3.12. Methodology for Estimating Net Carbon Stock Changes in Forest Lands Remaining Forest Lands

This sub-annex expands on the methodology used to calculate net changes in carbon (C) stocks in forest ecosystems and in harvested wood products. Some of the details of C conversion factors and procedures for calculating net CO_2 flux for forests are provided below; more detailed descriptions of selected topics may be found in the cited references.

Carbon Stocks and Net Changes in Forest Ecosystem Carbon Stocks

C stocks were estimated at the inventory plot level for each C pool within each state in the conterminous United States based on availability of inventory data. Forest survey data in the United States were obtained from USDA Forest Service, Forest Inventory and Analysis (FIA) Resources Planning Act Assessment (RPA) databases or the individual state surveys in the FIA Database (FIADB), version 2.1. More complete information about these data is available at an FIA Internet site (FIA Database Retrieval System). All FIADB surveys used for C stock estimates were obtained from this site on September 30, 2005.

The first step in developing C estimates was to identify separate inventory surveys for each state and associate each with an average year for field collection of data. Most inventory databases provide the year, month, and day in which the data were collected for each plot. If only the year is specified, the date for collection of data is assigned the midpoint in the year. If data for an individual survey were collected over a number of years, an average value is calculated. A few surveys had missing or incorrect values for year of field data; in some cases it was possible to obtain this information from the regional FIA units, otherwise the year was inferred from other data. Some overlap exists between the RPA and FIADB inventories because the RPA summaries were compiled from the FIADB. Such overlaps are identified and adjusted to avoid duplication. Older surveys for some states, particularly in the West, have National Forest System lands surveyed at different times than other forest land in the state. For this reason, C stocks for National Forests were separately estimated from other forests to account for differences in average year. The inventories used for each state as well as average year identified for each are provided in Table A-180.

For each inventory summary in each state, each C pool was estimated using coefficients from the FORCARB2 model (Birdsey and Heath 1995, Birdsey and Heath 2001, Heath et al. 2003, Smith et al. 2004a). Coefficients of the model are applied to the survey data at the scale of FIA inventory plots; the results are estimates of C density (Mg per hectare) for a number of separate C pools. C stocks and fluxes for Forests Remaining Forests are reported in pools following IPCC *Good Practice Guidance for Land Use, Land-Use Change, and Forestry* (2003). FORCARB2 estimates C density for live trees, standing dead trees, understory vegetation, down dead wood, forest floor, and soil organic matter. All non-soil pools except forest floor can be separated into aboveground and belowground components. FORCARB2's live tree and understory C pools are pooled as biomass in this Inventory. Similarly, standing dead trees and down dead wood are pooled as dead wood in this Inventory. Definitions of forest floor and soil organic matter in FORCARB2 correspond to litter and forest soils, respectively, in IPCC *Good Practice Guidance for Land Use, Land-Use Change, and Forestry* (2003).

The tree C pools in FORCARB2 include aboveground and belowground (coarse root) C mass of live trees. Separate estimates are made for whole-tree and aboveground-only biomass. Thus, the belowground portion is determined as the difference between the two estimates. Tree C estimates are based on Jenkins et al. (2003) and are functions of tree species and diameter as well as forest type and region. Some survey data do not provide measurements of individual trees; tree C in these plots are estimated from plot-level growing stock volume of live trees and equations based on Smith et al. (2003). C mass of wood is 50 percent of dry weight (IPCC/UNEP/OECD/IEA 1997). The minimum-sized tree included in these FIA data is one-inch diameter (2.54 cm) at diameter breast height (1.3 meter); this represents the minimum size included in the tree C pools.

A second, but minor, component of biomass is understory vegetation. Understory vegetation is defined in FORCARB2 as all biomass of undergrowth plants in a forest, including woody shrubs and trees less than one-inch diameter, measured at breast height. In this Inventory, it is assumed that 10 percent of understory C mass is belowground. This general root-to-shoot ratio (0.11) is near the lower range of temperate forest values provided in IPCC *LULUCF Good Practice Guidance* (2003) and was selected based on two general assumptions: ratios are likely to be lower for light-limited understory vegetation as compared with larger trees, and a greater proportion of all root mass will be less than 2 mm diameter. C density estimates are based on Birdsey (1996) and were applied at the inventory plot level (Smith et al. 2004a).

Dead wood includes the FORCARB2 pools of down dead wood and standing dead trees. Down dead wood is defined as pieces of dead wood greater than 7.5 cm diameter, at transect intersection, that are not attached to live or standing dead trees. Down dead wood includes stumps and roots of harvested trees. Ratio estimates of down dead wood to live tree biomass were developed by FORCARB2 simulations and applied at the plot level (Smith et al. 2004a). The standing dead tree C pools in FORCARB2 include aboveground and belowground (coarse root) mass. Estimates are based on Smith et al. (2003) and are functions of plot level growing stock volume of live trees, C density of live trees, forest type, and region.

Estimates of litter and soil organic carbon (SOC) are not based on C density of trees. Litter C is the pool of organic C (litter, duff, humus, and fine woody debris) above the mineral soil and includes woody fragments with diameters of up to 7.5 cm. Estimates are based on equations of Smith and Heath (2002) and applied at the plot level. Estimates of SOC are based on the national STATSGO spatial database (USDA 1991) and the general approach described by Amichev and Galbraith (2004). In their procedure, SOC was calculated for the conterminous United States using the STATSGO database, and data gaps were filled by representative values from similar soils. Links to region and forest type groups were developed with the assistance of the USDA Forest Service FIA Geospatial Service Center by overlaying FIA forest inventory plots on the soil C map.

An historical focus of the FIA program was to provide information on timber resources of the US. For this reason, some forest lands, which were less productive or reserved (i.e., land where harvesting was prohibited by law), were less intensively surveyed. This generally meant that forest type and area were identified but data were not collected on individual tree measurements. However, all annualized surveys initiated since 1998 have followed a new national plot design for all forest land (Alerich et al. 2005, FIA Database Retrieval System). The practical effect that this evolution in inventories has had on estimating forest C stocks from 1990 through the present is that some older surveys of lands do not have the stand level values for merchantable volume of wood or stand age, which are necessary inputs to FORCARB2. The data gaps in the surveys taken before 1998 were filled by assigning regional average C densities calculated from the more complete later inventories. The overall effect of this is to generate estimates for C stock with no net change in C density on those lands with gaps in past surveys.

Average C density values for forest ecosystem C pools according to region and forest types within regions are provided in Table A-181. Note that C densities reflect the most recent survey for each state as available in the FIADB, not potential maximum C storage. Thus, C densities are affected by the distribution of stand sizes within a forest type, which can range from regenerating to mature stands. A large proportion of young stands in a particular forest type is likely to reduce the regional average for C density.

The overall approach for determining forest C stocks and stock change was to estimate forest C stocks based on data from two forest surveys conducted several years apart (Table A-180). C stocks were calculated separately for each state based on inventories available since 1990 and for the most recent inventory prior to 1990. For each pool in each state in each year, C stocks were estimated by linear interpolation between survey years. Similarly, fluxes were estimated for each pool in each state by dividing the difference between two successive stocks by the number of intervening years between surveys. Thus, the number of separate stock change (net flux) estimates for each state was one less than the number of available inventories. Stocks and fluxes since the most recent survey were based on extrapolating estimates from the last two surveys. C stock and flux estimates for each pool were summed over all states to form estimates for the conterminous United States. Summed fluxes and stocks are in Table A-182 and Table A- 183, respectively.

Carbon in Harvested Wood Products

Estimates of C stock changes in wood products and wood discarded in landfills were based on the methods described by Skog and Nicholson (1998) which were based in turn on earlier efforts using similar approaches (Heath et al. 1996, Row and Phelps 1996). C stocks in wood products in use and wood products stored in landfills were estimated from 1910 onward based on several sets of historical data from the USDA Forest Service. These data include estimates of wood product demand, trade, and consumption (USDA 1964, Ulrich 1989, Howard 2001). Annual historical estimates and model projections of the production of wood products were used to divide consumed roundwood into wood product, wood mill residue, and pulp mill residue. To estimate the amount of time products remain in use before disposal, wood and paper products were divided into 21 categories, each with an estimated product half-life (Skog and Nicholson 1998). After disposal, the amount of waste burned was estimated. For products entering dumps or landfills, the proportion of C emitted as CO_2 or CH_4 was estimated using the maximum proportion of wood and paper converted to CO_2 or CH_4 in landfills for 5 product types. By following the fate of C from the wood harvested in each year from 1910 onward, the change in C stocks in wood products and landfills and the amount of C emitted to the atmosphere with and without energy recovery were estimated for each year through 2003. To account for imports and exports, the production approach was used, meaning that C in exported wood was counted as if it remained in the United States, and C in imported wood was not counted. From 1990 through 2002, the amount of C in exported wood averaged 6 Tg C per year, with little variation from year to year. Imports, which were not included in the harvested wood C stock estimates, increased from 7.2 Tg C per year in 1990 to 13 Tg C per year in 2002. For more details, see Skog and Nicholson (1998). Summaries of net fluxes and stocks for harvested wood in products and landfills are in Table A-182 and Table A- 183.

Uncertainty Analysis

The uncertainty analysis for total net flux of forest C (see Table 7-8 in LULUCF chapter) was consistent with the IPCC-recommended Tier 2 methodology (IPCC 2003). The estimates were simulated with Monte Carlo sampling of probability densities representing plot-level C for the forest ecosystem estimates following general methods described in Heath and Smith (2000b) and Smith and Heath (2000). Estimates of uncertainty for C in harvested wood were based on Skog et al. (2004). Monte Carlo sampling of all probability densities involved random sampling of equal-probable intervals. The 95 percent confidence interval about the simulated flux (Table A-180) is based on the bounds of the central 95 percent of the simulated probability density for flux.

Uncertainty about C density (Mg/ha) was defined for each of six FORCARB2 C pools for each inventory plot. Live and standing dead trees were assigned normal or truncated normal probability densities, which were defined according to Jenkins et al. (2003) and the species and number of trees measured on each plot. Down dead wood and forest floor were assigned skewed distributions, which assume that a small proportion of plots will have relatively high carbon densities. Understory and soil organic C were assigned uniform distributions to reflect the fact that the model currently has little information to assign plot-specific values. Monte Carlo sampling of live tree, down dead wood, and understory probabilities were highly correlated to reflect the same process in FORCARB2. Uncertainty about plot area was assigned a normal distribution and follows the accuracy standards defined for the surveys (Alerich et al. 2005). The uncertainty analysis of Skog et al. (2004) was developed for a slightly different estimate of C in harvested wood as compared with the method followed here (Skog and Nicholson 1998). Therefore, the probability densities for annual flux for wood products and landfilled wood were defined as uniform densities bounded by the summaries in Table 3 of Skog et al. (2004). Two effects of estimating uncertainty at the plot level and aggregating to state totals for determining net stock change (flux) are: 1) relative uncertainty tends to decrease, and 2) skewed probability densities for individual plots tend to approach normality as independent samples among plots are summed.

Table A-180: Source of forest inventory and average year of field used to estimate statewide carbon stocks

State[a]	Source of Inventory Data[b]	Average Year Assigned to Inventory[c]
Alabama	1987 RPA	1982
	FIADB, cycle 1	1990
	FIADB, cycle 7	1999
	FIADB, cycle 4	2002
Arizona, NFS	1987 RPA	1985
	FIADB, cycle 2	1996
	FIADB, cycle 3	2003
Arizona, all other	FIADB, cycle 1	1986
	FIADB, cycle 2	1992
	FIADB, cycle 3	2003
Arkansas	1987 RPA	1978
	FIADB, cycle 1	1996
	FIADB, cycle 3	2002
California, NFS	1987 RPA	1981
	1997 RPA	1993
	FIADB, cycle 5	2003

California, all other	1987 RPA	1983
	FIADB, cycle 3	1993
	FIADB, cycle 5	2003
Colorado, NFS	2002 RPA	1986
	FIADB, cycle 2	2004
Colorado, all other	2002 RPA	1979
	FIADB, cycle 2	2004
Connecticut	FIADB, cycle 3	1985
	FIADB, cycle 4	1998
	FIADB, cycle 5	2004
Delaware	FIADB, cycle 3	1986
	FIADB, cycle 4	1999
Florida	FIADB, cycle 1	1987
	FIADB, cycle 2	1995
Georgia	FIADB, cycle 1	1989
	FIADB, cycle 7	1997
	FIADB, cycle 4	2001
Idaho, NFS	1987 RPA	1982
	FIADB, cycle 1	1998
	FIADB, cycle 2	2005
Idaho, all other	1987 RPA	1981
	FIADB, cycle 1	1990
	FIADB, cycle 2	2005
Illinois	FIADB, cycle 3	1985
	FIADB, cycle 4	1998
	FIADB, cycle 5	2003
Indiana	FIADB, cycle 3	1986
	FIADB, cycle 4	1998
	FIADB, cycle 5	2001
Iowa	FIADB, cycle 3	1990
	FIADB, cycle 4	2002
Kansas	FIADB, cycle 3	1981
	FIADB, cycle 4	1994
	FIADB, cycle 5	2003
Kentucky	FIADB, cycle 1	1987
	FIADB, cycle 4	2002
Louisiana	1987 RPA	1984
	FIADB, cycle 1	1991
	FIADB, cycle 3	2003
Maine	1987 RPA	1983
	FIADB, cycle 4	1995
	FIADB, cycle 5	2002
Maryland	FIADB, cycle 4	1986
	FIADB, cycle 5	2000
Massachusetts	FIADB, cycle 3	1985
	FIADB, cycle 4	1998
	FIADB, cycle 5	2004
Michigan	FIADB, cycle 4	1980
	FIADB, cycle 5	1993
	FIADB, cycle 6	2002
Minnesota	FIADB, cycle 4	1977
	FIADB, cycle 5	1989
	FIADB, cycle 12	2001
Mississippi	1987 RPA	1977
	FIADB, cycle 1	1994
Missouri	FIADB, cycle 4	1988
	FIADB, cycle 5	2002
Montana, NFS	1987 RPA	1987
	FIADB, cycle 1	1996
	FIADB, cycle 2	2004
Montana, all other	FIADB, cycle 1	1989
	FIADB, cycle 2	2004

Nebraska	FIADB, cycle 2	1983
	FIADB, cycle 3	1995
	FIADB, cycle 4	2003
Nevada, NFS	1987 RPA	1984
	FIADB, cycle 1	1997
	FIADB, cycle 2	2005
Nevada, all other	FIADB, cycle 1	1981
	FIADB, cycle 2	2005
New Hampshire	FIADB, cycle 4	1983
	FIADB, cycle 5	1997
	FIADB, cycle 6	2004
New Jersey	FIADB, cycle 3	1987
	FIADB, cycle 4	1999
New Mexico, NFS	1987 RPA	1985
	FIADB, cycle 2	1997
New Mexico, all other	FIADB, cycle 1	1987
	FIADB, cycle 2	1991
New York	1987 RPA	1987
	2002 RPA	1993
	FIADB, cycle 5	2003
North Carolina	FIADB, cycle 1	1984
	FIADB, cycle 2	1990
	FIADB, cycle 3	2001
North Dakota	FIADB, cycle 2	1979
	FIADB, cycle 3	1995
	FIADB, cycle 4	2003
Ohio	1987 RPA	1987
	FIADB, cycle 4	1991
	FIADB, cycle 5	2003
Oklahoma	1987 RPA	1986
	FIADB, cycle 1	1992
Oregon, eastern NFS	1987 RPA	1987
	2002 RPA	1995
	FIADB, cycle 5	2003
Oregon, eastern all other	1987 RPA	1976
	FIADB, cycle 3	1991
	FIADB, cycle 4	1999
	FIADB, cycle 5	2003
Oregon, western NFS	1987 RPA	1986
	2002 RPA	1996
	FIADB, cycle 5	2003
Oregon, western all other	1997 RPA	1989
	2002 RPA	1997
	FIADB, cycle 5	2003
Pennsylvania	FIADB, cycle 4	1990
	FIADB, cycle 5	2002
Rhode Island	FIADB, cycle 3	1985
	FIADB, cycle 4	1999
	FIADB, cycle 5	2004
South Carolina	FIADB, cycle 1	1986
	FIADB, cycle 2	1993
	FIADB, cycle 3	2001
South Dakota, NFS	1997 RPA	1986
	FIADB, cycle 4	1999
	FIADB, cycle 5	2003
South Dakota, all other	1987 RPA	1987
	FIADB, cycle 4	1995
	FIADB, cycle 5	2003
Tennessee	FIADB, cycle 5	1989
	FIADB, cycle 6	1998
	FIADB, cycle 4	2002
Texas	1987 RPA	1986

	FIADB, cycle 1	1992
	FIADB, cycle 3	2003
Utah	1987 RPA	1977
	FIADB, cycle 1	1993
	FIADB, cycle 2	2003
Vermont	FIADB, cycle 4	1983
	FIADB, cycle 5	1997
	FIADB, cycle 6	2004
Virginia	FIADB, cycle 1	1985
	FIADB, cycle 2	1991
	FIADB, cycle 3	2000
Washington, eastern NFS	1987 RPA	1987
	2002 RPA	1995
	FIADB, cycle 5	2004
Washington, eastern all other	1987 RPA	1981
	FIADB, cycle 3	1992
	FIADB, cycle 5	2004
Washington, western NFS	1987 RPA	1987
	2002 RPA	1995
	FIADB, cycle 5	2004
Washington, western all other	1987 RPA	1979
	FIADB, cycle 3	1990
	FIADB, cycle 5	2004
West Virginia	FIADB, cycle 4	1988
	FIADB, cycle 5	2001
Wisconsin	FIADB, cycle 4	1982
	FIADB, cycle 5	1995
	FIADB, cycle 6	2002
Wyoming, NFS	1997 RPA	1982
	2002 RPA	1992
	FIADB, cycle 2	2000
Wyoming, all other	2002 RPA	1984
	FIADB, cycle 2	2001

[a] Inventories for 11 western states were separated into National Forest System (NFS) and all other forest land (all other). Oregon and Washington were also divided into eastern and western forests (east or west of the crest of the Cascade Mountains).
[b] FIADB is version 2.1 as available on the Internet September 30, 2005.
[c] Based on forest land survey plots and rounded to the nearest integer year.

Table A-181: Average carbon density (Mg/ha) by carbon pool and forest area (1000 ha) according to region and forest type, based on the most recent inventory survey available for each State from the FIADB (see Table A-180)

Region (States) Forest Types	Above-ground Biomass	Below-ground Biomass	Dead Wood	Litter	Soil Organic Carbon	Forest Area
	Carbon Density (Mg/ha)					1000 ha
Northeast (CT,DE,MA,MD,ME,NH,NJ,NY,OH,PA,RI,VT,WV)						
White/Red/Jack Pine	91.9	19.0	11.3	13.6	78.1	1,966
Spruce/Fir	51.4	10.9	11.8	30.6	98.0	2,972
Oak/Pine	73.6	14.5	8.9	27.1	66.9	1,403
Oak/Hickory	77.6	14.7	10.1	7.9	53.1	11,802
Elm/Ash/Cottonwood	51.2	9.7	8.1	23.9	111.7	1,266
Maple/Beech/Birch	75.1	14.4	12.4	26.4	69.6	15,239
Aspen/Birch	46.2	9.1	7.7	8.5	87.4	1,659
Minor Types and Nonstocked	42.9	8.6	6.2	13.8	81.8	1,218
Northern Lake States (MI,MN,WI)						
White/Red/Jack Pine	52.7	11.0	7.9	12.2	120.8	1,794
Spruce/Fir	41.1	8.7	8.3	32.5	261.8	3,081
Oak/Hickory	70.2	13.3	10.3	7.8	97.1	2,920
Elm/Ash/Cottonwood	50.1	9.6	8.6	25.5	179.9	1,652
Maple/Beech/Birch	71.4	13.7	10.9	26.4	134.3	5,110
Aspen/Birch	42.1	8.2	8.4	8.3	146.1	5,346

Minor Types and Nonstocked	37.4	7.4	6.2	11.1	127.2	886
Northern Prairie States						
(IA,IL,IN,KS,MO,ND,NE,SD)						
Ponderosa Pine	42.0	8.9	6.9	14.3	48.5	563
Oak/Pine	51.8	10.1	7.1	25.3	39.7	573
Oak/Hickory	68.4	12.9	9.2	7.5	49.1	8,154
Elm/Ash/Cottonwood	72.1	13.5	11.1	23.6	83.0	1,760
Maple/Beech/Birch	62.5	11.8	8.7	24.8	71.0	1,017
Minor Types and Nonstocked	36.1	7.2	5.8	12.5	58.8	884
South Central						
(AL,AR,KY,LA,MS,OK,TN,TX)						
Longleaf/Slash Pine	37.3	7.6	3.9	10.7	55.5	1,321
Loblolly/Shortleaf Pine	42.2	8.6	4.7	9.6	41.9	12,701
Oak/Pine	51.6	10.0	6.4	9.7	41.7	6,928
Oak/Hickory	63.5	11.9	7.3	6.4	38.6	18,841
Oak/Gum/Cypress	71.3	13.6	8.7	6.3	52.8	5,303
Elm/Ash/Cottonwood	57.7	10.9	7.8	5.8	49.9	2,455
Minor Types and Nonstocked	52.1	10.0	7.1	8.1	46.4	1,155
Southeast						
(FL,GA,NC,SC,VA)						
Longleaf/Slash Pine	30.5	6.2	3.3	9.5	110.0	4,185
Loblolly/Shortleaf Pine	44.8	9.2	5.5	9.2	72.9	8,691
Oak/Pine	49.4	9.6	5.5	9.1	61.4	4,928
Oak/Hickory	71.5	13.5	8.2	6.4	45.3	11,006
Oak/Gum/Cypress	71.4	13.8	9.0	6.3	158.0	4,643
Elm/Ash/Cottonwood	70.3	13.3	11.0	6.2	95.7	666
Minor Types and Nonstocked	40.5	7.8	5.7	6.3	87.2	1,129
Pacific Northwest, Westside						
(Western OR and WA)						
Douglas-fir	143.4	30.1	31.3	31.4	94.8	5,594
Fir/Spruce/Mt. Hemlock	144.1	30.4	37.5	37.9	62.1	1,215
Hemlock/Sitka Spruce	175.6	37.0	45.0	38.4	116.3	1,659
Alder/Maple	82.5	16.2	21.0	7.4	115.2	1,359
Minor Types and Nonstocked	69.4	13.8	12.0	13.7	83.0	1,276
Pacific Northwest, Eastside						
(Eastern OR and WA)						
Pinyon/Juniper	13.3	2.6	2.4	21.1	46.9	832
Douglas-fir	79.4	16.6	18.6	36.5	94.8	2,004
Ponderosa Pine	50.0	10.4	10.1	22.8	50.7	2,925
Fir/Spruce/Mt. Hemlock	95.5	20.2	27.0	37.9	62.1	1,573
Lodgepole Pine	41.2	8.7	9.7	21.0	52.0	1,034
Western Larch	70.7	14.8	18.9	36.1	45.1	288
Minor Types and Nonstocked	29.0	5.7	13.1	22.3	79.7	1,486
Pacific Southwest						
(CA)						
Pinyon/Juniper	25.6	5.0	1.9	21.1	26.3	789
Douglas-fir	156.8	32.4	32.8	34.8	40.1	442
Ponderosa Pine	51.9	10.8	10.1	35.1	41.3	376
Fir/Spruce/Mt. Hemlock	163.6	34.6	45.0	38.3	51.9	777
Lodgepole Pine	94.8	20.0	19.8	39.2	35.2	396
Redwood	200.4	41.8	42.0	60.8	53.8	274
California Mixed Conifer	116.7	24.5	28.8	37.6	49.8	3,825
Western Oak	67.1	12.8	7.4	29.0	27.6	3,677
Tanoak/Laurel	125.7	24.6	18.5	27.1	27.6	790
Minor Types and Nonstocked	37.2	7.2	9.0	23.9	38.0	1,935
Rocky Mountains, North						
(ID,MT)						
Douglas-fir	73.8	15.6	13.8	37.2	38.8	5,917
Ponderosa Pine	43.5	9.1	7.9	23.1	34.3	1,772
Fir/Spruce/Mt. Hemlock	68.1	14.4	21.2	37.3	44.1	4,574
Lodgepole Pine	55.2	11.8	10.4	23.3	37.2	2,622
Western Larch	63.2	13.3	14.9	35.9	34.2	411

Minor Types and Nonstocked	27.4	5.5	9.6	24.7	42.5	4,010
Rocky Mountains, South (AZ,CO,NM,NV,UT,WY)						
Pinyon/Juniper	22.1	4.5	0.8	21.1	19.7	19,809
Douglas-fir	72.6	15.4	16.4	38.0	30.9	1,719
Ponderosa Pine	48.5	10.2	8.2	23.6	24.1	3,453
Fir/Spruce/Mt. Hemlock	81.3	17.3	23.0	38.8	31.5	4,180
Lodgepole Pine	53.8	11.4	13.0	24.1	27.0	2,157
Aspen/Birch	56.2	10.8	11.6	28.5	58.8	2,589
Western Oak	19.8	3.8	2.2	27.1	38.0	2,874
Minor Types and Nonstocked	16.6	3.1	4.1	23.7	25.3	5,164

Table A-182: Net Annual Changes in Carbon Stocks (Tg C yr^{-1}) in Forest and Harvested Wood Pools, 1990-2004

Carbon Pool	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Forest	(154)	(157)	(145)	(112)	(109)	(78)	(74)	(82)	(113)	(115)	(115)	(115)	(115)	(115)	(115)
Live, aboveground	(92)	(92)	(87)	(71)	(70)	(63)	(62)	(67)	(78)	(84)	(85)	(85)	(85)	(85)	(85)
Live, belowground	(18)	(18)	(17)	(13)	(13)	(12)	(11)	(13)	(15)	(16)	(16)	(16)	(16)	(16)	(16)
Dead Wood	(12)	(13)	(11)	(9)	(10)	(8)	(8)	(8)	(11)	(10)	(9)	(9)	(9)	(9)	(9)
Litter	(23)	(20)	(17)	(11)	(7)	1	2	3	(3)	(7)	(7)	(7)	(7)	(7)	(7)
Soil Organic Carbon	(9)	(14)	(12)	(8)	(9)	4	5	3	(4)	1	3	3	3	3	3
Harvested Wood	(57)	(54)	(55)	(56)	(57)	(55)	(57)	(58)	(56)	(59)	(57)	(58)	(58)	(59)	(59)
Wood Products	(13)	(11)	(13)	(15)	(17)	(15)	(15)	(16)	(14)	(17)	(16)	(16)	(16)	(16)	(17)
Landfilled Wood	(44)	(43)	(43)	(41)	(41)	(41)	(41)	(42)	(42)	(42)	(41)	(42)	(42)	(42)	(43)
Total Net Flux	(211)	(211)	(200)	(167)	(166)	(133)	(131)	(140)	(169)	(174)	(172)	(173)	(173)	(173)	(174)

Table A- 183: Carbon Stocks (Tg C) in Forest and Harvested Wood Pools, 1990-2005

Carbon Pool	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Forest	39,508	39,661	39,818	39,963	40,074	40,183	40,261	40,335	40,417	40,529	40,645	40,760	40,874	40,989	41,103	41,218
Live, aboveground	14,334	14,426	14,518	14,605	14,676	14,746	14,809	14,871	14,938	15,016	15,100	15,184	15,269	15,354	15,438	15,523
Live, belowground	2,853	2,871	2,888	2,905	2,918	2,931	2,943	2,954	2,967	2,982	2,998	3,014	3,031	3,047	3,064	3,080
Dead Wood	2,409	2,421	2,434	2,445	2,454	2,464	2,472	2,479	2,488	2,499	2,509	2,518	2,527	2,536	2,545	2,554
Litter	4,492	4,515	4,535	4,553	4,563	4,570	4,570	4,568	4,565	4,569	4,575	4,583	4,590	4,597	4,604	4,612
Soil Organic Carbon	15,420	15,429	15,443	15,455	15,463	15,472	15,467	15,463	15,460	15,464	15,463	15,460	15,458	15,455	15,452	15,449
Harvested Wood	1,915	1,973	2,027	2,082	2,137	2,195	2,250	2,307	2,365	2,421	2,480	2,537	2,595	2,654	2,713	2,772
Wood Products	1,134	1,147	1,158	1,171	1,186	1,202	1,217	1,232	1,248	1,262	1,279	1,295	1,311	1,327	1,344	1,360
Landfilled Wood	781	825	868	911	952	992	1,033	1,074	1,117	1,159	1,200	1,242	1,284	1,327	1,369	1,411
Total Carbon Stock	41,423	41,634	41,845	42,044	42,212	42,378	42,511	42,642	42,782	42,951	43,125	43,297	43,470	43,643	43,816	43,990