VERIFICATION REPORT

VERIFICATION OF INTERIM REDD+ PERFORMANCE INDICATORS UNDER THE GUYANA-NORWAY REDD+ PARTNERSHIP

Monitoring Period:
1 January 2012 to 31 December 2012 – Year 3

REPORT NO. 2013-1760
REVISION NO. 01

DET NORSKE VERITAS

VERIFICATION REPORT

Date of first issue: 17 December 2013	Project No.: PRJC-467680-2013-CCS-NOR
Approved by Michael Lehmann	Organisational unit: Accredited Climate Change Services
Client: Ministry of Environment– Government of Norway	Client ref.: Maarten van der Eynden

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Summary:

DNV Climate Change Services AS (DNV) 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 2012 to 31 December 2012 – Year 3 as described in the Guyana REDD+ Monitoring Reporting and Verification System (MRVS) - Interim Measures Report, Version 3 dated 6 December 2013 produced by the Guyana Forestry Commission – Government of Guyana.

This report provides the verification methodology, results and statement.

Report No.: 2013-1760	Subject Group: Environment
Report title: Verification of Interim REDD+ Performance indicators under the Guyana-Norway REDD+ partnership	
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Work verified by: Andrés B. Espejo	
Date of this revision: 24 February 2014	Rev.: 01 / Number of: 33

Indexing terms

Key words REDD+ Guyana Norway Interim Indicators Verification	Service Area Verification Market Sector Forestry

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Table of Content *Page*

DNV VERIFICATION STATEMENT

Verification Objective

DNV Climate Change Services AS (DNV) 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 from the most recent version of the Joint Concept Note (31 March 2011). 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.
	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 relevant and therefore have not been considered. These are:

Degradation Indicators	6	Indicator 2.4:	Emissions resulting from subsistence forestry, land use and shifting cultivation lands (i.e. slash and burn agriculture)
Indicator on increased carbon removals	7	Indicator 3.1:	Encouragement of increasing carbon sink capacity of non-forest and forest land

In addition, DNV 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 2012 to 31 December 2012 – Year 3.

[*] Contract and scope signed between The Norwegian Ministry of Environment and DNV on 10 January 2011

[†] Guyana REDD+ Monitoring Reporting and Verification System (MRVS) - Interim Measures Report, Guyana Forestry Commission, 16 March 2011

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. This does not include individual or aggregate level of error associated with technical equipment (e.g. sensors) or remote sensing methods (e.g. visual interpretation). However, for Indicator 1 – gross deforestation rate, this has been addressed by an independent accuracy assessment.

Verification criteria

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

- 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 (2012).
- 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.
- Good Practice Guidance for Land Use, Land-Use Change and Forestry (2003).

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 October 2013 until 24 February 2014 and included desk reviews of relevant documentation and datasets as listed in the verification report and an on-site assessment in Guyana from 21 November 2013 to 26 November 2013.

As part of the verification, the results of the independent accuracy assessment included in the Interim Measures Report dated 6 December 2013 were verified.

Conclusions

It is DNV's opinion that the results provided in the Interim Measures Report by Guyana Forestry Commission dated 6 December 2013:

- 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 has verified that the values for the interim indicators in this monitoring period (1 January 2012 to 31 December 2012 – Year 3) are:

Measure Ref	Indicator		Year 3 results
1	Indicator 1:	Gross Deforestation rate in Year 3	0.079%
2	Indicator 2.1:	Loss of intact forest landscapes	7.60 million ha
2b	Indicator 2.3:	Carbon loss as indirect effect of new infrastructure.	1 963 ha
3	Indicator 2.2:	Forest Management	2 159 151 tCO_2
4	Indicator 2.5:	Emissions resulting from illegal logging activities.	11 217 tCO_2
5	Indicator 2.6:	Emissions resulting from anthropogenic forest fires.	208 ha/year

Statement Issuing date

24 February 2014

Edwin Aalders
Team Leader

Michael Lehmann
Managing Director
DNV Climate Change Services AS

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

Abbreviations

ALOS AVNIR2	Advanced Land Observing Satellite Advanced Visible and Near Infrared Radiometer type 2
AVHRR	Advanced Very High Resolution Radiometer
ASAR	Phased Array Type C-band Synthetic Aperture Radar
CAR	Corrective Action Request
CBERS	China Brazil Earth Resource Satellite
CBM	Cubic Meter
CH_4	Methane
CL	Clarification request
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
CoC	Chain of Custody
DMC	Disaster Monitoring Constellation
DNV	Det Norske Veritas
DOS	Dark Object Subtraction
EVI	Enhanced Vegetation Index
FAR	Forward Action Request
FIRMS	Fire Information Resource Management System
GFC	Guyana Forestry Commission
GHG	Greenhouse gas(es)
GIS	Geographic Information System
GOES	Geostationary Operational Environmental Satellite
GOFC-GOLD	Global Observation of Forest Cover - Global Observation of Land Dynamics
GPG	Good Practice Guidelines
GWP	Global Warming Potential
IFL	Intact Forest Landscapes
IMR	Interim Measures Report
INPE	Instituto Nacional de Pesquisas Espaciais
IRS	Indian Remote Sensing Satellite
JCN	Joint Concept Note
MMU	Minimum Mapping Unit
MODIS	Moderate Resolution Imaging Spectroradiometer
MP	Monitoring Plan
MRVS	Monitoring Reporting and Verification System
P1	Benchmark Period 1 – from 1990 to 2000
P2	Benchmark Period 2 – from 2000 to 2005
P3	Benchmark Period 3 – from 2005 to 2009
PIF	Pseudo Invariant Features
QA/QC	Quality Assurance / Quality Control
REDD+	Reducing Emissions from Deforestation and Degradation
RP	Responsible Party of the assertions - GFC
RSB	REDD Sourcebook
SOP	Standard Operating Procedures
SPOT	Satellite Pour l'Observation de la Terre
TOR	Terms of Reference

UNFCCC	United Nations Climate Change Convention
USGS	United States Geological Survey
VCS	Verified Carbon Standard GHG programme
Year 2	Second monitoring period from October 1, 2010 to December 31, 2011
Year 3	Third monitoring period from January 1, 2012 to December 31, 2012

1 INTRODUCTION

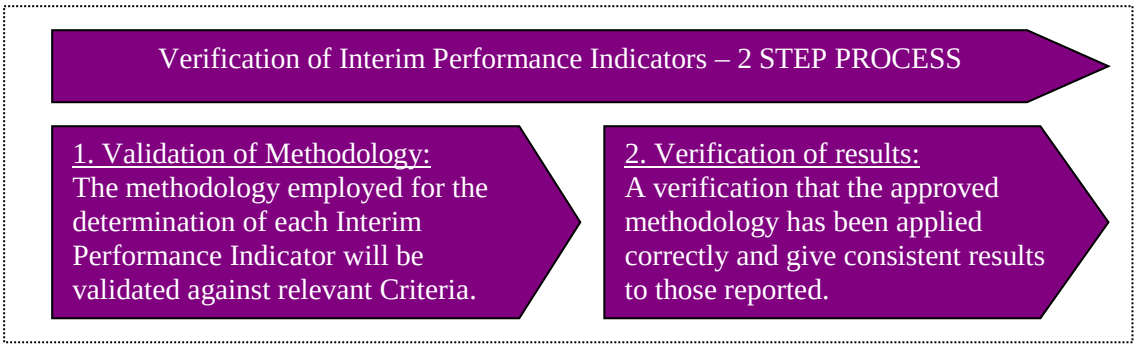
DNV Climate Change Services AS (DNV) has been contracted by the Ministry of Environment– Government of Norway to perform a non-accredited Verification of Interim REDD+ Performance indicators under the Guyana-Norway REDD+ partnership. According to the Joint Concept Note (JCN) signed between both parties, 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 /53/.

DNV has been tasked to verify the results in deforestation and forest degradation as measured using the interim indicators established in the Joint Concept Note, specifically as outlined below and as detailed in the JCN Table 2, pages 18-24 /53/:

- Gross Deforestation in the period from 1 January 2012 to 31 December 2012 – Year 3;
- 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;

2 BASIS OF VERIFICATION

In order to verify the Interim Performance Indicators, DNV has followed the principles and requirements for verifying GHG inventories and validating or verifying GHG projects defined by ISO 14064-3 /20/. 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.



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

2.1 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 /20/. There are two levels of assurance, reasonable or limited. The level of assurance affects the relative degree of confidence the

verifier requires in order to make a conclusion /20/ 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 /20/.

A limited level assurance is distinguishable from a reasonable level assurance in that there is less emphasis on detailed testing of data and information supplied to support the assertion /20/.

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.

2.2 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 (Version 3 of 6 December 2013) 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;

2.3 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” /20/. 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) /53/;
  - GOFC-GOLD REDD Source Book, 2012 /54/;
  - IPCC Good Practice Guidance /56//57//58/ and Guidelines /55/;
  - Approved REDD methodologies under the VCS programme /64/;
  - Peered reviewed publications /33//61/

2.4 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 /20/. Taking into consideration the TOR of the assignment /59/ and the provisions of the JCN /53/ the scope of the verification consists in the verification of the following deforestation and degradation Interim Measures Indicators as described in the JCN /53/:

Report Measure	Measure Ref	Indicator	
Deforestation Indicators	1	Indicator 1:	Gross Deforestation rate
Degradation Indicators	2	Indicator 2.1:	Loss of intact forest landscapes
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	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.

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 3 (1 January 2012 to 31 December 2012)
- *Frequency of subsequent verification processes*: Yearly verification
- *Intended user for the verification statement*: Government of Norway and Government of Guyana

2.5 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" /59/. 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 /59/.

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.

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. This does not include individual or aggregate level of error associated with technical equipment (e.g. sensors) or remote sensing methods (e.g. visual interpretation). However, for Indicator 1 – gross deforestation rate, this has been addressed by the independent accuracy assessment /18/.

3 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

				Type of involvement					
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	Flagstad	Ole A.	Norway	✓	✓	✓			
Internal Peer Reviewer	Espejo	Andrés B.	Spain					✓	✓

Duration of verification

Preparations: From 01 October 2013 to 20 December 2013

On-site verification: From 21 November 2013 to 26 November 2013

Reporting, calculation checks and QA/QC: From 01 October 2013 to 24 February 2014

3.1 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 IMR /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 /21//22//23//24//25//26//27//28//29//30/. 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.

3.2 Site visit

An on-site assessment was performed from 21 November 2013 to 26 November 2013; partly in GFC's main headquarters located in Georgetown, and partly in GFC's forest stations of Linden, Bamboo Landing and the base camp of Variety Woods and mining areas around Port Kaituma/Matthews Ridge.

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, 2.5 and 2.6. This verification took place in GFC's GIS office and by on-site verification in the area around Port Kaituma/Matthews Ridge.
- 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 last day of the audit, and which was supported by a field visit to GFC's forest stations and was carried out in the forest concession in and around Variety Woods, Linden station to allow cross-checking of information.

On 26 November 2013 a closing meeting with a preliminary reporting of the findings of the verification took place in the GFC's headquarters.

3.3 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 Annex A.

4 VERIFICATION FINDINGS

4.1 Interim indicator 1.1 - Gross Deforestation

4.1.1 Methodology validation

a Methodology description

While the Year 1 method relied completely on Landsat images, and the Year 2 method had partial coverage with 5m resolution RapidEye and still relied on 30m Landsat for the rest of the country, for Year 3 RP has acquired full coverage of RapidEye images for entire Guyana, with multiple acquisitions for most of the country. In total, 1380 RapidEye datasets were downloaded and processed, with imaging dates ranging from August to December 2012. This effectively finishes the transition from 30m Landsat to 5m RapidEye as base imagery for mapping that was started in Year 2. As the Year 2 mapping based on RapidEye appeared very accurate, this is seen as a welcome improvement by the audit team. It will further reduce the dependency on Landsat and improve mapping accuracy, both spatial and with regard to the ability to directly map forest degradation. Additionally, full Landsat coverage was downloaded and pre-processed by RP to account for areas with persistent cloud cover on all available RapidEye datasets.

Noteworthy is also the agreement that has been made between RP and RapidEye that RapidEye will use the Ground Control Points created in Year 3 by RP for coregistration of the original RapidEye data. This means that the labour intensive work of cooregistration will be done by RapidEye in Year 4.

RP has also used this much better dataset to take the opportunity to improve their forest/non-forest base layer (till now based on Landsat), by revisiting areas of doubt, building on the assumption that areas that are natural mature forest on the Year 3 RapidEye images should be forest in the forest/non-forest base layer. Areas of forest which were missing in the base layer, possibly due to cloud cover, or areas which were delineated badly, were updated according to the new RapidEye images.

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

DNV has observed that the Year 3 processing and mapping essentially builds on the methods developed for Year 2 and can be summarized by the following steps: 1) pre-processing of RapidEye data; 2) generating EVI based change polygons; 3) manually digitizing forest change and degradation:

1) In order to improve the geocorrection process, RapidEye data was delivered as level 1A image swaths to GFC. Those were co-registered to the general Geocover 2005 base layer, using ground control reference points. The same points can be used to different acquisitions of the same swath, and RP has made an agreement with RapidEye to supply their ground control points, which will then be used by RapidEye to apply the geocorrection for Year 4 acquisitions. Therefore, in Year 3 this was a relatively labour intensive process for GFC. It is envisaged that RapidEye will use these ground control points as a reference and deliver fully co-registered geocorrected data to GFC. After geocorrection, the RapidEye swaths were cut into squares of manageable size to allow for easier further handling.

2) Next step in the processing was radiometric normalization by Dark Object Subtraction (DOS) and calculating reflectance values from the raw data values. Then the EVI was calculated. To create a non-forest delineation from the EVI image, the EVI image is 'thresholded', starting with a default value which is then adapted to local scene conditions (e.g. vegetation composition, soil moisture content, shadow) by visual and numerical inspection and comparison of the result and the original DOS-corrected image while checking both forest and non-forest areas and their border. This is possible because in Guyana there is, in general, little to no gradual change from forest to non-forest in deforested areas; the change is normally very sudden. The higher and enhanced resolution of RapidEye in comparison to the Landsat images allows for an accurate delineation of the boundaries between forest and non-forest areas.
3) Once a suitable EVI threshold has been found, the threshold is applied to generate a non-forest image. Then the non-forest areas are filtered (using a clump-and-sieve filter) to get rid of most of the single-pixel noise and polygons are generated from the filtered areas. The resulting polygons are cleaned manually from influence of cloud, shadow, and ultimately intersected with the Year 2 forest map to get only the Year 3 forest change.

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

A persistent cloud map is generated with the areas that are cloudy in all available images. For these areas, if possible, alternative imagery is used (preferably Landsat), even though the much lower resolution does not allow for a detailed mapping in these areas. When recent over-flight photos were available, these were used as an additional mapping source. Because for Year 3 for almost all areas three RapidEye images were available, the total percentage of persistent cloud was lowered from almost 3% in Year 2 to less than 1% in Year 3.

This finishes the pre-processing phase, which has largely been automated. From here on, the mapping process starts, which is entirely manual..- The EVI based polygons go into the GIS system, and a GIS operator visits these polygons one by one (in a 1 km x1 km block-wise manner so as to structure the process). Then for each polygon, a visual inspection is done using the original RapidEye image and if necessary other RapidEye images from other dates and/or other imagery. If the polygon coincides indeed with a deforestation event and exceeds the 1 ha MMU, the extent of the polygon is edited (if necessary). In order to establish the changes over time, reference images from the other periods (e.g. P1, P2, P3, Year 1[*]) are used, whereby the current landcover, 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 block, a degradation analysis is done for the newly found areas with the block that represent a change, and older mining or infrastructure

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

deforestation polygons are revisited to check for possible new degradation around these features. For this the same toolbar is being used.

When the GIS operator is finished with a block, it is saved in a standardized way into the system and passed onto Quality Control. During QC the data in the database is checked for inconsistencies, and the mapped polygons are checked visually for correctness. Errors are corrected, and discussed with the relevant GIS operator.

DNV has verified this process with the mapping guide (Annex 9 of the report) /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.

b Validation criteria and Indicators

Criteria noted in the JCN /53/ 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 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 /53/ 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 /53/, GOFC-GOLD REDD Sourcebook /54/, and UNFCCC Good Practice Guidance (GPG) and Guidelines (GL) /55//56//57//58/ 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

RP 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 REDD sourcebook /54/. However, the applied methods are in line with the REDD Sourcebook as they rely on multi-date imagery and focusing on the forest change by updating forest cover maps of previous epochs (pre-classification). Furthermore, the RP applied QA/QC measures through the revisiting of 100% of the 10 km x 10 km grid cells used for aiding the visual interpretation which has been verified as having reduced the human error /1/.

Independent accuracy assessment

The verification team checked the methodology followed for this assessment /18/. According to this document /18/, the accuracy assessment randomly-sampled forested and non-forested locations using 5 km x 15 km grids stratified into regions of high and low risks of deforestation based on inclusion of such risk-based criteria as logging camps, settlements of greater than 1 000 persons, mining dredges or intersection with roads or trails using data made available by the RP. New in Year 3 is the use of GeoVantage airborne multi-spectral data. Main advantage is less dependency on the availability of Very High Resolution (VHR) satellite data, as the GeoVantage system allows for custom planning of flying missions. The GeoVantage imagery is also the reason for a switch from 10x10km to 5x15km grid size for sampling, because these rectangular grids allow for more efficient flying path of the GeoVantage plane. For a small part of the country, which was hard to fly with the GeoVantage system, additional VHR satellite images were used. Within each sampled grid, a systematic sample of points at regular 200 m intervals was created, yielding more than 300 points which also intersected with the acquired GeoVantage images per 5x15 grid block. Each point was enlarged/buffered into 1 ha sample circles - to meet the MMU and was used for direct manual assessment of cloud-free GeoVantage data. In all, a dataset of 55 119 (compared to 18 050 in Year 2) 1 ha sample circles were analyzed in a binary fashion to assess the Year 3 deforestation map and using a confusion matrix to measure accuracies.

The methodology followed meet best practice guidelines in terms of sample design and accounting for national conditions and capabilities /54/.

Conclusion

The verification team concluded that considerable progress is being made with the mapping methodology by the transition to country wide coverage of RapidEye images .The verification team also concludes that the analysis methodology used by the RP meets the applicable criteria, defined by the JCN /53/, GOFC-GOLD REDD Sourcebook /54/, and UNFCCC Good Practice Guidance (GPG) and Guidelines (GL) /55//56//57//58/. The verification team also concludes that the use of the GeoVantage system to create airborne very high resolution images for the accuracy assessment is a clear improvement over the use of available very high resolution satellite images, and allows for a much higher sample size and more accurate interpretation.

4.1.2 Verification of Indicator

Image processing

Radiometric normalization technique used the Dark Object Subtraction (DOS)/1/. Cloud-shadow masking methods used ‘thresholding’ in the blue band and additional manual inspection. These methods are adequate and in line with the REDD Sourcebook /54/. Least cloud cover RapidEye input images were selected and geometric correction of images was considered adequate. An examination of a selection of the input satellite scenes demonstrated that the RP had produced products meeting the 1 pixel accuracy, as suggested by guidance materials, for all periods.

Analysis methods

Deforestation in Year 3: Deforestation in Year 2 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 2, but now with full coverage, and that an independent accuracy report /18/ 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. 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 (Guyanese) and GFC staff.

An Excel sheet was developed for Year 3 to aid in the conversion from the GIS mapping output to the final figures on the indicators. The verification team has inspected this sheet and cross-checked the calculations, which were found to be correct. One inconsistency was found, which led to the issuance of CAR 1, due to not using the "Adopted Reference Measure" to calculate the final figures.

Accuracy assessment

The verification team checked the results of the independent accuracy assessment performed by the University of Durham /18/ and provided by the RP. According to this assessment the overall accuracy of the Year 3 deforestation mapping is equal to 99.76%, which exceeds the minimum accuracy acceptable for the mapping according to the REDD sourcebook /54/ and other applicable criteria /64/. The verification team has verified the results of the accuracy assessment by having the validation process demonstrated and checked for 1 validation tile. Also, the excel sheets used to calculate the final accuracy values were inspected and found to be correct.

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 3 is 0.079%.

4.2 Interim indicator 2.1 - Verification of the Loss of intact forest landscapes

4.2.1 Methodology validation

a Methodology description

The methodology followed by the RP 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 and Year 3 land use layers and excludes them /61/. 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 /61/. 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, areal calculation, and area-based selection are performed using ArcGIS v.10 modeling code /61/. 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 RP 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 problem.

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) /62/, as referred by JCN /53/. 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.* /62/ 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.* /62/ 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. /62/. 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

During the Year 2 verification the IFL value had been recalibrated by GFC to exclude all the land under mining licenses regardless whether the license holder already commenced mining or not. Following the Initial Comments of the Norwegian Government and the findings of Year 2 verification the JCN valid for the Year 3 audit required the GFC to revert back to the original IFL area calculation, which resulted that the Year 2 and Year 3 values are calculated in the same manner as during the year 1 Interim Report /65/. The verification team concludes that the analysis methodology used by the RP meets the definition and concept of Intact Forest Landscape /63/ and is in line with the recommendations of Potapov *et al.* /62/.

4.2.2 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 3 is 7.60 million ha. In Year 3 there was a loss in IFL area of 174 ha, with 101 ha of that being accounted for by newly entitled Amerindian land.

4.3 Interim indicator 2.2 - Verification of Forest Management

4.3.1 Methodology validation

a Methodology description

The RP has in place a forest monitoring system which has enforcement of forest legality amongst its main objectives /9/. The monitoring system has four main components in place:

- 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 /9/. 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/9/;
- Sawmills and Lumberyards monitoring: This component consists of the verification of the legality of sawmills and Lumberyards and their operation /23/
- Exports: This component of the monitoring system seeks to control all exportations and to check the legality of the produce to be exported /24/.

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

The existing CoC system is based on the traceability through the use of tags with a unique identification code on each unit of produce (i.e. log, lumber, etc.) /19/. The CoC system starts by the on-stand tagging of the forest produce (i.e. logs, lumber piles, poles and posts); once a tree is felled, the stump and the bole are tagged with the same sequence of numbers. This tag number provides a reference for the name of the operator and the geographic origin of the forest produce within the forest estate. This is required for any forest operation regardless of whether it is located in State Forest lands, Amerindian lands or private properties /19/.

The link between the tagging system and the produce information (e.g. origin, destination, volume, type of produce) is done through the volume declarations included in the removal permits.

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 has written procedures which are now in place, as DNV 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 verification /65//66/. The operator has to request for the issuance of a removal permit in any of the existing forest stations /19/ (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 /38/. 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 information /19/. As part of the QA/QC measures in place, the produce transported and the correctness of the removal permit are checked by one or various GFC strategically located check-points. This check is recorded in books stating the removal permit license, the type of produce, volumes and date of 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 /19/. 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.).

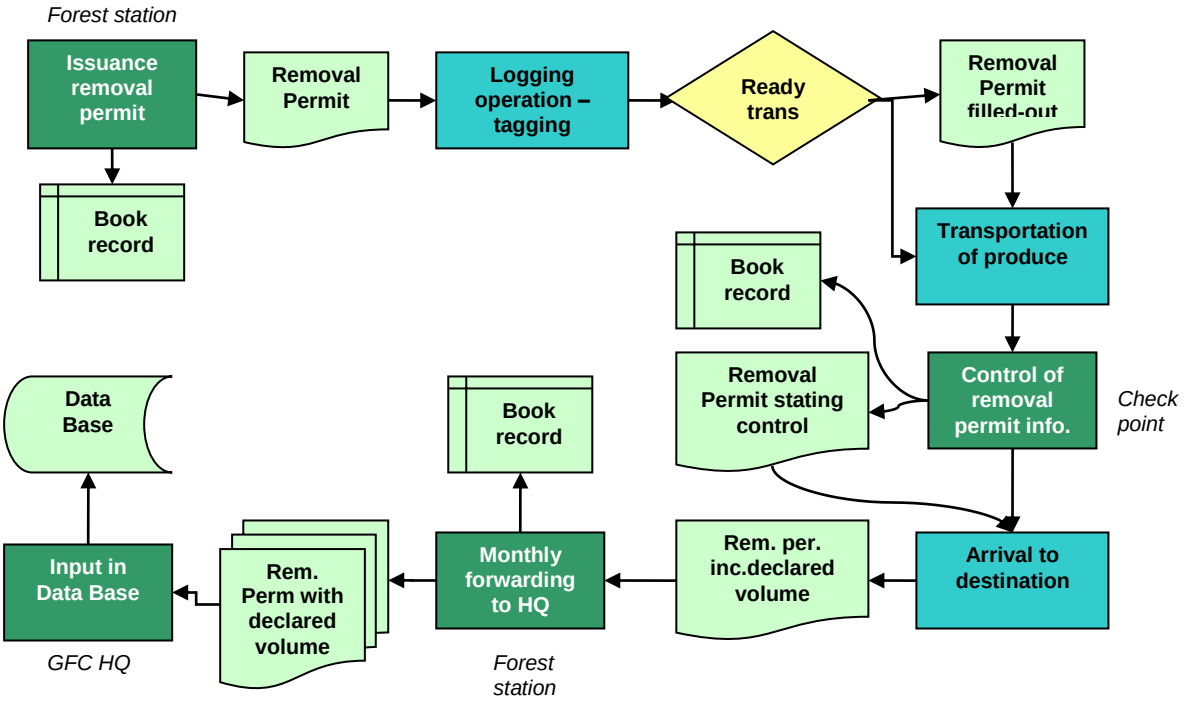

Figure 3. Monitoring process flow chart – State Forest Lands

Private Properties / Amerindian lands:

As in Year 1 & 2, the owner is not required to request a removal permit before the logging commences, however they are required to have a removal permit filled-out once the produce is to be transported outside the regular boundaries of the property (Figure 4). From that point forward, the monitoring system is similar to that of the State Forest lands.

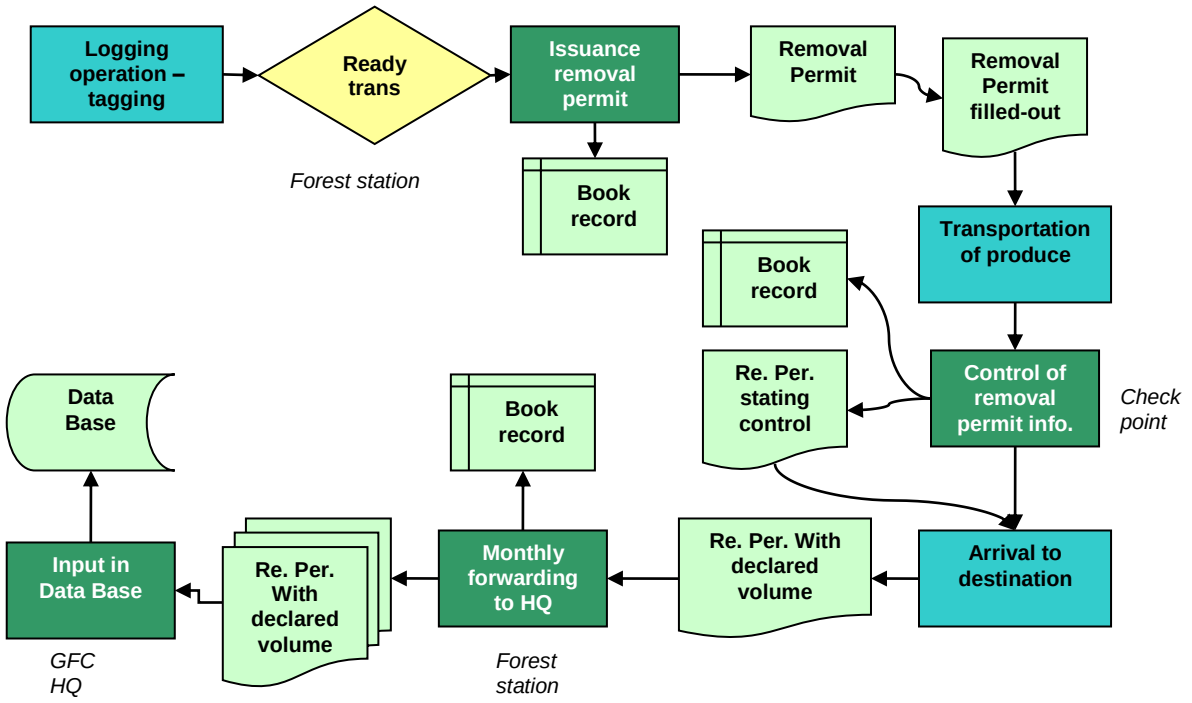

Figure 4 Monitoring process flow chart - <u>Private Properties / Amerindian lands</u>

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

Just as in Year 1 & 2, in case the operator does not have a removal permit or a removal permit has inconsistencies, the amount removed is recorded respectively in the Illegal Logging Databases or in the Procedural Breaches Database /30/. 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.

The reported results of the interim performance indicator for Year 3 are the total volume extracted in tCO_2 (expressed as 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.

In 2011 & 2012, RP 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 (0.98 tC/m^3), wood density of commercially harvested timber (0.38 tC/m^3/gap), logging infrastructure factor (skid trails, etc.) (34.11 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- *REDD Methodology Module: "Estimation of carbon stocks in the long-term wood products pool"* which DNV cross-checked and confirmed. This computation was based on all extracted wood biomass (including exports) captured by GFC's with the data available of wood harvested for during 1 January 2012 and 31 December 2012 (i.e. Year 3).

b Validation criteria and Indicators

According to the Joint Concept Note (JCN) on REDD+ cooperation between Guyana and Norway /53/ 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 is 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.* " /53/.

In line with the findings during the first and second verification /65/ 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 shall 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. This involves verification of each operation of the monitoring process: the data collection, QA/QC procedures for data collection, intermediate data recording, and data recording in the main data base, QA/QC procedures for data recording, reporting and QA/QC procedures for data reporting. For each of these operations, the verification team checked the training of personnel/31//32//35//38/ via interviews, which checked the GFC staff's knowledge of the procedures in place. Furthermore, the verification team performed spot checks of removal permits in order to verify the consistency of the information of each database, with the information in the removal permit (or illegal logging forms) and with the records available at the transit & forest stations (Linden (Transit station), Bamboo Landing (Forest station at

Variety Woods Ltd) and the Forest station at Basecamp of Variety Woods Ltd were audited) /32//42//43//44//50//52//51/.

The RP 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. Since the last audit the RP has finalised and updated its procedures based on the findings of the Year 2 verification /9//10//13//14//17//66/.

The preliminary data that has come out of the work that the GFC and Winrock has done show high level of consistency and predictability on the level of damage and impacts per cubic meter harvested. In addition to the effective implementation of these procedures GFC also was able to demonstrate its overall commitment to environmental protection and stakeholder consultation. During the visit to Variety Woods the audit team was able to verify how in collaboration with the logging company GFC had implemented a protective zoning area around the nesting area of a Harpy Eagle an endangered species native to Guyana.

The verification team concludes that the analysis methodology used by the RP meets provisions of the JCN /53/.

4.3.2 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 Linden (Transit station), Bamboo Landing (Forest/Transit station at Variety Woods Ltd) and the Forest station at Basecamp of Variety Woods Ltd forest stations were cross-checked against database records.
- Calculation: DNV 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 IMR and the VCS Module VMD0005.

The verification team did not detect any discrepancy that the reported assertions on Interim indicator 3 - Forest Management is equal to 2 195 151 tCO_2.

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

4.4.1 Methodology validation

a Methodology description

The Year 3 methodology to calculate the loss of carbon as an indirect effect of new infrastructure 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 or Year 1 & 2) /1/.

b Validation criteria and Indicators

The main validation criteria is the JCN /53/ 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 /53/ 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 (incl. mining sites, roads, pipelines, reservoirs etc.) As well as it 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." Validation of methodology against criteria

RP has fully adopted the degradation mapping method agreed upon in the JCN. Degradation is manually mapped using high-resolution images, starting within a buffer of 100 m from the outside edge of existing infrastructure. The verification team has checked the degradation mapping by the RP in the field by measuring degradation along 2 transects, starting from the mining-forest border, one through an area mapped as degraded, and one outside the area mapped as degraded. The team has found the degradation mapping to be consistent with the situation in the field.

The verification team concludes that the analysis methodology used by the RP meets provisions of the JCN /53/ and that the degradation mapping using RapidEye images is accurate.

Accuracy assessment

Additionally, the verification team checked the final results of the independent accuracy assessment performed by the University of Durham /18/ and provided by the RP. According to this assessment the overall accuracy of the Year 3 degradation mapping would be equal to 99.69% (97.08% in Year 2), which would confirm the acceptable accuracy of the mapping according to the REDD sourcebook /54/ and to other applicable criteria /63//64/. 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 the excel sheets used to calculate the final accuracy values.

4.4.2 Verification of Indicator

The verification team has visually inspected several parts of the RapidEye imagery and visited a mining area with degradation mapped next to the area, and has confirmed correspondence between the situation in the field and the mapping by measuring degradation along 2 transects. As a result the verification team concludes that the Year 3 method of mapping degradation is correct.

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.

The verification team has 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.

As a result, the verification team concludes that the Year 3 method conforms to the JCN requirements, and concludes that the value for indicator 2.3 for Year 3 is equal to 1 963 ha.

4.5 Interim indicator 2.4 – Emissons resulting from subsistence forestry, land use and shifting cultivationlands (i.e. slahs and burn agriculture)

In line with the JCN /53/ this indicator is presently not monitored till the full MRV is in place.

4.6 Interim indicator 2.5 - Emissions resulting from illegal logging activities

4.6.1 Methodology validation

a Methodology description

The monitoring of illegal logging is within the main objectives of the forest monitoring system described in section 4.4.1.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) /53/ 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 verification team concluded that the analysis methodology used by the RP meets the requirements of JCN /53/, and if applied correctly it will lead to assertions with minimum material discrepancies.

4.6.2 Verification of Indicator

In order to verify the reported assertions of Indicator 4 in Year 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 in the Linden (Transit station), Bamboo Landing (Forest/Transit station at Variety Woods Ltd) and the Forest station at Basecamp of Variety Woods Ltd were checked with the database records;

The estimated emissions from illegal logging rate for Year 3 is equal to 11 217 tCO_2.

4.7 Interim indicator 2.6 - Emissions resulting from anthropogenically caused forest fires

4.7.1 Methodology validation

MODIS Fire Hotspot data (FIRMS) are being used by RP to indicate the location of anthropogenic fires. High-resolution RapidEye data is being used to determine the extent of the burnt areas. 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.

4.7.2 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 208 ha/year. While much higher than the figure from year 2 (28 ha/year), this is still considerably lower than the initially estimated total of 1 706 ha/year /1//65/. Although Guyana has, during this monitoring period, seen a higher total number of ha affected by burning most if not all observed fires occurred in non-forested & savanna areas.

The verification team confirmed that the figure of 208 ha/year is consistent with the verification result.

4.8 Interim indicator 3.1 – Encouragement of increasing carbon sink capacity of non-forest and forest land

In line with the JCN /53/ this indicator is presently not monitored till the full MRV is in place.

5 COMMENTS BY STAKEHOLDERS TO REPORT

The Interim Measures Report was published for public comments from 16 October 2013 to 16 November 2013 in Guyana Forestry Commission's web page as well as distributed to a list of 63 individual stakeholders of 37 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 below text box. Response from the RP to these comments and the verification team's assessment are included.

Table 1: list of Stakeholders consulted by the Guyana Forestry Commission

	Name	Agency Role		Name	Agency Role
1	His Excellency President Donald Ramotar	Government of Guyana, Office of the President	33	David Singh	Conservation International (CI)
2	Former President Dr.BharratJagdeo	Government of Guyana	34	Annette Arjoon-Martins	Independent Member of Civil Society
3	Dr Roger Luncheon	Office of the President	35	Joe Singh	Individual Capacity
4	Minister Dr Ashni Singh	Ministry of Finance	36	David James	Individual Capacity
5	Minister Robert Persaud	Ministry of Natural Resources and Environment	37	Charles Hutchinson	World Wildlife Fund (WWF)
6	Minister Dr. Leslie Ramsammy	Ministry of Agriculture	38	Kapil Mohabir	Project management office, PO
7	Minister Pauline Sukhai	Ministry of Amerindian Affairs	39	Derrick John	National Toshaos Council (NTC)
8	ShyamNokta	Office of the President	40	Nikolaus Oudkerk	Project management office, PO
9	Andrew Bishop	Office of the President	41	PreeyaRampersaud	Office of Climate Change
10	Shereeda Yusuf	Office of the President	42	Dane Gobin	Iwokrama
11	James Singh	Guyana Forestry Commission	43	Colin Sparman	Guyana Gold & Diamond Miners Association
12	Pradeepa Bholanath	Guyana Forestry Commission	44	Donald Singh	Guyana Geology & Mines Commission
13	IndarjitRamdass	Environmental Protection Agency	45	Geeta Singh	Environmental Protection Agency
14	George Jarvis	Ministry of Agriculture	46	NaseemNasir	Guyana Lands & Surveys Commission
15	Peter Persaud	The Amerindian Action Movement of Guyana (TAAMOG)	47	Mohindra Chand	Forest Producers Association
16	Romel Simon	The National Amerindian Development Foundation (NADF)	48	Gregory Hodge	University of Guyana
17	Alfred King	Ministry of Culture	49	Herold Martin	GOFC-GOLD
18	HilbertusCort	Forest Producers Association (FPA)	50	Sandra Brown	Winrock International
19	Ronald Webster	Private Sector Commission (PSC)	51	Nancy Harris	Winrock International
20	Carvil Duncan	Federation of Independent Trade Unions of Guyana (FITUG)	52	Silvia Petrova	Winrock International
21	Hymawattie Lagan	Women's Affairs Bureau	53	Felipe Casarim	Winrock International

	Name	Agency Role		Name	Agency Role
20	Raquel Thomas-Caesar	Independent memeber	54	Katherine Goslee	Winrock International
23	Janice Bollers	Guyana Geology and Mines Commission (GGMC)	55	William Salas	Applied Geosolutions
24	Yvonne Pearson	Ministry of Amerindian Affairs	56	Bobby Braswell	Applied Geosolutions
25	PamelaMendonca	The Amerindian Action Movement of Guyana (TAAMOG)	57	Dr James Baker	Clinton Climate Initiative
26	Ashton Simon	The National Amerindian Development Foundation (NADF)	58	Maria Sanz Sanchez	UN REDD
27	Colin Klautky	Guyana Organisation of Indigenous People (GOIP)	59	Dr Jim Penman	IPCC Expert
28	George Norton	Guyana Organisation of Indigenous People (GOIP)	60	Rodrigo Martinez	IDB
29	Bertie Xavier	North Rupununi Development Board (NRDDB)	61	Ken Andrasko	FCPF
30	Edward Shields	Guyana Gold and Diamond Miners Association (GGDMA)	62	Maarten van der Eynden	Government of Norway
31	Gillian Burton	Trade Unions Congress (TUC)	63	Edwin Aalders	DNV
32	Paulette Bynoe	University of Guyana (UG)			

5.1 Received comments and response by the Guyana Forestry Commission

Comment by: Norwegian Ministry of the Environment, Ronald E. McRoberts and The Amerindian Action Movement of Guyana

☐ NGO ☒ Party ☒ Other Stakeholders

Sent on: 04 - 10 November 2013

Subject: Comments on GFC/Indufor report

Comment 1:

Comment by Norwegian Ministry of the Environmen and Ronald E. McRoberts: First of all, we would like to take this opportunity to congratulate you on submitting the third Interim Measures Report under the Guyana-Norway partnership. The work on MRV Guyana is doing is of high relevance not only to this partnership, but to the global REDD+ discussions in general. The authors are commended for a comprehensive and detailed report. Progress in estimating emissions factors and in-country building capacity is particularly encouraging. Comment from The Amerindian Action Movement of Guyana: TAAMOG congratulates the GFC for the Third Performance Report, which is very comprehensive and accurate produced jointly with Indufor as part of MRVS roadmap for REDD+, and Performance Reporting process under the Memorandum of Understanding (MOU) between the Governments of Guyana and Norway. This is a significant achievement.

Response GFC:

As we progressively build the elements of the MRV System, we aim to achieve a high quality of routine, accurate, complete, and consistent performance reporting that covers deforestation and forest degradation aspects that

integrates robust mechanism of monitoring and independent verification. In this context, we indeed hope to contribute to national and international discussions on REDD+ and MRVS.

DNV:

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

Comment by: Norwegian Ministry of the Environment, The Amerindian Action Movement of Guyana

☐ NGO ☒ Party ☒ Other Stakeholders

Sent on: 07 – 10 November 2013
Subject: Comments on GFC/Indufor report

Comment 2:

Norwegian Ministry of the Environment: A notable feature of the report is that the deforestation rate seems to have gone up in the third year compared to previous years. While this is of course a result that should be taken seriously, it is also important to keep in mind that the progress on MRV in Guyana now makes us all able to be more informed about these results. Understanding what happens makes it possible to tailor interventions, and this is an important element to consider.

The Amerindian Action Movement of Guyana (edited): TAAMOG views the report as technically sound and moreso its technical analysis which show that there is an increase of 0.079% in Deforestation as a result of Mining. For the year 2 reporting period Guyana's deforestation rate was 0.054%. But given this increase Guyana's deforestation rate continues to remain very very low far less that .1% which is among the lowest in the world, provides a sound indicator that Guyana continues to effectively practice Sustainable Forestry Management.

Response GFC:

We share this view and continue to develop the MRVS as an objective and technical instrument that serves a broader purpose beyond informing on deforestation rate. At the same time, in all instances, including those when there is an increase in deforestation rate, these results are submitted at the policy level with an objective of informing discussions and programmes in relevant areas.

DNV:

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

Comment by: Norwegian Ministry of the Environment

☐ NGO ☒ Party ☐ Other Stakeholders

Sent on: 07 November 2013
Subject: Comments on GFC/Indufor report

Comment 3:

We note with substantial interest that the time series that is being built up seems to make it possible to learn more about the dynamic of forest converting drivers in the country, and the MRVS could potentially be a highly significant policy development tool in this regard.

Another interesting finding is that all Year 3 deforestation falls inside the footprint of historical change areas. This shows again that the MRVS can also inform policy development and interventions.

Response GFC:

The intention of the MRV System is to inform policy and programmes for overall natural resources management and REDD+ development in Guyana. At the inception stage of the MRVS development, the Roadmap for the MRVS for Guyana proposes the development of the System based on drivers of deforestation and forest

degradation. Over the last three years in the implementation of the MRVS Roadmap, we have undertaken a policy based approach which speaks to drivers of forest change that are systematically monitored over time and reported on at every reporting period. As the time series is further strengthened, we now have a very useful instrument to inform monitoring and management programmes for natural resources planning and utilization, which is intended to inform policy development.

DNV:

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

Comment by: Norwegian Ministry of the Environment

☐ NGO ☒ Party ☐ Other Stakeholders

Sent on: 07 November 2013

Subject: Comments on GFC/Indufor report

Comment 4:

We want to highlight that the phasing out of this indicator is subject to other progress as described in the JCN of 2012, and that the implementation of the monitoring system alone is therefore not a sufficient justification for phasing out the indicator.

Response GFC:

We agree that the JCN is of course seen as the guiding document. It does however, need to be acknowledged that Guyana can be viewed as exceeding good practice guidelines as set out for forest monitoring for MRVs and a more advanced approach has been applied. Given that the country is now covered at 5 m resolution any change in forest state at and below the minimum mapping unit are very evident. This makes for a transparent unbiased assessment of forest change. The accuracy of the mapping is subject to two independent assessments, a formal accuracy assessment and an overall audit. It is suggested that IFL and the context that this proxy has been applied under is now outdated. The IFL concept is really meant to provide a high level assessment of regional change using medium resolution imagery. Guyana has since year 2 moved beyond medium resolution enabling it to provide spatially explicit assessment of forest change that extends beyond the boundary of the IFL.

DNV:

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

Comment by: Norwegian Ministry of the Environment and Ronald E. McRoberts

☐ NGO ☒ Party ☐ Other Stakeholders

Sent on: 04 & 07 November 2013

Subject: Comments on GFC/Indufor report

Comment 5:

Norwegian Ministry of the Environment: This is a very helpful table. One thing that we have also commented in previous years is that it would be very interesting to also see an assessment of uncertainty on the reported change rate (0.079 % for Year 3). We are aware that the accuracy assessment will be available in a few weeks. Will this year's accuracy assessment also include uncertainty assessment on the change rate? If not, could you please explain why it is not possible to present this uncertainty?

Ronald E. McRoberts (comment summarised): The authors state that the accuracy assessment for 2013 is yet to be completed. What are the impacts of this missing assessment on annual estimates of deforestation? Two issues are of concern. First, without an assessment of uncertainty, where is the evidence that differences between year 3 and previous years are statistically significantly different? If they are not statistically significantly different, then the differences should be attributed to factors such as classification and random sampling errors rather

than to actual change on the ground. Second, none of the estimates was adjusted for classification error. A map estimate is subject to classification error which, if it is systematic, induces bias into the estimation process.

The overall classification accuracy for 2012 was stated to be 98.6% (Section 8.2). Although that is an excellent accuracy, it does not necessarily indicate that the map-based estimates of change are not influenced by classification error.

Response GFC:

For historic periods, deforestation rate for periods presented were annualised. Uncertainty assessment is presented for the rate of change using a model-assisted difference estimator for which bias and variance within sampled statra are subject to assessment using probability-based estimators. Please refer to the Appendix for the full report on Accuracy Assessment. Page 23 of the Accuracy Assessment Report notes that: Although the expectation is that probability-based estimators are unbiased, this cannot be assumed. An elegant approach that combines the advantages of simple random sampling with model-based estimators is the model-assisted difference estimator (McRoberts 2010; McRobertset al. 2010a; McRoberts et al. 2010b, Næsset et al. 2011). A model-assisted estimator used map data to make an initial inference but uses the probability-based sample to validate the result (McRoberts and Walters 2012). In this analysis the model-assisted difference estimator has been applied separately to each stratum since forest area can be calculated easily from the GIS. Bias and Variance are estimated from the probability-based sample within each stratum.

DNV:

The verification team assessed the comment and concluded that GFC response had not addressed all the elements raised by the stakeholder consequently CAR 2 has been raised by the audit team.

REVISED RESPONSE GFC Following CAR2:

For historic periods, deforestation rate for periods presented were annualised. Uncertainty assessment is presented for the rate of change using a model-assisted difference estimator for which bias and variance within sampled strata are subject to assessment using probability-based estimators. Please refer to the Appendix for the full report on Accuracy Assessment. Page 23 of the Accuracy Assessment Report notes that: Although the expectation is that probability-based estimators are unbiased, this cannot be assumed. An elegant approach that combines the advantages of simple random sampling with model-based estimators is the model-assisted difference estimator (McRoberts 2010; McRobertset al. 2010a; McRoberts et al. 2010b, Næsset et al. 2011). A model-assisted estimator used map data to make an initial inference but uses the probability-based sample to validate the result (McRoberts and Walters 2012). In this analysis the model-assisted difference estimator has been applied separately to each stratum since forest area can be calculated easily from the GIS. Bias and Variance are estimated from the probability-based sample within each stratum. The Norwegian Ministry of Environment raise an important question about presenting uncertainty on deforestation rates. The rate of change of forest cover is calculated from measured deforestation in year n divided by measured forest area from year n-1. There are uncertainties associated with both the forest cover change (numerator) and the initial forest cover (denominator) in this calculation. The confidence intervals associated with these values are based on separate accuracy assessments, albeit using the same model-assisted difference estimator (McRoberts, 2010) to derive a Confidence Interval (CI). It should certainly be recognised that the rate is based on data with differing levels of certainty; Year 3 forest cover CI is smaller than Year 2 and based on a larger sample.

Comment by: Norwegian Ministry of the Environment

☐ NGO ☒ Party ☐ Other Stakeholders

Sent on: 07 November 2013

Subject: Comments on GFC/Indufor report

Comment 6:

We note that the forest area has been reassessed based on availability of higher resolution satellite imagery. Could you please briefly explain how consistency with the existing maps from previous years was ensured?

Response GFC:

The delineation of forest area was conducted with RapidEye 5 m imagery. At this resolution it is more readily apparent if areas meet the elected forest definition. In particular, areas previously identified as non-forest in 1990 were re-assessed and re-allocated as appropriate. This improvement work has resulted in an updated forest area. The intention is that this revised area be used as the benchmark from year 3 onwards.

DNV:

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

Comment by: Ronald E. McRoberts

☐ NGO ☐ Party ☒ Other Stakeholders

Sent on: 04 November 2013

Subject: Comments on GFC/Indufor report

Comment 7:

The Report states that the stock-change method was used to estimate deforestation. Was this really the case? Based on the extensive use of classified satellite imagery, it seems more likely that the gain-loss method which focuses on estimating activity areas (change classes) was used. Section 7.1 indicates that classification of change from forest to non-forest was based on comparisons of maps. This sounds a lot like the stock change rather than the gain-loss method?

Response GFC:

This aspect of the discussion focuses on the forest carbon monitoring system and not the forest area assessment aspect. The FCMS is another aspect of the MRVS development.

DNV:

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

Comment by: The Norwegian Ministry of the Environment

☐ NGO ☒ Party ☐ Other Stakeholders

Sent on: 07 November 2013

Subject: Comments on GFC/Indufor report

Comment 8:

We are encouraged also to see the progress Guyana seems to be making on adapting the monitoring format to IPCC standards and on developing operational methods to measure emissions from shifting cultivation as well as carbon sinks in the form of enhancements.

Response GFC:

Work has started in these areas in 2012, in the development of methodologies, and is planned to further advance in the next reporting period.

DNV:

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

Comment by: Norwegian Ministry of the Environment

☐ NGO ☒ Party ☐ Other Stakeholders

Sent on: 07 November 2013

Subject: Comments on GFC/Indufor report

Comment 9:

It is very interesting to see that Guyana has created a Protected Areas Commission. Is there already an assigned focal point for REDD+ relevant work in this Commission?

Response GFC:

The Protected Areas Commission comes under the Ministry of Natural Resources and the Environment. Within the Ministry, there is a focal person for Climate Change and REDD+.

DNV:

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

Comment by: Norwegian Ministry of the Environment

☐ NGO ☒ Party ☐ Other Stakeholders

Sent on: 07 November 2013

Subject: Comments on GFC/Indufor report

Comment 10:

It is stated that changes from non-forest land to forest land is being reported. We cannot seem to find information on this in the report. Is this because this reporting is not part of the interim measures reporting (that only accounts for gross deforestation – i.e. without regrowth)?

Response GFC:

Currently the monitoring methods developed are being evaluated. These areas are historical deforestation sites that could potentially regenerate. These areas are tracked, but further work is required to assess the potential carbon stocks across these sites. These are currently not part of the interim measures for reporting in this period as gross deforestation is the main indicator reported on for deforestation.

DNV:

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

Comment by: Norwegian Ministry of the Environment

☐ NGO ☒ Party ☐ Other Stakeholders

Sent on: 07 November 2013

Subject: Comments on GFC/Indufor report

Comment 11:

The section on forest degradation monitoring is very interesting. As these methods were developed for the Year 2 reporting, we are aware that these methods are described in more detail in the Year 2 IMR. On the other hand, these experiences could be of high value to other countries trying to achieve degradation monitoring. Are you and your partners planning on submitting the experiences related to degradation monitoring to scientific journals?

Response GFC:

Yes, this is being considered. The methods adopted are well developed and functional for Guyana.

DNV:

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

Comment by: Norwegian Ministry of the Environment

☐ NGO ☒ Party ☐ Other Stakeholders

Sent on: 07 November 2013
Subject: Comments on GFC/Indufor report

Comment 12:

It is very interesting to see that in mining sites revisited (1990 – 2012), no forest cover have regenerated. This indicated that the environmental impacts of mining methods used in the past are indeed significant. We agree that a long term measurement plan is a good idea.

Response GFC:

Land reclamation is found to be a prerequisite for regeneration and reforestation activities to occur. A Technical Work Group led by the Ministry of Natural Resources through the GGMC has been formed to coordinate these efforts. These are part of a longer term programme of work.

DNV:

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

Comment by: Norwegian Ministry of the Environment
☐ NGO ☒ Party ☐ Other Stakeholders

Sent on: 07 November 2013
Subject: Comments on GFC/Indufor report

Comment 13:

Another interesting finding is that all Year 3 deforestation falls inside the footprint of historical change areas. This shows again that the MRVS can also inform policy development and interventions.

Response GFC:

Yes, it allows for targeted intervention and potentially further improvements in compliance monitoring.

DNV:

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

Comment by: Norwegian Ministry of the Environment
☐ NGO ☒ Party ☐ Other Stakeholders

Sent on: 07 November 2013
Subject: Comments on GFC/Indufor report

Comment 14:

It is proposed that IFL change within Amerindian areas is not accounted for in the calculation of the financial remuneration. In our view, the IFL indicator is meant to assess performance in keeping IFL areas intact at an overall, national level, and that all change to IFL should therefore be calculated. As commented previously, any amendments to the IFL indicator relates to progress also on other deliverables in the JCN of 2012, and until this more overarching discussion takes place, we suggest keeping the indicator in its current form.

Response GFC:

The continued retention of a less scientific measure such as the IFL is not really in keeping with the overall intention of the JCN, Once on detection as part of the MRV and then again due to enforcement of this rudimentary proxy deforestation measure. Further, IFL intentionally makes provisions for "exclusions" and settlements such as titled Amerindian areas, qualify for such exclusions. The fact that these cannot all be

determined upfront as the process of land titling in Guyana is a continuous one, should not, in our view, be reason to prevent these from being excluded when titles are granted for Amerindian Villages. This, in our view, may be seen as an unintended disadvantage of the continuous land titling programme for Amerindian Villages.

DNV:

The verification team assessed the comment and the response to be satisfactory. During this years audit the verification team paid special attention to the IFL indicator in relation to newly entitled Amerindian land, and found it to be in agreement with the JCN.

Comment by: Norwegian Ministry of the Environment
☐ NGO ☒ Party ☐ Other Stakeholders

Sent on: 07 November 2013
Subject: Comments on GFC/Indufor report

Comment 15:

It is good to see that measurements of existing mining sites have been integrated within mapping protocols. Revisiting degradation sites is important, as degradation is a process that could happen over several years. This realization was also the reason why the original indicator was formulated as "50 % carbon loss per year". Of course, the new mapping method eliminates the need for applying such a default factor, but the sites should still be revisited to capture any degradation that happens after the first year.

Response GFC:

Yes, the aim is to also continue to refine and improve the methodology.

DNV:

The verification team assessed the comment and the response to be satisfactory. The verification team paid special attention to the mapping of degradation around older mining sites.

Comment by: Norwegian Ministry of the Environment
☐ NGO ☒ Party ☐ Other Stakeholders

Sent on: 07 November 2013
Subject: Comments on GFC/Indufor report

Comment 16:

A question out of mere curiosity; Do you have knowledge about the reason for the historical fire rates in Guyana being so massively higher than in the recent few years? Was the El Niño event described in the footnote that severe, or could there be other reasons?

Response GFC:

In 2000 there was a major fire event located around Linden. This occurred during an extended period of dry weather which was associated with the El Niño.

DNV:

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

6 REFERENCES

Documents provided by the Project Participants. These 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) Interim Measures Report, Version 1 dated16 October 2013,Version 2 dated 17 November 2013 and Version 3 dated 6 December 2013

/2/ Guyana Forestry Commission: *Geodatabase with all raw and processed datasets*, November 2013

/3/ Guyana Forestry Commission: *Data Base of Illegal logging activities for the four forestry divisions of Bce, Dem, Ess and Nwd – 1 January 2012 to 31December 2012 – Year 3*

/4/ Guyana Forestry Commission: *Data Base of Procedural Breaches for the four forestry divisions of Bce, Dem, Ess and Nwd – 1 January 2012 to 31December 2012 – Year 3*

/5/ Guyana Forestry Commission: *Data Base of wood harvesting declarations of wood extraction activities in lands classified as State Forest– 1 January 2012 to 31December 2012 – Year 3*

/6/ Guyana Forestry Commission: *Data Base of wood harvesting declarations of wood extraction activities in lands classified as Amerindian or Private Property– 1 January 2012 to 31December 2012 – Year 3*

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

/8/ Salas, W. Hagen, S, et al. Winrock International and Applied GeoSolution: *A Pilot Study to Assess Forest Degradation Surrounding New Infrastructure. Guyana Forestry Commission. February, 2012.*

/9/ *Guyana Forestry Commission: Sampling Design and Implementation Plan for Guyana's REDD+ Forest Carbon Monitoring System (FCMS) – July 2012*

/10/ *Guyana Forestry Commission: Spatial Analyses for Forest Carbon Stratification and Sampling Design for Guyana's FCMS: Phase II – June 2013*

/11/ *Logging_Plots_ALL TREES_May 14 2012.xls*

/12/ *Carbon Stock Calcualtions_MA-GFC_2013-v6_6.xls*

/13/ *Guyana Forestry Commission: Guyana FCMS Conversion Factor Handbook – Revised October 2013*

/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

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

/17/ Guyana Forestry Commission: *Standard Operating Procedures for the Forest Carbon Monitoring System of Guyana* – September 2012

/18/ Durham University*: Appenidix 2 to IMR –Accuracy Assessment* Report, November 2013

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

/19/ Guyana Forestry Commission: Manual of Procedures of Key Area of Forest Monitoring

/20/ ISO 14064-3: *Greenhouse gases — Part 3: Specification with guidance for the validation and verification of greenhouse gas assertions*, First edition, 1 March 2006

/21/ Guyana Forestry Commission: *Detention and Seizure Procedure*

/22/ Guyana Forestry Commission: *Forest Monitoring Operating Procedure*

/23/ Guyana Forestry Commission: *Procedure for Export of Forest Produce*

/24/ Guyana Forestry Commission: *Procedure for Issuance of Sawmill Licence*

/25/ Guyana Forestry Commission: *Procedure for issuing SFEP, http://www.forestry.gov.gy/publications.html*

/26/ Guyana Forestry Commission: *Procedure for issuing SFP, http://www.forestry.gov.gy/publications.html*

/27/ Guyana Forestry Commission: *Procedure for issuing TSA or WCL* , http://www.forestry.gov.gy/publications.html

/28/ Guyana Forestry Commission: *Procedure for Timber Dealers Licence*

/29/ 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

/30/ 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.

/31/ Tasreef Khan, Deputy Commissioner of Forests – GFC

/32/ Pradeepa Bholanath, Head, PDD-GFC

/33/ Monitoring Inspectors& Supervisor Bamboo Landing, Linden and Port Kaituma Forest station - GFC

/34/ NashetaDewnath, Programme Officer – REDD Section

/35/ Pete Watt, Consultant – Indufor

/36/ Jeff Pickering , Consultant – Indufor

/37/ Rosa Rivas Palma, Consultant – Indurfor

/38/ HaimwantPersuaud, Resource Information Officer – GFC

/39/ Jagdesh Singh – Deputy Commissioner, Forest Resources Management Division - GFC

/40/ Kerry Anne Cort – GIS/Remote Sensing Officer, Forest Resources Information Unit – GFC

/41/ Chandroutie Sookdeo – GIS/Remote Sensing Officer, Forest Resources Information Unit – GFC

/42/ Carey Bhojedat – Project Officer, REDD Secretariat – GFC

/43/ Nasheta Dewnath, Programme Officer, REDD Secretariat

/44/ Hansrajie Sookdeo, Project Officer – Data Management, REDD Secretariat

/45/ Danny Donoghue, Durham University

/46/ Abu Rushed Jamil Mahmood, Durham University

/47/ Niko Galiatsatos, Royal School of Military Survey
/48/ Sandra Brown, Winrock International
/49/ Felipe Casarim, Winrock International
/50/ GFC Station staff Bamboo Landing
/51/ GFC Station staff Variety Woods Base Camp
/52/ GFC Station staff Linden

Criteria of validation and verification

/53/ Government of Norway and Government of Guyana: *Joint Concept Note on REDD+ cooperation between Guyana and Norway*, 9 November 2009, March 2011 & December 2012

/54/ GOFC-GOLD, 2012, 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 COP18-1, (GOFC-GOLD Land Cover Project Office, Wageningen University, The Netherlands).

/55/ 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

/56/ IPCC (1997). *Revised 1996 IPCC Guidelines for National Greenhouse Inventories*. Houghton J.T., MeiraFilho L.G., Lim B., Tréanton K., Mamaty I., Bonduki Y., Griggs D.J. Callander B.A. (Eds). Intergovernmental Panel on Climate Change (IPCC), IPCC/OECD/IEA, Paris, France.

/57/ 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.

/58/ IPCC (2003). *Good Practice Guidance for Land Use, Land-Use Change and Forestry*. Penman J., Gytarsky M., Hiraishi T., Krug, T., Kruger D., Pipatti R., Buendia L., Miwa K., Ngara T., Tanabe K., Wagner F. (Eds).Intergovernmental Panel on Climate Change (IPCC), IPCC/IGES, Hayama, Japan.

/59/ Consultancy Assignment Agreement between Det Norske Veritas and Norwegian Ministry of Environment including Appendices to the agreement, 10 January 2011& Extension Agreement, 07 February 2012, 16 May 2013

/60/ Guyana Forestry Commission: *Code of Practice for Timber Harvesting 2nd Edition*, Final Version, November 2002

/61/ Poyry: *ArcToolbox model for the establishment of an IFL*

/62/ Potapov, P., A. Yaroshenko, S. Turubanova, M. Dubinin, L. Laestadius, C. Thies, D. Aksenov, A. Egorov, Y. Yesipova, I. Glushkov, M. Karpachevskiy, A. Kostikova, A. Manisha, E. Tsybikova, and I. Zhuravleva. 2008. *Mapping the world's intact forest landscapes by remote sensing*. Ecology and Society 13(2): 51.
[online] URL: http://www.ecologyandsociety.org/vol13/iss2/art51/

/63/ Intact Forest Landscapes: *Concept and definition of IntactForest Landscape*,

http://www.intactforests.org/concept.html

/64/ Voluntary Carbon Standard Association: *REDD Methodology Modules (REDD-MF)*, Approved VCS Methodology VM0007 Version 1.2

/65/ Det Norske Veritas: *Verification of Interim REDD+ Performance Indicators under the Guyana-Norway REDD+ Partnership, Monitoring Period: 01 October 2009 to 30 September 2010 – Year 1*, 18 February 2011

/66/ Det Norske Veritas: *Verification of Interim REDD+ Performance Indicators under the Guyana-Norway REDD+ Partnership, Monitoring Period: 01 October 2010 to 31 December 2011 – Year 2*, 16 September 2012

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APPENDIX A

CORRECTIVE ACTION REQUESTS, CLARIFICATION REQUESTS AND OBSERVATIONS

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

CAR ID	Major/ Minor	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
CAR 3	MINOR	**Requirement**: Interim indicator 2b – Carbon los as indirect effect of new infrastructure **Non-Compliance**: Accuracy assessment contains too few sample plots to provide sufficient accuracy on the degradation levels **Objective evidence:** During the current accuracy assessment it was concluded that current sample plan resulted in too few plots that contained degradation and not a high enough confidence interval can be achieved	The following recommendations have been added to the Independent Accuracy Assessment - Appendix 10 pg 36, recommendation 10. Allow sufficient time for the independent validation. The sample size used in 2012 appears insufficient for a full quantitative analysis of degradation drivers, particularly when sampling low-risk strata. We estimate that a sample of 80—100 Primary Sampling units will provide a sufficiently large sample to yield an area estimate, particularly if the additional PSUs are allocated to the high-risk stratum where Year 2 degradation is most like to be found.	The changes applied to the Independent Accuracy Assessment have been found adequate, however, in order to close out the CAR DNV will verify the implementation and effectiveness during the year 3 assessment **CAR: Open till next verification**. **Audit 2013:** Accuracy Assessment was able to have a significant higher sample size during this year's audit and demonstrated an overall accuracy of 99.76% which is an acceptable accuracy according to GOFC-GOLD REDD Sourcebook which indicates a significant lower acceptable overall accuracy. **CAR is closed**
CAR 5	MINOR	**Requirement**: Stakeholder consultation **Non-Compliance**: Stakeholder consultation not completed **Objective evidence:** Following the stakeholder consultation GFC provided full feedback on all the stakeholder comments received and integrated them in version 2 of the interim report, however did not follow up with the individual stakeholders on GFC	All Stakeholders have received feedback on comments sent. On 14th July, 2012, Version 2 of the Report was finalised and integrated stakeholder comments received during the public release period which ended on 6th July, 2012. The Report integrated identification, in relevant sections, of stakeholder comments	DNV has been able to verify that all responding stakeholders have been contacted and been informed about the GFC response to their comments. **CAR is closed**

CAR ID	Major/ Minor	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
		response to their individual comments with the exception of the Norway Government	made and a response on each comment. Additionally, on Monday 16th July, 2012, all stakeholders received feedback directly on their comments. Emails to this effect, were forwarded to DNV on 20th July, 2012.	
CAR 7	MINOR	**Requirement**: Interim Measure 2b – Carbon loss and indirect effect of new infrastructure **Non-Compliance**: Degradation only includes new degradations from newly established mines but not the re-opening of existing mines **Objective evidence:** While the GFC is currently assuming active degradation will only occur around recently active mining areas. During the field assessment it has become apparent that mining companies do come back to older sites to investigate the potential for extension by digging prospection pits (of about 1.5 by 2 meters). From the current text it is unclear whether this would be falling under the definition of new or not.	The intention is to revisit areas mapped as degradation in the Year 2 assessment, to see if the extent has changed. If detected, then the extent is updated and the change is accounted for in the current mapping period. This is only possible due to the planned acquisition of high resolution RapidEye identified for Year 3 which will essentially form the second layer in the data series at 5m resolution. The SOPs as they relate to mapping have been updated to reflect this, as has the main report. Additional information has been added to the following pages, tables and figures. Appendix 9: SoP for Forest Change Assessment: • Page 5, 24 • Table 2 • Figure 7	DNV agrees with the update made by GFC however the CAR will not be closed till the next verification once clarity has been obtained from the Norwegian government as well as the Year 3 data has been assessed and the current proposed process has showed to address the observations of the audit team. **CAR to be closed out during next verification** **Audit 2013:** During the audit special attention was given to the data interpretation and in particularly in relation to changes over time. The team found that GFC were able to identify any need for updating based on the consistent usage of high resolution RapidEye images throughout Guyana as well as events where such updates were made. **CAR is closed**

CAR ID	Major/ Minor	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
			• p. 21 section added titled Mapping Expanding Degradation • p.22 & p.23 - Table degradation around new infrastructure Updates also reflected in the main Report: • Figure 33 p.67 • Table 7-1 p. 68 P.72 section added titled Mapping Expanding Degradation We would like to add that the method that was applied for this indicator was consistent from year 1 to year 2. The GFC would follow up with the Government of Norway for the needed clarification in this area, to inform year 3 assessment.	

Observations

CAR ID	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
Obs1	**Requirement**: Interim indicator 3 Forest management **Potential Non-Compliance**: Errors in Mapping of activities due to the existing and passed way of position recording **Objective evidence**: During the field visit to Mabura audit team was not able to locate stumps using GFC GPS due to the fact that past GPSpositions were not properly converted to current used	In the starting phase (2010/2011) of the work on the forest carbon monitoring system, preliminary data were required to be collected to inform the full design of the system and importantly, to inform the Standard Operating Procedure to be used. The current national GIS procedure for Guyana requires for all data to be recorded in Provisional South American Datum of 1956 (PSAD 56). This procedure is currently being updated to the WGS 84 datum and it is expected	DNV assessment team has taken note of the explanation and will continue to observe if during future audits similar issues case problems in the execution of the audit work.

CAR ID	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
	GPScoordinates.	that this process will be updated in the near future. It should be noted that the difference in conversion between the PSAD 56 and the WGS 84, is 400m. The first field data collection for the system was conducted in Maburaand the data were collected in PSAD 56 but represented on the map as WGS 84. The Mabura plots have since been converted to the consistent data projection system.	
Obs2	**Requirement**: Interim indicator 1, 2 and 3 **Potential Non-Compliance**: Errors in data processing & delay timelines **Objective evidence:** • In order to achieve the highest level of cloud free images GFC currently waits till end ofthe year to start image interpretation which leaves little time for the overall process of interpretation, accuracy assessment and interim reporting. • GFC does not apply the same level of risk assessment in their project planning as they apply in their sampling technique in which low risk and high risk areas are treated differently in the sampling levels and project management	Good process requires for annual report to, as much as possible, use data from the end of the period of assessment. The GFC ensures that this is done as far as possible. The GFC indeed conducts risk assessment in project planning. GFC however acknowledge this comment and would like the opportunity to release a revised timetable for the Year 3 assessment for consideration by Norway. This work plan would take into consideration the elements and timelines required to meet the Interim Measures (IM). • image acquisition period • image pre-processing • Studies required to report additional IM • Change mapping • QA/QC of mapping • Independent Accuracy assessment • Reporting & stakeholder consultation • External Audit of the interim measures. This is in part due to the requirement to report change as close to the end of the reporting period (December).	DNV assessment team has taken note of the explanation and will continue to observe if during future audits similar issues may potentially case problems that may affect the ability of GFC in delivering auditable results.

CAR ID	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
		Once all images are acquired, work starts on the highest threat areas. This is therefore a key consideration in the project planning. As such, the second point raised, is not the case. The GFC does prioritise area based on risk. Permission to use imagery earlier than December for Year 2, has now been granted by Norway (4 June 2012) A sample grid 24 x 24 km is overlaid and as completed these grids are colour coded. This process allows for forward planning as the team are then able to calculate the resources required to complete the task. Further, the GFC notes that there continues to be delays in the receipt of finances by the GFC to commence the preliminary work on time. For example, for year 3 (January to December 2012) assessment year, no financing has been received by the GFC (as at end of July, 2012) to commence this work. This significantly inhibits the smooth work flow and effective planning	

Corrective action requests this year's audit

CAR ID	Major/ Minor/ Obs	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
CAR 1	**MAJOR**	**Requirement**: Interim Measures 2.6 (5[*]) Emissions resulting from forest fires **Non-Compliance**: Performance Year 3 versus reference level not correctly reported **Objective evidence**: • Table S1: Interim Measures of the Interim Report MRVS Interim Measures Report – Year 3 Version 2.pdf whilst presenting the correct Year 3 total, does not present the correct total for difference to reference measure.	The difference of Year 3 reported total for the indicator on Forest Fires of 208 ha was compared to the reduced balance of the Reference Level subtracting Year 2 total. A change was made to deduct the Year 3 total from the original total in the Reference Level and not the reduced total following the Year 2 deduction. This results with a Difference of Year 3 to Reference Measure being 1,498 ha and not 1,470 ha. The reported total for Year 3 of 208 ha remains the same. Corrective Action adopted in Version 3 of Report.	DNV has been able to verify the corrections and confirm the corrections to be correct. **CAR is closed**

[*]Number used in table S1 of the MRVS Interim Measures Report - Year 3 Version 2.pfd

CAR ID	Major/ Minor/ Obs	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
CAR 2	**MAJOR**	**Requirement**: Interim Measures 1.1 (1^1) Gross Deforestation, Interim Measures 2.1 (2^1) Loss of intact forest and Interim Measures 2.3 ($2b^1$) **Non-Compliance**: Stakeholder comments not fully responded in one instance. **Objective evidence:** A comment from Norwegian Ministry of the Environment on table S1 is only partly answered by the response by GFC. This is as regards to uncertainty assessment on the rate of deforestation whereby no explanation on why it is not possible to present on the uncertainty of change rate was provided.	The Norwegian Ministry of Environment raise an important question about presenting uncertainty on deforestation rates. The rate of change of forest cover is calculated from measured deforestation in *year n* divided by measured forest area from *year n-1*. There are uncertainties associated with both the forest cover change (numerator) and the initial forest cover (denominator) in this calculation. The confidence intervals associated with these values are based on separate accuracy assessments, albeit using the same model-assisted difference estimator (McRoberts, 2010) to derive a Confidence Interval (CI). It should certainly be recognised that the rate is based on data with differeing levels of certainty; Year 3 forest stock CI is smaller than Year 2 and based on a larger sample. Full response on the presenting of an uncertainty on the rate of change but rather on forest cover and deforestation, is provided. Corrective action adopted in Version 3 of the Report.	DNV has been able to verify revised Response in version 3 of the interim report and found it fully respond to the issues raised by the stakeholder. **CAR is closed**

CAR ID	Major/ Minor/ Obs	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
CAR 3	**MINOR**	**Requirement**: Interim Measures 1.1 (1^1) Gross Deforestation, Interim Measures 2.1 (2^1) Loss of intact forest and Interim Measures 2.3 ($2b^1$) **Non-Compliance**: Clarity on transition plan relating to internal capacity building and maintenance **Objective evidence:** Current management and oversight of the GIS unit is due to transition to a local actors, and it is not clear how GFC is able to ensure continued internal capacity building and maintenance which ensures the high level of delivery of GIS services	Within the year 3 (2012) assessment period, the most significant involvement of local resources was seen over the past 3 years. In this period, a separate and dedicated unit was established to perform MRV assessments and saw the contracting of 4 new staff for this purpose. This has brought the local staffing complement of the GFC, dedicated to this effort to 6 persons. For the 2012 assessment, whilst oversight was provided by a full time specialist of Indufor who was stationed in Guyana for 1 year, this effort was directed at building local capacities for not only GIS and RS mapping and analyses, but also project management and oversight. Evidence of this leadership role by GFC staff is evidenced by the degree of involvement in both mapping and management aspects of the Year 3 assessment process. It should be recognised that ongoing technical assistance is a feature of all international MRV systems – especially during the initial development phase. The GFC is mindful of this and will continue to use technical assistance as required to ensure future reporting adheres to GPG and meets the stipulated requirements.	DNV 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's assessment of response by Project Participants
			The plan in moving forward towards the Year 4 assessment is to maintain **efficient planning** for all activities related to forest cover monitoring and mapping, as well as **capitalising on the experiences** built within the new unit to fully and effectively manage and execute the analysis to be done.	

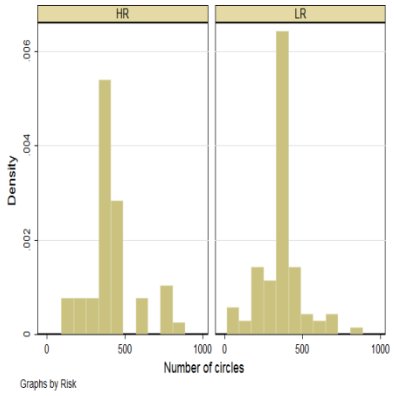
CAR ID	Major/ Minor/ Obs	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
CAR 4	**MINOR**	**Requirement**: Interim Measure 2.2 (3[1]) **Non-Compliance**: Expanding Staff Capacity in forest carbon monitoring beyond current levels. **Objective evidence:** Although the GIS staff has 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 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's assessment of response by Project Participants
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 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.	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 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.	DNV 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's assessment of response by Project Participants
			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 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.	

CAR ID	Major/ Minor/ Obs	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
Obs 1	**OBS**	**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 will follow up during upcoming audit

CAR ID	Major/ Minor/ Obs	Corrective action request	Response by Project Participants	DNV'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 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.	

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

CAR ID	Major/ Minor/ Obs	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
		In view of this, the reported results in the Accuracy Assessment on areas and confidence intervals may be 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 near impossible to create a national data set that would allow automatic classification; hence the trained expert interpretation team and QC procedures.	

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

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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 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 the Pacific Carbon Trust Advisory Panel.

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.

Ole Andreas Flagstad

Ole Andreas Flagstad holds a Master Degree in thermodynamics/energy efficiency and has an overall working experience of more than 20 years. He has worked both in public and private sector, including 5 years with a research institute (IFE) where specific responsibilities included running an energy efficiency network in the food industry and direct intervention with the industry.

Other work experience includes working in European research programmes, administring national research programmes and International Energy Agency annexes.

Ole worked for 5 years in DNV's research programme on energy covering topics in energy efficiency and sustainability issues in internal projects as well as national and international collaborations.

Ole has more than 6 years experience in validation and verification of projects within CDM, JI and other carbon credit schemes. His qualifications and experience in carbon credit schemes (primarily CDM and JI), qualifies him for different roles in a broad group of technical areas.

Andres B. Espejo

Andres Espejo is the founder and president of AFOLU Global Services. He has 10 years of experience in forest management and operations plus climate change. Andrés Espejo is a Natural Resource and Forestry Engineer, with strong technical expertise in quantification and modelling of biomass and carbon in the Agriculture, Forestry, and Other Land Use (AFOLU) sector, and also with extensive experience in monitoring, reporting and verification (MRV) of AFOLU carbon offset projects, programmes and initiatives under the main standards. In the climate change field, he has worked in a CDM DOE (Det Norske Veritas) and has been involved in more than 30 validations/verifications/assessments of Agriculture, Forestry and Other Land Use (AFOLU) initiatives, including the assessment of various REDD methodologies and projects and the assessment of two REDD national and sub-national MRV/RELs, including emission sources related to biomass burning in all cases. Mr. Espejo has a profound knowledge of AFOLU methodologies and requirements, REDD relevant COP decisions, 2006 IPCC GL, GOFC-GOLD REDD Sourcebook, etc. Additionally he has expertise in forest inventory, cruising, forest management and operations, forest certification, and financial analysis of various types of projects.