ANNEX 1 ECOLOGICAL PLANTS

AX1.1 INTRODUCTION

Planting has specific functions such as prevents erosion of soil surfaces, traps silt and prevents re-suspension, filters and treats pollution, provides wildlife habitat and promotes attractive and natural surroundings. Table AX1.1 which indicates the effectiveness of different vegetation in meeting specific objectives within a riparian buffer zone can be used for the mix design.

Table AX1.1: Relative Effectiveness of Different Vegetation Types for Providing Specific Benefits

Benefit	Vegetation		
	Grass	Shrub	Trees
Stabilizes bank erosion	Low to Medium	High	Medium to High
Traps sediment	High	Low to Medium	Low
Filters nutrients, pesticides, microbes			
- Sediment bound	High	Low	Low
- Soluble	Medium	Low	Medium
Provides aquatic habitat	Low	Medium	High
Provides wildlife habitat			
- Range/pasture wildlife	High	Medium	Low
- Forest wildlife	Low	Medium	High
Provides economic products	Medium	Low	
Provides visual diversity	Low to Medium	Medium	High
Prevents bank failures	Low	Medium	High
Provides flood conveyance	High	Low	Low

AX1.1.1 Plant Characteristics

Plant characteristics must be considered to determine how the plant provides interest and whether the plant will fit with the present and future landscapes. Some of these characteristics are colour, texture, and interest, i.e. flowers, fruit, leaves, stems or bark and growth rate. In urban or suburban settings, the landscape treatment of the stormwater facility shall be appealing and interesting. Careful consideration during designing and vegetation planting of a facility can result in greater public acceptance and increased property value.

AX1.1.2 Environmental Influences on Plants

General environmental factors and threats to investigate during site analysis are shows in Table AX1.2.

Table AX1.2: General Site Condition to Investigate (Shaw and Schmidt, 2003)

Environmental factors	Environmental threats
• Texture, organic content and pH of the soil • Anticipated water levels or soil moisture • Adjacent plant communities • Slopes • Surrounding weedy vegetation • Amount of sun or shade • Aspect (north, south, east or west facing slope)	• Flood depth and duration • Nutrients • Low water levels • Salt • Flood frequency • Turbidity • Wave energy • Erosion • Sediment loads • Invasive plants • Pollutants and toxins • Herbivores

AX1.1.3 Prohibited and Poisonous Plants

There are also plant species that are prohibited to be imported or grown in Malaysia under the Plant Quarantine Act (1976). If convicted, the offender(s) may be fined up RM10,000. Designers should refer to the quarantine and poisonous list of plant species provided by the Department of Agriculture in National Landscape Department Guideline for any landscape design.

AX1.2 SPECIFIC PLANTING CRITERIA

AX1.2.1 Ponds and Wetlands

a) Plant Selection

Basically ponds and wetlands should consist of vegetation with the following attributes:

- adaptation to the local climate and soils (native species);
- tolerance to pollutants in stormwater runoffs;
- high biomass production;
- perennial species;
- rapid growth but to avoid usage of noxious species; non-weedy, aesthetic habit;
- valuable as wildlife habitat; and
- broadest possible feasible mixture of plant species to maximise plant diversity and enhance stability of the pond or wetland.

b) Planting Zones

Planting zones are categorised into the 6 different zones, which is shown in Figure AX1.1. The criteria and recommended plant species for each zone are shown in following section.

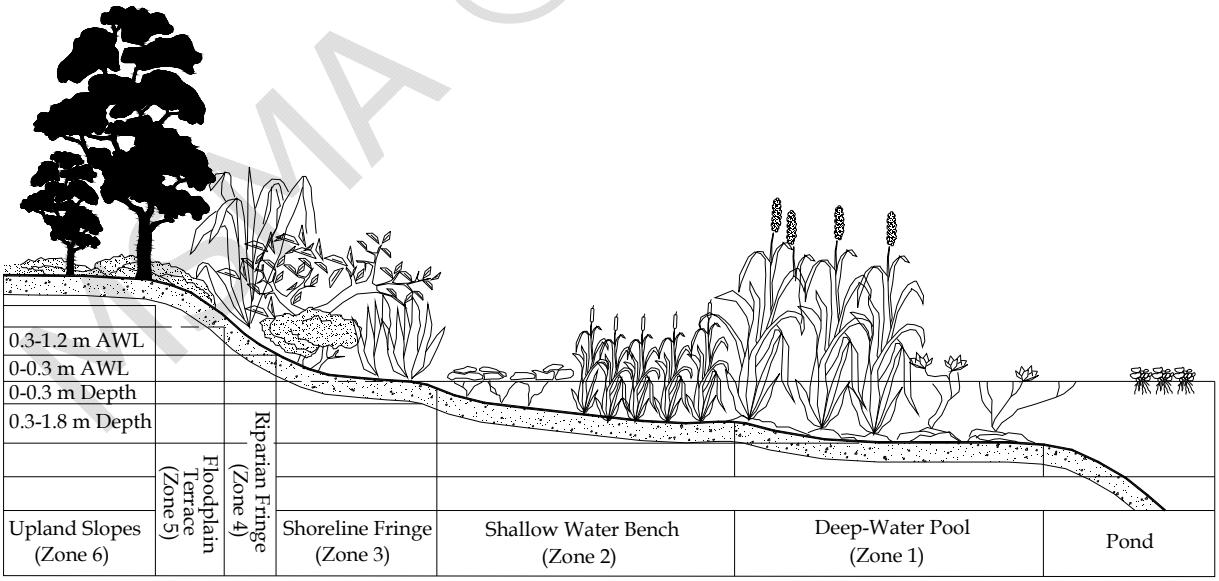

Figure AX1.1: Longitudinal Section of Typical Pond or Wetland

i) Zone 1: Deep-water Pool (0.3 – 1.8 m BWL)

Zone 1 should contain submerged aquatic plants that help to increase diversity and create habitat. (Table AX1.3). The functions of this zone is to reduce re-sedimentation and improve oxidation.

Table AX1.3: Recommended Plant Species for Zone 1 (Deep-water Pool)

Botanical Name	Common Name	P	B	E	A	I
Cyperus compactus	Swamp mariscus; Para-para	•				
Cyperus digitatus	Finger flatsedge; Rumput bunga satuan, Rumput musang	•				
Cyperus halpan	Sheathed flatsedge; Rumput sumbu, Bilis jantan, Para air	•		•		
Lepironia articulata	Tube sedge, Grey sedge, Blue rush, Twigrush; Purun, Kercut	•		•		
Nasturtium sp.	Nasturtium	•		•		
Nelumbo nucifera	Sacred lotus, Indian lotus, Bean of India; Telipok, Seroja India			•	•	
Nymphae lotus dentata	Tiger lotus, White lotus, Egyptian white water lily			•	•	
Nymphae nouchali	Star lotus, Red and blue water lily, Blue star water lily; Teratai putih hutan, Tanjung putih			•	•	
Nymphae rubra	India red water lily; Teratai merah			•	•	
Nymphae tashkent	Purple Water lily; Teratai ungu			•	•	
Phragmites karka	Common reed, Tall reed, Tropical reed; Rumput gedabong	•		•		
Phylidrum lanuginosum	Wooly water lily, Frogmouth, Fan grass; Rumput kipas	•		•		
Rynchospora corymbosa	Golden beak sedge; Rumput sendayan	•		•		
Scirpus grossus	Greater club rush; Rumput menderong, Rumput kumbar	•		•		
Scirpus juncoides	Upright club-rush; Rumput bulat	•				
Scleria sumatrensis	Sumatran scleria; Rumput kumba	•				
Typha latifolia	Bulrush, Broadleaf cattail; Banat	•		•	•	
Victoria sp.	Victoria water lily, Giant water lily, Royal water lily				•	

P = Pollution control B = Bank/slope protection

E = Ecological A = Aesthetic I = Indigenous

ii) Zone 2: Shallow Water Bench (0 to 0.3 m BWL)

Primary area for the emergent plants (Table AX1.4) may be located at the edge of the pond. When planted, Zone 2 can be an important habitat for many aquatic and non-aquatic animals creating a diverse food chain.

Table AX1.4: Recommended Plant Species for Zone 2 (Shallow Water Bench)

Botanical Name	Common Name	P	B	E	A	I
Cleome spinosa	Spider flower, Spider legs, Spiny spiderflower; Maman		•	•		
Eleocharis variegata	Spike rush; Ubi purun, Puron	•		•		
Eriocaulon longifolium	Asiatic pipewort, Longleaf pipewort; Rumput butang	•		•		
Fimbristylis globulosa	Globular fimbristylis, Globe fimbry; Rumput sadang	•		•		
Fuirena umbellata	Hairy blue sedge, Yefen; Rumput kelulut	•		•		
Hanguana malayana	Common hanguana, Common susum; Bakong, Bakong rimba		•		•	
Ludwigia adscendens	Floating Malayan willow, Creeping water primrose; Tinggir bangau		•		•	•
Ludwigia octovalis	Shrubby water primrose; Tinggir pasir		•	•		
Monochoria hastata	Monocharia, Arrowleaf pondweed; Keladi agas	•		•		
Pandanus immersus	Swamp/riverine pandanus; Pandan rasau		•			•
Pandanus sp.	Screw pine, Screw palm; Pandan pantai		•		•	•
Rynchospora corymbosa	Golden beak sedge; Rumput sendayan	•				
Sagittaria sagitaefolia	Arrowhead, Verigated lesser arrowhead; Bunga sagitaria kuning	•				
Scleria sumatrensis	Sumatran scleria; Rumput kumba	•				
Stachytapheta jamaicensis	Spotted basil, Blue porterweed; Selasih dandi, Pokok kecut kuda		•	•		
Vanda hookeriana	Kinta weed, Pencil Orchid; Anggrek pensil				•	•
Zingiberacae sp.	Wild ginger; Halia hutan			•	•	

P = Pollution control B = Bank/slope protection

E = Ecological A = Aesthetic I = Indigenous

iii) Zone 3: Shoreline Fringe (0 to 0.3 m AWL)

This zone can be found in a wet pond or shallow marsh. Many of the emergent plants in Zone 2 can also thrive in Zone 3 (Table AX1.5). If shading is needed along the shoreline, tree species are also recommended.

Table AX1.5: Recommended Plant Species for Zone 3 (Shoreline Fringe)

Botanical Name	Common Name	P	B	E	A	I
Alstonia spathulata	Marsh pulai, Siamese balsa, Hard milkwood; Pulai paya				•	
Artocarpus altilis	Breadfruit; Sukun			•		•
Cyrtostachys lakka	Red sealing-wax palm, Dwarf lipstick palm; Pinang merah, Pinang raja				•	
Dillenia suffruticosa	Shrubby simpoh, Shrubby dillenia; Simpoh air		•	•	•	•
Melaleuca leucadendron	Cajaput tree, Paper-bark tree, Weeping teat tree; Gelam			•		•
Pometia pinnata	Fijian longan, Island lychee; Kasai		•	•	•	•
Saraca thaipingensis	Yellow ashoka, Yellow saraca; Saraka kuning, Pokok gapis			•	•	•
Shorea longifolia	Meranti hitam paya				•	•
Shorea platycarpa	Light red meranti; Meranti paya				•	•
Sindora coriaceae	Sepetir licin, Sepetir minyak				•	•

P = Pollution control B = Bank/slope protection
E = Ecological A = Aesthetic I = Indigenous

iv) Zone 4: Riparian Fringe (0.3 – 1.2 m AWL)

Zone 4 extends from 0.3 m to 1.2 m in elevation above the normal pool. Plants in this zone are subject to periodic inundation after storms, and may experience saturated or partly saturated soil condition. Recommended plant species for Zone 4 are shows in Table AX1.6.

Table AX1.6: Recommended Plant Species for Zone 4 (Riparian Fringe)

Botanical Name	Common Name	P	B	E	A	I
Arachis pintoi	Yellow peanut plant, Pinto peanut; Kekacang, Kacang hias		•		•	
Asystasia gangetica	Creeping foxglove; Rumput itik			•	•	
Bambusa vulgaris	Common bamboo, Giant yellow clumping bamboo, Feathery Bamboo; Buluh minyak, Buluh gading, Buluh aur		•			
Caryota no	Giant fishtail palm; Tukas			•	•	
Cocoloba uvifera	Sea grape, Hopwood, Horsewood			•		
Cratoxylon arborescens	Mabberley; Geronggang, Seronggang		•			
Dillenia suffruticosa	Shrubby simpoh, Shrubby dillenia; Simpoh air		•	•	•	
Elaeocarpus nitidus	Walnut oil fruit; Pinang punai				•	
Ficus benjamina	Weeping fig, Benjamin fig; Ara beringin, Ara waringin	•	•	•		•
Ficus globosa	Bling fig; Ara kelalawar, Ara paya		•	•	•	
Johannesteijmannia altifron	Johanna palm, Diamond Joey, Joey palm		•	•	•	•
Koompassia malaccensis	Kempas tree; Kempas			•	•	•
Licuala spinosa	Mangrove fan palm, Spiny licuala, Good luck palm; Palas duri		•	•	•	•
Melia excelsa	Marrango tree, Philipine neem tree; Sentang				•	
Nephrolepis sp.	Sword fern; Paku		•	•	•	

P = Pollution control B = Bank/slope protection
E = Ecological A = Aesthetic I = Indigenous

v) Zone 5: Floodplain Terrace (Infrequently Inundated)

Zone 5 is periodically inundated by floodwaters that quickly recede in a day or less. Key landscaping objectives for Zone 5 are to stabilise the steep slope of this zone and establish low maintenance natural vegetation. Recommended plant species for Zone 5 are shows in Table AX1.7.

Table AX1.7: Recommended Plant Species for Zone 5 (Floodplain Terrace)

Botanical Name	Common Name	P	B	E	A	I
Alstonia angustiloba	Common pulai; Pulai		•	•	•	•
Archontophoenix alexandrae	Alexandra palm, Alexander palm, King palm; Palma Iskandar		•		•	
Costus speciosus	Malay ginger, Crape ginger, Spiral flag; Setawar tawar			•	•	•
Dendrocalamus giganteus	Giant bamboo; Buluh betong		•	•		•
Dyera costulata	Jelutong tree; Jelutong, Jelutong burit, Jelutong paya		•		•	•
Fagraea fragrans	Tembusu tree; Tembusu		•	•	•	•
Heliconia psittacorum	Parrot's beak, Parakeet flower, Parrot's flower			•	•	
Lagerstroemia flos-reginae	Queens crape myrtle, Pride of India, Rose of India; Bungor		•		•	•
Melastoma malabathricum	Malabar melastome, Straits Rhododendron; Senduduk, Keduduk, Senggani,		•	•		•
Messua ferrea	Ceylon ironwood, Indian rose chestnut; Penaga lilin		•	•	•	•
Mussaenda erythrophylla	Ashanti blood, Red flag bush, Tropical dogwood; Janda kaya			•	•	
Oncosperma horridum	Thorny palm, Mountain nibung palm; Bayas		•			•
Oncosperma tigillarium	Nibung palm; Nibung		•	•		•
Pandanus pigmeus	Small screwpine; Pandan kuning		•		•	
Pisonia alba	Lettuce tree, Cabbage tree, Moonlight tree; Menkudu siam		•		•	
Tacca chantrieri	Bat head lily, Bat Flower, Devil Flower; Misai baung			•	•	•

P = Pollution control B = Bank/slope protection
E = Ecological A = Aesthetic I = Indigenous

vi) Zone 6: Upland Slopes (Seldom or Never Inundated)

The last zone extends above the maximum 100-year water surface elevation, and often includes the outer buffer of a pond or wetland. Care should be taken to locate plants so they will not overgrow these routes or create hiding places that might make the area unsafe. Recommended plant species for Zone 6 are shows in Table AX1.8.

Table AX1.8: Recommended Plant Species for Zone 6 (Upland Slopes)

Botanical Name	Common Name	P	B	A	E	I
Bauhina blakeana	Hong Kong ochid tree; Tapak kuda			•		•
Cananga odorata	Cananga tree, Dwarf Ylang Ylang; Kenanga			•	•	•
Canarium vulgaris	Kanari nut tree; Kenari			•	•	
Cassia fistula	Golden shower tree, Indian laburnum; Senong, Dulang				•	
Cicca accida	Tree bears; Cermai			•	•	•
Cinnamomum iners	Wild cinnamonhindi; Kayu manis			•		•
Dryobalanops aromatica	Sumatra camphor; Kapur barus			•		•
Eucalyptus deglupta	Mindanao gum; Kayu putih			•		
Flacourtia inermis	Batoko plum; Rokam			•	•	•
Hibiscus mutabilis	Confederate rose, Cotton rosemallow; Baru landak, Bebaru			•		
Livistona rotundifolia	Footstool palm; Serdang			•	•	
Melia excelsa	Marrango tree, Philipine neem tree; Sentang			•	•	•
Milletia atropurpurea	Purple milletia; Tulang daing			•	•	•
Peltophorum pterocarpum	Yellow flame; Batai laut		•	•	•	•
Pritchardia pacifica	Fiji fan palm; Palma kipas Fiji			•		
Raphis excelsa	Broadleaf lady palm, Bamboo palm; Rafis, Pinang rotan			•		
Roystonea regia	Royal palm; Palma diraja			•		
Tectona grandis	Teak; Jati			•	•	•
Zizyphus mauritania	Indian Jujube; Bidara			•		

P = Pollution control B = Bank/slope protection
E = Ecological A = Aesthetic I = Indigenous

AX1.2.2 Infiltration Systems

Suitable plant species for these systems are given in Table AX1.9. They, however, are subjected to the following design constraints:

- Planting a vegetated filter strip of at least 5.5 m width will cause sediments to settle out before reaching the facility, thereby reducing the possibility of clogging;
- Determine areas that will be saturated with water and water table depth so that appropriate plants may be selected (hydrology will be similar to bioretention facilities);
- Plants known to send down deep taproots should be avoided in system where filter fabric is used as part of facility design;
- Test soil condition to determine if soil amendments are necessary;
- Plants shall be located so that access is possible for structure maintenance;
- Stabilise heavy flow areas with erosion control mats or sod; and
- Temporarily divert flows from seeded areas until vegetation is established.

Table AX1.9: Recommended Shrubs and Grass Species for the System

Botanical Name	Common Name
Alocasia sp.	Alocasia, Taro; Keladi
Alpinia sanderae	Variegated Ginger; Halia hiasan
Calathea sp.	Peacock plant; Lerek
Canna generalis	Canna lily; Bunga tasbih
Cassia alata	Wild senna, Ringworm bush; Gelenggang
Cleome speciosa	Spiny spiderflower; Maman
Gesneriaceae sp.	Cloudforest flower; Letup-letup
Ipomea involucrata	Keledek nyiru
Ixora javanica	Jungle flame, Jungle geranium; Siantan
Turnera ulmiflora	Yellow buttercups, Yellow alder, Sage Rose, Cuban buttercup; Turnera
Zoysia matrella	Manila grass, Manila temple grass, Korean grass; Rumput siglap

AX1.2.3 Bioretention Systems

a) Soil Bed Characteristic

Soil bed characteristics for bioretention systems are perhaps as important as the facility, location, size, and treatment volume. The soil must be permeable enough to allow runoff to infiltrate through the media, while having characteristics suitable to promote and sustain a robust vegetative cover crop. Therefore, the soils must have balance soil chemistry and physical properties to support biotic communities above and below ground.

b) Planting Plan Design Consideration

- Native plant species should be specified over exotic or foreign species.
- Appropriate vegetation should be selected based on the zone of hydraulic tolerance.
- Species layout should generally be random and natural.
- A canopy should be established with an under storey of shrubs and herbaceous materials.
- Woody vegetation should not be specified in the vicinity of inflow location.
- Trees should be planted primarily along the perimeter of the bioretention area.
- Urban stressors (e.g. wind, sun, exposure, insect and disease).

- Infestation and drought should be considered when laying out the planting plan.
- Noxious weeds should not be specified.
- Aesthetics and visual characteristics should be a prime consideration.
- Traffic and safety issues must be considered.
- Existing and proposed utilities must be identified and considered

Plants selection should be based on the goal of simulating a terrestrial forested community of native species. Bioretention simulates an upland-species ecosystem. The community should be dominated by trees, but have a distinct community of under storey trees, shrubs and herbaceous materials (see Table AX1.10).

Table AX1.10: Suggested Plant Species for Bioretention Areas

Botanical Name	Common Name
Ground Cover/Shrubs/Palms	
Arundina graminifolia	Tapah weed, Bamboo orchid, Bird orchid; Anggerik buluh, Anggerik tanah
Cyclosorus aridus	Dry wood-fern; Paku paya
Ipomoea cairica	Railway creeper, Ivy-leaved Morning Glory; Seri pagi jalar
Ishaemum muticum	Seashore centipede grass, Drought grass; Rumput tembaga jantan, Rumput Kemarau
Trees	
Alstonia spathulata	Marsh pulai, Siamese balsa, Hard milkwood; Pulai paya
Ploiarium alternifolium	Cicada tree; Riang-riang
Saraca thaipingensis	Yellow ashoka, Yellow saraca; Saraka kuning, Pokok gapis

There are essentially three zones within the bioretention system as show in Figure AX1.2.

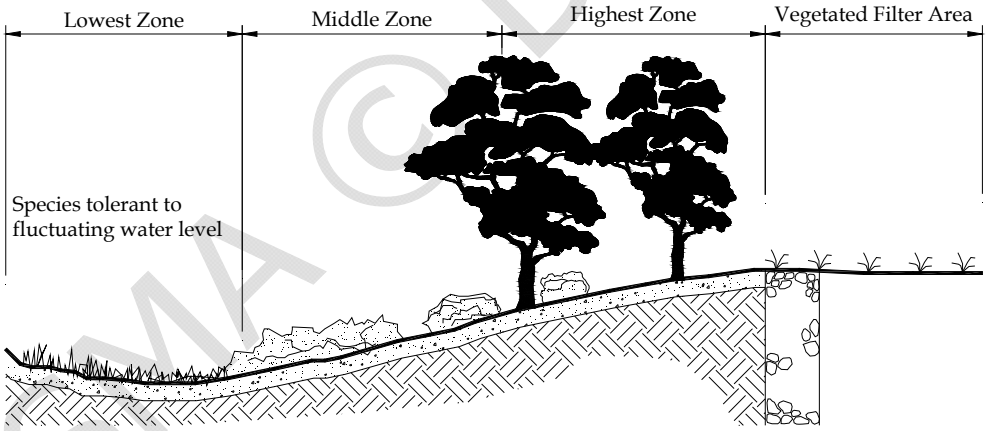

Figure AX1.2: Planting Zones for Bioretention System

Table AX1.11: Recommended Ground Cover Species for Grassed Channel, Vegetated Filter Area and Swale

	Botanical Name	Common Name
Grassed Channel, Vegetated Filter Area	*Ageratum conyzoides*	Chick weed, Goatweed; Rumput tahi ayam
	Arachis pintoi	Yellow peanut plant, Pinto peanut; Kekacang, Kacang hias
	Asystasia gangetica	Creeping foxglove; Rumput itik
	Chloris barbata	Swollen finger grass; Rumput mekar
	Clidemia hirta	Soupbush; Senduduk bulu
	Commelina nudiflora	Common spiderwort; Rumput aur
	Croton hirtus	Kroton berbulu, Cenderai gajah
	Digitaria fuscescens	Yellow crab grass; Rumput jejari halus
	Echinochloa colonum	Junglerice; Rumput kekusa kecil
	Elephantopus scaber	Prickly-leaved elephant's foot; Rumput tutup bumi
	Eupatorium odoratum	Common floss flower; Rumput kapal terbang
	Gomphrena globosa	Globe amaranthus; Bunga butang
	Merremia umbellata	Yellow wood rose; Akar senduduk belanga
	Paspalum conjugatum	Buffalo grass; Rumput lembu
	Phanera audax	Akar merak
	Phanera integrifolia	Akar kuning raja
	Phaseolus pubescens	Kacang faseolus bulu
	Pueraria phaseoloides	Puero; Kekacang
	Stachytapheta jamaicensis	Spotted basil, Blue porterweed; Selasih dandi, Pokok kecut kuda
Swale	*Axonophus compressus*	Cow grass; Rumput pahit
	Brachiaria sp.	Tanner grass; Rumput malela
	Cynodon dactylon	Bermudagrass; Rumput bermuda
	Panicum virgatum	Switch grass, Tall panic grass, Water panicum, Thatchgrass
	Vetiveria zizaniodes	Vertiver grass; Rumput wangi

Table AX1.12: Recommended Main Ground Cover for Channel Slope Erosion/Treatment

Botanical Name/Synthetic Material	Common Name
Axonopus compressus 'mutiara'	Pearl grass; Rumput mutiara
Axonopus affinis	Narrowleaf carpet grass; Rumput karpet
Brachiaria sp.	Tanner grass; Rumput malela
Cynodon dactylon	Bermuda grass; Rumput bermuda
Digitaria didactylia	Serangoon grass
Panicum virgatum	Switch grass, Tall panic grass, Water panicum, Thatchgrass
Stenotaphrum secundatum	St. Augustine
Stenotaphrum secundatum variegatum	Variegated St. Augustine grass
Vetiveria zizaniodes	Vertiver grass; Rumput wangi
Zoysia sp.	Emerald Grass

AX1.2.4 Swales, Grassed Channel and Vegetated Filter Areas

Flows are reduced by roughness of grasses and water quality is further improved. These grasses are sod farming and withstand frequent inundation, and are thus ideal for the grassed channel, vegetated filter area, and swale environments (Tables AX1.11 and AX1.12).

a) Topsoil

Topsoil is important in preserving and protecting the ground surface from erosion and is able to absorb stormwater runoff more efficiently. Removal of topsoil will deplete the land fertility for planting and also cause erosion and siltation of the channels.

Compacted soils will need to be tilled before grass seeding or planting. At least 100 mm of the following recommended topsoil mix is required: 50-80% sandy loam, 10-20% clay and 10-20% composite organic matter.

b) Seeding Criteria

The planting criteria for swale, grassed channel, and vegetated filter area are as follows:

- Ground cover should be tolerant to frequent inundation and erosion. Where possible one or more of the grasses should be in the seed mixes;
- grass should be able to survive flood, drought, grazing animals and other forces of nature;
- Cheap and easy to establish and maintain;
- Has deep penetration root system, which can grow up to 3 metres in length. Long roots are very useful in improving stability of earth slopes as they provide reinforcement by holding the soil particles together and more importantly, remove subsoil mixture, which is detrimental to slope stability; and
- Able to survive on many soil types almost regardless of fertility, alkalinity or salinity.

c) Planting Plan

The quality of the grass seed used is important. Fresh and recleaned grass seeds of the latest crop available shall be used. General guidelines for establishing an effective grass lining are as follows:

- Prepare a good, firm seed bed;
- Use a crop residue or a mulch to protect the grass during establishment;
- Allow 3 months for grass to show an adequate stand;
- Select a simple grass mixture that best fits the conditions of the swale;
- Use good quality seed from grass origins and strains known to be adaptable to the site;
- Plant at the best date for the selected grass species;
- Use planting equipment and methods that give uniform distributions and proper placement of seed;
- Water grass as required to supplement rainfall until it is established;
- Fertilise according to the needs of the grass and the soils as shown by soil tests;
- Overseed or repair bare spots with sod chunks or mulch as necessary;
- Avoid driving vehicles on the swale or damaging the sod with tillage; and
- Mow when grass can make good regrowth.

Table AX1.13: Recommended Palm and Shrub Species for River Corridor

Botanical Name	Common name	Planting Zones					Plant Tolerances (1= tolerant, 2= tolerance some, 3= intolerant)				
		Margin	Lower Bank	Upper Bank	Terrace Face	Upper Terrace	Sun	Shade	Wet	Dry	Wind
Palms											
Archontophoenix alexandrae	Alexandra palm, Alexander palm, King palm; Palma Iskandar				•	•	2	1	1	2	1
Arenga pinnata	Sugar palm; Kabung				•	•	2	2	1	2	1
Calamus sp.	Rattan; Rotan				•	•	3	1	2	2	3
Carpentaria acuminata	Carpentaria palm				•	•	1	1	1	3	2
Cyrtostachys renda	Malaya sealing wax palm; Pinang merah				•	•	2	1	1	2	1
Dendrocalamus giganteus	Giant bamboo; Buluh betong			•	•	•	1	2	1	2	1
Eugeissona tristis	Wild bornean sago; Bertam				•	•	3	1	2	2	2
Licuala spinosa	Mangrove fan palm, Spiny licuala, Good luck palm; Palas duri				•	•	1	1	1	3	2
Metroxylon sagu	Sago palm; Sagu				•	•	2	2	1	3	2
Oncosperma horridum	Thorny palm, Mountain nibung palm; Bayas				•	•	2	2	1	2	1
Oncosperma tigillarium	Nibung palm; Nibung				•	•	2	2	1	2	1
Phyllostachys sulphurea	Sulphur bamboo; Buluh kuning			•	•	•	1	2	1	2	1
Pinanga malaiana	Malaya sealing wax palm; Legong/Pinang hutan				•	•	3	1	1	3	3
Ptychosperma macarthurii	Macarthur palm; Cluster palm, Hurricane palm; Palma Macarthur				•	•	2	2	1	2	2
Shrubs											
Alpinia purpurata	Red ginger; Alpinia merah				•	•	2	1	2	3	2
Ardisisa crenata	Hen's eyes; Mata ayam			•	•	•	2	2	2	2	2
Asplenium nidus	Bird's nest fern; Paku langsuir, Daun semun		•	•	•	•	3	1	1	3	2
Cassia alata	Wild senna, Ringworm bush; Gelenggang				•	•	2	2	1	2	3
Cyperus sp.	Nutsedge; Rusiga	•	•	•	•	•	1	2	1	2	1
Gleichenia linearis	Tangle fern; Paku resam		•	•	•	•	2	1	1	2	1
Heliconia rostrata	Hanging lobster claw; Heliconia sepit ketam				•	•	3	1	2	3	3
Monochoria hastata	Monocharia, Arrowleaf pondweed; Keladi agas	•					1	2	1	3	2
Nephrolepis exaltata	Sword fern; Paku		•	•	•	•	3	1	1	3	2
Pandanus malayanus	Screw pine; Pandan		•	•	•	•	2	1	1	2	2
Phyllagathis rotundifolia	Solomon's sole; Akar serau malam, Tapak Sulaiman, Tapak gajah, Seri bulan			•	•	•	3	1	1	2	2
Platycerium coronarium	Stagshot, Stag's horn fern, Tanduk rusa		•	•	•	•	3	1	1	3	3
Sagittaria sagitaefolia	Arrowhead, Verigated lesser arrowhead; Bunga sagitaria kuning	•					2	2	1	3	2
Syngonium podophyllum	White butterfly, Singonium		•	•	•	•	3	1	1	3	2
Tacca chintrieri	Bat head lily, Bat Flower, Devil Flower; Misai baung		•	•	•	•	3	1	1	3	3
Typha latifolia	Bulrush, Broadleaf cattail; Banat	•					1	2	1	3	2

Table AX1.14: Recommended Tree Species for River Corridor

Botanical Name	Common Name	Planting Zones					Plant Tolerances				
							1= tolerant 2= tolerate some 3 =intolerant				
		Margin	Lower Bank	Upper Bank	Terrace Face	Upper Terrace	Sun	Shade	Wet	Dry	Wind
Trees											
Alstonia spathulata	Marsh pulai, Siamese balsa, Hard milkwood; Pulai paya		•	•	•	•	1	2	1	2	2
Artocarpus peduncularis	Terap tree; Terap		•	•	•	•	1	1	1	2	1
Calophyllum sp.	Punna; Bintangor			•	•	•	1	2	1	2	1
Cananga odorata	Cananga tree, Dwarf Ylang Ylang; Kenanga			•	•	•	1	1	1	2	1
Daemonorops angustiloba	Water rattan; Rotan getah		•	•	•	•	3	1	1	3	3
Derris heptaphylla	Tuba			•	•	•	1	2	1	2	1
Eugenia densiflora	Kelat jambu air			•	•	•	1	2	1	2	3
Eugenia spicata	Firefly bush, Spicate eugenia; Kelat nenasi		•	•	•	•	1	2	1	2	3
Ficus benjamina	Weeping fig, Benjamin fig; Ara beringin, Ara waringin		•	•	•	•	1	1	1	1	1
Ficus globosa	Bling fig; Ara kelalawar, Ara paya		•	•	•	•	1	1	1	1	1
Ficus hispida	Hairy fig; Ara kelumpang		•	•	•	•	2	2	1	2	2
Fragrae fragrans	Ironwood; Tembusu		•	•	•	•	1	1	1	2	1
Gluta velutina	Water rengas; Rengas air			•	•	•	1	1	1	2	1
Intsia palembanica	Marabaw Tree of Malacca, Malacca teak; Merbau		•	•	•	•	1	1	1	2	1
Koompasia malaccensis	Kempas tree; Kempas				•	•	1	1	1	2	1
Lagerstroemia flos-reginae	Queens crape myrtle, Pride of India, Rose of India; Bungor			•	•	•	1	2	1	2	1
Licuala spinosa	Mangrove fan palm, Spiny licuala, Good luck palm; Palas duri			•	•	•	3	1	1	3	3
Macaranga sp.	Mahang tree; Mahang				•	•	1	1	1	2	2
Mallotus sp.	Balik angin				•	•	1	1	1	1	1
Melaleuca leucadendron	Cajaput tree, Paper-bark tree, Weeping teat tree; Gelam				•	•	1	2	1	2	1
Milletia hemsleyana	Stem bark; Jada		•		•	•	1	1	2	2	1
Parkia javanica	Sataw; Petai kerayung		•		•	•	1	1	1	2	1
Polyalthia sclerophylla	Mast tree; Mempisang, Jangkang			•	•	•	1	1	1	2	2
Pometia pinnata	Fijian longan, Island lychee; Kasai		•	•	•	•	1	1	1	1	1
Pterocarpus indicus	Malay paduak, New Guinea rosewood; Sena, Anggsana			•	•	•	1	1	1	1	2
Pterolobium javanicum	Bullock's eye; Mata lembu		•		•	•	1	1	1	2	2
Saraca thaipingensis	Yellow ashoka, Yellow saraca; Saraka kuning, Pokok gapis			•	•	•	3	1	1	3	2
Sonneratia caseolaris	Apple mangrove; Perepat			•	•	•	3	1	1	3	2

AX1.2.5 Natural Channel, River Corridor and Riparian Zone

Riverside or riparian vegetation helps to protect the riverbank, provide breeding ground for aquatic life, temporarily holding overflow, as well as trap sediments and some pollutants (Tables AX1.13 and AX1.14). Identification of suitable plant species shall be based on the hydrologic zones or sections of the channel.

a) Planting Guide

- Determine the profile of the river to identify the different characteristics or vegetation zones;
- Prepare a planting plan with composition of the plant species for the zones;
- Space plants according to the zone they belong in, and their mature size. An approximation of one plant per square metre will be generally sufficient. Rushes, small sedges and ferns can be planted up to three plants per square metre;
- Select indigenous and hardy species that are adaptable and tolerant to site and soil conditions of floodplains and riparian zones;
- Order plants well in advance of planting. Select a nursery specialising in native plants;
- Plant appropriate species right down to the water's edge or margin;
- Prepare the site well in advance of planting;
- Remove invasive weeds such as *Imprata cylindrica*, *Euchornia sp*, *Mimusa pudica* and *Mimusa indica* (Semalu);
- Clear all vegetation for about 1 metre diameter around each planting position;
- Set out plants in their correct zones. Plants should be spaced out according to how large they will eventually grow into;
- Before planting, prune off entangled roots. Set the plants into a bed of soft, worked soil at the bottom of the hole, and repack crumbed soil around the root mass tightly to prevent air gaps;
- Ensure plants within the channel are well planted and compacted around the base;
- On wet sites, plant in a shallower hole so that the top of the root mass and associated soil are at ground level or even slightly mounded above it in permanently saturated condition;
- For poor soil, slow-release fertiliser should be applied to each plant. Short-term fertiliser should be applied to the ground after planting and before mulching; and
- Mulch should not be applied on wet sites or anywhere near the water flow, as mulch is likely to be washed away and may caused stream blockages.

b) Selecting Plant Species

Due to the different conditions for establishment and growth of plants with soggy and inundated soil, riverside plants can be categorised into different vegetated zones. These zones are based on slope condition and distance from the water edge. The species commonly found along the rivers are recommended for planting in restoring the river and its corridor into its natural forms and function creating the riverine landscape and parkland.

AX1.3 OTHER CONSIDERATIONS IN PLANTING

AX1.3.1 Wild Collection

Wild plants are important as they are more adapted to the local environmental conditions (Table AX1.15). Wild plants have acclimated to local soils, typical hydrologic region and weather. Wild plants will initiate new growth more quickly and develop more robust growth habits at earlier stage than plants secured from nurseries as seed or potted plants.

Table AX1.15: Recommended Wild Plant Species

Botanical Name	Common Name
Alstonia spathulata	Marsh pulai, Siamese balsa, Hard milkwood; Pulai paya
Bambusa vulgaris	Common bamboo, Giant yellow clumping bamboo, Feathery Bamboo; Buluh minyak, Buluh gading, Buluh aur
Lepironia articulata	Tube sedge, Grey sedge, Blue rush, Twigrush; Purun, Kercut
Litsea teysmanni	Medang kelor
Ludwigia adscendens	Floating Malayan willow herb; Tinggir bangau
Monchoria hastata	Hastate-leafed pondweed; Keladi agas
Pandanus immersus	Swam/riverrine pandanus; Pandan rasau
Phragmites karka	Common reed, Tall reed, Tropical reed; Rumput gedabong
Phylidrum lanuginosum	Fan grass; Rumput kipas
Pometia pinnata	Fijian longan, Island lychee; Kasai
Oncosperma tigilarium	Nibung palm; Nibung
Scirpus grassus	Greater club rush; Rumput menderong
Turnera ulmifolia	Holy rose, Yellow buttercup, Cuban buttercup; Turnera, Lidah kucing, Bunga pukul delapan
Typha angustifolia	Narrow cattail, Lesser bulrush, Lesser reedmace; Banat

AX1.3.2 Habitat Creation

Riparian vegetation performs a long list of important functions in the creation and maintenance of fish and wildlife habitat. Those functions can be summarised as follows:

- Riparian vegetation moderates water temperature, making the river habitable for fish and other aquatic life;
- Tree roots, shrub species and other growth bind the stream bank soil and provide resistance to erosive forces of the water (Tables AX1.16 and AX1.17). This produces deeper channels with banks that are undercut but held together with exposed root systems. These undercut banks complete with overhang vegetation, provide important escape cover for fish;
- Most of the river/stream's biological energy and the base of the food chain for stream life come from the leaves, fruits, seeds, cones and other parts of the plants; and
- Woody debris that falls into the river forms pools for fish, creates habitat by causing backwater pools and provides storage areas for sediment that otherwise might be released into spawning areas.

Planting for ponds, wetlands and large channels such as river shall incorporate opportunities for creation of wildlife habitat (Figure AX1.3).

Malayan Box Turtle | Small Clawed Otter | Monkey | Common Myna | Little Egret

Figure AX1.3: Local Wildlife Attracted to the River Ecosystem (Wildlife at USM Wetland)

Table AX1.16: Recommended Trees and Palm Species for Wildlife Habitat

Botanical Name	Common Name
Artocarpus altilis	Breadfruit; Sukun
Ceiba pentandra	Kapok tree, Silk cotton, Java cotton; Kekabu, Kabu-kabu, Kapuk randu
Cyrtostachys lakka	Red sealing wax palm, Dwarf lipstick palm; Pinang merah, Pinang raja
Cordia sebestana 'aurea'	Orange geiger tree
Dillenia indica	Elephant apple; Simpoh India
Diospyros discolor	Butter fruit; Mentega
Eugenia polyantha	Indonesian bay leaf; Kelat
Ficus benjamina	Weeping fig, Benjamin fig; Ara beringin, Ara waringin
Intsia palembanica	Marabaw tree of Malacca, Malacca teak; Sepetir
Livistona chinensis	Fountain palm; Serdang
Melia excelsa	Marrango tree, Philipine neem tree; Sentang
Mimusop elengi	Bullet-wood Tree; Bunga tanjung
Muntigia calabura	Cherry tree, Strawberry tree, Cotton candy berry; Kerukup Siam, Ceri kampung
Musa sp.	Wild banana; Pisang hutan
Pitcellobium dulce	Madras thorn, Manila tamarind, Monkeypod; Asam Belanda
Pometia pinnata	Fijian longan, Island lychee; Kasai
Ptychosperma macarthurii	Macarthur palm; Cluster palm, Hurricane palm; Palma Macarthur
Samanea saman	Rain tree, Cow tamarind; Hujan-hujan, Pukul lima jari
Sapium indicum	Tallow tree; Gurah
Sterculia foetida	Hazel sterculia, Great sterculia Skunk flower; Kelumpang
Sterculia nobilis	Chinese chestnut
Terminalia catappa	Tropical almond, Sea almond; Ketapang

Table AX1.17: Recommended Shrub Species for Wildlife Habitat

Botanical Name	Common Name
Ardisia crispa	Hen's eyes, Coral berry; Mata ayam, Mata Pelanduk, Akar bebuluh
Asplenium nidus	Bird's nest fern; Paku langsuir, Daun semun
Asystasia gangetica	Creeping foxglove; Rumput itik
Carissa grandiflora	Common carissa, Natal palm, Boxwood beauty
Cassia alata	Wild senna, Ringworm bush; Gelenggang
Gesneriaceae sp.	Cloudforest flower; Letup-letup
Graminae sp.	Darnel; Rumput tebu
Hanguana malayana	Common hanguana, Common susum; Bakong, Bakong rimba
Ixora javanica	Jungle flame, Jungle geranium; Siantan
Melastoma malabathricum	Malabar melastome, Straits Rhododendron; Senduduk, Keduduk, Senggani
Nymphae sp.	Water lily; Teratai
Phragmites karka	Common reed, Tall reed, Tropical reed; Rumput gedabong
Placerium coronarium	Stagshot, Stag's horn fern; Tanduk rusa
Premna obtusifolia	Premna; Bebuta
Stachytapheta jamaicensis	Spotted basil, Blue porterweed; Selasih dandi, Pokok kecut kuda
Tacca chantrieri	Bat head lily; Janggut baung
Turnera ulmifolia	Holy rose, Yellow buttercup, Cuban buttercup; Turnera, Lidah kucing, Bunga pukul delapan
Typha latifolia	Bulrush, Broadleaf cattail; Banat

AX1.4 GENERAL PLANTING AND CONSTRUCTION METHOD

General planting methods apply to all plants discussed earlier to be used in various stormwater facilities such as ponds, wetlands, swales, engineered channels and river corridors.

- Trees or shrubs known to have long taproots should not be within the vicinity of earth dam, weir or subsurface drainage facilities;
- Trees or shrubs shall be away from the maintenance width requirements and in accordance with reserve width as specify in design criteria;
- Tree and shrubs should be at least 5 m away from perforated pipes;
- Trees and shrubs should be at least 7.5 m away from a riser structure;
- Provide 4.5 m clearance from a non-clogging, low flow orifice;
- Herbaceous embankment plantings should be limited to 30 cm in height. This is to allow visibility for the inspector who is looking for burrowing rodents that may compromise the integrity of the embankment;
- Provide slope stabilisation methods for slopes steeper than 2:1 such as erosion control mats. Also, use seed mixes with quick germination rates in this area;
- Augment temporary seeding measures with container crowns or root mats for more permanent plants;
- Use erosion control mats and fabrics in channels that are subject to frequent washouts;
- Stabilise all emergency spillways with plants that can withstand strong flows;
- Select plants with fibrous root system and not taproot root system to avoid damage to underground components of certain stormwater facilities such as underdrains;
- Sod channel areas that are not stabilised by erosion control mats;
- Divert flows temporarily from seeded areas until stabilised;
- Check water tolerances of existing plant materials prior to inundation of area;
- Stabilise aquatic and safety benches with emergent wetland plants and wet seed mixes;
- Do not block maintenance access to structures with trees or shrubs;
- Avoid plantings that will require routine or intensive chemical application (i.e. turf area) ;
- Have soil tested to determine if there is a need for amendments;
- Decrease the areas where turf is use. Use low maintenance ground cover to absorb run-off;
- Plant stream and water buffers with trees, shrubs, ornamental grasses and herbaceous materials where possible, to stabilise banks and provide shade;
- Maintain and frame desirable views. Be careful not to block views at entrances, exits, or difficult road curves. Use plants to screen off unattractive views of the site or facility. Aesthetics and visual characteristics should be a prime consideration;
- Use plants to prohibit pedestrian access to pools or slopes that may be unsafe;
- The designer should carefully consider the long-term vegetation management strategy for the BMP, keeping in mind the 'maintenance legacy for the future owners. Keep maintenance areas and access free of vegetation to allow vehicle clearance. Provide a planting surface that can withstand the compaction of vehicles using maintenance access roads. Make sure the facility maintenance agreement includes requirements for landscaping or vegetation maintenance;
- If a BMP is likely to receive excessive amounts of deicing salt, salt tolerant plants should be used;
- Provide signage at areas of stormwater facilities to help educate the public;

- Avoid the overuse of any plant species; and
- Preserve existing natural vegetation when possible.

It is necessary to test the soil to be used as planting medium in order to determine the following:

- pH, whether acid, neutral or alkaline;
- Major soil nutrients; nitrogen, phosphorus, potassium; and
- Minerals; such as chelated iron, lime.

AX1.5 POST PLANTING MANAGEMENT

Post planting management covers proper horticultural practices and maintenance to encourage the establishment of newly planted trees.

- Newly installed plant requires water in order to recover from the shock of being transplanted. Some source of water is to be provided especially during dry periods. This will reduce plant loss and provide the new plant with chance to establish root growth;
- Weeding around plants is essential to avoid competition and stress. This should be carried out after 2 months of planting or on a monthly basis as required;
- At the water margin, careful weed control is needed on an on-going basis until the area is self-maintaining, or until the plantings have overtopped the grass;
- Clearing of weeds and pruning of trees after 4 and 12 months of planting are required;
- After 6 months of planting, pruning and trimming of unwanted shoots should be carried out. This will encourage growth and development of quality plants in term of height. Weeding shall be required too;
- Familiarity with the common problems and indications of post planting stress could aid in recognising stress early and minimising the potential damage;
- Stressed plants are at higher risks to attract pests and diseases;
- Stress can be minimised and eliminated by judicious watering;
- Excess watering especially from irrigation systems causes anaerobic (low oxygen) soils, killing the small absorbing roots. With unhealthy roots the symptom can be similar to drought stress, with dull or drooping leaves and branch tips, scorched leaves margins, and eventual dieback;
- Regular check on the plant's health for several years, normally up to 4 years after establishment;
- Insect and disease control may periodically be required; and
- Monitor the growth of the riverine vegetation and enjoy the sight as they thrive and attract wildlife and become self maintaining.

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2. Jabatan Landskap Negara. (2008). *Garis Panduan Landskap Negara, Edisi 2*. Kementerian Perumahan dan Kerajaan Tempatan Malaysia.
3. Shaw, D. and Schmidt, R. (2003). *Plant for Stormwater Design - Species Selection for the Upper Midwest. Operations and Environmental Review Section*. Regional Environmental Management Division, Minnesota Pollution Control Agency.

APPENDIX AX1.A Recommended Plants Species for Zone 1 (Deep Water Pool)

Cyperus compactus

Cyperus digitatus

Cyperus halpan

Lepironia articulata

Nasturtium sp.

Nelumbo nucifera

Nymphaea lotus dentata

Nymphaea nouchali

Nymphaea rubra

Nymphaea tashkent

Phyragmites karka

Phylidrum lanuginosum

Rynchospora corymbosa

Scirpus grassus

Scirpus juncoides

Typha latifolia

Scleria sumatrensis

Victoria sp.

APPENDIX AX1.B Recommended Plants Species for Zone 2 (The Shallow Water Bench)

Cleome spinosa

Eleocharis vaiegata

Eriocalon longifolium

Fimbristylis glabulosa

Fuirena umbellata

Hanguana malayana

Ludwigia adscendens

Ludwigia actovalvis

Monocharia hastata

Pandanus immersus

Pandanus sp.

Rynchospora corymbosa

Sagittaria sagietafolia

Scleria sumatrensis

Stachhytapheta jamaicensis

Vanda hookeriana

Zingiberaceae sp.

APPENDIX AX1.C Recommended Plants Species for Zone 3 (Shoreline Fringe)

Alstonia spathulata

Artocarpus altilis

Barringtonia asiatica

Caryota mitis

Cystostachys lakka

Dillenia suffructicosa

Melaleuca leucadendron

Pometia pinnata

Saraca thaipingensis

Shorea platycarpa

Sindora coriaceae

Spathodea campanulata

APPENDIX AX1.D Recommended Plants Species for Zone 4 (Riparian Fringe, Periodically Inundated)

Arachis pintoi

Asystasia gangentica

Bambusa vulgaris

Caryoto no

Cocoloba uvifera

Cratoxylon arborescens

Dillenia suffruticosa

Elaeocarpus

Ficus benjamina

Ficus globosa

Johannesteijsmannia altifrons

Koompassia malaccensis

Licuala spinosa

Melia excelsa

Nephrolepis sp.

APPENDIX AX1.E Recommended Plants Species for Zone 5 (Floodplain Terrace, Infrequently Inundated)

Alstonia angustiloba

Archontophoenix alexandrae

Costus speciosus

Dendrocalamus giganteus

Dyera costulata

Fragrae fragrans

Heliconia psitacorrum 'yellow'

Legerstroemia flos reginea

Melastoma malabathricum

Messua ferrea

Mussaenda erythrophylla

Oncosperma horridum

Oncosperma tigillarium

Pandanus pigneus

Pisonia alba

Tacca chantrieri

APPENDIX AX1.F Recommended Plants Species for Zone 6 (Upland Slopes, Seldom or Never Inundated)

Bauhinia blakeana

Cananga odorata

Canarium vulgaris

Cassia fitsula

Cicca acida

Cinnamomum iners

Dryobalanops aromatic

Eucalyptus deglupta

Flacourtia inermis

Hibiscus mutabilis

Livistona rotundifolia

Melia excelsa

Milletia atropurpurea

Peltophorum pterocarpum

Pritchardia pacifica

Rhapis excelsa

Roystonea regia

Tectona grandis

Zizyphus mauritinia

APPENDIX AX1.G Recommended Grass Species for Grassed Channel, Vegetated Filter Strips and Swales

Axonopus compressus

Axonopus affinis

Digitaria didactylia

Panicum virgatum

Brachiaria sp.

Cynodon dactylon

Stenotaphrum secundatum

Stenotaphrum secundatum variegatum

Zoysia sp.

Vetiveria zizaniodes

Croton hirtus

Asystasia gangetica

Arachis pintoi

Chloris barbata

Eupatorium odoratum

APPENDIX AX1.H Recommended Plants Species for River Margin

Scirpus grossus

Scirpus juncoides

Cyperus compactus

Cyperus digitatus

Pandanus sp.

Zingiberaceace sp.

Typha latifolia

Fimbristylis glabulosa

Vanda hookeriana

Caladium hortulanum

Dieffenbachia maculata

Phragmites karka

Cleome spinosa

Stachytarpheta jamaicensis

Monochoria hastata

Ludwigia octovalvis

Limnocharis flava

Ipomea aquatica

Ludwigia adscendens

Hanguana malayana

APPENDIX AX1.I Recommended Plants Species for Stream Lower Bank

Oncosperma horridum

Cyrtostachys lakka

Pometia pinnata

Ficus rocemosa

Anglaia odoratissima

Sacara thaipingensis

Bambusa vulgaris

Milletia hemsleyana

Spondias pinnata

Alstonia spathulata

Pandanus immersus

Pentaspadon velutinum

Licuala spinosa

Heliconia sp.

Baekia fructescens

Cassia alata

Pandanus sp.

Alocasia acrorrhiza

Piper sarmentesum

Ludwigia adscendens

Hymenocallis specisa

Nephrolepis sp.

Quisqalis indica

Arundina graminifolia

Hydrocutycle asitica

APPENDIX AX1.J Recommended Plants Species for Stream Upper Bank

Sterculia foetida

Gironniera rarvifolia

Pellacalyx axillaris

Cocoloba uvifera

Sterculia sp.

Lagerstroemia speciosa

Bauhinia integrifolia

Bambusa sp.

Ptychosperma macarthurii

Musa velatino

Heliconia psittacorum

Piper sarmentosum

Crinum asiaticum

Gesneriaceae sp.

Sindora coriacea

Parkia javanica

Eugenia densiflora

Dillenia sp.

Croton sp.

Asystasia gangetica

Mussaenda erythophylla

Costus speciosus

Vinca rosea

APPENDIX AX1.K Recommended Plants Species for Stream Terrace Face

Pterocymbium javanicum

Dyera costulata

Hopea odorata

Cassia spectabilis

Ficus benjamina

Lagerstroemia flos-reginae

Spondias pinnata

Swietenia mahagoni

Artocarpus altilis

Pisonia alba

Eugenia polyantha

Heliconia indiva

Gigantochloa wrayi

Dendrocalamus giganteus

Phyllostachys aures

Arenga pinnata

Ardisia crispa

Hemigraphis colorata

Ervatamia corymbosa

Nicolaia clatior

Pandanus sp. 'green dwarf'

Daemonocarpus angustifolia

Turnera ulmifolia

APPENDIX AX1.L Recommended Plants Species for Stream Upper Terrace


Agathis dammara


Tabebuia rosea


Pisonia alba


Cinnamomum iners


Filicium decipiens


Amherstia nobilis


Mimusops elengi


Cassia fitsula


Erythrina glauca


Delonix regia


Flacourtia inermis


Cocos nucifera


Livistona


Pritchardia


Archontophoenix


Samanea saman


Heliconia rostrata


Canna generallis


Zephyranthes sp.


Furaraea giganteca


Muntingia calabura


Nerium oleander


Heliconia sp.


Croton sp.

APPENDIX AX1.M Recommended Plants Species for Ecological Plants/Fruits Bearing Trees

Artocarpus altilis

Terminalia catappa

Ficus benjamina

Pometia pinnata

Diospyros discolor

Mimosop elengi

Pitchelobium dulce

Spondias pinnata

Sterculia foetida

Melia excelsa

Ficus sp.

Eugenia polyantha

Sterculia nobilis

Sapium indicum

Cordia sebestena aurea

Musa sumatrana

Premna obtusifolia

Carissa grandiflora

Ptychosperma macarthurii

Cyrtostachys lakka

Livistona chinensis

Ardisia crispa

Muntingia calabura

APPENDIX AX1.N Recommended Plants Species for Wild Life Attraction/Breeding Habitat Creation

Melaleuca leucadendron

Cassia alata

Samanea saman

Intsia palembanica

Graminae sp.

Heliconia psittacorum 'hybrid'

Stachytarpheta jamaicensis

Gesneriaceae sp.

Nymphaea sp.

Setaria pumila

Tacca chantrieri

Asystasia gangetica

Hanguana malayana

Fuirena umbellata

Typha latifolia

Ixora javanica

Asplenium nidus

Phragmites karka