



NOAA FISHERIES SERVICE



Invasive species are commonly introduced to new areas via contaminated road and construction equipment (Photo credit: MN Department of Agriculture).



Equipment arriving on site should always be thoroughly inspected and cleaned to remove plants, seeds, and materials that may be hitchhiking (Photo Credit: NOAA).

Preventing Invasive Species: Cleaning Land Vehicles, Equipment, and Personal Gear

Background

To prevent the accidental introduction of invasive species during construction or maintenance activities, all tracked equipment involved in earthwork should be cleaned to remove plants, seeds, and other materials that may be hitchhiking before arrival on site. If equipment is used in earthwork where invasive species are known to exist, then the equipment should be cleaned before being moved to any portion of the site that is known to be free of invasive species.

Personal gear and clothing should be cleaned before and/or after use by soaking, dipping in, or scrubbing with hot water, or in one of the chemical decontamination solutions listed below.

Cleaning Methods

Set up the best staging area possible for cleaning operations. A paved area with accommodations to elevate vehicles or otherwise allow easy access to the undersides of vehicles and equipment is ideal. Equipment of all types should be cleaned at the location of last use. If this is not possible, arrange for cleaning at a facility that is specially designed for equipment cleaning.

Water runoff carrying soil, seeds, animals, and petroleum residue must be managed with the use of berms or other containment. Silt fence installed along perimeters of work areas can also aid in preventing spread of contaminated materials outside of the washdown location.

Despite very careful efforts to capture and quarantine materials from cleaning operations, site-specific invasions are likely to occur; therefore, part of the cleaning process should involve monitoring the washdown areas for invasive species and using appropriate control methods early to prevent additional spread.

Personnel who use equipment during cleaning operations are responsible for properly using Personal Protective Equipment (PPE) that is appropriate to the cleaning activity. Using cleaning and disinfectant chemicals, power washers, air compressors, and other types of cleaning equipment may present working hazards. PPE items to protect hearing, skin, eyes, and respiration may be required. All personnel should undergo proper training of all equipment prior to performing any cleaning operation.



Brushing (Physical Removal)

Brushing is considered to be moderately effective in removing the majority of plant material from equipment or gear. A follow-up with water washing, high-pressure air blasting, or high-pressure wash is also recommended.

- If there is a nap to fabric (e.g., upholstery, carpeting, or clothing), brush with the nap rather than against it. Brushing against the nap could further embed small seeds into the material. High-pressure compressed air blasting may be used to assist soil removal.
- A combination of soft and stiff bristles of varying length is recommended for use on carpeting or components made of rubber, nylon, or plastic.
- Bristles of medium length and stiffness are desired for removal of soil and other matter from fabrics and upholstery.
- Stiff bristles are recommended for the tread of wheels that become encrusted with soil and mud. Metal bristles may also be used to remove soil or concrete in treads, but heavier wear and tear to the equipment will result.



To prevent the spread of invasive species, all clothing and field equipment should be inspected and cleaned before leaving the worksite.

Vacuuuming (Physical Removal)

Vacuuuming equipment or clothing with a brush attachment is suggested to remove most loose particle matter, but care should be taken because small seeds may become further embedded in materials. To prevent contained plant and soil matter from being redeposited following the cleaning process, collected matter should be bagged and incinerated or disposed of in a sanitary landfill. A follow-up with water washing, high-pressure air blasting, or high-pressure wash is also recommended.

Use of Adhesive Roller (Physical Removal)

Adhesive is considered to be moderately effective in removing plant material from equipment or gear. Seed and fragment materials readily attach to the adhesive sheets and are effectively lifted out of seams and the weave of loose particle fabrics; however, proper attention and care given during removal is a direct reflection of the potential efficiency of this technique. To prevent contained plant and soil matter from being redeposited following the cleaning process, adhesive sheets should be bagged and incinerated or disposed of in a sanitary landfill. A follow-up with water washing, high-pressure air blasting, or high-pressure wash is also recommended.

Thermal Treatment

Thermal treatments involve the use of extremely hot temperatures in order to kill all invasive material. Using steam, hot air, or hot water to clean vehicles and field equipment has proven to be especially effective when used to bring the object's surface temperature up to 140 °F for 30 seconds. A hand-held infrared thermometer can be used to verify the surface temperature. Disadvantages to the use of thermal treatments are the apparent risk of burns, its labor-intensive nature, and the initial investment cost of equipment.



Chemical Treatment

Many chemical agents are available to prevent the potential movement of invasive species. However, the use of chemical treatments sometimes poses disposal and wastewater concerns. If chemical treatments are used, local standards of waste disposal must be followed. Since local regulations for chemical disposal may vary, always contact a local chemical waste management facility, the Environmental Protection Agency, or refer to the Material Safety Data Sheet for recommendations on proper disposal prior to use of any chemical. Some state states may also require certification or licensing for personnel who use chemical treatments. Finally, some solutions may cause corrosion on metal surfaces and electrical connections; thus be sure to follow all label restrictions and manufacture guidelines. Following treatment, rinse all surfaces with clean water and dry thoroughly.



Invasive plants can be spread as hitchhikers on vehicles. Photo Credit (USDI Bureau of Land Management)

Diluted household bleach solution provides an inexpensive, effective way to control invasive species. Soak or spray equipment for at least one minute with a 2% bleach solution (3 ounces of household bleach mixed with 1 gallon of water). If invasive pathogens or diseases are suspected, a 10% solution should be used (13 ounces of household bleach mixed with 1 gallon of water). Note that bleach is an extremely effective disinfection agent, but it is a caustic substance that can be corrosive to aluminum and other sensitive fishing and boating equipment.



Since mud can be laden with seeds or plants parts, personal gear and clothing should be thoroughly cleaning to prevent moving invasive species into new areas. (Photo Credit: Bureau of Reclamation).

Of the materials traditionally used to disinfect for human or animal health purposes, quaternary ammonium compounds have been found to be effective in controlling viruses and pathogens. Commercial formulations, such as Parvasol® and Kennelsol®, are available through laboratory or veterinary supply companies. Household cleansers/disinfectants, such as Formula 409® and Fantastic® that contain the quaternary ammonium compound alkyl dimethyl benzyl ammonium chloride can also be used to disinfect equipment. These solutions can be used full strength as a spray, or diluted for soaking with 2 parts water to 1 part disinfectant. For all materials, follow label instructions and be sure to soak equipment for a minimum of 10 minutes. *Be sure to dispose of materials away from surface waters in accordance with label restrictions.*

Other common chemical decontamination methods are:

- Undiluted white vinegar for 20 minutes.
- 1% potassium permanganate solution at 24-hour exposure.
- 5% quaternary ammonium solution for 10 minutes.
- 250 mg/L ROCCAL (benzalkonium chloride) for 15 minutes
- 500 mg/L hydrogen peroxide for 60 minutes
- 167 mg/L formalin for 60 minutes
- 1% table salt (based on 312 g per cup sodium chloride) for 24 hours



General Water Washing

General water washing can be used in conjunction with a physical removal technique such as brushing or vacuuming and is moderately effective in removing residual foreign materials, although small and embedded seeds are capable of persisting. In addition, some seeds may remain viable following a wash treatment. In situations where known invasive materials are present, wastewater can be treated or filtered, and the waste materials bagged and incinerated or disposed of in a sanitary landfill.

High-Pressure Water Washing

High-pressure washing is the most effective means of cleaning heavily soiled and contaminated items to eliminate invasive species materials and prevent their spread. There are many models of high-pressure washers, from simple hand-held nozzles to laser guided, robotic control systems. In some cases, containment and operation sheds are portable. Not all items are capable of withstanding the pressure of this treatment, and it should only be used where applicable. In certain situations cleaning with compressed air, rather than water, could prevent damage to certain equipment areas such as engine wiring systems and vehicle cabs.



Identifying a facility to properly wash vehicles and equipment is an important step in the prevention of invasive species (Photo credit: Bureau of Reclamation).

Minimum water pressure for vehicle cleaning should be at least 90 pounds per square inch. Water can be supplied as high volume/low pressure or low volume/high pressure. Each option has advantages and disadvantages based on specific cleaning needs and water availability. Heavy accumulations of soil and debris on large land-use equipment can best be cleaned using high volumes of water, but it may create water treatment or disposal issues. Still, some currently available cleaning systems can effectively remove large accumulations of soil with relatively low-volume water delivery.

Water Availability and Disposal

Freshwater in a quantity suitable for all cleaning operations is necessary. When this is not possible, consideration should be given to other water options such as water recycling systems or use of compressed air to remove soil. Raw water, or even gray water, is sometimes used, but potential health issues may require precautions such as immunizations or specialized safety equipment for personnel. If pumping water from field sources, unintentional movement of exotic plants, algae, and other invasive aquatic species must be addressed. Proper placement of pumps away from aquatic or shoreline vegetation that is known to be invasive is a practical first step.

Water storage tanks, filters, and recapture systems can offer adequate onsite water supplies with less water use than would otherwise be necessary without recycling. By using sand or cartridge filters, many contaminated substances can be captured during cleaning operations to be safely handled later. In addition to soil and invasive species, wash water and used wash water filters may also contain oily residues from cleaning certain types of equipment. Such items may require handling, treatment, and disposal according to state and local standards.

Activities that require usage of water also need to consider invasive species control. The equipment used in transporting and spraying water should be cleaned before arrival on site.



Suggested Resources:

[Comparison of Relocatable Commercial Vehicle Washing Systems](#)

Fleming J. September 2008. U.S. Department of Agriculture, Forest Service San Dimas Technology & Development Center. 0851 1809 - SDTDC. 36 pp. Available online at: http://www.weedcenter.org/management/docs/09_VehicleWashingSystemReport.pdf
This report compares a range of vehicle washing systems with respect to efficacy, economics, waste containment, waste disposal, and the viability of any propagules that were collected in the cleaning process.

[Guide of Noxious Weed Prevention Practices](#)

U.S. Department of Agriculture, Forest Service. July 2001. 25 pp. Available online at: http://www.fs.fed.us/rangelands/ftp/invasives/documents/GuidetoNoxWeedPrevPractices_07052001.pdf
This document provides a comprehensive directory of weed prevention practices for use in Forest Service planning and wildland resource management activities and operations.

[Inspection and Cleaning Manual for Equipment and Vehicles to Prevent the Spread of Invasive Species](#)

U.S. Department of the Interior Bureau of Reclamation. 2009. Technical Memorandum No. 86-68220-07-05. 203 pp. Available online at: http://www.usbr.gov/pps/EquipmentInspectionandCleaningManual_Sept09.pdf
This manual provides recommendations for inspection and cleaning of vehicles and equipment as a prevention tool to limit the spread of invasive species.

[Invasive Plant Prevention](#)

U.S. Department of Agriculture, Forest Service. 2002. Invasive Plant Management: CIPM Online Textbook. Chapter 10 Invasive Plant Prevention; Adapted from USDA Forest Service Guide to Noxious Weed Prevention Practices. Available online at: http://www.weedcenter.org/textbook/10_prevention.html
This guide provides practical, proactive weed-prevention guidelines.

[Invasive Plant Prevention Guidelines](#)

Center for Invasive Plant Management. September 2003. Compiled by J. Clark, Bozemon, MT. 15 pp. Available online at: http://www.weedcenter.org/store/docs/CIPM_prevention.pdf
This document provides guidelines for prevention and for developing weed management areas.

[National Cooperative Highway Research Program \(NCHRP\) Synthesis 363: Control of Invasive Species.](#)

The Transportation Research Board of the National Academies. 2006. Transportation Research Board, Washington D.C. 126 pp. Available online at: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_363.pdf
The report explores the extent to which the state departments of transportation are prevent and controlling invasive species, restoring habitats, and conducting research. Successful practices and documented as well as lessons learned.

[Transfer of Invasive Species Associated with the Movement of Military Equipment and Personnel.](#)

Cofrancesco, Jr. AF., Reaves DR, Averett DE. July 2007. Army Corp of Engineers, Engineer Research and Development Center. ERDC/EL TR-07-8. Washington D.C., 126 pp. Available online at: <http://el.erd.c.usace.army.mil/elpubs/pdf/trel07-8.pdf>
This document provides an overview of the current process that exists to clean, inspect, and regulate the movement of invasive species through ports of embarkation and debarkation.

[Invasive Species Best Management Practices for Transportation and Utility Rights-of-Way](#)

Wisconsin Council on Forestry. January 2010. 63 pp. Available online at: <http://council.wisconsinforestry.org/invasives/transportation/pdf/ROW-Manual.pdf>
The guidelines in this manual apply to utility and transportation corridor construction and maintenance activities.

[Wisconsin's Forestry BMPs for Invasive Species. A Field manual for Foresters, Landowners, and Loggers](#)

Wisconsin Council on Forestry. March 2009. 56 pp. Available online at: http://council.wisconsinforestry.org/invasives/pdf/FinalForestryBMPManual_03-26-09.pdf
This document provides information on prevention, control, and monitoring of priority species in forested landscapes.

[Wisconsin's Urban Forestry BMPs for Preventing the Introduction and Spread of Invasive Species](#)

Wisconsin Council on Forestry. August 2009, 102 pp. Available online at: http://council.wisconsinforestry.org/invasives/pdf/UF-BMP-ConsolidatedManual_090811.pdf
This document provides information on prevention, control, and monitoring of priority species in urban forests