6.0 Global Ecological Cycles

6.1 Background

Global ecological cycles, is a reflection of the need to recognize the important role that forests play in global ecological cycles through recycling the earth's water, carbon, oxygen and other life sustaining elements. Through review of these cycles potential transboundary effects of forest management activities are examined. In terms of national criteria, global ecological cycles can be viewed in the context of four values:

- Contributions to the global carbon budget
- Forest land conversion
- Forest sector carbon dioxide conservation
- Contributions to hydrological cycles

For the purpose of this EIS, an additional value has been added in order to fulfill requirements for examination of transboundary effects as defined in the Manitoba Environment EIS Guidelines.

The additional value is:

- Atmosphere

A single matrix is utilized to cover global ecological cycles and is presented at the end of this Section in Table 6:

Table 6 Global Ecological Cycles

The fourth value, Contributions to Hydrologic Cycles, has been included in Table 5 under Surface Water and under Ground Water and associated text appears in associated documentation.

6.2 Atmosphere

6.2.1 Introduction

The added value, atmosphere, is reflected in the anticipated effect of forest management activities within FML 01 upon the atmosphere in a global context. These components are represented in Table 6.

6.2.2 Data Adequacy and Gaps

FSP sources of information include:

- Description of climate for FML 01 (Section 3.1.1)

- Description of global climate change and carbon budget (Section 3.1.10)

Other sources of information include:

- Natural Resources Canada (http://canadaforests.nrcan.gc.ca/articletopic/top_suj/2) (August 2009)
- *The importance of forest sector adaptation to climate change* (Lempriere et. al. 2008)
- Canadian Institute for Climate Studies (http://www.cics.uvic.ca/) (August 2009)

These sources of information represent the best information currently available for the review of atmospheric conditions as related to FML 01.

The SFM Criteria and Indicators (C & I) framework developed by Tembec during the preparation of the FSP provides the framework to be utilized for monitoring of indicators for measurement of progress towards targets established in the FSP. Indicators developed to represent global ecological cycles will provide improved data regarding the components referenced in Table 6 as the monitoring program for adaptive management is implemented during the FSP 20 year period. Relevant indicators for global ecological cycles are indicated in the LLI Indicator 4.1.3.1 which will provide enhanced data as time moves forward relative to atmospheric components indicated in Table 6.

6.2.3 Forest Management Activities Assessment

Planning

Planning of forest management activities includes development of road infrastructure as well as the provision of cutblocks sufficient to meet the fibre requirements of Tembec and other forest product operators on FML 01. While meeting these needs, planning is undertaken to provide for the level of access and timber volumes required along with sufficient contingency area while limiting operations to prevent any unnecessary development and operations. This is done in recognition of non-timber values throughout FML 01 and to keep costs of the operation competitive.

Access management activities have an influence upon the potential impacts to air quality at the local level as reflected in the increased availability of road infrastructure in FML 01 by the public. This increased availability of roads for vehicular travel can increase overall travel in the area dependent upon what alternative locations may have otherwise been utilized for various activities by the travelling public. This may lead to some local increase in exhaust emissions adding to atmospheric carbon levels. This increased use, insignificant in a global context, is mitigated through planning of roads to minimize extent to that required to meet fibre needs and on-going decommissioning of road infrastructure to limit the available road network to only that required to meet forest management requirements at any given time.

- All-weather, dry-weather and winter road networks are limited to the extent required in order to undertake forest management activities, including logging and forest renewal. This assists in minimizing the availability of roads for vehicle use.

- Access management controls including closures and decommissioning and revegetation of dry-weather roads in conjunction with recognition of non-timber values assist in minimizing vehicular travel by the public (WDS – 009 and the FSP Section 5.1.2.2, 5.13.1 and 5.13.5).

Harvesting

Harvesting activities result in the alteration of the forest vegetative cover at the site/stand level. This alteration to a younger forest stage as a result of subsequent forest renewal activities has implications for local microclimate conditions and air.

Logging activities can lead to insignificant impacts to climate in terms of effects upon the microclimate due to canopy removal during harvesting. These impacts however, are generally localized in extent to the affected cutblock areas and mitigated in a spatial sense through forest operating practices that include retaining understory vegetation and maintaining buffers and leave areas in operating areas. In a temporal context, follow-up forest renewal activities designed to replace the previous stand with one of similar composition, provides mitigation. In this sense the process of harvest and renewal approximates that which is occurring through natural disturbance processes (forest fire, insect and disease infestations. Over the past 2 decades, a much smaller proportion of FML 01 is harvested than is burned in forest fires and afflicted by insect and disease infestations (FSP Tables 3.6, 3.7 and 5.1). In a global context the impacts of forest harvesting upon climate are insignificant and mitigable.

Slash and woody debris management involves some burning of logging debris piles, which could have some short-term impacts upon air quality. Such impacts would generally be localized but could have some potential for transboundary effect dependent upon location and wind conditions. Most woody debris is managed by delimbing within the harvest area (WDS–WI–012); however, the burning of logging slash debris may be undertaken in relation with in-bush chipping operations where it has been determined that spreading of the debris is not the preferred treatment. In any case these effects are of a short-term duration and insignificant in a global context.

Timber transportation to mill can lead to impacts upon air quality through burning of fossil fuels, adding carbon dioxide to the atmosphere. As with public use of roads, this activity represents an insignificant impact in the global context. As part of its on-going planning of operating areas and infrastructure, Tembec attempts to minimize, to the extent possible, the long-term average haul distance to the mill site in order to minimize and stabilize haul costs. This provides the additional benefit of minimizing fuel consumption required for the truck haul.

Forest Renewal

Forest renewal activities are undertaken to follow-up upon harvesting activities and complement natural regeneration to re-establish forest cover and eventually forest canopy conditions. As described earlier, forest renewal assists to provide mitigation of the impacts of harvesting on local micro-site climate conditions and air quality.

Tree establishment has a positive impact on the atmosphere in the long-term through the influence of the trees at a local level in moderating micro-sites and cycling of carbon dioxide and contributing to improved air quality. Forest renewal of areas, harvested within limits determined to be sustainable, provides positive mitigation for the impacts of harvesting.

Forest Protection

Forest protection in terms of fire control is utilized to provide protection of values, both timber and non-timber, across the forested zone of Manitoba, with the degree of control effort related to the values of the area and the availability of protection resources.

Control of forest fires can have a positive impact in terms of air quality through reduction of carbon dioxide and particulate matter generated from large forest fires. Even with a level of forest fire control, there will continue to be wild fires; however, fire control will provide some level of reduced impact on a landscape level in concert with identified values.

Equipment Use

Heavy equipment use including all machine operations to harvest and transport wood to the mill, infrastructure construction, forest renewal, site decommissioning and fuel and waste management can have impacts to air quality.

- The use of heavy equipment in undertaking forest management activities for FML 01 will have some localized impacts upon air quality as a result of emissions from the burning of hydrocarbons; however, these effects are insignificant in a landscape or global context.

Atmospheric impacts from forest management activities generally occur at a local level in terms of influences upon climate and changes in micro-site climate due to alterations of local forest cover. At the landscape level such changes are insignificant in relationship to the on-going changes inherent in the boreal forest due to natural disturbance and renewal. Air quality is influenced to some extent by the emissions generated by the use of heavy equipment for forest management activities and by the public travelling on forest access roads. In addition, the particulate matter arising from forest fires can cause some localized and even wider-spread degradation of air quality on a short-term basis. Limits to the active overall access network in place at any given time, fire control activities and forest renewal assist in mitigation of these

concerns, which, when considered in the context of cumulative impacts to the boreal forest landscape over North America are insignificant.

6.3 Contributions to Global Carbon Budget

6.3.1 Introduction

Contributions to the global carbon budget, is reflected in the anticipated effect of forest management activities within FML 01 upon the carbon budget in a global context. The component forest sector carbon budget is represented in Table 6.

6.3.2 Data Adequacy and Gaps

FSP sources of information include:

- Description of global climate change and carbon budget (Section 3.1.10)
- Carbon budget modeling (Section 4.3)
- Carbon budget objective (Section 5.2.1.4.1)

Other sources of information include:

- Natural Resources Canada, Carbon Budget Model CBM-CFS3.
- Natural Resources Canada (http://canadaforests.nrcan.gc.ca/articletopic/top_suj/2) (August 2009)
- *The importance of forest sector adaptation to climate change* (Lempriere et. al. 2008)
- Canadian Institute for Climate Studies (http://www.cics.uvic.ca/) (August 2009)

The SFM Criteria and Indicators (C & I) framework developed by Tembec during the preparation of the FSP provides the framework to be utilized for monitoring of indicators for measurement of progress towards targets established in the FSP. Indicators developed to represent contributions to the global carbon budget will provide improved data regarding the components referenced in Table 6 as the monitoring program for adaptive management is implemented during the FSP 20 year period. Relevant management objective for global ecological cycles are indicated Section 5.2.1.4.1 of the FSP. LLI Indicators 4.1.1.1, 4.1.1.2, 4.1.2.1 and 4.1.3.1 will provide enhanced data as time moves forward relative to the global carbon budget components indicated in Table 6.

6.3.3 Forest Management Activities Assessment

Planning

Planning activities as they relate to contributions to the global carbon budget take place through sustainability modeling. Through this process the sustainable timber supply which can be harvested and renewed while retaining a relatively constant level of standing inventory is determined. In determining the sustainable harvest level, the Canadian Forest Service

(CFS) Carbon Budget Model CBM-CFS3 was incorporated into the modeling process as described in Section 4.3 of the FSP. The Carbon Budget Model is a landscape-level forest carbon accounting framework that simulates, over a given period of time, carbon dynamics of above-ground and below-ground forest biomass and dead organic matter. Landscape-level forest carbon accounting is carried out in the CBM-CFS3 by tracking the carbon dynamics associated with both stand-level and landscape-level processes. Using the harvest level determined from this process for application to planning of harvest and renewal operations allows for a relatively constant carbon sink to remain in place across FML 01.

- A management objective (FSP Section 5.2.1.4.1) has been established to maintain the FML as a carbon sink for a minimum of 50 years. This objective was maintained in the draft 2009-2028 FSP as described in Section 4.3.1 of the FSP; however, the FML could only be maintained as a carbon sink for 40 years in the 2010-2029 FSP modeling addendum (FSP Section 4.3.2) where Nopiming Park was removed from the net landbase. This is attributed to the death age scenario used in the MC base case modeling (FSP Section 4.1). Further research in determining successional pathways for forest stands would assist in providing a more accurate accounting of the carbon budget for FML 01.

- LLI Indicator 4.1.1.2 reports on the carbon pool values for FML 01 based on the sustainability analysis conducted in the FSP.

Harvest and renewal planning is undertaken to address the multitude of non-timber values that exist across the landscape while providing for the supply of timber to the Tembec mill and other allocated parties according to the determined sustainable harvest level. Actions that provide additional outside sources of fibre supply effect the overall requirement for timber from FML 01.

- The use of the carbon budget model CBM-CFS3, as described in Section 4.3 of the FSP, results in the FML acting as a carbon sink while timber harvest and forest renewal activities are taking place. The FML becomes a carbon source once large areas of forest die as a result of the death age scenario used in the MC base case modeling (FSP Section 4.1). Further research in determining successional pathways for forest stands would assist in providing a more accurate accounting of the carbon budget for FML 01.

- The collection and production of re-cycled pulp in the de-inking plant by Tembec would have a positive impact upon the carbon budget of FML 01 in terms of the resulting replacement of fiber which would otherwise be required for harvest to produce the same amount of product at the mill. The Pine Falls de-ink plant was indefinitely idled in March 2008 due to the high cost of recycled fiber and production cost to produce pulp. If the de-ink plant were to resume operation, it would have a positive impact on the carbon budget.

Sustainability modeling, undertaken in the preparation of the FSP, can result in significant impacts to the forest cover of FML 01 based upon implementation of timber harvest levels determined as sustainable from the modeling. This would, in turn impact upon the carbon pool of the forest. In terms of the overall forest sector carbon budget, the landbase within FML 01

does represent a portion of the forested landbase, and as such, contributes to the global carbon budget. In this regard the potential for changes to the standing inventory of trees and depletions and offsetting renewal should be considered as part of the total cumulative over the entire boreal forest and as such is significant.

- As described earlier, results of the modeling are derived based upon an established current forest inventory and predictions of forest succession and growth and yield. The use of the carbon budget model CBM-CFS3, as described in Section 4.3 of the FSP, results in the FML acting as a carbon sink while timber harvest and forest renewal activities are taking place. The FML becomes a carbon source once large areas of forest die as a result of the death age scenario used in the MC base case modeling (FSP Section 4.1). Further research in determining successional pathways for forest stands would assist in providing a more accurate accounting of the carbon budget for FML 01.

- Mitigation during the modeling process occurs through:

    - Use of the best available data in developing predictions of forest succession and growth and yield for application in the model including MC data local to FML 01 and expert experience drawn from across Manitoba familiar with harvest and renewal results and forest succession in the boreal forest (FSP Section 4.0)

    - The models applied to FML 01 (Woodstock ^{TM} and Patchworks ^{TM}) have both been utilized in a number of applications across the boreal forest in Canada.

    - The carbon budget model CBM-CFS3 has been developed by Natural Resources Canada in order to analyze past and future changes in carbon stocks associated with forest biomass and dead organic matter. It also helps to explore how natural disturbance, forest management, growth, and decomposition rates might affect forest carbon stocks.

    - Re-curing analysis of the sustainable harvest level is undertaken every 20 years in association with the preparation of the FSP. Intermediate analysis will also be undertaken should major fire events, as determined by Manitoba Conservation (FSP Section 4.1), result in a substantial change to the forest composition and age class structure from that which had been forecasted from the previous FSP modeling work. This adaptive management approach to determination of the sustainable harvest level allows for incorporation of improved forest succession and growth and yield data as time moves forward and future FSPs and associated modeling work is undertaken.

- This approach can assist in providing a more or less constant standing inventory of trees across FML 01 that contributes in turn to the carbon budget with levels of harvest, fire loss and other depletions offset by forest renewal activities and natural regeneration for the forest of FML 01.

- The modeling results, as described in Section 4.1 and 4.3 of the FSP, indicate the sustainable harvest levels available for FML 01 for the upcoming 20 year period. These results were then utilized as a maximum in the preparation of the harvest plan for the FSP.

- The carbon budget modeling, as described in Section 4.3 of the FSP, provides a prediction of future carbon stocks and changes in carbon stocks through scenario and risk analyses. The on-going use of this model and the establishment of successional pathways, in co-operation with MC, will provide a monitoring function and the capacity for adaptive management of carbon pools based on sustainable harvest level determination.

- Within the C & I framework related indicators include:

    - Indicator 4.1.1.2 reports on the projected carbon pool values, from the CFS carbon budget model, for FML 01.

    - Indicator 4.1.2.1 reports on the production of recycled pulp from the de-ink plant.

Harvesting

Harvesting activities result in altering of the forest cover in FML 01 through logging of mature and over-mature trees and the subsequent removal of the bole component. This results in a change to the carbon sequestering cycle taking place on the site. Harvesting generally results in a reduction in carbon pools because harvesting targets older stands and it removes stemwood biomass carbon which during natural disturbances, is added to the soil and detritus pools (Kurz *et al*. 1998). More recent work by Kurtz, as reported by CFS (2007), found that Canada's forests were a carbon sink for the period 1990 to 2005 except for a five year period of extensive forest fires. CFS (2007) went on to state that harvests do not fluctuate much over time and therefore do not contribute significantly to the risk of a source and that the main risk is fire and insect outbreaks. One must also account for the steady annual production of harvested material into manufactured wood products which carry a significant service life and thus represent a carbon store (Price et al. 1996).

Logging of trees from FML 01 for the purpose of producing forest products has a significant impact upon the carbon budget through reduction in the standing biomass across FML 01.

- The use of the carbon budget model CBM-CFS3, as described in Section 4.3 of the FSP, results in the FML acting as a carbon sink while timber harvest and forest renewal activities are taking place. The FML becomes a carbon source once large areas of forest die as a result of the death age scenario used in the MC base case modeling (FSP Section 4.1). Further research in determining successional pathways for forest stands would assist in providing a more accurate accounting of the carbon budget for FML 01.

- In Price et al. (1996) among other objectives the authors addressed how operational harvesting, in the boreal forest, affects carbon sequestering in a managed forest as compared to the unexploited state. Their results are based on a carbon budget model specific to Canadian forests. They report that their model indicates that harvesting with silviculture activities are likely beneficial for long term sequestering of carbon. In their study of a boreal ecosystem the natural disturbance intervals of 50 years, is significantly shorter than typical economic rotation age of 80 years and management practices which suppress natural disturbances would also increase carbon storage.

- As described earlier with regard to planning, sustainability modeling also assists in this regard through establishment of sustainable harvest levels to govern volumes logged. This, along with application of minimum harvest age, the maintenance of old forests, the requirement for forest renewal, and fire control activities should combine to achieve a relatively stable standing inventory or level of biomass over the long-term acting as a carbon sink.

Forest Renewal

Forest renewal activities supplement natural regeneration processes through the application of site preparation, scarification, tree establishment, and stand tending treatments to previously logged sites. These activities thereby assist and accelerate the establishment of new forest tree cover on the site leading to positive impacts on the contribution of sites to the forest sector carbon budget. Forest ecosystems play an important role in global carbon both as a store and as either source or sink of atmospheric carbon (Kurz *et al*. 1998). The most important contribution to the global carbon balance is land use change following deforestation accounting for approximately 20% of the net annual atmospheric CO_2 emissions (Apps *et al*. 1999). Forest renewal activities that are promptly undertaken following harvesting provide mitigation of such concerns in forest management activities as applied to the boreal forest in general and FML 01 in particular.

Site preparation and scarification and tree establishment and mechanical stand tending have positive impacts on the forest sector carbon budget by replacing the original mature and over-mature trees previously removed through logging with younger faster growing seedlings. The newly established trees are then in a position to accumulate biomass over their lifetime, adding to the overall carbon-sequestering component of the existing forest and adding to the carbon sink thereby reducing atmospheric carbon levels.

Forest Protection

Forest protection activities play a role relative to the carbon budget in terms of minimizing losses of standing inventory. As described earlier, however, fire is a dominant disturbance factor in the succession of forest stands in the boreal forest and will continue to have a major influence in the ongoing renewal of FML 01. Through fire control activities targeted at areas of high timber and non-timber values some assistance

is provided in stabilizing the standing forest inventory (growing stock) at any given time across FML 01.

Fire control has positive impacts to the forest sector carbon budget through maintaining or minimizing the loss of the forest growing stock in conjunction with forest renewal activities and the application of sustainable harvest levels to logging. Fire burns, on average, 1.5% of Canadian forests per year and release a considerable amount of carbon since wood is 50% carbon (CPPA, 1998). Fire control therefore can minimize the emission of atmospheric carbon. Fire control also minimizes the subsequent release particulate matter into the atmosphere from the forest fire.

In the global context impacts from activities within FML 01 are insignificant, however the cumulative impacts over the North American boreal forest should be considered when assessing impacts. One must keep in mind that most carbon related impacts are transboundary in extent. Generally impacts to global carbon are positive through planning, forest renewal and fire control. Planning and logging can cause impacts mitigated through application of best available information to modeling analysis to determine sustainable harvest levels and carbon pools and the on-going refinement of this data and continuing re-calculation of sustainable harvest levels on a periodic basis and in response to major fire losses. Forest renewal activities assist in mitigating effects of harvesting through replacement of older stands containing accumulated carbon with younger faster growing trees available for future carbon sequestering.

6.4 Forest Land Conversion

6.4.1 Introduction

Forest land conversion, is reflected in the anticipated effect of forest management activities within FML 01 upon the forested landbase in a global context. The components are represented in Table 6.

6.4.2 Data Adequacy and Gaps

FSP sources of information include:

- Description of vegetation resources of FML 01 (Sections 3.1.7)
- MC Forest Inventory including forest tree species and age class description (Section 5.9.4) and accompanying maps (figure 5.26 and 5.27) and tables (Table 5.15 and 5.16)
- Projection of growing stock for FML 01 based upon proposed harvest volumes, from sustainability analysis, (Section 4.1, Appendix V Figure 4)

Other sources of information include:

- Manitoba FEC system (V-types and S-types) in place for Provincial forest resource including FML 01
- High Conservation Value Forest report for FML 01 (Kotak et.al. 2009)

On-going Operational Data Sources include:

- On-going update of MC Forest Inventory by the Province including forest tree species and age class
- On-going update of net standing timber volumes calculated from updated forest inventory taking into account all depletions and forest renewal status to date
- PHA including tree species, volumes, age class, FEC V-type and soils description

These sources of information represent the best information currently available for the monitoring and reporting of forest land status on FML 01. Regular updating of the MC Inventory by Tembec (WDS – 001) for harvest, road construction and renewal activities and by the Province for forest fire and insect/disease depletions will provide the basis for measurement of forest land status.

6.4.3 Forest Management Activities Assessment

Infrastructure Development

Infrastructure development activities, particularly the construction of all-weather roads, have the potential to result in alterations to the site that lead to a change in status of the land from forested to non-forested. Such alterations to the soil and site growing conditions and follow-up maintenance can remove the conditions necessary for forest vegetation to establish and grow. For infrastructure such as dry-weather and winter roads, as well as camp, timber and fuel storage sites, these altered conditions are for a temporary duration such that the status of the land does not change. Once the service life has ended, decommissioning and re-vegetation will return these sites to a forested state, generally to a younger successional state than was originally on the site prior to the infrastructure being developed.
Impacts can be summarized as:

All-weather road development represents a permanent conversion of forest landbase to non-forest in that the duration of use is considered to be permanent.

- The FSP establishes a management objective which limits road construction within a watershed to 0.58 km./km^2 (FSP Section 5.3.1.3.2). This is the only forest management activity that results in the long-term change in status of forested land. Given the relatively small proportion of land involved in permanent long-term road construction this impact is insignificant in a landscape and global context.

- Within the LLI framework, Indicator 4.1.1.1 provides for tracking of the area of forested and non-forested land on FML 01 converted to permanent roads or other human caused land uses. Indicator 1.1.3.3 tracks the km./km^2 of road construction by watershed.

Decommissioning activities assist in mitigating the potential for conversion of sites to non-forested status as a result of temporary infrastructure development as described above.

- As described in WDS – WI – 015, 016 and 035 to 039, actions such as the rolling back and spreading of woody and other organic debris, removal of approaches and planting and natural re-vegetation of temporary infrastructure sites assists in accelerating the return of these sites to a forested state. Without such measures sites would generally be anticipated to return to a forested state, provided that suitable soil and other conditions are present, but at a slower rate of development.

Forest Renewal

Forest renewal activities, as well as the natural regeneration processes that will occur on naturally depleted (primarily fire) and cutover sites in the boreal forest, are the fundamental factors that result in forested land retaining this status following harvesting and temporary infrastructure use on the land.

Site preparation and scarification and tree establishment have positive impacts in terms of the potential for forest land conversion to non-forested status. These activities, in conjunction with the natural regeneration processes of the tree and other vegetation species of the boreal forest, enable the continuing forest productivity of sites disturbed by harvesting, temporary infrastructure development and natural disturbances.

- It is the commitment to the forest renewal process that separates forest management activities, particularly logging, from some other land-based activities in terms of conversion of forest land to non-forest status. All lands harvested by Tembec are scheduled for forest renewal either through natural regeneration or assisted by planting. As such, forest renewal activities have a positive impact in maintaining the forested land base on FML 01.

- LLI Indicators 2.1.2.1 and 2.1.2.2 have been established to track forest renewal success for silviculture surveys conducted 7 and 14 years following harvest.

To track the success and develop any required follow-up renewal plans monitoring of forest renewal success is carried out through regeneration surveys 7 years after harvest and FTG surveys, 14 years after harvest as specified in MC guidelines (2005 and 2003A). This monitoring process in conjunction with the provincial requirement for renewal certification of all harvested areas ensures that the mitigation provided through forest renewal activities will maintain these lands in forested status. All-weather roads do permanently remove a component of forest from the land base. In the context of FML 01, where a target road density of no more than 0.58 km./km^2, by watershed, has been established, this conversion is insignificant. Developments of all other infrastructure are a mitigable impact because of their

temporary duration and planned decommissioning. Similarly, logging of lands is considered to be different from many other land-based activities in terms of potential to convert forested land to non-forested status as a result of the natural regeneration processes present in the boreal forest complemented by the forest renewal process.

6.5 Forest Sector Carbon Dioxide Conservation

6.5.1 Introduction

Forest sector carbon dioxide is reflected in the anticipated effect of the utilization of fossil fuels in undertaking forest management activities within FML 01. These components are represented in Table 6.

6.5.2 Data Adequacy and Gaps

FSP sources of information include:

- Descriptions of forest operations relating to use of equipment

6.5.3 Forest Management Activities Assessment

Harvesting

Harvesting activities include the operation of heavy equipment, evaluated in a following section, in addition to the subsequent transport of harvested timber to the mill. The removal and processing of timber has potential impacts to non-renewable resources in terms of hydrocarbon fuel consumption during machine use and timber transport using trucks.

Timber transportation to mill, based primarily on the truck haul, as in most types of industrial applications, depends upon the utilization of fossil fuels. Proper maintenance of equipment and follow-up on potential innovations to reduce fuel use can assist in mitigation of this impact, which in a global context is insignificant.

- Mitigation is assisted in terms of total fuel use by maximizing haul loads at all times within provincial regulations.

- Tembec minimizes, to the extent possible, the long-term haul distance to the mill site through the planning of access roads and use of the public road system.

Equipment Use

Fuel consumption from equipment use including all machine operations to harvest timber, infrastructure construction, forest renewal, site decommissioning and fuel and waste management can have impacts on non-renewable energy resources.

In-block operations utilizing heavy equipment, as in most types of industrial applications, depend upon the utilization of fossil fuels. Proper maintenance of equipment and follow-up on potential innovations to reduce fuel use can assist in mitigation of this impact, which in a global context is insignificant.

Forest sector carbon dioxide conservation is reflected in the use of fossil fuels during forest management activities. In the context of the use of fossil fuels for similar industrial applications relying upon mechanized machine use, impacts are insignificant from consumption of fuels by heavy equipment and trucks.

Forest management activities on FML 01 impact global ecological cycles at a relatively small scale. Most impacts are transboundary in nature and should be considered in the context of cumulative impacts from all harvesting within the boreal forest in North America. Within the context of FML 01, all impacts, whether significant or insignificant, are mitigable through planning, decommissioning or forest renewal.