HCS assessment PT. WINA – Wilmar Balikpapan
Phase 2: Patch analysis and proposed conservation areas

Background

During 25th to 29th of March 2014, TFT conducted HCS assessment training for Wilmar employees in accordance with Willmar's No Deforestation, No Peat and No Exploitation Policy. During this training a HCS assessment was commenced for the PT WINA industrial site at Balikpapan and a report summarising the findings was prepared in April 2014. Phase 2 of the HCS assessment involved applying the HCS Decision Tree and conducting a Rapid Biodiversity Assessment at the PT WINA site during 18th to 24th of August.

Objectives

The objectives of the report are:

- To prioritise the HCS areas identified in phase 1 of the HCS assessment using the HCS Forest Patch Analysis Decision Tree and to identify candidate areas for conservation which have a high likelihood of maintaining (or reverting to) their ecological function and for which long term protection is likely to be viable.
- To produce a HCS conservation planning map identifying non-forest areas suitable for development and HCS areas which are candidates for conservation; subject to FPIC of the communities and the necessary steps to ensure the long-term viability of the area.

HCS methodology

The HCS methodology involves two phases. Phase 1 works through a process to stratify the vegetation within the development area to determine potential HCS areas. Phase 2 takes the results of Phase 1 and defines those patches of potential HCS to conserve. Both phases are illustrated below.

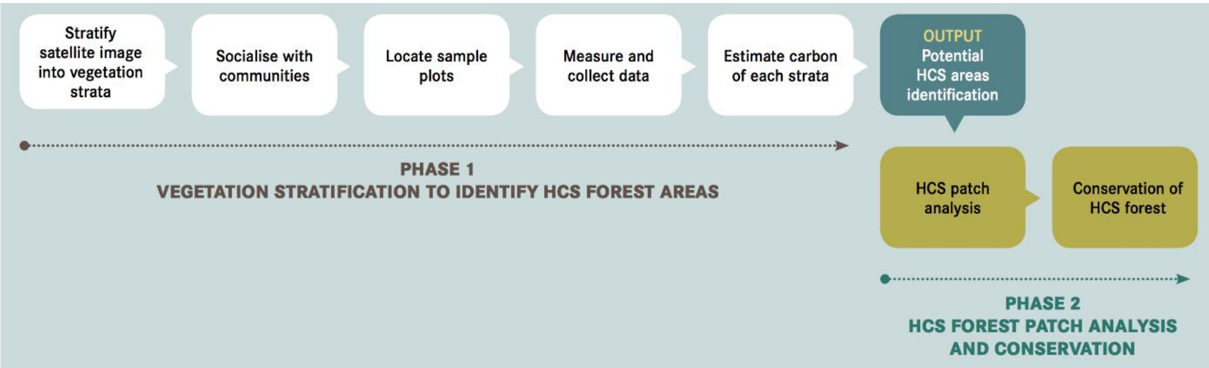


Figure 1: Steps in Phase 1 of the HCS Assessment Process

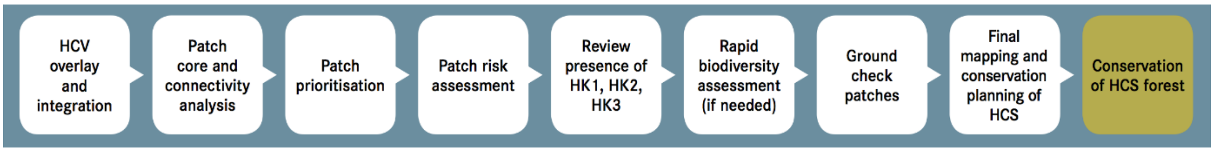


Figure 2: Steps in Phase 2 of the HCS Assessment Process

The HCS Decision Tree Assessment is a process that utilizes the results of the HCS stratification and sample plot measurements completed in Phase 1 of the HCS analysis, along with other key information such as legal requirements (e.g. riparian areas and steep slopes) and High Conservation Value (HCV) areas, to make decisions on appropriate management actions for patches of HCS. The patch analysis and conservation process is shown below with additional explanatory notes in Appendix A.

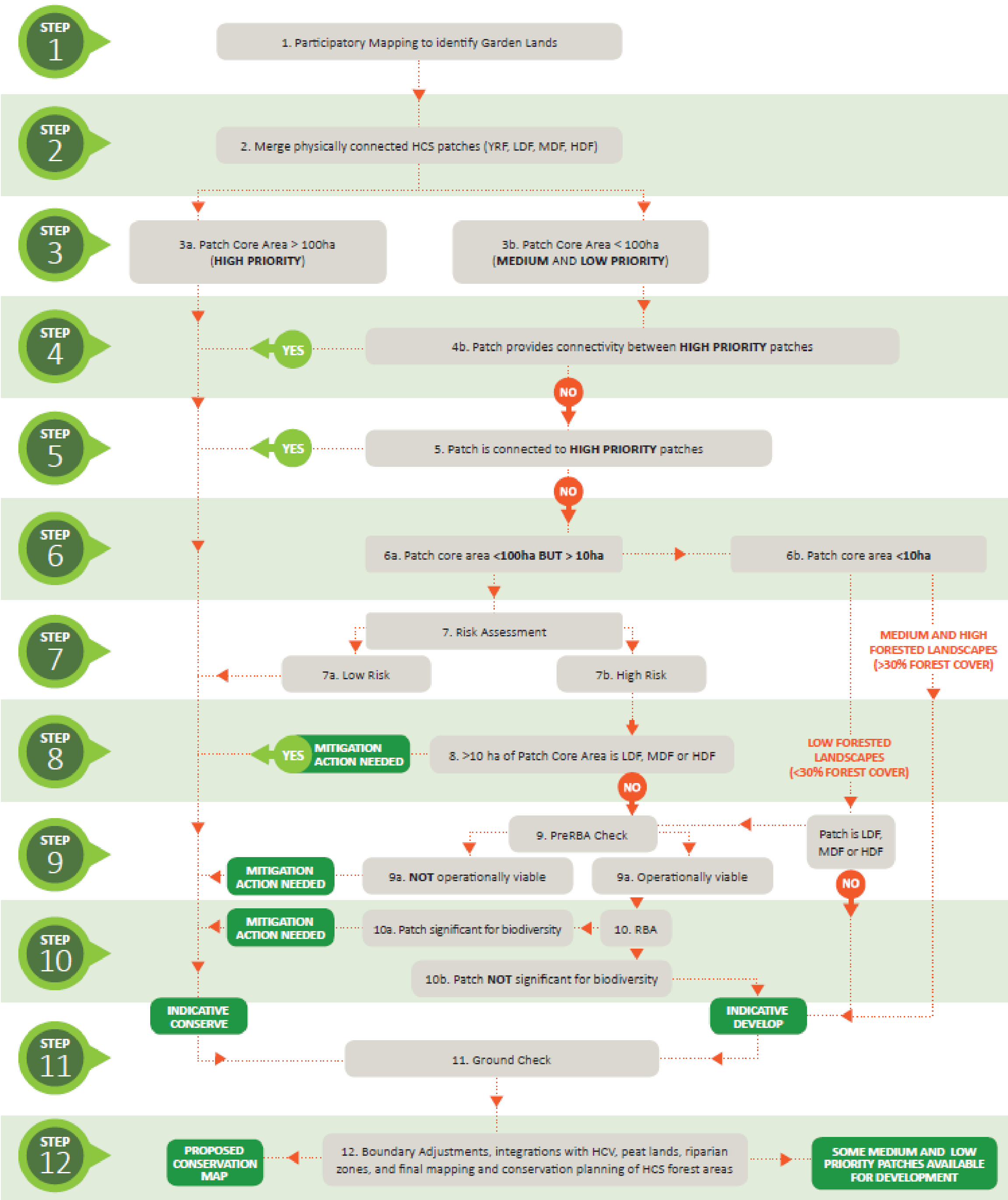


Figure 3. HCS Assessment Decision Tree[1]

[1] A HCS toolkit is planned for release in calendar year 2014 which will describe the HCS process in detail and elaborate on all terminology. In the interim, the application notes in Appendix A provide a guideline to the methodology.

Decision Tree Step 1: Identify Community Land.

The first step of the patch analysis involves participatory mapping to identify lands which are used by local communities. A HCV study was completed during the 20th - 24th of February 2013 which concluded that there were no HCV 5 natural areas critical to meeting the basic needs of local people or HCV 6 areas critical for maintaining the cultural identity of local communities. Through further independent analysis of historical remote sensing data and ground checking surveys it has been confirmed that there are no community farms or other developments either in or adjacent to the PT WINA site. The bulking station and jetty constructed by PT WINA at this site is situated on lands which previously contained a mixture of aquaculture ponds, mangrove swamps and mixed vegetation. After Wilmar purchased the lands from their original owners the aquaculture ponds were converted into their current state as an industrial bulking station. Prior to implementation of the HCS land use recommendations, it is recommended that an FPIC process be completed for all the land designated for development and conservation.

Decision Tree Steps 2 to 5: Patch Identification, Prioritisation and Connectivity Analysis

Through the core analysis described in Appendix A, each HCS patch has been classified into one of three priority classes: High (>100Ha), Medium (≤100 but ≥10 Ha) and Low (<10 Ha). In the core analysis, forest patches are assessed on the basis on their ecological function, therefore the boundaries of forest patches are not limited to the boundaries of the industrial site. The forest data used for the basis of the core analysis is shown in figure 4 below.

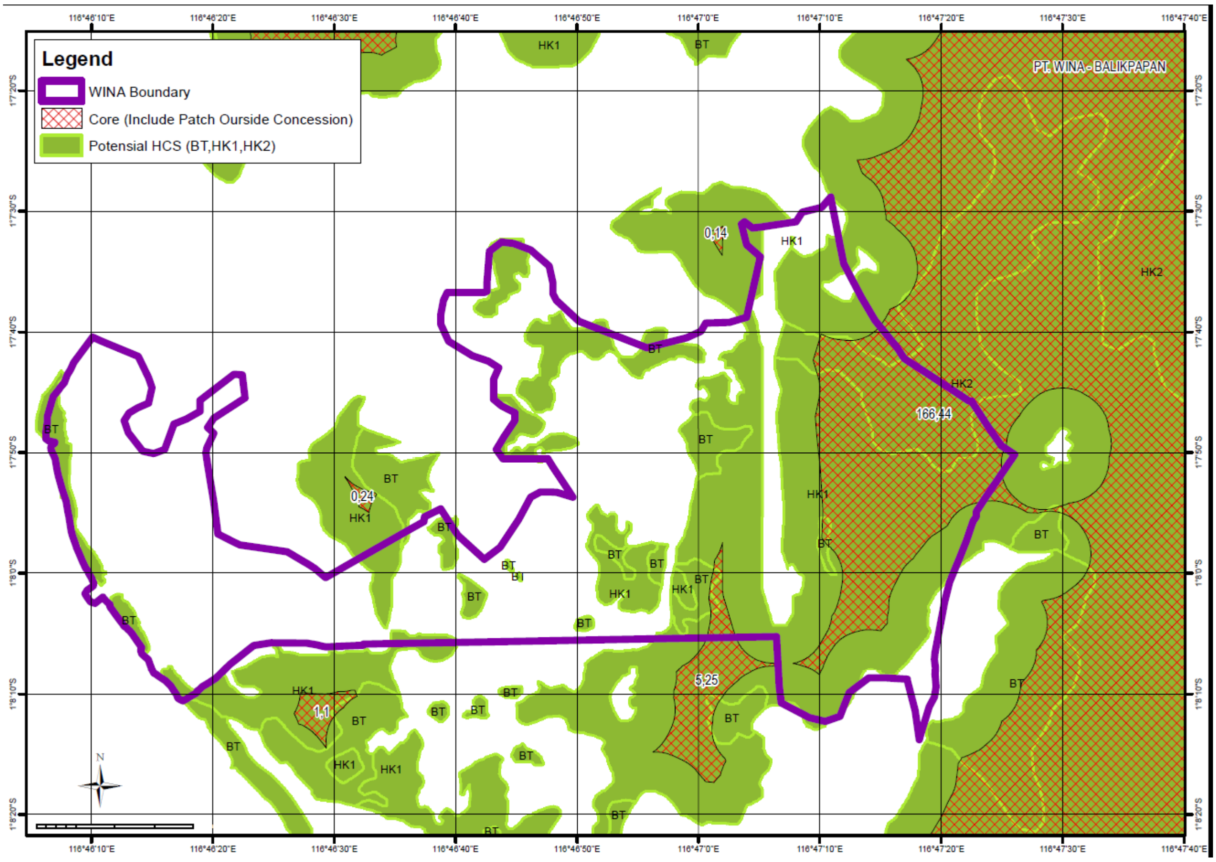


Figure 4. HCS Core Analysis of PT. WINA

Figure 5 containing the results of the core analysis shows that the site contains one high priority patch (# 11) which is connected to the buffer zone of the adjacent Sungai Wain protected area to the east of the PT WINA site. The remaining nine patches have a core less than 10 hectares and are therefore classified as low priority. Through the connectivity analysis it was found that only one of the nine low priority patches (# 10) is connected to the high priority patch (# 11) due to the distance between the edges of the two patches being less than 200m.

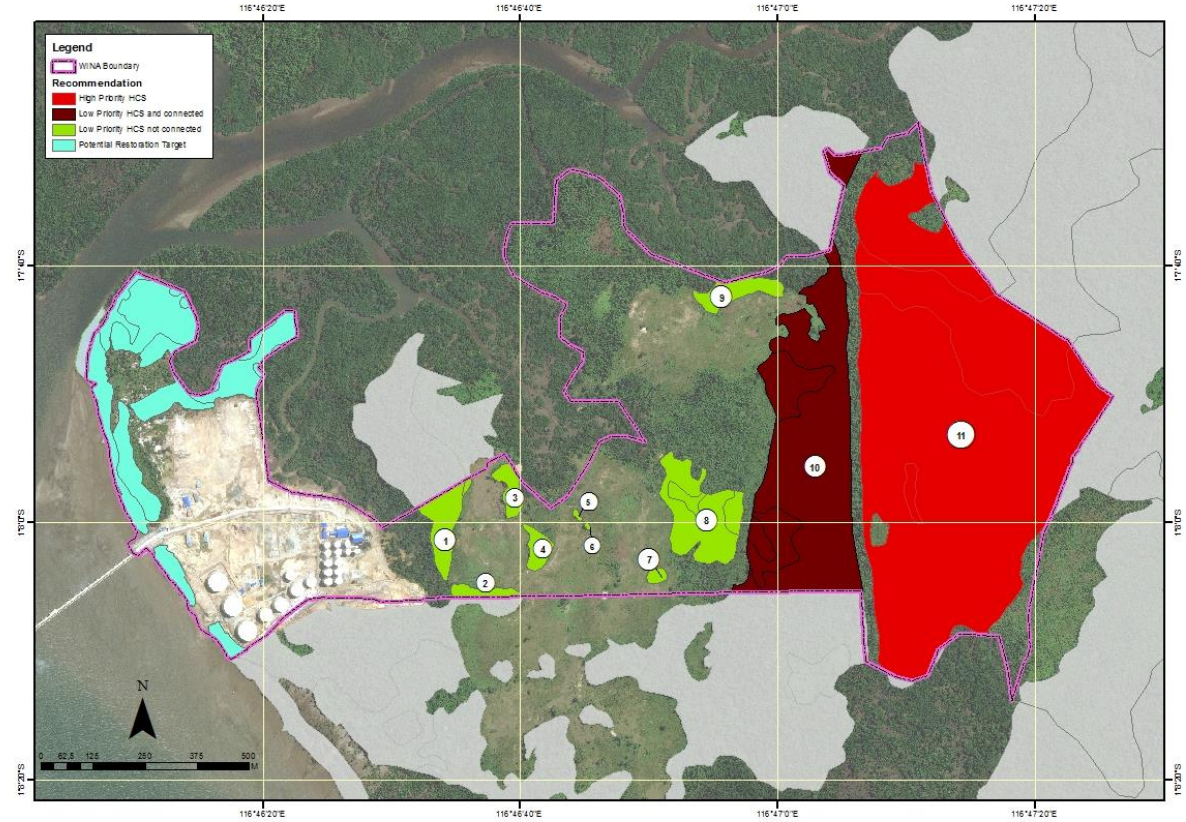


Figure 5. HCS Patch Analysis of PT. WINA

<u>Decision Tree Steps 6 to 11: Forest Landscape Assessment, Risk Assessment, Rapid Biodiversity Assessment and Ground Checks.</u>

Patch #11 is a high priority patch connected to the buffer zone of the Sungai Wain protected area and as such it directly qualifies for conservation status. The forest patch is adjacent to a major arterial road being constructed by the Government of Kota Balikpapan which poses a substantial risk to the long term viability of this patch. Therefore, a management plan will need to be developed and implemented in co-ordination with the local government and communities including measures designed to mitigate the risks associated with the adjacent road.

All of the ten remaining patches are low priority patches with cores sizes less than 10 hectares. In low forest cover landscapes small (low priority) patches will have greater importance for conservation of carbon and biodiversity. However, over 30% of the PT WINA site contains HK1 or HK2 forest and it is located directly adjacent to the Sungai Wain high forest cover landscape. As such, the PT WINA site is located within a medium to high forested landscape. In accordance with step 6 of the decision tree, these low priority patches do not qualify directly for conservation as they are not connected to a high priority patch. Instead, the decision as to whether these patches should be conserved or developed is made during Step 12 of the decision tree when the final HCS Boundary Adjustment is made to develop a conservation plan that that has the highest likelihood of ecological viability.

Patch #10 is located within 200m of the High Priority patch #11. On the basis of proximity these two patches are considered connected and, in this context, patch #10 would typically be considered for conservation. However, the two patches are separated by a road being constructed by the

Government of Kota Balikpapan. A thirty meter wide corridor has already been cleared between the two patches to accommodate the road. Once finished, this road will present a major impediment for animals potentially migrating between the patches. In accordance with the risk assessment in Step 7 of the decision tree, all patches within 1km of public roads are considered to be at high risk and long term protection is unlikely to be viable. As such, the decision as to whether patch #10 should be conserved or developed is made during Step 12 of the decision tree together with the nine other low priority patches. To inform this decision, a Rapid Biodiversity Assessment was conducted for patch #10 as part of the ground check required in Step 11 of the decision tree. The RBA methodology is shown in Appendix B and a separate RBA report has been produced. The results from this report are summarised below:

Instances of Rare, Threatened and Endangered (RTE) category Vegetation in the lowland forest ecosystems of Patch #10.

One instance of RTE category vegetation was found in the lowland forest ecosystems; kruing (*Dipterocarpus kunstleri King*) is categorized as Critically Endangered according to the IUCN Red list.

Table 1: Instances of RTE category Birds in the lowland forest ecosystems of Patch #10.

No.	Common Name	Scientific Name	Gov't Reg. Status			CITES Status			IUCN Status		
			No	D	E + D	III	II	I	LC/DD/LR	NT/VU	En/CR/Ext
			1	2	3	1	2	3	1	2	3
1	Crested Goshawk	*Accipiter trivirgatus*		D							
2	Rhinoceros Hornbill	*Buceros rhinoceros*		D			App II			NT	
3	Hill Myna	*Gracula religiosa*		D			App II		LC		
4	Copper-throated Sunbird	*Nectarinia calcostetha*		D							
5	Collared Kingfisher	*Todiramphus chloris*		D							
6	Collared Owlet	*Glaucidium brodiei*					App II				
7	Banded Pitta	*Pitta guajana*		D			App II		LC		

Table 2: Instances of RTE category Mammals in the lowland forest ecosystems of Patch #10.

No.	Common Name	Scientific Name	Gov't Reg. Status			CITES Status			IUCN Status		
			No	D	E+ D	III	II	I	LC/DD/LR	NT/VU	En/CR/Ext
			1	2	3	1	2	3	1	2	3
1	Southern Red Muntjac	*Muntiacus muntjak*		D					LC		
2	Crab-eating Macaque	*Macaca fascicularis*					App II		LC		
3	Pygmy Treeshrew	*Tupaia minor*					App II		LC		
4	Javan Chevrotain	*Tragulus javanicus*		D					LC		
5	Sunda Pangolin	*Manis javanica*		D			APP II				CR

Ground checks have been performed at the site to check if there are any community gardens. No evidence was found of community gardens in or adjacent to the PT WINA boundary during the ground check but some of the land was found to be being used as grazing land for buffalo. Therefore, the FPIC process is required to be completed to gain consent from community landowners before development and conservation plans are implemented.

Decision Tree Step 12: Boundary Adjustments, integration with HCV, peat land, riparian zones, and final mapping and conservation planning of HCS forest areas

In the final step of the patch analysis, potential conservation areas are evaluated from a bigger picture landscape perspective to consider the landscape matrix with the aim of producing a conservation plan that integrates all set aside categories (Community protected areas, HCV, HCS, riparian, peat, etc.) and has the highest likelihood of ecological viability. Account is taken also on whether the conservation of a patch would fundamentally compromise the sites operation, such as blocking a critical access point to a significant area of the site. Integration of the HCS map with other categories is shown in the figure below.

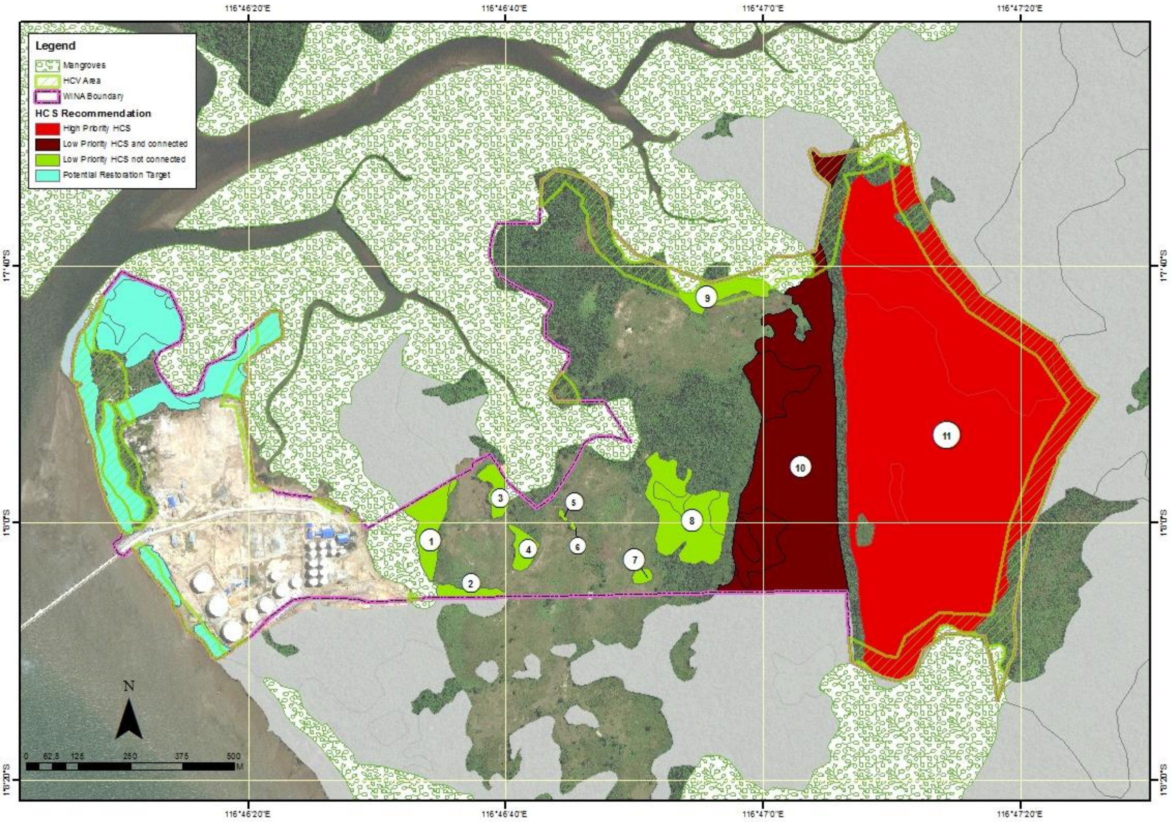


Figure 5. Integration of HCS with HCV areas and mangrove areas.

<u>Final Boundary Adjustments</u>

The single large High Priority patch #11 has been prioritised for conservation. The remaining low priority patches #1 to #10 in this medium-high forested landscape have not been designated for conservation due to the high risk associated with the government road which dissects the PT WINA site. Patches #4, #5, #6, #7 & #8 are recommended to be incorporated into development areas. Patches #1, #2, #3, #9 and #10 border with mangroves, riparian areas or HCV areas and it is recommended that a portion of these patches is conserved to provide suitable buffers to the mangrove, riparian and HCV areas. It is also noted that patch #10 contains a forested hill as shown in the figure below and clearance of this forested hill may result in significant sediment runoff into the adjacent mangrove system and Balikpapan bay. As such, clearance can only be considered if the sediment run-off, which is a serious threat to the mangrove, can be contained.

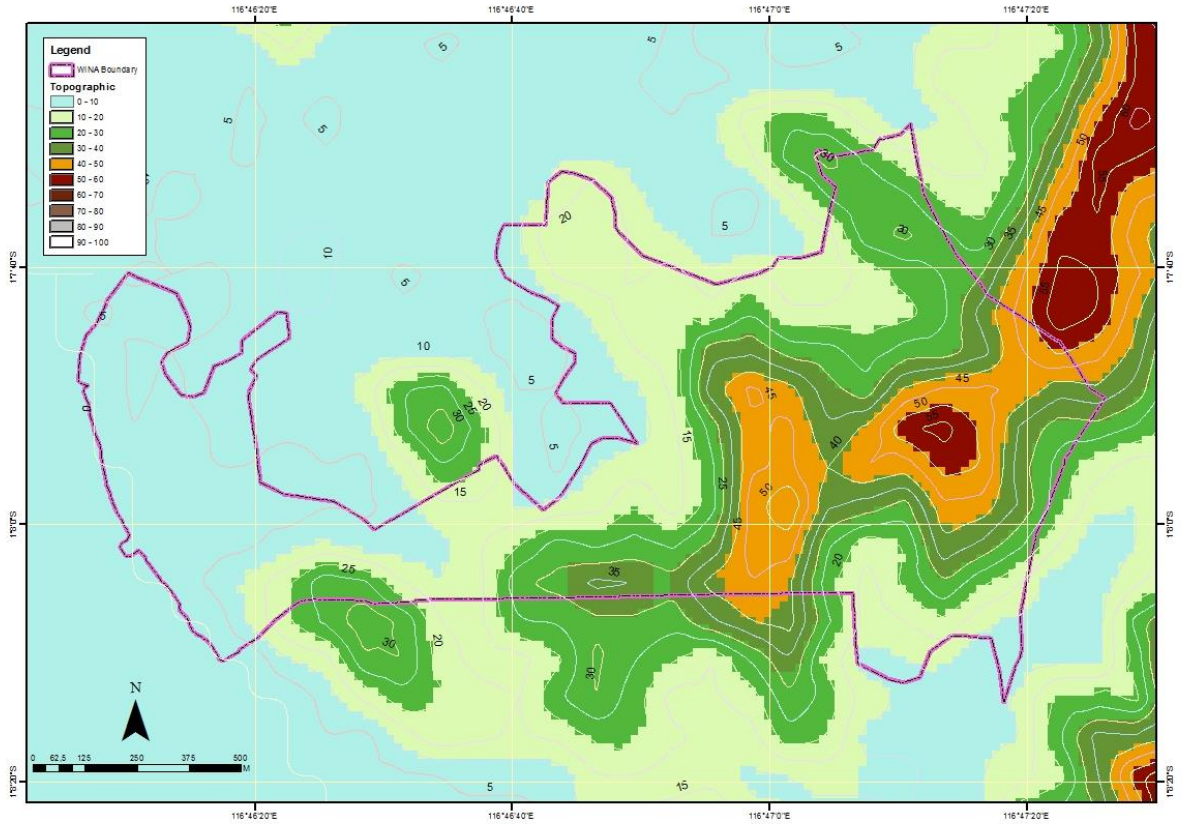


Figure 6. Digital Terrain Map of the PT. WINA site

The RBA for patch #10 identified three especially significant species: a single Kruing tree, a Rhinoceros Hornbill and a Sunda Pangolin. The Kruing tree (*Dipterocarpus kunstleri King*) is classified as Critically Endangered (CR) on the IUCN red list. The Rhinoceros hornbill (*Buceros rhinoceros*) is classified as a protected species in accordance with Indonesian Government Regulation, Appendix II Cites and is classified as near threatened (NT) on the IUCN Red List. The Sunda Pangolin (*Manis javanica*) is classified as a protected species in accordance with Indonesian Government Regulation, Appendix II Cites and is classified as Critically Endangered (CR) on the IUCN Red List. While these are especially important species of flora and fauna, a key concern to the long term survival of patch #10 is the road along its eastern edge. The increasing presence of traffic and people is very likely to deter animals from using the patch. The road effectively fragments the patch from the larger intact forest area to the east. In such a fragmented scenario and with the increasing human pressure, it is predicted that this patch would deteriorate without significant mitigation actions from PT WINA. TFT recommends that PT WINA focus such mitigation action instead on the larger intact forest area covered by patch #11. This patch is believed to provide a much better outcome for conservation.

The below map illustrates proposed conservation areas in PT WINA, resulting from the patch analysis Decision Tree matrix.

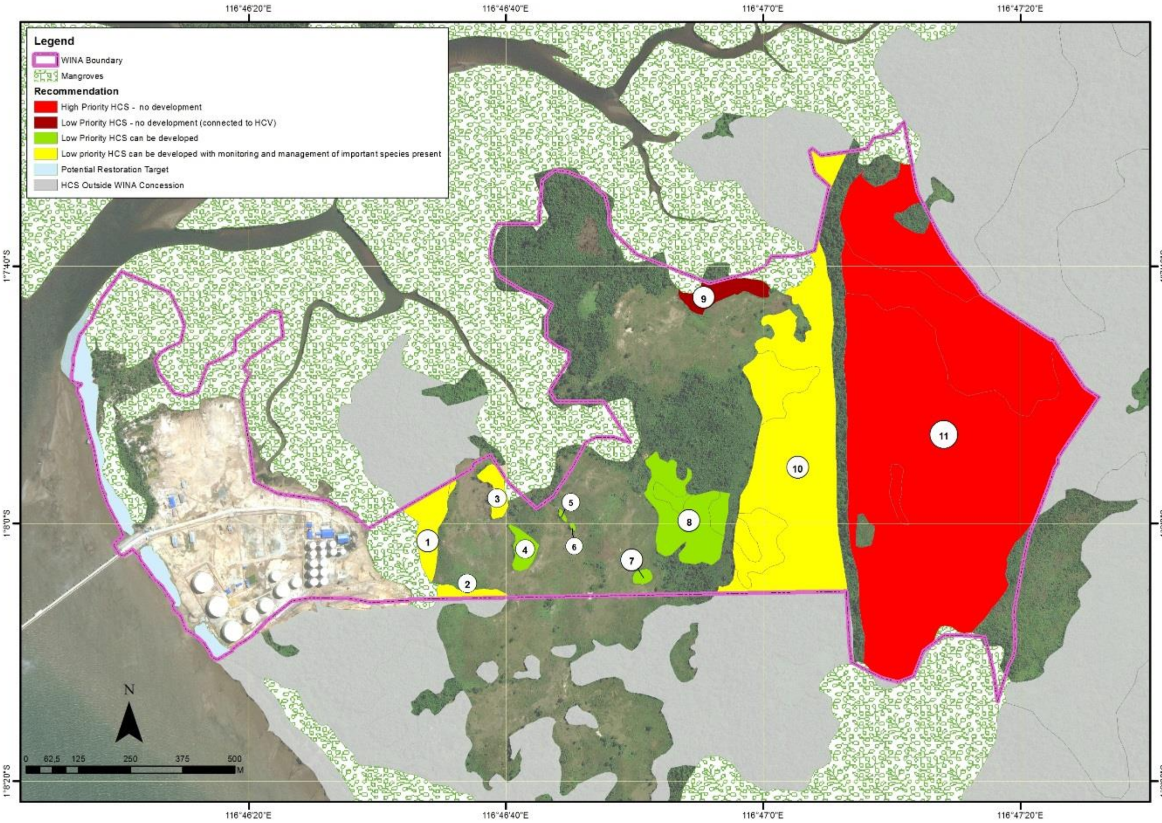


Figure 7. Map of the proposed HCS conservation and development areas in PT. WINA

Appendix A. Patch analysis and conservation

Explanatory Notes on HCS Forest Patch Analysis Decision Tree Steps

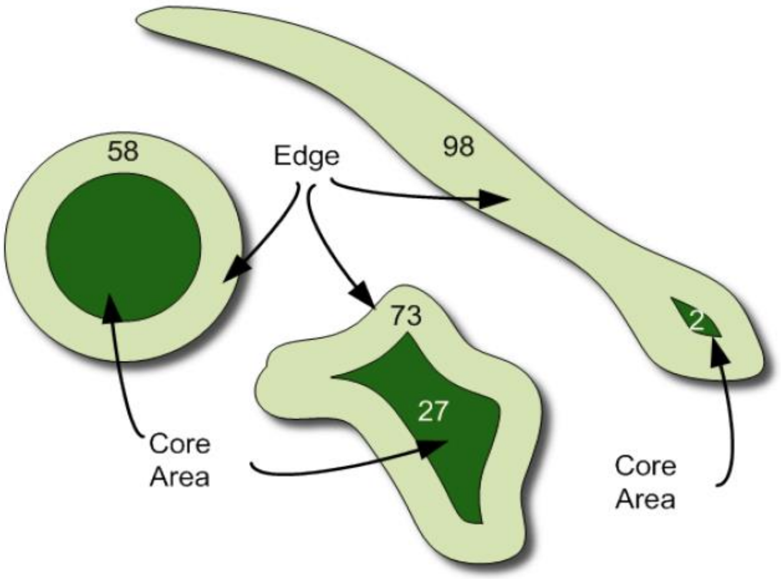
1. Participatory mapping to identify community land use must be completed prior to the final HCS stratification and the HCS patch analysis. Maps of garden and future farm lands that are areas fundamental to meeting basic food needs [2] are completed and recorded on maps. If these areas are located within the concession then they will be enclaved and excluded from HCS analysis and plantation development.

2. Extracting all HCS forest strata: High Density Forest through to Young Regenerating Forest (BT) are extracted from non HCS strata to form one HCS layer. Where HCS patches are physically connected to each other they are merged to form one patch. This merge function influences the results achieved for Step 3 (Core analysis).

   Overlay with HCV: Overlay of areas to be protected including community protected areas, HCV, peat or areas that cannot be developed due to government regulation. This is for information only at this point in order to consider where these areas are that will protected anyway in relation to any potential HCS areas. The full integration of HCV areas with HCS patches will occur at step 12. This will include areas that are protected for biodiversity values (HCV1-3), ecosystem services (HCV4) or important social/cultural uses (HCV5 & 6).

3. **Core analysis[3]:** HCS Forest patches with a core area greater than 10 ha are identified using an internal (negative) buffer of 100 m. Patches with a greater core area will be more viable in the long term as they are beyond the more severe 'edge effects' – this is the primary filter for selecting patches for conservation. This does not rule out patches with no core as having value for connectivity via corridors or stepping stones. This includes consideration that palm plantations in the landscape matrix provide a reduction in the edge effects when they have reached sufficient maturity compared with an open land.

[2] This shall provisionally be no less than 1 ha per person in the land owning community who resides there.
[3] See 'HCS Forest Patch Conservation – background and principles' paper for the conservation science behind 'core' and connectivity.



Prioritisation: The larger the size of the patch core the higher the likelihood to maintain or revert to its ecological function as a forest including conserving carbon and biodiversity values. Patches are therefore prioritized accordingly:

3a. A patch that contains a core of more than 100 ha of HCS forest is considered **High Priority** and will be marked for conservation.

3b. A patch that contains a core of 10 – 100 ha of HCS forest is considered **Medium Priority** and a patch that contains a core less than 10ha of forest is considered **Low Priority.** Both will be further assessed for connectivity between high priority patches (Step 4) and proximity to large patches (Step 5).

4. **Connectivity of medium and low priority patches to high priority patches:** Connectivity is important to facilitate dispersal of biodiversity between patches. Importance is therefore given to firstly identifying **Low** and **Medium Priority** patches that create connectivity between **High Priority** patches.

   Connectivity is defined as two patch edges within 200m of each other. Using a positive buffering approach **Medium** and **Low Priority** patches are assessed to identify those that provide connectivity between **High Priority** patches and marked for conservation. Importantly connectivity can be provided by multiple patches between High Priority patches.

5. **Medium** and **Low Priority** patches that do not provide connectivity between **High Priority** patches but have an immediate connection to **High Priority** patches are marked for conservation. **Medium Priority** patches that do not have an immediate connectivity to **High Priority** patches are reviewed in Step 8 (Risk Assessment). **Low Priority** patches that do not have an immediate connectivity to **High Priority** patches are reviewed in Steps 8 & 12 (Boundary Adjustment).

6. **Separation of Medium and Low Priority Patches:** medium priority patches (10-100ha core) are separated (6a) and subjected to a Risk Assessment (Step 7). Low priority patches are analysed for

presence of HDF/MDF/LDF – if a presence is found and is within a low forest cover landscape[4] (<30%) then the patch moves to an RBA (Step 10). In low forest cover landscapes small patches will have greater importance for conservation of carbon and biodiversity. If not it is held for consideration during the final boundary adjustment and land use planning phase (Steps 12).

7. **Risk assessment -** A risk assessment is performed to assess the proximity of the medium priority forest patches to public roads, settlements, rivers, and other anthropogenic activities (such as mining, logging, plantation, etc.). A set of buffers of 2 km from settlements and 1 km for others relative to above factors is placed in the map using GIS software to assess the indicative level of potential threat arising from these access or human activities. The risk classifications are:

   a) Medium Priority patches outside these risk zones are identified as low risk areas and can be marked for potential conservation to go to Step 12 (Boundary Adjustment)
   b) Medium Priority HCS forest patches located inside these risk zones are identified as high risk and unlikely to be viably protected. They are further assessed in Step 8 (review of High/Medium/Low Density Forest).

8. **Review of presence of LDF/HK1- MDF/HK2 HDF/HK3**: a review of LDF-MDF-HDF presence is performed for medium priority high risk areas (7 – b) as part of the precautionary principle in implementing this patch selection process.
   For medium priority (10-100 ha) HCS patches that are high risk, a further analysis is performed to assess whether they contain a total of >10ha of LDF, MDF or HDF (HK1/HK2/HK3). If such HCS forest areas are identified this patch is marked for potential conservation with mitigation measures to reduce the threat to these forests such as co-management with the local community, employing forest 'guards' or 'guardians, and supporting incentives that place a value on the forest including NTFPs or conservation compensation payments.

9. **Rapid Biodiversity Assessment Pre-check:** A RBA Pre-check is carried out prior to the full RBA. The aim is to identify any impediments to development and operations. Any areas found to have impediments are moved to either conservation (e.g. riparian areas, swamp areas, steep slopes) or enclaved from development (e.g. gold mining areas).

10. **Rapid Biodiversity Assessment (RBA):** The RBA assessment is a combination of desktop review of existing data on the site and field based surveys of targeted sites. It will involve appropriate sample techniques for at a minimum mammals, birds, flora, reptiles and invertebrates. It is noted that high quality HCV assessments (especially with fine resolution surveys) contribute considerably towards the RBA as providing baseline data on what species, habitat and ecosystems would be expected to be found in the patches identified for a RBA. This would also likely reduce the intensity and therefore cost of the RBA. This step is designed to be precautionary towards important biodiversity values that are not captured by any of the steps above or in HCV areas. It will aid in the decision as to whether some of the medium priority forest patches are to be conserved or developed. A rapid assessment of biodiversity values is performed in these areas by qualified biodiversity assessors and experts to determine if any high values are present.

    High biodiversity includes any species listed by: the IUCN as endangered or threatened (including near threatened), IUCN Red Listed, CITES, any nationally, regionally or local endemic species, any

[4] Landscape definition: A geographical mosaic composed of interacting ecosystems resulting from the influence of geological, topographical, soil, climatic, biotic and human interactions in a given area. (Source: IUCN). If this is not well defined nor a data set available for the focus area, then the surrounding area with similar landform, topography, altitude and climate would be sufficient.

concentrations of or habitat of regionally or locally rare or uncommon species, or simply high concentrations or combinations of species and their habitat. If there are no high biodiversity values identified, the forest patch may be developed (10b of DT). If there are high biodiversity values present they will move to the HCV protection process if they also qualify as HCV1-3, or if non-HCV the areas are conserved unless there are fundamental viability issues (e.g. isolation, proximity to risk, small size) or it can be proven that the HBV value present is already well protected in the other patches or existing conservation areas in the landscape and the conservation of this patch would provide no additional biodiversity benefit. This latter process can be incorporated into the final conservation planning process following advice from appropriate experts including local community representatives

11. **Ground Check** – while step 1 removes enclaved garden areas and identifies community use areas, it may be that some areas are missed or it may not be able to differentiate all rubber or community gardens from forest. Therefore after performing all the steps above, a ground check needs to be performed to:
    - **a)** Provide an additional check of any potential HCS areas for conservation and exclude areas of rubber, community orchards or plantations, or community gardens not previously identified,(these have a predominance (>50% of stems or canopy) of rubber, fruit or garden trees). Areas that do not have a dominance of rubber, fruit and garden trees are considered HCS.
    - **b)** Check the location and boundaries of any community protected areas, and then incorporate them into final conservation plans.
    - **c)** Check other development constraint to areas marked "develop" such as mining activities, or other situation unfavourable for oil palm development (riparian zone, flooded area, steep slopes, unsuitable soils (including peat land), etc.).

12. **Boundary Adjustments, integration with HCV, peat land, riparian zones, and final mapping and conservation planning of HCS forest areas -** Potential conservation areas are evaluated from a bigger picture landscape perspective to consider the landscape matrix[5] to ensure connectivity of patches, corridors between forest areas (including those outside of the concession), stepping stone forest patches to provide connectivity, and coherence of shape with the aim of producing a conservation plan that integrates all set aside categories (Community protected areas, HCV, HCS, riparian, peat, etc.) and has the highest likelihood of ecological viability. Account is taken also on whether the conservation of a patch would fundamentally compromise the plantation operation including blocking a critical access point to a significant area of the concession or are of a configuration and shape that make planting block establishment impossible. General guidelines for this process are:
    1. Integration with HCV, Peat lands and Riparian zones: proposed HCS forest areas are combined and integrated with other layers of protection in the landscape. This may combine or be carried out together with boundary adjustments and the final connectivity decisions following consideration of the landscape matrix.
    2. Boundary Adjustments: boundaries may be rounded to cut off small irregular points or 'fingers' of Young Re-growth Forest /BT (where there is 100% edge effect i.e. less than 200 m wide) or to bridge gaps/pockets to infill and make a more practical plantation boundary as well as give a more even edge for forest conservation. This is a 'give and take' approach to rationalize the boundary for management.
    3. High risk medium priority patches with fragmented cores: small (<10 ha sub-cores) outlier areas of the patch may be excised if they do not provide

[5] Landscape Matrix: areas not designated primarily for conservation of biodiversity, natural ecosystems, ecological processes, and services (regardless of their current condition as natural, modified or man-made).

connectivity or do not function as stepping stone areas and may be removed from HCS, or they may be expanded on to rationalize the patch. Again on a give and take approach.

iv. RBA findings should be considered alongside the degree of forest conserved or protected in the landscape, and in particular the degree to which large patches can be conserved by the company together with the community. The general rule is that the more fragmented and the lower the amount of forest in the landscape then the greater the importance of small patches, and with landscapes that have very high forest cover (e.g. over 80%) the focus will move to conserving larger continuous patches.
v. Patches should be combined with riparian zones where possible and their position in relation to other patches considered in order to contribute to coherent linkages and corridors in the landscape. These can include 'stepping stone' patches that can act as refuge areas for weak flying birds or small animals moving through the landscape.
vi. The final HCS conservation plan proposal is vetted by an independent conservation science expert.

13. **HCS Forest Conservation –** This is the phase after the decision tree where final (following up on early participatory processes on the conservation/development package) socialization and FPIC is sought for the conservation of the HCS forest areas. The conservation plan is integrated with the participatory land use map of the communities, and the necessary steps taken to ensure the long-term viability of the area, including negotiating co-management with the local community, settling any compensatory payments, and arrangements with local, provincial or national governments to secure the conservation status of the area.

Appendix B. Rapid Biodiversity Assessment Methodology

RBA Procedures

1. **The objective of the RBA is to identify vegetation and wildlife.**

2. **The vegetation objects to be identified are undergrowth, liana, empifit and woody plants.**

3. **The wildlife objects to be identified are mammals, aves, reptiles and amphibians (herpetofauna).**

4. **Identification methods**

4.1 Data collection method

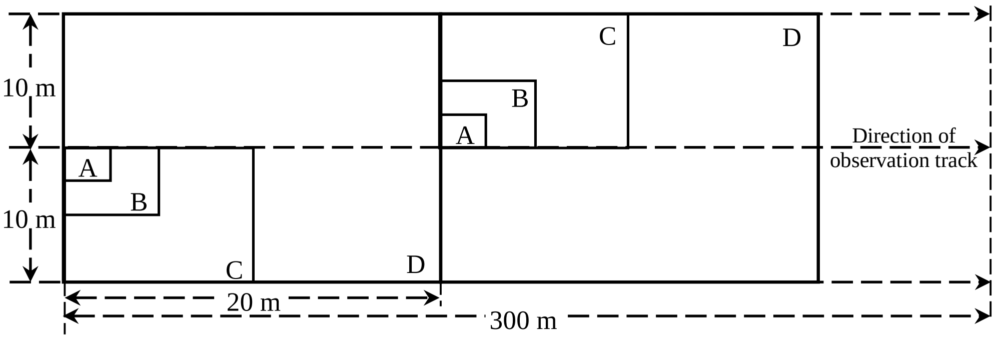
The wildlife and vegetation inventory is conducted by using the *line transect* method as follows:

- Determine the location/spread and movement line direction or observation track.
- Determine the length of transect line (*L*, which is the distance from T_0 to Ta). The distance of the *transect line* for each observation unit is a maximum of 300 m.
- Determine the starting point of the line or observation track, then give a mark so that the mark can be easily found when we have to return to the starting point. The observation starting point may be in form of a road or already existing border marks. Determine the binding point and starting point at the observed line. The determination of the binding point may be done by using natural signs such as a river or boundary poles on the channel. The signage in the binding point may use available paint.
- After determining the binding point, starting point and azimuth at the *transect line* in the field, the line is cleared and the marking is made by marking the trees that are located along the line that has been measured.
- Preparation of *transect line*. The transect line is made based on the determined azimuth until the end of the line according to the determined length of line.
  - Draw the location of spread of each observation line on the map.
  - Determine (together with the observation team) the starting and finishing time of observation.
  - 3 people are needed to conduct the flora-fauna observation and monitoring, with the following tasks:
    - (i) Person 1: this person is assigned to record all information about the species inside the observation plot.
    - (ii) Person 2: this person is assigned to identify the species and to measure the diameter of trees.
    - (iii) Person 3: this person is assigned to measure the distance between the animal and the "Person 1" and the distance between the *transect line* and position of animal. This person will measure the distance and determine the direction (using a compass).

- The following needs to be done before and during the observation:
  - (i) Do not use brightly colored clothing, such as red, yellow, etc. Do not use perfume or other fragrances that can be easily detected and would cause the animals to avoid the observer.
  - (ii) Move slowly so that the presence of the observer does not disturb or frighten the animals.
  - (iii) Do not make noise or speak in a loud voice, which may cause the animal to avoid the observation area before the observer has the opportunity to make the observation.
  - (iv) Smoking is prohibited during the observation of wildlife.
  - (v) Record all large mammal species that are found, either directly or indirectly.
  - (vi) It is prohibited to activate the mobile phone during the wildlife observation process.

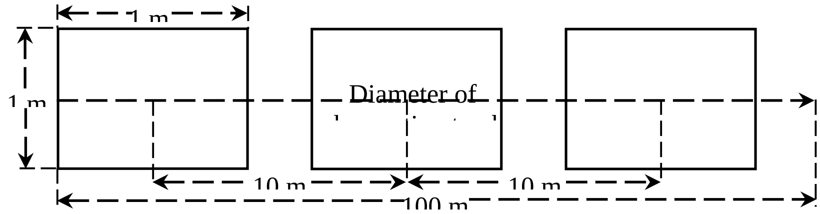
4.2 Vegetation

The data collection of the plant is conducted by using the *transect line* method with a maximum line length of 500 m for each location. This vegetation analysis method is conducted in a compartment, which is divided into sub-compartments. The compartment with a size of 20x20 m^2 is used for vegetation data collection on the growth level of trees/liana/empifit, the compartment with a size of 10x10 m^2 is used for collection of vegetation data on the pole growth level, the compartment with a size of 5x5 m^2 is used for collection of vegetation data pile growth level, and the pole with a size of 2x2 m^2 is used for the collection of vegetation data on the nursery growth level. The form for the plant observation sample unit is presented below in Picture 1.



Picture 1 Vegetation observation sample unit form: A plot of 2x2 m^2, B plot of 5x5 m^2, C plot of 10x10 m^2 and D plot of 20x20 m^2

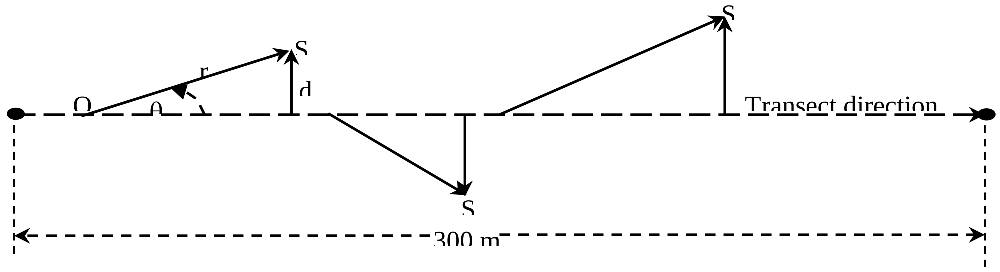
The data collection for undergrowth is conducted by using the sample unit, which is based on the line compartment method approach. Each sample unit has a length of 100 m and a width of 1.0 m. Each sample unit will be divided into compartments with the size of 1x1 m^2, which are each placed at a distance of 10 m from the centre point of the compartment (Picture 2).



Picture 2 Form of the undergrowth observation sample unit

4.3 Mammals

Data collection for terrestrial and arboreal mammals is conducted by observing each type of land cover. It observes the lines of the sample unit, namely the *transect line* method, which is in maximum 300 m for each sample unit (Picture 3). In order to ensure the data accuracy, the observation of mammals is conducted three times in a day, including in the morning (around 05.30-09.00 am), afternoon (around 02.30-06.00 pm) and night (07.00-11.00 pm). The way of collecting the data for mammals' parameter is the observer walks slowly following the transect line direction and simultaneously records all animal species that are found, either directly or indirectly. The data of animal species including their population characteristics that may be recorded are only for animals that are located in front of the observer's position. In this case, the observer must not record the animals which are located behind him/her. The observation is conducted two times by repeating each line.



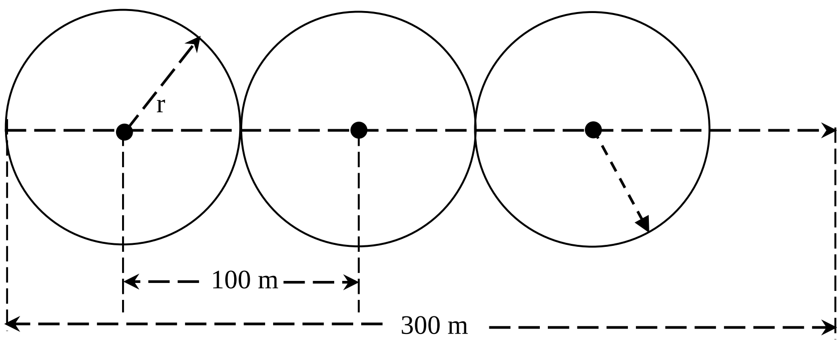
Picture 3 Transect line design for observation of big mammals: d = vertical distance between the animal's position and observation track (d=r.Sinθ), r = distance between wildlife and observer, θ = angle between the animal position and observation track, O = observer position, and S = animal position.

4.4 Herpetofauna (Reptiles and Amphibians)

The data collection of amphibians and reptiles is conducted by using the *visual encounter survey* (VES) method at the observation transect which is a maximum of 300 m length and 20 m width. The data collection is conducted at night (07.00 pm to 11.00 pm). The observation is conducted two times by repeating each line.

4.5 Aves (Birds)

The observation on Aves is conducted by using the transect line combination sample unit with the *variable circular plot* (VCP). The distance between a centre plot and another is 100 m, while the length of each transect is a maximum of 300 m (4 plots). The form of the Aves observation sample unit is as presented in Picture 4.



Picture 4 Design of Aves inventory with the VCP method

The observation of Aves species is conducted during the interval time of 05:30–09:00 am for the morning period and 03:00 – 06:00 pm for the afternoon period.

The data recording is conducted by observing the Aves in the overall observation circle, which is recorded within the interval of 5 minutes (for 15 minutes on each observation point). The observation is conducted two times by repeating each line.

5. Recording data

5.1 Vegetation

- Tree: species, total number, individual, diameter at chest height (±130 cm), total height (TT), branch free height (TBC), crown closure.
- Pole: type, diameter at chest height (±130 cm), total height (TT), and branch free height (TBC)
- Pile, nursery and undergrowth: total and type.
  The data obtained will be entered into the *tally sheet*.

5.2 Mammals

The data collection includes the individual types and total of each species that is found, the distance between the wildlife and observer's position, the contact angle between the position of the detected animal and observer's position, the observation track line, the time at which the animal species is found (hour; minute), type of meeting (nesting/sleeping places or sound signs). All data obtained will be entered into the *tally sheet*.

5.3 Herpetofauna

The data collection includes the species, total individuals per species, discovery location and type of meeting. The data obtained will be entered into the *tally sheet*.

5.4 Aves

The data collection in the Aves' observation is including the species, total individuals per species, location/position at the observation period (ground surface, forest floor, the bottom, central or upper crown), and the distance between the observer and object/animal. In order to obtain additional information on various species of Aves found in the study location, interviews are made with the local community groups. The data obtained will be entered into the *tally sheet*.

6.Techniques for identifying species

The species can be identified by:

- Looking at the main identifier, vegetation (in form of leaf shape, shape of leaf nerves, leaf texture, etc.) and for animals (in form of fur/feather colour, beak, voice, tail, eyes, head).
- Referring to the field manual or the literature study which is based on previous research or existing theories. This literature study covers the identification of species, habitat, behaviour and traces of wildlife. The information or data can be obtained from institutions or study centres in possession of literature on wildlife. In order to identify species, it is suggested to use the species identification instruction book or guidebook for field observation such as *Field Guide for Identification of Aves in Java, Bali, Kalimantan and Sumatera, "A Field Guide to the Mammals of Borneo"* and other books. The identification on the status of protected or non-protected animals is shown in Government Regulation No. 7 of 1999 concerning Conservation of Plant and Animal Species. The book on "Implementation of CITES Conversion in Indonesia" may be used in order to identify the status of animals in the international world trade and contains the list of animals and plants included in the category of Appendix I, II and II and IUCN.

- The herbarium or specimen is made for species that are not identified yet.

7. Data Processing

7.1 Composition and structure of vegetation

The composition of species is calculated based on the quantitative parameter values of plants, which reflect the level of spread, dominance and abundance in a forest community. These values can be expressed in the form of absolute value or relative value. The values are formulated based on the sample taken by using the line compartment method as follows (Soerianegara and Indrawan 1983):

$$\text{Density (K)} = \frac{\text{Total individuals of a species}}{\text{Total extent of sample unit}}$$

$$\text{Relative Density Relative (KR)} = \frac{\text{Density of a species}}{\text{Density of all species}} \times 100\%$$

$$\text{Frequency (F)} = \frac{\text{Total plots found of a species}}{\text{Total sample units}}$$

$$\text{Relative Frequency (FR)} = \frac{\text{Frequency of a species}}{\text{Total frequency of all types}} \times 100\%$$

$$\text{Dominance (D)} = \frac{\text{Bottom section extent of a species}}{\text{Total extent of sample unit}}$$

$$\text{Relative Dominance (DR)} = \frac{\text{Dominance of a species}}{\text{Total dominance of all species}} \times 100\%$$

Important Value Index = KR + FR + DR

7.2 Diversity of Flora and Fauna Species

The diversity of species based on the type of land cover is analysed by using the alpha diversity index, which covers: a) Shannon diversity index, b) Simpson diversity index, and c) Simpson equitability index (Krebs 1989). The Shannon diversity index is calculated by using the following equation:

$$H' = \sum_{i=1}^{s} p_i . \ln(p_i)$$

$$p_i = \frac{n_i}{N} = \frac{n_i}{\sum_{i=1}^{s} n_i}$$

Remarks:

H' = Shannon diversity index

N = total number of individuals of all species that are found

n_i = total number of individuals of species i
s = total species found
p_i = individual proportion of species i

According to Whittaker (1972), the H' variety can be calculated by using the following equation:

$$Var(H') = \frac{\sum p_i.[\ln(p_i)]^2 - [\sum p_i.\ln(p_i)]^2}{N} + \frac{s-1}{2.N^2}$$

In order to test the H' value difference among the sample units, the Hutcheson (1970) method can be used for the significance test with the t test. The statistical equation for such a test is as follows:

$$t_h = \frac{H_1' - H_2'}{\sqrt{Var.(H_1') + Var.(H_2')}}$$

$$df = \frac{[Var.(H_1') + Var.(H_2')]^2}{\left(\frac{Var.(H_1')}{N_1}\right) + \left(\frac{Var.(H_2')}{N_2}\right)}$$

Remarks:

$Var(H_1')$ = Shannon diversity index variance at first sample
$Var(H_2')$ = Shannon index diversity at second sample
H_1' = Shannon diversity index at first sample
H_2' = Shannon diversity index at second sample
N1 = Total individuals at first sample
N2 = Total individuals at second sample
df = free degree

Simpson (1949) provided the opportunity to two individuals that are randomly drawn from the large unlimited community based on the difference of species, as follows:

$$D_S = \sum p_i^2$$

Remarks:

D_S = Simpson index
p_i = individual proportion of I species, = n_i/N

The species equitability index is the index that is possibly the most used by ecological experts. The species equity index based on Simpson is calculated by using the following equation:

$$E_D = \frac{D}{D_{max}} = \frac{1}{\sum_{i=1}^{s} p_i^2} x \frac{1}{s}$$

Remarks:

ED	=	species equitability index (equitability=evenness)
D	=	Simpson index
D_{max}	=	S or total species found
p_i	=	total individual proportion of species i, = n_i/N
n_i	=	total individuals of species i
N	=	total individuals of all species

7.3 Similarity of Flora and Fauna Communities

The similarity of communities is one of the beta diversity indexes. The similarity of communities can be determined by using the Jaccard Index or Sörensen (Krebs 1989) equation. The Jaccard or Sörensen similarity index has a maximum value of 1, which shows the existing high similarity level or species that are found at two identical locations. If such index has the value of 0, then it means that both locations have no similarity at all and no species is found at both compared locations.

The community similarity index equation based on Jaccard is as follows:

$$C_J = \frac{j}{a + b - j}$$

Remarks:

C_J	=	Jaccard coefficient index
j	=	total species found at both communities
a and b	=	total species found at community A & community B

The Sörensen community equity index that has been modified by Bray-Curtis is as follows:

$$C_S = \frac{2j}{a + b}$$

Remarks:

C_S	=	Sörensen index or Czekanowski coefficient
j	=	total species found at both communities
a and b	=	total species found at community A & community B

7.4 Population Density Estimation

The following formula is used for the population estimation with the combination method:

$$\hat{D} = \frac{\sum_{i=1}^{n} x_i}{2.L.w} \quad atau \quad \hat{D} = \frac{\sum_{i=1}^{n} x_i}{a}$$

Where:

$\hat{D}$ = estimated population density (individual/km^2 or individual/ha)

x_i = total individuals found at contact -i either at the time of calculation with the point or with the track (individual) method

L = length of the observation transect line (m)

w = left or right width of the observation line (m)

a = extent of each observation line (km^2 or ha)

i = contact of observer and wildlife

8. Data analysis

a. If the biodiversity index (H) at the pole or tree or wildlife level is above 3, then the area should be conserved.
b. If the biodiversity index (H) at the pole or tree or wildlife level is below 3, then the protection status study is carried out on the species found in the area.
c. If it is viewed from the normal growth structure at the natural forest, the species diversity index of the nursery level > pile level > pole level > tree level undergrowth level, so that the regeneration of the vegetation species can run well. If the growth does not follow a pattern or there is disturbance at one of the levels, then the forest may be said as experiencing succession (Resosoedarmo, et all, 1992).
d. In case the habitat growth structure is close to the natural forest normal structure or the community similarity index is above 0.75 of the control habitat, then the area should be conserved.
e. In case the habitat growth structure is far from the natural forest's normal structure or the community similarity index is below 0.75 of the control habitat, then the protection status study is carried out on the species found in the area.

9. Species Status Verification

a. The species status verification is carried out by way of matching the survey results on species data with the Cites, IUCN documents and Government Regulations of the Republic of Indonesia No. 7 of 1999.
b. In case no species which are included in the RTE category according to Cites, IUCN and Government Regulation of the Republic of Indonesia No. 7 of 1999 are found in the area, then the area can be converted into an oil palm plantation.
c. In case species which are included in the RTE category according to Cites, IUCN and Government Regulation of the Republic of Indonesia No. 7 of 1999 are found in the area, then the analysis is carried out on the survival ability of species in the area.
d. The survival ability of species is determined from the population analysis, structure, sex ration and potential of food for those species.
e. In case the species that are included in the RTE category are included in the category of unable to survive in their habitat, therefore, the area can be converted into an oil palm plantation.
f. In case the species included in the RTE category are able to survive in their habitat, then the area should be conserved.

Flow Diagram of RBA Identification