

**LEGISLATIVE COUNCIL
PANEL ON DEVELOPMENT**

**Tree Management on Private Properties and Revamp of the Guidelines for
Tree Risk Assessment and Management Arrangement**

Follow-up Actions to Meeting on 24 November 2015

1. The Administration was requested to provide the following information --
 - (a) A copy of the draft Handbook on Tree Management; and
 - (b) Upon the receipt of a complaint/notification from members of the public about the identification of a high-risk tree on private land, what action the Administration will take to mitigate the risk (other than informing the property owner(s) concerned about the risk).

2. The Administration's responses are as below:
 - (a) The soft copy of the draft Handbook is attached in the reply email.
 - (b) Private land owners are responsible for the overall management of trees within their land premises, including undertaking appropriate risk mitigation measures whenever the need arises. For trees within private land posing an immediate danger to the public, the assistance from the Fire Services Department may be sought for entering the private premises to remove the hazard. For non-imminent cases, the Lands Department (LandsD) will issue advisory letters to the land owners concerned requesting appropriate risk mitigation measures to be implemented. If lease conditions require the concerned land owners to properly maintain the trees, LandsD can take lease enforcement action against the land owners.

HANDBOOK ON TREE MANAGEMENT

(DRAFT)

*Draft for comment
(Version: 31 August 2015)*

**Greening, Landscape and Tree Management Section
Development Bureau
The Government of the Hong Kong Special Administrative Region**

AUGUST 2015

HANDBOOK ON TREE MANAGEMENT

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LIST OF ABBREVIATIONS

AAP	Accredited Arboricultural Practitioners
BMO	Building Management Ordinance
BRR	Brown Root Rot
DEVB	Development Bureau
DLO	District Lands Office
GLTMS	Greening, Landscape and Tree Management Section
HTM	Handbook on Tree Management
LandsD	Lands Department

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GLOSSARY OF TERMS

Arboricultural service

Engagement of qualified professionals to provide works related to tree works, including but not limiting to tree survey, preparation of tree inventory, tree inspection, tree risk assessment, mitigation measure, planting, transplanting, tree surgery work and control of pest and disease.

Common parts

Apart from the parts specified for the exclusive use, occupation or enjoyment of an owner, all other parts of the building and those parts specified in Schedule 1 to the Building Management Ordinance, e.g. structural parts, lifts, clubhouses, gardens and lawns, are the common parts of the building. Owners may refer to the Deed of Mutual Covenant to ascertain the common parts of their building.

Owner

A person who for the time being appears from the records at the Land Registry to be the owner of an undivided share in land on which there is a building and a registered mortgagee in possession of such share.

Lot owner

The owner of any piece or parcel of ground demised under a Government lease.

Mitigation measures

Tree works as recommended in tree inspection or tree risk assessment to mitigate potential tree risk for protection of public safety. Mitigation measures include the removal of defective parts of tree, installation of support system, pest and disease control, etc.

Qualified Professional

A qualified service provider and member of professional group with recognised qualifications and expertise to carry out arboricultural works.

Tree inventory

A tree database containing the latest tree and site information, including tree identity number, species, size, health and structural condition, number of each tree species, photo and location plan.

Tree Owner

A person, who is the owner of an undivided share of a building, also owns the trees that are growing on the common parts of the building.

PART 1 – DUTY OF CARE OF TREE OWNERS

1.1 PURPOSE

This ‘Handbook on Tree Management’ (HTM) has been developed by the Greening, Landscape and Tree Management Section (GLTMS) of the Development Bureau (DEVB). It provides Tree Owners the guideline and standard of good practice for management of their trees.

1.2 OBJECTIVES

<p>For Tree Owners</p> <ul style="list-style-type: none">▪ Understand your legal responsibilities of tree safety on your property.▪ Understand the importance of routine tree inspection, regular tree maintenance and use of Qualified Professionals to implement tree works. <p>For Property Managers</p> <ul style="list-style-type: none">▪ Understand the role you play in the application of the HTM on behalf of your Tree Owners.▪ Engage Qualified Professionals for all tree works. <p>For Qualified Professionals</p> <ul style="list-style-type: none">▪ Follow the HTM.▪ Be diligent in your assessments and maintain the standard of expertise expected of a Qualified Professional.▪ Only engage qualified contractors or personnel with demonstrated knowledge and experience.

1.3 IMPORTANCE OF TREE MANAGEMENT

1.3.1 Trees are Living Organisms

Just like human beings, trees are living organisms. It is normal and natural for trees to age with time. As part of its aging process, trees may:

- Shed and drop some branches
- Get sick and suffer from poor health
- Become susceptible to pest or disease and become weak
- Come under attack by wildlife

Structural and health conditions of trees will change with their life cycle and surroundings. Trees are particularly vulnerable in stormy weather.

The landscape environment we create will also affect the life of trees. A range of factors can make your trees weak and sick such as:

- Bad design: mismatch of tree species and growing place
- Bad landscape details: poor growing environment such as confined root space
- Bad supply: poor stock quality
- Bad installation: poor soil condition
- Bad management: poor assessment of tree health and tree risk
- Bad maintenance: cutting the main root; lack of water; bad pruning

A suitable growing environment and proper tree care is important for maintaining trees in stable and healthy conditions. Trees without proper management can become weak, deteriorate and eventually fail.

To the Tree Owners: damage to your property will be insignificant when faced with the possibility of human injury and death.

1.3.2 Trees are Valuable Assets

Structurally stable and healthy trees can add value to your property over time. Trees improve our outdoor environment and enhance our physical, emotional, intellectual and cultural well-being. Effective tree management and maintenance is an investment in our future.

1.3.3 Managing Tree Safety

Human safety is the most important aspect in tree risk management. Tree Owners must validate management diligence to keep trees in healthy and structurally sound conditions, recognise hazardous trees and take proper mitigation measures in a timely manner to protect human safety.

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1.4 THE LEGAL FRAMEWORK

1.4.1 Common Law Duty of Care

The Owner of a land has a common law duty of care to maintain his/her land, including trees growing on the land, so as to ensure that they will not pose danger to his/her neighbours and the public. The Owner can be held liable for personal injury and/or property damage arising from failure to observe the duty.

1.4.2 Building Management Ordinance (Chapter 344)

Where owners of a building have formed an owners' corporation under the Building Management Ordinance (BMO) (Chapter 344, Laws of Hong Kong), the responsibility for management of the common parts of the building rests with the owners' corporation.

Under the BMO, owners' corporation has a duty to maintain the common parts of the building in a state of good and serviceable repair and clean condition. Hence, an owners' corporation must properly manage and maintain landscaping areas, such as lawns and gardens, within the common parts.

1.4.3 Code of Practice on Building Management and Maintenance

In performing its duties and exercising its powers under the BMO, an owners' corporation is guided by the 'Code of Practice on Building Management and Maintenance' issued by the Secretary for Home Affairs under section 44(1) of the BMO. The purpose of the Code of Practice is to publicise standards and practices of management and safety in relation to the common parts of a building for owners' corporation to observe and follow. Failure to observe the Code of Practice may be relied upon as tending to establish or to negative any liability which is in question in a civil or criminal proceeding.

The HTM forms part of the Code of Practice (in progress). Owners' corporation are advised to follow the HTM to achieve effective tree management and maintenance.

1.4.4 Occupiers Liability Ordinance (Chapter 314)

The Occupiers Liability Ordinance (Chapter 314, Laws of Hong Kong) imposes on occupier of premises, that is the person in control of the premises, a duty to his/her visitor to take such care as is reasonable in the circumstances to see that his/her visitor will be reasonably safe in using the premises for the permitted purposes, a breach of which can give rise to civil liability.

1.4.5 Provisions in Land Leases

In the sale or grant of a plot of land, the Lands Department (LandsD) executes a lease with the purchaser/grantee, who will then be the owner of the land and is required to comply with the lease conditions. Leases executed at different times contain different conditions prevailing at that time. Lot owners (including the above purchasers /grantees and their subsequent assignees) have to check and comply with the lease conditions.

For lease of a private lot containing a tree preservation clause; the lot owner has to, except in an emergency situation, obtain written consent from LandsD for tree removal and pruning works. The application must meet the requirements specified in the Lands Administration Office Practice Note No. 7/2007 – Tree Preservation and Tree Removal Application for Building Development in Private Projects or its subsequent updated version. In granting a written consent, the relevant District Lands Office (DLO) may impose conditions on transplanting, compensatory landscaping or replanting as deemed appropriate.

Tree pruning or removal within a private lot are to be carried out by Qualified Professional(s) appointed by the lot owner if the tree within the lot is considered to pose an imminent danger where public safety is at risk after assessment by a professional employed by the lot owner meeting the requirements of the Lands Administration Office Practice Note No. 7/2007. The lot owner or his/her representative has to submit a detailed report prepared by the professional to LandsD within 21 days after the pruning or removal of the tree.

If a lot owner carries out tree removal or pruning without DLO's written consent, appropriate action will be taken by DLO upon detection. Such action includes issuing warning letters to the lot owner, requiring the lot owner to carry out compensatory planting or pay a premium.

The information in this Section is for general reference only and should not be relied on as professional legal advice. Tree Owners are advised to seek assistance from your lawyers should you have doubts about your duties and liabilities in your specific case.

1.5 TREE OWNERS' RESPONSIBILITIES

1.5.1 Engaging Qualified Professionals for Tree Works

Tree inspection, tree risk assessment and mitigation works involve arboricultural knowledge and require professional input. Tree Owners should always engage the services of Qualified Professionals to advise, supervise and handle all matters in relation to tree works. Selection of Qualified Professionals with good reputation and demonstrated experience are essential for quality results.

Appendix 1 - List of Qualified Service Providers and Members of Professional Groups on Tree Management

Appendix 2 - Sample Brief for Procurement of Arboricultural Service

1.5.2 Following Standards and Best Practices

The GLTMS is responsible for providing policy steer and advice to the tree management work of government departments. The Section promulgates standards in tree management and promotes the professionalism of the arboriculture industry.

The GLTMS regularly organises seminars and workshops on different tree management topics to arouse the awareness of Tree Owners on their responsibilities in proper tree management and the importance of proper tree maintenance. A wide range of online information including guidelines, publications, videos are available at www.trees.gov.hk.

While the guidelines promulgated by the GLTMS are intended primarily for government departments, Tree Owners are advised to take reference of the guidelines and standards and adopt them as appropriate. A section on 'Information About Tree Maintenance for Private Properties' (http://www.trees.gov.hk/en/tree_care/info_tree_maintenance_pp/index.html) has been specifically developed for private property owners and property managers in carrying out tree management works.

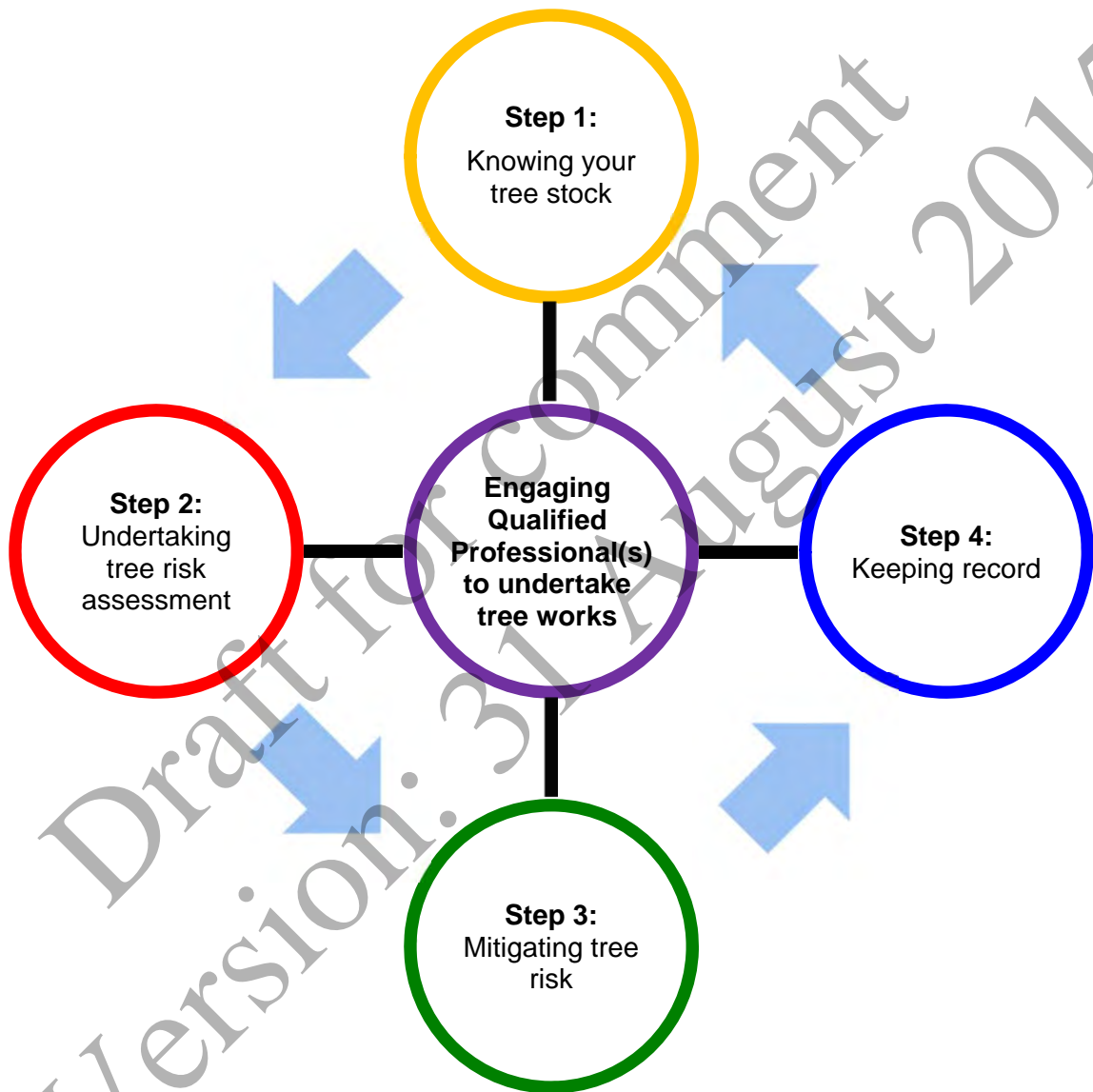
1.5.3 Performing Routine Tree Inspection

Routine tree inspection can help to identify early symptoms of deterioration in tree. Tree inspection needs to be carried out continuously as part of day-to-day tree maintenance work. Tree Owners are advised to check your trees after inclement weather to make sure they are not adversely affected by the heavy rain and strong wind.

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PART 2 – KEY STEPS IN TREE RISK MANAGEMENT

Tree Owners are required to exercise proper tree risk assessment and mitigation measures to minimise risk of tree failure. This requires engagement of Qualified Professionals for the works. The following diagram illustrates the steps to be taken by Tree Owners for effective tree risk management.



A proper tree risk management covers four fundamental aspects.

2.1 KNOWING YOUR TREE STOCK

Knowing the conditions your trees is the first step in implementing effective tree risk management. A good tree inventory can facilitate Tree Owners to establish a maintenance programme and prepare budget estimation for maintenance works.

#	Requirements
1	Ascertain the extent of areas with trees within your land.
2	Engage a Qualified Professional to collect and record: <ul style="list-style-type: none"> ▪ Basic tree information, including tree identity number, species, size, health and structural conditions; ▪ Site information, such as number of each tree species, photos and location plan.
3	For new planting schemes, the designer who is responsible for the planting design needs to prepare the tree inventory as part of design service and submit to the Tree Owner for record.
4	Update tree inventory as part of inspection programme.
5	Have Qualified Professional to check for completeness and accuracy.

Appendix 3 - Sample Format of Tree Inventory

2.2 UNDERTAKING TREE RISK ASSESSMENT

The purpose of tree risk assessment is to identify potential tree risks and carry out mitigation measures in a timely manner to reduce the risks.

#	Requirements
1	Refer to the 'Guidelines for Tree Risk Assessment and Management' (http://www.trees.gov.hk/filemanager/content/attachments/TRAM_Guidelines_2014.pdf) issued by the GLTMS in carrying out tree risk assessment.
2	Conduct assessment within three months before the onset of the wet season.
3	Undertake inspection of all CAT I trees within three days after lowering of a Red or Black Rainstorm Signal.
4	Undertake inspection of all CAT I trees within one week after lowering of Typhoon Signal No.8 or above.

Appendix 4 - Guidelines for Tree Risk Assessment and Management

The tree risk assessment should be carried out in the following two stages.

2.2.1 Tree Risk Assessment on Area Basis

Areas of land with trees are defined according to the level of use in target areas. Targets are people, property, or human activities that can be injured, damaged, or disrupted by a tree failure. By identifying the frequently used areas in target areas, Tree Owners can allocate resources to these areas with higher priority for more effective tree risk assessment.

Tree Owners are recommended to coordinate with property managers and Qualified Professionals on the categorisation of tree risk management zone in accordance with the area usage and information in the tree inventory.

Categorisation of different potential risk zones is illustrated in the following table.

Intensity of Use in Target Area	Potential Risk Zone	Priority for Tree Risk Management	Inspection Frequency
<u>Intensive use</u> Areas of high traffic flow and high pedestrian flow such as entrances, sitting-out areas, children play areas, footpaths, vehicular access, etc.	High (Category I)	Top priority	At least once a year before onset of wet season and when necessary
<u>Infrequent use</u> Areas of low traffic flow and low pedestrian flow such as roads with limited access, maintenance access, etc.	Medium (Category II)	Secondary priority	Every 3 to 5 years
<u>Rare use</u> Areas of very rare access such as inaccessible areas, dense vegetated areas, etc.	Low (Category III)	Low priority	When necessary

2.2.2 Tree Risk Assessment on Tree Basis

The engaged Qualified Professional is required to conduct tree risk assessment in group and individually to identify any potential trees risk and provide timely mitigation to alleviate the risk.

(a) Tree Group Inspection (Form 1)

Purpose: to facilitate an initial screening of trees.

Each tree in a tree group has to be inspected systematically for identifying potential tree hazards or tree required for detailed individual tree risk assessment (Form 2).

(b) Individual Tree Risk Assessment (Form 2)

Purpose: to conduct a detailed assessment of an individual tree that needs special attention.

This is an in-depth inspection that examines the full range of tree defects and site conditions present to determine the risk level of a tree to fail and strike a target.

A tree hazard rating with follow-up mitigation actions to address the identified defects and tree problems are given in the assessment. In some cases, use of advance equipment is required to identify, analyse and evaluate the inspected tree.

Appendix 5 - Examples of Common Tree Defects

2.3 MITIGATING TREE RISK

If the defects are not promptly rectified, it can lead to tree failure and cause serious or fatal injuries.

2.3.1 Mitigation Measures after Tree Risk Assessment

Appropriate mitigation measures as recommended in tree risk assessment are to be carried out in a timely manner and include:

- Pest and disease control
- Pruning
- Cordon off the tree fall zone
- Installation of support system
- Continuous monitoring of defect
- Tree removal

2.3.2 Tree Removal Procedures and Compensatory Planting

Tree Owners are required to proactively carry out tree pruning or removal if the tree is considered to have the risk of failure.

#	Requirements
1	Follow requirements in the lease conditions and Lands Administration Office Practice Note No. 7/2007 – Tree Preservation and Tree Removal Application for Building Development in Private Projects or its subsequent updated version for application of tree removal.
2	After removal of tree(s), carry out compensatory planting in accordance with the requirements as stated in the practice note.

2.3.3 Urgent Tree Removal

#	Requirements
1	Follow requirements stated in the Lands Administration Office Practice Note No. 7/2007 or its subsequent updated version to carry out urgent tree removal work.
2	Take full photographic record on the concerned tree(s) before removal or pruning of the damaged tree(s) due to natural causes or emergency situations where safety is at stake.
3	Photograph taking and tree removal can be carried out in parallel for expeditious emergency action if considered necessary.
4	In any case, inform Lands Department within 21 calendar days after the incident.
5	After removal of tree(s), carry out compensatory planting in accordance with the requirements as stated in the practice note.

2.3.4 Emergency Tree Failure Incident

Call 999 for assistance in emergency situation if a tree poses an imminent danger of collapse.

2.3.5 Safety Precautions

Provisions of safe working practices are set down in law in the Occupational Safety and Health Ordinance (Cap 509).

'Every employer must, so far as reasonably practicable, ensure the safety and health at work of all the employer's employees.'

- Provide and maintain a safe system of work to ensure the safety and health of the employees involved in the works
- Verify that all contractors have qualified safe work policies and implementation procedures.

(a) Safe Access

- Tree Owners have to provide a safe access for carrying out tree works, especially for trees located on slopes and retaining walls.
- Reference can be made to the 'Guidelines on Safe Access for Slope Maintenance' issued by the Geotechnical Engineering Office of the Civil Engineering and Development Department in safe access on slope(http://www.cedd.gov.hk/eng/publications/geo_reports/doc/er136/er136.pdf).

(b) Arboriculture Occupational Safety and Health

Refer to the 'Guidelines on Arboriculture Occupational Safety and Health' (http://www.trees.gov.hk/filemanager/content/attachments/OSH_Guidelines_2012_Dec_Issue.pdf) issued by the GLTMS to implement adequate occupational safety and health measures in carrying out the tree works.

Appendix 6 - Guidelines on Arboriculture Occupational Safety and Health

2.4 KEEPING RECORD

Tree Owners need to keep a complete set of inspection findings and recommendations of tree inspection properly and systematically for planning of tree maintenance and management works. Information to be recorded includes:

- Tree inventory
- Records of maintenance inspections
- Recommended mitigation measures and actions taken
- Photo records

Comprehensive and tracking mitigation measures can demonstrate that Tree Owners have taken reasonable care in tree management.

Appendix 7 - Sample of Master List of Documents and Record of Tree Works

PART 3 – GENERAL TREE CARE

Prevention is always better than cure. Proper tree care can help to promote healthy tree growth and reduce development of hazardous tree defects. Tree Owners need to engage qualified landscape contractors with demonstrated knowledge and experience to carry out regular maintenance to keep your trees in healthy conditions.

An overview of tree maintenance and planting practice essentials is provided in this section. More detailed information on tree care can be found in GLTMS website at www.trees.gov.hk.

3.1 TREE MAINTENANCE

3.1.1 Performing Regular Tree Maintenance

Proper tree maintenance contributes to the healthy growth and good form of trees. Many tree failure incidents are the result of lack of regular maintenance, poor tree maintenance practices and other malpractices in tree care.

#	Requirements
1	Landscape contractors have to follow guidelines and best practice to carry out regular tree maintenance properly to upkeep the trees in healthy and structurally sound conditions.
2	Regular tree maintenance operation includes proper watering, weeding, pruning, fertilising, mulching, staking, pest and disease control, etc.

Appendix 8 - Proper Planting Practice - Staking and Guying

http://www.greening.gov.hk/en/preservation/new/Staking_Guying_eng_aug2011.jpg

Appendix 9 - Management Guidelines for Mature Trees

[https://www.trees.gov.hk/filemanager/content/attachments/Paper_Mature_Trees_\(finalised_and_issued\).pdf](https://www.trees.gov.hk/filemanager/content/attachments/Paper_Mature_Trees_(finalised_and_issued).pdf)

Appendix 10 - Management Guidelines for Stonewall Trees

http://www.trees.gov.hk/filemanager/content/attachments/Guilelines_for_stonewall_trees.pdf

3.1.2 Maintaining Good Environment for Tree Growth

The relationship between tree root systems and the characteristics of the soils in which they grow has a greater influence on tree health than any other single factor. To provide a favourable environment for tree growth, landscape contractors need to:

#	Requirements
1	Provide soil with suitable texture, structure, pH value, and water-holding capacity for roots to anchor and obtain water, oxygen and nutrients in soil.
2	Keep the area around the base of tree trunk clear of vegetation, excessive soil and mulch fill.

Appendix 11 - Keep Sufficient Space Clear of Vegetation at the Base of Trees

<http://www.greening.gov.hk/en/preservation/new/spaceAtTreeBase.jpg>

3.1.3 Tackling Insect Pest and Fungal Disease

Insect pest and fungal disease can threaten tree health and structure. In Hong Kong, termites and Brown Root Rot (BRR) disease are the two key pest and fungal disease impacts on our trees. BRR disease is prevalent in tropical and subtropical areas. There is currently no direct remedy for BRR infected trees.

(a) Termites

#	Requirements
1	An indicator of wood decay.
2	Some species actively consume wood and can cause significant impact to structural stability.
3	Engage pest control professional to treat the infestation promptly.

(b) Brown Root Rot (BRR) disease

#	Requirements
1	Highly pathogenic and infectious.
2	Cause rapid root decay and may lead to tree collapse.
3	Early detection of BRR signs and symptoms can help to control the disease through timely removal of the infected trees.

Appendix 12 - Guidelines on Brown Root Rot Disease

[http://www.trees.gov.hk/filemanager/content/attachments/Guidelines_on_Brown_Root_Rot_Disease\(version_for_the_general_public\)EN.pdf](http://www.trees.gov.hk/filemanager/content/attachments/Guidelines_on_Brown_Root_Rot_Disease(version_for_the_general_public)EN.pdf)

Appendix 13 - Note on Common Wood Decay Fungi on Urban Trees of Hong Kong

[http://www.trees.gov.hk/filemanager/content/attachments/Note_on_Common_Wood_Decay_Fungi_on_Urban_Trees_of_HK\(May2015\).pdf](http://www.trees.gov.hk/filemanager/content/attachments/Note_on_Common_Wood_Decay_Fungi_on_Urban_Trees_of_HK(May2015).pdf)

3.1.4 Protecting Trees during Development

During development, construction activities near trees can cause serious impacts to trees. Landscape contractors have to undertake precautionary measures to minimise the damage and subsequent risks associated with trees during and after construction.

#	Requirements
1	Plan in advance for tree preservation before works.
2	Erect protection fence to prevent physical damages to trees and their roots.

Appendix 14 - Guidelines on Tree Preservation during Development

http://www.trees.gov.hk/filemanager/content/attachments/Guidelines_on_Tree_Preservation_during_Development.pdf

Appendix 15 - Design for Tree Protection Zone

http://www.greening.gov.hk/en/preservation/new/designForTreeProtectiveZone_b.jpg

3.1.5 Performing Good Tree Pruning Practices

Pruning is the most common maintenance operation in tree care. Proper pruning can:

- Improve tree health and appearance
- Prevent development of many hazardous tree defects
- Reduce the risk of tree failure

Improper tree pruning is detrimental to the appearance and healthy growth of trees and may result in irrecoverable damage to the structure of trees. Landscape contractors need to follow GLTMS guidelines to carry out pruning works safely and properly.

Appendix 16 - General Guidelines on Tree Pruning

<http://www.trees.gov.hk/filemanager/content/attachments/guideline.pdf>

Appendix 17 - Do's and Don'ts in Pruning (Factsheet)

<http://www.trees.gov.hk/filemanager/content/attachments/factsheet.pdf>

Appendix 18 - Do's and Don'ts in Pruning (Leaflet)

<http://www.trees.gov.hk/filemanager/content/attachments/leaflet.pdf>

3.1.6 Keeping Maintenance Records

All inspection and maintenance records have to be documented properly. They need to contain:

- Date of operation
- Person responsible for the works
- Relevant tree information
- Operation details
- Photographic records showing the trees before and after treatment

The records on tree works can:

- Facilitate the monitoring of tree condition
- Assess the effectiveness of treatment
- Decide alternative follow up measures
- Demonstrate Tree Owners have taken reasonable care in proper tree management

Appendix 19 - Sample of Tree Maintenance Record

3.2 TREE PLANTING AND REPLACEMENT

3.2.1 Selecting Right Tree at Right Place

Selecting the right tree at the right place is the basic principle in tree selection. The following factors have to be considered before planting.

- Sufficient space both above and below ground has to be allowed for the ultimate size of tree
- Purpose of tree planting
- Design intention
- Condition of planting site
- Tree characteristics
- Growing requirements of tree

Appendix 20 - Selection of Trees

http://www.greening.gov.hk/EN/docs/Selection_of_Trees_Eng.pdf

3.2.2 Selecting Healthy Stock

Landscape contractors should provide high quality nursery stocks to Tree Owners. Substandard nursery materials can cause tree health and structural problems in future. A high-quality tree consists of the following characteristics:

- A central leader with good taper and free of co-dominant stems
- A strong form with well-spaced and firmly attached branches
- A balanced canopy with normal foliage and good live-crown ratio
- A trunk with no wound or damage
- A good quality root system with sufficient size and no defect

Appendix 21 - Select and Plant Good Specimens

http://www.greening.gov.hk/en/preservation/new/goodSpecimen_a.jpg

3.2.3 Considering Site Environment

When allocating space for tree planting, the mature form, height and crown spread of the trees as well as the purpose of planting have to be considered. Sufficient growing space and adequate distance between trees and adjacent structures have to be allowed in planning stage. Trees that are planted too close to building structures can result in imbalance form and poor health in the long run.

Appendix 22 - Provide Adequate Growing Space for Future Growth of Canopy

http://www.greening.gov.hk/en/preservation/new/adequateGrowingSpace_notTooDense_a.jpg

Appendix 23 - Provide Sufficient Growing Space between Trees and Adjacent Buildings/Structures

http://www.greening.gov.hk/en/preservation/new/sufficientGrowingSpace_betweenBuildings_a.jpg

Appendix 24 - Guideline on Pavement Renovation Works and Tree Stability

http://www.trees.gov.hk/filemanager/content/attachments/Guideline_on_Pavement_Renovation_Works_and_Tree_Stability.pdf

3.2.4 Providing Establishment Maintenance

For newly planted trees, landscape contractors have to:

#	Requirements
1	Apply appropriate irrigation.
2	Maintain well drainage system.
3	Conduct regular weeding.
4	Install staking and guying to provide support for trees.
5	Apply appropriate mulching to control weed growth, retain moisture, relieve soil compaction and release nutrients to the soil.
6	Conduct proper formative pruning for young trees to create a balanced and healthy tree form.

**APPENDIX 1 – LIST OF QUALIFIED SERVICE PROVIDERS AND MEMBERS IN
PROFESSIONAL GROUPS ON TREE MANAGEMENT**

Tree Owners can refer to the following lists for information on the qualified professional groups for tree works.

- List of Approved Suppliers of Materials and Specialist Contractors for Public Works / Landscaping
www.devb.gov.hk/Supplier.aspx?section=83&lang=1&id=80
- International Society of Arboriculture, Hong Kong Chapter
www.isahongkong.com
- The Hong Kong Institute of Landscape Architects, Accredited Arboricultural Practitioners (AAP)
www.hkila.com/v2/aap.php

Reference can also be made to other professional institutes for tree management work and the relevant information in the following website.

www.trees.gov.hk/en/about_gltms/arboriculture_organisations/index.html.

APPENDIX 2 – SAMPLE BRIEF FOR PROCUREMENT OF ARBORICULTURAL SERVICE

This sample brief is for reference only. Tree Owners shall modify the content/scope of work to suit their own requirements in conducting tree works.

1. Objective of the Assignment

- 1.1 The objective of this Assignment is to *prepare/update tree inventory, carry out tree risk assessment, and undertake associated mitigation measures** for trees within the assessment area. The location and extent of assessment area is shown in Appendix ____.

2. Scope of Work

- 2.1 Arboricultural services to be carried out under this Assignment shall cover the following scope of work.

- (i) To prepare/update* tree inventory for existing trees;
- (ii) To carry out a tree risk assessment, including 'Area Basis' and 'Tree Basis' inspection, for trees within the assessment area through on-the-ground or aerial inspection (optional) [*for tree(s) that cannot be assessed/evaluated comprehensively on ground level*];
- (iii) To identify any immediate danger and recommend emergency measures if necessary;
- (iv) To record the inspection findings;
- (v) To recommend appropriate mitigation measures; and
- (vi) To carry out and record the recommended mitigation measures (optional) [*tree owner can consider to carry out the mitigation measures under a separate contract*]

3. Description of the Assignment

- 3.1 The services provided by the Contractor to complete this Assignment shall meet the requirements as listed in clause 3.2 to 3.3 and to the satisfaction of the Employer.

3.2 Preparation/Updating* of Tree Inventory

3.2.1 The Contractor shall prepare/update* the tree inventory to record all information of existing trees within the assessment areas. Basic tree information, including tree identity number, species, size, health and structural conditions, and site information, such as number of each tree species, photos, location plan, shall be included in the tree inventory.

3.3 Tree Risk Assessment

3.3.1 The Tree Risk Assessment shall be carried out in the following two stages.

- (i) Area Basis Assessment; and
- (ii) Tree Basis Assessment.

3.3.2 The Contractor shall make reference to the latest version of 'Guidelines for Tree Risk Assessment & Management Arrangement on an Area Basis and on a Tree Basis' issued by the Greening, Landscape, and Tree Management Section (GLTMS) of the Development Bureau (DEVB) in carrying out the Tree Risk Assessment.

3.3.3 Area Basis Assessment

- (i) The Contractor shall categorise the assessment area into different Potential Risk Zones in accordance with the following table.

Intensity of Use in Target Area	Potential Risk Zone
<u>Intensive use</u> Area of high traffic flow and high pedestrian flow such as entrances, sitting-out areas, children play areas, footpaths, vehicular access, etc.	High (Category I)
<u>Infrequent use</u> Areas of low traffic flow and low pedestrian flow such as roads with limited access, maintenance access, etc.	Medium (Category II)
<u>Rare use</u> Areas of very rare access such as inaccessible areas, dense vegetated areas, etc.	Low (Category III)

- (ii) After the completion of 'Area Basis Assessment', the Contractor shall submit an assessment report with a layout plan including the following.
 - (a) The boundary of the assessment area and demarcation of different Potential Risk Zones with different colours/legends/ annotations; and
 - (b) Locations of all the existing trees.

3.2.4 Tree Basis Assessment - Tree Group Inspection (Form 1)

- (i) After completion of the Area Basis Assessment, the Contractor shall carry out Tree Group Inspection for the trees within Category I Potential Risk Zone.
- (ii) The main objective of Tree Group Inspection is to facilitate an initial screening of trees. Each tree in a tree group has to be inspected systematically for identifying potential tree hazards or tree required for more detailed individual tree risk assessment.
- (iii) The Contractor shall carry out of any tests to the trees necessary for identifying trees for remedial action or detailed tree risk assessment.
- (iv) The Contractor shall submit the Tree Group Inspection report comprising the following to the Employer.
 - (a) The completed and endorsed Tree Group Inspection Form(s);
 - (b) Site plan(s) showing the locations of the trees within Category I Potential Risk Zone;
 - (c) Photo record(s) of the trees; and
 - (d) Records of mitigation measures* *[delete if mitigation measures to be carried out under a separate contract]*.

3.2.5 Tree Basis Assessment - Individual Tree Risk Assessment (Form 2)

- (i) After completion of the Tree Group Inspection (Form 1), the Contractor shall carry out Individual Tree Risk Assessment for the tree(s) recommended for such assessment in the Tree Group Inspection report.
- (ii) The Contractor shall submit the Individual Tree Risk Assessment report comprising the following to the Employer.
 - (a) The completed and endorsed Form(s) 2 (Tree Risk Assessment Form);
 - (b) Site plan(s) showing the tree location;
 - (c) Photo record(s) of the tree;

- (d) Other documents, such as any test report on the tree as necessary for further investigating the suspected defects to facilitate assessment of the tree condition and tree failure potential; and
- (e) Records of mitigation measures* *[delete if mitigation measures to be carried out under a separate contract]*.

3.2.6 The Contractor shall provide all necessary tools, equipment and transportation for carrying out the Tree Group Inspection, Individual Tree Risk Assessment and mitigation measures* *[delete if mitigation measures to be carried out under a separate contract]*.

4. Deliverables

4.1 The Contractor shall provide the following deliverables after completion of each stage of the works as part of the Assignment.

- (i) _____ copies of the updated* Tree Inventory;
- (ii) _____ copies of Area Basis Assessment Report;
- (iii) _____ copies of Tree Group Inspection Report;
- (iv) _____ copies of Individual Tree Risk Assessment Report; and
- (v) _____ copies of record of completed mitigation measures*. *[delete if mitigation measures are carried out under a separate contract]*

4.2 All the submitted reports shall be in the form of an A4-sized, bound report which shall bear a report cover indicating the Contract number, the Contract title, the date of the report, and that the report is prepared by the approved Inspection Officer and endorsed by the Endorsement Officer. The format of the report shall be agreed by the Employer prior to submission of the report.

4.3 The Contractor shall provide hard and soft (electronic files) copies of all drawings and documents as required by the Employer during the contract period of the Assignment.

5. Programme of Implementation

5.1 The due date for the commencement of the Assignment shall be _____. The due date(s) for the completion of Section 3 of the Assignment, including the submission of Inspection Reports and all necessary mitigation measures* *[delete if mitigation measures to be carried out under a separate contract]*, shall be _____.

5.2 The Contractor shall submit the draft programme and revised draft programme within the following periods:

(i) Submission of the draft programme:

Within __ weeks of the due date for commencement of the Assignment

(ii) Submission of revised draft programme:

Within __ weeks from the instruction of the Employer

5.3 The draft programme and revised draft programme shall detail the activities to be carried out and target dates for particular tasks. The Contractor shall discuss with the Employer during the above periods to agree the timing of submission of reports, other documents and plans for each of the main elements of the Assignment.

6. Standards and Specifications

6.1 The Contractor shall adopt such guidelines, standards and specifications as are applicable to and in current use by the Government of the Hong Kong Special Administrative Region or, if non-existent, international Codes of Practice and Specifications. Reference can be made to the list of guidance documents in tree risk assessment and tree maintenance in the website of GLTMS at www.trees.gov.hk.

7. Information Provided by the Employer

7.1 All available information relevant to the Assignment will be provided to the Contractor.

APPENDIX 3 – SAMPLE FORMAT OF TREE INVENTORY

TREE INVENTORY

A. General Information

Property Name:	
Address:	

B. Tree Schedule

Tree No.	Tree Species		Overall Height (M)	DBH (mm)	Crown Spread (M)	Location	Tree Condition	Photo No.
	Chinese Name	Botanical Name						

C. Attached Information

Site plan
 Tree Layout Plan
 Tree record photo

Other drawing(s), e.g. updated planting plan to illustrate removed or added tree (Please specify)

Prepared by : _____

Reviewed and Approved by : _____

Post and Organisation: _____

Post and Organisation: _____

Signature: _____

Signature: _____

Date: _____

Date: _____

**Guidelines for Tree Risk Assessment and Management Arrangement
On an Area Basis and on a Tree Basis**



**GREENING, LANDSCAPE AND TREE MANAGEMENT SECTION
DEVELOPMENT BUREAU**

October 2014 (7th Edition)

**GUIDELINES FOR TREE RISK ASSESSMENT AND MANAGEMENT
ARRANGEMENT ON AN AREA BASIS AND ON A TREE BASIS**

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Annexes

- A. Form 1: Tree Group Inspection Form
- B. Form 2: Tree Risk Assessment Form
- C. Pictorial Guide for Tree Maintenance to Reduce Tree Risks
- D. Guidelines on Photo-Taking of Tree Conditions in the Process of Tree Risk Assessment

Tree Management Office

Greening, Landscape and Tree Management Section

Development Bureau

www.trees.gov.hk

Guidelines for Tree Risk Assessment and Management Arrangement on an “Area Basis” and a “Tree Basis”

1. Background

1.1 Pursuant to the recommendation in the *Report of the Task Force on Tree Management – People, Trees, Harmony* published on 29 June 2009 and Coroner’s Court recommendation on fatal tree incident at Yuen Chau Kok dated 12 July 2011, the Development Bureau (DEVB) has introduced and updated a set of new tree risk assessment arrangements since January 2010 for implementation by the tree management departments in order to better protect public safety. These arrangements, which were formulated with reference to the international best practices with due consideration to the circumstances in Hong Kong, are based on a dual approach –

- (a) **“Area Basis”** assessment – departments concerned will first identify those areas where members of public will be affected if a tree fails; and
- (b) **“Tree Basis”** assessment – once an area is identified, staff in the department concerned will identify those trees which may be problematic/important, and assess their conditions in accordance with a standardised format with particular emphasis on the risk angle. Old and Valuable Trees (OVTs) will as a rule be included for close monitoring.

1.2 Appropriate risk mitigation measures will then be identified having regard to the specific conditions of individual trees that pose a risk to public safety. As recommended by the Task Force, in case of conflicts between tree preservation and public safety, the latter should be given a higher priority.

1.3 In view of the varying circumstances of the tree management departments and resource limitations, the Task Force considered it necessary to allow suitable flexibility in the implementation of the tree risk assessment arrangements across departments. It is envisaged that over time, Government will be able to systematically build up a comprehensive database of the conditions of trees located on government lands for guiding the formulation of necessary remedial actions and risk mitigation measures as well as facilitating future monitoring of the conditions of these trees.

1.4 In the light of the previous practical experience gained from the tree risk assessment exercise, the Tree Management Office (TMO) of DEVB has updated the Guidelines for Tree Risk Assessment and Management Arrangement for implementation.

2. Purpose of the Guidelines

2.1 Risk is the combination of the likelihood of an event and severity of the potential consequence. A systematic process for tree risk assessment is essential to identify, analyse and evaluate tree risk. The Guidelines elaborate on the methodology for demarcating tree risk management zones on an “Area Basis” and for carrying out tree risk assessment on a “Tree Basis”, including the application of the tree assessment forms: *Form 1 – Tree Group Inspection Form* (in Annex A) and *Form 2 – Tree Risk Assessment Form* (in Annex B).

2.2 Tree risk management is not a one-off exercise. It constitutes a professional approach to tree management and helps ensuring the long-term sustainability of our trees. The methodology set out in the Guidelines assists departments in identifying trees with health and/or structural problem(s) in a systematic manner so that remedial actions can be taken in a timely manner to alleviate the potential risks.

3. Tree Risk Assessment on an “Area Basis”

3.1 Government is striving to uplift the quality of our living environment through active planting, proper maintenance and preservation of trees together with other vegetation. As trees are living organisms, their health and structural conditions will change with their life cycle and their surroundings, especially in inclement weather. Government has a duty of care on the proper maintenance of trees for the protection of public safety, through appropriate tree risk assessment and management arrangement.

3.2 With over millions of trees in urbanised areas of Hong Kong, it is not practical, if not impossible, to cover every tree with an individual tree assessment. Therefore, the objective of the “Area Basis” assessment is to focus on areas where targets will be subject to risk of significant/unacceptable harm in the event of a tree failure so that the tree management departments can allocate their resources to these areas with higher priority for more effective tree risk management.

3.3 The process of tree risk assessment on an “Area Basis”

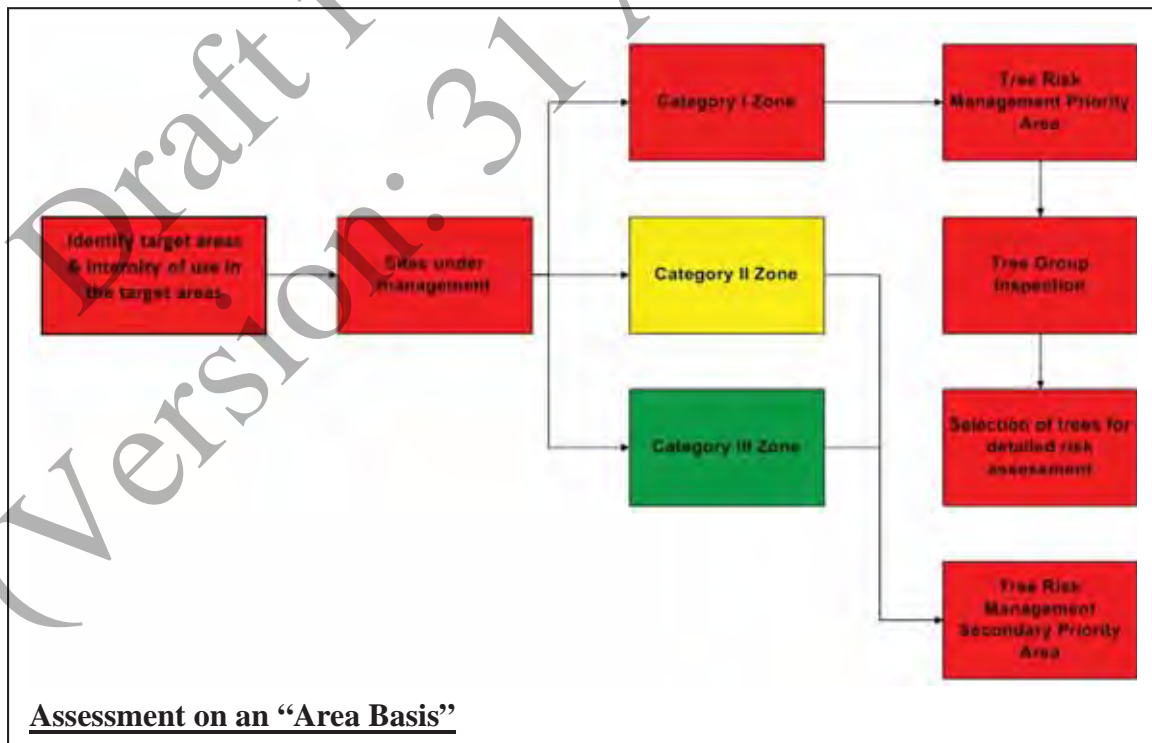
3.3.1 The tree risk assessment on an “Area Basis” aims to:

- (1) **Identify** areas where failure of tree will pose a hazard to public safety or cause disruption to human activity; and
- (2) **Prioritise** effort of tree risk management according to the frequency of use of the area.

3.3.2 Targets are people, property, or human activities that could be injured, damaged, or disrupted by a tree failure, e.g. partial or complete closure of road traffic. A tree cannot be a hazard without the presence of a target. For sites managed by departments, tree risk management zones can be determined based on the intensity of use in target areas which can be affected by tree failure.

Intensity of Use in Target Area	Tree Risk Management Zone
<p><u>Intensive Use</u> Areas of high traffic flow and high pedestrian flow such as public parks, playgrounds, crowded streets, busy carriageways, schools, etc.</p>	Category I
<p><u>Infrequent Use</u> Areas of low traffic flow and low pedestrian flow such as road verges of limited access, countryside roads, village footpaths, etc.</p>	Category II
<p><u>Rare Use</u> Areas with very rare public access such as inaccessible areas, remote countryside slopes, dense woodlands, maintenance access not open for public, etc.</p>	Category III

Determination of tree risk management priority areas



3.3.3 Tree management departments are required to categorise sites under their management into tree risk management zones, such as Category I Zone, Category II Zone and Category III Zone being an “Area Basis” approach having regard to the intensity of use in the target areas. Category I Zone is designated as tree risk management priority area, whereas Category II Zone and Category III Zone are designated as tree risk management secondary priority areas. Such site categorisation covers sites temporarily under the management of works departments during the course of public works project(s). Works departments should approach the departments that previously managed the site for records of previous tree inspections to familiarise themselves with pre-existing tree conditions.

3.3.4 For Category I Zone, tree risk assessment should be carried out regularly (at least annually) and when necessary to cope with the changing conditions of the trees. We recommend the tree management departments to carry out tree risk assessment for Category II Zone and Category III Zone when they have already completed tree risk assessment for all trees in Category I Zone and if resources permit. For Category II Zone, tree risk assessment at 3-5 years interval per cycle is recommended.

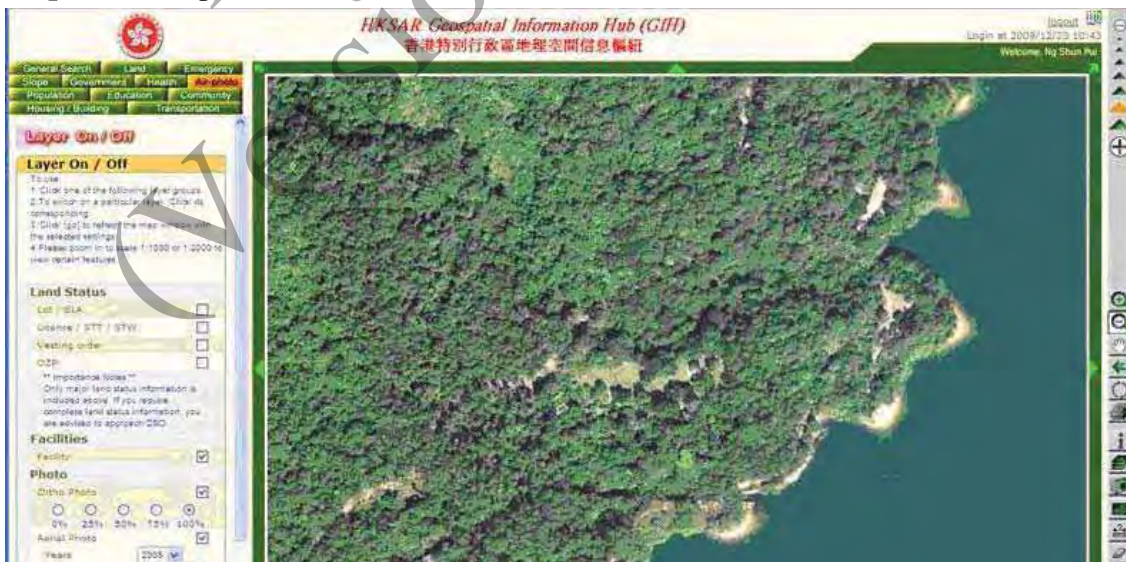
3.3.5 For OVTs and stonewall trees, tree risk assessment (Form 2 inspection under Section 4.4 of the guidelines) should be carried out at least twice a year to enhance close monitoring the conditions of these valuable and/or special trees.

3.4 Working examples of demarcation of tree risk management zone on an “Area Basis”

3.4.1 An example in a country park

Example – AFCD case: Shing Mun Country Park

Step 1: Desktop Demarcation



Step 2



Step 3

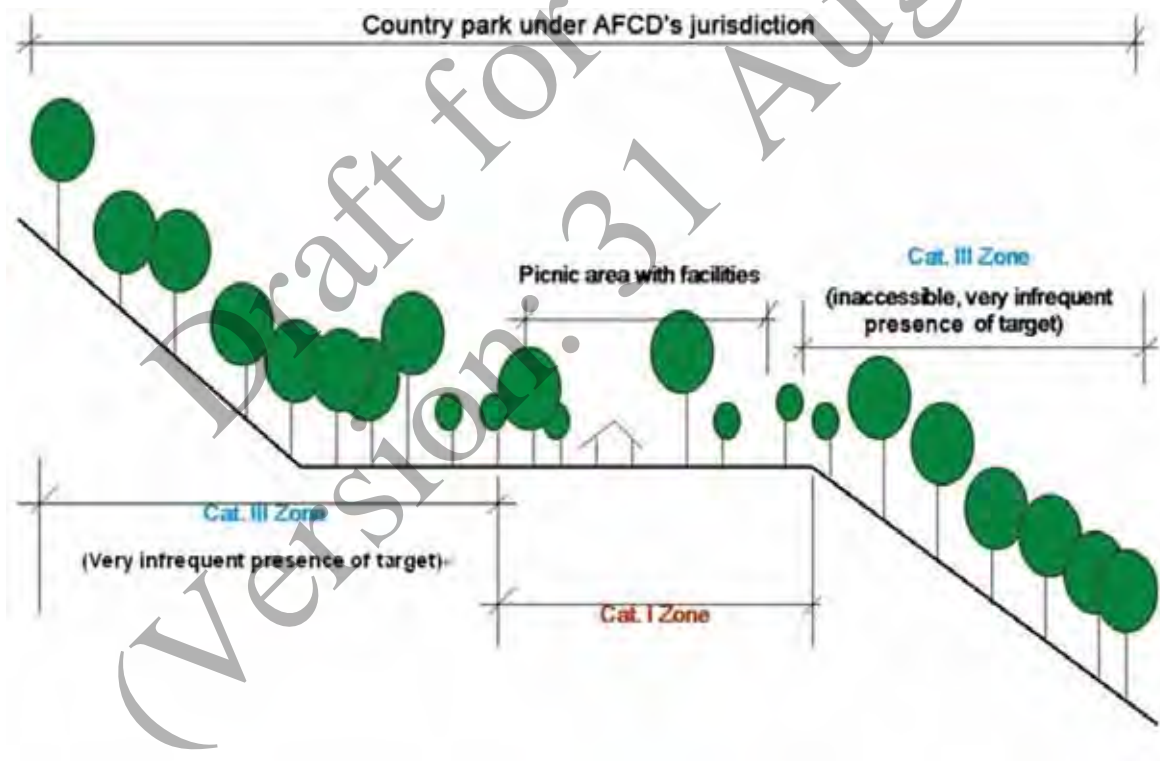


Step 4



(source of photo:
AFCD)

Step 5



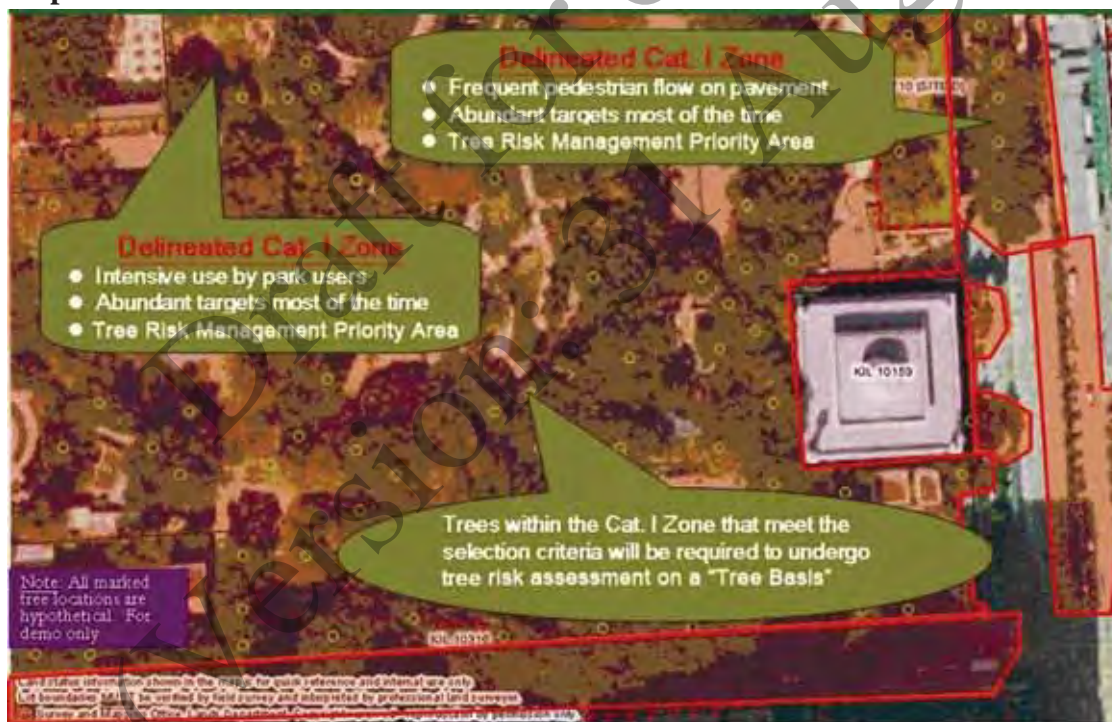
3.4.2 An example in a public park

Example – LCSD case: Kowloon Park and pavements along Nathan Road, Tsim Sha Tsui

Step 1: Desktop Demarcation



Step 2



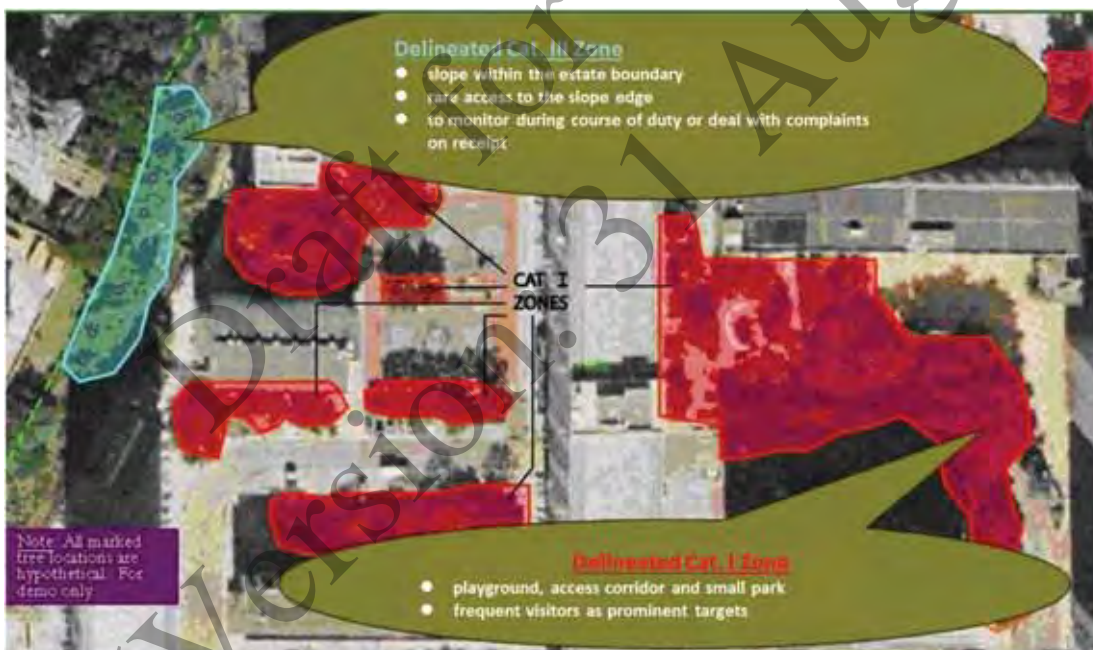
3.4.3 An example in a public housing estate

Example – HD case: Lei Muk Shu Estate, Kwai Chung

Step 1: Desktop Demarcation



Step 2



Step 3



Step 4



3.4.4 An example in a water service reservoir

Example – WSD case: Tsuen Wan No. 2 Fresh Water Service Reservoir, Kwai Chung

Step 1: Desktop Demarcation



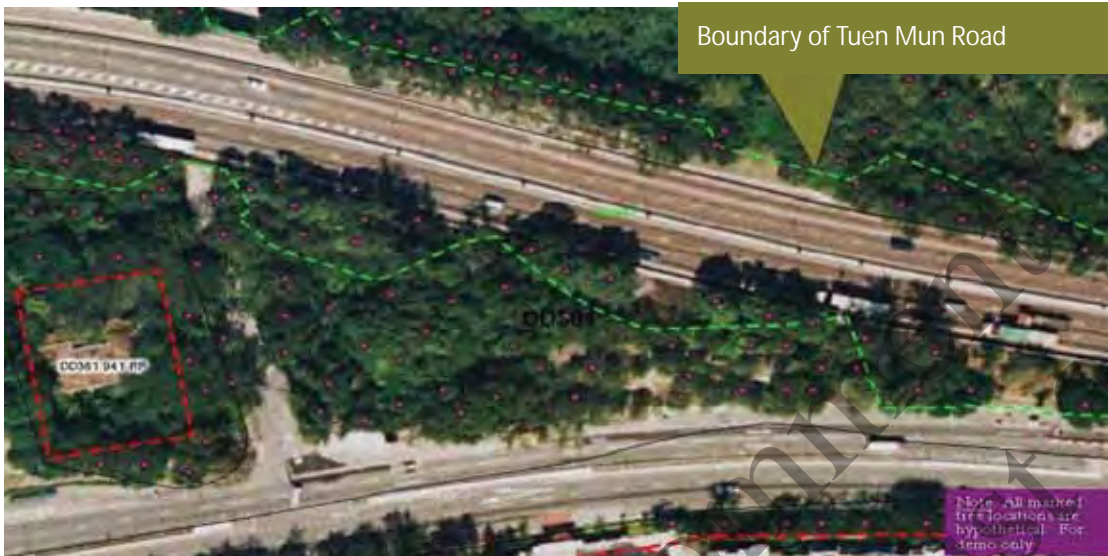
Step 2



3.4.5 An example along a highway

Example – HyD case: a site along Tuen Mun Road

Step 1: Desktop Demarcation

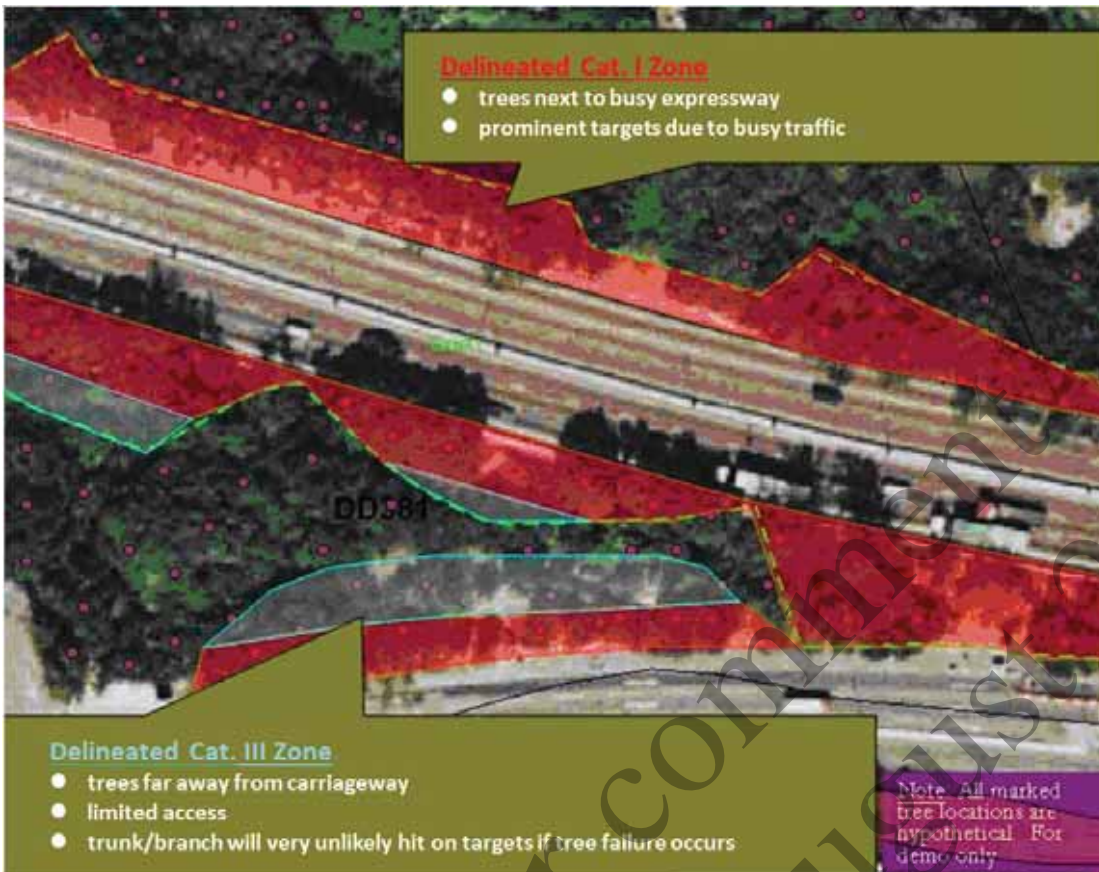


Step 2

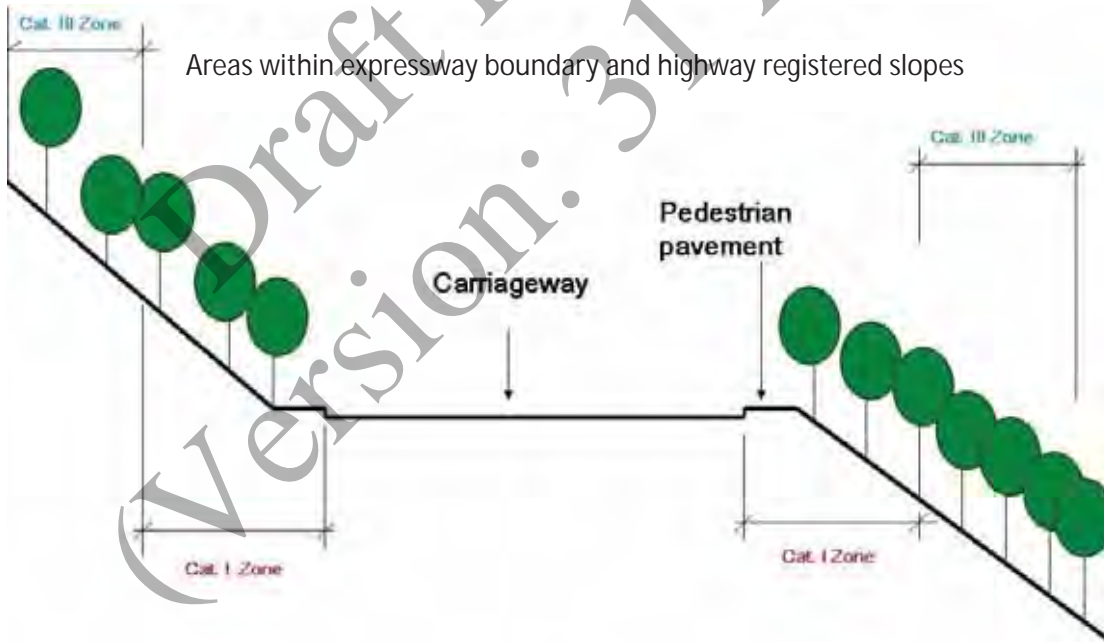


*highway registered slopes mean slopes maintained by HyD as registered in the Slope Maintenance Responsibility Information System (SMRIS) of LandsD

Step 3



Step 4



A registered slope maintained by HyD



3.4.6 An example of a construction site

Example – CEDD case: a construction site in Central

3.4.6.1 As a general principle, the party that is maintaining the tree when risk assessment is required should be responsible for undertaking the tree risk assessment. After construction, if a works department is still maintaining a tree during the establishment period or the aftercare period for OVTs, the works department concerned should be responsible for the tree risk assessment. If a tree has been handed over to the maintenance department for long-term maintenance after construction, the maintenance department concerned should then be responsible for the tree risk assessment.

3.4.6.2 When carrying out tree risk assessment, if the site (or part of the site) falls in a Category I Zone, the concerned department should proceed with a tree group inspection (Form 1) and, where appropriate, a detailed assessment using Form 2 for individual trees.



3.4.6.3 Construction sites occupy space in transition from an original use to a new use. In many cases a full tree survey may exist for the project that is under construction and this may be used to understand the baseline condition of the trees at the construction site(s).

3.4.6.4 In undertaking tree risk assessment, the following considerations should be taken into account:

- ◆ Trees on site are normally hoarded off to protect them. This reduces the risk if areas within the hoarding area are not accessible, i.e. no target.
- ◆ The location of the trees on the site influences the risk. Trees located fully within the site and are potentially affecting only the site area may be classified as Category II Zone. Trees located on site but potentially affecting a public area off site (e.g. adjacent to a public roadside) should be classified as Category I Zone.

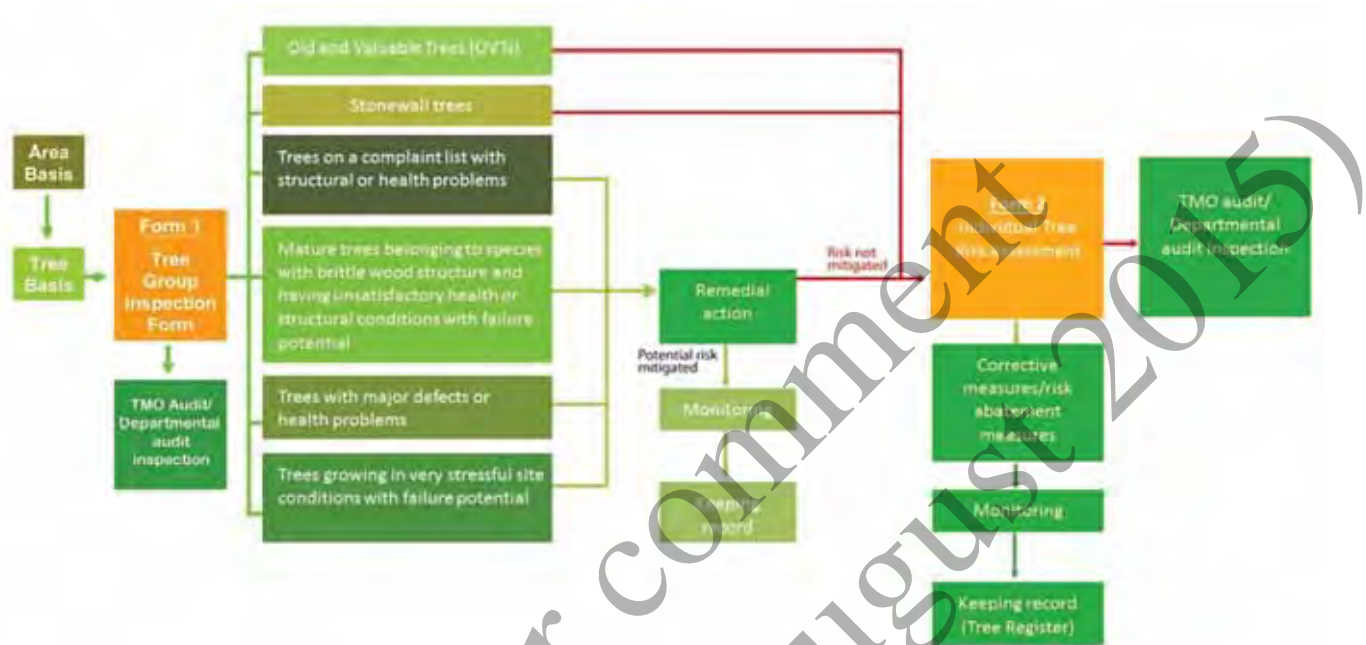
3.4.6.5 Trees in construction sites may be subject to higher stress than normal due to changes in their environmental conditions (e.g. changes in water table levels, dust, vibration, soil compaction, etc.). As such, more frequent (e.g. monthly) risk assessment should be conducted in the initial stage of the operation phase of the new development.

4. Tree Risk Assessment on a “Tree Basis”

4.1 Once a tree risk management priority area is identified, staff in the department concerned should identify those trees which may be problematic/important, assess their health and structural

conditions systematically and professionally with particular emphasis on the risk perspective, and record the inspection findings using standardised forms promulgated by the TMO (i.e. Form 1 and Form 2).

4.2 Procedure of tree risk assessment on an “Area Basis” and a “Tree Basis”



4.3 Use of Form 1 – Tree Group Inspection Form

4.3.1 Objective of Form 1

The main objective of Form 1 is to facilitate initial screening of trees, keeping records for further monitoring, and identifying potential tree hazards for appropriate remedial measures or for more detailed individual tree risk assessment using Form 2.

For trees in the tree risk management priority area, they should first be screened by way of a tree group inspection using **Form 1 – Tree Group Inspection Form**. For users with Tree Management Information System (TMIS) accounts, the use of Form 1 under the TMIS format is recommended. Tree group inspection is an important step to screen out problematic trees and those require special care. The use of binoculars in a tree group inspection to obtain a closer view of the conditions of the canopy at a higher level, when required, is desirable. Appropriate equipment and hand tools such as mallet, hand spade and probe, etc. should be used for preliminary assessment of individual trees when

required so as to help deciding if a Form 2 inspection would be necessary for a particular tree in question. Sounding tests should be conducted, when required, for trunks or accessible scaffold limbs with decay or suspected decay cavity to assess the extent of structural problems.

4.3.2 Although Form 1 does not require recording of details of the individual trees in a tree group, the Inspection Officer should inspect each tree in the tree group systematically, paying particular attention to potential tree hazards due to the health conditions or structural conditions of each individual tree. While not all trees falling into the tree risk management priority area need to be covered by detailed tree risk assessments using Form 2, for the purpose of identifying potential tree hazards for mitigation action, we encourage the concerned tree management departments to build up an inventory of these trees over time to facilitate future tree management. For tree risk management purpose in the present exercise, all trees meeting the following criteria and located on government land are required to be assessed using **Form 2 – Tree Risk Assessment Form** –

- (i) OVTs,
- (ii) Stonewall trees, and
- (iii) Trees with mitigation measures outstanding/require continuous monitoring. Please refer to Annex C for an illustrated guide on identification of tree potential hazards.



Stonewall trees on Forbes Street

4.3.3 Trees meeting the criteria of **“Trees on a complaint list with structural or health problems”**, **“Mature trees belonging to species with brittle wood structure and having unsatisfactory health or structural conditions with failure potential”**, **“Tree with major defects or health problems”**, and **“Tree growing in very stressful site conditions with failure potential”** should be identified for implementing proper mitigation measures and/or monitoring. It is recommended that assessment using Form 2 should be conducted for those trees requiring continued monitoring so as to facilitate thorough assessment of the tree condition and formulation of appropriate mitigation measures.

4.3.4 Explanatory Notes for Form 1

4.3.4.1 General Information

- ◆ Recent tree survey details, if available (i.e. details of surveys conducted within 2 years before the date of the Form 1 inspections), of the site concerned could be consulted for the required information in “General Tree Information” upon verification or updating. The relevant tree survey report should be attached to Form 1 for reference. The Inspection Officer should refer to the records of previous inspections conducted for the same site and/or trees in the same site, as applicable, to help identifying changes in the site conditions or tree conditions that warrant special attention.
- ◆ The “Inspection Officer” usually is the frontline staff member who conducts the tree risk assessment. To be qualified as “Inspection Officers” for Form 1, they are required to meet the following requirements on both training/qualification AND work experience:-

Training/Qualification	<p>(a) have attended and completed the following training courses organised by the TMO:-</p> <ol style="list-style-type: none"> 1. Comprehensive Tree Risk Assessment and Management Training Course with assessment; OR 2. Refresher Course with assessment; OR <p>(b) have undertaken equivalent departmental training recognised by the TMO; OR</p> <p>(c) have successfully undertaken training programmes recognised by the TMO, such as Tree Risk Assessment Qualification (TRAQ) organised by the International Society of Arboriculture (ISA) or Professional Tree Inspection by Lantra Awards; OR</p> <p>(d) have valid qualification or certification awarded by recognised institution or industry organisation on arboriculture, such as Certified Arborist of the ISA, Registered Arborist (Level 3 or above) of Arboriculture Australia, Technician Member or above of the Arboriculture Association of the United Kingdom, Accredited Arboricultural Practitioner of the Hong Kong Institute of Landscape Architects, Professional Diploma Programme in Arboriculture or Tree Risk Assessment and Management of the School of Continuing and Professional Studies, Chinese University of Hong Kong (CUSCS), Advanced Diploma in Tree Management and Conservation of the School of Professional and Continuing Education, University of Hong Kong (HKU SPACE), Certificate in Professional Tree Management of the Open University of Hong Kong, Professional Diploma in Horticulture and Landscape Management of the Technological and Higher Education Institute of Hong Kong (THEi), etc.</p>
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Work Experience	Have at least 2 years of work experience in tree care and are familiar with tree risk assessment/management.
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- ◆ For outsourced tree inspection works, the consultant/contractor staff can serve as the “Inspection Officer” to conduct the tree risk assessment, whereas the same requirements on training/qualification AND work experience apply.
- ◆ The “Endorsement Officer” is the supervisory/managerial staff who oversees the tree risk assessment process and at a rank higher than that of the Inspection Officer. To be qualified as the “Endorsement Officer” for Form 1, they are required to meet the following requirements on training/qualification:-

Training/Qualification	<p>(a) have attended and completed the following training courses organised by the TMO:-</p> <ol style="list-style-type: none"> 1. Comprehensive Tree Risk Assessment and Management Training Course with assessment; OR 2. Refresher Course with assessment; OR 3. Tree Risk Management Training Course with assessment; OR <p>(b) have undertaken equivalent departmental training recognised by the TMO; OR</p> <p>(c) have successfully undertaken training programmes recognised by the TMO, such as TRAQ organised the ISA or Professional Tree Inspection by Lantra Awards; OR</p> <p>(d) have valid qualification or certification awarded by recognised institution or industry organisation on arboriculture, such as Certified Arborist of ISA, Registered Arborist (Level 3 or above) of Arboriculture Australia, Technician Member or above of the Arboriculture Association of the United Kingdom, Accredited Arboricultural Practitioner of the Hong Kong Institute of Landscape Architects, Professional Diploma Programme in Arboriculture or Tree Risk Assessment and Management of the School of Continuing and Professional Studies, Chinese University of Hong Kong (CUSCS), Advanced Diploma in Tree Management and Conservation of the School of Professional and Continuing Education, University of Hong Kong (HKU SPACE), Certificate in Professional Tree Management of the Open University of Hong Kong, Professional Diploma in Horticulture and Landscape Management of the THEi, etc.</p>
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- ◆ For outsourced tree inspection works, the supervisory/managerial staff of the consultant/contractor firm can serve as “Endorsement Officer”, whereas the same requirements on training/qualification apply.

4.3.4.2 Location Information

- ◆ This information is self-explanatory. Additional information that may help identifying the location of the tree group (e.g. lamp post no., registered slope no., other prominent landmarks nearby, etc.) should be recorded in the “Others” field.

4.3.4.3 General Tree Information

- ◆ **Number of trees covered by a Form 1** – To safeguard the quality of the tree group inspection, the size and coverage of each tree group should not be excessively large. Using a single form to cover for all trees in a large park, a housing estate or a district with many streets is not desirable. The Inspection Officer should duly consider the limitations of visual tree assessment and adequacy of the recorded information when devising the size and coverage of each tree group. In general, it is recommended that each tree group should contain no more than 50 trees in sites with reasonable accessibility. For trees subject to site constraint such as growing on a vegetated slope, it is recommended that each tree group should in principle contain no more than 100 trees and if not reasonably practicable due to constraints in site conditions, it can be adjusted to suit the physical boundary (e.g. surface channel or maintenance access) on site on an exceptional basis. For departments with individual assessment for each and every tree in detail, the tree group size covered in each form can be larger than the recommended tree group size to suit physical condition of the site such as slope areas and building platform areas. The recommended tree group size does not apply to Category III zone.
- ◆ **Main tree species in the group (Diameter at Breast Height (DBH) \geq 95mm) and minority tree species of significant size (i.e. approximately DBH \geq 300mm)** – an indicative description of the diversity and distribution of tree species in the tree group. The approximate quantity (in number) of each tree species in the tree group should be recorded under “Approximate number of trees”.
- ◆ **Range of tree height** – indicative description of tree height of each specified tree species.
- ◆ **Overall health condition and overall structural condition** – (Refer to Annex C – ‘Pictorial Guide for Tree Maintenance to Reduce Tree Risks’). These two sections are to record the overall health and structural conditions of each specified tree species.

- ◆ **Other remarks** - Additional information on trees which require further attention should be recorded in this column to facilitate identification of appropriate follow-up action and future monitoring of tree conditions. The structural defects or health problems of an individual tree within a tree group should be described in the column and recorded with location marked on plan. Adequate photo records should be taken in accordance to the ‘**Guidelines on Photo-Taking of Tree Conditions in the Process of Tree Risk Assessment**’ at Annex D.

4.3.4.4 Target

- ◆ **Target** – Targets are people, property, or human activities that could be injured, damaged, or disrupted by a tree failure. For the roadside case, with reference to the prevailing international practices, the possible Tree Fall Zone (TFZ) is defined as 1.5 times of the height of a tree planted along the roadside kerb or slope. The TFZ should be adjusted according to the angle of the lean of a tree and site conditions (e.g. the gradient of the slope where the tree is located).
- ◆ **Does target exist?** – The Inspection Officer should consider if any target exists within the target area of the tree group.
- ◆ **Can targets be moved?** – For example, a picnic table beneath a defective tree inside a country park can be moved to other areas to minimise the presence of targets near the tree.
- ◆ **Can the use of the site be restricted?** – For example, fencing off the site to avoid presence of target beneath the tree.
- ◆ **Frequency of use of the location**
 - ◇ **Constant use** – For example, presence of a house next to a tree represents “constant use” as the house is static and a pavement along Nathan Road with very busy pedestrian and vehicular flow is also under “constant use”.
 - ◇ **Frequent use** – For example, a park with regular visitors is of “frequent use”.
 - ◇ **Intermittent use** – A recreational cycling path used intermittently is an example.
 - ◇ **Occasional use** – For example, a maintenance path with restricted access and limited to use by the maintenance party is of “occasional use”.

4.3.4.5 Identification of Trees for Remedial Action or Detailed Tree Risk Assessment (Form 2)

During the tree group inspection (Form 1), it is essential to identify potential tree hazards so that remedial action or detailed tree risk assessment (using Form 2) for the trees concerned can be carried out in a timely manner. The identification process should cover the following types of trees:

- ◆ **OVTs and/or Stonewall Trees** - OVTs and/or stonewall trees are generally regarded as important features of high conservation, heritage and amenity values. All OVTs should be covered by a detailed tree risk assessment using Form 2, irrespective of the tree size. For stonewall trees, those with a tree diameter at breast height, measured at 1.3m from the base of the main root on the wall, 95mm or more should be covered by a detailed tree risk assessment using Form 2.
- ◆ **Trees on complaint list with structural or health problems** - Trees may be under complaint for various reasons. Detailed tree risk assessment is required only for outstanding tree complaints related to **structural** or **health** problems. Examples of major defects or health problems including but not limited to large cavity, co-dominant trunks with included bark, decayed or damaged structural roots at trunk base, extensive die-back twigs, insect pest infestation, recurrence of fungal fruiting bodies. It is not mandatory to conduct a detailed tree risk assessment for a tree under complaint if remedial action has already been taken or will be taken immediately to alleviate/eliminate the potential risk.
- ◆ **Mature trees belonging to species with brittle wood structure and having unsatisfactory health or structural conditions with failure potential** - Some tree species have brittle wood structure which makes them more prone to branch or trunk failure. These species include *Delonix regia* (鳳凰木), *Erythrina variegata* (刺桐), *Alstonia scholaris* (糖膠樹), *Aleurites moluccana* (石栗) and *Celtis sinensis* (朴樹). Trees species with brittle wood structure but of a smaller mature size such as *Bauhinia* (洋紫荊) are not classified under this category. It is not mandatory to conduct detailed tree risk assessment for a tree species of a mature size with brittle branches if no obvious defect that will promote failure is observed. The objective of highlighting this criterion is to remind Inspection Officers to pay special attention to tree defects of the concerned species and consider whether a detailed assessment using Form 2 is required for monitoring purpose.
- ◆ **Trees with major defects or health problems** (refer to Annex C – ‘Pictorial Guide for

Tree Maintenance to Reduce Tree Risks) - Signs and symptoms of health problems or defects of varying nature can be found in trees in the course of their lifecycle. Attention should be paid for the presence of Brown Root Rot Disease, particularly for large mature trees. The information on symptoms and control measures for Brown Root Rot Disease is available in the TMO's website (<http://www.trees.gov.hk/en/home/index.html>) and the intranet under Cyber Manual for Greening (<http://devb.host.ccgo.hksarg/en/treerisk/index.html>) for reference. If the defects/health problems are of a minor nature, it may not be necessary to mandatorily conduct a detailed tree risk assessment. If the identified defects or health problems can be rectified with immediate follow-up measures, for example, removal of hangers and dead branches, to alleviate the potential risk, it would not be necessary to conduct a detailed tree risk assessment. In case of doubt, we recommend conducting a detailed assessment using Form 2 on the subject tree to determine the required risk attenuation action.

- ◆ **Trees growing in very stressful site conditions with failure potential** - Stressful site conditions may weaken the tree health and/or structural condition and increase the failure potential. Some examples are as follows:
 - (a) **Confined growing area** – For example, shotcreted slopes or concrete footpaths where tree roots are severely restricted by concrete. Trees in tree pits surrounded by permeable flexible paving may be excluded from this category.



(b) **Trees under cover or low headroom** – For example, trees under building canopies or footbridges where space for tree crown extension is limited.

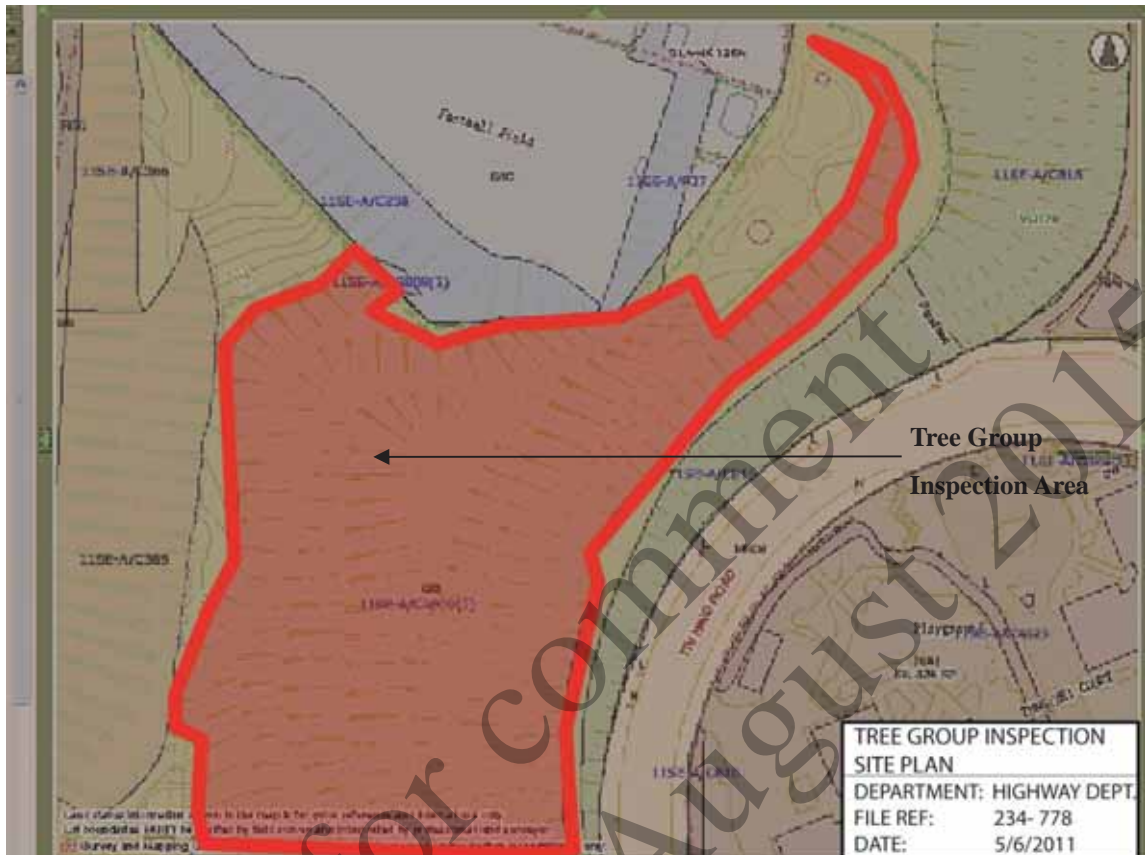


Tree growing under a footbridge with restricted headroom

- ◆ Apart from assessing the health condition/structural stability of these trees and identifying appropriate remedial actions, consideration should be given to formulate measures that can effectively relieve the stressful site conditions (e.g. expand the tree planter, transplant the tree, remove the clutter under the tree, etc.) subject to consideration of the site conditions and detailed tree inspections.
- ◆ **Remedial Action or Detailed Tree Risk Assessment (Form 2)** – Tree number, species, location and relevant information for trees requiring remedial action or detailed tree risk assessment (Form 2) should be provided in the Form with clear description on the extent and type of remedial works required. The records of maintenance operations should be properly documented.
- ◆ **Anticipated Date of Completion** – It is necessary for the tree maintenance departments to record the anticipated date of completion for the works to be carried out for necessary monitoring, record and audit purpose.

4.3.4.6 Attached Information

(a) Example of a site plan



(b) Example of tree photos – overview and close-up photos

- ◆ **Photographic Record** – The completed Form 1 should be accompanied by photographic record showing an overview of the tree group inspection site and diagnostic features of the tree defects observed to facilitate follow-up action on tree problems, and for audit as well as future monitoring and reference. Sample photos are shown below. Please also refer to the ‘**Guidelines on Photo-Taking of Tree Conditions in the Process of Tree Risk Assessment**’ at Annex D for the detailed requirements. If the tree species cannot be identified on site, the Inspection Officer can take photos of the tree(s) and seek professional assistance afterwards. The Inspection Officer may use supplementary sheets to record the details of the tree species under assessment.
- ◆ **Others** – Other observations requiring follow up actions such as overgrown ground vegetation near root flare/trunk base requiring clearance by the management department or agent to facilitate root collar/trunk base inspection has to be explicitly recorded.



Site Plan



Photo no. 1 - Site condition



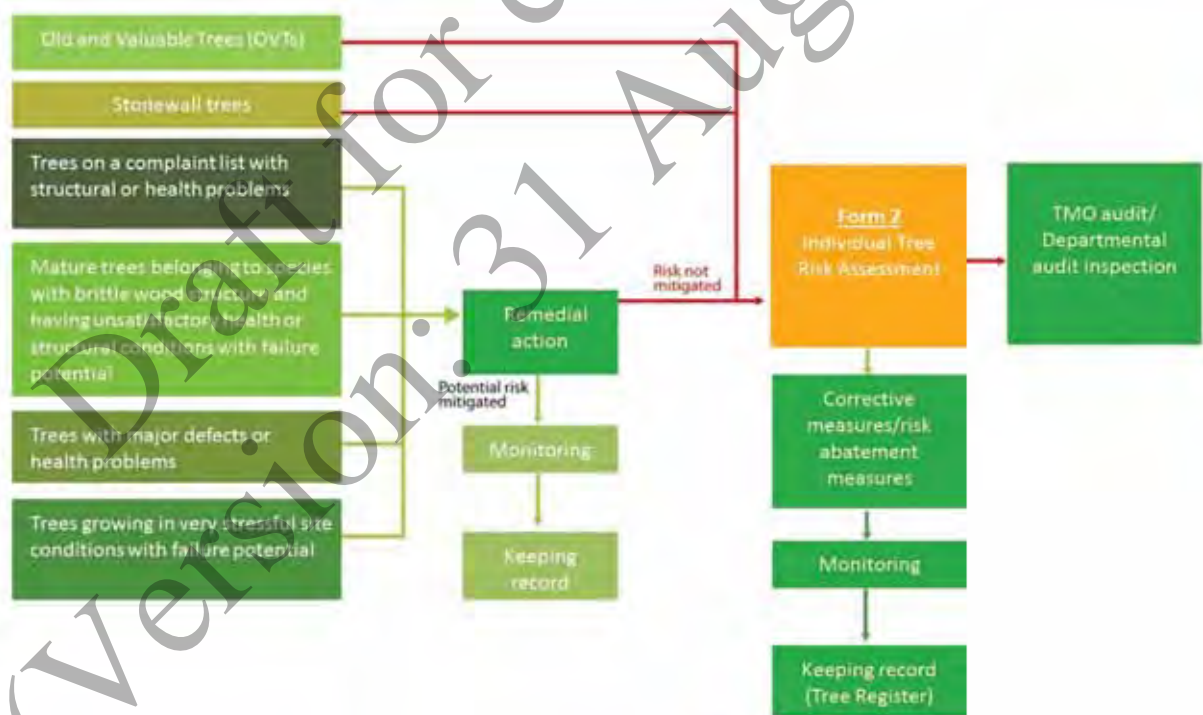
Photo no. 2 - *Ficus hispida* to be removed

4.4 Use of Form 2 – Tree Risk Assessment Form

4.4.1 Objective of Form 2

This Form is used for conducting detailed assessment of individual trees that need special attention. For users with TMIS accounts, the use of Form 2 under the TMIS format is recommended. Appropriate equipment and hand tools such as binoculars, mallet, hand spade and probe, etc. should be used for individual tree assessment when required. Sounding tests should be conducted for trunks or accessible scaffold limbs with decay or suspected decay cavity to assess the extent of structural problems. The Inspection Officer is required to give a tree hazard rating with recommendations on follow-up (corrective) actions to address the identified defects and tree problems. It is mandatory to carry out Form 2 inspection on all OVTs and/or stonewall trees. Other types of trees that are subject to Form 2 tree inspection are shown in the chart in paragraph 4.4.2 below.

4.4.2 When to use Form 2



4.4.3 Explanatory Notes for Form 2

4.4.3.1 General Information

- ◆ The Inspection Officer should refer to the records of previous inspections conducted for the same site and/or trees in the same site, as applicable, to help identifying changes in the site conditions or tree conditions that warrant special attention.
- ◆ The “Inspection Officer” undertaking a Form 2 inspection is required to have met the following requirements on training, qualification AND work experience:-

Training	<p>(a) have attended and completed the following training courses organised by the TMO:-</p> <ol style="list-style-type: none"> 1. Comprehensive Tree Risk Assessment and Management Training Course with assessment; OR 2. Refresher Course with assessment; OR <p>(b) have undertaken equivalent departmental training recognised by the TMO; OR</p> <p>(c) have successfully undertaken training programmes recognised by the TMO, such as TRAQ organised by the ISA or Professional Tree Inspection by Lantra Awards.</p>
Qualification	<p>Have valid qualification or certification awarded by recognised institution or industry organisation on arboriculture, such as Certified Arborist of ISA, Registered Arborist (Level 3 or above) of Arboriculture Australia, Technician Member or above of the Arboriculture Association of the United Kingdom, Accredited Arboricultural Practitioner of the Hong Kong Institute of Landscape Architects, Professional Diploma Programme in Arboriculture or Tree Risk Assessment and Management of the School of Continuing and Professional Studies, Chinese University of Hong Kong (CUSCS), Advanced Diploma in Tree Management and Conservation of the School of Professional and Continuing Education, University of Hong Kong (HKU SPACE), Certificate in Professional Tree Management of the Open University of Hong Kong, Professional Diploma in Horticulture and Landscape Management of the THEi, etc.</p>
Work Experience	<p>Have at least 2 years of work experience in tree care and are familiar with tree risk assessment/management.</p>

- ◆ For outsourced tree inspection works, the consultant/contractor staff can serve as the “Inspection Officer” to conduct the tree risk assessment, whereas the same requirements on training, qualification AND work experience apply.

- ◆ The “Endorsement Officer” is the supervisory/managerial staff who oversees the tree risk assessment process and at a rank higher than that of the Inspection Officer. To be qualified as the “Endorsement Officer” for Form 2, they should meet the following requirements on training/qualification:-

Training/Qualification	<p>(a) have attended and completed the following training courses organised by the TMO:-</p> <ol style="list-style-type: none"> 1. Comprehensive Tree Risk Assessment and Management Training Course with assessment; OR 2. Refresher Course with assessment; OR 3. Tree Risk Management Training Course with assessment; OR <p>(b) have undertaken equivalent departmental training recognised by the TMO; OR</p> <p>(c) have successfully undertaken training programmes recognised by the TMO, such as TRAQ organised by the ISA or Professional Tree Inspection by Lantra Awards; OR</p> <p>(d) have valid qualification or certification awarded by recognised institution or industry organisation on arboriculture, such as Certified Arborist of ISA, Registered Arborist (Level 3 or above) of Arboriculture Australia, Technician Member or above of the Arboriculture Association of the United Kingdom, Accredited Arboricultural Practitioner of the Hong Kong Institute of Landscape Architects, Professional Diploma Programme in Arboriculture or Tree Risk Assessment and Management of the School of Continuing and Professional Studies, Chinese University of Hong Kong (CUSCS), Advanced Diploma in Tree Management and Conservation of the School of Professional and Continuing Education, University of Hong Kong (HKU SPACE), Certificate in Professional Tree Management of the Open University of Hong Kong, Professional Diploma in Horticulture and Landscape Management of the THEi, etc.</p>
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- ◆ For outsourced tree inspection works, the supervisory/managerial staff of the consultant/contractor firm can serve as “Endorsement Officer”, whereas the same requirements on training/qualification apply.

4.4.3.2 Location information

- ◆ Please refer to the guidelines for Form 1 as set out in 4.3.4.2.

4.4.3.3 No. of Tree Trunk and Tree DBH

- ◆ The tree with multiple trunks should have each trunk numbered in sequence (i.e. #1,

#2...etc.) and the photographic records should include such numbers.

- ◆ The DBH, measured at 1.3 m above the ground. For measurement of trees with multiple trunks, please refer to AFCD's Nature Conservation Practice Note No. 02 (Rev. Jun 2006) "*Measurement of Diameter at Breast Height (DBH)*" at http://www.afcd.gov.hk/english/conservation/con_tech/con_tech.html and Development Bureau's Technical Circular (Works) DEVB TC(W) No. 10/2013 "**Tree Preservation**" at <http://www.devb.gov.hk/TechnicalCirculars.aspx?section=53&lang=1>.

4.4.3.4 **Tree height**

- ◆ The height of the tree above ground to the top of the tree crown. An indicative estimate would suffice. For accurate measurement, the use of a clinometer/range pole is recommended.

4.4.3.5 **Tree spread**

- ◆ The width of the tree crown. An indicative estimate would suffice. For asymmetric tree crown, please measure the longest axis.

4.4.3.6 **Age class**

- ◆ A broad indication of the tree age class would suffice.

4.4.3.7 **General condition, Crown condition, Branch condition, Trunk condition and Root condition**

- ◆ Please refer to Annex C - '**Pictorial Guide for Tree Maintenance to Reduce Tree Risks**'.

4.4.3.8 **Site condition**

- ◆ Site disturbed by construction activities – Self-explanatory.
- ◆ Soil condition – Self-explanatory.
- ◆ Restricted root growth area inside dripline – The Inspection Officer should tick the most appropriate box to reflect the site condition.
- ◆ Tree location with exposure to wind.

4.4.3.9 Target

- ◆ Please refer to the guidelines for Form 1 as set out in 4.3.4.4
- ◆ “Use under tree” – The Inspection Officer should tick the relevant use of areas under the tree. Please specify in the “Others” column as appropriate.

4.4.3.10 Hazard rating

- ◆ In tree risk assessment, a potential hazard exists if tree part(s) is/are identified as a likely source of harm. The hazard rating helps to conclude the overall risk level and decide on the appropriate follow-up action so as to reduce the risk posed to public safety. The focus is on identifying and prioritising appropriate hazard abatement measures for high-scoring trees. The hazard rating consists of three components:-

Failure Potential	This relates to the likelihood of failure of a defective tree or branch.
Size of Part	This relates to the diameter of a defective part which would affect the consequence of failure.
Target Rating	This relates to use of the target area which would affect the likelihood of impacting a target by the concerned defective tree part.

Generally speaking, trees with a total score of 9 to 12 in the hazard rating as evaluated using TRA Form 2 warrant special attention.

4.4.3.11 Remedial/Risk Mitigation Measures

- ◆ To recommend remedial/risk mitigation measures to reduce the potential tree risk.
- ◆ To provide a record of continuous tree monitoring/management efforts.
- ◆ The removal of defective parts of the tree, installation of support system, pest and disease control should be undertaken in a timely manner. It is necessary to mitigate the tree risk promptly to protect public safety.
- ◆ The date of completion of the risk mitigation measures should be recorded as appropriate.
- ◆ **Comments** – This is the very important part of the detailed assessment of the tree’s problem and corresponding remedial/risk mitigation measures. It should consist of a critical review and analysis of the collected information, comparison with previous records and a comprehensive recommendation, if required, based on the systematic observation as detailed in the Form 2.

4.4.3.12 Attached Information

- ◆ A **Site Plan** with the tree location and photo(s) should be attached to Form 2 in every case.
- ◆ Please attach records of tree inspection by resistography or sonic tomography, if available as supplementary information.
- ◆ **Photographic Records** – The completed Form 2 should be accompanied by photographic record showing an overview of the site and the trees under assessment. Please refer to ‘**Guidelines on Photo-taking of Tree Conditions in the Process of Tree Risk Assessment**’ (Annex D) for the detailed requirements.
- ◆ **Others** – Other observations requiring follow up actions such as overgrown ground vegetation near root flare/trunk base requiring clearance by the management department or agent to facilitate root collar inspection has to be explicitly recorded.



Location Plan



Photo no. 2 – Highly restricted growing conditions



Photo no. 1 – Overview



Photo no. 3 – Wounds on branches

5. Audit Inspection

5.1 Tree management departments are required to set up a departmental audit checking

mechanism to ensure that tree risk assessments, whether using Form 1 and/or Form 2, are properly and professionally carried out, and that necessary mitigation measures are carried out promptly so as to protect public safety.

5.2 Departments are also required to keep a retrievable and accurate record of the tree risk assessments, risk mitigation measures and monitoring programme undertaken for the trees under their management. In carrying out the audit checks, departments should, in particular, review the accuracy and completeness of the records made as well as the appropriateness of the remedial measures and the timeliness of their completion. Since tree conditions may change over time, the audit checks should be conducted as soon as practicable so as to monitor the quality of the assessment. Any irregularities identified during the audit checks should be followed up promptly.

5.3 Departmental audit checks should cover tree risk assessments and follow-up actions carried out by both in-house staff and outsourced service providers. The “Guideline for Auditing of Tree Risk Assessment for Tree Management Departments” is available in the Cyber Manual for Greening for reference.

5.4 If there are complex, doubtful or sensitive cases and/or situations that are likely to arouse significant public/media concern, colleagues should draw such cases to the attention of the directorate officers within their departments who, if considered necessary, may approach the TMO for advice.

5.5 Tree risk assessments and related procedures carried out by departments are subject to further audit checks by the TMO.

6. Development Bureau’s Tree Register

6.1 Problematic trees identified in the tree risk assessment for which mitigation measures have yet to be completed and those trees requiring monitoring (including OVts and stonewall trees) are required to be uploaded to the Tree Register at www.trees.gov.hk to enhance transparency and to facilitate community surveillance of the conditions of the trees concerned.

6.2 Departments are required to submit the required tree information as well as subsequent updates to the TMO in a timely manner for uploading onto the Tree Register for public information. Reference should be made to “Guidelines on Tree Register – data input and updating” in the Cyber Manual for Greening.

6.3 Departments should closely monitor the conditions of those trees included in the Tree Register so that timely actions will be taken in response to any change in the tree conditions. Relevant information should also be timely sent to the TMO for updating the Tree Register.

7. Points to Note – Remedial/Risk Mitigation Measures and Compensatory Planting

7.1 In the process of carrying out tree risk assessments and remedial/risk mitigation measures/actions on trees, officers should ensure that no trees are unnecessarily felled or excessively pruned as stipulated in DEVB TC(W) No. 10/2013 ‘Tree Preservation’. Departments should note that tree preservation and conservation remains a primary concern. Reference should be made to the guidelines promulgated by the TMO on proper pruning practices (e.g. ‘General Guidelines on Tree Pruning’ and ‘Do’s and Don’ts in Pruning’). Besides, tree removal should be the last resort.

7.2 Routine arboricultural maintenance includes, but is not limited to, pruning and removal of common undesirable species, overgrown or over-congested vegetation, damaged/unhealthy/structurally unstable trees and dead trees in order to achieve a desired management objective and woodland management should follow the requirements in paragraphs 36 and 39 of DEVB TC(W) No. 10/2013. Compensatory planting should be encouraged as far as practicable. However, factors such as growing space and soil to sustain healthy tree growth, gradient of slopes, etc., should also be considered, and the requirements stated in the Technical Circular on ‘Tree Preservation’ (DEVB TC(W) No. 10/2013) on compensatory planting should be followed.

Draft for comment 2015
Version: 31 August 2015

FORM 1: TREE GROUP INSPECTION FORM**表格 1: 樹群檢查表格****General Information 基本資料**

Department 部門:		Inspection officer 巡查人員:		Post 職位:	
File Ref. 檔案編號:		Endorsement Officer 覆核人員:		Post 職位:	
Date of Inspection 巡查日期:		Last Inspection Date 上次巡查日期:			
Project/Contract No. 合約/工程編號:					
Inspection Frequency 巡查週期:					

Location Information 位置資料

Location 地點:		Nearby Utility Post No. 就近公用設施編號:	
Location Types 地點類別: (multiple answers allowed 可選多於一項)	<input type="checkbox"/> Roadside Landscaped Area 路旁綠化地區 <input type="checkbox"/> Public Park/Recreation Venue 公園/康樂場地 <input type="checkbox"/> Remote countryside 偏遠郊區 <input type="checkbox"/> Vacant Government land 政府空置土地 <input type="checkbox"/> Others (please specify) 其他 (請說明): _____	<input type="checkbox"/> Central divider 中央分隔帶 <input type="checkbox"/> Unallocated Government Land 未撥用的政府土地 <input type="checkbox"/> Recreational site/facilities inside country park 郊野公園內康樂用地或設施 <input type="checkbox"/> SIMAR slopes 系統性鑑辨維修責任的斜坡	<input type="checkbox"/> Tree pit 樹穴 <input type="checkbox"/> Village environs 鄉村範圍

General Tree Information 樹木基本資料

The size of a tree group should be defined by location types, such as public park, SIMAR slopes, tree pits, etc. with due consideration given to the limitations of visual tree assessment. 在決定樹群的大小時，應參照地點類別，如公園、系統性鑑辨維修責任的斜坡、樹槽等，並需考慮目測法的局限。

Main tree species in the group (DBH ≥ 95 mm) and minority tree species of significant size (i.e. approx. DBH ≥ 300 mm) (see Note 2) 在群組內的主要樹種(胸徑 ≥ 95 毫米)及樹幹胸徑或高度或樹冠範圍較大的樹種(即胸徑約 ≥ 300 毫米)(見備註 2)	Approx. number of trees in the relevant species 該樹種在樹群內的大概數目	Range of tree height (m) 該樹種的高度範圍	Overall health condition 整體健康狀況 (good, fair, poor 好, 一般, 差)	Overall structural condition 整體結構狀況 (good, fair, poor 好, 一般, 差)	Other remarks (Any special tree condition, e.g. dying/dead, pest/disease problem and structural defects; and soil condition 其他評語 (樹木狀況例如: 凋謝/枯樹/有病蟲害或結構問題; 及泥土狀況)

* Delete as appropriate 請刪去不適用者

Target 目標物

TARGET (people or property potentially affected by tree/branch failure) 目標 (因樹木倒塌或枝條斷裂而受影響的人或財產)
Does target exist? 目標物是否存在? <input type="checkbox"/> Yes 是 <input type="checkbox"/> No 否
Can target be moved? 能否移除目標物? <input type="checkbox"/> Yes 是 <input type="checkbox"/> No 否
Can the use of site be restricted? 可否限制場地的使用? <input type="checkbox"/> Yes 是 <input type="checkbox"/> No 否
Frequency of use of location 使用該地點的頻密程度: <input type="checkbox"/> Occasional use 偶爾使用 <input type="checkbox"/> Intermittent use 間歇使用 <input type="checkbox"/> Frequent use 經常使用 <input type="checkbox"/> Constant use 恆常使用

Identification of Trees for Remedial Action or Detailed Tree Risk Assessment (Form 2)

識別樹木以採取風險緩減措施或進行詳細樹木風險評估 (表格 2)

Trees falling under the following criteria 樹木屬於以下任何一項或多於一項類別	Number of trees 樹木數量	Remedial action or detailed tree risk assessment (Form 2) 緩減措施或詳細的樹木風險評估(表格 2)	Anticipated date of completion 預計完工日期	Date of completion 完工日期
(1) Old and Valuable Tree (OVT) 古樹名木 (use Form 2) (使用表格 2)				
(2) Stonewall tree 石牆樹 (use Form 2) (使用表格 2)				
(3) Trees on complaint list with structural or health problems 投訴個案中有結構或健康問題的樹木 (see Note 1) (見備註 1)				
(4) Mature trees belonging to species with brittle wood structure and having unsatisfactory health or structural conditions with failure potential 屬木質脆弱品種並已屆成熟樹齡而健康或結構欠佳的樹木 (see Note 1) (見備註 1)				
(5) Tree with major defects or health problems 有明顯缺陷或健康問題的樹木 (see Note 1) (見備註 1)				
(6) Trees growing in very stressful site conditions with failure potential (see Note 1) 生長於非常擠壓環境的樹木並有樹枝或樹幹倒塌風險(見備註 1)				

Attached Information 附夾資料

<input type="checkbox"/> Site plan 場地平面圖 <input type="checkbox"/> Photo record 相片紀錄 <input type="checkbox"/> Others 其他 (please specify 請說明) _____

Note 1: If remedial action (such as pruning) undertaken cannot mitigate the potential risk of tree or branch failure, detailed tree risk assessment (using Form 2) should be carried out.

備註 1: 若風險緩減措施(如修剪枝幹)仍未能解決倒塌或枝條斷裂的潛在風險，應為該樹進行詳細的樹木風險評估(表格 2)。

Note 2: Please read in conjunction with TMO's Guidelines on Tree Risk Assessment and Management Arrangement (Para. 4.3. refers.)

備註 2: 請參閱樹木管理辦事處的樹木風險評估安排及管理指引(第 4.3 段)

FORM 2: TREE RISK ASSESSMENT FORM

表格 2: 樹木風險評估表格

General Information 基本資料

Department 部門:		Inspection officer 巡查人員:		Post 職位:	
File Ref. 檔案編號:		Endorsement Officer 覆核人員:		Post 職位:	
Date of Inspection 巡查日期:		Last Inspection Date 上次巡查日期:			
Project/Contract No 合約/工程編號:					
Inspection Frequency 巡查週期:					

Location Information 位置資料

Tree ID 樹木編號:						Tree Species 樹木品種:					
Location 地點:						Nearby Utility Post No 就近公用設施編號:					
Location Types 地點類別: (multiple answers allowed 可選多於一項):	<input type="checkbox"/> Roadside Landscaped Area 路旁綠化地區 <input type="checkbox"/> Public Park/Recreation Venue 公園/康樂場地 <input type="checkbox"/> Remote countryside 偏遠郊區 <input type="checkbox"/> Vacant Government land 政府空置土地 <input type="checkbox"/> Others (please specify) 其他 (請說明):					<input type="checkbox"/> Central divider 中央分隔帶 <input type="checkbox"/> Tree pit 樹穴 <input type="checkbox"/> Village environs 鄉村範圍 <input type="checkbox"/> Unallocated Government Land 未撥用的政府土地 <input type="checkbox"/> Recreational site/facilities inside country park 郊野公園內康樂用地或設施 <input type="checkbox"/> SIMAR slopes 系統性鑑辨維修責任的斜坡					
No(s). of Trunk(s) (#) 主幹數目(#):		DBH of tree trunk(s)(mm) (1.3m above soil level) 胸徑離地面 1.3 米(毫米):	#1	#2	#3	#4	#5	Aggregated DBH (mm)總胸徑(毫米): (see note 2 見附註二)			
Tree Height(m)樹高(米):						Tree Spread(m) 樹冠闊度(米):					
Age class 樹齡組別:	<input type="checkbox"/> young 幼 <input type="checkbox"/> mature 成熟 <input type="checkbox"/> senescent 衰老										

GENERAL CONDITION 基本狀況	CROWN CONDITION 樹冠狀況	Severity of Defects 嚴重程度: (see note 1 見附註一)	BRANCH CONDITION 枝幹狀況 (multiple answers allowed 可選多於一項):	Severity of Defects 嚴重程度: (see note 1 見附註一)
Foliage density 葉片密度: <input type="checkbox"/> Normal 正常 <input type="checkbox"/> Sparse 稀疏	Heavy crown load 樹冠負荷太重: <input type="checkbox"/> Yes 是 <input type="checkbox"/> No 否		<input type="checkbox"/> Co-dominant branches 等勢枝 <input type="checkbox"/> Included bark 內夾樹皮 <input type="checkbox"/> Cavities 樹洞 <input type="checkbox"/> Cracks/splits 裂縫/裂開 <input type="checkbox"/> Wounds/Mechanical injury 明顯傷痕/機械破損 <input type="checkbox"/> Dead branches/Hangers 枯死/懸吊斷枝 <input type="checkbox"/> Crooks/abrupt bends 不常規彎曲 <input type="checkbox"/> Cross branches 疊枝 <input type="checkbox"/> Heavy lateral limb 重側枝 <input type="checkbox"/> Lion's tailing 獅尾 (excessive end weight on branch 枝端過重)	
Foliage colour 葉片顏色 <input type="checkbox"/> Normal 正常 <input type="checkbox"/> Chlorotic 萎黃 <input type="checkbox"/> Brown (signs of wilting) 褐色 (呈現枯萎徵狀)	Live crown ratio 活冠比: (foliage canopy / total height of tree) 有葉的樹冠 / 樹高 <input type="checkbox"/> Low 低 < 40% <input type="checkbox"/> Medium 中 40 - 70% <input type="checkbox"/> High 高 > 70%		<input type="checkbox"/> Bleeding/sap flow 滲液 Parasitic/Epiphytic plants 寄生/附生植物 <input type="checkbox"/> Yes 是 <input type="checkbox"/> No 否 (If yes please specify type 如有請說明種類)	
Leaf Size 葉片大小 <input type="checkbox"/> Normal 正常 <input type="checkbox"/> Abnormal 不正常	Dieback twigs 枯枝: <input type="checkbox"/> <5% crown 樹冠 <input type="checkbox"/> 5 - 20% crown 樹冠 <input type="checkbox"/> 21 + 50% crown 樹冠 <input type="checkbox"/> >50% crown 樹冠		Signs of pests and disease 呈現病蟲害徵狀: <input type="checkbox"/> Yes 是 <input type="checkbox"/> No 否 (If yes please specify type 如有請說明種類)	
Epicormics 水橫枝: <input type="checkbox"/> Yes 是 <input type="checkbox"/> No 否 (please specify the location and severity 請說明位置及嚴重程度) (see note 1 見附註一)	Crown reduced/excessively thinned/ topped/ pollarded: 樹冠大幅減少 或削頂 或截頭 <input type="checkbox"/> Yes 是 <input type="checkbox"/> No 否		<input type="checkbox"/> Others (please specify): 其他(請說明)	
Tree vigor 茁壯程度: <input type="checkbox"/> Good 好 <input type="checkbox"/> Average 良 <input type="checkbox"/> Poor 差	Asymmetric tree canopy 樹冠不對稱: <input type="checkbox"/> Yes 是 <input type="checkbox"/> No 否		Signs of pests and disease 呈現病蟲害徵狀: <input type="checkbox"/> Yes 是 <input type="checkbox"/> No 否 (If yes please specify type 如有請說明種類)	
Lean 傾斜 <input type="checkbox"/> Yes 是 <input type="checkbox"/> No 否 Degree from vertical 傾斜角度: _____ ° <input type="checkbox"/> Natural due to phototropism/self - corrected 趨光性或已自然修正 <input type="checkbox"/> Recently tilted/Unstable root- plate 新近傾斜/根基不穩	Soil cracks or cracks in structure(s) behind lean 有土壤裂縫或裂縫處於傾斜部位背後: <input type="checkbox"/> Yes 是 <input type="checkbox"/> No 否		<input type="checkbox"/> Others (please specify): 其他(請說明)	

Note 1: Severity of defects can be categorized as "Severe"(S), "Moderate" (M), "Low" (L) and "Insignificant" (O)

附註一: 嚴重程度可分為“極之嚴重”(S), “中度嚴重”(M), “輕度嚴重”(L), 及“不嚴重”(O).

Note 2: Please refer to AFCD's NCPN No. 02 (Rev. Jun 2006) & ETWB No.3/2006

附註二: 請參考漁護署的自然護理作業備考第2號(2006年6月修訂)以及環境運輸及工務局的工程技術通告第3/2006號。³

TRUNK CONDITION 主幹狀況 (multiple answers allowed 可選多於一項):	Severity of Defects 嚴重程度: (see note 1 見附註一)	ROOT CONDITION 根部狀況 (multiple answers allowed 可選多於一項):	Severity of Defects 嚴重程度: (see note 1 見附註一)	SITE CONDITION 樹木生長環境 (multiple answers allowed 可選多於一項):
<input type="checkbox"/> #1 Decay/Cavity 腐爛/樹洞(open 可見的) Length 高: _____ (mm) Width 闊: _____ (mm) Depth 深: _____ (mm)		<input type="checkbox"/> Root flare/collar not visible 根脊不現		Site disturbed by construction activities 鄰近環境受工程影響: <input type="checkbox"/> Road widening 道路擴寬 <input type="checkbox"/> Drain replacement 渠道重鋪 <input type="checkbox"/> Soil grade reduce/ increase 地表上升或下降 <input type="checkbox"/> Site clearing 地盤平整活動 <input type="checkbox"/> Soil heaving 土壤脹起 <input type="checkbox"/> Laying of new footpath 鋪設行人道 <input type="checkbox"/> Laying of underground utilities 鋪設地下設施 <input type="checkbox"/> New flower beds/ new lawn below tree 在樹下加建花園/草坪 <input type="checkbox"/> Others (please specify) 其他(請說明)
<input type="checkbox"/> #2 Decay/Cavity 腐爛/樹洞(open 可見的) Length 高: _____ (mm) Width 闊: _____ (mm) Depth 深: _____ (mm)		<input type="checkbox"/> Root rot 根部腐壞		Soil condition 土壤情況 <input type="checkbox"/> Sandy 沙質 <input type="checkbox"/> Clay 黏土 <input type="checkbox"/> Water logging 積水 <input type="checkbox"/> Soil compaction 土壤被擠壓
<input type="checkbox"/> #3 Decay/Cavity 腐爛/樹洞(open 可見的) Length 高: _____ (mm) Width 闊: _____ (mm) Depth 深: _____ (mm)		<input type="checkbox"/> Cracks/splits 裂縫或裂開		Restricted root growth area inside dripline 於滴水線範圍內有障礙物限制根部生長 <input type="checkbox"/> Yes 是 <input type="checkbox"/> No 否 <input type="checkbox"/> < 25% <input type="checkbox"/> 26-50% <input type="checkbox"/> 51-75% <input type="checkbox"/> >75%
<input type="checkbox"/> Poor taper 不良漸尖生長 <input type="checkbox"/> Codominant trunks 等勢幹 <input type="checkbox"/> Included bark 內夾樹皮 <input type="checkbox"/> Cracks/splits 裂縫或裂開 <input type="checkbox"/> Abnormal bark crack 不尋常樹皮裂縫		<input type="checkbox"/> Cut/pruned roots 根部經切割或截根		Width of Planting area 種植面範圍 <input type="checkbox"/> < 1.2m <input type="checkbox"/> 1.3- 2m <input type="checkbox"/> 2.1- 3m <input type="checkbox"/> 3.1- 4m <input type="checkbox"/> > 4m
<input type="checkbox"/> Bulge 腫脹 <input type="checkbox"/> Fungal fruiting bodies 呈現菌類子實體 <input type="checkbox"/> Exposed dead wood 枯幹外露 <input type="checkbox"/> Wounds/Mechanical injury 明顯傷痕/機械破損		<input type="checkbox"/> Fungal fruiting bodies 呈現菌類子實體		Tree location with exposure to wind 樹木所在地點的受風情況: <input type="checkbox"/> Single tree 單獨一棵 <input type="checkbox"/> Tree with emergent canopy 樹冠層以上 <input type="checkbox"/> Edge of a group of trees 樹群邊緣 <input type="checkbox"/> Recently exposed 新近外露
<input type="checkbox"/> Large wound/ crack/ decay on circumference 大範圍破損或裂縫或腐爛 <input type="checkbox"/> Bleeding/sap flow 滲液		<input type="checkbox"/> Dead surface roots 根部枯萎		<input type="checkbox"/> Others (please specify): 其他(請說明)
<input type="checkbox"/> Signs of pests and disease 呈現病蟲害徵狀: <input type="checkbox"/> Yes 是 <input type="checkbox"/> No 否 (If yes, please specify type 如有, 請說明種類)		<input type="checkbox"/> Exposed root 根部外露		<input type="checkbox"/> Others (please specify): 其他(請說明)
<input type="checkbox"/> Others (please specify): 其他(請說明)		<input type="checkbox"/> Mechanical injury 機械破損		Use under tree 在樹下之用途: (multiple answers allowed 可選多於一項): <input type="checkbox"/> Building 建築物 <input type="checkbox"/> Parking 停車位 <input type="checkbox"/> Traffic 交通 <input type="checkbox"/> Recreation 康樂 <input type="checkbox"/> Gathering point 聚集地點 <input type="checkbox"/> Pedestrians 行人道 <input type="checkbox"/> Hardscape 園藝景觀裝置 <input type="checkbox"/> Others 其他 (please specify 請說明):
<input type="checkbox"/> Signs of pests and disease 呈現病蟲害徵狀: <input type="checkbox"/> Yes 是 <input type="checkbox"/> No 否 (If yes, please specify type 如有, 請說明種類)		<input type="checkbox"/> Termites/borers injury 白蟻或蛀心蟲蛀蝕		Can target be moved 能否移除目標? <input type="checkbox"/> Yes 是 <input type="checkbox"/> No 否
<input type="checkbox"/> Others (please specify): 其他(請說明)		<input type="checkbox"/> Root-plate movement 根基移位		Can use of site be restricted 可否限制場地的使用? <input type="checkbox"/> Yes 是 <input type="checkbox"/> No 否
<input type="checkbox"/> Others (please specify): 其他(請說明)		<input type="checkbox"/> Girdling roots 纏繞根		Frequency of use of location 使用該地點的頻密程度: <input type="checkbox"/> Occasional use 偶爾使用 <input type="checkbox"/> Intermittent use 間歇使用 <input type="checkbox"/> Frequent use 經常使用 <input type="checkbox"/> Constant use 恆常使用
<input type="checkbox"/> Signs of pests and disease 呈現病蟲害徵狀: <input type="checkbox"/> Yes 是 <input type="checkbox"/> No 否 (If yes, please specify type 如有, 請說明種類)		<input type="checkbox"/> Rooting area restricted 根部伸展範圍受限制: <input type="checkbox"/> Yes 是 <input type="checkbox"/> No 否 (If yes please specify 如有請說明) <input type="checkbox"/> Drain 渠道 <input type="checkbox"/> Footpath/pavement 行人道 <input type="checkbox"/> Road curb 路肩 <input type="checkbox"/> Retaining structure 護土結構 <input type="checkbox"/> Footings or railings 地基或欄杆 <input type="checkbox"/> Others (please specify): 其他(請說明)		

TARGET (people or property potentially affected by tree/branch failure) 目標 (因樹木/枝幹倒下而致可能受影響的人或財產):

Use under tree 在樹下之用途: (multiple answers allowed 可選多於一項):

- Building 建築物 Parking 停車位 Traffic 交通 Recreation 康樂
 Gathering point 聚集地點 Pedestrians 行人道 Hardscape 園藝景觀裝置
 Others 其他 (please specify 請說明):

Can target be moved 能否移除目標? Yes 是 No 否

Can use of site be restricted 可否限制場地的使用? Yes 是 No 否

Frequency of use of location 使用該地點的頻密程度:

- Occasional use 偶爾使用 Intermittent use 間歇使用 Frequent use 經常使用 Constant use 恆常使用

Note 1: Severity of defects can be categorized as "Severe"(S), "Moderate" (M), "Low" (L) and "Insignificant" (O)

附註一: 嚴重程度可分為“極之嚴重”(S), “中度嚴重”(M), “輕度嚴重”(L), 及“不嚴重”(O).

Note 2: Please refer to AFCD's NCPN No. 02 (Rev. Jun 2006) & ETWB No.3/2006

附註二: 請參考漁護署的自然護理作業備考第2號(2006年6月修訂)以及環境運輸及工務局的工程技術通告第3/2006號.

HAZARD RATING 危害評估:	
Tree or part likely to fall 樹木或枝條有可能倒下: <input type="checkbox"/> Trunk 樹幹 <input type="checkbox"/> Branch/limb 枝幹 <input type="checkbox"/> Whole 整棵	Failure potential 倒下的可能性: <input type="checkbox"/> 1=low 低 <input type="checkbox"/> 2=medium 中 <input type="checkbox"/> 3=high 高 <input type="checkbox"/> 4=severe 極高
Failure Potential + Size of Part + Target Rating = Hazard Rating 倒塌可能 + 部位大小 + 目標評估 = 危害評估 _____ + _____ + _____ = _____	Size of part 部位大小: <input type="checkbox"/> 1= < 150mm <input type="checkbox"/> 2= 150 - 450mm <input type="checkbox"/> 3= 451 - 750mm <input type="checkbox"/> 4= > 750mm
	Target rating 目標評估: <input type="checkbox"/> 1 – occasional use 偶爾使用 <input type="checkbox"/> 2 – intermittent use 間歇使用 <input type="checkbox"/> 3 – frequent use 經常使用 <input type="checkbox"/> 4 – constant use 恆常使用

REMEDIAL/RISK MITIGATION MEASURES 風險緩減措施 (can tick more than one 可選多於一項)*:	
<input type="checkbox"/> Remedial/Risk Mitigation measures taken. 已施行的風險緩減措施 (please specify 請說明): _____	
<input type="checkbox"/> Remedial/Risk Mitigation measures proposed to be taken as specified below: 將會施行以下所指明的風險緩減措施:	
<input type="checkbox"/> Pruning 修剪: <input type="checkbox"/> Remove defective parts 移去有缺陷部份 <input type="checkbox"/> Crown thinning 疏減樹冠 <input type="checkbox"/> Crown raising 提升樹冠	<input type="checkbox"/> Crown cleaning 清理樹冠 <input type="checkbox"/> Remove stub 移去殘端部份 <input type="checkbox"/> Crown reduction 縮減樹冠 Date: _____
<input type="checkbox"/> Tree Removal 移除樹木: <input type="checkbox"/> Cabling/Bracing/Propping 安裝纜索或支撐物: <input type="checkbox"/> Move Target 移走目標: <input type="checkbox"/> Restrict use within tree fall zone 限制可能發生樹木倒下或枝條斷裂的範圍使用 <input type="checkbox"/> Pest/ disease control 控制病蟲害: <input type="checkbox"/> Needs further inspection within _____ months 需於 _____ 個月內再次檢查樹木 (please specify 請說明): _____	Anticipated Date of Completion 預計完成日期 Date of Completion 完成日期 Date: _____ Date: _____ Date: _____ Date: _____ Date: _____
Comments 評註: _____	

ATTACHED INFORMATION 附夾資料:	
<input type="checkbox"/> Site plans 場地平面圖 <input type="checkbox"/> Resistograph 微鑽阻力測試 <input type="checkbox"/> Others 其他 (please specify 請說明)	<input type="checkbox"/> Tree photos 樹木相片 <input type="checkbox"/> Tomography 聲納圖像

Attention Please 請注意:

- Please submit information on the condition of the tree under assessment and the mitigation measures undertaken/proposed to be undertaken to the Tree Management Office in a timely manner for uploading onto the Tree Register at www.trees.gov.hk.
 請將有關樹木評估狀況和緩減措施資料適時遞交樹木管理辦事處以便上載有關資料於樹木管理辦事處網頁 www.trees.gov.hk。
- Please read in conjunction with TMO's Guidelines on Tree Risk Assessment and Management Arrangement (Para. 4.4 refers.)
 請參閱樹木管理辦事處的樹木風險評估安排及管理指引(第 4.4 節)。

(Form 2 12/2011)

Note 1: Severity of defects can be categorized as "Severe"(S), "Moderate" (M), "Low" (L) and "Insignificant" (O)

附註一: 嚴重程度可分為“極之嚴重”(S), “中度嚴重”(M), “輕度嚴重”(L), 及“不嚴重”(O)。

Note 2: Please refer to AFCD's NCPN No. 02 (Rev. Jun 2006) & ETWB No.3/2006

附註二: 請參考漁護署的自然護理作業備考第2號(2006年6月修訂)以及環境運輸及工務局的工程技術通告第3/2006號。

**Guidelines on Photo-Taking of Tree Conditions
in the Process of Tree Risk Assessment**

A) General	
<ul style="list-style-type: none"> • All photographs should be illustrated with the dates when the photographs were taken. • The photo records should be coloured photos clearly showing the tree conditions. • Proper annotations and descriptions should be provided to illustrate the conditions of trees. • For record of remedial mitigation measures, photos showing the conditions before and after the operations should be taken from similar view angles as far as possible to facilitate comparison. 	
B) Photo Records in Form 1	
Items	Photos to cover the following aspects
Overall condition	<ul style="list-style-type: none"> • Overall view showing the tree group and its adjacent site conditions
	<ul style="list-style-type: none"> • Closer views of the tree group from different angles clearly showing its conditions
	<ul style="list-style-type: none"> • Views showing site conditions or changes that may have an impact on tree health or structural conditions
	<ul style="list-style-type: none"> • Views clearly showing tree health and structural conditions, in particular for stand-alone trees and street trees, should be captured as far as practicable unless tree parts are obscured due to site constraints (such as those on steep slopes or trees in clusters) • A photo can cover more than one tree if it can capture the general conditions of trees
	<ul style="list-style-type: none"> • Close-up views clearly showing trees having notable arboricultural defects, disorders or anomalies (if any)
C) Photo Records in Form 2	
Overall condition	<ul style="list-style-type: none"> • Overall view showing the tree from different angles, its adjacent site condition and extent of leaning (if applicable)
	<ul style="list-style-type: none"> • Views showing site conditions or changes that may have an impact on tree health or structural conditions
Crown condition	<ul style="list-style-type: none"> • Views showing general conditions of the crown to illustrate the vigor, foliage density and colour; • Close up views for the following features (if any): <ul style="list-style-type: none"> - abnormal leaf size with reference scale; - dieback twigs; - epicormics; - signs of pest or disease; and

	<ul style="list-style-type: none"> - other notable arboricultural defects or disorders.
<p>Trunk and Branch Conditions</p>	<ul style="list-style-type: none"> • Views showing general conditions of the trunk(s) and major branches illustrating the structural integrity; • Close up views for the following features (if any): <ul style="list-style-type: none"> - co-dominant trunks or branches; - poor taper; - included bark or weak attachment; - decay or cavity; - cracks or splits; - wounds and woundwood development; - dead branches or hangers; - crook or abrupt bends; - crossed branches; - heavy lateral limb; - lion tailing; - bleeding or sap flow; - fungal fruiting bodies; - parasitic plants; - signs of pests and diseases; and - other notable arboricultural defects or disorders
<p>Lower Trunk / Root Condition</p>	<ul style="list-style-type: none"> • Stressful site conditions, including construction activities within the tree protection zone and any other activities or restrictions that may damage the root system and the overall structural stability of the trees. Views showing general conditions of the root flare and disturbance that may damage the root zone; • Close up views of the following features (if any): <ul style="list-style-type: none"> - root rot; - exposed roots; - girdling roots; - cracks or splits; - mechanical damage; - root-plate movement; - soil cracks or other cracks; - fruiting bodies; - signs of pests and disease; and - other notable arboricultural defects or disorders

APPENDIX 5 - COMMON TREE DEFECTS

1.0 Recognising Tree Defects

Trees are living organisms that undergo their normal lifecycles. No trees are absolutely 'safe'. They may exhibit defects in their health and structural conditions as they grow and age. Recognising the nature and severity of the defects and their implications in tree stability contributes an important part to any tree inspection and risk assessment. Proper mitigation measures to reduce tree hazards can only be made with proper diagnosis of tree problems.

2.0 Common Tree Defects

Healthy trees are exemplified by full crowns, vigorous branches, and healthy, full-sized leaves. However, green foliage in the crown does not ensure that the tree is safe. Trees in good health condition may exhibit structural defects such as hollow trunks, etc. Dead trees should be removed as soon as they are identified.

Common tree defects include wood decay, cracks, weak branch unions, cankers, root problems, poor tree structure, and dead wood. The same type of problems can be seen at different parts of a tree which may constitute different degrees of tree hazards. Therefore it is important to understand signs and symptoms associated with different types of defects during tree inspection.

The 'Pictorial Guide for Tree Maintenance to Reduce Tree Risks' ([http://www.trees.gov.hk/filemanager/content/attachments/Pictorial Guide for Tree Maintenance.pdf](http://www.trees.gov.hk/filemanager/content/attachments/Pictorial_Guide_for_Tree_Maintenance.pdf)) issued by the GLTMS provides illustrated examples to the identification and proposed mitigation of the various tree defects. Examples of common tree defects are illustrated in Photo 2.1 to 2.10.



Photo 2.1 - Severe leaning



Photo 2.2 - Extensive dieback twigs



Photo 2.3 - Codominant stems with crack/decay



Photo 2.4 - V-shaped Crotch with cracks/split



Photo 2.5 - Severely cut/damaged roots



Photo 2.6 - Fungal fruiting bodies at root





Photo 2.7 - Brown root rot disease



Photo 2.8 - Wood decay/cavity at basal area/root flare



Photo 2.9 - Root-plate movement



Photo 2.10 – Sign of termites



Guidelines on Arboriculture Occupational Safety and Health

**GREENING, LANDSCAPE AND TREE MANAGEMENT SECTION
DEVELOPMENT BUREAU**

December 2012

*Draft for comment
Version: 31 August 2015*

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Draft for comment
(Version: 31 August 2015)

1.0 Introduction

1.1 Risk is inherent in all forms of works and tree work is no exception. A culture of safety and health is essential in any organization. This should permeate all levels of the organization and be established and maintained through training, qualifications, procedures, etc. Under **Section 6(1) of the Occupational Safety and Health Ordinance**, “*Every employer must, so far as reasonably practicable, ensure the safety and health at work of all the employer's employees.*” Employer covers both the employer of a company and of a service contract.

1.2 Tree work includes pruning, tree removal, cabling, bracing, guying, cavity treatment and/or other arboricultural treatment to be undertaken at ground or elevated level. Tree work, if not properly carried out with adequate safety measures, can be hazardous for those engaged in it and for people and property in the vicinity of the work.

1.3 Provision of a safe system of work is essential and tree work should be undertaken by trained and experienced personnel. A suitable and safe method should be adopted and adequate occupational safety and health measures should be implemented in carrying out the tree work. Such information, instruction, training and supervision as may be necessary to ensure, so far as reasonably practicable, the safety and health at work of the employer's employees should also be provided.

2.0 Provision of a Safe System of Work

2.1 A safe system of work is a formal procedure which results from systematic examination of a task in order to identify all the hazards. It defines safe methods to ensure that hazards are eliminated or risk minimized.

2.2 Where hazards cannot be eliminated and some elements of risk remain, a safe system of work should be developed and put in place before commencement of tree work.

2.3 Employers responsible for tree work should provide and maintain safety system of work to ensure the safety and health of the employees/workers involved in tree work. This requires the employers to assess the task, identify the hazards, define safe methods, implement the system and monitor the system.

2.4 Reference should be made to the Labour Department's prevailing guidelines on occupational safety and health including “Safe System of Work” and “Five Steps to Information, Instruction and Training” (<http://www.labour.gov.hk/eng/public/index.htm>).

3.0 Team Work

3.1 Tree work is a team work which should be carried out by trained and experienced personnel. The employer should assign a Tree Work Supervisor who is competent to supervise the tree work to ensure that the work is carried out in accordance with good arboricultural practice and adequate occupational safety and health measures, including procedures as laid down in the safe system of work.

3.2 Workers participating in tree work operations should receive relevant training for the assigned tasks to be performed. As a general rule of thumb, tree work operations should not be performed alone by a Tree Worker and effective communication should be maintained between members of the team. The team should include Tree Work Supervisor and Tree Workers who have met the requirements as detailed in Annex I.

4.0 Adoption of a Suitable and Safe Method

4.1 The Tree Work Supervisor should assess the task, identify the potential hazards, evaluate the risks and formulate the most appropriate and safe method to carry out the tree work. Risk assessment on the potential hazards, method to be adopted and relevant occupational safety and health measures to be implemented should be prepared and properly documented and communicated to all personnel involved in the tree work.

4.2 Wherever practicable, the work should be carried out from ground level. This may be achieved by using suitable job method such as using extending equipment or tools to perform the work from ground level.

4.3 If it is inevitable to work at height, appropriate access equipment such as elevating work platforms, scaffolds, podium steps or ladders should be used as safe means of access. Also, elevating work platforms and scaffolds should be used to provide safe means of support when work is being carried out.

4.4 In situations where the use of the above means are not reasonably practicable, other alternative means, such as the use of rope access system, can be considered. The Tree Work Supervisor should confirm the appropriateness of the method if rope access is adopted. The aerial tree work by climbing should be carried out by Tree Workers satisfying the requirements in Annex I(C) (i.e. Tree Worker (Tree Climbing)). Relevant safety practices/instructions and devices in accordance with recognized standards should apply (please refer to paragraph 5.6 below).

4.5 Before carrying out the tree work on site, risk assessment on the potential hazards, method adopted, occupational safety and health measures

should be properly documented and communicated to all personnel involved in the tree work.

5.0 Occupational Safety and Health Measures

5.1 General

5.1.1 Compliance with the relevant prevailing occupational safety and health requirements and guidelines as promulgated by Labour Department is essential. The following paragraphs introduce the general occupational safety and health measures, which are not exhaustive, associated with tree work for reference. All Tree Workers should receive relevant training for the required skills in carrying out tree work. The Tree Work Supervisor should formulate specific occupational safety and health measures to suit the operation.

5.1.2 When tree work is to be conducted at or near public area, the Tree Work Supervisor should assess potential hazards to the public. Appropriate measures, such as provision of warning signs, temporary fencing and/or guarding, should be adopted when there is a potential risk affecting the public.

5.2 Good Communication

5.2.1 Good communication should be maintained between Tree Workers and Tree Work Supervisor involved in the tree work so that each one is well aware of the duty, work arrangement, potential hazards, occupational health and safety measures and progress of the operation. A job briefing should be provided before tree work begins to facilitate good communication in carrying out the tree work on site.

5.3 Personal Protective Equipment (PPE)

5.3.1 Tree Workers should wear appropriate clothing and footwear. Loose-fitting clothing and slippers should not be allowed. The PPE includes, but is not limited to, head protection (helmets), reflective vests, protective gloves, sturdy boots, chainsaw-resistant chaps, safety goggles and hearing protection. They should comply with relevant standards to suit the work required.

5.3.2 Suitable and adequate PPE should be provided for use by Tree Workers involved in carrying out tree work. They should also be trained in the proper use, care and maintenance of PPE.

5.3.3 The employer should implement a monitoring system to ensure proper use of the PPE by the workers. Proper maintenance programme of the PPE so provided by the employer should be in place to ensure that the PPE is kept in a serviceable state as well as a safe-to-use manner.

5.4 Traffic Flow

5.4.1 For tree work to be performed in area with traffic flow, Temporary Traffic Arrangement (TTA) has to be instituted to protect the safety of the public as well as the Tree Workers. Adequate lighting, signing and guarding complying with the requirements of "Code of Practice for the Lighting, Signing and Guarding of Road Works" issued by Highways Department should be provided (<http://www.hyd.gov.hk/eng/public/publications/index.htm>).

5.5 Underground Utilities

5.5.1 Underground utilities include gas pipes, electrical cables, cables for telephones, water pipes, drainage and sewerage pipes buried underground. Tree work, such as planting or removal of tree stump, may cause damage to underground utilities which in turn poses hazards. The presence of underground utilities should be checked and identified on site with adequate precautions if the required excavation or stump removal work, particularly removal of large deep-rooted stump along public pavement, may affect the underground utilities.

5.5.2 When working in the vicinity of utilities, hand tools should be used with due care. Relevant utility companies should be contacted for precautionary protection measures.

5.6 Work at Height

5.6.1 If work at height is required, a safe access, egress and working condition to prevent fall from height, including steep slope, should be provided. The following publications and the prevailing guidelines issued by the Labour Department are relevant (<http://www.labour.gov.hk/eng/public/index.htm>).

- ◆ “Safety at Work – A Guide to Ladders and Elevated Working Platforms”
- ◆ “Guidance Notes on Safe Use of Power-operated Elevating Work Platforms”

- ◆ “Code of Practice for Metal Scaffolding Safety”
- ◆ “Code of Practice for Bamboo Scaffolding Safety”
- ◆ “Guidance Notes on Classification and Use of Safety Belts and their Anchorage System”

Other relevant references include:

- ◆ “2011 Best Practice Guidelines for Safety and Health in Tree Work Part one: Arboriculture” New Zealand: The New Zealand Arboricultural Association: 2011.
- ◆ “A Guide to Good Climbing Practice” UK: The Arboricultural Association: 2005.
- ◆ “AFAG 401 Tree-climbing operations” UK: The Health and Safety Executive.
- ◆ “American National Standard for Arboricultural Operations – Safety Requirement (ANSI® Z133.1-2006)”. Champaign: International Society of Arboriculture: 2006.

5.7 Falling Objects

5.7.1 Falling objects may include materials, tools, debris and/or cut tree parts falling from height. Loose tools should be carried in tool bags and properly secured. Throwing of large cut tree parts from height should be avoided as far as possible. Where a working platform is used, the working platform should be fully boarded and toe-boards alongside the edge of working platform should be installed.

5.7.2 Where members of the public may be present within the tree work area, measures to ensure their safety should be instituted e.g. cordoning off the work area with suitable barriers, erecting appropriate warning signs and arranging Tree Workers to guard the work area.

5.8 Manual or Mechanical Handling

5.8.1 To reduce the hazards associated with lifting or delivery of tree parts, large tree parts should be cut into smaller manageable sizes. The size of tree parts should be determined by the Tree Work Supervisor to avoid overloading, taking into account the working load of the equipment, machinery and environmental

condition e.g. strong wind.

5.8.2 Tree parts, particularly sizable pieces, should be secured properly before cutting and delivery. Care should be taken for possible physical damage to the Tree Worker caused by swinging of tree parts during operation.

5.9 Impact with Overhead Obstacles or Tree Parts

5.9.1 Overhead obstacles should be identified, particularly overhead electrical lines and apparatus. Adequate safety precautions, including keeping safe clearance from overhead obstacles should be adopted in carrying out tree work. When elevating work platform is in use, the travelling route should be within the vision of the operator of the platform.

5.9.2 In tree felling operations, the tree can split upward from the back cut (known as “barber chair”) which may hit the Tree Worker standing directly behind the tree. The Tree Worker should stand to one side of the tree when making the back cut and plan for an escape route on either side 45° opposite to the direction of fall. Adequate steps should also be taken to prevent tree trunk from rolling on sloping site when the branches are removed to minimize hazards to the Tree Worker.

5.10 Electrical Hazards

5.10.1 Tree Workers should receive relevant training in handling electrical hazards. Electrical hazards should be identified before performing tree work. These include the existence of overhead power lines, underground cables or electrical apparatus and the use of electrical tools. A safe working distance from overhead electrical line or electrical apparatus should be maintained when carrying out tree work. Reference should be made to the “Code of Practice on Working near Electricity Supply Lines” issued by the Electrical and Mechanical Services Department.

5.11 Use of Equipment

5.11.1 All equipment, including hand tools or machinery, should be inspected prior to operation and should be properly and regularly maintained. The equipment should be fit for the purposes and should comply with relevant standards with evidence of conformity.

5.11.2 Tree Workers should use all equipment in correct posture. They should

receive relevant training in the use of hand tools and mechanical equipment, such as pole pruner and chainsaw, so that hazards associated with the use of them can be minimized.

5.12 Heat-Related Disorders

5.12.1 Heat-related disorders include heat stroke, heat cramps and heat exhaustion. They are associated with working under prolonged and/or high environmental heat exposure which results in overheating and dehydration.

5.12.2 As precautionary measures, wearing of suitable clothing to facilitate heat dissipation and provision of adequate drinking water and rest breaks to Tree Workers are required. Training on the awareness of heat-related disorders and associated first aid procedures should be provided to all personnel involved in tree work.

5.13 Application of Chemicals

5.13.1 Application of chemicals, such as fungicides and insecticides, is a common practice in tree care operations. The chemicals should be properly labeled and stored in a cool, dry and well-ventilated place away from direct sunlight and dampness. Dosages and application methods as recommended by the manufacturers should be followed. Disposal of chemicals should follow an approved hazardous waste management procedure.

5.13.2 The intake of chemicals can be made through direct contact, inhalation and/or ingestion. Tree Workers should wear suitable protective clothing, gloves, goggles or face shields to prevent direct contact with chemicals. Properly fitted respirators should be worn to protect Tree Workers from inhaling harmful chemicals. Eating or smoking should not be allowed during chemical applications and before cleansing procedures have completed after chemical applications.

5.13.3 Tree Workers should also take note of the surroundings and minimize harms to the public caused by inhaling or contacting chemicals. This includes guarding the site with warning notices and paying attention to the wind direction during spraying to avoid spreading chemicals. If required, warning notices should be posted to keep people and their domestic animals off the site after application of chemicals.

5.14 Inclement Weather

5.14.1 This includes poor weather conditions, such as strong wind, thunderstorm and heavy rainstorm, which adversely affect the safe operation of

tree work. With the exception of emergency work performed by well-trained Tree Workers having adopted necessary safety precautions, no tree work should be carried out during inclement weather.

5.15 Hazards associated with Plants and Animals

5.15.1 These hazards include bites by snakes or insects (such as mosquitoes, bees and Red Imported Fire Ants) and direct contact with poisonous plants. Training should be provided for identification of hazardous plants and animals and the associated treatment.

5.15.2 Tree Workers should wear suitable clothing and gloves to minimize skin exposure to insect bites and scratches by poisonous plants. They should apply insect repellent to exposed skin when required. If severe reactions upon bites or contact with poisonous plants are observed, prompt medical treatment should be sought.

5.16 Fire Precautions

5.16.1 Fire may result from improper use of gasoline-powered equipment. Smoking should be prohibited when handling flammable liquid. Trucks transporting tree work equipment should be equipped with fire extinguishers and Tree Workers should be trained to use fire extinguishers in case of fire to reduce the risk of personal injury and spread of fire to other wooded area.

5.17 First-aid and Emergency Procedures

5.17.1 Procedures covering emergency arrangements, rescue and first aid procedures should be formulated and well-communicated to the Tree Workers by the Tree Work Supervisor. Emergency drills should be regularly conducted, with the performance properly recorded and reviewed. First-aid kits with appropriate medical and rescue contents should be provided and maintained.

5.17.2 For tree climbing operations, a minimum of two Tree Workers must be present and one of them should be stationed on the ground, competent and equipped to perform aerial rescue without delay.

Requirements of Tree Work Supervisor and Tree Workers

A) Tree Work Supervisor

A Tree Work Supervisor is a person who has:

Training	(a) received relevant training in occupational safety and health relating to tree work operation covering, hazard identification, risk assessment and supervision, and
	(b) (i) completed training in tree work operations provided by trainers with practical experience and expertise recognized by the employer; or (ii) completed training or vocational assessment in tree work operations offered by recognised institutions or industry organisations; or (iii) be a Certified Arborist of the International Society of Arboriculture, Registered Arborist (Level 3 or above) of Arboriculture Australia, Technician Member or above of the Arboriculture Association of the United Kingdom or the Accredited Arboricultural Practitioner of the Hong Kong Institute of Landscape Architects, those having taken the Professional Diploma Programme in Arboriculture of the Chinese University of Hong Kong or equivalent or above, and
Work Experience	(c) with at least 2 years work experience in tree care.

Notes:

- a) Training in tree work operations provided by trainers with practical experience and expertise recognized by the employer include in-house training provided by government departments.
- b) Examples of recognized institutions or industry organizations include Occupational Safety and Health Council, Vocational Training Council and Construction Industry Council.
- c) The employer may appoint two persons to cover for the above requirements in (1) arboricultural and (2) occupational safety and health aspects separately if necessary. Each of them should have at least 2 years relevant work experience. However, they should work together to address the occupational safety and health issues associated with tree work.

B) Tree Worker

A Tree Worker is a person who has:

Training	(a) received basic training in occupational safety and health relating to tree work operation; and
	(b) (i) completed relevant job/task specific training in tree work operations by trainers with practical experience and expertise recognized by the employer; or (ii) completed relevant job/task specific training or vocational assessment in tree work operations by recognized institutions or industry organisations; and
Work Experience	(c) with at least 1 year work experience in tree care if aerial tree work is involved.

C) Tree Worker (Tree Climbing)

A Tree worker (Tree Climbing) is a person who has:

Training	(a) received basic training in occupational safety and health relating to tree work operation; and
	(b) (i) completed training in tree work operations (including tree climbing (rope access), use of chainsaw and aerial rescue) by trainers with practical experience and expertise recognized by the employer; or (ii) completed training or vocational assessment in tree work operations (including tree climbing (rope access), use of chainsaw and aerial rescue) by recognized institutions or industry organisations; or (iii) be a “Certified Tree Worker Climber Specialist” of the International Society of Arboriculture, those having taken Professional Diploma Programme in Arboriculture of the Chinese University of Hong Kong or equivalent or above; and
	(c) with at least 1 year work experience in tree care.

Notes:

- a) Training in tree work operations provided by trainers with practical experience and expertise recognized by the employer include in-house training provided by government departments.
- b) Examples of recognized institutions or industry organizations include Occupational Safety and Health Council, Vocational Training Council and Construction Industry Council.

APPENDIX 7 – SAMPLE OF MASTER LIST OF DOCUMENT AND RECORD ON TREE WORKS

List of Document and Record on Tree Works

1. Site boundary plan shown on the lease documents and/or the Deed of Mutual Covenant
2. Tree inventory
3. Records of tree inspection
4. Records of tree maintenance work
5. Tree Risk Assessment Report
 - Records of Area Basis Assessment
 - Records of Tree Group Inspection Form (Form 1)
 - Records of Individual Tree Risk Assessment Form (Form 2)
 - Records of mitigation measures
6. Other tree inspection report

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Proper Planting Practice

Staking and Guying of Trees

Staking or guying tree can be an important step to successful tree planting and initial establishment. However, this step has to be carried out properly to achieve desirable result and not to cause more harm than good to the public and the trees.

When should we stake trees?

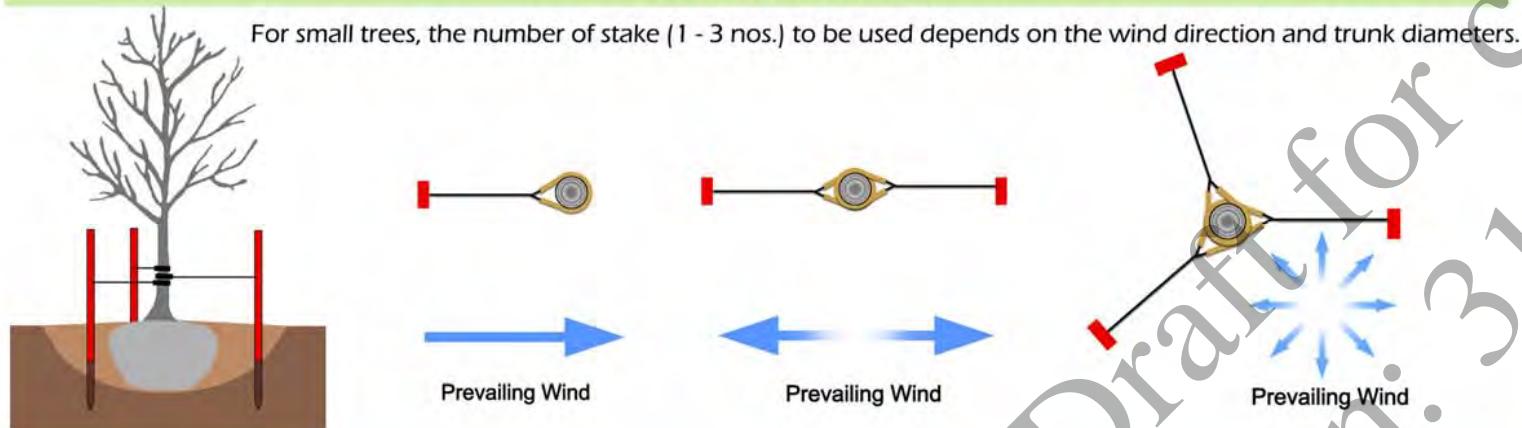
Good trees with sizable root balls (usually with underground guying system) may not require staking. Staking to be used when necessary, e.g. on exposed windy site.

Important notes about staking and guying trees

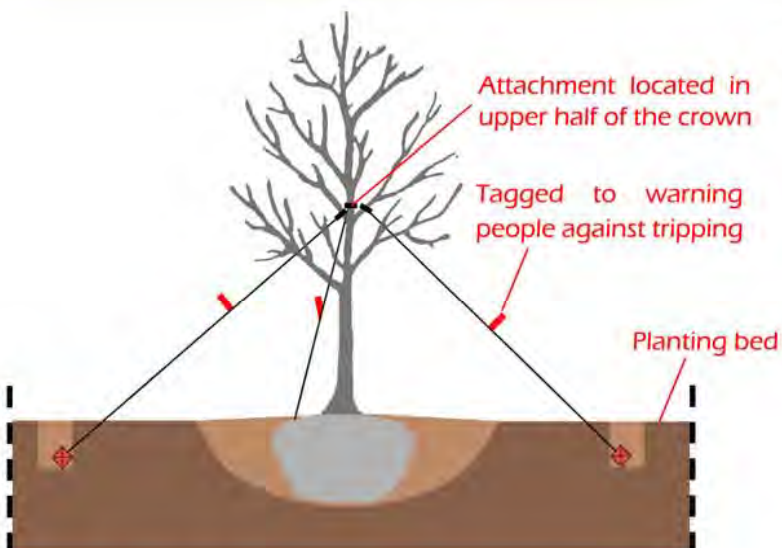
- Staking and guying should not stay too long and should be removed in general after establishment period.
- Do not drive stakes through root ball because this may damage roots.
- The stakes/guy ties should be inspected and adjusted regularly to avoid girdling of tree trunk.
- Avoid placing stakes or guying anchors outside planting bed as much as possible because they may become a tripping hazard to passers-by.

How to stake/guy a newly planted/transplanted tree?

1. Staking Method

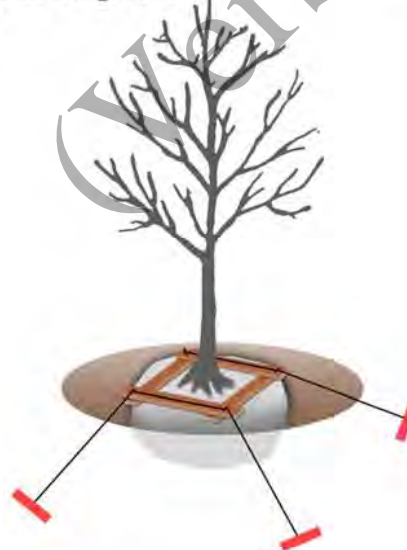


2. Tree-to-Ground Guying



3. Underground Tree Guying

Provide support for trees without interfering with traffic or appearance above ground.



Myths

The higher the stakes are attached to the tree, the more stable is the support to the tree.



The more support is installed; the more stable is the tree.



The tree should be tied very tightly.



Tree grille can prevent toppling of tree.



Facts

Stakes should be placed at around 1/3 or at a suitable height of the tree to allow some trunk movement.

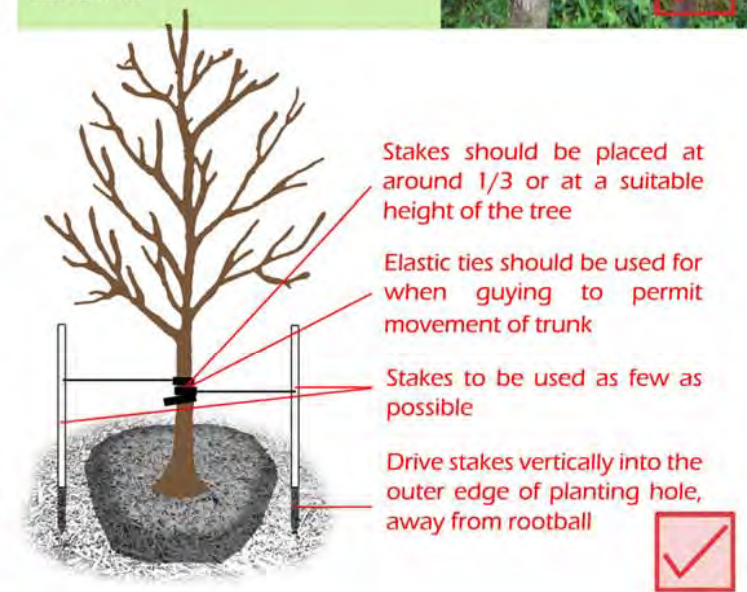


Support should be used as few as possible. As staking/guying may restrict trunk movement, limits the development of the trunk and the root system, and therefore weakens the tree's stability in the long run.

Some flexibility should be allowed because slight movement in wind encourages root growth and trunk taper development.



Tree grille is used to protect trees from root compaction only and would not provide structural support of tree. Tree grille may girdle the trunk if centre hole is too small.



References:

Edward F. Gilman, *An Illustrated Guide to Pruning*, 2nd edition, Delmar Cengage Learning, 2002

Harris, R.W., Clark, J.R., & Matheny, N.P., *Arboriculture: Integrated Management of Landscape Trees, Shrubs, and Vines*, 4th edition, Prentice Hall, Upper Saddle River, NJ, 2004

Smiley, E.T., and Lilly, S., *Best Management Practices - Tree Support Systems: Cabling, Bracing, Guying, and Propping (Revised)*, International Society of Arboriculture, U.S., 2005.

Watson, Gary W. and Himelick E.B., *Principles and Practices of Planting Trees and Shrubs*, International Society of Arboriculture, U.S., 1997.

Whitcomb, Carl E., *Establishment and Maintenance of Landscape Plants II*, Lacebark, Inc., 2006

Management Guidelines for Mature Trees



**GREENING, LANDSCAPE AND TREE MANAGEMENT SECTION
DEVELOPMENT BUREAU**

December 2014

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1.0 Introduction

1.1 Mature trees, in particular those with good health and structure, are important assets to a city. They constitute key natural components of urban ecosystems and contribute to many aspects, including that of environmental improvement, aesthetic enhancement, ecological and biodiversity enrichment, and economic, social and health benefits (Jim and Zhang, 2013). Mature trees are of particular value, and proper care is required to preserve these valuable landscape assets.

1.2 Tree biology is dynamic, changing as a tree ages (Clark, 1983). Mature trees are those being close to maximum height and exhibiting reduced shoot elongation (either as decreased elongation or a reduced number of flushes per year) (Clark and Matheny, 1991). When trees age, they become slower in growth as they approach maximum age, and become more vulnerable to disease, wind and other causes of death (Goff and West, 1975). Understanding the biology of mature trees is thus an integral component for developing proper tree management strategies and programmes.

1.3 The “Management Guidelines for Mature Trees” (Guidelines) serve as a reference for the management departments responsible for regular maintenance of trees with a view to promoting the health and structural stability of mature trees and optimising their longevity. Due to large quantity of trees in the territory, the Guidelines are focusing on mature trees with individual trunk(s) over 750mm DBH (Diameter at Breast Height¹) growing in areas with intensive use (i.e. Category I zone under tree risk assessment) and Old and Valuable Trees (OVTs). It is necessary for managerial staff to disseminate the message in the Guidelines to staff at frontline and supervisory levels and also contractors and consultants for successful implementation.

2.0 Biological Aspects for Mature Trees

2.1 At maturity, the degree of apical control frequently lessens and a rounded crown results. Mature trees generally possess sound structure, even though inherent structural problems and numerous internal compartments may

¹ The measurement of DBH should follow Nature Conservation Practice Note No. 2 issued by the Agriculture, Fisheries and Conservation Department.

be present. They appear healthy and vigorous and may persist in this condition for long period of time; indeed, for much of their life span (Clark and Matheny, 1991).

2.2 Trees obtain energy through photosynthesis for biological functions. Surplus energy is stored in reserve to overcome periods of stress when energy production cannot meet demand. Young trees have a high photosynthetic area to biomass ratio and generate surplus of energy as reserve which facilitate rapid growth and tolerate change or stress. Mature trees have a lower ratio and most of the energy produced by the leaves is used for maintenance of existing tissues, defence against pests and diseases and reproduction through seeds and fruits but less for growth. The reserve for stored energy in mature trees is minimal when comparing with young plants and their ability to tolerate change or stress is therefore low.

2.3 Urban trees are often confronted with a lot of environmental stresses such as compaction, lack of nutrients, damage by construction and roadwork activities, etc. In the changing environment like Hong Kong, the main predisposing causes of their decline were related to root damage and soil disturbance (Jim, 2005). **Table 1** highlights the patterns of death in landscape trees. The damage on trees is cumulative and irreversible. Trees have to

Structure failure	Branch, crown and stem failure, uprooting, decay, girdling
Environmental degradation	
Acute	Flooding, fire, vandalism, construction injury, drought, high or low temperature
Chronic	Soil toxicity, soil compaction, air pollution, restricted growing space, low fertility, severe pruning
Parasitic invasion	Insect, fungus, bacterium, virus, mycoplasma-like organism, parasitic plant

Table 1 – Patterns of death in landscape trees (Clark and Matheny, 1991)

alter their growth patterns and relocate their resources in order to establish the internal balance with the environment. For mature trees, they are in a delicate balance with their environment and exposure to multiple or chronic stress will aggravate the health problem leading to decline due to limited energy reserve. The characteristics of mature and declining trees are listed in **Table 2**. Therefore, it is important to maintain a stable environment around mature trees to prevent or minimise stress and avoid entering the mortality spiral, where a series of sequential events result in death (Clark and Matheny, 1991). Degradation of growth space or disturbance adversely affecting the growing

conditions of mature trees should be avoided as far as practicable.

Character	Mature tree	Declining tree
Shoot elongation - extent	normal for species	greatly reduced
pattern	normal for species	single flush only
Crown form	normal - some loss of apical control	stag-headed, dieback
Foliage development	normal	reduced size and density
Foliage retention (evergreens)	normal	poor
Presence of epicormic shoots	generally absent	present
Compartmentalization response	normal for species	reduced
Wound-wood formation	normal for species	inhibited/reduced
Integrity of bark	strong	weak
Susceptibility to parasites	normal for species	increased
Reproductive behaviour	normal, may be cyclic	may produce stress crops
Stress response	normal	reduced
Fall colouration	normal	premature

Table 2 – Characteristics of mature and declining trees (Clark and Matheny, 1991)

2.4 To delay the transition from maturity to decline and death, tree management programmes should be proactive rather than reactive and treatment should be applied preventively to maintain tree health rather than remedial once decline begins (Fraedrich, 1999).

3.0 Management Strategies of Mature Trees

3.1 A stable tree structure can reduce the incident of tree failure. Causing wounds on mature trees will demand tree's extra resource for defence. Wounds are also vulnerable to decay and entry of pathogens which will adversely affect both tree health and structure.

3.2 Site disturbance and unfavourable growing condition will create constraints on resource availability and induce stress on mature trees. These will weaken tree health and make them more susceptible to disease problems. The disease problems will draw mature trees' scarce resource for defence and the result can lead to irreversible tree decline and death. For site disturbance involving excavation or compaction within root zone, it may cause damage to structural roots which will adversely affect tree's stability.

3.3 Mature trees have limited ability to recover from stress and damage, proactive and preventive measures are the critical elements in the formulation of management strategies for mature trees. The goal of arboricultural management should aim at creating a stable crown structure, minimise

detrimental disturbance and to minimise parasite infection so that the onset of decline and the entry into the mortality spiral will be delayed to enhance longevity (Clark and Matheny, 1991). The key practices to enhance longevity are listed in **Table 3**. Based on the biological characteristics of mature trees, the key management strategies are:

- ♦ to maintain a stable tree structure by reducing the chance of damage due to tree failure, and
- ♦ to promote tree health by minimising stress through the provision of a stable and favourable growing environment.

Promotion of a stable environment	Plant the right plant in the right place Irrigate according to species requirement Maintain existing/adequate drainage Monitor and maintain soil fertility Develop a pest management programme Minimise soil compaction Minimise grade and other soil change
Development of stable structure	Plant material with well-developed structure (root and crown) Develop early crown training programme Prune to natural targets Minimise mechanical injury

Table 3 – Arboricultural practices that enhance longevity
(Clark and Matheny, 1991)

4.0 Tree Inspection

4.1 Regular tree inspection is an essential means in proactive tree management to identify changes in tree conditions and site disturbance which may be corrected before irreversible decline occurs. It should be a continuous and long-term monitoring process rather than a one-off exercise. It is recommended that detailed tree inspection for mature trees with individual trunk(s) over 750mm DBH growing in areas within Category I tree risk zone should be conducted at least annually. For OVTs, inspection should be conducted at least at least twice a year to cover changes over wet and dry seasons. Supplementary inspection should also be conducted in situations when the trees require close monitoring due to health or structural problems or after severe inclement weather in order to identify the need for remedial measures.

4.2 A standard report format to record all findings during inspection covering the assessment on tree health and structural conditions as well as site

information is required. The use of “Form 2” under the “*Guidelines for Tree Risk Assessment and Management Arrangement on an Area Basis and on a Tree Basis*” issued by the Greening, Landscape and Tree Management Section, the Development Bureau (GLTMS) for inspection of these large mature trees is recommended. Inspection should be conducted by staff with relevant training, qualification and work experience as specified in the guidelines.

4.3 During inspection of mature trees, particular attention should be drawn to the following aspects for a systematic and thorough checking of tree conditions:

4.3.1 Cross checking with the previous inspection and maintenance records to identify any significant changes requiring attention that should be recorded. For monitoring of major structural defects such as cavities, cracks and decayed or damaged areas developed on mature trees, physical measurement on their dimensions should be conducted, preferably fixed reference points should be set to facilitate long-term monitoring.



Photo 1 - Conduct sounding test by a mallet to assist in estimating the presence of internal decay

4.3.2 Sounding test in trunk and/or accessible scaffold limbs should be performed to assist in identifying the presence of internal decay. If severe decay is suspected, additional assessments such as tomographic and/or resistographic testing should be performed to evaluate more accurately the extent of decay and monitor the change in the remaining sound wood over time.

4.3.3 Root collar inspection should be conducted to identify defects which will adversely affect structural stability. Hand tools, if required, should be used with care to excavate soil to check for suspected decay and damage in tree roots. Sufficient space clear of vegetation at the

base of trees should be maintained as dense vegetation obstructs thorough tree inspection at the lower trunk and root zone. Constant replacements of annuals/seasonal flowers disturb tree roots and create a moist environment which promote decay and therefore should be avoided. For details, please refer to “*Proper Planting Practice – Keep Sufficient Space Clear of Vegetation at the Base of Trees*” promulgated by the GLTMS.



Photo 2 – Maintain sufficient space clear of vegetation at the base of trees

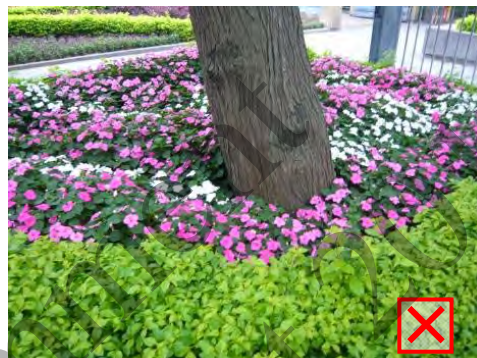


Photo 3 - Dense planting around trunk base should be avoided as it will affect root collar inspection and cause soil disturbance within root zone during horticultural maintenance

- 4.3.4 For mature trees with tree supporting system installed, the need for adjusting the hardware and stability condition should be checked.
- 4.3.5 For trees in areas with frequent use and suspected structural defects which may be difficult to inspect at ground level, it is recommended that aerial inspection should be conducted to assess the structural conditions and the need of mitigation measures.
- 4.3.6 Site disturbances, e.g. cutting of roots, compaction and construction works, etc., should be identified to facilitate assessment of the extent of damage and the need of remedial measures.
- 4.3.7 The need of soil and/or foliar tests for the mature trees would be necessary to evaluate any fertility/soil problems, especially when there have been changes of site conditions after the construction activities in the vicinity.

5.0 Tree Maintenance

5.1 The maintenance operations should be carried out by trained personnel under supervision in accordance with good arboricultural practices. In line with the management strategies for mature trees, the following paragraphs outline the major tree maintenance operations.

5.2 Arboricultural Practices

5.2.1 Trees growing in urban areas are usually exposed to harsh man-made environment and the adoption of appropriate arboricultural practices, e.g. pruning, irrigation and fertilisation, would ameliorate the growing conditions and reduce stress to facilitate healthy establishment of trees. However, improper arboricultural practices can also induce stress and cause decline in tree health. Knowledge of proper arboricultural practices is important to avoid unnecessary tree damage and promote tree health. An optimal management programme should begin early in the life of the tree for creating a continuum of stability. While the long term programme of tree care are beneficial, the application of arboricultural practices to mature trees that have not had such care represents a change in their environment. As such these arboricultural practices may be a stress on the trees, the tree management personnel has to assess the pros and cons of each practice before application (Clark and Matheny, 1991).

5.2.2 Pruning

5.2.2.1 Pruning is the most common maintenance operation in tree care. Pruning for mature trees are quite different than those used for young trees. Structural pruning for young trees can eliminate many future problems associated with problematic branching and poor branch structure. It is generally more efficient to prune trees early and with small cuts than to delay pruning until trees



Photo 4 - Formation of woundwood over large pruning wound is difficult and it will lead to decay

aged and have serious structural problems (Gilman, 2012). For the general guidance on proper pruning, please refer to “*General Guidelines on Tree Pruning*” and “*Do’s and Don’ts in Pruning*” promulgated by the GLTMS.

5.2.2.2 No trees should be pruned without first establishing clearly defined objectives (Gilman and Bisson, 2007). Pruning of mature trees must be done judiciously. For pruning large and mature trees, the focus should be on ensuring human safety and passage, minimising limb failure and total tree failure near targets and maintaining tree health and vigor. Crown cleaning should be conducted to remove dead, dying, diseased and broken branches and the living tissues should be kept intact in order to maximise the retention of energy producing surface and limit the extent of wounding. For trees suffering from stress or in declining conditions, it is crucial to refrain from removing any live foliage because they need as much sugar-generating capacity as possible (Gilman, 2011).



Photo 5 - Improper pruning caused by excessive removal on inner branches results in over lifting of crowns and lion-tailing.

5.2.2.3 Lion-tailing shifts the centre of gravity higher where wind speed is greater, and creates substantially weakened branches that may break easily in storms or simply under their own weight (Gilman, 2012). This will also hinder the development of proper branch taper and weaken the tree structure. For situations which have justified objectives for selective crown thinning or reduction involving live branches, pruning should be concentrated on branch ends and lion-tailing should be avoided.

5.2.2.4 Removal of too many live branches in a single operation can deplete energy reserve and induce physiological stress on mature trees which should be avoided as far as possible. Extent of live branch removal should be minimised as far as practicable. For old and weak trees,

the pruning percentage of live branches should be reduced. Splitting of pruning works into sessions separated by months or years to reduce the impact on mature trees should also be considered.

- 5.2.2.5 For the mature trees that suffer from damage due to storms or previous improper pruning treatments, crown restoration should be carried out by sprouts management which involves selective removal, reduction and retention of sprouts for development into permanent branches (Gilman and Partin, 2007). This may require several pruning cycles and years to train the sprouts into new branches to restore the tree structure.

5.2.3 Irrigation

- 5.2.3.1 Water is essential for plant physiological functions. Over irrigation, however, can encourage root rot infections and cause root suffocation. Water requirements for individual trees vary by species, age and environmental conditions. Maintaining suitable amount of water in soil to avoid moisture stress is crucial for tree growth.

- 5.2.3.2 In general, mature trees growing in natural setting, such as hillside, have established extensive root system and therefore artificial irrigation may not be necessary. However, in urban areas, water availability in confined planting space is generally limited and as a result irrigation may be required as supplemental water source to promote tree growth and prevent moisture stress during droughts. In such situation, tensiometer or other soil moisture sensors can be used to monitor the soil moisture content and the need of irrigation to facilitate development of watering schedule for mature trees.



Photo 6 - Tensiometer installed in root zone to monitor soil moisture

- 5.2.3.3 Irrigation, if required, should be applied on root zone for thorough infiltration of water into the soil. Watering at lower trunk or trunk

flare should be avoided as it encourages fungal growth and root collar diseases which will adversely affect the health and stability of mature trees.

- 5.2.3.4 Irrigation without adequate drainage is equally detrimental to tree health and provision of adequate drainage is essential. Where soil becomes persistently waterlogged due to improper drainage, it should be corrected by installing drainage pipes or trenching with care to reduce root damage.

5.2.4 Fertilisation

- 5.2.4.1 Nutrients are substances required by plants for growth and metabolic functions. These nutrients are normally present in sufficient quantities in a natural habitat. However, in an urban environment, topsoil rich in organic matters is frequently removed which disrupts the return of nutrients to soil. Imported soil may not have sufficient nutrients and the activity of beneficial soil microorganisms is limited. Fertilisation should be considered for trees growing in urban setting with poor health due to nutrient stress.

- 5.2.4.2 However, incorrect application of fertilisers may increase susceptibility to pests and diseases and result in tree decline. To determine the need of fertilisation and nutrient problems, soil test and/or foliar analysis should be considered to determine the nutrient deficiency. In selecting a suitable fertiliser, soil pH should also be considered as it will affect availability of nutrients.

5.2.5 Mulching

- 5.2.5.1 Mulches are materials placed on soil and the use of organic mulches made from plant matters such as wood chips or shredded bark is preferred. Mulching can reduce environmental stress by providing trees with a more



Photo 7 - Provision of a layer of organic mulch in the root zone can improve the rooting environment for trees

moderate root environment to improve root growth. It can improve moisture retention, suppress weed, encourage growth of beneficial soil organisms, relieve soil compaction and release nutrients to soil.

5.2.5.2 For proactive mature tree management, application of mulching in the root zone on flat or gentle area to create a favourable rooting environment is encouraged. The mulched area is recommended to extend over as much of the root system as possible which can be allowed by other site usage requirements. Piling of mulches against trunk base is inappropriate as it will increase the vulnerability of root collar diseases.

5.2.6 Pest and Disease Management

5.2.6.1 Pests are organisms which adversely affect tree health, structure and appearance resulting in damage or nuisance. Examples include insects, ticks, spiders, fungi, bacteria, viruses, snails, rodents, weeds and parasitic vines. Pest problems are usually associated with other primary causes such as environmental or cultural factors. Therefore, accurate diagnosis is fundamental to address pest problems.

5.2.6.2 Parasitic invasion including that of insect, fungus, virus, bacterium, parasitic plant may cause death of a mature tree. Integrated Pest Management (IPM) approach combining both preventive and control tactics through physical, biological, cultural and chemical methods should be employed to minimise adverse impact to plant health.

5.2.6.3 Attention should be drawn to pest, e.g. termite, which may affect structural stability causing tree failure. Prompt treatment to eradicate such pest problem is required and this may involve the use of registered pesticides approved by the Agriculture, Fisheries and Conservation Department (AFCD) in the link: http://www.afcd.gov.hk/english/quarantine/qua_pesticide/qua_pes_pe/s/qua_pes_pes.html. The application methods for registered pesticides should follow recommendations from the manufacturers.

5.2.6.4 Invasive and parasitic plants such as Mikania (*Mikania micrantha*) and Dodder (*Cuscuta* spp.) should be removed (please refer to the

approaches to control *Mikania* as recommended by AFCD in the link: https://www.afcd.gov.hk/english/conservation/con_flo/About_Mikania/about_mikania.html#c). Generally, other non-parasitic epiphytic plants growing on trees can be retained unless they cause overloading of tree crowns or excessive moisture leading to decay.

5.2.6.5 *Phellinus noxius* is an aggressive fungal pathogen that causes Brown Root Rot (BRR) disease. It is highly pathogenic and infectious which will cause root decay and may lead to tree collapse. When a tree management department identifies typical signs and symptoms of BRR disease infection, a report for the suspected case should be made promptly to the Tree Management Office of the GLTMS. As BRR disease may spread to adjacent plants, special care and treatment on trees infected with BRR disease should be undertaken in accordance with “*Guidelines on Brown Root Rot Disease*” issued by the GLTMS.

5.2.7 Aerial Roots Management

5.2.7.1 Chinese banyan (*Ficus microcarpa*) is one of the most common mature tree species found in Hong Kong. They have the ability to develop an extensive aerial root system to capture water and nutrients from the surroundings to become lignified that give support to the tree.



Photo 8 - Installation of guiding tubes to facilitate development of lignified aerial roots to the ground for additional supports

5.2.7.2 One of the best management treatments for the mature banyan is to make use of this growing characteristic to improve stability of the trees. For details of various treatments of aerial roots to improve the structural stability, please refer to the “*Management Guidelines for Stonewall Trees*” issued by the GLTMS.

5.3 Mitigation Measures

5.3.1 It is not uncommon for mature trees to have health and structural

defects due to aging as well as impacts from the natural and man-made environment. As mature trees have limited ability to recover when declining, timely mitigation measures would be necessary.

5.3.2 Continuous monitoring is also required to determine the effectiveness of the remedial measures and the need for additional or alternative treatments. The following paragraphs outline the key remedial measures applicable for mature trees.

5.3.3 Minimise Compaction and Grade Changes

5.3.3.1 Prevention against damage to trees is the best mitigation measure. It is important to protect the growing space both above and below ground from degradation. Soil compaction and grade change around the tree should be minimised in order to protect the root zone. To balance the need of development and the preservation of trees, adequate tree protection measures should be implemented to prevent tree damage, particularly before and during construction activities.



Photo 9 - Excavation within tree protection zone will cause significant damage to root system

These include the provision of Tree Protection Zone (TPZ) and erection of a robust protection fence to protect from disturbance, at the onset of construction. It is important to note that the planning for proper tree protection starts early in the initial planning and design stage and implements through detailed documentation process and subsequently through careful supervision during construction. The requirements of TPZ are detailed in ETWB TC(W) No. 29/2004 'Registration of Old and Valuable Trees, and Guidelines for the Preservation' and DEVB TC(W) No. 10/2013 'Tree Preservation' and 'Management Guidelines for Stonewall Trees'.

- 5.3.3.2 Construction traffic within TPZ should be avoided by careful site planning for alternatives. For temporary traffic within TPZ which cannot be avoided, adequate protection against compaction should be provided e.g. use of plywood sheet over thick mulching on top of soil to reduce localised compaction.
- 5.3.3.3 Grade changes within TPZ should be avoided by proper site planning and design. Open trenching and excavation within TPZ should be avoided. Alignment of underground utility should be diverted away from TPZ. Alternative construction methods, e.g. micro-tunnelling underneath root zone, should be proactively considered wherever applicable to minimise the impact if adjustment of the alignment is not practical. Further information on “*Tree Protection Measures*” and “*Tree Care during Construction*” etc. are available in the <http://www.trees.gov.hk>.
- 5.3.3.4 Sufficient space for tree growth is necessary for the long term health and stability of trees. Growing trees in open soil and planting area should be given priority instead of in a tree pit, where space is available. For situations where tree pits are necessary, they should be large enough to support the long term growth of trees. Adjacent paving design is also important for providing a desirable environment for tree growth, keeping the tree in good health condition, and avoiding future maintenance problems. In general, a tree should not be surrounded by concrete around the root collar, and sufficient space should be allowed at the base of trees. Permeable paving which allows penetration of air and water in general is recommended. Please refer to the “*Guideline on Pavement Renovation Works and Tree Stability*” issued by the GLTMS for more information.

5.3.4 Tree Support Systems

- 5.3.4.1 Tree support systems involve the installation of hardware in trees to offer supplemental supports by limiting the movement of limbs or trunks, providing additional supports for trees. A properly installed tree support system can reduce the risk of tree failure and extend the lifespan of a tree.

5.3.4.2 For large mature trees, the combination of pruning operations and installation of tree support systems may mitigate the risk of failure. The contact points between the supporting system and tree parts should be designed to minimise damage to the bark.

5.3.5 Soil Improvement

5.3.5.1 Soil compaction is one of the most common problems accountable for the decline of urban mature trees. Compacted soil imposes physical resistance to root growth, reduces soil oxygen level and inhibits water retention which are detrimental to root growth. Similar to other stresses, it is easier to avoid compaction with proper design and protection during construction than to correct it after occurrence.



Photo 10 - Improvement by enlargement of planting area around a mature tree has been carried out at the above site

5.3.5.2 Increasing the area of permeable surface and proper soil cultivation can help to enhance water and air movement to the roots and alleviate stress induced by compaction. For mature trees growing in confined pits or planters surrounded with concrete paving or structures, consideration can be given to enlarge the planting areas to improve growing conditions. In carrying out the improvement works, precautionary measures should follow the “*Guideline on Pavement Renovation Works and Tree Stability*” issued by the GLTMS.

5.3.5.3 Soil cultivation is a measure that can mitigate the impact of compacted soil. This can be done manually by hand tools to increase pore spaces. Other methods include the use of equipment such as air spade.

5.3.6 Decay and Cavity Treatments

5.3.6.1 Most mature trees grow in association with some degrees of decay and wounds. Application of wound dressing is not recommended as it cannot facilitate wound closure and may encourage accumulation of

moisture which will cause decay. Exposed wood should preferably be left untreated, particularly if it is stable and in good condition. Partial removal of decayed wood may be beneficial to minimise food source for development of wood-rotting fungi.

5.3.6.2 The best remedial measure is to improve the growing conditions for mature trees to encourage woundwood and new wood formation to compensate for the weakened structure due to decay.

5.3.7 Tree Removal

5.3.7.1 Tree removal should be the last resort when there is no practical alternative to cure the tree or to reduce the risk of tree failure to an acceptable level. When a tree poses imminent danger to life and property, felling the tree should be carried out in a timely manner to address public safety.

5.3.7.2 Since old trees have cultural and emotional attachment to the community, communication with the public to explain the tree conditions and measures adopted before removal would be desirable. This can address the public concerns and provide an opportunity to present the tree problems from the professional side so that a mutual understanding on the required tree works can be achieved.

5.3.7.3 If tree removal is considered appropriate, replacement planting of suitable species to suit the site conditions should be considered to restore the greenery. The procedure for tree removal should follow 'Development Bureau Technical Circular (Works) No. 10/2013 – Tree Preservation'. For removal of OVTs, the procedure in ETWB TC(W) No. 29/2004 'Registration of Old and Valuable Trees, and Guidelines for the Preservation' should be followed.

6.0 Record and Monitoring

6.1 The maintenance records should be properly documented. The reports for maintenance operations should contain information such as date of operation, party and/or person responsible for maintenance works, relevant tree information, operation details (e.g. dosage and materials), photographic records

showing the trees before and after treatment, preferably from the same view angle.

6.2 The inspection and maintenance records are essential to facilitate monitoring of tree condition, determining the effectiveness of treatment and formulating alternative follow up measures. For trees requiring continuous monitoring due to health or structural concern, they should be uploaded to the Tree Register in order to facilitate community-wide surveillance.

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Management Guidelines for Stonewall Trees



**GREENING, LANDSCAPE AND TREE MANAGEMENT SECTION
DEVELOPMENT BUREAU**

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1.0 Introduction

1.1 Stonewall trees are unique landscape, ecological and amenity features in our city. Since the founding of the city in the 1840s, there has been acute demand of land for urban growth. To overcome the hilly terrain with limited flat land for development, stone retaining walls of various types were built by traditional Chinese masonry techniques to provide horizontal platforms and stabilise disturbed terrain. With the sub-tropical climate, the presence of plant species usually *Ficus* spp. with strangler growing habit, joints between the stonewall blocks, the soil behind the walls and ground water seepage have permitted plant growth and stonewall trees have established on vertical surfaces on the stone retaining walls. These unique trees enrich the urban ecology and offer greenery to ameliorate the congested urban environment in Hong Kong.

1.2 Few cities in the world have so many stone retaining walls with spontaneous vegetation in an urban setting (Jim, 2010). The traditional craft in masonry wall construction is no longer present and there is no new stone wall constructed by traditional craftsmanship thus making stonewall trees unique heritage that deserve and require proper management.

1.3 Tree species with strangler growing habit are able to secure a strong grip on vertical wall surface and adapt to such harsh growing environment. These include *Ficus microcarpa*, *F. subpisocarpa* (*F. superba* var. *japonica*), *F. hispida* and *F. virens* which constitute the majority of stonewall tree species as they can fit into the vertical habitat for successful establishment on stone walls to become sizable landscape features. Other common species include *Celtis sinensis* and *Broussonetia papyrifera* (Jim, 1998).

1.4 Wall trees growing on stone walls are natural-cum-cultural assets and special preservation measures are required. The “Management Guidelines for Stonewall Trees” (Guidelines) serve as a reference for tree management

departments in the management of stonewall trees with a view to promoting their health and structure, minimising their risk of failure and optimising their longevity.

2.0 Definition of Stonewall Trees

2.1 A stonewall tree is defined as a tree growing on a stone retaining wall satisfying the following criteria.

a) Wall Trees

“A wall tree should have most of its roots spreading on or penetrating through the wall face, and with the trunk base situated within the confines of a wall. A tree overhanging above a wall but not physically attached to it, and a tree with trunk base and most roots located outside a wall’s boundaries, did not qualify.”
(Jim, 1998).

b) Stone Retaining Walls

Stone retaining walls consist of rubble walls composed of stones of regular or irregular size and shape and tied face walls with well shaped blocks. Free-standing walls, concrete walls or concrete walls with a stone veneer are excluded. Maintenance departments should check with the Geotechnical Engineering Office (GEO) to verify the structure of stone retaining walls if in doubt.

3.0 Growing Habit of Stonewall Trees

3.1 Geotechnical works relating to the stability of stone walls are not covered in the Guidelines. Reference should be made to “Geotechnical Manual for Slopes”, “Technical Guidelines on Landscape Treatment for Slopes”, “GEO Report No. 257 – Study on Masonry Walls with Trees” and other relevant documents published by Civil Engineering and Development Department.

Stabilisation treatment of walls, if required, should be sympathetic to growth of trees, and less damaging method, e.g. recessed soil nail installation, should be adopted.

3.2 Stone retaining walls provide vertical growing environment for establishment of stonewall trees. Seeds of stonewall tree species are brought to wall surfaces by frugivorous birds or bats. Relying on limited moisture available on the wall surfaces, these seeds germinate and extend their roots to explore openings or joints on stone walls and penetrate through the walls to secure their footings and absorb water and nutrients from the aft-soil (i.e. soil behind retaining walls) to sustain their growth. The ecology of stone walls is unique and where stability of the walls is not affected, small plants (e.g. saplings, climbers, ferns, native herbaceous) should be kept intact.

3.3 Roots developed on the wall surfaces also extend their colonies by sending absorbing roots to reach the soil at toe or crest of the walls to capture more water and nutrients for growth. The surface roots also fuse together at intersections to form a distinctive root network enhancing the grip on the walls. For species with aerial roots, these roots provide additional support to improve stability of stonewall trees when lignified, particularly if they can reach the soil to become prop-like supports.



Photo No. 1 – Distinctive root network on retaining wall surface

4.0 Review of Stonewall Tree Failure Cases

4.1 Based on available tree failure records from the maintenance departments, it is found that the main mode of failure associated with stonewall trees is uprooting during adverse weather conditions, e.g. typhoons. Most of the tree failure cases did not involve damage to the stone retaining walls and only a few cases caused localised damage.

4.2 The tree failure cases involve detachment of the roots from the wall surfaces and breakage of the roots penetrated into the walls on the tension side and rupture of the surface roots near the trunk base on the compression side. In general, it is observed that the fallen stonewall trees had only several root ingress points on the walls but the strength of root anchorage could afford establishment of sizable stonewall trees. Although the root anchorage was strong, failure would occur when excessive static and wind loads were transferred from the stems and canopies during adverse weather conditions.

5.0 Management Strategies of Stonewall Trees

5.1 The stability of trees on stone walls depends on the static and wind loads on the trunk, branches and crown as well as the strength of root anchorage (Chan, 2000). The management strategies of stonewall trees are formulated to focus on the integrity of the tree structure and root anchorage to reduce the risk of tree failure and promote tree health.

5.2 The key management strategies are:

- ◆ to maintain a balanced crown architecture and branch structure which enhance stability; and
- ◆ to improve root anchorage and strengthen support.

6.0 Inspection of Stonewall Trees

6.1 Regular tree inspection is essential to monitor the tree condition and identify the required maintenance measures. Inspection should be conducted by staff with relevant training and work experience.

6.2 Periodic inspection should be conducted to suit the maintenance requirements and in line with tree risk assessment requirements of the Tree Management Office (TMO). Supplementary inspection after inclement weather to identify the extent of damage and need of remedial works is required. Inspection frequency should be increased when the stonewall trees require close monitoring due to health or structural concerns.

6.3 Thorough inspection of the entire stonewall tree and its surroundings, with particular focus on the following aspects, in line with the management strategies is required. These include, but are not limited to, the identification of:

- ◆ structural defects, such as broken or dead branches, decay, cavities, splits, cracks, weak attachments, included bark, cross branching, hangers and deformed growth requiring remedial treatment;
- ◆ overgrown, weak and defective branches, scaffold limbs with poor taper requiring end weight reduction;
- ◆ the need of selective thinning of epicormic growth to improve branch structure;
- ◆ serious leaning or imbalance crown requiring pruning to rectify the form;
- ◆ the need of pruning to maintain a reasonable crown size and balanced architecture as well as branch structure taking into account the strength of

- root anchorage to enhance stability;
- ◆ detachment of root anchorage and damage or decay of roots attached to the stone retaining wall, particularly those surface roots with visible entry points to the stone wall;
- ◆ aerial roots requiring guiding to provide potential lignified support;
- ◆ symptoms and signs of plant disorders such as fungal fruiting body and termite trails;
- ◆ adequacy of clearance to traffic and adjacent property;
- ◆ the need for provision or adjustment of installed tree support systems;
- ◆ damage or displacement of masonry blocks on the stone retaining wall requiring referral to a geotechnical engineer for follow up checking;
- ◆ recent changes to its surroundings such as trenches, grade changes, compaction, construction and demolition activities which may weaken root anchorage and increase exposure of the tree to wind;
- ◆ opportunities for providing enlarged planting areas at toe or crest of the stone retaining wall; and
- ◆ opportunities for guiding roots to soil.

6.4 Further investigation of the structural conditions by resistographic and tomographic instruments should be conducted if required. Monitoring of movement on stone walls should be considered if stability of the stone walls is a concern upon inspection by a geotechnical engineer.

7.0 Maintenance of Stonewall Trees

7.1 Maintenance operations should be carried out in accordance with the recommendations arising from the inspections. The operations should be

carried out by trained personnel under supervision of trained and experienced supervisors with good knowledge in respect of the care of stonewall trees to ensure that maintenance operations can be carried out properly and safely in accordance with the proper arboricultural practices.

7.2 The following paragraphs outline the key measures in the maintenance of stonewall trees. These include preventive measures to promote tree health and structure, and remedial treatments of tree defects to reduce potential risks.

7.3 Pruning

7.3.1 Pruning should be carried out in accordance with the proper pruning practices promulgated by the TMO, for example, “General Guidelines on Tree Pruning” in the website <http://www.trees.gov.hk> and reference can be made to the international standards and best practices such as the standards promulgated by American National Standards Institute, the British Standards Institution, the International Society of Arboriculture, and Arboricultural Association. Prune only when necessary. The extent of pruning and size of pruning wounds should be minimised as far as practicable to any reduce stress to the stonewall trees and the vulnerability to pest and disease attack from pruning wounds. It is recommended that no more than 25% of the live crown, if justified, should be pruned in any one year. Large pruning wounds and removal of large branches should be avoided. Malpractices such as topping, lion tailing, excessive pruning should not be performed. The amount, location and method of pruning should be prescribed by a trained tree management professional and implemented by a worker/contractor with appropriate skills.

7.3.2 Remove Defective Branches

Dead, diseased or broken branches should be removed as appropriate to address structural and health concerns. Defective branches with weakened mechanical strength and other defects due to advanced decay, cavity formation, and crack development at critical junctures and cross branching should be removed. Stubs should also be removed in order to avoid decay spreading to the parent stems or branches.

7.3.3 Reduce Excessive Branch End Weight

An appropriate amount of end weight should be removed where necessary to reduce the load and abate the risk of failure under the following circumstances: overgrown branches and poor taper, branches suffering from decay or cavity at critical points with reduced load-bearing capacity, truncated branches due to improper heading cut, or long, heavy and upright epicormic branches developed at or near the cut wounds with decay.

7.3.4 Rectify Imbalance Tree Crown

Low leaning angle is common in stonewall trees because of the vertical habitat and the presence of physical obstacles at the back of the walls. The natural leaning and “imbalanced” crown of stonewall trees to suit their growing habit against a vertical wall should not be directly compared to that of trees growing on ground. As a reference for stonewall trees, due to their special habitat, tilting reaching beyond 40° would be considered as heavy lean that deserve close attention (Jim, 2012). Reduction pruning to shorten severe leaning branches should be considered in order to rectify the imbalanced tree crown and improve stability if necessary.

7.3.5 Maintain Optimal Size of Tree Crown

Static load and wind load to stonewall trees are proportional to the frontal area of tree crown. For stonewall trees with large tree crowns but limited root attachment and support, the force transferring from the crown to the root anchorage during windy conditions is large and the risk of uprooting of stonewall trees would increase, especially if the stonewall trees are located at exposed locations (Chan, 2000). Reduction pruning should be performed to reduce the size of tree crown when necessary to avoid excessive loading to root anchorage.

7.3.6 Provide Adequate Clearance from Road Traffic and Properties

7.3.6.1 Mechanical damage by moving vehicles can cause severe impacts to stonewall trees protruding from stone retaining walls along the roadside. A stonewall tree may fail if hit by a heavy vehicle. Low and overhanging branches affecting traffic flow should be appropriately pruned to provide adequate clearance. In general, a head room clearance of 5.5m is required for public roads. Warning signs or markings should be provided, if required, for tree parts which are close to traffic corridors.

7.3.6.2 For branches that are very close to properties or structures, reduction pruning to provide adequate clearance should be carried out to prevent branches from hitting and damaging adjacent properties in windy conditions.

7.4 Utilise Aerial Roots as Lignified Support

7.4.1 Stonewall tree species with aerial roots that capture water and nutrients from the surroundings have the potential to develop and provide additional

lignified support. Therefore, aerial roots should be retained whenever practicable and trimming of them should be the last resort.

7.4.2 The best treatment is to allow aerial roots to reach the soil at ground to become upright lignified support for stonewall trees. If no soil is located underneath the aerial roots, opening up of paving to allow aerial roots to anchor at the ground with soil should be considered. At the same time, it would be necessary to consider the adequate strength of the whole root system to support the increased canopy size and the proportionate growth of the aerial roots to form a prop-like support. Guide tubes or ushering ropes can be used to facilitate aerial roots to reach the ground/soil quickly. If these measures are not feasible, aerial roots can be guided and ushered along branches by ropes made of degradable materials to locations for landing and anchorage. Where soil is not available in the vicinity, aerial roots can be ushered along branches to the main stems or scaffold branches to form lignified support to reinforce the branch structure. Aerial roots should be retained whenever practicable. Trimming, cutting or twisting around branches should not be allowed. Keeping joints of masonry walls unsealed is important for the root growth.



Photo No. 2 – Lignified aerial roots forming natural prop-like supports to improve stability of stonewall tree



Photo No. 3 – An example of guiding aerial roots by plastic tubes filled with planting medium



Photo No. 4 – Aerial roots ushered along branches to the main stems or scaffold branches to form lignified support



Photo No. 5 – Aerial roots forming lignified support to strength the branch support structure

7.5 Protect Root Anchorage from Damage

7.5.1 The lignified roots on stone walls are vital for root anchorage. Damage or decay of these roots, particularly those structural roots near the trunk base and those having penetrated into the walls, would weaken the root anchorage and stability of stonewall trees.

7.5.2 Damage to these roots should be avoided and treatment on exposed wounds, such as fungicide, should be promptly applied for effective control against decay or infection. Removal of the joint filler embedding the roots growing on the retaining walls to relieve the roots from girdling should be considered. Where soil nails have to be installed in slope stabilisation works, they should be carefully located to minimise damage to the root anchorage. During construction, tree protection zones (TPZs) should be provided to cater for the roots behind and in front of the stone retaining walls.

7.6 Create Rooting Areas at Toe and Crest of Retaining Walls

Paved areas should be opened up where practicable by creating rooting areas at toe and crest of retaining walls, as it can improve water and nutrient supply and thus encourage root growth which will as a result provide extra physical support to the stonewall trees. Therefore, there should be no sealing of joints unnecessarily and in particular, at the toe of walls.



Photo No. 6 – Provision of rooting areas at the toe of the retaining wall



Photo No. 7 – Provision of rooting areas at the crest of the retaining wall

7.7 Install Tree Support System

Tree support system, which in general includes cabling, bracing, propping and guying, should be installed as appropriate taking into account the tree dynamics and practicality of installing these systems.

7.8 Integrated Pest Management (IPM)

7.8.1 Pest problems should be addressed by IPM through appropriate physical, biological, cultural or chemical methods.

7.8.2 If signs and symptoms of the Brown Root Rot (BRR) disease infection are identified, a report should be made to the TMO. Special treatment on trees infected with the BRR disease should be carried out in accordance with the prevailing guidelines promulgated by the TMO such as the “Guidelines on

Brown Root Rot Disease” which is available at www.trees.gov.hk.

7.9 Protection of Stonewall Trees during Construction

7.9.1 TPZs during construction should cover the entire wall structure, the stonewall trees, exposed roots and adequate volume of undisturbed aft-soil. The TPZ, where practicable, should consist of (a) the back root protection zone (i.e. area behind the wall), (b) the front root protection zone (i.e. area in front of the wall), and (c) stem protection zone. A tree specialist with good knowledge and experience on stonewall trees preservation should advise on the extent of the TPZ.

7.9.2 Cordon hoarding should be erected around the TPZ and construction activities that are harmful to stonewall trees must be prohibited unless adequate protection arrangements agreed by the tree specialist are put in place. The implementation of tree protection measures should be closely monitored on site throughout the construction period.

7.9.3 Damage to stems and roots of stonewall trees should be avoided during the upgrading of masonry walls through appropriate design measures and close supervision during construction.

7.10 Tree Removal

7.10.1 In a situation where there is a high risk of tree failure that threatens public safety and no appropriate remedial measures are available, the tree should be removed in a timely manner to reduce the risk to an acceptable level.

7.10.2 Removal of stonewall trees should follow proper procedures. The

TMO should be notified beforehand and the removal operation should be properly documented with photo records and provided for the TMO's reference.

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Proper Planting Practice

Keep Sufficient Space Clear of Vegetation at the Base of Trees

1. In the design, installation and maintenance of vegetation cover, try to keep the area around the base of tree trunk clear of vegetation or excessive soil/mulch fill (i.e. fill above the level of tree root collar) where practicable, to avoid adverse impact on tree growth and hindrance to tree inspection.

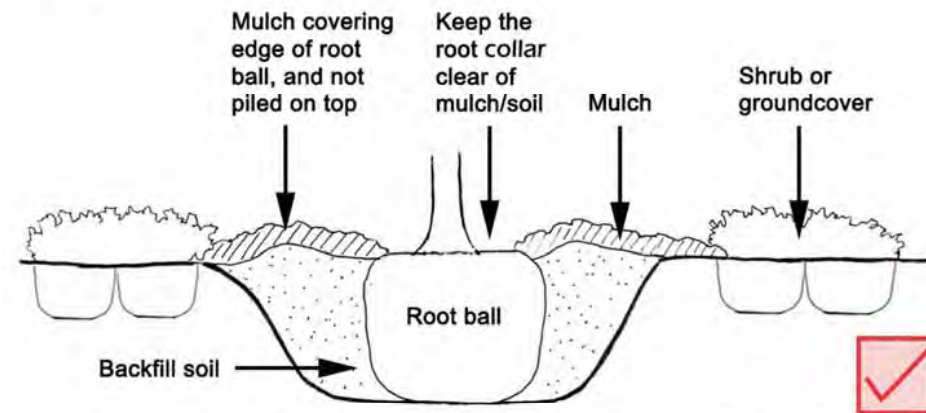


Figure 1 Keep the root collar clear of mulch/soil/other plants.



Photo 1 Keep sufficient space at the base of trees clear of dense vegetation. Apply mulching beyond root collar; and where space allows, extensive application of mulching at root zone is recommended in particular for large trees.



Photo 2 Dense vegetation obstructs thorough tree inspection at the lower trunk and root zone.



Photo 3 Constant replacement of annuals disturb tree roots.

2. How far should the area around the base of tree trunk be cleared of vegetation or excessive soil/mulch fill?

- The edge of the clearance zone is recommended to be around 150 mm – 300 mm from the tree trunk, depending on the size of the tree and its root flare as well as the actual site condition.
- There may be cases where clearance of vegetation around the base of tree trunk is not appropriate, such as on slopes where vegetation clearance will lead to soil erosion and may disturb the natural succession process of slope vegetation cover. Selective cutting back of undergrowth to facilitate tree inspection may be necessary in this situation.
- Professional judgment is essential in deciding the actual size of the clearance zone and how clearance should be carried out.

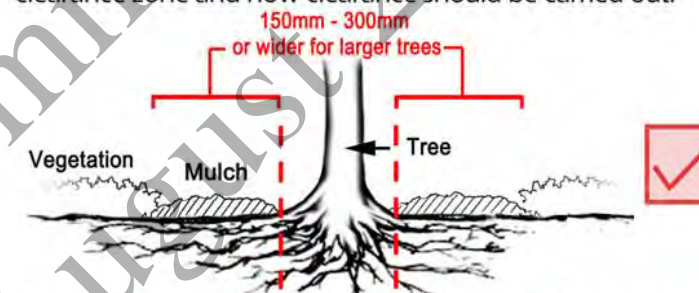


Figure 2 Keep a 'Vegetation-clear' zone at the base of tree.

3. Disadvantages of having vegetation or excessive soil/mulch fill at the area around of the base of tree trunk –

- Adverse impact on tree growth
 - Undergrowth (shrubs/ground covers/grass) will compete with trees in the uptake of soil water and nutrient.
 - Undergrowth that requires frequent replacement (such as seasonal flowering plants and annuals) will result in constant disturbance and damage to tree roots.
 - Undergrowth may require more frequent watering (such as ground covers and grass), which together with the dense vegetation cover creates moist environment that promotes fungal diseases at the base of tree trunk.
 - Excessive soil/mulch fill will reduce oxygen supply to tree roots, resulting in suffocation and decay of tree roots.
- Hindrance to tree inspection
 - Dense undergrowth or excessive soil/mulch fill will obscure the base of tree trunk, making any defects at this part of the tree not readily discernible during tree inspection.

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Photo 4 Annuals or shrubs planted under trees compete with trees for space, air, water and nutrients.



Photo 5 Soil piling above the root collar would lead to suffocation of roots and decay at the lower trunk/ root collar.

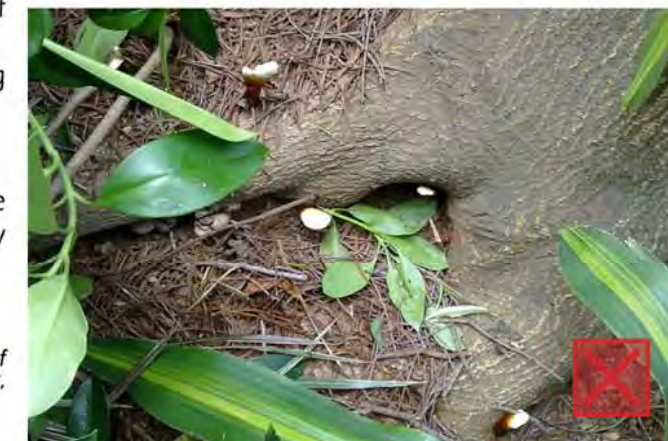


Photo 6 Moist environment created by dense ground vegetation promotes fungal growth around trunk base / root collar.



GUIDELINES ON BROWN ROOT ROT DISEASE

Issue Date: December 2012

TREE MANAGEMENT OFFICE

GREENING, LANDSCAPE AND TREE MANAGEMENT SECTION

DEVELOPMENT BUREAU

THE GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION

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Annexes

- I. Pictorial Guide of Brown Root Rot (BRR) Disease**
- II. Frequently asked questions on BRR Disease**

Enquiries:

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Guidelines on Brown Root Rot Disease

1. Purpose

1.1. This guideline on Brown Root Rot (BRR) Disease focuses on disease management strategy, identification of suspected cases and removal procedures of infected trees.

2. What is Brown Root Rot Disease?

2.1. *Phellinus noxius* is an aggressive fungal pathogen that causes BRR disease. The disease mainly spreads through root-to-root contact or through infested wood debris in soil. There may also be a possibility of spreading the disease through the dissemination of basidiospores from fruiting bodies. It is prevalent in tropical and subtropical regions and has a wide host range covering over 200 plant species in 59 families. In Hong Kong, a number of trees species such as *Aleurities moluccana*, *Bombax ceiba*, *Celtis sinensis*, *Delonix regia*, *Ficus microcarpa*, *Ficus benjamina*, *Gleditsia fera*, *Lophostemon confertus*, and *Mangifera indica* have recently been confirmed to have contracted the disease. There is currently no effective cure to the disease.

2.2. Due to the highly pathogenic and infectious nature of *Phellinus noxius*, it is essential to step up measures to avoid the local establishment of BRR disease. Present literature and overseas experience indicate that the most effective way of prevention is through the promotion of tree health and the reduction of the inoculum of *Phellinus noxius*. These are achievable by the implementation of a vigilant surveillance programme. This programme should consist of three components, namely, a management strategy to prevent local spread, a referral mechanism for reporting of suspected cases and a removal procedure of infected trees.

3. Identification of Suspected BRR Cases

3.1. The following steps should be followed in identifying BRR disease.

- Step 1. Look for trees with the following abnormality at the crown:
 - sparse foliage density;
 - abnormal foliage colour;

- abnormal leaf size; and
- dieback twigs.

Section A of Annex I contains a pictorial guide on crown abnormality.

- Step 2. Then, further examination of the entire lower trunk, root collar and individual roots of the trees is required to ascertain whether the trees initially identified have one or more of the typical BRR signs, i.e. fruiting bodies of *Phellinus noxius*, mycelial encrustation, soil aggregates, mycelial nets. **Section B to E of Annex I contains photographic records of fruiting bodies of *Phellinus noxius*, mycelial encrustation, soil aggregates and mycelial nets.** Root excavation with appropriate tools (e.g. handheld adze, digger, air spade, etc.) may be required to expose the root collar and roots for further examination of typical signs of BRR disease. Soil aggregate and mycelial nets, observable after scraping off bark tissue using appropriate tools (e.g. knife) are indicative of BRR. Please note that bark tissue should only be scrapped off from decayed, damaged or dead wood/roots. The use of mallets may assist to differentiate healthy wood/roots from decayed, damaged or dead wood/roots. Damage to healthy wood/roots should be avoided as this may cause unnecessary damage to the tree, which may also create open wounds for fungal invasion.
- Step 3. If a tree with crown abnormality identified in step 1 contains one or more of the typical signs of BRR disease in step 2 examination, the tree is considered a suspected BRR infection case.

3.2. The confirmation of BRR disease can be made through further field diagnosis based on observable signs, or field diagnosis followed by laboratory diagnosis based on culture and/or molecular techniques. Upon confirmation, recommendations should be made based on the information provided in para. 4.1.2 on handling the confirmed case.

4. Management Strategy

4.1. We adopt a dual-pronged management strategy comprising of precautionary and preventive measures. The objectives of this approach

are to keep our trees healthy, and at the same time to minimize the source of BRR inoculum as far as possible.

4.1.1 Precautionary Measures

- Proper tree planting and maintenance practices are the best precaution one can take against BRR disease. These practices include planting the right tree at the right place, providing sufficient growing space, planting at the right depth, proper irrigation and fertilization regimes, and mulching of root zone, not to mention regular and proper pruning. In particular, number and size of pruning wounds as well as damage to the roots should be kept to a minimum. This reduces the surface area where infection may start off. For details on tree maintenance, please refer to the relevant guidelines issued by the Tree Management Office.

4.1.2. Preventive Measures

- Preventive measures are necessary to minimize the source of BRR inoculum and control the spread of the BRR through removal of diseased parts. Trees in the Category I of Tree Risk Management Zone (i.e. areas of high traffic flow and high pedestrian flow such as public parks, playgrounds, roadside etc) infected with BRR disease should be removed entirely, including fruiting bodies, stumps, wood debris and associated fine roots in soil medium. For details on the Tree Risk Management Zones, please refer to the Guidelines for Tree Risk Assessment and Management Arrangement on an “Area Basis” and a “Tree Basis” which may be downloaded at <http://www.trees.gov.hk>.
- There are however occasions where preservation of a tree is warranted e.g. Old and Valuable Trees or trees that draw strong public sentiment for preservation. The tree concerned should be quarantined to avoid local spreading. The structural stability of the retained infected tree should first be ascertained by conducting a thorough tree risk assessment. This should include, among other normal produces, soil excavation with proper tools (e.g. adze, digger or air spade, if applicable) and advanced examination techniques including tomography and resistography, to examine the extent of the infection and decay at critical locations, such the root collar and

subsoil surface levels.

- For structurally stable trees at the early stage of BRR infection (i.e. trees confirmed with laboratory diagnosis based on culture and/or molecular techniques showing no foliage abnormality and typical signs/symptoms of BRR), treatment efforts can still be made through the creation of physical barrier by digging a trench and the use of chemicals as a means to retard the spread of BRR. It must be borne in mind that treatment through chemical means is only an interim measure for suppressing early stage of BRR infection, and will not revitalize the long term health and structural stability of the trees. Regular monitoring and assessment are still necessary. Trees that are structurally safe should be closely monitored on at least a quarterly basis. The tree should also be lodged under the Tree Register.

5. Removal Procedures for BRR Disease Infected Trees

5.1. For confirmed cases that require removal, the proper disposal of diseased parts (i.e. woody stumps, roots systems, fruiting bodies, fine roots in soils, debris) and subsequent removal or sanitation of the soil medium is very important. **The removal procedures of trees infected with BRR disease are summarised below:**

- Step 1. The above ground parts of BRR infected trees could be removed initially before proceeding to the removal of the tree stump and roots. The entire tree stump, infected roots in the soil, and the fruiting bodies should be incinerated or properly disposed of. Measures needed to be taken to prevent accidental dissemination of contaminated soil/ infected tissues to the surrounding environment during transportation to landfill area. Removal of tree stump and large root pieces may require machines, while fine root or root pieces larger than 1cm in diameter in soil need to be manually removed and packed in strong plastic bags before disposal to landfill area. To ensure complete removal of the source of inoculum, other vegetation (i.e. shrubs, perennials, herbaceous) within the dripline area and/or growing in the root zone area of the infected tree should also be removed. Trees in the vicinity should be checked for BRR infection as well.

- Step 2. According to the literature, mycelia of *Phellinus noxius* could survive in decayed root tissues in the soil for 10 years or more. As there may be infected roots in the soil, treatment should cover also the soil. Depending on site conditions, the soil medium containing the infected debris could either be disposed of or disinfected with a soil fumigant. Application dosage and safety measures from the manufacturers should be carefully read and followed before using a specific soil fumigant. If disinfection or replacement of soil could not be done due to site constraint (i.e. on slope or inaccessible area), tree replanting should be avoided.
- Step 3. Tools like adze, knives, scissors, shovels etc. and transportation equipment (such as car hopper etc.) used in the infested area should be thoroughly disinfected (e.g. with 70% ethanol or 1:49 bleach) after operation.

6. Frequently asked questions on BRR Disease

6.1. A list of frequently asked questions at **Annex II** is provided to facilitate the understanding of BRR's biology background, diagnostic methods, identification of suspected cases, management strategy, and removal procedures of trees infected with BRR disease.

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A. Crown Condition



Photo 1 *Ficus microcarpa* (OVT E/2): branch dieback, defoliation and leaf size reduction.



Photo 2 *Ficus microcarpa* (OVT WCH/10): branch dieback, defoliation and leaf size reduction.



Photo 3 and 4 *Ficus microcarpa*: yellowing, leaf size reduction on the upper portion of the tree, defoliation and dieback.



Photo 5 and 6 *Celtis sinensis*: branch dieback, defoliation, leaf size reduction and yellowing

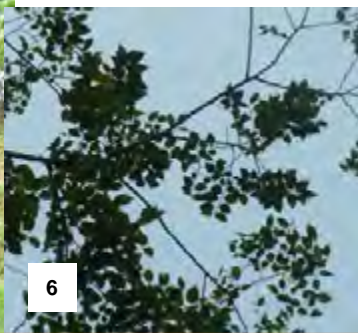


Photo 7 *Ficus microcarpa* showing normal healthy crown condition.

B. Fruiting Bodies of *Phellinus noxius*



Photo 8 Fruiting bodies on *Ficus microcarpa*. **Photo 9** Primordial stage of fruiting bodies (with white advancing margin and drops of exudates). **Photo 10** Senescent fruiting body.



Photo 11 and 12 Primordial stage of *Phellinus noxius* fruiting bodies on *Celtis sinensis* (with white advancing margin and drops of exudates).

B. Fruiting Bodies of *Phellinus noxius* (Con't)

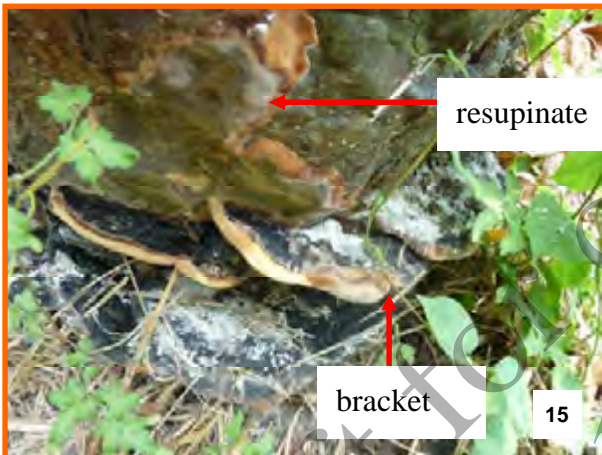


13



14

Photo 13 and 14 Primordial and premature senescent stages of fruiting bodies on lower trunk of *Ficus microcarpa*. Photos were taken at two weeks interval.



resupinate

bracket

15



bracket

16

Photo 15 and 16 Mature fruiting bodies (resupinate/ bracket forms) on dead stump and root of *Ficus microcarpa*.



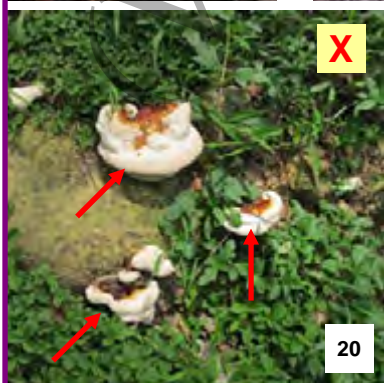
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18



19



20



21

Examples of Non-*Phellinus noxius* fruiting bodies Photo 17 and 18 Fungus with pinkish colour on root collar of *Ficus microcarpa*. Photos were taken at two months interval. **Photo 19, 20 and 21** Fruiting bodies of *Ganoderma* spp. (Hong Kong).

C. Mycelial encrustation of *Phellinus noxius* (flecky appearance on the outer surface of structural roots, root collar and lower trunk)

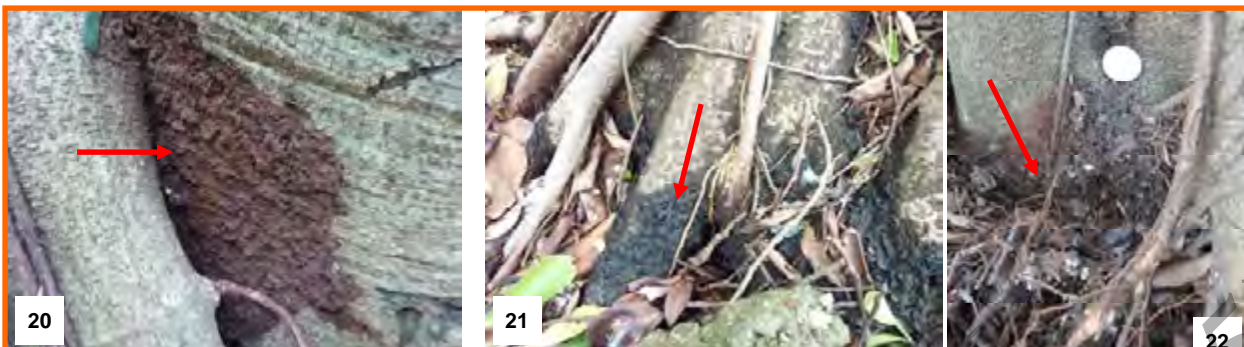


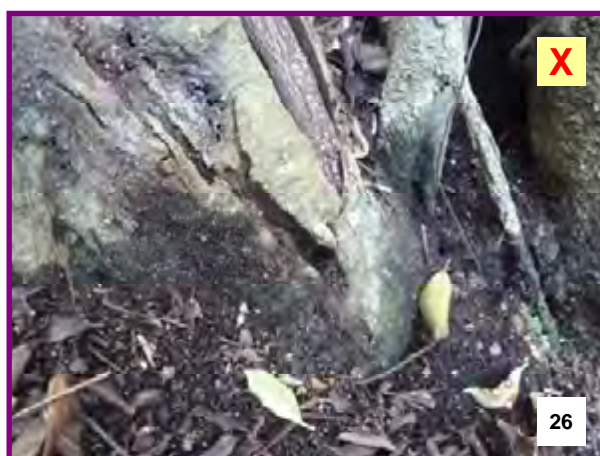
Photo 20 Mycelial encrustation on lower trunk of *Ficus microcarpa*. **Photo 21 and 22** Mycelial encrustation on root collar of *Ficus microcarpa*.



Photo 23 and 24 Mycelial encrustation on structural root of *Ficus microcarpa*.

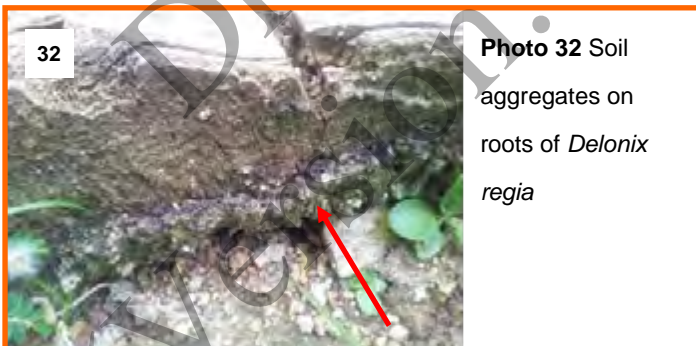
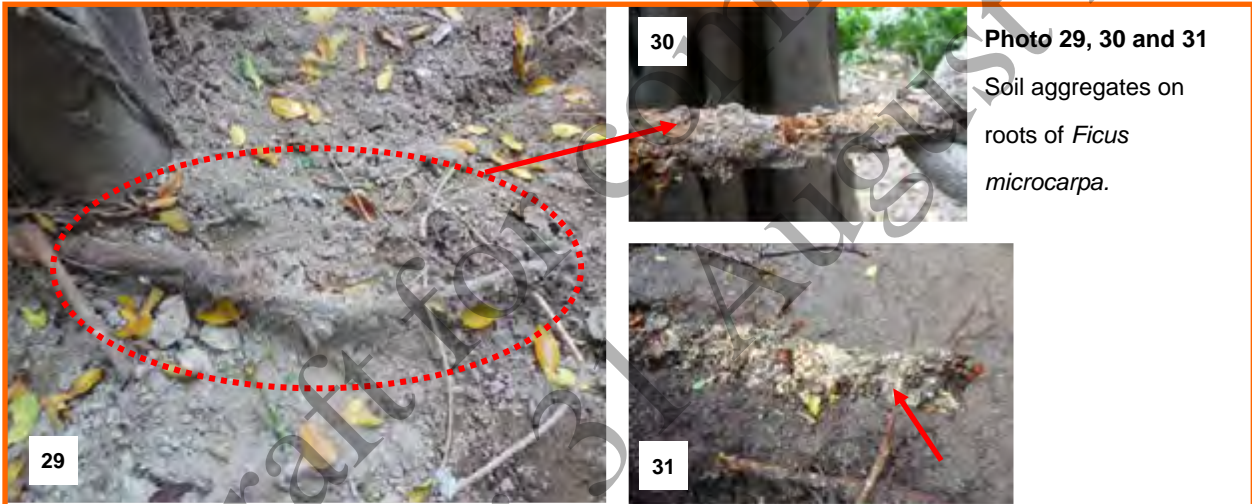
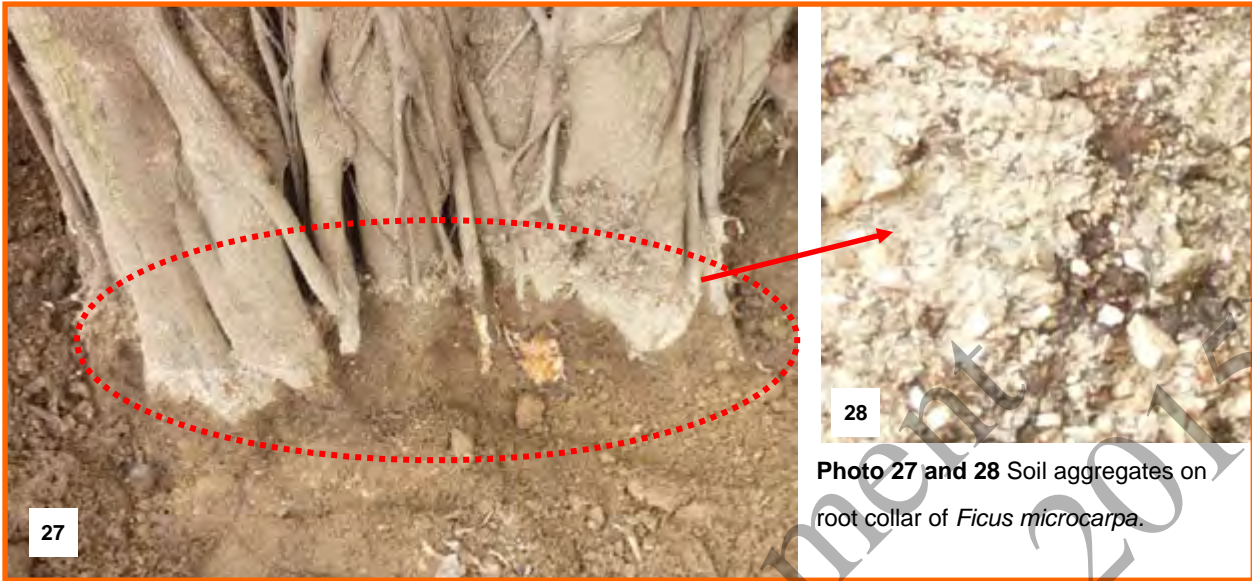


Photo 25 Mycelial encrustation on root collar of *Delonix regia*.

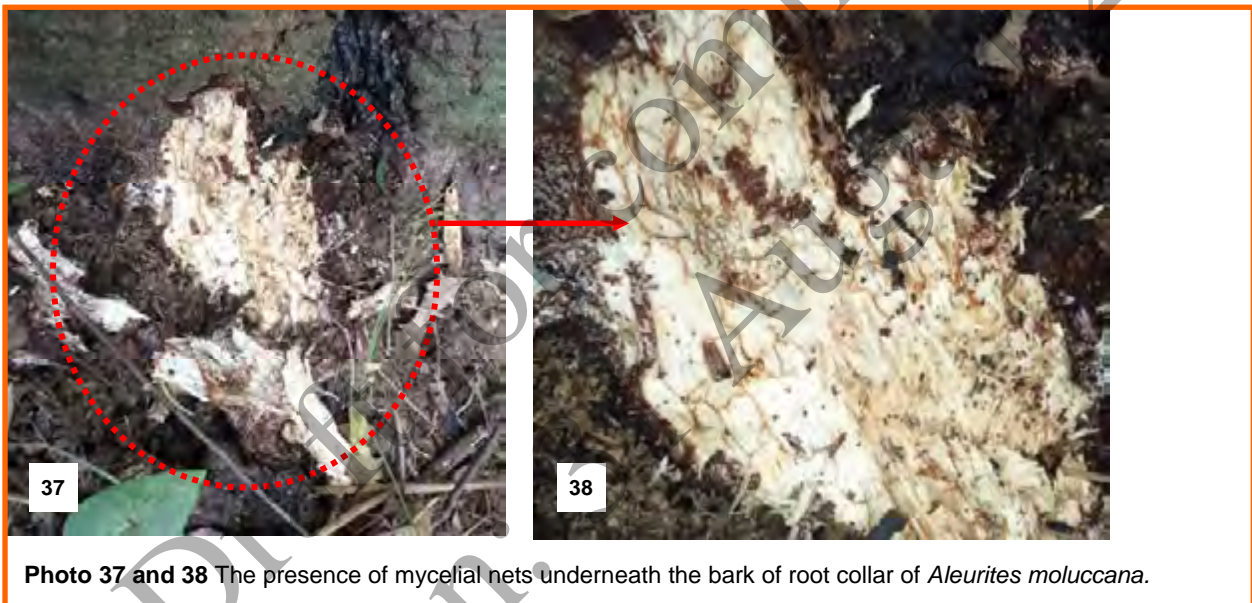
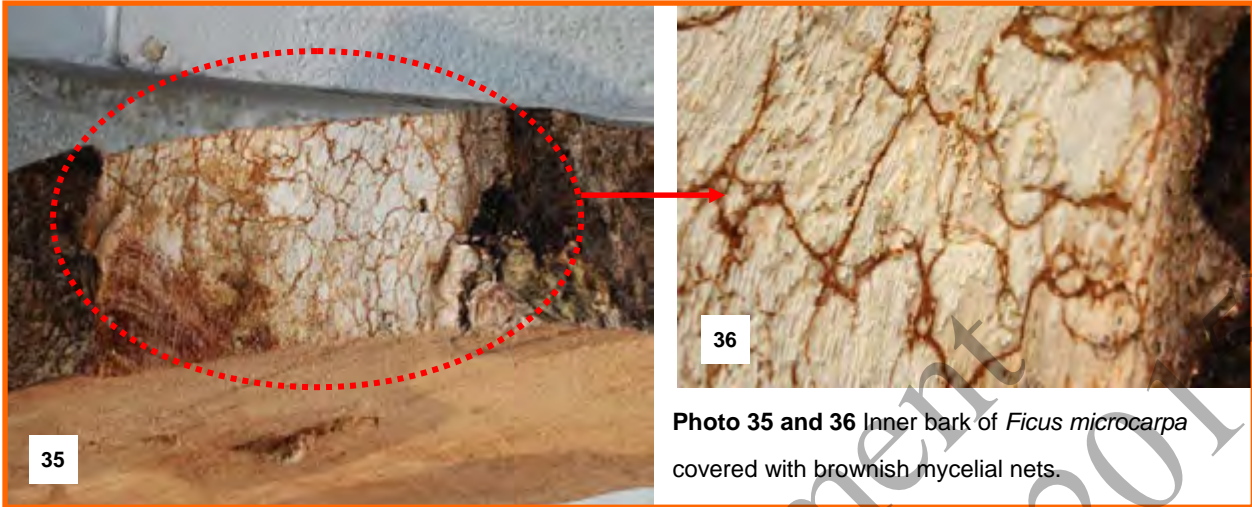


Example of Non-*Phellinus noxius* **Photo 26** Algal growth on root collar of *Ficus microcarpa* (dark green to dark brown in appearance).

D. Soil aggregates of *Phellinus noxius* infected trees: A layer of adhering soil particles and fungal mycelia. The outer bark surface appears rough.



E. Mycelial nets of *Phellinus noxius* infected trees: Ectotrophic mycelium (brownish or black lines) located between the bark and sapwood



Annex II

Frequently asked questions on Brown Root Rot Disease

Biological Background:

Q1. What is *Phellinus noxius*?

A1. *Phellinus noxius* is a fungus that causes BRR disease on trees. Belonging to the genus *Phellinus*, *P. noxius* is placed under the family of Hymenochaetaceae within the Phylum Basidiomycota. Most of the species within the genus *Phellinus* act as saprotrophs in nature or as weak pathogens on trees. Only very few species are pathogenic with strong virulence, and *P. noxius* is one of the strongest among them. It prefers acidic, hot and humid conditions. It is characterised by its brownish black fruiting bodies (which will turn black with a drop of 3-5% KOH) with no clamp connections in its vegetative hyphae. The species within *Phellinus* are the typical white rotters, which can release enzymes through the action of microhyphae and decompose lignin and polysaccharides such as cellulose, hemicellulose and pectic substance, resulting in wood decay. *Phellinus noxius* causes white simultaneous rot in which the major components of wood (i.e. cellulose, hemicellulose and lignin) degrade at approximately the same rate.

Q2. What is the host range of *Phellinus noxius*?

A2. It has been reported that over 200 plant species in 59 families are hosts to *Phellinus noxius*. In Hong Kong, we know that trees species such as *Aleurites moluccana*, *Bombax ceiba*, *Celtis sinensis*, *Delonix regia*, *Ficus microcarpa*, *Ficus benjamina*, *Gleditsia fera*, *Lophostemon confertus*, and *Mangifera indica* are host to BRR disease.

Q3. What are the potential infection routes of BRR disease in tree?

A3. The disease mainly spreads through root-to-root contact or through infested wood debris in soil, though there may be the possibility of spreading of the disease through the dissemination of basidiospores from fruiting bodies. According to literature, mature fruiting bodies of *Phellinus noxius* seldom form in nature, though their basidiospores may assist in the long range dissemination of the fungus. In Hong Kong, there were observations that fruiting bodies of *Phellinus noxius* produced massive basidiospores on infected trees. The prevalence of the fruiting bodies in this region remains unknown. **The potential infection route of BRR disease in trees is shown**

in diagram 1.

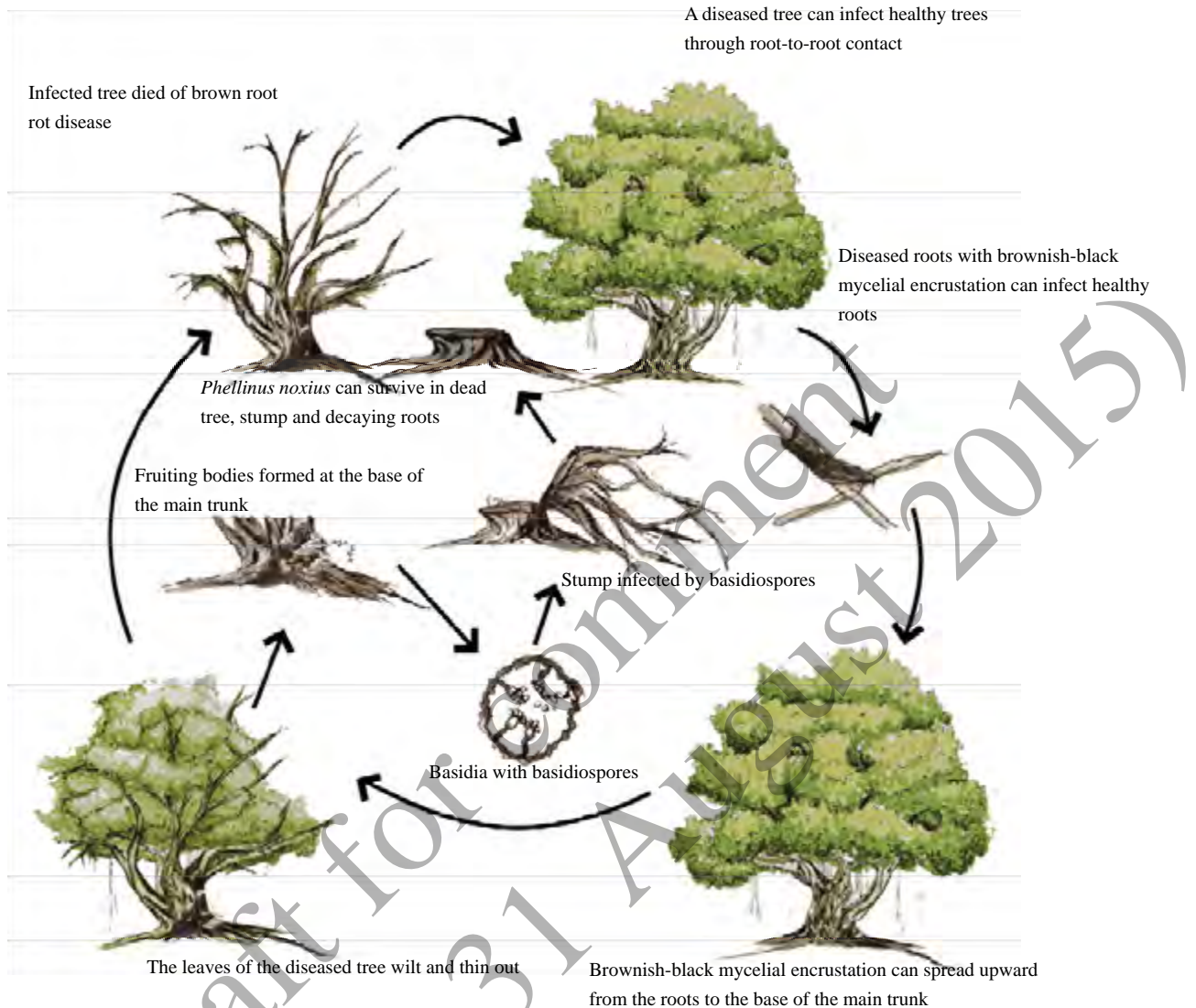


Diagram 1. The potential infection routes of brown root rot disease in trees (Based on Brooks, F.E, 2002. Brown root rot. The Plant Health Instructor).

Q4. What are the geographical ranges of BRR disease?

A4. The disease is prevalent in tropical and subtropical regions in different part of the world and has been found in Asian countries & regions such as Japan, Mainland China, Hong Kong, Taiwan, Malaysia, Singapore as well as Central America, Africa and Oceania.

Q5. Is there an effective cure to BRR disease?

A5. According to literatures and expert opinion, there is yet to be an effective cure for BRR disease.

Diagnostic Methods:

Q6. What are the methods available for diagnosis of BRR disease on trees?

A6. There are currently two main levels of diagnostic methods available for determination of BRR disease in trees, namely **field diagnosis through visual tree assessment** and **laboratory diagnosis through fungal isolation method and/or molecular diagnosis**.

Q7. How is BRR disease detected through field diagnosis?

A7. Field diagnosis through visual tree assessment is based on observable symptoms and signs of BRR. There are two steps. Step 1: Identify abnormal crown symptoms (e.g. sparse foliage density, abnormal foliage colour (chlorosis), abnormal leaf size, dieback twigs) as these are exhibited in infected trees. Step 2: examine the entire lower trunk, root collar and individual roots of the trees to look for typical signs of BRR disease, i.e. a) fruiting bodies of *Phellinus noxius*, b) mycelial encrustation, c) soil aggregates and d) mycelial nets. If a tree with a crown abnormality contains one or more of the typical signs of BRR disease under step 2 examination, the tree is considered infected with BRR disease.

Q8. What crown symptoms are observed on trees with BRR disease?

A8. Symptoms of the disease are of two types, namely slow decline and rapid decline. For trees experiencing slow decline, the most noticeable symptoms may include crown thinning out gradually and turning yellowish and their leaves reduced in size or even dropped as a result of early senescence. The trees could be dead in months or one to two years and structurally become unstable. Trees suffering from quick decline will wilt rapidly. Their leaves become brownish in color and the trees will die within weeks. The leaves of the dead trees will not fall immediately but remain attached on the branches for months. **Please refer to section A of Annex I in pictorial guide for general symptom of trees infected with BRR disease.**

Q9. Are the general symptoms observed on tree crown unique to BRR disease?

A9. No, the abnormal crown symptoms are commonly associated with root diseases and malfunctions, and are not unique to BRR disease. Thus, it is important to further examine the lower trunk, root collar and roots for typical signs of BRR disease.

Q10. Elaborate on the typical signs of BRR disease to look for at the lower trunk, root collar and individual roots of the trees.

A10. The typical signs of BRR disease are a) fruiting bodies of *Phellinus noxius*, b) mycelial encrustation, c) soil aggregates and d) mycelial nets.

(a) The appearance, on lower trunk or roots, of brownish-black/dark greyish-brown colored imbricate or resupinate fruiting bodies of *Phellinus noxius* with their characteristic porous hymenium surface up-facing is an obvious sign of BRR infection. The sizes of fruiting bodies vary greatly ranging from 3-10 cm in length to 8-20 cm in width. The fruiting bodies of *Phellinus noxius* are the sexual stage of the fungal lifecycle and their development, under the right conditions, begin with the formation of the primordial stage. The developing fruiting bodies would continue to grow in size, reach a stage of maturity in bracket and/or resupinate forms from which basidiospores are formed for dissemination, and end at senescence. There are occasions where the developing fruiting bodies become abortive and reach premature senescence without forming basidiospores. **Please refer to section B of Annex I in the Pictorial Guide for fruiting bodies of *Phellinus noxius* on infected trees.**

(b) If the mycelia of *Phellinus noxius* are spreading under the bark, or under the outer layer of roots, these parts can peel off easily. The diseased parts look rough with flaky appearance on their surfaces covered by a brownish-black mycelial encrustation. Normally, the mycelial encrustation can extend from the root collar to 1 m high on the tree trunk. There are also reported cases from the literature that mycelial encrustation can reach 2-3 m in height. **Please refer to section C of Annex I in the Pictorial Guide for mycelial encrustation.**

(c) and (d) If fruiting bodies of *Phellinus noxius* and mycelial encrustation cannot be found, the bark of the entire lower trunk/root collar and the outer layer of all the roots of the suspected diseased tree should be examined. If necessary, cut open with appropriate tools (e.g. handheld adze, knife, etc.) upon soil

excavation to check for soil aggregates and yellow, dark brown or brownish-black mycelial netting on the inner surface between the bark and the wood tissues. **Please refer to sections D and E of Annex I in Pictorial Guide for soil aggregates and mycelial nets.**

Q11. Are tools required in checking the lower trunk, root collar and individual roots of trees?

A11. Yes, root excavation with appropriate tools (e.g. handheld adze, digger, air spade, etc.) may be required to expose the root collar and roots. The exposed root collar and roots could subsequently be examined for the typical signs of BRR disease. Scraping off of bark tissue should only be conducted on decayed, damaged or dead wood/roots. Mallets may be used to differentiate healthy wood/roots from decayed, damaged or dead wood/roots. Damage to healthy wood/roots should be avoided as this may cause unnecessary damage to the tree, which may also create open wound for fungal invasion.

Q12. Is it difficult to diagnose BRR disease on trees in early stage of infection?

A12. Yes, early diagnostic symptoms of BRR disease are often difficult to detect, despite the fact that the disease can cause a rapid decline in tree growth conditions within a short time. More often than not, obvious symptoms will only be visible at a late stage of infection. Once symptoms such as abnormal crown symptoms (e.g. sparse foliage density, abnormal foliage colour (chlorosis), abnormal leaf size, dieback twigs are discernible in the above ground portion of the tree, the majority of its roots are likely to have been infected and the tree basically cannot be cured.

Q13. Under what circumstances are laboratory diagnosis used in BRR detection?

A13. Laboratory diagnosis would be required to confirm disease status of trees exhibiting no detectable symptoms and signs of BRR disease (i.e. trees in the root zone area of another tree infected with BRR). Laboratory diagnosis would also serve as a tool to verify the findings of field diagnosis on trees of special significance (i.e. Old and Valuable Trees).

Management Strategy of BRR Disease

Q14. What are the management strategies of BRR disease in Hong Kong?

A14. We adopt a dual-pronged management strategy comprising precautionary and preventive measures. The objectives of this approach are to keep our trees healthy, and at the same time to minimize the source of BRR inoculum as far as possible.

Q15. What are the precautionary measures for BRR disease management?

A15. Proper tree planting and maintenance practices are the best precaution one can take against BRR disease. These practices include planting the right tree at the right place, providing sufficient growing space, planting at the right depth, proper irrigation and fertilization regimes, and mulching of root zone, not to mention regular and proper pruning. In particular, number and size of pruning wounds as well as damage to the roots should be kept to a minimum. This reduces the surface area where infection may start off.

Q16. What are the preventive measures for BRR disease management?

A16. Preventive measures are necessary to minimize the source of BRR inoculum and control the spread of the BRR through removal of diseased parts. Trees in the Category I of Tree Risk Management Zone (i.e. areas of high traffic flow and high pedestrian flow such as public parks, playgrounds, roadside etc) infected with BRR disease should be removed entirely, including fruiting bodies, stumps, wood debris and associated fine roots in soil medium.

Q17. How are trees of special value and significance infected by BRR disease treated?

A17. There are occasions where preservation of a tree warrants retention (e.g. Old and Valuable Trees or trees that draw strong public sentiment for preservation). In these circumstances, the structural stability of the infected tree should be ascertained by conducting a thorough tree risk assessment, followed by soil excavation with proper tools (e.g. adze, digger or air spade, if applicable) to examine the extent of the infection and decay at critical locations, such as at the root collar and subsoil surface levels. The use of advanced examination techniques such as tomography and resistography will offer additional information about the extent of internal decay at

the root collar and sub-soil levels. Trees that are structurally unstable should be cordoned off and removed as soon as possible. Trees that are justified for retention from a structural stand point should be closely monitored on a quarterly basis to re-assess their structural integrity/stability.

Q18. How the stability of trees infected with BRR disease may be ascertained?

A18. Since BRR disease causes root rot at the lower trunk above grade level (e.g. it could be observed up to 2 m in some tree species) and/or root collar and/or roots at the sub-soil level, it is essential to evaluate the thickness of sound wood of the tree at horizontal plane at critical levels (i.e. area showing decay and/or specific signs/symptoms of BRR disease) of the lower trunk, as well as at the trunk base, through the use of tomography and/or resistography. For sub-soil level evaluation, the trunk base or even at lower levels (e.g. after soil excavation using spade and/or air spade without affecting tree stability) could be assessed using resistography drilling at an angle (45 degree) downwards which could provide some indication on the relative soundness of tree roots.

Q19. What is the effectiveness of chemical control on BRR infected trees?

A19. Treatment through chemical means is only an interim measure. It will not revitalize a tree or improve its structural stability. Interim measures may include applying fungicides to trees at the early stage of BRR infection showing no foliage abnormality or major symptoms of BRR.

Removal Procedures of BRR Infected Trees

Q20. Is the installation of trench recommended to prevent spread of BRR disease to neighboring trees?

A20. Yes, this is because root to root contact is still the main route of transmission of BRR disease. It is important to prevent the spread of the disease through digging of a trench ideally of 1 m depth by 1 m width at the dripline of an infected tree, followed by application of a root barrier to separate it from healthy ones. Such application, however, may not be feasible for trees with restricted root zone such as trees on planter or trees grown on slopes.

Q21. Will annuals and shrubs be carriers of BRR disease?

A21. Yes, annuals and shrubs may be carriers of BRR disease. As such, it is advisable to avoid planting such vegetation near the root zone, particularly under Old and Valuable Trees or mature trees in confined, restricted or graded areas. This is to minimize the inoculum of BRR disease. Please also refer to “Proper planting Practice-Keep Sufficient Space Clear of Vegetation at the base of Tree” available at www.greening.gov.hk

Q22. Is the removal of fruiting bodies of *Phellinus noxius* an effective way to prevent the spread of the disease?

A22. While fruiting bodies of *Phellinus noxius* should be removed and properly disposed of as soon as possible, they are the sexual stage of fungi and their removal can only prevent the dissemination of basidiospores, but could not remove the mycelia that are present in the infected trees.

Q23. How should the soil medium containing the infected debris be handled?

A23. Depending on the amount of soil that needs to be handled, the soil medium could either be disposed of at landfills or disinfected with a soil fumigant on-site. For instance, if a manageable amount of soil could be replaced (i.e. in a planting strip or confined planter), the contaminated soil should be disposed of at landfills.

Q24. Do we need to sterilise the tools after examining trees with BRR disease?

A24. Yes, tools like adze, knives, scissors, shovels etc. and transportation equipment (such as hopper car etc.) used in the infected area should be disinfected (e.g. with 70% ethanol or 1:49 bleach) after operation.

**Note on Common Wood Decay Fungi on
Urban Trees of Hong Kong**

**Greening, Landscape and Tree Management Section
Development Bureau
The Government of the Hong Kong Special Administrative Region**

May 2015

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1. INTRODUCTION

Wood decay is predominantly driven by wood decay fungi that possess a whole array of enzymes for impairing the structural strength and physiological function of living trees. In this regard, the Tree Management Office (TMO) has produced and compiled this note (with photographic illustrations) on 12 common wood decay fungi that occur on the urban trees of Hong Kong. Detailed information about the individual fungal species is based on a previous consultancy study commissioned by the TMO on the “Occurrence and Distribution of Common Wood Decay Fungi on Trees of Hong Kong” undertaken by the University of Hong Kong from late 2011 to early 2014. The study involved a territory-wide baseline survey in some of the populated areas of Hong Kong and collected information on the distribution and occurrences of local wood decay (saprotrophic and pathogenic) fungi. This study is also aimed to enhance our understanding of the arboricultural significance of certain fungal decay on urban trees.

Any further enquiries on this note or related issues should be directed to:

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2. PURPOSE OF THIS NOTE

This note aims to provide the government departments and other arboricultural practitioners a quick and illustrative reference for the identification of common wood decay fungi associated with living trees to facilitate early identification of problems during the Tree Risk Assessment* process and/or other routine tree inspection.

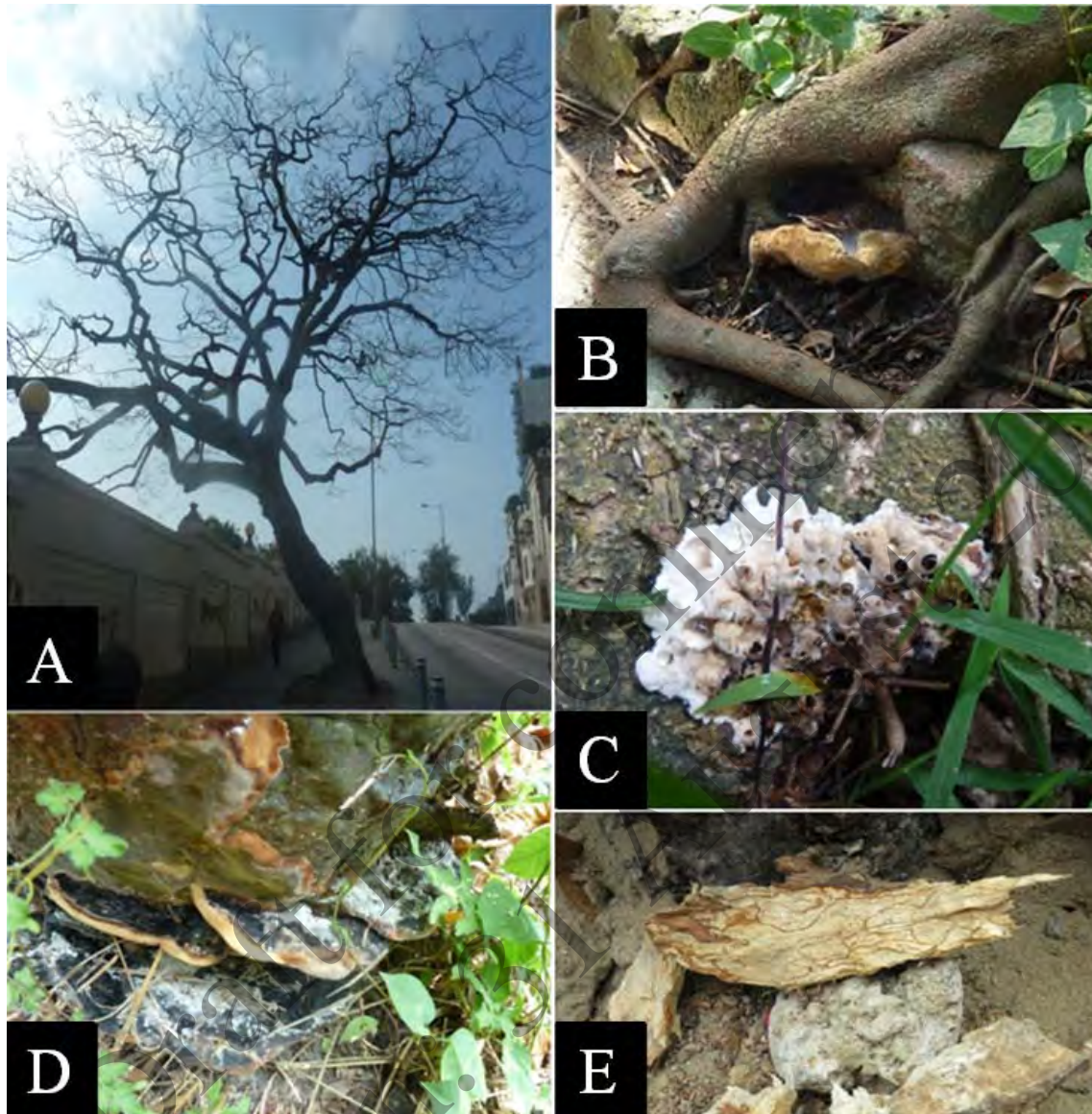
To facilitate users' application of this note, the 12 wood decay fungi have been categorised in terms of their arboricultural significance particularly the potential risks of tree failure that they may cause. Four risk categories, each of which has been assigned a specific colour code (RED, ORANGE, YELLOW or GREEN in descending order of risk) have been established taking into account the information about their pathogenicity, virulence, local occurrence, impact arising from their infection on the prognosis of the health and stability of the infected trees. Recommendations on the management of trees infected with each species are also provided. As a general rule, trees infected with wood decay fungi in the RED category should be urgently attended to while those in the GREEN category could be kept under monitoring in view of their limited impact to the trees but their presence indicate the presence of dead/decaying wood.

Nevertheless, it should be borne in mind that the presence of particular wood decay fungi is only one of the many factors that have to be considered when evaluating the potential risk of tree failure in the urban settings. Other factors that may affect the health/structural conditions of the trees under inspection should also be taken into account when formulating mitigation measures.

* Please refer to the 'Guidelines for Tree Risk Assessment and Management Arrangement on an Area Basis and on a Tree Basis' issued by the Greening, Landscape and Tree Management Section, Development Bureau, available at www.trees.gov.hk.

3. COMMON WOOD DECAY FUNGI

*Phellinus noxius*¹



(A) *Delonix regia* infected by *Phellinus noxius* resulting in abnormal defoliation. (B) Mature fruiting body of *P. noxius* on the root of a *Ficus microcarpa*. (C) Primordial stage fruiting bodies of *P. noxius* on *Celtis sinensis* (with white margin and droplets of exudates). (D) Mature fruiting bodies of *P. noxius* on a dead tree stump. (E) Mycelial nets on dead stump of *Aleurites moluccana*.

¹ *Phellinus noxius* (Corner) G. Cunn., Bulletin of the New Zealand Department of Industrial Research 164: 221 (1965).

FRUITING BODY

Mature fruiting bodies perennial, usually from about 3 × 4 cm to 10 × 20 cm up to 40 × 75 cm, mostly solitary, sessile; pilei appanate, dimidiate or appressed-reflexed, surface dark brown to almost black, glabrous, and narrowly but irregularly zonate, margin white then concolourous, obtuse; pore surface grayish brown to brown, irregular, polygonal, tubes in one to four layers, 1-3 mm long, similar in colour to the pore surface, tubes contrasted sharply with the deep chocolate brown of the context; spores 3-3.5 μm × 3.5-4.5 μm, broadly ellipsoid, smooth, thick-walled, hyaline.

DISTRIBUTION AND HOST RANGE

This fungus is prevalent in tropical and subtropical regions in different parts of the world and has been found in Asian countries and areas such as Japan, China, Hong Kong Special Administrative Region (SAR), Macau SAR, Taiwan, Malaysia, Singapore as well as Central America, Africa and Oceania.

Over 200 plant species in 59 families are known hosts to *P. noxius* worldwide. Locally, host trees species include *Acacia confusa*, *Aleurities moluccana*, *Bauhinia* spp., *Bombax ceiba*, *Celtis sinensis*, *Delonix regia*, *Ficus microcarpa*, *Ficus benjamina*, *Ficus elastica*, *Gleditsia fera*, and *Melia azedarach* etc. that grow on artificially created or disturbed sites along roadsides, on artificial slopes and in parks.

SIGNS AND SYMPTOMS.

This fungus causes the Brown Root Rot (BRR) disease on trees. Infected trees would become structurally unstable and symptoms of the disease may emerge progressively through gradual thinning out of the crown, yellowing of the leaves, reduction in leaf size or shedding of leaves as a result of impaired water transportation function of the vascular system. Infected trees could die in a few months' time but may survive another one to two years. Some infected trees would suffer quick decline in conditions and wilt rapidly. Their leaves would turn brown in colour and the trees could die within weeks, with wilted leaves of the dead trees remaining attached on the branches for months. The typical signs of BRR disease include fruiting bodies (i.e. primordial/mature stages), mycelial encrustation, soil aggregates and mycelial nets.

PATHOLOGY

P. noxius is a pathogenic fungus with strong virulence causing a white simultaneous rot usually on the roots and root collars of infected trees but could occasionally be observed on locations higher up on trees. Wounds are not a prerequisite for infection for this fungus as it can actively infect living trees. Infection could be by means of root to root contact and by dissemination of basidiospores from mature fruiting bodies.

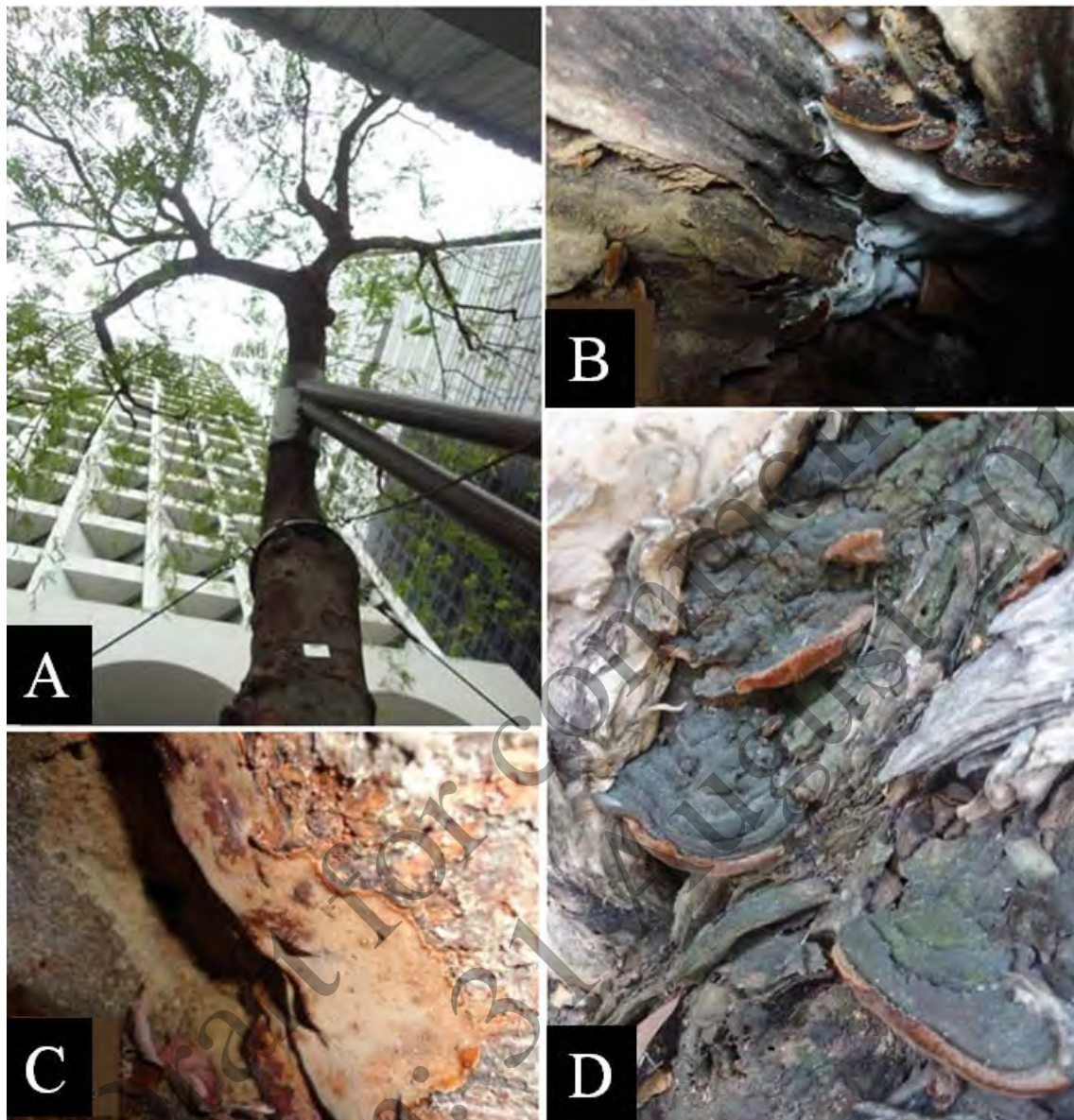
MANAGEMENT AND CONTROL

Risk category: High (RED)

Since this fungus could severely impact on the health and structural stability of the infected trees and there is currently no direct remedy for the BRR disease, removal of infected trees remains the most effective means to mitigate risk and control the spread of disease. Besides tree removal, all precautionary measures should be undertaken to prevent the spread of the disease to other healthy trees.

The 'Guidelines on Brown Root Rot Disease' issued by the Tree Management Office provides comprehensive information on the BRR disease and its management strategy, which is available at www.trees.gov.hk.

*Fuscoporia senex*²



(A) A *Cassia javanica* var. *indochinensis* colonised by *Fuscoporia senex*. (B) The fruiting bodies of *F. senex* in the cavity of *Sophora japonica*. (C) The fruiting bodies of *F. senex* located in the stem cavity of *Syzygium samarangense*. (D) The fruiting bodies of *F. senex* located on the stem cavity of *Melaleuca cajuputi* subsp. *cumingiana*.

² *Fuscoporia senex* (Nees & Mont.) Ghobad-Nejhad, *Mycotaxon* 101: 208 (2007). Index Fungorum and Mycobank as the two main fungal depositories hold different views on the taxonomy of this fungus. The former uses *Fuscoporia senex* as the current name while the latter uses *Phellinus senex*. *Fuscoporia senex* is adopted as the current name in this note.

FRUITING BODY

Fruiting bodies perennial, up to 3.5 × 8.5 cm and 2 cm thick, solitary, broadly attached to substrate, semicircular, convex, consistency coriaceous to woody hard; pilei surface first fulvous then brown to raw umber, finely velvety tomentose, narrow concentric sulcate zones with stiff, erect hairs, margin 1 mm thick, paler, obtuse, entire, context fibrous, glossy, dark blond to golden brown, a darker line above the tubes, 2 mm thick; pore surface fulvous then brownish grey, pores round and small, 10-11 per mm, layers up to 6 mm thick, margin sterile, fulvous; spores 4-6 × 3-4 μm, broadly ellipsoid, smooth, hyaline.

DISTRIBUTION AND HOST RANGE

Host trees recorded locally include *Albizia lebbek*, *Cassia javanica* var. *indochinensis*, *Melaleuca cajuputi* subsp. *cumingiana* and *Syzygium samarangense*.

SIGNS AND SYMPTOMS

There is not much information on the mode of infection for this species. Nevertheless, it is mostly observed on wounds and basal cavities on main trunks. Once entered through wounds, it may cause localised decay at first and move on to colonisation of deadwood. The presence of fruiting bodies on tree host is an obvious sign of advanced infection by this fungus. The infected trees may show non-specific symptoms such as crown defoliation, cavities and cracks at the advanced stage of infection.

PATHOLOGY

This fungus has a pantropical distribution range, including its presence in China. It could grow as a saprotrophic fungus on deadwood but could also act as a wound parasite causing white stringy rot in the heartwood of standing trees, particularly on stressed hosts.

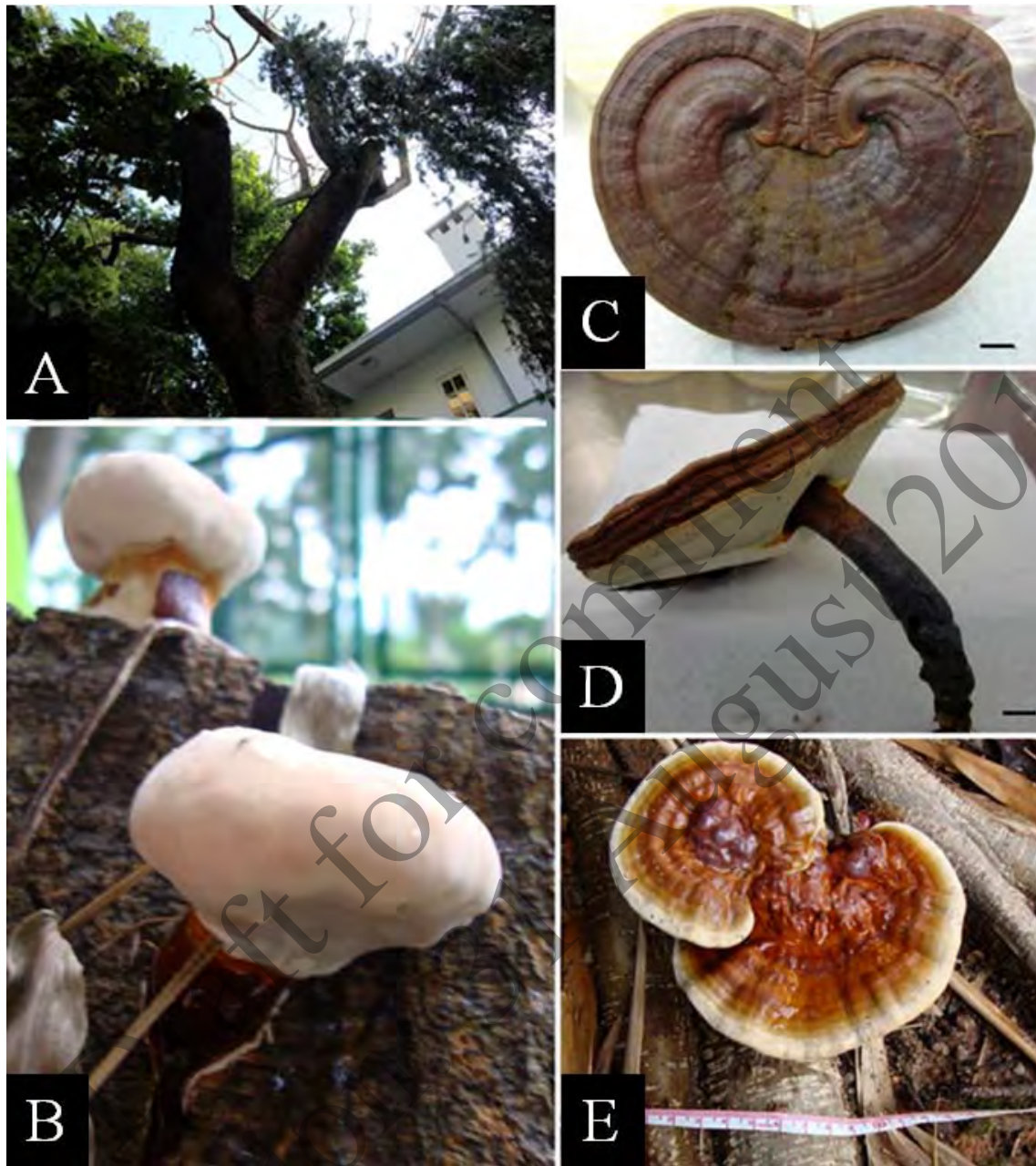
MANAGEMENT AND CONTROL

Risk category: Moderate (ORANGE)

As this fungus is mainly associated with wounds and cavities of the main trunks and some structural branches, trees infected with this fungus should be monitored on a regular basis. Fruiting bodies of this fungus observed on trees should be removed to minimise the building-up of fungal inoculum. Fungicides may still be used as an interim measure for trees exhibiting early or advanced stage of infection, though the treatment may not be effective to hamper the onset of the disease. As wounds may serve as entry court for this fungus, trees should be avoided and minimised from injury arisen from large area pruning cut/mechanical damages as far as possible. At the advanced stage of infection in which the structural integrity of the trees is undermined and could not be mitigated through pruning and/or installation of props/wires, removal of structural limbs concerned and/or whole tree should be considered.

Draft for comment
Version: 31 August 2015

Ganoderma lucidum (broad sense)³



(A) *Albizia lebbek* infected by *G. lucidum*. (B) Immature fruit-bodies of *G. lucidum* on a wood stump. (C) A mature fruit-body of *G. lucidum*. Scale bars of C and D = 1cm. (D) Side-view of a fruit-body of *G. lucidum*. (E) Fruiting bodies of *G. lucidum* on a root of *Ficus microcarpa*.

³ *Ganoderma lucidum* (Curtis) P. Karst., *Revue Mycologique Toulouse* 3 (9): 17 (1881). Please note that *Ganoderma lucidum sensu lato* (broad sense) covers the species *Ganoderma lucidum* and *Ganoderma tropicum* within this complex that are commonly found in Hong Kong and could only be authenticated through micro-morphology, cultural characteristics and phylogenetic analysis.

FRUITING BODY

Fruiting bodies 2 × 4 cm to 4 × 8 cm in size and 1 cm to 3 cm in thickness; pilei reniform, flat, spongy, corky or woody when aged, yellowish-brown to red brown in colour, with a white margin, lacquer-like luster, striate, young or fresh fruiting bodies occasionally appeared as chunks of white mycelia-like masses on the stalks; stipes 7-15 cm long, 1-2.5 cm thick, lateral; pore surface white, with yellow patches sometimes, blood red to purple red when touched, pores round 5-6 per mm; spores 9-12 × 4.5-7.5 µm, oval, brown.

DISTRIBUTION AND HOST RANGE

Ganoderma lucidum sensu lato (broad sense) infects broadleaved trees. Locally it is commonly found on *Acacia confusa* and *Ficus microcarpa*.

SIGNS AND SYMPTOMS

Ganoderma lucidum sensu lato (broad sense) is mainly associated with roots and root collar regions. Occasionally the lower trunks would also be affected. At the early stage of infection, no obvious abnormality could be observed in the tree crown, although fruiting bodies of the fungus may be present. As the infection continues, crown abnormality (e.g. sparse foliage density, small leaf size, discolouration on leave, etc.) become obvious along with profuse formation of annual fruiting bodies on roots, root collar and lower trunk of the infected tree. Fruiting bodies are easily observable during wet season and withered, discoloured ones could also be observed in the dry season. At the time of sporulation, brownish yellow powdery spores could sometimes be found near the fruiting bodies.

PATHOLOGY

It is a pathogenic fungus causing white rot decay on trunks and roots, which can lead to tree death in a few years after infection, in particular, if the trees have been under stress.

MANAGEMENT AND CONTROL

Risk category: Moderate (ORANGE)

Since this fungus could adversely affect tree health and structural stability, infected trees should be put under regular monitoring. Fruiting bodies of this fungus observed on trees should be removed to minimise the risk of building up of fungal inoculum and infecting adjacent trees. Fungicides may still be used as an interim measure for trees exhibiting early or advanced stage of infection, though the treatment may not be effective to hamper the onset of the disease. At the advanced stage of infection in which the structural integrity of the trees is undermined and could not be mitigated through installation of props and wires, removal of structural limbs and/or whole tree should be considered.

Draft for comment
(Version: 31 August 2015)

*Ganoderma applanatum*⁴



(A), (B) and (C) Mature fruiting body of *Ganoderma applanatum* at the trunk.

⁴ *Ganoderma applanatum* (Pers.) Pat., Bulletin de la Société Mycologique de France 5: 67 (1889).

FRUITING BODY

Fruiting bodies perennial, 10-20 cm × 5-15 cm and 1.5-12 cm thick; pilei broadly rounded, hoof-shaped or irregularly shaped bracket, flat and directly attached to the substrate in clusters and tiers, cork-like to woody, grey turning into brown, upper surface forming an uneven crust, with ridges and concentrated furrows, covered by a thick chocolate brown to copper coloured layer of spore powder up to 1 mm thick, fresh fruiting bodies with white margin and slightly rounded, stalkless; pore surface white but becoming brown when damaged or with age, pores 4-5 per mm; spores 7.5-10 µm × 4.5-6.4 µm, oval, brown or yellowish brown.

DISTRIBUTION AND HOST RANGE

This fungus has a worldwide distribution and locally it could be found on broadleaved trees such as *Acacia confusa*, *Ficus microcarpa*, *Hibiscus tiliaceus* and *Sapium sebiferum*. Occasionally found on coniferous trees.

SIGNS AND SYMPTOMS

This fungus is mainly associated with roots and root collar of tree trunks, particularly on trees with obvious open wound and/or root damages. Trees with early stage of fungal infection by this fungus may experience stunted growth and non-specific symptoms on the crown such as defoliation and abnormal leaf size and colour. As the infection advances over time, crown symptoms may get worsen and accompanied by bark loosening at the infection zone.

Perennial fruiting bodies are often observed at the advanced stage of infection during which the fungus may have already been well-established by spreading vertically and radially along the trunk.

PATHOLOGY

This white rot fungus is known for its capacity in impacting the health and structural stability of trees in the urban environment. Some experts view it as a predominantly saprotrophic fungus with the ability to degrade deadwood while others consider it as a pathogenic wood decay fungus with strong virulence owing largely to its association with extensive internal decay. Nevertheless, the ability of this fungus in colonising the heartwood and sapwood of trees substantiates the pathogenic nature of this fungus.

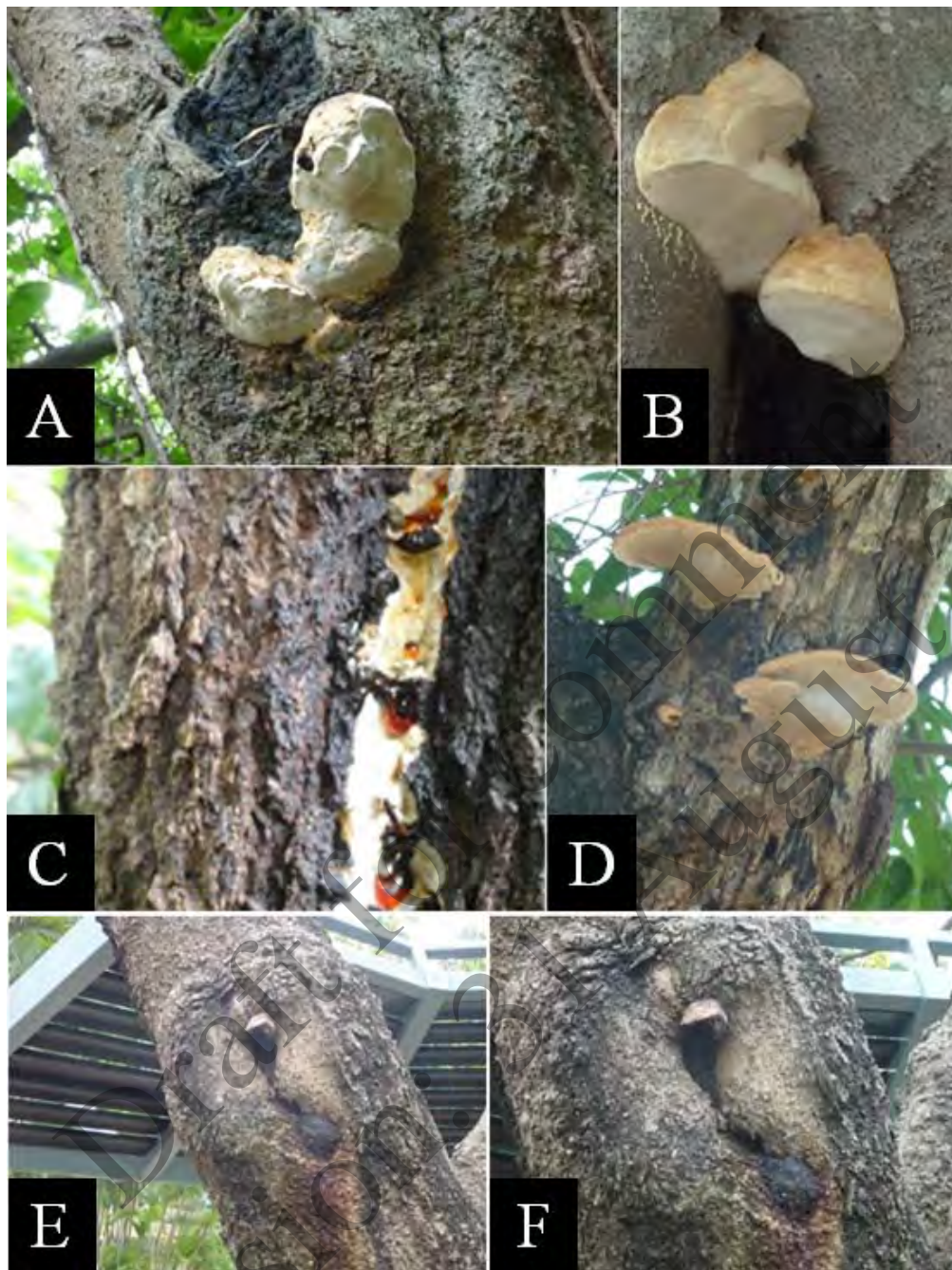
MANAGEMENT AND CONTROL

Risk category: Moderate (ORANGE)

Since this fungus could adversely affect tree health and structural stability, infected trees should be put under regular monitoring. As the disease may be disseminated through basidiospores, fruiting bodies observed should be removed to minimise the risk of building up of fungal inoculum in the infected trees. To reduce the chance of fungal infection, trees should be properly maintained and avoided from injury through pruning with large pruning wounds and/or large area mechanical damages. Fungicides may still be used as an interim measure for trees exhibiting early or advanced stage of infection, though the treatment may not be effective to hamper the onset of the disease. At the advanced stage of infection in which the structural integrity of the trees is undermined and could not be mitigated through installation of props and wires, removal of structural limbs and/or whole tree should be considered.

Draft for comment
Version: 31 August 2015

*Inonotus rickii*⁵



(A) Anamorph or asexual stage of *Inonotus rickii* (i.e. *Ptychogaster cubensis*) observed on the trunk of *Celtis sinensis*. (B) Anamorph of *I. rickii* (i.e. *P. cubensis*) near a canker of *Celtis sinensis*. (C) Immature fruiting bodies of *I. rickii* on a trunk. (D) Mature fruiting bodies of *I. rickii* on a decaying branch. (E) Senescent asexual fruiting bodies (*P. cubensis*) on a cavity of *Celtis sinensis*. (F) Close-up view of the senescent asexual fruiting bodies (*P. cubensis*).

⁵ *Inonotus rickii* (Pat.) D.A. Reid, Kew Bulletin 12 (1): 141 (1957).

FRUITING BODY

Sexual stage: fruiting bodies annual, up to 45 cm wide and 10 cm thick, sessile, attached to the substrate widely and firmly; pilei appanate to unguates, single to imbricate, at first soft and fleshy and then becoming firm, margin acute or obtuse, entire, undulate, upper surface golden brown and tomentose in younger parts, oldest parts dark rusty brown and rough, becoming rimose; pore surface pale brown, round to angular, 2-4 per mm; spores 6-8.5-(9) $\mu\text{m} \times 4.5-5.5 \mu\text{m}$, broadly ellipsoidal, thick-walled, golden yellow.

Asexual stage: asexual fruiting bodies (i.e. anamorph of *Inonotus rickii*, also named as *Ptychogaster cubensis*) semi-spherical or cushion shaped-like mass, soft and fleshy at first, velvety to the touch, yellowish brown to golden brown without the hymenial layer; becoming dark brownish and brittle, crumbling with the inner parts totally disintegrating to a mass of chlamydospores (i.e. thick-walled resting spores) when aged.

DISTRIBUTION AND HOST RANGE

This fungus has a worldwide distribution extending from tropical to temperate regions affecting trees in both the rural and urban settings. Locally, this fungus is found on broadleaved trees such as *Celtis sinensis*, *Cinnamomum camphora* and *Sapindus saponaria* along roadsides, on slopes and in parks.

SIGNS AND SYMPTOMS.

As wounds serve as entry courts for this fungus, fruiting bodies are often found associated with pruning wounds and cankers on branches and main trunks. Most often, the semi-spherical/cushion shaped-like mass asexual fruiting bodies instead of the sexual fruiting bodies are observed emerging from branch stubs, pruning wounds, and cankers of the infected trees during rainy seasons. Later at the dry seasons as the asexual fruiting bodies age, they often turn dark-brownish and become senescent.

Similar to most wood decay fungi, early stage of fungal infection is not easily detected. As the infection progresses, the crown may exhibit non-specific symptoms such as defoliation, dieback and chlorosis. After establishment, the fungus starts causing localised decay and spread vertically and horizontally and cause internal decay. At the advanced stage after years of infection, crown dieback associated with structural weakness may eventually be experienced on the infected trees.

PATHOLOGY

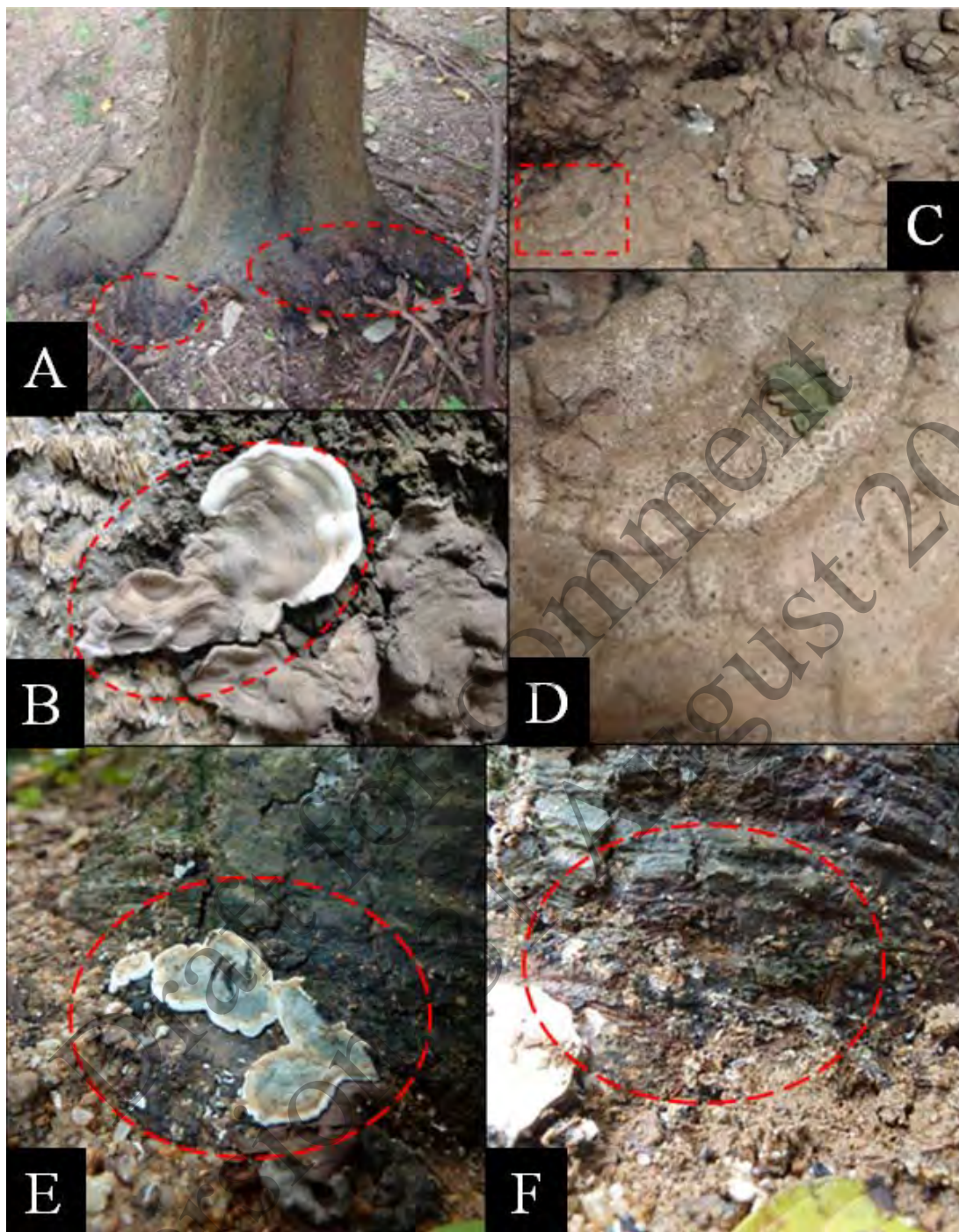
This white rot fungus is a well-documented canker causing pathogen with moderate virulence in Europe. It is able to cause decay on heartwood as well as sapwood and cambium on branches and trunks of trees resulting in eventual tree decline and mortality.

MANAGEMENT AND CONTROL

Risk category: Moderate (**ORANGE**)

Since this fungus would adversely affect tree health and structural stability, infected trees should be put under regular monitoring. Fruiting bodies of sexual stage (*Inonotus rickii*) and their asexual anamorphs (*Ptychogaster cubensis*) observed should be removed to minimise the building of fungal inoculum. Fungicides may still be used as an interim measure for trees exhibiting early or advanced stage of infection, though the treatment may not be effective to hamper the onset of the disease. To reduce the potential damage of this fungus, trees should be minimised from injury arisen from large area pruning cut/mechanical damages. At the advanced stage of infection in which the structural integrity of the trees is undermined and could not be mitigated through pruning/installation of props and wires, removal of structural limbs and/or whole tree should be considered.

*Kretzschmaria sandvicensis*⁶



(A) Fruiting bodies of *Kretzschmaria* sp. at a root collar of *Celtis sinensis*. (B) Primordial fruiting body of *K. sandvicensis* colonised on *C. sinensis*. (C) Mature fruiting bodies of *K. sandvicensis* colonised on *C. sinensis*. (D) Close-up of the mature fruiting body enlarged from C (the red square part). (E) Primordial fruiting body of *K. sandvicensis* colonised on *C. sinensis*. (F) Decaying tissue underneath the fruiting body in (E).

⁶ *Kretzschmaria sandvicensis* (Reichardt) J.D. Rogers & Y.M. Ju (1998).

FRUITING BODY

Stromata 1.5-7 cm in diameter, 2-3 mm thick, separated, aggregated or fused, attached to substrate with narrow connectives, with crenate margins, surface brown-coppery to dark brown, with reticulate cracks, immediately beneath surface carbonaceous, tissue between and beneath perithecia brown to dark brown; perithecia 1.3-1.8 mm high, 0.6-1.5 mm wide, globose to obovoid; ostioles papillate to finely papillate; asci 7-9 μm \times 3-4.5 μm , with apical ring bluing in Melzer's iodine reagent, urn-shaped; ascospores 33-43 μm \times 8-11 μm , unicellular, dark brown, fusiform to ellipsoid, inequilateral, smooth, germ slit straight, slightly less than or nearly equaling spore length.

DISTRIBUTION AND HOST RANGE

Kretzschmaria species have a worldwide distribution with *K. sandvicensis* occurring in the tropics. Locally, *K. sandvicensis* is found on *Celtis sinensis* and *Ficus microcarpa* along roadsides and in parks.

SIGNS AND SYMPTOMS

K. sandvicensis is found associated with roots and tree collar region of infected trees. Obvious symptoms may not be easily discerned on infected tree as infection is a slow process. During the advanced stage of infection, non-specific symptoms such as crown defoliation and cankers on lower trunk may be observed on infected trees. Both the primordial grayish leathery white margins fruiting bodies and the mature carbonaceous lumpy fruiting bodies (i.e. stromata), though inconspicuous, could be found on the roots and root collar regions of infected trees and served as readily available signs to confirm the presence of this fungus. Extensive decay of woody tissue could be observed underneath the locations where fruiting bodies are found.

PATHOLOGY

Kretzschmaria spp. cause soft and white rot decay on trees. This fungus could grow readily on woody substrata as a saprotrophic fungus but could act readily as a pathogenic fungus causing damages to sapwood and heartwood of living trees.

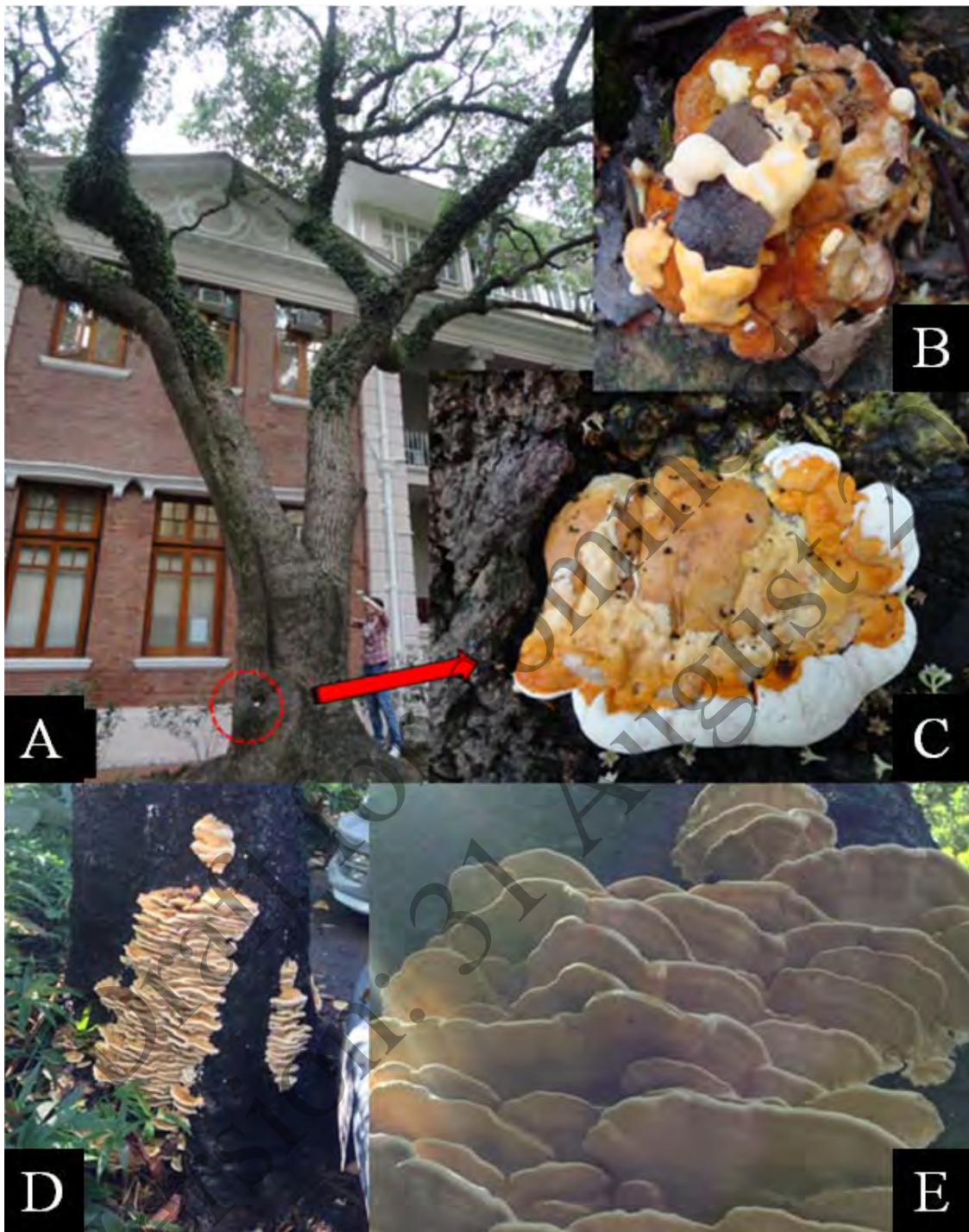
MANAGEMENT AND CONTROL

Risk category: Moderate (ORANGE)

Since this fungus would adversely affect tree health and structural stability, infected trees should be put under regular monitoring. As infection could be initiated through wounds, trees should be kept healthy and prevented from damages that would result in mechanical wounds of the lower trunk and the root systems. Fruiting bodies, if discernible and spotted should be removed to minimise the risk of building up of fungal inoculum and infecting adjacent trees. Fungicides may be used for trees exhibiting early or advanced stage of infection, though the treatment may not be effective to hamper the onset of the disease. At the advanced stage of infection in which the structural integrity of the trees is undermined and could not be mitigated through installation of props and wires, removal of structural limbs and/or whole tree should be considered.

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*Rigidoporus ulmarius*⁷



(A) *Cinnamomum camphora* infected with *Rigidoporus ulmarius*. (B) Fruiting bodies of *R. ulmarius*. (C) Close-up of the fruiting bodies of *R. ulmarius* in (A). (D) Clusters of fruiting bodies of *R. ulmarius*. (E) The under-side of the fruiting bodies of *R. ulmarius*.

⁷ *Rigidoporus ulmarius* (Sowerby) Imazeki, Bulletin of the Government Forest Experimental Station Meguro 57: 97 (1952).

FRUITING BODY

Fruiting bodies up to 30 cm across, thick; pilei semi-circular, flat, hoof-shaped or irregular, woody yet pliable, upper surface cream-coloured, usually with green algal growth in older specimens; pore surface red-orange, fading to buff or dull pink with age, tube layers cinnamon brown in contrast to the paler flesh, pores 5-6 per mm; spores 5-7 μm , round, smooth-walled, hyaline.

DISTRIBUTION AND HOST RANGE

This fungus is mainly found in the tropical and subtropical regions but has also been reported in the temperate region. Locally, it is found in broadleaved trees such as *Celtis sinensis* and *Delonix regia*.

SIGNS AND SYMPTOMS

This fungus is mainly associated with root collars and lower trunks of infected trees. Like most wood decay fungi, symptoms associated with inception decay at the early stage of fungal infection is not easily detected. As the decay advances during the late stage of infection, non-specific symptoms such as crown defoliation and internal decay may be experienced on the infected trees. Fruiting bodies of this fungus serve as readily observable signs which occur individually or in aggregated forms on trunks.

PATHOLOGY

This fungus is a pathogenic wood decay fungus with the ability to cause white rot decay on the root collars and lower trunks. Trees after years of infection by this fungus would start experiencing decline as the fungus could gradually disrupt the function of vascular system in the sapwood and degrade the heartwood.

MANAGEMENT AND CONTROL

Risk category: Moderate (ORANGE)

Since this fungus would adversely affect tree health and structural stability, infected trees should be put under regular monitoring. Avoidance of tree injury from pruning and mechanical damages could substantially reduce the chance of infection by this fungus as the main route of infection is from basidiospores. Fruiting bodies should be removed to minimise the risk of building up of fungal inoculum and infecting adjacent trees. Fungicides may be used for trees exhibiting early or advanced stage of infection, though the treatment may not be effective to hamper the onset of the disease. At the advanced stage of infection in which the structural integrity of the trees are undermined and could not be mitigated through pruning/installation of props and wires, removal of structural limbs and/or whole tree should be considered.

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Version: 31 August 2015

*Earliella scabrosa*⁸



(A) *Earliella scabrosa* on dead tree. (B) Young fruiting body of *E. scabrosa* on a dead tree. (C) and (D) Upper and underside of a mature fruiting body of *E. scabrosa* detached from on a fallen branch. Scale bars of C and D = 1cm.

⁸ *Earliella scabrosa* (Pers.) Gilb. & Ryvarden, Mycotaxon 22 (2): 364 (1985).



(E) *Ficus microcarpa* colonised by *Earliella scabrosa*. (F) Surface of the fruiting body of *E. scabrosa*. (G) The underside of the fruiting body of *E. scabrosa* showing the hymenium layer. (H) Enlarged picture showing the pores from C (indicated with red rectangular).

FRUITING BODY

Fruiting bodies sessile, resupinate or laterally attach to wood surface; pilei 1 × 2 cm to 4 × 6 cm in size, bracket-shaped, grow in bunches, tough and coriaceous, white at early stage, later covered with red or red-brown layer of cutin with white margin; pore surface white to cork coloured, 2-3 per mm, irregular shaped; spores 8-12.5 µm × 3.5-5 µm, cylindrical to oblong ellipsoid, hyaline.

DISTRIBUTION AND HOST RANGE

This fungus is mainly found in the tropical region and associated with broadleaved trees such as *Acacia* spp., *Ficus microcarpa* etc. as well as on dead/dying trees locally in urbanised setting along roadsides, on slopes and in parks. It is also found associated with surface of pruning wounds on braches and damaged areas on the tree trunks.

SIGNS AND SYMPTOMS

As wounds serve as entry courts for this fungus, fruiting bodies could be observed on pruning wounds and damaged tissues on branches and tree trunks. This fungus is likely to cause localised decay on tree. Most often trees observed with this fungus are already weakened with non-specific symptoms of crown abnormality such as defoliation, dieback and small leave size, etc.

PATHOLOGY

This fungus is reported as a saprotrophic fungus on deadwood and causing white rot decay, but its ability to associate with exposed living tissues (sapwood) on the main trunk of weakened tree hosts reveals the weakly pathogenic nature of this fungus with low virulence. Further to the degradation by this fungus, the infected trees may be subject to attack by other opportunistic fungal pathogens.

MANAGEMENT AND CONTROL

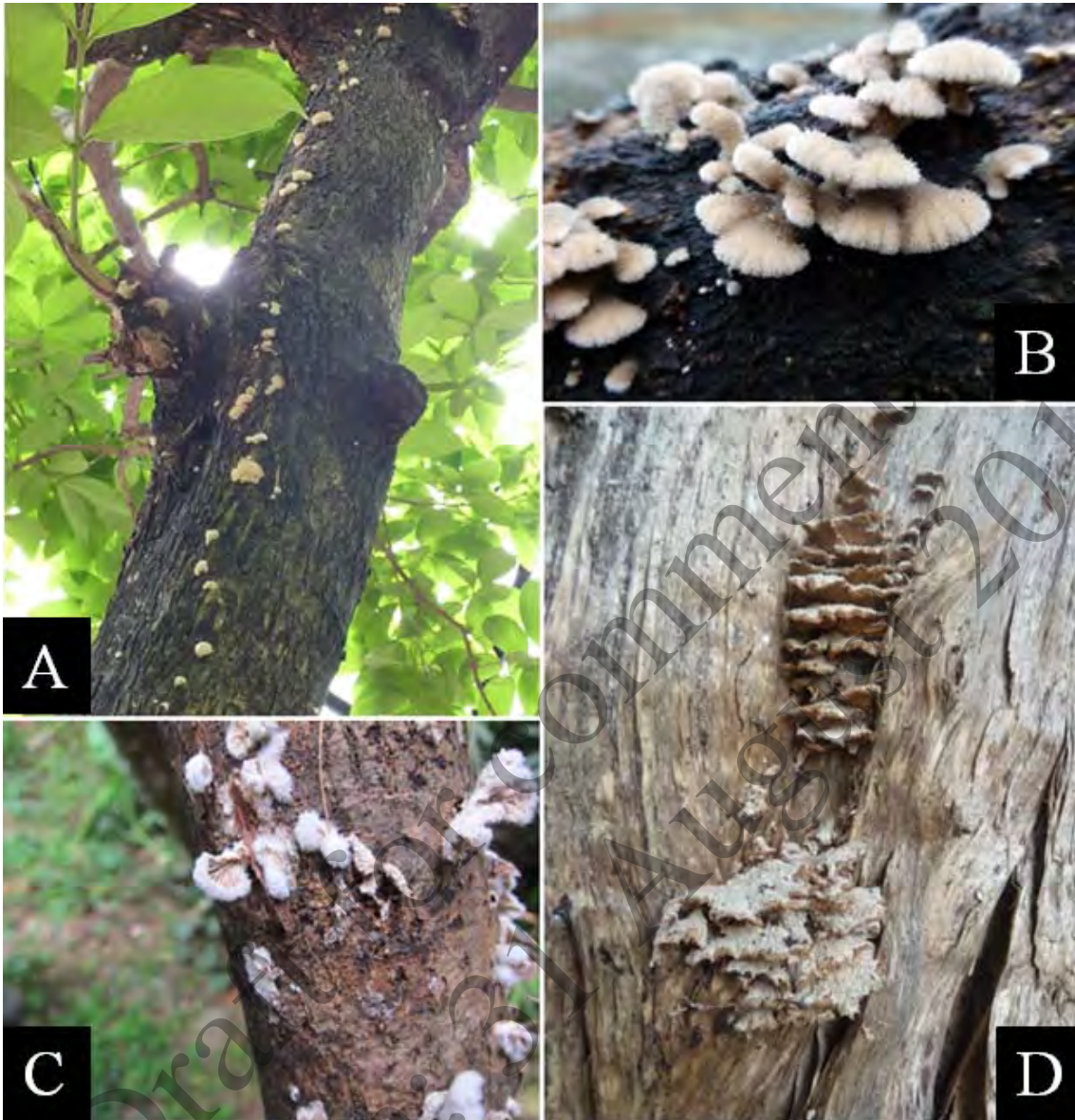
Risk category: Low (YELLOW)

Since this fungus may aggravate the health and structural stability of weakened trees, infected trees should be put under monitoring if the fungus is associated with the main trunk and major branches of stressed trees. For trees observed with this fungus on small branches, the defective part should be removed. Fruiting bodies observed on trees should be removed to minimise building-up of fungal inoculum. Fungicides may be applied on the trees as an interim measure to retard fungal growth.

As there are occasions where trees detected with *Earliella scabrosa* are also infected with some other pathogenic root rotting fungi such as *Phellinus noxius* and *Ganoderma* spp., it is advisable to check the root and root collar regions of the host trees for the presence of other pathogenic root rotting fungi. As wounds may serve as entry courts for this fungus, trees should be avoided and minimised from injury arisen from large area pruning cut/mechanical damages.

Draft for comment
Version: 31 August 2015

*Schizophyllum commune*⁹



(A) Fruiting bodies of *Schizophyllum commune* colonised the bark of *Lagerstroemia speciosa*. (B) The upper surface of fruiting bodies of *S. commune*. (C) The lower surface of the fruiting bodies of *S. commune*. (D) Senescent fruiting bodies of *S. commune* on a dead tree trunk.

⁹ *Schizophyllum commune* Fr., Systema Mycologicum 1:330 (1821).

FRUITING BODY

Fruiting bodies (pilei) 1-3(5) cm in diameter, round, fan-shaped or kidney-shaped, flesh hard, becoming thin and elastic when wet, and fragile under dry conditions, outer surface felted, wavy, slightly lined, with white, grey-white or pale orange areas, margin curling inwards, either split or lobed, stemless, simply sitting on the substrate; spores 5-5.5 μm \times 2 μm , oblong, hyaline.

DISTRIBUTION AND HOST RANGE

This fungus has a worldwide distribution and has a very broad host range. Locally, it could be observed on broadleaved trees such as *Acacia* spp., *Celtis sinensis* and *Lagerstroemia speciosa* along roadsides, on slopes and in parks.

SIGNS AND SYMPTOMS

Wounds from pruning cuts as well as injury arisen from low temperature and sunscald damages could readily serve as entry courts for this fungus. As such, it is often found associated with wounded barks and cankers on branches and trunks of trees. Once established on infected trees, localised decay may proceed and pave the way for further infection by other opportunistic wood decay fungi. Most trees observed with the presence of this fungus are usually already weakened and exhibit non-specific symptoms of tree crown abnormality such as defoliation, dieback and small leave size etc.

PATHOLOGY

This white rot fungus is regarded as a saprotrophic fungus with the ability to recycle deadwood but may also cause damages on weakened trees as a pathogenic fungus with weak virulence. It is therefore regarded as a wound parasite having the ability to cause wood decay on injured cambium/sapwood and exposed heartwood.

MANAGEMENT AND CONTROL

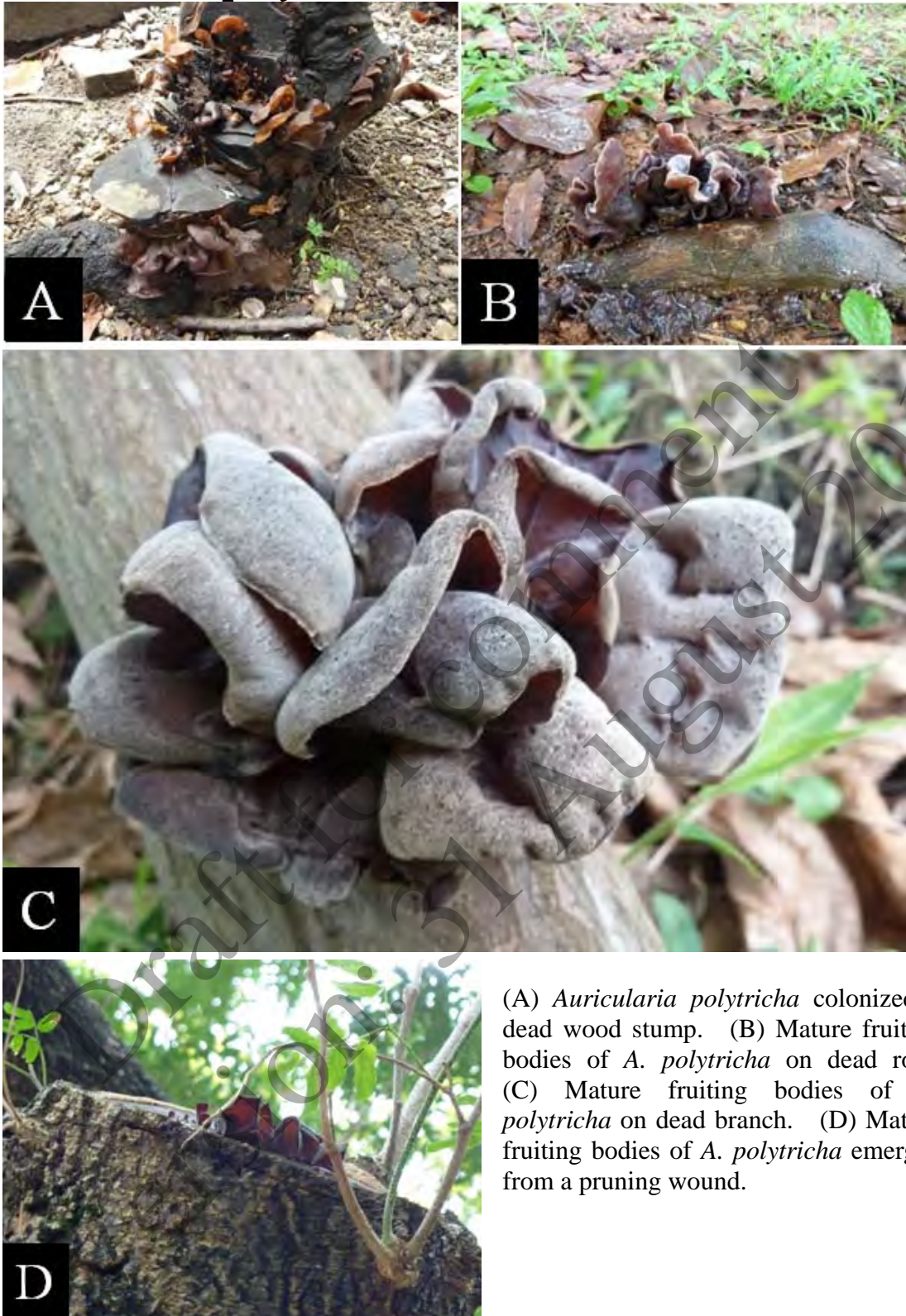
Risk category: Low (YELLOW)

Since this fungus may affect the health and structural stability of trees, mitigation measures should be exercised depending on tree conditions and the location at which the fungus is observed. Trees infected with this fungus should be put under monitoring only if the fungus is associated with the main trunk or structural branches of trees. Alternatively, removal of the defective parts could be considered if the fungus is observed on small size branches with weak attachment. Fungicides may be applied on trees infected with this fungus as an interim measure to retard fungal growth.

It is worthy to note that as fruiting bodies of this fungus are relatively small, they may not be easily detected. As such, one should carefully examine for sign of this fungus, particularly in wounded areas of the trees during inspection. By increasing tree vigour through proper tree care regimes and minimising tree damage from pruning cuts, the chance of fungal infection would be substantially reduced.

Draft for comment (2015)
Version: 31 August 2015

*Auricularia polytricha*¹⁰



(A) *Auricularia polytricha* colonized a dead wood stump. (B) Mature fruiting bodies of *A. polytricha* on dead root. (C) Mature fruiting bodies of *A. polytricha* on dead branch. (D) Mature fruiting bodies of *A. polytricha* emerged from a pruning wound.

¹⁰ *Auricularia polytricha* (Mont.) Sacc., Atti dell'Istituto Veneto Scienze 3:722 (1885).

FRUITING BODY

Fruiting bodies annual, 4-16 cm wide, resupinate or pileate, loosely attached, laterally and sometimes by a very short stalk, elastic, gelatinous, hymenium smooth, or wrinkled, pale brown to dark brown to blackish brown with a whitish boom, sterile surface dark yellowish brown to dark brown with greyish brown bands, hairy, silky; hairs up to 0.6mm long, thick-walled; basidia 46-60µm × 4-5.5 µm, cylindrical, hyaline, 3-septate, with 1-3 lateral sterigmata; spores 13-16µm × 4-5.5 µm, reniform to allantoid, hyaline, guttulate.

DISTRIBUTION AND HOST RANGE

This fungus is widely distributed throughout the world. Locally, it is found on broadleaved trees, such as *Acacia confusa*, *Aleurites moluccana*, *Celtis sinensis* and *Ficus microcarpa* in urbanised setting along roadsides, on slopes and in parks.

SIGNS AND SYMPTOMS

This fungus is found associated with surface of pruning wounds, dying and dead branches as well as dead trees. Fresh pruning cuts and dying/dead branches with defoliation are locations to observe for the fungus. Fruiting bodies serve as obvious sign for this species.

PATHOLOGY

It is a saprotrophic fungus with the ability to cause white rot decay on dead and decaying wood tissue.

MANAGEMENT AND CONTROL

Risk category: Insignificant (**GREEN**)

Although there is insignificant concern on tree health and structural stability due to the presence of this fungus, the trees should be checked for the presence and extent of localised decay in the region where fruiting bodies are observed. Branches with weak attachment observed with sign of this fungus should be removed.

*Hexagonia tenuis*¹¹



(A) Dead branches of a *Dimocarpus longan* were colonised by *Hexagonia tenuis*. (B) Mature fruiting bodies of *H. tenuis* on a dead branch of the *D. longan*. (C) Mature fruiting bodies of *H. tenuis* (upper-side) on dead log. (D) Mature fruiting bodies of *H. tenuis* (under-side) on dead log.

¹¹ *Hexagonia tenuis* (Hook.) Fr., *Epicrisis Systematis Mycologici*: 498 (1838).

FRUITING BODY

Fruiting bodies (pilei) annual to perennial, 3-5 cm × 4-8 cm and 0.2 cm thick, solitary or in clusters, pileate, flabelliform to semi-circular bracket, broadly or narrowly attached to the substrate or almost stipitate, thin, flexible and coriaceous when dry, upper surface concentrically zoned, ochraceous to dark brown; pore surface with grayish to ashy bluish tint, pores angular to hexagonal, very variable, mostly 2 per mm; spores ellipsoidal, smooth-walled hyaline.

DISTRIBUTION AND HOST RANGE

This fungus has a worldwide distribution. Locally it is commonly found on broadleaved trees such as *Delonix regia*, *Ficus microcarpa* and *Dimocarpus longan* in urbanised setting along roadsides, on slopes and in parks.

SIGNS AND SYMPTOMS

Fruiting bodies of this fungus are mainly found on dying/dead branches, dead trees as well as aged pruning cuts.

PATHOLOGY

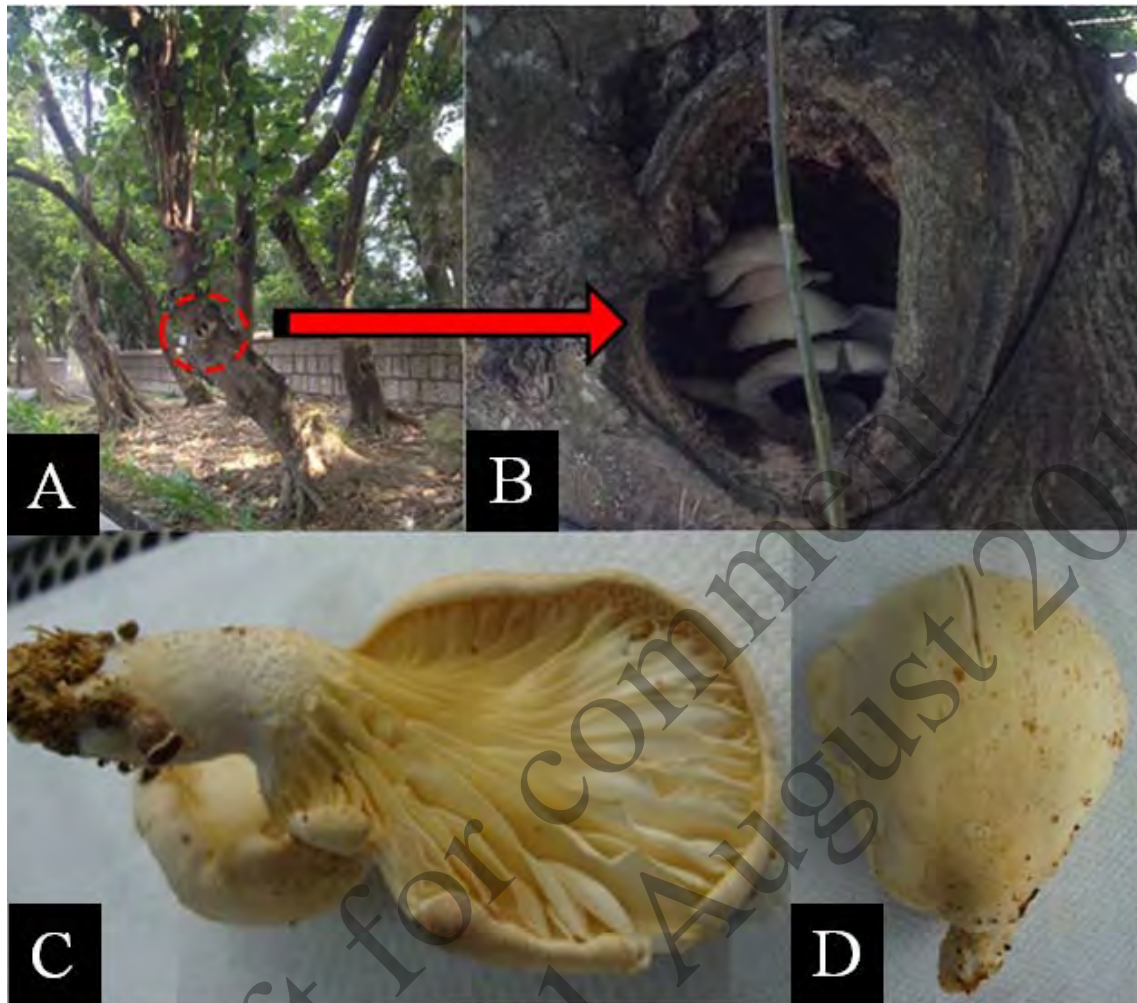
It is a saprotrophic fungus with the ability to cause white rot decay on dead and decaying wood tissue.

MANAGEMENT AND CONTROL

Risk category: Insignificant (**GREEN**)

Although there is insignificant concern on tree health and structural stability due to the presence of this fungus, the trees should be checked for the presence and extent of localised decay in the region where fruiting bodies are observed. Dead branches and branches with weak attachment observed with sign of this fungus should be removed.

*Pleurotus cystidiosus*¹²



(A) *Pleurotus cystidiosus* in the cavity of a *Hibiscus tiliaceus*. (B) Close-up of the fruiting bodies of *P. cystidiosus* in (A). (C) The under-side of the fruiting body of *P. cystidiosus*. (D) The upper-side of the fruiting body of *P. cystidiosus*.

¹² *Pleurotus cystidiosus* O.K. Mill., Mycologia 61: 889 (1969).

FRUITING BODY

Fruiting bodies up to 9.0 cm in height, pleurotoid; pilei up to 10.5 cm in diameter, depressed, surface grayish brown bearing brownish to purplish squamules, dry, fleshy, flesh up to 0.3 cm thick, white, lamellae yellowish white, decurrent, extending down on to the stipe, subdistant (up to 0.4 cm apart from each other), unequal, divided into two tiers, ventricose, gill edges wavy, spore print white; stipe 4.5 to 6.5 cm long, 2.2 to 3 cm broad, grayish brown, lateral, tapering downwards, solid, flesh white underneath; basidia 33.0-50.0 × 5.0-8.3 μm; spores 8.5-14.5 × 4.5-6.64 μm, oblong, elliptical, inamyloid.

DISTRIBUTION AND HOST RANGE

This fungus is mainly found in the tropical and subtropical regions. Locally, it is found in broadleaved trees such as *Hibiscus tiliaceus* etc.

SIGNS AND SYMPTOMS

This fungus is found associated with wounds, cavities, dying and dead branches as well as dead trees. Fresh pruning cuts, exposed wood and dying/dead branches with defoliation are locations to observe for the fungus. Fruiting bodies serve as obvious sign for the presence of this saprotrophic fungus on trees.

PATHOLOGY

It is a saprotrophic fungus with the ability to cause white rot decay on dead and decaying wood tissue.

MANAGEMENT AND CONTROL

Risk category: Insignificant (**GREEN**)

Though there is insignificant concern on tree health and structural stability due to the presence of this fungus, the trees should be checked for the presence and extent of localised decay in the region where fruiting bodies are observed. Dead branches and branches with weak attachment observed with sign of this fungus should be removed.

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Guidelines on Tree Preservation during Development

**Greening, Landscape and Tree Management Section
Development Bureau
The Government of the Hong Kong Special Administrative Region**

April 2015

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1. Introduction

1.1 Trees are important elements in the city landscape and valuable assets in the community. They are dynamic living components of the urban ecosystem and their growth and structural stability change over time and environmental conditions. Infrastructure development both in reforming and modifying the cityscape is common. Trees are thus often subject to potential impact of new development and renovation of existing roads, utilities, facilities and other structures.

1.2 Tree preservation is necessary because trees play an important role environmentally and culturally. It is an integral part of a development project and requires careful planning in all stages from planning, design, construction to post-construction. Preserving the right trees and protecting them from damage can maintain greenery and minimise subsequent costs for the rehabilitation of a tree or its ultimate removal.

1.3 The ‘Guidelines on Tree Preservation during Development’ (the Guidelines) provides general reference for preserving trees which are subject to construction activities. It offers guidelines on proper practice for managing trees throughout different stages of the development. The objectives of the Guidelines are to identify the suitable trees for preservation, suggest appropriate tree preservation measures and integrate tree management with development activities in a sustainable manner. The Guidelines are relevant to those who are involved in the planning, design, management and supervision in different aspects of a project sharing the common concern on tree preservation.

1.4 The Guidelines should be read in conjunction with the prevailing circular(s) and relevant document(s), e.g. ‘Tree Preservation’ (Development Bureau Technical Circular (Works) No. 10/2013)¹, Contract Provisions for Preservation of Existing Trees (with or without Old and Valuable Trees)² Guidelines on Tree Transplanting³ and other tree protection practices during construction promulgated by the Greening, Landscape and Tree Management

¹ Source: <http://www.devb.gov.hk/filemanager/technicalcirculares/en/upload/327/1/C-2013-10-0-1.pdf>

² Source: http://devb.host.ccgo.hksarg/en/tree_preservation/PPET_Content_Frame.html and
http://devb.host.ccgo.hksarg/en/tree_preservation/PPETwOVT_Content_Frame.html

³ Source: http://www.trees.gov.hk/filemanager/content/attachments/Guidelines_on_Tree_Transplanting.pdf

Section of the Development Bureau which are available from the trees website at www.trees.gov.hk.

*Draft for comment
(Version: 31 August 2015)*

2. Background and guiding principles of tree preservation

2.1. The goal of tree preservation in a development project is to identify and preserve trees with good health, structure and form, while felling trees which are of poor health or structure, or unable to survive effects of construction and have major conflict with the designated use of the site.

2.2. Development activities can affect the health, growth and stability of trees. If the extent of change is too great, trees become weakened and may die. Likewise, their ability to acclimate to new site conditions and tolerate environmental stress declines with age/health condition. Young and healthy trees are in general more resilient to changes whereas old and mature trees or individual trees of poor health are more sensitive to stress. It is for this reason that retention of old trees during development requires special attention and a programme of long term care.

2.3. For a tree to be preserved and protected on site, due consideration should be given to provide adequate space for the function and growth of its root and canopy.

2.4. All parts of a tree can be damaged by construction. A tree that has taken many years to reach maturity can be damaged or killed by unwitting or negligent actions. Trees damaged during construction may take years to exhibit symptoms and eventually need to be treated or removed, often at great expense.

2.5. Successful tree preservation occurs when the goals of the project are achieved with minimal impact to trees designated for preservation (Matheny and Clark, 1998) and should adhere to several important principles.

2.5.1. Successful tree preservation requires the commitment and involvement of all parties involved in the project in different phases; and effective communication on tree preservation among team members is essential.

- 2.5.2. Members of the project team should be familiar with the rudimentary aspects of tree growth and development and understand the relationships between tree survival and construction practices. Tree specialists/arborists should be involved early to give advice on survey and tree assessment, preservation measures and on site monitoring etc.
- 2.5.3. Trees preservation begins in early planning stage and develops through design, construction and maintenance phases. A decision to preserve and remove specific trees should be discussed and determined at the same time when site layout and grading etc. are considered.
- 2.5.4. Trees differ in their ability to tolerate changes which are often constrained by the species, age, structure and vigor, both on the basis of their intrinsic characteristics and their response to potential construction impacts. Tree preservation⁴ is a thoughtful process of selecting suitable trees for protection and felling trees that cannot, or should not, be preserved. Evaluation of suitability of individual trees for preservation is an important task. Trees that are to be preserved must be carefully selected in order to make sure that they will survive the construction impacts, adapt to a new environment and perform well in the new landscape. Trees that are poor in health or structure or unable to survive construction impacts are not suitable for preservation.
- 2.5.5. The focus of tree preservation during development is on prevention of damage as there are few remedial treatments and the ability of a tree to recover from all construction injuries is generally limited. Injury should be avoided during all stages of development in particular as construction impacts are cumulative.

⁴ Factors to be considered on tree assessment for tree preservation, transplanting and felling can be referred to the Development Bureau Technical Circular (Works) No. 10/2013 'Tree Preservation' vide

<http://www.devb.gov.hk/filemanager/technicalcirculars/en/upload/327/1/C-2013-10-0-1.pdf>

- 2.5.6. Information from the field survey is crucial to determine the construction plans and activities and to facilitate a decision on the siting of the development with its likely impacts on trees. Information therefore should be accurate for the successful tree preservation.
- 2.5.7. Trees require sufficient space for the growth of canopy and root systems. Adequate space should be allowed to minimise the impacts from construction, and to ensure the healthy growth of a tree over time.
- 2.6. The major causes of injury, which are by no means exhaustive, are:
- Root cutting or damage – due to excavation or trenching; as over 90% of the roots are located at the top 1m of soil, working around trees can easily cut roots;
 - Soil compaction – results in less root growth or reduced aeration with long term implications;
 - Grade changes – lowering of level leads to root removal while raising of level leads to root suffocation;
 - Mechanical injury to trunk, roots and crown – injury to conductive and protective tissues, i.e. bark, phloem, cambium and xylem, reduces the capacity of trees to transport water, nutrients and carbohydrates. Injury also leads to invasion/infection of pathogens.

3. Process

3.1. During the various stages of construction, the following key points related to tree preservation should be noted.

3.2. Planning

3.2.1. This stage involves the initial site evaluation where the land, tree and building needs are all evaluated and defined. Trees immediately adjacent to the site that will be impacted by the construction or may affect the construction activity should also be included. Information collected is to facilitate a decision to establish the relative importance of the existing trees on a construction site which should be preserved and protected or removed. Due consideration should also be taken to avoid causing damage to trees during the site evaluation work.

3.3. Design

3.3.1. During the design phase, the project team sites the building and supporting infrastructure appropriately. Trees covered in the survey are assessed and determined on how they can be incorporated into the development or to be transplanted or felled.

3.3.2. The trees' location relative to the structures should be considered so that the trees have sufficient space to grow and are adequately protected during construction. It is also important that the project team should incorporate the design considerations on the future use of the areas within and/or the TPZ in relation to the future and proper growth of the preserved trees in the vicinity. Inappropriate design for the future use of the areas may have long term implications on the micro-climate and the growth environment of the trees.

3.3.3. The following should be considered for trees to be preserved.

- Tree protection zone (TPZ)

TPZ is considered as the minimum area around a tree deemed to contain sufficient roots and rooting volume to maintain the tree's viability, and where the protection of the roots and soil structure is treated as a priority. Methods generally used include

- the 'Dripline method', i.e. the tree canopy dripline is used to define the boundary of the TPZ and the entire area within the dripline is considered the TPZ;
- the 'Tree height method', i.e. the circular area with the radius equal to the height of the tree; and
- the 'Trunk diameter method', i.e. multiply the trunk diameter at 1.4 m by 6 to 18 to determine the radius of the TPZ, etc. (Fite and Smiley, 2008)

Under general circumstances in Hong Kong, the 'Dripline method' is adopted. However, for narrow canopied trees, the 'Tree height method' would be appropriate. The 'Trunk diameter' method would be suitable for trees which are leaning or of irregular conformation.

A bigger TPZ is usually preferred. The tolerance level of a tree may depend on tree species, age/size, health/vigor, site conditions etc. and further deliberation on factors on a case by case basis would be necessary.

There is a need to consider factors such as site conditions, technical issues and cost effectiveness etc. to work out a balanced arrangement. There are situations in which the designation of TPZ at dripline may not be practicable, e.g. a slope with dense vegetation cover, roadside verge or trees grown on the stonewall⁵. The advice from the tree

⁵ For details about the protection of stonewall trees during construction, please refer to the Management Guidelines for Stonewall Trees vide http://www.trees.gov.hk/filemanager/content/attachments/Guilelines_for_stone_wall_trees.pdf

specialist/arborist has to be sought on adequate tree protective measures and design.

A TPZ will ensure that a tree is protected during development, has enough space for root and branch growth, and will receive adequate supplies of soil nutrients, air and water. It is also a specified area around, above and below ground and at a given distance from the trunk set aside for the protection of the root system and the crown of a tree at where it is potentially subject to damage by development.

The TPZ should be protected from construction disturbances. No grading, excavation or construction activity is to be allowed save with special consideration and approval given. Where appropriate, a cross-section showing the proposed architectural and engineering features around trees proposed to be retained should be provided to show that sufficient vertical and horizontal space can be reserved for TPZs.

- Tree protection fences

TPZ must be surrounded by strong fences sturdy enough to withstand impacts from the construction activities including vehicles and machinery at the beginning of contract including site investigation works before the construction on site. The fences should be rigid and complete and its foundation should avoid contact with the structural roots. Weak fencing such as nylon netting is not appropriate for protecting trees.

At where the erection of protective fencing is not practicable or the preserved tree grows on a retaining structure, alternative tree protective measures such as temporary protective plank armouring should be considered. If necessary, coverings should be laid on top of the temporary protective mulching to provide additional protection from soil compaction due to passage of vehicles, equipment or machinery.

Warning signs and notices are to be installed at the fences denoting the 'tree protection zone' to prohibit the entry of equipment or construction activities.



Photo 1

A tree should be protected by strong protective fence at the TPZ wherein construction activities are not allowed



Photo 2

A tree without protective fence will be vulnerable to damage caused by construction activities

- Tree preservation plan (TPP)

Information on TPZ and the location, size and conditions of trees from the tree survey reports should be clearly shown and included in a TPP as part of the contract documents.

The TPZ should be superimposed on a layout plan showing the spatial relationships between trees and the development. The TPZ should not be interfered by uses such as storage, parking area or vehicular/pedestrian access. The TPP should clearly indicate the location of protective fence to be erected around the preserved trees. The extent and type of ground protection or other measures to protect the roots from compaction should also be indicated.

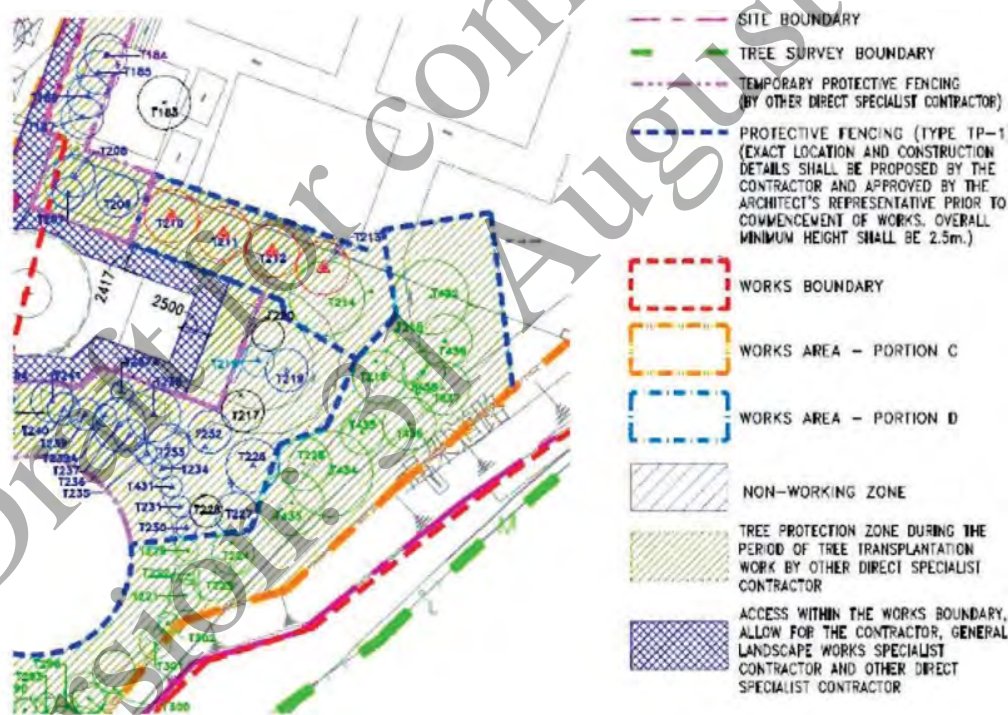


Figure 1

Tree Preservation Plan (TPP) is a part of the contract drawings: with levels, TPZ, protective fence, circulation routes indicated⁶.

⁶ Source: Proper Planting Practice – Design for Tree Protection Zone
http://www.greening.gov.hk/en/preservation/new/designForTreeProtectiveZone_b.jpg



Photo 3

A tree adjacent to the construction area is properly fenced off and protected by strong fences

- Soil compaction controls and storage areas

Major causes of soil compaction are due to vehicular movements and the storage of heavy machinery/equipment/materials near a preserved tree.

Soil compaction decreases soil permeability and interferes with essential gas exchange processes and percolation, and impairs drainage. Besides, the fine, absorbing roots concentrated in the upper centimeters of soil can easily be damaged or killed by heavy construction equipment travelling across or grading the site.



Photo 4

Heavy vehicles or equipment stationed in the vicinity of a preserved tree not only cause damage to the tree but also add weight to the soil causing compaction

Mechanical damage of tree trunk or surface roots or spillage of chemicals can cause irreparable damage. It is important to prevent soil compaction by diverting traffic routes and designating storage areas away from trees. Spreading a layer of woodchips on soil surface can also reduce compaction. The designation of TPZ and installation of strong protective fence can effectively prevent damage from compaction and storage.



Photo 5 and Photo 6

Areas in the vicinity of a preserved tree should be free from storage and dumping

- Existing and proposed utilities alignment

Both existing and new trenches and overhead wires for utilities should be identified and marked on the plan.

Trenching or excavation near a tree can cause substantial root damage or root loss and should be avoided as far as possible. Depending on the extent, cutting of roots will affect the absorption and anchorage of the tree, which may lead to decline of tree vigor or even tree collapse.

- Grade change

In term of grade change, consideration on tree preservation should be given either to build “tree island” or “tree well” to encompass an area extending at least to the TPZ⁷. [Figures 2, 3 and 4]

⁷ Source: Case Study: Tree Preservation and Level Change vide http://devb.host.ccg.hksarg/en/tree_preservation/Lesson_Learnt_Sau_Ming_Road_Bombax_change_in_soil_level.pdf

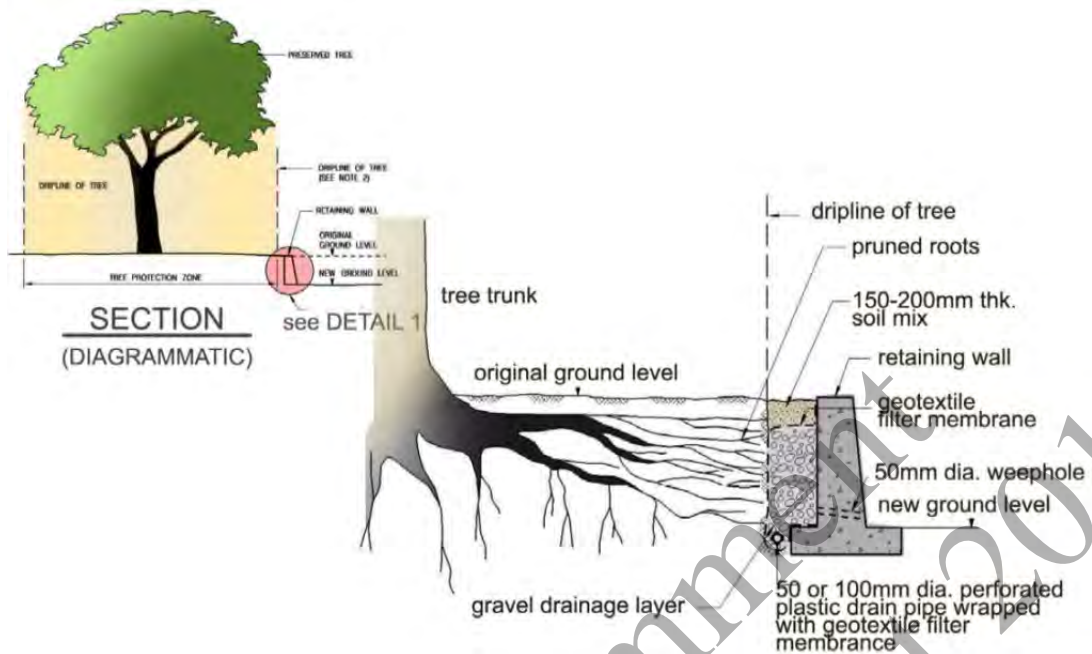


Figure 2
Construction of tree island for lowering of soil level

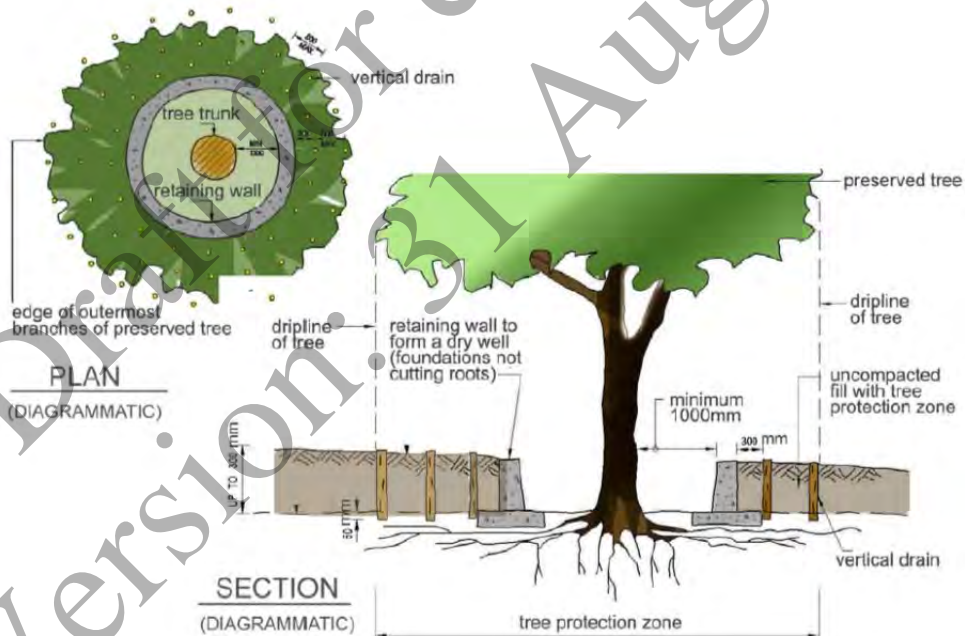


Figure 3
Construction of tree well for increasing soil level (minor to moderate rise up to 300mm)

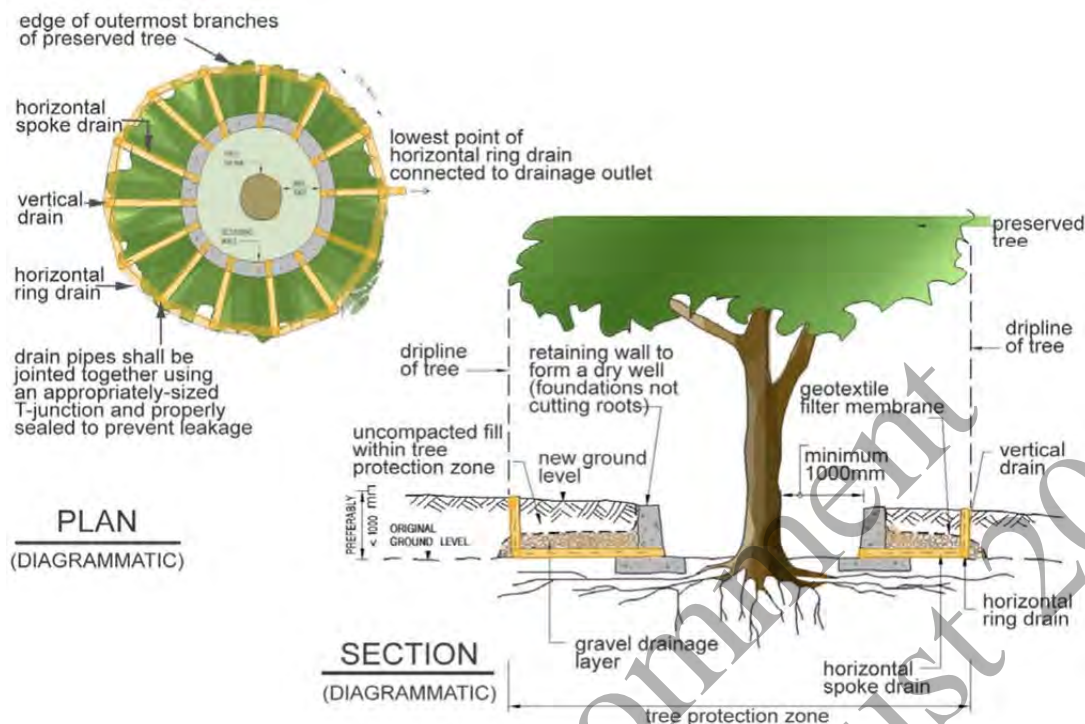


Figure 4

Construction of tree well for increasing soil level (major rise >300mm)

- Other on-site activities
 - Consideration should also be given to properly irrigate the trees and to spray water to remove the accumulated construction dust during dry season in order to lessen the chances of decline and to maintain the vigor of trees.
 - Potential change in local hydrology due to site changes should be considered and prevented as far as possible.

3.4. Construction

3.4.1. The construction phase is when most activities occur on a project site. It starts with site investigation, then site preparation and ends when building and landscaping are finished.

- 3.4.2. Site inspections are needed to maintain the integrity of the TPZ. The purpose is to verify that all tree protection measures are in place, followed and observed during the construction works.
- 3.4.3. Trees should be inspected on a regular basis to watch for signs of stresses, such as dieback, leaf loss, or general decline in tree health or appearance and to look for and prevent tree damage with symptoms of construction injury. Photographic records are necessary in order to keep track of the tree condition.
- 3.4.4. During construction, trees can be damaged by soil compaction, pollution from effluent water, machine petroleum or chemical spillage, grade changes, root crushing and pruning, damage to the bark, improper pruning of branches, incorrect storage of construction machinery/materials, and dumping of construction wastes (Elmendorf, Gerhold, & Kuhns, 2005). Common types and symptoms of construction injury are suggested at Tables 1 and 2⁸ below.

Table 1

Types of construction injury

- Soil compaction or pollution
- Root removal and wounds
- Disruption of mycorrhizae and other beneficial soil organisms
- Trunk and butt wounds
- Branch wounds
- Leaf injury
- Unwarranted tree removal

Table 2: Symptoms of construction injury (Soil destruction)

- Reduced canopy density
- Reduced leaf size
- Lighter green colour of the foliage
- Branch/canopy dieback
- Development of early fall colour or leaf drop
- Suckers or epicormic shoots from damaged roots
- Long term decline in health

- 3.4.5. Landscape installations, e.g. irrigation or lighting installation are a common cause of tree root damage. Monitoring of these activities is essential.

⁸ Source: Elmendorf, Gerhold, & Kuhns, 2005

- Appropriate measures on proper tree care should be in place which include corrective pruning when trees exhibit signs of stresses.
- Temporary trunk or branch protection is sometimes required. Warning signs are also required if branches are spanning across the TPZ to reach the vehicular passage.



Photo 7

Appropriate sign is required to indicate the spanning of tree branches which require special attention

- 3.4.6. Monitoring and moderating the construction activities is essential for the success of the project. Site meetings and reporting are necessary in order to keep all parties in the construction team informed about tree related activities and to reinforce the importance of tree protection activities. Any foreseeable damage should be reported through the prescribed chain of command and corrected as soon as possible.

Table 3

Do and Don't⁹

<ul style="list-style-type: none"> ● Do install strong protective fencing at the TPZ before construction on site ● Designate specific sites for equipment/disposal of debris ● Do appoint qualified and trained personnel for works and monitoring ● Designate vehicular/foot paths and storage areas away from TPZ ● Do monitor the tree conditions and report on anomalies 	<ul style="list-style-type: none"> ● Don't girdle a tree with wire ● Don't nail anything into a tree ● Don't stockpile around a tree ● Don't undertake works within the TPZ ● Don't top a tree ● Don't use trees as anchor ● Don't work with machines near a tree ● Don't cut, trench, excavate/raise soil level within TPZ ● Don't pollute the soil ● Don't allow traffic over root system ● Don't sever main roots near the trunk
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3.4.7. Level of compliance and condition of the trees should be well monitored. In the event of damage to fence or trees, the damage should be properly reported and rectified quickly.

⁹ Source: Tree Care during Construction at http://www.trees.gov.hk/filemanager/content/attachments/Tree_Care_during_Construction.pdf

3.5. Post-construction

- 3.5.1. The post-construction phase begins when the construction and landscape installation have finished.
- 3.5.2. Tree health and structure should be thoroughly evaluated again to determine if any changes have occurred during the construction process. If there is any observed deterioration of tree health and/or structure, remedial treatments should be recommended and implemented. The findings of inspections and evaluations should be included in a management plan for the maintenance party.
- 3.5.3. Once construction is complete, the TPZ fencing may be removed, but monitoring by the tree specialist/arborist should continue. Monitoring should include managing soil moisture, maintaining mulch, assessing tree damage, and inspecting for insect pests and disease pathogens. Treatments should be prescribed when problems are detected. Trees known to be hazardous should be felled in order to reduce long term management, liability and risk elements.
- 3.5.4. It is important that all construction materials, such as hoardings, barriers, tree labels, etc., should be removed before a construction project is considered to be satisfactorily completed. Arrangement on handing over of the facilities and the trees between the project proponent department and the department responsible for the subsequent maintenance should be arranged. All defects or irregularities to be followed up after the handing over and during the defect liability period should be properly recorded.

4. Treatment of trees damaged during development

4.1. Despite the best intentions and most stringent tree protection measures, trees may still be injured during construction. Construction damage can be permanent and often irreversible. There are few remedial treatments to improve injured trees.

4.2. Some trees decline slowly over years while others may die instantly. During construction, trees can be damaged by causes such as soil compaction, water/petroleum pollution, grade changes, root crushing and pruning, damage to the bark, improper pruning of branches, incorrect storage of construction machine/equipment/materials, and dumping of construction wastes. The following maintenance care should be taken into consideration.

- Branches that are split, broken, diseased or dead should be removed.
- If branches or tree trunks need additional support, evaluate the benefits of installing cables or other means of supports. Likewise, in case if there are damage of the tree roots and the tree structure is likely to be affected, appropriate means of support is required.
- Adequate but not excessive irrigation can help the trees to recover from stresses. A long, slow soak over the entire root zone is preferred than frequent and shallow watering.
- Mulch covering the root system can enhance root growth, moderate soil temperatures, maintain moisture and reduce competition from weeds and grass.
- Traditional wound dressings, once thought to accelerate wound closure and reduce decay, are not substantiated by research¹⁰. They are primarily used for cosmetic purposes and are neither required nor recommended in most cases.

¹⁰ There are researches on trial use of biological control agents as wound dressing material for fungal decay control but no conclusive findings have been published as of to date.

- If a wound is found on the tree trunk, carefully cut the loose bark to form a clean, smooth surface of healthy wood and bark. Take care not to damage healthy tissue and do not widen the wound more than necessary. Jagged edges can be cut away carefully with a sharp knife, taking care not to cut into the living tissues.
- Fertilization is usually not necessary. It should only be applied after laboratory tests of soil samples to understand the deficiency.
- Applying herbicides/fungicides/insecticides only if it is necessary and appropriate for the purpose.
- Soil compaction and grade increases deplete the oxygen supply to tree roots. To improve soil aeration, vertical mulching¹¹ and radial trenching¹² are techniques used to improve conditions for root growth. Use of air excavator has proven effective for soil aeration and radial trenching.



Photo 8

Vertical mulching can improve soil aeration and root growth

¹¹ Vertical mulching involves making holes in the ground with a drill or an air tool and the holes may be filled with organic material such as compost or other materials to improve aeration.

¹² Radial trenching is made in a radial pattern throughout the root zone and should extend at least as far as the dripline. The trenches are backfilled with native soil and compost and sometimes other amendments are added.

- Soil that has been polluted should be removed and replaced, where feasible/appropriate. Polluted soil near trees should be removed carefully as far as practicable with hand tools to avoid further damage to roots. Quality soil mix can be applied to improve nutrient deficiency due to the prolonged period of construction activities.

*Draft for comment
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Design For Tree Protection Zone

For effective tree protection on site:

- the knowledge and understanding of tree protection and active participation of all levels of the project management, design and construction team is required.
- team work is essential.
- planning and demarcation of an adequate tree protection zone at the initial planning and design stage is essential; not as an after thought.
- the objective is to prevent damage rather than undertake remedial work afterwards since most damage is irreversible and cumulative.
- the major threats to trees in works areas are compaction, root damage and change in level. Robust protection fence shall be installed at the beginning of the construction phase and last through out the construction to protect trees.
- no dumping, storage of materials, change in level, excavation, cutting of roots/ branches or parking is allowed within the fenced area of the tree protection zone.
- regular inspection to check the health and structural condition of trees in construction site is required.
- contractors shall be reminded of their responsibilities under the contract to protect trees in construction site. Poor performance in tree works / protection should be reflected in contractor's performance reports.

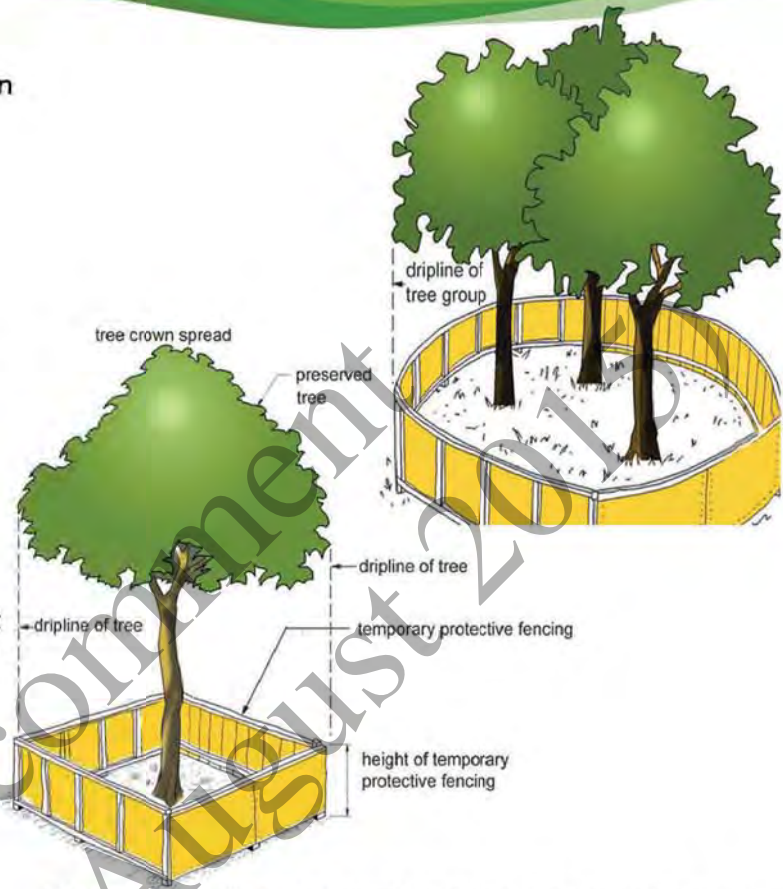


Diagram 1 Installation of robust fencing at tree protection zone throughout the construction period is required. (dripline is a good reference though consideration of larger zone is required for older trees) No construction activity, dumping, storage of material and parking is allowed within the fenced area. (Multiple trees above, Single tree below)

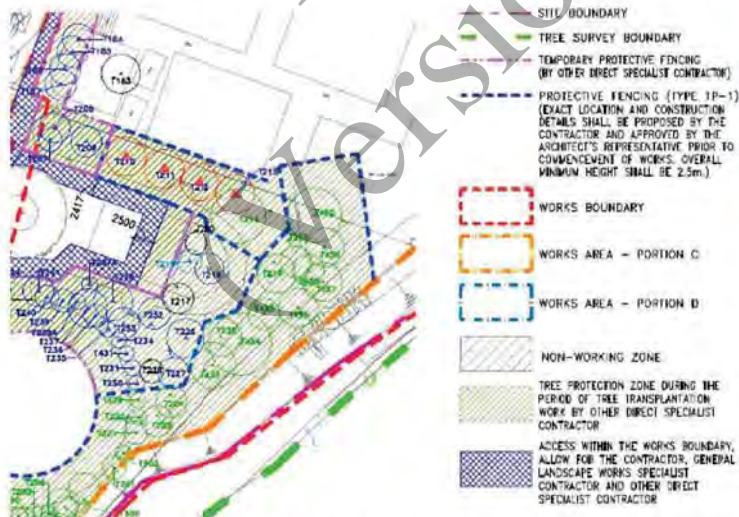


Diagram 2 Tree Protection Plan is a part of the contract drawings: with levels, tree protection zone, circulation routes indicated.

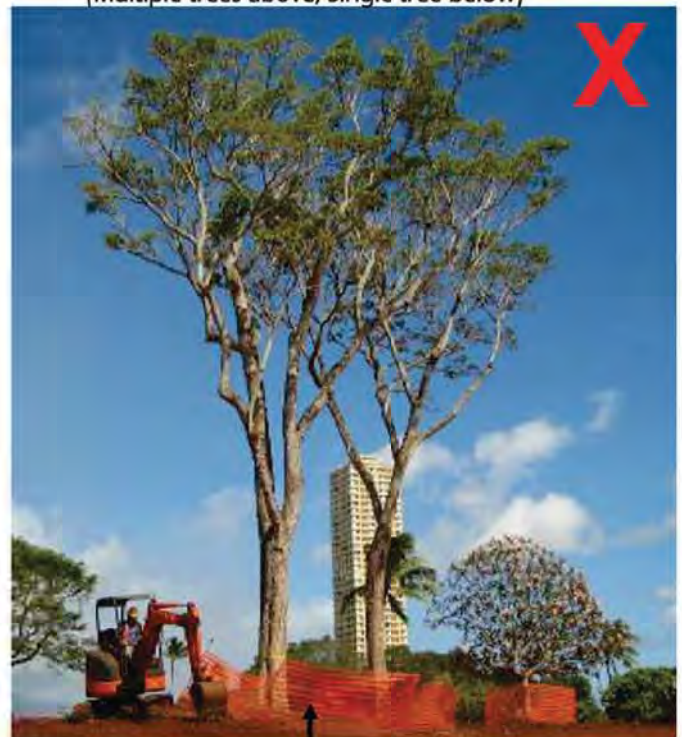


Photo 1 Weak fencing is not enough for protecting trees in construction site.

General Guidelines on Tree Pruning

Tree pruning is the removal of unwanted branches from a tree such as those shown on **Fig. (1)** either for reducing risk and inconvenience to the public, maintaining or improving tree health and structure, or improving appearance of trees. Improper tree pruning is detrimental to the appearance and healthy growth of trees and may result in irrecoverable damage to trees. These general guidelines provide basic information on tree pruning and issues requiring particular attention during execution of works. Tree pruning should be carried out by trained personnel and under proper supervision by experienced person with expertise in horticulture, arboriculture and tree care.

Purposes of Tree Pruning

2. The objectives of pruning should be established prior to commencement of any pruning operation. The purposes of tree pruning are broadly grouped under the following three categories –

- (a) **Reducing Risk and Inconvenience to the Public**
 - (i) keeping the roads clear and safe by removing the branches which obscure sight line of motorists or physically obstruct the vehicular accesses, leaving insufficient head room for large vehicles or double-decked buses.
 - (ii) preventing interlacement with overhead cables by regular pruning of trees to maintain acceptable clearance from overhead cables.
 - (iii) protecting pedestrians and properties from damage by dead, hanging and detached twigs/branches falling from the tree. Twigs/branches with potential to fall should be removed once detected.
 - (iv) maintaining road lighting condition by removing the branches of trees blocking street lamps.
- (b) **Maintaining or Improving Health and Structure of Trees**

To maintain trees in healthy growing conditions by -

 - (i) controlling invasion of pests and diseases by removing dead or insect-carrying twigs and branches in order to eliminate the harbourage for pests and diseases.

- (ii) avoiding wastage of food reserve by removing weak branches and undesirable shoots originating from the tree base to save food reserve for healthy parts of the tree.
 - (iii) allowing more light and air in or through the crown by removing overcrowded leaves, twigs and branches.
 - (iv) minimizing the chance of damage under strong wind through reducing the weight of tree by pruning out overcrowded twigs and branches. This is essential particularly when the root anchorage of tree is not firm when the root system is disturbed by transplantation or adjacent construction work.
- (c) Improving Appearance of Trees
To maintain trees in their most desirable form and structure.

Types of Pruning

3. The types of pruning are broadly grouped under the five categories listed below –

- (a) Formative Pruning
Selective pruning of the lateral branches of a tree so as to develop a strong and straight trunk, a well-balanced crown with properly spaced scaffolding branches and a clear central leader.
- (b) Crown Lifting
Selective pruning to remove lower branches to increase vertical clearance from ground level.
- (c) Crown Reduction
Selective pruning to reduce the overall height and spread of the crown, leaving the tree in a well-balanced and natural form and shape.
- (d) Crown Thinning
Selective pruning to remove weak, thin, crossing and live branches to reduce the density of foliage. Crown thinning should not affect the overall height and spread of the tree.
- (e) Cleaning

Selective pruning to remove dead, withered, damaged or diseased branches.

Timing of Pruning

4. The best timing for pruning each species may vary and expert advice should be sought when necessary. In general, the following criteria apply -

(a) Evergreen Tree

Pruning of evergreen trees just before spring is preferred due to faster healing in the coming growing season.

(b) Deciduous Tree

Pruning of deciduous trees after shedding leaves in winter when trees are dormant is preferred. This can minimize the risk of pest problem associated with wounding and allowing trees to take advantage of the full growing season to close and compartmentalize wounds.

(c) Young Tree

Suitable structural pruning of young trees would facilitate the development of a straight trunk.

5. Pruning for improvement on health of trees or reducing risk and inconvenience to the public may be conducted as and when required.

Safety Measures

6. The following safety measures are recommended for pruning operations to protect the operatives and public -

(a) Avoid pruning trees on humid, windy and rainy days as far as possible.

(b) Deploy adequate manpower to maintain traffic flow.

(c) Clear and fence off the tree pruning area to prevent entry by others.

(d) Place directional/warning signs to divert traffic/pedestrian, with approval from the authority, if necessary.

- (e) Operatives to put on proper protective clothing such as goggles, chainsaw trousers, safety boots, gloves and helmets.
- (f) Use appropriate tools for the job such as small chainsaws, polesaws, tubular saws, long pruners, ladders and ropes.
- (g) Remove objects attached to the trees which may hinder the pruning operation.
- (h) Bring along a first-aid kit for emergency.

Pruning Techniques

7. Pruning should be performed by trained personnel and under proper supervision by experienced person with expertise in horticulture, arboriculture and tree care to ensure that it is done safely and properly. Some common pruning techniques are listed below for reference.

- (a) Dead branches must be cut back to live tissue/growing point as shown on **Fig. (2)**.
- (b) Single top cut resulting bark tearing should be avoided and instead under cut technique should apply as shown on **Fig. (3) and (4)**.
- (c) Where removal of a whole lateral branch is required, do not cut flush to the main trunk or leaving a stub as shown on **Fig. (5) and (6)**. The final cut shall be made close to the trunk or parent limb, without cutting into the branch bark ridge or collar as specified in **Fig (7) and Fig (8)**. Long and heavy branches should be cut in sequence of section by section.
- (d) Avoid topping (i.e. cutting the trunk and branches between nodes leaving stubs) on mature trees as shown on **Fig (9)**. Topping would damage the tree form and structure as well as initiate decay in trunk and branches.

Points To Note

8. Some general good practices are listed below for reference -

- (a) Over pruning would affect the healthy growth of trees. A good practice is to limit the removal of crown to not more than one quarter of the original coverage in each pruning operation. Also, the crown should be kept in a well-balanced and natural form and shape after pruning.
- (b) Pruning prior to flowering seasons of trees should be avoided.
- (c) Clean and sharp tools should be used to produce smooth and clean cuts to facilitate healing and reduce the risks of attack by insects and fungi.

ETWB
February 2007

Draft for comment
(Version: 31 August 2015)

Unwanted Woods on a Tree

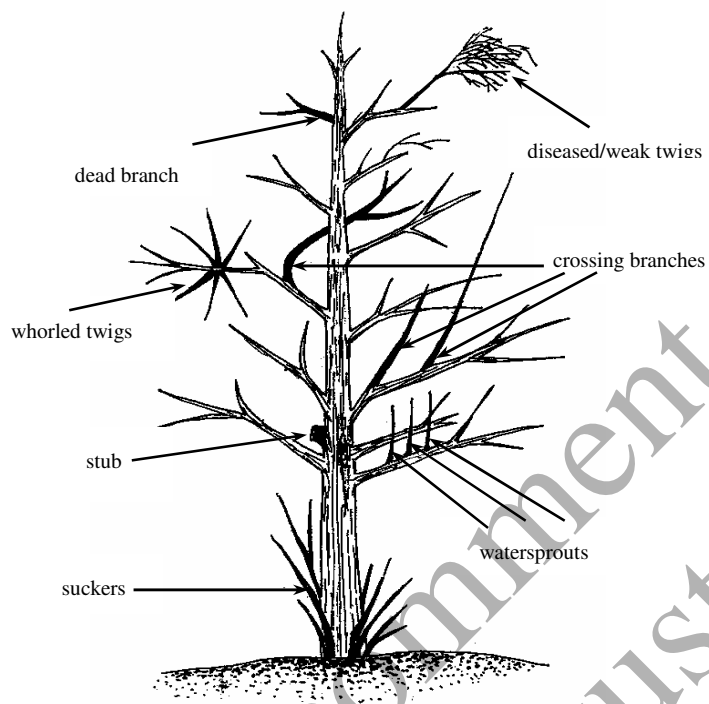


Fig. (1) Unwanted woods on a tree

Removal of Dead Twigs and Branches

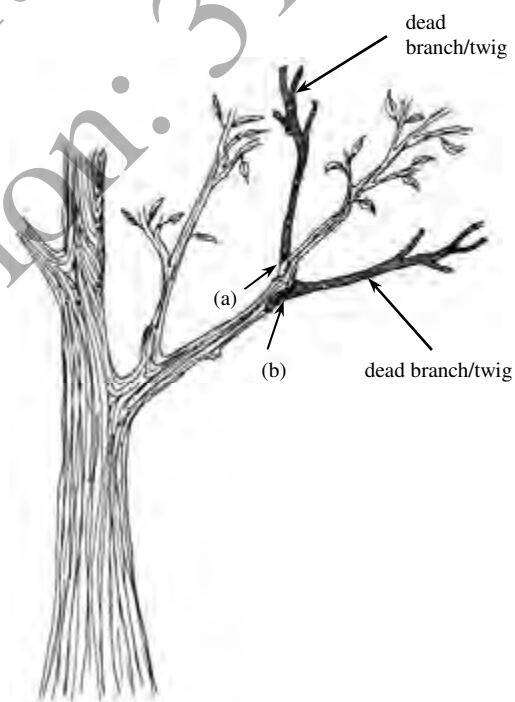


Fig. (2) (a) and (b) are ideal positions of cuts

Avoid Bark Tearing

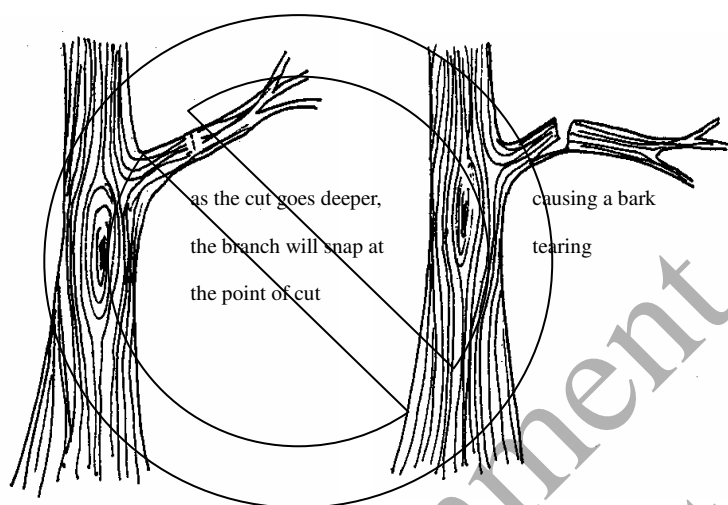


Fig. (3) A single top cut resulting bark tearing

Using Under Cut Technique

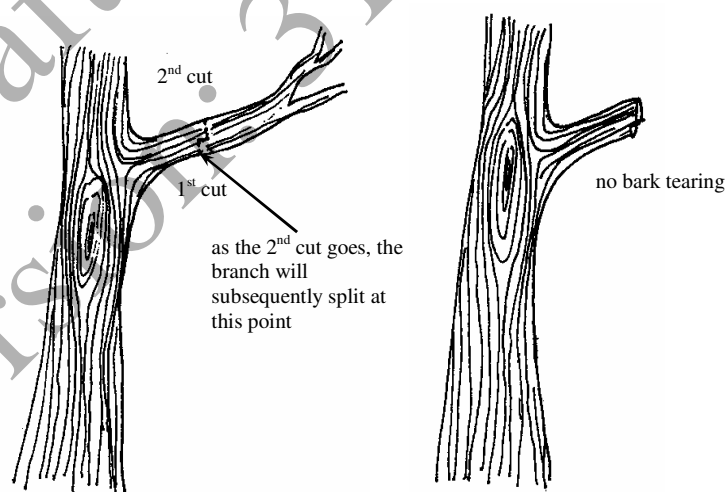


Fig. (4) Using under cut technique to avoid bark tearing. If the branch is a long and heavy branch, it should be cut in sequence of section by section. The final cut shall be made close to the trunk or parent limb, without cutting into the branch bark ridge or collar as specified in Fig (7) and Fig (8).

Do Not Leave a Stub

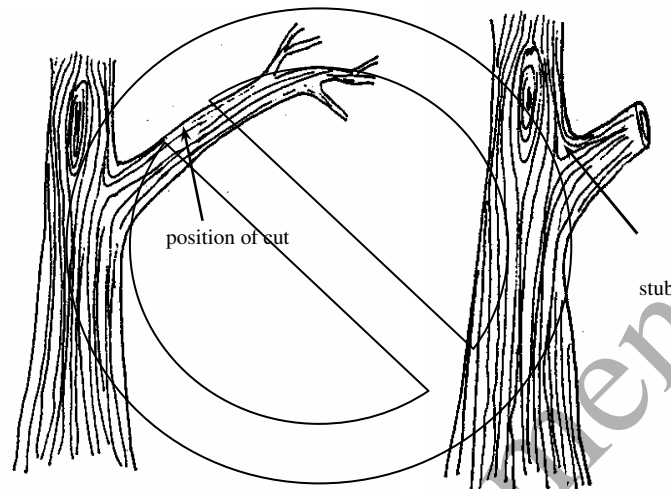


Fig. (5) The final cut has been poorly positioned leaving a stub.

Do Not Make a Flush Cut

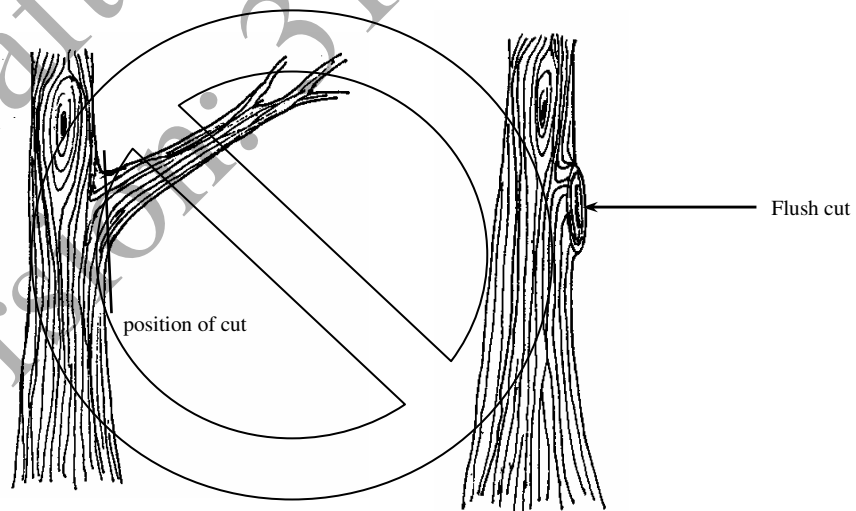


Fig. (6) The final cut has been positioned too close to the trunk and damaged the branch collar.

Removal of Branch with Visible Branch Collar

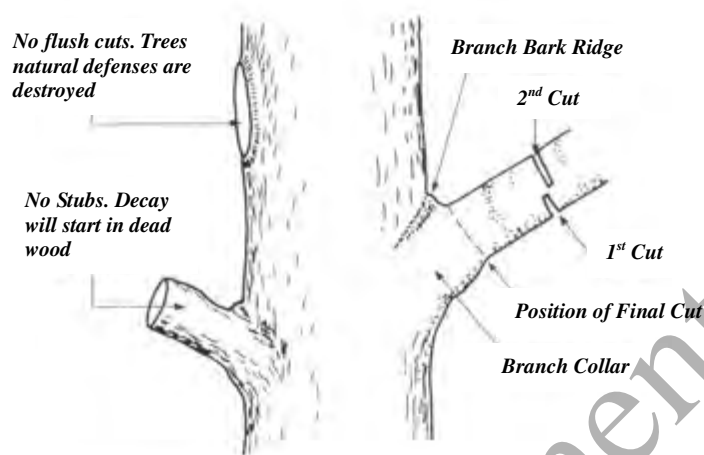


Fig. (7) Removal of branch with visible branch collar, the 1st cut is an under cut to avoid bark tearing, the 2nd cut is to remove the branch and the final cut is to remove the remaining stub without cutting into the branch bark ridge or collar.

Removal of Branch Without Visible Branch Collar

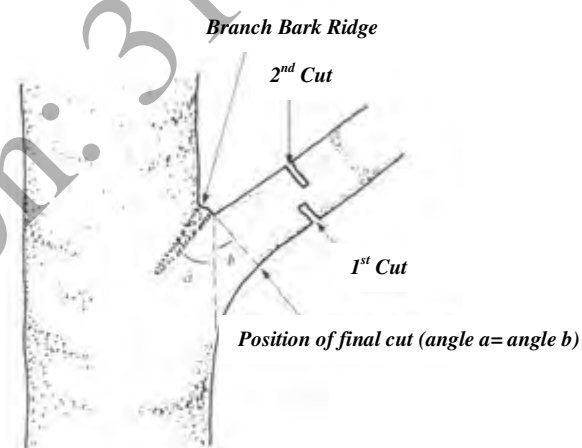


Fig. (8) The position of the cuts using branch bark ridge as guide where angle $a = \text{angle } b$. The 1st cut is an under cut to avoid bark tearing, the 2nd cut is to remove the branch and the final cut is to remove the remaining stub without cutting into the branch bark ridge or collar.

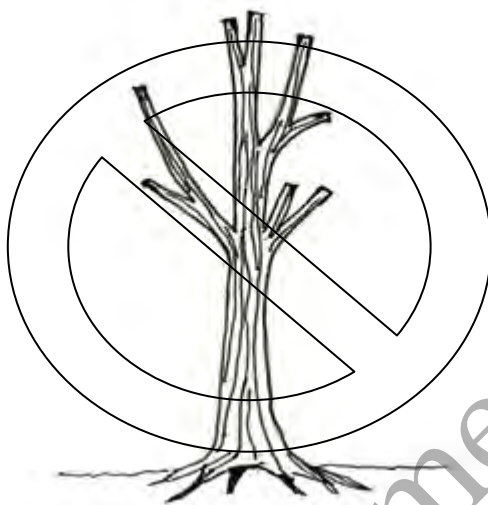
Do not Top a Tree

Fig. (9) No topping of tree trunk and branches

Draft for comment
(Version: 31 August 2015)

DO's and DON'Ts in Pruning



Introduction

"Pruning is one of the best things an arborist can do for a tree but one of the worst things we can do to a tree"

-Alex Shigo

Pruning is the most common tree maintenance work. Proper pruning helps to selectively remove defective parts of a tree and improves the structure of a tree, thereby contributes to the overall tree health and structure and reduces the risk a tree may cause to nearby persons or properties. Improper ways of pruning, in particular topping, can be detrimental to the health and structure of a tree and make a tree hazardous, hence it is essential to establish clearly defined objectives before commencement of any pruning

PROPER TREE PRUNING

	✓ DO's	✗ DON'Ts
Objective	<ul style="list-style-type: none"> Prune as necessary. 	<ul style="list-style-type: none"> Do not prune excessively or unnecessarily.
Common Types of Pruning	<ul style="list-style-type: none"> Crown Cleaning Crown Thinning Crown Reduction Crown Raising 	<ul style="list-style-type: none"> Lion Tailing Topping Over Lifting
Where to prune?	<ul style="list-style-type: none"> Edge of Branch Collar 	<ul style="list-style-type: none"> Stub remaining Flush Cut Large Pruning Cut
How to make pruning cut?	<ul style="list-style-type: none"> 3-point Cut 	<ul style="list-style-type: none"> Jagged Wounds Bark Tearing

How much to prune?

In general, pruning of large/mature trees should be avoided as far as practicable. No more than 25% of the live crown should be removed in any one year even for young trees.

Common Types of Pruning

✓ Crown Cleaning

Definition: Crown cleaning consists of selective removal of dead, dying, diseased and weak branches from a tree's crown.

Objective: As a tree grows, defective branches and watersprouts are found in the tree's crown from time to time. If these are not removed in a timely manner, the condition may worsen and affect the overall health of the tree.

Do's: Crown cleaning can be undertaken any time to correct these small growth problems before they have a chance to become major problems.



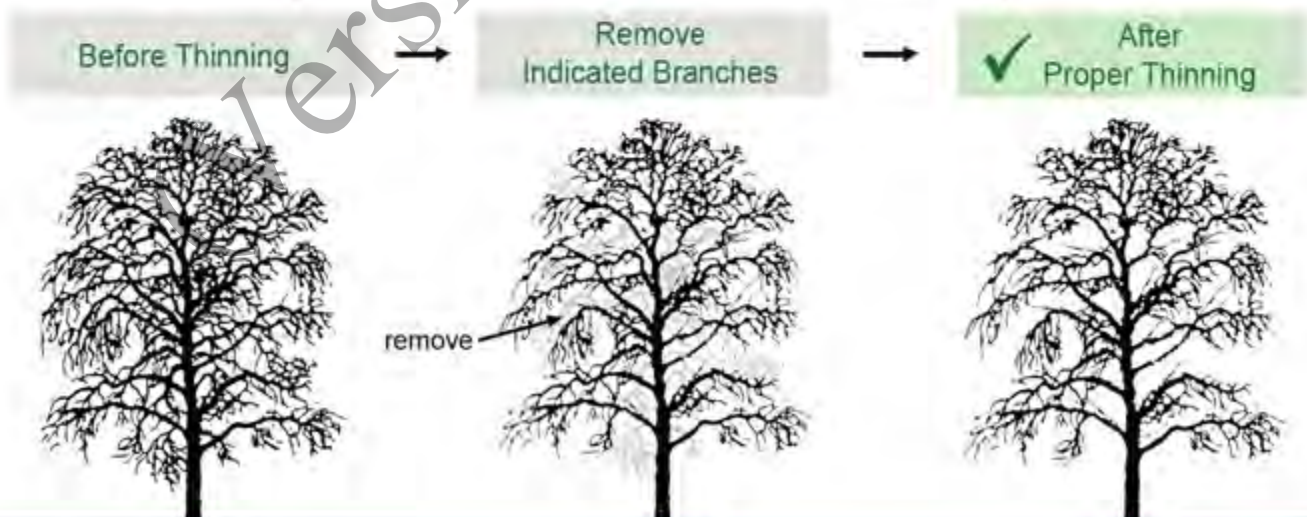
✓ Crown Thinning

Definition: Crown Thinning involves crown cleaning as well as the selective removal of small branches to reduce crown density.

Objective: To allow sunlight and air movement to penetrate to interior branches by developing a lighter and more open branch canopy.

Do's: Crown Thinning should be performed in a way to maintain an even distribution of branches and foliage, and care must be taken not to over-thin a tree. The extent of thinning in a year should be in the range of 10-15% of the live crown and should not exceed 25% in any case, especially for mature trees.

Don'ts: Clearing too much inner foliage will adversely affect the health of a tree. Vigorous production of watersprouts on interior limbs indicates over-thinning.



Common Types of Pruning

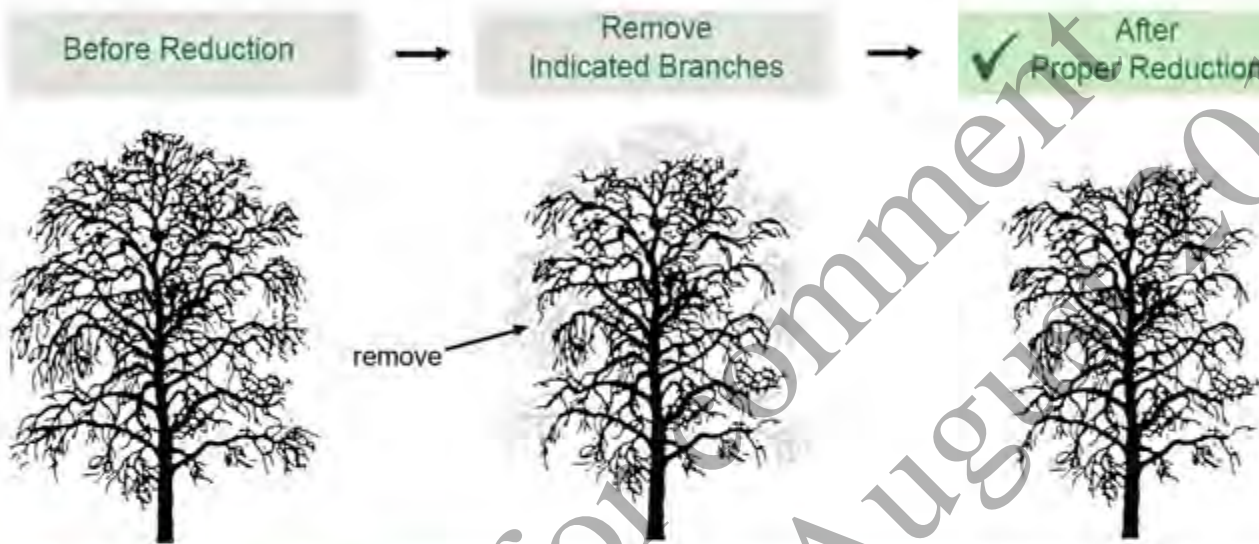
✓ Crown Reduction

Definition: Crown reduction is the selective removal of branches and stems to reduce the height and/or spread of a tree.

Objective: This type of pruning should be done when there is a need to minimize risk of failure of a tree, or reduce interference onto nearby buildings or other structures.

Do's: Reduction shortens stems and branches back to live lateral branches.

Don'ts: Reduction should be avoided for mature, old or stressed trees. In any case, no more than 25% of the foliage should be removed.



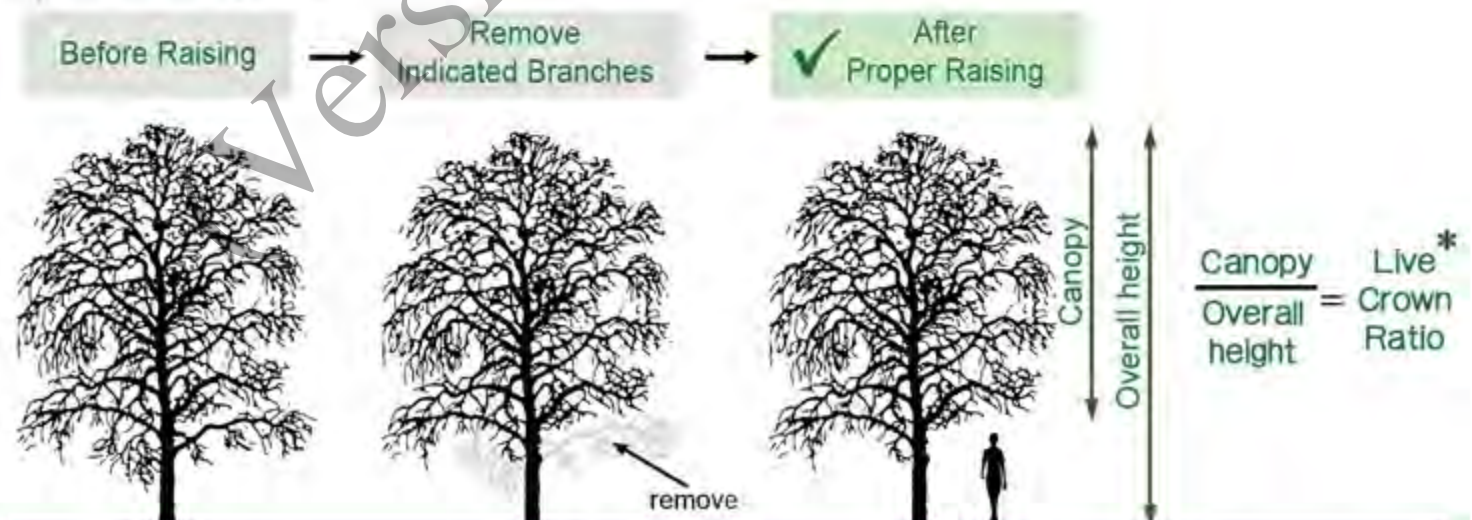
✓ Crown Raising

Definition: Crown Raising involves removal of lower branches of a tree.

Objective: To provide head height clearance for buildings, signs, vehicles, and pedestrians.

Do's: The resulting live crown ratio* should be more than 60%. Crown raising is best done gradually over a period of years.

Don'ts: Excessive removal of lower limbs should be avoided so that development of trunk taper is not affected.



Where to prune?

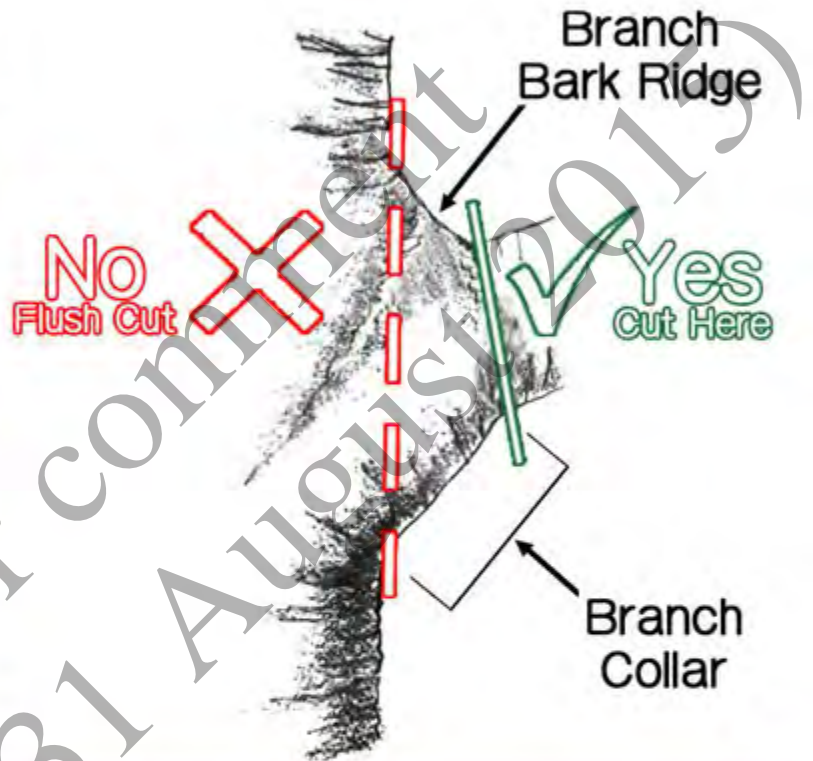
✓ Edge of the Branch Collar

Scenario 1- when there is **visible** Branch Collar

At the base of a branch where it joins the trunk, a **branch collar** can often be seen as a distinct swelling on the bottom, sides, and top of the branch base.

Do's: When removing a branch, it is best to make the pruning cut as close to the trunk as possible but just outside the edge of the collar. This will leave the branch protection zone intact, and prevent any possible decay from spreading to the trunk.

Dont's: Damage to the collar due to improper pruning may initiate decay in the trunk below the pruning wound.



Scenario 2- when there is **no visible** Branch Collar

Do's: Create an imaginary line parallel with the trunk when there is **no visible branch collar**. Duplicate the angle between the Branch Bark Ridge and the imaginary line to another side of the line. Execute the pruning cut from the top of the branch that shows an abrupt turn into the union.



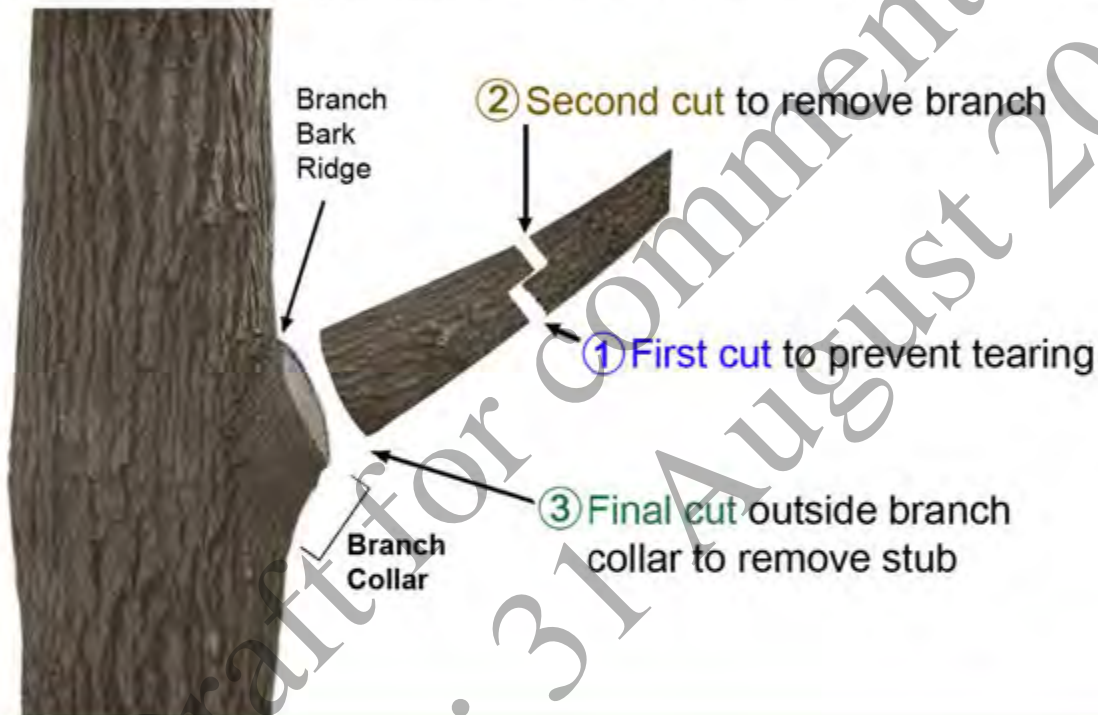
How to make pruning cut?

✓ 3-point Cut

Objective: The most efficient and least damaging way to remove large branches without causing damage to the tree is adopting a 3-cut approach, by which a branch is removed by three sequential cuts.

Do's:

- ① **The first cut** undercuts the limb at some distance away from the parent branch or trunk. A properly made undercut eliminates the chance of bark tearing during removal of the limb.
- ② **The second cut** is a top cut undertaken slightly further out than the undercut which helps to remove the limb.
- ③ **The final cut** is performed just outside the branch collar to remove the resultant stub.



Good pruning cut will help tree to compartmentalize decay



Complete closing of wound after a few years

Common Types of Improper Pruning



No Topping

1. Starvation:

- After topping, a large portion of the tree crown is removed.
- The removal of green foliage which is the source of food production will temporarily cut off the food making ability.

2. Insects and Diseases:

- After topping, the large diameter and the terminal location of these cuts reduce the process of 'Compartmentalization Of Decay In Trees', i.e. the natural process of wound closure in trees.
- The tree becomes vulnerable to pests and diseases.

3. Weak Limbs:

- Extensive water sprouts will develop, giving rise to new limbs that are weakly attached.
- These weak attachments are prone to failure.

4. Ugliness:

- The tree form is heavily distorted. Even if the tree survives, it will never return to its original and natural form.
- The valuable landscape for the community is permanently lost.

5. Cost:

- The adverse impact on the tree may give rise to increased expenses in the long term, due to the replacement cost, the risk of liability from failure of weakened branches, and increased future maintenance.



Common Types of Improper Pruning



No Lion Tailing

Definition: If only the branches from the interior of the canopy are removed, too much weight at the ends of the branches would cause limbs to over-elongate, a situation known as lion-tailing.

Why Not: Lion-tailing may result in sunburn, watersprouts, reduced branch taper, weakened branch structure and breakage.



No Over-Lifting

Definition: A common malpractice on pruning a large tree or when performing crown raising is removing many or all interior low branches, giving rise to a situation known as over-lifting.

Why Not:

- Interior branches also provide food source needed by the tree to carry on normal defense and other functions.
- Health of the tree can be adversely affected with removal of excessive live tissues.
- A poor tree form with low live crown ratio is created.
- The tree will become more prone to failure.



Where to prune?



No Flush Cut

Definition: Cutting into the branch collar creates a flush cut.

Why Not: A pruning cut flush with the trunk will damage the branch collar and make a larger wound that opens the trunk to decay, causes cracks, and increases the likelihood of disease infection.



No Stub remaining

Definition: Pruning cut that is located far beyond the branch collar will leave behind a branch stub.

Why Not: The remaining stub is susceptible to wood-decaying organisms, especially while the cut is open to the air, before wound-wood completely closes over it. Decay beginning in stubs can break through the branch protection zone and move into the trunk, causing trunk rot and increasing the potential of branch/trunk failure.



No Large Pruning Cut

Why Not: Large pruning cut outside of branch collar exposes a large area of heartwood and creates a large wound that increases the likelihood of decay and disease infection.



How to make pruning cut?



No Bark Tearing

Why Not:

- Tree bark protects the inner bark that is responsible for bringing food produced by the leaves to the rest of the tree.
- When a pruning cut is improperly made resulting in bark tearing, the branch collar is damaged and this would impair the tree's ability to close wound and will lead to decay.

No Jagged Wounds

Do's:

- A clean cut during pruning is important.
- Pruning tools should be sharp so as to make clean cuts without jagged edges or stubs. Tools adequate for the size of cuts being made should be selected.

Why Not:

- Jagged wounds don't close well and may lead to more extensive decay, resulting in more broken limbs.
- Jagged wounds will interfere with the tree's ability to transport nutrients and therefore affect the overall tree health.



General Note

Please read in conjunction with 'Guidelines on Pruning' at <http://www.devb.gov.hk/greening/en/preservation/guidelines.pdf>

References

- Gilman, E. F., "An Illustrated Guide to Pruning", 2nd edition, Delmar Publishers, Albany NY, 2002
- Gilman, E. F., Lilly S.J., "Best Management Practices- Tree Pruning", International Society of Arboriculture, US, 2002
- Harris, R.W., Clark, J.R., & Matheny, N.P., "Arboriculture: Integrated Management of Landscape Trees, Shrubs, and Vines", 4th edition, Prentice Hall, Upper Saddle River, NJ, 2004
- Hazell, J., et al., "Guidance Note 8- Framework For Tree Work Contracts", The Arboricultural Association, UK, 2009
- Tree Care Industry Association, "American National Standard for Tree Care Operations- Tree, Shrub, and Other Woody Plant Maintenance- Standard Practices (Pruning) (A300, Part1)", Tree Care Industry Association, Manchester, NH, 2007

目的 Objective

- ✓ 對 Do's**
- 在展開修剪工作前，須清楚定下修剪的目的。
 - 有需要時才修剪。
 - It is essential to establish clearly defined objectives before commencement of any pruning operation.
 - Prune as necessary.

常見的修剪 Common Types of Pruning

• 清理樹冠 Crown Cleaning



• 提升樹冠 Crown Raising



應該在哪裡修剪? Where to prune?

• 枝領外圍 Edge of Branch Collar



如何妥善地修剪樹木? How to make pruning cut?

• 三刀法 3-point Cut



✗ 不要 Don'ts

- 不要過度修剪；如非需要，不應修剪。
- 每年修剪幅度應盡量減低；並且應避免不必要地修剪成熟或衰老的樹木。
- Do not prune excessively or unnecessarily.
- Keep annual pruning to the minimum and do not prune mature tree or over mature tree as far as practicable.

✗ 錯

• 獅尾式修剪 Lion Tailing



• 過度提升樹冠 Over Lifting



• 截頂 Topping



• 留下枝柄 Stub remaining



• 過大的剪切口 Large Pruning Cut



• 平貼樹幹切割 Flush Cut



• 扯脫樹皮 Bark Tearing



• 鋸齒狀的傷口 Jagged Wounds



備忘 Note

請瀏覽 <http://www.devb.gov.hk/greening/tc/preservation/guidelines.pdf> 網址，與「修剪樹木的一般指引」一起參閱。
Please read in conjunction with 'Guidelines on Pruning' at <http://www.devb.gov.hk/greening/en/preservation/guidelines.pdf>

參考資料 References

Gilman, E. F., "An Illustrated Guide to Pruning", 2nd edition, Delmar Publishers, Albany NY, 2002
 Gilman, E. F., Lilly S.J., "Best Management Practices- Tree Pruning", International Society of Arboriculture, US, 2002
 Harris, R.W., Clark, J.R., & Matheny, N.P., "Arboriculture: Integrated Management of Landscape Trees, Shrubs, and Vines", 4th edition, Prentice Hall, Upper Saddle River, N.J, 2004
 Hazell, J., et al., "Guidance Note 8- Framework For Tree Work Contracts", The Arboricultural Association, UK, 2009
 Tree Care Industry Association, "American National Standard for Tree Care Operations- Tree, Shrub, and Other Woody Plant Maintenance- Standard Practices (Pruning) (A300, Part1)", Tree Care Industry Association, Manchester, NH, 2007

APPENDIX 19 – SAMPLE OF TREE MAINTENANCE RECORD

Tree Maintenance Record

A. General Information

Location:			
Date:		Weather:	

B. Maintenance Work

Maintenance Item	Tick if Action Taken	Remarks (tree no., tree condition, mitigation measures, etc.)
(a) Watering		
(b) Pruning		
(c) Fertilising		
(d) Weeding		
(e) Mulching		
(f) Staking		
(g) Pest and disease control		
(h) Others		

C. Record Photos

Prepared by :

Signature:

Date:

Reviewed and Approved by :

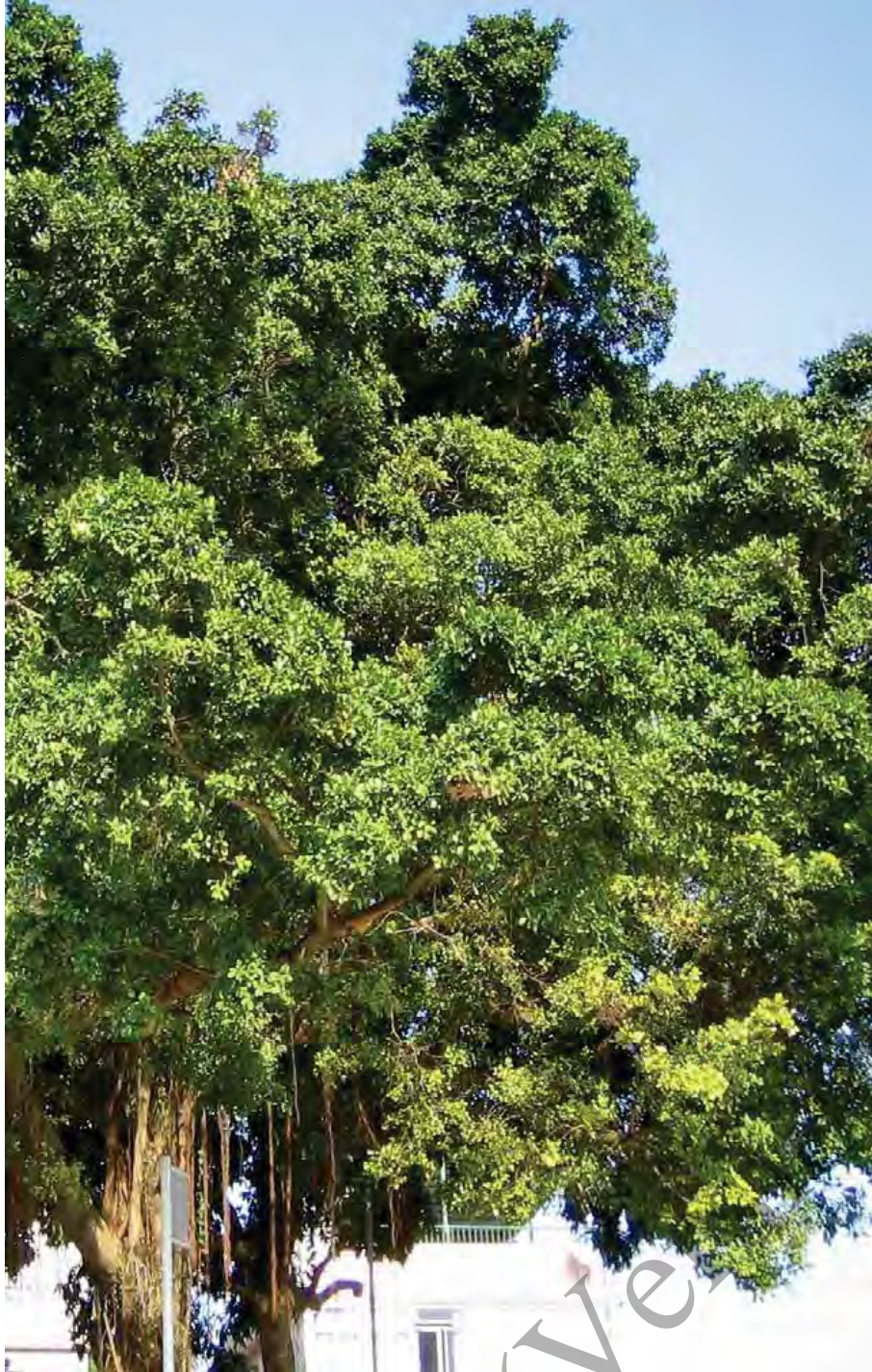
Signature:

Date:



Selection of Trees





Content

- *Tree Selection Consideration*
 - *Design / Tree Function*
 - *Tree Requirements*
 - *Site Restrictions*
 - *Biotic / Abiotic challenges*
- *Decision-making Process*
- *Nursery Stock Selection*
 - *Bare Root*
 - *Balled & Burlapped*
 - *Container*
 - *Field Stock*
- *Select Quality Trees*



Right Tree for the Right Place



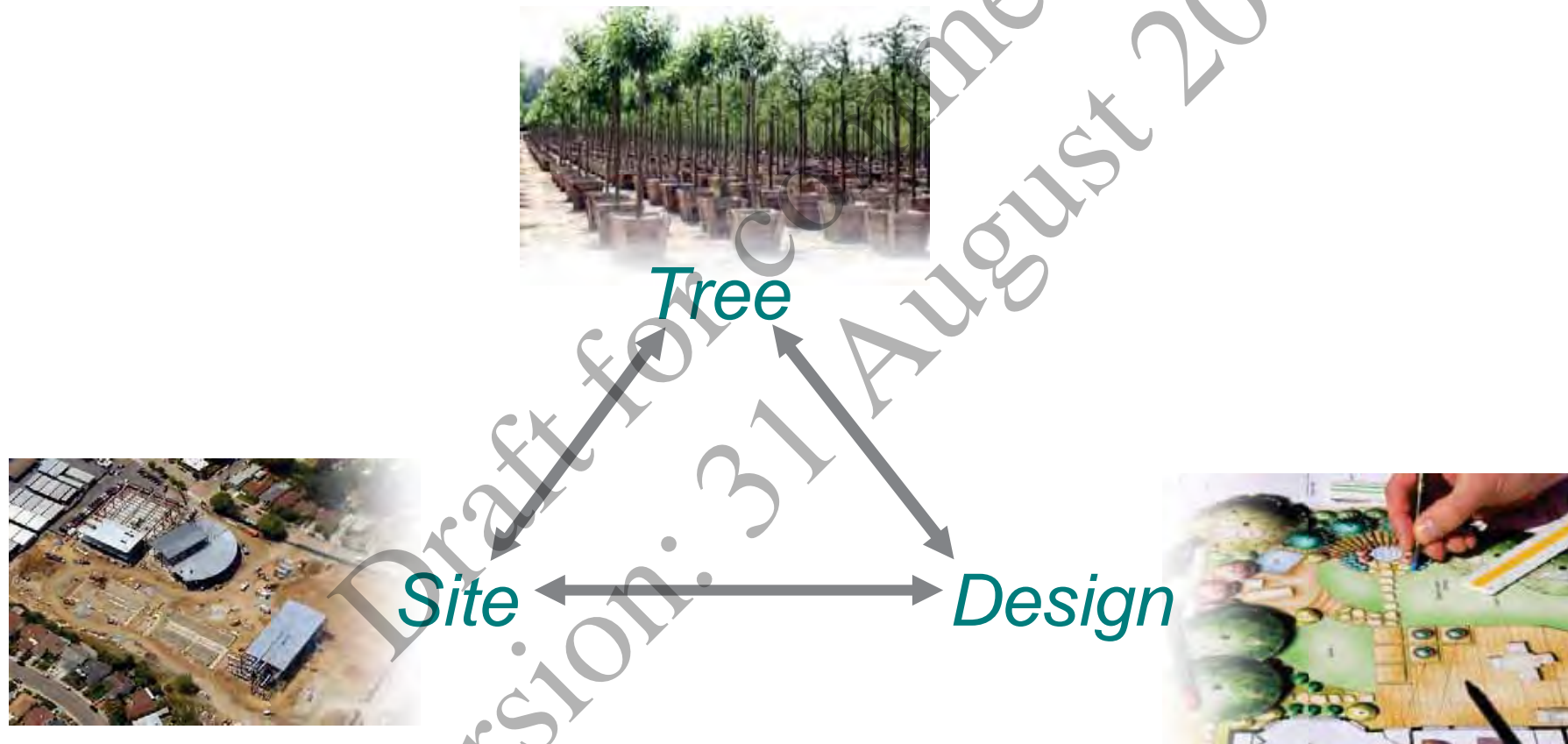
Long Term Success:

- *Tree characteristics match site characteristics*
- *Site characteristics match tree characteristics*



Right Tree for the Right Place

Selection consideration



Source:
<http://www.treenurseries.us/nursery-pots-600.jpg>
<http://www.patio-design.net/wp-content/uploads/2013/03/140453929.jpg>
<http://www.allamericanpatriots.com/files/images/school-construction-site-california.jpg>



Right Tree for the Right Place

Designers/ Engineers/ Arborists can't make the rules:



Big trees for big sites



Small trees for small sites



Big trees for small sites?

- *Nature makes the rules*
- *Engineers/Landscape Architects/Installers are not magicians*
- *Site modifications to meet nature's requirements are possible*
 - *Requires time and \$\$\$*



Right Tree for the Right Place



Design / Tree Function

Tree Requirements



Site Restrictions

Biotic / Abiotic Challenges



Source:
http://gallery.mailchimp.com/6bc0262b6ec3a7753aae616b9/images/1_1.jpg



Tree Selection Consideration

Design/Tree Function - Why?

- Shade
- Focal Point
- Fruit/Flowers
- Fragrance
- Screen/Buffer
- Aesthetic Attributes
 - Showy flowers & fruit
 - Interesting growth form
 - Attractive bark
 - Leaf form, texture & colour



Tree Selection Consideration

Tree Requirements



Hardiness Zone (Climatic condition)

Space



Water Availability



Soil

Light



Tree Selection Consideration

Hardiness zones

- *Defined area in which a specific category of plant life is capable of growing*
- *Defined by climatic conditions, including its ability to withstand the **minimum temperatures** of the zone.*



Space

- *Growth form / size*
- *Mature height*
- *Mature crown spread*
- *Mature DBH*



Tree Selection Consideration



Water Availability

- Amount
 - Timing
 - Seasonal differences
 - Soil type
- **Deep and infrequent irrigation** encourages deep root system
 - **The most beneficial time for watering is during the late afternoon and early morning**



Tree Selection Consideration

Soil

- pH
- Structure
- Water holding / drainage
- Volume
- Fertility



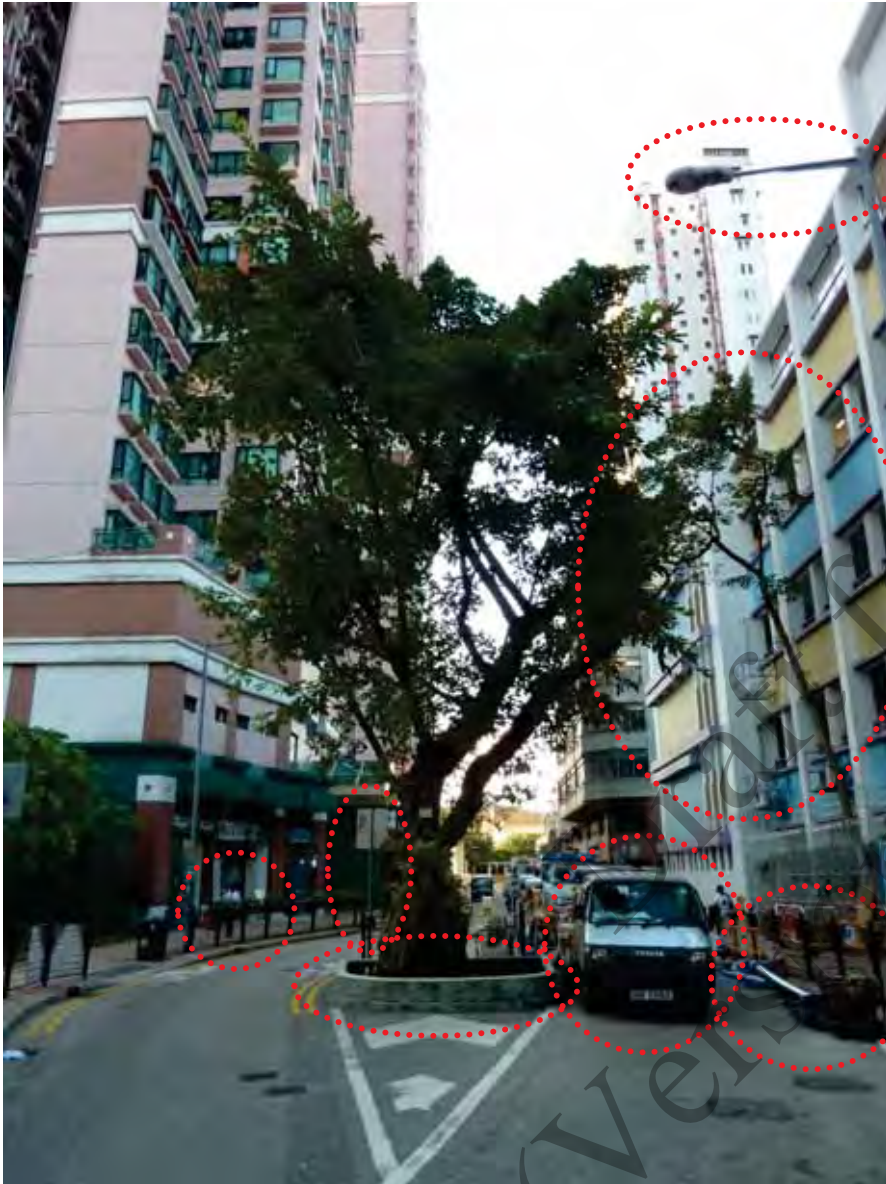
Light

- Direct
- Filtered
- Shade

<http://www.thedailygreen.com/green-homes/blogs/organic-gardening/greenhouses-houseplants-460320>



Tree Selection Consideration



Site Restrictions

- *Underground utilities*
- *Overhead utilities*
- *Streets / sidewalks*
- *Vehicles / pedestrians*
- *Buildings*
- *Signs / lights*
- *Root zone (especially within mature dripline)*
- *Viewplanes*
- *Tree debris*
- *Wind*
- *Salt*
- *Light*



Tree Selection Consideration



Underground Utilities

- Tree root characteristics



Overhead Utilities

- Tree height (<8m)



Tree Selection Consideration

Streets / Sidewalks

- Distance from tree
- Soil structure / surface



Vehicles / Pedestrians

- Tree form – branch spread
- Lowest limb



Tree Selection Consideration



Buildings

- Distance from structure
- Tree form – branch spread

Signs / Light

- Distance from structure
- Tree form – branch spread



Tree Selection Consideration



Viewplanes

- Tree height
- Tree form – branch spread
- Sight from potential obstructions



Tree Debris

- Leaf, flower and fruit drop
- Amount and timing



Tree Selection Consideration



Root Zone

- Especially within mature dripline



Tree Selection Consideration



Wind

- Tree structural strength
- Branch breakage
- Leaves shredded
- Drying



Salt

- Salt spray tolerance

Source:
<http://us.123rf.com/400wm/400/400/400/elarina/400/400/elarina1109/elarina110900082/10573684-the-structure-of-the-seabed-sand-and-salt-waves-in-clear-water-blurring-at-the-edges.jpg>
<http://media-cdn.tripadvisor.com/media/photo-s/02/2d/9e/0b/sand-beach-salt-water.jpg>



Tree Selection Consideration



Biotic / Abiotic Challenges

- Insect/disease susceptibility
- Drought tolerance
- Species characteristics
- Maintenance requirements
- Influence of other plants



Tree Selection Consideration



Draft for Comment
(Version: 21 August 2015)

Insect / Disease Susceptibility



Tree Selection Consideration



VS



Drought Tolerance

http://www.ctahr.hawaii.edu/nelsons/papaya/1_lightning_injury_papaya_1_wilting1.jpg



Tree Selection Consideration



Species Characteristics

1. Weak structure
2. Surface roots
3. Invasive roots
4. Debris
5. Thorns
6. Bees

Source:
http://farm4.static.flickr.com/3397/3548016047_850389b8b4.jpg



Tree Selection Consideration

Maintenance Requirements



- Irrigation



Debris



- Pruning

Source:
<http://canopytrees.co.uk/wp-content/uploads/2012/06/Hedge-Trimming-1.jpg>



Tree Selection Consideration



Leucaena leucocephala (銀合歡)

Influence of other plants

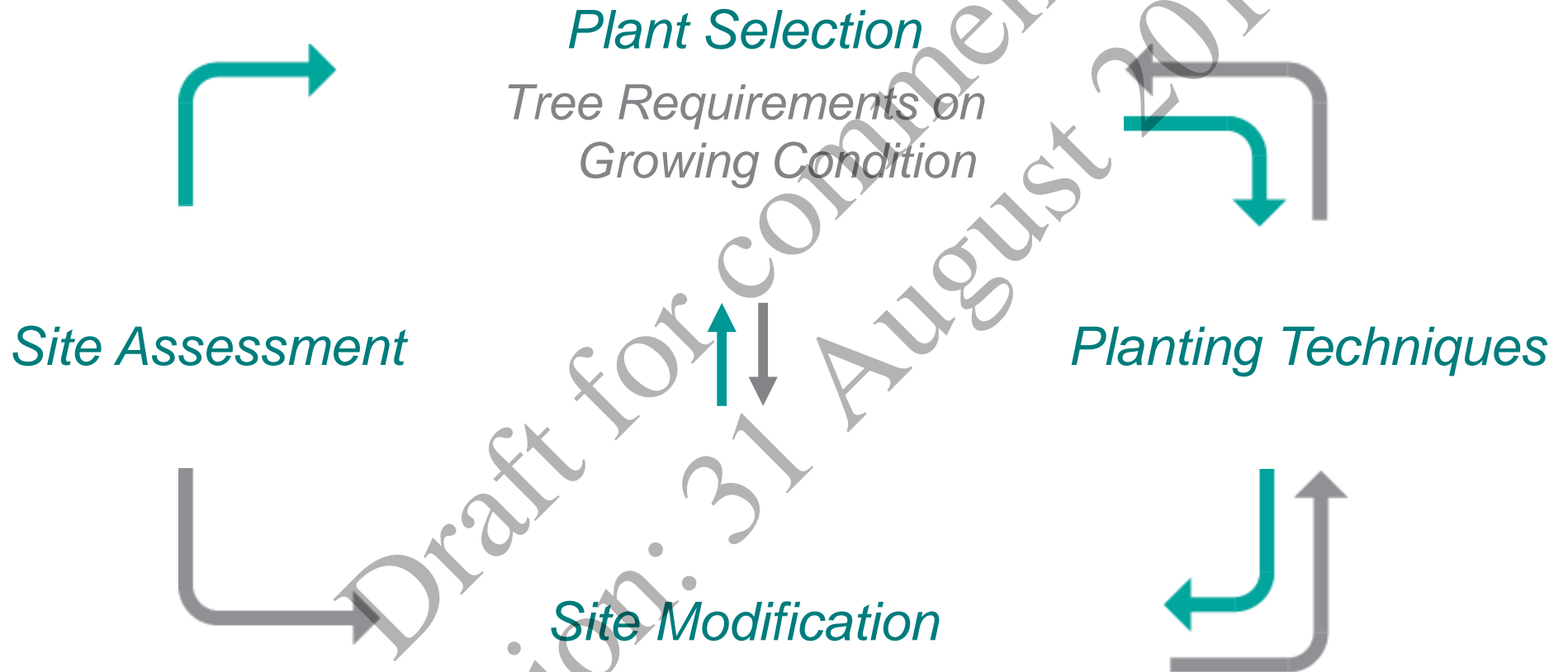
- Shade
- Competition – moisture and nutrients
- Allelopathy

Source:

<http://163.23.253.211/93-94/94%E5%B9%B4/53/%E9%8A%80%E5%90%88%E6%AD%A1/銀合歡01.jpg>



The Decision-making Process



The Decision-making Process

- *Every site requires slightly different cultural treatment*
- *Variation within a site*
- *Requires cooperation & communication between:*
 - *Designer / Engineer*
 - *Landscape Architect*
 - *Qualified Arborist*
 - *Installer*
 - *Maintenance agent*



Challenges of Urban Site



- *Soils disturbed, often compact*
- *Limited soil volume*
- *Low organic and nutrients*
- *Limited watering*
- *Reflected light & heat*
- *Salt & other toxic chemicals*
- *Poor species diversity - monocultures*
- *Intense human pressure*



Nursery Stock Selection



Start with quality stock

- *minimizes current and future maintenance*
- *ensures achievement of functional tree value*
- *minimizes public safety risks in the future*

<http://www.plantmeafruitree.com/wp-content/uploads/2012/05/Stone-Fruit-Nursery-crop.jpg/>



Nursery Stock Selection

Growing Method



Bare Root



Balled & Burlapped



Container



Field Stock

http://ucanr.edu/blogs/slomggarden/blogfiles/13659_original.jpg
<http://elizabethfarms.com/evergreens/wp-content/uploads/2012/04/balled-and-burlapped-trees.jp>
http://blooms4all.com/topicimages/fruit_trees_in_containers.jpg
<http://www.ghumil.com/wp-content/uploads/alone-tree-in-green-field-hd-wallpaper.jpg>



Bare Root



Bare Root



Balled & Burlapped



Container



Field Stock

Advantages

- Easy to transport
- No soil (light weight & no soil borne insects & diseases)
- Capture more roots
- Can easily inspect & prune damaged or defective roots

Disadvantages

- Roots susceptible to drying
- Supply is traditionally limited to small-sized plants



Balled and Burlapped



Bare Root



Balled & Burlapped



Container



Field Stock

Advantages

- *Easy to store*
- *Can be planted anytime*
- *Relatively drought tolerant during establishment*
- *Usually grown locally*
- *Low maintenance establishment*

Disadvantages

- *Heavy (difficult to handle)*
- *Loss of absorptive roots (up to 90 - 95%)*
- *Synthetic fabrics **must be** removed*



Container



Bare Root



Balled & Burlapped



Container



Field Stock

Advantages

- Easy to transport
- Can be planted anytime



Disadvantages

- Girdling roots
- Fabricated soil mix (water movement)



Field Stock



Bare Root



Balled & Burlapped



Container



Field Stock

Advantages

- *Transplant large trees*
- *Reduced incidents of girdling roots*

Disadvantages

- *Heavy (difficult to handle)*
- *Large trees*
- *Expensive*
- *Usually inadequate root ball size*
- *Usually poorly pruned to facilitate transport*



Stock Size



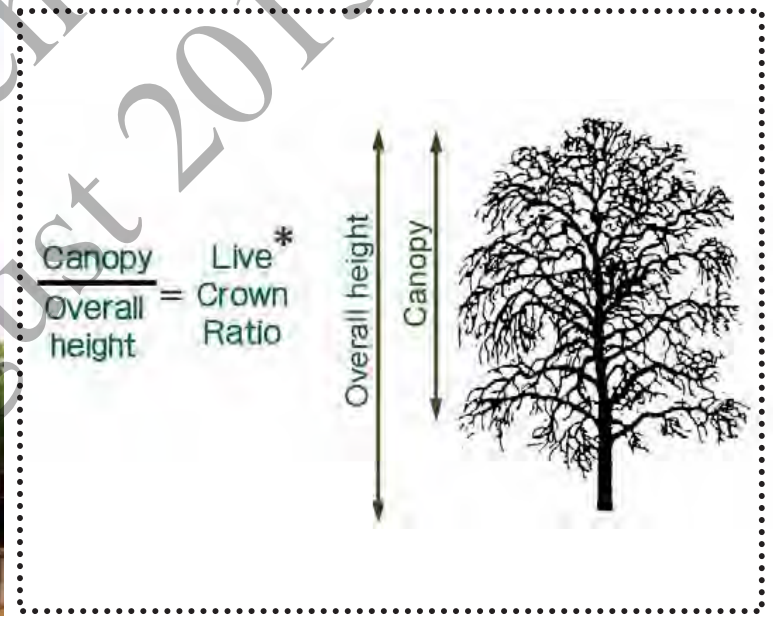
Bigger is not better

Larger plants

- *get more stresses*
- *adapt and thrive more slowly*
- *are more susceptible to insect / disease attack*



Select Quality Trees



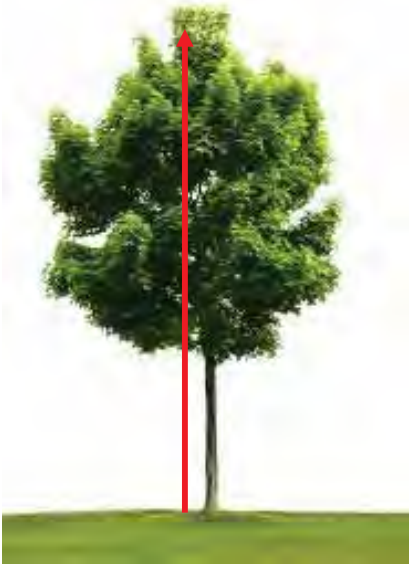
Avoid unnecessary future costs and failure

- Size diameter at breast height (DBH) as specified for the project
- Proper structural pruning
- Transportability
- At least 60% of height is crown

http://www.lacrestatree.com/images/lacresta/spotlight_images/03-Tree_Moving.jpg/



Select Quality Trees



Natural structure and architecture

- Dominant central leader
- No significant crossing limbs
- No included bark
- Main branch connections $< 2/3$ diameter of trunk
- Proper branch spacing and symmetry

<http://www.stcatharines.ca/en/resources/tree.jpg>



Select Quality Trees



Inadequate root ball size

Adequate root ball as per tree size

Guide: 300mm diameter per 25mm trunk caliper

Select Quality Trees



Satisfactory vigor:

- Normal leaf size and color
- Vigorous shoot growth
- Satisfactory foliage density

<http://www.preservationtreecare.net/images/Tree.jpg>
<http://hort.ifas.ufl.edu/woody//images/goodquality6.jpg>
<http://www.tennessee recycling.net/assets/images/tree.jpg>



Select Quality Trees



Satisfactory condition:

- *No signs or symptoms of significant insect or disease infestation*
- *No significant damage to trunk and / or limbs*
- *Wounds (<10% circumference & <50mm length)*

<http://www.mobot.org/gardeninghelp/images/Pests/Pest673.jpg>



Select Quality Trees



Healthy root system:

- No significant crushed or torn roots
- Network of white, vigorous young roots
- Satisfactory root size and distribution
- <20% trunk diameter growing from container
- No large girdling roots
- No large 'J' roots

http://www.canby.com/benwalker/SuperiorTrees_files/image024.jpg

www.ctahr.hawaii.edu/nelsons/coffee/coffee.html

http://fanntum.com/images/advantages/root_circling.jpg

<https://sharepoint.cahnrs.wsu.edu/blogs/urbanhort/Lists/Photos/Plant%20inspection/knee%20root.jpg>



Select Quality Trees

Root flare properly above ground level



<http://http://www.houston-imports.com/forums/showthread.php?p=12616525>

<http://http://www.treesquirrel.us/root-flare.jpg>



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Greening, Landscape and Tree Management Section, Development Bureau

Select Quality Trees



Good soil structure in root ball

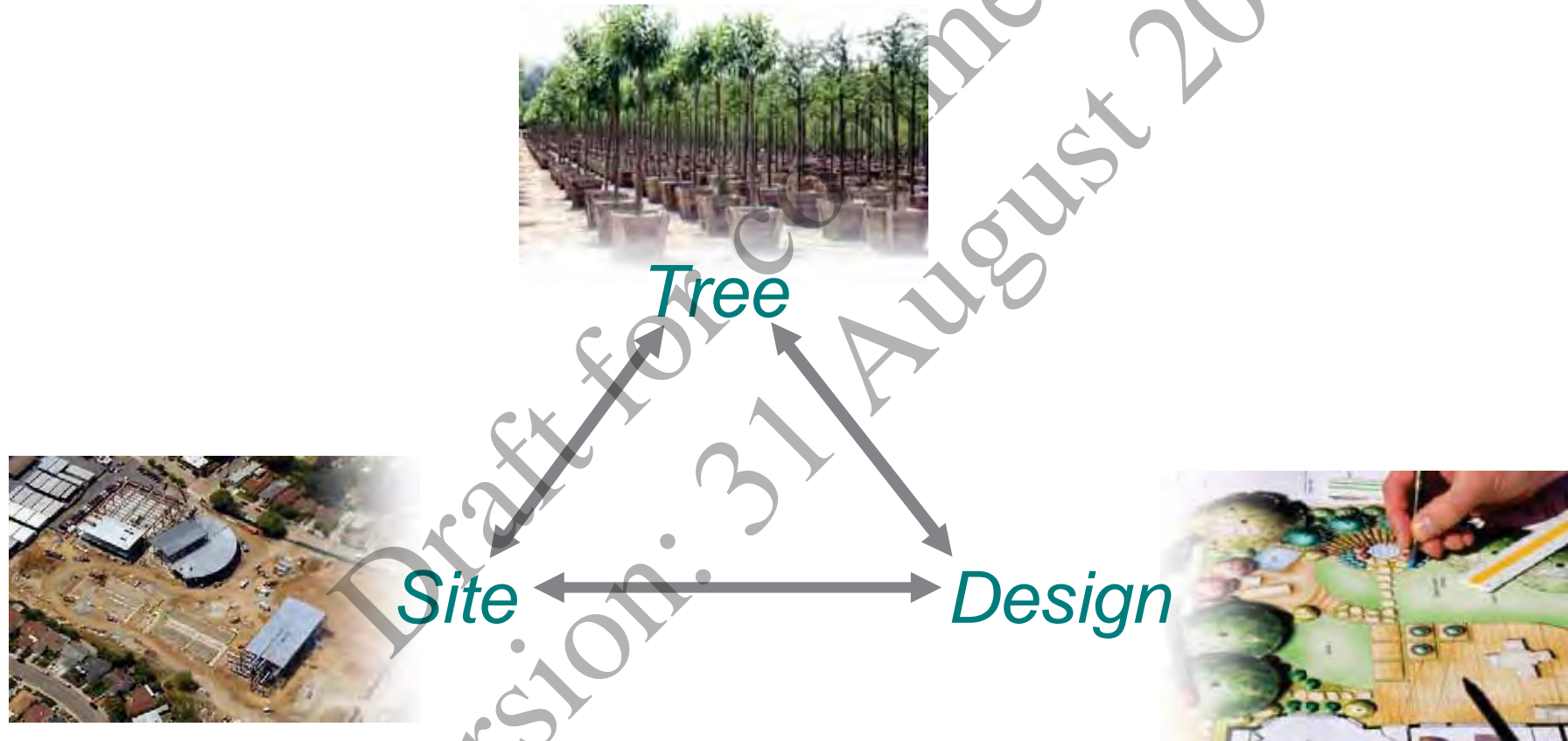
When tree is gently pushed, root crown does not move in soil

<http://homemag.co.za/files/2012/09/55.jpg>



Conclusion

Selection consideration



<http://www.treenurseries.us/nursery-pots-600.jpg>
http://www.paularojas.com/wp-content/uploads/2008/06/landscape_architect.jpg
http://www.allamericanpatriots.com/48746113_california-construction-company-and-district-offic



Select and plant good specimens



Photo 1 Specimens with good form and structure with sufficient root ball size without girdling roots



Photo 2 Example of the poor quality root ball

- Only accept and plant good specimens that fulfil the contract specifications

Specimens with good health and structure have the following characteristics:

- Central leader with good taper (except multi stem species)
- Good spacing of scaffolding branches (Diagram 1)
- Free of co-dominant stems
- Balanced canopy and normal foliage
- Good live-crown ratio (Diagram 2)
- Sufficient rootball size
- Free of root defects e.g. circling roots, kinked roots, girdling roots
- Free of large wound / cavity / split / crack
- Free of pest / disease
- Free of structural defect

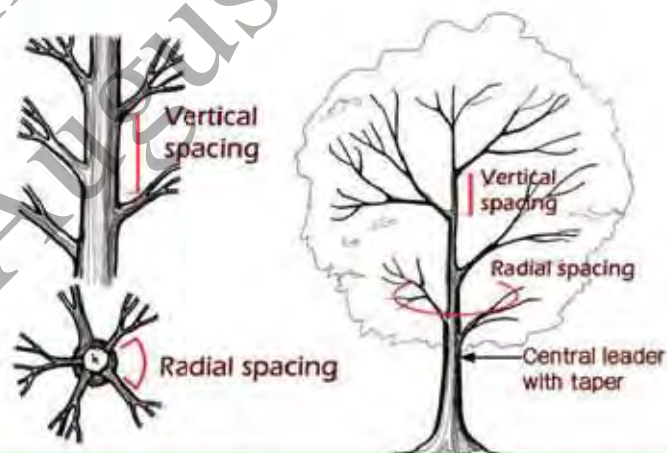


Diagram 1: Scaffold branches require proper vertical and radial spacing on the trunk.

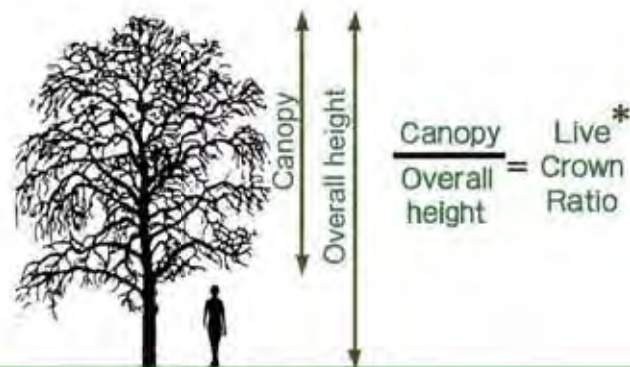


Diagram 2: The live crown ratio* should be more than 60%

Provide Adequate Growing Space For Future Growth Of Canopy



Photo 1 & 2 Trees planted too close for instant greening effect will lead to poor health and structure of trees in the long run

Photo 3 & 4 Trees planted with adequate spacing will develop better form and structure

The Importance of Adequate Growing Space

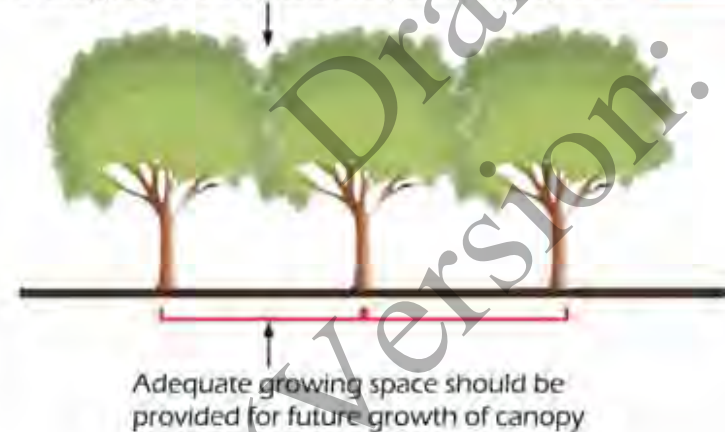
Adequate growing space is required for roots to anchor and obtain water, oxygen, and nutrients; and also for the crown to develop proper structure. In general landscape planting, trees planted too close will result in poor health and structure¹.

When allocating space for trees, the mature form, height and crown spread of the trees as well as the purpose of the planting should be taken into consideration.

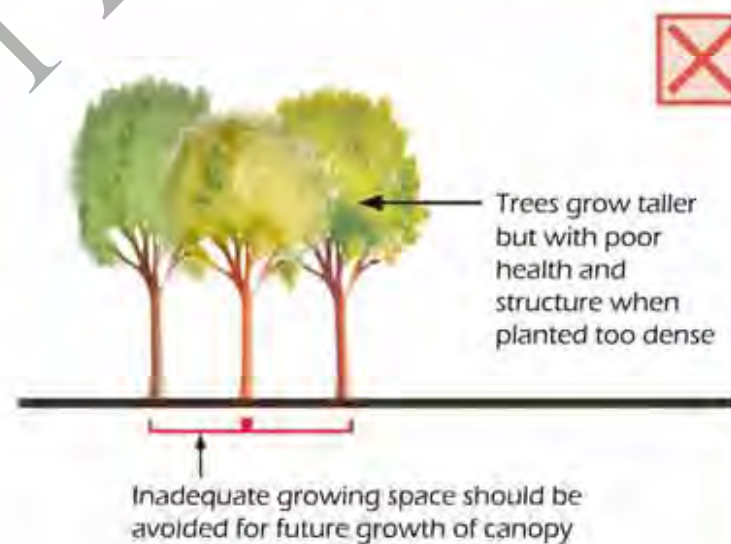
In a spacious location, trees are best to be planted to allow the full width of the mature canopy. However, trees are very often used to achieve certain purposes such as to screen a view or achieve a desirable shade etc. Flexibility should therefore be allowed for some overlapping of tree canopies to an extent that is appropriate for the situation.

Adequate Spacing

Provided that the extent of overlapping will not adversely affect the tree structure, partial overlapping of canopies is acceptable/appropriate



Narrow Spacing



Narrow spacing may lead to:

- significant crown competition
- poor structure as trees cannot develop to full form or well developed taper
- susceptibility to wind or sun damage if one or more trees in the same stand die
- more disease and insect problems
- more long term stress related problem

¹ Trees, however, may be planted closely together in forestry plantation to achieve the desired vegetation coverage quickly during the early afforestation stage, or in specially designed urban landscape setting to establish the initial greening effect. This type of planting should be supported with a proper maintenance plan for thinning/removal of overcrowded trees for the long term benefit of tree health and structure.

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 Gilman, Edward F., *Trees for Urban and Suburban Landscapes*, Delmar Publishers, U.S., 1997
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 Whitcomb, Carl E., *Establishment and Maintenance of Landscape Plants II*, Lacebark Inc.
 Crooning, Landscape and Tree Management Section / Development Bureau

Proper Planting Practice

Provide Sufficient Growing Space Between Trees and Adjacent Buildings/Structures



Photo 1 Trees planted too close to buildings/structures will result in imbalance form and poor health.



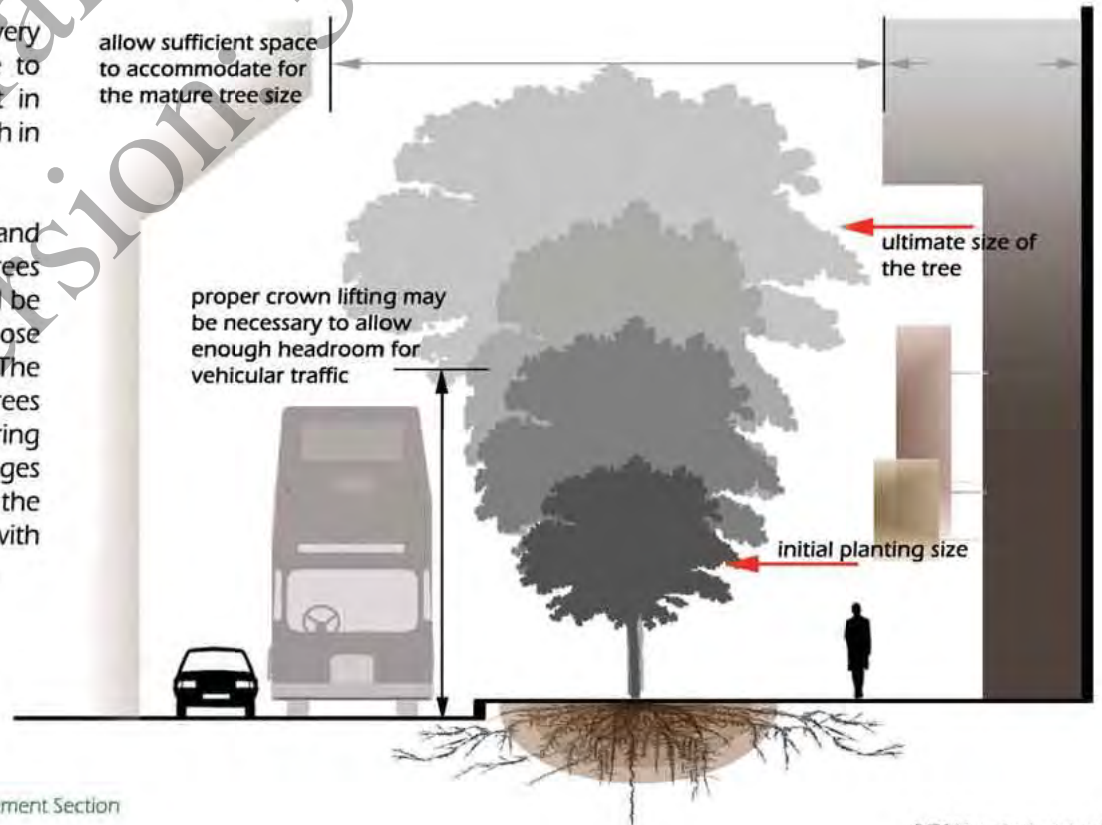
Photo 2 Deformed tree form is a result of planting tree too near to adjacent structure.

Trees become larger in size every year. Trees planted too close to buildings/structures will result in imbalance form and poor health in the long run.

allow sufficient space to accommodate for the mature tree size

Sufficient growing space and adequate distance between trees and adjacent structures should be allowed. Avoid planting too close to buildings and structures. The mature height and spread of trees should be considered during design and implementation stages to ensure that in the long run the trees will not be in conflict with adjacent buildings/ structures.

proper crown lifting may be necessary to allow enough headroom for vehicular traffic



Guideline on Pavement Renovation Works and Tree Stability

Greening, Landscape and Tree Management Section

Development Bureau

The Government of the Hong Kong Special Administrative Region

April 2013

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(Version: 31 August 2015)

1. Introduction

There is a keen competition for space in urban area. Trees are often found growing in tree pits or planters surrounded with concrete in paved area, with solid paving very close to the tree trunks. These trees often suffer from restricted growing space and the lack of air and water under impermeable surfaces. In some cases, tree roots grow vigorously and even uplift the pavement. While in other situations, roots may be cut off or damaged during pavement repair work.

A way to improve the growing environment of existing trees in paved area with confined growing space is to increase the area of permeable surface for better water and air movement to roots by removing or opening up the impermeable hard paving in a timely manner. However, precautionary measures have to be appropriately planned and implemented to ensure the stability of trees before works are undertaken.

2. Root Biology

Tree roots serve the primary functions of anchorage, storage, absorption and conduction. Larger roots play a major role in anchorage, storage, and conduction. Absorbing roots are small, fibrous, primary tissues that grow at the ends of and along the main, woody roots which are important for water and mineral uptake. Roots grow where moisture, nutrients and oxygen are available in soil. As a result, most absorbing roots as well as the horizontal,

lateral roots grow near the soil surface. As roots need oxygen for growth, they do not penetrate into the compacted, oxygen-poor soil under impervious paved surfaces.

3. Ensuring Tree Stability for Pavement Renovation Works

Trees are highly adaptable to the surrounding environment. When roots come in contact with a hard surface, such as a concrete footpath or kerb, they tend to grow along the hard surface and sometimes even integrate with features such as tree grilles when tree pits are not enlarged or tree grilles not removed / adjusted in a timely manner. (Fig. 1).

For some tree species with aggressive roots, they may lift the paving when their roots grow under the paving (Fig. 2).

To ameliorate the situation, pavement renovation is sometimes undertaken to enlarge the space or opening at the root crown. It would be comparatively simple to remove paving blocks in areas with flexible paving. However, in locations with inflexible concrete pavement and / or kerbs around tree pits or planters, when the rigid concrete is removed, the sudden loss of the support provided by the hard surface could lead to toppling of trees. It is therefore important to plan ahead for the works, assess the site situation and stability of the trees, provide additional support as appropriate before the works commence, and implement the work with personnel of suitable expertise under proper supervision.



Fig. 1 The tree roots grow along hard surface



Fig. 2 Pavement lifting caused by root growth

4. Lessons Learnt from Past Incidents

4.1 Case 1

A *Ficus microcarpa* (Chinese Banyan) collapsed after removing the adjacent concrete paving (Fig. 3). It was revealed that the concrete tree pit and the structural roots were bound together. There was no additional support provided to the tree before the removal of paving.



Fig. 3 *Ficus microcarpa* collapsed during repaving

4.2 Case 2

Another *Ficus microcarpa* (Chinese Banyan) collapsed during tree pit enlargement works when the surrounding pavement around the tree pit was removed (Fig. 4).



Fig. 4 *Ficus microcarpa* collapsed during tree pit enlargement works

Both trees in the above cases grew in small tree pits and most roots were confined in the small, restricted growing space. The rather large trees with wide crown spread had inadequate anchorage. The concrete rims of the tree pits were held in place by the adjacent rigid concrete paving, and in turn provided support to the trees. Once the concrete paving adjacent to the trees was removed, the sudden loss of the support induced the collapse.

5. Precautionary Measures for Renovation / Works or Removal of existing hard surface around trees

For trees growing in confined pits surrounded by rigid hard paving instead of flexible paving, the stability of the tree may be adversely affected if the hard surface is removed suddenly. The following precautionary measures are recommended:

(i) Planning

It is necessary to plan ahead before works. The site situation and condition of the tree including the pattern and distribution of roots should be checked. The rigid paving material such as *in-situ* concrete surrounding the trunk base might have provided some degree of support to the tree. Therefore the potential effect of the works on the stability of the tree has to be assessed. The extent of the work may have to be adjusted accordingly. Contractors should employ competent personnel with arboricultural knowledge to plan and implement works around trees. Site supervisory staff involved should also be trained and briefed of the precautionary measures.

The need of a permanent and robust support system should also be considered in the long run in particular for trees with large canopies and have been confined in restricted tree pits with rigid paving for a prolonged period.

(ii) Temporary support

Proper temporary support by means of either staking, guying or propping should be provided before commencing the works. The temporary support may be removed subsequent to the work after the stability of the tree is ascertained.

(iii) Site work and supervision

It is advisable to hand dig the hard surface, instead of using machinery, in phases around a tree. After the removal of hard surface, if soil backfilling or mulching cannot be arranged immediately, exposed roots should be covered by clean and moist hessian to prevent desiccation and to protect the roots from rapid temperature and moisture changes. No roots should be cut without the supervision of personnel with arboricultural knowledge.

6. Other Recommended Practices

For long term healthy growth of trees in paved area, the following practices are recommended:

(i) Design for sufficient space for tree growth

For the healthy growth of trees in the long run, providing a planting area with sufficient space for tree roots to grow is generally preferable to growing trees in pits with limited space (Fig. 5).



Fig. 5a & 5b Healthy tree growth in planting strips

In situations with site constraints, and tree pits or planters are used, their sizes should be maximized as far as practicable to allow sufficient space and drainage for tree growth. Several tree pits can be joined together to form a larger planting area.

Adjacent paving design is also important for providing a desirable environment for tree growth, keeping the tree in good health condition, and avoiding future maintenance problems. In general, a tree should not be surrounded by concrete around the root collar (Fig. 6). Sufficient space should be allowed at the base of trees (Fig. 7). Permeable paving which allows penetration of air and water in general is recommended.



Fig. 6 A bad example showing a tree surrounded by concrete around the root collar



Fig. 7 Adequate unsealed space around the base of trees

(ii) Right tree for the right place

Choosing the right tree to match a particular site is the fundamental principle of tree selection. Sufficient space both above and below ground has to be provided for the ultimate size of trees. Large canopy trees are suitable for a site that have sufficient space for the mature size of the trees and are not appropriate for narrow pavements. Trees with aggressive roots / buttress roots such as *Ficus* species are in general not suitable for planting in confined tree pits (Fig. 8) and along narrow pavements.



Fig. 8 Trees with aggressive roots in confined tree pits

- (iii) Adequate unsealed space around the base of trees

Adequate unsealed space should be provided around the base of trees for infiltration of water and air into the root zone.

- (iv) Expandable tree grilles

Expandable tree grilles with adjustable panels or flexible and permeable paver blocks on sand base (Fig. 9) that can be easily removed/ adjusted to allow for growth of trees should be used.

They should be adjusted in a timely manner.



Fig. 9 Permeable paver blocks on sand base

(v) Soil corridor / Soil vault

The use of soil corridor and soil vault may also be considered to provide adequate soil volume underneath the pavement for healthy growth of trees.

(vi) Soil Quality

In general, it is necessary to ensure that the soil composition and quality in the planting area are suitable for tree growth. Soil may be ameliorated as appropriate before planting.

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