Carbon Farming (Reduction of Greenhouse Gas Emissions through Early Dry Season Savanna Burning) Methodology Determination 2012

Carbon Credits (Carbon Farming Initiative) Act 2011

I, MARK DREYFUS, Parliamentary Secretary for Climate Change and Energy Efficiency, make this Methodology Determination under subsection 106 (1) of the *Carbon Credits (Carbon Farming Initiative) Act 2011*.

Dated 8 June 2012

MARK DREYFUS
Parliamentary Secretary for Climate Change and Energy Efficiency

Page

Contents

Part 1 Preliminary

1.1 Name of Methodology Determination

This Methodology Determination is the *Carbon Farming (Reduction of Greenhouse Gas Emissions through Early Dry Season Savanna Burning) Methodology Determination 2012.*

1.2 Commencement

This Methodology Determination commences on 1 July 2010.

Note: Because this Methodology Determination operates on a full calendar year basis, offsets projects under the Methodology Determination will need to commence after the conclusion of the late dry season that is taken to end on 31 December 2010.

1.3 Application

This Methodology Determination applies to a project to avoid the emission of methane (CH_4) and nitrous oxide (N_2O) through the use of strategic early dry season fire management across the savannas in Australia that receive more than 1000 mm long-term annual average rainfall.

1.4 Definitions

In this determination:

Act means the *Carbon Credits (Carbon Farming Initiative) Act 2011*.

annual fire map means a fire map which shows fire scars for a calendar year for each vegetation class in the project area.

baseline period means the period of ten years mentioned in subsection 3.19 (1) or 3.19 (2), whichever is applicable to the project.

coarse fuel means twigs and dead branches of not less than 6 mm in diameter and not more than 50 mm in diameter.

data waypoint means a point within a project area where information is collected.

early dry season means the months in a calendar year that are not the late dry season.

early dry season (EDS) burning means a fire or prescribed burn which occurs in the early dry season.

fine fuel means grass, leaf litter, bark and small twigs of less than 6 mm in diameter.

fire map means a geospatial map in raster format which shows the presence and absence of fire scars within the project area by way of pixels representing burnt or unburnt areas.

fire scar area means the spatial extent, within a project, that has been affected by fire.

fire scar means an area that has been burnt.

fire season means a season that is either the early dry season or the late dry season.

fuel load estimation period means the five years immediately prior to the baseline period.

GPS means global positioning system.

greenhouse gas assessment boundary means the boundary specified under section 3.2.

GWP means Global Warming Potential.

heavy fuel means branches and logs of greater than 50 mm in diameter.

late dry season means the period, for a region, in a calendar year, determined in accordance with section 3.3.

monthly fire map means a fire map relating to one or more calendar months of a year.

Note: Monthly fire maps must also meet the requirements relating to format resolution and other matters set out in section 3.26.

NAFI means the North Australian Fire Information website.

Note: NAFI can be accessed at www.firenorth.org.au.

NGER Measurement Determination means the applicable determination made under subsection 10 (3) of the *National Greenhouse and Energy Reporting Act 2007* as in force from time to time.

NGER Regulations means the *National Greenhouse and Energy Reporting Regulations 2008,* as in force from time to time.

raster format means, for a map, the division of the map into a grid of pixels that can be coded according to characteristics of, or relating to, the area represented by the pixel.

registered greenhouse and energy auditor has the meaning given by the *National Greenhouse and Energy Reporting Act 2007*, as in force from time to time.

Regulations means the *Carbon credits (Carbon Farming Initiative) Regulations 2011,* as in force from time to time.

Savanna burning 1000 mm rainfall map means the map that shows the eligible land area under this Methodology Determination (above 1000 mm of rainfall).

Note: This map can be found at www.climatechange.gov.au.

seasonal fire map means a fire map relating to either the early dry season or the late dry season.

Note: Seasonal fire maps must also meet the requirements relating to format, resolution and other matters set out in section 3.27.

shrubs means living plants with a stem diameter of less than 50 mm at a height of 1.3 m.

strategic early dry season fire management is the planned and purposeful deployment of prescribed early dry season burns in combination with other natural and constructed barriers to stop the spread of fire.

vegetation map means a geospatial map in raster format which identifies the class and location of vegetation in the project area.

Note: Vegetation maps must also meet the requirements relating to format, resolution and other matters set out in section 3.25.

YSLB means the number of years since a pixel was last burnt.

Note: Several other words and expressions used in this Methodology Determination have the meaning given by section 5 of the Act and by the Regulations. These terms include:

- baseline;
- carbon dioxide equivalence;
- eligible offsets project;
- emission;
- greenhouse gas;
- offsets project;
- offsets report;
- project;
- project area;
- project proponent;
- Regulator;
- reporting period.

1.5 Interpretation

A reference in this Methodology Determination to a section, subsection, paragraph, subparagraph, Part, Division, subdivision, Schedule, Equation, or a part thereof is, unless otherwise stated, to be read as a reference to such a part or aspect of this Methodology Determination.

Part 2 Project Requirements

2.1 Requirements that must be met for an offsets project to be an eligible offsets project

(1) For paragraph 106 (1) (b) of the Act, this section sets out requirements that must be met for an offsets project to which this Methodology Determination applies to be an eligible offsets project.

(2) The project must:

(a) be located in an area which, according to the savanna burning 1000 mm rainfall map, receives more than 1000 mm long-term average annual rainfall;

(b) contain only one or more of the following vegetation classes as described in Schedule 1:

(i) eucalypt open forest with tussock grass ground layer (EOF);

(ii) eucalypt woodland, with tussock grass ground layer (EW);

(iii) sandstone woodland with a mixed tussock and/or hummock (spinifex) grass ground layer (SW); and

(iv) sandstone heath with a ground layer dominated by hummock grasses (spinifex) (SH).

(3) The project must apply strategic early dry season fire management in the project area.

(4) The project must not use other indirect methods for reducing the fire area, such as the introduction of cattle to a project area.

(5) The project cannot reduce the fire area within the project area by inducing an increase in late dry season fires in area/s bordering the project area.

Federal Register of Legislative Instruments F2012L01499

Part 3 Calculating the carbon dioxide equivalent net abatement amount for a project

Division 3.1 Preliminary

3.1 General

(1) For paragraph 106 (1) (c) of the Act, this Part sets out calculations that must be carried out, and other requirements that must be met, to ascertain the annual carbon dioxide equivalent (CO_2-e) net abatement amount for an offsets project to which this Methodology Determination applies.

(2) Calculations performed in accordance with this Part will provide the carbon dioxide equivalent net abatement amount for one calendar year of an offsets project. If the reporting period consists of more than one calendar year, the calculations in this Part must be performed for each year of the reporting period and summed.

(3) If a project area contains regions with different start dates of their late dry seasons, the CO_2-e net abatement amount must be calculated separately for each region for each year of the reporting period and then summed to provide the CO_2-e net abatement amount for the project area for the reporting period.

(4) In carrying out the calculations in this Part:

(a) The project must use:

i. a vegetation map for the project that is developed in accordance with section 3.24 and validated in accordance with section 3.25; and

ii. monthly fire maps that comply with the requirements of section 3.26 and that are created or sourced for each month of each year in the fuel load estimation period, the baseline period and the reporting period.

(b) the data used in the calculations must comply with the data collection requirements specified in this Part;

(c) project proponents must record the results of calculations in the manner and form specified in this Part; and

(d) if a calculation in this Part refers to a factor or parameter prescribed in the NGER Measurement Determination or the NGER Regulations, the person carrying out the calculations must apply, to the entire offsets reporting period, the NGER Measurement Determination or NGER Regulations in force at the time that the offsets report was submitted or was required to be submitted, whichever occurs first.

3.2 Greenhouse gas assessment boundary

The following greenhouse gases must be taken into account when making calculations under this Part in respect of each of the following kinds of activities within the project. No other gases may be taken into account in respect of project activities, nor may gases from activities that are not specified below be taken into account.

Gases accounted for in the abatement calculations.

Project activity	**Greenhouse gas**
Burning of flammable living and dead vegetation (fine, coarse and heavy fuels and shrubs) in the project area during the baseline period and project activity period.	CH_4 N_2O
Fuel use to establish and maintain the project, for example, for helicopters and other energy-consuming equipment or drip torches.	Carbon dioxide (CO_2) CH_4 N_2O

3.3 The start of the late dry season

(1) For each year of the baseline period and the reporting period, the Department must determine and publish on the Department's website:

(a) the defined start date of the late dry season for a region; and

(b) the method used to determine the start date.

Note The date is accessible at www.climatechange.gov.au.

(2) The start date of the late dry season must be no earlier than 1 July and be no later than 31 August.

(3) For the purposes of this Methodology Determination the late dry season is taken to end on 31 December in a given year.

(4) The start date of the late dry season for a region is taken to be 1 August if the Department does not make a determination under subsection (1).

(5) The start date of the late dry season for a project area must be recorded in Table 9 of Form 1 and Form 2 of Schedule 2 and must be used in any calculation of emissions for a project area that is required by this Methodology Determination.

Division 3.2 Calculations

Subdivision 3.2.1 Developing maps and calculating fire scar area

3.4 Developing maps used to calculate emissions

(1) A vegetation map for the project area that meets the requirements of a vegetation map given at section 3.24 and is validated in accordance with section 3.25 must be developed, using GIS software.

(2) The area of each vegetation class in terms of the number of pixels must be calculated using GIS software.

(3) Monthly fire maps meeting the requirements of section 3.26 must be sourced or developed for the fuel estimation period, the baseline period, and the reporting period.

(4) Monthly fire maps must be sourced for every month of every year for the baseline period, the fuel estimation period and the reporting period to develop the fire maps specified at subsection (5).

(5) Seasonal fire maps must be developed in accordance with section 3.27 and, if not sourced from NAFI, validated in accordance with section 3.28.

3.5 Calculating the fire scar area (A) in the early dry season and the late dry season periods for each vegetation class

(1) The fire scar area in a project area must be calculated in hectares for each fire season for each calendar year of the baseline period and the reporting period according to vegetation class, using GIS software.

(2) Subsection (1) must be implemented by overlaying the vegetation map described in section 3.4 (1) with the seasonal fire maps described in section 3.4 (5), to produce a raster map that allocates a vegetation class and a fire season to each pixel that is part of a fire scar.

(3) The fire scar area in the raster map in subsection (2) must be converted to hectares using GIS software and the results of this calculation must be recorded in Table 10 of Form 1 of Schedule 2 for each year of the baseline period and the reporting period.

Subdivision 3.2.2 Calculating annual fire emissions for the baseline period and the project period

3.6 Calculating annual fire emissions

(1) The annual emissions of greenhouse gases from fire for an offsets project must be calculated for each calendar year of the baseline period and the reporting period using the following formula:

$E_{fire}CO_2\text{-}e = Ab \times Pe$	**Equation 1**

where:

$E_{fire}CO_2$-e = annual fire emissions, the annual emissions of greenhouse gases (tonnes CO_2-e) from fire for an offsets project over a calendar year.

Ab = area burnt, the fire scar area in hectares, taking patchiness into account, calculated as per section 3.7.

Pe = potential emissions, the emissions per unit area that would occur if that area was burnt (tonnes per hectare, t/ha^{-1}) comprising the sum of Pe_{CH_4} and Pe_{N_2O}, calculated as per section 3.8.

(2) Annual fire emissions must be calculated annually for each greenhouse gas (CH_4 and N_2O) according to each vegetation class and fire season in accordance with section 3.18.

(3) This calculation is undertaken by multiplying the values in Table 11 with the corresponding values in Table 21 as described in section 3.18. The results must be recorded in Table 22 of Form 1 and Form 2 of Schedule 2.

3.7 Calculating the area burnt (Ab)

(1) The area burnt for the purposes of Equation 1 is the amount calculated using the following formula:

$Ab = A \times P$	**Equation 2**

where:

Ab = area burnt, the fire affected area in hectares, taking patchiness into account.

A = fire scar area within the project area in each fire season for each vegetation class, measured in hectares calculated using section 3.5 and recorded in Table 10 of Form 1 of Schedule 2.

P = patchiness, the fraction of the fire scar area that is presumed to be burnt when fire occurs — for the early dry season, patchiness is taken to be 0.709 and for the late dry season, patchiness is taken to be 0.889.

(2) The area burnt must be calculated annually for each combination of fire season and vegetation class.

(3) The results must be recorded in Table 11 of Form 1 and Form 2 of Schedule 2.

3.8 Calculating potential emissions (Pe)

(1) The potential emissions for the purposes of Equation 1 must be calculated for each combination of vegetation class, fuel size class and fire season using the following formulas:

(i) for CH_4 using the following equation:

$\mathbf{Pe_{CH_4} = BEF \times FL \times EF_{CH_4} \times CC \times M_{CH_4}}$	**Equation 3**

(ii) for N_2O using the following equation:

$\mathbf{Pe_{N_2O} = BEF \times FL \times EF_{N_2O} \times CC \times NC \times M_{N_2O}}$	**Equation 4**

where:

$\mathbf{Pe_{CH_4}}$ = potential emissions of CH_4 (tonnes per hectare) for a given vegetation class, fuel size class and fire season.

$\mathbf{Pe_{N_2O}}$ = potential emissions of N_2O (tonnes per hectare) for a given vegetation class, fuel size class and fire season.

BEF = burning efficiency, being the mass proportion of the mass of combusted fuel that is volatilised in a fire, taken from Table 1 in section 3.9.

FL = fuel load (t ha^{-1}) taken from Table 2 in section 3.10.

$\mathbf{EF_{CH_4}}$ = emission factor for CH_4 for the specified vegetation class and fuel size class taken from Table 4 in section 3.14.

$\mathbf{EF_{N_2O}}$ = emission factor for N_2O for the specified vegetation class and fuel size class taken from Table 5 in section 3.14.

CC = carbon content of fuel for the specified fuel size class taken from Table 6 in section 3.15.

NC = elemental nitrogen to carbon ratio for the specified fuel size class taken from Table 7 in section 3.16.

M = ratio of molecular mass to the elemental mass for CH_4 and N_2O taken from Table 8 in section 3.17.

(2) The potential emissions for CH_4 in the early dry season for each combination of vegetation class and fuel size class must be recorded in Table 17 of Form 1 of Schedule 2.

(3) The potential emissions for CH_4 in the late dry season for each combination of vegetation class and fuel size class must be recorded in Table 18 of Form 1 of Schedule 2.

(4) The potential emissions for N_2O in the early dry season for each combination of vegetation class and fuel size class must be recorded in Table 19 of Form 1 of Schedule 2.

(5) The potential emissions for N_2O in the late dry season for each combination of vegetation class and fuel size class must be recorded in Table 20 of Form 1 of Schedule 2.

Note: The calculation of the potential emissions for CH_4 and N_2O are operationalised by applying the following equations, which involve multiplying the corresponding values in the relevant tables, and presenting the results in Tables 17–20 of Form 1 of Schedule 2.

For Pe_{CH_4} = Table 1 x Table 13 x Table 4 x Table 6 x Table 8_{CH_4}

For Pe_{N_2O} = Table 1 x Table 13 x Table 5 x Table 6 x Table 7 x Table 8_{N_2O}

(6) The total potential emissions for each greenhouse gas in each fire season for each vegetation class must be recorded in Table 21 of Form 1 of Schedule 2.

3.9 Burning Efficiency (BEF)

For the purposes of Equations 3 and 4, the burning efficiency (BEF) for fine, coarse, heavy and shrub fuel size classes for the early and late dry season is taken to be the amount set out in the following table:

Table 1: Burning Efficiency

Fuel size class	Early Dry Season	Late Dry Season
Fine	0.658	0.7608
Coarse	0.13192	0.31844
Heavy	0.1448	0.2676
Shrub	0.2556	0.3464

3.10 Fuel Load (FL)

(1) For the purposes of Equations 3 and 4, the fuel load (FL) for coarse, heavy and shrub fuel size classes for a vegetation class, is taken to be the amount set out in the following table:

Table 2: Fuel loads for coarse, heavy and shrub fuel size classes

Vegetation class	Fuel size class		
	Coarse	Heavy	Shrub
EOF	1.4	4.8	1.5
EW	0.90	2.2	0.5
SW	1.2	3.4	1.7
SH	0.6	1.7	1.8

(2) For the purposes of Equations 3 and 4, the fuel load (FL) for the fine fuel size class must be calculated according to sections 3.11, 3.12 and 3.13.

3.11 Calculating years since last burnt (YSLB) for a pixel

(1) Years since last burnt (YSLB) must be calculated for each year in the baseline period and the reporting period, using GIS software.

(2) Calculation of YSLB for each year of the baseline period and the reporting period must involve the analysis of fire maps for a given calendar year (the analysis year) and for the previous five years.

(3) When the earliest five years of the baseline period are analysed, the annual fire maps developed in the fuel load estimation period must be used to provide maps for the five years preceding the analysis year.

(4) YSLB must be calculated using the following process:

(a) the monthly fire maps described in section 3.4 must be aggregated into calendar year fire maps for the analysis year and for each of the five years preceding it, with each pixel showing whether the area represented by the pixel was burnt or unburnt (described as '***burnt pixels***' and '***unburnt pixels***' respectively in this Methodology Determination);

(b) the relevant Gregorian calendar year must be assigned (as a value) to all burnt pixels in each fire year;

(c) a zero value must be assigned to all unburnt pixels;

(d) a name must be assigned to each of the six maps using the following convention:

(i) the analysis year must be named Gy; and

(ii) the five maps preceding the analysis year must be named Gy-1 to Gy-5 in sequence, with Gy-1 being the year immediately preceding the analysis year;

(e) five maps must be generated that show the difference in values between the analysis year and each of the other five years by undertaking a standard grid operation in GIS software that takes the values assigned to each pixel from the analysis year map and subtracts the corresponding values in each of the five other maps in turn;

(f) this analysis produces five maps that must be named Dy-1 to Dy-5;

Note: For example, Dy-1 represents the values allocated to each pixel in Gy minus the values allocated to each pixel in Gy-1. Dy-2 represents the values allocated to each pixel in Gy minus the values allocated to each pixel in Gy-2 and so on. The five maps that are the product of this analysis will be:

1. Dy-1 = Gy – Gy-1;
2. Dy-2 = Gy – Gy-2;
3. Dy-3 = Gy – Gy-3;
4. Dy-4 = Gy – Gy-4; and
5. Dy-5 = Gy – Gy-5;

(g) the minimum value allocated to each corresponding pixel in each map must be calculated using a standard grid operation in GIS software and presented in a single map, which will have one of the following values for each pixel:

(i) a pixel value of zero, which means no fire in that pixel in any year;

(ii) a pixel value of a large negative number (e.g. -2006), which means not burnt in the analysis year but burnt in one or more of the other years;

(iii) a pixel value of one to five, which means burnt in the analysis year and also burnt in another year; or

(iv) a pixel value equal to the value of the analysis year, which means burnt in the analysis year and in no other year.

(h) the values assigned to each pixel in this map must be modified using the following formula:

(i) if the value in a pixel is a negative value, the pixel must be modified to show zero;

(ii) if the value in a pixel is more than five, the pixel must be modified to show six; and

(iii) if the value is in the range from zero to five, no change must be made to the value shown in the pixel.

(i) the output of this process is a single map (***the YSLB map***) with YSLB values that show the YSLB. These values are in the range zero to six where:

(i) values one to five represent the number of years since the previous fire in that pixel;

(ii) a value of six means that pixel was burnt more than five years previously (or never burnt); and

(iii) a value of zero means that the pixel was not burnt in the analysis year.

3.12 Calculating the relative frequency distribution of fire history

(1) The YSLB map developed under section 3.11 must be overlayed with the vegetation map developed according to subsection 3.4 (1) and the number of pixels burnt (N_b) in each vegetation class for each YSLB value determined.

(2) These values (N_b) must be recorded in the appropriate cell in Table 14 of Form 1 of Schedule 2 and summed across the rows to calculate N_{total}, the total number of burnt pixels by vegetation class.

(3) A relative frequency distribution of each YSLB value for each vegetation class must be produced using the values for N_b and N_{total} in Table 14 of Form 1 of Schedule 2 and the following formula:

Relative frequency distribution of YSLB values = N_b / N_{total}	**Equation 5**

where:

Relative frequency distribution of YSLB values = the number of pixels burnt in each vegetation class for each YSLB value.

N_b = the number of burnt pixels for each vegetation class by YSLB.

N_{total} = the sum of N_b values for each vegetation class.

(4) The relative frequency distribution of YSLB values must be calculated for each vegetation class and recorded in Table 15 of Form 1 of Schedule 2.

3.13 Calculating the fuel load for fine fuels

(1) The fuel accumulation values (tonnes per hectare) for fine fuels based on YSLB is taken to be the amount set out in the following table:

Table 3: Fuel accumulation values for fine fuels (t ha^{-1})

Vegetation class	**YSLB (n)**					
	1	**2**	**3**	**4**	**5**	**>5**
EOF	2.74	4.25	5.07	5.53	5.78	6.06
EW	3.80	4.41	4.51	4.53	4.53	4.53
SW	2.08	3.41	4.25	4.79	5.14	5.68
SH	1.88	3.55	5.03	6.35	7.51	11.64

(2) The fine fuel load values must be calculated by multiplying the frequency distribution of YSLB values recorded in Table 15 of Form 1 of Schedule 2 by the corresponding fuel accumulation value for fine fuels given in Table 3 above and the results recorded in Table 16 of Form 1 of Schedule 2.

(3) The total fine fuel load values for each vegetation class obtained by totalling the value of each row of Table 16 of Form 1 of Schedule 2 must be recorded in Table 13 of Form 1 of Schedule 2.

3.14 Emission factors (EF)

(1) For the purposes of paragraph 3.8 (1) (i), the emission factor for CH_4 for each vegetation class and fuel size class is taken to be the amount set out in the following table:

Table 4: Emissions Factors for methane

	Fuel size class			
Vegetation class	**Fine**	**Coarse**	**Heavy**	**Shrub**
EOF	0.0031	0.0031	0.01	0.0031
EW	0.0031	0.0031	0.01	0.0031
SW	0.0031	0.0031	0.01	0.0031
SH	0.0015	0.0015	0.01	0.0015

(2) For the purposes of paragraph 3.8 (1) (ii), the emission factor for N_2O for each vegetation class and fuel size class is taken to be the amount set out in the following table:

Table 5: Emissions Factors for nitrous oxide

	Fuel size class			
Vegetation class	**Fine**	**Coarse**	**Heavy**	**Shrub**
EOF	0.0075	0.0075	0.0036	0.0075
EW	0.0075	0.0075	0.0036	0.0075
SW	0.0075	0.0075	0.0036	0.0075
SH	0.0066	0.0066	0.0036	0.0066

3.15 Carbon Content (CC)

(1) For the purposes of subsection 3.8 (1), the carbon content for each fuel size class is taken to be the amount set out in the following table:

Table 6: Carbon Content

	Fuel size class			
Elemental content	**Fine**	**Coarse**	**Heavy**	**Shrub**
Carbon	0.46	0.46	0.46	0.46

3.16 Nitrogen to Carbon Ratio (NC)

(1) For the purposes of paragraph 3.8 (1) (ii), the nitrogen to carbon ratio for each fuel size class is taken to be the amount set out in the following table:

Table 7: Nitrogen to carbon ratio

Elemental content	Fuel size class			
	Fine	Coarse	Heavy	Shrub
Nitrogen to carbon ratio	0.0096	0.0081	0.0081	0.0093

3.17 Converting the Molecular mass to Elemental Mass (M)

(1) For the purposes of subsection 3.8 (1), the value of emissions of CH_4 and N_2O must be converted from the molecular mass to the elemental mass.

(2) For the purposes of subsection 3.8 (1), the conversion factor is the ratio of molecular mass to elemental mass for each of CH_4 and N_2O and is taken to be the amount set out in the following table:

Table 8: Molecular mass to elemental mass

Gas	Conversion factor (M)
CH_4	1.3333
N_2O	1.5714

3.18 Calculating the annual fire emissions in tonnes CO_2-e

(1) The annual fire emissions of each greenhouse gas (tonnes of greenhouse gas emitted) in each fire season for each vegetation type must be calculated and the results must be recorded in Table 22 of Form 1 and Form 2 of Schedule 2.

(2) This calculation is done by multiplying the values in Table 11 with the corresponding values in Table 21.

Note: For example, the value in the first column and the first row of Table 11 must be multiplied by the value in the first row and the first column of Table 21 and the result would be recorded in the first row of the first column of Table 22. The value in the first column and the first row of Table 11 must also be multiplied by the value in the first row and the third column of Table 21 and the result would be recorded in the first row of the third column of Table 22. This calculation must be repeated for each value in Table 21 with the appropriate value in Table 11 to populate the first four rows and the four columns of Table 22.

(3) The annual fire emissions of each greenhouse gas (tonnes of CO_2-e) must be calculated and the results must be recorded in Table 23 of Form 1 of Schedule 2. This must be done by multiplying the total annual emissions of each greenhouse gas by the GWP as specified in regulation 2.02 of the NGER Regulations.

(4) The annual fire emissions ($E_{fire}CO_2$-e (tonnes of CO_2-e)) for each year in the reporting period must be calculated and the results must be recorded in Table 25 of Form 1 and Form 2 of Schedule 2. This must be done by adding the total annual CO_2 equivalent emissions of each greenhouse gas (CH_4 and N_2O) from Table 23 of Form 1 of Schedule 2.

3.19 Calculating average baseline emissions

(1) For paragraph 106 (4) (f) of the Act, the baseline for a project is, subject to subsection (2), the annual emissions of CH_4 and N_2O in tonnes of CO_2-e for the project area, determined in accordance with subdivision 3.2.2, averaged over the ten years immediately preceding project commencement.

(2) Where strategic early dry season fire management has been conducted in the project area for at least one year but no more than six consecutive years immediately preceding the commencement of an eligible offsets project, the project proponent may adopt as the baseline the annual emissions of CH_4 and N_2O from the project area, determined in accordance with subdivision 3.2.2, averaged over the ten years immediately preceding the commencement of that early dry season burning.

Note: Even if early dry season burning occurred in the project area for more than six years immediately preceding project commencement, the reference period for calculating the baseline under subsection (2) is the ten years immediately preceding the period up to six years during which early dry season burning occurred prior to project commencement.

(3) The annual emissions, in tonnes of CO_2-e, for each year that is included in the calculation of the project baseline emissions, and the sum of the annual emissions to determine the total emissions over the baseline period, must be recorded in Table 24 of Form 1 and Form 2 of Schedule 2.

(4) The average annual emissions for the baseline period must be calculated and recorded in Table 24 of Form 1 and Form 2 of Schedule 2.

Subdivision 3.2.3 Calculating total annual project emissions

3.20 Calculating the emissions from fuel used to establish and manage a project

(1) The total emissions of greenhouse gases from fuel used to establish and manage an offset project must be calculated for each fuel class and each greenhouse gas for each year in the reporting period.

(2) Greenhouse gas emissions from fuel use must be estimated using the energy content factors and emission factors specified in Schedule 1 of the NGER Measurement Determination in force at the time the offsets report is submitted or was required to be submitted, whichever is earlier.

(3) The total emissions of greenhouse gases from fuel used to establish and manage an offset project for each fuel type and each greenhouse gas is to be calculated using the following formula:

$$E_{ij} = \frac{Q_i \ EC_i \times EF_{ijoxec}}{1000}$$	**Equation 6**

where:

E_{ij} = emissions from fuel for each fuel type and each greenhouse gas (tonnes emitted).

i = fuel type.

j = greenhouse gas type (CO_2, N_2O, CH_4).

Q_i = quantity of the specified fuel type, measured in cubic metres or gigajoules.

EC_i = energy content factor of fuel type (i) (gigajoules per kilolitre) (If Q_i is measured in gigajoules, then EC_i is 1).

EF_{ijoxec} = emission factor for each gas type (j) (which includes the effect of an oxidation factor) for fuel type (i) (kilograms CO_2-e per gigajoule).

(4) The total emissions of greenhouse gases from fuel used to establish and manage an offset project is to be calculated using the following formula:

$$E_{fuel} = \sum_{1}^{N_{i,j}} E_{ij}$$	**Equation 7**

where:

E_{fuel} = total emissions from fuel use (tonnes CO_2-e).

E_{ij} = emissions from fuel for each fuel type and each greenhouse gas (tonnes emitted).

i = fuel type.

j = greenhouse gas type (CO_2, N_2O, CH_4).

(5) The total emissions of greenhouse gases from fuel used to establish and manage an offset project (E_{fuel}) must be recorded in Table 26 of Form 1 of Schedule 2.

3.21 Calculating total project emissions

The total annual amount of emissions of carbon dioxide equivalents for an offsets project is to be calculated using the following formula and recorded in Table 27 of Form 1 of Schedule 2:

$$E_{total}CO_2\text{-}e = E_{fire}CO_2\text{-}e + E_{fuel}$$	**Equation 8**

where:

$E_{total}CO_2$-e = the total annual project emissions from the project, in tonnes of CO_2-e.

$E_{fire}CO_2$-e = annual fire emissions resulting from section 3.6, in tonnes of CO_2-e.

E_{fuel} = emissions from fuel resulting from section 3.20, in tonnes of CO_2-e.

Subdivision 3.2.4 Calculating net annual greenhouse gas abatement

3.22 Calculating net annual greenhouse gas abatement

For paragraph 106 (1) (c) of the Act, the CO_2-e net annual abatement amount for an offsets project to which this Methodology Determination applies is taken, for the purposes of the Act, to be the amount calculated using the following formula and recorded in Table 28 of Form 1 and Form 2 of Schedule 2:

$A_{net}CO_2\text{-}e = E_{BL}CO_2\text{-}e - E_{total}CO_2\text{-}e$	**Equation 9**

where:

$A_{net}CO_2$-e = the net abatement amount for an offsets project to which this Methodology Determination applies for a reporting period, in tonnes of CO_2-e.

$E_{BL}CO_2$-e = the baseline for a project being the average of annual total CH_4 and N_2O emissions (in tonnes of CO_2-e) from the project area for the applicable period, taken from Table 24 in Form 1 of Schedule 2.

$E_{total}CO_2$-e = the total annual project emissions from the project area, in tonnes of CO_2-e, as calculated according to section 3.21.

Division 3.3 Data collection

3.23 Data collection

(1) Data must be collected to develop vegetation and fire maps in accordance with this Division.

(2) Vegetation maps and fire maps must be validated in accordance with this Division.

(3) Data must be collected on the quantity of liquid fuel, recorded in kilolitres (kL), for each fuel type used in the project.

(4) If helicopters have been used in the project, and the quantity of liquid fuel for use in the helicopter is not available, data must be collected on the hours of flight time undertaken for the project and fuel estimated accordingly.

3.24 Requirements for a vegetation map

A vegetation map must:

(a) be in raster format;

(b) assign a vegetation class to each pixel that represents a part of the project area, according to the vegetation classes specified in Schedule 1;

(c) be based on mapping products describing vegetation structure and ancillary land information such as soil type and foliage projective cover; and

(d) include at least one input of a cloud-free satellite image made not more than three years prior to project commencement and with a minimum pixel size of 250 m^2.

3.25 Validation of a vegetation map

(1) Vegetation maps must be validated in accordance with this Methodology Determination to be not less than 80 per cent accurate overall at a maximum scale of 1:100 000.

(2) The accuracy of a vegetation map must be validated, using information from independent data waypoints as follows:

(a) the independent data waypoint information must be derived from GPS-based comprehensive ground information, or aerial-based stratified random sampling, that covers all vegetation types in the project area;

(b) for project areas over 10 000 km^2:

(i) not less than 500 independent data waypoints must be used to refine the map; and

(ii) an additional 500 independent data waypoints must be used to assess the accuracy of the map;

(c) for project areas less than 10 000 km^2:

(i) not less than 250 independent data waypoints must be used to refine the map; and

(ii) an additional 250 independent data waypoints must be used to assess the accuracy of the map;

(d) independent data waypoints must:

(i) be of the order of one hectare in area and be congruent with the scale of the vegetation map; and

(ii) be collected with reference to transects or a grid that samples all vegetation classes over the project area;

(e) geospatial software must be used to validate the vegetation map:

(i) the independent data waypoints must be intersected with the vegetation map to derive a standard error matrix including errors of omission and commission; and

(ii) the data in the standard error matrix must be used to determine the accuracy of the map as a percentage;

(f) the data from paragraph (2) (e) must be used to improve the accuracy of the vegetation map.

3.26 Monthly fire maps

(1) Monthly fire maps must be in raster format.

(2) A monthly fire map used to calculate the baseline emissions of a project area for the purposes of this Methodology Determination must have a spatial resolution no less than 1 km^2 per pixel.

(3) A monthly fire map used to calculate project emissions of a project area for the purposes of this Methodology Determination must have a spatial resolution no less than 250 m^2 per pixel.

(4) A monthly fire map used in relation to a baseline period, a reporting period or a fuel load estimation period must adopt a consistent time series and be derived from a single satellite imagery product. The time series used to calculate the baseline period emissions and reporting period emissions do not, however, have to be consistent with each other.

Note: Gaps in the availability of satellite imagery may be filled by supplementing fine scale products with coarser scale products.

3.27 Seasonal fire maps

(1) Seasonal fire maps must be in raster format.

(2) Monthly fire maps for an entire calendar year must be combined to develop a seasonal fire map for the fire seasons in each calendar year in the baseline period and the project reporting period as follows:

(a) all monthly fire maps from 1 January in a given year until the start of the late dry season must be combined into an early dry season fire map; and

(b) all monthly fire maps from the start of the late dry season to 31 December in a given year must be combined into a late dry season map.

(3) A seasonal fire map used to calculate the baseline emissions of a project area must have a spatial resolution of no less than 1 km^2 per pixel.

(4) A seasonal fire map used to calculate the project emissions of a project area must have a spatial resolution of no less than 250 m^2 per pixel.

(5) A seasonal fire map used in relation to a baseline period, a reporting period or a fuel load estimation period must be of a consistent time series, be from a single satellite imagery product, and be based on a time resolution of one month or less. The time series used to calculate the baseline period emissions, fuel loads and reporting period emissions do not, however, have to be consistent with each other.

Note: Gaps in the availability of satellite imagery products may be filled by supplementing fine scale products with coarser scale products.

3.28 Seasonal fire maps not sourced from NAFI

(1) Seasonal fire maps must be in raster format.

(2) Seasonal fire maps that are not developed from monthly fire maps sourced from NAFI must be validated by a registered greenhouse and energy auditor to be at least 80 per cent accurate overall for fire scars in the project area at a 1:100 000 scale for each year of the project.

(3) Validation of seasonal fire maps not sourced from NAFI must be carried out in accordance with this section.

(4) Validation of a seasonal fire map must be carried out using information gathered from independent data waypoints using GPS-based comprehensive aerial-based random sampling, which incorporates all vegetation types in the project area.

(5) In carrying out the data collection required in subsection (3):

(a) data must be collected from the waypoints along a series of transects that sample the areas containing fire activity for each fire season; and

(b) at each data waypoint the registered greenhouse and energy auditor must undertake an on-site visual assessment and note:

(i) the vegetation class; and

(ii) whether the area is 'burnt' or 'unburnt'.

(6) For project areas over 10 000 km^2, data from at least 500 independent data waypoints must be collected to validate the map.

(7) For project areas less than 10 000 km^2, data from at least 250 independent data waypoints must be collected to validate the map.

(8) The registered greenhouse and energy auditor must:

(a) use GIS software to validate each seasonal fire map. In so doing:

(i) the independent data waypoint must be intersected with the seasonal fire map to derive a standard error matrix including errors of omission and commission; and

(ii) the data in the standard error matrix must be used to determine the accuracy of the map as a percentage; and

(b) produce a detailed report of the validation.

Part 4 Monitoring, record-keeping and reporting requirements

Division 4.1 General

4.1 Application

For the purposes of subsection 106 (3) of the Act, a project proponent of an offsets project to which this Methodology Determination applies must comply with the monitoring, record-keeping and reporting requirements of this Division.

Division 4.2 Record-keeping requirements

4.2 Records that must be kept

The project proponent must make and keep the following records of the information:

(a) all primary maps and data used as inputs into both baseline and project emissions calculations, in electronic form:

(i) maps must be retained in standard geospatial formats;

(ii) data sets must be retained in standard spreadsheet or text formats; and

(iii) copies of all mapping products consulted and produced to generate the maps;

(b) a GIS map combining the vegetation map (to define the project area) and the savanna burning 1000 mm map must be developed to provide evidence that the project falls within the above 1000 mm rainfall area;

(c) data sources used for compiling the vegetation map, including copies of all mapping products consulted and produced;

(d) seasonal fire maps for each year in the baseline period and reporting periods;

(e) all monthly fire maps and supporting data sets that underpin the monthly fire maps as required under section 3.4, including:

(i) maps used to calculate baseline emissions; and

(ii) maps used to calculate annual project emissions;

(f) YSLB maps for the project area, and the data used to develop the maps;

(g) evidence of the validation of the vegetation map, including:

(i) the results of the validation assessment;

(ii) the data sources used for undertaking the validation assessment, including copies of all mapping and sampling products consulted and produced;

(iii) all GIS maps depicting the position of all independent data waypoints collected;

(iv) the GIS map that shows the intersection of the independent data waypoints and the vegetation map; and

(v) the matrix showing quantitative evidence of errors of omission and commission by vegetation class and evidence that the final vegetation map is at least 80% reliable;

(h) for a fire map sourced from NAFI, evidence of the source;

(i) for a fire map not sourced from NAFI:

(i) the registered greenhouse and energy auditor's validation assessment report of the fire map;

(ii) the data sources used for undertaking the validation assessment, including copies of all mapping and sampling products consulted and produced;

(iii) all GIS maps depicting the position of all independent data waypoints collected;

(iv) the GIS map that shows the intersection of the independent data waypoints and the seasonal fire maps; and

(v) the matrix showing quantitative evidence of errors of omission and commission by vegetation class and evidence that the final vegetation map is at least 80% reliable;

(j) if the data collected by the registered greenhouse and energy auditor's validation assessment has been used to increase the accuracy of a fire map, the original fire map and the adjusted fire map;

(k) the results of all calculations specified in Part 3 in the tables specified in Form 1 at Schedule 2;

(l) records of early dry season burning activities undertaken, including location, timing and method; and

(m) evidence of fuel use (including invoices and receipts and, in the case of helicopter use if fuel use receipts are not available, record of hours of flight).

Division 4.3 Offsets report requirements

4.3 Information that must be included in the first offsets report

The following information is required to be included in the first offsets report for a project to which this Methodology Determination applies:

(a) the CO_2-e net abatement amount for the project;

(b) the validated vegetation map of the project area;

(c) the map described in paragraph 4.2 (b);

(d) a description of the early dry season burning, including the location, timing and method of prescribed burns;

(e) the seasonal fire maps for the project area for the baseline period and the reporting period;

(f) for a fire map sourced from NAFI, evidence of the source;

(g) for fire maps not sourced from NAFI, the report of the registered greenhouse and energy auditor's report relating to the validation of the early dry season and late dry season fire maps; and

(h) the results of the calculations and other information given in Form 2 of Schedule 2.

4.4 Subsequent reporting periods

The following information is required to be included in the second and subsequent offsets reports:

(a) the CO_2-e net abatement amount for the project;

(b) a description of the early dry season burning regime, including the location, timing and method of prescribed burns;

(c) the early dry season fire maps of the project area for the years in the reporting period;

(d) the late dry season fire maps of the project area for the years in the reporting period;

(e) for a fire map sourced from NAFI, evidence of the source;

(f) for fire maps not sourced from NAFI, the report of the registered greenhouse and energy auditor's report relating to the validation of the early dry season and late dry season fire maps; and

(g) the results of the calculations and other information given in Form 2 of Schedule 2.

Note

1. All legislative instruments and compilations are registered on the Federal Register of Legislative Instruments kept under the *Legislative Instruments Act 2003.* See www.frli.gov.au.

Schedule 1

Vegetation classes

Vegetation class	Canopy Height (m)	Foliage cover (%)	Characteristic species			Characteristic substrates
			Canopy trees	***Shrubs***	***Grasses***	
EOF	Majority >15	30-70 (trees)	Tall eucalypts (e.g. *Eucalyptus tetrodonta*, *E. miniata*, *Corymbia nesophila*)	Various—well developed shrub layer may / may not be present	Native perennial and annual tussock grasses	Well drained deep soils, often sandy loams
EW	Majority >8	10-30 (trees)	Various eucalypts, often with other taxa (e.g. *Erythrophleum*, *Terminalia*, *Xanthostemon*)	Various—well developed shrub layer may / may not be present	Native perennial and annual tussock grasses	Various situations, from well-drained gravelly sites to those with impeded drainage
SW	Majority >8	10-30 (trees)	Various eucalypts, often with other taxa (e.g. *Erythrophleum*, *Terminalia*, *Xanthostemon*)	Various—well developed shrub layer may /may not be present. Where present, may include woody heath taxa as listed for Sandstone heath	Mixture of native perennial and annual tussock and hummock (*Triodia*) grasses	Shallow to rocky substrates derived typically from sandstone, metamorphosed sandstone (e.g. quartzite), sometimes laterised
SH	Majority <5	<10-30 (shrubs)	Occasional trees	Conspicuous cover of heathy shrubs (e.g. *Acacia*, *Calytrix*, *Grevillea*, *Hibbertia*, *Hibiscus*, *Jacksonia*, *Tephrosia*, *Verticordia*)	Hummock (*Triodia*) grasses, with other perennial restios (*Lepyrodia*, *Dapsilanthus*) and sedges (*Schoenus sparteus*)	Shallow to rocky substrates derived from sandstone; sandsheets

Schedule 2 Forms

Form 1 Record of Calculations

The results of all calculations prescribed by Part 2 must be recorded in the following tables and be retained by the project proponent.

Table 9: Start of the LDS for project region

Year	Month that represents the start of the LDS

Table 10: Fire scar area (A) by vegetation class and fire season (ha)

Vegetation class	Fire season	
	EDS	LDS
EOF		
EW		
SW		
SH		

Table 11: Area burnt by fire season and vegetation class (ha)

Vegetation class	Fire season	
	EDS	LDS
EOF		
EW		
SW		
SH		

Table 13: Fuel loads for each vegetation class (t ha^{-1})

Vegetation class	Fuel size class			
	Fine	Coarse	Heavy	Shrub
EOF	Import values from Table 16	1.4	4.8	1.5
EW	Import values from Table 16	0.9	2.2	0.5
SW	Import values from Table 16	1.2	3.4	1.7
SH	Import values from Table 16	0.6	1.7	1.8

Table 14: Number of burnt pixels by YSLB

Vegetation class	YSLB						Total
	1	2	3	4	5	>5	
EOF	N_b	N_b	N_b	N_b	N_b	N_b	N_{total}
EW	N_b	N_b	N_b	N_b	N_b	N_b	N_{total}
SW	N_b	N_b	N_b	N_b	N_b	N_b	N_{total}
SH	N_b	N_b	N_b	N_b	N_b	N_b	N_{total}

Table 15: Relative frequency distribution of YSLB values

Vegetation class	YSLB						Total
	1	2	3	4	5	>5	
EOF							1
EW							1
SW							1
SH							1

Table 16: Fine fuel load (t ha^{-1})

Vegetation class	YSLB						Total
	1	2	3	4	5	>5	
EOF							Record and transfer to Table 13
EW							Record and transfer to Table 13
SW							Record and transfer to Table 13
SH							Record and transfer to Table 13

Table 17: Potential emissions for CH_4 in EDS (t ha^{-1})

Vegetation class	Fuel size class				
	Fine	Coarse	Heavy	Shrub	Total
EOF					
EW					
SW					
SH					

Table 18: Potential emissions for CH_4 in LDS (t ha^{-1})

Vegetation class	Fuel size class				
	Fine	Coarse	Heavy	Shrub	Total
EOF					
EW					
SW					
SH					

Table 19: Potential emissions for N_20 in EDS (t ha^{-1})

Vegetation class	Fuel size class				
	Fine	Coarse	Heavy	Shrub	Total
EOF					
EW					
SW					
SH					

Table 20: Potential emissions for N_2O in LDS (t ha^{-1})

Vegetation class	Fuel size class				
	Fine	Coarse	Heavy	Shrub	Total
EOF					
EW					
SW					
SH					

Table 21: Potential emissions for each gas in each fire season by vegetation class (t ha^{-1})

Vegetation class	Gas (CH_4)		Gas (N_2O)	
	EDS (totals from Table 17)	LDS (totals from Table 18)	EDS (totals from Table 19)	LDS (totals from Table 20)
EOF				
EW				
SW				
SH				

Table 22: Emissions by gas by vegetation class by fire season (tonnes)

Vegetation class	Gas (CH_4)		Gas (N_2O)	
	EDS	LDS	EDS	LDS
EOF				
EW				
SW				
SH				
Total (fire season)				
Total (Gas)				

Table 23: Total annual emissions (tonnes CO_2-e)

	GWP	E	E_{CO2}-e
CH_4	Value as specified in regulation 2.02 of the NGER Regulations		
N_20	Value as specified in regulation 2.02 of the NGER Regulations		
Total			

Table 24: Project baseline (tonnes CO_2-e)

Baseline year	Annual Emissions (E_{CO2}-e)
y-10	
y-9	
y-8	
y-7	
y-6	
y-5	
y-4	
y-3	
y-2	
y-1	
Total	
Average (project baseline, $E_{BL}CO_2$-e)	

Table 25: Annual emissions from fire (tonnes CO_2-e)

Year	Annual project emissions ($E_{fire}CO_2$-e)

Table 26: Emissions from fuel use (tonnes CO_2-e)

	Fuel type	Amount used (litres)	Emissions from fuel use
Source a			
Source b			
Total ($E_{fuel}CO_2$-e)			

Table 27: Annual project emissions (tonnes CO_2-e)

Year	Total annual Emissions ($E_{total}CO_2$-e)

Table 28: Net annual project abatement (tonnes CO_2-e)

Year	Net annual project abatement ($A_{net}CO_2$-e)

Form 2 Record of Calculations for Offsets Reports

The results of calculations prescribed by Part 3 must be recorded in the following tables and be provided in the offsets report for the first reporting period and subsequent reporting periods.

Table 9: Start of the LDS for project region

Year	Month that represents the start of the LDS

Table 11: Area burnt by fire season and vegetation class (ha)

Vegetation class	Fire season	
	EDS	LDS
EOF		
EW		
SW		
SH		

Table 22: Emissions by gas by vegetation class by fire season (tonnes)

Vegetation class	Gas (CH_4)		Gas (N_2O)	
	EDS	LDS	EDS	LDS
EOF				
EW				
SW				
SH				
Total (fire season)				
Total (Gas)				

Table 24: Project baseline (tonnes CO_2-e)

Baseline year	Annual Emissions (E_{CO2}-e)
y-10	
y-9	
y-8	
y-7	
y-6	
y-5	
y-4	
y-3	
y-2	
y-1	
Total	
Average (project baseline, $E_{BL}CO_2$-e)	

Table 25: Annual emissions from fire (tonnes CO_2-e)

Year	Annual project emissions ($E_{fire}CO_2$-e)

Table 28: Net annual project abatement (tonnes CO_2-e)

Year	Net annual project abatement ($A_{net}CO_2$-e)