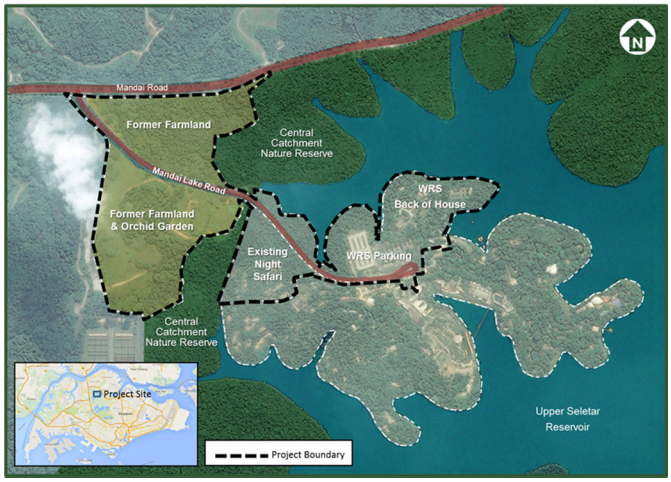
Mandai Park Holdings

Environmental Impact Assessment,
Non-Technical Summary

Introduction

Mandai Park Holdings Pte Ltd (MPH) has submitted a proposal for the development of new attractions (the Project) to complement the existing nature based attractions in the Mandai area. The Project area, which includes land that has been identified for development since 2007, is located outside of the Central Catchment Nature Reserve (CCNR).



As part of the planning and design process, MPH commissioned an Environmental Impact Assessment (EIA) of the Project. The EIA process commenced with the screening and scoping of possible environmental impacts in late 2014. Baseline environmental surveys of the Project area then commenced in March 2015 to characterise the sensitivity of the environment that may be affected by the Project. The impact assessment involved the prediction and evaluation of environmental impacts from the construction and operation of the Project based on the concept design. This enabled the establishment of measures to mitigate impacts, which will be monitored in accordance with an Environmental Management and Monitoring Plan (EMMP).

Stakeholder Engagement

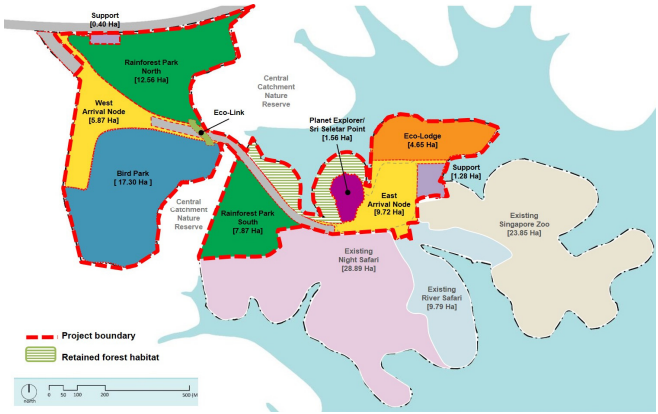
There has been extensive engagement with external stakeholders, including government agencies and nature groups, throughout the progression of the concept design, masterplan and EIA. This has enabled potential impacts to be identified and measures to be incorporated into the concept design and EMMP in order to avoid or mitigate these impacts. Stakeholder engagement will continue beyond the EIA and into the detailed design, construction and operational phases.

The Project

The Project involves the development of approximately 35.4 ha of land to the west of the existing Singapore Zoo. Historically, the land included a village, farmland and the Mandai orchid farm. This land is currently disused. In addition, there will also be redevelopment within the land area currently leased by Wildlife Reserves Singapore (WRS). The total area for development is 63.94 ha. There will be no development within the CCNR.

The new attractions will comprise a rainforest-themed park; a new bird park to replace the existing Jurong Bird Park; an indoor facility for conservation, research and educational programs and exhibitions; accommodation and camping facilities; and public amenities including food and beverage outlets. Development of these new attractions will require modifications to existing facilities, infrastructure and utilities such as parking areas, drainage systems, pedestrian boardwalks, and the upgrading of Mandai Lake Road.

A central component of the conceptual design is a forested Eco-Link to establish connectivity between two fragmented sections of the CCNR on either side of Mandai Lake Road.



Conceptual Master Plan

Development Of The Concept Design

From the outset of the planning stage, guiding principles were developed in consultation with agencies to inform the conceptualisation process. These included minimising the Project footprint to protect and retain habitats and areas of

high biodiversity value, and the facilitation of connectivity between habitats.

During the masterplanning stage, experts also worked collaboratively with MPH to develop a concept design which incorporates environmental impact minimisation measures following the mitigation hierarchy of "avoid, minimise, manage, and compensate". Some of the key measures integrated into the concept design are as follows:

Eco-Link

Several designs for an Eco-Link were considered to establish connectivity between the two fragmented sections of the CCNR on either side of Mandai Lake Road. The configuration selected aims to maximise ground-level connectivity across Mandai Lake Road for species within the CCNR. The Eco-Link will also be wholly constructed within a buffer area outside of the CCNR, avoiding any direct impact on vegetation and trees within the CCNR.

Combining the Planet Explorer and Sri Seletar Point Facilities

The original plan was to build the educational/conferencing facilities, known as Planet Explorer and Sri Seletar Point, as separate buildings along the reservoir edge. This was subsequently modified to incorporate both facilities into a single building constructed on the existing WRS carpark to reduce the building footprint and avoid any impact on the nearby forested area, which is of high biodiversity value. Other areas of high biodiversity value, e.g. the mature forest north of the existing Night Safari and Mandai Lake Road, were also delineated as areas which will be avoided and protected.

Location of Arrival Nodes

The initial plan incorporated a single arrival area for members of the public, at the eastern side of the Project area adjacent to the CCNR. To avoid introducing a large number of visitors to one arrival area next to the CCNR, the concept design evolved to incorporate two arrival nodes, one to the west and one to the east of the CCNR. This change helps to spread out visitors and diverts a significant proportion of visitors away from the sensitive areas around the CCNR.

Location of the Bird Park and Rainforest Park

The location for the new Bird Park was originally planned to be on the north side of Mandai Lake Road, while the southern area of Mandai Lake Road was going to be a Rainforest Park. These locations were switched following a review of the EIA baseline survey results that indicated higher biodiversity values of the land (in particular, the presence of more mature trees) to the north of Mandai Lake Road. Relocating the Rainforest Park to the north of Mandai Lake Road will better protect the existing forest, as the mature trees can be integrated into the Rainforest Park design.

Buffer Zones

Land will be set aside within the Project area to maintain a 45 m to 50 m wide buffer zone between the eastern boundaries of the development and the CCNR, to minimise potential edge effects and disturbance to flora and fauna within the CCNR. There will be no development or vegetation clearance (except for the purpose of constructing the Eco-Link) within the buffer zone and fencing will be erected to prevent unauthorised human access to the CCNR.

Walkways and Boardwalks

The pedestrian walkways and boardwalks have also been designed to be sensitive to the movement of indigenous wildlife and have been routed to avoid the areas of high biodiversity value.

Baseline Environment

Field surveys were undertaken within and surrounding the Project area to establish the baseline environmental conditions, including:

- Surface water quality;
- Soil and groundwater;
- Ambient noise;
- Ambient air quality; and
- Ecology and biodiversity.

Existing water features in the Project area include perimeter drains, roadside drains, an unnamed stream and the Upper Seletar Reservoir. Baseline surveys were conducted close to where construction and operational activities will take place. The survey results indicated that water quality at these areas were within regulatory limits.

Soil and groundwater surveys were undertaken at locations based on a review of the historical land use and the proposed underground structures, such as carparks. The analytical

results were within standards and were typical of the natural variation in Singapore. Groundwater in the Project area ranges from 0.8 to 6.0 m below ground level and generally flows northwest and away from the Upper Seletar Reservoir.

Noise was monitored at selected locations and was supplemented by short-term measurements and vehicular traffic counts. Noise was monitored at levels up to 75 dB(A) near Mandai Lake Road, whereas noise levels in the forested areas away from Mandai Lake Road were up to 69 dB(A). Ambient noise at locations south of Mandai Lake Road was influenced by natural sounds and overhead aircraft with the highest noise level recorded at 73 dB(A). Noise within the existing Singapore Zoo was found to range between 43 and 78 dB(A).

Particulate matter less than 10 microns in diameter (PM_{10}) was measured to establish the ambient air quality due to existing emission sources such as vehicular traffic along Mandai Road and Mandai Lake Road. Results taken during the south-east monsoon period were generally within the Singapore air quality targets, while the inter-monsoon survey was adversely affected by haze from forest fires in Indonesia last year.

The biodiversity surveys undertaken were completed by local specialists, including specialists from the National University of Singapore and Lee Kong Chian Natural History Museum. The groups of flora and fauna surveyed were selected to provide a representative coverage of the biodiversity of the site. Forest mapping was undertaken to identify the distribution of habitats within the site to determine species associations and important habitats for species that utilise the site.

Findings from the biodiversity field surveys highlighted a number of internationally and nationally threatened species (such as the Sunda Pangolin (*Manis javanica*) and Straw-headed Bulbul (*Pycnonotus zeylanicus*)) within the Project area. A significant number of exotic and invasive plant species (such as the *Cecropia pachystachya* tree and African tulip (*Spathodea campanulata*)) were also identified within the Project area.

Environmental Impacts During Construction

Sources

The conceptual design of the Project and potential construction activities were reviewed and key sources of environmental impacts identified. The main activities that will generate impacts during the construction phase will include vegetation clearance, earthworks, demolition, piling and excavation. Environmental impacts may also possibly arise from accidental or unplanned events.

The assessment factored in potential interactions between the impacts from the Project and impacts from other future developments, which are unrelated to the Project but may occur in the area if the construction phases were to coincide. Termed as cumulative impacts, the consideration of these encouraged a holistic evaluation of the environmental risks associated with the Project.

Environmental Impacts

Environmental impacts associated with the Project were found in relation to habitats and species, groundwater; elevated light; noise and vibration levels; and pollution to water and air.

Dust will be generated from earth-moving activities undertaken during the construction phase and during the transport of construction materials. Visitors and staff in adjacent WRS sites as well as flora and fauna within the CCNR and buffer zone will experience an increase in dust levels.

Mitigation measures were developed to reduce impacts associated with dust generation to a level as low as reasonably practicable. These include using water to suppress dust and enclosing buildings to be demolished. With these mitigation measures in place, air quality impacts from construction and vehicular movement are not expected to create significant impacts.

The Project is located close to the Upper Seletar Reservoir and other surface streams within the Sungei Mandai Water Catchment Area that serve critical water supply and ecological functions. Mitigation measures to reduce this impact level to as low as reasonably practicable focus on reducing spillage and earth movement, good material storage practices and waste control. Earth Control measures will also be developed and implemented to ensure that perimeter drains (existing or temporary provisions) are maintained to capture any

contaminated runoff and other discharges from the worksite during construction. Discharge of pumped groundwater to the Upper Seletar Reservoir and surface streams will also be prohibited; this and other wastewater will be treated and removed from the site in compliance with PUB standards.

Mitigation measures developed to reduce impacts to soil and groundwater include allocating designated, bunded areas for vehicle maintenance and mechanical repairs, as well as the monitoring of groundwater quality and flow gradients.

Elevated noise levels are anticipated from demolition works, piling and the operation of construction equipment and heavy vehicles. In order to reduce noise impacts to as low as reasonably practicable, the project will restrict construction to daytime hours, adopt quieter piling methods and install acoustic barriers at appropriate locations. Regular noise monitoring will be undertaken to ensure compliance against regulated limits.

Once the sites of former plantations and villages, the Project area has been earmarked for development by the government. With the earlier removal of these settlements and the time-lag between clearance and development, some secondary regeneration of the forests has occurred within this land which has been impacted from earlier uses.

Construction will result in a reduction in habitat resources, disturbance and displacement of wildlife and restrictions to wildlife movement in the land earmarked for development.

The main Project components have been designed to preserve existing habitats and to restore connectivity by establishing land buffers adjacent to the CCNR, retaining vegetation within the Project area to limit the amount of vegetation clearance required, and building an Eco-Link across Mandai Lake Road. Two areas of significant forest value will also be retained within the Project area and will not be developed.

Focus was placed on reducing the impacts to threatened species and habitats identified from the baseline study, including nationally critically endangered species such as the Sunda Pangolin and Lesser Mousedeer.

Measures are also in place to significantly reduce the possibility of other effects such as potential mortality of animals from accidental vehicle or equipment strikes, degradation of habitats by accidental introduction of invasive species or accidental release of pollutants, and potential increase in populations of species requiring management such as the Sambar Deer and the Wild Boar.

A wildlife monitoring programme within and around the Project area will be initiated during the early stages of the Project development and will continue through to operating the new facilities. This will monitor the effects on fauna so that additional measures can be taken, as necessary.

With appropriate mitigation measures, most of the impacts that could threaten the viability/function of populations or habitats in the study area can be significantly reduced.

(Top) Secondary forest at the Project area. (Bottom) Wildlife found in the study area include the Spotted Tree Frog (Vulnerable – SRDB; Near Threatened – IUCN) and the Straw-headed Bulbul (Endangered – SRDB; Vulnerable – IUCN).

A multi-phased construction and park opening approach is recommended to reduce impacts on species. In addition, the Project will implement a Wildlife Protection Plan to manage impacts to wildlife during construction with the aim of protecting and retaining key species and habitats. Restoration of the site will commence at the onset of construction according to a Forest Restoration Plan and efforts will continue through the Project lifespan. During construction, invasive and weed species will be managed. Training will also be provided to all workers on site to educate them about the ecological sensitivities at the Project area and to enforce good

behaviours. Measures implemented will include long-term monitoring to gather data that will inform future management decisions. Where available, data from surrounding committed developments will also be integrated with the long-term monitoring reviews.

Environmental Management and Monitoring

Mitigation measures for the Project were developed in conjunction with MPH, masterplanners, technical agencies and ecology specialists. The mitigation measures, along with corresponding monitoring requirements, are documented in an EMMP. The aim of the EMMP is to ensure compliance with the mitigation measures identified under the impact assessment, and to monitor the environmental impacts of the project implementation such that corrective actions can be taken and necessary modifications made to the Project should there be any exceedance in impact level. It outlines the roles and responsibilities of key members of the Project team, reporting requirements and management of change procedures.

Environmental Impacts During Operations

The operation phase of the Project presents an ongoing opportunity for the rehabilitation and rejuvenation of the Mandai area. While the activities during the construction phase will cause impacts over the short term, the operation phase seeks to reverse these impacts through habitat enhancement to leave a long-lasting positive legacy on native biodiversity in the area.

Sources

The activities undertaken during the operation phase differ from those in construction phase. Maintenance of attractions, landscaping and animal husbandry have the potential to give rise to environmental impacts during operations. The presence of exotic species and increases in vehicular traffic along Mandai Lake Road and Mandai Road, waste creation, littering events, and potential human-wildlife conflicts are anticipated. With more visitors coming to the area, this will invariably lead to an increase in environmental emissions and human-induced events. Unplanned events such as fire, accidental spills and overflow of stormwater from the surface water drainage system caused by a major rainfall event are additional potential sources of environmental impact.

Environmental Impacts

The operation phase of the Project will see an increase in vehicular traffic along Mandai Lake Road and Mandai Road, increasing the volumes of air pollutants emitted. The Project has carried out a traffic impact assessment study that recommends improvements to traffic infrastructure to accommodate the projected increase in vehicular traffic and to ensure that traffic is managed so any impacts to local air quality are reduced to as low as reasonably practicable.

The Project will treat animal waste water to national standards at dedicated on-site treatment plants before discharging it outside water catchment.

The establishment of the Project will lead to an increase in paved and impervious areas, therefore increasing the amount of surface runoff. In accordance with the Project's commitment to prohibit discharge of polluted surface runoff to the Upper Seletar Reservoir, additional drainage infrastructure will be put in place. A surface water monitoring programme will be implemented to track the effectiveness of the mitigation measures and inform the response to changes in water quality.

Operational impacts to habitats and species include the creation of barriers to wildlife movement from the built environment, risk of introduction of invasive species and diseases to native populations, noise impacts, and potential animal escapees from the Project into the CCNR and surrounding areas. The Project will take ownership of the monitoring, maintenance and upkeep of the Eco-Link and buffer areas during the operation phase, providing a safe pathway for wildlife to move between the northern and southern parts of the CCNR. The Forest Restoration Plan that will be implemented includes measures to restore identified forest areas within the Project area. Visitor education will also be conducted to promote awareness of responsible behaviours towards wildlife. Through design and operational protocols, the Project will also reduce the likelihood of potential escape of species and the introduction of invasive species.

Environmental Management and Monitoring Plan

Similar to the construction phase, mitigation measures for the operation phase were developed in conjunction with MPH, masterplanners, government agencies and ecology specialists. The mitigation measures and corresponding monitoring requirements are documented in the Project EMMP.

Conclusion

In line with international best practice, an EIA has been undertaken on the concept design of the MPH development. The concept design, masterplan and EIA have now integrated numerous measures to avoid, minimise, manage and compensate for environmental impacts associated with a development of this nature. With the implementation of measures contained in the EMMP, the EIA has concluded that the majority of impacts can be reduced to a residual impact magnitude of small or below.

Periodic Project updates will be posted to: *www.mandai.com*.