

### **SUMMARY AND RESPONSE TO PEER-REVIEW COMMENTS**

A draft Methodology for Quantification, Monitoring, Reporting and Verification of Greenhouse Gas Emissions Reductions and Removals from Improved Forest Management on Canadian Forestlands was developed by Dr. John Kershaw and Yung-Han Hsu based in Fredericton, NB Canada in cooperation with Bluesource LLC, Finite Carbon and American Carbon Registry (ACR), for potential approval by ACR.

All new methodologies and methodology modifications, whether developed internally or brought to ACR by external parties, undergo a process of public consultation and scientific peer review prior to approval.

The methodology was posted for public comment from December 1, 2020 – February 22, 2021. The methodology was reviewed by an independent panel of experts from March 1, 2021 – September 3, 2021 . Peer reviewer comments and author responses are documented [here](#).

#	Document Section	R1 Comment	R1 Author Response	R2 Comment	R2 Author Response
1	Acronyms and Definitions	<p>You have these two definitions: “ERT = Emission reduction ton” and “ton = 1,000 kg”.</p> <p>But in Canada (and most of the metric world) we refer to 1,000 kg as a “tonne”, not a “ton” – i.e., a tonne is 1,000 kg (2,204.6 pounds) and a ton is 2,000 pounds. Your definitions will be confusing for Canadians.</p>	<p>In the methodology, the ACR definition of “ton” is used consistently with a metric “tonne”. ACR has replaced or clarified all references to “tons” with “tonnes” throughout.</p>	OK, <b>issue closed.</b>	
2	Acronyms and Definitions	<p>You define TSA as “an area of private or Provincial Crown land...”, which made me assume that this protocol was for</p>	<p>The term “Timber Supply Area” has been removed from the protocol to eliminate</p>	OK, <b>issue closed.</b>	

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		<p>both private and Crown (public) land. Then I got to the Applicability section and realized the protocol is only for private land and a few Crown land exceptions (Indigenous lands, community forests). I would change the definition of TSA to be a generic definition for the project area, such as “the area or areas of land on which project proponents will undertake the project activities” (from VCS’s BC Forest Carbon protocol).</p>	<p>ambiguity. TSA has been replaced with “Forest Products Supply Area” and the definition has been revised to “An area of <del>private or Provincial Crown</del> land producing forest products and fulfilling the needs of a given geographic market. Such areas must be defined by the Project Proponent and accompanied by verifiable evidence that any forest products produced on forested landholdings owned</p>		

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			<p>or managed by the Project Proponent and not enrolled in the carbon project fulfill separate and distinct market demand, such that leakage can be reasonably expected not to occur.”</p> <p>There are no Crown land exceptions within this protocol. The generic definition you recommend is specific to the project area and does not satisfy the sustainable management requirements.</p>		
3	1.2	I find your use of this term “provincial	Section 1.2 has been revised to	OK, <b>issue closed.</b>	

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		<p>Crown forestland license” to be confusing. My understanding of public land tenure systems in Canada is that all public land forest tenure (including community forests) falls under some form of a “provincial Crown forestland license”, except for Indigenous lands. Is this correct? And if so, why not just say that in order to be applicable, the project area must either be privately owned, a community forest, or Indigenous lands?</p>	<p>state: “This methodology is not applicable on provincial or federal Crown land. It is applicable on all other forestlands within Canada.”</p>		

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4	1.2	<p>Why prohibit non-indigenous tree species in the project scenario? Instead, perhaps you could require the project developer show that these non-indigenous plantations pass a financial investment test of additionality (i.e. these plantations are only viable because of the revenue from ERTs). Indeed, faster growing tree species have been shown to have higher sequestration rates and could therefore improve project economics.</p>	<p>Prohibiting non-native trees species in the project scenario is consistent with ACR’s natural management requirements (section A.3.3 ACR Standard v7.0). Please note that exceptions to these requirements may be granted when the species is considered naturalized or when provided verifiable evidence that the species does not affect local ecosystems. In either instance, the Project Proponent must also demonstrate that this type of plantation</p>	<p>OK, <b>issue closed.</b></p>	

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			conversion is commonplace for the region.		
5	3.1	The Faustmann approach using a discount rate might be appropriate for baseline estimates on private forestland (and perhaps some Indigenous lands), but this approach doesn't apply to public land community forests, which according to their Crown land forest tenure requirements would most likely be managed according to the principals of sustained yield. Instead of maximizing NPV (as per Faustmann),	Provincial and/or federal Crown land is not applicable to this methodology (see also section 1.2), the reference to community forests was for municipalities that own fee simple forestland and do not have Crown land forest tenure requirements. Therefore, the Faustmann approach is appropriate for this methodology.	How is a municipality (i.e., a municipal government) different than the provincial or federal government? I don't understand why Canada's federal and provincial governments require forestland be managed according to the principals of Sustained Yield, and yet this methodology assumes that a municipality would own forestland and manage it for profit maximization (i.e., Faustmann). Is	The key differentiator between a municipally owned forest and a provincially or federally owned forest (Crown land) is the applicability of forest management regulations and prescriptions. In the majority of cases, municipalities are not subject to any restrictions in forest management unless they designate themselves land for special protection. This means that a municipally owned forest that justifies

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		<p>sustained yield management maximizes the annual allowable cut over a very long (i.e., 200-year) planning horizon.</p>		<p>there evidence of Canadian municipalities actually managing forestland according to Faustmann? Or are these lands usually managed for conservation and parks/recreation? Along these same lines, I have similar concerns about forestland owned by an environmental NGO and upon which the ENGO wants to do an IFM carbon project. Would such a project by an ENGO use a profit maximizing Faustmann baseline at 4% for land that it has owned for many years and</p>	<p>a baseline based on profit maximization satisfies a regulatory additionality test. The question then is whether it is common practice.</p> <p>Most municipally owned forests voluntarily manage according to principles of sustainable yield. However, it is very much common practice for municipalities to sell forested property to fund budget gaps and pay for ongoing forest and land management activities. These properties are most often cleared for development or</p>



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				<p>never used for timber production? It seems an unlikely baseline. In all of these cases (municipal land, ENGO land, and perhaps even Indigenous land) I wonder if a better baseline would be to simulate the carbon inventory based on the historical land use.</p>	<p>managed intensively by the new owners.</p> <p>In considering a forest carbon project on their lands, an Ontario municipal council that manages according to sustainable yield on the lands they own, stated that they had gone from over ~70% forested cover in the county 50 years ago to about 5% forested cover and saw the forest carbon project as an opportunity to retain what little was left and reverse that trend if possible.</p>

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					<p>IFM projects are about attaching a financial value to the carbon sequestration benefits of trees where timber is currently the only financial value. This allows private and municipal landowners to meet their corporate or public goals related to financial management and achieve a higher standard of sustainable forest management. In today's environment of high timber prices and constraints on public budgets, municipalities face significant pressure to harvest more</p>

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					<p>intensively and sell off timberlands to deal with budget cuts and make forest and land management financially self-sustaining, so as not to depend on the tax base. History shows that voluntary principles of sustainable yield don't stand up to economic realities in the long-term.</p> <p>Specific examples have been provided separately.</p> <p>Regarding harvesting on first nation reserves, there is an entire federal regulation that covers this. Quite a common</p>

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					<p>practice for reserves in the commercial forest zone.  <a href="https://laws-lois.justice.gc.ca/en/g/regulations/C.R.C.,_c._961/FullText.html">https://laws-lois.justice.gc.ca/en/g/regulations/C.R.C.,_c._961/FullText.html</a></p> <p>Reviewer response #5 continued at bottom of table.</p>
6	Table 1	Who/what would be conducting an IFM project on “non-federal public lands” in Canada? And why would these projects get a lower discount rate than projects on Indigenous lands?	A municipality that owns fee simple forestland would be conducting an IFM project on “non-federal public lands” in Canada. These projects would get a lower discount rate than projects on Indigenous lands because the discount rate is determined by an	Again, I’m skeptical about a municipality managing its forestland for profit maximization (as per comment #5), but if you were to justify it somehow, I still find the last row of Table 1 confusing because it doesn’t refer to provincial forestland. If this last row is only for municipally owned	Please refer to response on comment #5 regarding NPV maximization on municipal lands.  Regarding table 1 discount rates, the last row has been updated as suggested to “non-federal and non-provincial public lands”.

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			organization's cost of capital. A municipality's cost of capital will be much lower than other private organizations due to the sovereign backing.	community forestland, then why not change the last row from "non-federal public lands" to "municipally-owned community forests"? Or perhaps change it to "non-federal and non-provincial public lands"?	<u>Reviewer Response:</u> I have issues with using NPV maximization for estimating the baseline, as will be raised below in my response for Comment #5. But in regard to this comment, and how it relates to Table 1: <b>issue closed.</b>
7	3.3	In this section there are too many terms used for the same unit of measure: "tons", "metric tons", "metric tonnes". To be consistent, I suggest changing everything to "tonnes", as per the change in definition suggested	ACR has revised, consistent with comment #1.	OK, <b>issue closed.</b>	

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		above in Comment #1.			
8	Equation 5	Why is the denominator in this equation the number 21? Shouldn't it be 20?	To derive long-term baseline stocking over a 20-year timeframe the Project Proponent must average carbon stocks over a 20-year duration, including initial carbon stocks at t=0. As such, the denominator must consider 21 datapoints in the long-term average.	OK, <b>issue closed.</b>	
9	Equations 6 and 7	These two equations were confusing until I referred to the US IFM methodology. I think what you have in the US methodology is easier to understand.	Equations 6 and 7 of the Canada IFM were purposely added to clarify methodology intent. We also plan to add them to the U.S. IFM methodology at its next update.	OK, <b>issue closed.</b>	

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			Equations 6 and 7 identify the year $t=T$ when initial carbon stocks are above or below baseline (respectively). There were previously no formalized equations denoting $t=T$ . The equations 6 and 7 from the U.S. methodology are still available as equations 8 and 10 in the Canada IFM.		
10	Equations 6, 7, 8, 9	In the definitions of these equations, most of the time “ $t$ ” isn’t actually a “year”, as you specify in the definitions – it’s actually the “reporting period” (unless of course the project developer was to	If I understand correctly, this comment applies to all methodology equations including the parameter “ $t$ ” (Time in years). Your correct parameter “ $t$ ” is consistent with the methodology definition of	OK, <b>issue closed</b> .	

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		report each year, but given the slow growth of forests in Canada and the high costs of reporting, this seems unlikely). Regardless, I think “reporting period” is less confusing.	“Reporting Period”. We’ve attempted to clarify this in the text under the premise that time in years can be fractional (see Section 3.3 and elsewhere -- “...the change in baseline carbon stocks be computed for each time period, t”.		
11	Pg. 35/36	In the table of multipliers, there is both “tons” and “tonnes”. Once again, I find this confusing. I recommend to simply use “tonnes” for metric tonnes and keep the use of “tons” for U.S. tons. This is the norm in the scientific	ACR has revised, consistent with comment #1.	OK, <b>issue closed.</b>	



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		literature, even for U.S. scientists.			
12	Pg. 38	There are default values for the different product classes in the case that mill production data is not available, but there aren't default "in-use" vs "landfill" values in the case that these data are not available. Yet, it seems to me that the "in-use" values will be harder to get than the mill production data – hence, I suggest providing a table of default values based on verified sources in the literature.	According to Section 3.3.2 there are 5 steps to account for wood products in the project and baseline scenarios. Carbon in harvested wood delivered to mills is derived in step 1 and adjusted for mill efficiencies and storage factors by product in steps 2 and 3, respectfully. The same default product class breakdowns assigned for in-use (step 3) are also relevant to landfill (step 4). We have added clarification to step 4 of Section	OK, <b>issue closed</b> .	

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			3.3.2 to further clarify.		
13	Equation 25	<p>I don't understand this equation. Part of the confusion is that there are two definitions for "t" – in one case it's "the vintage year" and in other cases it's the "reporting period" (again, it's the same issue as listed above in Comment #10). My intuition tells me that these three equations (25, 26, 27) are a way of assigning vintage years to ERTs generated over a multi-year reporting period. However, if this is indeed the case, I don't think these equations make it clear.</p>	<p>See response to comment 10 and also paragraph ahead of equation 25: "ERTs by vintage shall then be determined by prorating Reporting Period calendar days within vintage year t (Equation 25)...". You are correct equation 25 is used in assigning vintage year when a reporting period spans multiple calendar years.</p>	OK, <b>issue closed</b> .	

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14	Equation 25, 25, 27	If I am correct that it applies a vintage year to projects that have multi-year reporting periods: why is this unique to the Canadian ACR IFM methodology? And why do other Canadian IFM methodologies (such as the BC VCS methodology) not assign such vintages?	ACR has added the functional equivalent of equations 25, 26 and 27 to the U.S. IFM methodology within an <u>errata and clarification</u> document and intends to fully integrate these equations to the U.S. methodology at its next update. Assigning vintage is required to market carbon credits under CORSIA.	OK, <b>issue closed</b> .	
15	1.2	Some groups who hold a forest license on public land (e.g., community forests) can use this methodology, but private forest products companies which also hold	This methodology is not for any entity holding a forest license on public lands. Jurisdictions would need to establish Atmospheric Benefit Sharing	Public land is land owned by a government. By that definition, land owned by a municipal government is also public land. So how can you reply that	We erroneously responded that this methodology is not applicable to public lands. As stated within the methodology, it is not applicable to provincial or

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		<p>timber licenses on public land can't use it. Why not allow a private forest products company to carry out an IFM carbon project on Crown land? By eliminating these companies, you are eliminating over half of Canada's forests.</p>	<p>Agreements with tenure holders before a carbon project could take place on public lands. It was considered but as it's more complicated on crown land, we're eliminating.</p>	<p>"This methodology is not for any entity holding a forest license on public lands." If a municipality leases its forestland to a community forest organization, how is that different than a province leasing its forestland to a community forest organization? Why would the provincial government need an Atmospheric Benefit Sharing Agreement but not a municipal government?</p>	<p>federally owned Crown land. A lease is not the same as a license. Forestry companies operate under licenses, while some community forests operate under leases. The distinction is however important (see CRA website for an explanation of the differences). <a href="https://www.canada.ca/en/revenue-agency/services/for ms-publications/publications/p-062/distinction-between-lease-license-similar-arrangements.html">https://www.canada.ca/en/revenue-agency/services/for ms-publications/publications/p-062/distinction-between-lease-license-similar-arrangements.html</a></p> <p>As described in the answer to question</p>

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					<p>#5, the important differentiator is not whether the entity that owns the land is a public institution, but whether it is subject to forest management regulations. This differentiation is relevant because forests subject to forest management regulations have different considerations for additionality. It is also relevant because Crown forests are owned by the province and not the licensed operators managing the forests and making decisions that sequester more or less carbon. As</p>

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					<p>such, any actions by a licensed operator to sequester more CO2 lead to environmental benefits that are owned by the province, not the operator. Conversely, Municipal land is owned in fee simple title in the same way private timberlands are. As such, a municipality both controls the forest management practices and owns the land, therefore they do not need an Atmospheric Benefits Sharing Agreement. Crown land is not owned by the Province in fee simple title.</p>

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					Reviewer Response: OK, <b>issue closed.</b>
16	1.3	Exclusion of litter/forest floor C and soil organic C will likely exclude the ability to properly account for certain types of projects related to harvest residues. For example (but not limited to), increased utilization of harvest residue or other underutilized components (rather than a baseline of either slash burning or leaving the material on site to decay) requires an accounting of their alternate fates in litter or soil C. This is especially the	In this methodology (similar to the U.S. IFM) the litter/forest floor and soil organic C pools are excluded and their contribution to C stocks is considered de minimis. This is because forest carbon markets have typically regarded these pools as not financially feasible to measure (measurement costs outweigh carbon revenues). Also, since the litter/forest floor and soil organic carbon pools are expected to	Yes, I understand the cost issue related to measuring these pools. I think it will need to be clearly specified that anything that may affect the soil and DOM C pools must be treated the same in the baseline and in the project. So, for example, if site preparation prior to planting is to occur, then the SAME site preparation must occur in the baseline and the project. Similarly, if harvest residues are to be removed or burned or left on site, then this must	At project start date the same site conditions exist in the baseline and project scenarios. From these initial conditions, a baseline incorporating all relevant forest management and site preparation requirements is modeled over 100 years. These requirements are specified in Section 3.1: "The baseline management scenario shall be based on treatment levels...that seek to perpetuate existing onsite timber producing species

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		<p>case if the time period of one benefits accrue (soon after the project happens, or sometime later in the future) is important.</p>	<p>increase under the project (relative to the baseline scenario), exclusion of these pools is conservative.</p>	<p>occur also in both scenarios, baseline, and project.</p> <p>Note that these effects can be significant, especially if the time course of when benefits accrue is important. If one wishes to have benefits sooner, then the treatment of soil and DOM C can be very important.</p> <p>It might also be useful to suggest that if an assumption is made that soil and DOM C will increase in the project relative to the baseline (and therefore exclusion is conservative),</p>	<p>while fully utilizing available growing space” and “Required inputs for the project NPV calculation include... reforestation and related costs, silvicultural treatment costs, and carrying costs”. The project scenario is measured and inherently includes any relevant site preparation treatments and costs to forest management activities.</p> <p>The assumption that IFM project activities will maintain or increase soil and DOM C stocks compared to</p>



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				<p>that there must be some modelling or scientific justification for this provided.</p> <p>A good recent review of the effects of forest management on soil carbon is provided in the following:</p> <p><a href="https://www.sciencedirect.com/science/article/pii/S0378112720300268">https://www.sciencedirect.com/science/article/pii/S0378112720300268</a></p>	<p>baseline is common in the carbon market (see <a href="#">CAR</a> and <a href="#">Verra</a> protocols) and supported by the literature. Table 1 and citations within Mayer et al. (2020) provide excellent high-level summary of the neutral to positive effects of IFM activities upon soil carbon, including retention of primary forest, reduced harvest frequency and intensity, management of stand density and thinning and management for increased species diversity.</p>

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					Reviewer Response: <b>Issue closed.</b>
17	3.3.1	When multiple models are available for a given situation, how are you going to stop proponents from trying all of them and choosing the one that gives them the most benefit?	The same models and equations used to construct the baseline are used in the project scenario. Because crediting is determined by the delta between baseline and project scenario stocks, there is no “benefit” to using one model as opposed to another. We have further clarified in Section 3.3.1 that “The same model must be used in baseline and project scenario stocking projections”.	Agree that this eliminates most of the concern. It’s still possible, however, to game things and try different acceptable approaches (e.g. the approaches (a) and (b) you describe in 3.3.1.1) to see which one gets you a larger difference between baseline and project, even if baseline and project use the same methods. My original comment 6 was related to this same point.	The intention of this methodology is not to require or focus on utilizing the most conservative of the available models, which would inherently necessitate duplicate quantification for all projects by the project proponent, verification body, and ACR. As you state in your response to comment 6, though different models may produce different outputs, the outputs are equally legitimate and simply

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					<p>reflective of the fact that different models make different predictions.</p> <p>We feel providing multiple model / quantification options is important for the use and scalability of this methodology.</p> <p><u>Reviewer response:</u>  <span style="background-color: #90EE90;">issue closed.</span></p>
18	3.3.1.1	CBM-CFS3 isn't just a tool for estimating biomass. It can also do a full simulation of soil and Dead organic matter C, as well as the impact of a wide range of disturbances (see also comment 1)	We are aware of CBM-CFS3 capabilities. This protocol, like its American counterpart, requires field data verification. For this protocol, we limit CBM-CFS3 to the conversion of	I am in agreement with the need for field verification. I will just point out that In the absence of modelling of soil and DOM C or disturbance effects, there is no need to use CBM-CFS3. Merchantable	We agree that CBM-CFS3 does not have to be directly used, but think it is a beneficial and important option worthy of inclusion. If users do not want to use CBM-CFS3 we have given them option (a). These

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			<p>merchantable volume to biomass. The soil and organic matter can be included in the protocol and CBM-CFS3 could possibly be used for those components as well.</p> <p>Please note that these limitations on the use of CBM-CFS3 is for consistency and links back to the field verification, not because ACR or any of the authors of this protocol feel there are errors in CBM-CFS3.</p>	<p>volume (correctly compiled according to province specific stump height, minimum dbh and top dbh criteria) may be converted directly to biomass (and therefore also C) by simply using the equations themselves. The models and parameters are available at <a href="https://nfi.nfis.org/en/biomass">https://nfi.nfis.org/en/biomass</a>. A web-based calculator is available at : <a href="https://nfi.nfis.org/en/biomass_stand_merch">https://nfi.nfis.org/en/biomass_stand_merch</a></p>	<p>are the two approaches prescribed under this protocol, though we acknowledge other techniques are possible.</p> <p>Reviewer Response: <b>Issue closed.</b></p>
19	3.3.1	"carbon per acre" should be "carbon per hectare" in Canada. (this change needs to be	ACR has replaced "carbon per acre" references with "carbon per hectare".	<b>Issue closed.</b>	

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		made in several places, so please check this over carefully)			
20	3.3.1.1	<p>There is some confusion here about the biomass equations and this section will need a significant re-write for more clarity.</p> <p>Ung et al. and Lambert et al. are tree level equations that estimate biomass of individual trees (kg/tree) from dbh or dbh/height. If one of the models in 3.3.1 generates tree list output (e.g. species, dbh, ht), then one can use Ung or Lambert to estimate the</p>	<p>There was no confusion here, just the mixing of alternative methods together. The idea is that project developers can estimate biomass either directly from field (or projected) tree lists and scale up, or by developing merchantable yield tables and using CBM-CFS3.</p> <p>To avoid this confusion, we have moved all text around the use of CBM-CFS3 to the paragraph</p>	<p>I am replying here to comments 5 and 6 since they are related. I know that there are two approaches, just as you described in comment 6, and this is now somewhat more clearly articulated. I might just have 1 more look at this to make sure that there is no possibility for confusion, of which some still remains</p> <p>For example, the new sections 3.3.1.1 (a) and (b) are in</p>	<p>We have now clarified in section 3.3.1.1 that “The mean carbon stock <b>at project start date...</b>is estimated based on field measurements..” and “<b>These initial stock measurements are subsequently used in modeling baseline stocks over the crediting period</b>”. In section 4.3 we’ve also more clearly stated that “<b>Project scenario stocks are determined by periodically</b></p>

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		<p>biomass directly, no need for another model (possibly Li et al. if one wishes to have belowground biomass also).</p> <p>The CBM-CFS3 instead estimates biomass (Mg/ha) from merchantable volume yield curves (m3/ha). Most of the relevant details on these models are provided here: <a href="http://cfs.nrcan.gc.ca/publications?id=27434">http://cfs.nrcan.gc.ca/publications?id=27434</a></p> <p>Further information on all the biomass models, including calculators and parameters, is provided at: <a href="https://nfi.nfis.org/en">https://nfi.nfis.org/en</a></p>	<p>addressing plot-level biomass. The steps for estimating biomass and carbon from trees or yield tables were already separated into two distinct sections.</p> <p>We also have distinguished the two approaches with subsection identifiers (a &amp; b).</p>	<p>section 3.1.1 “Stocking Level Projections in the Baseline”. However, these approaches are the same (I think) that would be used in both the baseline and in the project (basically, any time the biomass or C is quantified, these are the approaches).</p> <p>As I understand it, the baseline is always a modelled construct describing a hypothetical thing that would have happened, if the project was not implemented, and yet by placing</p>	<p><b>remeasuring plots...and modeling carbon stocks to a discrete point in time”.</b></p> <p>We have also added a definition of the CBM-CFS3 aboveground components at the beginning of 3.3.1.1.(b) with the component definitions in (a).</p> <p><u>Reviewer Response:</u> <b>issue closed.</b></p>

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		<p>In this section, you could also cite the scientific paper for CBM-CFS3, Kurz et al. 2009. Ecological Modelling 220:480-504.</p>		<p>section 3.3.1.1 where it's now, it describes a series of things that one is to go out into the forest to measure. This might cause confusion because it seems like one should go out and measure the baseline, which isn't something that occurs. I guess the possible purpose of these descriptions here is to provide the estimate of the forest state at the beginning of the project period? Maybe clarify this.</p> <p>Note also. In 3.3.1.1(b), CBM-CFS3 provides</p>	

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				<p>estimates in “merchantable”, “other”, “foliage”, “coarse root” and “Fine root’ pools. It doesn’t provide estimates of C in these 4 biomass pools (See also other comment).</p> <p>My point regarding the placement of 3.3.1.1 applies also to 3.3.1.2 Dead Wood Calculation. Also note, if CBM-CFS3 is used, it provides estimates of C in dead wood (snags, branch snags, and medium pools of the model). Are the measurements in the section to be</p>	



#	Document Section	R1 Comment	R1 Author Response	R2 Comment	R2 Author Response
				done when CBM-CFS3 is used? Also note my suggestion that there might be no need to use CBM-CFS3, if soil and DOM C (of which dead wood is a component) are not considered because you can just use the equations themselves directly.	
21	3.3.1.1	Further to the above, the growth model from section 3.3.1 that generates a tree list (species, dbh, ht) can also be used to estimate merchantable volumes (m3 rather than biomass (kg)) for each tree. These can be scaled	There are TWO streams for calculating biomass from the field data: one from tree lists (field data or projections) and the other from merchantable yield tables derived from field data or projections and	I think we are on the same page, and I didn't mean to imply that you said CBM-CFS3 was in error, I was just saying that it is not an error if the two approaches outlined come to different answers as they are both	We agree (and further respond in comment 2) with the assertion that while two approved approaches may result in slightly different outcomes, both are legitimate.  <u>Reviewer Response:</u> <b>Issue closed.</b>

#	Document Section	R1 Comment	R1 Author Response	R2 Comment	R2 Author Response
		<p>up and used to calculate biomass using the stand level (m3/ha to Mg/ha) biomass equations described above. The answer will be different from the biomass Mg/ha obtained by summing the individual tree model estimates. This is NOT an error, as both models are equally legitimate. I guess that using the same approaches helps to minimize the effect to a degree (but this won't eliminate effect of model selection uncertainty since time trends might be different).</p>	<p>then applying CBM-CFS3. The two methods are not allowed to be mixed and must be held constant across time. We have now clearly identified these two methods by subsection (a) and (b). Hopefully this change makes it clear that the two approaches are different and represent alternative approaches.</p> <p>Nowhere in this section do we refer to CBM-CFS3 as erroneous, it is a different approach and legitimate as the reviewer points</p>	<p>legitimate, and a difference simply reflects the fact that different models make different predictions (a common occurrence in any model intercomparison study).</p> <p>I have mostly dealt with this comment in my response to comment 5.</p>	

#	Document Section	R1 Comment	R1 Author Response	R2 Comment	R2 Author Response
			<p>out. Being different simply means the Project Proponent chooses one approach or the other, but never mixes the approaches across the project.</p> <p>Ultimately it is the differences between baseline and project offsets that are of interest. Any biases and errors in the models would be consistent within an approach.</p>		
22	3.5	<p>It may be useful to cite in this section this paper:  <a href="https://cdnscepub.com/doi/full/10.1139/cjfr-2012-0454">https://cdnscepub.com/doi/full/10.1139/cjfr-2012-0454</a></p>	<p>Uncertainty in offset programs is estimated from the sample not the calculations. By standardizing the calculations any</p>	<p>I understand, and I think that if we were sitting down having a conversation, then we would mostly be able to come an</p>	<p>We have clarified in 3.5 that uncertainty assessments do not include model uncertainty and that this is controlled</p>

#	Document Section	R1 Comment	R1 Author Response	R2 Comment	R2 Author Response
		<p>It deals with estimating uncertainty for the Canadian tree level biomass equations. It may also be useful in this section to cite this paper: <a href="https://cdnscepub.com/doi/full/10.1139/cjfr-2017-0088">https://cdnscepub.com/doi/full/10.1139/cjfr-2017-0088</a></p> <p>It deals with uncertainty estimates for CBM-CFS3 as applied in GHG inventory in Canada</p>	<p>errors and/or biases in the calculations would be the same in the baseline and project totals. Since it is the difference that is of interest it is assumed that the biases cancel through the calculation of the differences and the error remaining is the sampling error.</p>	<p>understanding about this. I've read the uncertainty calculation part of the document again and I think it's the best you can do. I have only a few things further.</p> <p>The cancelling out assumption is one that is commonly made. As I understand it, this assumes that the errors related to e.g. model structure, model parameters, etc. (i.e. errors that you do not consider in the calculation at present) in the baseline and in the project are highly correlated in which case this</p>	<p>(minimized) by standardizing models for baseline and project projections.</p> <p>Bayesian model calibration via Monte Carlo simulation could address these additional sources of uncertainty but also require certain assumptions about model parameter distributions across various treatments. This protocol requires subsequent field verification. This should identify model biases early and adjust offset benefits appropriately.</p>

#	Document Section	R1 Comment	R1 Author Response	R2 Comment	R2 Author Response
				<p>assumption would be true. If instead these errors are independent, then they will not cancel out and this assumption would be less true. I think more scientific work may need to be done on this issue.</p> <p>In my own work, I mostly use Monte Carlo simulation for uncertainty estimation. Consider in this case a baseline scenario B and a project scenario P, calculated using a model with X uncertain parameters for which we will draw random values. If I run 1000</p>	<p>Reviewer Response:  <span style="background-color: #90EE90;">Issue closed.</span></p>

#	Document Section	R1 Comment	R1 Author Response	R2 Comment	R2 Author Response
				<p>simulations, I may design this in two ways, one in which I draw 1000 random sets of uncertain parameters X a single time, and apply those to simulations 1,2,3,...1000 of both B and P.</p> <p>Alternatively, I may draw 1000 random sets of X and apply these to B, then draw another independent 1000 random sets of X and apply those to P. The resulting uncertainty for P-B differs between these cases and it is uncertain which is the right way to do it and reasonable people could</p>	

#	Document Section	R1 Comment	R1 Author Response	R2 Comment	R2 Author Response
				<p>probably disagree about this.</p> <p>A possible way around this is to just be more explicit that only the error related to sampling is included, and therefore this is a minimum uncertainty estimate (true uncertainty is likely to be higher).</p>	
23	3.5	<p>The use of percentage uncertainties in this section is possible because all the values discussed are essentially carbon stocks that are expected to be bounded on the low end by zero. Carbon fluxes (or</p>	<p>We used weighted averages to calculate combined uncertainty rather than pooled estimates of additive variance – this produces slightly larger uncertainties. Percentages are used to standardize</p>	<p>Understood, and agree that there is no further comment beyond what I said for comment 7 above. <b>issue closed.</b></p>	

#	Document Section	R1 Comment	R1 Author Response	R2 Comment	R2 Author Response
		<p>the difference in stocks between scenarios) may be above or below zero so in those cases percentage uncertainties wouldn't be appropriate (because any percentage of zero is still zero)</p>	<p>uncertainties across different projects. In the uncertainty calculation for the change, which as the reviewer points out could be zero or very close to zero, percentages are not calculated on the basis of the net change, but rather on the magnitude of the changes (i.e., absolute values) and again, a weighted average is used. This bounds the uncertainty between baseline and project and prevents spikes in uncertainty except where change is very small (a situation where the project would have</p>		



#	Document Section	R1 Comment	R1 Author Response	R2 Comment	R2 Author Response
			no (or limited) value.		
24	3.5	<p>A general comment here might be an example of what you mean by “90% confidence interval” since this might be interpreted differently by different people, and because of the general bias of humans to prefer precise estimates to accurate ones (i.e. overconfidence, see here: <a href="https://www.nature.com/articles/nature10384?message-global=remove&amp;page=1">https://www.nature.com/articles/nature10384?message-global=remove&amp;page=1</a>)</p> <p>I suspect that people will interpret</p>	<p>The 90% confidence interval is used to compare observed uncertainty against prescribed uncertainty limits (10% in this protocol). Changing confidence from 95% to 90% does not “increase precision” it decreases the confidence width and the confidence with which we hold that width to be true. Expressing the uncertainty in term of a 90% confidence width is consistent with the protocol’s deductions for</p>	<p>My main point was to avoid the situation where people provide estimates that are overconfident (particularly since there is an incentive to meet an uncertainty threshold). In general, I think we are on the same page and have a similar understanding of all these issues. I’ve responded to the general sentiment in other comments (11 and 14). <b>Issue closed.</b></p>	

#	Document Section	R1 Comment	R1 Author Response	R2 Comment	R2 Author Response
		<p>this instruction in a way that leads them to provide the most precise estimates possible, and this should be avoided. A description of what you mean by “90% confidence interval” might avoid some of this.</p>	<p>uncertainties greater than 10%. The verification mechanisms of the offset projects are designed to make sure that the developers are following protocol and acceptable methodologies to avoid use of techniques that overstate precision. Accuracy can only be assessed if and only if the true values are known (which will never be the case in carbon estimates). By adopting consistent and unbiased methods, we reduce the risk of</p>		

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			<p>bias and better assure the precision and accuracy are one in the same. Given that, ultimately, we calculate differences between two estimates should minimize any effects of bias.</p>		
25	3.3.1.2.2	<p>Dead wood lying on the forest floor (CWD) would probably be considered in soil and DOM C, already excluded by the protocol as written (see 1). Also, when C is lost from CWD it doesn't necessarily immediately emit to the atmosphere</p>	<p>Lying dead wood is considered an optional pool in Section 1.3 of the methodology. The excluded (litter/forest floor and soil organic C) pools are differentiated from the lying dead pool by the sampling guidelines provided in Section 3.3.1.2.2.</p>	<p>Understood, and I guess what this implies is that if CBM-CFS3 is used, then it is used only for live biomass since the "medium" pool from that model (which is what lying dead wood is called in its nomenclature) would not be able to be used to</p>	<p>We have clarified in section 3.3.1.2 that if estimates of deadwood are to be derived using the CBM-CFS3, projects must include a model calibration and verification procedure that utilizes field data collected via sampling procedures</p>

#	Document Section	R1 Comment	R1 Author Response	R2 Comment	R2 Author Response
		(e.g. some will fragment, etc. and be incorporated into the soil, etc.). I think the motivation in including CWD in the protocol is so that logging slash can be accounted for in some way and this approach is certainly one way, another would be to use models that explicitly account for these dynamics.	Specifically, step 1 clarifies only lying dead wood $\geq 10$ cm diameter is eligible for this pool.	estimate this pool since it can't differentiate dead material of different diameters.	prescribed in the relevant subsection.  <u>Reviewer Response:</u> <b>Issue closed.</b>
26	4.3	Ahh, I see that you have a methodology document cited here now for the uncertainty calculations. An example might be useful.	Yes, this protocol is aimed at serving as overall guidance with methods described more fully in the methodology documents.	<b>Issue closed.</b>	
27	4.8	All comments with respect to section	Given that the uncertainties are	Yes, understood now. See also my	We now clearly state in section 3.5

#	Document Section	R1 Comment	R1 Author Response	R2 Comment	R2 Author Response
		3.5 (7, 8, and 9) are also applicable here. Also, what happens if uncertainties are not normally distributed?	calculated from sample data and are expressed about a mean, the central limit theorem applies in this situation and uncertainties should be approximately normally distributed. Again, the uncertainties are used to net down project offsets if they exceed a prescribed threshold (10% in this protocol).	reply to comment 14. My reason for worrying about this is that because there is a financial incentive to get the uncertainty below the threshold (and because true uncertainty is hard to verify) then the safest thing is to specify exactly how it is to be calculated because then at least everyone is treated consistently (even if the estimated uncertainty is probably far from the true uncertainty).	that uncertainty is based upon sampling error. Reduced uncertainty comes at the cost of measuring more plots and decreased project net value.  <u>Reviewer Response:</u> <b>issue closed.</b>
28	5.1	Ahh, I see some of my earlier comments are addressed here in	Yes, and this is partially addressed in the responses above. The protocol	<b>issue closed.</b>	

#	Document Section	R1 Comment	R1 Author Response	R2 Comment	R2 Author Response
		<p>the last paragraph “When choosing key parameters.....”. But, see comment 14</p>	<p>is an adaptation from the American one and largely follows the same methods with the Canadian context provided in place of the American context. The protocol is complex and understanding the protocol requires careful reading of the entire document. Hopefully some of the edits we have made addresses some of the issues in flow that you have pointed out.</p>		
29	6.3	<p>Earlier comment 8 applies. One could imagine cases where DeltaCBSL,t is zero (because it</p>	<p>Actually, this calculation would result in a spike in uncertainty (ultimately infinite if</p>	<p>Understood, and I realize that there is no perfect way to calculate the</p>	

#	Document Section	R1 Comment	R1 Author Response	R2 Comment	R2 Author Response
		<p>doesn't change or changes little from year to year). This doesn't mean that its uncertainty is zero (or close to zero), but this calculation implies that it is.</p>	<p>X/0 occurred). If change is 0, the project has no offsets and the project value is 0, by making Eq 22 such that it ignores the direction or change and only calculates uncertainty relative to the magnitude of change, it bounds the uncertainty between baseline and project values. Through the revision of this protocol, we have examined a number of expressions for uncertainty associated with change and this was the best compromise.</p>	<p>uncertainty. <b>Issue closed.</b></p>	

#	Document Section	R1 Comment	R1 Author Response	R2 Comment	R2 Author Response
30	6.3	How are you going to verify that the uncertainties are actually 10%, independently of the provided calculation (i.e., how will you know that the proponent is not bluffing?)	All projects undergo rigorous verification including requirements for field validation. The requirements to use specific equations and models and use the same approaches for baseline and project estimates minimizes the opportunities for “bluffing”. Uncertainties are derived for field data not model projections which further reduces opportunities for “bluffing”.	I already dealt with this in my other replies. Issue closed.	
31	Equation 17	The description for DeltaDead says “dead wood pools live trees”. Need to clarify as dead trees	Revised parameter description in equation 17 to state “Change in the project carbon stock	Issue closed.	



#	Document Section	R1 Comment	R1 Author Response	R2 Comment	R2 Author Response
		can't be live trees. Do you mean standing trees?	stored in dead wood for year t". Also revised equation 6, 7 and 8 for same edit.		
32	Page 31 Step 3	CBM-CFS3 provides merchantable, other, and foliage biomass rather than wood bark branches and foliage. And in any case, what would be the justification for only including some biomass pools rather than all of them (this isn't the only spot where its implied that proponent has a choice).	It is my understanding that CBM-CFS3 provides estimates of biomass components beyond those listed by the reviewer. The choice of components is consistent with the American protocol and reflects the fact that component ratios for all species, regions, and biomass components are not always available and allows for some flexibility for the developers. The	Individual tree biomass equations and the merchantable stand volume to biomass equations provide estimates for wood, bark, branches, and foliage.  CBM-CFS3 provides biomass pools "merchantable", "other", "foliage", "coarse roots" and "fine roots". Definitions for these are provided in the various papers and manuals documenting the model. While CBM-	We have addressed this issue by defining the pools depending on whether an individual tree approach or CBM-CFS3 is used – this should now address the differences in pools between the Lambert equations and CBM-CFS3.  <u>Reviewer Response:</u> <b>Issue closed.</b>

#	Document Section	R1 Comment	R1 Author Response	R2 Comment	R2 Author Response
			<p>components included are not allowed to change over time and must be the same in the baseline and project scenarios.</p>	<p>CFS3 does use the same stand level volume to biomass models as described at the nfi website (i.e. Boudewyn et al.), the model subdivides these into component pools differently, so the totals are the same, but the components are different.</p>	
33	Page 31 Step 5	<p>CBM-CFS3 already outputs in C not biomass so no need to further multiply by 0.5 for outputs from that model.</p>	<p>CBM-CFS3 outputs in a number of units, including biomass and C. As explained above in comments 3 &amp; 5, CBM-CFS3's use is limited in this protocol to the conversion of merchantable yield to biomass and</p>	<p>I understand your point about the consistency, and I didn't take anything as criticism of the model (sorry if it seemed this way).  However, I must clarify that CBM-CFS3 outputs in C units (megagrams C</p>	<p>We have modified our approach (step 3) to utilize carbon estimates from CBM-CFS3 subject to appropriate volume-to-biomass and biomass-to-carbon conversion factors.</p>

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			<p>subsequent conversion of biomass to C follows the protocol's directive. This is for consistency with the field data -&gt; C procedure and is not a reflection on the accuracy or applicability of CBM-CFS3 to do these calculations. Projects must use consistent methods to be comparable both over time and across different projects. The choice of this route was based on discussions with ACR, the authors of this protocol, and carbon developers and verifiers.</p>	<p>per hectare) for all pools. (I have been part of the development and maintenance of this model for almost 20 years, so I know. Also, see any documentation for the model).</p> <p>If CBM-CFS3 is used to convert volume (m3) to biomass the output will be in C units already (no need to multiply by 0.5). If instead the merchantable stand volume to biomass conversion equations (at <a href="https://nfi.nfis.org/en/biomass">https://nfi.nfis.org/en/biomass</a>, as referred to also above) then the outputs will be in mass unit (similarly,</p>	<p>Reviewer Response:  <span style="background-color: #90EE90;">Issue closed.</span></p>

#	Document Section	R1 Comment	R1 Author Response	R2 Comment	R2 Author Response
				<p>individual tree biomass equations will be output in mass units).</p> <p>So, care must be taken here to not get values that are accidentally double or half of what you want them to be.</p>	

**COMMENT #5 CONTINUED (Reviewer response to authors):**

**Regarding municipal government owned forestland:**

You argue that municipalities pass the regulatory additionality test, however, reality tells us that forest management regulations are not required, since municipal governments have other reasons (such as keeping citizens happy in order to get re-elected) for managing forests sustainably. Indeed, the links provided in your response are for two municipalities which have managed their forests according to sustained yield practices for decades, even in the absence of any regulation. Hence, the baseline for these municipalities should be based on the trend shown from the historical carbon inventory estimated over the previous decades of sustained yield management; conversely, the baseline should not be a speculative and unrealistic assumption that these municipal forests would be sold in their entirety to a private entity and then aggressively harvested, as prescribed in this protocol. Since many of the forest stands around municipalities in Canada are mature, the NPV-maximizing Faustmann formula in the protocol will prescribe that these mature stands be rapidly harvested and converted to fast growing plantations. Even under a devastating budget situation, it is difficult to imagine the citizens of these municipalities (or other municipalities in Canada) allowing their elected governments to sell-off their entire municipal forestland to an NPV-maximizing private operator with intentions of liquidating the mature timber. Using an aggressive baseline scenario such as this will yield unrealistically high volumes of ERTs, and therefore many of the ERTs



generated would not be real or additional – i.e., they would not offset the actual GHG emissions that they were purchased to offset, thereby actually harming the atmosphere.

The only exception for allowing the baseline for a municipal owned forest to be based on the NPV-maximizing Faustmann calculation would be: (1) if there is evidence (e.g., from the minutes of municipal government meetings) that the sale of all the municipal forest to a liquidation logger is imminent, and (2) that there is community support for such a sale. Otherwise, for this IFM protocol to generate high quality offsets which are real and additional, the baseline should be a realistic projection based on the historical carbon inventories over previous years of municipal forest management; and if no forest management has ever been conducted by the municipality in the past, the baseline should be based on a sustained yield harvest level, since it is the *de facto* norm for municipal forests.

And in response to your argument that “it is very much common practice for municipalities to sell forested property to fund budget gaps and pay for ongoing forest and land management activities”: there are cases where portions of a municipality’s forestland are sold to developers; but it would be highly unusual for a municipality to sell all of its forestland all at once, as is assumed in this protocol. Indeed, if a municipality has been selling off parts of its forestland to fund budget gaps, as is the case for the municipality that, as you state in your response, “had gone from over ~70% forested cover in the county 50 years ago to about 5% forested cover”, then this trend of declining forest carbon will be very evident (and easily projected forwards) when estimating the baseline from historical forest carbon levels.

**Regarding privately owned forestland:**

Please note that you did not respond to my question in Comment #5 about Environmental NGOs purchasing private land for conservation purposes. In the ENGO case, the baseline should once again be based on a realistic projection of what the carbon inventories would be in the future under the management of the previous owners – i.e., if the forest had been owned by a logger who had aggressively managed it, then that would be baseline going forward, and if it had been previously managed for sustained yield, then that would be the baseline going forward. Indeed, the only situation I can foresee whereby the NPV-maximizing Faustmann calculation would be used for estimating the baseline would be if an industrial or non-industrial private forest owner wished to undertake an IFM carbon offset project.



**Author Response:**

The following text changes have been made to ACR Standard/Canada IFM methodology (change in **bold**):

- Table 4 ACR Standard: Edit section as follows:

*“For IFM, the start date may be denoted by one of the following:*

1. **Land acquisition or easement enrollment date**
2. *The date that the Project Proponent began to apply the land management regime to increase carbon stocks and/or reduce emissions relative to the baseline.*
3. **The date that the Project Proponent first demonstrated good faith effort to implement a carbon project. Such demonstrations must include documented evidence of:**
  - a. *The date the Project Proponent initiated a forest inventory for a carbon project*
  - b. *The date the Project Proponent entered into a contractual relationship **or signed a corporate or board resolution** to implement a carbon project*
  - c. *The date the project was submitted to ACR for listing review*
4. **Other dates may be approved case-by-case on the basis of reasonable demonstration of intent to pursue carbon project origination”**

- IFM methodology Acronyms and definitions: Add definition of **“Working Forest”**: **“A forest that is managed to generate timber revenue, amongst other possible ecosystem services and revenue streams”**.

- Section 3.1 IFM methodology: **“The IFM baseline is the legally permissible harvest scenario that seeks to maximize NPV of perpetual wood products harvests. NPV baseline modeling must use the annual discount rate based on the current ownership class (Table 1), except for those projects in which land acquisition date occurred within 1 year of the project start date. In this case, NPV discount rate of the prior ownership class may be employed.** The baseline management scenario shall be based on silvicultural prescriptions in published recommendations from state or federal agencies to perpetuate existing onsite timber producing species while fully utilizing available growing space. **All legally binding constraints to forest management (in place > 1 year prior to project start date) must be considered in baseline modeling. Voluntary best management practices to protect water, soil stability, forest productivity, and**



wildlife, as prescribed by applicable federal, state, or local government agencies, are considered legally binding constraints to forest management. The resulting harvest schedule is used to establish baseline stocking levels through the Crediting Period.

1. Section 3.1 IFM methodology: Add new paragraph: **“In cases where the mission, objective or goal of an NGO includes land conservation and stewardship, the Project Proponent (NGO or associated private entity claiming carbon credit ownership) must justify the baseline scenario by demonstrating<sup>11</sup> they manage their lands consistent with the definition of a “working forest”. If sufficient justification can be provided and verified, baseline harvest levels may be determined using an NPV analysis at the 4% harvest discount rate for NGO’s. In the baseline, harvests and silviculture must also be constrained such that documented long-term management objectives of the NGO, specific to the project area if available, can reasonably and verifiably be expected to be accomplished.**
  - Section 3.1 IFM methodology: Add new paragraph: **The baseline scenario’s harvested output volume must not exceed the regional mill capacity for the species and size forest products produced throughout the crediting period. If baseline harvested forest product output assumes increased regional mill capacity over time, the Project Proponent must provide an analysis demonstrating the feasibility of future mills that could be opened within the bounds of historical (<40 years) market conditions or credible forecasts of future viability, and the baseline harvest schedule must temporally account for mill construction or expansion. Mills must be within hauling distances that allow the baseline’s forest management activities to be economical. The feasibility of the baseline harvest regime must be demonstrated with mill reports, testimony from a Professional Forester, published literature from a state or federal agency, or other verifiable evidence.**

**Baseline scenario forest management must also be plausible given fundamental institutional barriers<sup>2</sup> not captured as legal constraints or in the NPV calculation. Projects in which land acquisition date occurred within 1 year of the project start date may**

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<sup>1</sup> This demonstration not relevant for NGO projects with project start dates within one year of land acquisition and using NPV discount rate of the prior ownership class. For this demonstration, evidence may include terms of legal ownership, a conservation easement, a forest management plan, forest certification documentation, or other verifiable evidence meeting the intent of this methodology.

<sup>2</sup> “Fundamental institutional barriers” are political, social, or operational barriers to the baseline harvest regime engrained in the management of a specific property and unlikely to change over time.



**consider the institutional barriers of the prior ownership.** Consideration shall be given to a reasonable range of feasible baseline assumptions and the selected assumptions should be plausible for the duration of the baseline application.

Reviewer Response: **Issue closed.**