10 Vegetation

The program calculates GHG emissions associated with the vegetation activities of land use change and the planting of new trees.

The program calculates GHG emissions from vegetation activities according to the IPCC protocol for vegetation since it has default values that work well with the information typically available for development projects. This method is similar to the CAR Forest Protocol[54] and the Center for Urban Forest Research Tree Carbon Calculator[55], but it has more general default values available that will generally apply to all areas of California without requiring detailed site-specific information[56].

10.1 Land Use Change

A development which changes land use type results in changes in CO_2 sequestration from the atmosphere which would not have been captured had there been no land-type change.

Overall Change in Sequestered CO_2 [MT CO_2]

$$= \sum_i \left(SeqCO_2\right)_i \times \left(area\right)_i - \sum_j \left(SeqCO_2\right)_j \times \left(area\right)_j$$

Where:

$SeqCO_2$	=	mass of sequestered CO_2 per unit area [MT CO_2/acre]
area	=	area of land for specific land use type [acre]
i	=	index for final land use type
j	=	index for initial land use type

Overall change in sequestered CO_2 is the summation of sequestered CO_2 from initial land use type multiplied by area of land for initial land use type subtracted by the summation of sequestered CO_2 from final land use type multiplied by area of land for final land use type. There is no reduction in GHG emissions associated with preservation of a land.

$SeqCO_2$

The mass of sequestered CO_2 per unit area [MT CO_2/acre] is dependent on the specific land use type. The program uses default CO_2 sequestration values from CCAR for each land use that will be preserved or created:

[54] CCAR. 2007. Forest Sector Protocol Version 2.1. September. Available at: http://www.climateregistry.org/resources/docs/protocols/industry/forest/forest_sector_protocol_version_2.1_sept2007.pdf

[55] Available at: http://www.fs.fed.us/ccrc/topics/urban-forests/ctcc/

[56] The CAR Forest Protocol and Urban Forest Research Tree Carbon Calculator are not used since their main focus is annual emissions for carbon offset considerations. As such they are designed to work with very specific details of the vegetation that is not available at a CEQA level of analysis.

this is equivalent CO2 stored in mature vegetation per acre
this is not a sequestration rate as in MT CO2/acre/year

Land Use	Sub-Category	Default CO_2 accumulation per acre (MT CO_2/ acre)
Forest Land	Scrub	14.3
	Trees	111
Cropland	--	6.20
Grassland	--	4.31
Wetlands	--	0

The EIR uses the 4.31 figure as an annual CO2 capture rate of CO2/acre/year.
It is not a rate.

The default annual CO_2 is calculated by multiplying total biomass (MT dry matter/acre) from IPCC data by the carbon fraction in plant material (0.47), then using the ratio of molecular weights (44/12) to convert from MT of carbon (C) to MT of carbon dioxide (CO_2).

Vegetation Type

Vegetation types are defined by IPCC as follows:

(i) Forest Land

This category includes all land with woody vegetation consistent with thresholds used to define Forest Land in the national greenhouse gas inventory. It also includes systems with a vegetation structure that currently fall below, but *in situ* could potentially reach the threshold values used by a country to define the Forest Land category.

(ii) Cropland

This category includes cropped land, including rice fields, and agro-forestry systems where the vegetation structure falls below the thresholds used for the Forest Land category.

(iii) Grassland

This category includes rangelands and pasture land that are not considered Cropland. It also includes systems with woody vegetation and other non-grass vegetation such as herbs and brushes that fall below the threshold values used in the Forest Land category. The category also includes all grassland from wild lands to recreational areas as well as agricultural and silvi-pastural systems, consistent with national definitions.

(iv) Wetlands

This category includes areas of peat extraction and land that is covered or saturated by water for all or part of the year (e.g., peatlands) and that does not fall into the Forest Land, Cropland, Grassland or Settlements categories. It includes reservoirs as a managed sub-division and natural rivers and lakes as unmanaged sub-divisions.

Area

The user must specify area of land in acres for specific final and initial land use types. These area changes include not only the area of land that will be converted to buildings, but also areas disrupted by the construction of utility corridors, water tank sites, and associated borrow and

grading areas. Areas temporarily disturbed that will eventually recover to become vegetated will not be counted as vegetation removed as there is no net change in vegetation or land use.[57]

10.2 Sequestration

Planting trees will sequester CO_2 and is considered to result in a one-time carbon-stock change. Trees sequester CO_2 while they are actively growing. The amount of CO_2 sequestered depends on the type of tree.

sequestration rate only comes in to calculate carbon storage in a mature landscape

$$\text{Total Sequestered } CO_2 = (\text{Growing Period} \times \sum_{i=1}^{n} [\text{ Sequestration } i \times \text{Trees } i \text{ }])$$

Where:

Growing Period = Growing period for all trees, expressed in years (20).
n = Number of broad species classes.
Sequestration i = Default annual CO_2 accumulation per tree for broad species class *i.*
Trees i = Number of net new trees of broad species class *i.*

Total Sequestered CO_2 is the growing period for all trees multiplied by the summation of annual CO_2 accumulation multiplied by the number of new trees per broad species class.

Growing Period

The program assumes the IPCC active growing period of 20 years. Thereafter, the accumulation of carbon in biomass slows with age, and will be completely offset by losses from clipping, pruning, and occasional death. Actual active growing periods are subject to, among other things, species, climate regime, and planting density. Note that trees may also be replaced at the end of the 20-year cycle, which would result in additional years of carbon sequestration. However, this would be offset by the potential net release of carbon from the removal of the replaced tree.

[57] This assumption facilitates the calculation as a yearly growth rate and CO_2 removal rate does not have to be calculated. As long as the disturbed land will indeed return to its original state, this assumption is valid for time periods over 20 years.

Sequestration

The program uses default annual CO_2 accumulation per tree for broad species class as follows:

Broad species class	**Default annual CO_2 accumulation per tree[1] (MT CO_2/ year)**
Aspen	0.0352
Soft maple	0.0433
Mixed hardwood	0.0367
Hardwood maple	0.0521
Juniper	0.0121
Cedar/larch	0.0264
Douglas fir	0.0447
True fir/Hemlock	0.0381
Pine	0.0319
Spruce	0.0337
Miscellaneous[2]	0.0354

1. IPCC's carbon (C) values converted to carbon dioxide (CO_2) using ratio of molecular weights (44/12).
2. Average of all other broad species classes. To be assumed if tree type is not known.