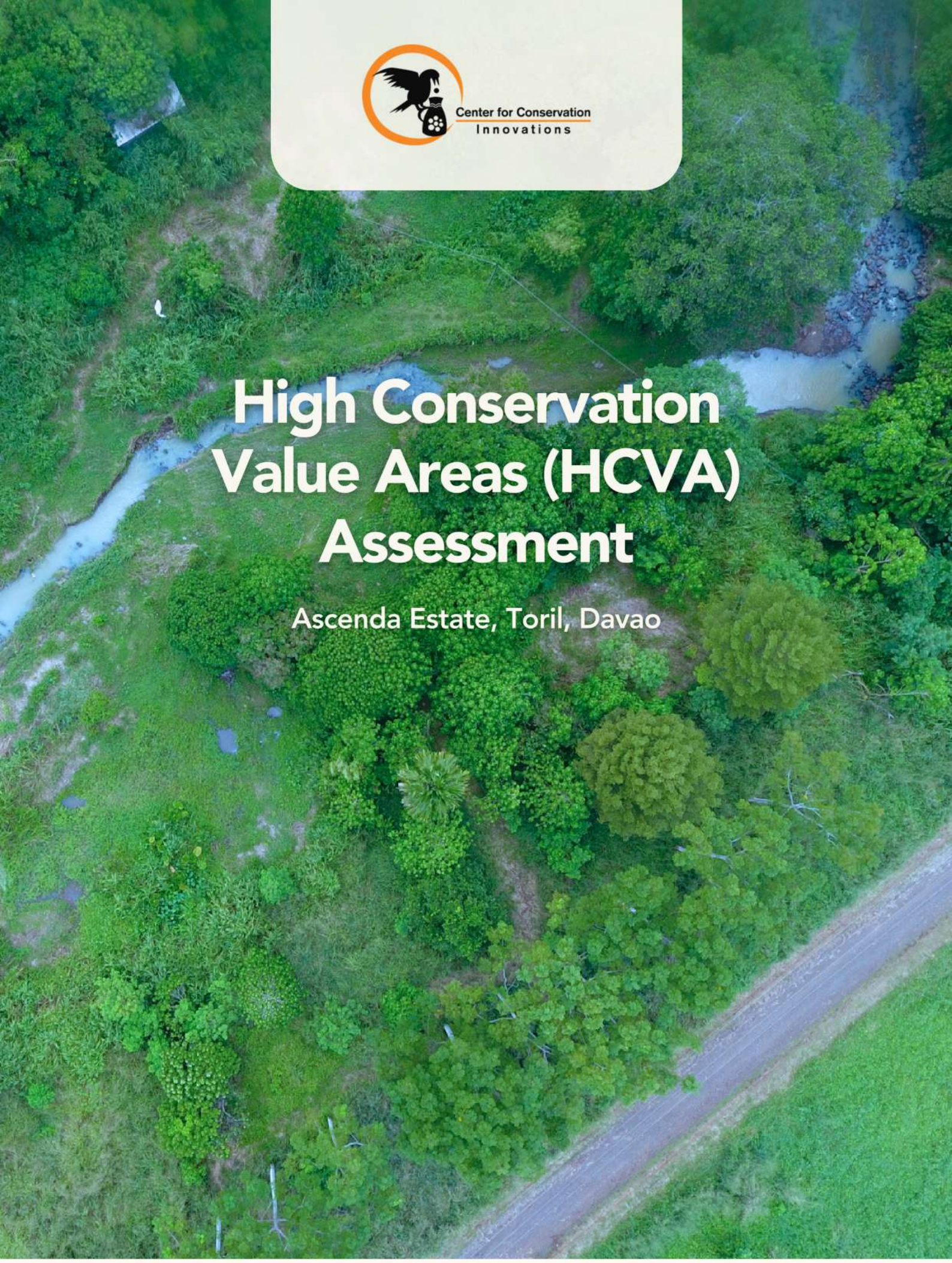

Center for Conservation Innovations

High Conservation Value Areas (HCVA) Assessment

Ascenda Estate, Toril, Davao

January 2024

High Conservation Value Areas (HCVA) Assessment in Ascenda Estate, Toril, Davao

TECHNICAL REPORT

FINAL REPORT

January 2024

I. Table of Contents

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II. Acronyms & Abbreviations

DENR	Department of Environment and Natural Resources
DAO	DENR Administrative Order
HCVA	High Conservation Value Areas Approach
KBA	Key Biodiversity Area
Ha	Hectares
AOI	Area of interest

Species Endemism Classification

PE	Philippine-endemic
IE	Island-endemic
R	Resident
M	Migratory
R & M	Resident and Migratory
N	Native
I	Introduced
Nat.	Naturalized

IUCN/DAO Red List Classification

CR	Critically Endangered
EN	Endangered
VU	Vulnerables
NT	Near-threatened
LC	Least Concern
DD	Data Deficient
NE	Not Evaluated
OTS	Other Threatened Species (DAO 2017-11/ DAO 2019-09)
OWS	Other Wildlife Species (DAO 2017-11/ DAO 2019-09)

Executive Summary

The High Conservation Value Areas (HCVA) concept is designed to help managers improve the social and environmental sustainability of project activities with the end goal of reducing negative impacts on biodiversity, ecosystems, and ecosystem services. Fundamental to the HCVA concept is that development and on-site activities are undertaken in such a manner that protects and enhances conservation values, rather than simply designating no-go zones.

The Accendo Commercial Corporation, an affiliate of Ayala Land Inc., requested an HCVA assessment to be conducted in the proposed Ascenda Estate (65 hectares) located in Toril, Davao. HCVAs are sites containing environmental, social, or cultural attributes considered to be of outstanding significance at the local, regional, or global level. Determining HCVAs is based on the identification of six conservation values, namely: (1) species diversity; (2) landscape-level ecosystems; (3) ecosystems and habitats; (4) critical ecosystem services; (5) community needs; and (6) cultural values. Surveys were conducted within Ascenda Estate in November 2023 using standard biodiversity assessment techniques, ground-truthing through foot patrols, and remotely piloted aircraft systems. Existing HCVs in the project site were then described and mapped.

HCV 1
Out of the 195 species recorded in Ascenda Estate, 31 are endemic to the Philippines, e.g, Antipolo (*Artocarpus blancoi),* Philippine Hanging Parrot (*Loriculus philippensis),* Guaiabero (*Bolbopsittacus lunalutus*), Red-keeled Flowerpecker (*Dicaeum australe*), Greater Musky Fruit Bat (*Ptenochirus jagori*), White-eared Brown Dove (*Phapitreron leucotis*), Small Disked Frog (*Limnonectes leytensis*), Luzon Wart Frog (*Fejervarya vittigera*), Philippine Sailfin Lizard (*Hydrosaurus pustulatus*), and Yellow-headed Monitor Lizard (*Varanus* cumingi). **The presence of these species highlights the conservation value of estate.**

There is **one faunal species and four plant species considered as threatened by the International Union for Conservation of Nature (IUCN) Redlist of Threatened species** (2023). Narra (*Pterocarpus indicus*) is classified as Endangered; the Mindanao Fanged Frog (*Limnonectes* cf. *magnus*) and Bayante (*Aglaia rimosa*) as Near Threatened; Manila Palm (*Adonidia merrillii*) and Bagras (*Eucalyptus deglupta*) as Vulnerable. There are **six faunal species** and **two plant species** considered threatened by the Department of Environment and Natural Resources (DENR) Department Administrative Order (**DAO**) 2017-11 and 2019-09 **threatened list of species**. The Philippine Hanging Parrot (*Loriculus philippensis*) is classified as critically endangered; Molave (*Vitex parviflora*) as endangered; Philippine Sailfin Lizard (*Hydrosaurus pustulatus*), Samar cobra (*Naja samarensis*), Yellow-headed Monitor Lizard (*Varanus cumingi*), and Reticulated Python (*Malayopython reticulatus*) as Other threatened species; and Narra as Vulnerable species. The occurrence of species threatened by extinction in Ascenda Estate signifies the role it could play in helping protect these species.

HCV 2

The project area has undergone significant degradation in the past, with grasslands (28.28 ha or 41.05%) being the most dominant land class in the area. This indicates the absence of HCV 2 (i.e., large landscape-level ecosystems or intact forest landscapes). However, the estate's distance to Mt. Apo Natural Park to its western side suggests that it may have been part of a larger mosaic of forest ecosystems, possibly a former lowland evergreen forest, prior to its degradation.

HCV 3

A segment of the Lipadas river exists in the estate. Freshwater ecosystems, in general, are considered threatened because they are one of the most important yet most degraded ecosystems. It plays a fundamental role in the biogeochemical cycles, nutrient cycling, and human civilization. Protection and rehabilitation of the riparian ecosystem will contribute to further improving this conservation value. On the other hand, there are **no threatened terrestrial ecosystems and natural forest ecosystems** detected in the estate. However, habitat assessment results suggest **certain areas are actively regenerating and are in its early stages of succession**. As the landscape outside the estate is already severely degraded, enhancing the vegetation cover and rebuilding ecological networks within the estate can help minimize further isolation, however small the area is. Enhancing the overall ecological quality and structure of the estate by creating new habitats, "pitstops", and buffers that are important for wildlife is necessary.

HCV 4

The presence of HCV 4 cannot be identified within the estate at present. However, with proper care and rehabilitation of the natural habitats, ecosystem services can be fostered and restored. The presence of the Lipadas River segment within the project area does not guarantee water purification and regulation services. The riparian vegetation is dominated by grasses and the few trees found along the banks of the river do not have extensive and deep root systems capable of landslide mitigation and soil erosion control. **By rehabilitating the river ecosystem it can provide more habitat and provision for faunal species. It can also improve water quality.**

HCV 5

No local communities inside the project area are dependent on natural resources for their basic needs such as food, shelter or livelihood.

HCV 6

Some areas in the estate, through their biophysical qualities, are identified as having **potential cultural services that can contribute to overall recreation and creative expressions.**

Threats

The presence of alien and invasive species, e.g., African Tulip, Gmelina, Trailing Daisy, Hagonoy, and Napier Grass, can threaten the overall health of the ecosystem and disrupt natural processes. Other threats identified in the project area were hunting, excessive residual sediments in the river, water pollution, and flooding.

Recommendations

Detailed management and mitigation measures were identified to protect and enhance the HCVs and address existing threats. These recommendations include the following:

- No cutting of trees that are threatened (Molave and Narra) and endemic (Antipolo). Where possible, do not clear native trees. If management does decide to clear non-native fruiting trees, we recommend replacing these with native fruiting trees and planting them in areas identified for recreation.
- Eradicate the aggressive landscape plants and invasive alien plant species (IAPS) within the project area. Eliminate new IAPS seedlings through mechanical methods then gradually replace mature trees with native vegetation
- Rehabilitate green spaces through rewilding. This involves a deliberate change from a manicured landscape to an intentional state of wildness. It also improves the provision of ecosystem services (HCVs) with minimal intervention.
- Observe appropriate buffer zones along the river to maintain the natural state of the watercourse. Do not clear riparian vegetation because it helps stabilize the banks, prevent erosion, minimize flooding, and improve water quality.
- Conduct regular monitoring of the flora, fauna, and threats in the area.
- Implement mitigation strategies during pre-construction and construction phase to reduce impact of site activities to biodiversity. Consider how the timing, phasing, and direction of clearing, construction, and footprint development will affect sensitive time windows for different species. Follow protocols on wildlife encounters and conduct on-site briefings for contractors and workers.

1 Introduction

Purpose of the Assessment

The Center for Conservation Innovations Ph Inc. (CCIPH) conducted the High Conservation Value Areas (HCVA) assessment for the Ascenda Estate (65 hectares), Toril, Davao City, Philippines. This project was requested by the Accendo Commercial Corporation and implemented for four months (October 2023 to January 2024). The timeline for this project can be found in the **Annex 8**. The assessment aimed to:

1. Establish ecological baselines for fauna and flora while identifying threats to biodiversity;
2. Determine alterations in land cover and pinpoint the specific locations of High Conservation Values (HCVs); and
3. Identify the existence of ecosystem services and assess potential threats to High Conservation Values (HCVs).

High Conservation Values (HCV)

High Conservation Values (HCVs) are environmental, social, and cultural aspects of an area that are considered to be of high importance at the regional, national, or global level. Areas where these values are present and/or where their existence and maintenance are crucial for the identified HCV are referred to as High Conservation Value Areas or HCVAs. The Forest Stewardship Council defined HCVs according to six categories (**Table 1**).

Table 1

Table 1. The six HCV categories and their definitions

	HCV	Definition
1	**Species Diversity**	Concentrations of biological diversity including endemic species, and rare, threatened or endangered species, that are significant at global, regional or national levels.
2	**Landscape-level Ecosystems, Ecosystem Mosaics, and IFL**	Large landscape-level ecosystems, ecosystem mosaics and Intact Forest Landscapes (IFL) that are significant at global, regional or national levels, and that contain viable populations of the great majority of the naturally occurring species in natural patterns of distribution and abundance
3	**Ecosystems and Habitats**	Rare, threatened, or endangered ecosystems, habitats or refugia.
4	**Ecosystem Services**	Basic ecosystem services in critical situations, including protection of water catchments and control of erosion of vulnerable soils and slopes.
5	**Community Needs**	Sites and resources fundamental for satisfying the basic necessities of local communities or indigenous peoples, identified through engagement with these communities or indigenous peoples.
6	**Cultural Values**	Sites, resources, habitats and landscapes of global or national cultural, archaeological or historical significance, and/or of critical cultural, ecological, economic or religious/sacred importance for the traditional cultures of local communities or indigenous peoples, identified through engagement with these local communities or indigenous peoples.

Location of the Assessment

Toril is the 4th largest district in Davao with a population of 13,602 in the 2020 census (CPDO, 2021). The HCVA assessment was conducted at Ascenda Estate, a private property in Brgy. Marapangi, Toril, Davao on November 7 to 19, 2023. The site is located within the Estate's commercial district and has a total area of 65 hectares (**Figure 1**). Regular visitors within the area consist mainly of guard staff and workers of the estate.

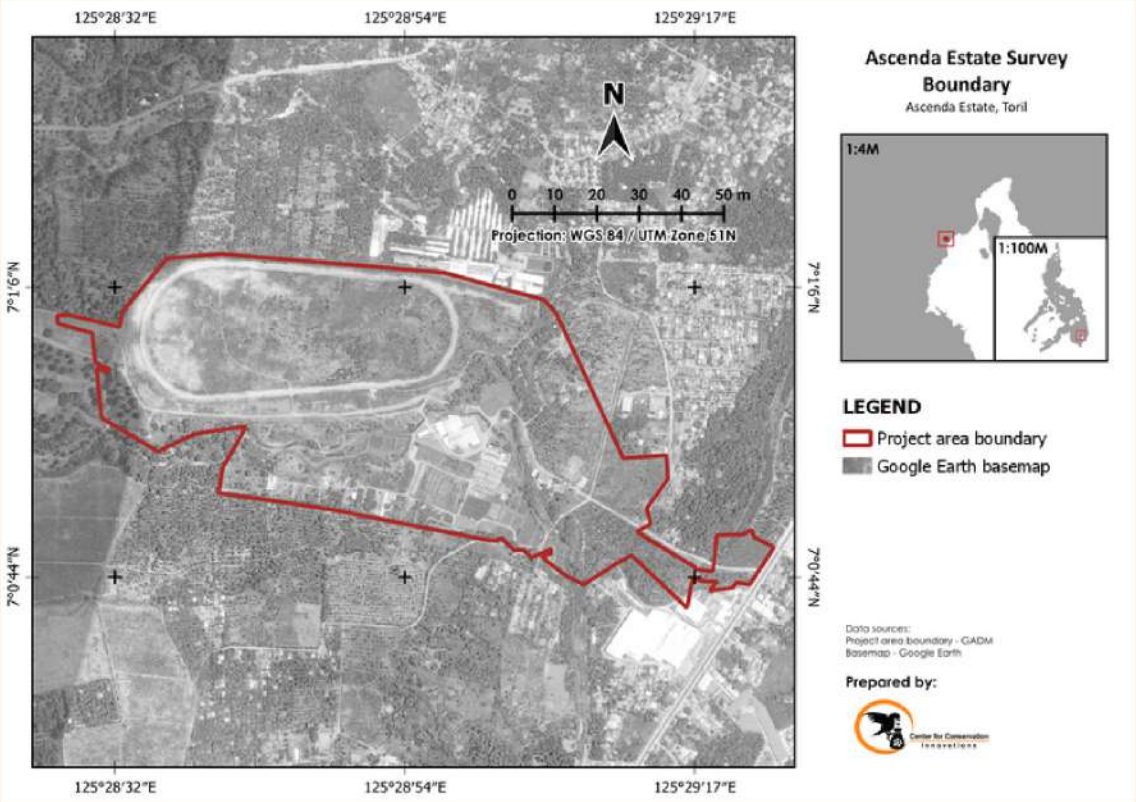


Figure 1. Map showing the boundary of the Ascenda Estate located in barangay Marapangi, Toril, Davao City.

2 Methodology

Field Assessment Methods

Flora and Fauna Assessment

The presence of HCV 1 and HCV 2 were assessed using 63-point stations established for terrestrial biodiversity. The positions of the point stations were randomly generated, with 100-meter intervals spaced at each station (**Figure 2**). We identified threatened and endangered species using the International Union for Conservation of Nature (IUCN) Redlist of Threatened species (2023) and the Department of Environment and Natural Resources (DENR) Department Administrative Order (DAO) 2017-11 and 2019-09.

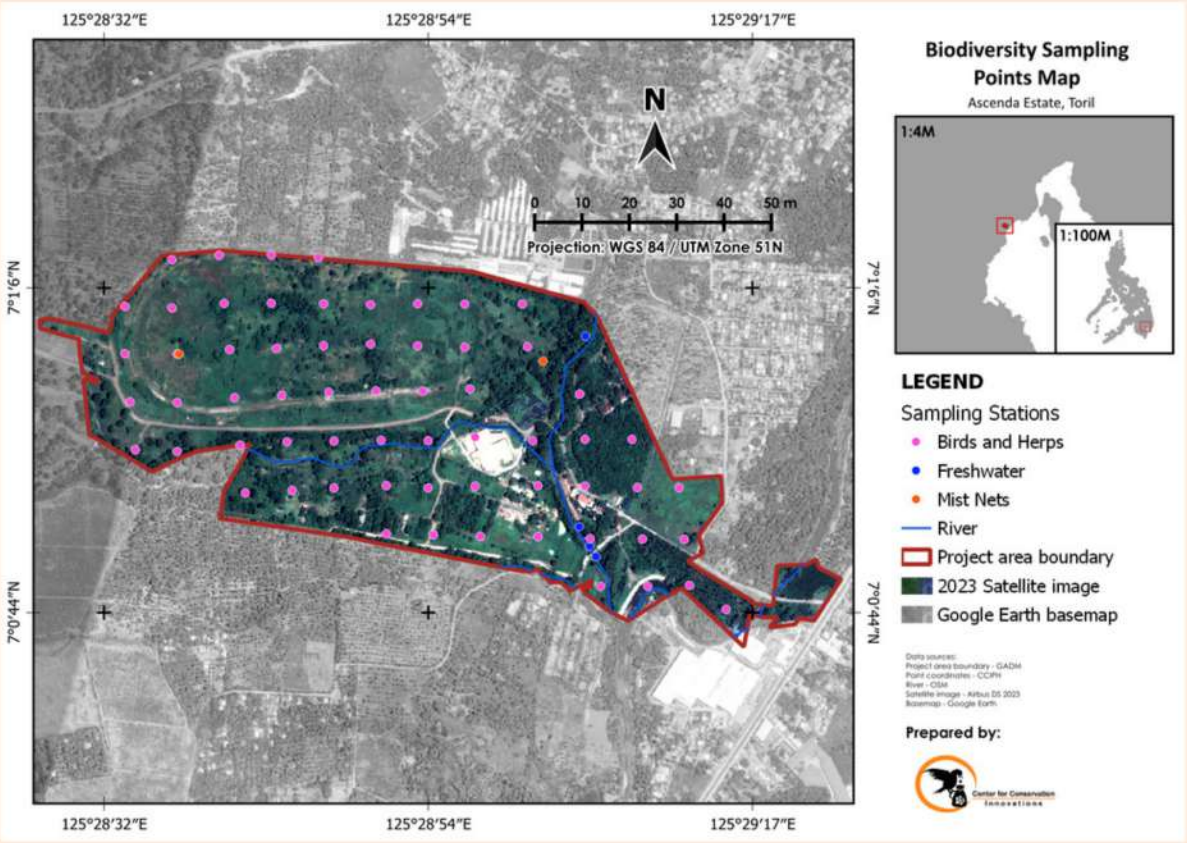


Figure 2. Map showing the sampling station of birds, herps, freshwater, and mist nets.

Flora and Habitat Survey

A 5-meter radius circular plot was established at each station to survey flora (HCV 1) and habitat characteristics (HCV 2). We recorded the tree, understory, and ground cover species within the circular plots (**Figure 3**). This also includes canopy cover readings, number of understory vegetation (saplings, bamboo clumps, palms, rattans, tree ferns), number of fruiting or flowering trees, and percent ground cover. Additionally, a full inventory of canopy trees[1] was carried out within the site. This inventory includes geotagging (GPS coordinates), measuring the diameter at breast height (DBH) and the height of each tree.

Figure 3. (A) Measuring the trunk diameter of a tree.
(B) Identification of species for the full species inventory.

Birds Survey

Point counts were conducted to assess bird communities (HCV 1). This method entailed an observer standing at the center of the point and recording all birds that were seen or heard with a maximum radial distance of 50 meters. The species name, number of birds or birds in a group (for those in flocks), distance from the bird to the center of the station, bird activity, and time of survey were recorded.

Herpetofauna Survey

Herpetofauna or amphibians and reptiles (HCV 1) were surveyed within the established sampling stations via the point count method. All amphibians and reptiles observed within a radial distance of 10 meters were recorded, documented, and released. Additionally, to account diurnal and nocturnal herpetofauna species both day and night sampling were conducted.

1 Only trees with a DBH of >10cm were included in the inventory (BMB and GIZ, 2017)

Mammals Survey

Mist nets and live traps were placed to survey volant and non-volant mammals (HCV 1). All individuals caught were measured, documented, and released (**Figure 4**). General observations for species were also noted in the species list, which included species recorded outside the survey time or point stations.

Figure 4. Retrieval of bats from mist nets for volant mammal sampling.

Freshwater Assessment

There were four sampling stations established for freshwater assessment. This is based on the accessibility and desirability of the location (USGS, 2018). A narrative description was recorded of the water bodies sampled (HCV 3) (**Figure 5**). This narrative includes descriptions on habit, local weather conditions, atmospheric temperature, color, odor, and biological characteristics (USGS, 2018). Additionally, wetted width, water depth, flow rate, and physicochemical parameters of the water tributaries were collected. Measurements were done in triplicate using the concurrent water sampling method.

Figure 5. Habitat assessment of Lipadas river in Ascenda estate, Toril Davao

Geospatial Assessment

Mapping of the High Conservation Value Areas (HCVA) was done through data stocktaking; ground-truthing surveys; image interpretation; and further processing of land cover classification and land cover change analysis (HCV 2 & HCV3). These approaches were carried out to fully assess the landscape in the project area. See **Annex 6** for the detailed methodologies used for mapping HCV 2 and HCV 3.

Stocktaking and Pre-work

Before the field survey, data stocktaking, and desktop work was performed to distinguish the landscape-level ecosystem and land cover in the project area. We used satellite imagery to generate a preliminary land cover classification map to assess the area of interest (AOI), adopting the six land cover class categories from the Intergovernmental Panel on Climate Change. The six classes used were Forest, grassland, wetlands, cropland, settlements, and other Lands (IPCC, 2003). These classes will undergo relabeling considering a more fitting land cover class type once visited on the ground. Having these accurate maps are important when identifying HCVAs. Thus, the datasets gathered from the satellite images must be supplemented by primary data from ground-truthing surveys.

Ground truthing using Remotely Piloted Aircraft System

Extraction of land cover data from satellite images is not easy and this initially requires manually interpreting land cover patches, which might be visually confused with another land cover type. Correctly interpreting a particular patch for its appropriate land cover is critical when it is used to train the software to automatically distinguish almost all patches for their correct land cover classes. To cross-check the presence of particular classes of land cover within the project area, we conducted seven flight missions in the systematically placed 15 random reference points, which are attributed with land cover class type as shown in the reference point and flight plan map in **Annex 4**. Remotely Piloted Aircraft System (RPAS) activity was conducted for ground-truthing (**Figure 6**). The list of flight missions conducted, survey date, location, and area covered in Ascenda Estate can be found in **Annex 5**. After the flight data acquisition, the RPAS photos collected were preprocessed and stitched to form an orthomosaic image. The orthomosaic image was used to validate and interpret the satellite images, map out the historical and contemporary land cover maps, and detect land cover changes in the estate.

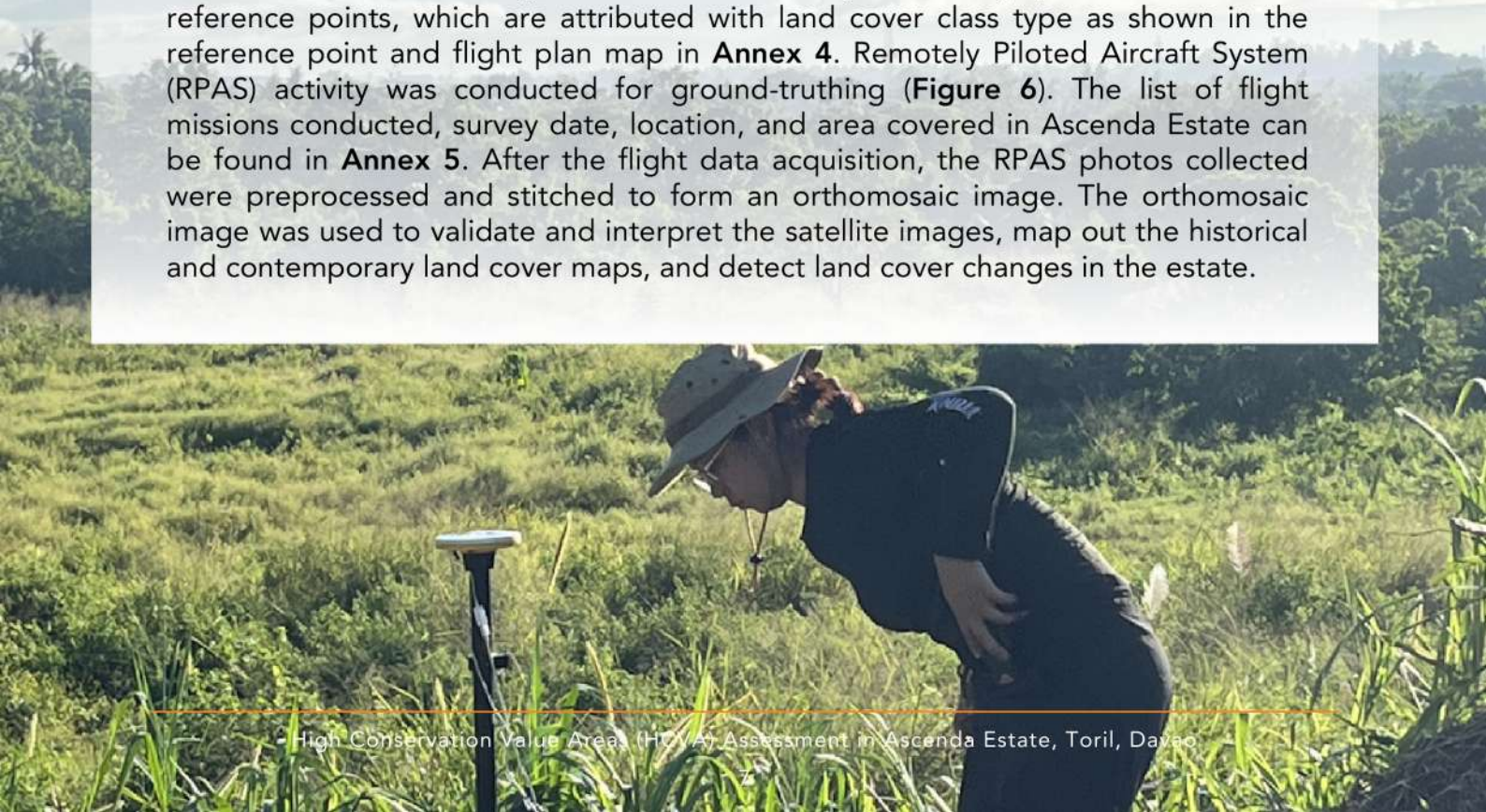


Figure 6. Ground-truthing survey team conducting flight data acquisition inside the Ascenda estate, Toril, Davao City.

Image interpretation and generation of training data polygons for processing

Following the ground-truthing through RPAS survey and processing of the orthorectified mosaics from the aerial photos, we developed the training data and delineated it into homogeneous samples of polygons with corresponding interpretations of land cover class type. These training data polygons are essential for the processing of land cover maps from high-resolution satellite images. It was a challenge to develop a distinct interpretation of the orthomosaic images, given that these interpretations had to be translated into the context of the satellite images.

Land cover classification and land cover change analysis

Historical and contemporary land cover classes were generated from the processed satellite images and incorporated with images obtained from the ground-truthing through RPAS. This analysis involved a direct-change interpretation of the multi-temporal image stack consisting of images from two time periods to illustrate the contemporary land cover and determine the extent of change. We generated land cover change classes using a supervised classification algorithm and calculated area statistics using the raster calculator. A more detailed methodology is found in **Annex 6**.

Mapping of High Conservation Value Areas (HCVAs)

Using relevant information obtained from the HCVA assessment, the HCVAs were mapped to identify the critical areas for protection and management within Ascenda Estate. Areas with overlapping HCVs with a high incidence of threats were considered as high priority areas for management. Mitigation interventions were identified for areas where HCVs and project operations or development are present.

Socioeconomic, Cultural, and Threats Assessment

The socioeconomic, cultural, and threats were assessed and surveyed using 77 reference points (HCV4, HCV5, and HCV 6). The points were randomly generated with a 100-meter radius interval. Ground-truthing data on ecosystem services, cultural values, and incidence of threats were collected at each reference point (**Figure 7**). The IUCN Threats Classification Scheme v3.3 (IUCN, 2023) was used to classify threats as a reference. Additionally, informal interviews with three informants were done to gather additional information about the potential HCVs and existing HCV threats (**Figure 8**).

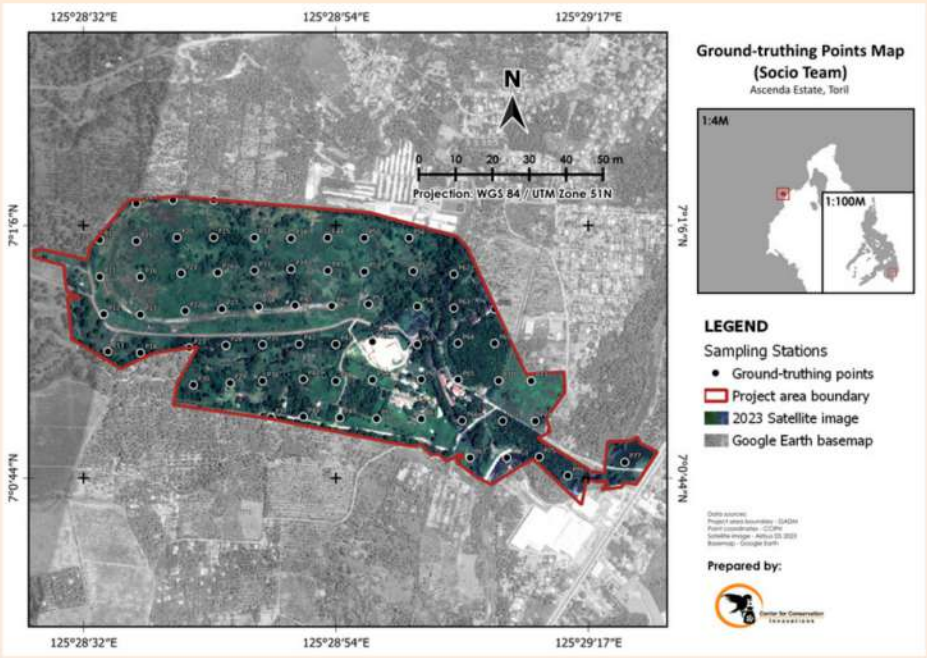


Figure 7. Map showing the reference point for ground–truthing.

Furthermore, the team identified potential sites for recreational activities by utilizing the assessment's biodiversity and land cover data. We overlaid the data and created a visual representation of green spaces with the highest potential for ecotourism development. Based on these overlays, we selected green spaces, prioritizing potential ecological value and considering minimal environmental impact during development.

Figure 8. CCIPH conducting key (A) Informant Interviews and (B) ground surveys.

3 High Conservation Value Areas

The table below summarizes the preliminary results of the HCVA assessment.

Table 2. Summary table of the presence or absence of HCVs in the Ascenda Estate Project Area.

	HCV	Present/Absent	Justification of HCV Identification
1	Concentration of biological diversity including endemic species, and rare, threatened or endangered species	Present	195 species, of which 31 are Philippine Endemic, five are listed as threatened species under the IUCN Red List of Threatened Species, and eight are nationally threatened based on DENR DAO 2017-11, 2019-09.
2	Large landscape-level ecosystems, and ecosystem mosaics	Absent	There are no large-landscape ecosystems and ecosystem mosaics in Ascenda. Project site exhibits disturbed and inconsistent vegetation structures which is dominated by huge land of grasses.
3	Rare, threatened, or endangered ecosystems, habitats or refugia.	Present	There is an increased spatial extent of trees in the project area; allied to the presence of notable native tree species although there are vigorous invasive alien tree species. However, these areas are too small to be considered a refugia or to support viable populations of species. A freshwater ecosystem is present in the area that can be considered under HCV3.
4	Basic ecosystem services in critical situations	Absent	The Lipadas River does not guarantee water purification services and the lack of natural vegetation suggests it is incapable of landslide mitigation and soil erosion control services.
5	Sites and resources fundamental for satisfying the basic necessities of local communities or Indigenous Peoples	Absent	The absence of local communities directly benefiting from the ecosystem services inside the assessment area indicates the absence of HCV 5
6	Cultural values	Potential	Despite the absence of indigenous communities inside the assessment area, the presence of recreational and cultural values within Ascenda supports the potential presence of HCV 6.

HCV 1 (Species Diversity) - PRESENT

We recorded 195 species of flora and fauna within the project area. Species consisted of 64 avifauna, 26 herpetofauna, five mammals, and 100 plant species. We recorded 31 species (16%) that are considered endemic in the Philippines. Birds had the highest number of endemic species while most species of plants within the project area are either native (non-endemic) or introduced to the Philippines. This indicates that HCV 1 is present within the project area.

Flora

A total of 100 plant species were identified during the survey, 38 tree species and 62 non-tree species. Antipolo (*Artocarpus blancoi*) is the only endemic flora recorded within the project site. Notably, based on the IUCN Redlist of threatened species, we recorded four threatened native species. Narra was classified as Endangered. Bayante (*Aglia rimosa)* as Near threatened. Two species were classified as Vulnerable, namely Bagras (*Eucalyptus deglupta*) and Manila palm (*Adonidia merrillii*). (**Table 3**). In addition, Molave (*Vitex parviflora*) is a widespread tree species that is nationally protected and classified as Endangered under DAO 2017-11 (**Table 3**). Both Narra and Molave rank among the most valuable woods in the Philippines and these trees are widely harvested for timber (**Figure 9**) (Vozzo, 2002; Orwa et al., 2009). Overexploitation of the highly prized Narra and molave timbers, together with habitat destruction, has led to the reduction of their subpopulations in the wild (Useful Tropical Plants, 2020). On the other hand, Manila Palm and Bagras are popular ornamental plants but populations within their respective natural habitat are also decreasing (Orwa et al., 2009; Useful Tropical Plants, 2020). Only one sapling of Bagras was recorded within the site and the few stands of Manila Palm were likely planted in the area as part of the previous landscape plan.

Aside from the aforementioned species, Big-leaf mahogany (*Swietenia macrophylla*) is also classified as threatened by IUCN (2023) but recognized as an invasive and alien species (IAS) in the Philippines. Most trees recorded on the project site, including the Narra trees, appear to be intentionally planted for landscaping purposes. The location of the identified trees that have <10 cm DBH are presented in **Figure 10** while location of each threatened native tree species in project site Davao City is presented in **Figure 11**.

Figure 9. Notable flora species found in Ascenda estate.
(A) Narra (*P. indicus*) and (B) Molave (*V. parviflora*)

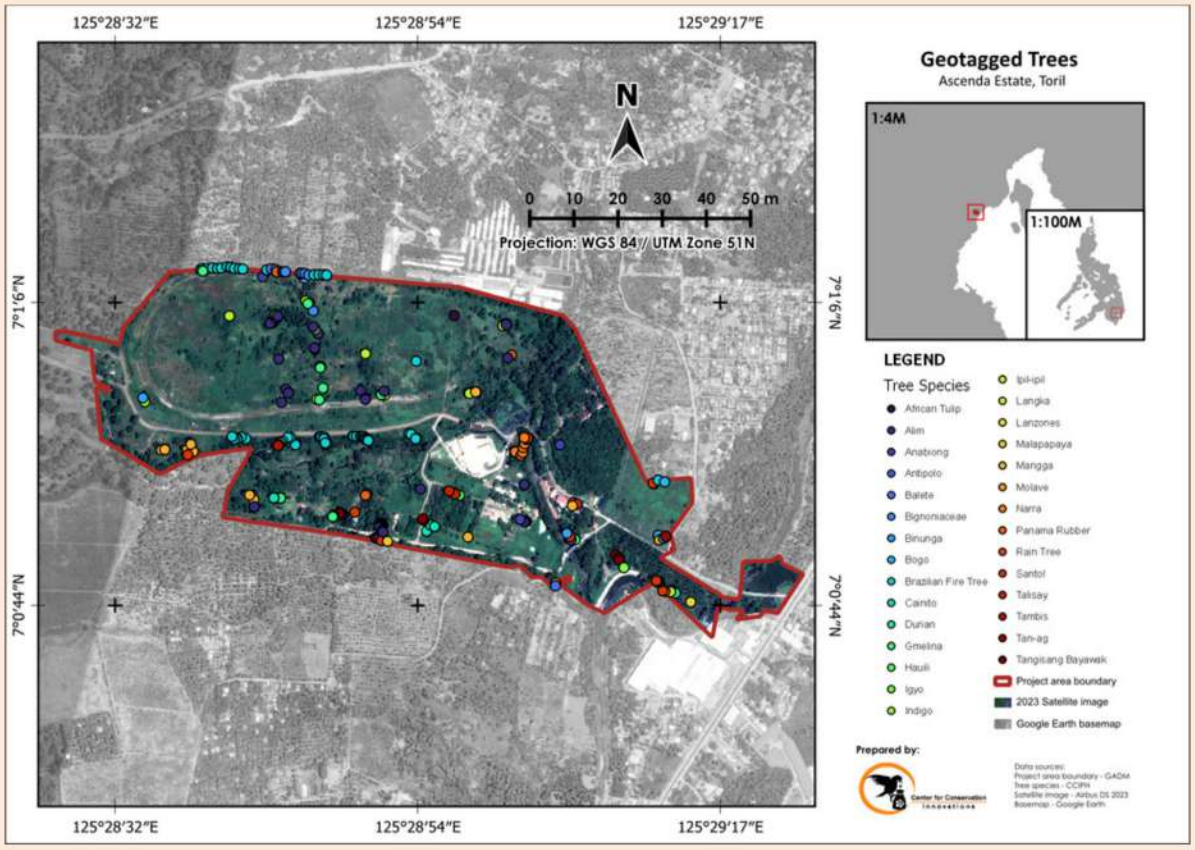


Figure 10. Map showing the geotagged tree species in Ascenda Estate, Toril, Davao City. Geotagged trees have DBH (diameter at breast height) of more than 10 cm. Some areas in the map dominated by coconut, banana, bamboo, and understorey vegetation were not included in the tree inventory.

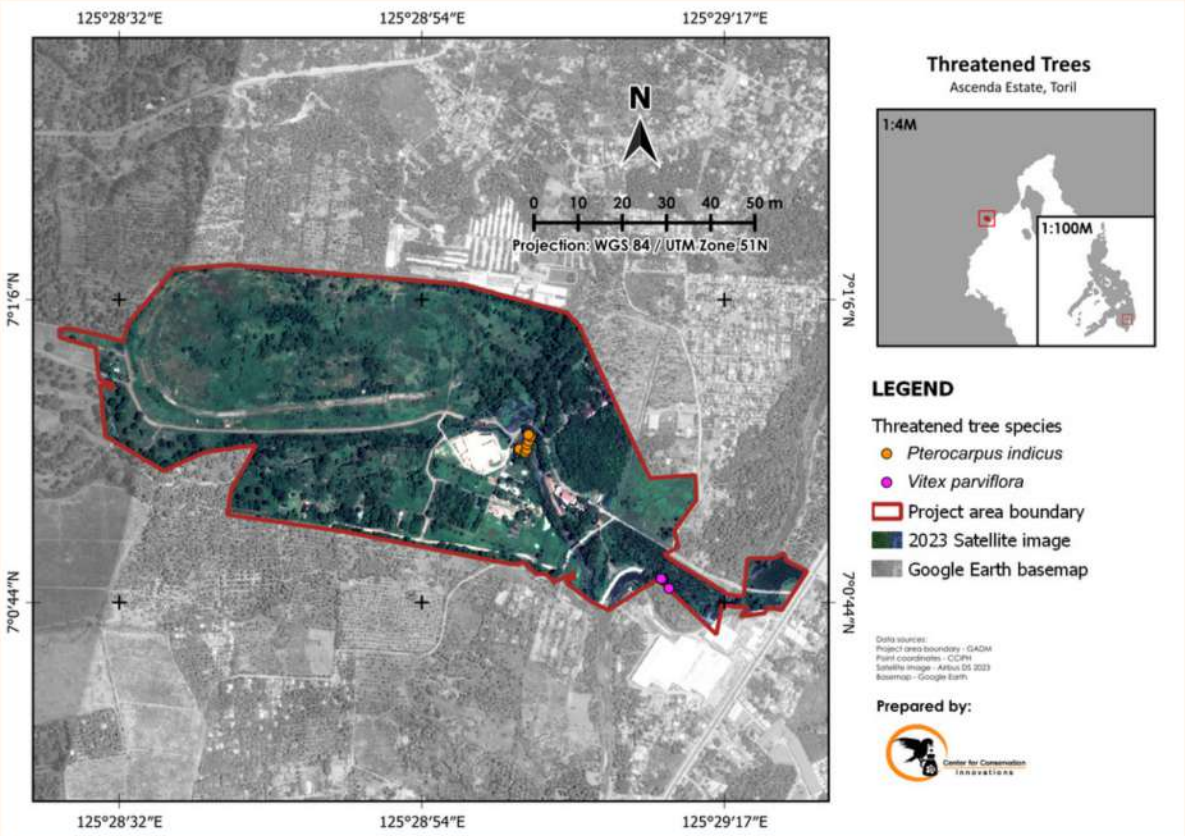


Figure 11. Map showing the location of each threatened native tree species in Ascenda Estate, Toril, Davao City.

Birds

We recorded 64 species of birds in Ascenda Estate. Of which, 17 species are endemic to the Philippines. Two endemic parrot species are present in the project site, the Guiabero (*Bolbopsittacus lunalutus*) and the Philippine Hanging-Parrot (*Loriculus philippensis*) (**Figure 12A**). Both parrots are predominantly fruit-eating birds and are commonly found in lowland forests, adjacent cleared country, and cultivated areas. Food sources in Ascenda Estate include fruit trees such as mango (*Mangifera indica*), santol (*Sandoricum koetjape*), caimito (*Chrysophyllum cainito*), and various *Ficus sp.* The Philippine Hanging Parrot, while classified as Least Concern on the IUCN Red List, the national government has identified the species as Critically Endangered under the DENR DAO 2019-09. This species is considered to be one of the most commonly traded endemic birds in the country. It is prized locally and internationally for its colorful plumage. Other endemic birds observed such as the White-eared Brown Dove (*Phapitreron leucotis*), Brown Tit-Babbler (*Macronous striaticeps*), are Brown-breasted Kingfisher (*Halcyon gularis*) considered as forest generalist species. These species occur in densely vegetated areas and are tolerant of anthropogenic pressure, to an extent. Migratory birds were also recorded. All ten species inhabit open country, grasslands, shrublands and forest edges. These species migrate cyclically to the Philippines during wintering seasons, from October to December and January to March. These include Intermediate Egret (*Ardea intermedia*) and Brown Shrike (*Lanius cristatus*) (**Figure 12B-C**). A complete list of birds in Ascenda Estate are found in **Annex 1A**.

Figure 12. Notable birds observed in Ascenda Estate. (A) Philippine Hanging-Parrot (*Loriculus philippensis*), (B) Intermediate Egret (*Ardea intermedia*); (C) Brown Shrike (*Lanius cristatus*); and (D) Red Keeled Flowerpecker (*Dicaeum australe*).

Herpetofauna

A total of 26 species of amphibians and reptiles were recorded during the biodiversity survey. This included nine species of amphibians and 17 reptile species (13 species of lizards and skinks, and four snakes). Of the 26, 11 are Philippine endemic species. See **Figure 13** for photos of endemic and threatened herpetofaunal species.

There were four endemic frog species recorded within the estate. This included the globally (NT; IUCN Red List 2023) and nationally threatened (OTS; DENR DAO 2019-09) Mindanao Fanged Frog (*Limnonectes cf. magnus*). Mindanao Fanged Frogs occur throughout Mindanao and are known to occur syntopically, within close proximity under the same geographic range, as other *Limnonectes* species (Magdua et al. 2022). This includes the Small Disked Frog (*L. leytensis*), another endemic frog found within Ascenda Estate. The two species mentioned are dependent on the presence of clear freshwater streams. Another species observed was Luzon Wart Frog (*Fejervarya vittigera*), an endemic species capable of surviving in disturbed water bodies such as man-made ponds and canals (Venturina et al. 2020). Lastly, the recorded Philippine Sticky Frog (*Kalophrynus sinensis*) is another ground-dwelling frog found only within the country. This species is dependent on moist leaf litter and the presence of small temporary ponds along the forest floor (Mugot & Binaday 2020). The only arboreal or tree-dwelling frog recorded within the estate was Common Tree Frog (*Polypedates leucomystax*), a native species that is widely distributed throughout Southeast Asia.

Moreover, 14 species of lizards were recorded, including five Philippine endemics. Of these five, two are nationally protected (OTS; DENR DAO 2019-09) endemic species, namely the Philippine Sailfin Lizard (*Hydrosaurus pustulatus*) and Yellow-headed Monitor Lizard (*Varanus cumingi*). The Green-winged Flying Lizard (Draco cyanopterus) is another endemic species recorded within the project site. It feeds primarily on ants and can be observed crawling along tree trunks during the day (Sy, 2023). The three aforementioned species are all threatened by the illegal wildlife trade due to their desirability as exotic pets. Two species of endemic skinks were also recorded, including Graceful Burrowing Skink (*Brachymeles gracilis*), which is found only on the island of Mindanao, and Banded Sphenomorphus (*Sphenomorphus fasciatus*). Lastly, an endemic subspecies of skink Emerald Tree Skink (*Lamprolepis smaragdina philippinica*) was also observed within the project site. This is a visually striking species of skink, particularly when the sun hits its smooth emerald green scales. *Lamprolepis smaragdina* is a species that is also found in Indonesia, Malaysia, Papua New Guinea, Marshall Islands, Taiwan, and Micronesia (Uetz et al., 2021), but the observed individual belongs to a genetically distinct subspecies only found in the Philippines. As only the subspecies is endemic, it is not included in our endemic species count.

Four species of snakes were recorded during the biodiversity survey within Ascenda Estate. This included the endemic and nationally protected (OTS, DENR DAO 2019-09) Samar Cobra (*Naja samarensis*). Equipped with its own potent venom, Samar Cobra is one of the few predators capable of preying upon highly invasive and toxic Cane Toads (Sy, 2023). Two species of bronzeback snakes were recorded, namely the Maren's Bronzeback (*Dendrelaphis marenae*) and the endemic Philippine Bronzeback (*D. philippinensis*). Both species feed on lizards and frogs from both on the forest floor and on trees. Lastly, the Reticulated Python (*Malayopython reticulatus*) was also observed within the state. This nationally protected (OTS, DENR DAO 2019-09) species grows to be one of the largest snakes in the world and feeds on birds, mammals, and other reptiles (Sy, 2023).

Figure 13. Notable herpetofaunal species in Ascenda Estate. (A) Small Disked Frog (*Limnonectes leytensis*), (B) Mindanao Fanged Frog (*Limnonectes* cf. *magnus*), (C) Luzon Wart Frog (*Fejervarya vittigera*), (D) Graceful Burrowing Skink (*Brachymeles gracilis*), (E) Emerald Tree Skink (*Lamprolepis smaragdina philippinica*), (F) Green-winged Flying Lizard (*Draco cyanopterus*), (G) Philippine Bronzeback (*Dendrelaphis philippinensis*), (H) Reticulated Python (*Malayopython reticulatus*).

Mammals

Four species of volant mammals were recorded during the field survey. All are common fruit and nectar bats. One of the species, the Greater Musky Fruit Bat (*Ptenochirus jagori*), is widespread but endemic to the Philippines (**Figure 14A**). The most abundant species during the survey was the Lesser Dog-faced Fruit Bat (*Cynopterus brachyotis*) (**Figure 14B**). These two fruit bat species are commonly found anywhere in the Philippines, including urban and residential areas, as long as there are fruiting trees nearby.

No non-volant mammals were caught in the cage traps during the survey, but the presence of an invasive pest species, the Oriental House Rat (*Rattus tanezumi*) was detected by chance observation. This species is indicative of anthropogenic disturbance.

Figure 14. Notable volant mammal species found within Ascenda Estate. (A) Greater Musky Fruit Bat (*Ptenochirus jagori*) and (B) Lesser Dog-faced Fruit Bat (*Cynopterus brachyotis*).

Table 3. List threatened, or endemic fauna and flora (HCV 1) found in the Ascenda Estate, Brgy. Marapangi, Toril, Davao. *Refer to Annex 1 for the complete list of species.*

Family	Common Name	Scientific Name	IUCN	DAO	Endemism
Fauna					
Agamidae	Green-winged Flying Lizard	*Draco cyanopterus*	LC	OTS	E
Agamidae	Philippine Sailfin Lizard	*Hydrosaurus pustulatus*	LC	OWS	E
Alcedinidae	Brown-breasted Kingfisher	*Halcyon gularis*	LC	OWS	E
Apodidae	Ridgetop Swiftlet	*Collocalia isonota*	LC	OWS	E
Apodidae	Ameline Swiftlet	*Aerodramus amelis*	LC	OWS	E
Caprimulgidae	Philippine Nightjar	*Caprimulgus manillensis*	LC	OWS	E
Colubridae	Philippine Bronzeback	*Dendrelaphis philippinensis*	LC	OWS	E
Columbidae	White-eared Brown Dove (Short-billed)	*Phapitreron leucotis brevirostris/occipitalis*	LC	OWS	E
Cuculidae	Philippine Coucal	*Centropus viridis*	LC	OWS	E
Dicaeidae	Red-keeled Flowerpecker	*Dicaeum australe*	LC	OWS	E
Dicroglossidae	Luzon Wart Frog	*Fejervarya vittigera*	LC	OWS	E
Dicroglossidae	Mindanao Fanged Frog	*Limnonectes cf. magnus*	NT	OTS	E
Dicroglossidae	Small disked Frog	*Limnonectes leytensis*	LC	OWS	E
Elapidae	Samar Cobra	*Naja samarensis*	LC	OTS	E
Microhylidae	Philippine Sticky Frog	*Kalophrynus sinensis*	LC	OWS	E
Nectariniidae	Olive-backed Sunbird (Garden)	*Cinnyris jugularis*	LC	OWS	E
Nectariniidae	Orange-tufted Spiderhunter	*Arachnothera flammifera*	LC	OWS	E
Nectariniidae	Naked-faced Spiderhunter	*Arachnothera clarae*	LC	OWS	E
Psittaculidae	Guaiabero	*Bolbopsittacus lunulatus*	LC	OWS	E
Psittaculidae	Philippine Hanging Parrot	*Loriculus philippensis*	LC	CR	E
Pteripodidae	Greater Musky Fruit Bat	*Ptenochirus jagori*	LC	OWS	E
Pycnonotidae	Yellow-wattled Bulbul	*Microtarsus urostictus*	LC	OWS	E
Pythonidae	Reticulated python	*Malayopython reticulatus*	LC	OTS	N
Rallidae	Plain Bush-hen	*Amaurornis olivacea*	LC	OWS	E
Rhipiduridae	Philippine Pied Fantail	*Rhipidura nigritorquis*	LC	OWS	E

Family	Common Name	Scientific Name	IUCN	DAO	Endemism
Fauna					
Scincidae	Graceful Burrowing Skink	*Brachymeles gracilis*	LC	OWS	E
Scincidae	Banded Sphenomorphus	*Sphenomorphus fasciatus*	LC	OWS	E
Strigidae	Everett's Scops Owl	*Otus everetti*	LC	OWS	E
Timaliidae	Brown Tit-Babbler	*Macronus striaticeps*	LC	OWS	E
Varanidae	Yellow-headed Monitor Lizard	*Varanus cumingi*	LC	OTS	E
Flora					
Arecaceae	Manila Palm	*Adonidia merrillii*	VU	OWS	N
Fabacaeae	Narra	*Pterocarpus indicus*	EN	VU	N
Fabacaeae	Narra	*Pterocarpus indicus*	EN	VU	N
Meliaceae	Mahogany	*Swietenia macrophylla*	VU	-	I
Myrtaceae	Bagras	*Eucalyptus deglupta*	VU	OWS	N
Verbenaceae	Molave / Tugas	*Vitex parviflora*	LC	EN	N

*CR = critically endangered; EN = endangered; VU = vulnerable; NT = Near Threatened; LC= least concern; PE = Philippine endemic; NPE = Near Philippine endemic; ME = Mindanao endemic; R = resident; OTS = other threatened species; OWS = Other Wildlife Species
(*Note: Local Names are based on the WBCP 2021 checklist of birds in the Philippines*)

HCV 2 (Landscape-level ecosystem and ecosystem mosaics) - ABSENT

HCV 2 is defined as the presence of large landscape-level ecosystems and ecosystem mosaics or Intact Forest Landscapes (IFL) that can support viable populations of important species of fauna and flora. However, our land cover analysis revealed that the area is dominated by anthropogenic grassland. Anthropogenic grasslands are grasslands that have been heavily modified by human activities throughout the years[2]. Such degradation can lead to habitat loss as the area is unable to support the majority of naturally occurring species in their natural patterns of distribution. HCV 2 is, therefore, absent.

Aside from grasslands, the spatial extent and resulting contemporary land cover classification map classified eight more land cover classes. These classes consist of trees, shrubs, bare areas, built-up, water bodies, waterlogged areas, and perennial crops; each with descriptive detail on **Annex 7**. **Figure 15** shows the final classification results with further aggregation of mixed vegetation areas; whereas grasses cover a total of 28.28 ha across the Ascenda Estate and with a distinct presence of trees, bamboos, and shrubs (**Table 4**). A significant portion of the surrounding areas are dependent on extensive grazing, specially on the center portion of the project site where there are densely distributed patches of grasses (*Poaceae*), shrubs, and leguminous vines (*Macroptilium atropurpureum*). Whereby domestic livestock are allowed to roam around and consume the low-growing plants.

Tree stands are still present in the area surrounding the perennial crops, while bamboo stands occur in disturbed areas surrounded by shrubs and near the courses of water. These tree stands consist mostly of introduced species (*e.g., Schizolobium parahyba, Mangifera indica, Leucaena leucocephala, Gmelina arborea*), and native pioneer species (*e.g., Melanolepis multiglandulosa, Macaranga tanarius, Ficus spp*). The presence of pioneer species (early colonizers) indicates that certain areas are in the early stages of succession after a major disturbance. Perennial croplands are mostly planted with coconuts and bananas while riparian areas are covered with saplings and bamboo. The dominance of non-native and non-naturalized species in the area suggests intentional introduction for food production or landscaping purposes. Our analysis also revealed grass and nearby built-up areas with waterlogged soils, so it quickly becomes excessively wet throughout the season and unable to drain out water easily. These waterlogged areas are prone to erosion and constrain plant growth.

2 Dove, M. Anthropogenic grasslands in Southeast Asia: Sociology of knowledge and implications for agroforestry. Agroforestry Systems 61, 423–435 (2004). https://doi.org/10.1023/B:AGFO.0000029013.29092.36

Table 4. Calculated area statistics of contemporary cover between land cover classes.

LAND COVER	AREA (ha)
Bare	0.21
Grasses	28.28
Shrubs	7.88
Built-up	5.21
Water	1.25
Trees	9.94
Perennial crops	8.63
Waterlogged areas	1.26
Bamboo	6.23
TOTAL	**68.89**

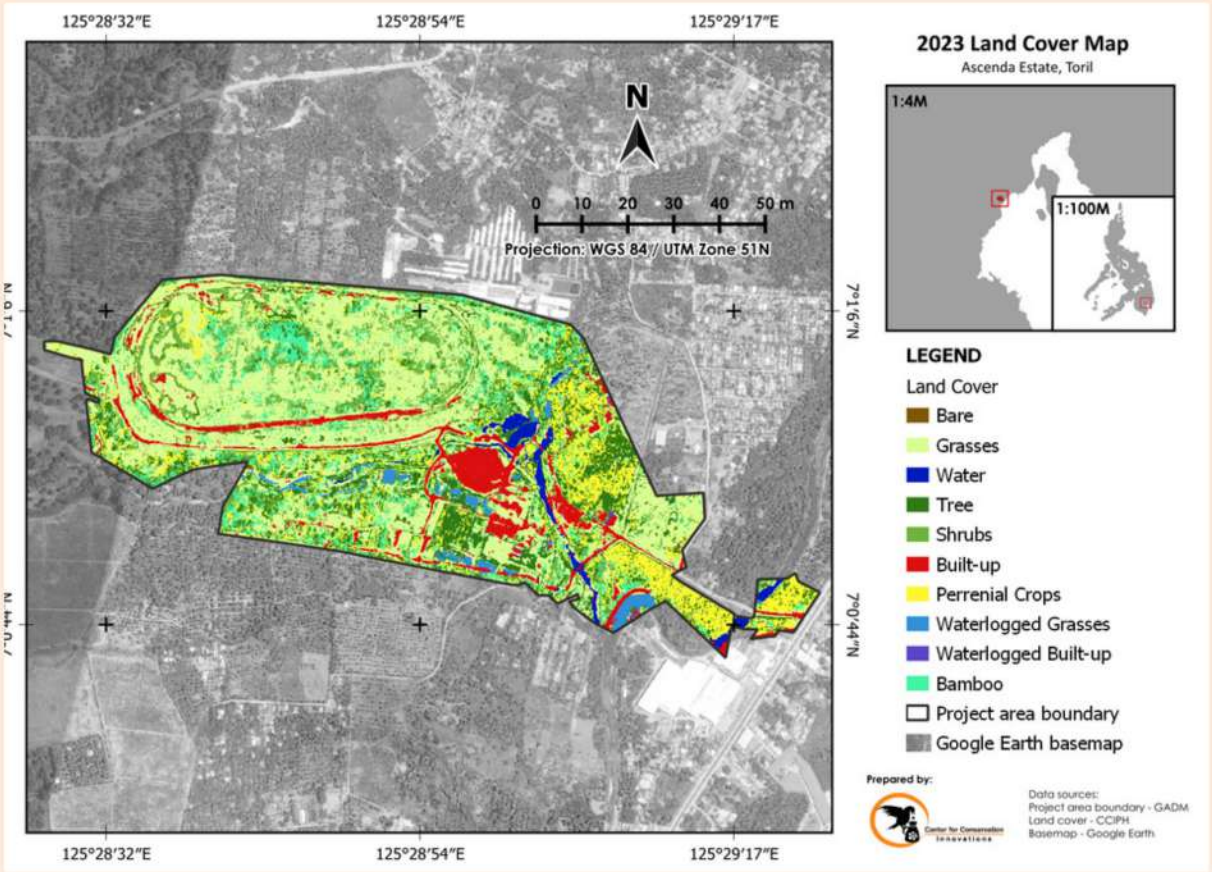


Figure 15. Map showing the Contemporary land cover map of the Ascenda Estate, Toril, Davao.

Nearby Protected Areas, Key Biodiversity Areas and Other Significant Landscapes

The project area is near Mt. Apo Natural Park with a distance of 10.5km, as well as Marine KBAs of Talicud Island and Davao Gulf (**Figure 16 and 17**). This implies that the original habitat in Toril could be part of the lowland evergreen forests of Southeastern Mindanao. Large remnants of lowland dipterocarp forests in Mindanao can be found in Mt. Apo National Park. Mt Apo's natural habitats include lowland evergreen forest (dipterocarp forest), which has mostly been destroyed for farming, lower and upper montane forests, tropical subalpine (bonsai forest), scrub, and summit grassland. More than 800 species of vascular plants were recorded, including HCV1 species. The forest below 1,000 m has been cleared to a large extent, but large patches can still support certain populations of endemic and threatened species like Red Lauan (*Shorea negrosensis)*, Apitong (*Dipterocarpus grandiflorus)*, and *Vatica mangachapoi* (Salvana et al., 2019). No remnants of these species were recorded during the assessment because after a series of large-scale degradation within the estate, the area has reverted back to its early succession stage. Pioneer species such as Tibig (*Ficus nota)*, Antipolo, and Alim (*Melanolepis multiglandulosa)* dominate the area; these are the same species found in the forest edges and disturbed parts of Mt. Apo Natural Park and the rest of Mindanao.

The species richness of Mt. Apo, particularly for avifauna, can be attributed to the elevational gradient, diversity of forest habitats, and species richness of tree species within Mt. Apo (Mohagan et al. 2015). Avifaunal species shared between Mt. Apo and Ascenda Estate appear to be those classified as generalist species that are suited to low elevations (Mohagan et al. 2015; Mohagan et al. 2018). These species are capable of surviving in disturbed or degraded habitats proximal to humans. Avifaunal species that the two areas can share include the Brown Tit Babbler (*Macronus striaticeps*), Red-keeled Flowerpecker (*Dicaeum australe*) (Mohagan et al., 2015), Orange-bellied Flowerpecker (*Dicaeum trigonostigma*), Brown Shrike (*Lanius cristatus*), White-eared Brown Dove (*Phapitreron leucotis*), Yellow-vented Bulbul (*Pycnonotus goiavier*), and White-bellied Munia (*Lonchura leucogastra*) (iNaturalist Community, 2024). Raptors that fly overhead and have wide habitat ranges such as the Grey-faced Buzzard (*Butastur indicus*) and Brahminy Kite (*Haliastur indus*) may also be spotted in both Ascenda Estate and Mt. Apo (iNaturalist Community, 2024). Generalist and disturbance-tolerant amphibian species may also be shared by the two areas, including the Mindanao Fanged Frog (*Limnonectes* cf. *magnus*) and Asiatic Tree Frog (*Polypedates leucomystax*) (Mohagan et al., 2018; iNaturalist Community, 2024). We expect that by restoring and rewilding Ascenda Estate, the vegetation patches can provide small ecological networks that can be beneficial to wildlife and increase species diversity in the area.

For the river network, there appears to be no literature supporting the connectivity of the Lipadas river with the Davao coastal area. Public data on aquatic species found in Lipadas River is also not available.

Figure 16 & 17

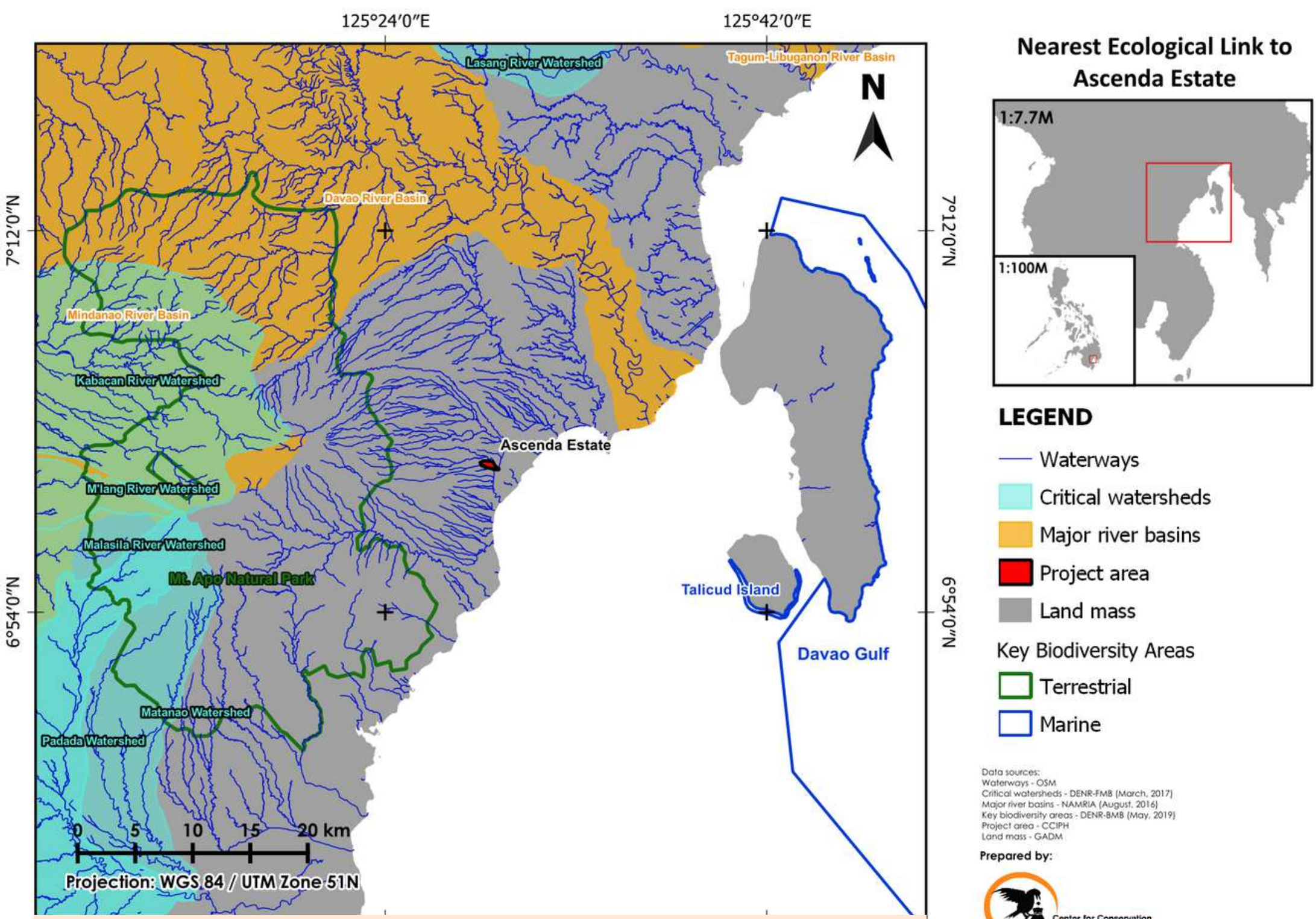


Figure 16. Map showing the nearest Key Biodiversity Areas with the Ascenda Estate in Toril.

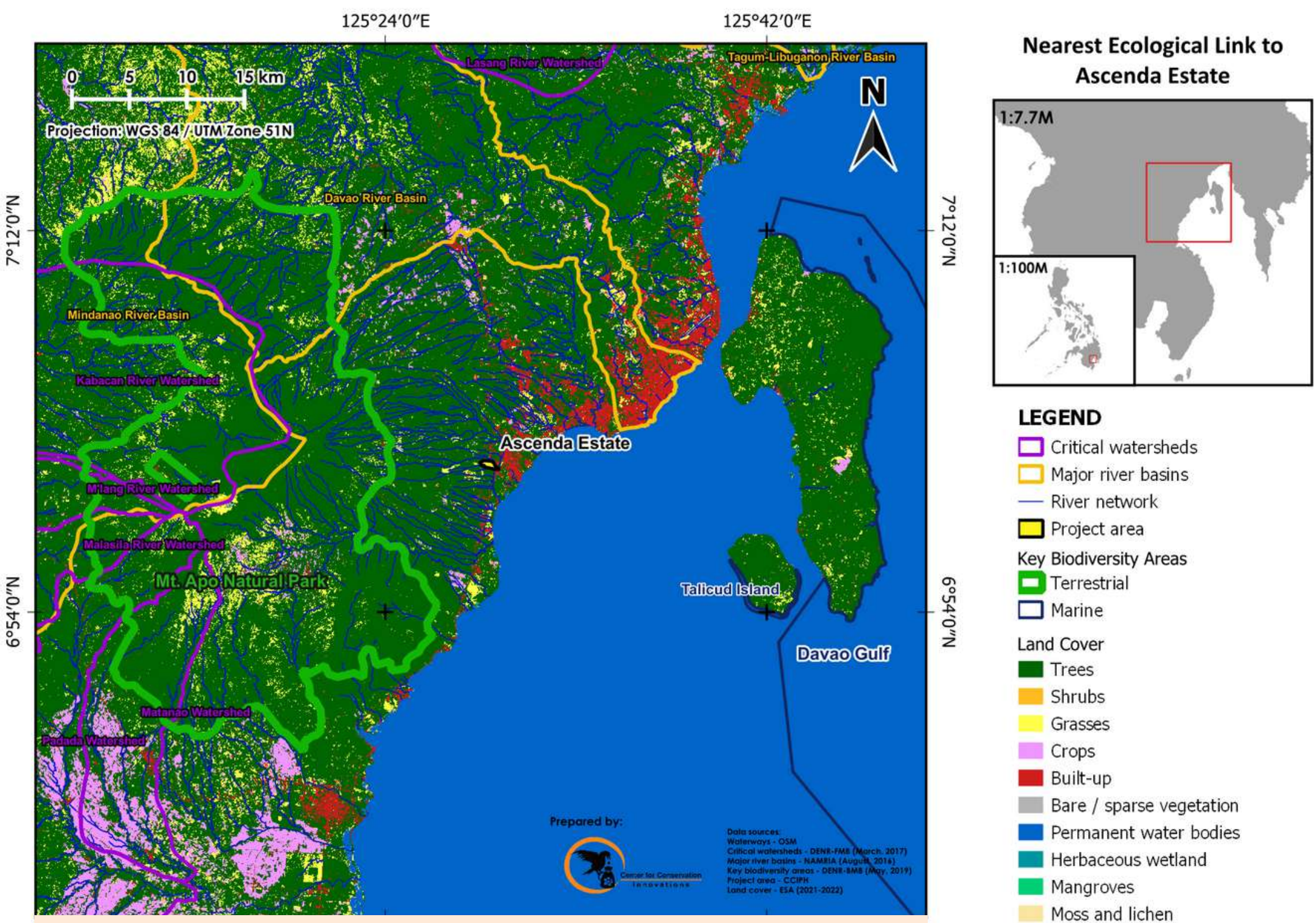


Figure 17. Map showing the nearest ecological link to Ascenda Estate, Toril.

HCV 3: Ecosystems and Habitats - PRESENT

Freshwater ecosystem - PRESENT

The Lipadas River is a stream located in Davao city with a basin catchment area of 133 km2 and ranges in elevation between 114.263 m in MSL to - 2.673 MSL (Paringit & Acosta, 2017). The approximate length of this river is 9.6 km that encompasses Brgy. Alambre, Lubogan, Toril, Lizada, and Sirawan.

The Lipadas stream segment observed in Ascenda Estate can be considered as HCV 3. It has different habitat types such as riffle, pool, and dry areas. The water has no odor, low flow level, and is clear. Analysis of all sampling points indicated that both pH and water temperature fall within the normal range according to DAO 2016-08 water quality guidelines for Class C (**Annex 3**). This suggests that the water body can be used for (1) fisheries to support fish propagation and growth, (2) recreational Water Class II activities such as boating, fishing, or similar pursuits, and (3) agriculture and irrigation. There were no macrophytes, but tilapia fish were observed in the river.

The wetted width of the river is ~16 m with both banks having sparse riparian vegetation composed of trees, shrubs, and grass. These patches of vegetation are observed to protect the bank from flood flows and erosion. Furthermore, the stream beds are composed of sand, small pebbles, fine-grained silt, and sand. On the right bank, adjacent land use such as residential, light grazing, livestock raising were observed. Meanwhile, The left bank of the river has sparse vegetation dominated by Napier grass (*Cenchrus purpureus*). In site four, we recorded the presence of man-made banks (**Figure 18D**). The water can be occasionally brown due to the run off of sediments from mining activities near the area. As an HCV3, management interventions must focus on improving water quality of the Lipadas stream segment.

Figure 18. Photos of each sampling point for freshwater assessment. (A) downstream (B & C) midstream, and (D) upstream.

Natural Terrestrial Ecosystem - ABSENT

Land cover change analysis suggests the absence of naturally occurring ecosystems that can be considered threatened, rare or as wildlife refugia. We also did not detect any areas that can be classified as forest in our 2014 land cover analysis. Reduction in sizes of land cover were observed for grasses, shrubs, bare areas, built-up and water between 2014 and 2023 (**Table 5** and **Figure 19**). On the other hand, we observed an increase in the spatial extent of trees and waterlogged areas in the same timeframe. The increase in tree cover could be a sign that certain areas in Ascenda are in its early stages of succession and regeneration. The increase in tree cover could also be attributed to the planting of common fruiting trees. No changes were detected in perennial crops, waterlogged built-up and bamboo.

Table 5. Area statistics for land cover change between years 2014 and 2023.

LAND COVER	2014 AREA (ha)	2023 AREA (ha)	CHANGE
Bare	4.79	0.21	-4.58
Grasses	28.97	28.28	-0.69
Shrubs	8.39	7.88	-0.51
Built-up	5.46	5.21	-0.25
Water	2.95	1.25	-1.70
Trees	3.41	9.94	6.53
Perennial crops	8.63	8.63	0.00
Waterlogged areas	0.06	1.26	1.19
Bamboo	6.23	6.23	0.00
TOTAL	68.89	68.89	0.00
		Color Coding	reduction
			increase

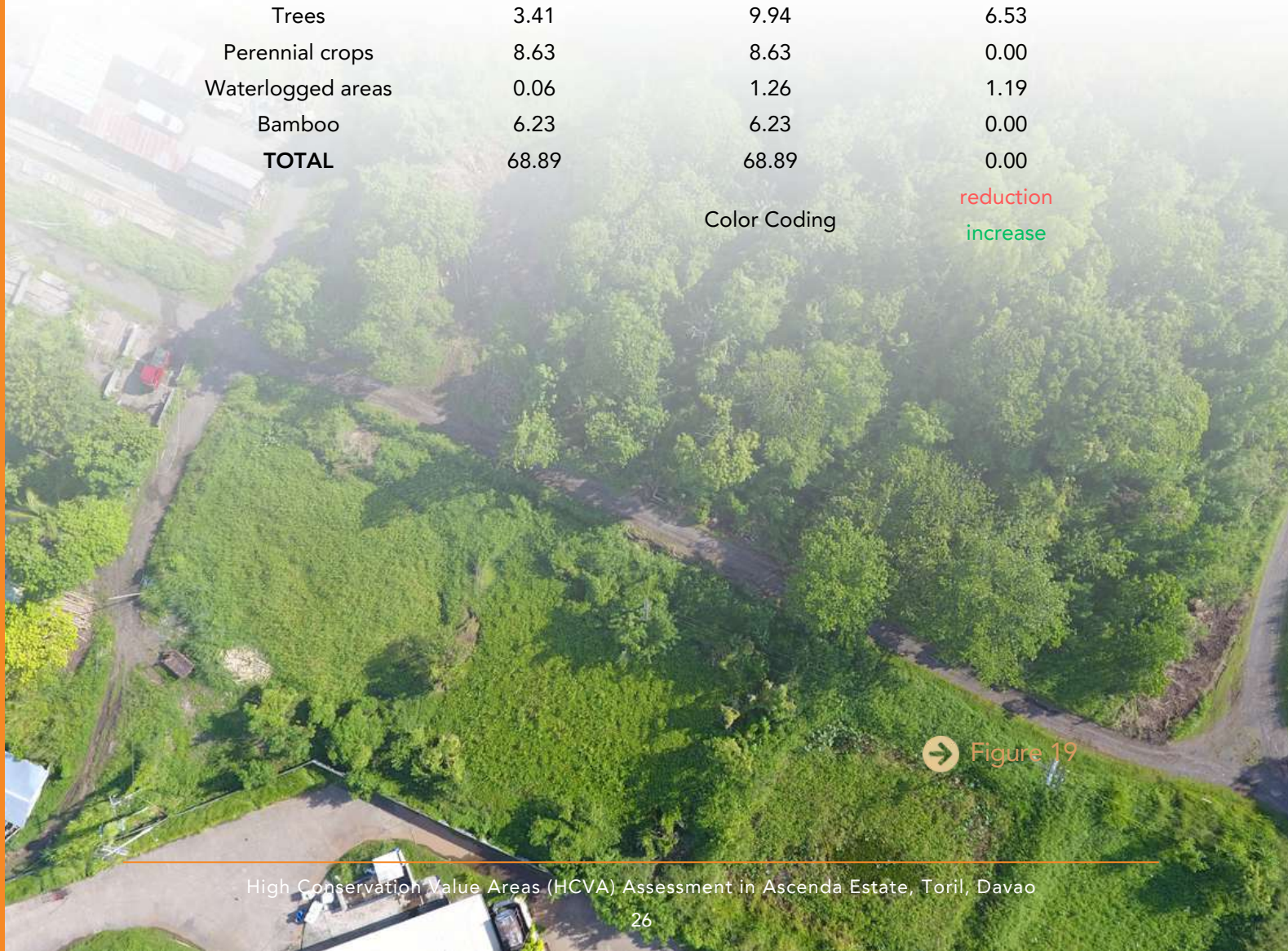
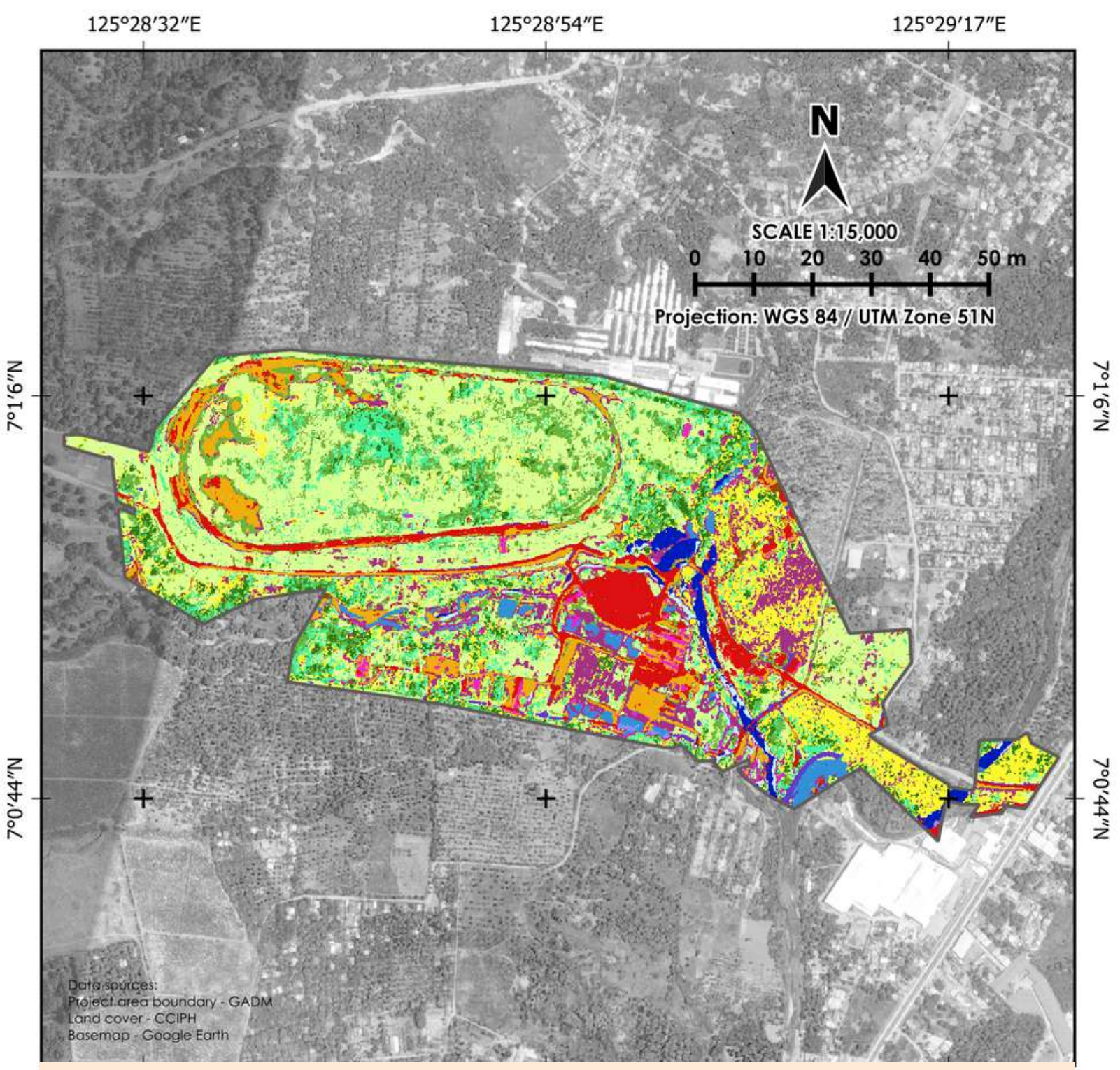
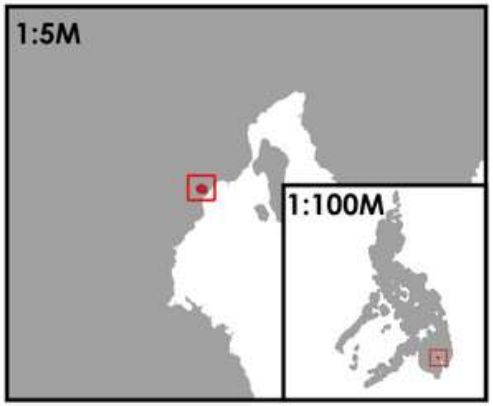


Figure 19



Land Cover Change Map

Ascenda Estate, Toril



LEGEND

Land Cover Change

- Bare to Bare
- Bare to Grasses
- Grasses to Grasses
- Grasses to Water
- Grasses to Tree
- Shrubs to Shrubs
- Shrubs to Built-up
- Built-up to Grasses
- Built-up to Built-up
- Water to Grasses
- Water to Built-up
- Water to Water
- Tree to Tree
- Perrenial Crops to Perrenial Crops
- Water to Waterlogged Grasses
- Waterlogged Built-up to Waterlogged Built-up
- Bamboo to Bamboo
- Project area boundary
- Google Earth basemap

Prepared by: Center for Conservation Innovations

Figure 19. Map showing the land cover change analysis in the Ascenda Estate from 2014 to 2023.

HCV 4: Ecosystem services in critical situations - ABSENT

The ground survey and key informant interviews (KII) revealed that HCV 4 is absent. The Lipadas River indicates the presence of a freshwater ecosystem; however, it does not guarantee water purification service, suggesting an absence of clean water sources and water flow regulation. Ground surveys revealed that the Project area is dominated by anthropogenic grassland (e.g., Napier grass), shrubland with a mix of native and introduced pioneer tree species, and perennial cropland dominated by coconut and banana. This indicates that the vegetation can no longer be considered natural. The minimal presence of tree species with extensive and deep root systems further suggests that landslide mitigation and soil erosion control services are absent in the area.

HCV 5: Community Needs - ABSENT

HCV 5 refers to sites and resources essential for meeting the basic needs of local communities. These resources are irreplaceable, and their loss or damage would severely impact dependent communities. Locals primarily utilize the Lipadas River for fishing, indicating a potential source of food and income. Hunting for wild animals, including birds and bats, occurs for personal consumption, suggesting another resource used by locals. However, there are no local communities inside the assessment area, and only locals from Barangays Marapangi and Lizada, which are adjacent communities, benefit from the potential HCV 5 resources. The absence of local communities directly benefiting from these services inside the assessment area indicates that HCV 5 is absent.

HCV 6: Cultural Values - WITH POTENTIAL

There are no indigenous and local communities residing in the Ascenda Estate. However, there are areas that can provide recreational values (**Figure 20**). The biodiversity data overlaid with the land cover data and Ascenda Estate masterplan, revealed potential areas for ecotourism (referred to the map as blocks 1, 2, 3 and open spaces). Developing eco parks and expanding green spaces can foster biodiversity by creating habitats for local wildlife while simultaneously offering social benefits like recreation, relaxation, and connection with nature (Waugh, 2022). Beyond the eco park, the team considered the artificial pond's ecotourism potential. Areas near the artificial pond have the presence of native tree species. The artificial pond is suitable to be a wild space where plants and animals can thrive without constant human interference (Threlfall & Kendal, 2018). The management and mitigation plan of this report further discusses our recommendations for the sites identified as HCV 6.

Figure 20

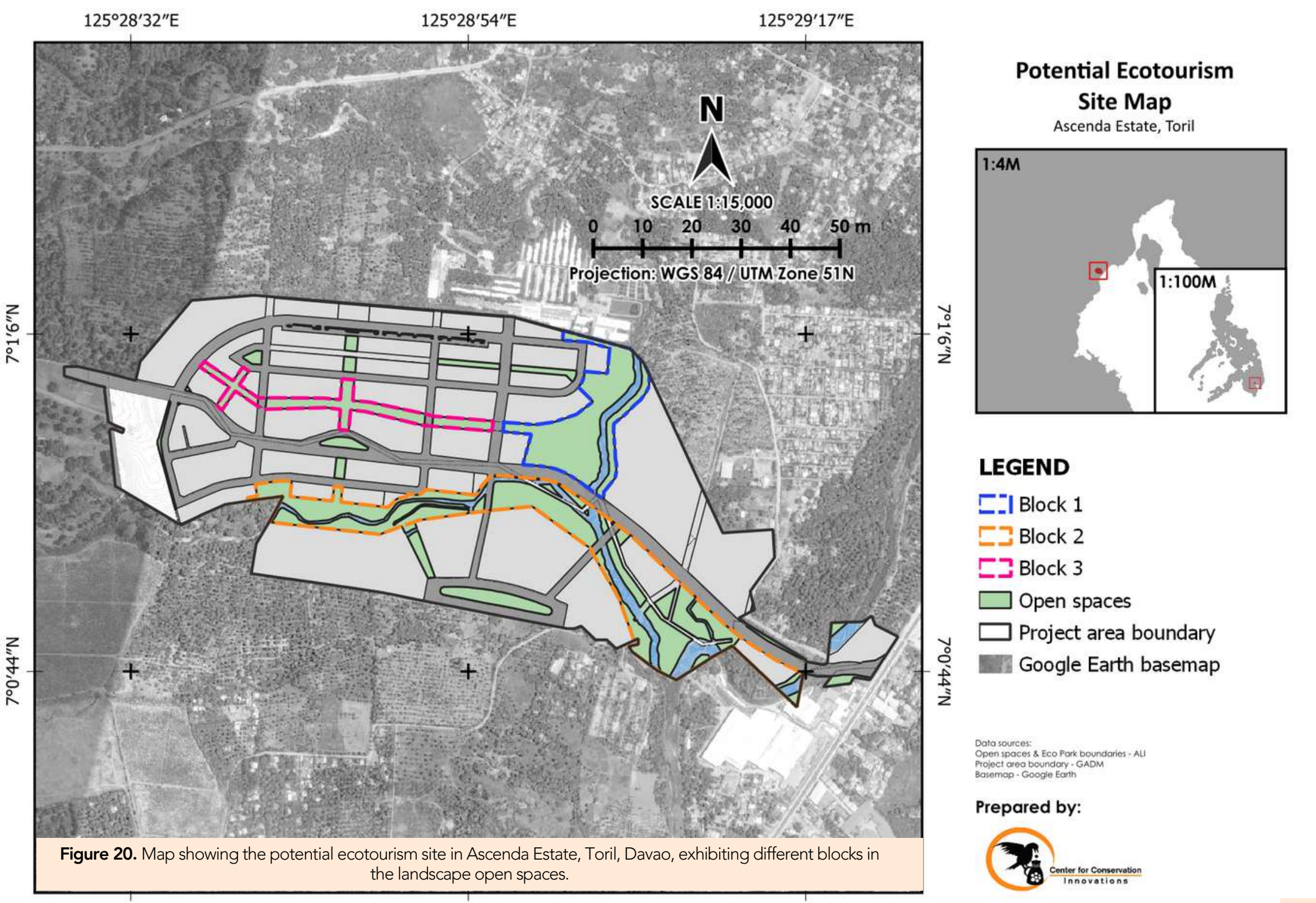


Figure 20. Map showing the potential ecotourism site in Ascenda Estate, Toril, Davao, exhibiting different blocks in the landscape open spaces.

4 Threats to HCV and Recommended Interventions

Water Pollution

IUCN category: Pollution: Domestic & urban waste water

HCV affected: HCV 1 (species diversity) and HCV 3 (Ecosystem and habitat)

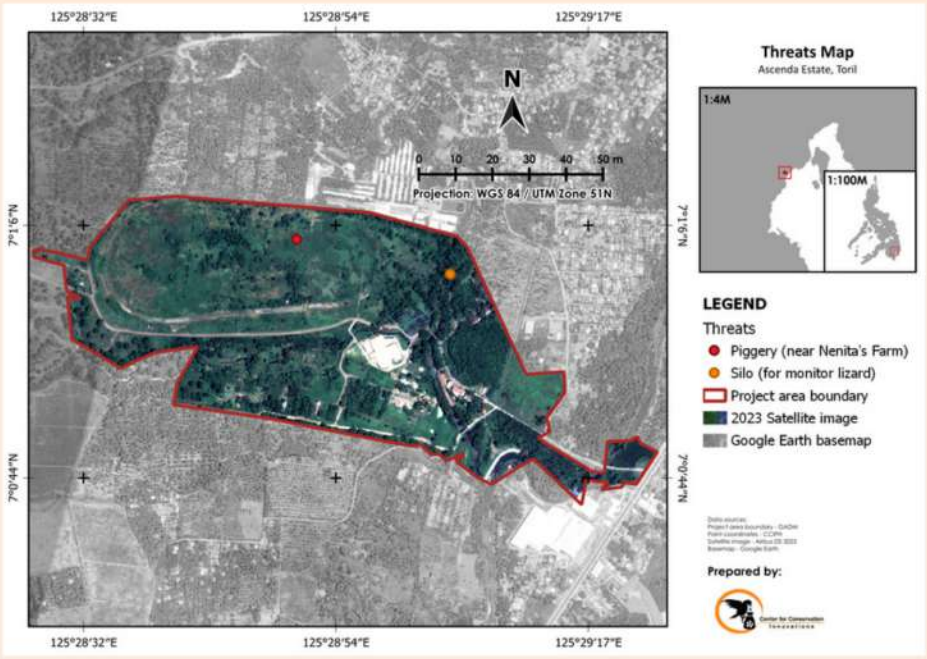


Figure 21. Map showing the threats observed in Ascenda Estate, Toril based on ground-truthing and interviews.

Description of the threat: Pig farms were observed within the Ascenda Estate. Pigs are an important source of meat in the Philippines as they are common in Filipino diets (Huynh 2006). Informants confirmed that the pig farm near Nenita's Farm will be dismantled when development begins. However, concerns remain about nearby operational pig farms utilizing lagoon-type sewage systems. According to informants, it overflows into the river during heavy rains (**Figure 21**). Wastes of pigs commonly carry parasites, bacteria, and viruses. The run-off pollutes the water body via excessive nutrient loading (e.g., nitrogen and phosphorus). Thus, poor water quality can result from excessive algal growth, eutrophication, and increase in water turbidity, making it toxic to fish (He et al. 2016). The wastes contaminate the river, thereby affecting species that depend on the river, and also humans who benefit from it for recreational activities. Moreover, this may also pose danger to the public health of the residents nearby.

Recommended intervention: In order to handle excess flow from the lagoon, we recommend drawdowns during low-flow periods, in anticipation of heavy or persistent rains. Periodic measurement and removal of bottom deposits might also help preserve the lagoon volume. If possible, a high flow response plan may be developed. If left unmitigated, excessive and continuous runoff can lead to the death of the water body. Thus, the ecosystem services provided by the river for recreational activities such as fishing may be lost.

Hunting

IUCN category: Biological resource use: Hunting and collecting terrestrial animals

HCV affected: HCV 1 (Species diversity)

Description of the threat: Subsistence hunting of terrestrial animals for local consumption has been recorded to occur on the site. Locals residing outside the estate often hunt birds and bats using handguns, while monitor lizards are hunted using traps called "silos" (**Figure 21**). Hunting, if unsustainable and unregulated, may affect the animal population andiversity (HCV 1). Populations of the targeted species (e.g., birds, bats, and monitor lizards) may directly reduce, potentially leading to their decline. This type of activity may also potentially affect ecosystem services. The decrease in the number of birds and bats in the area due to hunting, for example, may disrupt important ecosystem functions such as pollination and seed dispersal, impacting the health and resilience of the ecosystem.

According to the informants, the frequency of hunting in the area has gradually decreased over the years because of restricted access. This action may reduce hunting pressure, allowing hunted species to recover and help minimize damage or disturbance to habitat that may lead to improved biodiversity.

Recommended intervention: Access to the site has been restricted as part of securing the area. This action has helped in reducing hunting activity. Additionally, the estate management may also develop enforcement and awareness strategies. They can implement a monitoring system to track and assess the hunting area. However, this may require adequate resources and staffing for effective patrolling and monitoring. They can also conduct activities that will raise awareness (e.g., IECs) about the importance of protecting these species.

Excessive residual sediments

IUCN category: Climate change and severe weather: Excessive river runoff due to heavy rainfall

HCV affected: HCV 1 (Species diversity) and HCV 3 (Ecosystems and habitat)

Description of the threat: The nearby river in the estate has been experiencing excessive soil runoff, rendering its waters turbid. Informants confirmed that rapid runoff can be observed in the river during heavy rainfall, particularly during short periods. Heavy rains over a short period can overwhelm the capacity of the soil to absorb water, leading to rapid runoff into the river. The reduced vegetation cover near the riverbanks further exacerbates the situation. Commonly observed vegetation in the area were perennial crops and grasses. Trees help absorb and slow down rainwater, but their reduced presence can expose the soil and even accelerate runoff. Increased water flow can scour riverbanks and carry away soil, leading to habitat destruction and sedimentation buildup in the downstream areas. It can also reduce the water quality, which may be harmful to human health and unsuitable for recreation or irrigation. Small watercourses have relatively low biodiversity and are prone to biodegradation due to the presence of water, small size, and low water level (Kelly-Quin et al. 2019).

Recommended intervention: The management can consider restoration of the natural landscape of the riparian areas to filter and retain runoff naturally. The gradual increase of native riparian vegetation can lead to a stable bank and avoid further erosion and runoff in the watercourses. Vegetation can also filter pollutants and runoff from the surrounding land, improving water quality in the river. Additionally, we can further reduce the impact of erosion and runoff by relocating roads to minimize the disturbance in riparian vegetation and aquatic habitats.

Invasive and Alien species

IUCN category: Invasive and other problematic species, genes and diseases: Invasive Non-native/Alien Species

HCV affected: HCV 1 (Species diversity) and HCV 3 (Ecosystems and habitat)

Description of the threat: Invasive alien species (IAS) are regarded as a global problem that threatens the integrity of many ecosystems and causes severe ecological, economic, and social consequences. In the ecological setting, IAS are notorious for affecting ecosystem processes, altering the species composition and structure of natural habitats, and outcompeting native species, resulting in a decrease in indigenous flora and fauna diversity (Mavimbela et al., 2018). On the socio-economic aspect, the presence of IAS can damage infrastructures and affect the well-being of native animals and humans. This clearly underlines the need to develop control and management techniques to decrease the consequences of IAS on biodiversity and ecosystems.