TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

LIST OF FIGURES

LIST OF TABLES

LIST OF PHOTOGRAPHS

ABBREVIATIONS

o	degree
‘	minute
“	second
%	Percentage
AMSL	Above Mean Sea Level
CAPA	current available production area
cm	centimetre
dbh	diameter breast height
DOE	Department of Environment Malaysia
EPD	Environmental Protection Department Sabah
EIA	Environmental Impact Assessment
FFPCP	Forest Fire Prevention and Control Plan
FMP	Forest Management Plan
FMU	Forest Management Unit
F.R.	Forest Reserve
g	gram
ha	hectare
IPMP	Integrated Plantation Management Programme
ITP	Industrial Tree Plantation
JAS	Jabatan Alam Sekitar Malaysia
JKKK	Jawatankuasa Kemajuan & Keselamatan Kampong
JPAS	Jabatan Perlindungan Alam Sekitar Sabah
KAN	Ketua Anak Negeri
KBDI	Keetah-Byram Drought Index
Kg.	Kampong
km	kilometre
m^3	cubic metre
m	metre
mm	millimetre
MBCA	Maliau Basin Conservation Area
mg/L	milligram per litre
NFM	Natural Forest Management
RIL	Reduced Impact Logging
RM	Ringgit Malaysia
SFD	Sapulut Forest Development Sdn Bhd
SFMLA	Sustainable Forest Management Licence Agreement
Sg.	Sungai
sm	sentimeter
ToR	Terms of Reference
TWC	Tibow Water Catchment
V.J.R.	Virgin Jungle Reserve
WWF	World Wide Fund for Nature

1 EXECUTIVE SUMMARY

Bahasa Malaysia

1.1 Projek

1.1.1 Penerangan Projek

Pendahuluan

Sapulut Forest Development Sdn Bhd (SFD) bercadang untuk membalak dan menanam hutan dalam kawasan Unit Pengurusan Hutan, FMU 14. Tapak projek terletak di Hutan Simpan Sapulut, hutan simpan kelas dua untuk tujuan pembalakan.

Pengurusan Hutan Berkekalan

SFD telah menandatangani perjanjian (SFMLA: 04/97) dengan Kerajaan Negeri Sabah pada bulan September 1997 untuk menguruskan hutan simpan kelas II di Hutan Simpan Sapulut, yang dikenali sebagai Perjanjian Lesen Pengurusan Hutan Berkekalan (SFMLA) kawasan FMU 14. Kawasan tersebut akan diuruskan secara berkekalan dalam masa jangka panjang (100 tahun) untuk tujuan ekonomi, sosial dan ekologi.

Kawasan Projek

Jumlah keseluruhan kawasan projek atau kawasan produk sediada masakini (CAPA) ialah 95,300 hektar dan dizonkan berdasarkan kepada garispanduan polisi pengurusan hutan berkekalan, yang meliputi konservasi (17 % dari jumlah keseluruhan kawasan), produksi (Pengurusan Hutan Semula Jadi, NFM – 54 %) dan produksi (Penanaman Pokok Industri, ITP – 29 %).

Pengurusan Hutan Semula Jadi (NFM)

Jumlah keseluruhan kawasan yang dikategorikan sebagai NFM ialah 51,248 hektar. Walau bagaimanapun, memandangkan stok tumbuhan yang rendah, pembalakan akan hanya dilakukan di dalam kawasan seluas 11,594 hektar sahaja.

Rawatan Silivikultural

Rawatan silvikultural akan dilakukan di kawasan NFM untuk meningkatkan stok tumbuhan hutan semula jadi. Dianggarkan antara tahun 2005 dan 2013, rawatan silvikultural akan merangkumi kawasan seluas 9,771 hektar, dengan purata rawatan 1,000 hektar setahun.

Penanaman Pengayaan

Penanaman pengayaan akan dilakukan di kawasan degradasi NFM. Ini akan melibatkan penanaman benih-benih asli di kawasan di mana tiada ataupun kurang pokok-pokok tanaman berpotensi. Walau bagaimanapun, disebabkan praktikaliti dan operasi yang mahal, ianya hanya akan dilakukan di dalam sepamjang 300 meter jalan masuk dan jika benar-benar perlu.

Penanaman Pokok Industri (ITP)

Kawasan hutan yang telah banyak kali dibalak seluas 27,736 hektar akan dijadikan lebih produktif melalui pembangunan pemulihan hutan atau Penanaman Pokok Industri (ITP). Kawasan yang akan dipulihkan dihadkan kepada kawasan yang mempunyai kecerunan kurang dari 15 darjah sahaja. Purata kadar kerja pemulihan hutan ialah kira-kira 3,000 hektar setahun.

Pokok-pokok yang akan ditanam termasuklah spesis bukan asli (lebih kurang 65 % dari jumlah kawasan) iaitu *Acacia Mangium* (30 %), *Getah* (20 %), *Albizia* (10 %) dan *Teak* dan lain-lain (5 %); dan spesis asli (lebih kurang 35 % dari jumlah kawasan) iaitu *Laran*, *Binuang, Jelutong, Kapur* dan *Seraya*. Sebelum pemulihan hutan, kayu lebihan di kawasan ITP akan dibalak, dengan purata pembalakan 3,000 hektar setahun, antara tahun 2004 dan 2013.

Konservasi

Kawasan selebihnya seluas kira-kira 16,316 hektar akan diuruskan terutamanya sebagai konservasi (kawasan berkecerunan melebihi 25 darjah) dan perlindungan (simpanan sungai).

Hutan Komuniti

Program hutan komuniti akan dilaksanakan dimana masyarakat tempatan akan diberikan latihan dan digalakkan melibatkan dalam aktiviti perhutanan termasuklan penanman hutan, operasi silvikultural, pembersihan dan pemuliharan sempadan, dan pembekalan bahan-bahan penanaman.

Sumber Hutan

Keadaan lebihan hutan adalah rendah dan kebanyakanya tidak mempunyai pokok komersial melebihi 39 sm dbh. Jumlah lebihan pokok antara 20 sm to 39 sm dbh untuk kawasan ITP dianggarkan 53.46 metrik padu sehektare (m^3/ha) atau 109 pokok sehektar. Jumlah pokok melebihi 60 sm dbh untuk kawasan NFM ialah 13.64 m^3/ha atau 2 pokok sehektar.

Kapasiti Pembalakan

Kapasaiti operasi pembalakan untuk kawasan ITP ialah antara 13,000 hingga 14,000 metrik padu (m^3) sebulan dengan aktiviti pembalakan selama 10 tahun; dan untuk kawasan NFM ialah antara 6,000 hingga 8,000 m^3 sebulan dengan aktiviti pembalakan selama 3 tahun.

Pengangkutan

Kayu-kayan yang telah dibalak akan diangkut menggunkan lori balak melalui jalan sediada Jalan Tekala, Jalan Sapulut – Kalabakan dan Jalan Kalabakan – Tawau. Kayu-kayan samaada akan diproses di kilang papan berdekatan tapak projek (akan dibangunkan dan dioperasikan oleh kontraktor pembalakan) atau dijual kepada kilang-kilang papan di sekitar Sabah.

1.1.2 Penerangan Tapak

Tapak Projek

Tapak projek terletak di dalam Hutan Simpan Sapulut, Daerah Nabawan. Ianya terletak betul-betul di timur Pekan Sapulut, 35 km di selatan-tenggara Pekan Nabawan dan 85 km di barat-baratlaut Pekan Kalabakan. Kawasan pembalakan terletak dibawah kuasa Jabatan Perhutanan Daerah Tibow.

Berhampiran dan di utara ialah Unit Pengurusan Hutan, FMU 11 (sebahagian Hutan Simpan Sapulut). Kawasan Konsesi Yayasan Sabah terletak betul-betul di utara dan timur tapak projek. Bersempadan di timur laut ialah Kawasan Konservasi Lembangan Maliau (MBCA), hutan perlindungan asli bermutu tinggi. Di selatan, ianya berkongsi sempadan dengan FMU 13 (sebahagian dari Hutan Simpan Sapulut) dan FMU 25 (sebahagian Hutan Simpan Sapulut dan Hutan Simpan Kalabakan).

Tapak projek boleh dihubungi dari Tawau melalui Pekan Kalabakan menggunakan kombinasi jalan batu kelikir dan jalan balak, dari Jalan Tekala dan Jalan Kalabakan - Tawau. Tapak projek juga boleh dimasuki melalui Keningau melalui Pekan Nabawan menggunkan kombinasi jalan berturap dan jalan batu kelikir, dari Jalan Keningau – Sapulut dan Jalan Sapulut - Kalabakan.

Kegunaan Tanah

Corak utama kegunaan tanah di kawasan ini ialah hutan belantara / kedua, tanaman pertanian dan kawasan berpenduduk. Di dalam tapak projek, jenis tanaman utama ialah hutan montan, hutan bercampur dipterokap tanah tinggi, hutan dipterokap tanah rendah dan tanaman tetap. Tapak projek telahpun dibalak beberapa balik sebelum ini oleh tidak kurang dari 26 kontraktor, dengan pembalakan terakhir pada tahun 2003.

Topograpi

Topografi kawasan didalam tapak projek adalah di antara 200 hingga 1,200 meter (m) diatas purata permukaan laut (AMSL). Lebih kurang 7,946 hektar ataupun 8.3 peratus kawasan projek mempunyai kecerunan melebihi 25 darjah.

Meteorologi

Cuaca di kawasan ini ialah cuaca khatulistiwa dengan suhu tetap, kelembapan tinggi dan hujan yang berlebihan. Hujan terutamanya perolakan tetapi dipengaruhi oleh musim monsun. Purata hutan tahunan ialah kira-kira 2319 mm setahun dengan purata bulanan 198 mm.

Archaeologi

Terdapat tiga kawasan sensitive arkeologi di dalam dan di sekeliling kawasan projek termasuklah Batu Saap (di dalam tapak projek), Batu Punggul (0.3 km ke barat) dan Batu Tinahas Cave (0.5 km ke barat). Kawasan-kawasan ini tidak mempunyai nilai-nilai arkeologi tetapi dipulihara untuk tujuan pelancongan. Terdapat juga empat tapak perkuburan masyarakat Murut tempatan di sekitar tapak projek, terutamanya berdekatan kawasan berpenduduk.

Kawasan Pelancongan

Terdapat dua kawasan pelancongan di sekitar kawasan projek, termasuk di Tibow (di dalam kawasan yang digazetkan untuk Jabatan Perhutanan Tibow) dan di Sabuda (6 km ke timur tapak projek). Kawasan-kawasan pelancongan ini direkabentuk untuk menampong aktiviti berkaitan dengan Lembangan Maliau. Terdapat juga pelan jangka panjang untuk menubuhkan sebuah pecan baru di Tibow. Walau bagaimanapun, sehingga kini tidak ada pelan yang diluluskan atau digazetkan samada untuk kawasan pelancongan ataupun untuk Pekan Tibow.

Hydrologi

Sistem sungai utama yang mungkin terganggu oleh projek ini termasuklah Sg Siliawan, Sg Pinangah, Sg Lombunaan, Sg Saburan, Sg Sansiang, Sg Tibow, Sg Palangan, Sg Sakikilan, Sg Sabunutan, Sg Beliar, Sg Sablangan, Sg Simatuoh, Sg Salung, Sg Lalobou, Sg Sinikalaun, Sg Sapulut, Sg Pampangon and Sg Logongon. Sungai-sungai utama lain yang terdapat di sekitar kawasan projek termasuklah Sg Penawan, Sg Sumatalun and Sg Pensiangan.

Sumber Air

Tidak ada skim bekalan air minuman Kerajaan yang diketahui atau digazetkan beroperasi di kawasan projek. Penduduk tempatan bergatung kepada graviti dan perigi untuk bekalan air harian. Takat pengambilan air mereka terletak di luar tapak projek. Walau bagaimanapun, sebahagian dari kawasan tadahan air mereka mungkin terganggu, terutamanya yang terletak di sepanjang Sg Sapulut dan Sg Tibow. Tambahan pula, dimusim kemarau, kebanyakan penduduk tempatan meperolehi air terus dari Sg Salung, Sg Sinikalaun, Sg Logongon dan Sg Sapulut untuk bekalan air harian.

Di dalam tapak projek terdapat satu cadangan kawasan tadahan air yang dikenali sebagai Kawasan Tadahan Tibow (TWC) dengan keluasan kira-kira 690 hektar. TWC berdasarkan alur Sg Sansiang dan akan digunakan untuk cadangan Pekan Tibow. Walau bagaimanapun, hinggi kini tidak ada pelan tadahan air yang di luluskan atau digazetkan.

Navigasi

Untuk navigasi, sungai-sungai tempatan termasuklah Sg Saburan, Sg Salung, Sg Sinikalaun, Sg Logongon, Sg Pampangon and Sg Sapulut digunakan sebagai jalan masuk, terutamanya antara kawasan yang tidak mempunyai rangkaian jalan raya. Sungai-sungai ini juga digunakan untuk aktiviti perikanan.

Kualiti Air

Persampelan alam sekitar untuk kualiti air dilakukan semasa penyiasatan tapak. Secara keseluruhannya, kualiti air sungai-sungai tempatan adalah baik. Parameter air yang dianalisa memenuhi Piawai IIB, Paiwaian Interim Kualiti Air JAS, yang mana secara amnya boleh digunakan untuk bekalan aira. Walau bagaimanapun, Sg Sapulut, Sg Salung dan Sg Logongon adalah tercemar dengan kepekatan pepejal terampai dan minyak dan geris yang tinggi. Ini mungkin disebabkan oleh aktiviti-aktiviti pembalakan di kawasan Sapulut, Pensiangan dan Kalabakan.

Flora

Vegetasi utama termasuklah Hutan-Hutan Tanah Tinggi dan Tanah Rendah Campuran Dipterokap, yang mana telah dibalak sejak tahun 1970an. Vegetasi lain termasuklah Hutan Tanah Tinggi Campuran Dipterokap dan Keranga, Hutan Tanah Tinggi Keranga, dan Hutan Tanah Rendah Campuran Dipterokap dan Keranga. Terdapat juga sedikit vegetasi lain seperti Hutan Montane Tanah Rendah dan Hutan Tanah Tinggi Campuran Dipterokap dan Batu Kapur.

Kajian biologi menemui lebih kurang 321 spesis fauna di dalam tapak projek. Memandangkan ianya terletak berhampiran dengan Kawasan Konservasi Lembangan Maliau, terdapat tujuh sepsis flora yang dilindungi termasuklah Halia Hutan, Lampias, Polod dan Botu. Terdapat juga lima sepsis herba di dalam tapakm projek termasuklah *Adina rubella*, *Coyx lachrymal*, *Mallotus apelta*, *Pteris multifida* dan *Pyrrosia lingua*.

Fauna

Kawasan projek mempunyai populasi hidupan liar yang tinggi, walaupun telah dibalak beberapa kali sebelum ini dan masakini, yang diketahui akan menganggu dan merubah habitat semulajadinya. Kajian tapak menunjukkan keadaan dan populasi hidupan liar yang baik. Sebanyak 34 spesis mamalia direkodkan di dalam tapak projek, termasuklah tujuh sepsis yang dilindungi.

Hidupan liar besar seperti Gajah (*Elephas maximus*) dan Orang Utan (*Pongo pygmaeus*) diketahui berada di kawasan ini, seperti disahkan oleh penduduk tempatan. Kajian sebelum ini juga menunjukan kumpulan-kumpulan gajah dilihat di beberapa kawasan berlainan dalam Hutan-Hutan Simpan Sapulut dan Gunung Rara. Berdasarkan informasi dari WWF Malaysia, tenggara tapak projek adalah sebahagian dari laluan migrasi gajah antara Lembah Danum dan sempedan Indonesia. Rhino juga diketahui berada di kawasan ini dimana kajian lalu menunjukan perlihatan di Huta-Hutan Simpan Sapulut dan Kalabakan.

Pemburuan

Pemburuan hidupan liar dilakukan oleh pendudk tempatan di empat kawasan utama di dalam dan di sekitar kawasan projek. Buruan hidupan liar yang popular ialah babi hutan dan payau.

Habitat Akuatik

Habitat akuatik yang diketahui di kawasan ini terhad kepada akuatik ikan air tawar, krustacea, mollusca dan alga di sepanjang sungai-sungai tempatan. Tidak ada spesis akuatik yang dilindungi atau diancam kepupusan. Berdasarkan informasi dari penduduk tempatan, terdapat banyak ikan di Sg Saburan, Sg Salung, Sg Sinikalaun, Sg Logongon, Sg Pampangon Sg Sapulut, Sg Sansiang dan Sg Tibow. Aktiviti perikanan biasa ialah menggunakan pancing tangan, dan “jala” atau “pukat”.

Kawasan Sensitif

MBCA yang terletak betul-betul di timur laut tapak projek mempunyai keluasan lebih kurang 58,840 hektar. Lembangan Maliau ialah lembangan berupa piring kerana ianya di kelilingi oleh tubir rim dengan ketinggian antara 1500 m hingga 1900 m AMSL. MBCA ialah kawasan hutan yang unik dan semula jadi yang ditumbuhi oleh hutan montane rendah dan rawa, dan juga hutan tanah rendah dipterokap. Adalah dilaporkan terdapat banyak spesis tumbuhan di Lembangan Maliau, kebanyakannya susah diketahui dan memerlukan pakar biologi.

Kawasan Phenologi seluas 120 hektar terletak di dalam kawasan (berdekatan Sg Saburan). Kawasan in dilindungi untuk pemerhatian tentang kajian peristiwa semula jadi atau peredaran tumbuhan dan binatang dengan hubungan mereka kepada iklim dan cuaca, dan bagaimana mereka bertindakbalas kepada pertukaran musim di persekitaran mereka disebabkan oleh banyak faktor seperti latitud, ketinggian dan kesan penampan kawasan air yang besar.

Berdasarkan kajian WWF, terdapat tiga jenut-garam di dalam dan di sekitar tapak projek. Satu jenut-garam terletak di dalam tapak projek (berdekatan Sg Salung). Di sekeliling, terdapat satu jenut-garam kira-kira 500 m ke timur (dalam kawasan Hutan Simpan Gunung Rara) dan satu lagi terletak 6 km ke selatan. Jenut-garam ini diketahui digunakan oleh gajah dan babi hutan sebagai sumber air kaya-mineral dan selalunya sebagai kawasan perumahan hidupan liar.

Sg Siliawan V.J.R. (2,136 hektar) dan Sg Sansiang V.J.R. (34 hektar) berkongsi sempadan dengan projek ini. Nurod Urod V.J.R. (1,705 hektar) terletak lebih kurang 200 m ke timur tapak projek. Kesemua hutan-hutan simpan ini diklasifikasikan sebagai Kelas VI Hutan Simpan Dara untuk tujuan penyelidikan hutan.

Sosio-ekonomi

Tidak terdapat kampong ataupun kawasan berpenduduk di dalam tapak projek, kecuali satu kem pekerja yang dipunyai oleh pemaju projek dan satu kem pekerja lain yang dipunyai oleh kontraktor persendirian (Atlantic Sawmill).

Kawasan berpenduduk utama terletak di barat dan barat daya tapak projek, iaitu di kawasan tanah Kerajaan di sepanjang Sg Sapulut, Sg Pampangon dan Sg Logongon. Terdapat 29 kampong tempatan dengan jumlah populasi 3,526. Di sebelah timur tapak projek, kawasan berpenduduk tehad kepada Jabatan Perhutanan Tibow, yang disediakan dengan pejabat dan kem pekerja (29 orang).

Profil Masyarakat

Masyarakat tempatan terdiri dari kumpulan etnik Murut Tagol. Masyarakat ini ialah penduduk yang terlibat dengan pertanian setempat, yang tidak menggunakan sumber di tapak projek kerana kawasan sumber hutan tanah Kerajaan mencukupi untuk memenuhi keperluan tempatan. Aktiviti ekonomi tempatan ialah pertanian, perhutanan dan pemburuan.

Majoriti penduduk ialah Bumiputera dari masyarakat Murut dan Kadazan. Takat pembelajaran mereka adalah rendah dengan kurang dari 10 peratus penduduk menamatkan persekolhan menengah dan kebanyakannya kerja di sector pertanian. Majoriti penduduk duduk di rumah sendiri melebihi 10 tahun dan dikategorikan sebagai penduduk tempatan. Takat ekonomi penduduk dikategorikan sebagai kelas rendah dengan majority berpendapatan kurang dari RM300 sebulan. Kebanyakan penduduk terlibat dengan perikanan, pemburuan atau pertanian untuk menampung sara hidup harian.

Perkampongan mereka tidak mempunyai bekalan air Kerajaan, dengan majority penduduk bergantung kepada sistem air graviti dari sungai-sungai tempatan. Jalan masuk adalah terhad dan selalunya dalam keadaan teruk dimusim hujan, dengan majoriti penduduk bergantung kepada sungai-sungai tempatan untuki navigasi.

Persepsi

Majoriti penduduk bersetuju dengan perlaksanaan projek. Mereka bersetuju kerana projek ini mungkin memberikan (i) jalan masuk; (ii) menyediakan peluang pekerjaan; dan (iii) memajukan kawasan sekeliling.

Tidak persetujuan utama keatas projek ialah berkaitan dengan pencemaran air sungai yang menganggu aktiviti harian penduduk tempatan. Sebahagian dari yang tidak bersetuju menyatakan syarat-syarat yang berpatutan yang berkaitan dengan keperluan bekalan air bersih, samada dalam bentuk kemudahan simpanan air ataupun perlindungan kawasan tadahan air. Mereka mungkin bersetuju dengan projek ini, jika bekalan air bersih berterusan dapat diberikan. Adalah dipercayai, dengan perlaksanaan beberapa langkah-langkah mitigasi semasa operasi projek yang dicadangkan oleh Kajian EIA ini, perlindungan tambahan sumber air dapat diperolehi.

1.2 Kesimpulan

1.2.1 Impak Alam Sekitar

Kualiti Air

Memandangkan terdapat beberapa kawasan di tapak projek yang dijangka memberikan kadar hakisan tanah yang tinggi, tidak ada pembalakan dibenarkan di kawasan tersebut. Pembalakan dikawasan selebihnya adalah dibenarkan tetapi langkah pengawalan yang cukup seperti dinyatakan di Bab 5 mestilah dilaksanakan.

Kegunaan Air

Impak ke atas kegunaan air dijangka signifikan, memandangkan sungai-sungai tempatan digunakan sebagai sumber air, navigasi dan perikanan.

Ekologi

Impak biologi dijangka signifikan, memandangkan kawasan tersebut mempunyai spesis flora dan fauna yang dilindungi terutamanya binatang besar seperti gajah, orang utan dan badak.

Risiko Kebakaran

Berdasarkan kepada rekod yang lepas, tidak ada insiden kebakaran hutan di tapak projek. Walaubagaimanapun, perhatian mestilah diberikan kepada (i) penanaman spesis bukan semula jadi seperti *Acacia*; (ii) pembakaran terkawal yang tidak menentu; dan (iii) praktis pembakaran terbuka untuk tujuan pertanian pindah di sekitar tapak projek yang mungkin boleh membawa kepada risiko kebakaran hutan.

Arkeologi

Impak arkeologi dijangka signifikan, memandangkan terdapat satu tapak arkeologi di dalam tapak projek. Tambahan pula, ptojrk ini mungkin menganggu laluan ke tapak-tapak arkeologi di dalam dan di sekeliling tapak projek.

Hydrologi

Impak hidrologi dari hasil sedimen adalah dijangka akan terus tinggi, kemungkinan disumbangkan oleh aktiviti pembalakan sebelum ini.

Trafik & Pengangkutan

Memandangkan jumlah pengangkutan yang dihasilkan oleh projek ini adalah rendah, potensi impak ke atas sosio-ekonomi dijangka tidak signifikan. Walau bagaimanapun, perhatian mestilah diberikan kepada penggunaan cadangan Jalan Sapulut – Kalabakan untuk aktiviti pengangkutan pembalakan/penanaman kerana laluan ini melintasi beberapa kampong tempatan dan dianggap sebagai jalan awam utama.

Sosio-ekonomi

Impak keatas aktiviti-aktiviti sosial, ekonomi dan kebudayaan adalah dijangka tidak signifikan, memandangkan penduduk tempatan tidak bergantung kepada projek ini. Walaubagaimanapun, perhatian mestilah diberikan kepada aktiviti pemburuan hidupan liar di tapak projek oleh penduduk tempatan.

Analisa Kos-Faedah

Impak berkaitan dengan Penanaman Pokok Industri mungkin signifikan untuk kawasan hutan semula jadi yang bermutu tinggi. Walau bagaimanapun, memandangkan tapak projek ialah kawasan hutan yang telah banyak terganggu, impak lebihannya adalah sederhana.

Bahan Kimia

Impak penggunaan bahan kimia dijangka signifikan, jika tiada prosedur kesihatan, keselamatan dan alam sekitar yang teratur semasa penggunaan, penyimpanan dan pengendalian.

Sisa Buangan

Walaupun jumlah sisa buangan yang dihasilkan dan dilupuskan adalah kecil, tetapi impaknya ke atas pencemaran tanah dan sistem sungai mungkin ketara, jika tidak dikendalikan secara teratur, dan perlu diberi perhatian rapi. Jumlah sisa biomas adalah tinggi dan prosedur pelupusan yang berkesan mestilah dilaksanakan.

Penamatan

Disebabkan tapak kem, tapak semaian dan kemudahan pembalakan/penanaman diperbuat dari struktur sementara, impak dari penamatan adalah dijangka rendah.

Impak Kumulatif

Aktiviti pembalakan/penanaman ini yang beroperasi sendiri tidak akan memberikan impak kumulatif yang ketara. Tetapi jika jumlah aktiviti pembalakan/penanaman yang banyak dan beroperasi secara serentak di dalam kawasan yang sama mungkin akan memberikan impak ke atas sumber biologi, kualiti udara, kualiti air dan persekitaran sosio-ekonomi.

1.2.2 Langkah Pengawalan

Pengezonan Kawasan Pembalakan/Penanaman

- *Kawasan Pembalakan/Penanaman* – Tidak membalak/menanam di kawasan berhakisan tanah tinggi dan kawasan konservasi yang telah dikenalpasti.
- *Penandaan* – Kawasan larangan pembalakan/penanaman mestilah ditandakan di peta; dan ditandakan, dicat merah dan disediakan papan tanda di lapangan.
- *Mengemaskini Pelan Pengurusan Hutan* – Mengkaji dan mengemaskini Pelan Pengurusan Hutan sediada untuk mengelakkan pembalakan atau penanaman hutan di kawasan yang dilindungi.

Penyediaan Simpanan Sungai

- *Simpanan Sungai* – Menyediakan simpanan sungai sekurang-kurangnya 50 meter setiap tebing untuk Sg Sansiang, Sg Saburan, Sg Salung, Sg Lalobou, Sg Palangan, Sg Pinangah, Sg Simatuoh, Sg Sablangan, Sg Tibow, alur Sg Sansiang dan alur Sg Sapulut; sekurang-kurangnya 30 meter setiap tebing untuk sungai yang mempunyai kelebaran melebihi 3 meter tetapi kurang dari 20 meter (Sg Siliawan, Sg Lombunaan, Sg sakikilan, Sg Sabunutan, Sg Sablangan, Sg Beliar dan Sg Sinikalaun); dan sekurang-kurangnya 5 meter setiap tebing untuk lain-lain alur kecil. Pembalakan atau penanaman tidak dibenarkan di simpanan sungai.
- *Penandaan* – Kawasan simpanan sungai mestilah ditandakan di peta; dan ditandakan, dicat merah dan disediakan papan tanda di lapangan.

Konservasi Tanah

- *Pembalakan/Penanaman Berperingkat* – Kerja-kerja pembalakan/penanaman tidak dilakukan serentak tetapi berperingkat-peringkat untuk mengurangkan hakisan tanah dengan meminimakan luas kawasan terbuka; menghadkan masa antara akhir pembersihan tanah dan awal penanaman kepada kurang dari tiga bulan; dan masa memulakan pembukaan tanah bersesuaian dengan masa potensi hakisan rendah.
- *Pembukaan Tanah* – Meminimakan takat tanah terganggu semasa pembukaan kawasan ITP dari penggunaan peralatan berat; dan memaksimakan penyimpanan dan liputan tanaman keatas tanah.
- *Pemulihan Tanah* – Mengangkut kayu-kayan kecil yang ditumbangkan menggunakan tenaga manusia atau meninggalkannya di tapak untuk pemulihan tanah.
- *Kawalan Hakisan* – Jika perlu, menanam vegetasi legum ke atas kawasan terbuka yang luas; mengurangkan panjang dan kecuraman cerun untuk mengurangkan laju larian air permukaan; dan menentukan jalan balak/tanam, tril gelincir dan kawasan pendaratan dibina mengikut topografi kawasan.
- *Perparitan* – Tapak kem dan panggung utama mestilah disediakan dengan sistem perparitan.
- *Kolam Mendap* – Tapak kem dan panggung utama mestilah disediakan dengan kolam-kolam mendap.

Mengubah Praktis Operasi

- *Pembalakan* – Untuk kawasan NFM, pokok yang dibenarkan ditebang ialah antara 60 sm hingga 120 sm dbh sahaja.
- *Jalan Balak/Tanam* – Menggunakan semula jalan lama, jika sesuai; dan mengawal jarak, lebar dan kecerunan jalan. Jalan-jalan utama dan kedua mestilah masing-masing mempunyai kepadatan 7 m sehektar dan 14 m sehektar.
- *Lorong Penarikan* – Menggunakan semula lorong penarikan lama, jika sesuai; mengawal jarak, lebar dan kecerunan jalan. Jumlah keluasan keseluruhan kesemua lorong penarikan haruslah masing-masing tidak melebihi 6 % dan 12 % daripada jumlah keluasan bersih kawasan yang dibalak di NFM dan kawasan ditanam di ITP.

- *Panggung* – Menggunakan semula panggung lama, jika sesuai; setiap panggung mestilah masing-masing tidak melebihi 0.5 hektar dan 1.0 hektar untuk NFM dan ITP; diletakkan jauh dari sungai; dan disediakan dengan perparitan dan kolam mendap. Jumlah keluasan keseluruhan kesemua panggung haruslah masing-masing tidak melebihi 0.7 % daripada jumlah keluasan bersih kawasan yang dibalak dan 1.5 % daripada jumlah keluasan bersih kawasan yang ditanam.
- *Tapak Kem* – Menggunakan semula tapak kem lama, jika sesuai; setiap tapak kem mestilah masing-masing tidak melebihi 0.4 ha dan 1.0 hektar untuk NFM dan ITP; diletakkan jauh dari sungai; dan disediakan dengan perparitan dan kolam mendap.
- *Lintasan Aliran* – Menyediakan lintasan aliran seperti pembentung atau jambatan; tidak menghalang ataupun mengubah aliran sungai; dan menghadkan jumlah lintasan.
- *Penumbangan Pokok* – Menggunakan kaedah penebangan berarah; pokok mestilah dijatuhkan jauh dari sungai; dan kenderaan tidak dibenarkan memasuki kawasan simpanan sungai.

Prihatin Sosio-Ekonomi

- *Perlindungan Kawasan Tadahan Air* – Mengawal air larian dari kawasan projek untuk mepastikan kawasan tadahan dan takat pengambilan air penduduk tempatan tidak terganggu; tidak melakukan penanaman di kawasan cadangan Tadahan Air Tibow, dan kawasan tadahan air Kg Tataluan, Kg Simatuoh, Kg Samuran, Kg Tonomon dan Jabatan Perhutanan Tibow; dan kawasan tadahan air mestilah ditandakan di peta; dan ditandakan, dicat merah dan disediakan papan tanda di lapangan.
- *Perlindungan Sumber Air* – Membantu penduduk tempatan yang terlibat dalam menyediakan bekalan air yang bersih dengan menyediakan bantuan kewangan atau peralatan; dan menentukan bekalan air dan kehidupan harian penduduk tempatan tidak terganggu.
- *Perhutanan Masyarakat* – Mengenalpasti peluang-peluang potensi eko-pelancongan di kawasan projek; dan membantu penduduk tempatan dalam memulakan penubuhan aktiviti eko-pelancongan..
- *Rangkaian Jalan* – Membantu penduduk tempatan dalam penyediaan jalan masuk ke kampong-kampong; dan menentukan jalan-jalan tersebut dipulihara sepanjang masa.
- *Pekerjaan* – Peluang pekerjaan mestilah diberikan kepada penduduk tempatan.
- *Dailog* – Menyediakan program perhubungan awam yang teratur dengan penduduk dan penguasa tempatan.

Perlindungan Flora & Fauna

- *Perlindungan Kawasan Konservasi Lembangan Maliau* – Tidak membalak atau menanam di dalam MBCA Zon Penampan 1 seluas 8,495 hektar; dan tidak menanam di dalam MBCA Zon Penampan 2 seluas 20,641 hektar.
- *Perlindungan Kawasan Sensitif* – Tidak membalak atau menanam di Kawasan Phenologi selau 120 ha; tidak membalak atau menanam dan menyediakan zon penampan biologi selebar 100 m diantara tapak projek dan kawasan dilindungi Sg Siliawan V.J.R., Sg Sansiang V.J.R. dan Kawasan Phenologi; dan tidak membalak atau menanam dan menyediakan zon penampan selebar 50 m diantara tapak projek dan kawasan berdekatan FMU 13, FMU 25 dan kawasan perumahan.

- *Hidupan Liar Yang Dilindungi* – Tidak menanam di Kawasan Utama Tinggi untuk melindungi gajah dan orang utan dan menyediakan laluan hidupan liar di kawasan tersebut; dan mendapatkan kebenaran Jabatan Hidupan Liar untuk penanaman di Kawasan Utama seluas 9,843 hektar dan Kawasan Badak seluas 16,842 hektar.
- *Perlindungan Jenut-Garam* – Tidak membalak atau menanam dan menyediakan simpanan biologi di jenut-garam dengan zon penampan berjejari 100 m; dan tidak membalak atau menanam dan menyediakan laluan selebar 50 m dari Sg Salung dan Sg Lalobou.
- *Perlindungan Fauna* – Memberikan peluang kepada hidupan liar berpindah ke kawasan berdekatan dengan melaksanakan pembalakan/penanaman berperingkat-peringkat; dan tidak membalak atau menanam dan menyediakan laluan hidupan liar di sepanjang Sg Sansiang, Sg Salung, Sg Lalobou, Sg Palangan dan Sg Pinangah.
- *Perlindungan Flora* – Mengawal pemungutan spesis flora yang dilindungi; memberitahu/mendidik pekerja mengenai larangan tersebut; dan mengenalpasti pokok-pokok yang dilindungi untuk tujuan konservasi.
- *Pemburuan* – Tidak membalak atau menanam di dalam kawasan pemburuan yang telah dikenalpasti untuk mempastikan kesenimbungan bekalan hidupan liar untuk faedah penduduk tempatan; melarang pemburuan haram samada oleh pekerja, keluarga ataupun orang yang tidak dibenarkan; memberitahu/mendidik pekerja mengenai larangaan tersebut; meminimakan jumnlah pekerja tinggal di tapak projek; dan melaksanakan langkah-langkah mengawal pemburuan haram.
- *Notifikasi* – Memberitahu Jabatan Hidupan Liar sebelum kerja-kerja pembalakan/penanaman bermula; dan memberitahu dengan kadar segera Jabatan Hidupan Liar, Jabatan Perhutanan dan Jabatan Perikanan jika terjumpa/mengetahui/menyedari adanya spesis fauna, flora ataupun akuatik yang dilindungi; dan tidak membalak/menanam di kawasan tersebut.
- *Pentadbiran* – Kawasan-kawasan yang dilindungi kerana ekologi yang sensitif hendaklah ditandakan di peta dan di tapak dan dikecualikan dari pembalakkan/penanaman; menjalankan aktiviti pembalakan/penanaman secara berhati-hati berdekatan kawasan ekologi/botani yang sensitif kerana adanya spesies flora dan fauna yang perlu dilindungi; dan melantik Pegawai Pengurusan Alam Sekitar sepenuh masa yang berkelayakan untuk tujuan perlindungan biologi.
- *Penandaan* – Sempadan kawasan/zon penampan biologi atau kawasan yang mempunyai sepsis dilindungi ataupun kawasan pemburuan mestilah ditandakan di peta; dan ditandakan, dicat merah dan disediakan papan tanda di lapangan.

Pengurusan Kebakaran Hutan

- *Pengurusan Kebakaran* – Menyediakan dan melaksanakan "Pelan Pencegahan dan Kawalan Kebakaran Hutan"; melaksanakan dril kebakaran, latihan dan program kesedaran; dan membina dan menyelanggara 'fire break'.
- *Sistem Amaran Kebakaran* – Menyediakan sistem amaran kebakaran awal termasuklah menara kawalan api dan perondaan kerap.
- *Pembakaran Terkawal* – Boleh malakukan pembakaran terkawal di kawasan ITP untuk rawatan silvikultural berdasarkan syarat-syarat pengurusan asap yang boleh diterima; mendapat kebenaran dari Jabatan Perhutanan dan Jabatan Alam Sekitar Malaysia sebelum melakukan pembakaran; tidak melakukan pembakaran dalam kawasan 100 m lebar dari sempedan dalam projek; dan setiap pembakaran mestilah dipeta dan dokumentasikan.
- *Tiada Pembakaran Terbuka* – Tidak melakukan pembakaran terbuka di tapak projek, samada untuk pelupusan sisa, sampah ataupun biomas.

Perlindungan Arkeologi

- *Tapak Arkaeologi* – Tidak membalak atau menanam dan menyediakan simpanan arkaeologi untuk Batu Saap; dan menyediakan laluan untuk Batu Saap, Batu Punggul dan Gua Batu Tinahas.
- *Tanah Perkuburan* – Tidak membalak atau menanam dan menyediakan simpanan arkaeologi untuk mana-mana tanah perkuburan yang dijumpai di dalam tapak projek.
- *Notifikasi* – Memberitahu Jabatan Muzium dan Ketua Kampung / JKKK berdekatan jika terjumpa/mengetahui adanya bahan arkeologi ataupun bersejarah, dan tidak membalak/menanam dikawasan tersebut; dan memberitahu Kementerian Pelancongan, Kebudayaan dan Alam Sekitar Sabah tentang penemuan kawasan pelancongan atau berkepentingan botani seperti air terjun, kolam, bukit, gunung, gua, dan dilarang membalak di kawasan berkenaan.
- *Pentadbiran* – Kawasan larangan arkeologi dan laluan; atau kawasan penemuan arkeologi/bersejarah, kawasan potensi pelancongan atau kepentingan botani haruslah di tandakan (di peta dan di lapangan) dan dikecualikan daripada pembalakan/penanaman.

Trafik & Pengangkutan

- *Papan Tanda* – Menyediakan papan tanda di tempat masuk ke tapak projek, di persimpangan jalan utama, di tapak kem, di tapak semaian dan dekat kawasan berpenduduk.
- *Kawalan Pengangkutan* – Menjadualkan operasi pengangkutan supaya tidak memasuki atau meninggalkan kawasan berpenduduk atau pekan utama semasa waktu sibuk atau di malam hari; dan jika perlu mengawal habuk dari aktiviti pengangkutan dengan melakukan penyiraman air secara sistematik.
- *Keselamatan Pengangkutan* – Mengawal pergerakan kenderaan pengangkutan untuk menggurangkan impak keatas trafik dan navigasi tempatan; memasang lampu pada lori balak, kenderaan pengangkutan, skow, baj dan bot kerja supaya dapat dilihat pada malam hari ataupun semasa cuaca buruk; dan mematuhi sepenuhnya keperluan-keperluan beroperasi di atas tanah dan air.
- *Keselamatan Pejalan Kaki* – Menyediakan lintasan pejalan kaki yang teratur dan mencukupi di sepanjang jalan balak utama.
- *Keselamatan Hidupan Liar* – Menyediakan lintasan hidupan liar di sepanjang jalan balak utama.
- *Pentadbiran* – Mendapatkan kebenaran Jabatan Kerja Raya atau Pejabat Daerah Nabawan sebelum membina jalan balak/tanam menghubungi jalan awam; dan kerap berkonsultasi dengan penguasa tempatan mengenai aktiviti pengangkutan projek.

Pengurusan Penanaman

- *Tapak Semaian* – Membina tapak semaian sekurang-kurangnya 50 meter dari sungai/alur; dan mengawal air larian dari tapak semaian melalui kolam mendap untuk peneutralan.
- *Bahan Kimia* – Membina tapak penyimpan bahan kimia sekurang-kurangnya 50 meter dari sungai/alur; menyimpan bahan kimia di kontena yang sesuai; tapak simpanan mestilah dipagar, ditutup, mempunyai lantai tidak bolos dan disediakan perparitan teratur; dan meminimakan penggunaan baja dengan menggunakan bahan semula jadi ataupun menggunakan kaedah pemotongan manual.

- *Pentadbiran* – Menyediakan dan melaksanakan "Program Pengurusan Penanaman Bersepadu" terhadap kesuburan tanaman untuk menggalakkan ketahanan kepada serangga dan penyakit; menggunakan baja semula jadi; dan melaksanakan kawalan maksima terhadap serangga biologi.

Pengurusan Sisa

- *Penyimpanan Sisa* – Membina tapak simpanan bahan berbahaya sekurang-kurangnya 50 meter dari sungai/alur; mengambil dan menyimpan sisa minyak dari peralatan dan kenderaan pembalakkan/penanaman; menyimpan di bekas yang sesuai untuk pelupusan; dan tapak sementara simpanan minyak mestilah dipagari, ditutupi, mempunyai lantai tidak bolos dan disediakan dengan perparitan teratur.
- *Sampah Sarap* – Memungut dan melupus sampah sarap secara menanam di tapak kem dengan menyediakan lubang khas; dan melarang pembakaran sampah ataupun pembuangan terus ke sungai / kawasan rendah.
- *Biomas* – Sisa biomas dari pembalakan/penanaman mestilah dibuang di tapak projek dan tidak memasuki sungai/alur; sungai/alur yang dipenuhi atau dicemari sisa biomas mestilah dibersihkan sepenuhnya; dan menyiasat penggunaan kayu-kayan kecil yang ditebang untuk empulur venier.
- *Sisa Kumbahan* – Menyediakan sistem rawatan kumbahan asas di tapak projek.

Penamatan

- *Membersihkan Tapak* – Merobohkan semua struktur; memindahkan semua benda-benda; membersihkan kawasan yang tercemar; dan membuka dan memperbaiki semua lintasan aliran.
- *Kawalan Tapak* – Memantau jalan masuk ke tapak projek dengan menyediakan pintu masuk terkawal, dan menyediakan papan tanda; and memberitahu pihak berkuasa tempatan tentang penutupan tapak.
- *Rehabilitasi* – Memperbaiki kawasan yang tidak stabil; menanam pokok di jalan-jalan yang ditamatkan; dan menanam vegetasi di kawasan terbuka luas.

Langkah Mitigasi Kedua

- *Menaiktaraf Jalan* – Kerap memulihara jalan yang menghubungi tapak projek dan jalan awam dengan bergabung/bekerjasama dengan pihak pembalak/penanam yang lain.
- *Perlindungan Hidupan Liar* – Menyediakan bantuan dalam mengenalpasti atau menempatkan semula hidupan liar dan melindungi penduduk tempatan dari ancaman hidupan liar, dengan bergabung/bekerjasama dengan pembalak/penanam lain, sekiranya perlu.
- *Perlindungan Arkaeologi* – Menyediakan bantuan dalam memulihara legenda tempatan atau mengenalpasti lokasi yang mempunyai nilai arkeologi, dengan bergabung/bekerjasama dengan pembalak/penanam lain, sekiranya perlu.
- *Teknik RIL* – Melaksanakan sepenuhnya keperluan, peraturan dan kaedah Jabatan Perhutanan dalam penggunaan teknik RIL untuk mengurangkan impak pembalakan di hutan simpan yang bergazet.

1.2.3 Program Pengawasan

Mengemukakan kepada JPAS enam bulan sekali perkara-perkara berikut:

Zon

- Pelan susur dan gambar kawasan dilarang membalak atau menanam termasuklah kawasan berisiko hakisan tanah tinggi, simpanan sungai, kawasan konservasi, zon penampan biologi, simpanan arkeologi, kawasan tadahan air dan kawasan pemburuan hidupan liar, dengan menunjukkan sempadan dan papan tanda.
- Gambar satelit menunjukkan kawasan pembalakan dan penanaman.

Konservasi Tanah

- Pelan susur dan gambar kawasan pembalakan/penanaman (termasuk pembalakan/penanaman berfasa, jalan utama, jalan sekunder, jalan penarikan, lorong penarikan, tapak kem, panggung, lintasan sungai, dll).
- Jadual operasi pembalakan sebenar yang menunjukkan lokasi, tempoh dan kawasan operasi di peta dan deskripsi.
- Salinan teknik persediaan tanah termasuk masa diantara pembersihan tanah dan penanaman, dan kawasan yang terlibat.
- Kolam-kolam mendap dan perparitan (lokasi pada pelan susur, gambar dan spesifikasi).
- Jadual penyelenggaraan sebenar kolam mendap dan sistem perparitan, di mana yang perlu.

Mengubah Praktis Operasi

- Peratus jumlah kawasan yang dibalak/ditanam oleh jalan balak/tanam, lorong penarikan dan panggung.
- Lokasi dan deskripsi jalan balak/tanam baru, jalan digunakan semula dan jalan lama yang ditamatkan.
- Jumlah bulanan dan jenis kawasan yang ditanam atau pokok yang ditebang / dikeluarkan dari kawasan konsisi.
- Pelan susur, gambar, lokasi dan dimensi/kawasan setiap panggung, tapak kem dan tapak semaian.

Keprihatinan Sosio-Ekonomi

- Pelan susur dan gambar sistem graviti air tempatan dan takat pengambilan air.
- Pelan susur dan gambar kawasan tadahan air yang tidak terganggu termasuk cadangan Tadahan Air Tibow dan tadahan air kampong-kampong tempatan, dengan menunjukkan sempadan dan papan tanda.
- Jika diperlukan, mengemukakan salinan surat sumbangan kepada penduduk tempatan yang terlibat yang dipersetujui oleh Pejabat Daerah, JKKK atau Ketua Kampong.
- Gambar kemudahan simpanan atau pengedaran air untuk penduduk tempatan yang terlibat.
- Salinan program untuk penduduk tempatan (jumlah penduduk dan nama kampong) yang terlibat dengan aktiviti perhutanan masyarakat, eko-pelancongan, rangkaian jalan, pekerjaan atau kebudayaan.
- Salinan program perhubungan awam dengan penduduk dan penguasa tempatan.

Pengurusan Flora & Fauna

- Pelan susur dan gambar MBCA Zon Penampan 1 dan MBCA Zon Penampan 2, dengan menunjukkan sempadan dan papan tanda.
- Pelan susur dan gambar zon penampan ekologi kepada Kawasan Phenologi, Sg Siliawan V.J.R dan Sg Sansiang V.J.R, dengan menunjukkan sempadan dan papan tanda.
- Pelan susur dan gambar Kawasan Utama Tinggi dan Kawasan Utama untuk Gajah dan Orang Utan, dan Kawasan Badak, dengan menunjukkan sempadan dan papan tanda.
- Salinan surat kelulusan dari Jabatan Perlindungan Hidupan Liar untuk aktiviti penanaman dalam Kawasan Utama.
- Pelan susur dan gambar simpanan biologi dan laluan jenut-garam, dengan menunjukkan sempadan dan papan tanda.
- Pelan susur dan gambar koridor hidupan liar, dengan menunjukkan sempadan dan papan tanda.
- Salinan surat, program kesedaran/latihan dan gambar papan tanda yang memberitahu pekerja tentang ketidakbolehan melakukan pemburuan atau perikanan haram atau larangan memungut spesis flora yang dilindungi.
- Pelan susur dan gambar kawalan laluan pintu diantara tapak projek dan kawasan sekelilingnya.
- Pelan susur dan gambar kawasan pemburuan yang dibenarkan, dengan menunjukkan sempadan dan papan tanda.
- Salinan surat pemberitahuan kepada Jabatan Hidupan Liar sebelum memulakan operasi pembalakan/penanaman.
- Nama dan jawatan Pakar Biologi, Pakar Hidupan Liar ataupun Jururunding Alam Sekitar yang dilantik.
- Rekod penemuan spesis biologi yang dilindungi di dalam tapak projek (nyatakan lokasi, spesis, bilangan dan penguasa tempatan yang dihubungi/dimaklumi).

Pengurusan Kebakaran Hutan

- Salinan dikumen “Pelan Pencegahan dan Kawalan Kebakaran Hutan” (FFPCP) yang telah diluluskan.
- Lapuran tahunan perlaksanaan FFPCP termasuk drill, latihan dan program kesedaran kebakaran.
- Pelan susur dan gambar kawasan langkau api, dengan menunjukkan sempadan dan papan tanda.
- Pelan susur dan gambar kemudahan mengawal dan mencegah kebakaran termasuk papan api, papan tanda pencegahan kebakaran, menara api, tangki simpanan air dan kemudahan melawan api.
- Pelan susur, gambar dan deskripsi aktiviti pembakaran terkawal di kawasan ITP.
- Pelan susur dan dokumentasi insiden kebakaran hutan, samada di dalam dan di kawasan berhampiran tapak projek.

Pengurusan Arkeologi

- Pelan susur dan gambar zon penampan dan laluan ke tapak arkeologi Batu Saap, dengan menunjukkan sempadan dan papan tanda.
- Pelan susur dan gambar laluan ke tapak arkeologi Batu Punggul dan Gua Batu Tinahas, dengan menunjukkan sempadan dan papan tanda.
- Rekod penemuan arkeologi artifak atau kawasan pelancongan (nyatakan lokasi, jenis dan penguasa tempatan yang dihubungi/dimaklumi).

Kawalan Trafik & Pengangkutan

- Pelan susur dan gambar papan tanda trafik di tapak projek, persimpangan jalan utama, tapak kem, tapak semaian dan kawasan berpenduduk / pekan.
- Pelan susur dan gambar papan jalan balak/tanam utama; dan lori balak, kenderaan pengangkutan, baj/skow dan bot kerja yang terlibat dengan aktiviti pengangkutan.
- Jadual aktiviti pengangkutan sebenar menunjukkan kuantiti muatan, jumlah trip, laluan dan destinasi.
- Pelan susur dan gambar papan lintasan orang berjalan kaki dan hidupan liar.
- Salinan surat kebenaran dari penguasa tempatan berkenaan pembinaan dan pemuliharaan jalan-jalan balak/tanam yang menhubungi jalan awam.
- Minit mesyuarat berkenaan konsultasi dengan penduduk dan penguasa tempatan berkenaan aktiviti pengangkutan projek.

Pengurusan Penanaman

- Salinan dokumen “Program Pengurusan Penanaman Bersepadau” (IPMP) yang telah diluluskan.
- Laporan tahunan perlaksanaan IPMP termasuk jenis, kuantiti dan spesifikasi racun herba, racun perosak dan baja yang digunakan dalam aktiviti penanaman.
- Pelan susur dan dan gambar tapak semaian.
- Pelan susur dan gambar tapak simpanan bahan kimia dan kawasan pelupusan termasuk kawasan simpanan, sistem lantai, perparitan dan papan tanda.
- Insiden perosak dan penyakit menganggu penanaman.

Pengurusan Sisa

- Pelan susur dan gambar tapak pelupusan sementara sisa minyak, sampah sarap, sisa biomas dan kemudahan kumbahan termasuk kawasan simpanan, sistem lantai, perparitan dan papan tanda.
- Jumlah isipadu bulanan dan jenis sisa dan biomass yang terhasil, dikendalikan, dikumpul dan dilupuskan. Sekiranya dilupuskan di luar tapak projek, nyatakan kuantiti, jenis dan destinasi pelupusan tersebut.
- Data penyiasatan tentang penggunaan kayu-kayan kecil yang ditebang untuk empulur venier.

Pelan Penamatan

- Pelan susur dan gambar kawasan yang telah ditamatkan (termasuk tapak yang telah dibersihkan, pembaikan cerun, kawasan ditanam semula, pembukaan lintasan aliran, papan tanda), di mana yang perlu.
- Pelan susur dan gambar laluan ke tapak yang telah ditamatkan dan papan tanda.
- Salinan surat pemberitahuan kepada penguasa tempatan tentang penamatan projek.

Pengawasan Kualiti Air

- Pemantauan tiga bulan sekali kualiti air sungai untuk pepejal, kekeruhan dan minyak & gris di hilir tapak projek sepanjang (Sg Sapulut, Sg Siliawan, Sg Pinangah, Sg Saburan, Sg Sansiang, Sg Tibow, Sg Simatuoh, Sg Beliar, Sg Salung, Sg Sinikalaun dan Sg Logongon).
- Gambar keadaan kualiti air Sg Siliawan, Sg Pinangah, Sg Lombunaan, Sg Saburan, Sg Sansiang, Sg Tibow, Sg Palangan, Sg Sakikilan, Sg Sabunutan, Sg Beliar, Sg Kuala Sumatalun, Sg Sinikalaun, Sg Salung, Sg Lalobou, Sg Simatuoh, Sg Sapulut, Sg Pampangon dan Sg Logongon (di dalam kawasan projek dan sepanjang 1 km di hilir sungai dari sempadan projek).
- Rekod insiden ataupun aduan berkenaan pencemaran air.

Pengawasan Meteorologi

- Pemantauan bulanan suhu, kelambapan, hujan, penyejatan dan angin di tapak projek (Tapak kem SFD).
- Analisa tahunan trend metorologi.

Pengawasan Hidupan Liar

- Pemantauan enam bulan sekali gajah, badak, orang utan dan spesis hidupan liar yang dilindungi dalam tapak projek (barat laut, hulu Sg Pinangah, Batu Saap, di sepanjang Jalan Sapulut- Kalabakan, Kup A, Kup D, Kawasan Phenologi, Kup B, Kup C, Kawasan ITP, hulu Sg Beliar, jenut-garam, Sg Pinangah, Sg Siliawan, Sg Lombunaan, Sg Saburan, Sg Sapulut, Sg Simatuoh, Sg Sansiang, Sg Tibow, Sg Sakikilan, Sg Sabunutan, Sg Sablangan, Sg Salung, Sg Lalobou, Sg Sinikalaun dan Sg Beliar).
- Pengkalandata taburan hidupan liar termasuk jenut-garam, laluan perpindahan gajah dan kawasan pemburuan.

Lain-Lain

- Bantuan kepada penduduk tempatan terhadap penyelenggaraan jalan, perlindungan hidupan liar, perlindungan arkeologi atau sosio ekonomi samada berbentuk kewangan atau lain-lain.

English

1.3 The Project

1.3.1 Project Description

Introduction

Sapulut Forest Development Sdn Bhd (SFD) proposed to carry out forest logging and plantation activities within Forest Management Unit, FMU 14. The project site is located within Sapulut Forest Reserve, a Class II Commercial Forest Reserve for logging purposes.

Sustainable Forest Management

SFD entered into an agreement (SFMLA: 04/97) with the State Government of Sabah in September 1997 to manage a Commercial Class II forest at the Sapulut Forest Reserve, which is referred to as Sustainable Forest Management Licence Agreement (SFMLA) area of FMU 14. The area shall be managed over a long-term period (100 years) on a sustainable basis for economic, social and ecological purposes.

Project Area

Total project area or current available production area (CAPA) is 95,300 hectares (ha) and zoned according to the guideline of sustainable forest management policy, to include conservation (17 % of the total area), production (Natural Forest Management, NFM – 54 %) and production (Industrial Tree Plantation, ITP – 29 %).

Natural Forest Management (NFM)

The total net area designated for NFM is 51,248 ha. However, in view of low growing stock in most of the area, logging shall only be carried out within an area of 11,594 ha.

Silvicultural Treatment

Silvicultural treatment shall also be carried out within NFM area to improve the growing stocks of natural forest. It is estimated that between year 2005 to 2013, silvicultural treatment shall cover approximately 9,771 ha of the area, with an annual rate of 1,000 ha per year.

Enrichment Planting

Enrichment planting shall also be carried out within degraded NFM area. This involves the process of planting indigenous seedlings in areas where no or limited potential crop trees. However, due to practicality and expensive operation, it shall only be carried out within 300 m of access roads and when absolutely necessary.

Industrial Tree Planting (ITP)

The heavily logged area of 27,736 ha shall be made productive through forest restoration development or Industrial Tree Plantation (ITP). Areas to be restored are confined to the degraded areas with slopes less than 15 degrees. The average annual rate of forest restoration works shall be approximately 3,000 ha per year. Trees to be planted include non-native species (approximately 65 % of the total area) of *Acacia Mangium* (30 %), *Rubber* (20 %), *Albizia* (10 %) and *Teak* and others (5 %); and indigenous species (approximately 35 % of the total area) of *Laran*, *Binuang, Jelutong, Kapur* and *Seraya*. Prior to forest restoration, residual timber within the ITP area shall be harvested, with an annual harvesting rate of approximately 3,000 ha between the year 2004 and 2013.

Conservation

The remaining area of approximately 16,316 ha shall be managed primarily for conservation (area with slope greater than 25°) and protection (riverine reserve).

Community Forest

Community forest programme shall also be undertaken where members of the community will be given training and to be encouraged to participate in forest activities including forest plantation, silvicultural operations, clearing and maintaining external boundaries, and supplying planting materials.

Forest Resources

The residual conditions are very much degraded, mostly devoid of commercial trees above 39 cm dbh. The remaining volume of trees between 20 cm to 39 cm dbh for ITP area is estimated as 53.46 cubic metre per hectare (m^3/ha) or 109 trees per ha. The volume of trees above 60 cm dbh for NFM area remain at 13.64 m^3/ha or 2 trees per ha.

Logging Capacity

The harvesting operational capacity for ITP area is between 13,000 to 14,000 cubic metres (m^3) per month, with logging activity to last in 10 years; and for NFM area is between 6,000 to 8,000 m^3 per month with logging activity to last in 3 years.

Transportation

Felled round logs shall be transported by logging trucks via the existing Jalan Tekala, Jalan Sapulut – Kalabakan and Jalan Kalabakan – Tawau. Logs shall either be processed at sawmills near the project site (to be set-up and operated by logging contractors) or sold to local sawmills in other parts of Sabah.

1.3.2 Site Description

Project Site

The project site is located within Sapulut Forest Reserve, District of Nabawan. It is situated immediately east of Sapulut Township, 35 km south-southeast of Nabawan Township and 85 km west-northwest of Kalabakan Township. Logging area is under the jurisdiction of Jabatan Perhutanan Daerah Tibow.

Adjacent and towards the north are Forest Management Unit, FMU 11 (part of Sapulut F.R.). Yayasan Sabah Concession Area is located immediately to the north and east of the project site. Bordering its northeastern boundary is the Maliau Basin Conservation Area (MBCA), a prestine and high value protection forest. In the south, it shares a common boundary with FMU 13 (part of Sapulut F.R.) and FMU 25 (part of Sapulut F.R. and part of Kalabakan F.R.), respectively.

The project site is accessible from Tawau via Kalabakan Township using a combination of gravel and logging roads, off Jalan Tekala and Jalan Kalabakan - Tawau. The site is also accessible from Keningau via Nabawan Township using a combination of sealed and gravel roads, off Jalan Keningau – Sapulut and Jalan Sapulut - Kalabakan.

Land Use

Major land use patterns in the area include jungle / secondary forest, agricultural plantation and human settlements. Within the project site, the main vegetation types include montane forest, highland mix dipterocarp forest, lowland dipterocarp forest and permanent cultivation. The project site has been logged several times previously with at least 26 logging contractors, with the last logging activity in 2003.

Topography

Ground elevations within the project site vary between 200 to 1,200 metres (m) Above Mean Sea Level (AMSL). Approximately 7,946 ha or 8.3 percent of the project area having slopes exceeding 25 degrees.

Meteorology

The climate of this subregion is a typical equatorial climate with uniform temperature, high humidity and substantial amount of rainfall. Rainfall is predominantly convectional although the monsoons have intensifying influence. Cumulative annual rainfall for the area averages approximately 2319 mm per year with monthly average of 198 mm.

Archaeology

There are three archaeological sensitive areas within and in the vicinity of the project area including Batu Saap (within the project site), Batu Punggul (0.3 km west) and Batu Tinahas Cave (0.5 km west). These areas have no archaeological values but preserved for tourism purposes. In addition, four burial sites of local Murut community are known to exist in the vicinity of the project area, particularly near human settlements.

Tourism Area

There are two proposed tourism development areas in the vicinity of the project area, including at Tibow (within the gazetted area of Jabatan Perhutanan Tibow) and at Sabuda (6 km east of the project site). These tourism areas will be designed to cater for activities related to Maliau Basin. There is a long-term plan to create a new township at Tibow. However, to-date there is no approved or gazetted plan of either the tourism areas or Tibow Township.

Hydrology

Main riverine systems that could be affected by the project include Sg Siliawan, Sg Pinangah, Sg Lombunaan, Sg Saburan, Sg Sansiang, Sg Tibow, Sg Palangan, Sg Sakikilan, Sg Sabunutan, Sg Beliar, Sg Sablangan, Sg Simatuoh, Sg Salung, Sg Lalobou, Sg Sinikalaun, Sg Sapulut, Sg Pampangon and Sg Logongon. Other major riverine systems in the vicinity include Sg Penawan, Sg Sumatalun and Sg Pensiangan.

Water Supply

There is no known or gazetted Government potable water supply scheme in operation within the project area. Local population are known to rely on gravity and well water for their water supply. Their water intake points are located outside the project area. However part of their water catchments may be affected by the project, particularly along Sg Sapulut and Sg Tibow. In addition, during dry period, majority of the local population obtain water directly from Sg Salung, Sg Sinikalaun, Sg Logongon and Sg Sapulut for daily water supply.

Within the project site, there is one proposed water catchment area, known as Tibow Water Catchment (TWC) with an area of approximately 690 ha. TWC is based on tributaries of Sg Sansiang and identified to serve the proposed Tibow Township. However, to-date there is no approved or gazetted water catchment plan.

Navigation

As for navigation, local rivers including Sg Saburan, Sg Salung, Sg Sinikalaun, Sg Logongon, Sg Pampangon and Sg Sapulut are used for access, particularly between areas not served by road network. In addition, these rivers are also used for fishing activity.

Water Quality

Environmental baseline sampling on water quality was carried out during the site visit. In general, water quality of the local rivers is acceptable. The water parameters analysed comply with Standard IIB of DOE Interim Water Quality Standards, which generally acceptable for use as raw water supply. However, Sg Sapulut, Sg Salung and Sg Logongon exhibit polluted rivers with elevated suspended solids and oil and grease concentrations. This could be due to logging activities in Sapulut, Pensiangan and Kalabakan areas.

Flora

Predominant vegetations consist of Upland and Lowland Mixed Dipterocarp Forests, which have been heavily logged since the early 1970s. Other vegetations include Upland Mixed Dipterocarp & Kerangas Forest, Upland Kerangas Forest, and Lowland Mixed Dipterocarp & Kerangas Forest. Other smaller pockets of vegetations are the Lower Montane Forest and the Upland Mixed Dipterocarp & Limestone Forests. Biological survey found that there are approximately 321 faunal species within the project site. In view of close proximity to Maliau Basin Conservation Area (MBCA), seven protected floral species are known to be present in the area including Halia Hutan, Lampias, Polod and Botu. Five known herbal species are also known to exist within the project area including *Adina rubella*, *Coyx lachrymal*, *Mallotus apelta*, *Pteris multifida* and *Pyrrosia lingua*.

Fauna

The project area is rich in wildlife population despite of logging activities in the past and present, which may somewhat affects and alters their natural habitat. The site survey carried out indicates that the condition and population of wildlife in the forest is reasonably well. A total of 34 mammal species have been recorded within the project area, including 20 protected wildlife species.

Large animals of Elephant (*Elephas maximus*) and Orang Utan (*Pongo pygmaeus*) are known to exist in the area, as confirmed by local authorities/population. Previous surveys indicate that herds of elephants were sighted at different locations within Sapulut and Gunung Rara Forest Reserves. Based on World Wide Fund for Nature (WWF) Malaysia information, southeast of the project site is part of elephant migrating route between Danum Valley and Indonesian border. Sumatran Rhinoceros (*Dicerorhinus sumatrensis*) is also known to present in the area with previous surveys indicate sighting within Sapulut and Kalabakan Forest Reserves.

Hunting

Hunting is carried out by local population in four major sites within and in the immediate vicinity of the project area. Popular hunting animals include wild boar and "payau".

Aquatic Habitat

Aquatic habitat known to exist in the area are limited to freshwater fishes, crustacean, mollusca and algae along local rivers. None of these species are identified as endangered or protected species. Based on information from local population, high number of fishes is noted along Sg Saburan, Sg Salung, Sg Sinikalaun, Sg Logongon, Sg Pampangon Sg Sapulut, Sg Sansiang and Sg Tibow. Typical fishing activity is based on fishing hook and hand lines, and "jala" or "pukat".

Sensitive Areas

MBCA is located immediately northeast of the project site covering an area of approximately 58,840 ha. Maliau Basin is a saucer-like basin as it is surrounded by rim escarpment with heights ranging from 1500 m to 1900 m AMSL. MBCA is a unique and pristine rainforest area dominated by lower montane and heath forest, as well as lowland dipterocarp forest. It is reported that, significant numbers of plant species have been recorded in the Maliau Basin, with many are poorly known and could only be identified by biological specialists.

The Phenology Area of 120 ha is located within the project site (near Sg Saburan). This area is conserved for observation to study the timing of natural events or annual cycles of plants and animals along with their relationship to the weather and climate, and how they respond to seasonal changes in their environment because of many contributing factors such as latitude, altitude and buffering effects of large bodies of water.

Based on WWF study, there are three known salt licks within and in the immediate vicinity of the project site. One salt lick is known to exist within the project site (near Sg Salung). In the vicinity, one salt lick is located approximately 500 m to the east (within Gunung Rara F.R.) and the other at approximately 6 km south. These salt licks are known to attract mammals such as elephants and Bearded Pig, and used by these animals as their sources of mineral-rich water and normally as their animal home range.

Sg Siliawan V.J.R. (2,136 ha) and Sg Sansiang V.J.R. (34 ha) share common boundaries with the project site. Nurod Urod V.J.R. (1,705 ha) is located approximately 200 m east of the project site. These forest reserves are classified as Class VI Virgin Jungle Reserve for the purpose of forest research.

Socio-economic

There are no villages or human settlements within the project site, except of one staff quarters owned by the project proponent and another staff quarters owned by a private operator (Atlantic Sawmill).

Major human settlements are located mainly west and southwest of the project site, within the State land along Sg Sapulut, Sg Pampangon and Sg Logongon. There are 29 local villages with a total population of 3,526. In the eastern area of the project site, human settlement is limited to Jabatan Perhutanan Tibow, which is provided with main office and staff quarters (29 personnel).

Community Profile

The local communities are mainly from Murut Tagol ethnic group. These communities are sedentary agriculturists, who do not have to use the resources in the project area because State land forest resources are sufficient to meet the local needs. Their main economic activities are agriculture, forestry and hunting.

Majority of the population is Bumiputera origin of Murut and Kadazana community. Their education level is low with less than 10 percent of the population having completed secondary education and mainly working in the agricultural sector. Majority of the population stays in owned houses for more than 10 years and considered as local population. The population economic level is considered as lower class with majority having incomes of less than RM 300 per month. Majority of the population involve either in fishing, hunting or farming to supplement their daily livelihood.

The area is not served with water supply, where majority of the population relies on gravity water system from local rivers. Road access is also limited and often in poor condition during rainy periods, with majority of population relies on local rivers for navigation.

Perception

Majority of the population in the study area expressed favourable views of the project. Those populations who agreed stated that the project may (i) provide road access; (ii) create more employment opportunities; and (iii) further development to the surrounding area.

Major disagreements to the project are mainly related to the river water pollution that affects local population daily activities. Some of those disagreed imposed reasonable conditions mainly related to the requirements of clean water supply, either in the form of water storage facility or protection of water catchment areas. Accordingly, they may agree to the project if continuous supply of clean can be assured. It is believed that with the implementation of various mitigation measures during project operation arise from this EIA Study, additional protection on water supply can be achieved.

1.4 Findings

1.4.1 Environmental Impacts

Water Quality

As several areas within the project site are predicted to generate high soil erosion rates, logging and plantation should be prohibited within this area. Logging and plantation activity on the remaining area is allowed but appropriate mitigation measures as described in Chapter 5 should be adopted.

Water Use

The impacts on water use could be significant, as local rivers are used for water supply, navigation and fishing.

Ecology

The biological impact is expected to be significant, as the area has protected floral and faunal species particularly large terrestrial animals such as elephant, orang utan and rhinocerous.

Fire Hazard

Based on previous records, there was no forest fire incident within the project area. However, precautions should be made to (i) plantation of non-native species such as *Acacia*; (ii) uncontrolled prescribed burning; and (iii) unattended open burning for shifting cultivation activity in the surrounding areas that could lead to forest fires.

Archaeology

The archaeological impact could be significant, as there is one archaeological site within the project site. In addition, the project may also interfere with access to archaeological sites within and in the immediate vicinity of the project site.

Hydrology

Impact on hydrology from sediment yield is expected to remain high, probably contributed by the previous uncontrolled logging activity.

Traffic & Transportation

As the number of truck trips per day generated by the project is low, the potential socio-economic impact is expected to be minimal. However, consideration should be given on the usage of the proposed Jalan Sapulut – Kalabakan for logging/plantation transportation activity as the route passes several local villages and considered as main public road.

Socio-economic

Impact on social, economic and cultural activities is expected to be not significant, due to non-dependent of local population to the project area. However, long-term impact on local population wildlife hunting activity within the project site should be considered.

Cost-Benefit Analysis

Impacts associated with Industrial Tree Plantation could be significant for high-value natural forests. However, as the project site consist of highly degraded forest, the residual impacts are considered acceptable.

Chemicals

Impact on chemicals usage could be significant, if no proper health, safety and environmental procedures in application, storage and handling.

Waste Disposal

Although the quantity of wastes and biomass generated and disposed of is small, their impacts on land and river system could be significant if not properly managed, which may require special attentions. Quantity of biomass to be disposed of is large and effective disposal procedures should be implemented.

Abandonment

As campsite, nursery and logging/plantation facilities are made of temporary structures, abandonment impact is expected to be minimal.

Cumulative Impact

Cumulative impact from the proposed logging/plantation operation alone may not be significant, but simultaneous operations of large number of logging/plantation operators within the same area may impact the overall biological resources, air quality, water quality and socio-economic environment.

1.4.2 Recommended Mitigation Measures

Zoning of Logging/Plantation Area

- *Logging Area* – Prohibit logging/plantation on high soil erosion and conservation areas.
- *Marking* – Prohibited logging/plantation areas should be marked on map; and marked, painted with red colour, and sign posted on-site.
- *Up-date Forest Management Plan* – Revise and up-date the existing Forest Management Plant to exclude logging or plantation within the protection areas.

Provision of Riverine Reserve

- *Riverine Reserve* – Provide riverine reserve of at least 50 m each bank for Sg Sansiang, Sg Saburan, Sg Salung, Sg Lalobou, Sg Palangan, Sg Pinangah, Sg Simatuoh, Sg Sablangan, Sg Tibow, tributaries of Sg Sansiang and tributaries of Sg Sapulut; at least 30 m each bank for rivers having width more than 3 m but less 20 m (Sg Siliawan, Sg Lombunaan, Sg sakikilan, Sg Sabunutan, Sg Sablangan, Sg Beliar and Sg Sinikalaun); and at least 5 m each bank for other small streams. No logging or plantation within riverine reserve.
- *Marking* – Riverine reserve should be marked on map; and marked, painted with red colour, and sign posted on-site.

Soil Conservation

- *Stage Logging/Plantation* – Stage operation to avoid the concentration of successive cuts or logging/plantation in one contiguous area by minimising size of exposed area; limit period between end of land clearing and start of plantation to not more than three months; and time the land preparation to coincide with period of lower erosion potential.
- *Soil Preparation* – Minimise the extent of soil impacted in ITP preparation from the usage of heavy machinery; and maximise the retention and coverage of plant material over the soil.
- *Soil Restoration* – Transport felled small-size trees by manpower or leave them on-site for soil restoration.
- *Erosion Control* – Where necessary, re-vegetated large exposed areas with leguminous cover plants; minimise length and steepness of slopes to reduce the velocity of runoff; and fit the construction of logging/plantation roads, skidding trails and landings to the existing terrain.
- *Perimeter Drainage* – Main campsite and stumping point should be provided with perimeter drainage.
- *Sedimentation Pond* – Main campsite and stumping point should be provided with sedimentation ponds.

Modifying Operational Practices

- *Harvesting* – For NFM area, trees allowed for harvesting should be between 60 cm to 120 cm dbh only.
- *Logging/Plantation Roads* – Re-use old roads, if possible; and control distance, width and slope of roads. The primary and secondary roads should be maintained at a density of 7 m per hectare and 14 m per hectare, respectively.
- *Skid Trails* – Re-use old skid trails, if possible; and control distance, width and slope of skid trails. Total area of all skid trails should not more than 6 % and 12 % of total logging area in NFM and total plantation area in ITP, respectively.
- *Landings* – Re-use old landings, if possible; each landing area should not more than 0.5 ha and 1.0 ha for NFM and ITP area, respectively; sited away from river/stream; and to be provided with drainage and sedimentation pond. Total area of all landings should not more than 0.7 % of total logging area and 1.5 % of total plantation area, respectively.
- *Campsite* – Re-use old campsites, if possible; each campsite should not more than 0.4 ha and 1.0 ha for NFM and ITP area, respectively; sited away from river/stream; and to be provided with drainage and sedimentation pond.
- *Stream Crossings* – Adequate provisions should be made for stream crossings such as culvert or bridge; no blocking or diversion of river/stream is allowed; and minimise the number of crossings.
- *Tree Felling* – Apply directional felling; logs harvested should be felled away from the river; and no vehicle or tractor to enter a riverine reserve.

Socio-Economics Considerations

- *Protection of Water Catchment* – Control runoffs from the project area to ensure water catchments and intake points of local population are not affected; no plantation is allowed within the proposed Tibow Water Catchment area, and water catchment areas of Kg Tataluan, Kg Simatuoh, Kg Samuran, Kg Tonomon and Jabatan Perhutanan Tibow; and boundaries of catchment areas should be marked on map; and marked, painted with red colour, and sign posted on-site.
- *Protection of Water Resources* – Assist the affected local population in providing clean water supply by providing monetary or equipment assistance; and ensure that local population water supply and their daily livelihood is not affected by the project.
- *Community Forest* – Identify potential eco-tourim opportunities in the project area; and assist local population in setting-up of eco-tourism activity associated with the project.
- *Road Network* – Assist local population in providing road access to their villages; and ensure that road access is properly maintained at all times.
- *Employment* – Preference for employment should be given to local population.
- *Dialogue* – Set-up proper programme of public relations with the affected local population and local authorities.

Flora & Fauna Protection

- *Protection of Maliau Basin Conservation Area* – Prohibit logging or plantation within MBCA Buffer Zone 1 of 8,495 ha; and prohibit plantation within MBCA Buffer Zone 2 of 20,641 ha.
- *Protection of Sensitive Area* – Prohibit logging or plantation within Phenology Area of 120 ha; prohibit logging or plantation and provide biological buffer zone of at least 100 m width between the project site and protected areas of Sg Siliawan V.J.R., Sg Sansiang V.J.R. and Phenology Area; and prohibit logging or plantation and provide buffer zone of at least 50 m width between the project site and nearby surrounding areas of FMU 13, FMU 25 and village area.
- *Protected Wildlife* – Prohibit plantation within High Priority Area to protect Elephant and Orang Utan and provide wildlife corridor in this area; and obtain Jabatan Hidupan Liar approval on plantation within Priority Area of 9,843 ha and Rhinocerous Area of 16,842 ha.
- *Protection of Salt Lick* – Prohibit logging or plantation and provide biological reserve within the salt lick with buffer zone of at least 100 m radius; and prohibit logging or plantation and provide access of at least 50 m width from Sg Salung and Sg Lalobou.
- *Faunal Protection* – Provide adequate opportunity for the wildlife to escape and seek refuge in the nearby uncut area by implementing stage logging/plantation; and prohibit logging or plantation and provide wildlife corridor along Sg Sansiang, Sg Saburan, Sg Salung, Sg Lalobou, Sg Palangan and Sg Pinangah.
- *Floral Protection* – Impose control on collection of protected floral species; inform/educate workers of such restriction; and identify protected trees for conservation purposes.
- *Hunting* – Prohibit logging and plantation within the identified hunting areas to ensure continuous supply of wildlife for the benefits of local population; prohibit illegal hunting by workers, their families or unauthorised personnel; inform/educate workers of such restriction; minimise number of workers staying on-site; and implement anti-poaching measures.
- *Notification* – Notify Jabatan Hidupan Liar prior to the commencement of logging/plantation operation; immediately notify Jabatan Hidupan Liar, Jabatan Perhutanan or Jabatan Perikanan in case of meeting/knowing/discovering any protected faunal, floral or aquatic species; and not to log/plant within such area.
- *Administration* – Area of protected/unique floral or faunal species discovery should be marked (on-site and on map) appropriately and excluded from logging/plantation; carry out logging/plantation with extreme care on areas of ecological/botanical significance due to the presence of protected/sensitive floral and faunal species; and appoint a qualified full-time Environmental Management Officer for the purpose of biological protection.
- *Marking* – Boundaries of biological buffer zones/areas or area of protected species or hunting areas should be marked on map; and marked, painted with red colour, and sign posted on-site.

Forest Fire Management

- *Fire Management* – Formulate and implement "Forest Fire Prevention and Control Plan"; conduct regular fire drills, training and awareness programme; and construct and maintain fire break on high risk areas.
- *Fire Warning System* – Provide early warning system including fire look out towers and regular patrolling.

- *Controlled Burning* – Controlled burning on ITP area for silvicultural treatment is allowed based on acceptable smoke management conditions; approvals from Jabatan Perhutanan and Jabatan Alam Sekitar Malaysia should first be obtained prior to burning; no burning is allowed within 100 m of project internal boundaries; and each burning activity should be mapped and documented.
- *No Open Burning* – Prohibit open burning on-site, either for waste, garbage or biomass disposal.

Archaeological Protection

- *Archaeological Site* – Prohibit logging or plantation and provide archaeological reserve within Batu Saap; and provide access to Batu Saap, Batu Punggul and Batu Tinahas Cave.
- *Burial Site* – Prohibit logging or plantation and provide archaeological reserve within any burial sites found within the project site.
- *Notification* – Notify Jabatan Muzium and Ketua Kampong of nearest village on discovery of any significant archaeological or historical artefacts, and not to log/plant within such area; and notify Kementerian Pelancongan, Kebudayaan dan Alam Sekitar Sabah on the discovery of any significant tourism areas or botanical interests such as waterfalls, lakes, hills, mountains, caves, and not to log/plant within such area.
- *Administration* – Prohibited archaeological area and access; or area of discovery of archaeological / historical significant, high tourism potentials or botanical interest should be marked appropriately (on-site and map) and excluded from logging/plantation.

Traffic & Transportation

- *Traffic Signs* – Provide appropriate traffic signs near entrances to project site, at main road junctions, campsite, nursery and near populated areas to warn other road users of transportation activity.
- *Transportation Control* – Schedule transportation operation not to enter or leave populated areas or major townships during peak hours or night-times; and where necessary, control dust generated by transportation activity by carrying out systematic water spraying.
- *Transportation Safety* – Control movements of transportation vehicles to minimise impact to local traffic and navigation; prominently light logging trucks, transportation vehicles, scow, barge and workboat so that they area visible at night or during poor weather conditions; and comply fully with the requirements for operational activities on land and over water.
- *Pedestrian Safety* – Provide proper and adequate pedestrian crossings along main logging/plantation roads.
- *Wildlife Safety* – Provide at-grade wildlife crossings along main logging/plantation roads.
- *Administration* – Obtain approval of Jabatan Kerja Raya or Pejabat Daerah Nabawan prior to connection of logging/plantation roads to public roads; and hold regular consultation with local population/authorities pertaining to the project transportation activity.

Plantation Management

- *Nursery* – Site nursery at a distance of at least 50 m from stream/river; and control runoffs from nursery by routing to sedimentation ponds for neutralisation.
- *Chemicals* – Site chemical store at a distance of at least 50 m from stream/river; store chemicals in proper container; storage facility shall be fenced, covered, bunded, has impervious floor and drainage; and minimise usage of fertilizer by using natural material or apply manual slashing method.
- *Administration* – Formulate and implement "Integrated Plantation Management Programme" on plant vigour to promote resistance to insects and disease; utilise natural fertilisers; and apply maximum control of biological insect.

Waste Management

- *Hazardous Material/Waste* – Site hazardous material store at a distance of at least 50 m from stream/river; collect used oil and oily wastes from logging/plantation machinery and transportation vehicles; store in proper container for future disposal; and temporary storage facility shall be fenced, covered, bunded, has impervious floor and provided with proper drainage.
- *Garbage* – Collect and disposed of garbage near campsite, away from river/stream by means of burying; and prohibit burning of solid wastes within the project site or direct disposal to river or lower ground.
- *Biomass* – Biomass from logging/plantation should be secured on site, prevent from entering waterways, and disposed of properly; waterways filled or blocked by biomass/ debris should be cleared and restored to near original conditions; and investigate the use of felled small-size trees for core veneer.
- *Sewage Facility* – Provide basic sewage treatment facility on-site.

Abandonment

- *Site Clean-up* – Demolish all structures that cannot be made safe or cannot be assured to remain safe with time; remove all materials; clean / remedy any land contaminated with oily wastes; and remove all stream crossings and restore to near original condition.
- *Site Control* – Closely monitor access to the site by establishing a well guarded gate, and display appropriate warning signs; and inform appropriate authorities of the site closure.
- *Rehabilitation* – Stabilised/rehabilited unstable area; re-plant abandoned logging/plantation roads; and re-vegetate large exposed area.

Secondary Mitigation Measures

- *Road Improvement* – Regularly maintain roads linking project site and public roads, in conjunction with other logging/plantation operators in the area.
- *Wildlife Improvements* – If required, provide assistance in identifying/relocating large wildlife and in protecting local population, in conjunction with other logging/plantation operators in the area.
- *Archaeological Improvements* – If required, provide assistance on up-keeping of local legends or identifying archaeological value locations, in conjunction with other logging/plantation operators in the area.
- *Reduced Impact Logging* – Comply fully with Jabatan Perhutanan's requirements, procedures and methodologies on application of RIL technique for logging within gazetted forest reserve.

1.4.3 Recommended Monitoring Programme

The following should be presented to EPD on half-yearly basis:

Zoning

- Layout plan and photographs of prohibited logging and plantation area including high erosion risk area, riverine reserve, conservation area, biological buffer zone, archaeological reserve, water catchment area and wildlife hunting area, showing boundary marking and signage.
- Satellite image of logging and plantation area.

Soil Conservation

- Layout plan and photographs of the logging/plantation area (including phase logging/plantation, main roads, secondary roads, haul roads, skid trails, campsite, landings, stream crossings, etc.).
- Actual logging/plantation operation schedules indicating locality, period and area in map and descriptions.
- Copy of land preparation techniques including period between land clearing and plantation, and size of affected area.
- Sedimentation ponds and drainage ways (locations on layout plan, photographs and specifications).
- Actual maintenance schedule of ponds and drainageways, where necessary.

Modifying Operational Practices

- Percentage of total logging/plantation area with respect to logging/plantation roads, skid trails and landings.
- Location and description of new logging/plantation roads constructed, existing used re-used and old roads abandoned.
- Monthly volume and type of area planted or logs felled / taken out from concession area.
- Layout, photographs, location and dimensions/area of each landing, stumping point, campsite and nursery.

Socio-economic Considerations

- Layout plan and photographs of local gravity water system and water supply intake points.
- Layout plan and photographs of undisturbed or protected water catchment areas including the proposed Tibow Water Catchment and local villagers' water catchment, showing boundary marking and signage.
- If required, copy of letter on contributions to the affected local population on water supply protection, with agreement/endorsement by respective Pejabat Daerah, JKKK or Ketua Kampong.
- Photographs of water storage or distribution facility for the affected local villagers.
- Copy of programme of local population (number of people and their villages) participation in the project including community forest, eco-tourism, road network, employment or cultural activity.
- Copy of public relation programme with the affected local population/authorities.

Flora & Fauna Management

- Layout and photographs of MBCA Buffer Zone 1 and MBCA Buffer Zone 2, showing boundary marking and signage.
- Layout and photographs of ecological buffer zone to Phenology Area and Sg Siliawan and Sg Sansiang Virgin Jungle Reserves, showing boundary marking and signage.
- Layout and photographs of High Priority Area and Priority Area for Elephant and Orang Utan, and Rhinocerous Area, showing boundary marking and signage.
- Copy of approval letter from Jabatan Hidupan Liar on plantation activity within Priority Area.
- Layout and photographs of biological reserve and access to salt lick, showing boundary marking and signage.
- Layout and photographs of wildlife corridor, showing boundary marking and signage.
- Copy of letter, awareness/training programme and photographs of signage to inform workers of no illegal hunting or fishing or prohibition of collection of protected floral species.
- Layout plan and photographs of access gate control between the project site and surrounding areas.
- Layout plan and photographs of allowable wildlife hunting area, showing boundary marking and signage.
- Copy of anti-poaching measures undertaken within the project site.
- Copy of letter of notification to Jabatan Hidupan Liar prior to commencement of logging/plantation operation.
- Name and designation of the appointed Ecologist, Wildlife Expert or Environmental Consultant.
- Incident of discovery of protected floral or faunal species within project site (stating location, species, numbers, and authorities consulted/informed).

Forest Fire Management

- Copy of approved “Forest Fire Prevention and Control Plan (FFPCP)”.
- Annual report on implementation of FFPCP including fire drills, training, and awareness programme.
- Layout plan and photographs of fire break area, showing boundary marking and signage.
- Layout plan and photographs of fire prevention and control facilities including fire board, fire prevention signage, fire tower, water storage tank and fire fighting facilities.
- Layout plan, photographs and description of prescribed/controlled burning activities for ITP area.
- Layout plan and documented forest fire incidents, both within and in the immediate vicinity of the project site.

Archaeological Management

- Layout plan and photographs of buffer zone and access of Batu Saap archaeological site, showing boundary marking and signage.
- Layout plan and photographs of access to archaeological sites of Batu Punggul and Batu Tinahas Cave, showing boundary marking and signage.
- Incidents on discovery of archaeological artefacts or tourism areas (stating location, type and authorities consulted/informed).

Traffic & Transportation Control

- Layout plan and photographs of traffic signs at project site, main road junctions, campsite, nursery and human settlements / townships.
- Layout plan and photographs of main logging/plantation roads; and logging trucks, transportation vehicles, barge/scow and workboats involve in the transportation activity.
- Actual transportation activity schedules indicating quantity, no of trips, route, period and destination.
- Layout plan and photographs of pedestrian and wildlife crossings.
- Copy of approval letter from local authorities on construction or maintenance of logging/plantation roads connected to public road.
- Minutes of meeting on consultation with local population/authorities on project transportation activity.

Plantation Management

- Copy of approved "Integrated Plantation Management Programme (IPMP)".
- Annual report on the implementation of IPMP including type, quantity and specification of herbicide, pesticide and fertiliser used for plantation activity.
- Layout plan and photographs of nursery.
- Layout plan and photographs of chemical storage and disposal areas including storage area, floor system, drainage and signage.
- Incidents of pests and disease affecting plantation.

Waste Management

- Layout plan and photographs of the oily waste temporary storage area, garbage dumping site, biomass disposal area and sewage facility including storage area, floor system, drainage and signs.
- Monthly volume and type of wastes and biomass generated, handled, stored and disposed of. If disposed of outside project area, information on quantity, type and destination.
- Investigation data on the use of felled small-size trees for core veneer.

Abandonment Plan

- Layout plan and photographs of the abandoned area (including clean-up site, slope rehabilitation, re-vegetated area, removal of stream crossings, signs/notices), where necessary.
- Layout plan and photographs of abandoned site access and signage.
- Copy of notification letter to local authorities on project abandonment.

Water Quality Monitoring

- Quarterly water quality monitoring of suspended solids, turbidity and oil & grease downstream of the project site (Sg Sapulut, Sg Siliawan, Sg Pinangah, Sg Saburan, Sg Sansiang, Sg Tibow, Sg Simatuoh, Sg Beliar, Sg Salung, Sg Sinikalaun and Sg Logongon).
- Photographs of water quality conditions along Sg Siliawan, Sg Pinangah, Sg Lombunaan, Sg Saburan, Sg Sansiang, Sg Tibow, Sg Palangan, Sg Sakikilan, Sg Sabunutan, Sg Beliar, Sg Kuala Sumatalun, Sg Sinikalaun, Sg Salung, Sg Lalobou, Sg Simatuoh, Sg Sapulut, Sg Pampangon and Sg Logongon (within project site and along 1 km downstream from project boundary).
- Any incidences or complaints on water quality contamination from high turbidity or oil contamination.

Meteorology Monitoring

- Monthly monitoring of temperature, relative humidity, rainfall, evaporation and surface wind at the project site (SFD Campsite).
- Annual analysis should be carried out to determine the trend of meterological conditions.

Wildlife Monitoring

- Half yearly wildlife monitoring of elephant, rhino, orang utan and other protected wildlife species within the project site (Northwest, upstream Sg Pinangah, Batu Saap, Along Jalan Sapulut- Kalabakan, Coupe A, Coupe D, Phenology Area, Coupe B, Coupe C, ITP Area, Upstream Sg Beliar, Salt lick, Sg Pinangah, Sg Siliawan, Sg Lombunaan, Sg Saburan, Sg Sapulut, Sg Simatuoh, Sg Sansiang, Sg Tibow, Sg Sakikilan, Sg Sabunutan, Sg Sablangan, Sg Salung, Sg Lalobou, Sg Sinikalaun and Sg Beliar).
- Database of wildlife distribution including salt lick, elephant migration route and hunting area

Others

- Any form of contributions to local community on road maintenance, wildlife protection, archaeological protection or socio-economics either monetary or other assistance.

2 GENERAL INFORMATION

2.1 Project Title & Project Proponent

2.1.1 Project Title

The title of this project is:

> *"**Forest Logging and Plantation of 95,300 Hectares by Sapulut Forest Development Sdn Bhd within Forest Management Unit (FMU 14), Sapulut. Sabah.**"*

As this development is for a forest logging and plantation project, this report in places abbreviated the project as the *logging* or *plantation* or simply the *project.*

2.1.2 License Holder & Project Proponent

Sapulut Forest Development Sdn Bhd
Lot B8.1, 8th Floor, Block B
Bangunan KWSP
P.O. Box 11291
88814 KOTA KINABALU. Sabah

Contacts: *Tel: 088-236 828* *Fax: 088-235 841*

E-mail: vcswong@pc.jaring.my / petercstio@yahoo.com

Officer-in-charge: ***Victor C.S. Wong*** / ***Peter Tio Chee Si***
Managing Director / Group Property Manager

2.2 EIA Legal Requirement

2.2.1 EIA Requirement

Environmental Impact Assessment, or more often referred to as EIA, is a process to predict the environmental consequences of a project. The process is a mandatory requirement under Section 5 (1) of the *Conservation of Environment Enactment 1996* for activities prescribed in the *Conservation of Environment (Prescribed Activities) Order 1999*. Any person intending to carry out any prescribed activity shall submit a report on environmental impacts to the Director of *Environment Protection Department* Sabah for examination.

The above project is classified as Prescribed Activity under Sections 2(i) and 2(iii) of the *Conservation of Environment (Prescribed Activities) Order 1999*.

Section 2: Forestry

(i) Extraction or felling of timber covering an area 500 hectares or more.

(iii) Development of forest plantation having an area exceeding 500 hectares.

2.2.2 EIA Report

This EIA report presents an account of a special environmental impacts assessment study carried out in May to November 2004 to describe the existing environment surrounding the project site, predict significant environmental implications of the project activities, and identify appropriate mitigation measures and monitoring arrangement for the anticipated adverse impacts.

The Report has been prepared and formatted according to the guidelines and procedures as contained in the *Handbook for Environmental Impact Assessment (EIA) in Sabah, 2001* and *EIA Guidelines for Logging and Forest Clearance Activities, 2001* both published by Jabatan Perlindungan Alam Sekitar Sabah.

2.3 The Consultant

2.3.1 EIA Consultant

Sinoh Environmental Sdn Bhd
No: 13-3, Block G, 3rd Floor
Lintas Square, Jalan Lintas
88300 KOTA KINABALU. Sabah

Contacts: *Tel: 088-268 084* *Fax: 088-267 084*

E-mail: *sinoh@pc.jaring.my*

Team Leader: ***Ir. Sinoh Mohamad***
M Sc. Eng. (Env), B Sc. Eng. (Civil) (F.C. Hons), Dip Eng. (Civil), Cert. OSH
P Eng., MIEM, MEPRM, MENSEARCH, MAPCA, MISEE, AMIQ, AMINCE

EPD Reg. No: *F 002*

2.4 EIA Study Team

2.4.1 Environmental Consultant

The EIA consultant for the project is *Sinoh Environmental Sdn Bhd*.

Consultant:	SINOH ENVIRONMENTAL SDN BHD
EPD Registration No:	F 002
Date of Issue:	01 October 2004
Date of Expiry:	30 September 2005

Sinoh Environmental Sdn Bhd is a Sabah-owned environmental consultancy firm specialising in Environmental Impact Assessment (EIA), environmental management, environmental audit, environmental monitoring, environmental training, waste management, and pollution control. To-date the firm has completed more than 150 EIA studies for various projects in Sabah including industrial projects, power plants, housing, agriculture, port development, resort & recreational development, infrastructure, quarries, sand/stone mining, and forestry.

2.4.2 Individual Consultant

The study team comprised of 5 professionals in the field of environmental management and forest logging and plantation.

Expertise	*Specialist*	*Qualifications*
Environmental	Ir. Sinoh Mohamad	M Sc Eng (Env), B Sc Eng (Hons) (Civil)
Biology / Hydrology	Dr. Tony Grear	Ph D (Hydrology & Biological Science), B Sc (Hons) (Geological & Zoological Science)
Land Use / Socio-economic	Ibnil bin Ab Wahid	B Sc (Hons) (Development Science)
Forestry	Dydimus @ Day Joos J	B Sc (Hons) (Forestry)
Forestry	Betsy Sylvester	B Sc (Hons) (Forestry)

Ir. Sinoh Mohamad led and co-ordinated the Special EIA study. He has more than 20 years experience in the field of Environmental Management.

Consultant:	Ir. Sinoh Mohamad
EPD Regn No:	S 0010
Date of Issue:	01 October 2004
Date of Expiry:	30 September 2005
I.C. No:	600316-12-5643

Other Special EIA team members include the following:

Consultant:	Ibnil bin Ab Wahid	Dydimus @ Day Joos J.	Betsy Sylvester
EPD Regn No:	S 0014	S 0013	S 0012
Date of Issue:	01 October 2004	01 October 2004	01 October 2004
Date of Expiry:	30 September 2005	30 September 2005	30 September 2005
I.C. No:	710607-12-5413	790930-12-5221	800624-12-5174

Consultant:	Dr. Tony Greer
EPD Regn No:	S 0079
Date of Issue:	24 July 2004
Date of Expiry:	23 July 2005
Passport No:	740154261

2.4.3 EIA Assessors

Team Leader

Ir. Sinoh Mohamad
M Sc Eng (Environmental) (U.S.A.),
B Sc Eng (Civil) (First Class Hons) (U.K.),
Diploma Eng (Civil) (UTM), Cert. Occupational Safety & Health (U.K.),
P Eng., MIEM, MEPRM, MENSEARCH, MAPCA, MISEE,
AMIQ, AMINCE ……..

Team Members

Dr. Tony Greer
Ph D (Hydrology & Biological Science) (U.K.),
B Sc (Geological & Zoological Science) (Hons) (U.K.) ……..

Ibnil Abdul Wahid
B Sc (Development Science) (Hons) (UKM) ……..

Dydimus @ Day Joos J
B Sc (Forestry) (Hons) (UMS) ……..

Betsy Sylvester
B Sc (Forestry) (Hons) (UPM) ……..

3 PROJECT DESCRIPTION

3.1 Statement of Needs

The purpose of this forest logging and plantation project include:

- To sustainably manage forest area via forest plantation.
- To improve the state of poor forest condition through forest restoration, enrichment planting and silvicultural treatment.
- To improve and enhance the growth performance of the natural regenerations.
- To supply logs for own and local sawmills.
- To secure adequate and consistent supply of wood for downstream timber industry.
- To provide employment and business opportunities for Malaysians particularly the local population. This will assist in strengthening the Malaysian economy and improving the living standard of local community.

3.2 The Project

3.2.1 Concession Information

Licensee:	***Sapulut Forest Development Sdn Bhd***
Size of Area:	***95,300 Hectares***
Status of Area:	***Sapulut Forest Reserve (Class II)***
Concession:	***Forest Management Unit FMU 14***
Agreement:	***Sustainable Forest Management Licence Agreement SFMLA: 04/97***

3.2.2 Scope of Project

Introduction

Sapulut Forest Development Sdn Bhd (SFD) proposed to carry out forest logging and plantation activities within Forest Management Unit, FMU 14. The project site is located within Sapulut Forest Reserve, a Class II Commercial Forest Reserve for logging purposes (Figure 3.1).

Felled round logs shall be transported by logging trucks via the existing Jalan Tekala, Jalan Sapulut – Kalabakan and Jalan Kalabakan – Tawau. Logs shall either be processed at sawmills near the project site (to be set-up and operated by logging contractors) or sold to local sawmills in other parts of Sabah.

Sustainable Forest Management

SFD entered into an agreement (SFMLA: 04/97) with the State Government of Sabah in September 1997 to manage a Commercial Class II forest at the Sapulut Forest Reserve, which is referred to as Sustainable Forest Management Licence Agreement (SFMLA) area of FMU 14. The area shall be managed over a long-term period (100 years) on a sustainable basis for economic, social and ecological purposes.

The long-term objectives for the management of FMU 14 include the following:

- Restoring the highly exploited forests through forest restoration programmes or Industrial Tree Plantation (ITP);
- Enrichment of resource base within the Natural Forest Management (NFM) areas by carrying out silvicultural and forest rehabilitation activities;
- Preservation of the wildlife corridor and bio-diversity through environmental protection and mitigation of environmental impacts of any activities carried out within the project area; and
- Maximisation of yield through selection, tree breeding and improving the match between species and the productive potential and physical limitations of the site to ensure long-term sustainability.

Project Area

Total project area or current available production area (CAPA) is 95,300 hectares (ha) and zoned according to the guideline of sustainable forest management policy, to include conservation, production (Natural Forest Management, NFM) and production (Industrial Tree Plantation, ITP) as shown in Table 3.1 and Figure 3.2.

Table 3.1: Land Use Categories within FMU 14

Zone	No of Compartment	Gross Area (original)		Nett Area (final)	
		(ha)	(%)	(ha)	(%)
Conservation Area	12	3,685	4	16,316[a]	17
Natural Forest Management (NFM)	178	58,634	61	51,248[b]	54
Industrial Tree Plantation (ITP)	83	32,981	35	27,736[c]	29
TOTAL	**273**	**95,300**	**100**	**95,300**	**100**

Notes: a – include 3,778 ha slope > 25° and 12,538 ha riverine reserve
b – exclude 93 ha slope > 25° and 7,293 ha riverine reserve
c – exclude 5,245 ha riverine reserve

For efficient forest management, the project area is subdivided into compartments as the smallest management unit. There are 273 compartments with sizes ranging from 93 ha to 746 ha (Figure 3.3). Demarcation of compartments was done based on natural features such as rivers, streams, roads, and ridge tops.

Land Use Plan

The total net area designated for NFM is 51,248 ha. However, in view of low growing stock in most of the area, logging shall only be carried out within an area of 11,594 ha. Logging within this area has been approved by Jabatan Perhutanan for period between 2004 and 2007.

Silvicultural treatment shall also be carried out within NFM area to improve the growing stocks of natural forest. Treatment activities include tending of regeneration (cutting of creepers or climbers cutting, and eradication and control of climbing bamboos from infested potential crop trees), and liberation thinning (commercial potential crop trees are liberated from competition by other non-commercial species for light, water and nutrients). It is estimated that between the year 2005 to 2013, silvicultural treatment shall cover approximately 9,771 ha of the area, with an annual rate of 1,000 ha per year.

Enrichment planting shall also be carried out within degraded NFM area. This involves the process of planting indigenous seedlings in areas where no or limited potential crop trees. However, due to practicality and expensive operation, it shall only be carried out within 300 m of access roads and when absolutely necessary.

The heavily logged area of 27,736 ha shall be made productive through forest restoration development or Industrial Tree Plantation (ITP). Areas to be restored are confined to the degraded areas with slopes less than 15 degrees. The average annual rate of forest restoration works shall be approximately 3,000 ha per year. Trees to be planted include non-native species (approximately 65 % of the total area) of *Acacia Mangium* (30 %), *Rubber* (20 %), *Albizia* (10 %) and *Teak* and others (5 %); and indigenous species (approximately 35 % of the total area) of *Laran*, *Binuang, Jelutong, Kapur* and *Seraya*. Prior to forest restoration, residual timber within the ITP area shall be harvested, with an annual harvesting rate of approximately 3,000 ha between the year 2004 and 2013.

The remaining area of approximately 16,316 ha shall be managed primarily for conservation (area with slope greater than 25^{o}) and protection (riverine reserve).

Community forest programme shall also be undertaken where members of the community will be given training and to be encouraged to participate in forest activities including forest plantation, silvicultural operations, clearing and maintaining external boundaries, and supplying planting materials.

Forest Resources

Based on forest inventory in 1999, the volume of trees above 20 cm diameter breast height (dbh) for ITP area and above 60 cm dbh for NFM area is estimated as 89.03 cubic metre per hectare (m^3/ha) or 124 trees per ha, and 13.64 m^3/ha or 2 trees per ha, respectively. The composition of growing stock by species includes Dipterocarps of approximately 42 %, Non-Dipterocarps 17 %, Non-Commercial Timbers 38 % and Commercial Pioneers 3 %. *Red Seraya* takes up to 46 % of the Dipterocarps group followed by *White Seraya* at 20 %.

Forest inventory carried out in 1999 is no longer considered applicable since new short-term logging licences were issued to third parties to log within FMU 14 from 1999 to 2003. Within the harvested area, there would have no commercial trees above 60 cm diameter breast height (dbh) to be cut.

The forest resources in the FMU 14 area are very poor indicating that the logging operations in the area are not properly controlled and monitored.

The residual conditions are very much degraded, mostly devoid of commercial trees above 39 cm dbh. The remaining volume of trees between 20 cm to 39 cm dbh for ITP area is estimated as 53.46 cubic metre per hectare (m^3/ha) or 109 trees per ha. The volume of trees above 60 cm dbh for NFM area remain at 13.64 m^3/ha or 2 trees per ha.

Logging Capacity

In accordance to the Forest Management Plan (FMP) of FMU 14 for period 2004 to 2013, the ITP area designated for forest harvesting is approximately 30,103 ha and the NFM area designated for logging is approximately 11,594 ha.

The harvesting operational capacity for ITP area is between 13,000 to 14,000 cubic metres (m^3) per month, with logging activity to last in 10 years; and for NFM area is between 6,000 to 8,000 m^3 per month with logging activity to last in 3 years.

3.2.3 Project Main Activities

The project main activities include the following:

- Investigation and Development;
- Operational; and
- Abandonment.

3.2.3.1 Forest Logging

Forest logging shall be carried out on area designated as Natural Forest Management (NFM), normally areas under 25 degree slopes, which have not been designated as either Conservation Area or Industrial Tree Plantation (ITP) area.

Investigation & Development Phase

The investigation stage would involve the following:

- Boundary demarcation – cutting 2-metres wide rentices.
- Stand inventory – timber cruising to determine number and type of commercial trees per hectare.
- Harvest planning – physiography determination, road and skid trail alignment, selection of logging equipment, and log/yard determination.
- EIA Study – environmental site survey and assessment.

Operational Phase

The operational stage of the logging activities would involve the following:

- Road construction – construction of access roads, and stream/river crossings.
- Base camp establishment – clearing of land and construction of base camp for workers.
- Logging – felling of timber by means of ground-based tractor system or chainsaw, limited to trees between 60 cm to 120 cm dbh.
- Landing construction – clearing of land and construction of log yard.
- Skidding – trail clearing and log skidding which involves primary movement of logs from felling site to stumping points or pre-selected loading area. It requires ground-based tractors, which is fitted with winches, skidders or cables or combination of all, depending on terrain, road/track condition and distance.
- Bucking/debarking – cutting of felled trees to lengths using chainsaws, crowbars and other simple tools.
- Log loading – use of wheeled or track-type loaders fitted with log forks / hydraulic boom loaders / cranes for loading logs onto logging trucks.
- Hauling/trucking – transportation of logs from loading area to sawmills using logging trucks via Jalan Tekala and Jalan Sapulut - Kalabakan.

There shall be no ITP activities upon the cessation of logging operation within NFM area. However, silvicultural treatment and enrichment planting may be carried out on selected areas.

Abandonment Phase

Project abandonment can occur at any stage of the project, which may due to the down turn of the nation's economy, social acceptability of the project in the community, or unforeseen management and technical problems. The project will also be abandoned upon the expiration of Timber Licence Agreement (due in the year 2097).

The abandonment stage would involve the following:

- Camp demolition – pulling down of buildings.
- Restoration – removal of stream crossing, and rehabilitation of landing and campsite.

3.2.3.2 Forest Plantation

Industrial Tree Plantation (ITP) shall be carried out on areas identified as highly degraded forests where the possibility of these forests to regenerate into its original condition naturally is difficult or is not possible at all. Majority of these areas are those located below the 15 degree slopes.

In view of total change of landscape under industrial tree plantation, the project proponent would manage the area under forest restoration approach. The objective of forest restoration is to improve and enhance the productivity of the severely degraded forests by planting indigenous species (*Laran, Binuang, Jelutong, Hopea, Kapur* and *Seraya*) and other species (*Rubber*, *Teak, Acacia, Albizia* and others).

The initial works is to salvage (if any) all the remaining commercial species with diameter breast height greater than 20 cm. The ITP area shall then be cleared of the remaining trees and vegetations. However, if there are regenerations found during land clearing, where possible, shall be retained. Similarly, patches or pockets of areas having reasonable regenerations (poles or saplings) shall be maintained. Burning shall not be carried out, unless it is necessary.

Investigation & Development Phase

The investigation stage for plantation activities would involve the following:

- Feasibility study and development plan – formulate strategy of management and operation, evaluate overall profitability and financial viability of the project.
- EIA Study – environmental site survey and assessment.
- Boundary demarcation – cutting 2-metres wide rentices.
- Stand inventory – timber cruising to determine number and type of commercial trees per hectare.
- Harvest planning – physiography determination, road and skid trail alignment, selection of logging equipment, and log/yard determination.
- Investigation plan – to determine soil type, soil suitability, species suitability.
- Road planning – route identification, track and road construction. The existing primary and secondary logging roads shall be maintained. The primary road shall be maintained at a density of 7 m per hectare with a maximum gradient of 10 %, and to have a 20 m right of way and a surface width of 10 m. Secondary roads shall be maintained at a density of 14 m per hectare with a maximum gradient of 12 %, and surface width of 8 m.
- Site planning – preparation of planting block of 40 to 50 ha per block, and demarcation of boundaries. The planting distance within line shall be 2.5 and 5.0 m between lines.
- Planting planning – selection of good seedling, planting method, harvesting method and cost.

Operational Phase

The operational stage for plantation activities would involve the following:

- Base camp establishment – clearing of land and construction of base camp for workers.
- Logging – felling of timber by means of ground-based tractor system or chainsaw.
- Landing construction – clearing of land and construction of log yard.
- Skidding – trail clearing and log skidding which involves primary movement of logs from felling site to stumping points or pre-selected loading area. It requires ground-based tractors, which is fitted with winches, skidders or cables or combination of all, depending on terrain, road/track condition and distance.
- Bucking/debarking – cutting of felled trees to lengths using chainsaws, crowbars and other simple tools.
- Log loading – use of wheeled or track-type loaders fitted with log forks / hydraulic boom loaders / cranes for loading logs onto logging trucks.
- Hauling/trucking – transportation of logs from loading area to sawmills using logging trucks via Jalan Tekala and Jalan Sapulut - Kalabakan.
- Nursery establishment – setting-up of plantation nursery, each having area between 4 ha to 10 ha with *Sumi Sansui* system of irrigation. Preparation of nursery beds of 1 m by 3m for seeds germination and transfer to polybags. Use of Rock Phosphate (25 g) and Agroblen (10 g) for each polybag.
- Site preparation – consist of under-brushing, lining, clear felling of trees to remove excessive overhead, and preparing planting lines. Land clearing shall be carried out during non-rainy periods.
- Planting – preparation of good seedling and planting holes, positioning of seedling. The period between the end of land clearing and start of planting is limited to not more than three months.
- Transportation – transportation to end users in Sapulut, Kalabakan and surrounding area.
- Pests and diseases control – application, handling and disposal of pesticides, herbicides and fertiliser. Expired/contaminated chemicals and used containers/bags returned to suppliers.
- Fire breaks – extensive networks of firebreaks using natural and artificial boundaries shall be established. Fire towers shall also be erected at strategic sites and equipped with two-way radios.
- Maintenance – provision of extra seedling, weeding and planting path maintenance, thinning, fertiliser application, pest and diseases control, road and drain maintenance.

There will be continuous industrial tree plantation activities within ITP area upon the cessation of harvesting operation.

Abandonment Phase

Project abandonment can occur at any stage of the project, which may due to the down turn of the nation's economy, social acceptability of the project in the community, or unforeseen management and technical problems. The project will also be abandoned upon the expiration of Timber Licence Agreement (due in the year 2097).

The abandonment stage would involve the following:

- Camp demolition – pulling down of buildings.

3.2.3.3 Silvicultural Treatments

Silvicultural treatments shall be undertaken to improve the growth and survival of future crop trees. This will ensure that there will be adequate number of commercial trees that can reach harvestable size within the expected harvest time frame.

Investigation & Development Phase

The investigation stage would involve the following:

- Feasibility study and development plan – formulate strategy of management and operation, evaluate overall profitability and financial viability of the project.
- Treatment planning – to determine potential crop trees, non-commercial species, access, and disposal.

Operational Phase

The operational stage of the silvicultural treatment activities would involve the following:

- Climber cutting (tending of regeneration) – tending of trees with a height of 1.5 m and trees with a diameter at breast height of not more than 5 cm, to remove creepers or climbers and climbing bamboos from infested potential crop trees.
- Liberation thinning – Commercial potential crop trees from diameter 5 cm to 30 cm are liberated from competition by other non-commercial species for light, water and nutrients.
- Transportation – disposal of wastes.

There shall be continuous silvicultural treatments activities within NFM area.

Abandonment Phase

Project abandonment can occur at any stage of the project, which may due to the down turn of the nation's economy, social acceptability of the project in the community, or unforeseen management and technical problems. The project will also be abandoned upon the expiration of Timber Licence Agreement (due in the year 2097). The abandonment stage would involve the following:

- Restoration – restoration of area.

3.2.3.4 Enrichment Planting

Enrichment planting shall be carried out on degraded NFM area. Indigenous species suitable for planting include *Laran, Binuang, Jelutong, Hopea, Kapur* and *Seraya*. Enrichment planting is an expensive operation with little success. It therefore would only be carried out when absolutely necessary, that is, after a diagnostic sampling is done.

Investigation & Development Phase

The investigation stage would involve the following:

- Feasibility study and development plan – formulate strategy of management and operation, evaluate overall profitability and financial viability of the project.
- Investigation plan – to determine soil type, soil suitability, species suitability.
- Planting planning – selection of good seedling, planting method and cost.

Operational Phase

The operational stage of the enrichment planting activities would involve the following:

- Site preparation – consist of under-brushing, lining, and preparing planting lines.
- Planting preparation – preparation of good seedling and planting holes, positioning of seedling. Enrichment planting can be carried out either in clustered, gaps or by the line planting system.
- Planting – planting indigenous seedlings in areas where no or limited potential crop trees, practically not more than 300 m from access roads.
- Maintenance – provision of extra seedling, weeding and planting path maintenance, thinning, fertiliser application, pest and diseases control, road and drain maintenance.

There shall be continuous enrichment planting activities within NFM area.

Abandonment Phase

Project abandonment can occur at any stage of the project, which may due to the down turn of the nation's economy, social acceptability of the project in the community, or unforeseen management and technical problems. The project will also be abandoned upon the expiration of Timber Licence Agreement (due in the year 2097). The abandonment stage would involve the following:

- Restoration – restoration of planting area.

3.3 Project Site

3.3.1 Locality

The project site is located within Sapulut Forest Reserve, District of Nabawan (Figure 3.1). It is situated immediately east of Sapulut Township, 35 km south-southeast of Nabawan Township and 85 km west-northwest of Kalabakan Township. Logging area is under the jurisdiction of Jabatan Perhutanan Daerah Tibow.

Adjacent and towards the north are Forest Management Unit, FMU 11 (part of Sapulut F.R.). Yayasan Sabah Concession Area is located immediately to the north and east of the project site. Bordering its northeastern boundary is the Maliau Basin Conservation Area (MBCA), a prestine and high value protection forest. In the south, it shares a common boundary with FMU 13 (part of Sapulut F.R.) and FMU 25 (part of Sapulut F.R. and part of Kalabakan F.R.), respectively.

The logging area has the following end co-ordinates:

Table 3.3: Project Area Co-ordinates

Lot	Latitude	Longitude
Top Left	04° 48' 05" North	116° 31' 32" East
Top Right	04° 48' 39" North	116° 45' 58" East
Middle Left	04° 40' 23" North	116° 29' 14" East
Middle Right	04° 40' 23" North	116° 52' 19" East
Bottom Left	04° 32' 42" North	116° 27' 07" East
Bottom Right	04° 33' 28" North	116° 53' 05" East

The project site is accessible from Tawau via Kalabakan Township using a combination of gravel and logging roads, off Jalan Tekala and Jalan Kalabakan - Tawau. The site is also accessible from Keningau via Nabawan Township using a combination of sealed and gravel roads, off Jalan Keningau – Sapulut and Jalan Sapulut - Kalabakan.

3.3.2 Existing Land Use

Major land use patterns in the area include jungle / secondary forest, agricultural plantation and human settlements (Figure 3.4). Within the project site, the main vegetation types include montane forest, highland mix dipterocarp forest, lowland dipterocarp forest and permanent cultivation.

Other facilities in the vicinity include:

- Jabatan Perhutanan Tibow (within site).
- Sawmill: Atlantic (within site); Siliwantoh (8 km south).
- Campsite: SFD (3 camps within site); Idris Hydrualic (2 km south); Wamantol Enterprise (4 km west); Kenangan Cergas (5 km south); Sure Win Trading (8.5 km west; Army Camp – Kem Seri Seliku (10 km south).
- Cemetery: Kg Salong (0.6 km west); Kg Sinikalaun (1.0 km west); Kg Sandukon (1.2 km northeast); Kg Sosogoh (1.5 km west).
- School: SK Simatuoh (0.3 km north); SK Salong (0.5 km west); SK Sepulot (1.0 km southwest); SMK Sepulot (1.0 km southwest); SK Labang (3.0 km south): SK Pagalungan (7 km southwest); SK Sasandukon (7 km south); SK Saliko (9 km south).

3.3.3 Forest Fire

Forest Fire

There is no known forest fire incident recorded within Sapulut Forest Reserve or in the nearby areas.

3.3.4 Gazetted Land Use

The project site is located within the gazetted area of Sapulut Forest Reserve, a Class II Commercial Forest Reserve for logging purposes (Figure 3.5). Based on information from *Jabatan Perhutanan*, the future land use of the project site shall remain as forestry purposes. The area is a Forest Management Unit (FMU 14), a long-term sustainable forest management programme.

3.4 Site Characteristics

Main site visits were carried out in May, September and December 2004. In addition, the surrounding areas were also visited during the preparation of EIA Studies for other projects in Jan 2004; Mar, Apr & Sep 2003; Jul & Aug 2002; Mar & Dec 2001; and Oct & Nov 2000.

Table 3.3: Site Visits Schedule

Activity	Site Visits
Physical	11 to 13 May, 06 to 10 Sep & 13 to 17 Dec 2004
Biological	11 to 13 May, 06 to 10 Sep & 13 to 17 Dec 2004
Socio-Economic	11 to 13 May & 06 to 10 Sep 2004
Other EIAs	13 to 14 Jan 2004; 26 to 28 Mar, 01 to 04 Apr & 25 to 27 Sep 2003; 01 to 07 Jul & 02 Aug 2002; 07 to 08 Mar & 04 to 06 Dec 2001; 23 to 24 Oct & 20 to 21 Nov 2000

3.4.1 Physiography & Geology

Topography

Ground elevations within the project site vary between 200 to 1,200 metres (m) Above Mean Sea Level (AMSL). Approximately 7,946 ha or 8.3 percent of the project area having slopes exceeding 25 degrees. The topography and slope of the project area is shown in Figure 3.6.

Table 3.4: Slope Category within Project Area

Zone	No of Compartment	Elevation (m)	Area with slope (ha)			Total Area (ha)
			< 15°	15° – 25°	> 25°	
Conservation	12	750 - 1200	459	1,789	1,437	3,685
NFM	178	325 - 1000	25,702	28,143	4,789	58,634
ITP	83	200 - 800	19,858	11,403	1,720	32,981
Total	***273***	***200 - 1200***	***46,019***	***41,335***	***7,946***	***95,300***

Geology

The project site is formed of mainly of Sapulut, Tanjong and Labang Formations. Sapulut Formation is an Upper Cretaceous to Upper Eocene Strata, which consists of sandstone, siltstone, mudstone, conglomerate and limestone. Tanjong Formation is an Upper Cretaceous to Upper Eocene strata, which consists of mudstone, sandstone, siltstone, conglomerate, minor limestone and lignite. Labang Formation comprises of sandstone, siltstone, mudstone and limestone, which form of small synclinal basin in the Sapulut Valley.

Small area to the southeast corner of the project site is derived from Kapilit Formation. Kapilit Formation consists of sandstone and mudstone, with rare beds of coal, conglomerate and limestone, folded into a series of gentle synclines and steep anticlines in the south-eastern part of Pensiangan and upper Kinabatangan area.

Most of the streams, creeks and rivers in the area are either stones or gravel bedded. However, the parent materials of sandstone, mudstone, siltstone, conglomerate, limestone and ignite contributed very little towards the plant nutrient reserves in the soil, particularly soil derived from the parent material of sandstone and siltstone.

Soils

The main soil associations found within the project site are Lokan (43 %), Crocker (35 %) and Maliau (16 %). Pockets of Labau, Kalabakan, Serudong and Gomantong Associations are also found. These associations are generally associated with the geological landform of the area.

The main soil units recorded within the project area include Orthic Acrisol, Gambisol, Podzol, Gleysol and Lithosol. The dominant and major soil unit is Orthic Acrisol, which is sandy and low in fertility. It is derived mainly from the parent materials of sandstone, siltstone and mudstone. Details of soil characteristics are shown in Annex 1.1.

Generally, these soils are well drained and usually with soil texture ranging from sandy to clayey foam. This resulted in heavy leaching to the nutrients of the soil due to its low binding ability. In view of past management and repeated logging activities, large parts of the area inevitably experienced some erosion and compaction.

3.4.2 Meteorology

The climate of this subregion is a typical equatorial climate with uniform temperature, high humidity and substantial amount of rainfall. Its climatic variations are characterised by the effects of two monsoons regimes namely the May to September southwest monsoon and November to March northeast monsoon, with some modifications by intertrophical convergence and local topography. Details of meteorological data are shown in Annex 1.4.

Temperature

Temperature records show that a fairly uniform daily temperature experienced at this area. The average annual 24-hour mean temperature is 27° C. Average mean daily temperature for daytime is between 30.7° C and 32.9° C and for night-time is between 20.9° C and 23.1° C.

Rainfall

Rainfall is predominantly convectional although the monsoons have intensifying influence. Generally, there are two wet seasons in the area, which are monsoon in nature. These are within August to December and March to May yearly. However, the rainfall pattern in the area is unique. Even outside the monsoon period, the area is constantly being nourished by the consistent precipitation of convectional rain, which normally occurs in the afternoon. So virtually, there is no experience of distinctive dry season within the project area. Cumulative annual rainfall for the area averages approximately 2319 mm per year with monthly average of 198 mm.

Rainfall data in the surrounding area shows similar annual precipitation volume, except Maliau Basin. At Nabawan (35 km north-northwest), Luasong (30 km east) and Kalabakan (85 km east-southeast), the average annual rainfall is 2,816 mm, 2,322 mm and 2,090 mm, respectively. The average annual rainfall within Maliau Basin is estimated as 3,800 mm.

3.4.3 Archaeology & Tourism

Archaeology

There are three archaeological sensitive areas within and in the vicinity of the project area including Batu Saap, Batu Punggul and Batu Tinahas Cave (Figure 3.4 and Annex 1.3). Batu Saap is located within the project site. Batu Punggul and Batu Tinahas Cave are located approximately 0.3 km west and 0.5 km west, respectively. Based on information from Jabatan Muzium Negeri Sabah, these sites are gazetted as archaeological site except for Batu Saap. These areas have no archaeological values but preserved for tourism purposes. In addition, four burial sites of local Murut community are known to exist in the vicinity of the project area, particularly near human settlements.

Tourism

There are two proposed tourism development areas in the vicinity of the project area, namely (i) at Tibow (within the gazetted area of Jabatan Perhutanan Tibow) and at Sabuda (6 km east of the project site) (Figure 3.4). These tourism areas will be designed to cater for activities related to Maliau Basin. In addition, the tourism areas shall also be provided with rest area, car parks, souvenir shop, cafeteria, exhibition hall, administrative office, and possibly chalet accommodation. There is a long-term plan to create a new township at Tibow. However, to-date there is no approved or gazetted plan of either the tourism areas or Tibow Township.

3.4.4 Hydrology & Water Quality

Hydrology

The project area consists of two main rivers, which dissect the area from east to west (Sg Saburan) and from northeast to southwest (Sg Sansiang) directions following the landform and mountain ridges of the area. Sg Saburan and Sg Sansiang together with their tributaries are running from the highlands of Malian Basin Conservation Area on the east and cuts across the project area towards the lowland region in the west (Sapulut Township) and joining Sg Sapulut and finally to Sg Pensiangan.

Main riverine systems that could be affected by the project include Sg Siliawan, Sg Pinangah, Sg Lombunaan, Sg Saburan, Sg Sansiang, Sg Tibow, Sg Palangan, Sg Sakikilan, Sg Sabunutan, Sg Beliar, Sg Sablangan, Sg Simatuoh, Sg Salung, Sg Lalobou, Sg Sinikalaun, Sg Sapulut, Sg Pampangon and Sg Logongon. Other major riverine systems in the vicinity include Sg Penawan, Sg Sumatalun and Sg Pensiangan. Details of riverine system are shown in Annex 1.2.

Water Use

There is no known or gazetted Government potable water supply scheme in operation within the project area. Local population are known to rely on gravity and well water for their water supply. Their water intake points are located outside the project area. However part of their water catchments may be affected by the project, particularly along Sg Sapulut and Sg Tibow. In addition, during dry period, majority of the local population obtain water directly from Sg Salung, Sg Sinikalaun, Sg Logongon and Sg Sapulut for daily water supply. Details of water sources are shown in Annex 1.2.

Within the project site, there is one proposed water catchment area, known as Tibow Water Catchment (TWC) with an area of approximately 690 ha (Figure 3.4). TWC is based on tributaries of Sg Sansiang and identified to serve the proposed Tibow Township. However, to-date there is no approved or gazetted water catchment plan.

As for navigation, local rivers including Sg Saburan, Sg Salung, Sg Sinikalaun, Sg Logongon, Sg Pampangon and Sg Sapulut are used for access, particularly between areas not served by road network. In addition, these rivers are also used for fishing activity.

Water Quality

Environmental baseline sampling on water quality was carried out during the site visit. Details of water sampling are shown in Annex 2.4.

In general, water quality of the local rivers is acceptable. Based on chemical analysis and site visit, the physical appearance of Sg Siliawan, Sg Pinangah, Sg Saburan, Sg Sansiang, Sg Tibow, Sg Simatuoh, Sg Beliar and Sg Sinikalaun indicate that the water quality is relatively low in turbidity and suspended solid concentrations. There are no traces of oil and grease along these rivers. The water parameters analysed comply with Standard IIB of DOE Interim Water Quality Standards, which generally acceptable for use as raw water supply. However, Sg Sapulut, Sg Salung and Sg Logongon exhibit polluted rivers with elevated suspended solids and oil and grease concentrations. This could be due to logging activities in Sapulut, Pensiangan and Kalabakan areas.

3.4.5 Infrastructure

Road Structure

Typical logging road conditions of the project area are as follows:

Locality	*Latitude*	*Longitude*	*Width (m)*	*Slope (degrees)*	*Road Type*
Within site	04° 33' 52" N	116º 51' 17" E	12.4	7.0	Main
Within site	04° 39' 39" N	116º 50' 05" E	7.0	5.0	Main
Within site	04° 35' 16" N	116º 45' 31" E	2.8	4.5	Secondary
Within site	04° 35' 25" N	116º 48' 58" E	4.6	9.0	Secondary

Camp Site

There are three campsites owned by the project proponent, located within the project site to cater for existing forest logging operations within Coupes B, C & D.

Locality	*Latitude*	*Longitude*
Within site	04° 42' 46" N	116º 44' 11" E
Within site	04° 43' 02" N	116º 44' 13" E
Within site	04° 35' 20" N	116º 50' 44" E

Nursery

One nursery owned by the project proponent is currently in operation, catering to forest plantation activity within Compartments 165, 166, 168, 169, 170 and 171.

Locality	*Latitude*	*Longitude*	*Area (ha)*
Within site	04° 46' 37" N	116º 37' 55" E	4

Sawmill

There is one sawmill (Atlantic Sawmill) located within the project site and owned by a private operator.

Locality	*Latitude*	*Longitude*
Within site	04° 36' 34" N	116º 34' 45" E

3.5 Biological Environment

Biological environment in the project area comprises of (i) terrestrial habitat of primary/secondary forest, dipterocarp forest, montane forest, kerangas forest, riverine vegetation, and mixed agriculture; and (ii) aquatic habitat of local rivers. Details of biological environment are shown in Annex 1.5.

3.5.1 Flora & Fauna

Flora

Predominant vegetations consist of Upland (50.3 %) and Lowland (31.8 %) Mixed Dipterocarp Forests, which have been heavily logged since the early 1970s. Other vegetations include Upland Mixed Dipterocarp & Kerangas Forest (16.4 %), Upland Kerangas Forest (1.4 %), and Lowland Mixed Dipterocarp & Kerangas Forest (0.1 %). Other smaller pockets of vegetations are the Lower Montane Forest and the Upland Mixed Dipterocarp & Limestone Forests. Satellite image of the project area is shown in Figure 3.8.

The forest stand comprises many trees in the lower diameter classes and few dominants and co-dominants. Most of the trees are light demanders but have the ability to survive for long periods under suppressed conditions. Occasionally, gregarious tendencies occur due to various factors such as elevation and this result in almost pure stand of one species in the area. Occurring over such a large area and under a wide range of conditions of soils, elevation, topography, drainage and weather, variations in stand composition and structure are inevitable.

The Lowland Mixed Dipterocarp Forest usually extends up to an altitude of 750 m AMSL, which the stand structure and species composition begin to change to the Upland Mixed Dipterocarp Forest. Generally, the Lowland and Upland Mixed Dipterocarp Forests are characterised by the predominant of the family Dipterocarpaceae that accounts to 70 % to 90 % of the commercial timber volume present. The forest is generally heterogeneous with Dipterocarp species being predominant. The stand volume and species composition can be highly variable between sites. The most commonly occurring tree species belong to Dipterocarp genera of *Shorea, Parashorea, Dryobalanops* and *Dipterocarpus*. The Red, White and Yellow Seraya groups are the most commercial important groups present.

Biological survey found that there are approximately 321 faunal species within the project site. In view of close proximity to Maliau Basin Conservation Area (MBCA), seven protected floral species are known to be present in the area including angiosperm of Halia Hutan (*Globba propinqua* and *Zingiber sp.*), gymnosperm of Lampias (*Podocarpus imbricatus*, *P. nerifolius* and *P. polystachyus*), and palm of Polod (*Arenga undulatifolia*) and Botu (*Caryota mitis*). Five known herbal species are also known to exist within the project area including *Adina rubella*, *Coyx lachrymal*, *Mallotus apelta*, *Pteris multifida* and *Pyrrosia lingua*.

Fauna

The project area is rich in wildlife population despite of logging activities in the past and present, which may somewhat affects and alters their natural habitat. The site survey carried out indicates that the condition and population of wildlife in the forest is reasonably well.

A total of 34 mammal species have been recorded within the project area. They include 20 protected wildlife species including Sambar Deer (*Cervus unicolor)*, Barking Deer (*Muntiacus muntjak*), Elephant (*Elephas maximus*), Flying Lemur (*Cynocephalus variegates*), Bornean Gibbon (*Hylobates moloch*), Long-Tailed Macaque (*Macaca fascicularis)*, Pig-Tailed Macaque (*M. nemestrina*), Mouse-Deer (*Tragulus javanicus* and *T. napu*), Musang (*Hemigalus derbyanus*), Orang Utan (*Pongo pygmaeus*), Small-Clawed Otter (*Aonyx cinerea)*, Hairy-Nosed Otter (*Lutra sumatrana*), Pangolin (*Manis javanica*), Sumatran Rhinoceros (*Dicerorhinus sumatrensis*), Prevost Squirrel (*Callosciurus prevostil*), Giant Squirrel (*Ratufa affinis*), Tembadau (*Bos banteng*), Bearded Pig (*Sus barbatus*), Western Tarsier (*Tarsuis bacanus*), Smaller Mouse-Deer (*Tragulus javanicus*), Greater Mouse-Deer (*Tragulus napu*) and Banded Musang (*Hemigalus derbyanus*).

Large animals of Elephant (*Elephas maximus*) and Sumatran Rhinoceros (*Dicerorhinus sumatrensis*) are known to exist in the area, as confirmed by local authorities/population. Previous surveys indicate that herds of elephants were sighted at different locations within Sapulut and Gunung Rara Forest Reserves. Based on World Wide Fund for Nature (WWF) Malaysia information, southeast of the project site is part of elephant migrating route between Danum Valley and Indonesian border (Figure A1.5, Annex 1.5). Sumatran Rhinoceros is also known to present in the area with previous surveys indicate sighting within Sapulut and Kalabakan Forest Reserves. The most common of all the mammals are the Sambar Deer (*Cervus unicolor*) and Bearded Pig (*Sus barbatus*).

Hunting is carried out by local population within and in the immediate vicinity of the project area. Popular hunting animals include wild boar and “payau”. There are four main hunting sites, namely (i) downstream of Sg Saburan – frequented by villagers of Kg Labang, Kg Samuran, Kg Sandukon and Kg Liningkar; (ii) upstream of Sg Beliar – Kg Kakautar, Kg Sliko and Kg Sibuah; (iii) Sg Lalobou – Kg Tapuluon, Kg Balantos and Kg Salong; and (iv) Sg Sansiang V.J.R. – Kg Tataluan.

Diverse species of birds can be found in the area totalling not less than 163 species. They include 28 protected bird species including Besra (*Accipiter virgatus*), Brahminy Kite (*Haliastur Indus*), Bornean Bristle-Head (*Pityriasis gymnocephala*), Short-Toed Caucal (*Centropus rectunguis*), Oriental Darter (*Anhinga melanogaster*), Emerald Dove (*Chalcophaps indica*), Black Eagle (*Ictineatus malayensis*), White-Fronted Falconet (*Microhierax latifrons*), Sunda Blue Flycatcher (*Cyornis caerulata*), Asian Paradise Flycatcher (*Terpsiphone paradise*), Crested Goshawk (*Accipiter trivirgatus*), Great-Billed Heron (*Ardea sumantrana)*, Little Heron (*Butorides striatus*), Bushy-Crested Hornbill (*Annorrhinus galeritus*), White-Crested Hornbill (*Berenicornis comatus)*, Helmeted Hornbill (*Rhinoplax vigil*), Magpie Robin (*Copsychus saularis*), Brown Wood-Owl (*Strix leptogrammica*), Chestnut-Neckled Partridge (*Arborophilla charltonii*), Crimson-Headed Partridge (*Haematortyx sanguiniceps*), Crested Partridge (*Rollulus rouloul*), Argus Pheasant (*Lophura bulwerii* and *Argusianus argus*), Pigeon (*Treron capellei*), White-Rumped Shama (*Copsychus malabaricus*), Grey Wagtail (*Motacilla alba)*, Yellow Wagtail (*Motacilla flava*) and Rufous Woodpecker (*Celeus brachyurus*). Most of these bird species are characteristic of the lowland dipterocarp forest.

A total of 17 amphibian and 19 reptilian species are known to exist within the project area. There are no known protected amphibian species within the project site. However, 4 protected reptile species are recorded including Crocodile (*Crocodylus porosus*) (reported by local population along Sg Logongon), Monitor Lizard (*Varanus rudicolis* and *V. salvator*) and Reticulated Python (*Python reticulates*).

Aquatic

Aquatic habitat known to exist in the area are limited to freshwater fishes, crustacean, mollusca and algae along Sg Pinangah, Sg Siliawan, Sg Lombunaan, Sg Saburan, Sg Sapulut, Sg Simatuoh, Sg Sansiang, Sg Tibow, Sg Sakikilan, Sg Sabunutan, Sg Sablangan, Sg Salung, Sg Lalobou, Sg Sinikalaun and Sg Beliar. Commonly found aquatic species include Ikan Toruh, Botuon, Belanak Sungai, Dumpis, Terbol, Turongou, Salab, Pelian, Patin, Ketam Sungai, Udang Sungai, Siput Sungai and Alga. None of these species are identified as endangered or protected species.

Based on information from local population, high number of fishes is noted along Sg Saburan, Sg Salung, Sg Sinikalaun, Sg Logongon, Sg Pampangon Sg Sapulut, Sg Sansiang and Sg Tibow. Typical fishing activity is based on fishing hook and hand lines, and "jala" or "pukat".

3.5.2 Sensitive Area

Biologically sensitive areas (Figure 3.4 and Annex 1.5) within and in the vicinity of the project area include:

- *Conservation Area* – Maliau Basin Conservation Area (MBCA); and Phenology Area.
- *Biological Habitat* – Salt licks.
- *Virgin Jungle Reserve (V.J.R.)* – Sg Siliawan V.J.R.; Sg Sansiang V.J.R.; and Nurod Urod V.J.R.
- *Commercial Forest Reserve (F.R.)* – Sg Pinangah F.R.; Gunung Rara F.R.; and Kalabakan F.R.

Maliau Basin Conservation Area (MBCA)

MBCA is located immediately northeast of the project site covering an area of approximately 58,840 ha. Maliau Basin is a saucer-like basin as it is surrounded by rim escarpment with heights ranging from 1500 m to 1900 m AMSL. MBCA is a unique and pristine rainforest area dominated by lower montane and heath forest, as well as lowland dipterocarp forest. It is reported that, significant numbers of plant species have been recorded in the Maliau Basin, with many are poorly known and could only be identified by biological specialists. Apart from sensitive flora and fauna, it is home to Lake Linumunsut, which is Sabah's only true freshwater lake, as well as some 20 spectacular waterfalls including the magnificent seven-tier Maliau Falls, which have been left virtually untouched.

Phenology Area

The Phenology Area of 120 ha is located within the project site (near Sg Saburan). This area is conserved for observation to study the timing of natural events or annual cycles of plants and animals along with their relationship to the weather and climate, and how they respond to seasonal changes in their environment because of many contributing factors such as latitude, altitude and buffering effects of large bodies of water.

Salt Lick

There are three known salt licks within and in the immediate vicinity of the project site. One salt lick is known to exist within the project site (near Sg Salung). In the vicinity, one salt lick is located approximately 500 m to the east (within Gunung Rara F.R.) and the other at approximately 6 km south. These salt licks are known to attract mammals such as elephants and Bearded Pig, and used by these animals as their sources of mineral-rich water and normally as their animal home range.

Virgin Jungle Reserve

Sg Siliawan V.J.R. (2,136 ha) and Sg Sansiang V.J.R. (34 ha) share common boundaries with the project site. Nurod Urod V.J.R. (1,705 ha) is located approximately 200 m east of the project site. These forest reserves are classified as Class VI Virgin Jungle Reserve for the purpose of forest research.

Commercial Forest Reserve

Sg Pinangah F.R. (237,872 ha), Gunung Rara F.R. (219,794 ha) and Kalabakan F.R. (224,488 ha) are located north, east and southeast of the project site, respectively. These forest reserves are classified as Class II Forest Reserve for the purpose of commercial logging.

3.6 Socio-Economic

Details of socio-economic environment are shown in Annex 1.3.

3.6.1 Population

Project Site

There are no villages or human settlements within the project site, except of one staff quarters owned by the project proponent and another staff quarters owned by a private operator (Atlantic Sawmill).

Originally, there are five logging camps located at various sites within the project site, for operation of existing logging coupes. Four of these camps have since been abandoned in September and December 2004. The size of each logging camps depends largely on the period of the license, the size of the logging coupes and the number of workers. Most of the buildings are temporary or semi-permanent in nature, normally not more than one or two units of long *kongsi*. The temporary camps are usually built by sub-contractors who operate for a short periods and abandoned them thereafter.

In the Vicinity

Major human settlements are located mainly west and southwest of the project site, within the State land along Sg Sapulut, Sg Pampangon and Sg Logongon. These local villages with a total population of 3,526 include Sapulut Township, Kg Tataluan, Kg Sandukon, Kg Sanuank, Kg Samuran, Kg Labang, Kg Liningkar, Kg Simatuoh, Kg Siliawan, Kg Ampulos, Kg Tonomon, Kg Bigor, Kg Agis, Kg Tapuluon, Kg Balantos, Kg Salong, Kg Sinikalaun, Kg Sosogoh, Kg Kuyoh, Kg Sikait, Kg Kuala Sabenait, Kg Sumolopop, Kg Binanding, Kg Pagalungan, Kg Sumakiuwakiu, Kg Mangkam, Kg Silungai, Kg Kuala Sumatalun and Kg Sasandukon.

In the eastern area of the project site, human settlement is limited to Jabatan Perhutanan Tibow, which is provided with main office and staff quarters (29 personnel).

Transportation Route

Population that could be affected by transportation activity include the following:

- Sapulut area along Jalan Sapulut (Kg Siliawan and Kg Simatuoh); and
- Kalabakan area along Jalan Tekala (Jabatan Perhutanan Tibow).

3.6.2 Community Profile

The local communities are mainly from Murut Tagol ethnic group. These communities are sedentary agriculturists, who do not have to use the resources in the project area because State land forest resources are sufficient to meet the local needs. Their main economic activities are agriculture, forestry and hunting.

Majority of the population is Bumiputera origin of Murut and Kadazana community. Their education level is low with less than 10 percent of the population having completed secondary education and mainly working in the agricultural sector. Majority of the population stays in owned houses for more than 10 years and considered as local population. The population economic level is considered as lower class with majority having incomes of less than RM 300 per month. Majority of the population involve either in fishing, hunting or farming to supplement their daily livelihood.

The area is not served with water supply, where majority of the population relies on gravity water system from local rivers. Road access is also limited and often in poor condition during rainy periods, with majority of population relies on local rivers for navigation.

3.6.3 Perception

Majority of the population in the study area expressed favourable views of the project. Those populations who agreed stated that the project may (i) provide road access; (ii) create more employment opportunities; and (iii) further development to the surrounding area.

Socio-economic survey reveals the following:

- Most of the local population complaints on disturbance of their economic activities particularly hunting and fishing. Local population claimed that fish catch, hunted animal and traditional food supply is decreasing since logging operation started in the area.
- Majority of the local population rely on the main rivers as source of water for daily use. Their water intake points are located within the project area. However, some of their water catchment might be affected by the project. The affected population concerns on their requirements to obtain clean water supply continuously.
- Local population expressed appreciation on the existence of logging road, which improve their access and increase development activity in their area, particularly near Kg Simatuoh, Kg Labang and Kg Tataluan, which only accessible by foot or river previously. This logging activity directly improves local standards of living by providing alternative transportation networks.
- Minor complaints on water quality contamination from oil spills and high turbidity were also recorded, particularly along Sg Sapulut, Sg Salung and Sg Logongon.

Major disagreements to the project are mainly related to the river water pollution that affects local population daily activities. Some of those disagreed imposed reasonable conditions mainly related to the requirements of clean water supply, either in the form of water storage facility or protection of water catchment areas. Accordingly, they may agree to the project if continuous supply of clean can be assured. It is believed that with the implementation of various mitigation measures during project operation arise from this EIA Study, additional protection on water supply can be achieved.

3.7 Project Status

3.7.1 FMU

Sustainable Forest Management Licence Agreement, SFMLA 04/97 for the project site was signed on 10 September 1997 between the *State Government of Sabah* and *Sapulut Forest Development Sdn Bhd* (SFD). The agreement allows for SFD to undertake managing, planting and sivicultural treatments of natural and plantation forests or timber trees, and further to undertake felling, cutting, collecting, removing and converting trees and other forest produce, logs and timbers, within Forest Management Unit, FMU 14 of 95,300 ha.

3.7.2 History

Logging

Prior to the area being gazetted as a forest management unit, the work plan for these forest areas was based on area control. The area was divided into working blocks of various sized and shapes and issued short-term licences to many timber companies. Each working area is subdivided into annual coupes. The felling diameter for all commercial timber species is 60 cm dbh and above. Upon completion of logging, the coupe area was closed after preparation and submission of closing inspection report. Logging licensees within FMU 14 are shown in Figure 3.7.

A small portion of the forest area of Sapulut Forest Reserve was logged as early as 1956, but a larger part of the project area was harvested in the early 80s. By early 1990s, most of the areas are extensively logged. Some are being relogged for at least three times on a very short rotation period. Approximately half of the areas that are supposed to have some reasonably stockings have been extensively logged by third parties from 1999 until 2003 using the conventional method of harvesting. Many of the short-term logging holders have harvested trees far below the allowed diameter-cutting limit of 60 cm dbh. Consequently, the stand stocking in the area have been drastically reduced. Fortunately, all short-term licenses have expired in 2003, except for Sapulut Forest Development Sdn Bhd.

Silviculture

On record, the only silvicultural treatment carried out within Sapulut Forest Reserve between 1972 and 1986 is creeper cutting. There is no other form of pre- and post-harvesting silvicultural activities in the area, even for those areas where logging operation had ceased sometime ago.

3.7.3 Present Condition

Logging

Sapulut Forest Development Sdn Bhd is currently carrying out logging activity within FMU 14, based on *Jabatan Perhutanan* approval ref: JPHTN: P&O/100-24/01/15-04/2/2 dated 10 March 2003. The original approved logging areas were 11,800 ha from three coupes “A”, “B” and “C”. However, in view of some of the approved logging areas are located within Maliau Basin Conservation Area (MBCA) Buffer Zone 1, the concession areas were ‘adjusted’ for protection of MBCA. The final logging areas are 11,594 ha from four coupes “A”, “B”, “C” and “D”, with logging licences under SFMLA 04/97 due to expire on 07 July 2006, 09 December 2006, 18 February 2007 and 29 March 2007, respectively.

The original and final concession areas are shown in Figure 3.2. EIA for logging activity within these areas has been approved by *Jabatan Perlindungan Alam Sekitar* on 09 July 2003 (ref: JKAS/PP/12/600-1/01/1/160) for Coupe "A" and on 24 December 2003 (ref: JKAS/PP/12/600-1/01/1/170) for Coupes "B" and "C", respectively.

Plantation

Sapulut Forest Development Sdn Bhd is currently carrying out tree plantation activity within FMU 14 covering an area of approximately 2,811 ha (Figure 3.2). EIA for plantation activity within the area has been approved by *Jabatan Perlindungan Alam Sekitar* on 02 November 2004 (ref: JKAS/PP/12/600-1/01/3/11).

Forest Management

Sapulut Forest Development Sdn Bhd (SFD) is practising Sustainable Forest Management and in line with *Jabatan Perhutanan* requirement, SFD has completed its "Forest Management Plan" (FMP) document for the year 2004 to 2013. The FMP has been approved by *Jabatan Perhutanan* on 20 December 2004. In addition, the "Annual Work Plan" for period of 01 January 2004 to 31 December 2004 has been approved by *Jabatan Perhutanan* on 18 February 2004.

EIA

EIA Scoping Note for the project was approved by Jabatan Perlindungan Alam Sekitar (JPAS) on 12 August 2004 vide letter ref: JPAS/PP/12/600-1/01/3/10(3). In view of large operational area of 95,300 ha and due to close proximity to sensitive areas of Maliau Basin Conservation Area and Virgin Jungle Reserves of Sg Siliawan and Sg Sansiang, a Special EIA study is required.

Draft Terms of Reference (ToR) was submitted to JPAS on 24 August 2004 and a meeting to review the draft ToR was held on 28 September 2004. Additional information as required by JPAS vide letters ref: JPAS/PP/12/600-1/01/3/10(24) and (31) dated 21 Sep 2004 and 29 Sep 2004, respectively are incorporated in the Final Report of EIA ToR. The final EIA ToR was approved by JPAS vide letter ref: JKAS/PP/12/600-1/01/3/10(38) dated 18 October 2004. Copies of letters are shown in Annex 4.3.

Status

The status of approvals is as follows:

Approval	***Authority***	***Status***
Special Environmental Impact Assessment	Jabatan Perlindungan Alam Sekitar	Pending
Sustainable Forest Management Licence Agreement (SFMLA: 04/97)	State Government of Sabah	Approved
Forest Management Plan FMU 14	Jabatan Perhutanan	Approved
Notification of Logging & Plantation	Jabatan Hidupan Liar	Pending

3.7.4 Future Plan

Logging

The planned logging activity within NFM area will be carried out over three years period, beginning year 2003 until the year 2005 (Figure 3.9). The average annual rate of logging works will be approximately 3,800 ha. It is anticipated that approximately 11,594 ha of the forests logged during the plan period.

Year	Coupe	Compartment No	Area (ha)
2003	"A"	P123, P124, P125, P131, P132, P135, P138, P139	1,645
2004	"A" & "D"	P110, P112, P113, P114, P115, 116, 117, 118, P123, P124, P125 (Coupe "A"); P81, P82, P93, P94, P95, 96, 97, P98, P99, P100, P110, P111 (Coupe "D")	6,418
2005	"B" & "C"	P127, P129, P137, P138, P139, P140, P141, P143, P144, P146, P148, 149, P150, P154, P155, P157, 158, P159, P162, P167	3,531

Notes: Coupe "A" – 5,283 ha; Coupe "B" – 1,048 ha; Coupe "C" – 2,483 ha; Coupe "D" – 2,780 ha
P – Part of Compartment

Silvicultural Treatments

The planned silvicultural treatment within NFM area will be carried out over nine years period, beginning year 2005 until the year 2013 (Figure 3.9). The average annual rate of silvicultural treatment works will be approximately 1,000 ha. It is anticipated that approximately 9,771 ha of the forests treated during the plan period.

Year	Compartment No	Area (ha)
2004	-	-
2005	140, 141, 142	981
2006	151, 158	1,081
2007	159, 160, 162	1,205
2008	156, 161, 164	1,037
2009	154, 155, 163	1,086
2010	152, 153, 157	1,001
2011	146, 147, 148	1,101
2012	143, 149, 150	1,229
2013	136, 137, 144	1,050

Harvesting

The planned harvesting of residual timber prior to forest restoration within ITP area will be carried out over ten years period, beginning year 2004 until the year 2013. The average annual rate of harvesting works will be approximately 3,000 ha. It is anticipated that approximately 30,103 ha of the forests harvested during the plan period.

Year	Compartment No	Area (ha)
2004	165, 166, 168, 169, 170, 171	2,811
2005	167, 172, 173, 174, 175, 176, 177	2,824
2006	178, 179, 180, 181, 182, 183, 184, 185, 186	3,176
2007	187, 188, 189, 190, 191, 192	3,084
2008	193, 194, 195, 196, 197, 198	3,216
2009	199, 200, 201, 202, 203, 204, 205, 206, 207	3,035
2010	208, 209, 210, 211, 212, 213, 214, 215	3,154
2011	216, 217, 218, 219, 220, 221	3,195
2012	222, 223, 224, 225, 226, 227, 228	2,402
2013	236, 240, 241, 242, 243, 244, 245, 246, 251	3,206

Forest Restoration

The planned forest plantation activity within ITP area will be carried out over eight years period, beginning year 2006 until the year 2013 (Figure 3.9). The average annual rate of forest restoration works will be approximately 3,000 ha. Actual restoration works will start in year 3 to allow for infrastructure development which may take one to two years to complete, the set-up of nursery and seeds and seedlings procurement, which may have to be in the nursery for two years or more before they can be transplanted out in the field. It is anticipated that approximately 24,495 ha of the forests restored during the plan period.

Year	Compartment No	Area (ha)
2004	-	-
2005	-	-
2006	165, 166, 168, 169, 170, 171	2,811
2007	167, 172, 173, 174, 175, 176, 177	2,824
2008	178, 179, 180, 181, 182, 183, 184, 185, 186	3,176
2009	187, 188, 189, 190, 191, 192	3,084
2010	193, 194, 195, 196, 197, 198	3,216
2011	199, 200, 201, 202, 203, 204, 205, 206, 207	3,035
2012	208, 209, 210, 211, 212, 213, 214, 215	3,154
2013	216, 217, 218, 219, 220, 221	3,195

Figure 3.1: Project Locality Map

Figure 3.2: Concession Area Map

Figure 3.3: Compartment Map

Figure 3.4: Existing Land Use Map

Figure 3.5: Gazetted & Future Land Use Maps

Figure 3.6: Topographical & Slope Maps

Figure 3.7: Licences within FMU 14 Map

Figure 3.8: Landsat TM Satellite Image of FMU 14

Figure 3.9: Working Compartment Map

4 IMPACT PREDICTION & EVALUATION

4.1 The Most Important Environmental Impacts

Major adverse environmental impacts are:

1. *Water pollution* – soil erosion and chemical pollution from logging and plantation activities that could affect water quality of existing rivers / streams.
2. *Impact on water use* – potential contamination of gravity water system that could affect local community daily activity; and impact on the proposed Tibow Water Catchment Area.
3. *Ecology* – impacts to local flora, fauna and aquatic habitat within and in the immediate vicinity of the project site.

Other adverse environmental impacts include:

- *Fire hazards* – potential of forest fire that could lead to natural resources destruction and air pollution.
- *Archaeology* – impacts to archaeological sites that could affect local community heritage.
- *Hydrology* – siltation of waterways that could lead to downstream flooding.
- *Traffic and transportation safety* – increase in vehicular traffic from transportation activity that could induce socio-economic problems to local community.
- *Socio-economic* – impacts to local population socio-economics and cultural activities.
- *Cost-benefit analysis* – qualitative impacts of the project in terms of environmental costs and benefits.
- *Chemicals* – application, storage and handling of herbicide, pesticide and fertiliser which may affect health, safety and environment.
- *Waste disposal* – disposal of oily waste, garbage, sewage and biomass that could affect soil and water quality and drainage pattern of the area.
- *Impacts from abandonment* – impacts on safety from abandoned structures and water quality from exposed logging and plantation area.

Main potential environmental issues are expected from water quality contamination, interference to water use, and ecological impacts. In addition, impacts from forest fire, archaeology, hydrology, transportation, socio-economic, environmental costs and benefits, chemicals, waste disposal and abandonment could also be expected.

Water Quality

High-suspended solid concentrations downstream of the project site could be expected during logging operation mainly from soil erosion due to the high topography and steep slopes. In addition, the use of herbicide, pesticide and fertiliser in plantation activity may produce chemical pollution. This may impact water quality of local rivers.

Water Use

There are several human settlements located east of the project site, particularly along Sg Sapulut that relies on local rivers for daily water supply. Their water intake points are located outside the project area. However, parts of their water catchments are located within the project site and may be affected by the project. In addition, Jabatan Perhutanan Tibow is also dependent on Sg Tibow for water supply. Their water intake point and water catchment are located within the project site. This may induce significant socio-economic problems if no alternative water supply or water storage facility is provided to the affected local population.

Ecology

Impacts on natural habitats could be significant, as protected floral and faunal species are known to exist in the area. In addition, the project site is located close to sensitive areas of Maliau Basin Conservation Area, and Virgin Jungle Reserves of Sg Siliawan, Sg Sansiang and Nurod Urod. The project area is also known for the existence of large protected animals such as Elephant (*Elephas maximus*) and Rhino (*Dicerorhinus sumatrensis*), and sensitive habitats of salt licks. However, most of the biological habitats have been disturbed by previous logging operations where some 26 operators have logged the area between the year 1980 to 2003.

Forest Fire

There is potential for increase of fire hazards from logging and plantation activities. The risk of fire in plantation forests is higher than in natural forests but the later are not immune because of their heterogeneous sand conditions. Appropriate control should be implemented to minimise forest fire due to the presence of human settlements in the immediate vicinity that could lead to forest fire from unattended open burning of shifting cultivation activity.

Archaeology

Impact on archaeology could be expected as the area is known for archaeological sites such as Batu Saap, Batu Punggul and Batu Tinahas Cave. Batu Saap which is located within the project area should be protected. In addition, all archaeological sites shall be provided with sufficient buffer and access to maintain their archeological and tourism values.

Transportation

Impact on safety to road users along the main logging roads might also be increased from trucking activities, particularly near populated settlements. As the expected number of transportation trips from the project is relatively low, potential socio-economic impact is expected to be not significant.

Hydrology

The clearing of land for logging and plantation activities may result in less interception of rainwater. This in turn would give rise to shorter time for the rainwater to reach open channels and thus increases the peak runoff in the channels, which may cause severe flooding downstream. In addition, significant siltation problem and inappropriate biomass disposal may reduce channel capacity, thus increasing potential for stream overflow. However, as the project area has been extensively logged previously, most of the residual soils have been eroded. The resultant rate of siltation is expected to be lower and consequently minimise the hydrological impact.

Socio-Economic and Cultural

Sapulut is known as Murut community area which relies amongst others to forestry as source of income and living. The project implementation may impact local population socio-economic and cultural activities, particularly related to local logging, hunting, agriculture and fishing.

Environmental Costs and Benefits

The environmental costs of the project shall be balanced by the environmental benefits to ensure that the recommended mitigation measures are practical and acceptable.

Chemicals

Plantation activity is normally associated with the use of chemicals. Herbicide, pesticide and fertiliser shall be applied, stored and handled properly to minimise affect to health, safety and environment. Proper disposal of off-specification chemicals and contaminated containers is also important to minimise water and soil pollution.

Waste

The project is expected to generate oily wastes, solid wastes, biomass and sewage. In this respect, handling and disposal of fuel/oily wastes from logging machinery and transportation vehicles, garbage/sewage from campsite, biomass from logging and plantation activities, and sewage from campsites require specific considerations to avoid soil contamination and water pollution.

Abandonment

The project may be abandoned at any stage that could affect safety and water quality from abandoned logging and plantation area and facilities. However, as logging facilities are normally constructed of temporary structures, abandonment impact is expected to be minimal.

4.2 EIA Matrix

The Environmental Impact Assessment is an activity designed to identify and predict the impact on the biophysical environment and on Man's health and well being, taking into account the requirements of legislative proposals, policies, programmes, projects and operational procedures, and to interpret and communicate information about the impacts. Changes in the environment could be the result of natural or man-made processes and would have harmful or beneficial consequences, or both.

The project activities and their impacts on the environment will be viewed in an integrated manner so that the impacts can be assessed in terms of magnitude, prevalence, direction and frequency of occurrence, the risks involved and their consequences.

- The *magnitude* of change/effect, which is a measure of the importance in relation to the spatial boundaries: (1) change/effect only within the project site; (2) change/effect to local conditions and/or to areas immediately outside; (3) regional/national/international change/effect.

- The *permanence* of the impact, which defines whether the condition is temporary or permanent: (1) no change/not applicable; (2) temporary; (3) permanent.
- The *reversibility* of the condition, which defines whether the condition can be changed and is a measure of the control over the effect of the condition: (1) no change/not applicable; (2) reversible; (3) irreversible.
- To what extent the impact is *cumulative*, which is a measure of whether the effect will have a single direct effect or whether there will be a cumulative effect over time, or a synergistic effect with other conditions: (1) no change/not applicable; (2) non-cumulative/single; (3) cumulative.

The principal findings generated from an assessment of each activity's potential to impact on a multi-faced environment, encompassing physical, chemical, biological and human value (socio-economic) elements, are summarised graphically below:

Table 4.1: Impact Matrix

Environmental Issues	*Issues of Concern*	*Assessment*	*Impact*
Investigation & Development Phase			
Physical Issues:	N/A		
Ecological Issues:	N/A		
Socio-economic Issues:	N/A		
Operational Phase			
Physical Issues:	• Soil Erosion / Water Quality	2,3,3,3	• ***Major***
	• Hydrology	2,3,2,3	• Minor
	• Fire Hazard	2,3,3,1	• Minor
	• Chemicals	2,2,2,3	• Minor
	• Waste Disposal	2,2,1,1	• Minor
Ecological Issues:	• Natural Habitats	2,3,3,3	• ***Major***
Socio-economic Issues:	• Water Use	2,2,1,1	• ***Major***
	• Traffic	2,2,1,1	• Minor
	• Archaeology	2,3,1,1	• Minor
	• Socio-economic and culture	2,2,1,1	• Minor
	• Environmental costs and benefits	2,2,2,3	• Minor
Abandonment Phase			
Physical Issues:	• Safety	1,2,1,1	Minor
Ecological Issues:	N/A		
Socio-economic Issues:	N/A		

** Assessment based on:*
Magnitude of change/effect: 1: within project site; 2: local condition; 3: regional/national/international
Permanence: 1: no change/not applicable; 2: temporary; 3: permanent
Reversibility: 1: no change/not applicable; 2: reversible; 3: irreversible
Cumulative: 1: no change/not applicable; 2:non-cumulative/single; 3: cumulative/synergistic

4.3 Major Impacts Assessment

Operational Phase

4.3.1 Water Quality

Under natural forest conditions, rates of soil erosion are very low. However, the cutting of forest will, without fail, lead to large tracts of bare soil being exposed to weathering. Under heavy rain the bare soil will be subject to erosion and water runoff.

Most soil erosion will be caused by impact of falling and flowing water on exposed and unprotected soil material. The energy of rainfall tends to detach, disperse and transport soil particles. Surface runoff then carries the particles downslope. Such erosion may increase water turbidity and water sediment loading, which may results in sedimentation downstream, and consequently affect the river hydrology, morphology, and the aquatic ecosystems. Soil erosion is most severe when the logging takes place in sloping and hilly terrain.

The early stages of logging activities require the penetration of roads into previously undisturbed forest. Heavy logging equipment is used to cut, bulldoze and push earth during the initial and subsequent extraction phases of logging activity. However, the phase involving main logging road construction would be minimal, as the existing logging roads (from previous operations) would continue to be used.

Exposure and compaction of soil leads to hydrological change, increased erosion rates and water quality problems. During the course of the log extraction process there may be multiple passes of heavy machines on skid trails, coupled with the movement of tractors, loaders and trucks on roads and landings during the log production – all of which contribute towards the exposure and compaction of soil. In addition, increased rates of erosion occur when there is disturbance of the tree canopy and litter layer, resulting in increased exposure of the soil surface. Once exposed, erosion takes place through a sequence of process starting with the detachment of soil particles by rainfall splash, progressing onto sheet, rill and gully erosion.

Despite the difficulties and limitations associated with measuring erosion and suspended sediment, in Sabah, it has been that there is a clear link between logging activities and increases in sediment yield. It has been reported that sediment yields from logged catchment far exceeded those of nearby undisturbed catchment. Increases in sediment yield correlated with three sequential periods of logging activity, namely: (i) road construction, (ii) logging adjacent to the road, and (iii) log extraction.

4.3.1.1 Assessment

Impact of water quality is assessed based on the following:

- Site surveys on 11 to 13 May, 06 to 10 Sep and 13 to 17 Dec 2004.
- Topography map (Figure 3.4) produced from Restricted Maps of Jabatan Pemetaan Negara (scale 1:50,000).
- Slope map (Figure 3.4) produced by computer software SURFER from topography maps.
- Land cover map (Figure 3.2) produced from Land Cover Classification Map (scale 1:100,000); Restricted Maps of Jabatan Pemetaan Negara (scale 1:50,000); and The Soils of Sabah Map (scale 1:250,000).
- Soil map (Figure A1.1) produced from The Soils of Sabah Map (scale 1:250,000).
- Hydrology map (Figure A1.2) produced from Restricted Maps of Jabatan Pemetaan Negara (scale 1:50,000).
- Meteorological data (Figure A1.4) obtained from Jabatan Pengairan dan Saliran, Jabatan Pertanian and Jabatan Perkhidmatan Kajicuaca.

4.3.1.2 Findings

Potentially high soil erosion area within the project site is determined based on several factors including steep slope area, rainfall intensity, soil characteristics, vegetation cover and logging/plantation practices.

The soil erosion rates for the project area were determined using a computer modelling, CALSITE (Calibrated Simulation of Transported Erosion). The model is based on the Universal Soil Loss Equation (USLE). Details of parameters are shown in Annex 2.1. The logging/plantation activity may result in soil erosion rates of up to 3028.5 tonnes per hectare per year (tons/ha/yr). Soil erosion map for the project site is shown in Figure 4.1.

The above assessment is purely based on paper exercise, which may differ from the actual situation on site. In addition to the above area, any other high soil erosion area found within site should also be excluded from logging/plantation.

In view of the high potential soil erosion risks from the project, water quality contamination and siltation to river/streams downstream of the project site could be expected.

Although it is fully acknowledged that logging and other land development activities give rise to suspended sediment pollution, given the long term management options provided for within an FMU agreement, i.e. longer term planning and greater control over environmental management, it can be expected that the overall water quality within the project area will improve during the life time of the project. Similar conclusions may be drawn for aquatic habitats.

Impact Summary

As several areas within the project site are predicted to generate high soil erosion rates, logging and plantation should be prohibited within this area. Logging and plantation activity on the remaining area is allowed but appropriate mitigation measures as described in Chapter 5 should be adopted.

4.3.2 Water Use

Timber extraction activities affect local communities especially settlements nearby and downstream due to the degradation of water quality. Suspended solids may adversely affect water users and the aquatic ecosystem. The impact is particularly significant if water users downstream of the site are abstracting water for drinking/domestic use. Increased suspended sediment load may degrade potable water use and fish spawning spots resulting in fishing activity by local population hampered, while improper waste disposal from timber camps such as oil, grease and other refuse may cause health hazard.

4.3.2.1 Assessment

Impact on water use is assessed based on the following:

- Site surveys on 11 to 13 May, 06 to 10 Sep and 13 to 17 Dec 2004.
- Discussions with local population, particularly Jabatan Perhutanan Tibow.
- Discussions with local authorities, particularly Pejabat Daerah Nabawan, Pejabat Kesihatan Nabawan, Jabatan Perhutanan, Jabatan Air, Jabatan Pengairan & Saliran.

4.3.2.2 Findings

Runoffs from the project area flow to Sg Siliawan, Sg Pinangah, Sg Lombunaan, Sg Saburan, Sg Sansiang, Sg Tibow, Sg Palangan, Sg Sakikilan, Sg Sabunutan, Sg Beliar, Sg Sablangan, Sg Simatuoh, Sg Salung, Sg Lalobou, Sg Sinikalaun, Sg Sapulut, Sg Pampangon and Sg Logongon.

Local population rely on these rivers for water supply, with their water intake points are located outside the project area. However, parts of their water catchments are located within the project site and could be affected by the project. These include Kg Tataluan and Kg Samuran which rely on tributaries of Sg Sansing, Kg Tonomon and Kg Labang on tributary of Sg Sapulut, Kg Simatuoh on Sg Simatuoh, Jabatan Perhutanan Tibow on Sg Tibow, SFD Campsite on tributary of Sg Tibow and Atlantic Sawmill on Sg Sablangan. In addition, during dry period, majority of local population obtain water directly from Sg Salung, Sg Sinikalaun, Sg Logongon and Sg Sapulut for daily water supply.

An area east of the project site (Compartments 158, 159, 160, 162, 166, 166, 167) has been earmarked for future water catchment area to serve the proposed new Tibow Township. However, to-date there is no firm plan or gazetment. However, considerations should be given to protection of the proposed water catchment to ensure continuous good water quality at the end of the logging/plantation period.

As for navigation, local rivers including Sg Saburan, Sg Salung, Sg Sinikalaun, Sg Logongon, Sg Pampangon and Sg Sapulut are used for access, particularly between areas not served by road network.

These rivers are also used for fishing activity. Based on information from local population, high number of fishes is noted along Sg Saburan, Sg Salung, Sg Sinikalaun, Sg Logongon, Sg Pampangon Sg Sapulut, Sg Sansiang and Sg Tibow. Typical fishing activity is based on fishing hook and hand lines, and “jala” or “pukat”.

Impact Summary

The impacts on water use could be significant, as local rivers are used for water supply, navigation and fishing.

4.3.3 Ecology

Forest logging and plantation activities affect flora and fauna in several ways including the loss of vegetation, disturbances to habitat and loss of bio-diversity from logging and disturbances to aquatic life from soil erosion and water quality contamination.

The impact of logging and plantation on the biological environment will be the direct loss of the existing vegetation. Concerns should be addressed on unique or rare plants, or species of major conservation or scientific interest. The logging and plantation may initially deprive animals and birds of a place to live. Species having limited ability to migrate from the site may perish.

The principal proximate cause of losses of forest bio-diversity is the destruction of habitat, or its fragmentation and degradation. The tropical forests are fragile ecosystems and takes longer period of time to recover from severe or repeated human disturbance. This is partly because of the limited and/or scattered distribution of most species, their adaptation to specific ecological niches, and the inter-dependencies between species.

The running water aquatic ecosystem performs a vital ecological role in maintaining aquatic habitats. Logging can severely impact the total ecology of a stream from the base of the food chain; aquatics plants through to the fish and mammals. Logging can also directly destroy in-stream and river reserve habitats for a broad range of species as well as indirectly impair the functioning of the aquatic ecosystem in the affected nearby areas.

Aside from the direct loss of habitat, increased stream turbidity as a result of the logging and plantation activities may temporarily reduce light penetration within the river. This will directly impact rates of photosynthesis and therefore primary production rates. Increased sediment loads can also cause problems with fish spawning as deposited silts provide unfavourable conditions for adhesive eggs, causing an out migration of fish, crustaceans and invertebrates from affected areas. However, this impact would have to be assessed alongside ambient conditions.

4.3.3.1 Assessment

Impact on ecology is assessed based on the following:

- Site surveys on 11 to 13 May, 06 to 10 Sep and 13 to 17 Dec 2004.
- Discussions with local authorities, particularly Pejabat Daerah Nabawan, Jabatan Perhutanan Tibow, Jabatan Hidupan Liar and WWF.
- Literature review including documents on Forest Management Plan of FMU 14, and Maliau Basin Scientific Expedition.

4.3.3.2 Findings

Based on site survey, literature search and information from local population/authorities, the area has protected floral and faunal species. The number and composition of protected species are relatively high, despite being logged several times previously.

Flora

In view of close proximity to Maliau Basin Conservation Area (MBCA), seven protected floral species are known to be present in the area including Halia Hutan, Lampias, Polod and Botu. Five known herbal species are also known to exist within the project area including *Adina rubella*, *Coyx lachrymal*, *Mallotus apelta*, *Pteris multifida* and *Pyrrosia lingua*.

Fauna

A comprehensive faunal survey of the site is not possible, so some assumption have to be made on the species that may be present in the range of habitats within the project area. Most significantly, it has been reported that the Sumatran Rhinoceros, one of the world's rarest animals is found within the project area. Estimates of actual numbers remaining varies between 20 to 40 (1986) and 75 to 100 (1990). But regardless, the population in Sabah remains a global priority. It is also known that the Asian Elephant, and it is now known, that the population in Sabah is a new sub-species. In addition, the Orang utan, are also to be found within the project area.

The following threatened species are likely to occur within the project site (the list includes all mammals which occur in Sabah and are rated as Critically Endangered (CR), Endangered (EN) or Vulnerable (VU) in the 2003 IUCN Red List of Threatened Animals).

Critically Endangered:

Sumatran Rhinoceros (*Dicerorhinus sumatrensis*).

Endangered:

Asian Elephant (*Elephas maximus spp.*).
Banteng (*Bos javanicus*).
Bornean Tree Shrew (*Tupaia longipes*).
Borneo Water Shrew (*Chimarrogale phaeura*).
(Bornean) Orang-utan *pygmaeus*).
Otter Civet (*Cynogale bennetti*).

Vulnerable:

Asiatic Black Bear (*Ursus thibetanus*).
Bay Cat (*Catopuma badia*).
Bornean Smooth-tailed Tree Shrew (*Dendrogale melanura*). (Endemic to Malaysia.)
Clouded Leopard (*Neofelis nebulosa*).
Eurasian Otter (*Lutra lutra*).
Flat-headed Cat (*Prionailurus planiceps*).
Hairy-nosed Otter (*Lutra sumatrana*).
Hose's Palm Civet (*Diplogale hosei*). (Endemic to Malaysia.)
Malayan Porcupine (*Hystrix brachyura*).
Pig-tailed Macaque (*Macaca nemestrina*).

Borneo has a small but unique population of elephants. Several major portions of its former range in Borneo have been lost during the past two decades. Today, these elephants are confined to the southern and eastern parts of Sabah and the northwestern tip of Kalimantan. Previous surveys indicate that herds of elephants were sighted at different locations within Sapulut and Gunung Rara Forest Reserves. Based on World Wide Fund for Nature (WWF) Malaysia information, southeast of the project site is part of elephant migrating route between Danum Valley and Indonesian border. The greater part of this single population is found in Sabah. Given the remoteness of the area and the difficulty of the rugged terrain, the elephant population in Borneo, estimated to be more than 1,000 animals, represents one of the most important populations in Southeast Asia - provided its habitat remains intact.

Likewise, Sabah has an even smaller population of the Asian Two-horned Rhinoceros, also called the Sumatran Rhinoceros. Rhinocerous is known to present in the area with previous surveys indicate sighting within Sapulut and Kalabakan Forest Reserves. This endangered species numbers only 30 on the entire island of Borneo due to persecution for their horns and other body parts falsely believed to have medicinal value. This persecution continues still with the recent discovery of a headless Sumatran rhino outside the boundary of Maliau Basin.

Although the Sumatran rhino avoids areas where the primary forest has been substantially modified by logging, it prefers secondary forest where the upper canopy has been broken and the smaller shrubs, canes and vines on which it feeds are more numerous. For this reason, certain types of logging may actually be beneficial by encouraging this secondary growth. Unfortunately, the Sumatran rhino tends to return to favourite spots such as mud wallows and salt licks, and poachers use this to good advantage.

Asian elephants are increasingly threatened by development activities, land clearing, settlement and poaching for ivory. These activities lead to human-elephant conflict. Elephants and rhinos, being wide-ranging species, need large areas of natural habitats to live and breed. A crucial factor in the survival of both species is, amongst other things, the availability of large enough areas that are managed sustainably to meet the needs of both human and animal populations.

The most significant contribution the project can make is to abide by the zoning proposed by the Maliau Basin Conservation Area Management Plan. If and when other plans are developed by government or others, then the project proponent will consider development activities accordingly.

High Priority Area where significant number of Elephant and Orang Utan are recorded is located within the project site on the southeast corner (Figure A1.5). Any plantation activity within this area may impact the wildlife population significantly. Within the Priority Area for Elephant and Orang Utan and Rhinocerous Area, plantation activity is allowed as their recorded number is not significant. However, in complying with the wildlife protection regulations, Jabatan Hidupan Liar should be consulted so that wildlife area can be identified and re-location can be carried out, when necessary.

Sensitive Area

The project is also located close to biologically sensitive areas such as Maliau Basin Conservation Area, Phenology Area, Sg Siliawan V.J.R. and Sg Sansiang V.J.R. In addition, there is one salt lick located within the project site.

MBCA is located immediately northeast of the project site covering an area of approximately 58,840 ha and a saucer-like basin as it is surrounded by rim escarpment with heights ranging from 1500 m to 1900 m AMSL. MBCA is a unique and pristine rainforest area dominated by lower montane and heath forest, as well as lowland dipterocarp forest.

The Phenology Area of 120 ha is located within the project site (near Sg Saburan). This area is conserved for observation to study the timing of natural events or annual cycles of plants and animals along with their relationship to the weather and climate, and how they respond to seasonal changes in their environment because of many contributing factors such as latitude, altitude and buffering effects of large bodies of water.

Based on information from WWF and site survey, there are three known salt licks within and in the immediate vicinity of the project site. One salt lick is known to exist within the project site (near Sg Salung). In the vicinity, one salt lick is located approximately 500 m to the east (within Gunung Rara F.R.) and the other at approximately 6 km south. These salt licks are known to attract mammals such as elephants and Bearded Pig, and used by these animals as their sources of mineral-rich water and normally as their animal home range.

Sg Siliawan V.J.R. (2,136 ha) and Sg Sansiang V.J.R. (34 ha) share common boundaries with the project site. These forest reserves are classified as Class VI Virgin Jungle Reserve for the purpose of forest research.

Aquatic

In addition, the presence of local rivers including Sg Siliawan, Sg Pinangah, Sg Lombunaan, Sg Saburan, Sg Sansiang, Sg Tibow, Sg Palangan, Sg Sakikilan, Sg Sabunutan, Sg Beliar, Sg Sablangan, Sg Simatuoh, Sg Salung, Sg Lalobou and Sg Sinikalaun should be given due attention to ensure that riparian vegetation, aquatic habitat and water quality is protected.

Impact Summary

The biological impact is expected to be significant, as the area has protected floral and faunal species particularly large terrestrial animals such as elephant, orang utan and rhinocerous.

4.4 Minor Impacts Assessment

4.4.1 Fire Hazards

Logging increased fire hazard is related to a number of factors including change in microclimate and increases in the fuel available for burning in the form of logging debris. It has been shown that a selective logging operation that removes 4 - 8 trees per hectare was enough to reduce the canopy cover by half. Such disturbance is enough to transform previously fire resistant forest into fire susceptible forest with post logging fuel loads being three times higher than before. Large gaps reached a condition of being able to burn after 5 to 6 rainless days in the dry season.

Loss of forest by burning equates to burning of wildlife habitat and although the impacts have yet to be studied systematically, it is known that many plants and animals were killed as a result of the fires, and populations continued to be impacted as a result of habitat loss.

Forest fire may also caused indirectly by agricultural burning from shifting cultivation. Open burning is a dangerous operation particularly in a long dry period. Fire outbreak in the surrounding areas might occur if burning is not properly controlled and strictly supervised. Hazy weather conditions in Malaysia in 1997 and 1998 were attributed to large uncontrolled peat fires as a result of land clearing by burning for plantation activities.

4.4.1.1 Assessment

There is potential for increase of fire hazards from logging and plantation activities. The risk of fire in plantation forests is higher than in natural forests but the later are not immune because of their heterogeneous sand conditions. The potential for this to occur is predicted to be small, as no burning activity will be carried out on-site. However, plantation of *Acacia mangium* shall be closely controlled as these species are vulnerable to forest fire. The tree stand is susceptible to fire at year one to three, particularly during dry season from *Acacia* leaves mixed with other litters.

Based on previous records, there was no known forest fire incident within Sapulut Forest Reserve. However, precautions should be made to the unattended open burning for shifting cultivation activity in the surrounding areas that could lead to forest fires. The project site is located close to settlement areas along the eastern boundary, which can generate wild fire during dry season from unattended open burning for shifting cultivation.

Fire is the most economical traditional tool available for disposing of logging slash to convert logged over land into plantation (Annex 1.7). Modern foresters use prescribed or controlled burning as a silvicultural treatment. The objectives of controlled burning include (i) to remove logging slash for ease of planting; (ii) to reduce fuel accumulations that contribute to high-intensity wildfires; (iii) to reduce disease and insect problem; and (iv) to control undesirable and competing weed species. Even though prescribed burning has many agricultural benefits, such practice may lead to forest fire, if the activity is not properly controlled.

Impact Summary

Based on previous records, there was no forest fire incident within the project area. However, precautions should be made to (i) plantation of non-native species such as *Acacia*; (ii) uncontrolled prescribed burning; and (iii) unattended open burning for shifting cultivation activity in the surrounding areas that could lead to forest fires.

4.4.2 Archaeology

The impacts on archaeology may affect the historical, cultural and social of local community. These sensitive sites should be protected to ensure that the historical artefacts of local communities could be preserved for future generation.

4.4.2.1 Assessment

There is no known or gazetted archaeological site or local cemetery within the project site. In the vicinity, there are three known archaeological sites, namely Batu Saap (within the project site), Batu Punggul (0.3 km west) and Batu Tinahas Cave (0.5 km west). These areas have no archaeological values but preserved for tourism purposes.

In addition, there are four burial sites of local Murut community in the vicinity of the project site, mainly near human settlements. Batu Saap may be directly affected by the project, while the burial sites and access to the three archaeological sites may be indirectly affected.

Impact Summary

The archaeological impact could be significant, as there is one archaeological site within the project site. In addition, the project may also interfere with access to archaeological sites within and in the immediate vicinity of the project site.

4.4.3 Hydrology

The clearing of land for logging and plantation activity may result in less interception of rainwater. This in turn would give rise to shorter time for the rainwater to reach open channels and thus increases the peak runoff in the channels, which may contribute to increased peak discharges during flood events. In addition, significant siltation problem and inappropriate biomass disposal may reduce channel capacity, thus increasing potential for stream overflow.

4.4.3.1 Assessment

Soil erosion rate increases due to the removal of protective cover due to logging and conversion to forest plantation. The rate of erosion is normally higher during forest plantation due to clear felling activity. Based on water quality sampling, all rivers within the project site exhibit lower suspended solid concentrations of less than 20 mg/L, except Sg Salung, Sg Beliar and Sg Sansiang. Baseflow sediment concentrations under undisturbed and partially altered forested catchments were usually less than 10 mg/L. Higher suspended solid concentrations were noted downstream of the project area (Sg Sapulut – 211 mg/L and Sg Logongon 280 mg/L). This indicates that very fine sediments were carried downstream of the project area.

The actual sediment yield from the project is difficult to quantify due to absence of long-term data on river hydrological data. Based on estimates, the annual sediment load for Sg Sapulut is 266,101 MT or 3.3 MT per ha per year and Sg Logongon is 353,203 MT or 3.7 MT per ha per year. The predicted annual sediment is relatively high, compared to the sediment yield of forest areas of between 1.0 to 3.0 MT per ha per year. This probably contributed by the previous uncontrolled logging activity.

Impact Summary

Impact on hydrology from sediment yield is expected to remain high, probably contributed by the previous uncontrolled logging activity.

4.4.4 Traffic & Transportation

Traffic creates noise and dust as well as affecting existing traffic flows. Traffic associated with forestry activities is large logging trucks, which can be very noticeable near the project area. Traffic impacts on the road capacity can be assessed by considering the changes in average traffic density.

4.4.4.1 Assessment

The number of truck trips per day generated by the transportation activities along Jalan Tekala and Jalan Kalabakan - Tawau is small of approximately 38 logging truck trips per day for ITP area and 8 logging trucks trips per day for NFM area (see Annex 2.2). Furthermore, there are no major human settlements along the existing transportation route.

However, the proposed Jalan Sapulut – Kalabakan is to be constructed across the project site and expected to pass several villages including Kg Tataluan, Kg San dukon, Kg Simatuoh, Kg Ampulos, Kg Tonomon, Kg Bigor, Kg Sinsingon and Sapulut Township. The usage of this road for logging/plantation transportation activity may create socio-economic problems to the local population, particularly on safety, dust and noise pollution. In addition, the proposed road is considered as main public route linking the Interior and Tawau.

Impact Summary

As the number of truck trips per day generated by the project is low, the potential socio-economic impact is expected to be minimal. However, consideration should be given on the usage of the proposed Jalan Sapulut – Kalabakan for logging/plantation transportation activity as the route passes several local villages and considered as main public road.

4.4.5 Socio-Economics

Apart from water use, the project may interfere with land use thus affecting the local population social, economic and cultural activity. The main impacts are related to hunting and local forestry activity.

4.4.5.1 Assessment

Hunting is carried out by local population within and in the immediate vicinity of the project area. Popular hunting animals include wild boar and "payau". There are four main hunting sites, namely (i) downstream of Sg Saburan – frequented by villagers of Kg Labang, Kg Samuran, Kg Sandukon and Kg Liningkar (approximately 950 ha of Compartments 48, 63, 86 & 87); (ii) upstream of Sg Beliar – Kg Kakautar, Kg Sliko and Kg Sibuah (approximately of 750 ha of Compartments 216, 217, 219 & 232); (iii) Sg Lalobou – Kg Tapuluon, Kg Balantos and Kg Salong (approximately 515 ha of Compartments 250, 252, 253, 256 & 257); and (iv) Sg Sansiang V.J.R. – Kg Tataluan.

In addition, based on site survey, local population is alos dependent on the local timber for house construction and as source of fuel. Their area of coverage is limited to State land in the nearby area. In view of small number of population and large State land, local population does not encroach or rely on the project area.

The project does not affect local population in terms of access. Conversely, it provides good access to the area due to the absence of proper road networks. Local population expressed hope that the project would bring greater benefits in terms of land transportation from opening of many new roads in the area.

Impact Summary

Impact on social, economic and cultural activities is expected to be not significant, due to non-dependent of local population to the project area. However, long-term impact on local population wildlife hunting activity within the project site should be considered.

4.4.6 Cost Benefit Analysis

The environmental costs of the project shall be balanced by the environmental benefits to ensure that the recommended mitigation measures are practical and acceptable. However, it shall be noted that cost benefit analysis associated with converting natural forest into industrial tree plantations is a subjective matter. The range of complexities surrounding the tropical forests is not well understood, biologically or economically. The economic costs are difficult to quantify and therefore estimates vary greatly, depending on the assumption made. In this respect, the cost benefit analysis presented herewith is based purely on qualitative assessment only.

4.4.6.1 Assessment

The proposed project will bring benefits in-terms economic stimulus to the Sapulut area, as well as to the State of Sabah. There will be continuous supply of raw material for timber downstream industry.

In respect to comparative assessment between the needs to manage the area into either a mixture of Natural Forest Management (NFM) and Industrial Tree Plantation (ITP), or solely on NFM only, there are costs associated with forest conversion associated with the loss of natural forest eco-system. In addition, there are costs associated with high intensity, short-term cycles of clear-felling, harvesting and re-planting compared to the long-term and highly selective periodic harvesting cycles for NFM.

Major disadvantages of converting natural forests inti ITP include (i) loss of soil and fertility but offset by the use of fertiliser; (ii) increase in soil erosion thus leading to loss in water protection function; (iii) loss of floral habitat including herbal and medicinal plants; (iv) loss faunal habitat including wildlife hunting area; (v) increase in potential for forest fire due to the increase in forest debris; (vi) loss of carbon storage from land clearing; and (vii) loss of "values" of bio-diverse tropical eco-system.

The environmental costs associated with conversion of the natural forests to ITP highlighted above are related to extreme conditions. For the proposed project, the balance is achieved by minimising the "costs" through the introduction of silvicultural treatment and enrichment planting. As the growing stocks within the natural forests have declined significantly, the function of the area as floral and faunal habitat, carbon storage and bio-diversity "values" are somewhat reduced. The area considered as natural forests with significant forest resources are limited to 11,594 ha or 12 % of the overall area. Leaving the area to re-generate naturally may be unwise, as natural forests re-generation is long-term (60-years cycle).

Impact Summary

Impacts associated with Industrial Tree Plantation could be significant for high-value natural forests. However, as the project site consist of highly degraded forest, the residual impacts are considered acceptable.

4.4.7 Chemicals

Plantation activity is normally associated with use of various chemicals including herbicide, pesticide and fertiliser. Improper application, storage and handling of these chemicals may cause environmental problems as well as health risks.

4.4.7.1 Assessment

A nursery has been established and located approximately 1.5 km northeast of the project site. The nursery is located within the concession area of FMU 14, which is operated by the project proponent, Sapulut Forest Development Sdn Bhd. A chemical store will be constructed within the nursery and to be operated in accordance to the required health, safety and environmental requirements.

Impact Summary

Impact on chemicals usage could be significant, if no proper health, safety and environmental procedures in application, storage and handling.

4.4.8 Waste Disposal

Improper disposal of oily wastes such as hydraulic/motor oil from logging machinery and garbage from campsite, and from accidental spills of oil may cause land and water pollution. Oily wastes are categorised as scheduled wastes and their handling, storage, transportation and disposal are governed by Malaysian environmental regulations. In addition, biomass left from logging may enter waterways, reducing their carrying capacity and become hazards to navigational users.

4.4.8.1 Assessment

Fuel is normally stored on-site for use by logging/plantation machinery and transportation vehicles. In addition, used hydraulic/motor oil will also be generated. These oils are reused for chainsaw and finally disposed of appropriately. The quantity of fuel used and waste generated is expected to be small. This is normally placed near workshop within the campsite.

Garbage from campsite is normally collected and disposed of by burying at specific area within the campsite. Quanity of biomass from plantation is significant. It is normally left along the logging/plantation roads or stumping points allowing them to rot to improve soil fertility. However, these materials should be secured and controlled to ensure they do not enter waterways.

Impact Summary

Although the quantity of wastes and biomass generated and disposed of is small, their impacts on land and river system could be significant if not properly managed, which may require special attentions. Quanity of biomass to be disposed of is large and effective disposal procedures should be implemented.

Abandonment Phase

4.4.9 Safety

Although the possibility of abandonment of the project is unlikely, there has to be a contingency in the event of this happening in abnormal circumstances such as economic collapse or a poor market situation or other unpredicted calamities. The abandonment could take place at any stage of the project. Project abandonment may include demolition of campsite and associated logging/plantation facilities.

4.4.9.1 Assessment

The campsite and nursery are located outside the project area but within the project concession area (FMU 14). The wooden structures can easily be removed and site restored to acceptable conditions. However, consideration should be taken not to leave large bare unprotected soil (e.g. on stumping/landing points and slopes) or unattended stream crossings.

Impact Summary

As campsite, nursery and logging/plantation facilities are made of temporary structures, abandonment impact is expected to be minimal.

4.5 Cumulative Impacts

An overall assessment should be made and sensitive sites prioritised by considering multiple impacts and by integrating concerns, i.e. a combination of physical, ecological and social factors. Disturbance of a site that will result in multiple impacts would necessarily receive more attention than a single impact alone.

4.5.1.1 Assessment

The logging/plantation operation is concentrated on an area, limited to low soil erosion area and away from river system. This operation alone would not pose significant cumulative impact. However, other areas surrounding the project site will also be logged/planted under similar scheme.

A combination of large number of logging/plantation operations could pose cumulative impacts in particular to the biological resources, air quality, water quality and socio-economic impacts. Impact on biological resources may not be significant, as there will be areas not logged/planted due to protective nature such as steep slopes, high elevations and riverine reserve.

The main cumulative impact is expected from Industrial Tree Plantation (ITP) activity. However, the ITP is limited to a relatively small area of 27,736 ha or 29 % of the total project area. Moreover, the activity is not a complete elimination of forest area but rather a replenishment of different forest types. The balance of the area is either for NFM (11,594 ha or 12 % of the total project), silvicultural treatment (9,771 ha or 10 %) and conservation (16,316 ha or 17 %). Approximately 29,883 ha or 32 % of the area is to be left untouched.

The impact on air quality from reduction of carbon sink is a global phenomenon and may be significant if the overall area of Sapulut Commercial Forest Reserve and nearby Forest Reserves is logged/planted simultaneously. Impacts on water quality contamination and increase in transportation activities may be significant if large number of logging/plantation operators is allowed to operate simultaneously within the same area.

Special attention should be given to simultaneous logging/plantation of several logging/plantation operators in the area to determine the extent of and mitigate the cumulative impacts, if any.

Impact Summary

Cumulative impact from the proposed logging/plantation operation alone may not be significant, but simultaneous operations of large number of logging/plantation operators within the same area may impact the overall biological resources, air quality, water quality and socio-economic environment.

Figure 4.1: Soil Erosion Map

5 RECOMMENDED MITIGATION MEASURES

5.1 Recommendations

Key mitigation measures for this project include:

1. *Zoning of logging area* – Exclusion of logging/plantation activities on high risk area, conservation area, water catchment, ecological buffer zone or any protection area; and exact techniques for demarcation.
2. *Riverine reserve* - Provision of adequate riverine reserve based on river width, wildlife corridor and water catchment protection; and exact techniques for demarcation.
3. *Soil conservation* - Application of appropriate soil erosion control measures including phase or staggered logging; minimisation of period between land clearing and plantation; minimisation of land available for clearing and plantation; restriction of land clearing activity to less rainfall period; application of appropriate land clearing and land preparation techniques; and provisions of drainage and sedimentation ponds at campsite and stumping points / landings.
4. *Modifying operational practices* – Re-usage of old main and secondary roads; proper construction of infrastructures such as logging roads, skid trails, stumping points / landings, campsite, nursery and stream crossing; retaining trees below 60 cm dbh as future stocks and trees above 120 cm dbh as seed trees; and application of tree marking rules and directional felling.
5. *Socio-economics consideration* – Protection of water supply sources, water catchments and water intake points; effective consultation with the affected local population; provision of alternative water storage facility; provisions of employment and business opportunities to local population through community forest or eco-tourism development; and minimisation of impact on local population cultural activities and way of life.
6. *Flora and fauna protection* – Prohibition of logging and plantation within MBCA Buffer Zone and protected wildlife area; provision of sufficient buffer zone on biologically sensitive areas; provision of adequate opportunity for wildlife to escape; provision of wildlife corridor; protection of wildlife hunting area; control of access, hunting and fishing within the project site; appointment of Ecologist or Environmental Consultant; and provide adequate notifications to relevant local authorities.

Other relevant mitigation measures include:

- *Forest fire management* – Formulation and implementation of Forest Prevention and Control Plan; provision on fire drills, training and awareness programme; prohibition of open burning on-site; provision of early warning system; and provision of fire fighting water storage and delivery facilities.
- *Archaeological protection* – Provision of sufficient buffer zone and adequate access to archaeological sites; and provide adequate notifications to relevant local authorities.
- *Traffic and transportation control* – Provision of adequate traffic signs; and proper scheduling of transportation activity.
- *Plantation management* - Proper siting and operation of nursery and chemical storage facility; formulation and implementation of Integrated Plantation Management System; and proper application, storage and handling of herbicide, pesticide and fertiliser.

- *Waste management* - Proper handling and disposal of wastes including oily waste, garbage, sewage and biomass.
- *Abandonment plan* – Removal of buildings, structures and machineries; clean-up of contaminated area; restoration of disturbed areas; control of access to the project site; and adequate closure notification to local authorities.

5.2 Main Mitigation Measures

5.2.1 Zoning of Logging Area

Area comprising of significant regions of high soil erosion risk or area marked for conservation shall be excised from the project plan or marked for development with particular care. Allowable logging and plantation area is shown in Figure 5.1. Overall cost of mitigation on prohibited logging and plantation area is estimated at RM10,000.00.

Mitigation Measures

a) Protection Area

- No logging or plantation is allowed on high soil erosion and conservation areas of approximately 10,194 ha or 10.7 % of the total area.
- Logging or plantation on other areas is allowed but proper and adequate soil erosion control mitigation measures as described in this Chapter should be employed.
- Boundaries of high soil erosion and conservation areas should be marked on map; and marked, painted with red colour, and sign posted on-site.
- Any other areas found on site with potential for high soil erosion should be excised from logging or plantation, and marked accordingly.

b) Up-date Forest Management Plan

- The existing Forest Management Plan (FMP) should be revised and up-dated to exclude logging or plantation within the protection areas (due to high soil erosion, MBCA Buffer Zone, biological buffer zone, archaeological protection area, hunting area, Phenology Area, water catchment area, boundary buffer zone, Priority Area for Elephant & Orang Utan, and Rhinoverous Area) identified in this EIA Report.

5.2.2 Provision of Riverine Reserve

Many of the physical impacts of forest logging can be minimised by the provisions of buffer zones along riverbanks and streams. This will minimise the amount of sediment entering river system, minimise erosion of riverbanks, and minimise destruction of riparian habitat. Proposed riverine reserves for local rivers are shown in Figure 5.1. The overall cost of riverine reserve mitigation is estimated at RM25,000.00.

Width of riverine reserve is determined based on Sabah Water Resources Enactment. Part VII Section 40(1), which states that river reserve should be at least 20 m on each bank, for river channel not less than 3 m in width. In addition, Jabatan Perhutanan guidelines recommend riverine reserve of 30 m on each bank, irrespective of river width, to minimise impact to the river from tree felling operation.

There is approximately 1092 km length of rivers and streams within the project site, with 171 km are considered as main rivers with width exceeding 3 m.

Mitigation Measures

a) Protection of River

- Riverine reserve for Sg Sansiang, Sg Saburan, Sg Salung, Sg Lalobou, Sg Palangan and Sg Pinangah should be at least 50 m each bank. Large riverine reserve is required for wildlife corridor.
- Riverine reserve for Sg Simatuoh, Sg Sablangan, Sg Tibow, tributaries of Sg Sansiang and tributaries of Sg Sapulut should be at least 50 m each bank. Large riverine reserve is required as rivers/steams are used for water supply.
- Riverine reserve for rivers having width more than 3 m but less than 20 m (Sg Siliawan, Sg Lombunaan, Sg Sakikilan, Sg Sabunutan, Sg Sablangan, Sg Beliar and Sg Sinikalaun) should be at least 30 m each bank.
- Riverine reserve for other streams within site (river width less than 3 m) should be at least 5 m each bank.
- Riverine reserve of 12,538 ha or 13.2 % of the total area should be marked on map; and marked, painted with red colour, and sign posted on-site. No logging or plantation is allowed within riverine reserve.
- Any other streams found within site should be provided with appropriate riverine reserve, marked, painted and sign-posted accordingly.
- Riparian areas which have been cleared from previous logging activity should be immediately replanted and appropriate width of riverine reserve should be provided. As a guide, large rivers (width greater than 20 m) or use for water supply should be provided with riverine reserve of at least 50 m each bank, and small rivers (width between 3 to 20 m) should be provided with riverine reserve of at least 20 m each bank.

5.2.3 Soil Conservation

Applying appropriate soil engineering control measures can control soil erosion rate. The overall cost of soil erosion control measures is estimated at RM25,000.00.

Mitigation Measures

a) Stage Logging/Plantation

- Stage operation to avoid the concentration of successive cuts or logging/plantation in one contiguous area. Minimise size of exposed area by limiting each block of logging to between 50 to 100 ha and of plantation to between 40 to 50 ha. Phase logging and plantation based on compartments is shown in Figure 3.3 earlier.
- Plantation activity should be staged to minimise the size of exposed areas and the length of time the areas are exposed. The period between end of land clearing and start of plantation should be limited to not more than three months.
- The timing of land preparation should coincide with a dry season or a period of lower erosion potential. Lower erosion rate is expected during dry season as the rainfall intensity is low.

b) Soil Preparation

- In preparation for ITP area, minimise the extent of soil impacted from the usage of heavy machinery. For this reason, it is better to use bulldozers only for road re-construction, but use manpower and front-loaders for work on all soil surfaces that are to be planted. The front-loaders should be operated on top of felled vegetation (felled small trees, branches, leaves) to minimise exposure of bare soil and minimise compaction.

- Maximise the retention and coverage of plant material over the soil, where fire should be the last option for land clearing and preparation for ITP area on less fertile soils on slope. Fire is recommended only for land preparation for tree plantations in fertile lowlands where there is minimal erosion and soils are inherently fertile.

c) Soil Restoration

- Felled small-size trees (less than 30 cm dbh) should not be transported to main logging roads using heavy machinery, but best leave them on-site for soil restoration purposes.
- Alternatively, skidding can be done by manpower and winching to the road with long cable, to minimise soil impacts and potential employment opportunity to local population.

d) Erosion Control

- Vegetation is the most cost-effective form of erosion control as it prevents erosion rather than controls it. Where necessary, large exposed areas such as landing / stumping point should be re-vegetated with fast growing species. Leguminous cover plants such as *Calopogonium caeruleum*, *Centrosema pubescens* and *Pueraria javanica* can be used.
- Minimise length and steepness of slopes to reduce the velocity of runoff, thus reducing potential for erosion. For long or steep slopes, break up the slopes with terraces at regular intervals. Terraces will slow down the runoff and provide a place for small amounts of sediment to settle out. Stop bund shall be constructed at intervals of 10 m.
- Fit the construction of logging/plantation roads, skidding trails and landings to the existing terrain. When development is tailored to the natural contours of the land, little grading is necessary and erosion potential is consequently lower.

e) Perimeter Drainage

Divert runoff away from the campsite and stumping/landing points. This can be achieved by either diverting runoff to grass/vegetation area or to sedimentation pond for hilly or steep area. To minimise soil erosion and sedimentation, construction of strategically located silt-traps and their network of perimeter and feeder drains is recommended for main campsites. Use dykes or ditches to divert upland runoff away from the disturbed area to a stable outlet. Runoff from this drainage shall be directed to sedimentation ponds prior to final discharge.

- The location of drainage should be chosen to ensure that surface runoff flow to this drain before entering sedimentation pond and finally natural river/stream.
- Drain size should be able to handle peak runoff but should not less than the following dimensions: top width 1.0 m, bottom width 0.8 m, and depth of 0.5 m.
- Perimeter drainage should be maintained regularly by removing deposited silt, once monthly during dry period and once weekly during rainy period.
- Drain should not be constructed within the riverine reserve.

f) Sedimentation Pond

For hilly / steep area or large campsite, the use of sedimentation pond as final disposal is recommended. The pond should trap sediment on site by allowing the soil particles settling before final discharge to receiving waters. They serve by trapping the silt, hence "filtering" the water before discharge. The sedimentation ponds should be constructed and operated prior to any setting of main campsite or stumping points.

- Sedimentation pond should be provided at the final drainage outlet before entering natural river/stream (Figure 5.3).
- The number of pond should be able to handle maximum soil erosion but should not less than two with each pond has the following minimum dimensions: length 10 m, width 3.5 m, and depth of 2.0 m.
- The location of pond should be chosen to ensure that surface runoff from the perimeter drain enter the sedimentation pond.
- The pond should be built in parallel, to enable cleaning operations of sediment to be carried out regularly.
- Sedimentation pond should be maintained regularly by removing deposited silt, once monthly during dry period and once weekly during rainy period.
- Removed silt should not be placed in area where it can be carried over back to stream/drain, but place on a dedicated area near campsite. The dumping area should be provided with perimeter drainage and removed silt should be compacted once a week. Dumping area should be provided with 0.5 m bund, compacted and re-vegetated.
- Outlet of pond should be on top (weir type) to ensure effective retention of silt. For this reason, pond downstream wall should be properly design to accommodate pore pressure loading and to avoid wall failure. Bottom outlet with culvert opening should not be used for sedimentation pond.
- Pond should not be constructed within the riverine reserve.

5.2.4 Modifying Operational Practices

Some environmental impacts can be minimised through the application of appropriate work procedures.

Mitigation Measures

a) Harvesting

- For NFM area, trees allowed for harvesting should be between 60 cm to 120 cm dbh only. All tress below 60 cm dbh shall be retained for future stocks and trees above 120 cm dbh shall be retained as "seed trees" (mother trees).

b) Logging/Plantation Roads

- Re-use old main and secondary roads, if they are found to be operationally and environmentally acceptable.
- Road up-grading or new road construction should be taken with care, minimise cutting and filling, and to be carried out during dry period only.
- The primary roads should be maintained at a density of 7 m per hectare, and the secondary roads at a density of 14 m per hectare.
- Road width should be minimised appropriate to the transportation vehicles (Table 5.1).

- Logging/plantation roads should be constructed taking into consideration the allowable maximum slopes (Table 5.1).
- All logging/plantation roads should be marked on map; marked, painted and sign posted on-site.
- All main and secondary logging/plantation roads should be properly and regularly maintained to minimise soil erosion and to allow access during bad weather.
- Provide drainage along logging/plantation roads and maintain drains systematically.
- Provision of vegetation buffer within 10 m corridor along all main logging/plantation roads to minimise soil erosion. To allow for sunlight, top cutting is allowed but low vegetation cover on soil must be maintained within the 10 m corridor.

Table 5.1: Logging Road Specifications

Type of Road	Max Road Width (m)	Max Slope (degree)
Main Road	10	4.6
Secondary Road	8	5.7
Haul Road	6	8.5
Skid Trail	5	25.0

c) Skid Trails

- Re-use old skid trails, if they are found to be operationally and environmentally acceptable.
- Distance of skid trails should be minimised, with total area of all skid trails for NFM area should not more than 6 % of total logging area, and total area of all skid trails for ITP area should not more than 12 % of total plantation area.
- Main skid trails for NFM area should be marked on map; marked, painted and sign posted on-site.
- No ground skidding across streams or along riverine reserve to minimise soil damage and erosion.
- Avoid creation of excessive and long skid trails to minimise soil erosion.

d) Landings

- Re-use old stumping points or landings, if they are found to be operationally and environmentally acceptable.
- Each landing area should not more than 0.5 ha (e.g. 50 m x 100 m) for NFM area, and not more than 1.0 ha (e.g. 100 m x 100 m) for ITP area.
- Number of stumping points and landings should be minimised, with total area of all stumping points and landings within NFM area should not more than 0.7 % of total logging area, and total area of all stumping points and landings within ITP area should not more than 1.5 % of total logging/plantation area.
- Stumping points or landings should have gentle slope of between 2 to 3 degrees, and not constructed within riparian reserve.
- Main stumping points or landings located within steep area should be provided with adequate drainage and sedimentation pond (Figure 5.2).
- Stumping points or landings should not be sited within riverine reserve and to be located away from river/stream (at least 50 m).

e) Campsite

- Re-use old campsites, if they are found to be operationally and environmentally acceptable.
- Each campsite area should not more than 0.4 ha (e.g. 50 m x 80 m) for NFM area, and should not more than 1.0 ha (e.g. 50 m x 200 m) for ITP area.
- Campsite should not be sited within riverine reserve and to be located away from river/stream (at least 50 m).
- Main campsite located within steep area should be provided with adequate drainage and sedimentation pond (Figure 5.2).

f) Stream Crossings

- Adequate provisions should be made for stream crossings such as culvert or bridge; no blocking or diversion of river/stream is allowed. Each crossing should have dimensions similar or larger than the existing river/stream it crosses.
- The number of crossings should be minimised.
- Upon cessation of works on NFM area, all crossings should be removed and the area rehabilitated to near original conditions and to be planted with vegetation, where necessary.
- All stream crossings should be marked on map; marked and sign posted on-site.

g) Tree Felling

- Apply directional felling to avoid tree crowns falling into river or buffers (riverine reserve or prohibited logging area), and to minimise damage to the residual stock.
- Protected species are to be protected from damage.
- Adhere strictly to tree marking rules. Trees to be felled should be painted yellow and those to be preserved should be painted red.
- No vehicle or tractor to enter a riverine reserve.

5.2.5 Socio-Economic Considerations

Socio-economic considerations include protection of water resources, provisions of employment and business opportunities to local population, and public participation in social and economic activities. The overall cost of socio-economic considerations is estimated at RM25,000.00.

Mitigation Measures

a) Protection of Water Catchment

- Surface runoffs from the project area should be controlled to ensure that water catchments and intake points of local population are not affected. Construction of perimeter bund, adequate drainage and sedimentation ponds to treat or divert surface runoffs should be considered to ensure continuous protection of water resources.
- No plantation is allowed within the proposed Tibow Water Catchment (Compartments 158, 159, 160, 162, 166 & 167) of approximately 690 ha.
- No plantation is allowed within the water catchment areas of Kg Tataluan, Kg Simatuoh, Kg Samuran, Kg Tonomon and Jabatan Perhutanan Tibow of approximately 5,200 ha.
- Boundaries of water catchment areas should be marked on map; and marked, painted with red colour, and sign posted on-site.

b) Protection of Water Resources

- The project proponent should assist the affected local population in providing clean water supply by providing monetary or equipment assistance either in the forms of gravity feed systems, drums, wells, pumping facilities and water distribution systems.
- In conjunction with other logging operators in the area, ensure that local population water supply and their daily livelihood is not affected by the logging/plantation operation.
- If required, any monetary or equipment assistance to the affected local population shall be discussed and agreed by Pejabat Daerah, JKKK or Ketua Kampong.

c) Community Forest

- Implement tree farming project as part of Community Forestry Programme. Under this scheme, private land owners should be given subsidised planting material and free technical advice to enable them to establish wood lots in their idle land.
- Provide business opportunities to the local population particularly in the field of clearing and maintaining project external boundaries, and supplying plantation materials.

d) Eco-tourism

- In callobration with local population, identify potential eco-tourism opportunities. Batu Saap, Batu Punggul, Batu Tinahas Cave and Tibow have the potential to be developed into full-fledged eco-tourism areas.
- Assist local population in the setting up of eco-tourism activity particularly in prociding access, technical advise and where necessary initial capital costs.

e) Road Network

- Assist local population in providing road access to their villages.
- Ensure that road access is properly maintained at all times, particularly during rainy period.

f) Employment

- Preference for employment should be given to local population. This will provide some opportunities for the local people to participate in the development of the project, as well as providing them with an opportunity to earn extra income. In addition, their employment will prevent social resentment and conflicts, increase their positive feelings towards the project, and create a sense of pride towards the development of the area.

g) Dialogue

- Set-up proper programme of public relations. Two-way communications through dialogue help both parties to understand each other, set a forum for understanding, and establish rapport.
- Conduct a proper public relation exercise involving local authorities (including Pejabat Daerah Nabawan and Jabatan Perhutanan Tibow). Information about the numerous benefits of the project and the associated environmental impacts should be made readily available to the public.

- Hold regular meetings/dialogues with the affected population and their community leaders (including KAN, JKKK and Ketua kampong). The project proponent should explain to the villagers the nature of the project, the extent to which it will affect the villagers, and the mitigation measures undertaken or to be taken by the project proponent.

5.2.6 Flora & Fauna Protection

Biological species affected by the project or sensitive biological areas in the immediate vicinity should be protected. The overall cost for biological protection is estimated at RM50,000.00.

Mitigation Measures

a) Protection of Maliau Basin Conservation Area

- Prohibit logging or plantation activity within Buffer Zone 1 of Maliau Basin Conservation Area (approximately 8,495 ha).
- Prohibit plantation activity within Buffer Zone 2 of Maliau Basin Conservation Area (approximately 20,641 ha). Only NFM logging activity is allowed within this area.
- Boundaries of both MBCA Buffer Zones should be marked on map; and marked, painted with red colour, and sign posted on-site.
- Any rehabilitation activity within both MBCA Buffer Zones should be carried out with native species only.

b) Protection of Sensitive Area

- Prohinit logging or plantation activity within Phenology Area of 120 m.
- Provide biological buffer zone between the project site, protected areas of Sg Siliawan Virgin Jungle Reserve, Sg Sansiang Virgin Jungle Reserve and Phenology Area. A buffer of at least 100 m width should be established along boundaries of these sensitive areas, to minimise cross-over effects. No logging or plantation activity is allowed within this area.
- Provide buffer zone between the project site and the surrounding areas, including FMU 13, FMU 25 and village area. A buffer of at least 50 m width should be established along boundaries of these areas, to minimise cross-over effects. No plantation activity is allowed within this area.
- Boundaries of the buffer zone should be marked on map; and marked, painted with red colour, and sign posted on-site.

c) Protected Wildlife

- Prohibit plantation activity within High Priority Area (approximately 8,495 ha) to protect Elephant and Orang Utan. Only NFM logging activity is allowed within this area. Based on FMP, there is no plantation planned for this area.
- Plantation activity within Priority Area (approximately 9,843 ha) and Rhinoceros Area (approximately 16,842 ha) is allowed but should only be carried out after consultation with Jabatan Hidupan Liar. NFM logging activity is allowed within this area.
- Provide wildlife corridor within High Priority Area (southeast of the project site) to allow movements of Elephants and Orang Utans between Danum valley and Indonesian border. No logging or plantation activity is allowed within this area.
- Boundaries of High Priority Area, Priority Area and Rhinoceros Area should be marked on map; and marked, painted with red colour, and sign posted on-site.

d) Protection of Salt Lick

- Provide biological reserve within the salt lick (Compartment 251), with buffer zone of at least 100 m radius from outer boundary, to minimise the cross over effect. No logging or plantation activity is allowed within this area.
- Provide access of at least 50 m width from Sg Salung and Sg Lalobou to the salt lick. No logging or plantation activity is allowed within this area.
- Boundaries of biological buffer zone and access should be marked on map; and marked, painted with red colour, and sign posted on-site.

e) Faunal Protection

- Provide adequate opportunity for the wildlife to escape and seek refuge in the nearby undisturbed area by implementing stage logging/plantation.
- Large animal population within the project area should be protected by providing wildlife corridor, particularly along Sg Sansiang, Sg Saburan, Sg Lalobou, Sg Palangan, Sg Salung and Sg Pinangah. Riverine reserve of at least 100 m each bank should be provided along these rivers. No logging or plantation activity is allowed within this area.
- Identify other specific location or route taken by protected species of terrestrial animals, arboreal mammal, aquatic reptiles and birds within the project site, and provide appropriate signs / notices to warn others, particularly road users and local population.

f) Floral Protection

- Impose control on collection of protected floral species such as *gaharu*. Appropriate information should be posted at the project site office/quarters and sign posted on-site.
- Identify protected trees (including protected fruit tree species, fig trees and fern), herbs, green belts and landscape/ecological/architectural features of high value within the project area for preservation purposes.
- Protected floral species or trees should be marked on map; and marked, painted with red colour, and sign posted on-site.

g) Hunting

- Prohibit logging or plantation activity within the identified hunting areas (Compartments 48, 63, 86, 87, 216, 217, 219, 232, 250, 252, 253, 256 & 257) to ensure continuous supply of wildlife for the benefits of local population.
- Protected local hunting areas should be marked on map; and marked, painted with red colour, and sign posted on-site.
- Animal hunting within the project site is prohibited, either by workers, their family or unauthorised personnel. Hunting licence from Jabatan Hidupan Liar is required for such activity.
- Appropriate information on prohibition of hunting should be posted at the project site office/quarters and sign posted on-site. All workers including family members should be briefed/educated when reporting for duty. Quarterly briefing should also be carried out to remind them of illegal hunting.
- Number of workers staying on-site (including family members) shall be minimised to reduce the potential of poaching.
- Anti-poaching measures including regular patrol, security check at salt lick, access points and staff quarters should be carried out by the project proponent.

h) Notification

- Notify Jabatan Hidupan Liar, at least 30 days prior to the commencement of logging/plantation operation.
- Immediately notify Jabatan Hidupan Liar on discovery of any protected faunal species such as Elephant, Orang Utan, Rhino; or any significant biological habitats such as salt lick; and not to log or plant within such area.
- Notify Jabatan Perhutanan on discovery of any protected floral species such as Lampias, Polod; and not to log or plant within such area.
- Notify Jabatan Perikanan on discovery of any protected or unique aquatic species; and not to log or plant with such area.

i) Administration

- Prohibited ecological area, buffer zone or area of discovery of protected or unique floral or faunal species should be marked appropriately (on-site and on map) and excluded from logging/plantation.
- Carry out logging/plantation with extreme care on areas of ecological/botanical significance due to the presence of protected/sensitive floral and faunal species.
- For purpose of biological protection, appoint a qualified full time employee as Environmental Management Officer.

5.3 Additional Mitigation Measures

5.3.1 Forest Fire Management

Mitigating measures to minimise fire hazard include prohibition of open burning and provision of early warning system. The overall cost for forest fire control is estimated at RM20,000.00

Mitigation Measures

a) Fire Management

- Formulate and implement “Forest Fire Prevention and Control Plan”.
- Conduct regular fire drills, training and awareness programme on forest fire.
- Construct and maintain fire break of between 5 to 10 m width on high risk areas such as plantation edge bordering water catchment or human settlement area. Such fire break shall be passable by fire crew or four-wheeled drive vehicle.

b) Fire Warning System

- Provide early warning system including fire look out towers and regular patrolling.
- Provide water storage and delivery facilities, and identify water resources for fire fighting.

c) Controlled Burning

- For purpose of silvicultural treatment, controlled or prescribed burning is allowed within ITP area based on the acceptable smoke management conditions.
- Obtain written approvals from Jabatan Perhutanan and Jabatan Alam Sekitar Malaysia prior to any burning activity.

- Strict burning procedures should be observed including (i) burning to be carried out in 2 to 3 blocks, with total area of approximately 100 hectares at any one time; (ii) each block should be surrounded by plantation track which acts as firebreak; (iii) a fire fighting should be stationed at the burning site; (iv) ground should be lighted from the perimeter of the block so that the fire will burn towards the centre of the block; (v) burning is permitted only when the fire danger rating is medium or less, i.e. the Keetah-Byram Drought Index (KDBI) is in the range of 100 to 120; and (vi) burning is permitted only when the atmospheric ventilation is good and wind flow will not carry out the smoke to populated area.
- No burning is allowed within 100 m from project boundary to minimise fire to the surrounding area, particularly Sg Siliawan V.J.R., Sg Sansiang V.J.R., Phenology Area, Tibow Water Catchment, local villagers water catchments, FMU 13, FMU 25 and local settlements.
- Each controlled burning should be documented and marked on map.

d) No Open Burning

- Prohibit open burning on-site, either for waste, garbage or biomass disposal.

5.3.2 Archaeological Protection

There is no known or gazetted archaeological in the project area. However, in case of discovery or presence of significant archaeological/historical sites or areas with tourism potentials, logging/plantation should be carried out with extreme care. The overall cost for archaeological protection is estimated at RM10,000.00

Mitigation Measures

a) Archaeological Site

- Provide archaeological reserve within Batu Saap, with buffer zone of at least 50 m from outer boundary. No logging or plantation activity is allowed within this area.
- Provide access of at least 10 m width from main road (Jalan Sapulut – Kalabakan) to Batu Saap, Batu Punggul and Batu Tinahas Cave. No logging or plantation activity is allowed within this area.
- The archaeological protection area and road access should be marked on map; and marked, painted with red colour, and sign posted on-site.
- Any other archaeological found within the project site should be provided with appropriate buffer zone, marked, painted and sign-posted accordingly.

b) Burial Site

- Provide archaeological reserve within any burial sites found within the project site. Each protection area should have a minimum buffer zone of at least 50 m from outer boundary. No logging or plantation activity is allowed within this area.
- The protected burial sites should be marked on map; and marked, painted with red colour, and sign posted on-site.
- Any other burial sites found within the project site should be provided with appropriate buffer zone, marked, painted and sign-posted accordingly.

c) Notification

- Notify Jabatan Muzium and Ketua Kampong of nearest village on discovery of any significant archaeological or historical artefacts; and not to log or plant within such area. Items of concerns include unique jars, burial sites, stone monuments, earth monuments, historical travel routes, or caves.
- Notify Kementerian Pelancongan, Kebudayaan dan Alam Sekitar Sabah on discovery of any significant tourism areas or botanical interests such as waterfalls, lakes, hills, mountains, caves; and not to log or plant within such area.

d) Administration

- Prohibited archaeological area and access; or area of discovery of archaeological/historical significant, high tourism potentials or botanical interests should be marked appropriately (on-site and map) and excluded from logging/plantation.

5.3.3 Traffic & Transportation

Mitigating measures to control traffic and improve safety include provisions of traffic sign and proper scheduling of transportation activity. The overall cost for traffic control is estimated at RM10,000.00.

Mitigation Measures

a) Traffic Signs

- Provide appropriate traffic signs near entrances to project site, at main road junctions, campsite, nursery and near populated areas / townships to warn other road users of transportation activity.

b) Transportation Control

- Schedule transportation activity not to enter or leave populated areas or major townships during peak hours or night-times. In case of specific operational requirements (due to weather window or high demand) which require night-time operation, consultation with local villages shall be made, prior to commencement of transportation activity.
- Where necessary, control dust generated by transportation activity, particularly near populated areas. Systematic water spraying should be carried out, at least two to four times a day during dry periods.

c) Transportation Safety

- Movements of logging trucks and transportation vehicles should be controlled so that local traffic activity, particularly near human settlements or major townships would not be affected.
- Movements of scow or barge should be controlled so that local navigation activity would not be affected.
- Logging trucks, transportation vehicles, scow, barge and workboat should be prominently lighted up so that they are visible at night or even during poor weather conditions.
- Comply fully and at all times with the requirements of Jabatan Pengangkutan Jalan and Police for operational activities on land, and Jabatan Laut and Jabatan Pelabuhan dan Dermaga for operational activities over water.

d) Pedestrian Safety

- Proper and adequate pedestrian crossings shall be provided to allow public movements, particularly near human settlements, school, balai raya and clinics. The proposed locations are shown in Figure 5.1.

e) Wildlife Safety

- Wildlife crossing should be provided along main logging/plantation roads, particularly Jalan Sapulut – Kalabakan (Figure 5.1). Provide at-grade crossings near elephant migration area and salt lick area, with sign post of wildlife crossing located at 100 m before the crossing.

f) Administration

- Obtain approval from Jabatan Kerja Raya or Pejabat Daerah Nabawan, prior to connection of logging/plantation roads to public roads or use of public roads as logging/plantation roads.
- Consultations with Police, Pejabat Daerah Nabawan, Jabatan Pengangkutan Jalan, Police, Jabatan Kerja Raya, JKKK and Ketua Kampong should be held regularly to discuss issue pertaining to the project transportation activity. Quarterly meeting is recommended.

5.3.4 Plantation Management

Mitigating measures to improve plantation activity include proper siting of nursery, the setting-up of proper chemical storage facility, and proper application and handling of herbicide, pesticide and fertiliser. The overall cost for plantation management is estimated at RM20,000.00.

Mitigation Measures

a) Nursery

- Nursery shall be sited more than 50 m from any stream / river.
- Runoffs from nurseries should be controlled and routed to a properly designed sedimentation pond for neutralisation before final discharge

b) Chemicals

- Chemical store shall be sited more than 50 m from any stream / river. The storage facility shall be fenced, covered, bunded, has impervious floor and provided with proper drainage.
- Chemicals should be stored in proper container to minimise spillage.
- Excess or off-specification or water contaminated with herbicide, fertilizer and pesticide should be disposed of properly to an approved facility, at least once per year.
- Minimise use of fertilizer. Instead use compost media from paddy straw or others natural material.
- Practice manual method such as slashing during weeding to avoid excessive use of herbicide in replanting activities due to harmful affects to wildlife habitat or water quality.

c) Administration

- Formulate and implement "Integrated Plantation Management Programme" on plant vigour to promote resistance to insects and disease; utilising natural fertilisers; and biological insect control to maximum extent possible.

5.3.5 Waste Management

Mitigating measures to minimise impacts of improper wastes disposal include the setting-up of temporary oily storage facility and dedicated garbage dumpsite, regular disposal of oily waste to authorised site, and controlling disposal of biomass. The overall cost for waste management is estimated at RM10,000.00.

Mitigation Measures

a) Hazardous Material/Waste

- Collect used oil and oily wastes from logging/plantation machinery and transportation vehicles, and store in proper container for future disposal. The temporary storage facility shall be fenced, covered, bunded, has impervious floor and provided with proper drainage. The facility shall be sited more than 50 m from any stream / river.
- Disposed of oily wastes to approved facility for final disposal, at least once per year.
- Construct non-permeable bund surrounding the fuel storage tank to ensure that no oil enters stream, in case of spillage or leakage. The facility shall be sited more than 50 m from any stream / river.

b) Garbage

- Collect and place garbage near campsite, away from river/stream.
- Final disposal should be by means of burying. An area of 30 m wide, 30 m long and 5 m depth should be provided, lined with geotextile material. Dumpsite should be compacted and filled with 2 cm layer of earth weekly, to prevent odour and health problem.
- Burning of garbage or solid wastes within the project site or direct disposal to river or lower ground is strictly prohibited.

c) Biomass

- Biomass from logging/plantation should be secured on site, prevent from entering waterways, and disposed of properly. Waterways filled or blocked by biomass/ debris should be cleared and restored to near original conditions.
- Composting should be encouraged on-site, but no burning is allowed to prevent air pollution and forest fire.
- Investigate the use of felled small-size trees (less than 30 cm dbh) such as *Macaranga hypoleuca* (mahang daun putih) and *Tristaniopsis* (palawan) for core veneer.

d) Sewage Facility

- Sewage discharges from campsite should be directed to on-site basic treatment facility such as septic tank, prior to final discharge.

5.3.6 Abandonment

Mitigating measures to minimise impacts from abandonment include clearing up campsite, block access and informing appropriate authorities. Areas of concerns are the NFM area, which are not involved in plantation activity. The overall cost for abandonment control is estimated at RM20,000.00.

Mitigation Measures

a) Site Clean-up

- All structures that cannot be made safe or cannot be assured to remain safe with time should be demolished.
- All materials shall be removed and any land contaminated with oily wastes/garbage should be cleaned / remedied.
- All stream crossings should be removed and area restored to near original conditions

b) Site Control

- Access to and from the site should be closely monitored by establishing a well guarded gate, and displaying appropriate warning signs.
- Blocking of old logging roads should be carried out after the project has ceased or abandoned, to prevent access by poachers and illegal settlers.
- Appropriate authorities such as Jabatan Perhutanan, Jabatan Hidupan Liar, EPD, DOE, Pejabat Daerah, JKKK and Police should be informed of the site closure.

c) Rehabilitation

- Unstable area such as steep slopes should be stabilised/rehabilitated to minimise landslide and soil erosion.
- Abandoned logging or plantation roads should be re-planted with high quality trees to improve ground conditions and to prevent unauthorised access.
- Large exposed areas should re-vegetated with fast growing species such as legume. The re-vegetation should start immediately upon completion of each logging/plantation phase, and not upon the final abandonment.

5.4 Secondary Mitigation Measures

When it is not possible to directly mitigate the environmental impacts, secondary mitigation measures can be employed.

5.4.1 Road Improvements

Roads connecting the project site and public roads are also used by local population. Use of heavy vehicles and high frequency might result in structural damage and increased maintenance costs. Approval is required for the construction and maintenance of public road from Jabatan Kerja Raya and Pejabat Daerah Nabawan.

Mitigation Measures

- Where necessary, maintain regularly roads linking project site and public roads, in conjunction with other logging/plantation operators in the area.

5.4.2 Wildlife Improvements

The area surrounding the project site is known for the existence of protected floral and faunal species. The project proponent should participate in conservation of wildlife as well as protecting the safety of the local population.

Mitigation Measures

- If required, provide assistance in identifying/relocating large wildlife and in protecting local population, in conjunction with other logging/plantation operators in the area.

5.4.3 Archaeological Improvements

The area surrounding the project site is known for Murut legends and tourism sites. The project proponent may contribute to the up-keeping of these ancient sites and in addition could provide some financial assistance on research of local legends or conduct further site investigation on locations of other historical sites.

Mitigation Measures

- If required, provide assistance on up-keeping of local legends or conduct further site investigation on locations of other historical sites, in conjunction with other logging/plantation operators in the area.

5.4.4 Reduced Impact Logging (RIL) Technique

Logging based on conventional technique may cause severe damage to the environment from high soil erosion rates. Jabatan Perhutanan recommends that RIL technique be used for logging within gazetted commercial forest reserve. It is reported that RIL techniques can reduce incidental-logging damage to both the timber stand and soil by up to 50 %. Compared to conventional logging, which cause severe damage density of between 60 to 80 % over net logged area, RIL technique only cause low to medium level with damage density of between 30 to 40 % over net logged area.

Mitigation Measures

- Comply fully with Jabatan Perhutanan requirements, procedures and methodologies on application of RIL techniques for logging within Natural Forest Management (NFM) area.

Figure 5.1: Proposed Mitigation Measures

Figure 5.2: Typical Campsite & Stumping Point Arrangement

Figure 5.3: Typical Sedimentation Pond Arrangement

6 RECOMMENDED MONITORING PROGRAMME

It is recommended that the project proponent undertake an environmental monitoring programme during the project operational phase.

The aims of this monitoring are:

a) To identify potential problem areas related to the construction and operational, thus allowing the project proponent to implement changes that will reduce any exposure to statutory environmental legislation.

b) To provide a body of scientific data to support the statement that the project proponent is a competent and environmentally aware operator.

c) To provide insurance for the project proponent in the event of growing public and local authority opposition and likely future complaints.

d) To provide monitoring data for future environmental auditing.

Monitoring report should be presented to EPD on half-yearly basis to include requirements in this chapter (Figure 6.1). The monitoring report shall address activities within the existing work area for that particular period only, except of impact monitoring, which should be carried out continuously.

Based on topography, biological and socio-economic considerations, area of concern include (i) northeast area along boundary with Maliau Basin Conservation Area; (ii) southeast area due to presence of large protected wildlife notably elephants; (iii) southwest area due to presence of salt lick; (iv) montane forest area; and (iv) virgin jungle reserve areas.

6.1 Compliance Monitoring

Implementation of mitigation measures recommended in Chapter 5 should be monitored by the project proponent to ensure that the potential adverse significant impacts are controlled or minimised. Cost of compliance monitoring is estimated at RM30,000.00 per annum.

6.1.1 Prohibited Logging / Plantation Area

- Layout plan and photographs of prohibited logging or plantation areas of 33,834 ha or 35.5 % of the total area, showing boundary marking and signage.

Prohibited Logging or Plantation	***Area (ha)***
Conservation	3,685
Steep Slope	6,509
Riverine Reserve	12,538
MBCA Buffer Zone 1	8,495
Phenology Area	120
Biological Buffer Zone	270
Hunting Area	2,215
Archaeology	2
TOTAL	***33,834***

- Layout plan and photographs of prohibited plantation area of 8,140 ha or 8.5 % of the total area, showing boundary marking and signage.

Prohibited Plantation	***Area (ha)***
Water Catchment	5,890
Boundary Buffer Zone	2,250
TOTAL	***8,140***

- Layout plan and photographs of allowable plantation area of 26,685 ha or 28 % of the total area (after consultation with Jabatan Hidupan Liar), showing boundary marking and signage.

Prohibited Plantation	***Area (ha)***
Priority Area for Elephant & Orang Utan	9,843
Rhinocerous Area	16,842
TOTAL	***26,685***

- Use of satellite images to map out logging and plantation areas should be considered. Satellite imagery should be taken at various stages during the life cycle of the project to monitor compliance on riverine reserves, steep slopes, buffer zones, phase logging or plantation, burnt area. Recommended imagery is SPOT, with resolution of 20 metres for multi-spectral images and 10 metres for panchromatic. The land area covered by a full SPOT image is 60 km by 60 km. Recommended frequency is once per year.

6.1.2 Soil Conservation

- Layout plan and photographs of logging and plantation area (including phase logging/plantation, main logging/plantation roads, secondary roads, haul roads, skid trails, campsite, nursery, stumping points, landings, stream crossings, etc.).
- Actual logging, land clearing/preparation and plantation operations schedule indicating date, locality, period and area in map and descriptions. [*Example:* 1 – 15 April of 300 ha within compartments 233 and 234].
- Copy of land preparation techniques including period between land clearing and plantation, and size of affected area.
- Sedimentation ponds and drainage ways (locations on layout plan, photographs and specifications).
- Actual maintenance schedule of ponds and drainageways, where necessary [*Example:* For April, pond maintenance was carried out once – Period: 2 April].

6.1.3 Modifying Operational Practices

- Percentage of total logging and plantation area with respect to logging/plantation roads, skid trails and landings.
- Location and description of new logging/plantation roads constructed, existing logging/plantation roads re-used and old logging/plantation roads abandoned.
- Monthly volume and type of area planted or logs felled / taken out from concession area.
- Layout plan, photographs, location, and dimensions/area of each landing, stumping point, campsite and nursery.

6.1.4 Socio-Economic Considerations

- Layout plan and photographs of local gravity water system and water supply intake points.
- Layout plan and photographs of undisturbed or protected water catchment areas including the proposed Tibow Water Catchment and local villagers' water catchment, showing boundary marking and signage.
- If required, copy of letter on contributions to the affected local population on water supply protection, with agreement/endorsement by respective Pejabat Daerah, JKKK or Ketua Kampong.
- Photographs of water storage or distribution facility for the affected local villagers.
- Copy of programme of local population (number of people and their villages) participation in the project including community forest, eco-tourism, road network, employment or cultural activity.
- Copy of public relation programme with the affected local population/authorities.

6.1.5 Flora & Fauna Management

- Layout and photographs of MBCA Buffer Zone 1 and MBCA Buffer Zone 2, showing boundary marking and signage.
- Layout and photographs of ecological buffer zone to Phenology Area and Sg Siliawan and Sg Sansiang Virgin Jungle Reserves, showing boundary marking and signage.
- Layout and photographs of High Priority Area and Priority Area for Elephant and Orang Utan, and Rhinocerous Area, showing boundary marking and signage.
- Copy of approval letter from Jabatan Hidupan Liar on plantation activity within Priority Area.
- Layout and photographs of biological reserve and access to salt lick, showing boundary marking and signage.
- Layout and photographs of wildlife corridor, showing boundary marking and signage.
- Copy of letter, awareness/training programme and photographs of signage to inform workers of no illegal hunting or fishing or prohibition of collection of floral species.
- Photographs of access gate control between the project site and surrounding areas.
- Layout plan and photographs of allowable wildlife hunting area, showing boundary marking and signage.
- Copy of anti-poaching measures undertaken within the project site.
- Copy of letter of notification to Jabatan Hidupan Liar prior to commencement of logging/plantation operation.
- Name and designation of the appointed Ecologist, Wildlife Expert or Environmental Consultant.
- Incident of discovery of protected floral or faunal species within project site (stating location, species, numbers, and authorities consulted/informed).

6.1.6 Forest Fire Management

- Copy of approved "Forest Fire Prevention and Control Plan (FFPCP)".
- Annual report on implementation of FFPCP including fire drills, training, and awareness programme.
- Layout plan and photographs of fire break area, showing boundary marking and signage.
- Layout plan and photographs of fire prevention and control facilities including fire board, fire prevention signage, fire tower, water storage tank and fire fighting facilities.
- Layout plan, photographs and description of prescribed/controlled burning activities for ITP area.
- Layout plan and documented forest fire incidents, both within and in the immediate vicinity of the project site.

6.1.7 Archaeological Management

- Layout plan and photographs of buffer zone and access of Batu Saap archaeological site, showing boundary marking and signage.
- Layout plan and photographs of access to archaeological sites of Batu Punggul and Batu Tinahas Cave showing boundary marking and signage.
- Incidents on discovery of archaeological artefacts or tourism areas (stating location, type and authorities consulted/informed).

6.1.8 Traffic & Transportation Control

- Layout plan and photographs of traffic signs at project site, main road junctions, campsite, nursery and human settlements / townships.
- Photographs of main logging/plantation roads; and logging trucks, transportation vehicles, barge/scow and workboats involve in the transportation activity.
- Actual transportation activity schedules indicating quantity, no of trips, route, period and destination.
- Layout plan and photographs of pedestrian and wildlife crossings.
- Copy of approval letter from local authorities on construction or maintenance of logging/plantation roads connected to public road.
- Minutes of meeting on consultation with local population/authorities on project transportation activity.

6.1.9 Plantation Management

- Copy of approved "Integrated Plantation Management Programme (IPMP)".
- Annual report on the implementation of IPMP including type, quantity and specification of herbicide, pesticide and fertiliser used for plantation activity.
- Layout plan and photographs of nursery.
- Layout plan and photographs of chemical storage and disposal areas including storage area, floor system, drainage and signage.
- Incidents of pests and disease affecting plantation.

6.1.10 Waste Management

- Layout plan and photographs of the oily waste temporary storage area, garbage dumping site, biomass disposal area and sewage facility including storage area, floor system, drainage and signs.
- Monthly volume and type of wastes and biomass generated, handled, stored and disposed of. If disposed of outside project area, information on quantity, type and destination.
- Investigation data on the use of felled small-size trees for core veneer.

6.1.11 Abandonment Plan

- Layout plan and photographs of the abandoned area (including clean-up site, slope rehabilitation, re-vegetated area, removal of stream crossings, signs/notices), where necessary.
- Layout plan and photographs of abandoned site access and signage.
- Copy of notification letter to local authorities on project abandonment.

6.2 Impact Monitoring

In addition to the compliance monitoring, the project proponent should also carry out additional monitoring to ensure that other factors affecting the environment can be determined. Cost for this monitoring is estimated at RM20,000.00 per annum.

6.2.1 Water Quality

- Environmental monitoring of water quality along the rivers (Figure 6.1). *Locality*: 15 stations - (i) Sg Sapulut (W1); (ii) Sg Siliawan (W2); (iii) Sg Pinangah (W3); (iv) Sg Saburan (D/S) (W4); (v) Sg Saburan (U/S) (W5); (vi) Sg Sansiang (U/S) (W6); (vii) Sg Sansiang (D/S) (W7); (viii) Sg Tibow (W8); (ix) Sg Sansiang (W9); (x) Sg Simatuoh (W10); (xi) Sg Beliar (W11); (xii) Sg Salung (W12); (xiii) Sg Sinikalaun (W13); (xiv) Sg Logongon (W14); and (xv) Sg Sapulut (W15). *Parameter*: Suspended solids, turbidity, oil & grease. *Frequency*: (i) Quarterly during operation, and (ii) quarterly after abandonment for the next six months. *Limits*: (i) Suspended solids – 50 mg/L; Turbidity – 50 mg/L; Oil & Grease – Not detectable.
- Photographs of water quality conditions along Sg Siliawan, Sg Pinangah, Sg Lombunaan, Sg Saburan, Sg Sansiang, Sg Tibow, Sg Palangan, Sg Sakikilan, Sg Sabunutan, Sg Beliar, Sg Kuala Sumatalun, Sg Sinikalaun, Sg Salung, Sg Lalobou, Sg Simatuoh, Sg Sapulut, Sg Pampangon and Sg Logongon (within project site and along 1 km downstream from project boundary).
- Any incidences or complaints on water quality contamination from high turbidity or oil contamination.

6.2.2 Meteorology

- Monitoring of meteorological conditions (Figure 6.1). *Locality*: 1 station - (i) SFD Campsite (M1). *Parameter*: Temperature; Relative humidity; Rainfall; Evaporation; and Surface wind. *Frequency*: (i) Daily.
- Annual analysis should be carried out to determine the trend of meterological conditions.

6.2.3 Wildlife

- Wildlife monitoring programme (Figure 6.1). *Locality*: 27 stations - (i) Northwest (t1); (ii) Upstream Sg Pinangah (t2); (iii) Batu Saap (t3); (iv) Along Jalan Sapulut – Kalabakan (t4); (v) Coupe A (t5); (vi) Coupe D (t6); (vii) Phenology Area (t7); (viii) Coupe B (t8); (ix) Coupe C (t9); (x) ITP Area (t10); (xi) Upstream Sg Beliar (t11); (xii) Salt lick (t12); (xiii) Sg Pinangah (q1); (xiv) Sg Siliawan (q2); (xv) Sg Lombunaan (q3); (xvi) Sg Saburan (q4); (xvii) Sg Sapulut (q5); (xviii) Sg Simatuoh (q6); (xix) Sg Sansiang (q7); (xx) Sg Tibow (q8); (xxi) Sg Sakikilan (q9); (xxii) Sg Sabunutan (q10); (xxiii) Sg Sablangan (q11); (xxiv) Sg Salung (q12); (xxv) Sg Lalobou (q13); (xxvi) Sg Sinikalaun (q14); and (xxvii) Sg Beliar (q15). *Parameter*: Elephant; Rhino; Orang Utan; Other protected wildlife. *Frequency*: (i) Once in six months.
- Database of wildlife distribution including (i) salt lick area; (ii) elephant migration route; (iii) hunting area.

6.2.4 Others

- Any form of contributions to the affected local community on road maintenance, wildlife protection, archaeological improvements or socio-economics either monetary or other assistance.

Figure 6.1: Environmental Compliance Report – Proposed Table of Contents

1. INTRODUCTION

- 1.1 The Project
- 1.2 Aim of Monitoring
- 1.3 Report Title
- 1.4 Project Initiator
- 1.5 Environmental Consultant
- 1.6 Monitoring Arrangement

2. STATUS OF IMPLEMENTATION OF MITIGATION MEASURES

- 2.1 Water Protection
- 2.2 River Protection
- 2.3 Control of Soil Erosion
- 2.4 Logging / Plantation Control
- 2.5 Oily Waste Management
- 2.6 Solid Waste Management
- 2.7 Control of Forest Fire
- 2.8 Traffic and Transportation Control
- 2.9 Abandonment
- 2.10 Environmental Management Officer
- 2.11 Regulations Need to be Complied

3. COMENTS & RECOMMENDATIONS

- 3.1 Comments
- 3.2 Recommendations
- 3.4 Amendments

ANNEXES

- A: Layout Plan
- B: Recommended Mitigation Measures
- C: Physical Calculations
- D: EIA Approval Conditions

Figure 6.2: Proposed Monitoring Arrangement

Table 6.1: Proposed Environmental Monitoring Arrangement

Activity	No of Station	No of Monitoring		Location	Parameter
		Construction	Operation		
Photographs	10	-	2	Prohibited logging/plantation area	• Close-up of paint marking; signs/notices. • Overview of protected area.
	10	-	2	Ecological protection area (MBCA Buffer Zones Area 1 and Area 2; wildlife corridor & ecological buffer zone)	• Close-up of paint marking; signs/notices. • Overview of buffer zone.
	15	-	2	Riverine reserve of Sg Siliawan, Sg Pinangah, Sg Lombunaan, Sg Saburan, Sg Sansiang, Sg Tibow, Sg Palangan, Sg Sakikilan, Sg Sabunutan, Sg Beliar, Sg Kuala Sumatalun, Sg Sinikalaun, Sg Salung, Sg Lalobou and Sg Simatuoh.	• Close-up of paint marking; signs/notices. • Overview of vegetation along river.
	Varied	-	2	Logging and plantation area	• Overview of logging and plantation area; and infrastructure.
	5	-	2	Traffic signs	• Close-up signs (project site, road junction, populated area). • Overview of signs
	5	-	2	Oily waste storage Garbage dumping site Biomass disposal area Sewage treatment facility	• Close-up shed, floor system, drainage, signs. • Overview of waste/chemical storage area.
	Varied	-	2	Abandoned area	• Close-up clean-up site, slope rehabilitation, stream crossings, signs/notices. • Overview of abandoned area
	18	-	2	Sg Siliawan, Sg Pinangah, Sg Lombunaan, Sg Saburan, Sg Sansiang, Sg Tibow, Sg Palangan, Sg Sakikilan, Sg Sabunutan, Sg Beliar, Sg Kuala Sumatalun, Sg Sinikalaun, Sg Salung, Sg Lalobou, Sg Simatuoh, Sg Sapulut, Sg Pampangon and Sg Logongon.	• Overview of river conditions.

Table 6.1: Proposed Environmental Monitoring Arrangement (continued)

Activity	Type	No of Station	No of Monitoring		Location	Parameter
			Construction	Operation		
Map	Layout Plan	-	-	2	As Figures 3.4 & 5.1	• Logging/plantation area (phasing) • Prohibited logging and plantation area including riverine reserve; water catchment area; MBCA Buffer Zones Area 1 & Area 2; wildlife corridor; buffer zone; archaeological protection area • Infrastructure including campsite; nursery; logging roads, skid trails; landings; stream crossings; re-vegetated area; traffic signs; gate access • Waste handling facilities including oily waste storage; garbage disposal; sewage facility; chemical store • Abandoned and rehabilitated area • Water control facilities including drainage; sedimentation pond. • Socio-economic activities including gravity water system; water storage/tank; hunting area

Table 6.1: Proposed Environmental Monitoring Arrangement (continued)

Activity	Type	No of Station	No of Monitoring		Location	Parameter
			Construction	Operation		
Data	Production	-	-	2		• Quantity, type and period of planted area or logged felled and taken out
	Operations	Varied	-	2		• Landing/campsite/nursery (no & dimensions); skid trails & logging roads (area, width & slope) • Prescribed/controlled burning (locality, size, period) • Forest Fire Prevention and Control Plan document • Integrated Plantation Management Programme document
	Transportation	Varied	-	2		• Transportation schedule
	Waste	-	-	2		• Quantity; type; period; destination of waste and biomass handled, stored and disposed of
	Complaint	-	-	Varied		• Water pollution; road access; traffic safety
	Discovery	-	-	Varied		• Protected biological species • Historical sites/materials
	Contribution	-	-	Varied		• Road maintenance, wildlife improvement, archaeological study, and other assistances

Table 6.1: Proposed Environmental Monitoring Arrangement (continued)

Activity	Type	No of Station	No of Monitoring		Location	Parameter
			Construction	Operation		
Sampling	Water Quality	15	-	4 + 2*	• (i) Sg Sapulut (W1); (ii) Sg Siliawan (W2); (iii) Sg Pinangah (W3); (iv) Sg Saburan (D/S) (W4); (v) Sg Saburan (U/S) (W5); (vi) Sg Sansiang (U/S) (W6); (vii) Sg Sansiang (D/S) (W7); (viii) Sg Tibow (W8); (ix) Sg Sapulut (W9); (x) Sg Simatuoh (W10); (xi) Sg Beliar (W11); (xii) Sg Salung (W12); (xiii) Sg Sinikalaun (W13); (xiv) Sg Logongon (W14); and (xv) Sg Sapulut (W15).	• Suspended solids • Turbidity • Oil & grease
	Meteorology	1	-	12	• SFD Campsite	• Temperature • Relative humidity • Rainfall • Evaporation • Surface wind
	Wildlife	27	-	2	• (i) Northwest (t1); (ii) Upstream Sg Pinangah (t2); (iii) Batu Saap (t3); (iv) Along Jalan Sapulut – Kalabakan (t4); (v) Coupe A (t5); (vi) Coupe D (t6); (vii) Phenology Area (t7); (viii) Coupe B (t8); (ix) Coupe C (t9); (x) ITP Area (t10); (xi) Upstream Sg Beliar (t11); (xii) Salt lick (t12); (xiii) Sg Pinangah (q1); (xiv) Sg Siliawan (q2); (xv) Sg Lombunaan (q3); (xvi) Sg Saburan (q4); (xvii) Sg Sapulut (q5); (xviii) Sg Simatuoh (q6); (xix) Sg Sansiang (q7); (xx) Sg Tibow (q8); (xxi) Sg Sakikilan (q9); (xxii) Sg Sabunutan (q10); (xxiii) Sg Sablangan (q11); (xxiv) Sg Salung (q12); (xxv) Sg Lalobou (q13); (xxvi) Sg Sinikalaun (q14); and (xxvii) Sg Beliar (q15).	• Elephant • Rhino • Orang Utan • Other protected wildlife species

*Note: * Twice after cessation of logging*