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NOS - KLIMA- OG MILJØDEPARTEMENTET - REDD - KLIMAVERIFIKASJON

Verification of Interim REDD+ Performance indicators under the Guyana-Norway REDD+ partnership (Year 5)

Ministry of Environment– Government of Norway

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Task and objective:

DNV GL AS (DNV GL) has been commissioned by the Ministry of Environment– Government of Norway to perform a verification of the Interim Performance Indicators reported for the period 1 January 2014 to 31 December 2014 - Year 5 as described in the Guyana REDD+ Monitoring Reporting and Verification System (MRVS) - Interim Measures Report, Version 3 dated 30 November 2015 produced by the Guyana Forestry Commission – Government of Guyana.

This report provides the verification methodology, results and statement.

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Keywords:
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Reference to part of this report which may lead to misinterpretation is not permissible.

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1 DNV GL VERIFICATION STATEMENT

Verification Objective

DNV GL AS (DNV GL) has been commissioned by the Norwegian Ministry of Environment[*] to perform a verification of the Interim Performance Indicators under the Guyana-Norway partnership on REDD+ as reported in the Interim Measures Report[†]

Verification Scope

The relevant list of indicators for this verification is found in the most recent version of the Joint Concept Note (JCN) (third revision). The scope of this verification covers the following deforestation and degradation indicators:

Report Measure	Measure Ref	Indicator	
Deforestation Indicators	1	Indicator 1:	Gross Deforestation rate
Degradation Indicators	2	Indicator 2.1:	Loss of intact forest landscapes
	3	Indicator 2.2:	Forest Management (i.e. selective logging activities in natural or semi natural forests
	2b	Indicator 2.3:	Carbon loss as indirect effect of new infrastructure.
	6	Indicator 2.4:	Emissions resulting from subsistence forestry, land use and shifting cultivation lands (i.e. slash and burn agriculture)
	4	Indicator 2.5:	Emissions resulting from illegal logging activities.
	5	Indicator 2.6:	Emissions resulting from anthropogenic forest fires.

For this monitoring period there are a few indicators that are not required to be reported by the JCN in the current monitoring period and therefore have not been considered within the scope of this statement. These are:

Indicator on increased carbon removals	7	Indicator 3.1:	Encouragement of increasing carbon sink capacity of non-forest and forest land

In addition, DNV GL has assessed if the changes in the methodology applied for the determination of each Interim Performance Indicator in the previous verification period, particularly those obtained via geographical analysis, follows good practices as defined by a number reference documents (see below).

The geographical boundary of the verification is Guyana and the time period covered is 1 January 2014 to 31 December 2014.

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[*] Contract and scope signed between The Norwegian Ministry of Environment and DNV GL on 8 October 2014

[†] Guyana REDD+ Monitoring Reporting and Verification System (MRVS) - Interim Measures Report, Guyana Forestry Commission, 30 November 2015

Materiality

No level of materiality has been fixed by the Norwegian Ministry of Environment for this verification so any individual or aggregate errors, omissions and misrepresentations which result in discrepancies have been considered as material and requested to be corrected if feasible. This does not include individual or aggregate level of errors associated with technical equipment (e.g. sensors) or remote sensing methods (e.g. visual interpretation). However, for Indicator 1 – Gross deforestation rate and Indicator 2.1 - Loss of intact forest landscapes, have been addressed by an independent accuracy assessment performed by the Durham University.

Verification criteria

The following reference requirements have been considered during the verification by DNV GL:

- Join Concept Note on REDD+ cooperation between Guyana and Norway, Section 3: REDD-plus performance Indicators (dated 9 November 2009 and its amendment of March 2010 and March 2011).
- GOFC-GOLD REDD Source Book (2014).
- IPCC Guidelines for National Greenhouse Gas Inventories (2006) – Volume 4 Agriculture, Forestry and Other Land Use.
- Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (2000) – Chapter 4: Agriculture; Chapter 6: Quantifying; Chapter 8: Quality Assurance and Quality Control.

Verification activities

The verification has been guided by the provisions of ISO 14064-3 (1 ed., 2006) that cover the validation and verification of greenhouse gas assertions.

The verification took place from 01 September 2015 until 14 November 2015 and included desk reviews of relevant documentation and datasets as listed in the verification report and an on-site assessment in Guyana from 15 November 2015 to 22 November 2015.

As part of the verification, the results of the independent accuracy assessment included in the Interim Measures Report dated 30 November 2015 were verified.

Conclusions

It is DNV GL's opinion that the results provided in the Interim Measures Report by Guyana Forestry Commission dated 30 November 2015:

- have been obtained applying methodologies in accordance with internationally accepted good practices as defined by the verification criteria;

- are free from omissions and misrepresentations that could lead to material misstatements.

Furthermore, recommendations for improvements in future monitoring periods are summarised as Minor Corrective Action Requests (MINORs) or Observations. These MINORs and Observations are listed in Appendix A of the Verification Report.

DNV GL has verified that the values for the interim indicators in this monitoring period (1 January 2014 to 31 December 2014) are:

Measure Ref	Indicator		Year 5 results
1	Indicator 1:	Gross Deforestation rate in Year 5	0.065%
2	Indicator 2.1:	Loss of intact forest landscapes	7 604 314 ha (111 ha loss)
2b	Indicator 2.3:	Carbon loss as indirect effect of new infrastructure.	4 251 ha
3	Indicator 2.2:	Forest Management	3 366 326 tCO$_2$
4	Indicator 2.5:	Emissions resulting from illegal logging activities.	13 823 tCO2
5	Indicator 2.6:	Emissions resulting from anthropogenic forest fires.	265 ha/year
6	Indicator 2.4:	Emissions resulting from subsistence forestry, land use and shifting cultivation lands (i.e. slash and burn agriculture)	167 ha/yr
7	Indicator 2.7:	Encouragement of increasing carbon sink capacity of non-forest and forest land	73 ha[*]

Statement Issuing date

5 March 2016

Edwin Aalders

Team Leader

Trine Kopperud

Assessment Services Manager Nordics

-----END OF STATEMENT----

[*] Indicator 2.7 was reported for the first time by the Guyana Forestry Commission but is not yet part of the performance assessment. DNV GL assessed the accuracy and methodology as part of the overall system improvement process.
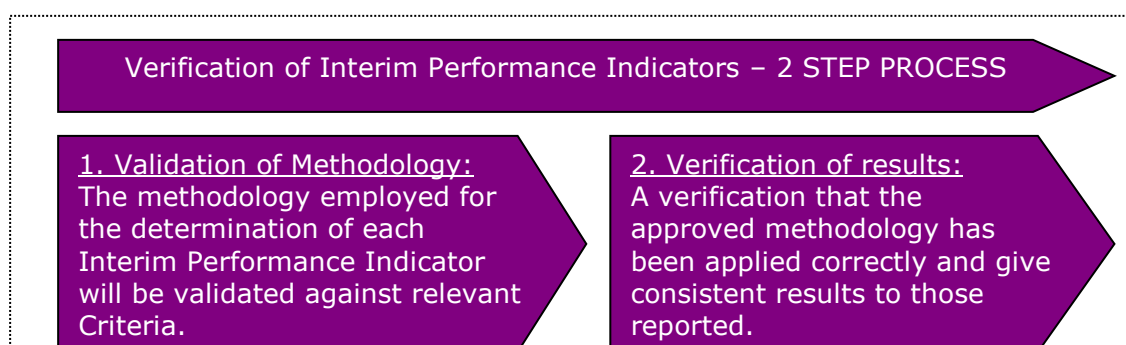
2 INTRODUCTION

DNV GL AS (DNV GL) has been contracted by the Ministry of Environment– Government of Norway to perform a non-accredited verification of Interim REDD+ Performance indicators under the Guyana-Norway REDD+ partnership. According to the Joint Concept Note (JCN) signed between both parties, these indicators will serve to evaluate Guyana's performance regarding REDD+ until a MRV system is in place which will serve to accurately monitor the emissions from deforestation /55/.

DNV GL has been tasked to verify the results in deforestation and forest degradation as measured using the Interim Performance Indicators established in the Joint Concept Note, specifically as outlined below and as detailed in the JCN Table 2, pages 22-28 /55/:

- Gross Deforestation in the period from 1 January 2014 to 31 December 2014 - Year 5;
- Loss of intact forest landscapes;
- Forest Management;
- Carbon loss as indirect effect of new infrastructure;
- Emissions resulting from illegal logging activities;
- Emissions resulting from anthropogenically caused forest fires;

3 BASIS OF VERIFICATION

In order to verify the Interim Performance Indicators, DNV GL has followed the principles and requirements for verifying GHG inventories and validating or verifying GHG projects defined by ISO 14064-3 /18/. This standard has served as guidance for the definition of the verification plan but it is important to note that this is not an accredited verification applying ISO 14064-3.

Verification of Interim Performance Indicators – 2 STEP PROCESS

1. Validation of Methodology:
The methodology employed for the determination of each Interim Performance Indicator will be validated against relevant Criteria.

2. Verification of results:
A verification that the approved methodology has been applied correctly and give consistent results to those reported.

ISO 14064-*Part 3: Specification with guidance for the validation and verification of greenhouse gas assertions*

3.1 Level of assurance

According to ISO 14064-3, the level of assurance is used to determine the depth of detail that a verifier designs into their validation or verification plan to determine if there are any material errors, omissions or misrepresentations /18/. There are two levels of assurance, reasonable and limited. The level of assurance affects the relative degree of confidence the verifier requires in order to make a conclusion /18/ and the wording in the validation or verification statements.

For a reasonable level of assurance, the validator or verifier provides a reasonable, but not absolute, level of assurance that the responsible party's assertion is materially correct /18/.

A limited level assurance is distinguishable from a reasonable level of assurance in that there is less emphasis on detailed testing of data and information supplied to support the assertion /18/.

The verification team has designed the verification plan in order to attain a reasonable level of assurance in the verification of the Interim Performance Indicators.

3.2 Objectives

The objective of the verification is to provide stakeholders with a professional and independent verification of the results reported in the Guyana REDD+ Monitoring Reporting and Verification System (MRVS) - Interim Measures Report (IMR) (Version 3 of 30 November 2015) on deforestation and forest degradation as measured using the Interim Measures Indicators.

This includes:

- Methodology validation; conformance of the analysis methodology and the monitoring system in place against applicable validation/verification criteria;
- Verification that the validated methodology has been followed to obtain the reported results;
- Verification of the results of the Interim Performance Indicators reported in the IMR;
- Verification that the comments from stakeholders have been taken into account in the IMR;

3.3 Criteria

According to the ISO14064-3 the validation/verification criteria would be the "policy, procedure or requirement used as a reference against which evidence is compared" /18/. Therefore, the validation of the analysis methodology and the verification of the reported results would be done against these criteria:

- Validation criteria
  - Main Criteria - Joint Concept Note (i.e. Section 3: REDD-plus Performance Indicators) /55/;
  - GOFC-GOLD REDD Source Book, 2014 /56/;
  - 2006 IPCC Guidelines /57/;
  - Approved REDD methodologies under the VCS programme /66/;
  - Peered reviewed publications /63/

3.4 Scope

According to ISO 14064-3, in determining the validation or verification scope, the validator or verifier should consider the extent and boundaries of the validation or verification process /18/. Taking into consideration the Terms of Reference (TOR) of the assignment /61/ and the provisions of the JCN /55/, the scope of the verification consists in the verification of the following deforestation and degradation Interim Measures Indicators as described in the JCN /55/:

Report Measure	Measure Ref	Indicator
Deforestation Indicators	1	Indicator 1: Gross Deforestation rate
Degradation Indicators	2	Indicator 2.1: Loss of intact forest landscapes
	3	Indicator 2.2: Forest Management (i.e. selective logging activities in natural or semi natural forests
	2b	Indicator 2.3: Carbon loss as indirect effect of new infrastructure.
	4	Indicator 2.5: Emissions resulting from illegal logging activities.
	5	Indicator 2.6: Emissions resulting from anthropogenic forest fires.
	6	Indicator 2.4: Emissions resulting from subsistence forestry, land use and shifting cultivation lands (i.e. slash and burn agriculture)
	7[*]	Indicator 2.7: Encouragement of increasing carbon sink capacity of non-forest and forest land.

Furthermore the specific verification scope for these indicators is:

- *Geographical boundaries*: Guyana
- *Organizational boundaries*: Guyana Forestry Commission (GFC)
- *Physical infrastructure, activities, technologies and processes of the organization*: GFC Geographic Information System and Wood Chain of Custody System.
- *Time period(s) to be covered*: Monitoring period: Year 5 (1 January 2014 to 31 December 2014)
- *Frequency of subsequent verification processes*: Yearly verification
- *Intended user for the verification statement*: Government of Norway and Government of Guyana

3.5 Materiality

According to ISO 14064-3 materiality is the "concept that individual or the aggregation of errors, omissions and misrepresentations could affect the assertion and could influence the intended users decisions" /61/. The concept of materiality is used when designing the validation or verification and sampling plans to determine the type of substantive processes used to minimize risk that the verifier will not detect a material discrepancy /61/.

In order to be consistent with the stated level of assurance, a verification plan and an intensive sampling plan have been designed to minimize risks that a material discrepancy would not be detected.

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[*] Indicator 2.7 was reported for the first time by the Guyana Forestry Commission but is not part yet of the performance assessment. DNV GL assessed the accuracy and methodology as part of the overall system improvement process.

No level of materiality has been fixed so any individual or aggregate errors, omissions and misrepresentations that can be quantified which result in discrepancies have been considered as material and requested to be corrected.

4   METHODOLOGY

The verification of the results has assessed all factors and issues that constitute the basis for the interim measures indicator's results. These include:

i) Guyana REDD+ Monitoring Reporting and Verification System (MRVS) - Interim Measures Report /1/;
ii) Geo-database with all the raw and processed datasets /2/;
iii) Database of wood harvesting declarations of wood extraction activities in lands classified as State Forest /5/;
iv) Database of wood harvesting declarations of wood extraction activities in lands classified as Amerindian or Private Property /6/;
v) Database of Procedural Breaches for the four forestry divisions of Bce, Dem, Ess and Nwd /4/;
vi) Database of Illegal logging activities for the four forestry divisions of Bce, Dem, Ess and Nwd /3/;

Verification team

Role	Last Name	First Name	Country	Desk review	Site visit	Reporting	Supervision of work	Technical review	Sectoral competence
Team leader	Aalders	Edwin	Norway	✓	✓	✓	✓		✓
Independent Expert	Schut	Vincent	The Netherlands	✓	✓	✓			✓
Validator	Reed	Pablo	United States of America	✓	✓	✓			✓
Internal Technical Reviewer	Kapambwe	Misheck	Zambia					✓	✓

Duration of verification

Preparations: From 01 September 2015 to 14 November 2015

On-site verification: From 15 November 2015 to 22 November 2015

Reporting, calculation checks and QA/QC: From 22 November 2015 to   5 March 2016

4.1   Review of documentation

In order to define the verification and sampling plan the verification team performed a review of all the documentation provided. This included the revision of the Interim Monitoring Report /1/, and also a desk review of the GFC's database with all the raw datasets and the processed datasets /2/. The verification team also reviewed the Standard Operating Procedures (SOP) followed by the GFC for the forest monitoring and the issuance of various permits /19//20//21//22//23//24//25//26//27//28/. This served to detect the process operations with the highest levels of risk of material discrepancy, and to consequently design the verification and sampling plan on the basis of this information.

4.2 Site visit

An on-site assessment was performed from 15 November 2015 to 22 November 2015; partly in GFC's main headquarters located in Georgetown, and partly in GFC's forest stations of Annai and Lethem, as well as the base camp of current operations for the Rupununi Timber Associations concession adjacent to Annai, and the shifting cultivation areas east of Lethem.

After the definition of the final verification and sampling plan, the actual verification on-site assessment was performed. During these days two different verification teams were created to focus on specific indicators:

Team 1 – remote sensing and GIS: This team carried out the verification of the Indicators 1, 2.1, 2.3, 2.4, 2.5 and 2.6. This verification took place in GFC's GIS office and by on-site verification in the area around Lethem.

Team 2 – forest management and illegal logging: This team carried out the verification of Indicators 2.2, 2.5 and 2.6. A verification of GFC's databases was carried out on the first and last day of the audit, which helped cross reference and spot-check documentation and procedures with the GFC's forest stations in the field, Annai and Lethem, as well with the Rupununi Timbers Association forest concession in and around the village of Annai. Beyond the cross-checking of information and procedures, interviews with respective staff and/or stakeholders were also carried out.

On 21 November 2015 a closing meeting with a preliminary reporting of the findings of the verification took place in the GFC's headquarters.

4.3 Reporting of findings

A major corrective action request (MAJOR) is issued, where:

   i.   the evidence provided to prove conformity is insufficient;
   ii.   mistakes have been made in applying assumptions, data or calculations which could have a material influence on the results;
   iii. non-compliance with relevant criteria;

A minor corrective action request (MINOR) is issued where:

   i.   the evidence provided to prove conformity is insufficient but does not lead to breakdown in the systems delivery;
   ii.   mistakes have been made in applying assumptions, data or calculations which could have an influence on the future results;
   iii. if a certain aspect has to be verified in the next verification event (e.g. foreseen modifications, etc.)

An observation shall be raised by the team as a team's recommendation in relation to future improvements of the analysis process or the monitoring of the interim measures indicators.

During the audit the team can also raise a clarification request (CL) when it has found that information is insufficient or not clear enough to validate or verify against applicable criteria.

The results are discussed in Chapter 4 and findings are listed in Appendix A.

5 MAIN PART OF THE REPORT

5.1 Interim indicator 1 - Gross Deforestation

5.1.1 Methodology validation

a Methodology description

For Year 5, the GFC again tasked and acquired full wall to wall coverage of Guyana with 5m RapidEye data. For almost every RapidEye scene footprint, three or more acquisitions were available, enabling the GFC to use an image from a different date in case of clouds.

For Year 3, the GFC acquired full image swaths from RapidEye and performed the geo-registration of these, which is a tedious job. An agreement with RapidEye was made to give them the resulting geo-registration information (control points), and have RapidEye perform the geo-registration using the points from the Reference Point (RP). For Year 4 this meant a lot less pre-processing work for the GFC because RapidEye is now delivered in correctly geo-registered image tiles. For Year 5, RapidEye additionally updated the geographic accuracy by using control points from Very High Resolution Digital Globe images, resulting in improvements of up to 30m in the West of Guyana.

In addition to the RapidEye images, full Landsat 8 (30m) coverage was acquired to assist for areas with persistent cloud cover in the RapidEye imagery.

Ancillary FIRMS (MODIS) fire hotspot data were acquired and used to aid in the classification of areas deforested due to fires.

DNV GL has observed that the Year 5 processing and mapping is essentially the same as in Year 3 and 4 and can be summarized by the following steps: 1) pre-processing of RapidEye data; 2) generating Enhanced Vegetation Index (EVI) based change polygons; 3) manually digitizing forest change and degradation. The pre-processing and EVI polygon are largely implemented as batch processes, requiring minimal human work.

The RapidEye pre-processing consists of the following steps:

1. Conversion from DN to top-of-atmosphere reflectance

2. Radiometric normalization by Dark Object Substraction (DOS)

3. EVI calculation

4. EVI thresholding on forest/non-forest boundary value

5. Filtering the resulting forest/non-forest image ("clump and sieve filter")

6. Conversion of the non-forest areas to polygons

In addition, a persistent cloud mask image is calculated, showing the areas which are cloudy on all available RapidEye images.

The resulting intermediate images from each processing step and the EVI threshold value used are saved for later reference.

This finishes the pre-processing phase, which has largely been automated. From here on, the mapping process starts which is entirely manual. The GFC has divided Guyana into 24 km x 24 km

tiles and each GIS operator gets allocated a set of tiles. New in Year 5 is that this tile-to-operator allocation is random, thus eliminating operator bias as much as possible. Each tile is again divided into 1 km x 1 km blocks, which are visited one by one by the operator. In every block, the new EVI polygons are checked with the available RapidEye imagery to decide if it indicates a deforestation event. If the polygon coincides indeed with a deforestation event and exceeds the 1 ha Minimal Measurement Unit (MMU), the extent of the polygon is edited to accurately match the actual change area (if necessary). In order to establish the changes over time, reference images from the other periods (e.g. P1, P2, P3, Year 1[*], etc.) are used, whereby the current land cover, the driver of the change, a reference to the image on which the change was based and the last image in the database where the area was still forest are entered and saved into the GIS database. As part of the quality control measures set up by GFC, a toolbar has been developed to ease this process and ensure that all data is complete and that no invalid combinations can be entered. After all polygons in the block have been inspected, the block is inspected for changes that the EVI threshold might have missed. Areas that are identified as being missed areas of deforestation and that exceed the MMU threshold are consequently mapped and included in the GIS database.

Finally, before the operator visits the next 1 km x 1 km block, a degradation analysis is done for the newly found areas with the block that represent a change. Older mining or infrastructure deforestation polygons are revisited to check for possible new degradation around these features. For this the same toolbar is being used.

All Land Cover mapping is done following specific mapping Standard Operating Procedures (SOPs) /8/, which ensures full consistency in the interpretation and data treatment. Considering this, training procedures in place, and the establishment of automatic operations in the processing change, it is confirmed that enough Quality Control (QC) procedures are in place to provide reliable mapping results.

When the GIS operator is finished with a 24 km x 24 km tile, it is saved in a standardized way into the system and passed onto Quality Assurance (QA). During the Quality Assurance stage the data in the database is checked for inconsistencies, and the mapped polygons are all checked visually for correctness. Errors are corrected, and discussed with the relevant GIS operator. 100% of the tiles are subjected to the QA procedure.

DNV GL has verified this process with the mapping procedure in the SOP /1/ and confirms that the team operates in line with the guide. The system is set up to automate those steps that can be automated, thereby minimizing risk of errors, and the mapping process itself is structured by using a series of toolbars which guides the operator through the process and performs basic checks to ensure that all data has been entered.

However, due to the improved geographic accuracy of the Year 5 RapidEye imagery, mismatches between this imagery, Year 5 GIS layers, and older polygons in the GIS were found by the verification team. In several of the investigated RapidEye tiles, mismatches of up to 60 meters were found. CAR 2 was raised on this issue. Clarification provided by GFC was deemed satisfactory by GFC and CAR 2 was closed.

b   Validation criteria and Indicators

Criteria noted in the JCN /55/ requires: 1) assessment of the rate of conversion of forest area as compared to an agreed reference level; 2) forests are defined by Guyana in accordance with the Marrakech accords; 3) conversion of natural forests to tree plantations shall count as deforestation with full carbon loss; 4) forest area converted to new infrastructure, including logging roads, shall

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[*] P1=1990-1999, P2=2000-2005, P3=2005-2009 and Year 1=2009-2010. These periods are defined in Year 1 Verification Report/63/

count as deforestation with full carbon loss; 5) forest cover on 1 October 2010 will be used as a baseline for monitoring gross deforestation; 6) reporting is to be based on medium resolution satellite imagery and *in-situ* observations where necessary; and, 7) monitoring shall detect and report on expansion of human infrastructure (e.g. new roads, settlements, pipelines, mining/agriculture activities etc.). The provisions made in the JCN /55/ were considered in the definition of the analysis methodology.

The verification team examined each area of the GIS and remote sensing methods used against recommended and suggested actionable criteria in the guidance documents (JCN /55/, GOFC-GOLD REDD Sourcebook /56/, and 2006 IPPC Guidelines (GL) /57/ to validate the methodology for measurement of gross deforestation followed by the RP. Specific areas included: geometric correction, radiometric normalization, cloud-masking, forest/non-forest assessment, and mapping quality control and assessment. In addition an independent accuracy assessment has been performed by the Durham University.

c   Validation of methodology against criteria

Generation of deforestation datasets

The GFC follows a hybrid method of automated and manual mapping. Automated tasks are used for procedures that are largely independent of local image circumstances, and manual processing is used where automated processing would probably introduce errors due to inconsistencies in image characteristics, which automation often has difficulties to deal with. The main reason for using manual digitizing is the excess in cloud cover of the datasets which made it practically impossible to use automated methods as recommended in the GOFC-GOLD REDD sourcebook /56/. However, the applied methods are in line with the GOFC-GOLD REDD Sourcebook as they rely on multi-date imagery and focus on the forest change by updating forest cover maps of previous epochs (pre-classification). Furthermore, the GFC applied QA/QC measures through the establishment of SOPs, establishment of automatic operations, and revisiting of 100% of the 24 km x 24 km grid cells used for aiding the visual interpretation. The measures and approaches have been verified as having reduced the human error /1/.

Independent accuracy assessment

Additionally, independent accuracy assessment is conducted as a verification procedure as defined by the 2006 IPCC GL. The verification team checked the methodology followed for this assessment /17/. According to this document /17/, the accuracy assessment builds further on the Year 4 sampling design, in order to generate a reference change dataset. Using a reference change dataset instead of a new random sampling reduces the uncertainties in forest change estimates, and allows getting confidence intervals for the change estimates.

The Year 5 sampling design uses the same two-stage sampling with stratification on the primary units (being the GeoVantage flight strips of 5x15km). In response to CAR 5 from Year 4, the primary units are stratified into 4 strata (no risk, low risk, medium risk or high risk). The selection of the primary units within the strata were as much as possible the same as in Year 4, thus continuing the reference change dataset. In total, 313 first stage samples (1x3 km rectangles within GeoVantage strips) were used. Each of these is subsampled with a 100x100m grid, resulting in 300 1ha sampling units.

The calculations for the Accuracy Assessment (AA) for Year 5 have all been implemented in R and the R survey package. R is an open source statistics package comparable to SAS (and a defacto academic standard). This in principle allows for a check by repeating the calculations, when GFC would decide to make the AA data and R scripts public, as the R software is freely available.

In accordance to Observation 1 of previous year's audit, the working toolbar for the GIS operators of the Accuracy Assessment has been overhauled. The verification team has checked the new toolbar and found it to be clear and easy to use, and therefore closes this observation.

In response to Observation 2 of last years' audit, the AA report of this year is much clearer in its formulations and does not mix anymore terminology of the independent change sample analysis and an assessment of GFC's map. The current AA does not access GFC's map directly, but does an independent, sample based change estimation, which is then compared with GFC's results. Terminology and reporting have been adapted to reflect this approach. The verification team therefore closes this observation.

The methodology followed best practice guidelines in terms of sample design and accounting for national conditions and capabilities /56/.

Conclusion

The verification team concludes that the analysis methodology used by the GFC meets the applicable criteria, defined by the JCN /55/, GOFC-GOLD REDD Sourcebook /56/, and 2006 IPPC Guidelines (GL) /57/. The verification team also concludes that this year's AA report finalizes the change of the AA to a reference change sample dataset, which is an improvement over the approach of Year 3 and earlier, as it allows for better estimates of the forest change certainties and their confidence limits. The verification team also concludes that the CARs and Observations from last year have been addressed properly.

5.1.2 Verification of Indicator

Image processing

The verification team confirmed that the radiometric normalization technique used is the Dark Object Subtraction (DOS)/1/ and that it was adequately implemented. Cloud-shadow masking methods used 'thresholding' in the blue band and additional manual inspection. These methods are adequate and in line with the GOFC-GOLD REDD Sourcebook /56/. Least cloud cover RapidEye input images were selected and geometric correction of images was considered adequate.

A CAR (CAR 4) was raised on the finding that geometric alignment between different RapidEye acquisitions for the same location was not always good enough. Misalignments of 3 pixels were found between several images. This will not have had much impact on the mapping and change analysis, but GFC should have a better QA/QC procedure in place for the RapidEye input images, and apply manual corrections if necessary.

Analysis methods

Deforestation in Year 5 was obtained through visual interpretation of RapidEye images, guided by automated delineation of non-forest features. Taking into account the fact that the same procedure was used for Year 4 and that an independent accuracy report /17/ has been produced confirming the accuracy of the mapping of RP, verification focused on conformance between the SOP (in this case: the mapping guide) and the actual mapping process. The verification team had the operators demonstrate the entire process for several different areas, and found that the operators followed the SOP, evidencing that these SOPs are adequately implemented. The verification team interviewed the operators and found their level of understanding of the processing and mapping tasks to be very good. It should be noted that operators are all local persons and GFC staff.

An Excel sheet was developed for Year 5 to aid in the conversion from the GIS mapping output to the final figures according to IPCC standards. The verification team cross-checked the figures in the IPCC tables and found those to be correct. It should be noted that the conversion of the GIS

mapping output to the figures and tables on the indicators however is still done manually, and in case of the IPCC tables it is still done by Indufor personnel.

Accuracy assessment

The verification team checked the results of the independent accuracy assessment performed by the University of Durham /17/ and provided by the RP. According to this assessment the gross deforestation rate for Year 5 is 0.062% (12 219 ha) with a standard error of 0.008 (1 506 ha). This agrees with the reported change rate by GFC, which is 0.065%.

According to the Accuracy Assessment, the degradation Y4-Y5 was 7 377 ha (0.046%), where GFC found an area of 4 231 ha to be degraded. Discussing this difference with the AA team it was concluded that this is probably due to the much higher resolution of the GeoVantage images used by the Accuracy Assessment team, as compared to the RapidEye images. This will allow the AA team to see much more detail, and pick up also areas with only little degradation. Though the figures differ considerably, the impact of the difference is deemed non-material by the verification team, as the absolute values are considered small. The verification team concludes that, though GFC probably misses a larger part of the more scattered and small-scale degradation, they are mapping the degradation in accordance with the standards, and limitations of the available RapidEye data in relation to the GeoVantage images.

The verification team has verified the results of the accuracy assessment by having the validation process demonstrated and checked for one (1) validation tile.

Conclusion

Taking into consideration all the findings obtained with the verification and sampling plan applied as stated above, and the final results provided for the independent accuracy assessment, the verification team considers that the validated methodology has been followed correctly and that reported results are free from omissions and misrepresentations that could lead to material misstatements.

The verification confirms the gross deforestation rate in Year 5 is 0.065%.

5.2 Verification of Interim indicator 2.1 - Loss of intact forest landscapes

5.2.1 Methodology validation

a   Methodology description

The methodology followed by the GFC to prepare the Year 1 intact forest landscape (IFL) layer uses the existing global IFL GIS layer as a starting point and then buffers various P1, P2, P3, Year 1, Year 2, Year 3 and Year 4 land use layers and excludes them /63/. Layers buffered and excluded are water bodies (including navigable rivers and shorelines), settlements and municipalities, agricultural concessions, and deforested areas. The deforested areas had been pre-selected to contain forestry roads, infrastructure roads, mining, and/or mining roads /63/. Forestry concessions were also extracted and are considered as logging at an industrial scale, though at low intensity. Once the deforested areas have been removed, the polygons allowed to remain in the resulting GIS layer will be larger than 50 000 hectares and capable of enclosing a circular object of 10 km radius. An assessment is made to ensure that at least a 2 km wide corridors or appendages are observed to and from areas meeting the applicability conditions. All of the buffering, exclusion, area calculation, and area-based selection are performed using ArcGIS v.10 modeling code /63/. Final identification of polygons meeting suitable width criteria is performed manually. Furthermore, in order to refine the IFL map, cleanup of island polygons which would fail either the 10 km size or 2 km width test was performed.

The GFC has included this operation in their procedures, though still as a manual post-processing operation. Given the fact that this operation involves only 9 large and non-complex polygons, the manual character of the operation is not deemed a source of potential material misstatements.

b   Validation criteria and Indicators

Criteria used to validate this landscape methodology included the existence of appropriate input data layers, and defined prerequisite processes for estimation (buffering and exclusion from the input layers) were sourced from Potapov *et al.* (2008) /64/, as referred by JCN /55/. The JCN specifically states that "*the total area of intact forest landscapes within the country should remain constant. Any loss of intact forest landscapes shall be accounted as deforestation with full carbon loss*". Potapov *et al.* also suggests that monitoring and estimation should use similar methods as for forest area change estimation. A footnote defines IFL "*as a territory within today's global extent of forest cover which contains forest and non-forest ecosystems minimally influenced by human economic activity, with an area of at least 500 km^2 (50 000 ha) and a minimal width of 10 km (measured as the diameter of a circle that is entirely inscribed within the boundaries of the territory).*" Potapov *et al.* /64/ had an additional size criteria stating that corridors or appendages to areas that meet the aforementioned spatial conditions must be at least 2 km wide.

Potapov *et al.* /64/ did their seminal work with a historical series of Landsat images, and wrote that construction of the IFL layer should start with the study area and then systematically identify and eliminate locations of human development. The specific areas of human influence that should be eliminated are: 1) settlements; 2) infrastructure used for transportation between settlements or for industrial development of natural resources, including roads (except unpaved trails), railways, navigable waterways (including seashore), pipelines, and power transmission lines; 3) areas used for agriculture and timber production; and 4) areas affected by industrial activities during the last 30-70 years, such as logging, mining, oil and gas exploration and extraction, peat extraction, etc. /64/. Buffers of 1 km were applied to settlements and transportation infrastructure. Burned areas from forest fires causing stand-replacing wildfires in the vicinity of infrastructure or developed areas should be eliminated.

c   Validation of methodology against criteria

The verification team concludes that the analysis methodology used by the GFC meets the definition and concept of Intact Forest Landscape /65/ and is in line with the recommendations of Potapov *et al.* /64/.

5.2.2 Verification of Indicator

The methodology of verification used by the verification team examined the existing GIS layers; spatial modeling code used by the RP, and output layers and had the operator demonstrate the procedure step by step.

The verification team concludes that the calculation of IFL is correct and, that the corrected benchmarks IFL figure for Year 5 is 7 604 314 ha. In Year 5 there was a loss in IFL area of 111 ha, with 63 ha of that being accounted for by newly titled Amerindian land.

5.3 Verification of Interim indicator 2.2 - Forest Management

5.3.1 Methodology validation

a   Methodology description

The GFC has a unique approach to sustainable forest management and has put in place a robust forest monitoring system, which has enforcement of forest legality amongst its main objectives /8/. The forest legality procedures and mechanisms are a direct result of years of experience and are governed by a series of guiding documents and legislation, mainly the country's Forestry Act, the National Forest Policy and Plan, and the Guyana Forestry Commissions' Work Plan. At the time of this verification, the monitoring division of the GFC consists of 205 staff, spread out over the head office personnel in Georgetown, 4 divisional stations, 39 field stations, and 10 mobile stations.

 In regards to the Forest Management Interim Indicator 2.2 , the most relevant aspect of the RP's forest monitoring system is its four main components to enforce forest legality:

- Forest Concession Monitoring: This part of the monitoring system consists of the monitoring of the concessions from a legal point of view (i.e., permitting, payment of royalties,…) and the strictness of the forest management activities performed by the concessionaires;
- Monitoring of forest produce in transit: This is the Chain of Custody (CoC) system that has been implemented in Guyana since the year 2000 /8/. This CoC system, of which the Log Tracking System is a main part, has as the main objective to verify the origin of raw material and to control the level of harvesting within State Forests /8/;
- Sawmills and Lumberyards monitoring: This component consists of the verification of the legality of sawmills and Lumberyards and their operation /21/
- Exports: This component of the monitoring system seeks to control all exportations and to check the legality of the produce to be exported /22/.

As in Year 1, 2, 3 and 4, all data used to calculate the Interim Indicator 3 for Year 5 is sourced from the monitoring of the forest production in transit or CoC component of the RP's monitoring system, and the verification has therefore concentrated on this.

The existing CoC system provides detectable evidence on the legitimacy, location and magnitude of forest operations in Guyana, and is currently applied to all forestry operations, including state forests, Amerindian reservations, as well as private properties. The system is based on the traceability of forest produce through the use of log tracking tags, which are assigned to all concessionaires and private forest holders who are involved in commercial logging operations in a given year. Log tagging is done at the stump, where half of the tag is affixed to the stump at the time of felling, and the other part of the tag bearing the same sequence of numbers as recorded on

the stump tag is affixed to the produce being removed and transported. This procedure is carried out for all types of forest produce, including logs, lumber piles, poles, and posts. The unique identification code on each unit of produce will indicate who the concessionary operator is, and can therefore help indicate the geographic origin of the forest produce. In addition, the tagging systems is linked to a quota system, where information is gathered in order to control the volume of produce being harvested from a given area, and which is calculated based on the assigned sustainable yield of the forest area in question and which also considers variables such as felling cycles, felling distances, and minimum girth requirements /8/.

The link between the tagging system and the produce information (e.g. origin, destination, volume, type of produce) is done through volume declarations, which are included within the removal permit records emitted by the RPs.

The monitoring process of the extracted volumes varies depending on whether the operation:

- Takes place in a State Forest lands and is not a procedural breach;
- Takes place in the private properties / Amerindian lands and is not a procedural breach;
- It is a procedural breach (i.e. State Forest lands or private properties / Amerindian lands);
- It is illegal logging.

The forest monitoring is implemented with written standard procedures which are now in place for each of these instances, as DNV-GL was able to confirm.

State Forest lands

The monitoring process for extracted volume from State Forest Lands remains the same as reported in Year 1, 2, 3 & 4 verification /68//69//70//71/. The operator has to request for the issuance of a removal permit in any of the existing forest stations /8/. (Figure 3) before the logging operations commence. The removal permit will be filled-out with the operator's details. Each forest station records the issuance of the removal permit in specific books and through approval letters emitted from the central office in Georgetown /29/ /36/ /53/. Once the operator is ready to transport forest produce beyond their regularized boundaries, they are required to complete the removal permit, stating the date of removal, destination, vehicle type, vehicle identification, name of driver/captain, specification of forest produce and associated tags (tags must be listed according to species and product type), volume and total tags used and any other relevant /8/. As part of the QA/QC measures set in place, the produce transported and the correctness of the respective removal permits are checked and verified at various GFC strategically located checkpoints. This check is recorded in books stating the removal permit license, the type of produce, volumes and date when the removal permit and the produce were checked. The issued removal permits are valid only for 30 days, and once the produce has reached the destination, concessionaires would have to declare the volume to the nearest forest station within 24 hours /8/. Every month, these removal permits are sent to the GFC's headquarters to be recorded in a specific database. Specific QA/QC measures are in place to assure that the recording errors are reduced to a minimum (i.e., by using formulae that check the consistency of data, regular consistency checks, restricted access to the database, etc.) /49/.
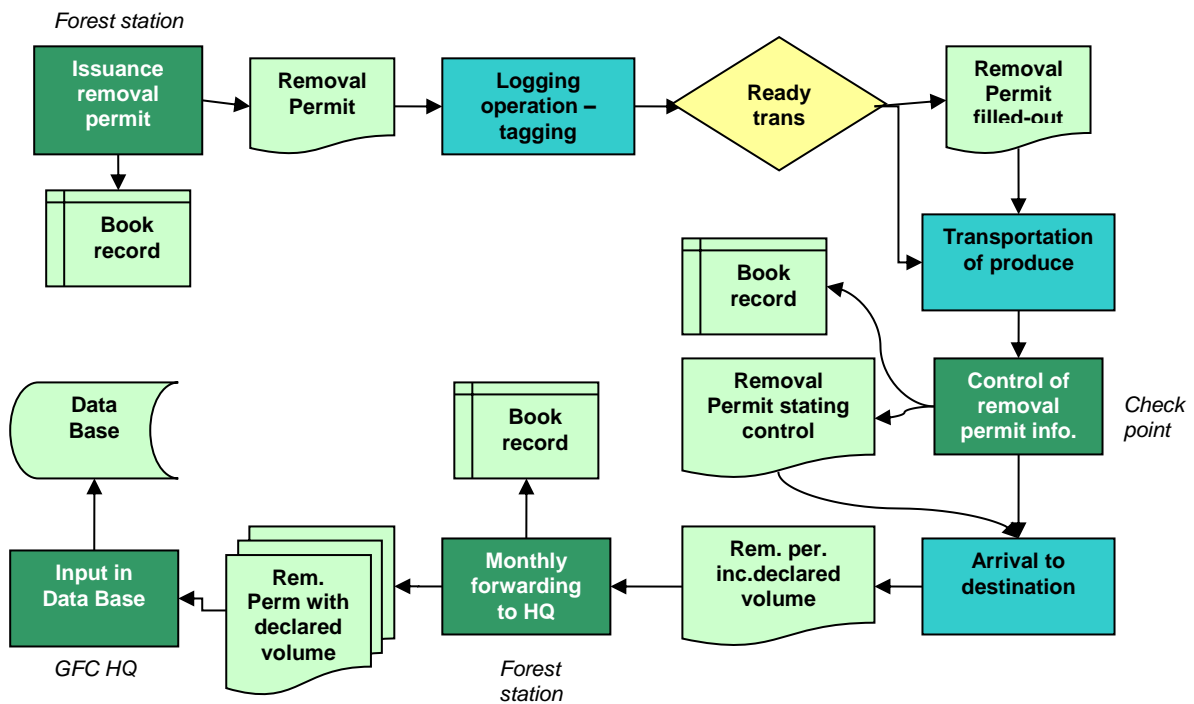
Figure 3. Monitoring process flow chart – State Forest Lands

Private Properties / Amerindian lands:

As in previous verification years 1, 2, 3 & 4, the owner is not required to request a removal permit before the logging commences when this occurs in private or Amerindian lands. However, the supposed owners of the logging produce are required to have a removal permit filled-out in any instance that the produce is to be transported outside the boundaries of the property (Figure 4). From that point forward, the monitoring system is similar to that of the State Forest lands.
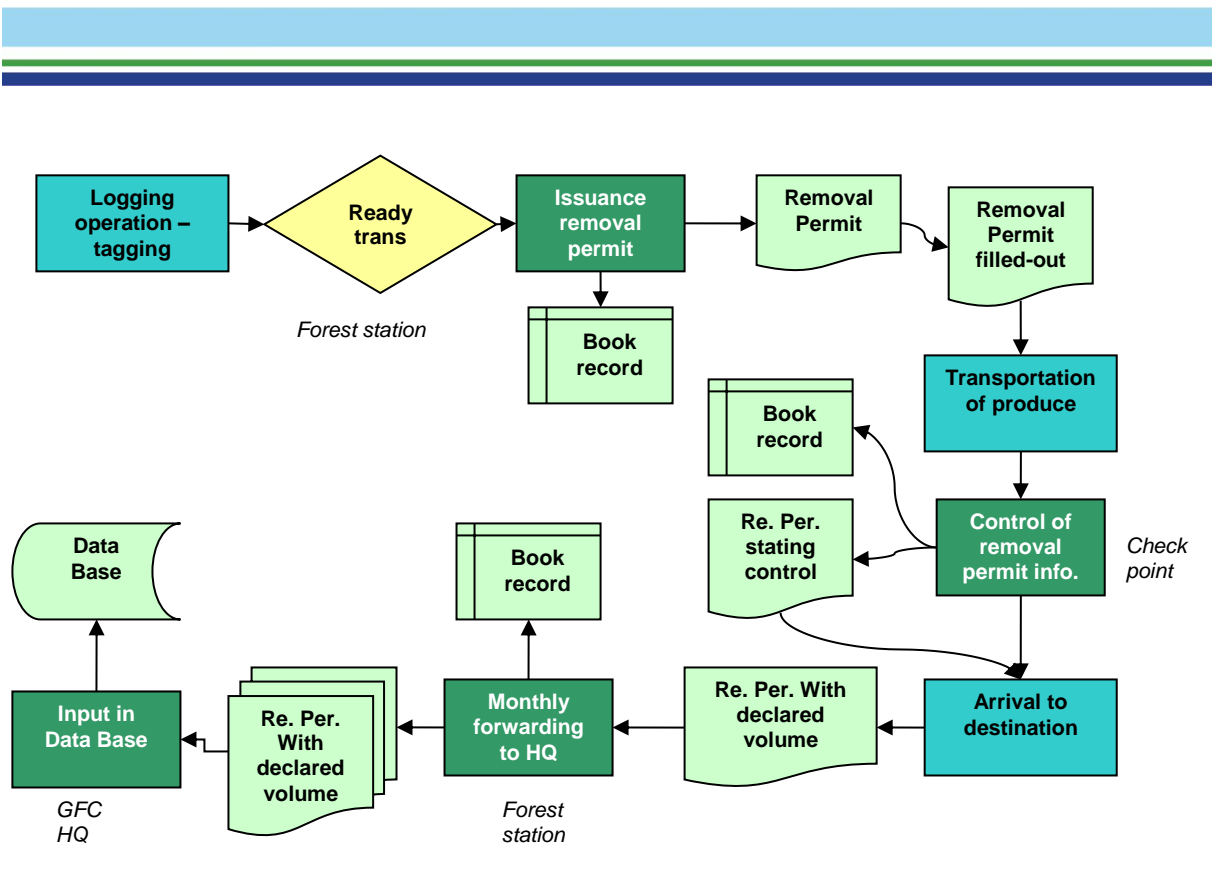
Figure 4 Monitoring process flow chart - <u>Private Properties / Amerindian lands</u>

<u>Procedural breach or an illegal logging breach</u>

As in previous verification years, in case the operator does not have a removal permit or a removal permit has inconsistencies, the amount removed is then recorded respectively into the Illegal Logging Database or in the Procedural Breaches Database /28/. Also, only in the case it is demonstrated after investigation that a certain operation is not considered legal logging or a procedural breach, the respective record is cancelled from this database and is added to the State Forest or private property/Amerindian databases. As is the case with the state forest database, volumes are reported to the data base according to species as well as to the type of product identified and deemed as "illegal" or a "procedural breach", which may be any of the following: charcoal; firewood, logs, lumber, piles, poles, posts, and spars.

The reported results of the interim performance indicator for Year 5, as in previous years, are therefore the total volume extracted in tCO_2 (expressed as Cubic Meters (CBM)) obtained from all the removal permits (or estimations by the authorities in case no removal permit is present) recorded in the four data bases: Forest state lands; Amerindian and private properties; Illegal logging database; and Procedural breaches database. In the case of Logs and Sawn-wood, values reported by the GFC officer reporting the illegal activity are divided by 0.7852 and 0.5 respectively, as the declared volume is not the real volume felled, but the commercial volume extracted /37/.

In 2011 & 2012, the GFC made progress towards developing a methodology and factors that relate total carbon emissions from biomass damage due to logging activities (collateral damage) to the volume of timber extracted. This has been achieved through a technical report by Winrock International (S. Brown et al.) for the GFC: Collateral Damage and Wood Products from Logging Practices in Guyana, December 2011 /7/ and Guyana FCMS Conversion Factor Handbook – Revised October 2013 /13/. The methodology applies the logging damage factor (0.95 tC/m^3), wood density of commercially harvested timber (0.38 tC/m^3/gap), logging infrastructure factor (skid trails, etc.) (32.84 tC/km) and the conversion factor for tC to tCO_2 in the conversion of total

volume in CBMs to tCO_2, and also includes storage in long term wood products /11/. Total carbon stock in long-term wood products was estimated from the extracted biomass carbon using Winjum et al 1998 formula and the approach in the approved VCS Module VMD0005 /67/ which DNV GL cross-checked and confirmed. This computation was based on all extracted wood biomass (including exports) captured by GFC's during the period 1 January 2014 to 31 December 2014 (i.e. Year 5) with the data available of the total wood volume harvested for during this period.

b   Validation criteria and Indicators

According to the Joint Concept Note (JCN) on REDD+ cooperation between Guyana and Norway /55/ one of the degradation indicators deals with forest management (i.e. selective logging) activities in natural or semi-natural forests:

-     "*All areas under forest management should be rigorously monitored and activities documented (i.e. concession activities, harvest estimates, timber imports/exports).*"

-     " *Increases in total extracted volume (as compared to mean volume 2003 – 2008) will be accounted as increased forest carbon emissions unless otherwise can be documented using the gain-loss or stock difference methods as described by the IPCC for forests remaining as forests. In addition to the harvested volume, an appropriate expansion factor of 25% (applied to the hole population of trees under forest management, i.e. harvested + remnant trees) shall be used to take account of carbon loss caused by collateral damage, etc., unless it is document that this has already been reflected in the recorded extracted volume.*"

According to the JCN, the way monitoring and estimation of the indicator shall be done is through "*Data on extracted volumes collected by the Forestry Commission. Independent forest monitoring will act as an additional data source on forest management to complement this information. Accounting of this indicator should be done in terms of carbon units referred as close as possible to extraction of biomass from the above ground carbon pool.*" /55/.

In line with the findings during the first, second, third, and fourth verifications /68//69//70//71/ it is understood that this would imply that the extracted volume makes reference to the total biomass removed from the above-ground carbon pool, which is closer to giving a reference on the forest degradation than the commercial volume harvested. Therefore, the methodology has once more been considered to take this provision into account.

c   Validation of methodology against criteria

In order to validate the methodology followed and the monitoring system in place, the verification team carried out a process-based assessment similar to Year 1, 2, 3 & 4. This involved spot check verifications of respective documentation and data operations for the following respective monitoring process:

- Legal Concession Agreements

- Boundary Demarcations

- Forest Management Plans – Inventories, Initial Business Plans

- Annual Operational Plans – Stock Maps, planned Infrastructure, etc.

- Quota System Adherence

- Log tracking and tagging

- Removal Permitting

- Production Register

- Licensing – Sawmill, Timber Dealer, Export

- Code of Practice adherence

- Data Procedures

    o Primary Collection

    o Intermediate/secondary data collection

    o Recording and storage of data bases (main and field offices)

    o Reporting (from field office to main office, other stakeholder reports)

    o QA/QC procedures for data collection, intermediate data recording, data recording in the main data base, procedures for data reporting.

For each of these operations, the verification team checked the training of personnel /29//30//36/ 51//52//53//54/ via interviews, which checked the GFC staff's knowledge of the procedures in place. Furthermore, the verification team also performed spot checks of removal permits and other relevant information in order to verify the consistency of the same in each database, with the information in the removal permit (or illegal logging forms) and with the records available at the transit & forest stations of Annai /54/ and Lethem /52/, and with personnel at the base camp of the Rupununi Timber Association concession /29//30//36/ 51//52//53//54/.

The GFC demonstrated the knowledge of the procedures in place, and no evidence was identified that could lead to believe that the monitoring system is not robust. The staff was well trained and during the audit showed great level of involvement and dedication to not only implementing the procedures, but also seeking changes to them when this would lead to an overall improvement of the system.

The preliminary data that has stemmed from the work that the GFC and Winrock have done has shown a high level of consistency and predictability on the level of damage and impacts per cubic meter harvested, as does the RP's adherence to the methodology to determine carbon stored in long-term wood products.

In view of the above, the verification concludes that the analysis methodology used by the GFC meets provisions of the JCN /55/.

5.3.2   Verification of Indicator

In order to verify the reported assertions of Indicator 3, the verification team performed the following checks:

- Consolidation, calculation and reporting: Confirmation that the total reported in the database is consistent with the figure reported in the IMR;
- Recording: Database records were randomly chosen and data was compared with the hard copy documents;
- Collection: Hard copy records and books located in the Annai and Lethem Transit/Forest stations, and through interviews with association members at the base camp of the Rupununi Timber Association. All data obtained from forest station and concession visits was then crosschecked against the respective database records.
- Calculation: DNV GL checked the database spread-sheets in the Forest Resources Management Division's REDD Secretariat and can confirm that the calculations embedded in the tool for estimating emissions and removals due to timber extraction reflected those described in the Interim Monitoring Report and the VCS Module VMD0005 /67/.

The verification team did not detect any discrepancy that the reported assertions on Interim indicator 3 - Forest Management is equal to 3 366 326 tCO$_2$.

5.4 Verification of Interim indicator 2.3 - Carbon loss as indirect effect of new infrastructure

5.4.1 Methodology validation

a   Methodology description

The Year 5 methodology to calculate the loss of carbon as an indirect effect of new infrastructure is the same as in Year 4, and was achieved through visual inspection and manual digitizing of degraded areas visible in the RapidEye imagery, within a buffer of 100 m (but possibly extending outside of this buffer) around new or existing mining areas and around roads related to mining, forestry, and infrastructure, but excluding existing deforested lands that intersected the degradation buffer (such as those from roads and infrastructures built during P1, P2, P3, P4 or Year 1 ,2, 3 or 4) /1/.

Accuracy assessment of degradation mapping is also conducted by the University of Durham following similar methods as those defined for the assessment of deforestation.

b   Validation criteria and Indicators

The main validation criteria is the JCN /55/ guidance document, as there are no other criteria listed in other guidance materials specific to detecting degradation from establishment of transportation infrastructure. Interpretation and mapping of new mining and roads related to mining, forestry, and infrastructure use the same methodology and criteria for verification found in the estimation of gross deforestation (see Section 4.1).

The JCN /55/ notes that the establishment of new infrastructure in forest areas often contributes to forest carbon loss outside the areas directly affected by the constructions. "It calls for detection of degradation in a 100m buffer surrounding new infrastructure (including mining sites, roads, pipelines, reservoirs, etc.) and applies a benchmark of a degradation area of 4 368 ha. Any degradation above this benchmark for the years after year 2 will lead to a reduced compensation unless other emission factors can be documented through the MRVS, these areas shall be accounted with a 50% annual carbon loss through forest degradation." Apart from this criterion, the recommendations made by the GOFC-GOLD REDD Sourcebook /56/ for mapping of degradation would also be applicable.

c   Validation of methodology against criteria

The GFC has fully adopted the degradation mapping method agreed upon in the JCN. Degradation is manually mapped using high-resolution imagery, starting within a buffer of 100 m from the outside edge of existing infrastructure. The verification team has checked the degradation and reporting in the GFS's GIS systems, and has found the degradation mapping to be consistent with the mapping SOP.

The verification team concludes that the analysis methodology used by the GFC meets provisions of the JCN /55/ and that the degradation mapping using RapidEye images is accurate.

5.4.2 Verification of Indicator

The verification team had the GIS operators re-map the degradation for several areas and compared the results with the initial degradation polygons. Based on its findings the verification team concludes that the mapping of degradation is done correctly and conform to the mapping SOP.

The verification team interviewed the GIS operators about their understanding of the degradation mapping method and concludes that the GIS operators are following their procedures /15/ and understand the reasoning behind it.

Additionally, the verification team checked the final results of the independent accuracy assessment performed by the University of Durham /17/ and provided by the RP. According to this assessment the overall accuracy of the Year 5 degradation mapping would be equal to 99.98% (97.69% in Year 3), which would confirm the acceptable accuracy of the mapping according to the REDD sourcebook /56/ and to other applicable criteria /65//66/. The verification team has verified the results of the accuracy assessment by having the process being demonstrated and checked for one (1) validation tile, and by inspecting and running the R scripts used to calculate the final accuracy values.

As a result, the verification team concludes that the Year 5 method conforms to the JCN requirements, and concludes that the value for Indicator 2.3 for Year 5 is equal to 4 251 ha.

5.5 Verification of Interim indicator 2.4 – Emissions resulting from subsistence forestry, land use and shifting cultivation lands (i.e. slash and burn agriculture)

5.5.1 Methodology validation

In line with the JCN /55/ this indicator is presently not monitored till the full MRV is in place. GFC has however like the previous year started to develop a methodology for measuring and reporting of this indicator. Areas of shifting cultivation which previously were mapped but not considered in the overall assessment are since 2013 being labeled in a manner that will allow tracking the specific changes overtime within the GIS system from Year 4 audit onwards. Shifting cultivation areas are either labeled as pioneer, when they appear to occur as a newly cut area within an area which was seen as high forest in the previous year, or as rotational, when found within a historical degraded and impacted area. All areas larger than 0.25 ha are being mapped and tracked.

The main validation criteria would be the GOFC-GOLD REDD Sourcebook /56/ as the JCN /55/ guidance document does not provide any guidance. The JCN only states that this indicator is not relevant for the interim period before a proper MRVS is in place.

The GFC has fully adopted the degradation mapping method agreed upon in the JCN. Degradation is manually mapped using high-resolution imagery. The verification team has checked the degradation and reporting in their GIS systems, and has found the degradation mapping to be consistent with the mapping SOP.

The verification team concludes that the analysis methodology used by the GFC meets provisions of the GOFC-GOLD REDD Sourcebook /56/.

5.5.2 Verification of Indicator

In line with the CAR 4 which was raised during the Year 4 audit the audit team the verification team has visited several active shifting cultivation areas on-site in the area east and south of Lethem. Like in the previous audit the team found that there were some discrepancies between the interpretation of the mapping unit and the actual field observations. The overall work of the GFC in relation to the CAR was not yet completed that would allow a full assessment of the field findings and the mapping interpretation. Consequently the verification team agreed to leave the CAR open to allow more research and fieldwork on the issue.

Since this Indicator is not yet formally part of the indicators to be verified the team did not conclude on the accuracy and correctness of the shifting cultivation figures 167 ha/yr.

5.6 Verification of Interim indicator 2.5 - Emissions resulting from illegal logging activities

5.6.1 Methodology validation

a Methodology description

The monitoring of illegal logging is within the main objectives of the forest monitoring system described in section a, as the monitoring system serves to enforce legality. Cases of illegal logging are found in the course of routine/impromptu operations performed by the GFC staff, or through information of these occurrences by stakeholders. In the case where investigation demonstrates that a certain operation is not considered illegal logging or a procedural breach, the respective record is cancelled from the illegal logging database and is added to the State Forest or private property/Amerindian databases.

b Validation criteria and Indicators

According to the Joint Concept Note (JCN) /55/ one of the degradation indicators has to cover illegal logging activities:

-    "Illegal logging results in unsustainable use of forest resources while undermining national and international climate change mitigation policies"
-    "Areas and processes of illegal logging should be monitored and documented as far as practicable"

The JCN specifies the way the indicator has to be monitored and estimated: "*The monitoring of illegal logging is within the main objectives of the GFC's forest monitoring system, and is informed by an illegal logging database. In addition to reporting on illegal logging via the database, Independent Forest Monitoring will support performance monitoring of forest legality through the IFM framework. Should IFM detect potentially significant challenges with the established forest monitoring system, this indicator will be reassessed. In the absence of hard data on volumes of illegally harvested wood, a default factor of 15% (as compared to the legally harvested volume) will be used. This factor can be adjusted up- and downwards depending on documentation on illegally harvested volumes, inter alia from Independent Forest Monitoring*". Furthermore, it states that another means of monitoring should include "*Medium resolution satellite to be used for detecting human infrastructure and targeted sampling of high-resolution satellite for selected sites,* and *Accounting of this indicator should be done in terms of carbon units referred as close as possible to extraction of biomass from the above ground carbon pool.*".

c Validation of methodology against criteria

The rate of illegal logging for the assessment Year 5, 1 January 2014 to 31 December 2014, is informed by a custom designed database that is updated monthly, and subject to routine internal audits, much like the processes established for the legal forest management practices mentioned in earlier sections of this report. DNV GL has verified that reporting on illegal logging activities is done via the GFC's 32 forest stations located countrywide, as well as by field, monitoring and audit teams, through the execution of both routine and random monitoring exercises and investigation procedures. The infractions are recorded, verified and audited at several levels, both in the field and at the main database. All infractions are summarized in the illegal logging database and result in a total volume being reported as illegal logging for any defined time period.

The verification team concluded that the analysis methodology used by the GFC meets the requirements of JCN /55/ and if applied correctly, it will lead to assertions with minimum material discrepancies.

5.6.2 Verification of Indicator

In order to verify the reported assertions of Indicator 2.5 in Year 5, the verification team performed the following checks:

- Consolidation, calculation and reporting: Confirmation that the total reported in the database is consistent with the figure reported in the IMR;
- Recording: Database records were randomly chosen and data was compared with the hard copy documents;
- Collection: Hard copy records from the Lethem and Annai forest/transport stations were checked with the database records. Since the Rupununi Timbers Association's operations are fairly recent, company records of illegal logging activity have been produced for the concession to date and not only for the period up to 31 December 2014;

The estimated emissions from illegal logging for Year 5 are equal to 13 823 tCO$_2$. The DNV GL team also verified that the calculations for arriving at this amount also took into consideration long term wood product storage, as well as collateral damage emission factors as was also done with the forest management indicator.

5.7 Verification of Interim indicator 2.6 - Emissions resulting from anthropogenically caused forest fires

5.7.1 Methodology validation

High-resolution RapidEye data is being used to find and determine the extent of the burnt areas. MODIS Fire Hotspot data (FIRMS) are being used by the GFC to assist in finding the location of anthropogenic fires and for the decision on whether the deforestation driver was fire or not. The detection of burnt areas has been integrated into the mapping procedures for deforestation and degradation, where fire is one of the possible drivers for a deforestation or degradation event. The combined use of high-resolution multispectral images with FIRMS fire hotspot data is in accordance with the GOFC GOLD Sourcebook /56/.

5.7.2 Verification of Indicator

The audit team has verified the correct operation of the GIS mapping team regarding mapping the extent of deforestation and degradation and their drivers, including fire, and found their mapping to be concise and consistent with their mapping SOP.

According to the reported assertions, the total burned area (degradation, not deforestation) in the analysis period was 173 ha/year. While there was a steady increase in year 2, 3 and 4 (28 ha/year, 208 ha/year and 395 ha /year), this years' area degraded by fire is considerably less than the 2 years before. Note that this indicator and indicator 2.4 might overlap with each other, as usually fire is used as a field preparation measure for areas under shifting cultivation.

The verification team confirmed that the figure of 265 ha/year is consistent with the verification result.

5.8 Verification of Interim indicator 2.7 – Encouragement of increasing carbon sink capacity of non-forest and forest land

In line with the JCN /55/ this indicator is presently not monitored till the full MRV is in place. GFC has however started to develop a methodology for measuring and reporting of this indicator. Areas which show recovery of forest stock at previously deforested areas are mapped for future assessments. Although the areas are not considered in the overall assessment, the areas are

distinctly labelled which will allow tracking and the specific changes overtime within the GIS system from Year 5 onwards. All areas larger than 0.25 ha are being mapped and tracked.

The main validation criteria would be the GOFC-GOLD REDD Sourcebook /56/ as the JCN /55/ guidance document does not provide any guidance. The JCN only states that this indicator is not relevant for the interim period before a proper MRVS is in place.

In line with the overall adoption of the GFC mapping methodology agreed upon in the JCN, reforestation is manually mapped using high-resolution imagery. The verification team has checked the reforestation areas and reporting in their GIS systems, and has found the mapping of the areas of recovery (reforestation) to be consistent with the mapping SOP.

The verification team concludes that the analysis methodology used by the GFC meets provisions of the GOFC-GOLD REDD Sourcebook /56/.

5.8.1 Verification of Indicator

The verification team examined the mapping of the GFC and underlying data. The mapping of areas demonstrating early recovery/reforestation was found to be accurate.

Since this Indicator is not yet formally part of the indicators to be verified the team did not conclude on the accuracy and correctness of the shifting cultivation figures of 73 ha.

6   STAKEHOLDER ENGAGEMENT

6.1   STAKEHOLDER COLLABORATION

6.1.1   Community Monitoring Reporting & Verification (CMRV)

In addition to the effective implementation of the procedures just described, GFC also was able to demonstrate its overall commitment to environmental protection and stakeholder consultation, as well as outreach programs with various stakeholders and/or communities under their forest management program. GFC staff have been trying to implement measures so as to socialize their process and illustrate the importance and benefit of their work to constituents so as to be seen as an enabling and friendly institution, rather than a strict enforcement and penalizing institution. One of the most promising aspects of this work in recent years has been the building of capacities within local Guyanan communities to conduct Community Monitoring Reporting & Verification activities (CMRV). Over the last couple of years, a focus has been placed on including local communities in the lifting and validating of field data to ensure that this was done in compliance with the GFC's Standard Operating Procedures. In this regard, community members were, and continue to be, trained in identifying and validating unique drivers, carrying out biomass and carbon quantifications, and methods of ground-truthing remote sensing data to varying degrees of extent. While the GFC is currently concentrating their efforts by providing guidance to certain communities, such as that of the Kanashen where they have begun collecting soil samples for estimating soil carbon contents and have been working with local tree spotters to identify tree species by their corresponding scientific names, other local communities have also been able to participate in similar programs, with the hopes of approaching a common development and use of the official SOPs at the national level to ensure completeness, transparency in procedures and continuity in activities both in and out of state lands. The GFC will thus seek to build on what has been achieved thus far at both the national and local levels to establish an exchange of data on forest change and carbon monitoring, reporting on REDD+ implementation and the continued creation of synergies between CMRV and national MRVS.

While there is no direct indicator presently monitoring these CMRV developments under the scope of this verification, the audit team found it worthwhile and was fortunate enough to be able to attend a meeting with local community participants of a CMRV program to gauge how such processes have been proceeding thus far, and to begin to understand how they could be further implemented and synergized with Guyana's forest management system in the future. On the afternoon of November 18, the audit team met with community members and representatives of the North Rupununi District Development Board (NRDDB) in the village of Annai, who have been involved in a pilot CMRV program with The Global Canopy Programme since 2011. Since the project's inception, sixteen Amerindian communities from the region have developed and run a community measuring, reporting, and verification system, from which local community members have been trained in collecting a wide range of data on natural resources, forest change, biomass, and wellbeing, using smartphones and open source software. Some of the most notable issues raised during this meeting and for the consideration of future CMRV synergies with the national monitoring systems are as follows:

- The enthusiasm and commitment on the side of community members for the program was found to be considerable. They have not only been excited and pleased to have participated in the process, but also mentioned that these exercises have improved their management strategies in general, how they have helped to strengthen local institutions, and how they have also helped inform important future management decisions for the community. All participants mentioned how they would wish to see the program continue.

- While all participants were thankful for the program, one common shortcoming that was mentioned was that of limiting the capacity building activities to field data collection and less-so on data interpretation and analysis. All community members mentioned that if a follow up or new CMRV program is to be implemented in the area in the future, that the required equipment, knowledge, and capacity to interpret, analyze and present results also be left behind at the village level.

- To date, it seems that the emphasis has been placed on the Monitoring and Reporting aspects of creating a CMRV system. This hence highlights the need to place future efforts on the Verification aspect of such systems, where perhaps either the GFC or an independent third party verification could be instituted so as to ensure work towards a complete implementation of all aspects of the monitoring system for REDD+ at both the community level and on a national scale.

- No matter how well developed Guyana's forest management system may become in the future, it is clear that the forestry commission will always have to deal with budgetary and personnel constraints, thereby further highlighting the importance of these programs to include local communities as integral partners in the national management system. This would help contribute towards the improvement and inclusion of field and ground-truthing data into the respective national and subnational forest monitoring systems. This process would not only increase stakeholder engagement and participation, but would also seek to simplify and reduce the cost of building capacity among stakeholders in the long run.

7 COMMENTS BY STAKEHOLDERS TO REPORT

The Interim Measures Report was published for public comments from 7 October 2015 to 7 November 2015 in Guyana Forestry Commission's web page as well as distributed to a list of 94 individual stakeholders of 39 different stakeholder organisations. A Public Notice was placed in the local media over the 4-week period. Comments received during this period are given in the text

box below. Response from the GFC to these comments and the verification team's assessment are also included.

Table 1: List of stakeholders consulted by the Guyana Forestry Commission

	Name	Agency Role		Name	Agency Role
1	William Salas	Applied Geosolutions	21	Gerard Alleng	IDB
2	Bobby Braswell	Applied Geosolutions	22	Annette Arjoon-Martins	Individual Capacity
3	Jonah Busch	Centre for Global Development	23	Joe Singh	Individual Capacity
4	Donna Lee	Climate Consultant	24	Dr. Jim Penman	IPCC Expert
5	Dr. James Baker	Clinton Climate Initiative	25	Dane Gobin	Iwokrama
6	David Singh	Conservation International (CI)	26	Mervin Williams*	Ministry of Indigenous Peoples Affairs
7	Dr. Alhassan Attah	DFID funded EU FLEGT Project Office	27	Joel Fredericks*	National Toshaos Council
8	Edwin Aalders*	DNV-GL	28	Bertie Xavier	North Rupununi Development Board (NRDDB)
9	Indarjit Ramdass†	Environmental Protection Agency	29	Evie Merethe Hagen	Norwegian Space Centre
10	Alexander Lotsch	FCPF	30	Andrew Bishop*	Office of Climate Change
11	Mohindra Chand*	Forest Products Association	31	Nikolaus Oudkerk	Project Management Office
12	Herold, Martin	GOFC GOLD	32	Ashton Simon	The National Amerindian Development Foundation (NADF)
13	Maarten van der Eynden	Government of Norway	33	Maria Sanz Sanchez	UN REDD
14	Hege Ragnhildstveit	Government of Norway	34	Erik Lindquist	UN REDD, FAO
15	Donald Singh	Guyana Geology and Mines Commission	35	Gregory Hodge*	University of Guyana
16	Donald Singh*	Guyana Geology and Mines Commission	36	Paulette Bynoe	University of Guyana (UG)
17	Colin Sparman*	Guyana Gold and Diamond Miners Association	37	Gregory Hodge	University of Guyana (UG)
18	Colin Sparman	Guyana Gold and Diamond Miners Association (GGDMA)	38	Sandra Brown	Winrock International
19	Naseem Nasir*	Guyana Lands and Surveys Commission	39	Felipe Casarim	Winrock International
20	Colin Klautky	Guyana Organisation of Indigenous People (GOIP)	40	Charles Hutchinson	WWF

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* Team leader of DNV GL audit team, for purpose of notification of start of stakeholder consultation only.
† Member of the MRVS Steering Committee

7.1 Received comments and response by the Guyana Forestry Commission

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Comment by: The Amerindian Action Movement of Guyana

☐ NGO   ☐ Party   ☒ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 1:

The Amerindian Action Movement of Guyana (TAAMOG) has perused the fifth performance report which covers the year 2014 on interim measures for reducing emissions for deforestation and forest degradation plus (REDD+), under Guyana's Monitoring, Reporting and Verification System (MRVS).

Response GFC:

Thank you. We are pleased to present the fifth annual report under the national MRVS and to build on the progress made over the past 4 years.

DNV GL:

The verification team assessed the comment and the response to be satisfactory.

Comment by: The Amerindian Action Movement of Guyana

☐ NGO   ☐ Party   ☒ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 2:

Be informed that TAAMOG is delighted to have discovered that Guyana's deforestation rate for the year 2014 is 0.065% quite a reduction from the 2013 rate of 0.068%. This demonstrates the continued excellent leadership, hard work and commitment by the Guyana Forestry Commission (GFC) towards the sustainable management of Guyana's Forests and the fight against global climate change and its dangerous consequences using our own Monitoring, Reporting and Verification System (MRVS).

TAAMOG extends congratulations to the Guyana Forestry Commission (GFC) and its workers on this significant achievement.

Response GFC:

We note the comment about reducing rates of deforestation and believe that this is a good indicator of policy and field monitoring of land use and management activities.

DNV GL:

The verification team assessed the comment and the response to be satisfactory.

Comment by: Conservation International, Guyana

☒ NGO   ☐ Party   ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 3:

CI-Guyana welcomes the opportunity to provide comments on the Year 5 Interim Measures Report (01 January 2014 – 31 December 2014). We commend the Guyana Forestry Commission (GFC) for the dedication it has placed on the completion of an assessment and report of a very high caliber.

At this time when countries across the globe are discussing how they intend to contribute to addressing global climate change, the production of Guyana's fifth consecutive assessment of forest carbon is especially important. The continued operation and advancement of forest monitoring continues to place Guyana in the forefront of the global discussions REDD+. We expect that the results of Guyana's forest carbon monitoring efforts will be fully utilized by all agencies and organisations involved in the management of natural resources to ensure effective management of forest carbon.

We offer for consideration the following comments and reactions intended to improve the accuracy, clarity, comprehensiveness and robustness of the Year 5 report, and further advance Guyana's Monitoring Reporting and Verification System (MRVS). These are presented noting that the current agreement between Guyana and Norway, under which these assessments have been completed, comes to an end this year and discussions are ongoing towards a continued relationship. Our comments also take into consideration the pioneering nature of Guyana's MRVS, and its potential to transform forest governance globally.

Response GFC*:*

Thank you for the feedback and continued support. One main factor that has impacted on the continuous improvement of the MRVS has been the very constructive inputs, both technical and administrative that have been received every year through the public review process. We value these inputs and hopefully you see them being used and clearly reflected in improving the process for every progressive year's reporting.

We have extended efforts to sharing the results across the natural resources management agencies. We also hope that the MRVS can continue to provide annual reporting and bring benefit locally and regionally.

The Guyana Norway Agreement provided the main basis for the commencement of the MRVS. Given that this agreement has come to an end in June 2015, Year 6 of the MRVS will depend, in part, on current, ongoing discussions on a continued partnership.

Based on the outcome of this, the shape of the Year 6 MRVS will reflect the developments over 2015 and may impact on aspects of future reporting under the MRVS, including satellite imagery options.

DNV GL:

The verification team assessed the comment and the response to be satisfactory.

Comment by: Conservation International, Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 4:

The shift toward reporting on LULUCF land classes in alignment with IPCC, and further division of the non-forest land classes will increase the efficiency at the level of national reporting for REDD+ and beyond. Monitoring of regeneration of deforested areas will help further refine assessments of

carbon gains and provide insight into the time needed for return to permanent forest biomass cover. Progress to improve reporting on shifting cultivation will also provide important insights into the dynamics of land-use changes and emissions/sequestration. Such progress and strengths presented provide the foundations for stronger MRVS.

Response GFC*:*

Our aim in moving to align the LULUCF and IPCC classes was to further advance synergy with international reporting requirements and standards.

Our intention is for the medium term plan, to further pursue the establishment of an emission factor for regenerated areas. We have attempted in this year's assessment to commence the spatial reporting on regenerated areas.

There is still a bit more that needs to be done to conclude the work on shifting agriculture and it is hoped that this will be concluded within Year 6 and at most, Year 7 of the MRVS development. The cycle of shifting agriculture, which demands a longer term time series of data to ascertain affirmative trends for Shifting Agriculture, will hopefully assist in the determination of firm and final conclusions on the monitoring of this driver.

Ultimately however, it is hoped that the focus of the MRVS be based on the main drivers of forest change for both deforestation and forest degradation. As such, it is intended that for small scale, low impact drivers, that do not result in a significant impact on deforestation and forest degradation, and therefore forest carbon emissions, that these eventually be deemphasized in the interest of enhancing focus on the main drivers and maximizing the cost benefit of the programme. Of course, keeping a close watch to ensure that the trend in the drivers in terms of scale and type, do not change over time, and if this indeed happens that the system responds to the monitoring of these changes, should always be an equal priority.

DNV GL:

The verification team assessed during interview with stakeholder /49//50/ and its own verification of the GFC corrective action in relation to CAR 2 of Year 4 audit.

Comment by: Conservation International, Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 5:

Guyana's MRVS must inform improved land management, especially in forested areas. To this end, measures must be implemented to continue to mainstream the use of the MRVS outputs by land managers and other stakeholders to address the drivers of deforestation and as a layer of monitoring of their operations. The presentation of data on detected change in protected areas and titled Amerindian lands, as done for the intact forest landscape (IFL), is a necessary step in this regards. Making the spatial data on forest change more widely available is also necessary to enable address of the drivers and improve needed transparency.

Response GFC*:*

We agree. The full use of the main results of the national MRVS have significant potential to inform not only decisions on land management but also land use planning. We therefore have available for use and will be ready to disseminate upon request, the results of the MRVS for purposes of national

land use policy development, updating/revision of the Natural Resources Sector Strategy, or any other required activities.

The data and results of the MRVS have been provided to the Geographic Information Management Unit of the Department of Natural Resources and the Environment which is responsible for further dissemination and analysis across the agencies. This data and results are also made available directly to the Agencies in the Department of Natural Resources and the Environment, along with the satellite imagery (for which 5 user licenses were acquired - RapidEye).

DNV GL:

The verification team assessed during interview with stakeholder /49//50/ the comment and considers the response to be satisfactory.

Comment by: Conservation International, Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 6:

The JCN calls for transparency, including an "institutionalized, systematic and transparent multi-stakeholder consultation process" and a MRV system based on "IPCC reporting principles of completeness, consistency, transparency,…". The report gives extensive details as to the methods and data used which is a commendable step towards ensuring transparency. The report however does not provide clear information on a few other aspect important to realizing transparency:

1.3.1 Are the data and images publically available for independent evaluation (beyond those carried out by University of Durham)?

1.3.2 Was external technical support received to carry out the mapping and, if yes, what was the extent and nature of that support?

Given the importance of transparency as well as capacity-building under REDD+ readiness activities, it would be useful to clarify these aspects.

Response GFC:

Thank you for you feedback on the matter of transparency. We share the view that full transparency can only be achieved if all essential aspects of the MRVS (data input, methods applied, accuracy assessment, results of the verification) embrace the tests of rigor that is expected for a MRVS to be credible and of a high standard. Over the years we have directed a concerted effort to attain a high level of transparency, and more importantly, improve on this level from year to year. Prior to addressing the specific points raised, we believe it is interesting to note the information below regarding the progressive efforts to strengthen and ensure transparency in the MRVS process:

- The MRVS Report is subject to accuracy assessment that is done based on an independent data set

- The Report is released for a period of one month for public review and feedback

- All comments are openly addressed and feedback given to parties

- The results are subject to independent verification

- The independent verification is subject to a peer review

The datasets acquired for the accuracy assessment are available for independent verification and are available, as are all other datasets, to DNV.

Technical support has been received to conduct mapping and assessment for Year 5 and this has been decreasing to just focus on development areas and new design work. There has been an evident shift away from integral involvement from consultants in the mapping and assessment process and to more advisory involvement. However, the involvement of the consultants helps to add a layer of validation to finals results and methods that feed into the generation of these results.

The GFC agrees that transparency and capacity building are two critical components of a well-developed MRVS.

DNV GL:

The verification team assessed during interview with stakeholder /49//50/ the comment and considers the response to be satisfactory.

Comment by: Conservation International, Guyana
☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 7:

1.4 Related to 1.2 above, continued detection of change IFL is cause for concern and signals the need for established means of securing forest carbon within this area. The continued absence of deliberate measures to address these continued impacts can jeopardize the success of Guyana's REDD+ programme.

Response GFC:

GFC agrees that monitoring Intact Forest Landscape has been helpful in understanding how larger areas of forests are being impacted by drivers of forest change. It should be noted that the majority of areas that are being lost are on Amerindian Lands which, if allowed for exclusion as the IFL clause speaks to, would eliminate significant areas under IFL loss reporting. Nevertheless, the point is valid as when REDD+ policies are operationalized, these may speak to the addressing of drivers (mining has been identified as the main driver leading to loss of IFL), and therefore address the issue of IFL.

DNV GL:

The verification team assessed the comment as part of its assessment of the respective indicator and during interview with stakeholder /49//50/ the comment and considers the response to be satisfactory.

Comment by: The Conservation International, Guyana
☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 8:

2.1 It is noted that the INDUFOR logo does not appear on the Year 5 report whereas it was included in Year 4. We assume that this is an indication of enhanced local capacity for the operation of a rigorous MRVS. If this is so, it should be highlighted within the report.

Response GFC:

Indufor's involvement in the Year 5 reporting has been more of an advisory nature. As such, the report is being issued by the GFC only, for the first time. This is clarified in the Preface of the Report. GFC also views this as an indication of growing capacity of the local team to undertake the majority of the national MRVS effort with internal resources.

DNV GL:

The verification team assessed during interview with stakeholder /49//50/ the comment and considers the response to be satisfactory.

Comment by: Conservation International, Guyana
☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 9:

2.2 We acknowledge the establishment and functioning of the National GIS Committee, the use of a common central repository for data for mainly state natural resource and environment agencies, and progress on a GIS policy. However, for a more effective and transparent MRVS and REDD+ programme, urgent effort is needed to provide the national Spatial Data Infrastructure to ensure involvement of other sectors and to make data more publicly available.

Response GFC:

The effort as suggested for an integrated spatial data infrastructure is noted. This effort is being led by the Department of Natural Resources and the Environment. The GFC is engaged in the process, as a member.

DNV GL:

The verification team assessed during interview with stakeholder /49//50/ the comment and considers the response to be satisfactory.

Comment by: Conservation International, Guyana
☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 10:

2.3 It would be helpful to include a description of progress, plans, and challenges/barriers to the implementation of CMRV. The Year 4 report highlighted the potential for CMRV to contribute to the effectiveness of the national MRVS, and extensive attention is given to CMRV projects and their potential to contribute to the national MRVS in Guyana's communication with the Carbon Fund. The Yr5 report does not however seem to mention CMRV and its role.

Response GFC:

Thank you for the comment. We have inserted a sub section that addresses this area in the Report – Section 5. In this section we shared information on its continued work on building capacities within communities to conduct Community Monitoring Reporting & Verification activities (CMRV) within the Konashen community.

DNV GL:

The verification team assessed during interview with stakeholder /49//50/ the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 11:

2.4 The JCN states that the MRVS should incorporate Tier 3 elements by end of 2015, including "use of comprehensive field sampling that is linked to GIS based systems which integrates land use and management activity data." Beyond the IFM of logging activities, it is not clear in the MRVS Report as to what field sampling has been done or is planned. The use of validation via application of GeoVantage imagery is useful for cross-checking the validity of the RapidEye assessments and reaching some areas of consistent cloud cover. However, it is unclear in the report the extent of application of systematic sampling and ground-visits for validation beyond those mentioned under the monitoring of degradation (p19). There are several places where "field inspections" and "field data" are mentioned but no clear explanation of how these were carried out, and their link to the maps.

Response GFC:

This aspect of field based sampling linked to GIS based systems is the basis of the Forest Carbon Monitoring System. To date we have established plots across the three forest carbon strata – high, medium and low potential for change. This has been described in previous MRVS Reports. Work is also ongoing on establishing emissions factors for drivers of forest change, including for forest degradation. These plots are all linked to the GIS platform. Section 5 now includes a sub section that outlines these developments in 2014/2015.

DNV GL:

The verification team assessed the modification within the report and during interview with stakeholder /49//50/ the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 12:

2.5 Page i. Reference should be made to Phase 2 of the Roadmap.

Response GFC:

Thank you for this feedback. This Section has been modified to include the Phase 2 Roadmap.

> *DNV GL:*
>
> *The verification team assessed the modification within the report and during interview with stakeholder /49//50/ the comment and considers the response to be satisfactory.*

Comment by: Conservation International Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 13:

2.6 Page i. Table S1 lists Reference Measure of 0.275% for deforestation yet the December 2014 document on Reference Levels proposes 0.25%. Please clarify this difference.

*2.29 Reference Measures. The reference level proposal submitted to the UNFCCC in December 2014 sets the reference level "using a global percent of forest carbon emissions of 0.44%, as the global level, and establishing the historic annual average emissions percent level for Guyana (2001-2012). This is different to the reference measure listed in the MRVS (based on 0.52% rate as per FRA 2010 and agreed under JCN). *Summarised*

Response GFC:

The 0.275% used in the MRVS Report comes from the agreements of the Guyana Norway bilateral cooperation. Guyana has been working on a national position for Reference Level for REDD+ that includes exploration and consideration of other levels.

DNV GL:

The verification team assessed during interview with stakeholder /49//50/ the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 14:

2.7 Page 3. The improvement in detection of forest area due to improved resolution mentioned should be stated as significant even though it does not affect the overall deforestation rate for Year 5.

Response GFC:

Thank you, we agree. We have added this in the Executive Summary of the Report.

DNV GL:

The verification team assessed the modification within the report and during interview with stakeholder /49//50/ the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 15:

2.8 Page 5. Please clarify the total area represented by the "isolated pockets of private lands" under the State Lands category. It is understood to be small but the size will be helpful to better understanding the scale.

Response GFC:

This is less than 1% of the total land category as the majority of areas are State Lands that are unallocated and allocated State Lands for purposes of Agriculture and other uses.

DNV GL:

The verification team assessed during interview with stakeholder /49//50/ the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 16:

2.9 Page 6. The legend of Map 2-1 is difficult to read and the map is unclear at the scale of the report. We suggest using different patterns rather than different colour to distinguish the various areas. Consideration should also be given to including a larger size map in the report, possible in the appendices.

Response GFC:

The map has been revised to enhance resolution overall, and visibility of the legend.

DNV GL:

The verification team assessed the modification within the report and during interview with stakeholder /49//50/ and the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 17:

2.10 Page 9. In Section 4, does "commensurate with approach 3" mean Tier 3?

Response GFC:

Approaches speak to the type of area change representation as explained in:

http://www.fao.org/forestry/16663-0d866304c10b8384d90eb4fdef89867df.pdf

Approach 3 speaks to tracking of land use conversion on a spatially explicit basis.

IPCC outlines three methodological tiers of establishing inventory measurement systems (carbon/biomass, and emission factors) with Tier 3 representing the higher order method and lower uncertainties. The Guyana approach, combines Tier 3 for forest carbon and emissions reporting and Approach 3 for activity data.

In summary therefore, these are two separate concepts with Guyana using Approach 3 and Tier 3.

DNV GL:

The verification team assessed during interview with stakeholder /49//50/ the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO　　　☐ Party　　　☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 18:

2.11 Page 10. Please clarify to whom the datasets mentioned have "been provided" by agencies. Please also include clarification of the conditions which make the progressive updating of the data necessary.

2.13 Page 12. Please clarify the extent to which the maps, images, and datasets are available to the other agencies and the public.

Response GFC:

Datasets have been made available to the natural resources agencies including the Guyana Geology and Mines Commission, through the repository of the Geographic information Management Unit of the Department of Natural Resources and the Environment. Conditions of use for the Rapid Eye Imagery allow for full user access as five licences have been acquired from the imagery provider. The details of the licence are available to each licence holder in the RapidEye User Agreement and entails the rights of each licence holder to generate individual products should they so desire. Every updated dataset is provided in the same format as the previous dataset which makes updating of existing layers easier.

There are licence limitations on the RapidEye imagery that determine public dissemination of the imagery but results of analysis are freely available and can be accessed through the GFC. This point has been clarified in this Section of the report.

DNV GL:

The verification team assessed during interview with stakeholder /49//50/ the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO　　　☐ Party　　　☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 19:

2.12 Page 12. Please clarify the role of the Protected Areas Commission under REDD+/MRVS as done for other agencies.

Response GFC:

An outline of the role of the PAC has been included in this section. It is explained that the PAC has an important role to play in the MRVS process whereby an important area of land allocation and management as classified under the MRVS relate to Protected Areas. As such, the MRVS Report on the forest cover change in these areas, as well as loss of IFL, relate directly to Protected Areas. This therefore makes the data inputs from the PAC important to the MRVS process and the results of the reporting, a useful data platform for the PAC.

DNV GL:

The verification team assessed during interview with stakeholder /49//50/ the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 20:

2.14 Page 16. Please clarify which areas are not feasible or unsafe for flights and if these are located in low risk areas due to distance from settlements, roads, etc.

Response GFC:

The areas that were not feasible to fly, and have been unsafe to fly, are the areas that are mountainous to the western part of Guyana and to the deep south. These areas are in low risk stratum and do not have a high occurrence of settlements or roads, etc.

DNV GL:

The verification team assessed during interview with stakeholder /49//50/ the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 21:

2.15 Section 5. The ER-PIN mentions the potential input of Global Canopy Programme, Project Fauna, and WWF data on shifting cultivation and secondary forests biomass. Please clarify how this data might have been used in this report and its potential to the MRVS.

Response GFC:

These initiatives work at the community level in building technical and human capacities and therefore positively impacts on the CMRV, and by extension the national MRVS. It also helps the national MRVS have a wider understanding of shifting cultivation at the community level.

DNV GL:

> *The verification team assessed during interview with stakeholder /49//50/ the comment and considers the response to be satisfactory.*

Comment by: Conservation International Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 22:

2.16 The approach implemented is robust. The use of EVI is supported by the scientific literature and the transition to RapidEye allows for high spatial resolution and temporal frequency of images. In comparison to Landsat, it is more effective in detecting degradation (see Hojas-Gascon et al 2015 experience in Tanzania). However, as is the case with many studies, there is a need for field data to determine the extent of degradation and related carbon emissions. This appears to be lacking from the current MRVS or the reporting does not make it sufficiently clear as to what field data is being used to cross-check. As GFC would be aware, there is potential for CMRV to contribute data to this process (see GCP/NRDDB/Iwokrama data on biomass in Minabs, ProjectFauna data for different forest types).

Response GFC:

Thank you for the observation. GFC and Winrock Int. are in the process of assigning Emission Factors for degradation activities.

In terms of the mapping approach the method implemented was developed in 2011. This process involved extensive fieldwork and analysis which is summarised in the Interim Measures Report

http://www.forestry.gov.gy/wp-content/uploads/2015/09/Guyana-MRVS-Interim-Measures-Report-Year-2-V3.pdf

From this work a Standard Operating Procedure was developed which has been in use since 2011. The mapping process and results have been subjected to independent annual accuracy assessment (University of Durham) which uses airborne aerial photography. In addition, the SOP and results are subject to an annual audit by DNV. Observations and comments made have led to improvements in GFC's SOP.

It is anticipated that once the EF are incorporated, that a more accurate estimate of the Carbon emissions will result.

DNV GL:

The verification team assessed during interview with stakeholder /49//50/ the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 23:

2.17 Progress is being made to refine emissions factors for Guyana and moved towards Tier 3 reporting (in some aspects this has already been achieved). The JCN states that an interim

emissions factors of 100tC/ha will be used for reductions in deforestation (significantly below the actual carbon content of most forests in Guyana) and 400tC/ha will be assumed to be emitted by degradation (which is higher than actual emissions). The RL submitted in December 2014, however, is based on 300tC/ha for deforestation. Please clarify at what state these all will be aligned within the MRVS.

Response GFC*:*

At the time of agreement of the JCN and commencement of the Guyana Norway agreement, the MRVS was just starting and as such, the technical work on forest carbon stock assessment had not yet started. We now have the majority of the results of this work which has informed the Report mentioned.

An update on the recent development under the Forest Carbon Monitoring System has been included in Section 5. All aspects of this system are available for verification by DNV.

DNV GL:

The verification team assessed, as part of its verification of the respective indicator and during interview with stakeholder /49//50/, the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana
☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 24:

2.18 Page 23. The justification for the use of EVI is sound and well described in Bholanath & Cort, 2015. This information could be included to further clarify for readers.

Response GFC*:*

Thank you for this recommendation. We have referenced this recent Paper in the Report for further reading. Some of the text taken from this Paper is also featured in this section.

DNV GL:

The verification team assessed the modification within the report and during interview with stakeholder /49//50/ and the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana
☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 25:

2.19 Page 23. It would be helpful to explain how the distribution of the areas under constant cloud cover relates to those of high forest cover change. Further clarification is needed because 0.2% is greater than the annual deforestation rate.

Response GFC*:*

Persistent areas of cloud are located around the coastal area and border with Venezuela. The cloud coverage is random, fragmented and scattered. Areas that cannot be mapped are tagged and

revisited in the subsequent assessment periods. Figure 5-3 in the Year 4 and Report shows the persistent cloud coverage over a two year period. This illustrates that if temporal coverage are considered then it is possible for forest change to be detected and reported. There is therefore low risk of areas being missed in either the year of assessment of next reporting year.

DNV GL:

The verification team assessed, during interview with stakeholder /49//50/, the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana
☒ NGO   ☐ Party   ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 26:

2.20 Page 25. The addition of "settlements" as a driver in Year 4 is an important advance given urbanization (3.8% annual rate).

Response GFC:

This is noted. The GFC shares the view that this is an area that should be continuously monitored and it also allows for synergies with IPCC categorisation.

DNV GL:

The verification team assessed, during interview with stakeholder /49//50/, the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana
☒ NGO   ☐ Party   ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 27:

2.21 Page 30. Assessment of "forest harvest" runs substantial risk of underestimating emissions given potential for illegal activities going undetected.

Response GFC:

The GFC's system of monitoring forest management and illegal logging allows for a robust network of human and physical capabilities, spread at strategic point throughout Guyana to monitor logging activities. Through a combination of routine and impromptu audits, the GFC's system has the capability to detect occurrences of illegal logging and prevents these as well. These have been validated through various external audits.

DNV GL:

The verification team assessed, as part of its verification of the indicator and during interview with stakeholder /49//50/, the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana
☒ NGO   ☐ Party   ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 28:

2.22 Page 30. Under Natural Events, please clarify what types of events are included here so as to address the potential for misinterpretation of anthropogenic events as natural.

Response GFC*:*

These changes are due to naturally occurring landsides, wind damage or fire. The remote location of these events is considered when they are mapped.

Examples of these are provided in the SOP developed for mapping. These are available in previous Interim Measures Report. http://www.forestry.gov.gy/wp-content/uploads/2015/09/Guyana-MRVS-Interim-Measures-Report-Year-2-V3.pdf

DNV GL:

The verification team assessed, during interview with stakeholder /49//50/, the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 29:

2.23 Page 31. Please clarify the potential for leakage of forest change to Amerindian lands and other lands not eligible under the LCDS.

Response GFC*:*

All areas are monitored based on a "wall to wall" analysis of Guyana's forest and land cover. As such, even though land classes and management systems are separated, all land and forest areas are monitored. There is therefore no potential that there will be leakage within or among categories, or that forest change will go undetected in Amerindian lands or any other category.

DNV GL:

The verification team assessed, during interview with stakeholder /49//50/, the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 30:

2.24 Page 31. A definition of the "carbon monitoring program" and how it contributes to the MRVS would be useful to be included.

Response GFC*:*

A description of the Carbon Monitoring Programme has been provided in the Year 2 and 3 Reports, and a progress update in the Year 4 Report. We try to have each successive report feature on the new elements of the systems being developed and to that effect, we have included in Section 5 of this report the recent developments in the FCMS.

DNV GL:

The verification team assessed, during interview with stakeholder /49//50/, the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 31:

2.25 Page 33. Other studies indicate the rate of forest lost in the region could be higher than the figure cited from the forest resources assessment rates across South America. This further highlights the status of Guyana as a High Forest Low Deforestation country within that context.

Response GFC:

This point is noted and we believe highlights the value of not using regional numbers only for forest area and change therein, but national number are proving to be critical in evaluating and analysing each individual country context.

DNV GL:

The verification team assessed, during interview with stakeholder /49//50/, the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 32:

2.26 Page 36. Under National Trends, forestry related degradation is reported to be relatively stable but this is an artifact of the methods for assessment (official records instead of direct/satellite observations) rather than necessarily a reflection of the reality on the ground.

Response GFC:

The method of assessing forest harvest impacts is based on production levels and the gain/loss method. This takes into consideration the rate of legal and illegal logging. The method applied is one that is reflective of the IPCC guidance and accepted standards and reflects the varying levels of utilization. There has been indeed some movement in production levels across the years. This is reflected in the upward and downward movement in forest carbon impacts from forest harvest activities. Some aspects of forest harvest are reported on based on satellite imagery such as forest roads/infrastructure, however, the GFC's studies have shown over the past three years that the imagery, even at 5m resolution cannot reliably report on levels of harvest. A robust system of

forest harvest volumes, that is open to independent verification, is still thought to be the more credible mechanism to report on forest harvest.

DNV GL:

The verification team assessed, during interview with stakeholder /49//50/, the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 33:

2.27 Pages 37-38. Maps 6-1 and 6-2 are very helpful in depicting the patterns and locations of deforestation over time. However, a larger map with greater detail and features (such as roads, rivers and places) to help identify locations should be included in the appendices.

Response GFC:

Appendix 8 has been added and includes the recommended maps at larger scale.

DNV GL:

The verification team assessed the modification within the report and, during interview with stakeholder /49//50/, the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 34:

2.28 Page 41. It is recognized that the extent of degradation, and thus emissions, will vary by fire intensity and frequency (see studies by Barlow et al as well as Nepstad et al in Brazil) and understory fires may remain undetected by satellite images (Alencar et al). Arnett et al (2015) indicate that RapidEye is capable of detecting low-intensity fires and damage at the tree level. Though the emissions from fires may be relatively small and difficult to detect, the extent to which this information might influence the MRVS should be discussed in the report given that climate change is likely to increase fire frequency and intensity, and that Guyana's MRVS is a model one.

Response GFC:

Thank you for the reference. Fire is detected when associated with pastoral, agricultural and shifting cultivation activities. These are classed as land clearance activities, land clearance, or across the savannah regions. Additionally, the MRVS currently separates out degradation by Fire. The SOP outlines the protocols for monitoring degradation by forest fires which is based on the interpretation of the spectral signature (to differentiate this from shifting agriculture) and the extent of forest cover loss (to differentiate this from fire causing deforestation). The analysis is informed by fire points that are provided by FIRMS fire point data from MODIS. Fire frequency has

changed over time and increases in frequency during the El Niño. If this weather pattern reoccurs then it likely that degradation events will increase in the drier savannah and coastal regions.

DNV GL:

The verification team assessed, during interview with stakeholder /49//50/, the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 35:

2.30 Page 51. It should be noted that the current methods go above and beyond what was required under the JCN (higher resolution images).

Response GFC:

We agree and the main reason for the use of high resolution imagery has been to enable the more detailed mapping of various drivers of forest degradation, including small scale mining areas and infrastructure impacts. The use of RapidEye 5m imagery has worked well for this purposes as it has for the other areas of monitoring for the MRVS.

DNV GL:

The verification team assessed during interview with stakeholder /49//50/ the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 36:

2.31 Page 51. Please clarify whether the purpose of the sentence; "Above ground biomass and below ground biomass combined represent approximately 75% of total carbon" is to highlight that soil carbon represents the remaining 25%.

Response GFC:

The material referenced here is for Bolivia (from GOFC-GOLD Sourcebook). This interpretation is correct.

DNV GL:

The verification team assessed, during interview with stakeholder /49//50/, the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 37:

2.32 Page 51. Please clarify how peat soils and wetlands are treated.

Response GFC:

All areas have been included in the national mapping and stratification and are also monitored for forest change through the national mapping effort. Soils are sampled across types and land classes and are included in results provided for each Stratum. Mangrove forest are included in monitoring of forest cover change as are Swamp forests. Wetlands, including the Rupununi wetlands are also include in the national MRVS mapping.

DNV GL:

The verification team assessed, during interview with stakeholder /49//50/, the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 38:

2.33 Page 52. The section on the IFL could be written to provide more clarity on what the IFL is and what its purpose is meant to be.

Response GFC:

Text has been added to provide clarity on the Indicator of IFL and how this is part of the national MRVS Interim Reporting.

DNV GL:

The verification team assessed, during interview with stakeholder /49//50/, the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 39:

2.34 Page 53. The definition of industrial logging presented does not seem to be the most appropriate given the rarity of clear-felling in the tropical context.

Response GFC:

We agree. This is the elaboration used by the definition of IFL. For this reason we have stated that this is indeed not applicable to the Guyana context.

DNV GL:

The verification team assessed, during interview with stakeholder /49//50/, the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 40:

2.35 Page 53. An area, partly covered by forest, in the Rupununi is allocated for oil exploration.

Response GFC:

This point is noted and all areas of forest will continue to be monitored for forest area change in each assessment year. The drivers of forest change are tracked for each period and provided in the reporting format.

DNV GL:

The verification team assessed, during interview with stakeholder /49//50/, the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 41:

2.36 Page 54. The rationale behind the selection of the 50% loss of biomass in degraded areas should be discussed.

Response GFC:

This has been a point of discussion for some time. The use of 50% was done at the start of the MRVS Reporting and used in the absence of a country based total at that time. Given that Guyana now has a well-developed system of MRVS, there are firm results that can be used that can well replace the 50% proxy. We will continue to follow up on this for any follow up reporting platforms.

DNV GL:

The verification team assessed, during interview with stakeholder /49//50/, the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 42:

2.37 Page 58. The use of VCS approved methods to estimate emissions from logging is a solid choice.

Response GFC:

We also agree with this and for this reason have continued to use this method for this driver.

DNV GL:

The verification team assessed, during interview with stakeholder /49//50/, the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 43:

2.38 Page 69. The acronym ESA should be spelt out.

Response GFC:

This has been spelt out in the revised report.

DNV GL:

The verification team assessed the modification within the report and during interview with stakeholder /49//50/ and the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 44:

2.39 Page 72. It seems inappropriate to suggest that a scenarios model could act as an accuracy assessment for the mapping. The mapping can assess accuracy of the model but not vice versa. The models can only account for changes that are within its parameters, so while they predict the direction of change, they should not be considered an indicator of the accuracy of maps of actual change.

Response GFC:

The intention is not to replace the Accuracy Assessment. The commentary provided outlines an alternative option whereby the Accuracy assessment could be conducted every second year. In the interim period the modelling could be used to support the findings of the annual deforestation mapping.

DNV GL:

The verification team, assessed during interview with stakeholder /49//50/, the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 45:

2.40 Page 76. The comparison with the University of Maryland Global Forest Change map is interesting and relevant work/research though unlikely to yield revisions to the GFC map unless it is intended that this could be a cheaper alternative in the future if it proves high correlation. It would be helpful to include the justification. It does show that the GFC mapping yields higher rates of deforestation and is thus conservative in its estimates of emissions reductions for deforestation.

Response GFC:

The UMd assessment was conducted to evaluate the use of such maps at a national-scale. The intention of the exercise was to highlight the applicability of such maps for reporting deforestation. In the future if Guyana were to reduce the frequency of reporting then potentially the Global map may be of use while still allowing Guyana to access performance-based payments in the intervening years.

DNV GL:

The verification team assessed, during interview with stakeholder /49//50/, the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO   ☐ Party   ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 46:

2.41 Page 78. The y-axis of the graph in figure 10-8 should be labeled.

Response GFC:

Figure is revised to include the Y axis label and properly display the trend line positioning.

DNV GL:

The verification team assessed the modification within the report and during interview with stakeholder /49//50/ and the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO   ☐ Party   ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 47:

3.1 The treatment of degradation from logging does not seem adequate in that:

3.1.1 It presents the risk of underestimating the extent of illegal logging activities as it depends on detection by government officials and is set as a percentage of the official records. Evidence of the validity of 15% as an accurate representation of actual illegal logging rates should be provided to justify its use especially given that information from other sources (e.g. www.globaltimber.org.uk) imply that it is not. The UNFCCC's response to the RL proposal (see FCCC/TAR/2015/GUY) states that the GFC assert that 15% is above the actual rate. A more complete study of trade data (especially for China and India) and internal markets for informal timber would help to refine and justify this rate

3.1.2 Assessments of illegal logging by government agencies, regardless of soundness, cannot be considered independent. This is not independent and runs the risk of underestimates.

We therefore recommend the commissioning of a fully independent study to estimate the level of illegal logging for each reporting period. We also assume that ongoing work towards meeting requirements under EU-FLEGT will assist in this regard.

Response GFC:

We note the points made. At the commencement of the Guyana Norway agreement in 2009, in the absence of a firm figure on illegal logging, the rate was stated as being at a maximum 15%. Over the course of the MRVS implementation, a robust system of reporting has been introduced and implemented and concludes on actual volume total of illegal logging. This is now being used and subject to independent verification every year.

EU FLEGT will further help to add another layer of validation to the GFC's systems.

DNV GL:

The verification team assessed, during interview with stakeholder /49//50/, the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO ☐ Party ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 48:

3.2 Amerindian Lands. Page 53. "It is proposed that deforestation located in Amerindian areas is not counted in calculating reduction in financial remuneration". This proposal is problematic given that:

3.2.1 Amerindian communities are facing invasions and encroachment from outsiders due to mining and road building (GCP 2014). This is likely to increase given the proximity of some roads (e.g. Lethem road) to Amerindian lands.

3.2.2 Disregarding mining or other activities in Amerindian lands could create perverse incentives to focus such activities in these lands and so result in leakage.

3.2.3 If they are not within the LCDS, they can be subject to leakage and negative social and environmental outcomes which need to be monitored.

It is assumed that the exclusion of Amerindian lands from the LCDS, and hence the MRVS, is a matter of respect for rights. We further assume that the opt-in mechanism, carried out with due process and FPIC, will provide opportunities for communities to participate and benefit from the initiative. However, given that Amerindian communities face encroachment and illegal activities by outsiders, changes to deforestation rates inside their lands should not be excluded.

Response GFC:

All Amerindian lands are included under the MRVS. All lands for that matter, including all forest and non-forest areas are included under the MRVS. Mapping is done on a "wall to wall" approach and as such all areas despite the land owner, manager, land use and forest type are monitored in the MRVS. The GFC reports on areas of forest change and emissions. We certainly will share these

point with relevant policy makers who would be the appropriate persons to use these suggestions to inform decision making.

DNV GL:

The verification team assessed, during interview with stakeholder /49//50/, the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO   ☐ Party   ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 49:

3.3 Costs. We are happy to see the exploration of other technologies as contained in the report related to the work of University of Maryland. Information on comparison of the costs of the current technologies with other feasible technologies would help provide assurances of the cost effectiveness of the technologies employed in the system. This is especially important given the model nature of Guyana's MRVS.

Response GFC:

We agree and are pleased to provide this additional aspects of the work under the MRVS Year 5 that has been executed in collaboration with our partners.

DNV GL:

The verification team assessed, during interview with stakeholder /49//50/, the comment and considers the response to be satisfactory.

Comment by: Conservation International Guyana

☒ NGO   ☐ Party   ☐ Other Stakeholders

Subject: Comments on MRVS Year 5 Report Ver. 1

Comment 50:

3.4 Safeguards. The report should include information on how the MRVS aligns with the safeguard information system as required under the UNFCCC.

Response GFC:

Area of work including CMRV, engagement with communities and indigenous villages and stakeholder, alignment with national forest programmes, including the forest carbon monitoring system, have been described in various aspects of the report, largely in Section 5. We will continue to include various additional aspects of our work in follow up reports as it relates to these areas.

DNV GL:

The verification team assessed, during interview with stakeholder /49//50/, the comment and considers the response to be satisfactory.

8 REFERENCES

Documents provided by the Project Participants have been used as direct sources of evidence for the periodic verification conclusions, and are usually further checked through interviews with key personnel.

/1/ Guyana Forestry Commission Guyana REDD+ Monitoring Reporting & Verification System (MRVS) Year 5 Interim Measures Report, Version 1 dated 7 October 2015, Version 2 dated 12 November 2015 and Version 3 dated 30 November 2015

/2/ Guyana Forestry Commission: *Geodatabase with all raw and processed datasets*, November 2015.

/3/ Guyana Forestry Commission: *Data Base of Illegal logging activities for the four forestry divisions of Bce, Dem, Ess and Nwd – 1 January 2014 to 31December 2014 – Year 5*

/4/ Guyana Forestry Commission: *Data Base of Procedural Breaches for the four forestry divisions of Bce, Dem, Ess and Nwd – 1 January 2014 to 31December 2014 – Year 5*

/5/ Guyana Forestry Commission: *Data Base of wood harvesting declarations of wood extraction activities in lands classified as State Forest– 1 January 2014 to 31December 2014 – Year 5*

/6/ Guyana Forestry Commission: *Data Base of wood harvesting declarations of wood extraction activities in lands classified as Amerindian or Private Property– 1 January 2014 to 31December 2014 – Year 5*

/7/ Winrock International: *Collateral Damage and Wood Products from Logging Practices in Guyana- December 2011*

/8/ *Guyana Forestry Commission: Standard Operating Procedures for the Forest Carbon Monitoring system of Guyana – Revised August 2015*

/9/ *Guyana Forestry Commission: Degradation around Mined Areas: Methods and Data Analyses for Estimating Emission Factor – November 2015*

/10/ *Report to ONF International - Winrock:Degradation around Mined Areas: Methods for developing emission factors – August 2015*

/11/ *Assessment of Illegal Logging Indicator Year 5; Illegal Logging Production Table Year 5 2014; and Wood Products Storage in Guayana_2014_Illegal Logging. Xlsx.*

/12/ *Assessment of Forest Management Indicator (Carbon Stock Calculations) Year 5.xlsx; Blocks Harvested 2014.docx; Collateral Damage and Carbon In Wood Extracted paper - WI Final.pdf; Forest Sector Tables BOG BOS 2014 - December 2014.xlsx; Production base sheet for computation 2014.xlsx; TSA WCL January-December 2014 Table.xlsx; Wood Products Storage in Guyana_ 2014 - Forest Management.xlsx.*

/13/ *Guyana Forestry Commission: Forest Carbon Monitoring System: Emission Factors and their Uncertainties, Version 2. June 2014.*

/14/ *Guyana Forestry Commission: Establishing a Reference Level for REDD+ in Guyana – June 2012*

/15/ The Guyana Forestry Commission and Indufor: Standard Operating Procedures for Forest Change Assessment: A Guide for Remote Sensing Processing & GIS Mapping – Year 5 Update

/16/ Sist, Plinio: 2000: *Reduced-impact logging in the tropics: objectives, principles and impacts.* International Forestry Review 2(I), 2000. Pages 3-10.

/17/ Durham University*: Appendix 7 to IMR –Accuracy Assessment* Report Year 5, 2nd October 2015

Background documents related to the design and/or methodologies employed in the design or other reference documents.

/18/ ISO 14064-3: *Greenhouse gases — Part 3: Specification with guidance for the validation and verification of greenhouse gas assertions*, First edition, 1 March 2006

/19/ Guyana Forestry Commission: *Detention and Seizure Procedure*

/20/ Guyana Forestry Commission: *Forest Monitoring Operating Procedure*

/21/ Guyana Forestry Commission: *Procedure for Export of Forest Produce*

/22/ Guyana Forestry Commission: *Procedure for Issuance of Sawmill Licence*

/23/ Guyana Forestry Commission: *Procedure for issuing SFEP*, http://www.forestry.gov.gy - *Publications*

/24/ Guyana Forestry Commission: *Procedure for issuing SFP*, http://www.forestry.gov.gy - *Publications*

/25/ Guyana Forestry Commission: *Procedure for issuing TSA or WCL ,* http://www.forestry.gov.gy - publications.html

/26/ Guyana Forestry Commission: *Procedure for Timber Dealers Licence*

/27/ Guyana Forestry Commission: *Forest inspector supervisory check list – Daily supervision of a forest station, midmonth and month end supervision, routine checks by forest rangers at forest stations, basic field verification,* January 2007

/28/ Guyana Forestry Commission: *forest station internal audit control record*

Persons interviewed during the initial verification, or persons who contributed with other information that are not included in the documents listed above.

/29/ Tasreef Khan, Deputy Commissioner of Forests – GFC

/30/ Pradeepa Bholanath, Head, PDD-GFC

/31/ Monitoring Inspectors & Supervisors: Lethem and Annai Forest stations – GFC

/32/ Nasheta Dewnath, Programme Officer – REDD Section

/33/ Jeremy Singh, Project Officer, Management Trainee REDD Secretariat

/34/ Chaplin Chan, Consultant – Indufor

/35/ Krishma Misir, Project Officer, REDD Secretariat

/36/ Ambeca Jaggessar, Resource Information Officer – GFC

/37/ Chetram Ramgobind – Program Officer, Illegal Logging and Procedural Breach Database - GFC, Forest Resources Management Division – GFC

/38/ Towana Smartt – GIS/Remote Sensing Officer, Forest Resources Information Unit – GFC

/39/ Chandroutie Sookdeo – GIS/Remote Sensing Officer, Forest Resources Information Unit – GFC

/40/ Dwayne Griffith, Project Officer, REDD Secretariat

/41/ Reshana L Thomas, Management Trainee

/42/ Hansrajie Sookdeo and Karishma Misir, Project Officers – Data Management, REDD Secretariat

/43/ Danny Donoghue, Durham University

/44/ Rawle Lewu, DCOF - FRMD

/45/ Jasmin Totaram, GIS/Remote Sensing Analyst

/46/ Basantie Sukhu, GIS/Remote Sensing Analyst

/47/	Naria Pank, GIS/Remote Sensing Analyst
/48/	Bibi Nafeeza Amin, GIS/Remote Sensing Analyst
/49/	David Singh, Executive Director, Guyana Programme at Conservation International
/50/	Curtis Bernard, Technical Director at Conservation International Guyana
51/	Basmatee Mohabeer – Office of Assistant commissioner of forests – legality monitoring and extension unit.
/52/	GFC Station staff in Lethem Forestry/Transport Station: Keyon Fraser
/53/	Rupununi Timber Association representatives: Divon Hamilton and SaintClair Hamilton
/54/	GFC Station staff in Annai Forest/Transport Station: Raevurn Jacobus

Criteria of validation and verification

/55/ Government of Norway and Government of Guyana: *Joint Concept Note on REDD+ cooperation between Guyana and Norway*, 9 November 2009, March 2011 & December 2012, and the 3rd revision

/56/ GOFC-GOLD, 2015, A sourcebook of methods and procedures for monitoring and reporting anthropogenic greenhouse gas emissions and removals associated with deforestation, gains and losses of carbon stocks in forests remaining forests, and forestation. GOFC-GOLD Report version COP21-1, (GOFC-GOLD Land Cover Project Office, Wageningen University, The Netherlands).

/57/ IPCC (2006): *2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme*. Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds).Published: IGES, Japan

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/59/ IPCC (2000). *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*. Penman J., Kruger D., Galbally I., Hiraishi T., Nyenzi B., Emmanuel S., Buendia L., Hoppaus R., Martinsen T., Meijer J., Miwa K., Tanabe K. (Eds). Intergovernmental Panel on Climate Change (IPCC), IPCC/OECD/IEA/IGES, Hayama, Japan.

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APPENDIX A

CORRECTIVE ACTION REQUESTS, CLARIFICATION REQUESTS AND OBSERVATIONS

MINOR Corrective action requests and Observations of the 2013 audit

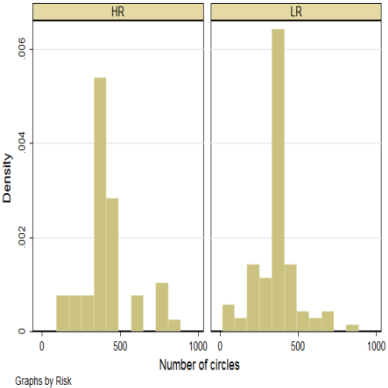| CAR ID	Major/ Minor	Corrective action request	Response by Project Participants	DNV GL's assessment of response by Project Participants
CAR 4	MINOR	**Requirement**: Interim Measure 2.2 (3[1]) **Non-Compliance**: Expanding Staff Capacity in forest carbon monitoring beyond current levels. **Objective evidence:** Although the GIS staff have seen expansion within the staffing the Forest Carbon Monitoring relays heavily on a few individuals and current work load may be heavy for existing local personnel under the programme.	The Forest Carbon Monitoring Unit within the GFC, has built significant capacity over the past 3 years in managing and implementing the activities involved in the execution of the monitoring programme. This is evidenced by dedicated staff who work on the management aspect of this activity, full time, as well as a cadre of field staff from the GFC Forest Resources Management division, who have been trained to perform activities such as data collection, recording and processing. All field activities are managed and executed by local staff, with support from external specialists in the area of design and future system development areas. There is scope to increase the number of local staff in the management aspect of the forest carbon monitoring system from its current level. However, this expansion will be managed with keen consideration to the fact that field work may be more extensive in the current design phase but perhaps less intensive in the full operational stage when relevant system elements would have already been established.	DNV GL assessed the CAR and actions undertaken by GFC and considered that with the further integration and actions undertaken by GFC a better resources management had been adopted by the GFC which will be further enhanced during upcoming monitoring period. Further integration between the two units has been observed during the 2015 audit, including joint training and information exchanges. **CAR closed**
CAR 5	MINOR	**Requirement**: Overall Guyana MRV programme **Non-Compliance**: Current system does not establish tolerance levels as part of a QA/QC design framework, necessary for an MRV system **Objective evidence:** • Current manuals cover the activities to be undertaken	Manuals of Procedures as seen in Sample Design, Standard Operating Procedures, and Mapping Protocols define system processes for both forest carbon and forest cover monitoring. QA and QC processes are embedded within these systems are designed to reflect best practice as recommended by	DNV GL during the audit assess the CAR and the updated procedures as well as new processes where possible GFC is now introducing clear alternatives and defaults within its processes. The SOPs have been updated to include for key activities fall back values and criteria, both as part of the mapping unit as well as the forest monitoring unit.

CAR ID	Major/ Minor	Corrective action request	Response by Project Participants	DNV GL's assessment of response by Project Participants
		however it does not cover predefined fall back options for errors in the system • Current QA&QC focus on fixing the problems found but not what the relevancies of the error and whether this has an effect on other data sets.	IPCC, GOFC GOLD as well as methods outlined in peer reviewed, published scientific studies. Current systems are designed to achieve as high accuracy and precisions levels that are possible. For example, main elements of the forest carbon monitoring system aim for statistical results that reflect 95% confidence level +/_ 15% of the mean. Although of minimal occurrence, in instances of errors in data collection and processing, currently, full system checks are performed across datasets. General tolerance levels for main components the forest area and forest carbon monitoring systems may be beneficial to the overall operation of the MRVS as well as integration within the relevant SOPs an aspect on the treatment and classification of known types of errors. Additionally, the GFC will further explore the possibility of using a common error term for field measurement to include, for example, Monte Carlo type error analysis. GFC is also working with Winrock International in developing an estimate of error due to the use of allometric model. However, the GFC notes that the sources of error from field measurement and the use of allometric equations is generally small compared to the sample error, which as mentioned earlier has been set by GFC at 95% CI of <15% of the mean for total carbon stocks. Sources of error will be examined and included to the extent possible once Monte Carlo type analysis has been developed and GFC staff	**CAR closed**

CAR ID	Major/ Minor	Corrective action request	Response by Project Participants	DNV GL's assessment of response by Project Participants
			trained. This will likely undertake a phased approach in implementation. In Year 4, GFC will include further internal consistency checks and assign the acceptable levels of accuracy to the deforestation and degradation mapping products. The actions required should these tolerances exceed the stated objectives will be included in the SOP for Mapping.	

Observations

OBS ID	Corrective action request	Response by Project Participants	DNV GL's assessment of response by Project Participants
Obs1	**Requirement**: Interim indicator 1, 2 and 3 **Potential Non-Compliance**: Accuracy assessment's sampling plan and estimate of standard error of the model-assisted estimator. **Objective evidence:** The DU has assumed the 1ha-plot as unit of observation and that it is stratified SRS. This is evidenced from the calculations such as the ones provided 11-8 for the High Risk Stratum, where the confusion matrix and all the calculations of the model-assisted estimator and its variance have been made considering the 1-ha plot as sampling unit (i.e. 24125 units in the matrix). Hence, it has been assumed that it is a SRS within that stratum, which differs from the sampling design.	**GFC Response:** The accuracy assessment report clearly states that "*A two-stage sampling with stratification of the primary units was adopted to provide precise estimates of forest area*." The first stage sample units are 15 by 1 Km rectangular areas derived from SRS (simple random sampling) of each of the two strata. The second stage systematically samples 1 ha mapping areas within each unit. The rationale is to calculate within-stratum means and variances and then weighted estimates of forest area, where the weights are proportional to the stratum sizes. The stratum size is derived from the analysis of deforestation risk carried out using relevant GIS data layers. As with SRS variance estimators, stratified estimators can be biased when used with systematic sampling. However, stratification of the model assisted difference estimator is, in this case, used to increase the precision of the forest area estimates; a variable closely related to the variable on which the stratification is based. The calculations were done separately by stratum and weights applied when combined.	DNV GL assessed the response and implementation to the observation and deemed the changes to be acceptable. **OBS closed.**

OBS ID	Corrective action request	Response by Project Participants	DNV GL's assessment of response by Project Participants
	This may have some implications as: a) The formulae for the model-assisted estimator and its variances sourced from Roberts & Walters (2012) assumes a SRS.	**GFC Response:** The formulae used is for the model assisted difference estimator is taken from McRoberts, Tomppo and Naesset (2010) Scandinavian Journal of Forest Research, 25, 368-381 and McRoberts (2010) Remote Sensing of Environment, 114, 1017-1025. and Sarndal and Swensson (1987) International Statistical Review, 55, 279-294 and McRoberts (pers comm to Indufor). The DNV GL notes suggest that the interim measures report might have used different terminology. The model assisted difference estimator uses the difference between a model (what Sarndall and Swensson refer to as a naïve estimator) and a probability-based sample. The DU accuracy assessment used a probability-based sample for the first stage and systematically sampled within this; potential bias was examined and an additional analysis of the sample sizes between the strata is presented below. There is no evidence of any systematic bias although the discussion in the report could have been clearer.	DNV GL assessed the response and implementation to the observation and deemed the changes to be acceptable. **OBS closed.**
	b) Stehman (1997) proves that estimating the overall accuracy of a cluster sampling (with equal-size clusters; in the Guyana case are unequal-size clusters) with formulae from a SRS may bias the results of the standard errors.	As said above, bias is always a problem in any systematic sampling procedure. The DNV GL feedback highlights possible bias associated with the GeoVantage flights not always mapping 15 km2 precisely. Durham University have looked at the distributions of the primary sampling units and these are shown in the density plots below. Analysis of variance shows that there is no significant difference in means between the two strata and standard deviations are very similar. [Bartlett's test of equal variances between Strata Chi2 = 0.8709; Prob>chi2 = 0.351]. Therefore, although it is not ideal to have variability in the size of the primary sample units, this was an unavoidable consequence of using an aircraft flying a low altitude over a rainforest; in some cases the imaging failed and only part of these data were collected, in other cases additional data were collected. There was no systematic pattern to this. In previous years, cloud cover resulted in some unevenness in sampling.	DNV GL assessed the response and implementation to the observation and deemed the changes to be acceptable. **OBS closed.**

OBS ID	Corrective action request	Response by Project Participants	DNV GL's assessment of response by Project Participants
		Graphs by Risk	
	In view of this, the reported results in the Accuracy Assessment on areas and confidence intervals <u>may be</u> biased. GFC are encouraged to improve this potential issue.	**GFC Response:** The land cover (LULC) change categories Guyana are Forest, Degraded Forest and various non-forest classes. The data that for land cover transitions are captured in the MRV and are replicated in the independent Accuracy Assessment; that is the drivers of change are recorded where possible. Some of the LULC change categories are very small in area (forest to Cropland is a good example) and robust statistical assessment of such change in Year 4 needs to be balanced against the priority of assessing deforestation and forest degradation due to mining and logging. GFC are aware that the use of stratified sampling and validation of satellite-based mapping with aerial GeoVantage data has reduced uncertainty in the aerial estimate of forest change for Year 3. If a similar approach is taken in Year 4, the estimate of deforestation rate will also be improved. It is appropriate that the Accuracy Assessment team be asked to model this uncertainty and where possible to comment on uncertainly by land cover type / change driver. The GFC mapping is based on expert manual interpretation of 5 m resolution satellite imagery. It is not a machine-based classification because cloud cover and image data quality over the entire country make it	DNV GL assessed the response and implementation to the observation and deemed the changes to be acceptable. **OBS closed.**

OBS ID	Corrective action request	Response by Project Participants	DNV GL's assessment of response by Project Participants
		near impossible to create a national data set that would allow automatic classification; hence the trained expert interpretation team and QC procedures.	
	GFC should note that this is in fact required by the 2006 IPCC GL for Tier1/2 + Approach 2/3 where the reporting is made over change categories and uncertainty has to be reported for the change categories (i.e. Forestland to Cropland), not the LULC categories (i.e. Forestland). So a future MRV compliant with 2006 IPCC GL will require determining the uncertainty in the estimation of change.	**GFC Response:** As a next step in Accuracy Assessment efforts when the full MRVS is in place, land cover change confusion matrix will be developed and uncertainties will be attached to each land use/cover category, thereby giving uncertainty in the estimate of change. At this point, the MRVS is in its final interim stage.	DNV GL assessed the response and implementation to the observation and deemed the changes to be acceptable. **OBS closed.**
Obs2	**Requirement**: Interim indicator 1, 2 and 3 **Potential Non-Compliance**: Inconsistency within the reporting. **Objective evidence**: • <u>Confusion matrix of the forest cover map (year 4) and degradation not considering two-stage sampling design</u>: Although DNV GL acknowledge that stratification has been taken into account in the current monitoring period, the confusion matrix provided in Table 5.1-5.3 seems to determine the different accuracy indicators using secondary sampling units without considering their grouping in primaries (e.g. the total is 54254 which is the number of secondary SUs). In order to obtain unbiased estimates of the different accuracy indicators the sampling design should be considered. Although, the		The AA has changed to a purely change-sample based approach, and has removed any remnants to the previously model-based approach from the report, such as the confusion matrices, thereby avoiding the confusion these caused

OBS ID	Corrective action request	Response by Project Participants	DNV GL's assessment of response by Project Participants
	estimate of accuracies should not be very different from the presented ones, GFC to considering the grouping in primaries for producing the confusion matrices and the different accuracy indicators.		
	• Reporting of uncertainties on accuracy indicators: Following Olofsson et al. (2014), it is good practice to report confidence intervals at 95% of the different accuracy indicators (i.e. overall, users and producers). GFC to consider reporting uncertainties of the accuracy indicators in the next monitoring period.		Uncertainty levels and confidence intervals are being reported by the AA
	• Forest Cover change Matrix: In order to have an estimate of the accuracy of the change map produced for year 4, a confusion matrix of the forest cover change and accuracy indicators should be provided. Section 4.9 seems to indicate that these results would be provided (i.e. Table 4.9.1) but the filled-out table is not found in the report. In previous monitoring periods is was not possible to derive this confusion matrix as there was no reference data on change classes, but now it would be possible to report this confusion matrix of the change map for forest cover change as it has been done for degradation. Hence, GCF is encouraged to consider reporting this in the next monitoring period along with uncertainties in accuracy		The AA has changed to a purely change-sample based approach, and has removed any remnants to the previously model-based approach from the report, such as the confusion matrices, thereby avoiding the confusion these caused

OBS ID	Corrective action request	Response by Project Participants	DNV GL's assessment of response by Project Participants
	indicators. GCF to consider the use of the following guidance provided in Olofsson et al. (2014) regarding reporting, yet with some adaptations in order to consider the specific sampling design.		
	• Deforestation by roads: The AA report indicates that the average estimate of deforestation using sampling could have been slightly over-estimated in relation to the estimate provided by wall-to-wall mapping. The issue was mainly related to the sampling units that intersected with roads, that were accounted as loss units, while logically they could be accounted as degraded or forest units. The University of Durham has indicated the urgent clarification of the mapping rules of these cases. The verification team agrees with this and would like to recommend to clarify the mapping rules of these areas for the next monitoring period, and/or to analyse the potential of using proportions of loss in the sampling units instead of a binomial variable, as used in Potapov et al. (2014).		Deforestation by roads has been measured by estimating the proportion of loss within the sample units. **OBS Closed**

MINOR Corrective action requests and Observations of the previous year's audit

CAR ID	Major/ Minor	Corrective action request	Response by Project Participants	DNV GL's assessment of response by Project Participants
CAR 2	MINOR	**Requirement**: Interim Measures 1.1 **Non-Compliance**: Current system does not systematically provide direct alignment between MRVS Reporting tables and the newly designed IPCC Reporting Results tables **Objective evidence:** • Currently system is set up to be fully compliant with the IPCC reporting. However, for some categories there is ambiguity as to the categorisation of drivers in MRV report for Norway and certain groupings of data are required from the IPCC data sheets, which are in part due to the categorisation not having been documented in the MRV Report. This could lead to miscategorising deforestation driver by forestry for Y4 (330 ha, table 6.2 p 35) whereby in the IPCC tables, forest infrastructure and mining infrastructure are categorised as one, but in the MRV Reporting tables, these are separated by Driver	Results tables for both MRVS and IPCC reporting aspects are accurate. Our understanding is that this corrective action came about because the initial report formatting in historical periods was not aligned with IPCC formats, as was not planned for or intended at that early stage. For example, forestry roads and mining roads have historically been included in forestry and mining separately in the typical MRVS Reporting tables, whereas under IPCC format being piloted in year 4, they are both grouped in one category. In Year 5 Reporting, the format in which the table is produced and the way in which the area change figures are reported will be altered to align more easily with IPCC classes, and to ensure there is no chance of any ambiguity. There continues to be an interest at the national level in Guyana, to separate infrastructure	The Guyana Forestry Commission has further advanced their integration of the IPCC Reporting Results tables, which have now also been included within the Monitoring report. During the audit it was found that both tables contained all date correctly. **CAR closed**
CAR 4	MINOR	**Requirement**: Interim Measures 2.2 and 2.4 **Non-Compliance**: Biomass assessment plots of degraded forest within shifting cultivation areas are not adequately reflected within	The brief inspection conducted during the audit indicated that rotational shifting cultivation was classified as pioneer. It is worth noting that this the first year shifting cultivation has been reported. It is anticipated that as an approach 3 MRVS	DNV GL observed during the audit the initial biomass establishment in relation to the biomass collection in the different shifting cultivation areas, which contain both recent and fallow areas of different ages. The work is not yet completed

CAR ID	Major/ Minor	Corrective action request	Response by Project Participants	DNV GL's assessment of response by Project Participants
		overall biomass calculation. **Objective evidence:** - Fieldwork evidence shows that most, if not all, SA mapped as pioneer actually is rotational. - Fieldwork evidence shows that the currently map identification of primary forest in shifting cultivation areas has led to the allocation of areas as primary forest where ground truthing of the same areas identified the area as rotational agriculture/degraded secondary forest.	and with further repeat image coverages the attribution of both historical and new shifting cultivation areas will be improved. While the areas in question still fall within Guyana's definition of forest, it is recognised that this is secondary forest. It is expected that the historical extent of shifting cultivation areas will improve in line with annual coverages of high resolution imagery. The current work on Emission Factors by GFC will account for the differing carbon contents. It is planned for field assessments to be conducted to inform an emission factor for Shifting Agriculture. This will inform the impact that this activity has on biomass. This will remove the dependence of categorising shifting agriculture type using remove sensing methods only, which evidently has specific challenges. It is envisaged that an Emission Factor will be developed in 2015-2016 for Shifting Agriculture. It is likely that the emission factor will be a function of the forest-fallow cycle and local practices. The challenge will be how to count for the net emissions from this activity. It is still being assessed whether Shifting Cultivation mosaics are lengthening or shortening or stable. This determination will help to decide their role. Once an estimate of the average C stock is derived in different Shifting Cultivation mosaics then this can be used with pioneer shifting cultivation—i.e. first time cleared, as the net effect will not be the C stock of the	and full analyses of both the biomass data collection and the actual biomass calculations are to be completed during 2015. **CAR be closed out during next verification**

CAR ID	Major/ Minor	Corrective action request	Response by Project Participants	DNV GL's assessment of response by Project Participants
			forest to begin with but the C stock of initial forest minus the long term average C stock of the Shifting Cultivation cycle. Additionally, the results that the Remote Sensing analyses can reliably deliver on SA will be reassessed and this will be used with the EF to derive carbon impact in these areas.	
CAR 5	MINOR	**Requirement**: 1.1, 2.1, 2.2, and 2.3 **Non-Compliance**: Required sampling strategy do not require reassessment of stratification over time. **Objective evidence:** • Stratification of the Accuracy Assessment is out of date missing HR area around Matthew Ridge • Stratification for the Biomass stratification is out of date BPMLA 12-2A already under gone forest change	The Change Sample approach used in the Y4 Accuracy Assessment used the same design as Y3 and the analytical approach has resulted in a significant reduction in the Sampling Error of forest loss and forest degradation area estimates. Nevertheless, deforestation is, as the audit team point out, encroaching into areas in the Low Risk stratum implying that the stratification is not optimum. The AA team acquired 10% additional randomly selected clusters in Y4 that were not used in the accuracy assessment but are available for Y5 assessment. In response to the CAR 5 - we note that financial and time resources are limited for acquisition of reference data; that the pattern of mining has changed with time; that 95% of degradation is associated with mining and mining-related infrastructure; that degradation can be identified with a good level of accuracy from aerial imagery and very high resolution satellite imagery. For year 5 the accuracy assessment will seek to revise the sampling stratification to maximize the precision of the estimate given the logistical constraints on the number of first-stage clusters that are randomly selected. Our analysis of the existing stratification using the Neyman	For the Y5 AA the stratification of Guyana has been revised into 4 classes that better represent the risk of deforestation, based on actual deforestation data from 1990-2013. **CAR closed**

CAR ID	Major/ Minor	Corrective action request	Response by Project Participants	DNV GL's assessment of response by Project Participants
			allocation equation, illustrates that it is possible to optimize the distribution of samples to achieve the same precision using fewer within-cluster samples.

In sum, we will seek efficiencies by (1) improving the stratification using knowledge of deforestation and degradation risk gained from observed patterns, and (2) use a mathematical approach to optimize the number and distribution of first-stage samples allocated to each risk stratum.

As part of the Sample Design for the Forest Carbon Monitoring System, and Stratification and the Long Term Monitoring Framework, the revision of the stratification for forest carbon is planned to take place every 5 years. This means that the system having been developed in 2010/2011. This means that in 2016, the stratification is planned for revision.

This will mean taking into consideration new infrastructure, areas of deforestation and forest degradation, and allocations. The point made in the CAR is taken and the process of revision of stratification is necessary as land uses are constantly ongoing and as a natural part of this process, brings about varying impacts on forest areas. The SOP for the Forest Carbon Monitoring System will be updated to take account of this likely occurrence and to outline a procedure for addressing this. Whilst there appears to be no expectation for stratification to be revised every month, or even every year, that within the frame of a specific stratification | |

CAR ID	Major/ Minor	Corrective action request	Response by Project Participants	DNV GL's assessment of response by Project Participants
			application, that provisions need to be clearly outlined to address any eventuality – like a randomly selected area, already having undergone forest change. A section is proposed to be added to the SOP for Forest Carbon Monitoring, to address this.	

Observations

OBS ID	Major/ Minor/ Obs	Corrective action request	Response by Project Participants	DNV GL's assessment of response by Project Participants
Obs 1	OBS	**Requirement**: Interim Indicator 1.1 **Potential Non-Compliance**: Misclassification of reference samples during Accuracy Assessment **Objective evidence:** Change toolbar to become comprehensible and useable for new people.	The GIS toolbar used for accuracy assessment has become complex as the assessment now incorporates a change sample analysis that compares only two independent reference data sets and compares the latest reference data with the GFC map product. For each of these assessments the accuracy assessment analyst may be required to indicate the driver of change and a possible mapping error should this be observed. For year 5 accuracy assessment, the GIS toolbar will be modified and simplified with the objective that it can be learned quickly by a new operator and that none of the drop down menu items are ambiguous.	DNV GL verified the updated toolbars, which included the removal of obsolete tool options and a clear layout for the users. **OBS closed**

Corrective action requests this year's audit

CAR ID	Major/ Minor/ Obs	Corrective action request	Response by Project Participants	DNV GL's assessment of response by Project Participants
CAR 1	MAJOR	**Requirement**: Overall MRV Report	The areas identified have been corrected in	DNV GL assessed the changes to

CAR ID	Major/ Minor/ Obs	Corrective action request	Response by Project Participants	DNV GL's assessment of response by Project Participants

		Non-Compliance: Report consists of instances of data not matching.
		Objective evidence:
		• Table 6-2 (page 34)
		   o Year 5 Forestry Deforestation is 191, should be 204
		   o - Year 5 Infrastructure Degradation is 43, should be 63
		• Table 8-2 (page 58) period contains 1 January 2013 – 31 December 2013 where it contains information for the period 1 January 2014 to 31 December 2014
		• Table 10-3 (page 72) Difference(%) for the period 2012 (year 3) is marked as -0.007 where it should be 0.007
			the Version 3 of the Report and related tables and text have also been modified.
			
			These have minimal impact on the total hectares and did not alter the deforestation rate nor the overall status of the Interim Measures.
				the report and is satisfied with the modifications made by the GCF.
				
				CAR is closed

CAR 2	MAJOR	**Requirement**: 1.1, 2.1, 2.2, 2.3 and 2.4 **Non-Compliance**: Historical GIS layers not confirm the Y5 RapidEye images in some cases. **Objective evidence**: • In some areas the GFC GIS layers show a significant shift (of up to 60 meters) (e.g. tile 214308, west side; tile 2140704) with the Y5 RapidEye images. The current mis-registration of GIS layers with the imagery could cause new deforestation or degradation to be missed, when it, due to these issues with registration, seems to coincide with already existing neighbouring deforestation/degradation and thus would be disregarded because of apparently no change. For Y5	It was recognized that when the base map was updated from Landsat to RapidEye full coverage, it would produce an offset/shift with the historical change mapped. To correct for this misalignment, each GFC Analyst was required to shift all historical change to fit the 2014 RapidEye imagery for each tile they were tasked with mapping before they started to digitize/map Year 5 change. We do recognize however that in identified areas, elements of the historical change remain misaligned with the 2014 RapidEye. To correct for this misalignment, the following is proposed and will be pursued in MRVS Year 6: Before the commencement of the year 6 mapping it is planned that each mapping analyst go through each RapidEye tile and manually correct for each	DNV GL accepts the proposed changes and actions proposed by GFC. Since the impact of the actions will have direct effect on the next year's data and not this year's data, the audit team will verify the effectiveness of the changes during the next audit. The Audit team downgrades this MAJOR to a MINOR full close out of CAR will have to be confirmed during the next audit. **CAR now a MINOR**

CAR ID	Major/ Minor/ Obs	Corrective action request	Response by Project Participants	DNV GL's assessment of response by Project Participants
		RapidEye updated the positional accuracy for Guyana, resulting in an offset (compared to Y4) for some areas up to 30 meters (according to p. 12). This could be the root cause of this shift. However, whatever the cause, to ensure accurate mapping for Y6 the GIS layers of GFC should match the future RapidEye images.	misalignment found with the historical change and the 2014 RapidEye. The analyst would use the same approach for mapping new change (systematically go through tile by tile) except in this instance, they would be correcting the historical change and ensuring that it is properly aligned with the 2014 RapidEye imagery.

As a secondary consideration there will be some exploration of the possibility of ordering the RapidEye 3B product which was used in 2013, as this aligns with historical change (this however would mean that GFC cannot use the updated base map and would need to align all change mapped for year 5 to the imagery (RapidEye 3B product) before GFC proceeds to do year 6 mapping). This is not the preferred option but will be explored to establish the pros and cons before a final decision is take on the next steps.
Further the GFC would be assessing whether year 6 or future RapidEye would be referenced to the same coordinates as year 5; also that any other imagery would also fit with the Year 5 image and derived map data. The SOP & QC rules may benefit from an update where historic GIS could be updated to reflect any shift in the current year's satellite imagery. E.g. for Year 6 data (where applicable) historic GIS will be shifted to show consistency with Year 6 imagery. In terms of the SOP, this step will go in the pre-processing stage (before digitising Year 6 change) so not to double count or misclassify any current changes.
We also note that shifting is very common between different sensors and also from year to year as ground control points are updated. | |

CAR ID	Major/ Minor/ Obs	Corrective action request	Response by Project Participants	DNV GL's assessment of response by Project Participants
			GFC has dealt with this issue in several examples over Phase 1 (Years 1 to 4 of the MRVS) and through consistent QC and results from the AA, image shifting has not been an issue where the reported figures are significantly inconsistent. We propose to continue using this approach moving forward as we are faced with similar challenges.	
CAR 3	MINOR	**Requirement**: 1.1 **Non-Compliance**: SOP are not followed in all events **Objective evidence**: • During the audit it was found that as part of the rechecks SOP instructions on Page 62 of the SOP for Carbon Measurements were not followed i.e.: o When the two measurements of DBH are with the allowable error range, the average of the two values is entered in the carbon calculator workbook (with notation made to indicate this was done) o Any error exceeding allowable limits will be used to calculate measurements error as described below and the identified errors should be corrected. • No record of the errors found during the QA&QC were found as outlined in Page 68 of the SOP for Carbon	In improving the MRV system the SOP guiding the implementation has to be updated from time to time. One such improvement is the updating of the QA/QC section of the SOP which was added in August 2015. Important to note is that this modification was done after the data on the medium potential for change area was collected. The procedure will however, still be applied to this data and will be reported in the final report on the carbon stocks assessment after all biomass data is processed for the MRV Phase 1. Since the data for the low potential for change is still being processed including the rechecks, this modification to the SOP will be applied to this data set. A tab will be created in the tool itself to track the errors of data entry during the rechecks also applicable to the low potential for change stratum. We also plan on conducting a continuous programme of training of new and current staff to keep staff abreast of all relevant areas of the FCMS. We note that in some cases, these will need to be refresher	DNV GL agrees with proposed planning of GFC however the CAR will not be closed till the next verification once the evidence of the implementation can be verified. **CAR to be closed out during next verification**

CAR ID	Major/ Minor/ Obs	Corrective action request	Response by Project Participants	DNV GL's assessment of response by Project Participants
		Measurements.	courses, and in other cases, courses on new developments and areas. In general, we would like to note that in our assessment, field errors are minimal and do not affect in any substantial way, the results and analysis.	
CAR 4	**MINOR**	**Requirement**: 1.1, 2.1, 2.2, 2.3 and 2.4 **Non-Compliance**: RapidEye co-registration indicates misalignment leading to shifts between RapidEye images **Objective evidence**: • For several RapidEye tiles, images for one tile taken at different dates in Y5 don't exactly match. For example between 2140602_2014-11-12_RE3_3A_298743 and 2140602_2014-11-16_RE2_3A_298743, the latter is shifted approximately 3 pixels (15 meter) to the east.	The GFC has taken note of this issue and determines this matter to only prevail on a small scale and does not affect the main results and analysis. This is an important matter however, for the future improvement of the MRVS and to correct this issue we propose the following: Consult with RapidEye to inquire if it is possible for them to correct the mis-alignment between scenes of imagery obtained for the same tile. Use the Georeferencing tool present in ArcGis to align imagery. The approach would be to check for the RapidEye tile/image that is best aligned with both historical and Year 5 change and shift all other imagery collected for this area to align them with the selected image (this would be done by doing a point shift). The GFC will consider ordering RapidEye swats and re co register imagery and forward the GCP's to RapidEye (this however does not guarantee that all images for the same area will line up, it is also time consuming). Thus, this is not the preferred option but will be examined nevertheless, as one alternative.	DNV GL agrees with proposed planning of GFC however the CAR will not be closed till the next verification once the evidence of the implementation can be verified. **CAR to be closed out during next verification**

CAR ID	Major/ Minor/ Obs	Corrective action request	Response by Project Participants	DNV GL's assessment of response by Project Participants
			In conclusion, the GFC notes that shifting of coincident tiles from the same year/delivery is an issue with the RE imagery provided to GFC. However, as a response for Year 6/Phase 2 development we will include an additional level of QC which will look at consistency of coincident tiles (mosaicked geo referenced products). Where tiles are offset we can apply a correction to align them correctly and/or inform RE of the misalignment should the number of tiles affected. The latter will likely be used should the issue be on a larger scale.	

OBS ID	Major/ Minor/ Obs	Corrective action request	Response by Project Participants	DNV GL's assessment of response by Project Participants
Obs 1	OBS	**Requirement**: Overall Guyana MRV programme **Potential Non-Compliance**: QA&QC will lead to additional costs and repeat activities **Objective evidence:** Current Re-check application of Biomass does not necessary clearly outline why the second review team is considered over ruling or the relation to the significance of the error within the overall objective to establish biomass volumes for different forest types.	We note this observation and would conduct the necessary follow up to address this. The GFC will work to further develop the blind checks as currently outlined in the SOPs: In areas such as Guyana where plot locations are widely disbursed, and travel to plots may take multiple days, it may not be feasible to have separate crews conduct blind checks on 10% of plots. Where this is the case, an alternative is to conduct blind checks with the same crew, but with members performing different tasks than during initial data collection – however tree spotters must remain identifying trees as this is a unique skill. This is followed by a series of steps given in detail in the SOPs. The point (referred to as Objective evidence),	DNV GL agrees with proposed planning of GFC during the upcoming audit the Audit team will pay additional attention to this area. **Obs to be verified during next audit**

OBS ID	Major/ Minor/ Obs	Corrective action request	Response by Project Participants	DNV GL's assessment of response by Project Participants
			with this outlined approach, will not lead to any one value over-ruling another and it will ensure that all measurements are correctly taken and recorded. The quantification of measurement error will then feed into further sensitivity analyses to identify if this source of error is important or not and how it will affect overall uncertainty as quantified by a Monte Carlo type of analysis.	
Obs2	**OBS**	**Requirement**: Interim Measures 2.2 and 2.4 **Potential Non-Compliance**: Original hypotheses around forest stratification (grouping of forest types) not confirmed in final stratum. **Objective evidence**: Originally GFC demonstrated and argued that carbon content within different forest types were negligible and as such could be group all under forest. However this was based on data collected predominantly within the traditional forest logged by commercial operations. Now that new data is getting available from the savannah areas (in LPfC stratum) where forest types appear to have lower carbon content, it is not clear if this original conclusion to group all forest types together holds true.	It is intended that following the completion of the three phases of data collection, matters such as those outlined in the objective evidence will be examined. One approach is to consider post stratification of the LPfC area where this matter seems to be prevalent. We note that this was not an issue in the other two strata of HPfC and MPfC where there are multiple forest types and a prevalence of logged and unlogged forest, along with other land use and land management activities. GFC will collate the results of the data analysis from the LPfC stratum and examine this further. This will be further examined in Year 6.	DNV GL agrees with proposed planning of GFC during the upcoming audit the Audit team will pay additional attention to this area. **Obs to be verified during next audit**

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APPENDIX B

CURRICULA VITAE OF THE VERIFICATION TEAM MEMBERS

Edwin Aalders

Mr Aalders has 20 years of experience as an assessor in Environmental Auditing and Policy and Management. Mr Aalders started his career in SGS in 1992 were he quickly became involved in the development of new environmental certification & control services. In 2004 he became the Director of the International Emission Trading Association (IETA) which he held till 2009. In addition to his role as Director in IETA he was the first CEO for the Verified Carbon Standard Association (VCSa) between November 2007 and October 2008. After leaving IETA Mr Aalders became a Partner with IDEAcarbon before joining DNV GL as at their Climate Change and Sustainable Development Department in 2011.

Throughout his career Mr Aalders lived and worked in the various developing and developed countries, particularly Latin America, Africa and Australasia, involved in developing new environmental markets services. At SGS his work covered the development of environmental programmes such as SGS' Services in for Climate Change, Marine Stewardship Council (MSC), Organic, GLOBALGAP and Forest Stewardship Council (FSC). Whilst within IETA he had the operational responsibility of IETAs overall activities and in particularly those related to the UNFCCC process (CDM & JI) as well as the voluntary market which ultimately led to the setting up of the VCSa.

Mr Aalders is and has been an elected member of roster of experts for the Methodology & Accreditation Panel Expert of the CDM & JI, member of the JI Accreditation Panel, and is currently member of the VCSa AFOLU Steering Committee and WOCAN.

Vincent Schut

Vincent Schut has over 10 years' experience in earth observation image analysis and received his MSc in Tropical Agriculture at Wageningen University in 2001. At SarVision, he coordinates the development of advanced optical image processing chains and supporting algorithms and software for semi-automated forest and land cover change monitoring in tropical forest areas. He is also responsible for the setup and maintenance of the processing computer systems and local area network. Vincent is an experienced programmer (python, idl, C, C++, java) working with ENVI/IDL, Quantum GIS, openJump. Over the years he has executed several field work campaigns in South East Asia and has good knowledge of the relation between imagery and land cover characteristics. He has successfully executed image processing assignments in support of national REDD MRV system development in Suriname, Colombia and Indonesia as well as private sector VCS projects.

Pablo Reed

Pablo Reed holds more than 12 years of experience in the fields of Forestry, Climate Change, and International Development. He holds a joint degree in Forest Engineering and Latin-American studies from the University of Washington, as well as a Masters in Environmental Management from the Yale School of Forestry and Environmental Studies. His interest and passion for conservation and development initiatives have led him to work in various countries and projects through the years, such as serving as country director for a USAID-led indigenous community mapping program in Guatemala; as an environmental consultant for the Academy of Educational Development in Panama; and as director for the Natural Resource Conservation Program with the Peace Corps in Ecuador. Since joining DNV GL in 2011, his work has mainly concentrated on the validation of Agriculture, Forestry, and Other Land Use (AFOLU)-sector carbon offset projects across the globe, and on Low Emissions Development Strategies (LEDs) and the design of Nationally Appropriate Mitigation Actions (NAMAs) for emerging economies in

Latin America. His main areas of interest and expertise concentrate on issues of community-based conservation, non-traditional land tenure arrangements, and the feasibility of incorporating indigenous community lands under Reducing Emissions from Deforestation and Degradation (REDD) and other payment-for-environmental-services type of initiatives. He is currently based out of Berkeley, California.

Dr Misheck C Kapambwe

Dr Kapambwe has over 20 years international experience in the fields of forestry, forest products processing and management, environmental management and resource conservation, climate change policy, climate change consulting, and academia. He has many years of experience as auditor, validator and verifier of numerous international forest carbon projects including REDD+ projects under CDM program, VCS, CCBA and ISO 14064 Standards. His experience also covers the fields of AFOLU methodology validation. His qualification, industrial experience and experience in forestry and forest industry demonstrate his sufficient sectoral competence in forestry (technical area & sectoral competence TA 14.1 & Sectoral Scope 14). He holds a PhD in forest products carbon accounting and a Masters Degree in Wood Science from the University of Melbourne (Australia), a Master of Business Administration (Sustainable Business) Degree from the University of South Australia (Australia), and also holds a Graduate Diploma in Forest Industries (Australia), a Diploma in Forestry (Zambia) and a Diploma in Sawmilling Technology (Zimbabwe)

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Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. We provide classification and technical assurance along with software and independent expert advisory services to the maritime, oil and gas, and energy industries. We also provide certification services to customers across a wide range of industries. Operating in more than 100 countries, our 16,000 professionals are dedicated to helping our customers make the world safer, smarter and greener.