Carbon Credits (Carbon Farming Initiative—Estimation of Soil Organic Carbon Sequestration using Measurement and Models) Methodology Determination 2021

I, Angus Taylor, Minister for Industry, Energy and Emissions Reduction, make the following legislative instrument.

Dated: 1 December 2021

Angus Taylor
Minister for Industry, Energy and Emissions Reduction

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Part 1—Preliminary

1 Name

This is the *Carbon Credits (Carbon Farming Initiative—Estimation of Soil Organic Carbon Sequestration using Measurement and Models) Methodology Determination 2021*.

2 Commencement

This determination commences on the day after it is registered.

3 Authority

This determination is made under subsection 106(1) of the *Carbon Credits (Carbon Farming Initiative) Act 2011*.

4 Duration

This determination remains in force for the period that:

(a) begins when this instrument commences; and

(b) ends on the day before this instrument would otherwise be repealed under subsection 50(1) of the *Legislation Act 2003*.

5 Definitions

In this determination:

2014 methodology determination means the *Carbon Credits (Carbon Farming Initiative) (Sequestering Carbon in Soils in Grazing Systems) Methodology Determination 2014*, or a version of that determination applicable to a project in accordance with sections 125, 126, 127 or 130 of the Act.

2015 methodology determination means the *Carbon Credits (Carbon Farming Initiative—Estimating Sequestration of Carbon in Soil Using Default Values) Methodology Determination 2015*.

2018 methodology determination means the *Carbon Credits (Carbon Farming Initiative—Measurement of Soil Carbon Sequestration in Agricultural Systems) Methodology Determination 2018*, or a version of that determination applicable to a project in accordance with sections 125, 126, 127 or 130 of the Act.

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

bare fallow, in relation to land, means land that is not seeded and has less than 40% ground cover for 3 months or longer.

baseline nominated soil depth means the nominated depth of soil in the baseline sampling round under subsection 7(1) of Schedule 1 or, as applicable pursuant to section 15, subsection 8(1) of Schedule 2.

baseline period means the 5 years immediately before the section 22 application or section 29 application relating to the project area.

baseline sampling round—see paragraph 4(1)(b) of Schedule 1 or, as applicable pursuant to section 15, subparagraph 5(2)(a)(i) of Schedule 2.

biochar means organic material (other than tyres or rubber products) that has undergone a pyrolysis or gasification process.

CEA—see subsection 5(1) of Schedule 1 or, as applicable pursuant to section 15, subsection 6(1) of Schedule 2.

CFI Regulations means the *Carbon Credits (Carbon Farming Initiative) Regulations 2011*.

CFI Rule means the *Carbon Credits (Carbon Farming Initiative) Rule 2015*.

clearing means the conversion of land with forest cover to land without forest cover through the destruction of trees or saplings by intentional burning, mechanical or chemical means.

cover crop means a crop that is planted for the purposes of improving the soil by providing ground cover.

cropping means using land to grow agricultural crops for commercial purposes.

Note: Cropping includes growing woody horticulture such as vines in vineyards but does not include planting forests.

CO_2-e means carbon dioxide equivalent.

designated waste-stream means an organic waste-stream from one of the following:

(a) intensive animal production;

(b) food processing;

(c) manufacturing;

Note: Manufacturing includes fibre processing.

(d) sawmill residue;

(e) municipal or commercial waste collection processes.

Note: Paragraph (e) includes collection processes involving human effluent.

de-stocked: an area of land under pasture is considered destocked if land which is permanent pasture, or pasture for a period of at least 2 years, is never grazed, nor intended to be grazed, by production livestock.

eligible land—see subsection 9(1).

eligible management activity—see subsection 7(2).

emissions accounting area—see subsection 5(6) of Schedule 1 or, as applicable pursuant to section 15, subsection 6(6) of Schedule 2.

estimation event—see section 2 of Schedule 2.

exclusion area—see subsection 5(5) of Schedule 1 or, as applicable pursuant to section 15, subsection 6(5) of Schedule 2.

fertiliser means any synthetic or non-synthetic substance that supplies key chemical elements to plants and soils to enhance plant growth and the fertility of soils.

first estimation event—see section 2 of Schedule 2.

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forest cover: an area of land has ***forest cover*** if:

(a) the land has an area of at least 0.2 of a hectare; and

(b) the land has trees that:

(i) are 2 metres or more in height; and

(ii) provide crown cover of at least 20% of the land.

forest potential: an area of land has ***forest potential*** if:

(a) the land has an area of at least 0.2 of a hectare; and

(b) the land has trees that, having regard to the location and characteristics of the land, are reasonably likely to:

(i) reach 2 metres or more in height; and

(ii) provide crown cover of at least 20% of the land.

gypsum means a product which is mainly composed of calcium sulfate dihydrate ($CaSO_4 \cdot 2H_2O$) and is used to manage soil sodicity or magnesic properties, or improve the structure of sodic clay soils.

hypersulfidic material has the meaning given by the *Australian Soil Classification (Second Edition)* published by the Commonwealth Scientific and Industrial Research Organisation in 2016.

Note: In 2021, the second edition of the Australian Soil Classification could be accessed from http://www.clw.csiro.au/ with the glossary available at http://www.clw.csiro.au/aclep/asc_re_on_line_V2/soilglos.htm#br

irrigation efficiency savings means improvements to the efficiency of irrigated water that:

(a) if the date on which the section 27 declaration of a project was made was on or after 30 August 2021—result from improving the efficiency of one or both of the following:

(i) on-farm irrigation infrastructure located within the project area;

(ii) management practices within the project area.

(b) if the date on which the section 27 declaration of a project was made was before 30 August 2021—result from improving the efficiency of one or both of the following:

(i) on-farm irrigation infrastructure;

(ii) management practices.

land management strategy—see subsection 13(1).

last estimation event—see section 2 of Schedule 2.

lime means a product which is mainly comprised of calcium carbonate ($CaCO_3$) or calcium magnesium carbonate ($CaMg(CO_3)_2$), or both, and which is used to manage acidity in agricultural soils.

Note: Calcium magnesium carbonate is commonly known as dolomite.

maintain: maintaining a land management activity at a point in time includes the circumstance where a completed land management activity has a continuing impact on the storage of additional soil organic carbon in the land at that point in time.

material deficiency means a concentration or availability of one or more nutrients in the soil, where the concentration or availability limits plant growth to materially less than could otherwise have been achieved in that location.

National Inventory Report means the report of that name produced by Australia in fulfilment of its obligations under the Climate Change Convention and the Kyoto Protocol, as in force from time to time.

Note: In 2021, the National Inventory Report could be accessed from http://www.industry.gov.au

native forest has the meaning given to it in the CFI Regulations.

net abatement amount, for an eligible offsets project in relation to a reporting period, means the carbon dioxide equivalent net abatement amount for the project in relation to the reporting period for the purposes of paragraph 106(1)(c) of the Act (see also section 20 of this determination).

new irrigation means new or additional irrigation applied to land in a project area for a project using water obtained through irrigation efficiency savings made after the date on which the section 27 declaration of the project was made.

NGER Act means the *National Greenhouse and Energy Reporting Act 2007*.

NGER Measurement Determination means the applicable determination made under subsection 10(3) of the NGER Act.

non-transferring project means a soil carbon project that is not a transferring project.

non-synthetic fertiliser means any biologically-derived solid or liquid substance that:

(a) where relevant—must be applied in accordance with the laws and regulations of the relevant State, Territory or local government; and

(b) is used to do at least one of the following:

(i) supply nutrients to plants and soils;

(ii) enhance plant growth and soil fertility;

(iii) add or stimulate microbial or other life in soils; and

(c) contains more than 5% organic content by weight; and

(d) does not include:

(i) non-biodegradable substances, such as plastics, rubber or coatings; or

(ii) biochar.

nutrient includes trace minerals, macro-nutrients (such as nitrogen, phosphorus, potassium and sulphur) and micro-nutrients.

organosol means soil containing more than 10% organic carbon within the upper 30 centimetres of the soil profile.

pasture means land that is under any combination of perennial grasses, annual grasses, or legumes, and on which production livestock is raised.

permanence obligation period, in relation to a soil carbon project, means the period from the declaration of the project until the last day the Regulator could issue a notice to relinquish Australian carbon credit units under Division 3 of Part 7 of the Act.

permanent pasture means agricultural land that is:

(a) continuously under pasture, including perennials and annual grasses and legumes; and

(b) not bare fallowed.

previous soil method—see subsection 9(6).

project means a soil carbon project.

production livestock means livestock managed for production purposes and from which commercial products or services are derived.

qualified person—see subsection 13(8).

relevant landholder, in relation to a land management strategy, means any person other than the project proponent who, whether by reason of ownership or otherwise, has operational control of land that is covered by the land management strategy.

responsible landholder means any person who, whether by reason of ownership or otherwise, has operational control, of the relevant land.

restricted non-synthetic fertiliser means a non-synthetic fertiliser that includes more than 5% organic matter by weight that does not satisfy one of the following:

(a) the organic matter previously formed part of a designated waste-stream;

(b) the organic matter is sourced from within a CEA that is part of the project.

Note: State, Territory or local government laws and/or regulations may apply to the use of restricted non-synthetic fertilisers.

sampling round means soil sampling conducted during a finite period to develop an estimate of soil organic carbon stocks at a particular point in time.

section 22 application, in relation to an eligible offsets project, means the application under section 22 of the Act for the declaration of the project as an eligible offsets project.

section 27 declaration, in relation to an eligible offsets project, means the declaration under section 27 of the Act that the project is an eligible offsets project.

section 29 application, in relation to an area of land, means an application made under regulations or legislative rules made for the purposes of section 29 of the Act to vary a section 27 declaration in relation to the area.

section 128 application, in relation to an eligible offsets project, means a request under subsection 128(1) of the Act to approve the application of this methodology determination to the project with effect from the start of a reporting period.

soil amendment means a substance to improve the health or quality of soil, such as fertiliser, recycled organic materials, lime or gypsum.

soil carbon project—see subsection 7(3).

soil core means a discrete portion of soil that has been extracted with a coring device, and includes the gravel and fine fraction.

soil landscape modification activity—see subsection 7(4).

soil organic carbon means the carbon contained within soil organic matter.

specified probability of exceedance means the probability of exceedance set out in the Supplement.

stratum means an area in a carbon estimation area.

stubble means the residue remaining on the soil surface after a crop has been harvested and prior to application of any management practice that incorporates the residues into the soil.

structure means an object that is made of several parts, that prevents pasture or cropping from occurring underneath more than 5% of the ground area of the object.

Note: This definition omits solar panels or other structures under which agricultural activities may still occur.

Supplement means the document entitled 'The Supplement—for Estimation of Soil Organic Carbon Sequestration Using Measurement and Models', as in force from time to time and available from the Regulator's website.

Note: In 2021 the Supplement could be viewed on the Clean Energy Regulator's website (http://www.cleanenergyregulator.gov.au).

synthetic fertiliser means any synthetic substance that:

(a) is used to supply nutrients to plants and soils to enhance plant growth and the fertility of soils; and

(b) where relevant—must be applied to the surface of, or incorporated into, agricultural soils in accordance with the laws of the relevant State, Territory or local government; and

(c) does not include biochar; and

(d) does not contain more than 5% organic matter by weight.

thinning in relation to land, means the removal of woody biomass (whether dead or alive) from the land.

tillage means any form of mechanical preparation of the soil.

transferring project means a soil carbon project to which this determination applies as a result of an approval under section 130 of the Act.

wetlands has the meaning given in the CFI Regulations.

Note: Other words and expressions used in this determination have the meaning given by the Act. These terms include:

25-year permanence period project
100-year permanence period project
Australian carbon credit unit
carbon dioxide equivalent
crediting period
Climate Change Convention
eligible carbon abatement
eligible offsets project
emission
greenhouse gas
Kyoto Protocol
offsets project
offsets report
project
project area
project proponent
regional natural resource management plan
Regulator
reporting period
sequestration offsets project

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6 References to factors and parameters from external sources

(1) If a calculation in this determination includes a factor or parameter that is defined or calculated by reference to another instrument or writing, the factor or parameter to be used for a reporting period is the factor or parameter referred to in, or calculated by reference to, the instrument or writing as in force at the end of the reporting period.

(2) Subsection (1) does not apply if:

(a) this determination specifies otherwise; or

(b) it is not possible to define or calculate the factor or parameter by reference to the instrument or writing as in force at the end of the reporting period.

Part 2—Soil carbon projects

7 Soil carbon projects

(1) For paragraph 106(1)(a) of the Act, this determination applies to a sequestration offsets project that:

(a) involves the sequestration of carbon in soil in an agricultural system through carrying out one or more eligible management activities; and

(b) can reasonably be expected to result in eligible carbon abatement; and

(c) has its project area within Australia, excluding the external territories.

(2) For this determination, a management activity is an ***eligible management activity*** if it:

(a) involves one of the following land management activities:

(i) applying nutrients to the land in the form of a synthetic or non-synthetic fertiliser to address a material deficiency;

Note: This may include, but is not limited to, use of compost or manure.

(ii) applying lime or other ameliorants to remediate acid soils;

(iii) applying gypsum to manage sodic or magnesic soils;

(iv) undertaking new irrigation;

(v) re-establishing or rejuvenating a pasture by seeding or pasture cropping;

(vi) establishing, and permanently maintaining, a pasture where there was previously no or limited pasture, such as on cropland or bare fallow;

(vii) altering the stocking rate, duration or intensity of grazing (or any combination of such activities) to promote soil vegetation cover or improve soil health, or both;

(viii) retaining stubble after a crop is harvested;

(ix) converting from intensive tillage practices to reduced or no tillage practices;

(x) modifying landscape or landform features to remediate land;

Note: This may include, but is not limited to, practices implemented for erosion control, surface water management, drainage/flood control, or alleviating soil compaction. Practices may include controlled traffic farming, deep ripping, water ponding or other means.

(xi) using mechanical means to add or redistribute soil through the soil profile;

Note: This may include, but is not limited to, clay delving, clay spreading or inversion tillage.

(xii) using legume species in cropping or pasture systems;

(xiii) using a cover crop to promote soil vegetation cover or improve soil health, or both; and

(b) is an improvement on the land management activities conducted in the agricultural system during the baseline period such that:

(i) at least one of the land management activities is new or materially different from the land management activities conducted during the baseline period; and

(ii) more carbon can reasonably be expected to be sequestered in that system as a result of carrying out that land management activity; and

Note: Paragraph (2)(b) is not intended to limit activities that may sequester carbon in soil, but to ensure that at least one new or materially different land management activity will be conducted for the project that can reasonably be expected to result in eligible carbon abatement.

(c) does not involve activities excluded by section 11 or in breach of section 12.

(3) A project covered by subsection (1) is a ***soil carbon project***.

(4) A land management activity covered by subparagraphs (2)(a)(x) or (xi) is a ***soil landscape modification activity***.

Part 3—Project requirements

Division 1—General

8 General

For paragraph 106(1)(b) of the Act, to be an eligible offsets project, a soil carbon project must meet the requirements in this Part.

9 Project area and eligible land

(1) The project area must include land (***eligible land***) meeting the following requirements:
  (a) during the whole of the baseline period the land was used for one or more of the following agricultural uses:
    (i) pasture;
    (ii) cropping;
    (iii) bare fallow;
  (b) there are no dwellings or other structures on the land;
  (c) as at the end of the baseline period, it was reasonable to expect that carrying out the eligible management activities proposed by the relevant land management strategies will increase the carbon sequestered in the land;
  (d) it is possible to sample the soil on the land consistently with the requirements of this determination.

(2) Land is not eligible land if:
  (a) the land:
    (i) is or becomes a project area or part of a project area of another eligible offsets project that is a sequestration offsets project; and
    (ii) is land with forest cover or land with forest potential; or

    Note: Land with forest cover or land with forest potential may be eligible land provided it meets the requirements in subsection (1) and is not excluded by subsection (2).

  (b) the land has been subject to:
    (i) illegal clearing of a native forest, or illegal draining of a wetland; or
    (ii) clearing of a native forest, or draining of a wetland (that was not an illegal clearing or draining), within:
      (A) 7 years of the lodgement of the section 22 application for the project or the section 29 application for the land; or
      (B) if there is a change in ownership of the land, after the clearing or the draining—5 years of the lodgement of the section 22 application for the project or the section 29 application for the land; or
  (c) the land contains organosol.

(3) The project area may include land which is not eligible land only if that land will not be part of a CEA for the project or is to remain part of a CEA in accordance with subsection 5(8) of Schedule 1 or, as applicable pursuant to section 15, subsection 6(8) of Schedule 2.

(4) A project area may be varied under the legislative rules only if one or more of the following apply:
  (a) the first offsets report for the project under subsection 76(1) of the Act has not been submitted;

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(b) the variation removes only areas that are exclusion areas or emissions accounting areas from the project area;

(c) the whole of the project area is removed from the project;

(d) one or more whole CEAs are removed in circumstances where:

(i) either:

(A) the sum of the most recent values for $\Delta SOC_{PoE,CEA\,(t_0 - t_x)}$ from equation 69 of Schedule 1 or, as applicable pursuant to section 15, from equation 116 of Schedule 2 for each CEA removed from the project is positive; or

(B) the removal is not for a purpose of increasing the credits issued under the Act in relation to the project area; and

(ii) if land management activities in a CEA to be removed from a project have moved carbon from that CEA to one or more other CEAs that are part of the project—all the CEAs that had received that carbon are also removed from the project;

(e) one or more whole CEAs or project areas are removed from the project after the end of the crediting period for the project.

Note: Any variation of a project area will also need to meet the requirements of the legislative rules and this will involve the relinquishment of any Australian carbon credit units issued in relation to any CEAs removed from the scheme. The removal of part of a project area that is a CEA or emissions accounting area will involve the recalculation of the baseline for the project area.

(5) If a previous soil carbon method was previously the applicable methodology determination in relation to a project area, an area of land is also eligible land if:

(a) it could be included in a carbon estimation area under that determination; and

(b) was mapped as part of a carbon estimation area at the commencement of this determination.

(6) In this section, ***previous soil carbon method*** means:

(a) the 2014 methodology determination;

(b) the 2015 methodology determination;

(c) the 2018 methodology determination.

10 Activities to be conducted

(1) The project proponent must, in all areas of land included in a CEA, carry out or maintain at least one eligible management activity until the end of the permanence obligation period for the project.

Note: The kind of eligible management activity may change for an area of land over time, so long as during each reporting period at least one eligible management activity is conducted or maintained.

(2) The first eligible management activity on each area of land included in a CEA must begin:

(a) after the project is declared an eligible offsets project; and

(b) before either the first subsequent sampling round (as per the definition in Schedule 1), or the first subsequent estimation event (as per the definition in Schedule 2) for the CEA; and

(c) before the end of the first reporting period after the CEA was included in the project area for the project.

(3) If a CEA includes land that is a permanent pasture, or has been used as pasture for a period of at least 2 years, the pasture must be grazed by production livestock at least once every 2 years, unless the land is de-stocked in compliance with subsection 11(2).

(4) The project proponent may undertake additional management activities provided those activities are not excluded under section 11 or would result in a breach of section 12.

11 Activities not to be conducted

(1) Activities excluded by this section must not be conducted on land that is, or is to be, part of a CEA in the period commencing on the date of the section 22 application for the project and ending at the end of the permanence obligation period for the project.

(2) Land under pasture must not be de-stocked unless:
   (a) the land is to be converted to a cropping system; or
   (b) the de-stocking period is within the relevant drought period for the land; or
   (c) the Regulator agrees in writing that exceptional circumstances exist.

Note 1: Reducing stocking density on land that is, or is to be, part of a CEA is not an excluded activity.

Note 2: Exceptional circumstances may include a disease outbreak among livestock.

(3) After the completion of the baseline sampling round:
   (a) land management activities must not disturb the soil any deeper than 10 centimetres above the baseline nominated soil depth;
   (b) pyrolysised material that is not biochar must not be applied.

(4) Land management activities must not be conducted on hypersulfidic material that would result in one or more of the following:
   (a) drainage;
   (b) physical disturbance;
   (c) the application of lime to the land.

Note: Project proponents may choose to exclude soils with hypersulfidic material (i.e. acid sulfate soils) from CEAs to avoid the risk of breaching this subsection.

(5) An activity notified to the project proponent in writing by the Regulator under subsection (6) must not be conducted.

(6) The Regulator may notify a project proponent of one or more activities that must not be conducted if:
   (a) the Regulator is satisfied that the activity may result in the crediting of non-genuine carbon abatement; and

Note: Actions which directly or indirectly increase the value of $\Delta SOC_{PA(t_0-t_x)}$ or reduce the value of E_{net} result in additional crediting under the Act. Non-genuine carbon abatement could include activities which increase crediting under this determination without a corresponding overall benefit from the removals or reduced emissions, such as through leakage.

   (b) the Regulator has consulted the project proponent on the need to make such a notification.

(7) In this section, ***relevant drought period*** for any land means the period of time:
   (a) commencing when the land is shown as mapped within a region which is recorded on the Bureau of Meteorology's 24-month recent and historical rainfall map, or another equivalent map approved by the Regulator, as having a rainfall percentile ranking as:

(i) serious deficiency (rainfall lies above the lowest five per cent of recorded rainfall but below the lowest ten per cent (decile range 1) for the period 1900-present); or

(ii) severe deficiency (rainfall is among the lowest five per cent for the period 1900-present); or

(iii) lowest on record (rainfall is lowest for the period 1900-present); or

(iv) some combination of clauses (i), (ii) and (iii); and

(b) ending on the date the land is no longer shown as mapped within that region.

Note : As of 17 August 2021, the Bureau of Meteorology's 24-month drought map was available at: http://www.bom.gov.au/climate/maps/rainfall/?variable=rainfall&map=drought&period=24month&region=nat&year=2021&month=09&day=30

12 Restricted activities

(1) Activities mentioned in this section must be conducted in accordance with this section on land that is, or is to be, part of a CEA in the period commencing on the date on which the section 22 application for the project is submitted and ending at the end of the permanence obligation period for the project.

(2) Woody vegetation may be cleared only if:

(a) any clearing is undertaken in accordance with any applicable regional natural resource management plan and Commonwealth, State, Territory or local government environmental and planning laws; and

(b) at least one of the following apply:

(i) the clearing is to manage woody horticulture crops, as part of standard business operations;

(ii) the clearing is required to manage woody horticulture crop, following a disturbance;

(iii) the clearing is to manage growth of a known weed species as defined in the CFI Regulations;

(iv) the clearing is required to reduce the risk of fire;

(v) the land was not forest cover in the 5 years prior to the lodgement of the section 22 application for the project or the section 29 application for the land.

(3) Thinning of the land is only permitted if:

(a) the thinning is to the extent necessary to comply with Commonwealth, State, Territory or local government environmental and planning laws; or

(b) the thinning is of woody biomass to be used either:

(i) as firewood for personal use and the carbon stock in the land after the thinning would not be more than 5% less than it would have been if the biomass was not thinned; or

(ii) in accordance with traditional indigenous practices or native title rights; or

(c) at least one of the following apply:

(i) the thinning is to manage woody horticulture crop, as part of standard business operations;

(ii) the thinning is required to manage woody horticulture crop, following a natural disturbance;

(iii) the thinning is to manage growth of a known weed species as defined in the CFI Regulations;

(iv) the thinning is required to reduce the risk of fire;

(v) the land was not forest cover in the 5 years prior to the lodgement of the section 22 application for the project or the section 29 application for the land.

(4) Land management activities may involve the addition or redistribution of soil using mechanical means (including through clay delving, clay spreading or water ponding) only if:

(a) the soil is sourced from CEAs that are part of the project; and

(b) sampling is undertaken at a baseline nominated soil depth greater than the depth of any soil:

(i) sourced for the land management activities; and

(ii) added to the soil profile; and

(iii) incorporated through the soil profile; and

(c) the land where any soil is sourced is remediated as soon as is practical.

Note: Remediation could involve returning sandy topsoil to a clay pit immediately after the clay is extracted.

(5) After completion of the baseline sampling round, soil amendments containing biochar may be added to soil within a CEA only if:

(a) the biochar was sourced or created from:

(i) CEAs that are part of the project; or

(ii) both of the following are satisfied:

(A) organic matter that previously formed part of a designated waste-stream;

(B) the application of the biochar to the CEA is in accordance with the laws and regulations of the relevant State, Territory or local government;

(b) otherwise—the soil amendments are applied:

(i) if the carbon content of the soil amendments is known—at a rate lower than 100kg of carbon per hectare per calendar year;

(ii) otherwise—at a rate lower than the default carbon content specified in the Supplement, per hectare per calendar year.

(6) After completion of the baseline sampling round, soil amendments containing coal may be added to soil within a CEA only if they are applied:

(a) if the carbon content of the soil amendments is known—at a rate lower than 100kg of carbon per hectare per calendar year; or

(b) otherwise—at a rate lower than the default carbon content specified in the Supplement, per hectare per calendar year.

(7) After completion of the baseline sampling round, restricted non-synthetic fertiliser may be added to soil within a CEA only if it is applied:

(a) if the carbon content of the restricted non-synthetic fertiliser is known—at a rate lower than 100kg of carbon per hectare per calendar year;

(b) otherwise—at a rate lower than the default carbon content specified in the Supplement, per hectare per calendar year.

Note: If a product is a combination of non-synthetic fertiliser and restricted non-synthetic fertiliser, the requirements of subsection (7) apply to the restricted non-synthetic fertiliser.

(8) After completion of the baseline sampling round, irrigation may be applied to CEAs within a project area only if both of the following apply:

(a) disregarding new irrigation, the annual level of irrigation for the project area, or the CEAs within the project area, is not more than 20% greater than the highest annual level of irrigation in the baseline period;

(b) disregarding new irrigation, the 5-yearly total level of irrigation for the project area, or the CEAs within the project area, is not more than 20% greater than the total level of irrigation in the baseline period.

13 Land management strategy

(1) A qualified person must prepare or review one or more written strategies (a ***land management strategy***) for the implementation of all eligible management activities to be carried out as part of the soil carbon project until the end of the permanence obligation period for the project that:

(a) includes information which demonstrates that:

(i) for all land included, or to be included, in a CEA, at least one eligible management activity will be carried out or maintained until the end of the permanence obligation period for the project; and

(ii) consideration has been given to the other activities being conducted in the project area and the environmental factors that may be incompatible with increasing soil organic carbon stocks and the steps that would be taken to address such incompatibility; and

Note: Limitations may include soil sodicity, soil structure, environmental factors and micronutrients.

(iii) consideration has been given to the other activities being conducted in the project area and the environmental factors that may present risks to maintaining soil organic carbon stocks and the steps that would be taken to address such risks; and

Note: Environmental factors may include changes in rainfall and temperature impacting the project area.

(iv) the overall impact of all land management activities conducted in the project area could reasonably be expected to improve soil organic carbon stocks over time; and

(b) includes a statement confirming that activities excluded by section 11, or in breach of section 12, are not being conducted or proposed to be conducted; and

(c) specifies:

(i) whether the project proponent intends to use either or both of the following:

(A) biochar;

(B) products containing human effluent;

as part of their project; and

(ii) the steps the project proponent needs to take in order to monitor the project's progress; and

(iii) the records the project proponent needs to keep relating to land management activities to verify that the overall objectives of the land management strategy are being achieved.

(2) The land management strategies must:

(a) cover all of the land included in the CEAs for the project; and

(b) cover all of the land in a given CEA in a single strategy.

(3) The initial land management strategies for the project must be prepared:

(a) if this determination is the applicable methodology determination for the project as a result of a 128 application—before submitting the first offsets report after making that application; or

(b) otherwise—before making the section 22 application for the project.

(4) If a project area is added to the project or land is added to a project area of the project as a result of a section 29 application:

(a) one or more existing land management strategies must be revised to cover the additional land or project area before making the section 29 application; or

(b) one or more new land management strategies must be prepared to cover the additional land or project area before making the section 29 application.

(5) The project proponent and each relevant landholder must provide a signed statement that they have read each of the land management strategies and agree to implement, or oversee the implementation of, each land management strategy.

(6) A qualified person must review, and if necessary, revise each strategy:

(a) at least once every 5 years until the end of the crediting period for the project; and

(b) at least once every 10 years until the end of the permanence obligation period for the project; and

(c) if land management activities being conducted change materially from those outlined in the land management strategy; and

(d) if the Regulator notifies a project proponent that a particular issue needs to be addressed in the strategy—by the date specified in the notification (which must be at least 3 months from the date of the notification).

(7) In providing a notification under paragraph (6)(d), the Regulator must take into account whether the carrying out of the land management strategy could reasonably be expected to result in the crediting of non-genuine carbon abatement.

(8) For the purposes of this section, a ***qualified person*** is a person who:

(a) has knowledge of agronomy and plant nutrition; and

(b) has experience in the provision of agricultural production advice; and

(c) has a good understanding of the influence of agricultural management on soil organic carbon; and

(d) meets any requirements included in the Supplement.

14 Information to be included in applications relating to the project

(1) The section 22 application, section 29 application or section 128 application for the project must include:

(a) a description of the land management activities that were carried out during the baseline period; and

(b) evidence that all of the land included, or to be included, in a CEA is eligible land; and

(c) if the project proponent wishes to undertake baseline sampling prior to the project being declared an eligible offsets project—a sampling plan for the baseline sampling round, prepared in accordance with the Supplement.

Note: Conducting baseline sampling will not assure that the project will be declared as an eligible offsets project.

(2) The section 22 application, section 29 application or section 128 application must include copies of the land management strategies prepared for the project.

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(3) However, if the Regulator is not satisfied that the land management strategies included under subsection (2) meet the requirements of section 13, the project is not an eligible offsets project or covered by this determination unless one or more revised land management strategies are provided which satisfy the Regulator that the requirements of section 13 have been met.

15 Operation of soil carbon projects

(1) Each project area and CEA of a soil carbon project must meet the requirements of Division 2 of Schedule 1 during each reporting period (including requirements relating to sampling and sampling design), unless it meets the requirements of Division 2 of Schedule 2 (including requirements relating to sampling and sampling design) during that period.

(2) If a project area or CEA of the project only meets the requirements of Division 2 of Schedule 2 during a reporting period (including requirements relating to sampling and sampling design), the project area or CEA must meet the requirements of that Division of that Schedule (including requirements relating to sampling and sampling design) during each subsequent reporting period.

(3) A soil carbon project must meet the requirements of section 8 of Schedule 1 during each reporting period, unless it meets the requirements of section 9 of Schedule 2 during that period.

(4) The amount of change in soil organic carbon for a reporting period for a CEA in a project area of the project with a specified probability of exceedance (the $\Delta \boldsymbol{SOC}_{\boldsymbol{PoE,CEA}(t_0 - t_x)}$), must be worked out using Schedule 1, unless that change for the CEA is worked out using Schedule 2.

(5) If the $\Delta \boldsymbol{SOC}_{\boldsymbol{PoE,CEA}(t_0 - t_x)}$ for a CEA in a project area of the project for a reporting period is worked out using Schedule 2, that value for the CEA for each subsequent reporting period must be worked out using Schedule 2.

Division 2—Additionality

16 Newness requirement

For subparagraph 27(4A)(a)(ii) of the Act, a requirement in lieu of the newness requirement for a soil carbon project is that the project complies with subparagraph 27(4A)(a)(i) of the Act, disregarding:

(a) the preparation of any land management strategy before the eligible management activity commences; and

(b) any baseline sampling undertaken before the project was declared an eligible offsets project by the Regulator, provided that the baseline sampling occurred:

(i) after the Regulator received a sampling plan for the baseline sampling round, prepared in accordance with the Supplement; and

(ii) after submission of the section 22 application for the project.

Part 4—Net abatement amount

Division 1—Preliminary

17 Operation of this Part

For paragraph 106(1)(c) of the Act, this Part specifies the method for working out the net abatement amount for a reporting period for a soil carbon project that is an eligible offsets project.

18 Overview of gases accounted for in abatement calculations

The following table provides an overview of the emissions sources and carbon pools, and the associated greenhouse gases, that are relevant to working out the net abatement amount for a soil carbon project.

Overview of gases accounted for in abatement calculations

Item	Relevant carbon pool or emission source		Greenhouse gas
1	Carbon pool	Soil organic carbon	Carbon dioxide (CO_2)
2	Emissions source	Livestock	Methane (CH_4) Nitrous oxide (N_2O)
3	Emissions source	Synthetic fertiliser	Nitrous oxide (N_2O) Carbon dioxide (CO_2)
4	Emissions source	Lime	Carbon dioxide (CO_2)
5	Emissions source	Tillage events	Nitrous oxide (N_2O) Carbon dioxide (CO_2) Methane (CH_4)
6	Emissions source	Soil landscape modification activities	Nitrous oxide (N_2O) Carbon dioxide (CO_2) Methane (CH_4)
7	Emissions source	Residues	Nitrous oxide (N_2O) Carbon dioxide (CO_2) Methane (CH_4)
8	Emissions source	Irrigation energy	Nitrous oxide (N_2O) Carbon dioxide (CO_2) Methane (CH_4)
9	Emissions source	Biochar	Carbon dioxide (CO_2)

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Division 2—Calculation of net abatement amount—general

19 Overview

This section sets out an overview of the method specified in this Part.

This determination accounts for carbon abatement from undertaking eligible management activities in accordance with this determination, crediting abatement from the carbon dioxide that is removed from the atmosphere and sequestered in soils.

A project covered by this determination is a sequestration offsets project, and is therefore subject to the obligations under the Act that relate to the permanence obligation period.

The net abatement amount in relation to a reporting period, for a soil carbon project under this determination, is given by the change in soil organic carbon between sampling rounds or estimation events in the CEAs that make up a project area, less an adjustment for when project emissions in the project area during the reporting period exceed average project emissions levels during the baseline period for the project area.

The calculation of the change in soil organic carbon levels is done in accordance with this Part and Divisions 3-5 of Schedule 1 or, as applicable pursuant to section 15, Divisions 3-5 of Schedule 2. The calculation of project emissions in the baseline period and reporting period is done in accordance with Part 7.

If the project has 2 or more project areas, the net abatement amount is calculated separately for each project area and added together.

20 The net abatement amount, *A*

For paragraph 106(1)(c) of the Act, the net abatement amount for a reporting period, $\boldsymbol{A}$, in tonnes CO_2-e, is worked out using the following equation:

$$A = \sum_{PA} A_{PA}$$ equation 1

where:

$\boldsymbol{A_{PA}}$ is the net abatement amount for the reporting period for a project area *PA* of the project, in tonnes CO_2-e, worked out using:

(a) if the project is a non-transferring project—equation 2;

(b) if the project is a transferring project—equation 3.

21 The net abatement amount for a project area for a non-transferring project, A_{PA}

For equation 1 for a non-transferring project, A_{PA}, for a project area *PA* for a reporting period *RP* is worked out, in tonnes CO_2-e, using the following equation:

$$A_{PA} = \Delta SOC_{PA(t_0-t_x)} \times \frac{44}{12} + \frac{RC}{D} - E_{net} - \sum_{RP=1}^{x-1} A_{PA,RP} \qquad \text{equation 2}$$

where:

$\Delta SOC_{PA(t_0-t_x)}$ is the change in soil organic carbon for the project area for the current reporting period *RP* from the baseline to the reporting period, in tonnes of soil organic carbon, worked out using equation 6.

RC is the total number of Australian carbon credit units:

(a) issued, before the end of the reporting period, in relation to each CEA that was removed from the project area before that time; and

Note: The ability to remove CEAs from a project area is limited by subsection 9(4).

(b) relinquished in relation to each CEA in the project area under sections 88, 90 or 91 of the Act before the end of the reporting period.

D is the aggregate of the permanence period discount number and the risk of reversal buffer number under section 16 of the Act associated with the Australian carbon credit units comprised in the definition of *RC* in this section.

x is the number of reporting periods, up to and including the current reporting period.

E_{net} is any net increase in emissions in the crediting period compared to the emissions in the baseline period, in tonnes CO_2-e, determined for the reporting period in accordance with section 26.

$A_{PA,RP}$ is:

(a) if the net abatement amount, A_{PA}, for the project area for a previous reporting period RP, worked out using equation 2, is greater than zero—that amount;

(b) otherwise—zero.

Note: For the first reporting period for the project, the summation at the end of equation 2, namely $\sum_{RP=1}^{x-1} A_{PA,RP}$, is equal to 0.

Note 1: The value for $\frac{RC}{D}$ must be worked out separately for each issue or relinquishment of Australian carbon credit units comprised in the definition of *RC* in this section, and all such values must be aggregated to work out the value for $\frac{RC}{D}$ applied to equation 2.

Note 2: The aggregate of the permanence period discount number and the risk of reversal buffer number under section 16 of the Act for the purposes of working out the value for *D* under this section associated with the Australian carbon credit units comprised in the definition of *RC* in this section would be:

- if the project was a 100-year permanence period project at the time of the issue of the units—0.95;
- if the project was a 25-year permanence period project at the time of the issue of the units—0.75.

Note 3: The above equation calculates the total change in soil organic carbon for the current sampling round compared with the baseline sampling round. It is therefore necessary to deduct all previous abatement that has been credited. As previous abatement will have deducted emissions in excess

of the average baseline emissions, it is necessary to deduct all excess emissions from previous reporting periods.

22 The net abatement amount for a project area for a transferring project, A_{PA}

(1) For equation 1 for a transferring project, $\boldsymbol{A_{PA}}$ for a project area *PA* for a reporting period *RP* is worked out, in tonnes CO_2-e, using the following equation:

$$A_{PA} = \Delta SOC_{PA(t_0-t_x)} \times \frac{44}{12} + \frac{RC}{D} - E_{net} - AP_{2014} - AP_{2015} - \sum_{RP=S}^{x-1} A_{PA,RP}$$

equation 3

where:

$\boldsymbol{\Delta SOC_{PA(t_0-t_x)}}$ is the change in soil organic carbon for the project area for the current reporting period *RP* from the baseline to the reporting period, in tonnes of soil organic carbon, worked out using equation 6.

$\boldsymbol{RC}$ is the total number of Australian carbon credit units:

(a) issued, before the end of the reporting period, in relation to each CEA that was removed from the project area before that time; and

Note: The ability to remove CEAs from a project area is limited by subsection 9(4).

(b) relinquished in relation to each CEA in the project area under sections 88, 90 or 91 of the Act before the end of the reporting period.

$\boldsymbol{D}$ is the aggregate of the permanence period discount number and the risk of reversal buffer number under section 16 of the Act associated with the Australian carbon credit units comprised in the definition of *RC* in this section.

$\boldsymbol{E_{net}}$ is any net increase in emissions in the crediting period compared to the emissions in the baseline period, in tonnes CO_2-e, determined for the reporting period in accordance with section 26.

$\boldsymbol{AP_{2014}}$ is:

(a) if the 2014 methodology determination was the applicable methodology determination for the project for a previous reporting period—the amount, in tonnes of CO_2-e, worked out using equation 4 that is greater than zero;

(b) otherwise—zero.

$\boldsymbol{AP_{2015}}$ is:

(a) if the 2015 methodology determination was the applicable methodology determination for the project for a previous reporting period—the amount, in tonnes of CO_2-e, worked out using equation 5 that is greater than zero;

(b) otherwise—zero.

$\boldsymbol{S}$ is the first reporting period for which this determination became the applicable methodology determination for the project.

$\boldsymbol{x}$ is the number of reporting periods for which this determination was the applicable methodology determination, up to and including the current reporting period.

$\boldsymbol{A_{PA,RP}}$ is:

(a) if the net abatement amount for the project area for a previous reporting period $\boldsymbol{RP}$ was worked out using equation 3, and if that amount was greater than zero—that amount;

(b) otherwise—zero.

Note: For the first reporting period for the project for which this determination was the applicable methodology determination, the summation at the end of equation 3, namely $\sum_{RP=1}^{x-1} A_{PA,RP}$, is equal to 0.

Note 1: The value for $\frac{RC}{D}$ must be worked out separately for each issue or relinquishment of Australian carbon credit units comprised in the definition of *RC* in this section, and all such values must be aggregated to work out the value for $\frac{RC}{D}$ applied to equation 3.

Note 2: The aggregate of the permanence period discount number and the risk of reversal buffer number under section 16 of the Act for the purposes of working out the value for *D* under this section associated with the Australian carbon credit units comprised in the definition of *RC* in this section would be:

- if the project was a 100-year permanence period project at the time of the issue of the units—0.95;
- if the project was a 25-year permanence period project at the time of the issue of the units—0.75.

23 Accounting for abatement recorded under the 2014 methodology determination

If the 2014 methodology determination was the applicable methodology determination for the project for a previous reporting period, AP_{2014} is worked out, in tonnes CO_2-e, using the following equation:

$$AP_{2014} = \sum_{Rc=1}^{x} NA_{Rc} \qquad \text{equation 4}$$

where:

$\boldsymbol{NA_{Rc}}$ is the project net abatement, in tonnes CO_2- e, for a reporting period *Rc* for which the 2014 methodology determination was the applicable methodology determination for the project, as worked out under Division 6.3 of Part 6 of the 2014 methodology determination.

$\boldsymbol{x}$ is the number of reporting periods for which the 2014 methodology determination was the applicable methodology determination for the project.

24 Accounting for abatement recorded under the 2015 methodology determination

If the 2015 methodology determination was the applicable methodology determination for the project for a previous reporting period, AP_{2015} is worked out, in tonnes CO_2-e, using the following equation:

$$AP_{2015} = \sum_{Rc=1}^{x} NA_{Rc,Proj} \qquad \text{equation 5}$$

where:

$\boldsymbol{NA_{Rc,Proj}}$ is the net abatement for the project for a reporting period *Rc*, in tonnes CO_2-e, as worked out using equation NA3 of the 2015 methodology determination.

$\boldsymbol{x}$ is the number of reporting periods for which the 2015 methodology determination was the applicable methodology determination for the project.

25 Change in soil organic carbon stock for a project area for a reporting period

(1) The $\Delta\boldsymbol{SOC_{PA(t_0-t_x)}}$ for a project area for a reporting period, in tonnes of soil organic carbon, is worked out using the following equation:

$$\Delta\boldsymbol{SOC_{PA(t_0-t_x)}} = \sum_{i=1}^{n}\left(\Delta SOC_{PoE,CEA_i} - Q_{B,CEA_i} - Q_{NSF,CEA_i}\right) \qquad \text{equation 6}$$

where:

$\boldsymbol{n}$ is the number of CEAs in the project area.

$\Delta\boldsymbol{SOC_{PoE,\,CEA_i}}$ is the change in soil organic carbon stocks with a specified probability of exceedance, in tonnes of soil organic carbon for the i^{th} CEA in the project area for the reporting period, given by:

(a) if, pursuant to section 15, Schedule 2 has been used for the CEA for the reporting period—the value of $\Delta\boldsymbol{SOC_{PoE,CEA(t_0-t_x)}}$ for the CEA for the reporting period worked out using equation 116;

(b) if, pursuant to section 15, Schedule 1 has been used for the CEA for the reporting period—the value of $\Delta\boldsymbol{SOC_{PoE,CEA(t_0-t_x)}}$ for the CEA for the reporting period as worked out using equation 69.

$\boldsymbol{Q_{B,CEA_i}}$ is the sum of the following:

(a) if the carbon content of any biochar applied in CEA_i in the project area in the relevant period defined in subsection (2) is known—the amount obtained by multiplying the carbon content of that biochar, expressed as a proportion, by the total quantity of that biochar, in tonnes, applied in the CEA in that period;

(b) if the carbon content of any biochar applied in CEA_i in the project area in the relevant period defined in subsection (2) is not known—the amount obtained by multiplying the default carbon content of biochar specified in the Supplement multiplied by the total quantity of that biochar, in tonnes, applied in the CEA in that period.

$\boldsymbol{Q_{NSF,CEA_i}}$ is the sum of the following:

(a) if the carbon content of any non-synthetic fertiliser applied in CEA_i in the project area in the relevant period defined in subsection (3) is known—the amount obtained by multiplying the carbon content of that non-synthetic fertiliser, expressed as a proportion, by the total quantity of that non-synthetic fertiliser, in tonnes, applied in the CEA in that period;

(b) if the carbon content of any non-synthetic fertiliser applied in CEA_i in the project area in the relevant period defined in subsection (3) is not known—the amount obtained by multiplying the default carbon content of non-synthetic fertiliser

specified in the Supplement by the total quantity of that non-synthetic fertiliser, in tonnes, applied in the CEA in that period.

(2) For the purposes of the definition of $\boldsymbol{Q_{B,CEA_i}}$ in subsection (1), the ***relevant period*** means the period:

(a) commencing from the start of the collection of samples for the baseline sampling round or, as applicable pursuant to section 15, the first estimation event; and

(b) ending on:

(i) the last day on which any samples are collected for the subsequent sampling round for the CEA for the reporting period; or

(ii) the later of:

(A) the last estimation event for the CEA for the reporting period; or

(B) the last sample collected for that event.

(3) For the purposes of the definition of $\boldsymbol{Q_{NSF,CEA_i}}$ in subsection (1), the ***relevant period*** means:

(a) if the relevant interval defined in subsection (4) is greater than two years—the period of two years before:

(i) the last day on which any samples are collected for the subsequent sampling round for the CEA for the reporting period; or

(ii) the later of:

(A) the last estimation event for the CEA for the reporting period; or

(B) the last sample collected for that event;

(b) if the relevant interval defined in subsection (4) is less than two years—the relevant interval.

(4) For the purposes of subsection (3), the ***relevant interval*** means the interval between:

(a) the start of the collection of samples for the baseline sampling round or, as applicable pursuant to section 15, the first estimation event; and

(b) either:

(i) the last day on which any samples are collected for the subsequent sampling round for the CEA for the reporting period; or

(ii) the later of:

(A) the last estimation event for the CEA for the reporting period; or

(B) the last sample collected for that event.

26 The total emissions for a project area for a project, $\boldsymbol{E_{net}}$

(1) This section must be used to determine $\boldsymbol{E_{net}}$ for a project area for a reporting period..

(2) If $\boldsymbol{E_{total}}$ for a project area for a reporting period, in tonnes CO_2-e, worked out using equation 7 is greater than 0, then $\boldsymbol{E_{net}}$ for the project area for the reporting period, in tonnes CO_2-e, for equation 2 is equal to $\boldsymbol{E_{total}}$.

(3) If $\boldsymbol{E_{total}}$ for a project area for a reporting period, in tonnes CO_2-e, worked out using equation 7 is less than or equal to 0, then $\boldsymbol{E_{net}}$ for the project area for the reporting period, in tonnes CO_2-e, for equation 2 is equal to 0.

(4) $\boldsymbol{E_{total}}$ for a project area for a reporting period, in tonnes CO_2-e, is worked out using the following equation:

$$E_{total} = \sum_{RP=1}^{x} \Delta Eall_{RP,PA} \qquad \text{equation 7}$$

where:

$\boldsymbol{RP}$ is the identifier for a reporting period.

$\boldsymbol{x}$ is the number of reporting periods up to and including the current reporting period.

$\Delta\boldsymbol{Eall_{RP,PA}}$ is the difference between the emissions for the project area in a reporting period *RP* and the baseline period, in tonnes CO_2-e, worked out using equation 48.

Part 5—Reporting, record-keeping, notification and monitoring requirements

Division 1—Offsets report requirements

31 Operation of this Division

For paragraph 106(3)(a) of the Act, this Division sets out information that must be included in an offsets report about a soil carbon project that is an eligible offsets project.

Note: Other reporting requirements are set out in rules made under the Act.

32 Information that must be included in offsets reports

(1) Each offsets report must include the following for the project:

(a) copies of the land management strategies applicable to the project during the reporting period;

(b) a description of the land management activities undertaken during the reporting period including an explanation of:

(i) how eligible management activities have been undertaken in each CEA during the reporting period; and

(ii) the extent to which the land management activities undertaken have implemented the relevant land management strategies;

(c) the number of sampling rounds or estimation events conducted during the reporting period for the CEAs included in the report;

(d) for each sampling round conducted in relation to a CEA included in the report until the end of the reporting period:

(i) the start and end date of that sampling round; and

(ii) the median day (within the meaning of the Supplement) of the sampling round;

(e) for each sampling round conducted during the reporting period, the following information,

(i) any spatial data files required to be created by the Supplement;

(ii) the accuracy of the GPS used to locate and record the location for each core collected;

(iii) the approach used to relocate a core location when an obstacle obstructs the intended core location;

(iv) an explanation of how the core points were randomly located;

(v) the diameter of the inner cutting edge of the coring device used for the sample;

(vi) the depth of the samples;

(vii) the location of each soil core sourced for a sample in accordance with the Supplement;

(viii) the laboratory used for the analysis of each sample;

(ix) the carbon content (as a percent of oven dry mass) of each sample analysed;

(f) the amount of each input and component of each equation or calculation that, under this determination and any Schedule of this determination, is used to work out the net abatement amount for the reporting period;

Note: This is in addition to the requirement in subparagraph 70(2)(d)(i) of the CFI Rule, which applies only to the final equation or calculation used to worked out the net abatement amount for the reporting period.

(g) for any modelled carbon stock estimates or validated-modelled carbon stock estimates used during the reporting period for the purposes of section 14 of Schedule 2—any information required by the Supplement;

(h) if activities are undertaken in a reporting period that were restricted under section 12—evidence that those requirements were met;

(i) if the Supplement requires a matter to be documented—that matter;

(j) a written statement from the project proponent verifying that the activities, or sampling or calculation approaches, have not been undertaken which could be reasonably expected to result in the crediting of non-genuine carbon abatement;

(k) a written statement, in a form approved by the Regulator, from the person, or persons, responsible for carrying out the sampling round verifying that:

(i) the person or persons have no financial interest in the project and were not influenced in any way to adjust the sampling; and

(ii) the sample collection and preparation were undertaken in accordance with this determination and the requirements of the Supplement; and

(iii) the sampling was not conducted in a manner, or at a time, that was likely to overestimate any increase in soil organic carbon in each carbon estimation area.

(2) If an offsets report is the first report after the declaration of the project as an eligible offsets project, it must include the following:

(a) the date the eligible management activities started in each CEA;

(b) a detailed description of all land management activities undertaken during the baseline period in each CEA;

(c) if any clearing or thinning has been conducted in a project area since submission of the section 22 application—evidence that the clearing is not in breach of subsection 12(2) (disregarding subsection 12(1)) and the thinning is not in breach of subsection 12(3) (disregarding subsection 12(1));

(d) if:

(i) any livestock emissions greater than zero are recorded during the baseline period for section 47; and

(ii) historical stock rate data is not known,

and if:

(iii) the evidence or data referred to in subsection (3) may be available to the project proponent—that evidence or data; or

(iv) otherwise—evidence that the evidence or data is unable to be obtained by the project proponent.

(3) The evidence and data to which paragraph (2)(d) applies is the following:

(a) if no part of the project area has been sold in the last 5 years—evidence of stock movements on and off the property from the National Livestock Identification System (NLIS);

(b) otherwise—for the project area or part of the project area that has been sold in the last 5 years:

(i) NLIS data from the time of the land sale to the end of the baseline period; and

(ii) NLIS data for the duration of the baseline for any CEAs for which the NLIS data was not affected by the land sale.

Note: In 2021 the National Livestock Identification System (NLIS) website was https://www.nlis.com.au/

(4) If an offsets report is the first report after an area was included in the project area for the project, it must include:

(a) the date the eligible management activities started in each CEA relating to the area added to the project; and

(b) a description of all land management activities undertaken during the baseline period in each CEA relating to the area added to the project, including the timing and duration of each activity.

Division 2—Notification requirements

33 Operation of this Division

For paragraph 106(3)(b) of the Act, this Division sets out requirements to notify one or more matters relating to the project to the Regulator for a soil carbon project that is an eligible offsets project during the permanence obligation period for the project.

Note: Other notification requirements are set out in rules made under the Act.

34 Notification requirements

(1) The project proponent must notify the Regulator within 60 days of becoming aware that an activity contrary to section 11 or 12 is conducted in the area of a CEA.

(2) If a land management strategy for the project changes, the project proponent must, within 60 days after the change, notify the Regulator of the change and within 9 months after the change, provide a copy of the new land management strategy to the Regulator.

(3) If the land management activities on land that is part of a CEA changes materially after the end of the first reporting period for the project, the project proponent must, within 60 days after the change, notify the Regulator of:
   (a) the nature of the change; and
   (b) whether the change is likely to materially impact the sequestration of carbon in the project area.

(4) Before the start of each sampling round, the project proponent must notify the Regulator of the intended location of each sample to be taken in accordance with the Supplement.

Division 3—Record-keeping requirements

35 Operation of this Division

For paragraph 106(3)(c) of the Act, this Division sets out record-keeping requirements for a soil carbon project that is an eligible offsets project.

Note: Other record-keeping requirements are set out in rules made under the Act.

36 Record-keeping requirements

The project proponent must keep records of the following:

(a) each land management strategy prepared for the project;

Note: This includes the initial land management strategy and all subsequent revised strategies.

(b) the identity, relevant experience and qualifications of:

(i) all qualified persons involved in the preparation or review of the land management strategies under section 13; and

(ii) all independent persons involved in soil sampling under subsection 7(2) of Schedule 1 or, as applicable pursuant to section 15, subsection 8(2) of Schedule 2;

(c) material and evidence used in the preparation of each land management strategy;

(d) material and evidence supporting each eligible management activity;

(e) the results of any testing undertaken as part of the project;

(f) material to demonstrate that each eligible management activity nominated for each CEA has been carried out or maintained;

(g) each input of each component of each equation or calculation that, under this determination and any Schedule of this determination, is used to work out the net abatement amount for a reporting period;

(h) records which demonstrate that the requirements of this determination and Supplement have been met;

(i) anything which is specified in a land management strategy for the project under paragraph 13(1)(c)(iii));

(j) if activities restricted by section 12 are conducted—evidence that the requirements of section 12 have been met;

(k) if the project proponent changes an eligible management activity or other land management activity from the land management strategy—the information and evidence of the change.

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Division 4—Monitoring requirements

37 Operation of this Division

For paragraph 106(3)(d) of the Act, this Division sets out:

(a) monitoring requirements for a soil carbon project that is an eligible offsets project; and

Note: Other monitoring requirements are set out in rules made under the Act.

(b) certain consequences if the project proponent fails to monitor the project as required.

38 Monitoring requirements

The project proponent must comply with the monitoring requirements set out in the following table in accordance with the instructions given in the table.

Monitoring requirements

Item	Parameter	Description	Units	Instructions
1	$Q_{LS_{gijk,B,PA}}$ (see section 48, equation 14)	Number of animals in livestock group *gijk* within the CEAs and emissions accounting areas of each project area in each year (*B*) of the baseline period.	Livestock head	Determined in accordance with section 39.
2	$D_{gijk,Y,PA}$ (see section 49, equation 16)	Period (in days) in year *B* of the baseline period that livestock group *gijk* was within the CEAs and emissions accounting areas of each project area.	Days	Determined in accordance with section 39.
3	$D_{gijk,RP,PA}$ (see section 55, equation 34)	Period (in days) that livestock group *gijk* was within the CEAs and emissions accounting areas of each project area.	Days	Determined in accordance with section 39.
4	AU_{PA} (see section 49, equation 15	Assessed annual carrying capacity of project area *PA*, in animal units.	Animal units	Determined in accordance with the process set out in the Supplement.
5	$AU_{Y,PA}$ (see section 49, equation 15	Stocking rate of project area *PA* for the first year *Y* of the project, in the same animal units as the value for AU_{PA}.	Animal units	Determined in accordance with the process set out in the Supplement.
6	$Q_{LS_{gijk},RP,PA}$ (see section 55 equation 34)	Number of animals in livestock group *gijk* that were within the CEAs and emissions accounting areas of each project area.	Livestock head	Determined in accordance with section 39.
7	$U_{RP,PA}$ (see section 56, equation 35)	Quantity of urea applied to the CEAs and emissions accounting areas of each project area.	t urea	Evidenced by invoices, contractual arrangements or sales records.

Monitoring requirements				
Item	**Parameter**	**Description**	**Units**	**Instructions**
8	$G_{SF_{fij},RP,PA}$ (see section 56 equation 36)	Quantity of synthetic fertiliser applied to the CEAs and emissions accounting areas of each project area.	t synthetic fertiliser	Evidenced by invoices, contractual arrangements or sales records.
9	$L_{l,RP,PA}$ (see section 57, equation 38)	Quantity of lime type *l* applied in the CEAs and emissions accounting areas of each project area.	t lime	Evidenced by invoices, contractual arrangements or sales records.
10	$Q_{v,RP,PA}$ (see section 58 equation 42)	Quantity of harvested crop by crop type *v* in the reporting period in the CEAs and emissions accounting areas of each project area.	t crop	Evidenced by invoices, contractual arrangements or other industry standard practices.
11	$RF_{v,RP,PA}$ (see section 58 equation 42)	Fraction of crop above ground residue from crop type *v* that was removed from the CEAs and emissions accounting areas of each project area.	Decimal	Evidenced by industry standard practices, such as cover rating assessments.
12	$Area\text{-}T_{RP,PA}$ (see section 58 equation 40 and equation 43)	Tilled area for pasture renewal or renovation in the CEAs and emissions accounting areas of each project area.	ha	Using mapping approach under the Supplement.
13	$AreaCC_{RP,PA,v}$ (see section 58 equation 44**)**	Area which is sown with cover crop in the CEAs and emissions accounting areas of each project area.	ha	Using mapping approach under the Supplement.
14	$RF_{CC,v\ ,RP,PA}$ (see section 58 equation 44)	The fraction of above ground cover crop residue of crop type $\boldsymbol{v}$ that was removed from the CEAs and emissions accounting areas for each project area.	Decimal	Evidenced by industry standard practices, such as cover rating assessments.
15	$Q_{l,RP,PA}$ (see section 59 equation 46)	Quantity of fuel used to irrigate the CEAs and emissions accounting areas of each project area.	kL	Evidenced by invoices or contractual arrangements and apportioned based on hectares of the carbon estimation area irrigated as a fraction of the total hectares of land irrigated and the fuel used to run all irrigation pumps on that land.

Monitoring requirements				
Item	**Parameter**	**Description**	**Units**	**Instructions**
16	$Q_{IP,RP,PA}$ (see section 59, equation 47)	Quantity of electricity used to irrigate the CEAs and emissions accounting areas of each project area.	kWh	Evidenced by invoices or contractual arrangements and apportioned based on hectares of the carbon estimation area irrigated as a fraction of the total hectares of land irrigated and the fuel used to run all pumps on that land. Where electricity purchased is measured in gigajoules (GJ), the quantity of kWh must be calculated by dividing the amount of GJ by 0.0036.
17	Q_F (see section 58 equation 40)	Quantity of fuel used to carry out soil landscape modification activities in the CEAs and emissions accounting areas of each project area.	kL	Evidenced by invoices or contractual arrangements.
18	Q_{B,CEA_i} (see section 25, equation 6)	Quantity of carbon in biochar (if known), or the quantity of biochar, applied to a CEA.	t	Evidenced by invoices, contractual arrangements or sales records. The carbon content should be evidenced by appropriate documentation, such as product labels, specifications or laboratory reports. If the quantity of carbon in biochar is not known, defaults must be used as outlined in the Supplement.
19	Q_{NSF,CEA_i} (see section 25, equation 6)	Quantity of carbon in non-synthetic fertilisers (if known), or the quantity of non-synthetic fertiliser, applied to a CEA.	t	Evidenced by invoices, contractual arrangements or sales records. The carbon content should be evidenced by appropriate documentation, such as product labels, specifications or laboratory reports. If the quantity of carbon in non-synthetic fertiliser is not known, defaults must be used as outlined in the Supplement.

Note: As emissions are calculated with reference to the CEAs and emissions accounting areas within a project area (see section 46), any emissions in exclusion areas do not need to be monitored.

39 Project monitoring—livestock

(1) Subject to section 40, for the baseline period and the crediting period, the project proponent must determine the following parameters at least once a year:
  (a) the number of animals within each project area, according to species, state/region and livestock class;
  (b) the number of days, according to season, that the animals are in each CEA in each project area within a year.

(2) For the purposes of determining the number of animals in each livestock class, the date of birth of each animal is deemed to be the first day of summer.

(3) For the purposes of this section, data collection:
  (a) may include the use of log books, farm gate records, or similar methods; and
  (b) must be sufficiently accurate to capture stock movements according to group characteristics, by day and by season.

40 Project monitoring—assumed baseline for livestock

If the project proponent is unable to access records to apply section 39 to the baseline period, an assessment of carrying capacity for the relevant project area must be obtained or calculated as set out in the Supplement to calculate an assumed average annual baseline emissions number for livestock emissions $\bar{E}_{LS,BP,PA}$ for section 47.

41 Project monitoring—land management strategy

(1) The project proponent must monitor the implementation of the land management strategy in each project area.

(2) If a land management strategy specifies additional steps to monitor a project in accordance with subparagraph 13(1)(c)(ii), those requirements must be met.

42 Consequences of not meeting requirement to monitor certain parameters

(1) If, during a particular period in a reporting period, a project proponent for a soil carbon project fails to monitor a parameter as required by the monitoring requirements for a project area, the value of APA in equation 2 or, as applicable, equation 3 for that reporting period is taken to be 0. In this determination this period is called the ***non-monitored period***.

(2) Subsection (1) does not apply if the Regulator determines that:
  (a) either:
    (i) the failure to monitor the parameter is likely to have only a minor or trivial impact on the value of A_{PA}; or
    (ii) alternative means have been applied to calculate a conservative estimate of the parameter; and
  (b) the project proponent is taking steps to monitor the parameter consistently with the monitoring requirements in subsequent reporting periods.

(3) The project proponent must make all practicable efforts to minimise the non-monitored period during a reporting period.

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(4) To avoid doubt, this determination does not prevent the Regulator from taking action under the Act, or regulations or rules made under the Act, in relation to the project proponent's failure to monitor a parameter as required by the determination.

Note: Examples of action that may be taken include the following:

(a) if the failure constitutes a breach of a civil penalty provision in section 194 of the Act (which deals with project monitoring requirements), the Regulator may apply for a civil penalty order in respect of the breach;

(b) if false or misleading information was given to the Regulator in relation to the failure, the Regulator may revoke the project's section 27 declaration under regulations or rules made for the purposes of section 38 of the Act;

(c) if the giving of false or misleading information in relation to the failure led to the issue of Australian carbon credit units, the Regulator may require all or some of those units to be relinquished under section 88 of the Act.

Part 6—Partial reporting

43 Partial reporting

For section 77A(2) of the Act, the division of the overall project must not result in the division of a project area.

Part 7—Calculation of Emissions

Division 1—Preliminary

44 Simplified outline of this Part

This Part provides for the calculation of the change in emissions in a reporting period from the average annual baseline emissions, known as $\Delta Eall_{RP,PA}$.

It does this by first calculating the annual average emissions in the baseline period and comparing that to emissions in the reporting period.

45 Definitions

In this Part:

$\Delta \boldsymbol{Eall_{RP,PA}}$—see equation 48.

NGA Factors document means the document entitled "National Greenhouse Accounts Factors", published by the Department and as in force from time to time.

Note: In 2021 the NGA Factors document could be viewed on the Department's website (http://www.industry.gov.au).

46 Application of this Part to CEAs and emissions accounting areas in a project area

The emissions calculated for a project area under this Part relate to all the CEAs and emissions accounting areas for the project area as at the end of the reporting period.

Note: Any emissions which relate to an exclusion area within a project area are not relevant to this Part. If the project area is varied between reporting periods, average annual baseline emissions will need to be recalculated for the new project area.

Division 2—Calculating average annual baseline emissions for a project area

47 Average annual baseline emissions for a project area

(1) The annual average emissions for the baseline period for a project area (the $\bar{E}_{all_{BP,PA}}$), in tonnes CO_2-e per year, must be calculated and is worked out using the following equation:

$$\bar{E}_{all_{BP,PA}} = \bar{E}_{LS,BP,PA} + \bar{E}_{SF,BP,PA} + \bar{E}_{L,BP,PA} + \bar{E}_{Res,BP,PA} + \bar{E}_{IEnergy,BP,PA} \quad \text{equation 12}$$

where:

$\bar{E}_{LS,BP,PA}$ is the average annual emissions from livestock during the baseline period *BP* for the project area *PA*, in tonnes CO_2-e per year, worked out using equation 13 or 15.

$\bar{E}_{SF,BP,PA}$ is the average annual emissions from synthetic fertiliser applied to project area *PA* during the baseline period *BP*, in tonnes CO_2-e per year, worked out using equation 17.

$\bar{E}_{L,BP,PA}$ is the average annual emissions from lime applied in the baseline period *BP* to project area *PA*, in tonnes CO_2-e per year, worked out using equation 20.

$\bar{E}_{Res,BP,PA}$ is the average annual emissions from all residues and tillage events and landscape modification activities in the baseline period *BP* in project area *PA*, in tonnes CO_2-e per year, worked out using equation 22.

$\bar{E}_{IEnergy,BP,PA}$ is the average annual emissions from irrigation energy in the baseline period *BP* in project area *PA*, in tonnes CO_2-e per year, worked out using equation 29.

(2) The project proponent may elect for one or all of the components of equation 12 to be zero for the baseline period (BP).

Note: A project proponent may need to make such an election if the component cannot be calculated from data available for the baseline period to ensure net abatement calculations are conservative.

48 Livestock emissions—if historical stock rate data is known

(1) This section applies if the project proponent is able to access records to apply section 39 to the baseline period.

(2) For equation 12, $\bar{E}_{LS,BP,PA}$ is worked out using the following equation:

$$\bar{E}_{LS,BP,PA} = \frac{1}{5}\sum_{B=1}^{5} E_{LS,B,PA} \quad \text{equation 13}$$

where:

$E_{LS,B,PA}$ is the total emissions from livestock during year *B* of the baseline period *BP* for the project area *PA*, in tonnes CO_2-e, worked out using equation 14.

B is the year of the baseline period, from 1 to 5.

(3) For equation 13, $E_{LS,B,PA}$ is worked out using the following equation:

$$E_{LS,B,PA} = \sum_{(\substack{\text{all groups} \\ gijk})} Q_{LS_{gijk},B,PA} \times D_{gijk,B,PA} \times \frac{EF_{LS_{gijk}}}{1000} \qquad \text{equation 14}$$

where:

$\boldsymbol{Q_{LS_{gijk},B,PA}}$ is the number of animals in livestock group *gijk* within project area *PA* in year *B* of the baseline emissions period, in livestock head.

$\boldsymbol{D_{gijk,B,PA}}$ is the number of days in year *B* of the baseline period that livestock group *gijk* was within the project area *PA*, in days.

$\boldsymbol{EF_{LS_{gijk}}}$is the default emissions factor for livestock group *gijk*, as set out in the Supplement, in kilograms CO_2-e per livestock head per day.

Note: The components of livestock group *gijk* are set out in the Supplement.

49 Livestock emissions—if historical stock rate data is not known

(1) This section applies if the project proponent is unable to access records for the duration of the baseline period to apply section 48.

(2) For equation 12, $\bar{E}_{LS,BP,PA}$ is given by the following equation:

$$\bar{E}_{LS,BP,PA} = \left(\frac{AU_{PA}}{AU_{Y,PA}}\right) E_{LS,Y,PA} \qquad \text{equation 15}$$

where:

$\boldsymbol{AU_{PA}}$ is the assessed annual carrying capacity of project area *PA*, in animal units, determined in accordance with the process set out in the supplement.

$\boldsymbol{AU_{Y,PA}}$ is the stocking rate of project area *PA* for the first year *Y* of the project, in the same animal units as the value for AU_{PA}.

$\boldsymbol{E_{LS,Y,PA}}$ is the total emissions from livestock during year first year of the project for the project area *PA,* in tonnes of CO_2-*e*, given by equation 16.

(3) For equation 15, $E_{LS,Y,PA}$ is given by the following equation:

$$E_{LS,Y,PA} = \sum_{(\substack{\text{all groups} \\ gijk})} Q_{LS_{gijk},Y,PA} \times D_{gijk,Y,PA} \times \frac{EF_{LS_{gijk}}}{1000} \qquad \text{equation 16}$$

where:

$\boldsymbol{Q_{LS_{gijk},Y,PA}}$ is number of animals in livestock group *gijk* within project area *PA* in the first year of the project *Y*, in livestock head.

$\boldsymbol{D_{gijk,Y,PA}}$ is the number of days in year *Y* that livestock group *gijk* was within the project area *PA*, in days.

$\boldsymbol{EF_{LS_{gijk}}}$ is the default emission factor for livestock group *gijk*, as set out in the Supplement, in kilograms of CO_2-e per livestock head per day.

Note: The components of livestock group *gijk* are set out in the Supplement.

50 Synthetic fertiliser emissions

(1) For equation 12, $\bar{E}_{SF,BP,PA}$ is worked out using the following equation:

$$\bar{E}_{SF,BP,PA} = \frac{1}{5}\sum_{B=1}^{5} E_{SF,B,PA} \qquad \text{equation 17}$$

where:

$\boldsymbol{E_{SF,B,PA}}$ is the total emissions from synthetic fertiliser during year B of the baseline period BP for the project area PA, in tonnes CO_2-e, worked out using equation 18.

$\boldsymbol{B}$ is the year of the baseline period, from 1 to 5.

(2) For equation 17, $E_{SF,B,PA}$ is worked out using the following equation:

$$E_{SF,B,PA} = E_{SF_N,B,PA} + U_{B,PA} \times EF_U \qquad \text{equation 18}$$

where:

$\boldsymbol{E_{SF_N,B,PA}}$ is nitrous oxide emissions from synthetic fertiliser applied to project area *PA* during year *B* of the baseline period, in tonnes CO_2-e, worked out using equation 19**.**

$\boldsymbol{U_{B,PA}}$ is the quantity of urea applied to project area *PA* during year *B* of the baseline period, in tonnes of urea.

$\boldsymbol{EF_U}$ is the default emissions factor for carbon dioxide emissions from urea as set out in the Supplement, in tonnes CO_2-e per tonne of urea.

(3) For equation 18, $E_{SF_N,B,PA}$ is worked out using the following equation:

$$E_{SF_N,B,PA} = \sum_{\binom{\text{all groups}}{fij}} G_{SF_{fij},B,PA} \times P_f \times EF_{SF_{fij}} \qquad \text{equation 19}$$

where:

$\boldsymbol{G_{SF_{fij},B,PA}}$ is the quantity of synthetic fertiliser group *fij* applied to project area *PA* during year *B* of the baseline period, in tonnes of fertiliser.

$\boldsymbol{P_f}$ is the proportion of nitrogen content of fertiliser *f* in synthetic fertiliser group *fij*, as provided by the manufacturer, in tonnes of nitrogen per tonne of fertiliser.

$\boldsymbol{EF_{SF_{fij}}}$ is the default emissions factor for synthetic fertiliser group *fij* as set out in the Supplement, in tonnes CO_2-e per tonne of nitrogen in fertiliser.

51 Lime emissions

(1) For equation 12, $\bar{E}_{L,BP,PA}$ is worked out using the following equation:

$$\bar{E}_{L,BP,PA} = \frac{1}{5}\sum_{B=1}^{5}\left(E_{L,B,PA}\right) \qquad \text{equation 20}$$

where:

$\boldsymbol{E_{L,B,PA}}$is the emissions from lime during year *B* of the baseline period *BP* for the project area *PA*, in tonnes CO_2-e,, worked out using equation 21.

$\boldsymbol{B}$ is the year of the baseline period, from 1 to 5.

(2) For equation 20, $E_{L,B,PA}$is worked out using the following equation:

$$E_{L,B,PA} = \sum_{l=1}^{n}\left(L_{l,B,PA} \times P_l \times EF_l\right) \qquad \text{equation 21}$$

where:

$\boldsymbol{L_{l,B,PA}}$ is the quantity of lime type *l* applied in year *B* of the baseline period *BP* for the project area *PA*, in tonnes.

$\boldsymbol{P_l}$ is the proportion of pure carbonate content of lime type *l*, as provided by the manufacturer, or, if unavailable, the default value as set out in the Supplement, in tonnes of pure carbonate/tonne of lime type *l*.

Note: The proportion of pure carbonate content of lime is described as its neutralising value and includes both calcium carbonate and magnesium carbonate

$\boldsymbol{EF_l}$ is the default emissions factor for pure carbonates in lime type *l* as set out in the Supplement, in tonnes CO_2-e per tonne of pure carbonate.

$\boldsymbol{l}$ is the type of lime as defined by the percentage carbonate content.

$\boldsymbol{n}$ is the number of types of lime applied in year *B* of the baseline period *BP*.

52 Residue, tillage and soil landscape modification emissions

(1) For equation 12, $\bar{E}_{Res,BP,PA}$ is worked out using the following equation:

$$\bar{E}_{Res,BP,PA} = \frac{1}{5}\sum_{B=1}^{5} E_{Res,B,PA} \qquad \text{equation 22}$$

where:

$\boldsymbol{E_{Res,B,PA}}$ is the total emissions from residues and tillage events and soil landscape modification activities during year *B* of the baseline period *BP* for the project area *PA*, in tonnes CO_2-e, worked out using equation 23.

$\boldsymbol{B}$ is the year of the baseline period, from 1 to 5.

(2) For equation 22, $E_{Res,B,PA}$ is worked out using the following equation:

$$E_{Res,B,PA} = E_{F,B,PA} + E_{R,B,PA} + E_{P,B,PA} + E_{CC,B,PA}$$ equation 23

where:

$\boldsymbol{E_{F,B,PA}}$ is the emissions from diesel fuel used for tillage events and soil landscape modification activities in year *B* of the baseline period in project area *PA,* in tonnes CO_2-e, worked out using equation 24**.**

$\boldsymbol{E_{R,B,PA}}$ is the emissions from the residues of all crop types in year *B* of the baseline period in project area *PA,* in tonnes CO_2-e, given by equation 25.

Note: To avoid doubt, sowing with tillage (e.g using discs or tynes) is considered tillage.

$\boldsymbol{E_{P,B,PA}}$ is the emissions from pasture tillage events i in year *B* of the baseline period in project area *PA,* in tonnes CO_2-e, worked out using equation 27.

$\boldsymbol{E_{CC,B,PA}}$ is the emissions from the residues of all cover crops in in year *B* of the baseline period in project area *PA,* in tonnes CO_2-e, worked out using equation 28.

(3) For equation 23, $E_{F,B,PA}$ is worked out using the following equation:

$$E_{F,B,PA} = \sum_{g=1}^{n} \left(\left(\frac{Area\text{-}T_{B,PA} \times \boldsymbol{EQ_F\text{-}T} \times EC_F \times EF_{Fg}}{1000} \right) + \left(\frac{Q_F \times EC_F \times EF_{Fg}}{1000} \right) \right)$$ equation 24

where:

$\boldsymbol{n}$ is the number of gas types *g*.

$\boldsymbol{Area\text{-}T_{B,PA}}$ is the tilled area in year *B* of the baseline period in a project area *PA*, in hectares.

$\boldsymbol{EQ_F\text{-}T}$is the estimate of the diesel fuel use in kilolitres per hectare determined by the Supplement for tillage events

$\boldsymbol{EC_F}$ is the energy content factor for diesel fuel set out in the NGER (Measurement) Determination, in gigajoules per kilolitre.

$\boldsymbol{EF_{Fg}}$ is the emissions factor for each gas type *g* for diesel fuel set out in the NGER (Measurement) Determination, in kilograms CO_2-e per gigajoule.

$\boldsymbol{Q_F}$ is the quantity of fuel used for soil landscape modification activities in year B of the baseline period in project area PA, in kilolitres.

Note: The value 1000 converts kilograms to tonnes.

(4) For equation 23, $E_{R,B,PA}$ is worked out using the following equation:

$$E_{R,B,PA} = \sum_{v=1}^{n} E_{R,v,B,PA}$$ equation 25

where:

$\boldsymbol{E_{R,v,B,PA}}$ is the emissions from the residues of crop type *v* in year *B* of the baseline period in project area *PA,* in tonnes CO_2-e, worked out using equation 26.

$\boldsymbol{n}$ is the number of crop types and residue burning combinations (burnt/unburnt) grown in year *B* in the project area *PA*.

$\boldsymbol{v}$ is the crop type as specified in the Supplement and residue burning status (burnt/unburnt)

Note: If residue burning only occurred for certain paddocks of a crop type, Equation 26 is repeated for the burnt and unburnt crop (with the harvested crop quantity attributable to paddocks of each status).

(5) For equation 25, $E_{R,v,B,PA}$ is worked out using the following equation:

$$\begin{aligned} E_{R,v,B,PA} = \Big(& Q_{v,B,PA} \times RC_v \times DM_v \times EF_{RD,N} \\ & \times \Big(\big(1 - RF_{v,B,PA}\big) \times (1 - FRRB_v) \times NC_{v,AG} \\ & + BGABRR_v \times NC_{v,BG} \Big) \Big) \\ & + \Big(Q_{v,B,PA} \times DM_v \\ & \times RC_v \times \big(1 - RF_{v,B,PA}\big) \times FRRB_v \times EF_{RB,v} \Big) \end{aligned}$$ equation 26

where:

$\boldsymbol{Q_{v,B,PA}}$ is quantity of harvested crop by crop type *v* in year *B* of the baseline period in project area *PA*, in tonnes of harvested crop type *v*.

$\boldsymbol{RC_v}$ is the above ground residue:harvested crop ratio for crop type *v* as set out in the Supplement.

$\boldsymbol{DM_v}$ is the dry matter fraction of residue from crop type *v*, as set out in the Supplement, as a decimal, in tonnes of dry matter per tonne of residue.

$\boldsymbol{EF_{RD,N}}$ is the emissions factor for residue decomposition as set out in the Supplement, in tonnes CO_2-e per tonne of nitrogen.

$\boldsymbol{RF_{v,B,PA}}$ is the fraction of above ground crop residue from crop type *v* that is removed after harvest but before residue burning, in year *B* of the baseline period in project area *PA*, as set out in the Supplement as a decimal.

$\boldsymbol{FRRB_v}$ is the fraction of above ground residue remaining at burning. If no burning has occurred, the value is 0. If residue burning has occurred, the value is set out in the supplement for crop type *v*, as a decimal.

$\boldsymbol{NC_{v,AG}}$ is the nitrogen content in crop residue above ground (AG) from crop type *v* as set out in the Supplement, in tonnes of nitrogen per tonne of above ground residue dry matter.

$\boldsymbol{BGABRR_{v}}$ is the below ground to above ground residue ratio for crop type v as set out in the Supplement

$\boldsymbol{NC_{v,BG}}$ is the nitrogen content in crop residue below ground (BG) from crop type *v* as set out in the Supplement, in tonnes of nitrogen per tonne of below ground residue dry matter.

$\boldsymbol{EF_{RB,v}}$ is the emissions factor for residue burning for crop type *v*, as set out in the Supplement, in tonnes CO_2-e per tonne of above ground crop residue dry matter

(6) For equation 23, $E_{P,B,PA}$ is worked out using the following equation:

$$E_{P,B,PA} = \sum_{v=1}^{n} DM_{v,P} \times Area\text{-}T_{B,PA} \times EF_{RD,N} \times \left(NC_{P,\boldsymbol{AG}} \times \left(1 - RF_{v,P,B,PA}\right) + NC_{P,BG} \times BGABRR_{v,P}\right) \quad \text{equation 27}$$

where:

n is the number of pasture types grown in year *B* in the project area *PA*.

v is the pasture type as specified in the Supplement

$\boldsymbol{DM_{v,P}}$ is the annual above ground dry matter yield for pasture type *v* as set out in the Supplement, in tonnes per hectare.

$\boldsymbol{Area\text{-}T_{B,PA}}$ is the tilled area for pasture renewal or renovation in year *B* of the baseline period in project area *PA*, in hectares.

$\boldsymbol{EF_{RD,N}}$ is the emissions factor for residue decomposition as set out in the Supplement, in tonnes CO_2-e per tonne of nitrogen.

$\boldsymbol{NC_{P,AG}}$ is the nitrogen content in above ground (AG) pasture residue as set out in the Supplement, in tonnes of nitrogen per tonne of pasture above ground dry matter.

$\boldsymbol{RF_{v,P,B,PA}}$ is the fraction of above ground crop residue from pasture that was removed in year *B* of the baseline period in project area *PA* as set out in the supplement, as a decimal.

$\boldsymbol{NC_{P,BG}}$ is the nitrogen content in pasture residue below ground *BG* from pasture type *v* as set out in the Supplement, in tonnes of nitrogen per tonne of pasture dry matter.

$\boldsymbol{BGABRR_{v,P}}$is the below ground to above ground residue ratio for pasture type v as set out in the Supplement.

(7) For equation 23, $E_{CC,RP}$ is worked out using the following equation:

$$E_{CC,B,PA} = \sum_{v=1}^{n} DM_{CC,v} \times AreaCC_{B,PA,v} \times EF_{RD,N} \times \left(NC_{CC,v,AG} \times \left(1 - RF_{CC,v,B,PA}\right) + NC_{CC,v,BG} \times BGABRR_{v,CC}\right) \quad \text{equation 28}$$

where:

$\boldsymbol{n}$ is the number of cover crops grown in in year *B* of the baseline period in project area *PA*.

$\boldsymbol{v}$ is the cover crop type as specified in the Supplement.

$\boldsymbol{DM_{CC,v}}$ is the annual above ground dry matter yield for cover crop $\boldsymbol{v}$ as set out in the Supplement, in tonnes of above ground dry matter per hectare.

$\boldsymbol{AreaCC_{B,PA,v}}$ is the area which is sown with cover crop $\boldsymbol{v}$ in year *B* of the baseline period in project area *PA*, in hectares.

$\boldsymbol{EF_{RD,N}}$is the emissions factor for residue decomposition as set out in the Supplement, in tonnes of CO_2-e per tonne of nitrogen.

$\boldsymbol{NC_{CC,v,AG}}$ is the nitrogen content in above ground *AG* cover crop residue, as set out in the Supplement for cover crop type $\boldsymbol{v}$, in tonnes of nitrogen per tonne of above ground cover crop dry matter.

$\boldsymbol{RF_{CC,v,B,PA}}$ is the fraction of above ground cover crop residue of cover crop type $\boldsymbol{v}$ that was removed in year *B* of the baseline period in project area *PA*, as a decimal value.

$\boldsymbol{NC_{CC,v,BG}}$ is the nitrogen content in below ground *BG* cover crop residue from cover crop type *v* as set out in the Supplement, in tonnes of nitrogen per tonne of below ground cover crop dry matter.

$\boldsymbol{BGABRR_{v,CC}}$is the below ground to above ground total dry matter ratio for cover crop type *v* as set out in the Supplement.

53 Irrigation energy emissions

(1) For equation 12, $\bar{E}_{IEnergy,BP,PA}$ is worked out using the following equation:

$$\bar{E}_{IEnergy,BP,PA} = \bar{E}_{IFuel,BP,PA} + \bar{E}_{IP,BP,PA} \qquad \text{equation 29}$$

where:

$\boldsymbol{\bar{E}_{IFuel,BP,PA}}$ is the average annual emissions from irrigation fuel in the baseline period *BP* for the project area *PA,* in tonnes CO_2-e, worked out using equation 30.

$\boldsymbol{\bar{E}_{IP,BP,PA}}$ is the average annual emissions from irrigation electricity in the baseline period *BP* for the project area *PA,* in tonnes CO_2-e, given by equation 31.

(2) For equation 29, $\bar{E}_{IFuel,BP,PA}$ is worked out using the following equation:

$$\bar{E}_{IFuel,BP,PA} = \frac{1}{5}\sum_{g=1}^{n}\left(\frac{Q_{I,BP,PA} \times EC_F \times EF_{Fg}}{1000}\right) \qquad \text{equation 30}$$

where:

$\boldsymbol{n}$ is the number of gas types *g*.

$\boldsymbol{Q_{I,BP,PA}}$ is the quantity of fuel used to irrigate project area P*A* in the baseline period, in kilolitres.

$\boldsymbol{EC_F}$ is the energy content factor for diesel fuel set out in the NGER (Measurement) Determination, in gigajoules per kilolitre.

$\boldsymbol{EF_{Fg}}$ is the emissions factor for each gas type *g* for diesel fuel set out in the NGER (Measurement) Determination, in kilograms CO_2-e per gigajoule.

Note: The value 1000 converts kilograms to tonnes.

(3) For equation 29, $\bar{E}_{IP,BP,PA}$ is worked out using the following equation:

$$\bar{E}_{IP,BP,PA} = \frac{1}{5}\left(Q_{IP,BP,PA} \times \frac{EF_{Elec}}{1000}\right) \qquad \text{equation 31}$$

where:

$\boldsymbol{Q_{IP,BP,PA}}$ is the quantity of electricity used to irrigate the project area *PA* over the baseline period, in kilowatt hours.

$\boldsymbol{EF_{Elec}}$ is:

(a) for electricity obtained from an electricity grid that is a grid in relation to which the NGA Factors document, in force at the end of the reporting period, includes an emissions factor—that factor, in kilograms CO_2-e per kilowatt hour; or

(b) for electricity obtained from an electricity grid not covered by paragraph (a) or obtained from a source other than an electricity grid:

(i) if the supplier of the electricity is able to provide an emissions factor that reflects the emissions intensity of the electricity (worked out in accordance with subsection (4)) and is applicable at the end of the reporting period—that factor, in kilograms CO_2-e per kilowatt hour (or its equivalent of tonnes CO_2-e per megawatt hours); or

(ii) otherwise—the emissions factor, in kilograms CO_2-e per kilowatt hour (or its equivalent of tonnes CO_2-e per megawatt hours), for off-grid electricity included in the NGA Factors document in force at the end of the reporting period.

(4) For subparagraph (b)(i) of the definition of EF_{Elec} in subsection (3), the emissions factor must be worked out:

(a) on a sent-out basis; and

(b) using a measurement or estimation approach that is consistent with the NGER (Measurement) Determination.

Division 3—Calculating average annual project emissions for a project area

54 Average annual project emissions for a project area

The annual average emissions for the reporting period for a project area (the $\bar{E}_{all_{RP,PA}}$), in tonnes CO_2-e per year, must be calculated and is worked out using the following equation:

$$\bar{E}all_{RP,PA} = \frac{(E_{LS,RP,PA} + E_{SF,RP,PA} + E_{L,RP,PA} + E_{Res,RP,PA} + E_{IEnergy,RP,PA})}{years_{RP}} \quad \text{equation 32}$$

where:

$E_{LS,RP,PA}$ is the total emissions from livestock during the reporting period *RP* for the project area *PA*, in tonnes CO_2-e per year, worked out using equation 33.

$E_{SF,RP,PA}$ is the total emissions from synthetic fertiliser applied to project area *PA* during the reporting period *RP*, in tonnes CO_2-e per year, worked out using equation 35

$E_{L,RP,PA}$ is the total carbon dioxide emissions from lime applied in the reporting period *RP* to project area *PA*, in tonnes CO_2-e per year, worked out using equation 37.

$E_{Res,RP,PA}$ is the total emissions from all tillage events in the reporting period *RP* in project area *PA*, in tonnes CO_2-e per year, worked out using equation 39.

$E_{IEnergy,RP,PA}$ is the total emissions from irrigation energy in the reporting period *RP* in project area *PA*, in tonnes CO_2-e per year, worked out using equation 45.

$years_{RP}$ is the number of years in the reporting period, in years.

55 Livestock emissions

(1) For equation 32, $E_{LS,RP,PA}$ is worked out using the following equation:

$$E_{LS,RP,PA} = \sum_{\binom{\text{all groups}}{gijk}} E_{LS_{gijk},RP,PA} \quad \text{equation 33}$$

where:

$E_{LS_{gijk},RP,PA}$ is the total emissions from livestock group *gijk* for the reporting period for the project area *PA*, in tonnes CO_2-e, worked out using equation 34.

(2) For equation 33, $E_{LS_{gijk},RP,PA}$ is worked out using the following equation:

$$E_{LS_{gijk},RP,PA} = Q_{LS_{gijk},RP,PA} \times D_{LS_{gijk},RP,PA} \times \frac{EF_{LS_{gijk}}}{1000} \quad \text{equation 34}$$

where:

$Q_{LS_{gijk},RP,PA}$ is the number of animals in livestock group *gijk* within project area *PA* in the reporting period *RP*, in livestock head.

$\boldsymbol{D_{LSgijk,RP,PA}}$ is the number of days in the reporting period that livestock group *gijk* was within the project area *PA*, in days.

$\boldsymbol{EF_{LS_{gijk}}}$ is the default emissions factor for livestock group *gijk*, as set out in the Supplement; in kilograms CO_2-e per livestock head per day.

Note: The components of livestock group *gijk* are set out in the Supplement.

56 Synthetic fertiliser emissions

(1) For equation 32, $E_{SF,RP,PA}$ is worked out using the following equation:

$$E_{SF,RP,PA} = E_{SF_N,RP,PA} + U_{RP,A} \times EF_U \qquad \text{equation 35}$$

where:

$\boldsymbol{E_{SF_N,RP,PA}}$ is nitrous oxide emissions from synthetic fertiliser applied to project area *PA* during the reporting period in tonnes CO_2-e, worked out using equation 36**.**

$\boldsymbol{U_{RP,PA}}$ is the quantity of urea applied to project area *PA* during the reporting period, in tonnes of urea.

$\boldsymbol{EF_U}$ is the default emissions factor for carbon dioxide emissions from urea as set out in the Supplement, in tonnes CO_2-e per tonne of urea.

(2) For equation 35, $E_{SF_N,RP,PA}$ is worked out using the following equation:

$$E_{SF_N,RP,PA} = \sum_{\binom{\text{all groups}}{fij}} G_{SF_{fij},RP,PA} \times P_f \times EF_{SF_{fij}} \qquad \text{equation 36}$$

where:

$\boldsymbol{G_{SF_{fij},RP,PA}}$ is the quantity of synthetic fertiliser group *fij* applied to project area *PA* during the reporting period, in tonnes of fertiliser.

$\boldsymbol{P_f}$ is the proportion of nitrogen content of fertiliser *f* in synthetic fertiliser group *fij*, as provided by the manufacturer, in tonnes of nitrogen per tonne of fertiliser.

$\boldsymbol{EF_{SF_{fij}}}$ is the default emissions factor for synthetic fertiliser group *fij* as set out in the Supplement, in tonnes CO_2-e per tonne of nitrogen in fertiliser.

57 Lime emissions

(1) For equation 32, $E_{L,RP,PA}$ is worked out using the following equation:

$$E_{L,RP,PA} = \sum_{l=1}^{n} E_{L,l,RP,PA} \qquad \text{equation 37}$$

where:

$\boldsymbol{E_{L,l,RP,PA}}$ is the emissions from lime type *l* applied during the reporting period *RP* for the project area *PA*, in tonnes CO_2-e, worked out using equation 38 .

$\boldsymbol{l}$ is the type of lime as defined by the percentage carbonate content.

$\boldsymbol{n}$ is the number of types of lime applied in the reporting period.

(2) For equation 37, $E_{L,l,RP,PA}$ is worked out using the following equation:

$$E_{L,l,RP,PA} = L_{l,RP,PA} \times P_l \times EF_l \qquad \text{equation 38}$$

where:

$\boldsymbol{L_{l,RP,PA}}$ is the quantity of lime type *l* applied in the reporting period in the project area *PA*, in tonnes.

$\boldsymbol{P_l}$ is the proportion of pure carbonate content of lime type *l*, as provided by the manufacturer, or if unavailable, the default value as set out in the Supplement, in tonnes of pure carbonate/tonne of lime type *l*.

Note: The proportion of pure carbonate content of lime is described as its neutralising value and includes both calcium carbonate and magnesium carbonate

$\boldsymbol{EF_l}$ is the default emissions factor for pure carbonates in lime type *l* as set out in the Supplement, in tonnes CO_2-e per tonne of pure carbonate.

$\boldsymbol{l}$ is the type of lime as defined by the percentage carbonate content.

58 Residue, tillage and soil landscape modification emissions

(1) For equation 32, $E_{Res,RP,PA}$ is worked out using the following equation:

$$E_{Res,RP,PA} = E_{F,RP,PA} + E_{R,RP,PA} + E_{P,RP,PA} + E_{CC,RP} \qquad \text{equation 39}$$

where:

$\boldsymbol{E_{F,RP,PA}}$ is the emissions from diesel fuel used for tillage events and soil landscape modification activities in the reporting period *RP* in project area *PA,* in tonnes CO_2-e, worked out using equation 40**.**

$\boldsymbol{E_{R,RP,PA}}$ is the emissions from the residues of all crop types, other than cover crops, in the reporting period *RP* in project area *PA,* in tonnes CO_2-e, worked out using equation 41.

$\boldsymbol{E_{P,RP,PA}}$ is the emissions from pasture tillage events in the reporting period *RP* in project area *PA,* in tonnes CO_2-e, worked out using equation 43.

$\boldsymbol{E_{CC,RP}}$ is the emissions from the residues of all cover crops in the reporting period *RP* in project area *PA,* in tonnes CO_2-e, worked out using equation 44.

(2) For equation 39, $E_{F,RP,PA}$ is worked out using the following equation:

$$E_{F,RP,PA} = \sum_{g=1}^{n} \left(\left(\frac{Area\text{-}T_{RP,PA} \times EQ_F\text{-}T \times EC_F \times EF_{Fg}}{1000} \right) + \left(\frac{Q_F \times EC_F \times EF_{Fg}}{1000} \right) \right) \quad \text{equation 40}$$

where:

$\boldsymbol{n}$ is the number of gas types *g*.

$\boldsymbol{Area\text{-}T_{RP,PA}}$ is the tilled area for pasture renewal or renovation in the reporting period in a project area *PA*, in hectares.

$\boldsymbol{EQ_F\text{-}T}$is the estimate of the diesel fuel use in kilolitres per hectare determined by the Supplement for tillage events.

$\boldsymbol{EC_F}$ is the energy content factor for diesel fuel set out in the NGER (Measurement) Determination, in gigajoules per kilolitre.

$\boldsymbol{EF_{Fg}}$ is the emissions factor for each gas type *g* for diesel fuel set out in the NGER (Measurement) Determination, in kilograms CO_2-e per gigajoule.

$\boldsymbol{Q_F}$ is the quantity of fuel used for soil landscape modification activities in the reporting period, in kilolitres.

Note: The value 1000 converts kilograms to tonnes

(3) For equation 39, $E_{R,RP,PA}$ is worked out using the following equation:

$$E_{R,RP,PA} = \sum_{v=1}^{n} E_{R,v,RP,PA} \quad \text{equation 41}$$

where:

$\boldsymbol{E_{R,v,RP,PA}}$ is the emissions from the residues of crop type *v* in the reporting period in project area *PA,* in tonnes CO_2-e, worked out using equation 42.

$\boldsymbol{n}$ is the number of crops and residue burning combinations(burnt/unburnt) grown in the reporting period in the project area *PA*.

$\boldsymbol{v}$ is the combination of crop type (burnt/unburnt) as specified in the Supplement and residue burning status (burnt/unburnt).

(4) For equation 41, $E_{R,v,RP,PA}$ is worked out using the following equation:

$$E_{R,v,RP,PA} = \left(Q_{v,RP,PA} \times RC_v \times DM_v \times EF_{RD,N} \times \left(\left(1 - \boldsymbol{RF_{v,RP,PA}}\right) \times (1 - FRRB_v) \times NC_{v,AG} + BGABRR_v \times NC_{v,BG}\right)\right) + \left(Q_{v,RP,PA} \times DM_v \times RC_v \times \left(1 - \boldsymbol{RF_{v,RP,PA}}\right) \times FRRB_v \times EF_{RB,v}\right) \quad \text{equation 42}$$

where:

$\boldsymbol{Q_{v,RP,PA}}$ is quantity of harvested crop for crop type *v* harvested in the reporting period in project area *PA*, in tonnes of harvested crop type *v*.

$\boldsymbol{RC_v}$ is the above ground residue: harvested crop ratio for crop type *v* as set out in the Supplement

$\boldsymbol{DM_v}$ is the dry matter fraction of residue from crop type *v*, as set out in the Supplement, as a decimal, in tonnes of dry matter per tonne of residue.

$\boldsymbol{EF_{RD,N}}$ is the emissions factor for residue decomposition as set out in the Supplement, in tonnes CO_2-e per tonne of nitrogen.

$\boldsymbol{RF_{v,RP,PA}}$ is the fraction of above ground crop residue from crop type *v* that is removed after harvest but before residue burning, in the reporting period, in project area *PA*, as set out in the Supplement as a decimal.

$\boldsymbol{FRRB_v}$ is the fraction of above ground residue remaining at burning. If no burning has occurred, the value is 0. If residue burning has occurred, the value is set out in the Supplement for crop type *v*, as a decimal.

$\boldsymbol{NC_{v,AG}}$ is the nitrogen content in crop residue above ground (AG) from crop type *v* as set out in the Supplement, in tonnes of nitrogen per tonne of above ground residue dry matter.

$\boldsymbol{BGABRR_v}$ is the below ground to above ground residue ratio for crop type v as set out in the Supplement

$\boldsymbol{NC_{v,BG}}$ is the nitrogen content in crop residue below ground (BG) from crop type *v* as set out in the Supplement, in tonnes of nitrogen per tonne of below ground residue dry matter.

$\boldsymbol{EF_{RB,v}}$ is the emissions factor for residue burning for crop type *v*, as set out in the Supplement, in tonnes of CO_2-e per tonne of above ground crop residue dry matter.

(5) For equation 39, $E_{P,RP,PA}$ is worked out using the following equation:

$$E_{P,RP,PA} = \sum_{v=1}^{n} DM_{v,P} \times Area\text{-}T_{RP,PA} \times EF_{RD,N} \times \left(NC_{P,AG} \times \left(1 - RF_{P,RP,PA}\right) + NC_{P,BG} \times BGABRR_{v,P}\right)$$

equation 43

where:

$\boldsymbol{n}$ is the number of pasture types grown in reporting period *RP* in the project area *PA*.

$\boldsymbol{v}$ is the pasture type as specified in the Supplement.

$\boldsymbol{DM_{v,P}}$ is the annual above ground dry matter yield for pasture type *v* as set out in the Supplement, in tonnes per hectare.

$\boldsymbol{Area\text{-}T_{RP,PA}}$ is the tilled area for pasture renewal or renovation in the reporting period in a project area *PA*, in hectares.

$\boldsymbol{EF_{RD,N}}$is the emissions factor for residue decomposition as set out in the Supplement, in tonnes CO_2-e per tonne of nitrogen.

$\boldsymbol{NC_{P,AG}}$ is the nitrogen content in above ground (AG) pasture residue as set out in the Supplement, in tonnes of nitrogen per tonne of pasture above ground dry matter.

$\boldsymbol{RF_{P,RP,PA}}$ is the fraction of above ground residue from pasture that was removed during the reporting period in project area *PA*, as set out in the Supplement, as a decimal.

$\boldsymbol{NC_{P,BG}}$ is the nitrogen content in pasture residue below ground *BG* from pasture type *v* as set out in the Supplement, in tonnes of nitrogen per tonne of pasture dry matter.

$\boldsymbol{BGABRR_{v,P}}$is the below ground to above ground residue ratio for pasture type v as set out in the Supplement.

(6) For equation 39, $E_{CC,RP}$ is worked out using the following equation:

$$E_{CC,RP,PA} = \sum_{v=1}^{n} DM_{CC,v} \times AreaCC_{RP,PA,v} \times EF_{RD,N} \times \left(NC_{CC,v,AG} \times \left(1 - RF_{CC,v,RP,PA}\right) + NC_{CC,v,BG} \times BGABRR_{v,CC}\right)$$

equation 44

where:

$\boldsymbol{n}$ is the number of cover crops grown in the reporting period in the project area *PA*.

$\boldsymbol{v}$ is the cover crop type as specified in the Supplement.

$\boldsymbol{DM_{CC,v}}$ is the annual above ground dry matter yield for cover crop $\boldsymbol{v}$ as set out in the Supplement, in tonnes of above ground dry matter per hectare.

$\boldsymbol{AreaCC_{RP,PA,v}}$ is the area which is sown with cover crop $\boldsymbol{v}$ in the reporting period in a project area *PA*, in hectares.

$\boldsymbol{EF_{RD,N}}$is the emissions factor for residue decomposition as set out in the Supplement, in tonnes CO_2-e per tonne of nitrogen.

$\boldsymbol{NC_{CC,v,AG}}$ is the nitrogen content in above ground *AG* cover crop residue as set out in the Supplement for cover crop type ***v***, in tonnes of nitrogen per tonne of above ground cover crop dry matter.

$\boldsymbol{RF_{CC,v,RP,PA}}$ is the fraction of above ground cover crop residue of cover crop type ***v*** that was removed during the reporting period in project area *PA*, as a decimal value.

$\boldsymbol{NC_{CC,v,BG}}$ is the nitrogen content in below ground *BG* cover crop residue from cover crop type *v* as set out in the Supplement, in tonnes of nitrogen per tonne of below ground cover crop dry matter.

$\boldsymbol{BGABRR_{v,CC}}$ is the below ground to above ground total dry matter ratio for cover crop type *v* as set out in the Supplement.

(1) For equation 32, $E_{IEnergy,RP,PA}$ is worked out using the following equation:

$$E_{IEnergy,RP,PA} = E_{IFuel,RP,PA} + E_{IP,RP,PA} \qquad \text{equation 45}$$

where:

$\boldsymbol{E_{IFuel,RP,PA}}$ is the emissions from irrigation fuel in the reporting period *RP* for the project area *PA*, in tonnes CO_2-e, worked out using equation 46.

$\boldsymbol{E_{IP,RP,PA}}$ is the emissions from irrigation electricity in the reporting period *RP* for the project area *PA*, in tonnes CO_2-e, worked out using equation 47.

(2) For equation 45, $E_{IFuel,RP,PA}$ is worked out using the following equation:

$$E_{IFuel,RP,PA} = \sum_{g=1}^{n} \left(\frac{Q_{I,RP,PA} \times EC_F \times EF_{Fg}}{1000} \right) \qquad \text{equation 46}$$

where:

n is the number of gas types *g*.

$\boldsymbol{Q_{I,RP,PA}}$ is the quantity of fuel used to irrigate project area *PA* in the reporting period, in kilolitres.

$\boldsymbol{EC_F}$ is the energy content factor for diesel fuel set out in the NGER (Measurement) Determination, in gigajoules per kilolitre.

$\boldsymbol{EF_{Fg}}$ is the emissions factor for each gas type *g* for diesel fuel set out in the NGER (Measurement) Determination, in kilograms CO_2-e per gigajoule.

(3) For equation 45, $E_{IP,RP,PA}$ is worked out using the following equation:

$$E_{IP,RP,PA} = Q_{IP,RP,PA} \times \frac{EF_{Elec}}{1000} \qquad \text{equation 47}$$

where:

$\boldsymbol{Q_{IP,RP,PA}}$ is the quantity of electricity used to irrigate the project area *PA* over the reporting period, in kilowatt hours.

$\boldsymbol{EF_{Elec}}$ is:

(a) for electricity obtained from an electricity grid that is a grid in relation to which the NGA Factors document, in force at the end of the reporting period, includes an emissions factor—that factor, in kilograms CO_2-e per kilowatt hour; or

(b) for electricity obtained from an electricity grid not covered by paragraph (a) or obtained from a source other than an electricity grid:

(i) if the supplier of the electricity is able to provide an emissions factor that reflects the emissions intensity of the electricity (worked out in accordance with subsection (4)) and is applicable at the end of the reporting period—that factor, in kilograms CO_2-e per kilowatt hour (or its equivalent of tonnes CO_2-e per megawatt hours); or

(ii) otherwise—the emissions factor, in kilograms CO_2-e per kilowatt hour (or its equivalent of tonnes CO_2-e per megawatt hours), for off-grid electricity included in the NGA Factors document in force at the end of the reporting period.

(4) For subparagraph (b)(i) of the definition of EF_{Elec} in subsection (3), the emissions factor must be worked out:

(a) on a sent-out basis; and

(b) using a measurement or estimation approach that is consistent with the NGER (Measurement) Determination.

Division 4—Calculating change in emissions

60 Change in project emissions from baseline in a reporting period

The difference between the emissions in the current reporting period *RP* and the baseline period (the $\Delta \boldsymbol{Eall_{RP,PA}}$) in tonnes CO_2-e, is worked out using the following equation:

$$\Delta Eall_{RP,PA} = (\bar{E}all_{RP,PA} - \bar{E}_{all_{BP,PA}}) \times years_{RP} \quad \text{equation 48}$$

where:

$\overline{\boldsymbol{E}}_{\boldsymbol{all_{RP,PA}}}$ is the average annual emissions from all sources during the reporting period *RP* for the project area *PA*, in tonnes CO_2-e, worked out using equation 32.

$\overline{\boldsymbol{E}}_{\boldsymbol{all_{BP,PA}}}$ is the average annual emissions from all sources during the baseline period *BP* for the project area *PA*, in tonnes CO_2-e, worked out using equation 12.

$\boldsymbol{years_{RP}}$ is the number of years in the reporting period, in years.

Schedule 1—Measurement-only approach to estimating soil organic carbon sequestration

Division 1—Preliminary

1 Simplified outline of this Schedule

This Schedule provides for the calculation of the change in soil organic carbon between reporting periods for a CEA of a soil carbon project which is an eligible offsets project, using a measurement-only approach.

To determine this amount using a measurement-only approach, in tonnes of carbon:

- samples of soil need to be collected and analysed consistent with the requirements of Division 2 of this Schedule and the Supplement;

- the soil organic carbon stock and sampling variance in a CEA needs to be calculated in accordance with Division 4 of this Schedule;

- the change in soil organic carbon stock for a reporting period needs to be calculated in accordance with Division 5 of this Schedule;

In accordance with Divisions 2 and 3 of this Schedule, the sampling, analysis and calculations of this Schedule need to be done separately for the upper soil layer (first 30 centimetres) and the entire soil profile (0-*x* centimetres). Data on the upper soil layer is included in offsets reporting to help Australia report its removals of greenhouse gases in its National Inventory Report.

A project proponent who uses this Schedule to calculate the amount of change in soil organic carbon for a CEA in a project area of a project for a reporting period, can change at any time to using the hybrid approach set out in Schedule 2 to calculate that amount for the CEA for a subsequent reporting period.

However, if the hybrid approach is used to calculate that amount for a CEA of a project for a reporting period, then the measurement-only approach in this Schedule cannot be used to calculate that amount for the CEA for any subsequent reporting period. However, this still allows the measurement-based approach under Schedule 2 to be used.

2 Definitions

In this Schedule:

0–30 cm layer of soil, means the soil layer measured from the soil surface to a soil depth of 30 centimetres.

0–x cm layer of soil, means the soil layer measured from the soil surface to a soil depth greater than 30 centimetres referred to as *x*.

30–x cm layer of soil, means the soil layer measured from the lower end of the 0-30 cm layer of the soil to the lower end of the 0-*x* cm layer of the soil.

composite sample—see section 3(1)(b) of this Schedule.

ESM—see section 12 of this Schedule.

fine earth means soil material having a particle size ≤ 2 mm.

gravel means soil material having a particle size > 2 mm.

layer means a 0-30 cm layer, 30-*x* cm layer or a 0-*x* cm layer.

sample—see section 3 of this Schedule.

stratum means an area in a carbon estimation area.

sub-layer means a depth of soil within a layer that is less than the layer.

Note: The 0-30 cm and 30-x cm layers of a sample will be sublayers of the 0-x cm layer of the sample.

$\boldsymbol{SOC_{CEA}}$—see paragraph 10(a) of this Schedule.

$\boldsymbol{SOC_i}$—see subsection 11 of this Schedule.

$\boldsymbol{V(SOC_{CEA})}$—see paragraph 10(b) of this Schedule.

whole soil means all material contained within a soil layer including gravel and fine earth.

3 What is a sample?

(1) In this Schedule a ***sample*** may be:

(a) an individual sample taken from a particular location; or

(b) a composite sample (***composite sample***) which combines samples taken from a number of locations into a single sample consistent with any requirements in the Supplement.

(2) A sample must be obtained and analysed consistent with the requirements in Division 2 of this Schedule.

Division 2—Operation of a soil carbon project using a measurement-only approach under this Schedule

4 Steps involved in accounting for a soil carbon project

(1) For each area of land included as part of a project area for a soil carbon project:
  (a) the land must be mapped according to section 5 of this Schedule; and
  (b) a baseline sampling round must be conducted for each CEA:
    (i) if the land is included in the project area when the section 27 declaration of the project is made—before the end of the first reporting period for the project; or
    (ii) if the land is included in the project area as the result of a section 29 application for the project—before the end of the first reporting period for the project during which the land is included in the project area; and
  (c) at least one subsequent sampling round must occur not later than every 5 years after the previous sampling round for each CEA for the duration of the crediting period for the project.

    Note: Sampling is not conducted on exclusion areas or emissions accounting areas.

(2) A subsequent sampling round is not required to be conducted for a CEA of a transferring project during the reporting period for which the project proponent may submit a transitional offsets report for the project.

(3) In this section, ***transitional offsets report*** means a transitional offsets report under section 68A of the CFI Rule.

(4) For each sampling round conducted for a CEA, the CEA must be divided into strata consistent with any requirements in the Supplement.

(5) For each reporting period for the project, all CEAs that have completed subsequent sampling rounds must be included in the net abatement calculations.

(6) Unless the Regulator agrees in writing that exceptional circumstances exist, a sampling round must meet any timing requirements specified in the Supplement.

  Note: Exceptional circumstances may include poor weather conditions that inhibit site access or where the soil moisture is unsuitable for sampling at the planned time.

5 Carbon estimation areas (CEAs), exclusion areas and emissions accounting areas

(1) The project proponent must map land within a project area for the project into one or more ***carbon estimation areas*** (CEAs) such that:
  (a) all the land in each CEA:
    (i) is eligible land; and
    (ii) is subject to the carrying out or maintenance of at least one eligible management activity until the end of the permanence obligation period for the project; and
    (iii) is within a single State or Territory; and
    (iv) has identical responsible landholders; and
  (b) if the project was declared as an eligible offsets project after 1 September 2020—the mapping is completed, and provided to the Regulator as required by the Supplement, prior to each baseline sampling round for each CEA.

(2) The project proponent may map non-contiguous parts of a project area as a single CEA, where the furthest boundaries of non-contiguous areas do not exceed 10 kilometres in distance from each other within a singular CEA.

(3) The boundaries of a CEA may be revised only to merge and split existing CEAs in accordance with requirements in the Supplement.

Note: If the boundaries of a CEA are revised, baseline emissions and baseline soil organic carbon stocks may need to be recalculated.

(4) The project proponent must not remove project areas which would remove part of a CEA, unless such removal is provided for in, and meets the requirements of, the Supplement.

(5) The project proponent may map other land within the project area for the project into one or more ***exclusion areas*** such that:

(a) no land management or agricultural activities are to be conducted in the area; and

(b) none of the land is included in a CEA.

Note: Exclusion areas would generally be dwellings, roads, dams or other infrastructure.

(6) Any part of the project area which is neither a CEA nor an exclusion area is an ***emissions accounting area.***

Note: The soil organic carbon stock change of an emissions accounting area is not included in the net abatement amount, but emissions from these areas are included in the net abatement amount calculations. Emissions accounting areas are likely to include agricultural land which is not suitable or conducive to sampling (such as rocky outcrops) and densely forested land where land management activities are not applied.

(7) Subsections (8), (9) and (10) apply to a CEA that:

(a) has been mapped in accordance with this section; and

(b) includes land that is not eligible, or has ceased to be eligible, because it does not satisfy paragraph 9(1)(b) of this determination (dwelling or structures); and

(c) has not been removed from the project area of the project.

(8) Despite subparagraph (1)(a)(i), ineligible land may remain in a CEA if:

(a) less than the smaller of 1% or 5 hectares of the area of the CEA is covered by dwellings or other structures; or

(b) the Regulator determines, in accordance with subsection (10), that the land can continue to remain in the CEA.

Note: CEAs must not contain dwelling or structures at the time of stratification, however land may remain in the CEA if dwellings or other structures are constructed on it after stratification in accordance with this subsection.

(9) If subsection (8) does not apply, land in CEAs that is ineligible land must be removed from the project area.

(10) The Regulator may determine that land can continue to be mapped as a CEA if:

(a) the Regulator has consulted with the project proponent about making such a determination; and

(b) the continued mapping of the CEA is unlikely to result in the crediting of non-genuine carbon abatement; and

(c) the Regulator considers that the continued mapping of the CEA is appropriate, having regard to all the circumstances.

(11) Subsection (12) applies to a CEA that:

(a) has been mapped in accordance with this section; and

(b) includes land that is not eligible, or has ceased to be eligible, because it does not satisfy paragraph 9(2)(a) of this determination.

(12) The project proponent must remove the CEA from the project area.

(13) The mapping of each CEA, exclusion area or emissions accounting area must be done in accordance with the Supplement.

6 Sampling design

(1) Each sampling round must involve, consistent with any requirements in the Supplement:
  (a) the division of each CEA into at least three strata; and
  (b) taking at least three samples in each stratum.

(2) The sampling design must meet any requirements included in the Supplement.

(3) For each sampling round, the project proponent must submit to the Regulator, prior to undertaking any sampling, a sampling plan for each CEA meeting any requirements included in the Supplement.

7 Sampling

(1) The nominated soil depth for a CEA:
  (a) must be 30 centimetres; and
  (b) must be greater than 30 centimetres where required by subsection 9(2)(b) of this Schedule or the Supplement; and
  (c) may be greater than 30 centimetres where this meets any requirements in the Supplement
  (d) must be consistent across the CEA.

(2) The sampling undertaken must:
  (a) aim to achieve:
    (i) for a sampling round after the baseline sampling round, the equivalent soil mass for the CEA as used for the previous sampling round; and
    (ii) the depth of soil disturbed by management activities (consistent with paragraph 9(2)(b)(i) of this Schedule) plus 10 centimetres; and
    (iii) depths consistent with the requirements in the Supplement; and

    Note: Bedrock or impenetrable layers may prevent a sample from achieving its nominated soil depth.

  (b) if the sampling undertaken achieves a depth greater than 30 centimetres—obtain and analyse separate information for the 0–30 cm layer of the soil and the soil at depth greater than 30 centimetres (which may include sub-layer analysis); and
  (c) be undertaken by an independent person who:
    (i) has experience in the collection of soil samples; and
    (ii) has a good understanding of the sampling requirements of this determination and the Supplement; and
    (iii) has no financial interest in the soil carbon project; and
    (iv) did not prepare or review the land management strategy for the project; and
    (v) meets any requirements included in the Supplement; and

Note 1: Being paid to undertake the sampling would not involve a breach of subparagraph (iii).

Note 2: See also the requirement in paragraph 32(1)(k) for the offsets report to include a written statement from the independent person.

(d) take into account any recommendations in the Supplement; and
(e) meet any requirements included in the Supplement.

8 Sample analysis

(1) The preparation of a soil sample and analysis of the soil sample must:
(a) meet any requirements included in the Supplement; and
(b) take into account any recommendations in the Supplement.

(2) The preparation of a soil sample must be undertaken by an independent person who meets the requirements set out in subparagraphs 7(2)(c)(ii) to (iv) of this Schedule.

Note: Being paid to undertake sampling preparation would not involve a breach of subsection (2).

Division 3—Working out the change in soil organic carbon stock for a CEA

9 Working out the change in soil organic carbon stock for a CEA

(1) If, pursuant to section 15 of this determination, the change in soil organic carbon stock for a reporting period for a CEA with a specified probability of exceedance is worked out using Schedule 1, then that change must be worked out using equation 69.

(2) In working out the change in soil organic carbon stock for a reporting period for a CEA with a specified probability of exceedance:

(a) both Divisions 4 and 5 of this Schedule must be applied to the 0-30 cm layer of a sample from the CEA; and

(b) both Divisions 4 and 5 of this Schedule must be applied to both the 0-30 cm and 0-*x* cm layers of the samples from the CEA if:

(i) land management activities disturb the soil deeper than 20 centimetres (where *x* must equal or exceed the depth of disturbance plus 10 centimetres); or

(ii) the project proponent elects to account for soil organic carbon changes for the 0-*x* cm layer of the samples from the CEA; or

(iii) after applying an estimate under equation 69 to the 0-x cm layer, the corresponding change in soil organic carbon stock in the 30-*x* cm layer in the CEA calculated is negative as determined by subsection (3); and

Note: Project proponents may elect to sample and account for changes in the 30-x cm layer, unless they are required to account for it under the circumstances listed in paragraph (2)(b). Accounting for the 30-*x* cm layer can make it more difficult to detect changes in the 0-30 cm layer due to potentially slower rates of change in the deeper layer and the effect of baseline carbon stocks on the standard error terms in equation 69. This subsection allows the 30-*x* cm layer to be monitored for soil organic carbon increases but accounting to occur just for the 0-30 cm layer, unless negative changes occur in the 30-*x* cm layer which then requires the 30-*x* cm layer to be included in accounting to prevent over-crediting.

(c) if Divisions 4 and 5 of this Schedule are applied to the 0-*x* cm layer of a sample from the CEA—the change in organic in soil organic carbon stock for a CEA for equation 69 is deemed to be the value for the 0-*x* cm layer of the sample, not the 0-30 cm layer.

Note: Crediting is based on the whole soil profile (0-*x* cm layer). Crediting can be based on only the 0-30 cm layer if permitted by this section. This is intended to allow results of the 30-*x* cm layer to only contribute to crediting once changes are observed in the layer. Reporting of 0-30 cm results is required, even if it does not impact crediting, to inform the national inventory.

(3) For the purposes of subparagraph (2)(b)(iii), the change in soil organic carbon stock in the 30-*x* cm layer of a sample from a CEA for a reporting period is taken to be negative if the change in that layer ($\Delta SOC_{PoE,CEA(t_0 - t_x),30-xcm}$) calculated in accordance with the following equation has a value less than 0:

$$\Delta SOC_{PoE,CEA(t_0 - t_x),30-xcm} = \left(\Delta SOC_{CEA\,(t_0 - t_x),0-xcm} + SE_{CEA(t_0-t_x)0-xcm} \times t_{\alpha(df)(0-xcm)}\right) - \left(\Delta SOC_{CEA\,(t_0 - t_x),0-30cm} + SE_{CEA(t_0-t_x)0-30cm} \times t_{\alpha(df)(0-30cm)}\right) \quad \text{equation 49}$$

where:

$\Delta \boldsymbol{SOC}_{\boldsymbol{CEA}\,(\boldsymbol{t_0 - t_x}),\boldsymbol{0-xcm}}$ is the change in soil organic carbon stock for the CEA for the reporting period between the baseline sampling round t_0 in the CEA and the last subsequent sampling round t_x in the reporting period, for the 0-*x* cm layer, worked out using equation 64.

$\boldsymbol{SE}_{CEA(t_0 - t_x)\boldsymbol{0-xcm}}$ is the standard error of the mean difference (the SE) between total soil organic carbon stock for the CEA between the baseline sampling round t_0 in the CEA and the last subsequent sampling round t_x in the CEA in the reporting period, in tonnes of soil organic carbon, for the 0-*x* cm layer, worked out using equation 65.

$\boldsymbol{t}_{\boldsymbol{\alpha(df)(0-xcm)}}$ is the value of the quantile function (inverse distribution function) for the t-distribution with the value for alpha ($\boldsymbol{\alpha}$) set out in the Supplement and the value for the degrees of freedom, $\boldsymbol{df}$ for the 0-*x* cm layer worked out using equation 66.

Note: The value of $\boldsymbol{t}_{\boldsymbol{\alpha(df)(0-xcm)}}$ should be negative.

$\Delta \boldsymbol{SOC}_{\boldsymbol{CEA}\,(\boldsymbol{t_0 - t_x}),\boldsymbol{0-30cm}}$ is the change in soil organic carbon stock for the CEA for the reporting period between the baseline sampling round t_0 in the CEA and the subsequent sampling round t_x in the reporting period, for the 0-30 cm layer, worked out using equation 64.

$\boldsymbol{SE}_{CEA(t_0 - t_x)\boldsymbol{0-30cm}}$ is the standard error of the mean difference (the SE) between total soil organic carbon stock for the CEA between the baseline sampling round t_0 in the CEA and the last subsequent sampling round t_x in the CEA in the reporting period, in tonnes of soil organic carbon, for the 0-30 cm layer, worked out using equation 65.

$\boldsymbol{t}_{\boldsymbol{\alpha(df)(0-30cm)}}$ is the value of the quantile function (inverse distribution function) for the t-distribution with the value for alpha ($\boldsymbol{\alpha}$) set out in the Supplement and the value for the degrees of freedom, $\boldsymbol{df}$ for the 0-30 cm layer worked out using equation 66.

Note: The value of $\boldsymbol{t}_{\boldsymbol{\alpha(df)(0-30cm)}}$ should be negative.

(4) The change in soil organic carbon stock with a specified probability of exceedance for a reporting period for a CEA which has not undergone a subsequent sampling round in the reporting period is zero.

Division 4—Working out the soil organic carbon stock and sampling variance for a CEA

10 Working out the soil organic carbon stock for a CEA and sampling variance

The following parameters must be worked out in accordance with Subdivision 2 or 3 of this Division for each sampling round:

(a) the soil organic carbon stock in a CEA (the $\boldsymbol{SOC_{CEA}}$), in tonnes of soil organic carbon;

(b) the sampling variance of the $\boldsymbol{SOC_{CEA}}$ for a CEA (the $\boldsymbol{V(SOC_{CEA})}$), in (tonnes of soil organic carbon)^2.

Subdivision 1—Working out the soil organic carbon stock in a sample using an equivalent soil mass for a CEA

11 Steps for working out the soil organic carbon stock in a sample

The soil organic carbon stock of sample *i* ($\boldsymbol{SOC_i}$), in tonnes of soil organic carbon per hectare, contained within an individual or composite soil sample must be worked out for each sample taken in a sampling round in accordance with this Division.

12 Determining Equivalent Soil Mass (ESM) from the soil masses derived during the baseline sampling round

(1) The equivalent soil mass (the ***ESM***), in tonnes of oven dry whole soil per hectare, for a CEA must be worked out in accordance with this section and the Supplement based on the samples collected from the CEA during the baseline sampling round.

Note: The Supplement may include provision for sub-layer analysis (analysing carbon stocks at more discrete intervals than 0-30 cm, 0-*x* cm) which allows for the mass of each sample to be adjusted by removing sub-layers from carbon stock estimates to keep soil masses between sample rounds comparable. Restrictions on removal of sub-layers will be subject to requirements such as to continue to account for the soil mass to the depth of any disturbance as per paragraph 9(2)(a) of this Schedule and the Supplement.

(2) Rank from smallest to largest for the CEA the mass of oven dry whole soil in the 0-30 cm or 0-*x* cm layer for the sample ($\boldsymbol{M_a}$) collected during the baseline sampling round, worked out in accordance with any requirements in the Supplement, in tonnes of oven dry whole soil per hectare.

(3) With the ranked samples from subsection (2), assign a sequential rank *k* from 1 for the smallest through to *N* for the largest, where *N* is the total number of samples collected for a CEA in the baseline sampling round.

(4) A percentile *P* must be worked out for each sample *k* using the following equation:

$$P = 100 \times \frac{(k-1)}{(N-1)} \qquad \text{equation 50}$$

where:

$\boldsymbol{k}$ is the value of the sequential rank assigned to a sample from the baseline sampling round under subsection (3).

$\boldsymbol{N}$ is the total number of samples collected from the CEA in the baseline sampling round.

(5) If one of the percentiles worked out by equation 50 for a sample is P_{Supp} —the *ESM* for the CEA is the mass of the layer given by subsection (3) for the relevant rank of *k*, , where P_{Supp} is the percentile value to which ESM is set, specified in the Supplement.

(6) If subsection (5) does not apply—the *ESM* for a CEA is worked out using the following equation:

$$ESM = M_{LB} + (M_{UB} - M_{LB}) \times \left(\frac{P_{Supp} - P_{LB}}{P_{UB} - P_{LB}}\right) \qquad \text{equation 51}$$

where:

$\boldsymbol{M_{LB}}$ is the mass of oven dry whole soil associated with the sample having the value of P worked out using equation 50 closest to and lower than $\boldsymbol{P_{Supp}}$, in tonnes of oven dry whole soil per hectare.

$\boldsymbol{M_{UB}}$ is the mass of oven dry whole soil associated with the sample, having the value of P worked out using equation 50 closest to and higher than $\boldsymbol{P_{Supp}}$, in tonnes of oven dry whole soil per hectare.

$\boldsymbol{P_{Supp}}$ is the percentile P determined in the Supplement.

$\boldsymbol{P_{LB}}$ is the percentile P associated with the sample used for M_{LB}, as a percentile.

$\boldsymbol{P_{UB}}$ is the percentile P associated with the sample used for M_{UB}, as a percentile.

Note: The sample used for M_{LB} is the lower bound *LB* and the sample used for M_{UB} is the upper bound *UB*.

The equivalent soil mass:

- acts as a cap to the mass of soil for which carbon stocks are calculated (both in the baseline and subsequent sampling rounds). Samples in subsequent rounds should target the equivalent soil mass set in the baseline sampling round.
- is intended to be set to the percentile sample weight, as defined in the Supplement, rather than average sample weight, to ensure that the mass is set at a rate that can be expected to be achieved most of the time (everything else being held equal) in subsequent samples. This avoids underestimating carbon stock changes as a result of collecting a mass less than the equivalent soil mass in subsequent sample rounds.
- may need to be recalculated for each layer (0-30 cm, 0-*x* cm) if sub-layers are excluded from calculations (for the purposes of equalising soil masses between sampling rounds) as permitted by the supplement.
- is defined for each 0-30 cm layer 0-*x* cm layer within each CEA in a project.

13 Working out the soil organic carbon stock in each layer

(1) The soil organic carbon stock SOC_i for each soil sample *i* within the 0-30 cm and 0-*x* cm layers, in tonnes of organic carbon per hectare, must be worked out under subsection (2) or (3) based on the relationship between:

(a) the mass of oven dry whole soil collected ($\boldsymbol{M_a}$) for the sample layer (0-30 cm and 0-*x* cm) worked out in accordance with any requirements in the Supplement, in tonnes of oven dry whole soil per hectare; and

(b) the equivalent soil mass (the ***ESM***) defined for the CEA in the baseline sampling round, given by section 12 of this Schedule, in tonnes of oven dry whole soil per hectare.

(2) If $M_a < ESM$, SOC_i is worked out using the following equation:

$$SOC_i = \sum_{sl=1}^{n} SOC_{sl}$$ equation 52

where:

$\boldsymbol{n}$ is the number of sub-layers in the 0-30 cm or 0-*x* cm layers and used to derive M_a (in accordance with any requirements in the Supplement).

Note: The value of n increases with increasing depth such that sub-layer 1 denotes the soil sub-layer including the soil surface and sub-layer n denotes the deepest sub-layer that contributes to equation 52 as required by the Supplement.

$\boldsymbol{sl}$ is the identifier for a soil sub-layer within the 0-30 cm or 0-*x* cm layers.

$\boldsymbol{SOC_{sl}}$ is the soil organic carbon stock in a soil sub-layer determined in accordance with any requirements in the Supplement, in tonnes of soil organic carbon per hectare.

(3) If $M_a \geq ESM$, SOC_i is worked out using the following equation:

$$SOC_i = \left(\sum_{sl=1}^{n-1} SOC_{sl}\right) + SOC_{sl=n} \times \frac{\left(ESM - \sum_{sl=1}^{n-1} M_{sl}\right)}{M_{sl=n}}$$ equation 53

where:

$\boldsymbol{n}$ is the number of sub-layers progressing incrementally down from the soil surface required to produce a value for M_a that is equal to or exceeds the ESM for the CEA given by section 12 of this Schedule, in tonnes of oven dry whole soil per hectare.

Note: The value of n increases with increasing depth such that sub-layer 1 denotes the soil sub-layer including the soil surface and sub-layer n denotes the sub-layer $M_a \geq ESM$.

$\boldsymbol{sl}$ is the identifier for a soil sub-layer within the 0-30 cm or 0-*x* cm layers.

$\boldsymbol{SOC_{sl}}$ is the soil organic carbon stock in a soil sub-layer determined in accordance with any requirements in the Supplement, in tonnes of soil organic carbon per hectare.

$\boldsymbol{\sum_{sl=1}^{n-1} SOC_{sl}}$ is the sum of soil organic carbon stocks in all sub-layers excluding sub-layer n, in tonnes of soil organic carbon per hectare.

$\boldsymbol{SOC_{sl=n}}$ is the soil organic carbon stock in the sub-layer n, in tonnes of soil organic carbon per hectare, determined in accordance with any requirements in the Supplement.

ESM is the equivalent soil mass for the CEA given by section 12 of this Schedule, in tonnes of oven dry whole soil per hectare.

$\boldsymbol{M_{sl}}$ is the oven dry mass of whole soil within a sub-layer, in tonnes of oven dry whole soil per hectare, determined in accordance with any requirements in the Supplement.

$\boldsymbol{\sum_{sl=1}^{n-1} M_{sl}}$ is the sum of the mass of oven dry whole soil in all sub-layers excluding sub-layer n, in tonnes of oven dry soil per hectare.

$\boldsymbol{M_{sl=n}}$ is the mass of oven dry whole soil contained in the soil sub-layer n, in tonnes of oven dry soil per hectare, determined in accordance with any requirements in the Supplement.

Subdivision 2—Working out the soil organic carbon stock and variance for a CEA where both compositing of cores across strata and equal area stratification are used

14 Application of this Subdivision

This subdivision applies to sampling which involves:

(a) compositing of cores across strata for carbon analysis; and

(b) strata that are equal in area within a CEA.

Note: For other sampling designs—see Subdivision 3. Because of these requirements all samples in this Subdivision are composite samples.

15 Mean soil organic carbon stock in a CEA

Work out the mean soil organic carbon stock in the CEA (the $\overline{SOC}_{CEA}$), in tonnes of soil organic carbon per hectare, using the following equation:

$$\overline{SOC}_{CEA} = \frac{\sum_{i=1}^{n} SOC_i}{n} \qquad \text{equation 54}$$

where:

$\boldsymbol{i}$ is an identifier for each composite soil sample collected from the CEA.

$\boldsymbol{n}$ is the total number of composite soil samples collected from the CEA.

$\boldsymbol{SOC_i}$ is the value for SOC_i, in tonnes of soil organic carbon per hectare, worked out using equation 52 or 53 for each sample *i* collected from the CEA.

16 Sampling variance of the mean soil organic carbon stock within a CEA

Work out the sampling variance of the mean soil organic carbon stock in the CEA (the $\boldsymbol{V\left(\overline{SOC}_{CEA}\right)}$) in (tonnes of soil organic carbon per hectare)^2 using the following equation:

$$V\left(\overline{SOC}_{CEA}\right) = \frac{\sum_{i=1}^{n}(SOC_i - \overline{SOC}_{CEA})^2}{n(n-1)} \qquad \text{equation 55}$$

where:

$\boldsymbol{i}$ is an identifier for each composite soil sample collected from the CEA

$\boldsymbol{n}$ is the total number of composite soil samples collected from the CEA.

$\boldsymbol{SOC_i}$ is the soil organic carbon stock for composite soil sample i, in tonnes of soil organic carbon per hectare, worked out using equation 52 or 53.

$\boldsymbol{\overline{SOC}_{CEA}}$ is the mean soil organic carbon stock in the CEA, in tonnes of soil organic carbon per hectare, worked out using equation 54.

17 Total soil organic carbon stock for a CEA

Work out the total soil organic carbon stock in the CEA (the $\boldsymbol{SOC_{CEA}}$), in tonnes of soil organic carbon, using the following equation:

$$SOC_{CEA} = \overline{SOC}_{CEA} \times A_{CEA} \quad \text{equation 56}$$

where:

$\boldsymbol{\overline{SOC}_{CEA}}$ is the mean soil organic carbon stock in the CEA, in tonnes of soil organic carbon per hectare, worked out using equation 54.

$\boldsymbol{A_{CEA}}$ is the area of the CEA, in hectares.

18 Sampling variance of the total soil organic carbon stock for a CEA

Work out the sampling variance of the total soil organic carbon stock within the CEA (the $\boldsymbol{V(SOC_{CEA})}$) in (tonnes of soil organic carbon)^2 using the following equation:

$$V(SOC_{CEA}) = {A_{CEA}}^2 \times V(\overline{SOC}_{CEA}) \quad \text{equation 57}$$

where:

$\boldsymbol{A_{CEA}}$ is the area of the CEA, in hectares.

$\boldsymbol{V\left(\overline{SOC}_{CEA}\right)}$ is the sampling variance of the mean soil organic carbon stock in the CEA worked out using equation 55, in (tonnes of soil organic carbon per hectare)^2.

Subdivision 3—Working out the soil organic carbon stock and sampling variance for a CEA in all circumstances other than when compositing of cores is across equal area strata

19 Application of this Subdivision

This subdivision applies to sampling which:

(a) involves:
  (i) preparation and analysis of soil samples from individual cores; or
  (ii) compositing of cores within strata; or
  (iii) analysis of intact cores; and
(b) comprises strata which are equal or unequal in area across a CEA; and
(c) is not covered by Subdivision 2.

20 Mean soil organic carbon stock in a stratum

Work out the mean soil organic carbon stock for each stratum *h* (the $\overline{\boldsymbol{SOC_h}}$), in the CEA, in tonnes of soil organic carbon per hectare, using the following equation:

$$\overline{SOC}_h = \frac{\sum_{i=1}^{n} SOC_i}{n} \qquad \text{equation 58}$$

where:

$\boldsymbol{i}$ is an identifier for each soil sample collected from the stratum *h*.

$\boldsymbol{n}$ is the number of samples collected from the stratum *h*.

$\boldsymbol{SOC_i}$ is the soil organic carbon stock for each sample *i* from stratum *h*, in tonnes of soil organic carbon per hectare, worked out using equation 52 or 53.

21 Sampling variance of the mean soil organic carbon stock within a stratum

Work out the sampling variance of the mean soil organic carbon for each stratum *h* in the CEA (the $\boldsymbol{V}(\overline{\boldsymbol{SOC_h}})$), in (tonnes of soil organic carbon per hectare)^2, using the following equation:

$$V(\overline{SOC}_h) = \frac{\sum_{i=1}^{n}(SOC_i - \overline{SOC}_h)^2}{n(n-1)} \qquad \text{equation 59}$$

where:

$\boldsymbol{i}$ is an identifier for each sample collected from the stratum *h*.

$\boldsymbol{n}$ is the number of samples collected from the stratum *h*.

$\boldsymbol{SOC_i}$ is the soil organic carbon stock for each sample *i* from stratum *h*, in tonnes of soil organic carbon per hectare, worked out using equation 52 or 53.

$\overline{\boldsymbol{SOC_h}}$ is the mean soil organic carbon stock in the stratum *h*, in tonnes of soil organic carbon per hectare, worked out using equation 58.

22 Mean soil organic carbon stock in a CEA

Work out the mean soil organic carbon stock in the CEA (the $\overline{\boldsymbol{SOC_{CEA}}}$), in tonnes of soil organic carbon per hectare, using the following equation:

$$\overline{SOC}_{CEA} = \sum_{h=1}^{H}(a_h \times \overline{SOC}_h) \qquad \text{equation 60}$$

where:

$\boldsymbol{h}$ is an identifier for the stratum.

$\boldsymbol{H}$ is the number of strata for the CEA.

$\boldsymbol{a_h}$ is the relative area of the CEA covered by stratum *h* in the CEA, expressed as a proportion of the total CEA area.

$\boldsymbol{\overline{SOC}_h}$ is the mean soil organic carbon stock in the stratum *h*, in tonnes of soil organic carbon per hectare, worked out using equation 58.

23 Sampling variance of the mean soil organic carbon stock within a CEA

Work out the sampling variance of the mean soil organic carbon for the CEA (the $\boldsymbol{V(\overline{SOC}_{CEA})}$), in (tonnes of soil organic carbon per hectare)^2, using the following equation:

$$V(\overline{SOC}_{CEA}) = \sum_{h=1}^{H} \left({a_h}^2 \times V(\overline{SOC}_h) \right) \qquad \text{equation 61}$$

where:

$\boldsymbol{h}$ is an identifier for the stratum.

$\boldsymbol{H}$ is the number of strata for the CEA.

$\boldsymbol{a_h}$ is the relative area of the CEA covered by stratum *h* in the CEA, expressed as a proportion of the total CEA.

$\boldsymbol{V(\overline{SOC}_h)}$ is the sampling variance of the mean soil organic carbon for stratum *h*, in (tonnes of soil organic carbon per hectare)^2, worked out using equation 59.

24 Total soil organic carbon stock for a CEA

Work out the total soil organic carbon stock for the CEA (the SOC_{CEA}), in tonnes of soil organic carbon, using the following equation:

$$SOC_{CEA} = \overline{SOC}_{CEA} \times A_{CEA} \qquad \text{equation 62}$$

where:

$\boldsymbol{\overline{SOC}_{CEA}}$ is the mean soil organic carbon stock for the CEA, in tonnes of carbon per hectare, worked out using equation 60.

$\boldsymbol{A_{CEA}}$ is the area of the CEA, in hectares.

25 Sampling variance of the soil organic carbon stock for a CEA

The sampling variance of soil organic carbon stock for the CEA (the $V(SOC_{CEA})$), in (tonnes of soil organic carbon)^2, is worked out using the following equation:

$$V(SOC_{CEA}) = {A_{CEA}}^2 \times V(\overline{SOC}_{CEA})$$

equation 63

where:

$\boldsymbol{A_{CEA}}$ is the total area of the CEA, in hectares.

$\boldsymbol{V(\overline{SOC}_{CEA})}$ is the sampling variance of the mean of the soil organic carbon in the CEA, in (tonnes of soil organic carbon per hectare)^2, worked out using equation 61.

Division 5—Working out the creditable change in soil organic carbon stock for a CEA

26 Working out the creditable change in soil organic carbon stock in a CEA for a reporting period

Subject to subsection 9(4) of this Schedule, the creditable change in soil organic carbon in a CEA with a specified probability of exceedance for a reporting period (the $\Delta \boldsymbol{SOC}_{\boldsymbol{PoE,CEA}\,(\boldsymbol{t_0}-\boldsymbol{t_x})}$), in tonnes of soil organic carbon, must be worked out in accordance with this Division.

27 Change in carbon stock between sampling rounds

Work out the change in soil organic carbon stock for each CEA between the baseline sampling round t_0 and the last subsequent sampling round t_x in the reporting period (the $\Delta \boldsymbol{SOC}_{\boldsymbol{CEA}(\boldsymbol{t_0}-\boldsymbol{t_x})}$), in tonnes of soil organic carbon, using the following equation:

$$\Delta SOC_{CEA(t_0-t_x)} = SOC_{CEA\,t_x} - SOC_{CEA\,t_0} \qquad \text{equation 64}$$

where:

$\boldsymbol{SOC}_{\boldsymbol{CEA}\,\boldsymbol{t_x}}$ is the value for SOC_{CEA} for the CEA in the last subsequent sampling round in the reporting period, in tonnes of soil organic carbon, worked out using equation 56 or 62.

$\boldsymbol{SOC}_{\boldsymbol{CEA}\,\boldsymbol{t_0}}$ is the value for SOC_{CEA} for the CEA in the baseline sampling round, in tonnes of soil organic carbon, worked out using equation 56 or 62.

Note: If the project is a transferring project for which the 2014 methodology determination or the 2018 methodology determination was the applicable methodology determination immediately before this determination became its applicable methodology determination, the original baseline is retained and used for working out $\boldsymbol{SOC}_{\boldsymbol{CEA}\,\boldsymbol{t_0}}$.

28 Standard error for change in soil organic carbon stock

Work out the standard error of the mean difference between total soil organic carbon stock for the CEA between the baseline sampling round t_0 and subsequent sampling round t_x (the $SE_{CEA(t_0-t_x)}$), in tonnes of soil organic carbon, using the following equation:

$$SE_{CEA(t_0-t_x)} = \sqrt{V\left(SOC_{CEA\,t_0}\right) + V\left(SOC_{CEA\,t_x}\right)} \qquad \text{equation 65}$$

where:

$\boldsymbol{V\left(SOC_{CEA\,t_0}\right)}$ is the value for $V(SOC_{CEA})$ for the CEA from the baseline sampling round, in tonnes of soil organic carbon, worked out using equation 57 or 63.

$\boldsymbol{V\left(SOC_{CEA\,t_x}\right)}$ is the value for $V(SOC_{CEA})$ for the CEA from the sampling round subsequent to the baseline sampling round, in tonnes of soil organic carbon, worked out using equation 57 or 63.

29 Degrees of freedom for a CEA between sample rounds

Work out the degrees of freedom (***df***) to use in equation 69 for the CEA between sample rounds, using the following equation:

$$df_{CEA\,t_0-t_x} = \frac{\left(V\left(SOC_{CEA_{t_0}}\right) + V\left(SOC_{CEA_{t_x}}\right)\right)^2}{\left(\frac{V\left(SOC_{CEA_{t_0}}\right)^2}{df_{CEA_{t_0}}} + \frac{V\left(SOC_{CEA_{t_x}}\right)^2}{df_{CEA_{t_x}}}\right)} \qquad \text{equation 66}$$

where:

$\boldsymbol{V\left(SOC_{CEA\,t_0}\right)}$ is the value for $V(SOC_{CEA})$ for the CEA from the baseline sampling round, in (tonnes of soil organic carbon)^2, worked out using equation 57 or 63.

$\boldsymbol{V\left(SOC_{CEA\,t_x}\right)}$ is the value for $V(SOC_{CEA})$ for the CEA from a subsequent sampling round, t_x, in (tonnes of soil organic carbon)^2, worked out using equation 57 or 63.

$\boldsymbol{df_{CEA_{t_0}}}$ is the value for df_{CEA} for the CEA from the baseline sampling round, worked out using equation 67 or 68.

$\boldsymbol{df_{CEA_{t_x}}}$ is the value for df_{CEA} for the CEA from a subsequent sampling round, worked out using equation 67 or 68.

30 Degrees of freedom associated with a sampling round (t_x) for a CEA where composite samples were collected across equal area strata

Where across-strata composite soil samples were collected across equal area strata in a sampling round, work out the degrees of freedom ($\boldsymbol{df_{CEA_{t_x}}}$) to use in equation 66 for a given sampling round, using the following equation:

$$df_{CEA_{t_x}} = \boldsymbol{n_c} - 1 \qquad \text{equation 67}$$

where:

$\boldsymbol{n_c}$ is the number of across-strata composite samples collected from the CEA for the t_x sampling round.

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31 Degrees of freedom associated with a sampling round (t_x) for all other cases

Where individual or within-strata composite samples were used, work out the degrees of freedom ($df_{CEA_{t_x}}$) to use in equation 66 for a given sampling round, using the following equation:

$$df_{CEA_{t_x}} = \frac{\left(\sum_{h=1}^{H} {a_h}^2 \times V(\overline{SOC}_h)\right)^2}{\sum_{h=1}^{H}\left(\frac{\left({a_h}^2 \times V(\overline{SOC}_h)\right)^2}{(n_h - 1)}\right)} \qquad \text{equation 68}$$

where:

h is an identifier for the stratum.

H is the number of strata for the CEA.

a_h is the relative area of the CEA covered by stratum h in the CEA, expressed as a proportion of the total CEA area.

$V(\overline{SOC}_h)$ is the sampling variance of the mean soil organic carbon for each stratum h in the CEA in (tonnes of soil organic carbon per hectare)^2, worked out using equation 59

n_h is the number of samples for each stratum h in the CEA (either within-strata composites samples or individual samples as appropriate).

Note 1: Equation 68 is a simplified equation using the condition that $\frac{{s_{\overline{SOC}_h}}^2}{n_h} = V(\overline{SOC}_h)$. The original version of the equation is: $df_{CEA_{t_x}} = \frac{\left(\sum_{h=1}^{H} {a_h}^2 \times \frac{{s_{\overline{SOC}_h}}^2}{n_h}\right)^2}{\sum_{h=1}^{H}\left(\frac{\left({a_h}^2 \times \frac{{s_{\overline{SOC}_h}}^2}{n_h}\right)^2}{(n_h - 1)}\right)}$

Note 2: Where a CEA contains three strata, equation 68 written in its expanded form, where the subscripts 1, 2, and 3 are used to denote values for stratum 1, stratum 2, and stratum 3, respectively takes the following form:

$$df_{CEA_{t_x}} = \frac{\left({a_1}^2 \times V(\overline{SOC}_1) + {a_2}^2 \times V(\overline{SOC}_2) + {a_3}^2 \times V(\overline{SOC}_3)\right)^2}{\frac{\left({a_1}^2 \times V(\overline{SOC}_1)\right)^2}{(n_1 - 1)} + \frac{\left({a_2}^2 \times V(\overline{SOC}_2)\right)^2}{(n_2 - 1)} + \frac{\left({a_3}^2 \times V(\overline{SOC}_3)\right)^2}{(n_3 - 1)}}$$

32 Change in soil organic carbon stock in the CEA with a specified probability of exceedance for a reporting period

Work out the change in soil organic carbon stock for a CEA for a reporting period between the baseline sampling round and the last subsequent sampling round for the reporting period associated with a specified probability of exceedance (the $\Delta SOC_{PoE,CEA(t_0 - t_x)}$), in tonnes of carbon, using the following equation:

$$\Delta SOC_{PoE,CEA(t_0 - t_x)} = \left(\Delta SOC_{CEA\,(t_0 - t_x)} + SE_{CEA(t_0 - t_x)} \times t_{\alpha(df)}\right) \times (1 - TD) \quad \text{equation 69}$$

where:

$\Delta \boldsymbol{SOC}_{\boldsymbol{CEA}\,(\boldsymbol{t_0 - t_x})}$ is the value for $\Delta SOC_{CEA\,(t_0 - t_x)}$, for the CEA for the reporting period, in tonnes of soil organic carbon, worked out using equation 64.

$\boldsymbol{SE}_{\boldsymbol{CEA}(\boldsymbol{t_0 - t_x})}$ is the value for *SE* for the CEA given by equation 65.

$\boldsymbol{t}_{\boldsymbol{\alpha}(\boldsymbol{df})}$ is the value of the quantile function (inverse distribution function) for the t distribution with the value for alpha ($\boldsymbol{\alpha}$) set out in the Supplement and with the value for the degrees of freedom df worked out using equation 66.

Note: An alpha ($\boldsymbol{\alpha}$) value of 0.4 would give a 60% probability of exceedance.

$\boldsymbol{TD}$ is equal to:

(a) if the calculation occurs for the baseline and first subsequent sampling rounds for the CEA—0.25;

Note: The 0.25 multiplier is a temporary discount to the creditable amount of change in soil organic carbon stock due to the use of only 2 measurements (the effect of climatic influences relative to management-induced changes is assumed to be less influential after three carbon stock estimations and the discount no longer applies). After 3 or more estimations, credits withheld due to the discount will be returned if carbon increases are maintained.

(b) otherwise—zero.

Schedule 2—Hybrid approach to estimating soil organic carbon sequestration

Division 1—Preliminary

1 Simplified outline of this Schedule

This Schedule provides for the calculation of the change in soil organic carbon stocks in a CEA between the last estimation event in the CEA for a reporting period and the first estimation event in the CEA, with a specified probability of exceedance, in tonnes of soil organic carbon for a CEA in the project area ($\Delta \boldsymbol{SOC}_{\boldsymbol{CEA_i}}$) for the purpose of section 25 of this determination. An estimation event represents a point in time for which carbon stocks in a CEA are estimated using sampling, modelling or a combination of the two estimation approaches.

Division 2 provides that for a CEA, soil organic carbon stock estimates must be provided at each estimation event, which, except for the first estimation event, must occur not less than one year and not more than five years after the last estimation event. Additionally, sampling in the CEA must occur such that the first estimation event is measurement-based or model-assisted, and that subsequent sampling must occur at least once every 10 years to validate modelled estimates.

Division 3 outlines the approach to working out soil organic carbon stocks for the 0-30 cm and 0-*x* cm layers. Data on the 0-30 cm layer is included in offsets reports to help Australia report its removals of greenhouse gases in its National Inventory Report.

Division 4 sets the Equivalent Soil Mass for a CEA for which the carbon stocks are compared over time from the first estimation event.

The mean and variance of the carbon stock for the equivalent soil mass, is worked out for a CEA for each estimation event, in tonnes CO_2-e. For this purpose, project proponents can either use:

- measurement-based estimates from soil core samples (Subdivision 2 of Division 4), using only the samples taken from the CEA for that estimation event;

- model-only estimates (Subdivision 3 of Division 4) that have been validated in other CEAs in accordance with the requirements of the Supplement; or

- model-assisted estimates (Subdivision 4 of Division 4), that use modelled estimates in conjunction with measured estimates from model-validation samples collected within the CEA after the modelled estimates have been provided to the Regulator. The model-validation sampling also allows model statistics to be worked out (under Subdivision 4 of Division 4) for the purposes of informing model-only estimates in other CEAs in accordance with the process set out in the Supplement.

Division 5 sets out that change in soil organic carbon in a CEA for a reporting period must be worked out between the first estimation event in the CEA and the last estimation event in the reporting period for a CEA. The difference is conservatively estimated by applying a specified probability of exceedance estimation based on the difference

between the mean of the soil organic carbon stock at the first estimation event and the mean of the soil organic carbon stock at the last estimation event in the reporting period. The probability of exceedance approach uses the variance of each estimate and its degrees of freedom (based on the number of samples taken), and a statistical confidence level set out in the Supplement (alpha value for the students t-test) to ensure the estimate of the change that has occurred in the CEA is conservative.

If a project proponent uses model-only or model-assisted estimates to calculate the change in soil organic carbon stock for a CEA for a reporting period, then Schedule 1 cannot be used to calculate that amount for the CEA for any subsequent reporting period.

2 Definitions

In this Schedule:

0–30 cm layer of soil means the soil layer measured from the soil surface to a soil depth of 30 centimetres.

0–x cm layer of soil means the soil layer measured from the soil surface to a soil depth greater than 30 centimetres referred to as *x*.

30–x cm layer, of soil, means the soil layer measured from the lower end of the 0-30 cm layer of the soil to the lower end of the 0-*x* cm layer of the soil.

calibration sample—see section 3(4) of this Schedule.

composite sample—see section 3 of this Schedule.

ESM—see section 13 of this Schedule.

estimation event is a point in time for which carbon stocks are estimated in a CEA in accordance with section 5 of this Schedule.

first estimation event, is the first estimation event for a CEA that occurred in accordance with paragraph 5(2)(a) of this Schedule.

fine earth means soil material having a particle size ≤ 2 mm.

gravel means soil material having a particle size > 2 mm.

last estimation event, for a CEA, is the last estimation event for the CEA in a reporting period which is covered in the offsets report for that reporting period.

layer means a 0-30 cm layer, 30-*x* cm layer or a 0-*x* cm layer.

modelled carbon stock estimate is:

(a) a model-only estimate of carbon stocks for a CEA for a time that corresponds, as closely as required by the Supplement, with an estimation event; and

(b) in the form of a geospatial file for the CEA (or multiple applicable CEAs) that meets the requirements of the Supplement; and

(c) provides at least three geospatially distinct estimates of carbon stocks (in tonnes of soil organic carbon per hectare) within each stratum in the CEA for as many layers (or sublayers) as nominated, or required, under section 10 of this Schedule, and a specification of the oven dry whole soil mass for each carbon stock, to enable validation of the model and estimation of variance in accordance with Division 4 of this Schedule.

model-validation sample—see section 3 of this Schedule.

sample—see section 3 of this Schedule.

sampling round—see section 7 of this Schedule.

stratum means an area in a carbon estimation area.

sub-layer means a depth of soil within a layer that is less than the layer.

Note: The 0-30 cm layer and 30-x cm layers of a sample will be sub-layers of the 0-x cm layer of the sample.

$\boldsymbol{SOC_{CEA}}$—see section 11 of this Schedule.

validated model carbon stock estimate is a modelled carbon stock estimate that meets the validation requirements set out in the Supplement and based on which of the following variables have been calculated:

(a) extrapolated bias of the model given by the Supplement, in tonnes of soil organic carbon per hectare;

(b) fraction of variance given by the Supplement, in tonnes of soil organic carbon per hectare;

(c) the correlation coefficient given by the Supplement.

$\boldsymbol{SV(SOC_{CEA})}$—see section 12 of this Schedule.

whole soil means all material contained within a soil layer including both gravel and fine earth.

3 What is a sample?

(1) In this Schedule a ***sample*** may be:

(a) an individual sample taken from a particular location; or

(b) a composite sample (***composite sample***) which combines samples taken from a number of locations into a single sample consistent with any requirements in the Supplement.

(2) A sample must be obtained and analysed consistent with the requirements in Division 2 of this Schedule.

(3) In this Schedule a ***model-validation sample*** is a sample that is:

(a) an individual sample taken from a particular location; and

(b) not a composite sample; and

(c) collected after a modelled carbon stock estimate is provided to the Regulator for an estimation event in the relevant CEA consistent with any requirements in the Supplement.

(4) In this Schedule a ***calibration sample*** is a sample that is collected before a modelled carbon stock estimate is provided to the Regulator for the relevant CEA consistent with any requirements in the Supplement.

Note: This definition is not intended to limit the data collected for the purposes of calibrating models but only what data can also feed into calculating abatement.

Division 2—Operation of a soil carbon project under this Schedule

Subdivision 1—Operation of Division

4 Operation of a soil carbon project

Where this Schedule has been applied to a CEA that is part of an eligible offsets project for an estimation event, the project must be operated in accordance with this Schedule for the relevant CEA for the duration of the project's crediting period.

Note: This Schedule allows measurement-based, model-only and model-assisted estimation of soil organic carbon stocks.

Subdivision 2—Project accounting

5 Steps involved in accounting for a soil carbon project

(1) For each area of land included as part of a project area for a soil carbon project, the land must be mapped according to section 6 of this Schedule.

(2) The following must occur, for each CEA:

(a) a first estimation event, involving:

(i) a sampling round (the baseline sampling round) in the CEA; and

(ii) for the CEA, an estimate of soil organic carbon stock under either Subdivision 1 of Division 4 of this Schedule as required by subsection 14(3) of this Schedule or Subdivision 4 of Division 4 of this Schedule as required by subsection 14(5) of this Schedule,

that must occur:

(iii) if the CEA is part of the project area of the project when the section 27 declaration for the project is made—before the end of the first reporting period for the project; or

(iv) if the CEA or any land in it is included in the project area as the result of a section 29 application—before the end of the first reporting period for the project during which the land is included in the project area; and

(b) for the duration of the crediting period for the project, at least one subsequent estimation event, involving:

(i) a sampling round in the CEA; and

(ii) for the CEA, an estimate of soil organic carbon stock under either Subdivision 1 of Division 4 of this Schedule as required by subsection 14(3) of this Schedule or Subdivisions 1 and 3 of Division 4 of this Schedule as required by subsection 14(5) of this Schedule,

that must occur not later than every 10 years after the previous estimation event for the CEA that meets the requirements of this subsection; and

(c) for the duration of the crediting period for the project, at least one subsequent estimation event, involving for the CEA, an estimate of soil organic carbon under Subdivisions 1, 2 or 3 of Division 4 of this Schedule as required, respectively, by subsections 14(3), 14(4) or 14(5) of this Schedule, that must occur not less than 1 year and not later than every 5 years after the previous estimation event for the CEA.

Note 1: The application of subsection 14(3) of this Schedule results in measurement-based estimates. The application of subsection 14(4) results in model-only estimates and subsection 14(5) results in model-assisted estimates (models with sampling).

Note 2: Sampling is not conducted on exclusion areas or emissions accounting areas.

(3) Unless the Regulator agrees in writing that exceptional circumstances exist, an estimation event must meet any timing requirements specified in the Supplement.

Note: Exceptional circumstances may include poor weather conditions that inhibit site access or where the soil moisture is unsuitable for sampling at the planned time.

(4) For each reporting period for the project, all CEAs for which an estimation event (other than the first estimation event) has been completed to determine an estimate of soil organic carbon in those CEAs under Subdivisions 1, 2 or 3 of Division 4 of this Schedule as required, respectively, by subsections 14(3), 14(4) or 14(5) of this Schedule, must be included in the net abatement calculations.

(5) For each estimation event conducted for a CEA, the CEA must be divided into strata consistent with any requirements in the Supplement.

6 Carbon estimation areas (CEAs), exclusion areas and emissions accounting areas

(1) The project proponent must map land within a project area for the project into one or more ***carbon estimation areas*** (CEAs) such that:

(a) all the land in each CEA:

(i) is eligible land; and

(ii) is subject to the carrying out or maintenance of at least one eligible management activity until the end of the permanence obligation period for the project; and

(iii) is within a single State or Territory; and

(iv) has identical responsible landholders; and

(b) if the project was declared as an eligible offsets project after 1 September 2020—the mapping is completed, and provided to the Regulator as required by the Supplement, prior to each first estimation event for each CEA.

(2) The project proponent may map non-contiguous parts of a project area as a single CEA, where the furthest boundaries of non-contiguous areas do not exceed 10 kilometres in distance from each other within a singular CEA.

(3) The boundaries of a CEA may be revised only to merge and split existing CEAs in accordance with requirements in the Supplement.

Note: If the boundaries of a CEA are revised, baseline emissions and baseline soil organic carbon stocks may need to be recalculated.

(4) The project must not remove project areas which would remove part of a CEA rather than the entire CEA unless such a removal is provided for in, and meets the requirements of the Supplement.

(5) The project proponent may map other land within the project area for the project into one or more ***exclusion areas*** such that:

(a) no land management or agricultural activities are to be conducted in the area; and

(b) none of the land is included in a CEA.

Note: Exclusion areas would generally be dwellings, roads, dams or other infrastructure.

(6) Any part of the project area which is neither a CEA nor an exclusion area is an ***emissions accounting area.***

Note: The soil organic carbon stock change of an emissions accounting area is not included in the net abatement amount, but emissions from these areas are included in the net abatement amount

calculations. Emissions accounting areas are likely to include agricultural land which is not suitable or conducive to sampling (such as rocky outcrops) and densely forested land where land management activities are not applied.

(7) Subsections (8), (9) and (10) apply to a CEA that:
  (a) has been mapped in accordance with this section; and
  (b) includes land that is not eligible, or has ceased to be eligible, because it does not satisfy paragraph 9(1)(b) of this determination (dwelling or structures); and
  (c) has not been removed from the project area of the project.

(8) Despite subparagraph (1)(a)(i), ineligible land may remain in a CEA if:
  (a) less than the smaller of 1% or 5 hectares of the area of the CEA is covered by dwellings or other structures; or
  (b) the Regulator determines, in accordance with subsection (10), that the land can continue to remain in the CEA.

Note: CEAs must not contain dwelling or structures at the time of stratification, however land may remain in the CEA if dwellings or other structures are constructed on it after stratification in accordance with subsection (8).

(9) If subsection (8) does not apply, land in CEAs that is ineligible land must be removed from the project area.

(10) The Regulator may determine that land can continue to be mapped as a CEA if:
  (a) the Regulator has consulted with the project proponent about making such a determination; and
  (b) the continued mapping of the CEA is unlikely to result in the crediting of non-genuine carbon abatement; and
  (c) the Regulator considers that the continued mapping of the CEA is appropriate, having regard to all the circumstances.

(11) Subsection (12) applies to a CEA that:
  (a) has been mapped in accordance with this section; and
  (b) includes land that is not eligible, or has ceased to be eligible, because it does not satisfy paragraph 9(2)(a) of this determination.

(12) The project proponent must remove the CEA from the project area.

(13) The mapping of each CEA, exclusion area or emissions accounting area must be done in accordance with the Supplement.

7 Sampling design

(1) Each estimation event must involve, consistent with any requirements in the Supplement:
  (a) the division of each CEA into at least three strata; and
  (b) taking at least three samples in each stratum where a sampling round is required under subsection 5(2).

(2) The sampling design must meet any requirements included in the Supplement.

(3) For each sampling round, the project proponent must submit to the Regulator, prior to undertaking any sampling, a sampling plan, meeting any requirements included in the Supplement.

8 Sampling

(1) The nominated soil depth for the baseline sampling round in a CEA:
  (a) must be 30 centimetres; and
  (b) must be greater than 30 centimetres where required by section 10(2)(b) of this Schedule, or the Supplement; and
  (c) may be greater than 30 centimetres where this meets any requirements in the Supplement; and
  (d) must be consistent across the CEA.

(2) The sampling undertaken must:
  (a) aim to achieve:
    (i) for an estimation event after the first estimation event—the equivalent soil mass for the CEA as used for the previous estimation event; and
    (ii) the depth of soil disturbed by management activities (consistent with section 10(2)(b)(ii) of this Schedule) plus 10 centimetres; and
    (iii) depths consistent with any requirements in the Supplement; and

    Note: Bedrock or impenetrable layers may prevent a sample from achieving its nominated soil depth.

  (b) if the sampling undertaken achieves a depth greater than 30 centimetres—obtain and analyse separate information for the 0-30 cm layer of the soil and the soil at depth greater than 30 centimetres (which may include sub-layer analysis); and
  (c) be undertaken by an independent person who:
    (i) has experience in the collection of soil samples; and
    (ii) has a good understanding of the sampling requirements of this determination and the Supplement; and
    (iii) has no financial interest in the soil carbon project; and
    (iv) did not prepare or review the land management strategy for the project; and
    (v) meets any requirements included in the Supplement; and

  Note : Being paid to undertake the sampling would not involve a breach of subparagraph (iii).

  (d) take into account any recommendations in the Supplement; and
  (e) meet any requirements included in the Supplement.

9 Sample analysis

(1) The preparation of a soil sample and analysis of the soil sample must:
  (a) meet any requirements included in the Supplement; and
  (b) take into account any recommendations in the Supplement.

(2) The preparation of a soil sample must be undertaken by a person who meets the requirements set out in subparagraphs 8(2)(c)(ii) to (iv) of this Schedule.

  Note: Being paid to undertake sampling preparation would not involve a breach of subsection (2).

Division 3—Working out the change in soil organic carbon stock for a CEA

10 Working out the change in soil organic carbon stock for a CEA

(1) If, pursuant to section 15 of this determination, the change in soil organic carbon stock for a reporting period for a CEA with a specified probability of exceedance is worked out using Schedule 2, then that change must be worked out using equation 116.

(2) In working out the change in soil organic carbon stock for a reporting period for a CEA with a specified probability of exceedance:

(a) for the 0-30 cm layer of the CEA, Division 4 of this Schedule must be applied to the first estimation event in the CEA and the last estimation event (that is not the first estimation event) in the reporting period, with Division 5 of this Schedule used to calculate the difference between the two estimation events; and

(b) for the 0-30 cm layers and 0-x cm layers of the CEA, Division 4 of this Schedule must be applied to the first estimation event in the CEA and the last estimation event (that is not the first estimation event) in the reporting period, with Division 5 of this Schedule used to calculate the difference between the two estimation events:

(i) if the project proponent elects to account for soil organic carbon changes for the 0-*x* cm layer of the estimation for the CEA; or

(ii) if land management activities disturb the soil deeper than 20 centimetres (where *x* must equal or exceed the depth of disturbance plus 10 centimetres); or

(iii) if an estimate under equation 116 were to be applied to the 0-x cm layer, and the corresponding change in soil organic carbon stock in the 30-*x* cm layer in the CEA calculated is negative as determined by subsection (3); and

Note: This subsection allows participants to elect to estimate and account for changes in the 30-x cm layer – unless they are required to account for it under the circumstances listed in paragraph (2)(b). Accounting for the 30-x cm layer can make it more difficult to detect changes in the 0-30 cm layer due to potentially slower rates of change in the deeper layer and the effect of baseline soil organic carbon stocks on the standard error terms in equation 116. The purpose of this subsection is to allow the 30-*x* cm layer to be monitored for soil organic carbon increases but accounting to occur just for the 0-30 cm layer, unless negative changes occur in the 30-*x* cm layer which then requires the 30-*x* cm layer to be included in accounting to prevent over crediting.

(c) if Divisions 4 and 5 of this Schedule are applied to the 0-x cm layer of the estimation for the CEA—the change in organic in soil organic carbon stock for a CEA for equation 116 is deemed to be the value for the 0-x cm layer, not the 0-30 cm layer.

Note: Crediting is based on the whole soil profile (0-x cm layer). However, crediting can be based on only the 0-30 cm layer if permitted by this section. Results of the 30-x cm layer contribute to crediting once changes are observed in the layer. Reporting of results in the 0-30 cm layer is required, even if it does not impact crediting, to inform the national inventory.

(3) For the purposes of subparagraph (2)(b)(iii), the change in soil organic carbon stock in the 30-x cm layer for a reporting period is taken to be negative if the change in that layer ($\Delta SOC_{PoE,CEA(t_0 - t_x),30-xcm}$) worked out in accordance with the following equation has a value less than 0:

$$\Delta SOC_{PoE,CEA(t_0 - t_x),30-xcm} = \left(\Delta SOC_{CEA\,(t_0 - t_x),0-xcm} + SE_{0-xcm} \times t_{\alpha(df)(0-xcm)}\right) - \left(\Delta SOC_{CEA\,(t_0 - t_x),0-30cm} + SE_{0-30cm} \times t_{\alpha(df)(0-30cm)}\right)$$ equation 70

where:

$\Delta \boldsymbol{SOC}_{\boldsymbol{CEA}\,(\boldsymbol{t_0}-\boldsymbol{t_x}),\boldsymbol{0-xcm}}$ is the change in soil organic carbon stock for the CEA for the reporting period between the first estimation event t_0 for the CEA and the last estimation event t_x for the CEA in the reporting period, for the 0-*x* cm layer, worked out using equation 113.

$\boldsymbol{SE}_{\boldsymbol{0-xcm}}$ is the standard error of the mean difference (the SE) between total soil organic carbon stock for the CEA between the first estimation event t_0 for the CEA and the last estimation event t_x for the CEA in the reporting period, in tonnes of soil organic carbon, for the 0-*x* cm layer, worked out using equation 114.

$\boldsymbol{t}_{\boldsymbol{\alpha(df)(0-xcm)}}$ is the value of the quantile function (inverse distribution function) for the t-distribution with the value for alpha ($\boldsymbol{\alpha}$) set out in the Supplement and the value for the degrees of freedom, $\boldsymbol{df}$ for the 0-x cm layer worked out using equation 115.

Note: The value should be negative.

$\Delta \boldsymbol{SOC}_{\boldsymbol{CEA}\,(\boldsymbol{t_0}-\boldsymbol{t_x}),\boldsymbol{0-30cm}}$ is the change in soil organic carbon stock for the CEA for the reporting period between the first estimation event t_0 for the CEA and the last estimation event t_x for the CEA in the reporting period, for the 0-30 cm layer, worked out using equation 113.

$\boldsymbol{SE}_{\boldsymbol{0-30cm}}$ is the standard error of the mean difference (the SE) between total soil organic carbon stock for the CEA between the first estimation event t_0 for the CEA and the last estimation event t_x for the CEA in the reporting period, in tonnes of soil organic carbon, for the 0-30 cm layer, worked out using equation 114

$\boldsymbol{t}_{\boldsymbol{\alpha(df)(0-30cm)}}$ is the value of the quantile function (inverse distribution function) for the t-distribution with the value for alpha ($\boldsymbol{\alpha}$) set out in the Supplement and the value for the degrees of freedom, $\boldsymbol{df}$ for the 0-30 cm layer worked out using equation 115.

Note: The value should be negative.

(4) The change in soil organic carbon stock with a specified probability of exceedance for a reporting period for a CEA which has not undergone an estimation event (or has only undertaken the first estimation event) in the reporting period is zero.

Division 4—Working out the soil organic carbon stock and sampling variance for a CEA

Subdivision 1—Area, soil mass and estimation approaches for the calculation of soil organic carbon stock and sampling variance for a CEA

11 Working out the soil organic carbon stock for a CEA

The total estimated soil organic carbon stock for a CEA (the $\boldsymbol{SOC_{CEA}}$), in tonnes of soil organic carbon, is worked out using the following equation:

$$SOC_{CEA} = \overline{SOC}_{CEA} \times A_{CEA} \quad \text{equation 71}$$

where:

$\boldsymbol{\overline{SOC}_{CEA}}$ is the mean soil organic carbon stock for the CEA, in tonnes of carbon per hectare, given by section 14 of this Schedule.

$\boldsymbol{A_{CEA}}$ is the area of the CEA, in hectares.

12 Working out the sampling variance of soil organic carbon stock for a CEA

The sampling variance of soil organic carbon stock for a CEA (the $\boldsymbol{SV(SOC_{CEA})}$), in (tonnes of soil organic carbon)^2, is worked out using the following equation:

$$SV(SOC_{CEA}) = {A_{CEA}}^2 \times SV(\overline{SOC}_{CEA}) \quad \text{equation 72}$$

where:

$\boldsymbol{A_{CEA}}$ is the area of the CEA, in hectares.

$\boldsymbol{SV(\overline{SOC}_{CEA})}$ is the sampling variance of the mean soil organic carbon stock for the CEA, in (tonnes of soil organic carbon per hectare)^2, given by section 14 of this Schedule.

13 Determining Equivalent Soil Mass (ESM) from the sampled soil masses derived during the baseline sampling round

(1) The equivalent soil mass (the ***ESM***), in tonnes of oven dry whole soil per hectare, for a CEA must be worked out in accordance with this section and the Supplement based on any samples collected from the CEA for the purposes of paragraph 5(2)(a) of this Schedule for the first estimation event**.**

Note 1: The Supplement may include provision for sub-layer analysis (analysing carbon stocks at more discrete intervals than 0-30 cm, 0-*x* cm) which allows for the mass of each sample to be adjusted by removing sub-layers from carbon stock estimates to keep masses between sample rounds comparable. Restrictions on removal of sub-layers will be subject to requirements such as to continue to account for the soil mass to the depth of any disturbance as per paragraph 8(2)(a) of this Schedule and the Supplement.

Note 2: The samples for which the ESM is worked out can include calibration samples and model-validation samples.

(2) Rank from smallest to largest for the CEA the mass of oven dry whole soil in the 0-30 cm or 0-*x* cm layer for the sample ($\boldsymbol{M_a}$) collected for the first estimation event, worked out in accordance with any requirements in the Supplement, in tonnes of oven dry whole soil per hectare.

(3) With the ranked samples from subsection (2), assign a sequential rank *k* from 1 for the smallest through to *N* for the largest, where *N* is the total number of samples collected for a CEA for the first estimation event.

(4) A percentile *P* must be worked out for each sample *k* using the following equation:

$$P = 100 \times \frac{(k-1)}{(N-1)} \qquad \text{equation 73}$$

where:

$\boldsymbol{k}$ is the value of the sequential rank assigned to a sample from the first estimation event under subsection (3).

$\boldsymbol{N}$ is the total number of samples collected from the CEA for the first estimation event.

(5) If one of the percentiles worked out in equation 73 for a sample is equal to P_{Supp}—the *ESM* for the CEA is the mass of the sample ($\boldsymbol{M_a}$) given by subsection (3) for the relevant rank of *k*, where P_{Supp} is the percentile value to which ESM is set, specified in the Supplement.

(6) If subsection (5) does not apply—the *ESM* for a CEA is given by the following equation:

$$ESM = M_{LB} + (M_{UB} - M_{LB}) \times \left(\frac{P_{Supp} - P_{LB}}{P_{UB} - P_{LB}}\right) \qquad \text{equation 74}$$

where:

$\boldsymbol{M_{LB}}$ is the mass of oven dry whole soil associated with the sample having the value of *P* given by equation 73 closest to and lower than $\boldsymbol{P_{Supp}}$, in tonnes of oven dry whole soil per hectare.

$\boldsymbol{M_{UB}}$ is the mass of oven dry whole soil associated with the sample, having the value of *P* given by equation 73 closest to and higher than $\boldsymbol{P_{Supp}}$, in tonnes of oven dry whole soil per hectare.

$\boldsymbol{P_{Supp}}$ is the percentile value to which the ESM is set, specified in the Supplement

$\boldsymbol{P_{LB}}$ is the percentile *P* associated with the sample used for M_{LB}, as a percentile.

$\boldsymbol{P_{UB}}$ is the percentile *P* associated with the sample used for M_{UB}, as a percentile.

Note: The sample used for M_{LB} is the lower bound *LB* and the sample used for M_{UB} is the upper bound *UB*.

The equivalent soil mass:

- acts as a cap to the mass of soil for which carbon stocks are worked out (both in the first and subsequent estimation event). Samples for subsequent estimation events should target the equivalent soil mass set for the first estimation event.
- is intended to be set to the nth percentile sample weight (set in the Supplement), rather than average sample weight, to ensure that the mass is set at a rate that can be expected to be

achieved around 90% of the time (everything else being held equal) in subsequent samples. This avoids underestimating carbon stock changes as a result of collecting a mass less than the equivalent soil mass in subsequent sample rounds.

- may need to be recalculated for each layer (0-30 cm, 0-*x* cm) if sub-layers are excluded from calculations (for the purposes of equalising soil masses between estimation events).
- is defined for each 0-30 cm layer and 0-*x* cm layer within each CEA in a project.

14 Approaches for estimating mean soil organic carbon stock and its sampling variance and degrees of freedom in a CEA

(1) The mean soil organic carbon stock for a CEA ($\overline{SOC}_{CEA}$), in tonnes of soil organic carbon per hectare, and its sampling variance ($SV(\overline{SOC}_{CEA})$), in (tonnes of soil organic carbon per hectare)^2, and degrees of freedom (df_{CEA}) must be worked out for the estimation event in accordance with the following subsections.

(2) If more than one of the following subsections could apply to the CEA for a reporting period, the subsection that results in the lowest value of $SV(\overline{SOC}_{CEA})$ for the CEA for the reporting period is taken to apply.

(3) If sampling has occurred in accordance with the Supplement for an estimation event, then Subdivision 2 of this Division must be applied to any samples collected for the estimation event, and, for the CEA for the reporting period:

(a) $\overline{SOC}_{CEA}$ is worked out using equation 78; and

(b) $SV(\overline{SOC}_{CEA})$ is worked out using equation 80; and

(c) df_{CEA} is worked out using equation 81 or 82, as applicable.

Note: This applies a measurement-based approach to soil organic carbon stock estimation. It applies to samples collected for a measurement-based approach, or for the purposes of calibration and validation of a model. Subsections (3) and (4) will also need to be applied if validated model carbon stock estimates or modelled carbon stock estimates are available, with the resulting estimates being compared under subsection (2).

(4) If validated model carbon stock estimates are available for an estimation event for a reporting period for the CEA, and model-validation sampling has not occurred in accordance with the Supplement for the estimation event, then Subdivision 3 of this Division must be applied, and, for the CEA for the reporting period:

(a) $\overline{SOC}_{CEA}$ is the $BiasAdjMod\overline{SOC}_{CEA}$ for the CEA, worked out using equation 86; and

(b) $SV(\overline{SOC}_{CEA})$ is the $ModSV\left(\overline{SOC}_{CEA,extr}\right)$ for the CEA, worked out using equation 87; and

(c) df_{CEA} is worked out using section 25 of this Schedule.

Note: This applies a model-only approach to soil organic carbon stock estimation. The validation approach and model requirements are set out in the Supplement. Subsections (2) and (3) will also apply if model calibration samples were collected from the CEA, with the resulting estimates being compared under subsection (2).

(5) If model carbon stock estimates or validated model carbon stock estimates are available for an estimation event for a reporting period for the CEA and model-validation sampling has occurred in accordance with the Supplement for the estimation event, then Subdivision 4 of this Division must be applied to the model-validation samples, and, for the CEA for the reporting period:

(a) $\overline{SOC}_{CEA}$ is the $Reg\overline{SOC}_{CEA}$ for the CEA, worked out using equation 104;

(b) $SV(\overline{SOC}_{CEA})$ is the $RegSV(\overline{SOC}_{CEA})$ for the CEA, worked out using equation 108; and

(c) df_{CEA} is worked out using equation 109.

Note: This applies a model-assisted approach to soil organic carbon stock estimation which uses samples in conjunction with modelled estimates to provide an estimate with potentially lower sampling variance than using samples alone. The approach is also used to calculate statistics that may be relevant to other CEAs using a model-only approach under subsection (4). The model requirements are set out in the Supplement. If model calibration samples were also collected from the CEA, subsection (2) will also apply, with the resulting estimates being compared under subsection (2).

Subdivision 2—Measurement-based soil organic carbon stock estimation and its sampling variance for the CEA for each estimation event

15 Working out the soil organic carbon stock of each sample in each layer

(1) The soil organic carbon stock ($\boldsymbol{SOC_i}$) for each soil sample *i*, for the 0-30 cm and 0-*x* cm layers, in tonnes of soil organic carbon per hectare, must be worked out under subsection (2) or (3) based on the relationship between:

(a) the mass of oven dry whole soil collected ($\boldsymbol{M_a}$) for the sample layer (0-30 cm and 0-*x* cm) worked out in accordance with any requirements in the Supplement, in tonnes of oven dry whole soil per hectare; and

(b) the equivalent soil mass (the ***ESM***) defined for the CEA, given by section 13 of this Schedule, in tonnes of oven dry whole soil per hectare.

(2) If $M_a < ESM$, SOC_i is worked out using the following equation:

$$SOC_i = \sum_{sl=1}^{n} SOC_{sl} \qquad \text{equation 75}$$

where:

$\boldsymbol{n}$ is the number of sub-layers in the 0-30 cm or 0-*x* cm layers and used to derive M_a (in accordance with any requirements in the Supplement).

Note: The value of n increases with increasing depth such that sub-layer 1 denotes the soil sub-layer including the soil surface and sub-layer n denotes the deepest sub-layer that contributes to equation 75 as required by the Supplement.

$\boldsymbol{sl}$ is the identifier for a soil sub-layer within the 0-30 cm or 0-*x* cm layers.

$\boldsymbol{SOC_{sl}}$ is the soil organic carbon stock in a soil sub-layer determined in accordance with any requirements in the Supplement, in tonnes of soil organic carbon per hectare.

(3) If $M_a \geq ESM$, SOC_i is given by the following equation:

$$SOC_i = \left(\sum_{sl=1}^{n-1} SOC_{sl}\right) + SOC_{sl=n} \times \frac{\left(ESM - \sum_{sl=1}^{n-1} M_{sl}\right)}{M_{sl=n}} \qquad \text{equation 76}$$

where:

$\boldsymbol{n}$ is the number of sub-layers progressing incrementally down from the soil surface required to produce a value for M_a that is equal to or exceeds the ESM, given by section 13 of this Schedule, in tonnes of oven dry whole soil per hectare.

Note: The value of n increases with increasing depth such that sub-layer 1 denotes the soil sub-layer including the soil surface and sub-layer n denotes the sub-layer $M_a \geq ESM$.

$\boldsymbol{sl}$ is the identifier for a soil sub-layer within the 0-30 cm or 0-*x* cm layers.

$\boldsymbol{SOC_{sl}}$ is the soil organic carbon stock in a soil sub-layer determined in accordance with any requirements in the Supplement, in tonnes of soil organic carbon per hectare.

$\sum_{sl=1}^{n-1} \boldsymbol{SOC_{sl}}$ is the sum of soil organic carbon stocks in all sub-layers excluding sub-layer n, in tonnes of soil organic carbon per hectare.

$\boldsymbol{SOC_{sl=n}}$ is the soil organic carbon stock in the sub-layer n, in tonnes of soil organic carbon per hectare, determined in accordance with any requirements in the Supplement.

$\boldsymbol{ESM}$ is the equivalent soil mass for the CEA where the soil samples were collected given by section 13 of this Schedule, in tonnes of oven dry whole soil per hectare.

$\boldsymbol{M_{sl}}$ is the oven dry mass of whole soil within a sub-layer, in tonnes of oven dry whole soil per hectare, determined in accordance with any requirements in the Supplement.

$\sum_{sl=1}^{n-1} \boldsymbol{M_{sl}}$ is the sum of the mass of oven dry whole soil in all sub-layers excluding sub-layer n, in tonnes of oven dry soil per hectare.

$\boldsymbol{M_{sl=n}}$ is the mass of oven dry whole soil contained in the soil sub-layer n, in tonnes of oven dry soil per hectare, determined in accordance with any requirements in the Supplement.

Note**:** The number of samples collected may inform for the calculation of statistics in the Supplement for the purposes of model-only estimates in other CEAs under Subdivision 2 of this Division. The number of samples may vary depending on the application of this subdivision. In some circumstances it is equivalent to only the number of model-validation samples (when this Subdivision is applied under subsection 14(5) or the number of validation and calibration samples (when this Subdivision is applied under subsection 14(3)).

16 Mean soil organic carbon stock in a stratum

Work out the mean soil organic carbon stock for each stratum *h* (the $\overline{SOC_h}$) in the CEA, in tonnes of soil organic carbon per hectare, using the following equation:

$$\overline{SOC_h} = \frac{\sum_{i=1}^{n_h} SOC_i}{n_h} \qquad \text{equation 77}$$

where:

$\boldsymbol{i}$ is an identifier for each soil sample collected from the stratum *h*.

$\boldsymbol{n_h}$ is the number of relevant samples collected from the stratum *h.*

$\boldsymbol{SOC_i}$ is the soil organic carbon stock for each sample i collected from stratum h , worked out using equation 75 or 76, in tonnes of soil organic carbon per hectare.

17 Area-weighted mean soil organic carbon stock in a CEA

Work out the area-weighted mean soil organic carbon stock in the CEA (the $\overline{\boldsymbol{SOC}}_{\boldsymbol{CEA}}$), in tonnes of soil organic carbon per hectare, using the following equation:

$$\overline{SOC}_{CEA} = \sum_{h=1}^{H} (a_h \times \overline{SOC}_h) \qquad \text{equation 78}$$

where:

$\boldsymbol{h}$ is an identifier for the stratum.

$\boldsymbol{H}$ is the number of strata for the CEA.

$\boldsymbol{a_h}$ is the relative area of the CEA covered by stratum *h* in the CEA, expressed as a proportion of the total CEA area.

$\overline{\boldsymbol{SOC}}_{\boldsymbol{h}}$ is the mean soil organic carbon stock in the stratum *h*, in tonnes of soil organic carbon per hectare, worked out using equation 77.

18 Sampling variance of the mean soil organic carbon stock within a stratum

Work out the sampling variance of the mean soil organic carbon stock for each stratum *h* in the CEA (the $\boldsymbol{SV}(\overline{\boldsymbol{SOC}}_{\boldsymbol{h}})$), in (tonnes of soil organic carbon per hectare)^2, using the following equation:

$$SV(\overline{SOC}_h) = \frac{\sum_{i=1}^{n_h} (SOC_i - \overline{SOC}_h)^2}{n_h\ (n_h\ - 1)} \qquad \text{equation 79}$$

where:

$\boldsymbol{i}$ is an identifier for each sample collected from the stratum *h*.

$\boldsymbol{n_h}$ is the number of relevant samples collected from the stratum *h.*

$\boldsymbol{SOC_i}$ is the soil organic carbon stock for each sample *i* from stratum *h*, in tonnes of soil organic carbon per hectare, worked out using equation 75 or 76.

$\overline{\boldsymbol{SOC}}_{\boldsymbol{h}}$ is the mean soil organic carbon stock in the stratum *h*, in tonnes of soil organic carbon per hectare, worked out using equation 77.

19 Sampling variance of the mean soil organic carbon stock within a CEA

Work out the sampling variance of the mean soil organic carbon for the CEA (the $\boldsymbol{SV}(\overline{\boldsymbol{SOC}}_{\boldsymbol{CEA}})$), in (tonnes of soil organic carbon per hectare)^2, using the following equation:

$$SV(\overline{SOC}_{CEA}) = \sum_{h=1}^{H} \left({a_h}^2 \times SV(\overline{SOC}_h)\right) \qquad \text{equation 80}$$

where:

$\boldsymbol{h}$ is an identifier for the stratum.

$\boldsymbol{H}$ is the number of strata for the CEA.

$\boldsymbol{a_h}$ is the relative area of the CEA covered by stratum *h* in the CEA, expressed as a proportion of the total CEA.

$\boldsymbol{SV(\overline{SOC}_h)}$ is the sampling variance of the mean soil organic carbon for stratum *h*, in (tonnes of soil organic carbon per hectare)^2, worked out using equation 79.

20 Degrees of freedom for the sampling variance of the mean soil organic carbon stock within a CEA

(1) Where individual or within-strata composite samples were used for the estimation event, work out the degrees of freedom ($\boldsymbol{df_{CEA}}$) to use in equation 115 for a given estimation event, using the following equation:

$$df_{CEA} = \frac{\left(\sum_{h=1}^{H} {a_h}^2 \times SV(\overline{SOC}_h)\right)^2}{\sum_{h=1}^{H}\left(\frac{\left({a_h}^2 \times SV(\overline{SOC}_h)\right)^2}{(n_h - 1)}\right)} \qquad \text{equation 81}$$

where:

$\boldsymbol{h}$ is an identifier for the stratum.

$\boldsymbol{H}$ is the number of strata for the CEA.

$\boldsymbol{a_h}$ is the relative area of the CEA covered by stratum *h* in the CEA, expressed as a proportion of the total CEA area.

$\boldsymbol{SV(\overline{SOC}_h)}$ is the sampling variance of the mean soil organic carbon for each stratum *h* in the CEA in (tonnes of soil organic carbon per hectare)^2, worked out using equation 79.

$\boldsymbol{n_h}$ is the number of relevant samples collected from the stratum $\boldsymbol{h}$ (either within-strata composites samples or individual samples as appropriate).

Note 1: Equation 81 is a simplified equation using the condition that $\frac{{s_{\overline{SOC}_h}}^2}{n_h} = V(\overline{SOC}_h)$. The original version of the equation is: $df_{CEA_{t_x}} = \frac{\left(\sum_{h=1}^{H} {a_h}^2 \times \frac{{s_{\overline{SOC}_h}}^2}{n_h}\right)^2}{\sum_{h=1}^{H}\left(\frac{\left({a_h}^2 \times \frac{{s_{\overline{SOC}_h}}^2}{n_h}\right)^2}{(n_h - 1)}\right)}$

Note 2: Where a CEA contains three strata, equation 81 written in its expanded form, where the subscripts 1, 2, and 3 are used to denote values for stratum 1, stratum 2, and stratum 3, respectively takes the following form:

$$df_{CEA_{t_x}} = \frac{\left({a_1}^2 \times V(\overline{SOC}_1) + {a_2}^2 \times V(\overline{SOC}_2) + {a_3}^2 \times V(\overline{SOC}_3)\right)^2}{\frac{\left({a_1}^2 \times V(\overline{SOC}_1)\right)^2}{(n_1 - 1)} + \frac{\left({a_2}^2 \times V(\overline{SOC}_2)\right)^2}{(n_2 - 1)} + \frac{\left({a_3}^2 \times V(\overline{SOC}_3)\right)^2}{(n_3 - 1)}}$$

(2) Where across-strata composite samples were collected across equal area strata, work out the degrees of freedom ($\boldsymbol{df_{CEA}}$) to use in equation 115 for a given estimation event, using the following equation:

$$df_{CEA_{t_x}} = n_c - 1 \qquad \text{equation 82}$$

where:

$\boldsymbol{n_c}$ is the number of relevant across-strata composite samples collected from CEA.

Subdivision 3—Model-only soil organic carbon stock estimation and its sampling variance for the CEA for each estimation event

21 Working out the modelled soil organic carbon stock in each layer of each stratum

(1) The modelled soil organic carbon stock ($Mod\overline{SOC}_h$) for each stratum *h* in the CEA, for the 0-30 cm and 0-*x* cm layers, in tonnes of organic carbon per hectare, must be worked out under subsection (2) or (3) based on the relationship between:

(a) the mass of oven dry whole soil in the stratum estimated by a validated model carbon stock estimate for the estimation event in accordance with any requirements in the Supplement ($\mathbf{Mod}\overline{\boldsymbol{M_{a,h}}}$) for the layer (0-30 cm or 0-*x* cm), in tonnes of oven dry whole soil per hectare; and

(b) the equivalent soil mass (the ***ESM***) defined for the CEA in the first estimation event given by section 13 of this Schedule, in tonnes of oven dry whole soil per hectare.

(2) If $\text{Mod}\overline{M_{a,h}} < ESM$, $\text{Mod}\overline{SOC}_h$ is worked out using the following equation:

$$Mod\overline{SOC}_h = \sum_{sl=1}^{n} Mod\overline{SOC}_{h,sl} \qquad \text{equation 83}$$

where:

$\boldsymbol{n}$ is the number of sub-layers in the 0-30 cm or 0-*x* cm layers and used to derive $\text{Mod}\overline{M_{a,h}}$(in accordance with the requirements in the Supplement).

Note: The value of n increases with increasing depth such that sub-layer 1 denotes the soil sub-layer including the soil surface and sub-layer n denotes the deepest sub-layer that contributes to equation 75 as required by the Supplement.

$\boldsymbol{sl}$ is the identifier for a soil sub-layer within the 0-30 cm or 0-*x* cm layers.

$\boldsymbol{Mod\overline{SOC}_{h,sl}}$ is the mean modelled soil organic carbon stock in a soil sub-layer, for stratum h, determined by a validated model carbon stock estimate for the estimation event in accordance with the requirements in the Supplement, in tonnes of soil organic carbon per hectare.

(3) If $\text{Mod}\overline{M_{a,h}} \geq ESM$, $Mod\overline{SOC}_h$ is worked out using the following equation:

$$Mod\overline{SOC}_h = \left(\sum_{sl=1}^{n-1} Mod\overline{SOC}_{h,sl}\right) + Mod\overline{SOC}_{h,sl=n} \times \frac{\left(ESM - \sum_{sl=1}^{n-1} \boldsymbol{Mod\overline{M}_{h,sl}}\right)}{\boldsymbol{Mod\overline{M}_{h,sl=n}}} \quad \text{equation 84}$$

where:

$\boldsymbol{n}$ is the number of sub-layers progressing incrementally down from the soil surface required to produce a value for $\text{Mod}\overline{M_{a,h}}$ that is equal to or exceeds the ESM for the CEA given by section 13 of this Schedule, in tonnes of oven dry whole soil per hectare.

Note: The value of n increases with increasing depth such that sub-layer 1 denotes the soil sub-layer including the soil surface and sub-layer n denotes the sub-layer $M_{a,h} \geq ESM$.

$\boldsymbol{sl}$ is the identifier for a soil sub-layer within the 0-30 cm or 0-*x* cm layers.

$\boldsymbol{Mod\overline{SOC}_{h,sl}}$ is the modelled soil organic carbon stock in a soil sub-layer, for stratum *h*, determined by a validated model carbon stock estimate for the estimation event in accordance with the requirements in the Supplement, in tonnes of soil organic carbon per hectare.

$\boldsymbol{\sum_{sl=1}^{n-1} Mod\overline{SOC}_{h,sl}}$ is the sum of modelled soil organic carbon stocks in all sub-layers excluding sub-layer n, for stratum *h*, determined by a validated model carbon stock estimate for the estimation event in accordance with any requirements in the Supplement, in tonnes of soil organic carbon per hectare.

$\boldsymbol{Mod\overline{SOC}_{h,sl=n}}$ is the modelled soil organic carbon stock in the soil sub-layer n, for stratum *h,* determined by a validated model carbon stock estimate for the estimation event in accordance with any requirements in the Supplement, in tonnes of soil organic carbon per hectare.

ESM is the equivalent soil mass for the CEA given by section 13 of this Schedule, in tonnes of oven dry whole soil per hectare.

$\boldsymbol{Mod\overline{M}_{h,sl}}$ is the modelled oven dry mass of whole soil within a sub-layer, for stratum h, determined by a validated model carbon stock estimate for the estimation event in accordance with any requirements in the Supplement, in tonnes of oven dry whole soil per hectare.

$\boldsymbol{\sum_{sl=1}^{n-1} Mod\overline{M}_{h,sl}}$ is the sum of the mass of oven dry whole soil in all sub-layers excluding sub-layer n, for stratum *h*, estimated by a validated model carbon stock estimate for the estimation event in accordance with the requirements in the Supplement, in tonnes of oven dry soil per hectare.

$\boldsymbol{Mod\overline{M}_{h,sl=n}}$ is the modelled mass of oven dry whole soil contained in the soil sub-layer n, for stratum h, estimated by a validated model carbon stock estimate for the estimation event in accordance with the requirements in the Supplement, in tonnes of oven dry soil per hectare.

22 Mean modelled soil organic carbon stock in a CEA

Work out the mean modelled soil organic carbon stock in the CEA (the $Mod\overline{SOC}_{CEA}$), in tonnes of soil organic carbon per hectare, using the following equation:

$$Mod\overline{SOC}_{CEA} = \sum_{h=1}^{H} (a_h \times Mod\overline{SOC}_h) \qquad \text{equation 85}$$

where:

$\boldsymbol{h}$ is an identifier for the stratum.

$\boldsymbol{H}$ is the number of strata for the CEA.

$\boldsymbol{a_h}$ is the relative area of the CEA covered by stratum *h* in the CEA, expressed as a proportion of the total CEA.

$\boldsymbol{Mod\overline{SOC}_h}$ is the mean soil organic carbon stock in the stratum *h*, in tonnes of soil organic carbon per hectare, worked out using section 21 of this Schedule.

23 Extrapolated bias-adjustment of the modelled soil organic carbon stock within a CEA

Work out the mean bias-adjusted modelled soil organic carbon stock for the CEA ($BiasAdjMod\overline{SOC}_{CEA}$), in tonnes of soil organic carbon per hectare, using the following equation:

$$BiasAdjMod\overline{SOC}_{CEA} = Mod\overline{SOC}_{CEA} - Bias_{Supp} \qquad \text{equation 86}$$

where:

$\boldsymbol{Mod\overline{SOC}_{CEA}}$ is the mean modelled soil organic carbon stock for the CEA, worked out using equation 85 of this Schedule, in tonnes of soil organic carbon per hectare.

$\boldsymbol{Bias_{Supp}}$ is the extrapolated bias of the model given by the Supplement for the validated model carbon stock estimates for the estimation event, in tonnes of soil organic carbon per hectare.

Note: The Supplement allows the bias of the model to be given from other CEAs where model-validation sampling occurred for the estimation event.

24 Extrapolated estimate of the sampling variance of mean carbon stocks in the CEA

Work out the extrapolated estimate of the sampling variance of mean carbon stocks in the CEA (the $ModSV\left(\overline{SOC}_{CEA,extr}\right)$, in (tonnes of soil organic carbon per hectare)^2, using the following equation:

$$ModSV\left(\overline{SOC}_{CEA,extr}\right) = BiasAdjMod\overline{SOC}_{CEA} \times fsv_{Supp} \times \left(1 + \left(d_{Supp} \times \left(1 - \left(r_{Supp}\right)^2\right)\right)\right) \qquad \text{equation 87}$$

where:

$\boldsymbol{BiasAdjMod\overline{SOC}_{CEA}}$ is the mean bias-adjusted modelled soil organic carbon stock for the CEA, worked out using equation 86, in tonnes of soil organic carbon per hectare.

$\boldsymbol{fsv_{Supp}}$ is the fraction of sampling variance given by the Supplement for validated model carbon stock estimate for the estimation event, in tonnes of soil organic carbon per hectare.

$\boldsymbol{d_{Supp}}$ is the discount factor for sampling variance given by the Supplement for the validated model carbon stock estimate for the estimation event.

$\boldsymbol{r_{Supp}}$ is the correlation coefficient given by the Supplement for the validated model carbon stock estimate for the estimation event.

Note: The fraction of sampling variance and the correlation coefficient are not sourced from the following Subdivision but rather from other CEAs (where model-validation sampling has occurred) in accordance with the Supplement

The discount factor for sampling variance provides an estimate of model variance for a CEA where model-validation sampling has not occurred based on the variance of the model for the CEA which was model-validation sampled for the estimation event. This ensures the calculation of the creditable change in soil organic carbon stock for a CEA where model-validation sampling has not occurred under Division 5 is conservative**.** The impact of the discount reduces to 0 as the coefficient of determination increases towards one.

25 Degrees of freedom for the sampling variance of the mean soil organic carbon stock within a CEA

The degrees of freedom ($\boldsymbol{df_{CEA}}$) to use in equation 115 for a given estimation event, is given by the Supplement for the validated model carbon stock estimate for the estimation event.

Subdivision 4—Model-assisted soil organic carbon stock estimation and its sampling variance in the CEA for each estimation event

26 Application of this subdivision

This Subdivision estimates soil organic carbon stock and its sampling variance using modelled soil organic carbon estimates and model-validation samples as required by subsection 14(5) of this Schedule.

27 Working out the modelled soil organic carbon stock in each layer of each stratum

(1) The modelled soil organic carbon stock $Mod\overline{SOC}_h$ for each stratum h in the CEA, for the 0-30 cm and 0-*x* cm layers, in tonnes of organic carbon per hectare, must be worked out under the subsection (2) or (3) based on the relationship between:

(a) the mass of oven dry whole soil in the stratum estimated by a modelled carbon stock estimate for the estimation event in accordance with any requirements in the Supplement ($\mathbf{Mod}\overline{\boldsymbol{M_{a,h}}}$) for the layer (0-30 cm or 0-*x* cm), in tonnes of oven dry whole soil per hectare; and

(b) the equivalent soil mass (the ***ESM***) defined for the CEA in the first estimation event given by section 13 of this Schedule, in tonnes of oven dry whole soil per hectare.

(2) If $\text{Mod}\overline{M_{a,h}} < ESM$, $\text{Mod}\overline{SOC_h}$ is given by the following equation:

$$Mod\overline{SOC_h} = \sum_{sl=1}^{n} Mod\overline{SOC}_{h,sl} \qquad \text{equation 88}$$

where:

$\boldsymbol{n}$ is the number of sub-layers in the 0-30 cm or 0-*x* cm layers and used to derive $\text{Mod}\overline{M_{a,h}}$(in accordance with the requirements in the Supplement).

$\boldsymbol{sl}$ is the identifier for a soil sub-layer within the 0-30 cm or 0-*x* cm layers.

$\boldsymbol{Mod\overline{SOC}_{h,sl}}$ is the mean modelled soil organic carbon stock in a soil sub-layer, for stratum h, determined by a modelled carbon stock estimate for the estimation event in accordance with the requirements in the Supplement, in tonnes of soil organic carbon per hectare.

(3) If $\text{Mod}\overline{M_{a,h}} \geq ESM$, $Mod\overline{SOC_h}$ is given by the following equation:

$$\begin{aligned} Mod\overline{SOC_h} \\ &= \left(\sum_{sl=1}^{n-1} Mod\overline{SOC}_{h,sl}\right) \\ &+ Mod\overline{SOC}_{h,sl=n} \\ &\times \frac{\left(ESM - \sum_{sl=1}^{n-1} Mod\overline{M_{h,sl}}\right)}{Mod\overline{M_{h,sl=n}}} \end{aligned} \qquad \text{equation 89}$$

where:

$\boldsymbol{n}$ is the number of sub-layers progressing incrementally down from the soil surface required to produce a value for $\text{Mod}\overline{M_{a,h}}$ that is equal to or exceeds the ESM for the CEA given by section 13 of this Schedule, in tonnes of oven dry whole soil per hectare.

Note: The value of n increases with increasing depth such that sub-layer 1 denotes the soil sub-layer including the soil surface and sub-layer *n* denotes the sub-layer $M_{a,h} \geq ESM$.

$\boldsymbol{sl}$ is the identifier for a soil sub-layer within the 0-30 cm or 0-*x* cm layers.

$\boldsymbol{Mod\overline{SOC}_{h,sl}}$ is the modelled soil organic carbon stock in a soil sub-layer, for stratum *h*, determined by a modelled carbon stock estimate for the estimation event in accordance with the requirements in the Supplement, in tonnes of soil organic carbon per hectare.

$\boldsymbol{\sum_{sl=1}^{n-1} Mod\overline{SOC}_{h,sl}}$ is the sum of modelled soil organic carbon stocks in all sub-layers excluding sub-layer n, for stratum *h*, determined by a modelled carbon stock estimate for the estimation event in accordance with any requirements in the Supplement, in tonnes of soil organic carbon per hectare.

$\boldsymbol{Mod\overline{SOC}_{h,sl=n}}$ is the modelled soil organic carbon stock in the soil sub-layer n, for stratum *h,* determined by a modelled carbon stock estimate for the estimation event in accordance with any requirements in the Supplement, in tonnes of soil organic carbon per hectare.

ESM is the equivalent soil mass for the CEA given by section 13 of this Schedule, in tonnes of oven dry whole soil per hectare.

$\boldsymbol{Mod\overline{M_{h,sl}}}$ is the modelled oven dry mass of whole soil within a sub-layer, for stratum h, determined by a modelled carbon stock estimate for the estimation event in accordance with any requirements in the Supplement, in tonnes of oven dry whole soil per hectare.

$\boldsymbol{\sum_{sl=1}^{n-1} Mod\overline{M_{h,sl}}}$ is the sum of the mass of oven dry whole soil in all sub-layers excluding sub-layer n, for stratum *h*, estimated by a by a modelled carbon stock estimate for the estimation event in accordance with the requirements in the Supplement, in tonnes of oven dry soil per hectare.

$\boldsymbol{Mod\overline{M_{h,sl=n}}}$ is the modelled mass of oven dry whole soil contained in the soil sub-layer n, for stratum h, estimated by a modelled carbon stock estimate for the estimation event in accordance with the requirements in the Supplement, in tonnes of oven dry soil per hectare.

28 Mean modelled soil organic carbon stock in a CEA

Work out the mean modelled soil organic carbon stock for the CEA (the $\boldsymbol{Mod\overline{SOC}_{CEA}}$), in tonnes of soil organic carbon per hectare, using the following equation:

$$Mod\overline{SOC}_{CEA} = \sum_{h=1}^{H} (a_h \times Mod\overline{SOC}_h) \qquad \text{equation 90}$$

where:

$\boldsymbol{h}$ is an identifier for the stratum.

$\boldsymbol{H}$ is the number of strata for the CEA.

$\boldsymbol{a_h}$ is the relative area of the CEA covered by stratum *h* in the CEA, expressed as a proportion of the total CEA.

$\boldsymbol{Mod\overline{SOC}_h}$ is the mean soil organic carbon stock in the stratum *h*, in tonnes of soil organic carbon per hectare, worked out using section 21 of this Schedule.

29 Working out the modelled soil organic carbon stock for each model-validation site

(1) The modelled soil organic carbon stock ($ModSOC_i$) for each model-validation site *i* in the CEA, within the 0-30 cm and 0-*x* cm layers, in tonnes of organic carbon per hectare, must be worked out under the subsection (2) or (3) based on the relationship between:

(a) the modelled mass of oven dry whole soil ($ModM_{a,i}$) estimated by a modelled carbon stock estimate for the estimation event, for a model-validation site *i*, in the layer (0-30 cm or 0-*x* cm), worked out in accordance with any requirements in the Supplement, in tonnes of oven dry whole soil per hectare; and

(b) the equivalent soil mass (***ESM***) defined for the CEA where the soil samples were collected in the baseline sample round given by section 13 of this Schedule, in tonnes of oven dry whole soil per hectare.

(2) If $ModM_{a,i} < ESM$, $ModSOC_i$ is given by the following equation:

$$ModSOC_i = \sum_{sl=1}^{n} ModSOC_{i,sl}$$ equation 91

where:

$\boldsymbol{n}$ is the number of sub-layers in the 0-30 cm or 0-*x* cm layer and used to derive $ModM_{a,i}$ (in accordance with any requirements in the Supplement).

Note: The value of n increases with increasing depth such that sub-layer 1 denotes the soil sub-layer including the soil surface and sub-layer n denotes the deepest sub-layer that contributes to equation 91 as required by the Supplement.

$\boldsymbol{sl}$ is the identifier for a soil sub-layer within the 0-30 cm or 0-*x* cm layer.

$\boldsymbol{i}$ is an identifier for each model-validation site collected from the stratum h.

$\boldsymbol{ModSOC_{i,sl}}$ is the modelled soil organic carbon stock in a soil sub-layer for model-validation site *i*, determined by a modelled carbon stock estimate for the estimation event in accordance with any requirements in the Supplement, in tonnes of soil organic carbon per hectare.

(3) If $ModM_{a,i} \geq ESM$, $ModSOC_i$ is given by the following equation:

$$ModSOC_i = \left(\sum_{sl=1}^{n-1} ModSOC_{i,sl}\right) + ModSOC_{i,sl=n} \times \frac{\left(ESM - \sum_{sl=1}^{n-1} ModM_{a,i,sl}\right)}{ModM_{a,i,sl=n}}$$ equation 92

where:

$\boldsymbol{n}$ is the number of sub-layers progressing incrementally down from the soil surface required to produce a value for $ModM_{a,i}$ that is equal to or exceeds the ESM for the CEA given by section 13 of this Schedule, in tonnes of oven dry whole soil per hectare.

Note: The value of n increases with increasing depth such that sub-layer 1 denotes the soil sub-layer including the soil surface and sub-layer *n* denotes the sub-layer $M_{a,i} \geq ESM$.

$\boldsymbol{sl}$ is the identifier for a soil sub-layer within the 0-30 cm or 0-*x* cm layer.

$\boldsymbol{i}$ is an identifier for each model-validation site collected from the stratum h.

$\boldsymbol{ModSOC_{i,sl}}$ is the modelled soil organic carbon stock in a soil sub-layer for model-validation site i determined by a modelled carbon stock estimate for the estimation event, in accordance with any requirements in the Supplement, in tonnes of soil organic carbon per hectare.

$\boldsymbol{\sum_{sl=1}^{n-1} ModSOC_{i,sl}}$ is the sum of modelled soil organic carbon stocks, for model-validation site *i*, in all sub-layers excluding sub-layer n, determined by a modelled carbon stock estimate for the estimation event, in accordance with any requirements in the Supplement, in tonnes of soil organic carbon per hectare.

$\boldsymbol{ModSOC_{i,sl=n}}$ is the modelled soil organic carbon stock, for model-validation site *i*, in sub-layer n, determined by a modelled carbon stock estimate for the estimation event, in accordance with any requirements in the Supplement, in tonnes of soil organic carbon per hectare.

ESM is the equivalent soil mass for the CEA given by section 13 of this Schedule, in tonnes of oven dry whole soil per hectare.

$\boldsymbol{ModM_{a,i,sl}}$ is the modelled oven dry mass of whole soil within a sub-layer, for model-validation site i, estimated by a modelled carbon stock estimate for the estimation event in accordance with the requirements in the Supplement, in tonnes of oven dry soil per hectare.

$\boldsymbol{\sum_{sl=1}^{n-1} ModM_{a,i,sl}}$ is the sum of the modelled mass of oven dry whole soil, for model-validation site *i*, in all sub-layers excluding sub-layer n, estimated by a modelled carbon stock estimate for the estimation event in accordance with the requirements in the Supplement, in tonnes of oven dry soil per hectare.

$\boldsymbol{ModM_{a,i,sl=n}}$ is the modelled mass of oven dry whole soil, for model-validation site i, in sub-layers n, estimated by a modelled carbon stock estimate for the estimation event in accordance with the requirements in the Supplement, in tonnes of oven dry soil per hectare.

30 Mean modelled soil organic carbon stock for each model-validation site in a stratum

Work out the mean modelled soil organic carbon stock for the model-validation sites, in each stratum *h* (the $Mod\overline{SOC}_{mvs,h}$), in tonnes of soil organic carbon per hectare, using the following equation:

$$Mod\overline{SOC}_{mvs,h} = \frac{\sum_{i=1}^{n_h} ModSOC_i}{n_h} \qquad \text{equation 93}$$

where:

$\boldsymbol{i}$ is the identifier for each model-validation site collected from the stratum h.

$\boldsymbol{n_h}$ is the number of model-validation samples collected from the stratum *h*.

ModSOC$_i$ is the modelled soil organic carbon stock for each model-validation site *i*, from stratum *h*, in tonnes of soil organic carbon per hectare, worked out using Section 29.

31 Working out the soil organic carbon stock of each model-validation site in each layer

(1) The soil organic carbon stock ($\boldsymbol{SOC_i}$) for each model-validation site *i*, for the 0-30 cm and 0-*x* cm layers, in tonnes of organic carbon per hectare, must be worked out under subsection (2) or (3) based on the relationship between:

(a) the mass of oven dry whole soil collected ($\boldsymbol{M_a}$) for the sample layer (0-30 cm and 0-*x* cm) worked out in accordance with any requirements in the Supplement, in tonnes of oven dry whole soil per hectare; and

(b) the equivalent soil mass (the ***ESM***) defined for the CEA, given by section 13 of this Schedule, in tonnes of oven dry whole soil per hectare.

(2) If $M_a < ESM$, SOC_i is worked out using the following equation:

$$SOC_i = \sum_{sl=1}^{n} SOC_{sl} \qquad \text{equation 94}$$

where:

$\boldsymbol{n}$ is the number of sub-layers in the 0-30 cm or 0-*x* cm layers and used to derive M_a (in accordance with any requirements in the Supplement).

Note: The value of n increases with increasing depth such that sub-layer 1 denotes the soil sub-layer including the soil surface and sub-layer n denotes the deepest sub-layer that contributes to equation 94 as required by the Supplement.

$\boldsymbol{sl}$ is the identifier for a soil sub-layer within the 0-30 cm or 0-*x* cm layers.

$\boldsymbol{SOC_{sl}}$ is the soil organic carbon stock in a soil sub-layer determined in accordance with any requirements in the Supplement, in tonnes of soil organic carbon per hectare.

(3) If $M_a \geq ESM$, SOC_i is given by the following equation:

$$SOC_i = \left(\sum_{sl=1}^{n-1} SOC_{sl}\right) + SOC_{sl=n} \times \frac{\left(ESM - \sum_{sl=1}^{n-1} M_{sl}\right)}{M_{sl=n}} \qquad \text{equation 95}$$

where:

$\boldsymbol{n}$ is the number of sub-layers progressing incrementally down from the soil surface required to produce a value for M_a that is equal to or exceeds the ESM, given by section 13 of this Schedule, in tonnes of oven dry whole soil per hectare.

Note: The value of n increases with increasing depth such that sub-layer 1 denotes the soil sub-layer including the soil surface and sub-layer n denotes the sub-layer $M_a \geq ESM$.

$\boldsymbol{sl}$ is the identifier for a soil sub-layer within the 0-30 cm or 0-*x* cm layers.

$\boldsymbol{SOC_{sl}}$ is the soil organic carbon stock in a soil sub-layer determined in accordance with any requirements in the Supplement, in tonnes of soil organic carbon per hectare.

$\sum_{sl=1}^{n-1} \boldsymbol{SOC_{sl}}$ is the sum of soil organic carbon stocks in all sub-layers excluding sub-layer n, in tonnes of soil organic carbon per hectare.

$\boldsymbol{SOC_{sl=n}}$ is the soil organic carbon stock in the sub-layer n, in tonnes of soil organic carbon per hectare, determined in accordance with any requirements in the Supplement.

ESM is the equivalent soil mass for the CEA where the soil samples were collected given by section 13 of this Schedule, in tonnes of oven dry whole soil per hectare.

$\boldsymbol{M_{sl}}$ is the oven dry mass of whole soil within a sub-layer, in tonnes of oven dry whole soil per hectare, determined in accordance with any requirements in the Supplement.

$\sum_{sl=1}^{n-1} \boldsymbol{M_{sl}}$ is the sum of the mass of oven dry whole soil in all sub-layers excluding sub-layer n, in tonnes of oven dry soil per hectare.

$\boldsymbol{M_{sl=n}}$ is the mass of oven dry whole soil contained in the soil sub-layer n, in tonnes of oven dry soil per hectare, determined in accordance with any requirements in the Supplement.

Note**:** This section is identical to section 15 in subdivision 2 using the measurement-based approach except that it is applied to only model-validation samples rather than any samples in the CEA (including calibration samples).

32 Mean soil organic carbon stock in a stratum from model-validation samples

Work out the mean soil organic carbon stock for each stratum *h* (the $\overline{SOC_h}$) in the CEA, in tonnes of soil organic carbon per hectare, using the following equation:

$$\overline{SOC_h} = \frac{\sum_{i=1}^{n_h} SOC_i}{n_h} \quad \text{equation 96}$$

where:

$\boldsymbol{i}$ is an identifier for each model-validation sample site i in i the stratum *h*.

$\boldsymbol{n_h}$ is the number of model validation samples collected from the stratum *h.*

$\boldsymbol{SOC_i}$ is the soil organic carbon stock for each sample site i in stratum h , worked out using equation 94 or 95, in tonnes of soil organic carbon per hectare.

Note: This section is identical to section 16 in subdivision 2 using the measurement-based approach except that it is applied to only model-validation samples rather than any samples in the CEA (including calibration samples).

33 Area-weighted mean soil organic carbon stock in a CEA from model-validation samples

Work out the area-weighted mean soil organic carbon stock in the CEA (the $\boldsymbol{\overline{SOC}_{CEA}}$), in tonnes of soil organic carbon per hectare, using the following equation:

$$\overline{SOC}_{CEA} = \sum_{h=1}^{H} (a_h \times \overline{SOC_h}) \quad \text{equation 97}$$

where:

$\boldsymbol{h}$ is an identifier for the stratum.

$\boldsymbol{H}$ is the number of strata for the CEA.

$\boldsymbol{a_h}$ is the relative area of the CEA covered by stratum *h* in the CEA, expressed as a proportion of the total CEA area.

$\boldsymbol{\overline{SOC_h}}$ is the mean soil organic carbon stock in the stratum *h*, in tonnes of soil organic carbon per hectare, worked out using equation 96.

Note: This section is identical to section 17 in subdivision 2 using the measurement-based approach except that it is applied to only model-validation samples rather than any samples in the CEA (including calibration samples).

34 Variance of the mean soil organic carbon stock within a stratum from model-validation samples

Work out the variance of the mean soil organic carbon stock for each stratum *h* in the CEA (the $\boldsymbol{V(\overline{SOC_h})}$), in (tonnes of soil organic carbon per hectare)^2, using the following equation:

$$V(\overline{SOC_h}) = \frac{\sum_{i=1}^{n_h}(SOC_i - \overline{SOC_h})^2}{(n_h - 1)} \qquad \text{equation 98}$$

where:

$\boldsymbol{i}$ is an identifier for each model-validation sample collected from the stratum *h*.

$\boldsymbol{n_h}$ is the number of model-validation samples collected from the stratum *h*.

$\boldsymbol{SOC_i}$ is the soil organic carbon stock for each sample *i* from stratum *h*, in tonnes of soil organic carbon per hectare, worked out using equation 94 or 95.

$\boldsymbol{\overline{SOC_h}}$ is the mean soil organic carbon stock in the stratum *h*, in tonnes of soil organic carbon per hectare, worked out using equation 96.

35 Variance of the mean soil organic carbon stock within a CEA from model-validation samples

Work out the variance of the mean soil organic carbon for the CEA (the $\boldsymbol{V(\overline{SOC_{CEA}})}$), in (tonnes of soil organic carbon per hectare)^2, using the following equation:

$$V(\overline{SOC_{CEA}}) = \sum_{h=1}^{H}\left({a_h}^2 \times V(\overline{SOC_h})\right) \qquad \text{equation 99}$$

where:

$\boldsymbol{h}$ is an identifier for the stratum.

$\boldsymbol{H}$ is the number of strata for the CEA.

$\boldsymbol{a_h}$ is the relative area of the CEA covered by stratum *h* in the CEA, expressed as a proportion of the total CEA.

$\boldsymbol{V(\overline{SOC_h})}$ is the variance of the mean soil organic carbon for stratum *h*, in (tonnes of soil organic carbon per hectare)^2, worked out using equation 98.

36 Sampling fraction in each stratum

Work out the sampling fraction (f_h) for each stratum using the following equation:

$$f_h = \frac{\sum_{n_{h,u}} ModEstA_h}{Area_h} \qquad \text{equation 100}$$

where:

$\boldsymbol{n_{h,u}}$ is number the model-validation samples, with unique modelled carbon stock estimate units (pixels/polygons) collected from the stratum h.

$\boldsymbol{ModEstA_h}$ is the area of a unique modelled carbon stock estimate unit (e.g. pixels) for the model-validation samples collected from the stratum *h*.

$\boldsymbol{Area_h}$ is the area of stratum *h.*

Note: The area of a single estimation area (e.g. pixel or polygon) is not counted twice if two sample locations happen to co-locate on the same modelled carbon stock estimate unit (e.g. pixel). At its most simple, this is the fraction of raster cells sampled in a CEA.

37 Sampling density weighting in each stratum

Work out the sampling density weighting (SDW_h) for each stratum using the following equation:

$$SDW_h = \frac{a_h^2(1 - f_h)}{n_h(n_h - 1)} \qquad \text{equation 101}$$

where:

$\boldsymbol{a_h}$ is the relative area of the CEA covered by stratum *h* in the CEA, expressed as a proportion of the total CEA.

$\boldsymbol{f_h}$ is the sampling fraction, worked out using equation 100.

$\boldsymbol{n_h}$ is the number of model-validation samples collected from the stratum *h*.

38 Area-weighted mean of the modelled carbon stocks at sample sites

Work out the area-weighted mean of the modelled carbon stock from the model-validation sites in the CEA ($\overline{ModSOC}_{mvs,CEA}$) using the following equation:

$$\overline{ModSOC}_{mvs,CEA} = \sum_h (a_h \times \overline{ModSOC}_{mvs,h}) \qquad \text{equation 102}$$

where:

$\boldsymbol{h}$ is the identifier for each stratum in the CEA.

$\boldsymbol{a_h}$ is the relative area of the CEA covered by stratum *h* in the CEA, expressed as a proportion of the total CEA.

Mod$\boldsymbol{\overline{SOC}_{mvs,h}}$ mean modelled soil organic carbon stock for the model-validation sites, in stratum *h,* in tonnes of soil organic carbon per hectare, worked out using equation 93.

39 Regression coefficient for the modelled and sampled carbon stocks in the CEA

Work out the regression coefficient (b_{CEA}) for the modelled and sampled carbon stocks in the CEA using the following equation:

$$b_{CEA} = \frac{\sum_h SDW_h \left(\sum_i (SOC_i - \overline{SOC}_h) \times \left(ModSOC_i - Mod\overline{SOC}_{mvs,h}\right)\right)}{\sum_h SDW_h \ \sum_i \left(ModSOC_i - Mod\overline{SOC}_{mvs,h}\right)^2} \quad \text{equation 103}$$

where:

$\boldsymbol{h}$ is the identifier for each stratum in the CEA.

$\boldsymbol{SDW_h}$ is the sampling density weighting for stratum h, given by equation 101.

$\boldsymbol{i}$ is the identifier for each model-validation site in the stratum *h*.

$\boldsymbol{SOC_i}$ is the soil organic carbon stock for model-validation site *i*, worked out using equation 95.

$\boldsymbol{\overline{SOC}_h}$ is the mean soil organic carbon stock for stratum *h*, worked out using equation 96.

$\boldsymbol{ModSOC_i}$ is the modelled soil organic carbon stock for model-validation site *i,* in tonnes of soil organic carbon per hectare, worked out using equation 91 or 92.

$\boldsymbol{Mod\overline{SOC}_{mvs,h}}$is the mean modelled soil organic carbon stock for the model-validation sites, in stratum *h*, in tonnes of soil organic carbon per hectare, worked out using equation 93.

40 Regression estimate of carbon stocks in the CEA

Work out the regression carbon stock estimate for the CEA ($\boldsymbol{Reg\overline{SOC}_{CEA}}$) using the following equation:

$$Reg\overline{SOC}_{CEA} = \overline{SOC}_{CEA} + b_{CEA}\left(Mod\overline{SOC}_{CEA} - \text{Mod}\overline{SOC}_{mvs,CEA}\right) \quad \text{equation 104}$$

where:

$\boldsymbol{\overline{SOC}_{CEA}}$ is the area-weighted mean of the sampled carbon stock, worked out using equation 97.

$\boldsymbol{b_{CEA}}$ is the regression coefficient for the modelled and sampled carbon stocks in the CEA, worked out using equation 103.

$\boldsymbol{Mod\overline{SOC}_{CEA}}$ is the mean modelled soil organic carbon stock, worked out using equation 90.

$\boldsymbol{Mod\overline{SOC}_{mvs,CEA}}$ is the area-weighted mean of the modelled carbon stock from the model-validation sites in the CEA, worked out using equation 102.

41 Variance of the modelled soil organic carbon stock within a stratum

Work out the variance of the mean modelled soil organic carbon for the model-validation sites for each stratum *h* in the CEA (the $\boldsymbol{V}(\overline{\boldsymbol{ModSOC}}_{\boldsymbol{mvs,h}})$), in (tonnes of soil organic carbon per hectare)^2, using the following equation:

$$V(Mod\overline{SOC}_{mvs,h}) = \frac{\sum_{i=1}^{n_h}\left(ModSOC_i - Mod\overline{SOC}_{mvs,h}\right)^2}{(n_h - 1)} \quad \text{equation 105}$$

where:

$\boldsymbol{i}$ is the identifier for each sample collected from the stratum *h*.

$\boldsymbol{n_h}$ is the number of model-validation samples collected from the stratum *h*.

$\boldsymbol{ModSOC_i}$ is the modelled soil organic carbon stock for each sample site *i* in stratum *h*, in tonnes of soil organic carbon per hectare, worked out using equation 91 or 92.

$\boldsymbol{Mod\overline{SOC}_{mvs,h}}$ is the mean modelled soil organic carbon stock for the model-validation sites for each stratum *h*, worked out using equation 93.

42 Covariance of the sampled and modelled soil organic carbon stocks in each stratum

Work out the covariance of the sampled and modelled soil organic carbon stocks for each stratum *h* in the CEA the $Cov\left(\overline{SOC}_h . Mod\overline{SOC}_{mvs,h}\right)$ in (tonnes of soil organic carbon per hectare)^2, using the following equation:

$$Cov(\overline{SOC}_h . Mod\overline{SOC}_{mvs,h}) = \frac{\sum_{i=1}^{n_h}(SOC_i - \overline{SOC}_h) \times \left(ModSOC_i - Mod\overline{SOC}_{mvs,h}\right)}{(n_h - 1)} \quad \text{equation 106}$$

where:

$\boldsymbol{i}$ is the identifier for each model-validation site in the stratum *h*.

$\boldsymbol{n_h}$ is the number of model-validation samples collected from the stratum *h*.

$\boldsymbol{SOC_i}$ is the soil organic carbon stock for each sample *i* from stratum *h*, in tonnes of soil organic carbon per hectare, worked out using equation 94 or 95.

$\boldsymbol{\overline{SOC}_h}$ is the mean soil organic carbon stock in the stratum *h*, in tonnes of soil organic carbon per hectare, worked out using equation 96.

$\boldsymbol{ModSOC_i}$ is the modelled soil organic carbon stock for each sample site *i* from stratum *h*, in tonnes of soil organic carbon per hectare, worked out using equation 91 or 92.

$\boldsymbol{Mod\overline{SOC}_{mvs,h}}$is the mean modelled soil organic carbon stock for each stratum *h*, worked out using equation 93.

43 Regression estimate of sampling variance of mean carbon stocks within a stratum

Work out the regression estimate of sampling variance of mean carbon stocks for each stratum *h* in the CEA (the $RegSV(\overline{SOC}_h)$) for the sampled and modelled carbon stocks in the CEA (tonnes of soil organic carbon per hectare)^2, using the following equation:

equation 107

$$RegSV(\overline{SOC}_h) = \frac{1-f_h}{n_h}\left(V(\overline{SOC}_h) - 2b_{CEA}Cov\left(\overline{SOC}_h . Mod\overline{SOC}_{mvs,h}\right) + {b_{CEA}}^2\, V\left(Mod\overline{SOC}_{mvs,h}\right)\right)$$

where:

$\boldsymbol{h}$ is the identifier for each stratum in the CEA.

$\boldsymbol{f_h}$ is the sampling fraction for the stratum *h*, worked out using equation 100.

$\boldsymbol{n_h}$ is the number of model-validation samples collected from the stratum *h*.

$\boldsymbol{V(\overline{SOC}_h)}$ is the variance of the mean soil organic carbon stock for the stratum *h*, worked out using equation 98.

$\boldsymbol{b_{CEA}}$ is the regression coefficient for the modelled and sampled carbon stocks in the CEA, worked out using equation 103.

$\boldsymbol{Cov(\overline{SOC}_h . Mod\overline{SOC}_{mvs,h})}$ is the covariance of the sampled and modelled soil organic carbon stocks in stratum h, worked out using equation 106.

$\mathbf{V}(\boldsymbol{Mod\overline{SOC}_{mvs,h}})$ is the variance of the mean modelled soil organic carbon for the model-validation sites for each stratum *h*, worked out using equation 105.

44 Regression estimate of sampling variance of mean carbon stocks in the CEA

Work out the regression estimate of sampling variance of mean carbon stocks in the CEA (the $RegSV(\overline{SOC}_{CEA})$) for the sampled and modelled carbon stocks in the CEA (tonnes of soil organic carbon per hectare)^2, using the following equation:

$$RegSV(\overline{SOC}_{CEA}) = \sum_{h=1}^{H} a_h^2 \times RegSV(\overline{SOC}_h)$$ equation 108

where:

$\boldsymbol{h}$ is the identifier for each stratum in the CEA.

$\boldsymbol{H}$ is the number of strata for the CEA.

$\boldsymbol{a_h}$ is the relative area of the CEA covered by stratum *h* in the CEA, expressed as a proportion of the total CEA.

$\boldsymbol{RegSV(\overline{SOC}_h)}$ is the regression estimate of sampling variance of mean carbon stocks for stratum h, worked out using equation 107, in (tonnes of soil organic carbon per hectare)^2.

45 Degrees of freedom for the regression estimate of sampling variance of mean carbon stocks in the CEA

Work out the degrees of freedom ($\boldsymbol{df_{CEA}}$) to use in equation 115 for a given estimation event, using the following equation:

$$df_{CEA} = \frac{\left(\sum_{h=1}^{H} {a_h}^2 \times RegSV(\overline{SOC}_h)\right)^2}{\sum_{h=1}^{H}\left(\frac{({a_h}^2 \times RegSV(\overline{SOC}_h))^2}{(n_h - 1)}\right)} \qquad \text{equation 109}$$

where:

$\boldsymbol{h}$ is an identifier for the stratum.

$\boldsymbol{H}$ is the number of strata for the CEA.

$\boldsymbol{a_h}$ is the relative area of the CEA covered by stratum *h* in the CEA, expressed as a proportion of the total CEA area.

$\boldsymbol{RegSV(\overline{SOC}_h)}$ is the regression estimate of sampling variance of mean carbon stocks for stratum h in the CEA, worked out using equation 106A, in (tonnes of soil organic carbon per hectare)^2.

$\boldsymbol{n_h}$ is the number of model validation samples collected from the stratum h.

Note 1: Equation 109 is a simplified equation using the condition that $\frac{{s_{\overline{SOC}_h}}^2}{n_h} = V(\overline{SOC}_h)$. The original version of the equation is: $df_{CEA_{t_x}} = \frac{\left(\sum_{h=1}^{H} {a_h}^2 \times \frac{{s_{\overline{SOC}_h}}^2}{n_h}\right)^2}{\sum_{h=1}^{H}\left(\frac{\left({a_h}^2 \times \frac{{s_{\overline{SOC}_h}}^2}{n_h}\right)^2}{(n_h - 1)}\right)}$

Note 2: Where a CEA contains three strata, equation 109 written in its expanded form, where the subscripts 1, 2, and 3 are used to denote values for stratum 1, stratum 2, and stratum 3, respectively takes the following form:

$$df_{CEA_{t_x}} = \frac{\left({a_1}^2 \times V(\overline{SOC}_1) + {a_2}^2 \times V(\overline{SOC}_2) + {a_3}^2 \times V(\overline{SOC}_3)\right)^2}{\frac{\left({a_1}^2 \times V(\overline{SOC}_1)\right)^2}{(n_1 - 1)} + \frac{\left({a_2}^2 \times V(\overline{SOC}_2)\right)^2}{(n_2 - 1)} + \frac{\left({a_3}^2 \times V(\overline{SOC}_3)\right)^2}{(n_3 - 1)}}$$

46 Bias of the carbon stock estimation in the CEA

Work out the bias of modelled values in the CEA ($\text{ModBias}_{\text{CEA}}$) using the following equation:

$$\text{ModBias}_{CEA} = \overline{ModSOC}_{mvs,CEA} - \overline{SOC}_{CEA} \qquad \text{equation 110}$$

where:

$\boldsymbol{\overline{ModSOC}_{mvs,CEA}}$ is the area-weighted mean of the modelled carbon stock from the model-validation sites in the CEA, worked out using equation 102.

$\boldsymbol{\overline{SOC}_{CEA}}$ *is* the area-weighted mean of the sampled soil organic carbon stock for the CEA, given by equation 97.

Note: This section does not directly inform the net abatement calculations for the CEA directly but rather are calculated for the purposes of model-validation statistics in the Supplement that allow for the use of model-only estimates in other CEAs.

47 Correlation of the sampled and modelled soil organic carbon stocks for the CEA

Work out correlation of the modelled and measured carbon stocks in the CEA (r_{CEA}) using the following equation:

$$r_{CEA} = \sum_h a_h \frac{Cov(SOC_h, ModSOC_{mvs,h})}{\sqrt{V(SOC_h)}\sqrt{V(ModSOC_{mvs,h})}} \qquad \text{equation 111}$$

where:

$\boldsymbol{h}$ is the identifier for each stratum in the CEA.

$\boldsymbol{a_h}$ is the relative area of the CEA covered by stratum *h* in the CEA, expressed as a proportion of the total CEA.

$\boldsymbol{Cov(\overline{SOC}_h . \overline{ModSOC}_h)}$ is the covariance of the sampled and modelled soil organic carbon stocks for each stratum h in the CEA, worked out using equation 106.

$\boldsymbol{V(\overline{SOC}_h)}$ is the variance of the mean soil organic carbon for each stratum *h*, worked out using equation 98, in (tonnes of soil organic carbon per hectare)^2.

$\boldsymbol{V(\overline{ModSOC}_{mvs,h})}$ is the variance of the mean modelled soil organic carbon for the model-validation sites for each stratum *h* , worked out using equation 105, in (tonnes of soil organic carbon per hectare)^2.

Note: This section does not directly inform the net abatement calculations for the CEA directly but rather are calculated for the purposes of model-validation statistics in the Supplement that allow for the use of model-only estimates in other CEAs.

48 Fraction of sampling variance in the CEA

Work out the fraction of sampling variance in the CEA (fsv_{CEA}) using the following equation:

$$fsv_{CEA} = \frac{RegSV(\overline{SOC}_{CEA})}{Reg\overline{SOC}_{CEA}}$$ equation 112

where:

$\boldsymbol{RegSV(\overline{SOC}_{CEA})}$is the regression estimate of sampling variance of mean carbon stocks in the CEA for the sampled and modelled carbon stocks in the CEA, worked out using equation 108, in (tonnes of soil organic carbon per hectare)^2.

$\boldsymbol{Reg\overline{SOC}_{CEA}}$ is the regression carbon stock estimate for the CEA, worked out using equation 104 in tonnes of soil organic carbon per hectare.

Note: This section does not directly inform the net abatement calculations for the CEA directly but rather are calculated for the purposes of model-validation statistics in the Supplement that allow for the use of model-only estimates in other CEAs.

Division 5—Working out the creditable change in soil organic carbon stock for a CEA

49 Working out the creditable change in soil organic carbon stock in a CEA for a reporting period

Subject to subsection 10(4) of this Schedule, the creditable change in soil organic carbon in each CEA associated with a specified probability of exceedance for a reporting period (the $\Delta \boldsymbol{SOC}_{\boldsymbol{PoE,CEA}\,(\boldsymbol{t_0}-\boldsymbol{t_x})}$), between the first estimation event in the CEA (t_0) and the last estimation event (t_x) in the reporting period, in tonnes of soil organic carbon, must be worked out in accordance with this Division.

50 Change in carbon stock between estimation events

Work out the change in soil organic carbon stock for the CEA between the first estimation event (t_0) and the last estimation event (t_x), in the reporting period (the $\Delta \boldsymbol{SOC}_{\boldsymbol{CEA}(\boldsymbol{t_0}-\boldsymbol{t_x})}$), in tonnes of soil organic carbon, using the following equation:

$$\Delta SOC_{CEA(t_0-t_x)} = SOC_{CEA\,t_x} - SOC_{CEA\,t_0} \qquad \text{equation 113}$$

where:

$\boldsymbol{SOC}_{\boldsymbol{CEA}\,\boldsymbol{t_x}}$ is the value for SOC_{CEA} for the CEA in the last estimation event that occurred in the reporting period, in tonnes of soil organic carbon, given by equation 71.

$\boldsymbol{SOC}_{\boldsymbol{CEA}\,\boldsymbol{t_0}}$ is the value for SOC_{CEA} for the CEA in the first estimation event in the CEA, in tonnes of soil organic carbon, given by equation 71.

51 Standard error for change in soil organic carbon stock

Work out the standard error of the mean difference between total soil organic carbon stock for the CEA between the first estimation event (t_0) and the last estimation event (t_x), in the reporting period (the SE), in tonnes of soil organic carbon, using the following equation:

$$SE_{CEA(t_0-t_x)} = \sqrt{SV\left(SOC_{CEA\,t_0}\right) + SV\left(SOC_{CEA\,t_x}\right)} \qquad \text{equation 114}$$

where:

$\boldsymbol{SV}\left(\boldsymbol{SOC}_{\boldsymbol{CEA}\,\boldsymbol{t_0}}\right)$ is the value for $SV(SOC_{CEA})$ for the CEA from the first estimation event in the CEA, (in tonnes of soil organic carbon)^2, worked out using equation 72.

$\boldsymbol{SV}\left(\boldsymbol{SOC}_{\boldsymbol{CEA}\,\boldsymbol{t_x}}\right)$ is the value for $SV(SOC_{CEA})$ for the CEA from the last estimation event in the reporting period, in (tonnes of soil organic carbon)^2, worked out using equation 72.

52 Degrees of freedom for a CEA between estimation events

Work out the degrees of freedom (***df)*** to use in equation 116 for the CEA, using the following equation:

$$df_{CEA\ t_0-t_x} = \frac{\left(SV\left(SOC_{CEA_{t_0}}\right) + SV\left(SOC_{CEA_{t_x}}\right)\right)^2}{\left(\frac{SV\left(SOC_{CEA_{t_0}}\right)^2}{df_{CEA_{t_0}}} + \frac{SV\left(SOC_{CEA_{t_x}}\right)^2}{df_{CEA_{t_x}}}\right)} \qquad \text{equation 115}$$

where:

$\boldsymbol{SV\left(SOC_{CEA\ t_0}\right)}$ is the is the value for $SV(SOC_{CEA})$ for the CEA from the first estimation event in the CEA, in (tonnes of soil organic carbon)^2, worked out using equation 72.

$\boldsymbol{SV\left(SOC_{CEA\ t_x}\right)}$ is the value for $SV(SOC_{CEA})$ for the CEA from the last estimation event in the reporting period, t_x, in (tonnes of soil organic carbon)^2, worked out using equation 72.

$\boldsymbol{df_{CEA_{t_0}}}$ is the value for df_{CEA} for the CEA from the first estimation event in the CEA, given by section 14 of this Schedule.

Note 1: The first estimation event must include sampling for consistency with paragraph 5(2)(a) of this Schedule, which requires sampling for the first estimation event.

$\boldsymbol{df_{CEA_{t_x}}}$ is the value for df_{CEA} for the CEA from the last estimation event in the reporting period, given by section 14 of this Schedule.

53 Change in soil organic carbon stock in the CEA with a specified probability of exceedance for a reporting period

Work out the change in soil organic carbon stock for a CEA for a reporting period between the first estimation event and a subsequent estimation event for the reporting period associated with a specified probability of exceedance (the $\boldsymbol{\Delta SOC_{PoE,CEA(t_0-t_x)}}$), in tonnes of soil organic carbon, using the following equation:

$$\Delta SOC_{PoE,CEA(t_0-t_x)} = \left(\Delta SOC_{CEA\ (t_0-t_x)} + SE_{CEA(t_0-t_x)} \times t_{\alpha(df)}\right) \times (1 - TD) \qquad \text{equation 116}$$

where:

$\boldsymbol{\Delta SOC_{CEA\ (t_0-t_x)}}$ is the value for $\Delta SOC_{CEA\ (t_0-t_x)}$, for the CEA for the reporting period, in tonnes of soil organic carbon, worked out using equation 113.

$\boldsymbol{SE_{CEA(t_0-t_x)}}$ is the value for *SE* for the CEA given by equation 114.

$\boldsymbol{t_{\alpha(df)}}$ is the value of the quantile function (inverse distribution function) for the t-distribution with the value for alpha ($\boldsymbol{\alpha}$) set out in the Supplement and with the value for the degrees of freedom $\boldsymbol{df_{CEA\ t_0-t_x}}$ worked out using equation 115.

Note: An alpha ($\boldsymbol{\alpha}$) value of 0.4 would give a 60% probability of exceedance.

TD is equal to:

(a) if the calculation occurs for the first and second estimation events for the CEA—0.25;

Note: The 0.25 multiplier is a temporary discount to the creditable amount of change in soil organic carbon stock due to the use of only 2 estimation events (the effect of climatic influences relative to management-induced changes is assumed to be less influential after three carbon stock estimations and the discount no longer applies). After 3 or more estimations, credits withheld due to the discount will be returned if carbon increases are maintained.

(b) otherwise—zero.