber plantations across Liberia;
- Provide effective and efficient measures for replanting including development of nursery sites;
- Optimize the management and protection of resources in the operating area;
- Educate all stakeholders (BRF and farmers/landowners) on international best practices for harvesting operation; and
- Lay the foundation for a harvesting management plan and strategy that will evolve as BR Fuel expands into other regions.

1.12 Outcomes from this management plan

The anticipated outcomes of this Management Plan are:

- Redundant rubber plantation harvesting is undertaken in a sustainable manner, and in accordance with current international standards and Liberian policies and legislation.
- All stakeholders are aware of regulatory, operational and conservation requirements, so that redundant rubber trees are managed sustainably.

1.13 Review of the management plan

This Management Plan shall guide operations until amended or replaced by a plan approved by the Environmental Protection Agency of Liberia. During the lifespan of the project, BRF will undertake evaluation programs in relation to the management and sustainable harvesting of redundant rubber plantations. These programs will continue to provide important information to improve the effectiveness and sustainability of redundant rubber plantation management under the BRF project, and to integrate such information and procedures into future revisions of the Harvesting Management Plan.

2.0 OBJECTIVES

2.1 Landowner's and BR Fuel's desired output

Analysis of information generated during consultation indicates the following general desired output of the landowners:

- That the plantation harvesting agreement will provide avenue for income for landowners while at the same time setting the pace for farm rejuvenation and future revenue

- That the farm be capable of achieving its productive stage within 7 (seven) years

BR Fuel's desired output is outlined above.

2.2 Time frame for results

It is the desire of the farmers/landowners that they will receive immediate and adequate remuneration for plantation harvested based on the output of the harvest program, which they indicate should run within 3 months of the agreement. Below is the estimated schedule of results for the harvesting management program:

Table 1 Activity Schedule

Activity	**Schedule**
Harvesting	October – April
Land preparation	January – April
Replanting	April - October
Return of farm to land owners	~ 8 years after harvesting

2.3 Socio-Economic and environmental benefits

2.3.1 Environmental

The sustainable harvesting and replanting of rubber trees from redundant rubber plantations, as described in this Harvesting Management Plan, will have a negligible impact on the environment or ecology of a particular area, relative to the ecological changes resulting from the harvesting and replanting practices. The harvesting will alter the habitat of shrubs, crawling rodents, insects, amphibians and reptiles in the project area. However, the retention of vegetation in the project surrounding area ensures that ecological values are maintained in the vicinity of operational areas and at the landscape level. This also ensures that there is adequate potential for the recolonization of the regenerating vegetation.

Traditionally rubber plantations have been created through conversion of native forest to plantation. The Environmental Protection Agency of Liberia, in an effort to protect biodiversity, requires a restriction on broad-scale plantation conversion of native forest. The phasing out of the conversion of native forest has brought forward the need for rubber plantation harvesting practices that also include sustainable replanting programs as outlined in this Harvesting Management Plan, so as to avoid further land conversion.

BRF is making use of an agricultural by-product, a large portion of which will be used to create Carbon Neutral power for Liberia. The environmental benefits of this activity are clear when considering the other power options which are currently diesel and heavy fuel oil. Furthermore, BRF will make some of the roots and branches available to local communities for charcoal production and firewood, thereby reducing the incentive for communities to use natural forest for charcoal production.

2.3.2 Social

The harvesting of rubber trees from redundant plantations is a sustainable practice which supports employment in the rubber sector, improves resource use and reduces the incentive for unsustainable harvesting. The harvesting of redundant rubber tree plantations provides full-time and part-time employment in rural and regional areas. Whilst the number of people employed in this industry may seem relatively small, it is significant for the individuals concerned, their families and the community as a whole. Such employment is important in rural areas with restricted alternative employment opportunities.

The harvesting and replanting activities undertaken by BRF will not only create jobs directly, but they will also rejuvenate the labor-intensive rubber industry in Liberia, thus having a significant impact on reducing unemployment in Liberia. Furthermore, BRF makes an effort to invest in the communities, in which they operate, for example by building wells, training fire squads and working to improve local hospitals.

2.3.3 Economic

The rubber sector faces the normal supply and demand risks associated with any economic enterprise. However, the rapid redundancy of many of the country's plantations, which are the only current source of latex supply, will lead to continued decline in the industry. This will result in the loss of large scale employment opportunities, and export earnings. The BRF project seeks to reverse this trend.

BRF will not only contribute to economic development in Liberia by rejuvenating the rubber industry, but it will also contribute to developing local economies by sourcing locally when feasible, improving Liberia's export economy by exporting woodchips, and encouraging investment by demonstrating the feasibility of operating in Liberia.

3.0 BASELINE CONDITIONS (STAND DESCRIPTION)

3.1 Project Setting

Buchanan Renewables Fuel intends to convert redundant rubber trees into chips for subsequent export and also the conversion of some to be used for the generation of electric power. The project is actively taking place in two counties (Grand Bassa and Montserrado counties) where unproductive rubber wood is being converted into chips. Table 1 identifies the areas already harvested in Grand Bassa County:

Table- 2: Areas already harvested and replanted in Grand Bassa County

Parcel or block name	Parcel/Block (hectares)	Parcel/Block (acres)	Quantity of redundant trees removed	Quantity already replanted
Holt Farm#1	3.8	9.39	1099	2050
Holt Farm#2	6.66	16.45	2900	4435
Hill Farm#1	7.53	18.60	2088	5020
Montgomery	5	12.35	2295	3337
Barchue Farm	10	24.70	7954	8100
Emmanuel Logan	3	7.41	1358	1730
Levi Martin Farm	3.8	9.39	1443	2554
Gabriel Brown Ext.	1	2.47	554	699
Gabriel Brown Farm	2.3	5.68	1500	1532
Hunter Farm	8.35	20.62	2772	5563
Francis Mayson Farm	10.4	25.69	4665	6921

BR Fuel is in the process of also mapping out, identifying and securing a number of farms around the countries. Currently, identification is taking place in Bong, Margibi, Montserrado Counties, etc.

The assessment of the farms to develop the baseline conditions took 10 days and covered the current status of the farms in general. Investigations prove that most clones planted on these farms were from *Hevea brasiliensis* and that these farms have been in existence for at least 25 years. Most farms assessed had their trees invaded by pests. Termites, root-feeding grubs and bark borers were dominant amongst the pests that had breed within these farms. Sucking insects such as mealy bugs and aphids on the other hand were also identified but only on few farms**.** Diseases, particularly those caused by fungi were observed in trees from seedling stage to maturity. Brown bast disease which causes flow of latex in disease bark to finally stop due to coagulation of latex within the vessels, were visible in all plantation/farms investigated.

The general topography is relatively mixed, consisting of steep hill and relatively flat areas with maximum elevation change of roughly 22-28 meters. Further north, the land area is very low and poorly drained. The remaining plantations are slightly rolling with undulating hills and wetlands. Small sections of young bushes and secondary forest

spread across the hilly terrains of most farms. However, their features and canopies are almost made invisible due to the rising height of rubber tree canopies. Damage of farms due to wildfire was also visible. There were no demarcation lines or conditions set in place by farm owners whereby plantations were free from the encroachment of young bushes and secondary forest which could pose a serious wildfire hazard. It was evident that in all of the farms there were no measures put in place to avoid wildfire. No fire belts were put in place in the past. Bushes were not only seen around farms, but all through the farms. Rubber seedlings were observed scattered in nearby surrounding bushes serving as footing for climbers and vines.

Risks of Wildfires

Weather conditions influence the susceptibility of an area to fire; such factors as temperature, humidity, and rainfall determine the rate and extent to which flammable material dries and, therefore, the combustibility of the forest. Wind movement tends to accelerate drying and to increase the severity of fires by speeding up combustion. The weather condition most favorable for the occurrence of wild fire within the project area is during the dry season, mainly the months of December, January, February and early March when the temperature is as high as 32ºC during the day with 65% relative humidity and the wind speed is up to 45 mph. There is little rain during this period, which means the vegetation and soil cover can get extremely dry.

The risks of wild fires that are likely to be associated with this project during the period indicated above are as follows:

Lightning ignitions, ignition from equipment exhaust, deliberate use of fire by locals for land clearing for agriculture, cigarettes, and arson. Such fires could destroy forested areas as well as homes and property bordering these areas. Small-scale, periodic wild fires can actually improve the health, resilience, and productivity of an ecosystem. When these fires do not occur often enough, however, flammable vegetation can build up, leading to a large-scale fire that harms plant and animal species. Education and regular patrols of project area and its surrounding, as well as having appropriate fire equipment on site, will help to prevent or control fires.

The sale of rubber has brought great economic benefits for farm owners and workers. Until now, rubber was sold for almost 20USD/per pound. The frequent tapping and visitation of workers and farm owners clearly explained why most rubber farms are accessible, although the roads have to be rehabilitated to improve its conditions.

4.0 EROSION AND SEDIMENT CONTROL MEASURES

4.1 Introduction

While protecting and improving land investment, controlling soil erosion will:

- sustain or improve crop yields
- reduce drainage costs
- retain nutrients and chemicals where applied
- reduce hazards when working on eroding soil, and
- help improve water quality.

Management of soil for water and wind erosion control is based on sensible soil conservation practices. The majority of these practices are recognized components of good soil, crop, and water management. In order to ensure better and effective erosion control measures, the following recommendations will be adhered to by BRF:

a. BR Fuel must maintain good soil structure
b. protect the soil surface by adequate crop and residue cover, and
c. use special structural erosion control practices where necessary.

These factors often control both water and wind erosion. Not all erosion control practices will fit into every farm management scheme. However, each erosion problem can be remedied by choosing one or more of the remedial practices appropriate to the problem.

4.2 Quantity of rainfall per year

The rainfall ranges in Liberia which is typical of the project area are from 2000 to 4000 mm/year with an average of 2,372.

4.3 Soil Structure

Good soil structure is a result of management systems that include the regular use of soil-improving crops such as forages; the frequent return of organic matter in residues and manure; and tillage practices that avoid unnecessary breakdown of soil structure.

A forage crop, such as grass-legume hay, cash crops such as peanuts and beans must be utilized on rubber farms which have already been harvested in order to improve soil structure.

Tillage practices also affect soil structure. Proper tillage reduces soil aggregates to the most effective size for a favorable seedbed. Excessive tillage, however, can break down soil aggregates, destroying the soil structure formed by good crop and residue management. Excessive tillage will also contribute to undesirable compaction; accelerate erosion, and waste time and energy. Timeliness of tillage operations are also important. For example, working finely-textured soils when wet should be avoided in order to

prevent compaction, puddling, and the resulting formation of hard clods when dry. Timely tillage will help maintain soil structure and reduce its erosion potential.

Figure 1: Photos of very compacted soil due to soil working during wet season:

4.4 Quantity of groundcover/mulch

The benefit of growing the appropriate crops on specific soils is important. Crops help reduce the erosive forces of water and wind by means of their canopy intercepting rain, and acting as a windbreak. Root systems stabilize the soil and reduce losses. Crop residues perform similar functions and, in addition, form small dams that help retain runoff water, thereby reducing erosion. Buchanan Renewables Fuel has maintained such practices on all harvested farms. See photo below. BR Fuel also encourages the growth of natural grasses.

Figure 2: Scattered pieces of tree residues.

In addition to crop residues and cover, BR Fuel has decided to use a large quantity of mulch obtained from ground stumps and roots. The mulch is to be used as groundcover for soil stabilization and to serve as nutrient enrichment for plants and the soil. Mulch also acts to reduce storm water run-off velocity and prevent sediment and nutrient pollution. Studies show that mulch can reduce soil loss from 45-99.8% and reduce water velocity from 24-78%.

BRF has also planted beans and peanuts on every replanted farm and anticipate continuing this practice on every farm. These actions will greatly increase nitrogen content in the soil. The continuous increase of nitrogen content will automatically lower the demand for fertilizer usage.

Additionally, these measures are recommended to be implemented by Buchanan Renewables Fuel for the mulching of farms/plantations:

1. All prepared areas for replanting shall be mulched;
2. Mulch shall be spread uniformly at a rate of 6 tons per acre in a continuous blanket over the area targeted for replanting;
3. Before mulch is applied on cut or fill slopes that are 3:1 or flatter and ditch slopes, BR Fuel shall remove and dispose of all exposed stones in excess of three (3") inches in diameter and all roots or other debris that will prevent proper contact of the mulch with the soil;
4. Mulch shall be uniformly spread which will provide an acceptable application that will allow some sunlight to penetrate and air to circulate but also partially shade the ground, reduce erosion, and conserve soil moisture;
5. Mulched areas shall be inspected regularly and mulch shall be replaced anywhere it has eroded. On very steep slopes, netting and anchoring may be required.
6. BR Fuel shall take sufficient precautions to prevent mulch from entering drainage through displacement by wind, water or other causes and shall promptly remove any blockage to drainage facilities that may occur.

4.5 Crop Rotations

Fallow land has the highest erosion potential in any cropping system. Row crops such as corn or beans reduce this potential by half, which is still considered to be excessive. Sod crops such as hay and permanent pasture keep soil erosion to a minimum and should, therefore, be used in rotation with other crops where erosion is a problem. Compared to continuous corn, hay or pasture crops reduce soil loss by about 90%. A rotation involving row crops and grain crops, while not as effective as a sod-based rotation, may reduce soil losses by 30% compared to continuous row crops.

A crop rotation that includes forages can reduce soil loss by water erosion and, at the same time, slow the buildup of insect and disease problems encountered with a

continuous cropping program. On farms where crop rotations are not adequate to control soil erosion, other conservation practices will be considered.

The below recommendations will be used considered to control both water and wind erosions on BRF operating farms.

Farm in sloping terrain and those having sectional slope, the following recommendation will be considered by BRF:

1. Conveyor drainage lines should be dug through the sloping section to convey runoff to designated areas;
2. Cover crop like beans and peanuts must be planted to slow down runoff and prevent erosion, but this must not be relied on for sustainable erosion control in slopping farm terrains;
3. In extreme slope terrains cover weeds or grasses should be planted on runoff routes to avoid the continuous digging and carrying away of soil from erosion/drainage paths;

For farms in almost level plain terrain, the following recommendation will be considered by BRF:

1. Bushes will be left along boundary of the farm(s) to serve as natural barrier against rushing wind which in most instances affect seedlings;
2. In areas where farm has a block of 50 hectare and more, trees and bushes must be left in between block of each 50 hectare to also serve as wind break for approaching wind;

It is also recommended that BR Fuel:

1. Should avoid excessive tillage of soil in order to avoid undesirable soil compaction, accelerate erosion and waste time and energy
2. Should consider timeliness of tillage operations, especially doing so in the wet season to prevent compaction, puddling and the formation of hard clods.
3. Should maintain crop residue on every harvested farm during replanting as it stabilizes the soil and reduces nutrients loss. It also forms small dams which assist in retaining runoff water.

4.6 Tillage Practices

Proper tillage practices employed separately or in combination with crop rotations can be very effective in reducing soil erosion losses. Compared to conventional plowing, a mulch tiller reduces soil loss by up to 40%. Compared to plowing, water-related soil losses can be reduced by up to 80%. The objective with any tillage practice is to leave the soil surface in a rough condition, and, where practical, protected with crop residues.

These conditions facilitate easier infiltration of water by slowing surface water runoff, and minimize soil erosion. It is expected that where tilling is necessary, BR Fuel will initiate these procedures.

4.7 Contour and Strip Cropping

On many of the farms assessed, there are a number of large slopping terrains. The following are recommended steps to control erosion by runoff and wind:

- Tillage and planting of the crop across, rather than with the slope, can reduce soil loss by 25% (value from parameters used in the Universal Soil Loss Equation).
- Strip cropping alternate hay and grain strips is an erosion control measure that can be used on long, smooth slopes where forages are part of the rotation. Strip cropping across the slope can reduce soil losses by 50% when compared to up-down slope cropping.
- Contour strip cropping will reduce soil losses even further. Strip cropping, ideally, involves alternating strips of forage and a row crop on the contour. In situations where forage is not being grown, cereal crops are a reasonable substitute to be alternated with corn or soybeans.

4.8 Wind Erosion Control

Management practices to control wind erosion are critical on sandy, muck, or peat soils, and should also be considered on clay or silty soils. Maintaining good soil structure and residue cover provides good resistance to wind erosion. Fencerows also provide good protection. Strip cropping or even planting crops at right angles to prevailing winds is a method of controlling wind erosion on land susceptible to strong winds.

Tree windbreaks should be created along the north and west boundaries of fields to be constantly used for nursery preparation, especially around fields where wind erosion is a particular problem. These can be created by leaving trees unharvested or, where necessary, planting a fast growing native species. This will avoid the continuous clearing of large areas within natural forest or young bushes for the nursery site as a well protected site will possess the quality necessary for such nursery activity. On very steep slopes or areas where blowouts or rills/gullies frequently occur, permanent sod or tree cover will be maintained, and may in fact provide better financial returns.

4.9 Structural Erosion Control Practices

When surface water concentrates, rills develop. If these rills are not addressed with appropriate control practices, a gully may result. While BR Fuel has demonstrated the practice of establishing runoff ditches on farms where erosion continue to be a problem for the soil and the rubber seedlings thereof, the problems often still remain. Runoff ditches are located along slopping terrains and marshy concentrated areas of farms where erosion continues to evolve. The 1x1foot in width and depth and approximately 50m in length for ditches assessed on Holt Farms 1 & 2, Montgomery and R. Francis Manson

Farms for instance clearly show that more needs to be done even with the introduction of these mechanisms. Water runoff may continue to be a problem on some areas even after conservation tillage and cropping practices are followed. In order to continuously secure the soil and crop planted especially during the heavy rain, consideration will be given to the below mechanism for all areas of farms in which runoff ditches are to be given consideration:

- There must be properly constructed and maintained waterway with good vegetative cover instead of a narrow strip. This is a practical way to prevent this type of water erosion.

- Waterways must have a shallow, saucer-shaped cross- section and an erosion-resistant vegetative cover to carry water safely. A wide, shallow waterway shape will facilitate machinery crossing.

Figure 3: various runoff ditches put in place by BR Fuel but which has been structured differently by continuous and heavy water flow.

- Drainage ditches should be regularly monitored and cleared of dirt and debris.
- Water and sediment control basins, or channel terraces must be set in place as these can also achieve the same objective as grassed waterways. They are used to pond surface water from small upland areas (less than 20 hectares) for short periods of time (less than 24 hours), and direct these flows into subsurface tile systems. These structures effectively reduce the peak flows of surface runoff and control rill and gully erosion.
- Buffer strips along the banks of drainage ditches and streams should be considered as these stabilize the banks by preventing slumping and washouts as well as subsequent siltation. The buffer strips should be maintained with grass cover. Ditch or stream banks should have proper side slopes based on the soil type and be permanently vegetated. Properly installed and maintained buffer strips and vegetated banks will reduce maintenance costs for ditch cleaning.
- Concentrated flows of surface water must be directed to protected points along the ditch bank where they may enter the watercourse. Drop structures such as rock chute spillways or drop pipe inlets will safely convey this water to the ditch or stream bottom.

The exact length, location and layout of drainage ditches will depend on the particular soil type and terrain on a given plantation. In general, however, drainage ditches will be arranged in a grid format, with collector ditches running in rows across the contour of the land intersected by perpendicular ditches, which guide run-off down the slope of the land into a drainage ditch at the bottom. The distance between the ditches will generally range from 50 to 100 feet; however, the exact distance will depend on the slope of the terrain and the soil characteristics.

Tile drainage systems can also be an effective means of reducing surface runoff. By maintaining the water table at a constant, desired level, the soil surface will remain in a drier condition to more effectively accept water without eroding. Tile drainage systems complement surface water control measures such as grassed waterways, water and sediment control basins, terracing and water inlet systems.

Tile drainage outlets should be protected from erosion at the point where tile systems enter ditches and streams. Proper installation of rock riprap or other erosion-resistant materials will ensure that tile water is safely discharged into watercourses.

Controlling livestock access to streams and ditches can be an effective means of maintaining bank stability, decreasing sedimentation, and improving water quality.

In summary, wind and water erosion control practices are based on maintaining a good soil structure, protecting the soil surface and making use of erosion control structures. Adherence to these practices will do much to enable farmers to continue to maximize crop yields, minimize soil erosion, and enhance the quality of surface water.

4.10 Riparian Management Zones (RMZs)

Riparian Management Zones (RMZs) are sometimes called buffer strips, filter strips, or streamside management areas or zones (see below). An RMZ occurs on both sides of perennial or intermittent streams and around the perimeter of bodies of open water (e.g. open water wetlands or lakes) where extra precaution is used in carrying out management activities including harvesting activities for wood to produce energy.

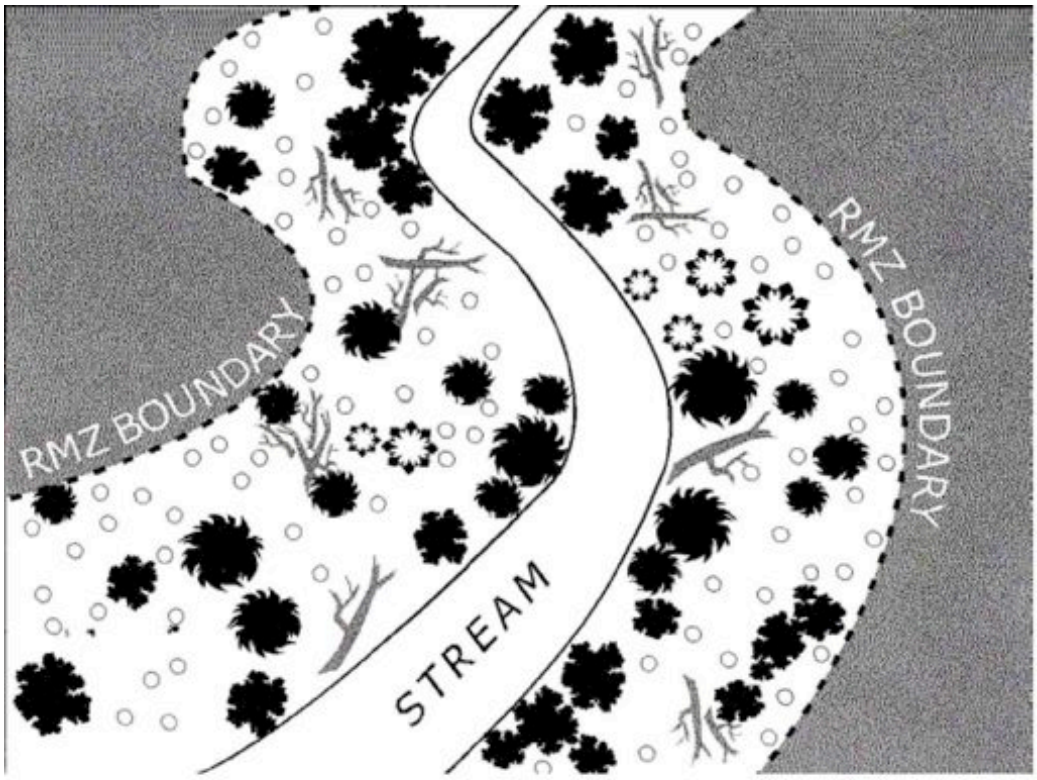


Figure 4. Example of a Riparian Management Zone

One of the purposes of a management zone is for water quality protection to provide an area of vegetation to interrupt water flow and to trap and filter out suspended sediments, nutrients, chemicals, and other polluting agents before they reach the body of water. An RMZ also provides shade to small streams, thus reducing thermal pollution.

That part of the zone nearest the stream bank can also make an important contribution to the aquatic food chain. As trees die within the RMZ, all or portions of them may fall over into the adjacent stream. This dead material provides aquatic habitat known as large woody structure (LWS). Naturally occurring LWS in lakes and streams provides essential areas of shaded cove for fish, amphibians and aquatic insects and can provide important

isolated platforms for reptiles and small mammals. As a general rule, trees that have the potential to provide LWS to a lake or stream should not be cut no matter how many they are within such location.[2] Recommended techniques to prevent and control impacts to water quality and quantity, riparian zones, and wetlands common to both plantation and managed natural forests include the following:

- Implementation of a riparian management zone (RMZ) plan. RMZs are typically established on the border of water bodies (e.g. lakes, navigable perennial/intermittent streams, non-navigable streams) to provide buffer zone to protect water bodies

4.10.1 Activities within the Riparian Management Zone

Best Management Practices do allow for forest management activities within the RMZ. These include:

Equipment operation and timber harvesting. The key is ensuring the water quality protection function of the RMZ is maintained (see Section "RMZ Water Quality Function Factors" hereafter) throughout the harvesting operation.

The RMZs should be maintained along all perennial and intermittent streams, lakes or ponds where nearby management activities result in surface/soil disturbance, earth changes and where erosion and sediment transport occur during rain events.

The RMZs are critical to watersheds, wildlife, fish, trees, and people for many different reasons. The management of BR Fuel must make sure that harvesting operation considers the importance of these zones in order not to abuse them. All those involve in the harvesting operation, especially heavy machinery operators will be educated about the facts of riparian zone:

- These RMZs are essential, in particular, for diverting pollutants flowing toward a waterway.

Adequate vegetation in a RMZ helps filter and trap pollutants such as sediment, excess nutrients, and other contaminants before they reach surface waters. Excessive disturbance of the forest floor within the RMZ minimizes its ability to prevent nonpoint source pollutants from reaching a stream or other water body. In fact, such disturbance might lead to the transport of sediment directly from the RMZ to the water body adjacent to it.

4.10.2 Site Specific Factors to Consider

BR Fuel harvesting operation occurring in or near a RMZ will plan carefully to assure that the water quality functions of the RMZs are maintained. Those unsure of the water quality impacts of a planned activity should seek the advice and assistance of foresters or

[2] This section on water quality is adapted from guidance available in FAO(1996) and Wisconsin Forest Management Guidelines(2003)

other natural resource professionals familiar with RMZ functions, or leave the RMZ undisturbed. The following are site specific factors to consider prior to harvesting or conducting other management activities in the RMZ:

- Water body characteristics.
- Slope.
- Soils.
- Aesthetics.
- Existing vegetation.
- Shade requirements to maintain water temperature.
- Time of year activity is scheduled to occur.
- Availability of large woody structure for the adjacent water body.
- Recent precipitation.
- Extent of soil saturation.

4.10.3 Riparian Management Zone Water Quality Function Factors

The water quality function of RMZs can be maintained by meeting the following specifications:

- ❖ Harvesting zones must be set up in each of the redundant rubber plantation/farm to make sure those engaged in the operation establish a minimum RMZ width of 100 feet, from each side of a stream, measured from the top of the bank of the lake or stream or the ordinary high water mark.

- ❖ RMZ width should be increased as slope percentages increase (see Table 3). RMZ width shown in Table 3 may need to be increased where domestic water supply could be impacted.

- ❖ While BR Fuel wishes to maximize the use of redundant rubber trees the company's harvesting /cutting specifications should be modified to retain a sufficient number of the redundant rubber trees to maintain shading of streams and to leave a relatively stable and undisturbed forest floor (less than 10 percent soil exposure).

Figure 5:Example of cutting specification over a valley composing of water way.

- ❖ Locate haul roads outside of RMZs. Where a road must cross a stream, it should do so at right angles.

- ❖ Locate equipment storage and maintenance sites and landings outside all RMZs.

- ❖ Remove all limbs and tops from harvested trees from streams and open water wetlands as these are considered sources of "unnatural" organic debris and impact aquatic habitat, including lowering levels of dissolved oxygen required to maintain a healthy coldwater fisheries.

- ❖ Skidders should not be operated in RMZs when soils are saturated as the soil easily compacts and runoff is not easily absorbed by the soils in the RMZ.

- ❖ Harvesting shall not occur within 50 feet (15m) of a water body. If harvesting must occur between 50 and 100 feet from water bodies, every effort should be used to remove timber from the zone with techniques such as cable harvesting, or use of tracked equipment with knuckle boom cranes to ensure equipment is not negatively impacting the RMZ's soil base. Even if the soil is not scarified, compaction will decrease the ability of the soil to absorb runoff.

- ❖ All roads, cuts and fills in the RMZ must be stabilized. Use appropriate seeding and mulching procedures. Energy dissipaters (e.g. rock ranging from 3-12 inches in diameter) should be installed at inlets and outlets of cross-drainage culverts located underneath roads approaching a stream.

- ❖ Drainage structures such as culverts, diversion ditches, conveyor belt water bars, and broad-based dips should be installed according to BMP specifications prior to roads and primary skid trails entering the boundary of a RMZ.

- ❖ Explore planting indigenous vegetation to strengthen the RMZ, as well as the possibility of planting vegetation with economic potential, such as medicinal plants, in the RMZ, beyond 50 feet from the water body. This could help to offset farmers' losses due to forgone rubber trees, while maintaining the health of the RMZ.

4.10.4 Riparian Management Zone Widths

More and more, forest water quality research indicates that a 100 foot or 30 meter RMZ is the minimum needed to protect water and aquatic habitat quality when conducting forest management activities adjacent to a water body, especially if the activity provides a source of sediment (e.g. dirt based forest road). Widths from 50 feet to 500 feet have also been suggested if management objectives include protecting wildlife habitat or controlling beaver activity on smaller streams.

Table 3 illustrates the minimum recommended widths for RMZs based on slope. Note that these widths are for overland sheet flows only. Nonpoint source pollutants

transported via concentrated flows into a RMZ will usually require additional measures, such as placing geotextile silt fence overlain by riprap or large sized rock, ranging from 3-12 inches diameter, for a width of 3 feet and a length of 5 feet. When measuring for a proper width of a RMZ, BR Fuel will take into account the natural variability of the landscape and widen the RMZ accordingly. Slope can be calculated with several methods, including using a string and line level, or using the services of a licensed professional surveyor.

BR fuel acknowledges that it takes years for deposited sediment to be cleansed from a stream, and will ensure that those in charge of harvesting operations or site managers will err on the side of caution when establishing the width of a RMZ. BR Fuel management will observe the minimum riparian management zones width adjusted for slope.

Table 3. Minimum Riparian Management Zone Width Adjusted for Slope.

Slope of Land Above Water Body or Stream (%)	Minimum Width of Riparian Management Zone (Feet)
0-10	100
10-20	115
20-30	135
30-40	155
40-50	175
50 +	Harvesting is not advised due to the high potential for erosion and sediment transport

Table 4: Soil Erosion Susceptibility [3]

Surface Soil Texture	Susceptibility to Erosion *(1=highest)*
Silt, silt loam, loam, very fine sandy loam	1
Sandy clay loam, silty clay loam, clay loam	2
fine loamy sand	3
Clay, silty clay, sandy clay, very Sandy loams, loamy sands, Sands	4

[3] *Courtesy of the Minnesota Forest Resources Council.)*

4.10.5 Management for Shade Intolerant Species within the RMZ

To meet wildlife goals, landowners may consider that managing for shade intolerant species, within the RMZ, is desirable but still want to protect the water quality protection functions of the RMZ. In general, landowners, loggers and land managers should consider if the amount of any timber harvest removal occurring in the RMZ 50-100 feet from the stream is compatible with the ecology of the stream.

4.11 Summary of Erosion and Sediment Control Measures

A summary of the Erosion and Sediment Control Measures that will be employed by BR Fuel follows in Table 5. Additional measures may be implemented as and when required.

Table 5. Summary of Erosion and Sedimentation Control Measures

CONTROL MEASURE	PARAMETERS AND CONDITIONS FOR MEASURE
NATURAL VEGETATION & DEBRIS	• On all terrain, natural vegetation and small debris will be left as far as possible during and after harvesting.
MULCHING	• Used on all harvested areas for erosion control and nutrient enrichment in the amount of 6 tons/acre • The concentration of mulch will be increased to ensure ground cover in areas with a slope over 30% and/or a soil erosion susceptibility of 1-2, and mulching will be tacked accordingly.
DRAINAGE DITCHES	• Used to pond surface water from small upland areas (less than 20 hectares) for short periods of time (less than 24 hours) • Used, in particular, on sites with sandy clay loam, silty clay loam, clay loam, fine loamy sand • Located along slopping terrains (greater than 10%) and marshy concentrated areas of farms where erosion continues to evolve • Located along contours and down sloping sections to convey runoff to designated areas • Distance between ditches depends on the contour of the land, slope and soil erosion susceptibility, as well as observed susceptibility of the land; however, for areas with a low risk of erosion (soil erosion susceptibility of 3-4 and a slope of less than 20%) ditches will generally be between 60-80 feet apart. This distance will decrease to around 30 feet as soil susceptibility and slope increase. • Where the slope is greater than 30% and/or soil susceptibility is 1-2, or where a particular threat of erosion is evident, grasses and brush will be planted along the edges of drainage ditches for increased stability. • Filter strips will be left or planted along drainage ditches and or streams that receive run-off from feeder ditches to control sediment run-off into waterways – see section 4.10 on Riparian Management Zones.

CROP PLANTING	• Used on most terrain, however, particularly on terrain with a slope greater than 20% and soil erosion susceptibility of 1-2. • Leguminous crops are planted along the contour of the land. The use of forage crops or cereals in rotation with legumes will also be considered in areas with a slope greater than 30% and soil erosion susceptibility of 1-2. • Used particularly on sandy, muck, or peat soils, and also required on clay or silty soils
CONTOUR REPLANTING	• Replanting of rubber trees will occur within 6 months of harvesting • Replanting will occur along the contour of the land
BUSH BUFFERS	• Left along the edges of blocks where high winds are common • Minimum width of 30 feet to be adjusted based on Table 10 • Left along streams and waterways – see section 4.10 or Riparian Management Zones
RIPARIAN MANAGEMENT ZONES	• RMZs will be left along all waterways in harvested areas • See Table 3 for parameters
WINDBREAKS	• Planted along the north and west boundaries of fields to be used for nursery preparation • Bush and/or tree breaks will be planted around fields where wind erosion is a particular problem • Minimum width of 30 feet to be adjusted based on Table 10

5.0 DESCRIPTION OF SOIL QUALITY IMPACTS AND MITIGATION MEASURES

Table 6: Soil Quality Impacts and Mitigation measures

Impact	Cause	Effect	Mitigation Measures
Compaction, rutting and displacement	Continuous movement of heavy equipment across the same ground can significantly compact fine-textured soils (such as those with clay) when they are wet	Compaction and rutting reduces growth of trees along the edges of tractor trails, and dragging logs along those trails may damage standing trees, creating entry courts for disease organisms and insects.	**Harvest Method** In the method proposed for this project, all rubber trees on a site are harvested for wood products, and the site will be replanted with seedlings and cash or other useful crops. This system works well for regenerating species such as rubber that require a great deal of sunlight as seedlings. Since harvesting equipment is only on site once every 20 to 25 years, there is less opportunity for soil compaction and damage to standing trees. It usually produces more revenue than selective cutting, and selective cutting is not as applicable or economically viable for plantation agriculture. Furthermore, a portion of the revenue will be allocated to site preparation and planting. **Harvest Design** In order to mitigate the impacts of compaction and rutting on soil, harvesting will be done primarily with cut-to-length technology. This system will use a rubber tired harvester-processor a rubber tired skidder and a rubber tired or tracked tree forwarder to minimize damage to the soil. The harvester processes trees at the stump, so there is no need to drag whole trees out of the forest and slash is treated in the fields which benefits nutrient cycling. The stump is later used as mulch. Scarring will be further minimized by careful operation. Soil disturbance is minimized because the forwarder makes every effort to carry logs instead of dragging them and to minimize travel distances and land covered. Soil disturbance will be further minimized by concentrating harvesting operations in the dry season (October to April) and, thus operating on dry ground. Following the thinning, slash will be carefully piled with a rubber tired or tracked grapple machine. This method produces much less soil disturbance and visual impact than the common practice of pushing slash together with a bulldozer or dragging whole trees to large landings. Grapple piling reduces fire hazard while helping to keep nutrients in the forest. Land use for landing, roads, and skid trails will be minimized

Impact	Cause	Effect	Mitigation Measures
Erosion	The impacts of soil erosion are likely to be caused by removal of plantation cover during harvesting. This may also increase erosion from natural causes such as wind and rain. Stacking of brush and slash and use of extraction lanes may also act to funnel water down erodible channels	Removal of protective soil cover (top soil) and anchoring roots which lead to land degradation, including nutrients leaching. This affects the productivity of the soil (pH,, nutrients and biological properties such as microflora and microfauna) and undermines revegetation	Mitigation actions for the management of soil erosion are based on sensible soil conservation practices. The majority of these practices are recognized components of good soil, crop, and water management. For effective erosion control the following will be instituted: d. Harvesting operations will be concentrated in dry season (October –April) to avoid the rainy season when soils are saturated as far as possible e. Begin less mechanical land preparation by January. Prepared land is covered with mulch and allowed to gain vegetative cover to avoid erosion from rain or wind. f. Commence replanting of cover crop and rubber over harvested area by April, including the use of nutrients and fertilizers g. Use special structural erosion control practices where necessary

6.0. DESCRIPTION OF BIODIVERSITY IMPACTS AND MITIGATION MEASURES

Harvesting influences various environmental factors including biodiversity. Perhaps the most constant characteristic of all ecosystems is "change". This change may not be visible on accustomed time scales. The harvesting method envisaged for this project may seem like a permanent change in the landscape, but in time it will return to the type of stand it was before harvesting. Although woodier biomass is removed in harvesting than in natural events, many of the changes that follow typical harvesting operations are no different than those that occur after a wildfire or hurricane. Plant and animal communities within the disturbed area shift to species that are best adapted to the new conditions of increased available sunlight, greater temperature extremes and altered species composition. Gradually, through a natural process termed ecological succession, the developing communities in the "disturbed" areas change to plant species that are adapted to shadier conditions, and to animal species that prefer the new plant communities for their food and nesting needs.

Eventually, succession results in a forest structure very similar to pre-harvesting conditions. Tree planting and other agricultural and silvicultural practices often hasten this process to meet management objectives. Each stage of succession adds to the biodiversity in a region. If all forests were old growth, there would be far less biodiversity than with forests that include a variety of different succession stages. Similarly, if all forests in a region were young plantations, there would be less diversity than with a mix of both young and old stands. Thus, harvesting may actually enhance the biodiversity across a landscape rather than being a disruption. Biodiversity will be maintained as long as there is a continuous renewing of young stands through harvesting operations or natural disturbances.

6.1 Fauna

Operational activities at the project site could disturb faunal populations, principally through habitat loss and destruction from land clearance leading to permanent species migration. Loss of habitat in the form of, for example, food source, migration routes, nesting sites (this may occur from actual removal or by isolation caused by haulage roads). As well, increase in human activity (intentional or unintentional, by increasing accessibility for example) leading to increased levels of hunting.

At present, the project area has limited species presence. The impact on fauna from operational activities is not expected to be significant. Moreover, investigations on all of the farms assessed clearly identified no rare, internationally protected or locally protected plants and or animal species.

Mitigation

BRF will not operate in natural forests. Staff of BRF will be prohibited from hunting, trapping, killing, harming or capturing of any wildlife, except where it threatens their lives. Approaches to discourage trade in wildlife will be mainly through education and awareness. Actions will be taken to conserve and protect permanent seasonal habitats such as wetlands to ensure their use for migration, spawning and rearing.

Riparian management zones will be maintained to preserve water quality and wildlife habitat (see section 4.10). BR Fuel will also explore the possibility of connecting these zones through corridors of natural vegetation across watershed boundaries to allow for the movement of animals and plants. The effectiveness of wildlife corridors for biodiversity conservation, however, is contingent on the support of farmers, adjacent land owners and local communities.

Where wildlife corridors are feasible, the particular size and design will depend on the slope variations within the proposed corridor, the quantity of wetlands and other sensitive areas requiring protection, and the presence and requirements of key species as determined by an ecologist or other relevant specialist. The minimum width of any corridor shall be 50 feet; however, widths may vary up to 500 feet.

6.2 Flora

The principal impact on vegetation during the project will be from direct vegetation removal (clearing of plantation and native grasses).

There are few stands of commercial trees overlooking some of the project areas. These are not covered under the harvesting management plan. There are no rare, threatened or endangered species within the site nor is it serving an important habitat function. The absence of rare, threatened or endangered species may clearly indicate that the clearing of vegetation will not be of great significance to the vegetation of the project terrain.

Mitigation

BR Fuel will:

1. Undertake vegetation removal only after detailed execution of the individual farm harvesting plan (see appendix A).
2. Retain surrounding natural vegetative cover as much as possible for its ecological role and function, such as to ensure a variety of succession stages.
3. Allow canopy closures over access roads to maintain habitat continuity.
4. Avoid using pesticide on natural vegetation, if they are to be used in any case, herbicides and pesticides should be biodegradable.
5. Leave roadside strips vegetated with natural cover.
6. Leave groups of trees and/or natural vegetation in and/or around the harvest area for regeneration purposes, and to provide den and nesting sites, food sources, cover and travel corridors for wildlife, including raptors. This may be achieved

through Riparian Management Zones and buffer zones between harvesting blocks. Appropriate conservation of understory species, as well as snags, slash and wood debris on site should also be consider to enhance wildlife habitat[4]

7. Ensure any buffer zone or corridor for wildlife has a minimum width of 50 feet (15m) and that the criteria defined in section 6.1 are used to define the actual parameters of the buffer zone.

6.3 Cultural and Natural Heritage Features

Br Fuel's operational activities could interfere with cultural and natural heritage features, such as ancestral cemeteries, that may be of significance to local communities or Liberia as a whole. Operational activities close to or in these sites may cause irreversible damage to the sites and create animosity between the company and local communities.

Mitigation

Although no significant cultural and natural heritage features have been identified on the farms on which BR Fuel is operating, BR Fuel will:

1. Work with farmers and nearby communities to identify significant cultural and natural heritage features on future operations sites.
2. Avoid operational activity within a minimum of 100 feet (30 m) of such sites. The exact size of the buffer zone will be determined depending on the specific features and requirements of the site, and in consultation with relevant community leaders and/or archaeological or other experts, depending on the nature of the site.
3. Identify potential impacts of operating near heritage features and define a mitigation strategy.
4. Work with local communities and community leaders to define suitable compensation where impacts cannot be avoided.

[4] IFC guidelines-plantations and managed natural forest

7.0 ADDITIONAL ENVIRONMENTAL IMPACTS

7.1 Impacts on Adjacent Lands

BR Fuel's operations may have impacts on the environmental conditions, biodiversity, local communities, and natural and cultural heritage on adjacent sites. Although, BR Fuel's experience suggests that adjacent lands consist primarily of bushland and rubber plantations, the company will:

1. Determine the use of adjacent lands.
2. Assess potential impacts on adjacent lands, including impacts on biodiversity, water quality, soil stability, air quality, local communities and natural and cultural heritage features.
3. Define mitigating measures similar to those described in this plan to mitigate on site impacts.
4. Leave a minimum of a 50 foot (15m) buffer zone when operating next to sensitive sites or ecosystems, wetlands or communities. The actual size of the buffer zone will be determined according to slope of the land as defined in Table 3 of section 4.10.4.
5. Partner with community leaders to address any potential cultural or community impacts

7.2 Impacts of Road Rehabilitation and Maintenance

BR Fuel will be required to grade and shape some of the main rural roads to facilitate transportation of woodchips and heavy machinery to and from plantations. It will also be required to clear, grade and shape some of the access roads leading to plantations. Further grading will have to be undertaken at least on an annual basis, to maintain road quality, particularly after the rainy season.

While no new roads will be built, the rehabilitation and maintenance efforts may have an impact on the surrounding water bodies and wildlife. Such impacts, however, are expected to be minimal, because ensuring roads are properly graded and shaped will help to minimize erosion and improve drainage. Furthermore, any overgrowth that will need to be cleared is likely to be bush that has grown up as a result of the limited use of access roads, and, as noted above, there is no evidence of the presence of threatened species in the region.

In undertaking road maintenance activities, particularly on private lands, BR Fuel will:

1. Establish a regular maintenance and road inspection schedule to identify issues and impacts before they arise.
2. Grade and shape road surfaces to maintain the drainage contour.
3. Fill holes as quickly as possible.
4. Ensure that drainage ditches are free from debris.
5. Ensure that heavy machinery is equipped with spill kits and that drivers are trained to use them.

8.0 DESCRIPTION OF SOLID WASTE MANAGEMENT PLANS

8.1 Slash disposal

Slash (stumps, tops, limbs, and rotten trees) left after harvesting is often the most undesirable visual effect of the harvesting operation. Slash abundance will be reduced by utilizing most of the harvested trees for the production of wood chips. Other parts of the trees such as stumps, tops, limbs and rotten tress will be given to the local to be removed for firewood, charcoal or other products, or used as mulch.

Slash also represents an important source of organic matter and nutrients for the soil, especially by evenly distributing it on the site. Limbing and topping trees where they are felled will help achieve this uniform slash distribution. Windrows and slash piles should be avoided in most situations although they can be used to provide habitat for small animals. The visual impact of slash will be lessened by lopping branches with saws or by chopping and crushing the material mechanically so it lies close to the ground. This will also hasten the decomposition process. Slash should not be pushed into ponds, piled in swamps, or left in streams, lakes, sinkholes or other water bodies.

8.2 Rubbish Disposal

Rubbish such as unwanted wire rope, oil and oil filters and other debris will be collected by the harvesting crew and recycled, composted or disposed of in secure areas designed in accordance with guidelines of the EPA. Additionally, all other municipal and hazardous waste will be disposed collected and disposed by EPA certified wasted disposal company. All food waste and organic matter will be composted and the composted material will be used as fertilizer for revegetation.

9.0 DESCRIPTION OF OCCUPATIONAL HEALTH AND SAFETY

Health and Safety Impacts

Harvesting operations will expose workers to various threats including the following: Insect and snake bites, lacerations from use of sharp tools/equipment, dust blown into eyes, high noise levels from working of heavy duty equipment and chain saws, injury resulting from falling trees and loose branches, fire and chemical hazards.

Outlets from on site water ponds will create areas of fast flowing water, which are favorable for the development of mosquito vectors responsible for diseases. Increased occurrences of diseases that may be induced by the presence of the water ponds include malaria, lymphatic filariasis as well as other diseases such as yellow fever.

Community health and safety also play a pivotal role in terms of occupational health and safety. Buchanan Renewables Fuel will also ensure that greater attention is given to the health of the community when dealing with their project. In compliance with the IFC guidelines 1.3 Community Health and Safety, BRF has avoided operating any section of their project area close to surface water bodies used by communities for drinking purpose.

Additionally, BRF has built some hand pumps and rehabilitated a number of them for several communities. In addition to these hand pumps, the company has provided support to the local hospital and trained and prepared the fire service department with available equipment to combat the sudden outbreak of any fire caused by natural of other means.

Safety to the community and other road users is also considered in the harvesting management plan of the company. Traffic signs with warning inscription of speed limits and road conditions are strategically posted especially on routes constantly plied by heavy trucks and other heavy equipment of the company. In fact, to minimize dust and damage to the road, there is periodic road rehabilitation. In addition, heavy trucks delivering goods and services use routes outside the city center for transportation to and from the port. Areas earmarked for harvesting and planting operations are often barricaded with red and with tags and manned by security to control and monitor the movement of others close to or along the operational areas. This has greatly reduced unnecessary accidents from pesticide exposure or contact with sharp equipment or tools. All of these precautionary procedures taken to include the community in its plan of actions have been rewarding and the company has resolved that it will continue in applying community health and safety hazards measures in its operating and management activities to include compliance to the IFC Guidelines:

- Water resources
- Fire
- Transportation
- Pesticide exposure

Mitigation

BRF will institute the following measures to ensure occupational health and safety:

- *Workers will be properly trained on the safe use of harvesting equipment and machinery, including work group coordination*
- *All equipment and machinery will be maintained as required and include the necessary safety devices (e.g. Blade guards on saw)*
- *Every worker involved with harvesting operations will be provided with Personal Protective Equipment (gloves, steel toe boots, ear plug, helmet, overhaul, goggles etc) as needed and will be dutifully required to wear them while on operational site*
- *First aid stations and trained first aid personnel will be available on site as well as two ambulance and procedures for emergency evacuation*
- *No worker apart from the heavy equipment operators and chain saw operators and an assistant will be permitted within two tree lengths when trees are being felled*
- *All workers will be trained in wind throw clearance before entering an affected area*
- *Employees when working under canopy will be required to wear helmets*

Fire hazard

- *A monitoring system will be put in place to monitor risk of fire incident for prompt response. In operational areas with close location to a village/town, local authorities and community residents will be involved with measures for monitoring and responding to fire risks.*
- *In keeping with BRF emergency response plans, workers will be trained and provided with resources including on-site fire extinguishers for immediate response to combat fire incidents and ambulances for evacuation. Procedures will include coordination with the BRF fire unit for back up support.*
- *Regularly remove high-hazard fuel accumulation*
- *Establish and maintain a network of fuel breaks of less flammable materials or cleared land to slow progress of fires and allow fire-fighting access*

Chemical hazard

- *Personnel working in areas requiring the use of pesticides such as nursery fields will be periodically trained on the application of pesticides as may be required. Supervisors will monitor these workers and ensure that they understand how to apply chemicals according to their labels.*
- *Avoid the application of pesticides close to watercourses*
- *Clean and dispose of pesticide packaging and containers to ensure that they are not subsequently used as containers for food or drinking water*
- *Ensure that neighboring communities are alerted on the application of pesticides in plantation areas in close proximity to villages/towns*

- *Always use biological, biodegradable or safe product, whenever feasible*
- *Avoid the aerial application of pesticides, whenever possible*

Water will be sprinkled on access roads during the dry season to control dust emissions. The noise emissions will be limited by appropriate soundproofing of individual pieces of equipment. Equipment will be fitted with special exhaust systems (mufflers). Additionally, the farmers will be required to wear personal noise-protection gear, e.g., ear protectors, where necessary.

Anybody using a chainsaw during harvesting operation will be required to wear safety footwear (a minimum of a steel toe-cap), leg protection, ear muffs and high visibility safety helmet and clothing. The saw must be in safe working order with a chain break or hand mitt fitted. Workers will be requested to wear eye protection, safety boots and have both a chain break and a hand mitt fitted to the chainsaw. Tree fallers are also required to carry felling wedges and first aid equipment must be on site.

In addition, the managements system implemented for the harvesting operation will control pools of stagnant water on site thereby eliminating fertile breeding grounds for waterborne disease vectors such as flies, mosquitoes and other parasites.

10.0 HARVESTING OPERATION

Table 7: block/parcel of redundant rubber farms already harvested and scheduled replanting

Parcel/Block (hectares)	Quantity already removed	Schedule of removal (start date)	Quantity already replanted	Schedule of replanting (end date)
3.8	1099	November 13, 2008	2050	20-May-08
6.66	2900	March 29,2008	4435	27-Sep-08
7.53	2088	January 7,2008	5020	12-Jul-08
5	2295	January 31, 2008	3337	22-Jul-08
10	7954	March 11,2008	8100	20-Aug-08
3	1358	February, 2008	1730	7-Jun-08
3.8	1443	February 1, 2008	2554	3-Sep-08
1	554	April 7,2008	699	4-Sep-08
2.3	1500	April 17,2008	1532	5-Sep-08
8.35	2772	January 25,2008	5563	12-Jun-08
10.4	4665	February 22, 2008	6921	3-Jul-08
Prep. In progress	19050	Oct 2,2008		
Prep. In progress	2405	September 14, 2008		
Prep. In progress	600	September 16, 2008		
Prep. In progress	4178	December 4, 2008		
Prep. In progress	577	Oct 10,2008		
Prep. In progress	1505	Nov 25,2008		
Prep. In progress	1821	Nov 10,2008		
	1100	Harvesting ongoing		

This harvesting operation has already covered 61.84 hectare from the total farms harvested. There are more trees planted than those harvested. This plan facilitates the harvesting operations to be used for all other farms to be harvested. The plan does not outline a quantity of redundant rubber trees to be harvested from any given farm/plantation nor does it state the amount of chips to be harvested from a specific location. This is largely due to the fact that farmers and landowners are unable to give a clear and factual record of the size or the details associated with their farms. Another reason is 90% of the farms harvested and to be harvested were never planted with the standard formation of 500 trees/ha.

The harvesting activities should be concentrated from October to April the following year. This period covers the entire dry season. Harvesting during such period greatly minimize soil impact.[5] Harvesting operations should be timed to avoid the wet season as far as possible, especially exceptionally wet periods, when soils are saturated. Land preparation for transplanting of seedlings follows from February (land preparation has

[5] IFC Guidelines: This sections on roads, skid trails/landing, and stream crossing are based on guidance adapted from FAO(1996)and Wisconsin Forest Management Guidelines(2003)

already started for this year) to September. The below activities will be executed by BR Fuel for sustainable harvesting.

10.1 Planning the Harvest

A harvest plan is an essential component of the harvesting operation, although the amount of detail in the plan will depend on the size of the area being harvested and the potential for adverse effects.

This harvest plan is the reference document for the entire BR Fuel harvesting project, and may cover many months of the company's operations throughout its lifespan around the country. It is the basis for formulating the harvesting prescription.

The Planning Process

This harvesting management plan has been designed to present some important aspects of harvest planning for BR Fuel's operation and to act as a guide to place into check BR Fuel operations. It defines the principles and standards that will guide all of BR Fuel's harvesting operations. The standards will be reflected in BR Fuel's operations over the nest six months (see Appendix D for a six-month harvesting and replanting plan), as well as all subsequent detailed harvesting and replanting plans.

Pre-Harvest Inventory

In order to ensure and enable effective harvest planning some form of pre-harvest inventory of the standing wood is important and will be considered by the harvesting personnel of Buchanan Renewables Fuel.

The inventory will provide:

- an estimate of total wood volume, which will influence the cost-effective design of roading and landings.

- the quantity likely to be produced as this is important in designing landings of sufficient size for sorting and stacking the wood. It may also dictate the likely markets, influencing the timing of the harvesting in order to maximize returns.

- the size of the trees, which will determine the size and type of machinery needed for harvesting.

Area Assessment and Identification of Constraints

Every site must be surveyed prior to harvesting. Surveys include assessing the total size of the property, site features, harvesting requirements, potential constraints and areas of significant impact, and are additional to the Pre-harvest Inventory. Issues to be assessed include:

- Total size of property and area for harvesting

- Topography
- Road and water networks
- Current and historical land cover
- Current and historical land use
- Use of adjacent land
- Baseline environmental data, including soil and water quality

Potential constraints that should be considered during the assessment include:

*any historic and cultural sites
*natural heritage features
*adverse ground conditions (erosion-prone, unstable or wet soils)
*stream- or lake-side management areas
*adjacent land uses, including residential areas
*land topography and steepness (and its suitability for different harvesting options -broken topography with slopes of 20 degrees or more will require hauler logging)
*down-stream uses such as water supply from streams or springs
*area of public access such as roads or walking tracks
*structures such as power lines and fences
*particular risk of wildfires
*hazards to harvest workers such as cliffs, tomos, rock falls, old fences and standing dead trees.

Upon completing the assessment and identifying constraints, the harvesters will take constraints into account and define mitigating measures, such as using lower impact hauler systems on erodible soils or avoiding damage to indigenous forest and scrub in stream or lake-side areas.

District and regional plans and requirements relevant to the particular site will also be examined. Rules which apply to vegetation clearance and earthworks are particularly important for harvesting operations. For example, a plantation may be able to be hauler logged as a permitted activity but ground-based extraction may be a controlled activity needing consent. In such a situation, the forest owner may use a hauler system even where topography would allow a cheaper, ground-based system.

Access to Public Highways

Access to a public highway from private land will meet the relevant local regulations in terms of safety for trucks and other road users.

The Harvesting Prescription

The harvesting prescription is based on the harvesting plan and will include any resource consent conditions. It clearly defines the work requirements for the operation, and will be produced as a written instruction for the harvesting operator and supervisor. The

harvesting work will be done according to the prescription and with supervision to check that the defined requirements are achieved.

The prescription will:

*identify the totally area of the property.

*identify the area to be harvested by description and map. This may include

Information about the stand, such as volume (total and average tree), tree diameter (average and range) and expected chip volumes

*include a map showing the location of roads, landings and which areas will use which harvesting methods

*identify any areas where environmental values require special care

*include any conditions which may be specified in resource consent

*identify supervision checklists for monitoring the operation

*include a copy of the amount of trees for the harvest

*detail site clean-up requirements at completion of the harvest.

The Harvesting Operation

The harvesting operation itself involves converting the redundant rubber trees to wood chips which are eventually to be used for energy and delivering the chips to the buyers. It includes felling, delimbing, extraction, drying to an expectable moisture content, chipping, loading and transportation.

Harvesting Management

Good harvest planning is often of little use if harvesting management is poor. Requirements in a sale contract are also of little use if they are not enforced. Harvesting needs to be supervised to ensure that contract conditions are met and the rubber farm owner receives the best value for the trees.

Harvest management is generally done by on-site supervision, using checklists and recording results on a regular basis (preferably weekly). Checklists can be created using the harvesting prescription, rubber farm owner requirements, legal requirements (including consents), and the chip buyer's specifications.

Pre-Harvesting Checks

The following questions should be satisfactorily answered before harvesting starts:

- Will the value of the redundant rubber farm be maximized through recovering high volume of chips?
- Will the BRF remain in business for the duration of the contract?
- Does BRF have a harvest prescription to follow, written by the company?

- Does BRF have a safety management plan in place? Has it been sighted? Has BRF been advised in writing of any unique features of the property that could put its employees at risk?
- Have all parties agreed on who pays for roading and tracking, and how the land will be left after harvest?
- Is BRF transport operations coordinated so that chips do not deteriorate before reaching storage areas?
- Have the necessary contracts been signed and financial guarantees put in place?
- Have any necessary resource consents been obtained?
- Is there a clear, written statement of how and when payment is calculated and received?
- Have potential environmental and social impacts been identified and are plans in place for their mitigation?

Harvesting Systems

Harvesting systems vary according to the form in which the wood is extracted. The harvesting system implemented by BR Fuel involves felling and extracting the whole tree to a landing. This leaves a clean site for replanting but removes unmerchantable debris from the site, concentrating it at the landing and reducing the nutrient recycling over the harvested area. This method is unavoidable on some hauler operations where chainsaw delimbing on steep slopes is too dangerous.

Looking after the Site during Harvesting

It is important to ensure the harvesting site is left in a state which will minimize costs and maximize growth in subsequent rotations. The following issues can affect the site and is recommended to be part of any checklist monitoring procedure for BRF:

1. **Completion Inspection**

Shortly before harvesting operations are complete, a thorough inspection of the site will be undertaken to ensure all the conditions of the contract have been met. It is easier to correct any problems while contractors and machinery are still on the site. When the job is completed, and all consent and other contract conditions have been met and documented, the contract will be signed off by the rubber farm owner and BR Fuel. Final payment will not be made until this final inspection and any remedial work are completed.

2. **Post-Harvesting Maintenance**

When the trees have been harvested and the site cleaned up, it can be used for its next purpose. The site than undergo soil preparation for the planting of rubber seedling. The site will not be “abandoned”, especially if there are soil and water values to be considered.

3. **Soil & Water Value Maintenance**

There may be a risk of erosion for a number of years after harvesting while the site "settles down". This was already evident on a number of sites assessed. The time will vary depending on topography and site, but as the next crop grows and areas of exposed soil are covered, the risk diminishes. Regular checks will be carried out by BR Fuel management and arrangements made for ongoing road and track maintenance to ensure that culverts and drainage systems are kept functional. If the owner wants the original contractor to undertake this work, the responsibility for these inspections (and any remedial work) will be defined in the harvesting operation contract. The work may be subject to a separate price or some other arrangement for paying the contractor.

4. **Site Clean-Up**

After harvesting, the site will be cleaned up to a pre-agreed level (which will be stated in the contract). There may also be a need to prepare the site for restocking, such as raking up some of the slash which often piles up around landings using a suitably equipped excavator, or ripping up old tracks using a tractor equipped with a ripper. It may also be necessary to repair fences and fix broken gates in the event harvesting activities occurred near this vicinity. As with soil and water maintenance, the responsibilities for this work and the payments involved will be specified in the contract.

Soils: Harvesting costs are likely to increase on soils which are waterlogged, erodible or prone to compaction, as they require systems which cause the least damage to the soil. Examples include high lead systems or equipment fitted with special tires or tracks. Planning the road and landing layout on these difficult soils will take more time, and their construction and maintenance costs are likely to be higher.

Access: The cost of access roads to a farm which is a long way from established roads will be high compared to farms adjacent to a public road.

If low quality public roads require upgrading, BR Fuel will advise the local authority of their intention to harvest (and therefore of the increasing road use) in advance. The local authority will then have a clear knowledge of BR Fuel activities and give their fullest support.

The quality of road access can affect transport cost. Trucks traveling on poor quality roads at low speed will carry less volume per hour than on good roads, increasing transport costs.

5. **Boundary Interference:** The cost of harvesting is likely to increase when the rubber farm area is adjacent to fences, neighbors and utilities (such as water, power and other public facility).

These factors will require additional management input and extra effort by BR Fuel.

11.0 HARVESTING EXPANSION PLAN

BR Fuel contracts with rubber plantation owners to harvest their rubber trees as a sustainable source of biomass for power generation and other potential uses. It is currently operating on a small number of farms in Grand Bassa County (see Map 3 in Appendix C); however, as the market for rubber woodchips expands and Buchanan Renewables Power's power plant comes online, BR Fuel will be expanding its operations to meet that demand. BR Fuel's current strategy is twofold:

1. Woodchips for export – BR Fuel will initiate harvesting operations for export in regions with high concentrations of rubber plantations, as well as proximity to viable ports.
    a. Stage 1 (starting in Year 1): Focus operations on plantations in the Grand Bassa area to minimize transportation required to export through the Port of Buchanan. Expand into River Cess and Bong Counties, and then Nimba County as required to meet demand.
    b. Stage 2 (starting in Years 4-5): Initiate operations on plantations in Maryland, Grand Kru and River Gee for export through the Port of Harper.
    c. Stage 3 (starting in Years 6-7): Initiate operations on plantations in Sinoe, Grand Gedeh and River Gee for export through the Port of Greenville.
2. Woodchips for local power generation – BR Fuel will concentrate its harvesting operations on plantations located in close proximity to the power plant that BR Power is building on the boarder of Margibi and Montserrado Counties. The power plant is expected to come on line at the end of 2010.
    a. Stage 1 (starting in Year 2): Focus operations on plantations in Margibi and Montserrado Counties, as well as parts of Bong, Bomi and Grand Bassa Counties.
    b. Stage 2 (starting in Years 5-6): Extend operations further into Bong, Bomi and potentially Nimba Counties.
    c. Stage 3: Explore other areas if additional power plants are built.

Throughout these areas, BR Fuel is contracting with smallholders as well as large plantation owners to meet sufficient demand for the export industry as well as the power plant. To facilitate strategic planning, it has embarked on a major data collection and mapping exercise, which is described below.

Mapping as a Foundation for Strategic and Environmental Planning

BR Fuel's preliminary investigation consisting of interviews, documentation reviews and exploratory expeditions suggests that approximately 600,000 acres of unproductive rubber trees are available in Liberia; however, very little detailed data is available from Government, non-governmental organizations, intergovernmental organizations or private agencies. Thus, in order to secure the information necessary to define a detailed expansion and harvesting strategy, BR is undertaking a major mapping and data collection effort.

A team is currently working to collect further data on and map out:

- The exact location and size of plantations
- Topography
- Road networks and conditions on and around plantations
- Water bodies on and around plantations
- Land use and vegetative cover on and around plantations
- Significant cultural and/or natural heritage features
- Location of nearby communities
- Any relevant soil and environmental features

The intensive data collection effort began in areas critical to early stage production of woodchips for the power plant (see Map 2 in Appendix C for some initial, broad-scale results of the mapping component of the effort). Over the next year, it will cover areas significant for stages 1 and 2 of the export and local power markets (see Map 4 in Appendix C). The effort will continue until all areas that may be relevant to BR Fuel's current and future operations have been mapped.

Harvesting Expansion

The data collection and mapping effort will help BR Fuel staff to detail a harvesting expansion strategy that is both efficient and compliant with the requirements of this Harvesting Management Plan and relevant international standards.

The map will, among other things, enable BR Fuel to ensure that adequate land cover is left between harvesting blocks on adjacent properties, determine the potential impact of operations on any downstream communities, and explore the potential for developing biodiversity corridors between sites.

This Harvesting Management Plan provides guidance for BR Fuel's current harvesting operations and takes a relatively site-specific approach to sustainable harvest management. The data collection and mapping effort will help BR Fuel to apply this approach at a broader, strategic level by enabling it to make landscape level harvesting and management decisions.

12.0 NURSERY MANAGEMENT AND REMEDIATION

Pre Project Vegetation & Land Use

BR Fuel has allocated 100 acres of land for the nursery activities. This area was leased for a period of 20 years from a private land owner (Mr. Hunter). Prior to the project, the vegetation cover comprise predominantly of shrubs and elephant grasses and a small portion of secondary vegetation. The area has been used for cattle grazing, gathering fire wood and local construction materials

Current Land Use

18 out of the 100 acres of land allocated for the nursery activities are currently being used for nursery germination beds and bud grafting. The nursery has been planted with erosion lines in order to minimize erosion on the site. It is anticipated that the 100 acres will eventually be used for the nursery program.

12.1 Nursery Management for Replanting

Nursery management is a key aspect in the harvesting management plan as it establishes the basic for sustainability of the entire project. The nursery management component of the project shall entail the following:

12.1.1 Land Preparation

Land preparation for the nursery shall run between June and July in preparation for seeds. Nursery beds will be formed parallel to each other at a density of 90cm between rolls and 22cm in rolls

12.1.2 Seed Collection

Seeds will be collected by end of August and placed in germination beds for a period of four days after which they will be transferred to the main nursery beds. Germinated seeds will be planted at a distance of 22cm apart from each other. These shall grow into seedlings and remain on the nursery for a period of eight months before bud grafting.

12.1.3 Bud Grafting

Seedlings will be bud grafted at a diameter of 1cm. Templates shall be used to determine the readiness of seedling for bud grafting. Bud grafting will be done based on the selected clones indicated below, however other efficient clones shall be selected for bud grafting as may be necessary :

RRIC-100 IRCA 41 GT-1
RRIM-600,
BP-217
BP-551

PR-107, and
PB-18/59

These clones will be budded on the seedling for 21 days before removal of the tape used for the bud grafting. A period of one week will be allowed for temperature adjustment and healing of the newly bud grafted stump before harvesting

12.1.4 Harvesting of Nursery

Stumps will be harvested upon maturity for transplanting. Harvested stumps will be cut above the bud patch at a length of 3 inches. Otena, a compound used to prevent disease, will be applied on the wound after cutting of the stump. Finally, all the roots will be pruned for field planting. Pruning will be conducted within every one week interval.

12.1.5 Maintenance

Fourteen days after planting, the germinating process for stumps begins. Some of these stumps may germinate at different parts of the stump, instead of the bud eye. At this stage pruning becomes necessary. Pruning will be carried out in order to remove unwanted branches from the stump so as to encourage fuller growth.

12.1.6 Fertilizers/Chemicals

The long term plan for fertilizing the farm will consider the use of organic fertilizer derived from animal manure and biochar. Initially, various kinds of fertilizers will be used including the following:

- NPK 15 15 15
- Urea
- TSP

Herbicide

- Glyfos

Glyfos is a foliar acting herbicide for the control of annual weeds, perennial grasses and the establishment and maintenance of perennial tree crops, industrial sites and aquatic environments.

Contents : Contains 410 g/l Glyphosate (in the form of 480g/l isopropylamine salt)
Active ingredient-41%
Inert ingredient 59%

The substance is certified by the Ghana EPA (Batch No.20080515)

Insecticides

- Plan Dec 25

Plan Dec 25 is a contact insecticide use for the control of general pests. It acts by contact and ingestion.

Contents : Deltamethrin 25g/l

The substance is certified by the Ghana EPA (Batch No.071012)

Fungicides

- Agrithane (Mancozeb 80wp)

Agrithane is used to control many fungal diseases (eg blight, leafspot, rusts, downy, mildew, scab, etc) in field crops, fruits, nuts, vegetable and ornaments. It is compactable with most common fungicides and insecticides

Contents : Manganese (16%)
Zinc (2%)
Ethylenebisdithiocarbamate (62%)
Inert material (20%)

12.2 Rehabilitation and Remediation

1. Rationale

Activities leading to the establishment of the nursery site, such as site clearing and landscaping, create changes to topography that may continue to cause visual impacts and erosion and loss of vegetation long after the life span of the project. The term rehabilitation is used to encompass all of those measures, which seek to repair disturbed or degraded land, and to return such land to a stable and nonpolluting state. While it is envisaged that BR Fuel will adopt ongoing sustainable nursery management practices, the main aim of rehabilitation measures as described herein are to:

1. Achieve long term stabilization of all worked out areas to control erosion;
2. Minimize visual impact of disturbed areas; and\
3. Restore the habitat of the project area close to its pre-project condition or even better
4. Ensure that worked out areas are safe for future uses.

2. Approach to Rehabilitation

The following is a recommended step-by-step approach to rehabilitation of the project area.

Step I - Site Clean Up

The first step in the remediation operation is a general clean up and making safe of the area. Site clean up works to be undertaken after completion of nursery operations include:

1. Removal of all fixed and mobile equipment;
2. Removal of all temporary and permanent structures unless required for a future use;
3. Removal and appropriate disposal of all waste materials;

During site clean up, it may be appropriate to deny vehicular and other access to the site in order to avoid disturbance to the rehabilitation exercise.

Step 2 - Site Preparation

Site preparation is vital to the successful stabilization and re-vegetation of any disturbed site. The first step in the site preparation process involves the reshaping of the area. The site should be shaped so as to blend in with the surrounding landscape. Stockpiles should be leveled or re-graded. The site should generally be left in a stable, free draining state that blends in with the surrounding area.

On erodible locations within the project area, it is most important that slopes be reduced during site preparation.

A stable final landform should be created before topsoil spreading. Topsoil should be re-spread uniformly over the area at a suitable depth to support natural revegetation.

All compacted areas should be deep ripped. This may be carried out before or after spreading topsoil. Ripping will promote water infiltration and root penetration. Ripping should be carried out when the soil is relatively dry to increase soil break-up. Ripping after soil spreading will also help to 'key' in the soil to the underlying material, and it provides a rough surface for seed application.

Step 3 Erosion Prevention

Erosion will continue long after the nursery activities have ceased unless preventative measures are implemented. Poor drainage management can lead to damage or destruction of the remediation investment.

It is recommended that existing drainage controls be retained as well as upslope of the area being rehabilitated, to slow down surface runoff. A rough surface will capture more water and allow rainfall to infiltrate rather than flow directly downhill. Deep ripping will improve water infiltration. Rip when the soil is relatively dry to increase shattering.

Step 4 Revegetation

At the request of the private land owner, BR Fuel plans to revegetate the nursery site by planting rubber trees within the 100 acres of land used for the nursery activities following strict standards and procedures for rubber cultivation as being applied in the Company

current replanting program. This will add value to the land use of the area and provide economic benefit for the land owner.

3. Determining Completion of Rehabilitation

The following measures are provided as a guide to BR Fuel to determine and assess rehabilitated areas.

Suggested minimum standards are:

- The rehabilitated area should be left in a stable and non-polluting state;
- The area must be suitable for the planned final use or rehabilitation objective;
- Rehabilitated areas should not be affected by continuing erosion;
- Rubber plantation should be established and effective over the site. The extent of re-vegetation will be dependent on factors such as tree density, species, and vegetative cover.

13.0 DESCRIPTION OF MONITORING MEASURES TO BE USED FOR ITEMS 4 TO 9

A number of parameters are to be monitored during operations of the project. Based on the principal issues and impacts identified during this study, and taking into consideration the roles and responsibilities of key institutions during the operation of the project, the following plan for monitoring will be implemented by BRF in concert with independent consultants in order to ensure adherence to the management plan and mitigation measures necessary for the operation of the project in an environmentally friendly manner:

Table 8: Monitoring Frequency and Location

Parameter	Frequency of Monitoring	Location of monitoring
Biological environment		
Air Quality Total Suspended Particles (TSPs)	Quarterly	Access roads, landing sites and harvested areas, stockpile areas at the boundaries of the site and along haulage roads
Noise Decibels	Quarterly	Harvesting areas, Stockpile areas where loading takes place and along the haulage path.
Water Quality, Ph, Temp, Turbidity, DTSs, DO, ORP, Conductivity	Quarterly	Points of site drainage-surface water within harvesting areas
Soil Ph, Temp, Texture, color, Nutrient content, erosion control	Quarterly	Harvested areas
Waste Management	Quarterly	Waste receptacles and large storage container, and general project area
Socio-economic environment		
Health and safety	Monthly	Use of protective gear by staff. Condition of fire-fighting equipment and first aid kits. Adequate and appropriate signage for emergencies. Location of Emergency Procedures. In house training to keep employees up to date with various safety procedures. Health conditions of staff
Employment and Benefits	Biannually	Number of residents employed, conditions of employment. Direct and indirect Socio-economic/environmental benefits provided for residents by company.
Number of trees harvested	Quarterly	Harvested farms
Number of trees replanted	Quarterly	Replanted farms
Condition and number of trees on nursery	Quarterly	Nursery site
Pests and diseases	Quarterly	Replanted farms and nurseries
Observance of RMZ	Quarterly	Harvested areas
Equipment	Biannually	Workshops and operating areas

Records of monitoring will be kept on-site and made available to EPA or other regulatory Authorities upon request. Monitoring results which exceed national standards/ international requirement (WHO/World Bank) will be reported to the EPA.

This Monitoring Plan is focused on social and environmental parameters to be monitored during the operation of the project. It is expected that there will be a routine schedule for Equipment Monitoring and Maintenance in keeping with equipment and machinery design standards and specification.

13.1 Mitigation and Monitoring Parameters

The Table below provides annual budget parameters for mitigation and monitoring actions that will be required to maintain this annual budgetary allocation and at the end of each year to revise the budget based on previous year's experiences and price/cost changes.

Table 9: Parameters for Mitigation and Monitoring

Impact Annual	**Action/s**	**Equipment/measures**	**Estimated Cost(annually)**	**Time frame**
Waste	Collection and disposal waste	Contract with EPA certified waste disposal company	4,000	**During Harvesting**
Water Pollution	Water quality tests such as pH, Turbidity, COD, ORP, Temp, DO and TSS Building of sediment traps and bearers traps Building of a berm around the fuel storage tanks and maintenance facilities	Samples collected and tested	2,000	**Quarterly**
Air Pollution	Air Quality tests such as Total Suspended Particles (TSP5)	Sample will be collected to be analyzed	500	**Quarterly**
Noise Pollution	Maintenance of equipment	Placement of Noise	1,000	**Biannually**

	Monitoring of noise levels around plant	meter — in house monitoring/ independent monitoring	500	**Quarterly**
Health and Safety	First Aid Kits Protective gear for workers e.g. gloves, overhauls, helmets, safety boots, dust/mist respirator and ear piece Training of workers in occupational health, safety and environment, Warning signs within facility	Have been sourced (Presence at sites) Have been sourced (Presently in use by workers on site) Trainings have been conducted Have been printed (Available on site)	15,000	**Quarterly** **Quarterly** **Annually** **Annually**
traffic	Maintenance of signs and markers	Have been maintained (Available on site)	500	**Quarterly**
Fire Equipment	Fire Extinguishers and other spill kit equipment.	Present at sites	10,000	**Quarterly**
Training	Training of personnel e.g. in First Aid and spill response as well as environmental monitoring and fire safety and emergency evacuation.	Training record/ interviews	15,000	**Annually**
Incidents and Emergencies	Response needed in event of accidents and emergencies.	Audit of reports	2,000	**Annually**
		TOTAL		**Annually**

14.0. COMPLIANCE WITH APPLICABLE REQUIREMENTS

A good and acceptable harvesting plan is one in line with acceptable standard; especially when such standards are in compliance with best international norms and practices.

The Environmental Protection Agency of Liberia (EPAL) is the legal agency by law (The Environment Protection and Management Law of the Republic of Liberia) to protect the environment through implementing the law. [6]The law may by published notice prescribe general guidelines or standards for the management of rivers, lakes, and wetlands which shall include the following: is composed of standards and guidelines set to regulate various project to be effected in compliance to protecting the environment:

a. Measure for the prevention or control of soil erosion;
b. The conservation of any vegetation growing in and around a river, lake or wetlands;
c. The contingency plan for the prevention and control of any deliberate or accidental discharged which is likely to pollute the river, wetland or lake;
d. The control measures to be taken in harvesting aquatic living and non-living resources to ensure optimum sustainable yield;
e. Used, erect, construct, place, alter, extend, remove or demolish any structure in, on, under, or over the bed;
f. Excavate, drill, tunnel or disturb the bed otherwise;
g. Direct or block a river, lake or wetland from its natural and normal course;
h. Respect the rules and regulations as stated in Part VII of the EPAL Act for Environmental Protection and Management, in particular, its sections 83, 84, and 85.

The Environment Protection and Management Law of the Republic of Liberia in line with other international standards also decided on the following measures among others for [7]conservation to energy and use of renewable sources:

a) Promoting measures for the conservation of non-renewable sources of energy; and
b) Promoting the best practices for renewable energy production.

Assessment on all rubber farms harvested and replanted by BR Fuel identified blocks/parcels from 1.05 to 10.39 hectare. Even with such small sections of land, BR Fuel continues to strive to implement best environmental practices. The company is operating primarily with smallholders; however, BR Fuel has resolved that in order to harvest a maximum area of a 50 hectare block, the company must reserve a narrow section of trees and bushes between adjacent or opposite blocks. This practice is in line with the International Finance Corporation Environmental, Health, and Safety Guidelines Forest Harvesting Operation:

[6] Environment Protection and Management Law of the Republic of Liberia-Part VI. Section 74 & 75
[7] Ibid, Section 81

- [8]Leave (reserve) trees or groups of trees in the harvest concession for regeneration purposes, and provide den and nesting sites, food source, cover, and travel corridors for wildlife, including raptors. Appropriate conservation of understory species , as well as snags, slash, and wood debris on site should also be considered to enhance wildlife habitat;
- Compartment (block) areas should be minimized (as far as economically practical) to reduce the contiguous land area exposed to wind and rain. Compartments should typically not exceed 50 hectare.

The exact dimensions of the buffer zone will depend on the soil and other environmental characteristics. However, on relatively flat ground, it is recommended that a buffer zone with a width of 30 feet be left between harvesting blocks. This would leave enough undisturbed space for trees of various sizes, as well as bushes to continue to prosper. It would also be of sufficient width to act as a wind and rain screen and a refuge for biodiversity. The width of the buffer zone, however, should be increased according to slope gradient and soil characteristics of the specific site (see recommended widths in the table below).

Table 10. Recommended width of Buffer Zones between Harvesting Blocks according to Soil Erosion Susceptibility and Slope of the Terrain

Slope (see Table 3)	**Soil Erosion Susceptibility (see Table 4)**	
	3-4	**1-2**
10-20	60 feet	90 feet
20-30	90 feet	120 feet
30-40	120 feet	150 feet
40-50	150 feet	150 feet

BR Fuel will adhere also to the IFC Guidelines on removal limited to unproductive rubber trees. As also mentioned in the guidelines, BR Fuel will monitor the harvesting operations that it keeps in line with the below:

- [9]Avoidance of large canopy holes by limiting proximity of trees to be harvested
- Harvesting should be avoided on slopes with gradients in excess of 30 percent.

As stated earlier in the harvesting management plan, the interval between removal of redundant rubber trees and replanting of seedlings clones is limited to 6 months. This will assist the company to better plan within a given time frame for specific activities and to maximize its resources wisely in order to achieve high yield.

[8] Wisconsin Forest Management Guidelines(2003)

[9] An example of issues covered as part of a forestry management plan is provided in Criteria 7 "Management Plan" of the Forest Stewardship Council Principles and Criteria for Forest Stewardship, available at http://www.fscus.org/images/documents/FSC_Principles_Criteria.pdf

Furthermore, BR Fuel will follow the recommendation of the International Rubber Research and Development Board (IRRDB) to replant at a maximum density of 500 trees per hectare. This will help to preserve long-term soil productivity. BR Fuel will also replant trees at a rate of at least 1 tree to every tree removed. On plantations where past replanting patters have led to a density of greater than 500 trees/ha, BR Fuel will abide by the maximum density recommended by IRRDB.

Riparian Management Zone Widths

As mentioned earlier in the harvesting plan, forest water quality research indicates that a 100 foot or 30 meter RMZ is the minimum needed to protect aquatic bodies. Widths or 50 feet to 500 feet have also been suggested if management objectives include protecting wildlife habitat or controlling beaver activity on smaller streams (see riparian management zones for more detail). BR Fuel will ensure that these guidelines are followed and monitored in compliance to international standards. In particular, it will ensure that no harvesting is conducted within 50 feet of water bodies.

15.0 ANNUAL REPORTING

BRF will produce quarterly reports of its harvesting operation which will be summed up to produce annual reports. The annual reports will provide a summary of the following:

1. Harvesting operation data

    a. Total property area under contract with farmers
    b. Total acreage of farms harvested
    c. Total acreage of farms replanted
    d. Number of trees harvested
    e. Number of trees replanted
    f. Total acreage of nursery fields
    g. Number of trees planted on nursery beds/species/clones

2. Compliance and monitoring report
    a. Summary results from monthly, quarterly and semi-annual monitoring outlined in Tables 7 & 8 above (Section 11)
    b. Assessment of results against standards and defined targets
    c. Remediation and mitigation measures where standards/targets are not met
    d. Definition of environmental goals targets for the following year

16.0 CONCLUSION

Harvesting operations are one of the primary tools by which a landowner attains the objective of rejuvenating his/her plantations when the trees become redundant and unproductive. Although the operations are, by nature, disruptive, they certainly do not need to hinder ecological or environmental functions and processes. Carefully and sustainably conducted, operations can even enhance aesthetic and ecological qualities of a rubber plantation stand. Wise selection of the appropriate regeneration method, application of Best Management Practices and other environmental guidelines, and carefully-negotiated plantation harvesting agreements are critical to environmentally sound harvesting.

Disciplined decision-making, prudent planning and conscientious control will allow BRF to conduct its harvesting operations with significant positive ecological, aesthetical, and socio-economical results.

APPENDIX A

HARVEST PLAN TEMPLATE FOR NEW FARMS

Landowner:
Address:
City/Town: County:
Phone:
Total Property Acreage: _____
Acreage of Area to be harvested: _____
Total Estimated Volume of Harvest: _____
Proposed Harvester: _____
Proposed Harvest Date: _____ through _____
Harvest Plan Prepared by: _____
Phone: _____
Date Prepared: _____

A map that shows total property size, areas to be harvested, topography, skid road layout, locations of all streams wetlands and water bodies and vegetation type designation, adjacent land us and cultural or natural heritage features is attached.

Baseline environmental data on soil and water quality is also attached.

Landowner's Objectives for the Property:

_____
_____
_____
_____

Potential Impact from Harvesting on the Ecology of the Site:
(Summary for entire site and actions to minimize the impact should be noted)
Water Quality:

_____
_____
_____
_____

Wildlife:

_____
_____
_____
_____

Aesthetics:

_____
_____

_____
_____

Recreation:
_____
_____
_____
_____

Note: A parcel owned by a single landowner may have several plantation stands that require different management prescriptions. Information for each stand where biomass will be harvested should be recorded separately.

Stand Number: _____
Size (acres): _____ Age Distribution: _____
Size Class: _____
Dominant Species:
_____
_____

Insect/Disease Problems:
_____
_____

Harvest History:
_____
_____

Average Basal Area: _____ Average Number Trees/acre: _____
Estimated Volume to Harvest: _____
Harvest Objective:
_____
_____
_____

Type of Harvest:
_____
_____

Agricultural and silviculture techniques to be used:
_____
_____
_____
Best Management Practices to be implemented:
_____
_____

APPENDIX B
SAMPLE SOIL AND WATER QUALITY BASELINE DATA

P. O. Box 2198
Warren Street/Camp Johnson Road
Monrovia, Liberia
Phone: (231) 5 620 44/06 518 443
Email: earthcons@yahoo.com
Website: www.earthconsliberia.com

Soil Analyses Report Form

Name of Project:	Harvest Management Plan	Client:	BR Fuel
Location:	Grand Bassa County	Date:	1/23/2009
Sample ID:	SS-1	Coordinate:	390539/851303 UTM
Elements/Metals Tested For:	Multiple	Technician:	Johnson Willabo, Jr.

Elements/Metals	Result	Comments	
pH	6.23	slightly acidic	
Nitrate Nitrogen	45		
Potassium (K) (K x 1.2)	medium		
Phorphorus (P) (P x 2.3=P_2O_5)	45		
Aluminum	low		
Ammonia Nitrogen	low		
Calcium	1400 ppm		
Chloride	500 ppm		
Ferric Iron	13.5 lb/acre		
Humus	4		
Magnesium	low		
Manganese	low		
Organic matter	3		
Sulfate	2000 ppm		

P. O. Box 2198
Warren Street/Camp Johnson Road
Monrovia, Liberia
Phone: (231) 5 620 4404/ 518 443
Email: earthcons@yahoo.com
Website: www.earthconsliberia.com

Water Analyses Report Form

Name of Project:	Harvest Management Plan	Client:	BR Fuel
Location:	Grand Bassa County	Date:	1/23/2009
Sample ID:	WS-1	Coordinate:	392143/951835 UTM
Elements/Metals Tested For:	Multiple	Technician:	Johnson Willabo, Jr.

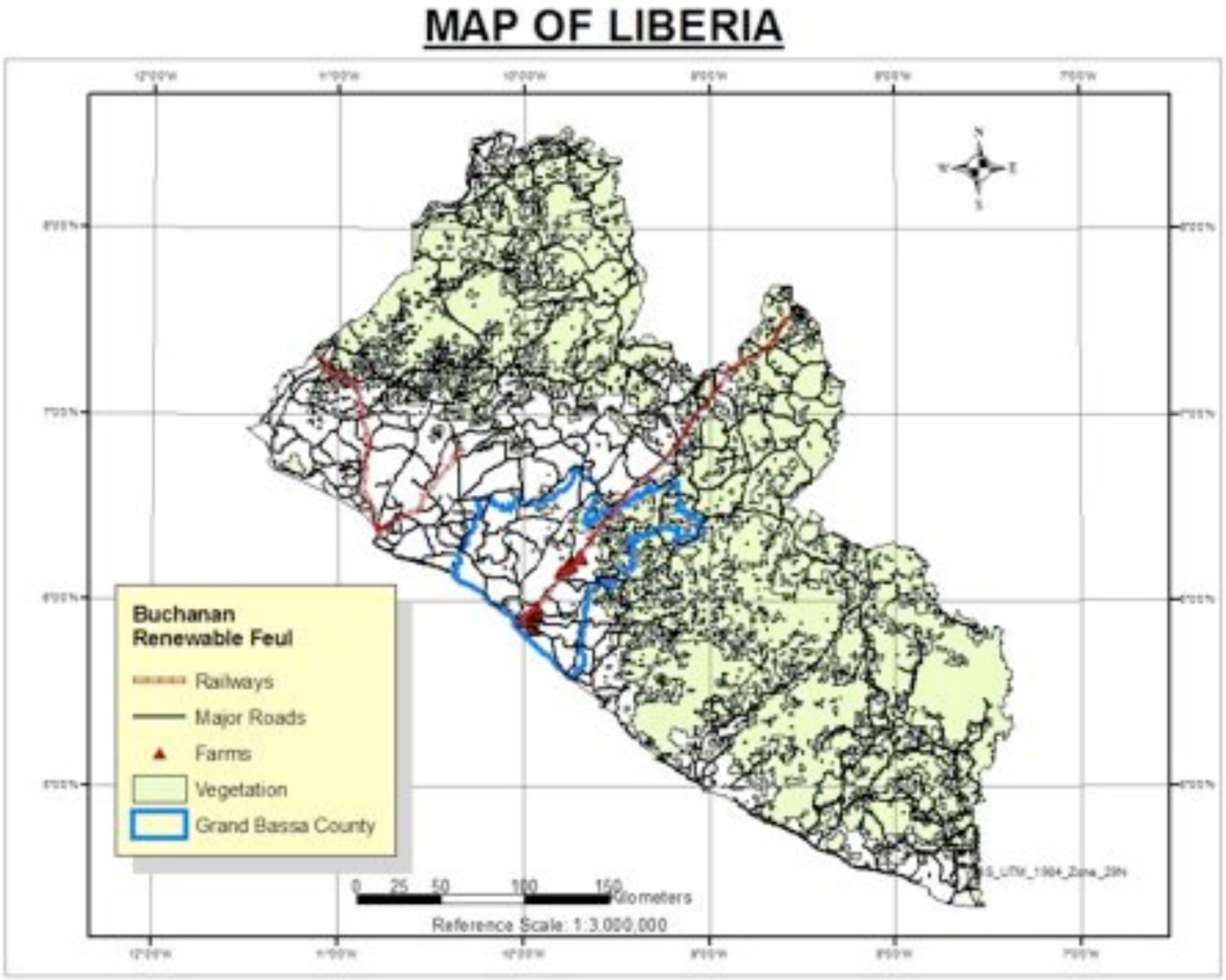
Elements/Metals	Method	Scope & Application	Spectrophotometer reading
Zinc	Zircon method (0.01 to 3.00 mg/l)	for water and waste water	0.07 mg/l
Chromium	1,5 diphwenylcarhydrazide method 0.01 to 0.700 mg/l	for water and waste water	0.003 mg/l
Nickel	1, (2 pyridylazo - 2 - Napthol) PAN method	for water and waste water	0.007 mg/l
Iron	Ferrozine Rapid Liquid method (0.009 to 1.40 mg/l	for boiler, cooling and natural water	0.021 mg/l
Copper	Bicinchoninate method (0.04 to 5.00 mg/l)	for water and waste water	0.0
Chlorine	DPD method (0.02 to 2.00 mg/l)	for residual chlorine and chloramine in water	0.1 mg/l

APPENDIX C
RELEVANT MAPS

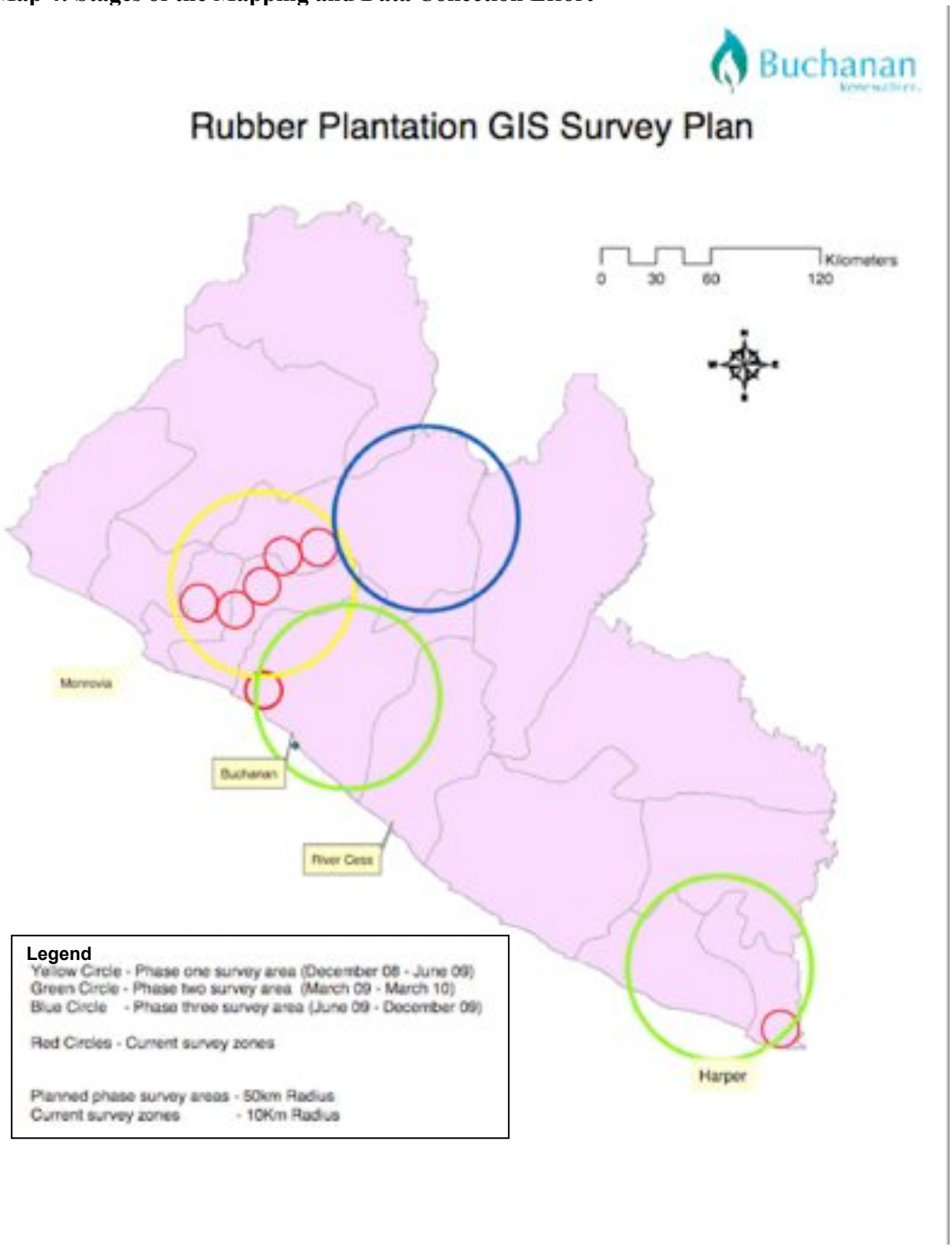
Map 1: Map of Liberia

Map 2: Plantations in Future Harvesting Areas - Totota

Map 3: Current Harvesting Sites



Map 4: Stages of the Mapping and Data Collection Effort



APPENDIX D
SIX-MONTH HARVESTING PLAN (MARCH – AUGUST 2009)

BR Fuel has completed all felling operations for the dry season and will be focused primarily on chipping rubber trees and replanting farms over the next six months. Its replanting operation will focus on the smallholder farms with which BR Fuel has contracted, while its chipping operation will focus primarily on its contract with the Liberian Agricultural Company (LAC).

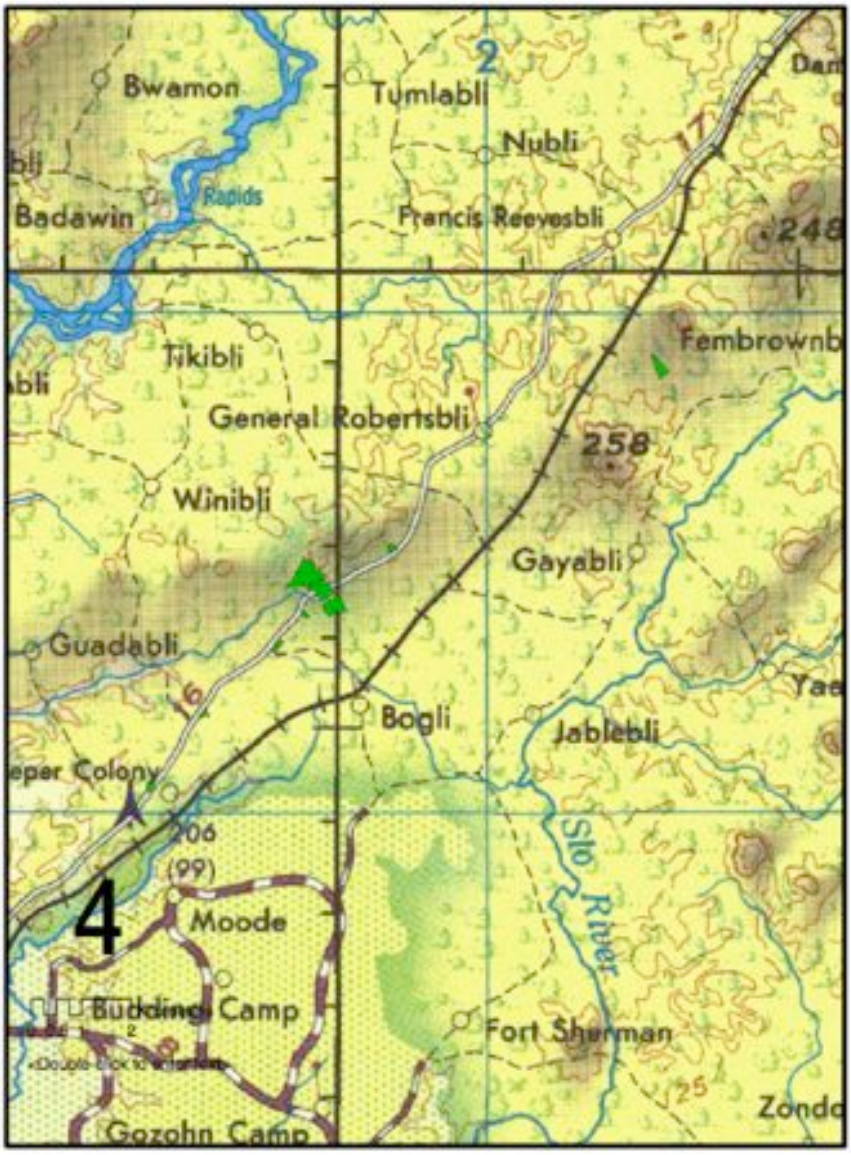
I. Smallholder Operations

Background

BR Fuel has already contracted with and felled 23 farms or 343 acres in Grand Bassa County (see Map 3 in Appendix C of the Harvesting Management Plan for the location of the smallholder farms). Farms range in size from 2 to 118 acres (maximum 48 ha) with an average size of 15 acres. All farms have been mapped out in green on Maps A and B below, which provide the topography and road and water ways around these farms.

Map A: Smallholder Farms in the Buchanan Area, Grand Bassa

Map B: Smallholder Farms in Compound 3, Grand Bassa



Maps A and B demonstrate that all farms are relatively close to major roadways, and distanced from one another, as well as community centers and major water bodies. As indicated in the Harvesting Management Plan, BR Fuel's environmental consultants found no evidence of threatened or endangered species on or around the plantations. Similarly, no significant natural or cultural heritage sites have been identified and the land adjacent to most farms is comprised of brush, rubber trees or secondary forest.

The size of the farms provided a natural limit to harvesting block size of under 50 ha, and their distance from one another limited contiguous harvesting. During harvesting, areas next to water bodies were left undisturbed in keeping with the need for buffer zones or Riparian Management Zones to maintain water quality and support the limited biodiversity in the area.

Of the 23 farms felled in the past year, 11 have already been replanted. These farms are listed in Table I, which outlines the planting density used, the replacement rate of trees, and the clones and cash crop planted. The 12 farms that have been felled, but still need to be cleared and/or replanted are listed in Table II below.

Table I. Harvested and Replanted Smallholder Farms

No	Name of farm	# of hectares	# of acres	planting density	trees out	trees in	date planted	clone planted	Cash crop
1	Holt Farm#1	4	9	2.5mX6m	1,099	2,050	20-Jul-08	RRIM-600	beans
2	Holt Farm#2	7	16	2.5mX6m	2,900	4,435	27-Sep-08	RRIM-600	peanuts
3	Hill Farm#1	8	19	2.5mX6m	2,088	5,020	12-Jul-08	RRIC-100	beans
4	Montgomery	5	12	2.5mX6m	2,295	3,337	22-Jul-08	RRIM-600	peanuts
5	Barchue Farm	10	25	2.5mX6m	7,954	8,100	30-Jul-08	RRIM-600	
6	Emmanuel Logan	3	7	2.5mX6m	1,358	1,730	7-Jun-08	RRIM-600	peanuts
7	Levi Martin Farm	4	9	2.5mX6m	1,443	2,554	3-Sep-08	RRIC-100	beans
8	Gabriel Brown Ext.	1	2	2.5mX6m	554	699	4-Sep-08	RRIC-100	beans
9	Gabriel Brown Farm	2	6	2.5mX6m	1,500	1,532	5-Sep-08	RRIC-100	beans
10	Hunter Farm	8	21	2.5mX6m	2,772	5,563	12-Jun-08	RRIC-100	peanuts
11	Francis Mayson Farm	10	26	2.5mX6m	4,665	6,921	3-Jul-08	GT-1	peanuts

Table II. Harvested Smallholder Farms Awaiting Replanting

No	Name of Farm	Property Size (Acres)	Area Harvested (Hectares)	(Acres)	Planting Density (Est.)	Trees Out	Trees In (Est.)
13	Hill Farm#2	50	7	17	3mx6m	4,178	3,440
14	Jeremiah Glay	?	2	5	3mx6m	577	1,012
15	Joe Jacobs	?	2	6	3mx6m	2,405	1,214
16	Aaron Lewis	?	1	2	3mx6m	600	405
17	Richard Whehgar	250	6	15	3mx6m	3,990	3,035
18	Julia Taylor	500	2	5	3mx6m	1,505	1,012
19	Lawrence Gbonzuu	50	3	7	3mx6m	1,891	1,416
12	Rosa Dillion Farm	?	48	118	3mx6m	19,050	23,877
20	Dillion extention	70	2	4	3mx6m	1,100	809
21	Mammie wee	6	2	4	3mx6m	847	809
22	Holt Farm #3	?	2	4	3mx6m	Not Chipped	809
23	Mcbeth MasonFarm	?	1	3	3mx6m	1,821	607

Table II defines the total size of each property (which in many cases is unknown to the landholder), the area contracted for harvesting and thus the area harvested, the estimated planting density, and the estimated number of trees that will be replanted. The number of trees replanted was estimated based on the maximum planting density of 500 trees/ha, while the planting configuration was changed from 2.5m x 6m in Table I to 3m x 6m to accommodate this new maximum density.

Clearing and Replanting Schedule

Over the next 6 months a number of activities, including land preparation, replanting and farm maintenance, will be undertaken on the 12 farms listed in Table II. An estimated schedule for this activity is outlined in Table III below.

Table III. Estimated Schedule for Clearing and Replanting of Smallholder Farms

No	Name of Farm	Area Harvested (Acres)	Date Cleared (est. end)	Site Prep (est. end)	Planting (est. start)	Crop Planting (est. start)	Maintenance
12	Hill Farm#2	17	10-Jan	16-Apr	9-Apr	11-May	ongoing
13	Jeremiah Glay	5	11-Jan	4-Apr	3-Apr	12-May	ongoing
14	Joe Jacobs	6	14-Jan	30-Mar	2-Apr	6-May	ongoing
15	Aaron Lewis	2	13-Feb	18-Apr	11-Apr	15-May	ongoing
16	Richard Whehgar	15	25-Feb	28-Apr	13-Apr	15-May	ongoing
17	Julia Taylor	5	28-Feb	20-May	17-Apr	20-May	ongoing
18	Lawrence Gbonzuu	7	12-Mar	6-Jun	6-Jun	9-Jun	ongoing
12	Rosa Dillion Farm	118	14-Mar	15-June	28-May	30-May	ongoing
19	Dillion extention	4	16-Mar	1-Jun	2-Jun	5-Jun	ongoing
20	Mammie wee	4	17-Mar	8-Jun	4-Jun	8-Jun	ongoing
21	Holt Farm #3	4	20-Mar	1-Jun	15-May	1-Jun	ongoing
22	Mcbeth Mason Farm	3	25-Mar	9-Jun	8-Jun	10-Jun	ongoing

In a limited number of cases, some clearing and chipping will be required during the month of March; however, most resources will be focused on land preparation and replanting.

The site preparation, which runs from January to June, begins with a post harvesting survey to determine the most effective replanting pattern and strategy according the soil type and contour of the land, as well as a pattern for any additional erosion control measures, such as drainage ditches or brush buffers that may be required. It also includes physical land preparation, light tillage to encourage drainage, holing, and the construction of drainage ditches and other erosion control measures.

Replanting of rubber trees follows land preparation, beginning in April and ending in October. Planting of cover crops for nutrient enrichment and erosion control begins in May and ends in

late June. Most preparation and all planting is carried out on foot to minimize compaction and encourage natural re-vegetation.

Site maintenance activities are initiated on sites as soon as they are cleared and continue throughout the next six months and beyond. Thus, they are ongoing on the 11 farms in Table I and are commencing on the remaining farms. Maintenance activities include, but are not limited to:

- Implementation, maintenance and monitoring of erosion control measures, including, for example, creating and clearing drainage ditches, measuring topsoil levels, monitoring water and sediment run-off, planting necessary bush buffers or windbreaks;
- Circle and blanket weeding (to commence upon replanting);
- Pruning (to commence upon replanting);
- Application of fertilizer when required (to commence upon replanting); and,
- Replacement of dead seedlings when required (to commence upon replanting).

Time frames and staff required for replanting and maintenance activities are summarized in the Table IV.

Table IV. Summary of Replanting and Maintenance Activities on all Smallholder Farms

Activities	Work force	Daily task	Duration	Start date	End date
Land Preparation	7	As needed	3 months	Jan. 8	May 30
Measuring of top soil	1	As needed	8 months	Jan 17	Oct. 31
Field survey	5	As needed	5 months	Jan.15	July 31
Bamboo lining	5	2,000	1 month	Jan. 16	March 3
Holing	20	1500	2 months	Jan 26.	Oct 31
Re vegetation	-	-	2 months	Jan.30	-
Plant & Appl. Fertlz.	15	1125	4 months	April 1	Oct 31
Planting of cover crops	5	7.5Kg	3 months	May	June 30
Circle weeding	10	600 tree	As needed	-	-
Blanket weeding	Hired labor	As needed	As needed	April 1	As needed
Pruning & Replanting	4	8,000	As required	Feb 1	As needed
Erosion control measure	All superv/ tech.	As needed	All time	As needed	As needed
Run off observe. & Control	All superv./ tech.	As needed	All time	As needed	As needed

Nursery Expansion

Over the next six months, the nursery will be expanded by 40 acres to strengthen its ability to accommodate the demand for seedlings during the next replanting season. The basic activities and time frames for expansion are outlined in Table V below.

All activities will be undertaken in keeping with the requirements of the Harvesting Management Plan, including with regard to required buffer and Riparian Management Zones and erosion control measures. However, given that the total size of the nursery will be 68 acres and that it is

not located near any significant waterways, cultural heritage sites, or sensitive ecosystems, it is not anticipated that buffer zones, other than Riparian Management Zones near small streams, will be required. Natural vegetation will be left along the North and West boundaries of the nursery to minimize any potential wind erosion.

The nursery covers relatively flat ground. Thus, the standard grid pattern of drainage ditches that has proven effective in the nursery to date will be employed to minimize erosion and sediment run-off, as well as allow for proper drainage of fields. The growth of natural vegetation along these ditches will be encouraged. Furthermore, all most land preparation and all replanting will be done on foot to prevent compaction and soil erosion.

Table V. Schedule for Nursery Expansion

No	Activities	Task	Workforce	Duration	Start date	End date
1	Land Clearing	40 acres	25	15 days	March 1	March 17
2	Nursery lay out	3,425 trenches	7	2 months	April 1	June 30
3	Digging trenches	3,425 trenches	25	1 month	April2	April 30
4	Prep. Of nursery beds	3,425	5	2 moths	April 2	May 31
5	Fertilizer Application (NPK)	48 bags	5	2.5 months	Sept. 10	Oct.10
6	Seed planting	500,000	8	2 months	August 15	Oct. 15
8	Nursery weeding	40 acres	Hired Labor	Ongoing	July 1	Ongoing
9	Bud wood garden up keep	Entire garden	2	Ongoing	April 1	Ongoing

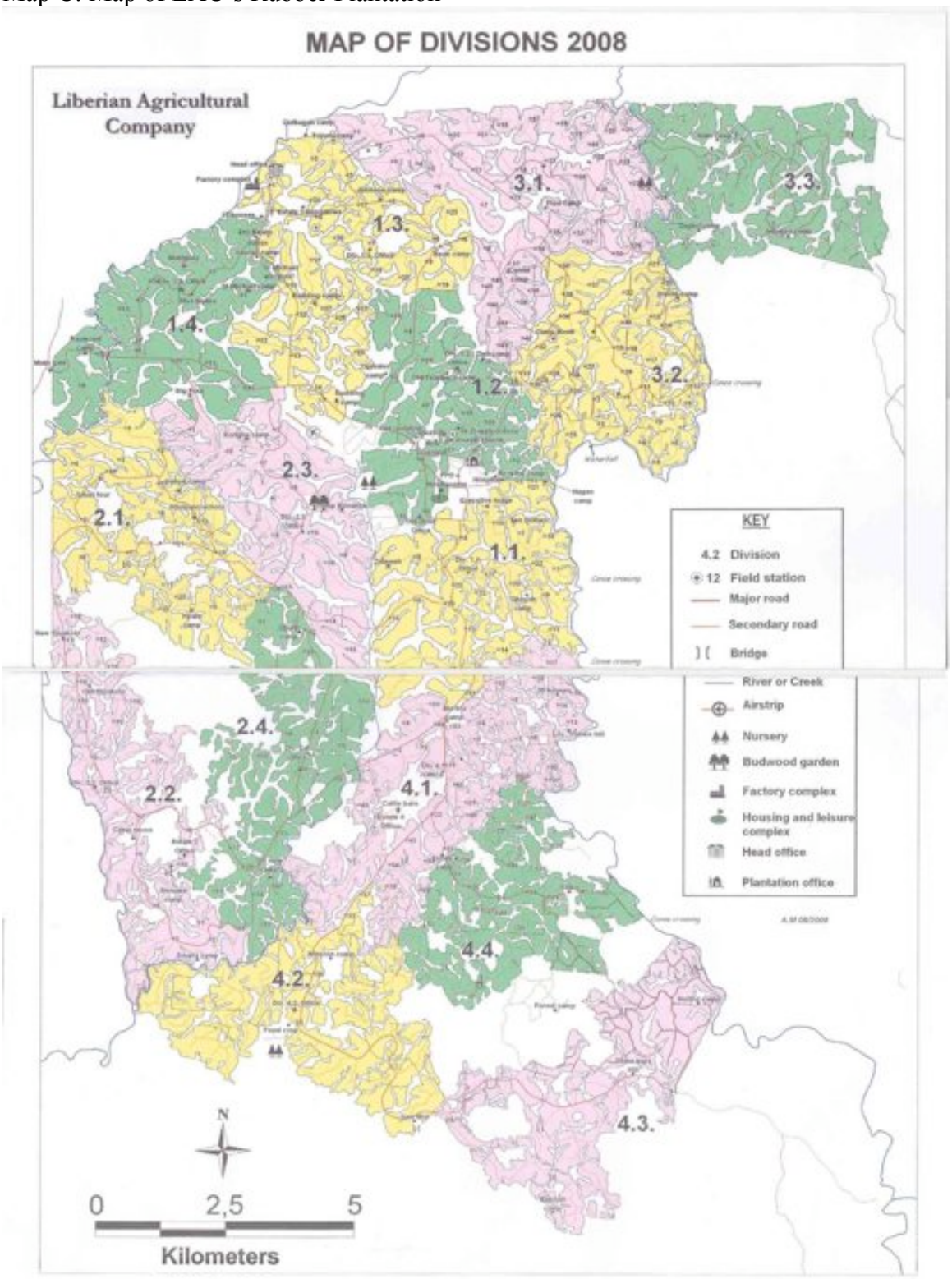
Road Rehabilitation

No major road rehabilitation will be required over the next six months as most farms are located along main roads. Regular road inspections and maintenance, however, will be conducted to ensure roads remain in suitable condition for operations and to facilitate drainage during the rainy season. These will be conducted informally by the land preparation and replanting teams using the roads, as well as formally by the road maintenance team.

II. LAC Operation

BR Fuel has been contracted by the Liberian Agricultural Company (LAC), a subsidiary of the Luxembourg registered SOCFINAL, and a recipient of IFC funding for rubber plantation rejuvenation in 1999. LAC is one of the largest rubber plantations in Liberia with approximately 13,000 ha of rubber trees planted in its 120,000 ha land concession (see Map C – Estates 1 and 2 are old trees and 3 and 4 are younger trees).

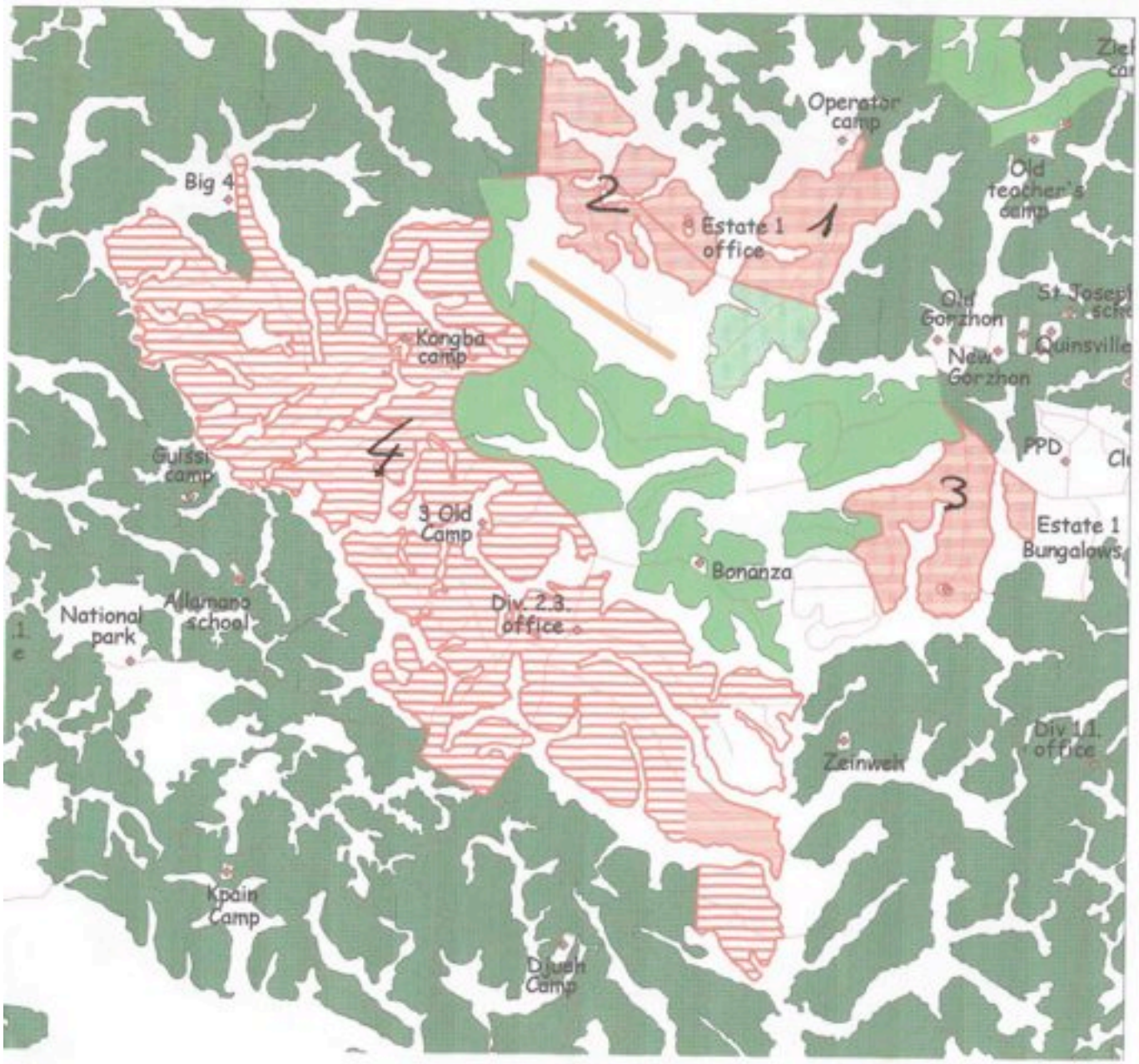
Map C: Map of LAC's Rubber Plantation



BR Fuel was contracted to clear and chip 784.5 ha of rubber trees for LAC. The particular area cleared by BR Fuel is located near estate 2.3 surrounding the airstrip (orange line). A detailed map of the area is included below (see Map D).

BR Fuel has completed the felling operation and is now in the process of chipping the remaining logs for transport to Buchanan. This will be completed by the end of March and requires only a small landing area on the roadside (approximately 1 acre). According to the agreement, LAC is responsible for site preparation and replanting the area in compliance with its policies and standards.

Map D: Area Harvested by BR Fuel in LAC



Map E can be interpreted as follows:

- Orange line – airstrip
- Faint pink lines – roads
- Green – planted rubber
- Pink – rubber trees harvested by BR Fuel
- White – where rubber has not been planted, generally natural vegetation

The entire harvested area (pink) comprises 784.5 ha of land. The initial trial area, marked with a 1 represents 50 ha, while sections 2 and 3 ranged from 67-75 ha; however, they are divided by natural vegetation into slightly smaller parcels (see white areas). Section 4 was completed in stages of smaller parcels and although contiguous in some places, buffer zones of natural vegetation of varying widths were left between many of the parcels, as evidenced by the white areas on the map. Again, there was no evidence of threatened or endangered species on site and harvesting operations were conducted at a significant distance form the National Park marked on the left-hand side of the map. No roads were rehabilitated on the LAC property and LAC was responsible for all road maintenance.

BR Fuel followed its best judgment in carrying out its operations for LAC; however, it completed the felling activities prior to the completion of the Harvesting Management Plan. Thus, while BR aimed to follow many of the principles of the plan, not all of the specific requirements were met. Now that those requirements are clear, BR Fuel will work closely with LAC to redefine any future contracts to directly reflect the specific requirements of this plan. Given the size of the area, there is tremendous opportunity for flexibility and creativity, including for developing a system of wildlife corridors between wetlands and buffer zones.

III. Conclusion

Over the next 6 months BR Fuel will be focused primarily on:

1. Completing all chipping prior to the start of the rainy season. This will provide BR Fuel with approximately 90,000 GMT of woodchips, which will be sufficient to meet projected demand over the next 6 months.
2. Replanting and maintaining all 23 smallholder farms.
3. Completing the data collection and mapping exercise (outlined in section 11 of the Harvesting Management Plan) for critical harvesting areas in Grand Bassa and around the site for the 35 MW power plant being built by Buchanan Renewables Power.
4. Defining a sustainable Harvesting Management Plan for the next dry season.

BR Fuel will carry out these activities in accordance with the principles and requirements of the Sustainable Harvesting Management Plan and will integrate those standards into its harvesting plan for the next dry season, as well as any future harvesting contracts.