Guidance for plant pathogen prevention when working at contaminated restoration sites or sites with rare plants and sensitive habitat

Why follow this guidance? Many plant pathogens, including *Phytophthora* species may be spread by movement of infested soil or plant debris. To help maintain healthy native plant habitat, it is critical to prevent pathogen spread within contaminated (infested) sites and into noninfested sites. Within many contaminated sites, pathogens are not distributed throughout the entire site, so preventing further spread can keep a bad situation from becoming worse. The following measures are designed to minimize the risk of spreading soil-borne plant pathogens in the process of working at contaminated restoration sites, noninfested sensitive habitats, or areas containing or adjacent to rare plant populations.

Definitions

A **contaminated or infested site** is defined as a site that has been tested and confirmed to contain an infestation of *Phytophthora* spp., or a site that is suspected to be contaminated (due to proximity to a contaminated site or from being located directly downstream or downslope of a contaminated site).

A **sensitive site** contains rare or endangered plants or vegetation communities, or is located adjacent to pristine or high-quality wildland habitat. A sensitive site is often designated by a qualified biologist prior to project construction.

1. General protocols

1.1. Cleaning and sanitation required before entering either sensitive or contaminated sites to prevent introduction of contamination from other locations

Phytophthora contamination may be present in agricultural and landscaped areas, on nursery stock, and in some infested native or restored habitat areas. Contamination can be spread via soil, plant material and debris, and water from infested areas. Arriving at the site with clean vehicles, equipment, tools, footwear, and clothes helps prevent unintentional contamination of the site from outside sources. Continual vigilance is needed, even if a site is contaminated with one or more species of *Phytophthora* because introducing additional pathogens can make a bad situation worse.

1.2. Cleaning and sanitation required when leaving a contaminated site to prevent pathogen spread to other locations

The risk of acquiring and spreading *Phytophthora* contamination is much greater when work occurs in areas known to be infested with these pathogens. When leaving contaminated sites, equipment, vehicles, footwear, and clothing should be cleaned to prevent pathogen movement to other sites.

2. Cleaning vehicles, equipment, and tools

2.1. Before arrival at the site, equipment, vehicles and tools must be free of soil including debris on tires, wheel wells, vehicle undercarriages, and other surfaces. A high pressure washer and/or compressed air may be used to ensure that soil and debris are completely removed.

2.2. Vehicles may be cleaned at a commercial vehicle or appropriate truck washing facility. Vehicles that only travel and park on paved public roads do not require external cleaning.

2.3. The interior of vehicles and equipment (cabs, etc.) must be free of mud, soil, gravel and other debris (vacuumed, swept or washed).

2.4. Small tools and equipment must be washed to be free of soil or other contamination and sanitized as described in section 5.

3. Cleaning footwear and clothes

3.1. Soles and uppers of footwear must be free of debris and soil before arriving at the site. Clean and sanitize footwear as described in section 5.

3.2. At the start of work at each new job site, worker clothes should be free of all mud or soil. If clothes are not freshly laundered, remove all debris and adhered soil with a stiff brush.

4. Preventing potential spread of contamination to or within sites

In a partially infested site, the potential for *Phytophthora* to spread within the site needs to be addressed. It is not practical to identify every portion of a site that contains or is free of *Phytophthora.* Because *Phytophthora* contamination is not visible, work practices should minimize unnecessary movement of soil within locations to prevent potential pathogen spread.

Specific portions of a site may be designated as having high or low risk of contamination. Areas with higher risk of contamination include areas adjacent to planted landscaping, areas previously planted with *Phytophthora*-infected stock, areas with existing or recently removed woody vegetation, and riparian areas. Areas with low risk of contamination include upland sites with only grassy vegetation or sites where surface soils have been removed.

4.1. Worker training and site access

4.1.1. Before entering the job site, field workers should receive training that includes information on *Phytophthora* diseases and how to prevent the spread of these and other soil-borne pathogens by following approved phytosanitary procedures.

4.1.2. Do not bring more vehicles into work sites than absolutely necessary. Within the site, keep vehicles on surfaced or graveled roads whenever possible to minimize soil movement.

4.1.3. Travel off roads or on unsurfaced roads should be avoided when such roads are wet enough that soil will stick to vehicle tires and undercarriages. In intermittently wet areas, avoid visits when roads are wet; schedule activities during dry conditions when the risk of moving wet soil is minimal.

4.1.4. To minimize the amount of time needed to decontaminate equipment, tools, gloves, and shoes, avoid working at sites under wet conditions or when soils are saturated.

4.2. Minimize unnecessary movement of soil and plant material within the site, especially from higher to lower risk areas

4.2.1. Plan work to minimize movement between areas with high and low risk of contamination. Where possible, complete work in low risk areas before moving to higher risk areas. Alternatively, restrict personnel to working in either high or low risk areas exclusively to reduce the need for decontamination.

4.2.2. Clean soil and plant debris from equipment and sanitize hand tools, buckets, gloves, and footwear when moving from higher risk to lower risk areas or when moving between widely separated portions of a site.

5. Procedures for sanitizing tools, surfaces, and footwear

Surfaces and tools should be clean and sanitized before use. Wood handles on tools should be sealed with a waterproof coating to make them easier to sanitize.

Before sanitizing, remove all soil and organic material (roots, sap, etc.) from the surface. If necessary, use a detergent solution and brush to scrub off surface contaminants. The sanitizing agent may also be used as a cleaning fluid. Screwdrivers or similar implements may be needed to clean soil out of crevices or shoe treads. Brushes and other implements used to help remove soil need to be cleaned and sanitized after use.

After surface soil and contamination are removed, treat the surface with one of the following sanitizing agents, allowing the appropriate contact time before use or rinsing. If surfaces are clean and dry, wet surfaces thoroughly and allow for the appropriate contact time. If the sanitizer has been used to help clean the surface, use fresh sanitizer to rinse off any dirty solution and again allow the required contact time. If treated surfaces are wetted with water, the sanitizing solution will become diluted. Apply enough sanitizer to completely displace the water film and then allow the required contact time. Sanitizing agents may be applied by using spray bottles and applied to thoroughly wet the surface. Observe all appropriate safety precautions to prevent contact with eyes or skin when using these agents.

Sanitizing agents

- 70-90% ethyl or isopropyl alcohol - spray to thoroughly wet the surface and allow to air dry before use
- freshly diluted bleach solution (0.525% sodium hypochlorite, Table 1) for a minimum of 1 minute (due to corrosivity, not advised for steel or other materials damaged by bleach)
- 2000 ppm quaternary ammonium disinfectant for 1 min (or according to manufacturer recommendations) - freshly made or tested to ensure target concentrations

Table 1. Dilutions of commonly available bleach products needed to obtain approximately 0.525% sodium hypochlorite concentrations (5000 ppm available chlorine).

Percent sodium hypochlorite in bleach	Parts bleach	Parts water	Diluted bleach percent sodium hypochlorite
5.25%	1	9	0.525%
6.0%	1	10.4	0.526%
8.25%	1	14.6	0.529%
8.3%	1	14.8	0.525%

For example, adding 100 ml of 5.25% bleach to 900 ml of water will make 1000 ml of 0.525% NaOCl solution. If using 8.3% bleach, add 100 ml of bleach to 1480 ml of water to make 1490 ml of 0.525% NaOCl.