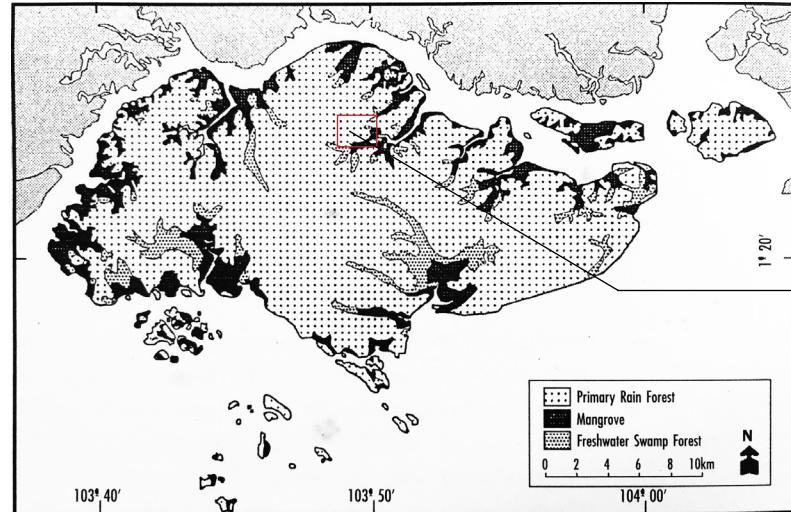
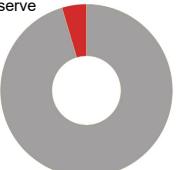
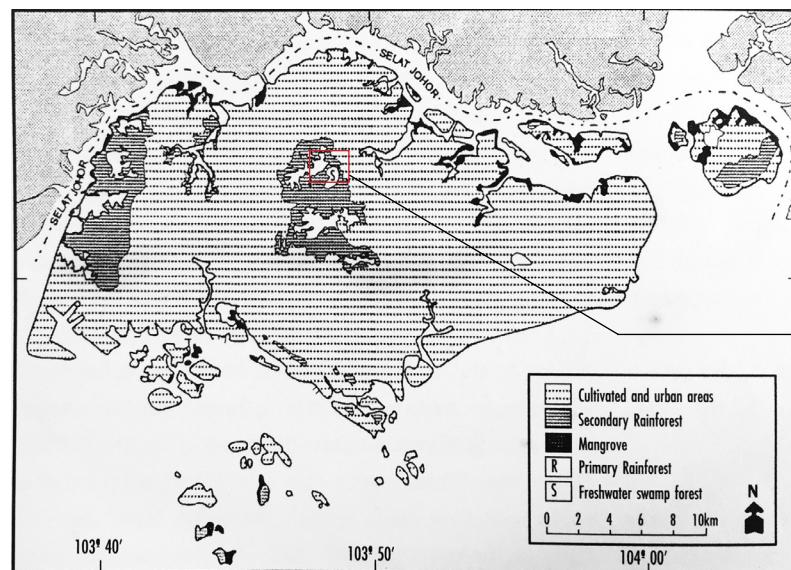




PARK CLASSIFICATION	
■	Playgrounds
---	1Km Buffer Zone
■	Golf Court
■	All Parks (surrounding CCNR)
□	URA_Subzone



1
Map showing major vegetation type (1819)



2
Map showing major vegetation type (1994)

Why Golf courses ?

6 golf courses are situated in last remaining primary forest of Singapore
Occupies 4% CCNR Area, contributing to soil and water pollution due to intensive maintenance regime

Ecological context



Keruing (*Dipterocarpus spp.*)



Meranti (*Shorea spp.*)

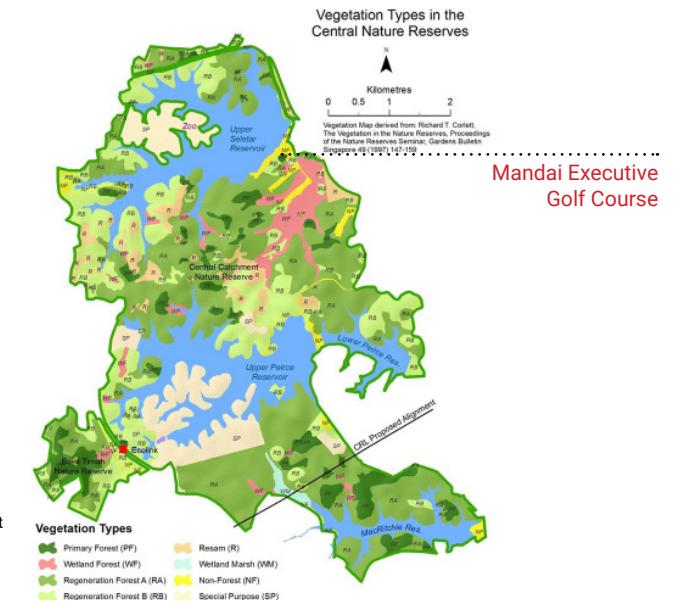
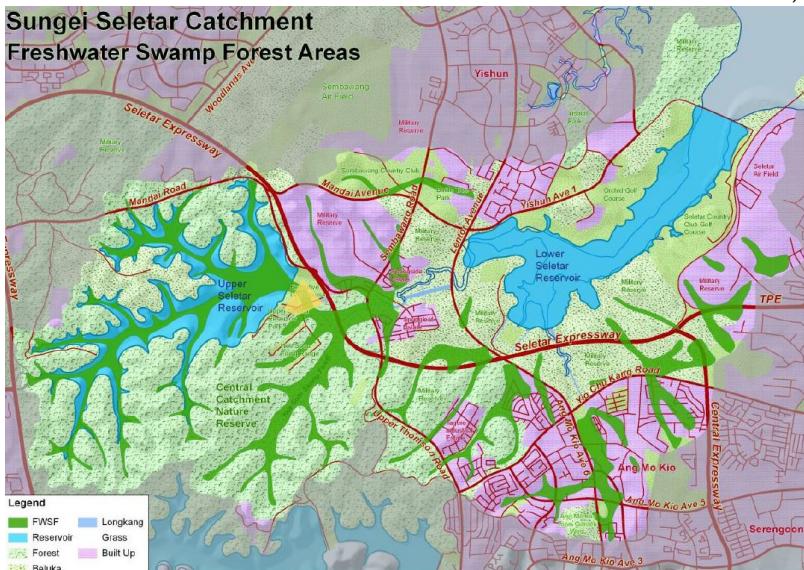


critically endangered Raffles
Banded Langur (*Presbytis
femoralis*)

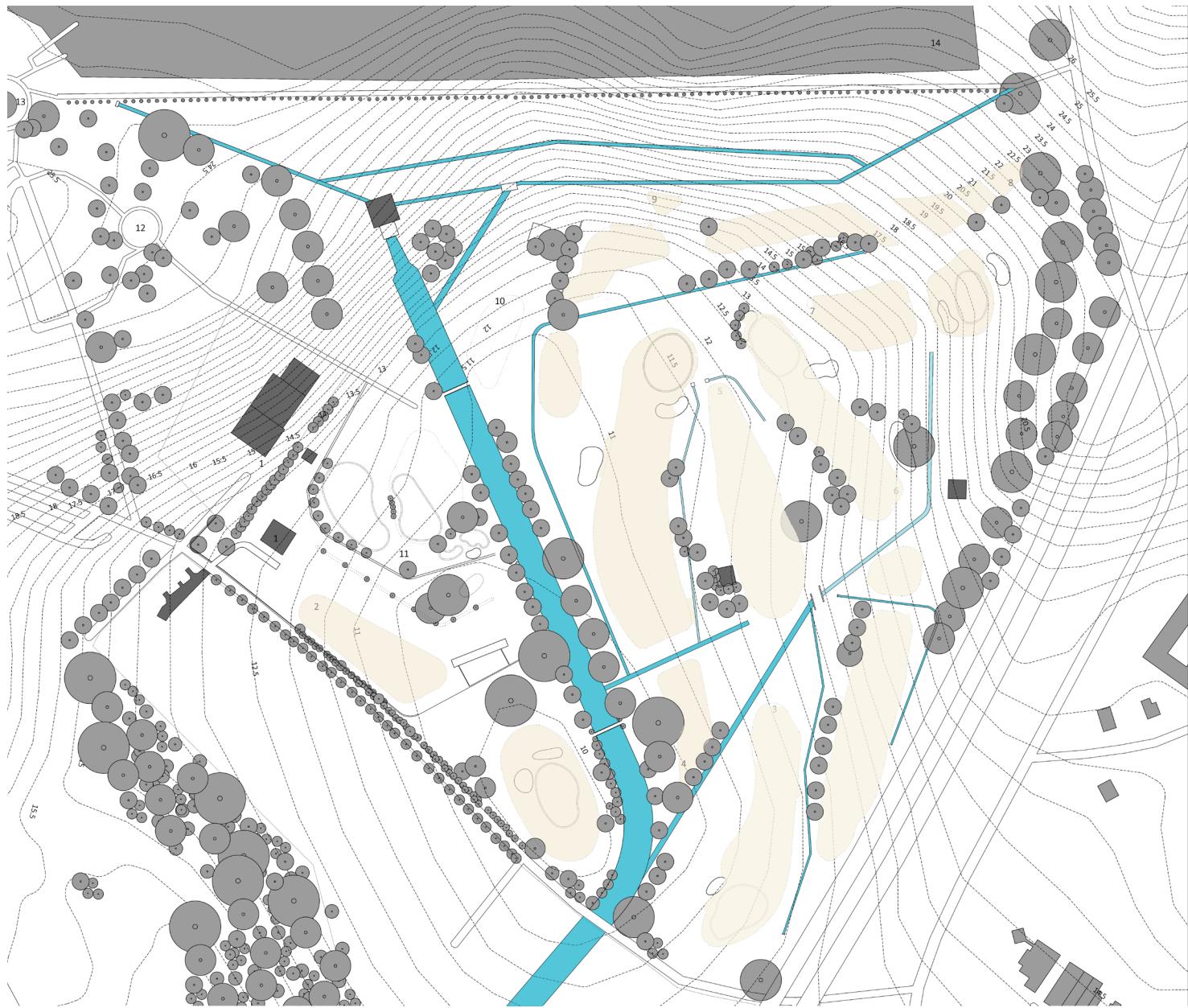


Sunda Pangolin (*Manis javanica*)

Dipterocarp forests, which are species-rich primary lowland forests, were once abundant in Singapore before human settlements developed. Today, less than 0.5% of the original primary forest cover remains and it can only be found in small patches within the Central Catchment Nature Reserve and the Bukit Timah Nature Reserve. An even rarer forest type in Singapore is the primary freshwater swamp forest, with the most significant remaining patch being the Nee Soon Swamp Forest in the Central Catchment Nature Reserve.¹ The existing habitats are home to a magnificent diversity of plants.



Site



Mandai Executive Golf Course

- 9 holes course
- Has varieties of Par 3s & 4s
- 40 bays of Driving Range

As a sport, from its beginning in Scotland, the game of golf has been connected to nature by playing and enjoying the game in natural surroundings. Ever since it has evolved into a refined practice of molding landscapes in peculiar way in order to suit the game. The regular use of pesticides and turf management chemicals heavily impact the environment and ecology.



Maintenance regime

Irrigation and Drainage

Average water requirement: 100,000 to 1,000,000 gallons (378.5 m³) of water per week in summer to maintain healthy vegetation.

Irrigation system: is comprised of sprinklers, field controllers, central control systems and valves. These are the components of an automatic sprinkler system.

Watering program: is developed to determine the timetable for the watering and how much of water to use. Different plants need different watering timetables. Some plants do not need to be watered every day but some others require daily watering.

Turf Management/ Pitch care

Mowing: though excessive mowing will compact the grass. During the growing season daily mowing is required.

Verticutting: to remove excessive thatch

Scarification: to remove moss and stop the collection of moisture on the green.

Grooming: to reduce the thickness of clumps.

Aerating: to remove excessive organic matter, modify the root zone composition, improve rooting and drainage

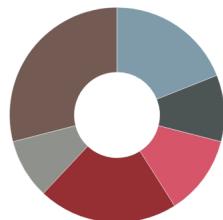
Soil surfactants and wetting agents: to manage localized dry spot

Turf type and required conditions

Turf: Blue serangoon grass (*Digitaria didactyla*)

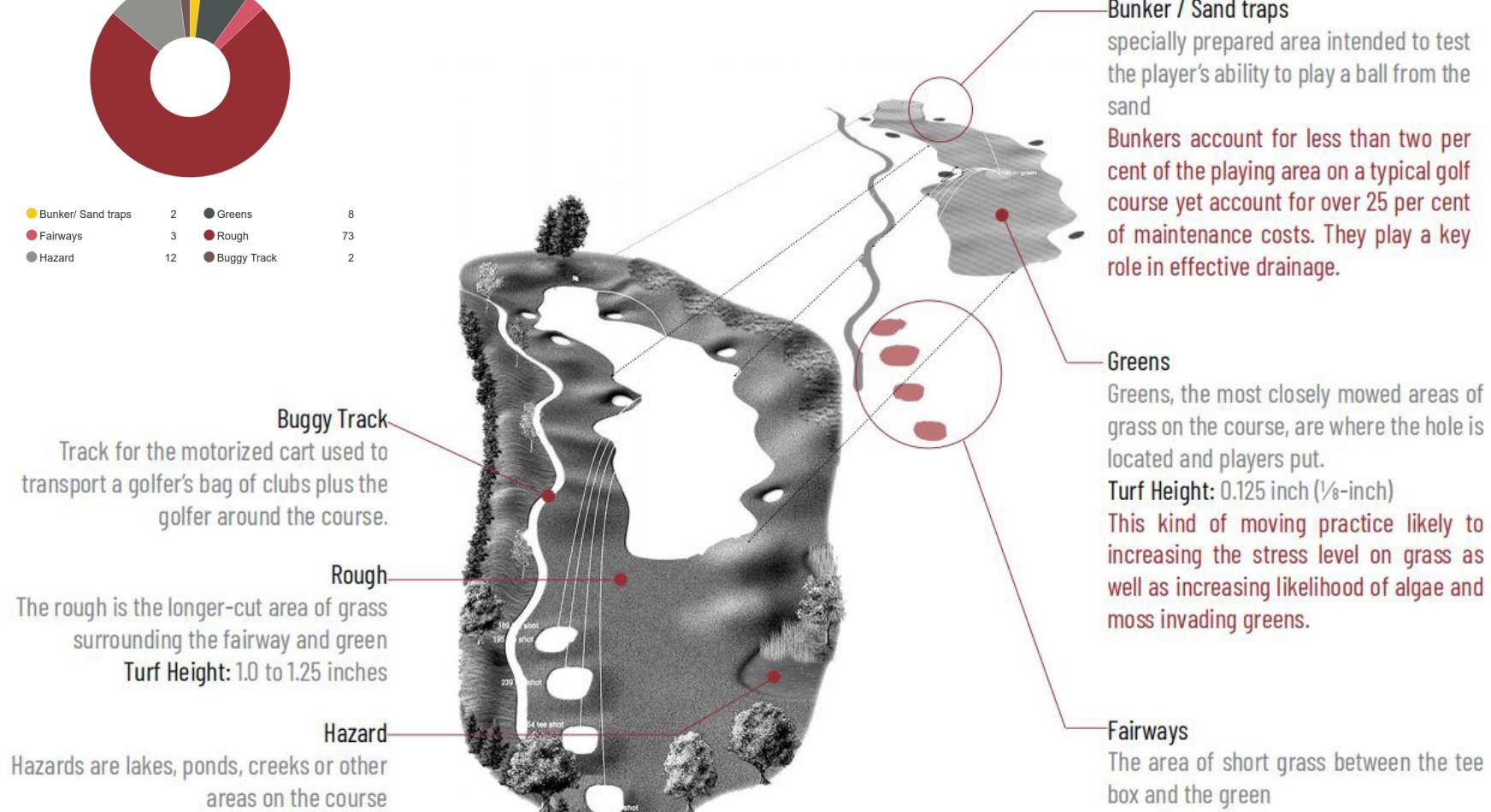
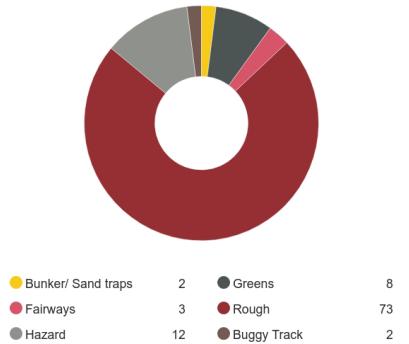
Soil Requirement: Fairly wide tolerance but definite preference for lighter soils, tolerant of low nutrient levels.

Moisture: 900–1,800 mm AAR, survives seasonal dry conditions and drought by losing all leaf.



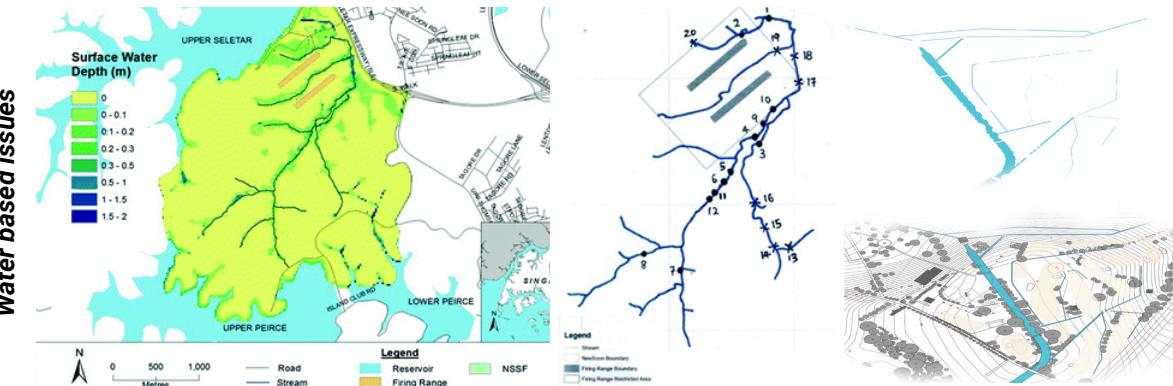
Building & Maintenance	19	Golf Operation labour	10
Sports & Recreation	12	G & A	21
Fixed Charged (Property, tax, etc)	9	Course maintenance	29

Area percentage distribution



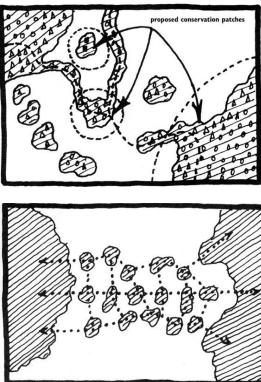
Issues identified

Water based issues



Canalization of natural water streams contributes to break in the natural flow of nutrients and aquatic life. Through research and studies, it is evident that locating Mandai Executive Golf course in this area has contributed to the shrinkage of footprint of Neeson Freshwater Swamp Forest

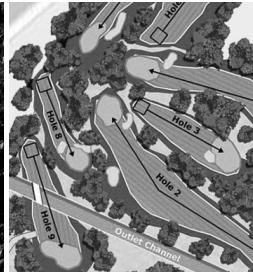
Forest Fragmentation



Lack of diverse fauna on the golf course. Out of 320 trees on the course, there are only 16 types planted repeatedly. List of tree species on MEGC are:

1. Pink Pou (Tabebuia rosea)
2. Jemerlang Laut (Peltophorum pterocarpum)
3. Callitris species (Cupressaceae)
4. Ordeal Tree (Erythrophleum suaveolens)
5. Royal Palm (Roystonea regia)
6. Kapok Tree (Ceiba Pentandra)
7. Bunga Tanjung (Mimusops elengi)
8. American Mahogany (Swietenia macrophylla)
9. Paper Bark Tree (Melaleuca cajuputi)
10. Jenaris (Callerya atropurpurea)
11. Jambu Laut (Synzygium Grande)
12. Sena (Pterocarpus indicus)
13. Burma Padauk (Pterocarpus macrocarpus)
14. Pakul Lima (Samanea saman)
15. Northern Banglow Palm (Archontophoenix Alexandrae)
16. Emang (Hopea mengarawan)

Diagram illustrating vegetation fragmentation



The land was cleared in 1993 for the construction of Mandai Executive Golf Course cleared up the forest existing over there creating complete segregation between regenerated forest. Within the Golf course, the lack of provision of continuous patches results into further forest fragmentation

Soil Degradation



Pesticide contamination mapping (lighter the shade, higher the accumulation tendency)
Golf courses demands high maintenance and usage of water. Frequent use of fertilizers and pesticides causes leaching and degrade water quality as water drains through regular irrigation. As water percolates, it tends to absorb pesticide residue eventually affecting soil quality and ground water quality.



Presence of green in the canal indicates the fertilizer overdose



White and black patches are indication of presence of weed and their resistance adoption to the fertilizer based treatments.

Proposed Master plan

WATER BASED SOLUTIONS

- Tapping into Rain water potentials
- Appropriate Drainage Network
- Irrigation



VEGETATION

- Creating continuous corridors
- Appropriate Plantation strategy
- Integrated Plant Management



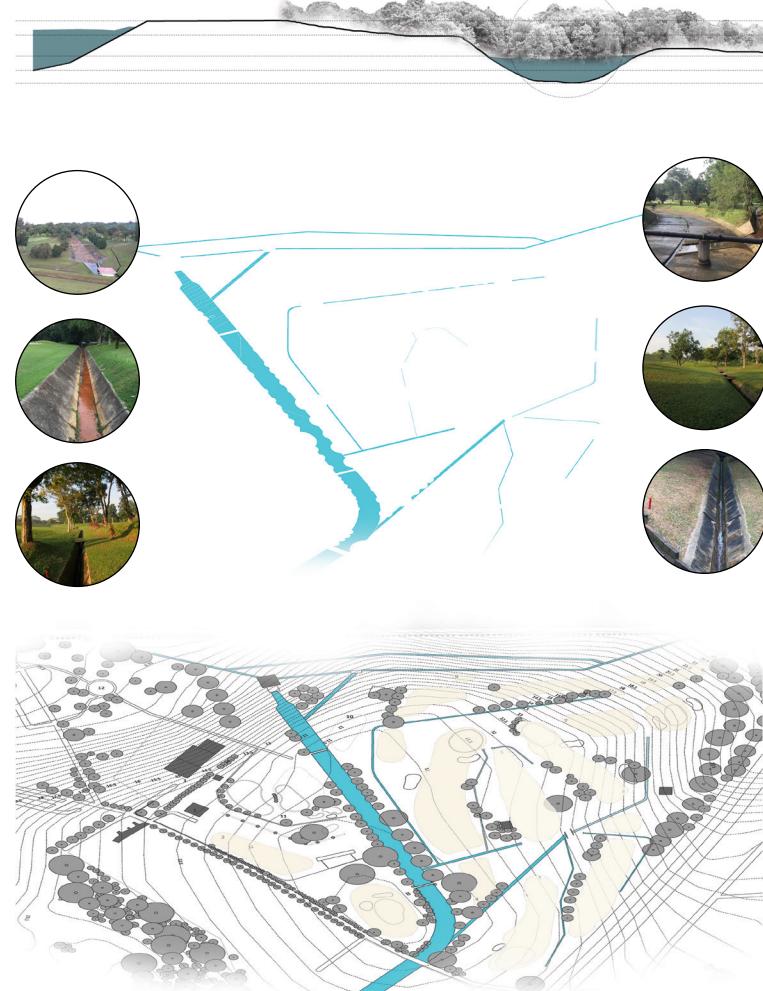
SOIL

- Appropriate Turf Selection
- Decreasing Greens and allowing Natural vegetation
- Sound Management Practice



DESIGN STRATEGY - 1 // TENDING THE WATER

Water based solutions



Existing network of Canal

To reduce the impacts of storm water on receiving water bodies, inlet control measures are designed to protect water quality by managing runoff before it is collected in the drainage system.

INLET CONTROL



Vegetation Zone// Band of small trees and shrubs is used to reduce the velocity of storm water to promote infiltration into the soil and settling of solids.

Bio-swale filter strip// Bands of close growing vegetation, usually grass, planted between pollutant source area and receiving water body to reduce pollutants such as sediment, organic matter & many trace metals by filtering action of vegetation.

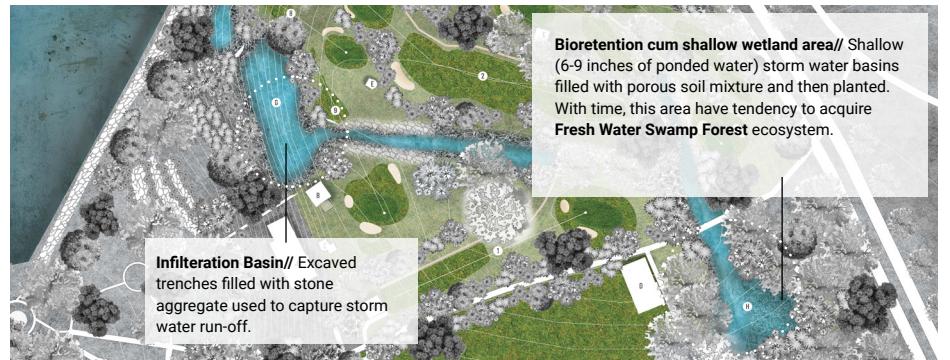
Vegetation Zone

Bio-swale filter strip

Vegetation zone

Water Collection Pond

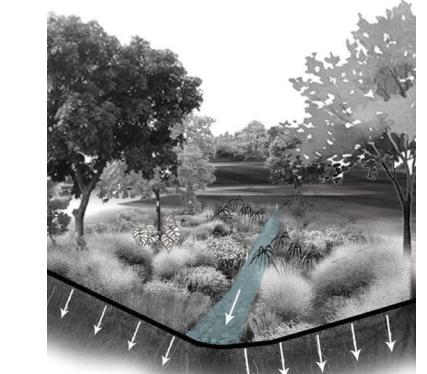
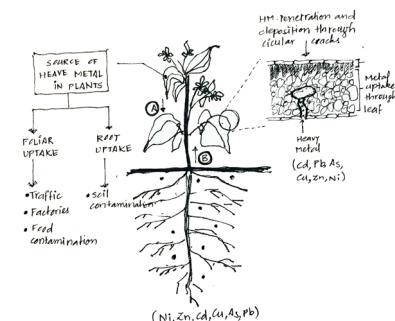
CATCHMENT



Infiltration Basin// Excaved trenches filled with stone aggregate used to capture storm water run-off.

Bioretention cum shallow wetland area// Shallow (6-9 inches of ponded water) storm water basins filled with porous soil mixture and then planted. With time, this area have tendency to acquire Fresh Water Swamp Forest ecosystem.

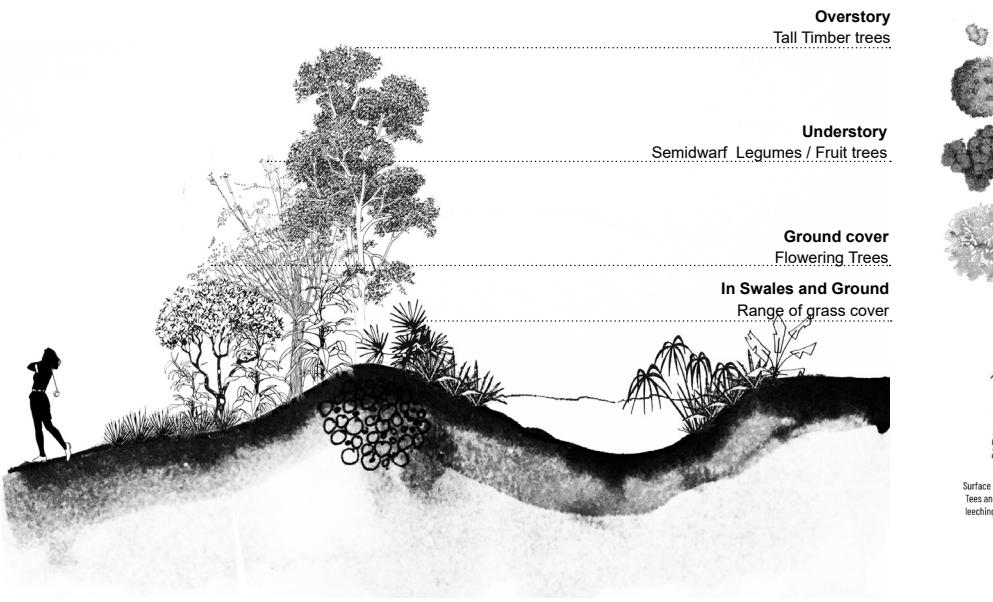
OUTLET CONTROL



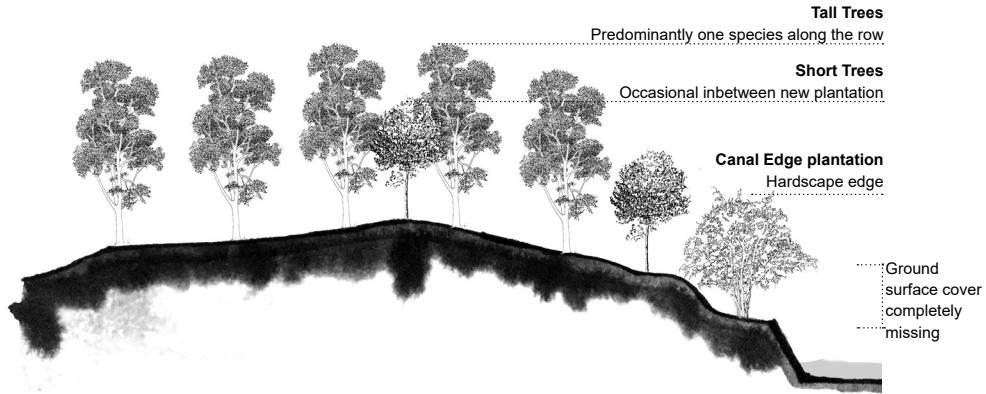
DESIGN STRATEGY - 2 // "LET IT GROW"

Plantation pallet and strategies

TRANSFORMED LANDSCAPE



EXISTING CONDITION



Overstory
Tall Timber trees

Understory
Semidwarf Legumes / Fruit trees

Ground cover
Flowering Trees
In Swales and Ground
Range of grass cover

Tall Trees
Predominantly one species along the row

Short Trees
Occasional inbetween new plantation

Canal Edge plantation
Hardscape edge

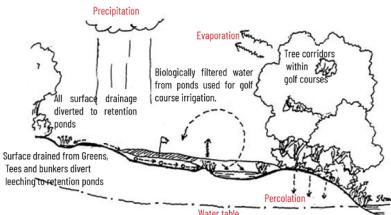
Ground surface cover
completely missing

Shrubs

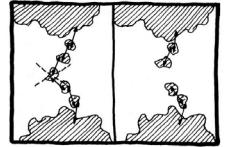
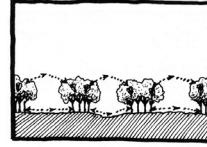
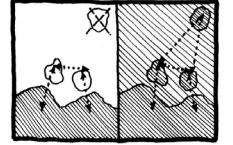
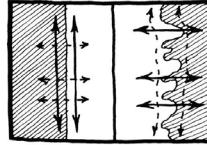
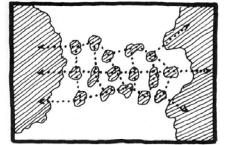
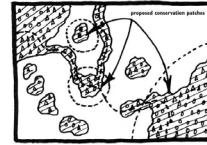
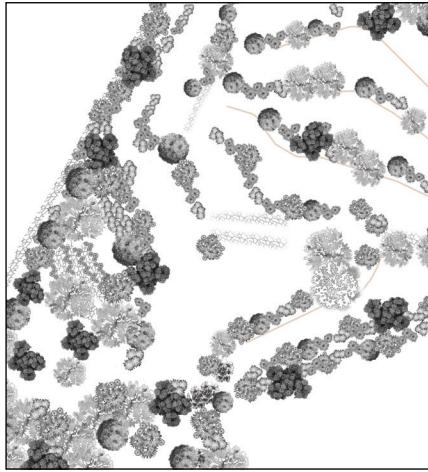
Flowering trees

Legumes or Bean trees/ Fruit Trees

Timber trees/
Rain trees



Patch - Corridor - Matrix Model



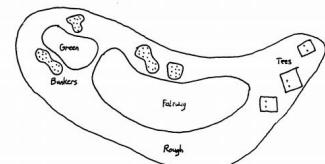
TREES RETAINED ON SITE



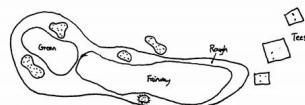
Landscapes are composed of elements - the spatial components that make up the landscape. A **patch** is a relatively homogeneous area that differs from its surroundings. A **corridor** is a narrow strip of land which differ from matrix on the either side of it. And a **matrix** is the "Background ecological system" of a landscape with high degree of connectivity. **Combination of these three spatial elements** are used to improve connectivity and movement from forest to the Golf course. The term "connectivity" here is defined as the measure of how connected or spatially continuous a corridor, network, or matrix is. A forest landscape (matrix) with fewer gaps in forest cover (open patches) will have higher connectivity. Here, the goal is to extend this connectivity within Golf course premises.

DESIGN STRATEGY - 3 // "LET IT FORM"

Tending the soil



Plan view of a typical Golf Course



Out - of - play areas in proposed design
(Opportunities for the use of native vegetation)

NAME :		PLAYER	MARKER
H'CAP :	DATE :		

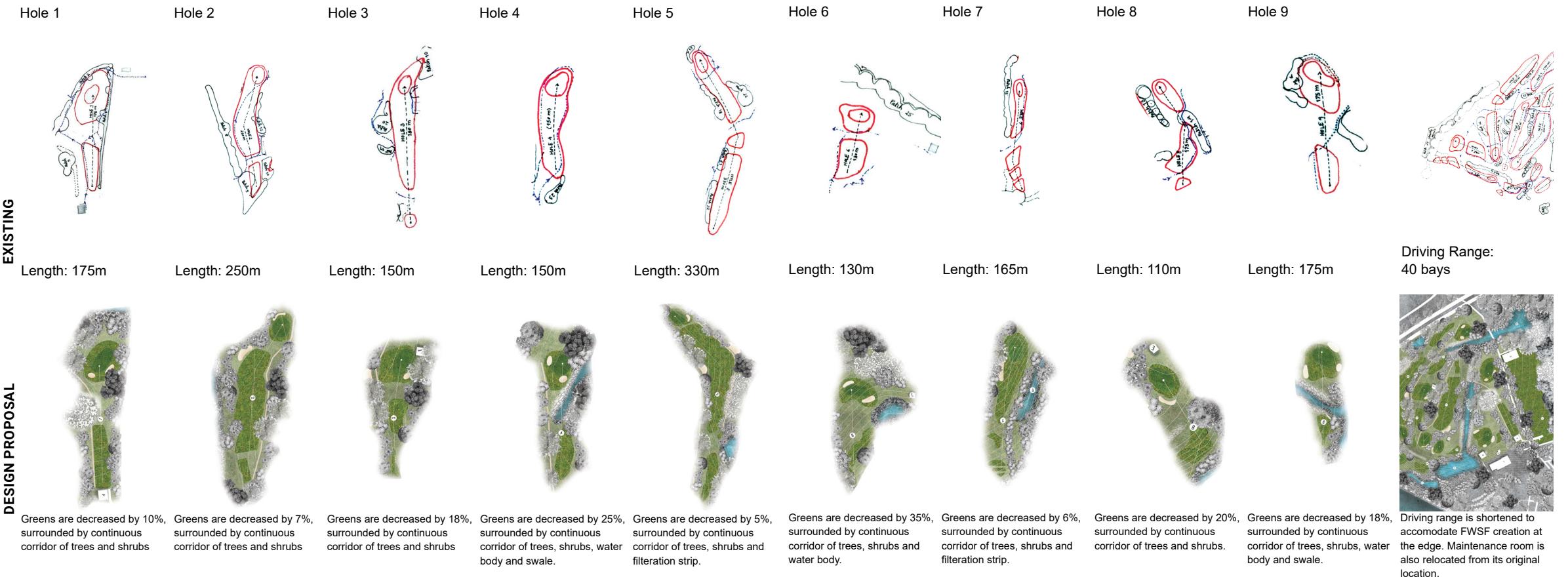
Hole	1	2	3	4	5	6	7	8	9	OUT
Black	175	250	150	150	330	130	165	110	175	1635
Blue	160	250	130	142	300	93	154	105	128	1462
White	135	233	110	116	273	83	125	90	112	1277
Red	88	215	90	95	232	69	115	77	98	1079
Par	3	4	3	3	4	3	3	3	3	29
Index	7	3	15	11	1	17	5	13	9	

Hole	COURSE RATING		SLOPE RATING
	TEES	9-HOLE	18-HOLE
Black	175	250	150
Blue	160	250	130
White	135	233	110
Red	88	215	90
Par	3	4	3
Index	8	4	16
10	11	12	13
Black	175	250	150
Blue	160	250	130
White	135	233	110
Red	88	215	90
Par	3	4	3
Index	8	4	16
14	15	16	17
Black	175	250	150
Blue	160	250	130
White	135	233	110
Red	88	215	90
Par	3	4	3
Index	8	4	16
18	IN	TOTAL	
Black	175	250	150
Blue	160	250	130
White	135	233	110
Red	88	215	90
Par	3	4	3
Index	8	4	16
105	110	115	120
128	128	125	127
1462	1462	154	155
2924	2924	105	110
2554	2554	112	112
2158	2158	115	115
58	58	77	77
		98	98
		1079	1079
		2158	2158

MEGC - Course rating card

A slope rating is computed from the difference between the bogey rating and the USGA course rating. A golf course of standard playing difficulty has a slope rating of 113, and slope ratings range from a minimum of 55 (very easy) to a maximum of 155 (extremely difficult).

Currently, Slope rating of MEGC is between 82-87. With the proposed changes and ecological intervention, the difficulty level of the Golf course is expected to rise upto 110 to 120.



Note: The length of the proposed course is kept as it is to meet the rules for 3s & 4s Par Golf Course design.

VISION

Before

After

