Manual on the Management of Brown Root Rot Disease

GREENING, LANDSCAPE AND TREE MANAGEMENT SECTION

DEVELOPMENT BUREAU

APRIL 2019

TABLE OF CONTENT

ANNEXES

PART 1 - INTRODUCTION

1.1 BROWN ROOT ROT DISEASE (BRRD)

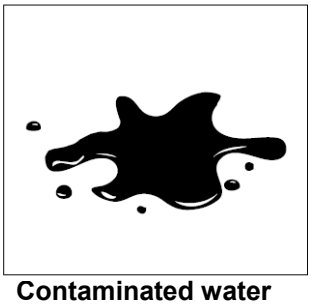
BRRD is caused by the aggressive fungal pathogen *Phellinus noxius*, a white rot fungus that could result in rapid health and structural deterioration of trees and may lead to tree failure.

It is an international disease prevalent in tropical and sub-tropical regions with no cure. There have been numerous claims of cures or effective management, but once the tree is infected, it cannot be cured. It can lead to swift deterioration in the health of a tree, causing eventual decay and irreversible structural damage to tree roots, posing a serious threat to public safety, and potentially spreading the disease to surrounding trees and vegetation.

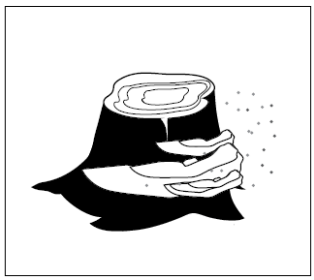
It can be spread through root contact, infected wood materials, contaminated soil, ground water, surface water, and even through the air by dissemination of basidiospores from fruiting bodies. The public shall stay away from known infected trees to avoid spreading of the disease via contaminated soil on shoes. Currently, BRRD has devastating impact on our landscape. Once a site is infected, it must be completely disinfected.

Infected wood material

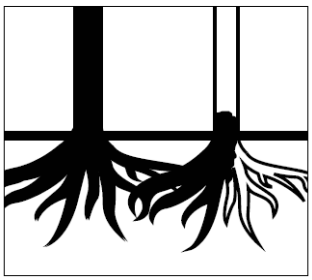
Contaminated soil



Contaminated water



Basidiospores from fruiting bodies



Root contact

1.2 PURPOSE OF THIS MANUAL

International best practice and policy position is to prevent the spread to other trees and vegetation and remove the infected material as soon as practicable, including the root system of the infected trees and other plants and associated soil within the infection area.

This Manual provides the proper removal and follow-up requirements of BRRD infected tree. The steps are clearly illustrated for better understanding by operating personnel. The Manual includes:

- Key information about the identification of BRRD infected trees;
- Personal protection equipment (PPE) in handling infected trees; and
- Step-by-step guide in planning, site preparation, removal, site clearance and post-removal follow-up requirements.

1.3 HOW THIS MANUAL CAN HELP?

For Tree Inspection Officers and tree management personnel (Please observe Part 2 and Part 4)

- Understand the typical symptoms and signs of BRRD infected trees.
- Understand the procedure in referring suspected and confirmed BRRD infected cases to the Greening, Landscape and Tree Management Section (GLTMS) and the necessary follow-up actions (only for government departments and bureaux).
- Understand the importance of on-site supervision.

For Tree Work Supervisors, Tree Workers and tree management personnel (Please observe Part 3 and Part 4)

- Understand the proper procedures and requirements in the removal of BRRD infected trees.
- Understand the necessary follow-up requirements after the removal of infected trees.

1.4 MANUAL STRUCTURE

The Manual comprises the following four parts, together with a set of supplementary annexes.

- **Part 1 – INTRODUCTION**

  Introduce BRRD and the purpose and target users of the manual;

- **Part 2 – PREVENTION**

  Provide the information on the characteristics of typical symptoms and signs of a BRRD infected tree, to facilitate the identification of BRRD and prevent further spread of the disease;

- **Part 3 – CONTROL**

  Detail a step-by-step requirement for the removal and clearance of BRRD infected trees, to minimise the disease pathogen and control the spread;

- **Part 4 – IMPLEMENTATION**

  Emphasise the importance of on-site supervision, to implement proper practices in BRRD infected tree management; and

- **Part 5 – ENQUIRY AND REREFENCES**

  Provide a list of references to supplement the information in the above parts.

PART 2 - PREVENTION

2.1 IDENTIFICATION OF BRRD INFECTION

Identification of BRRD infected trees can be carried out through field diagnosis or laboratory diagnosis or the combination of the two.

2.1.1 Field Diagnosis

Precautionary measures should be taken during field diagnosis, e.g. wearing suitable footwear, proper disinfection of footwear, used tools and equipment.

Typical symptoms of BRRD infection that could be identified by visual assessment of the tree crown include:

- Sparse foliage density;
- Abnormal foliage colour;
- Abnormal leaf size; and
- Dieback twigs.

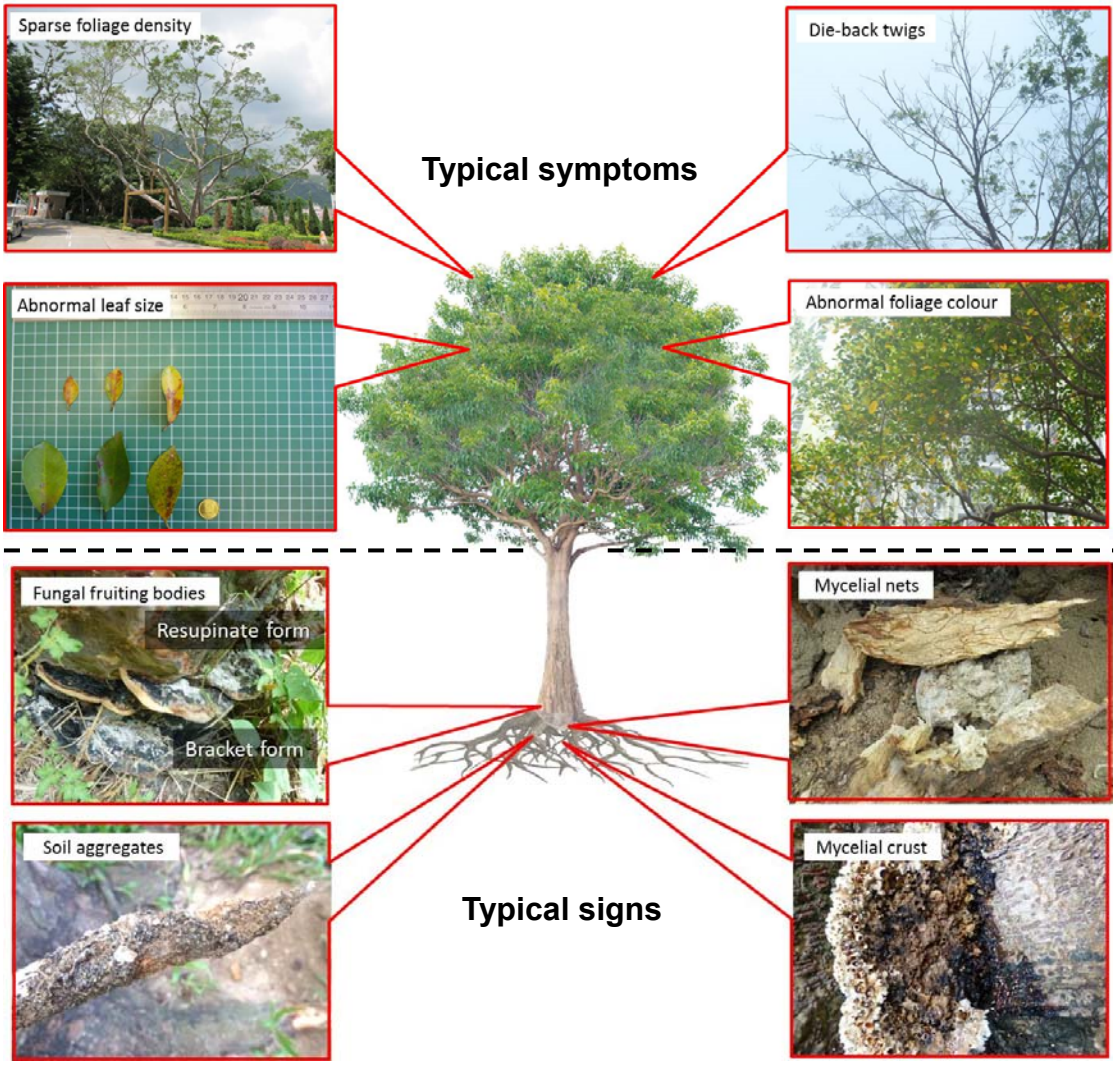
Trees having the above symptoms may NOT necessarily have BRRD infection. Further investigation on signs of infection is required.

Further detailed examination of the entire lower trunk, root collar and individual roots of the trees is also required to identify the BRRD signs. Root excavation and scraping off bark tissue with appropriate tools may be necessary to expose the roots and inner tissue for further examination of typical signs of BRRD infection which include:

- Fruiting bodies of *P. noxius*;
- Mycelial crust;
- Mycelial nets; and
- Soil aggregates.

Once the typical signs are observed on the trees, the infection is likely to be at advanced stage. PROMPT action shall be carried out to control the spread of disease.

However, unnecessary damage to healthy wood/roots should be avoided as this may create open wounds for fungal invasion. The use of mallets is recommended to differentiate healthy wood/roots from decayed, damaged or dead wood/roots



Annex A - Pictorial Guide for Identification of Brown Root Rot Disease Infected Trees

2.1.2 Laboratory Diagnosis

In certain situations or tree species, the symptoms and signs of BRRD infection may not be obvious and field diagnosis will not be effective enough to confirm the infection. Laboratory diagnosis can then be utilized to analyse samples from the trees with suspected BRRD infection. Samples could be cultured for fungal growth and subsequent molecular analysis through DNA sequencing or other techniques with equivalent analytical capacity to confirm the species of the fungi in the sample.

2.2 REPORTING AND CONFIRMATION OF BRRD INFECTED TREES

Suspected BRRD cases on government lands should be reported to departmental representative(s) for coordination of a departmental return to the Tree Management Office (TMO) of the GLTMS, Development Bureau (DEVB) for confirmation and record.

Please refer to **Annex B** for details of the referral mechanism and **Annex C** for the referral document:

Annex B - Procedures for Handling Suspected Brown Root Rot Disease (BRRD) Cases on Government Land

Annex C - Referral Form of Suspected Brown Root Rot Disease (BRRD) Case – from Departments

For guidance of further actions required after the referral of suspected BRRD cases to the TMO, please refer to **Annexes D to E**:

Annex D – Reply Slip for Referral of Suspected Brown Root Rot Disease (BRRD) Case - from TMO

Annex E - Reply Slip for Completion of Tree Removal Works of Brown Root Rot Disease (BRRD) Case – from Departments

2.3 HANDLING OF BRRD INFECTED TREES

For non-Old and Valuable Trees (OVTs) confirmed with BRRD infection, tree removal should be arranged within 4 weeks. If tree removal cannot be completed within 4 weeks, departments have to take the below actions:

1) Appropriate temporary mitigation measures should be completed as far as practicable to ensure public safety;
2) Continuous monitoring with Form 2 assessment should be arranged every 3 months to monitor the tree condition until the removal of the tree; and
3) Tree information should be uploaded to the Tree Register.

For OVTs confirmed with BRRD infection, departments have to take the below actions:

1) Continuous monitoring with Form 2 assessment should be arranged every 3 months to monitor the tree condition until the removal of the tree;
2) Tree information should be uploaded to the Tree Register;
3) Appropriate mitigation measures should be completed within 6 weeks as far as practicable to ensure public safety;
4) Proper arrangement to control the spread of disease should be implemented; and
5) Warning signs should be installed to notify the public.

Please refer to **Annex F** for the template of warning sign for OVTs infected with BRRD infection:

Annex F - Template of Warning Sign for Brown Root Rot Disease Infected Old and Valuable Trees

PART 3 - CONTROL

Infected materials, including infected tree trunk and branches, stump, roots, soil and adjoining vegetation, shall be promptly removed as far as practicable to control the spread of disease. In certain circumstances, the surrounding hard landscape has to be removed in order to facilitate the removal of infected material.

3.1 PHASE 1 – PLANNING AND PREPARATION FOR TREE REMOVAL

Proper planning and preparation ensure smooth workflow, and occupational safety and health (OSH) throughout the removal operation. Appropriate tools and equipment for removal works, including those for follow-up actions for the site and surrounding area, must be available at the site to avoid accidental spread of infected material.

Phase 1 – Planning and Preparation for Tree Removal

Step 1 - Plan for tree removal

Step 2 - Plan for necessary temporary traffic arrangement (TTA)

Step 3 - Prepare appropriate tools and equipment

Step 4 - Conduct job briefing

Step 1	Plan for tree removal
1.1	Make reference to the prevailing technical circulars or guidelines in arranging tree removal application to relevant departments.
1.2	Ascertain the objectives and requirements of the operation which may include stump removal or follow-up actions for the site.
1.3	Determine appropriate follow-up action for the site after tree removal such as: a) In-situ soil fumigation; and b) Excavation and removal of contaminated soil and backfilling.
1.4	Prepare method statement after necessary pre-works site visit that encompasses all works including site preparation and removal operation, necessary OSH considerations, communication plan, emergency plan and follow-up actions.
1.5	Conduct necessary consultation with stakeholders that would be affected by the works and sensitivity analysis for OVTs and Stonewall Trees and trees with significant values.
1.6	Assign personnel for different tasks in the tree removal operation.

Step 2	**Plan for necessary temporary traffic arrangement (TTA)** *[Optional: Only when the removal operation will affect nearby traffic]*
2.1	Apply TTA with the Transport Department (TD). Proposal should be submitted to the TD in advance for necessary assessment.]
2.2	Prepare traffic management roster assigning different tasks to personnel involved in the TTA for the traffic management during the operation when necessary. Assistance for traffic control and comments on the TTA should be sought from the Hong Kong Police Force if necessary
2.3	Designate a safe path for pedestrians.

Step 3	**Prepare appropriate tools and equipment**
3.1	Appropriate tools and equipment include: • Shielding material for cordoning off the works area, if site conditions allow. The shielding material should meet the following criteria: - ≥2m in height; - Minimum 90% shade weave; - Light weight and easy to transport; - Closed-bottom; and - No holes, rips or tears. • Stakes, ties, cables and footings to anchor and stabilise the shielding materials. • Warning signage to be displayed at prominent locations. • Disinfection materials and equipment include but not limited to: - Disinfectant (e.g. 70% ethanol or 1:49 bleach solution);

	- Fungicides or soil fumigants* for site disinfection; - PPE for handling disinfectant and other chemicals; - Disinfection mats made of absorbents materials and not smaller than 60 cm x 90 cm in size or disinfection trays that are made of durable material and not be smaller than 30 cm (W) x 60 cm (L) X 5 cm (D); and - Application device for large area or vehicle/ machinery disinfection. • Tools and equipment, vehicles and machinery for tree removal and follow-up actions for the site and surrounding area. • Tools and equipment for emergency response and temporary traffic arrangement. • Landscape materials, including clean soil for necessary backfilling, and follow-up actions for the site and surrounding area. • Vehicles with sturdy cover for disposal of infected materials to landfill.
3.2	Countercheck with the checklist of tools and equipment to ensure necessary items will be available on site. Please refer **Annex G**.

* Active ingredients of fungicides and soil fumigants should include:

Fungicides -

- Propiconazole;
- Triadimefon;
- Chlorothalonil; or
- Iprodione.

Soil Fumigants -

- Dazomet

Annex G - Checklist for Tools and Equipment and Personal Protection Equipment in the Removal of Brown Root Rot Disease (BRRD) Infected Tree

Step 4	Conduct job briefing
4.1	Conduct job briefing before the operation by Tree Works Supervisor to ensure all personnel involved: • Be clear in their own duties and responsibility • Understand the appropriate workflow of the tree removal operation; • Understand specific hazards associated with the operation before it starts or while it is in progress, especially on the nature of BRRD; • Be attentive to what other personnel are doing, as unexpected actions can create new hazards; • Comply with existing statutory OSH requirements and relevant guidelines for the use of all tools and materials and chemicals during all work procedures; • Maintain a good communication during the operation; • Equip with necessary and appropriate PPE and use it according to instructions; and • Understand the emergence plan and response in case of accident.

3.2 PHASE 2 – SITE ARRANGEMENT

To ensure that the operation is effective in managing and minimising the spread of disease, proper site arrangement is important. It should also minimize the disturbance to general public and enable safe working environment of the personnel involved. Tree work supervisors should be involved since this phase.

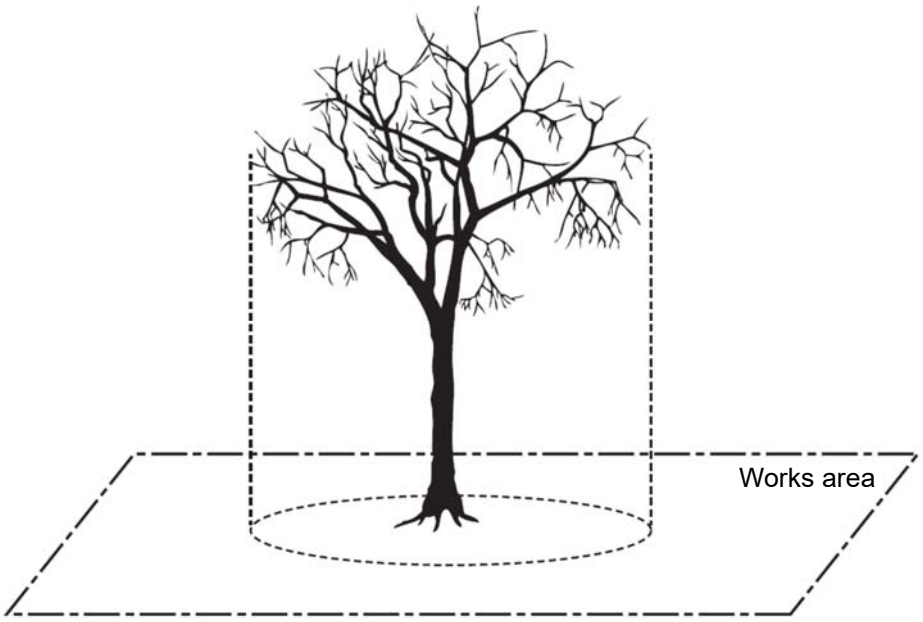
Phase 2 – Site Arrangement

Step 1 - Define Your Works Area

Step 2 - Display Proper Signage

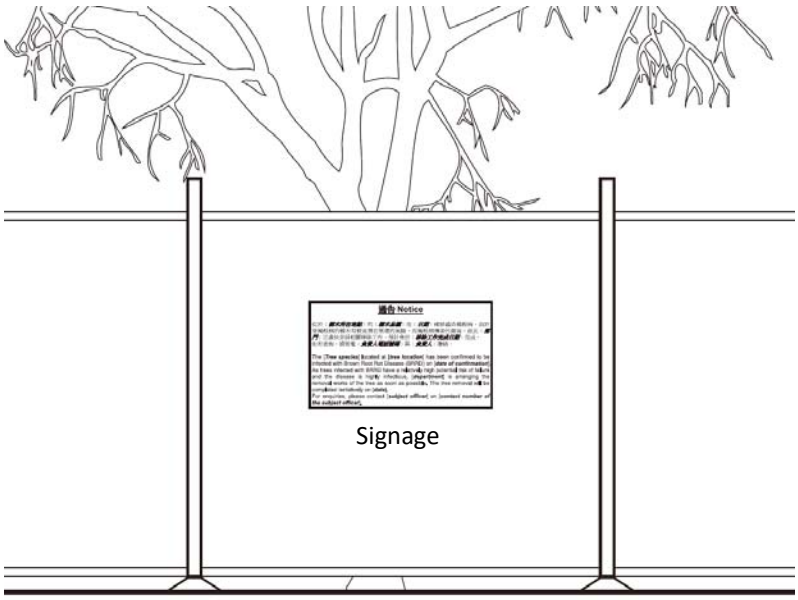
Step 3 - Prepare Your Works Area

Step 1	Define Your Works Area
1.1	Assess and determine the extent of works. This may include removal works of the infected tree; surrounding vegetation; soil and the entire root system, which will extend beyond the dripline.
1.2	Allow sufficient space to safely work within the works area. You may need to adjust the delineated works area during the operation to accommodate adjoining public uses if necessary. You may also need to stage your works according to the availability of space.
1.3	Include the temporary storage area for infected wood debris and soil and disinfection area for tools and footwear in the delineated works area.



Defining the works area

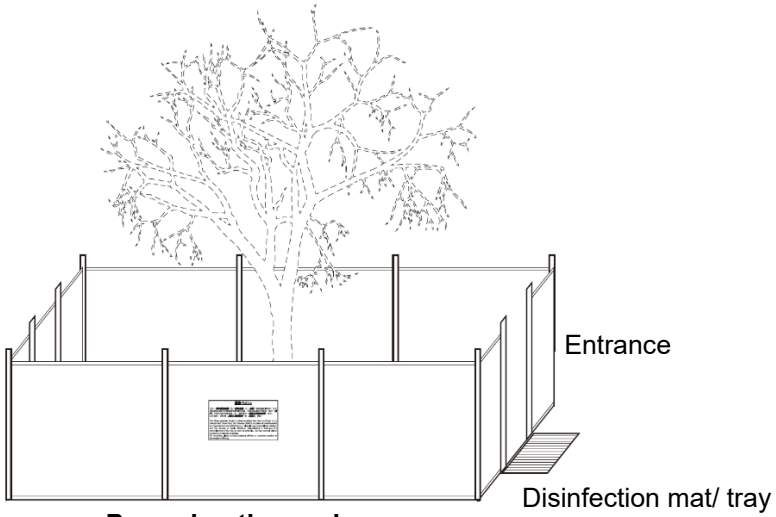
Step 2	Display Proper Signage
2.1	Install clear and proper warning signage with succinct messages at prominent locations nearby the delineated works area with information on: • Tree species; • Tree location; • Date of confirmation of BRRD infection; • Name of responsible department; • Tentative completion date of tree removal; and • Contact information.
2.2	Install appropriate signage to prohibit public access into the cordoned off areas and notify the public of the tree removal operation and the TTA, if any. Please refer to **Annex H** for the template of warning sign.



Displaying the proper signage

Annex H - Template of Warning Sign for Brown Root Rot Disease Infected Tree

Step 3	Prepare Your Works Area
3.1	Cordon off the delineated works area as described in **Step 1** in **Phase 2** with shielding materials and stakes mentioned in **Step 3** in **Phase 1** as far as practicable, if site condition allows.
3.2	Arrange proper entrance as decided in **Step 1** in **Phase 2**. All personnel should follow the designated entrance(s) in entering and exiting the works area.
3.3	Ensure the shielding material is tightly fixed, stable and secure at all time.
3.4	Place the disinfectant mat or tray at the designated entrance(s) of the works area designated in **Step 1** in **Phase 2**.
3.5	Apply the disinfectant to the disinfection mats and/or trays. If **disinfection mat** is used, soak the mat until it is saturated and disinfectant would be squeezed out when you lightly put your foot on it. If **disinfection tray** is used, fill the tray with disinfectant till it reaches a depth of not less than 3 cm.
3.6	Replenish with disinfectant when necessary.



Preparing the works area

3.3 PHASE 3 – REMOVAL PROCEDURES

Trees infected with BRRD and their surrounding area must be handled with great care. Understanding and following proper and well-planned removal procedure can minimize the spread of disease during the operation and at the same time uphold the OSH. The removed materials, especially tree stump and roots, should be handled and treated properly with great caution as the disease is highly infectious.

Phase 3 – Removal Procedures

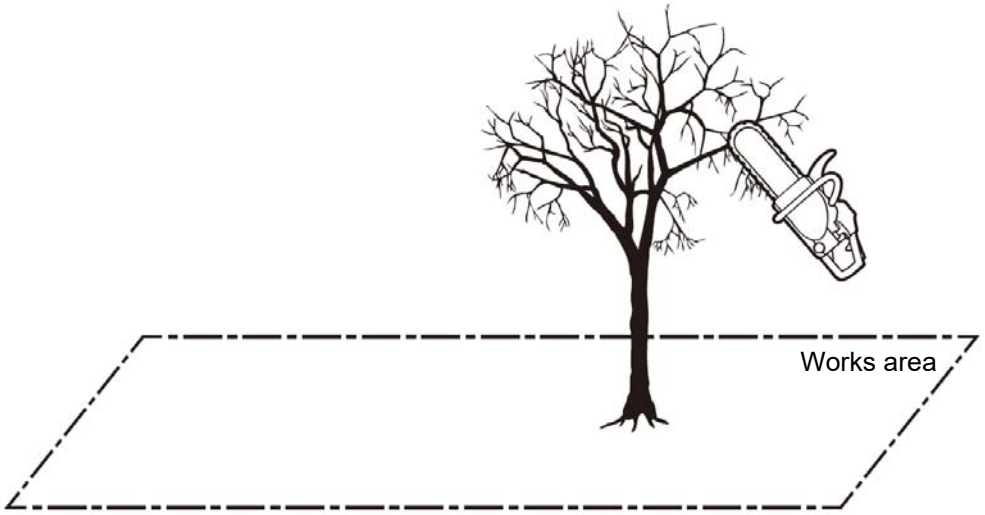
Step 1 - Remove and handle the tree branches and trunk

Step 2 - Remove and handle stump, roots and associated soil

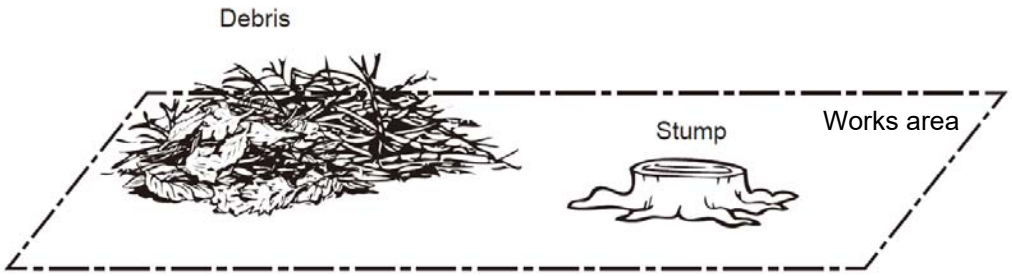
Step 3 - Dispose of wood debris and removed soil

Step 4 - Manage used tools and equipment

Step 1	Remove and handle the tree branches and trunk
1.1	Remove vegetation (e.g. shrubs, perennials or herbs) within the infected area, i.e. area with reference to but not limited to dripline area of the infected tree.
1.2	Remove the tree branches and trunk with proper procedure and tools and equipment.
1.3	Keep all removed tree parts and vegetation within the delineated works area.
1.4	Apply disinfectant to the removed tree parts and vegetation thoroughly.



Removing the tree branches and trunk



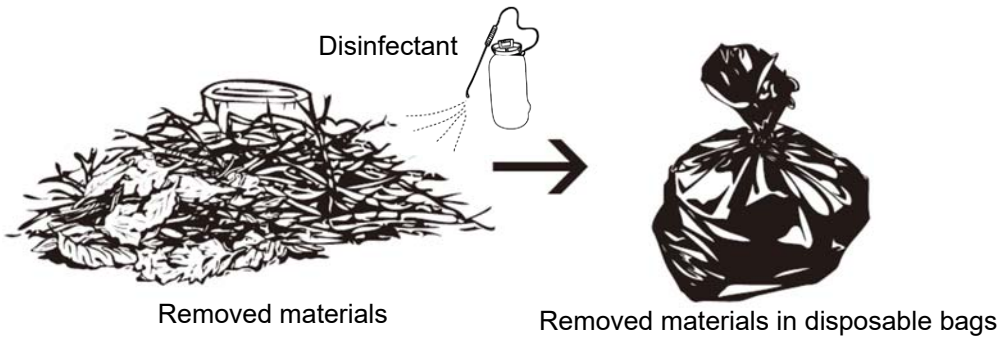
Handling the removed tree branches and trunk

Step 2	Remove and handle stump, roots and associated soil
2.1	Remove tree stump and roots that are larger than 1cm in diameter within infected area or within physical boundary as much as practicable, if site condition allows.
2.2	Apply disinfectant to the removed stump and roots thoroughly.
2.3*	Excavate all soil to a depth of 1m within the infected area.
2.4*	Apply disinfectant to the removed soil thoroughly.
2.5#	Pack the removed materials, including removed tree parts and vegetation in **Step 1** in **Phase 3**, into durable and disposable bags.

** If it is decided in Step 1 in Phase 1 that the site will be followed up with soil removal, site disinfection and replacement with clean soil.*

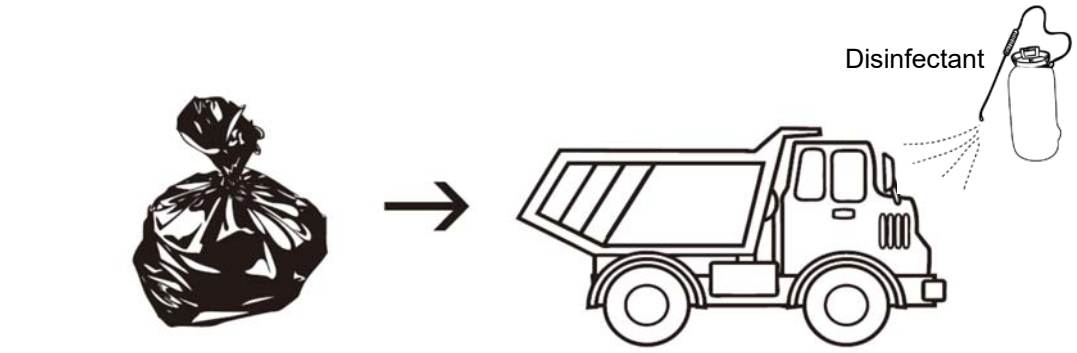
 # If the infected materials, except soil medium, is too large to be packed, they shall be uploaded to suitable vehicles directly and the vehicles shall be disinfected thoroughly after the disposal of the infected materials.

Removing and handling the stump, roots and associated soil

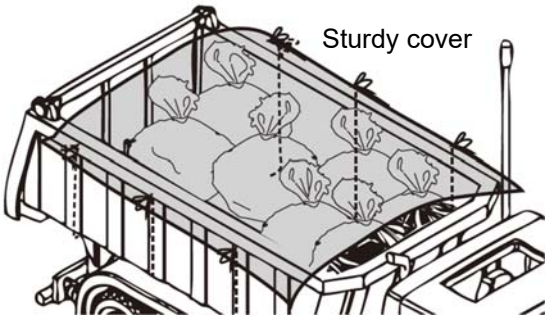


Handling the removed materials

Step 3	Dispose of wood debris and removed soil
3.1	Upload all packed removed materials and other infected materials onto designated vehicle.
3.2	Apply disinfectant to the materials thoroughly.
3.3	Cover the materials properly with sturdy cover to avoid accidental spread of the materials during transportation.



Uploading and disinfecting the removed materials



Covering the removed materials with sturdy cover

Step 4	Manage used tools and equipment
4.1	Put all tools and equipment used in the tree removal operation at a designated zone inside the works area for disinfection at later stage.
4.2	Designate a proper location inside the works area for disinfection of vehicles and machinery, except the vehicle for disposal of infected materials.
4.3	Ensure all tools and equipment will not be taken out of the site before the completion of disinfection.

Managing used tools and equipment

3.4 PHASE 4 – DISINFECTION PROCEDURES

Proper disinfection procedures are required during and after tree removal operation to minimize the spread of disease. The disinfection procedures must be thorough and covered every element involved in the operation.

Phase 4 – Disinfection Procedures

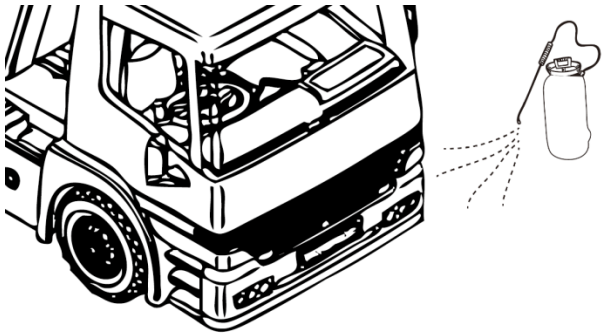
Step 1 - Disinfect the vehicle for disposal of infected materials

Step 2 - Disinfect used tools and equipment

Step 3 - Disinfect works area

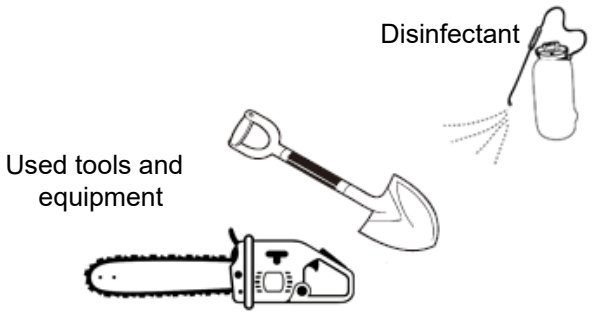
Step 4 - Disinfect hands and footwear

Step 1	Disinfect the vehicle for disposal of infected materials
1.1	Before leaving the works area (if the vehicle has entered the works area): • Wash away the soil and infected material on the tyres as far as practicable; and • Apply appropriate disinfectant thoroughly to the vehicle, especially the tyres. * Clean the tyres in trenches with disinfectant if site condition allows.
1.2	When leaving the landfill site: • Apply appropriate disinfectant thoroughly to the vehicle after the disposal of all infected materials, especially the container of the vehicle.
1.3	For other vehicles and machinery: • Wash away the soil and infected material on the tyres as far as practicable; and • Apply disinfectant thoroughly to the vehicles and machinery, especially the tyres. * Clean the tyres in trenches with disinfectant if possible.



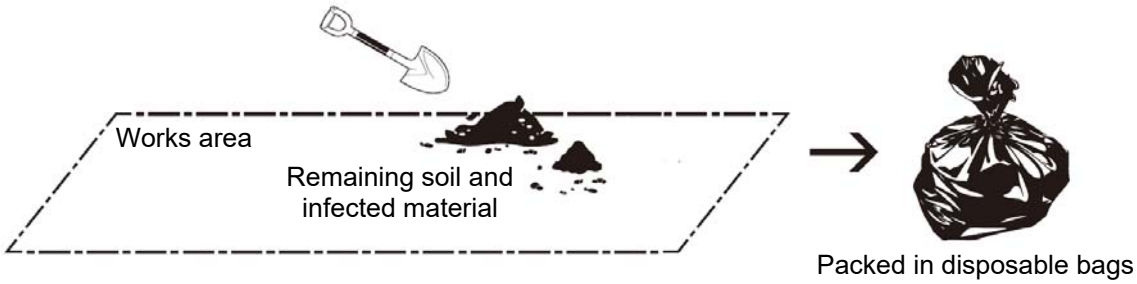
Washing soil away from the tyres and disinfecting the vehicle

Step 2	Disinfect used tools and equipment
2.1	Disinfect all tools, equipment and PPE used in the tree removal operation thoroughly, and ensure they will not be taken out of the works area before the completion of disinfection.

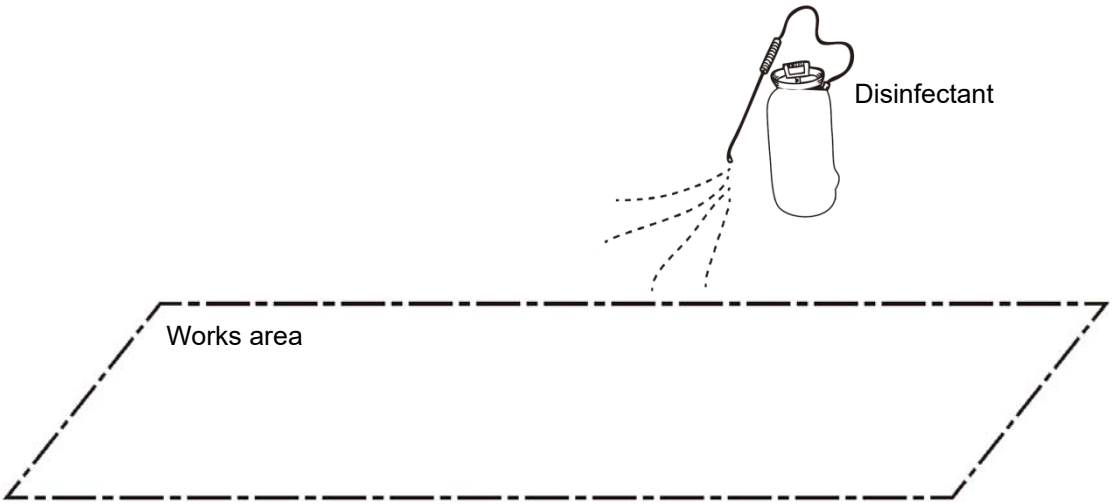


Disinfecting used tools and equipment

Step 3	Disinfect works area
3.1	Remove and clean up all soil and infected material in the works area as far as practicable, and treat and dispose it as infected wood debris following **Steps 2.5 to 3.3** in **Phase 3**.
3.2	Disinfect the whole delineated works area with disinfectant thoroughly.

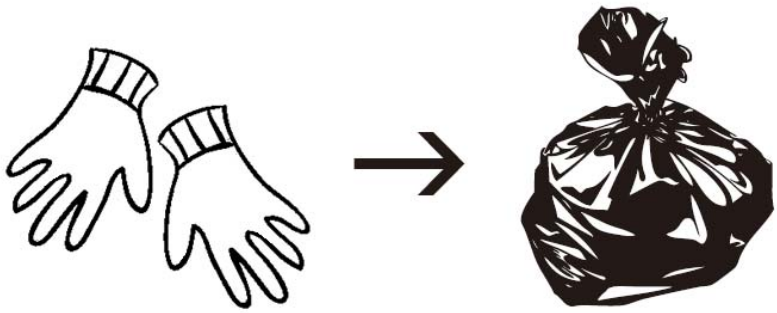


Cleaning up the works area



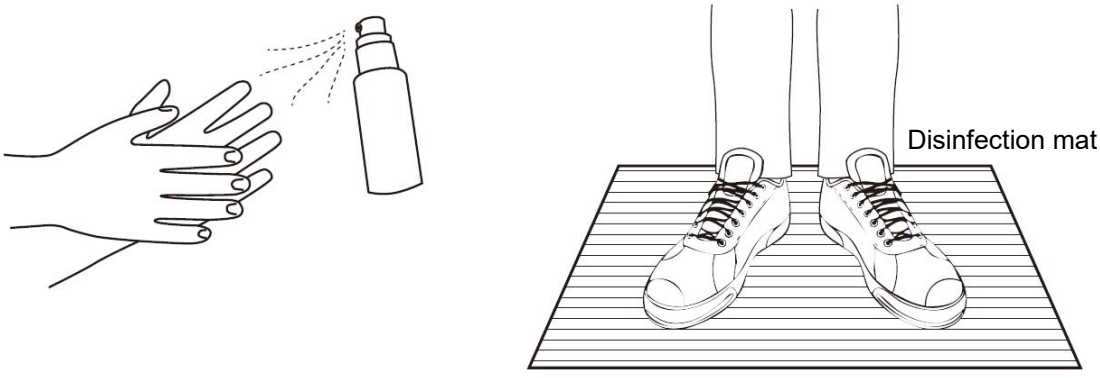
Disinfecting the whole works area

Step 4	Disinfect hands and footwear
4.1	Dispose of disposable PPE following **Steps 2.5 to 3.3** in **Phase 3**.
4.2	Disinfect hands and footwear at the end of the operation. * During the operation, any personnel exiting the works area shall have their footwear disinfected thoroughly on the disinfection mat/ tray at the entrance.



Disposable PPE Packed in disposable bags

Disposing disposable PPE



Disinfecting hands and footwear

3.5 PHASE 5 – FOLLOW-UP ACTIONS

After tree removal, proper follow-up actions are required. In addition, trees in vicinity must be carefully monitored to eradicate any possible source of BRRD in the area.

Phase 5 – Follow-up Actions

Step 1 - Manage infected site

Step 2 - Report tree removal operation

Step 3 - Monitor the trees in vicinity

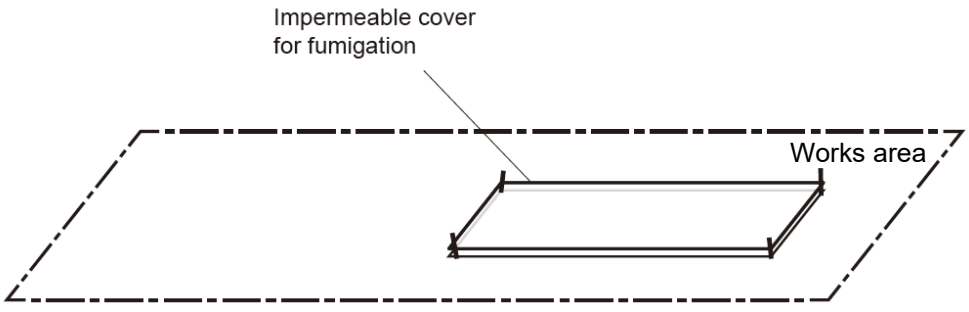
Step 1 - Manage infected site

After the removal operation, where site condition allows, the infected site should be managed with the following options of post-removal measures:

Option A

Conduct in-situ soil fumigation* following the instruction mentioned on the application manual of the fumigant. The area of fumigation should at least cover the infected area; and

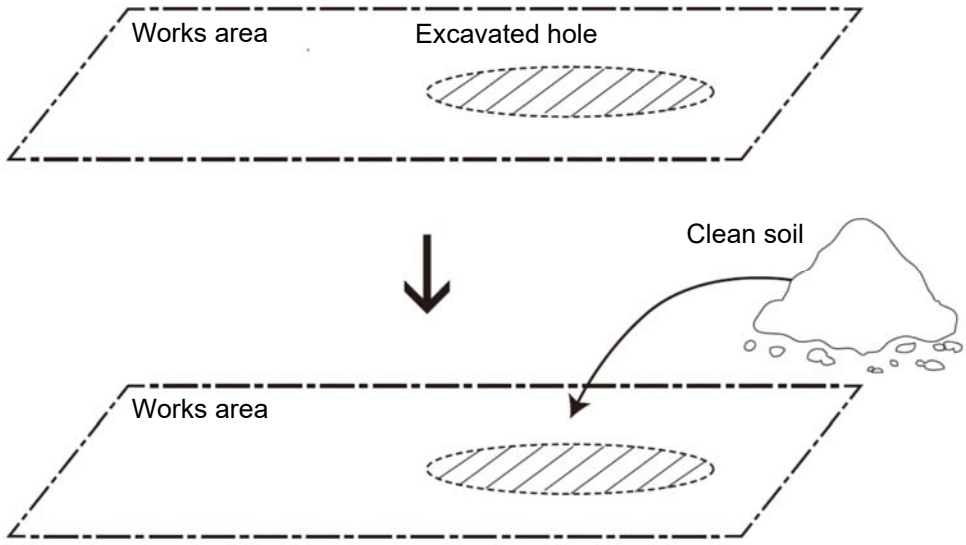
* *Toxic gas may be produced during the process of fumigation. Please implement necessary precautionary measures.*



Conducting in-situ soil fumigation

Option B

Excavate all soil to a depth of 1m within the infected area and refill with clean soil. The excavated soil shall be properly treated and disposed of following **Steps 2.5 to 3.3** in **Phase 3**. If the tree stump and its associated soil are located on a slope, please consult geotechnical engineer before the stump and soil removal.



Conducting soil excavation and refilling of clean soil

Replanting of trees is not recommended unless the site is proven to be rid of disease pathogen to avoid possible reoccurrence of BRRD.

Advice from geotechnical engineer should be sought in order to assess the feasibility and the implementation of Option B. For complicated cases, advice from the GLTMS may be sought.

Step 2	Report tree removal operation
2.1	Take photo record for the tree removal, site follow-up actions and disinfection of tools and equipment, vehicles and machinery.
2.2	Provide the information and photo record by filling in **Annex E** - "Reply Slip for Completion of Tree Removal Works of Brown Root Rot Disease (BRRD) Case – from Departments" to report completion of all operation procedures to GLTMS.

Annex E - Reply Slip for Completion of Tree Removal Works of Brown Root Rot Disease (BRRD) Case – from Departments

Step 3	Monitor the trees in vicinity
3.1	Monitor the condition of the trees in vicinity, especially trees growing in the same planter, on the same slope or with roots possibly interwined with the root system of the removed infected tree.
3.2	Observe and look for typical symptoms or signs of BRRD infection on trees in vicinity, especially during wet season.
3.3	Report suspected cases of infection to GLTMS.

PART 4 - IMPLEMENTATION

4.1 CONTRACT MANAGEMENT

Appropriate provisions for handling of BRRD infected trees should be incorporated into relevant vegetation maintenance contracts. The relevant information should include but not limited to the following:

- Method statement;
- Personnel qualification and requirements; and
- Supervision and checking mechanism.

4.1.1 Method Statement

A clear method statement is important to ensure the proper handling of BRRD infected trees. Tree management departments or tree owners shall encompass the steps in the removal of BRRD infected materials as mentioned in the **Part 2** of this manual in their contract.

№	Checklist: Method Statement	
1	Planning and Preparation for Tree Removal	☐
2	Site Arrangement	☐
3	Removal Procedures	☐
4	Disinfection Procedures	☐
5	Follow-up Actions	☐

Annex I - Sample Method Statement on Removal of Brown Root Rot Disease Infected Tree

4.1.2 Personnel Qualification and Requirements

Removal of BRRD infected tree involves arboricultural knowledge, understanding of the disease and OSH, which require professional input. Tree management departments or tree owners shall engage qualified personnel, including tree inspection officers, tree work supervisors and tree workers, to advise, supervise and handle all matters in relation to tree works.

Annex J - Requirements of Qualified Professionals for Arboricultural Works

4.2 ON-SITE SUPERVISION AND CHECKING MECHANISM

Stringent supervision and checking mechanism should be implemented when any tree work on BRRD infected trees are carried out to ensure due compliance of:

- Government policy;
- Procedural requirements; and
- Contract specifications.

№	Checklist: Supervision and Checking (Before Work Starts)
1	Prepare appropriate tools and equipment ☐
2	Conduct job briefing ☐
3	Define Your Works Area ☐
4	Display Proper Signage ☐
5	Prepare Your Works Area ☐

№	Checklist: Supervision and Checking (During Work)	
1	Remove and handle the above-ground part	☐
2	Remove and handle stump, roots and associated soil	☐
3	Dispose of wood debris and remove soil	☐
4	Manage used tools and equipment	☐
5	Disinfect the vehicle for disposal of infected materials	☐
6	Disinfect used tools and equipment	☐
7	Disinfect works area	☐
8	Manage infected site	☐
9	Record the tree removal operation properly	☐
10	Report tree removal operation	☐

PART 5 – ENQUIRY AND REFERENCES

5.1 ENQUIRY

Any further enquiry on this manual or related issues should be addressed to:

AS(TM)2

Greening, Landscape and Tree Management Section

Development Bureau, 16/F, West Wing

Central Government Offices

2 Tim Mei Avenue, Tamar, Hong Kong

5.2 REFERENCES

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