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GUIDANCE TO ADDRESS WORKER HEALTH AND SAFETY FOR BIOLOGICAL HAZARDS ASSOCIATED WITH COMPOSTING ROAD-KILLED DEER IN NEW YORK

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This report presents a recommended protocol for reduction of the biological hazards of tasks involved in the composting of road-killed deer, including: carcass collection and transport, vehicle and tool maintenance, the composting process (pile set-up, take-down, screening), and subsequent compost use. (Further information is available on other hazards related to composting; mechanical, ergonomic, heat and cold stress, etc., and can be provided if desired.) This is a report for Task 4 Subtask 4.1 of the *Pathogen Analysis of NYSDOT Road-killed Deer Carcass Compost Facilities* project sponsored by NYS Department of Transportation (NYSDOT) and implemented by the Cornell Waste Management Institute (CWMI). It is based upon (a) the literature search on the prevalence of pathogens in wildlife and on the conditions associated with their inactivation, which was conducted as Task 1 Subtask 1.2 by Ellen Harrison, Jean Bonhotal, and Mary Schwarz, (b) the results of the temperature and pathogen data analysis conducted as Tasks 1 – 3 by Ellen Harrison, Jean Bonhotal, and Mary Schwarz, (c) other references (cited below), and (d) discussions held during the TIRC meetings on 05/15-16/2007 .

The recommendations are discussed below as Appendix A; background information which yielded these recommendations is shown below as Appendix B. These recommendations were used to provide input into revising NYSDOT's current Safety Bulletin for Carcass collection and handling and to create a new Safety Bulletin dealing with carcass composting.

APPENDIX A: RECOMMENDATIONS BY INDIVIDUAL TASK OR PROCESS

For carcass-handling and vehicle/tool maintenance, current procedures would be continued except where there are additions or modifications of current NYSDOT procedures; no existing procedures were eliminated. The following is a detailed breakdown by task or process to show specific details.

TASK OR PROCESS *	TASK OR PROCESS HAZARDS	PERSONAL PROTECTIVE EQUIPMENT	ADMINISTRATIVE CONTROLS/WORK PRACTICES
Collecting, loading, transporting carcass (intact, damaged, bloated; or animal injured or stunned and not dead)	Exposure to animal skin, exudates, parasites, internal organs, feces, urine, blood, expelled gases/aerosols, bites/scratches, puncture wounds from bones**	Do not allow the carcass or other contaminated surfaces to come in contact with bare skin. Wear face shield or mask and goggles. "Mask" shall be N95 respirator (95% removal at > 0.3 u). Based upon potential exposures, a respirator would be needed. Biohazards with either (a) a biosafety level of 2 and with aerosol exposure potential or (b) biosafety level 3 (which have known respiratory transmission) were concluded as needing respiratory protection. At a minimum this would be a NIOSH-approved N95 respirator. An N95 is considered acceptable by CDC/NIOSH and/or by OSHA as appropriate for biosafety level 3 organisms such as tuberculosis and SARS, as well as for fungi. Clarify clothing, to be disposable or not? If not, change into street clothes before going home; bag work clothes and keep bagged until placed in washing machine; wash separately from family laundry. Use dedicated	**Training:** Avoid hand-to-mouth transfer, including nailbiting; wash hands before eating or smoking. Chronic wasting disease may be observable as prime-aged animal in poor condition; otherwise no other indicators in carcass. TICKS: As tick nymphs are about the size of a poppy seed, they often go unnoticed until fully engorged, and are therefore responsible for majority of human Lyme disease cases. Lyme Disease transmission unlikely before 36 hours of tick attachment; especially a problem at more than 48 hours; thus prophylactic antibiotic treatment after 2 days could be highly effective for persons bitten by a tick. Rickettsial diseases transmitted by bite in 2 – 20 hours after tick attachment. Check every 2 or 3 hours of outdoor activity for ticks on clothing or skin. Check self for ticks and have a "buddy" check you where you can't see so that all the following locations can be accounted for: behind knees, between fingers and toes, under arms, in and behind ears, on neck, hairline, and top of head; where clothing presses on the skin; beltline, under socks; groin. Location of tick may be obscure; bite typically painless. Bites from nymphs (1-2 mm, size of head of pin) might not be readily detected. Other types of bites may be indistinguishable from tick bites. **Work practices:** Pre-placement and annual physical examination. Follow DOT Safety Bulletin (1). Wash thoroughly with soap and hot water if cuts or scratches become contaminated. Pick up small carcasses in heavy plastic bags.

		work shoes or boots. Do not wear work shoes into personal vehicle. Gloves puncture-resistant for sharp bone fragments. Wear hat and tie hair back; light-colored clothing, long sleeves; tuck shirt into pants; with tight cuffs at wrists and ankles. Tuck pants into socks or boot tops, use two-sided tape around ankles to immobilize crawling ticks. Use repellent containing DEET on exposed skin except for face; use products containing permethrin on clothing not skin. DEET at 10 -35% considered optimal, no higher concentrations needed. Apply permethrin to clothing in well-ventilated area and allow to dry completely before wearing. Pre-treated clothing is available and effective for multiple laundering. If clothing soaked with blood or fluids, place in leak-proof bag or container and dispose in sealed bags. At end of shift, wash up and change to street clothing and shoes. Have extra set of work clothes for replacing those that become contaminated.	Seek medical attention if symptoms develop; especially sudden onset of fever, rash or flu-like illness for antibiotic therapy in early stages of infection. Also, severe headache, mild neck stiffness, fever, chills, migratory musculoskeletal pain, joint swelling and pain (especially knees), profound malaise and fatigue. Can develop into cardiovascular problems and chest pain; and/or neurological problems. At site of tick bite, localized infection may develop into "bull's eye" skin lesion (erythema migrans) in 3 – 32 days after exposure; and sometimes secondary sites develop remote from the primary site. Report febrile illness and consider this diagnosis even if definite tick attachment unknown or uncertain. Have a symptom/health reporting form to elicit prompt and complete information and enable rapid prophylaxis. Assume all animals are infected with rabies**.** After washing skin with soap and water, apply virucidal agent . If contact with animal fluids occurs or bloated animal vents or explodes producing fluid exposure, bag and ice carcass and report to proper authorities for rabies testing. If rabies is confirmed, direct exposed workers to proper facilities for rabies post-exposure vaccinations. Need to initiate post-exposure prophylaxis as soon as possible unless animal shown by testing not to be rabid. *If Mycobacterium bovis becomes an issue in NYS (currently at 5% prevalence), PPD testing could be instituted.* **Vaccination:** (special considerations needed for use of vaccines and immune globulins in persons with altered immunocompetence) Consider whether vaccination for *Francisella tularensis* may be warranted. USCDC recommends vaccination for those working with infected material in laboratories. Vaccination of adult diphtheria-tetanus toxoid at 10-year intervals highly recommended; also sufficient if wound minor and uncontaminated. For other wounds, booster is appropriate if person has not received toxoid within preceding 5 years. (Rabies immunization is discussed above as a post-exposure management procedure. Pre-exposure vaccination is available and is typically recommended for animal handlers; also useful protection for people with inapparent exposures to rabies. Serologic testing every 2 years; booster if antibody titer unacceptable.)

			(While a Q fever vaccine is available from US Army Medical Research Institute for Infectious Diseases, its use should be limited to those at high risk of exposure.) **Special groups:** Individuals with valvular heart disease are at elevated risk from *C. burnetii* (Q fever). For hepatitis E, serious risk during pregnancy; up to 25% mortality rate. Serologically-negative women of childbearing age who might become pregnant are at increased risk from *Toxoplasma gondi*. *Listeria* sp. can cause severe illness in pregnant women and immunocompromised persons.
Vehicle and tool maintenance	Splashing, aerosols; inhalation, skin/eye contact	N95 respirator, goggles, gloves, work clothes, dedicated work shoes or boots.	Use dedicated tools and decontaminate tools after use **Vaccination:** Vaccination of adult diphtheria-tetanus toxoid at 10-year intervals highly recommended; also sufficient if wound minor and uncontaminated. For other wounds, booster is appropriate if person has not received toxoid within preceding 5 years.
Wood chipping	Noisy equipment; impact of flying debris; dust; Inhalation, skin/eye contact	N95 respirator, goggles, gloves, work clothes, dedicated work shoes or boots; hard hat; faceshield. Hearing protection: ear muffs, plugs, or semi-inserts for noisy equipment.	**Work practices:** Additional information available on work procedures for wood chippers; preferred interlock which stops blades when hood opened.
Building compost pile or adding carcass to compost pile (includes handling of wood chips)	Noisy equipment Dusts and aerosols; inhalation, skin/eye contact	N95 respirator, goggles, gloves, work clothes, dedicated work shoes or boots. Enclosed cabs on payloaders or other equipment can substitute for the goggles or faceshield. However, air filters on such equipment may not be sufficient to substitute for respiratory protection. Unless one is working in an enclosed cab, a hard hat should be used for any tasks involving flying or falling objects including building the pile	**Vaccination:** Vaccination of adult diphtheria-tetanus toxoid at 10-year intervals highly recommended; also sufficient if wound minor and uncontaminated. For other wounds, booster is appropriate if person has not received toxoid within preceding 5 years. **Work practices:** Pre-placement and annual physical examination.

		and wood chipping. Hearing protection: ear muffs, plugs, or semi-inserts for noisy equipment; it is possible that sufficient noise reduction may be provided by an enclosed cab.	
Composting	Dusts and aerosols from wind and pile heat/activity; inhalation, skin/eye contact Noisy equipment	N95 respirator, goggles, gloves, work clothes, dedicated work shoes or boots. **Special groups:** People with specific allergies can exhibit immediate allergic reactions to fungi that may include irritation of the eyes, nose, and throat; chest construction and breathing difficulties, lethargy, and headache. Most fungi commonly encountered in the environment are unable to cause infectious disease. However, some species of fungi are considered opportunistic -- they can cause infection in people whose immune system is compromised (i.e. *immunodeficient*) by other diseases or treatments for those diseases. Examples include: diabetes, cancer (especially leukemia), cystic fibrosis, alcoholism, inherited immune deficiency, acquired immune deficiency (AIDS), invasive medical procedures, and certain medications (e.g. antibiotics, immunosuppressive drugs). For such persons, a higher level of respiratory protection may be necessary such as a powered air-	**Work practices:** Pre-placement and annual physical examination. **Vaccination:** Vaccination of adult diphtheria-tetanus toxoid at 10-year intervals highly recommended; also sufficient if wound minor and uncontaminated. For other wounds, booster is appropriate if person has not received toxoid within preceding 5 years.

		purifying respirator (PAPR).	
Screening finished compost	Dusts and aerosols Noisy equipment	N95 respirator, faceshield or goggles, gloves, work clothes, dedicated work shoes or boots. Unless one is working in an enclosed cab, a hard hat should be used for any tasks involving flying or falling objects.	**Work practices:** Analysis being conducted for particle size to investigate potential end use without screening (77) Pre-placement and annual physical examination. **Vaccination:** Vaccination of adult diphtheria-tetanus toxoid at 10-year intervals highly recommended; also sufficient if wound minor and uncontaminated. For other wounds, booster is appropriate if person has not received toxoid within preceding 5 years.
Breaking down pile and transferring compost	Dusts and aerosols Noisy equipment	Enclosed cabs on payloaders or other equipment can substitute for the goggles or faceshield. However, air filters on such equipment may not be sufficient to substitute for respiratory protection. N95 respirator, goggles, gloves, work clothes, dedicated work shoes or boots. Unless one is working in an enclosed cab, a hard hat should be used for any tasks involving flying or falling objects. Hearing protection: ear muffs, plugs, or semi-inserts for noisy equipment; it is possible that sufficient noise reduction may be provided by an enclosed cab.	**Work practices:** Pre-placement and annual physical examination.
Using and spreading compost (pneumatic, manually, dump truck, …?)	Dusts and aerosols	N95 respirator, goggles, gloves, work clothes, dedicated work shoes or boots.	**Work practices:** Pre-placement and annual physical examination. Allow 4-6 months after last carcass added and pile has reached 110F. Uses involving limited public contact; not on food crops. **Vaccination:** Vaccination of adult diphtheria-tetanus toxoid at 10-year intervals

			highly recommended; also sufficient if wound minor and uncontaminated. For other wounds, booster is appropriate if person has not received toxoid within preceding 5 years.

*Animal carcass composting does not involve any compost pile turning; thus this step and its potential exposure were omitted.
**Long bones may be a puncture problem throughout the process and into the final product, depending upon process control. (31)

APPENDIX B: BACKGROUND INFORMATION ON BIOLOGICAL HAZARDS CONSIDERED FOR EVALUATING HAZARDS AND RISKS

BACTERIA

Genus Species	**Route of Entry**	**Bio-Safety Level** (74)	**Task or Process Hazards**	**Hazard reduction using engineering controls or personal protective equipment**	**Background information and related administrative and/or process controls**
E. coli	Contact, ingestion (75)	Not found (assumed as per O157:H7)	Collection Transporting Vehicle/tool maint. Building pile	as per O157:H7	Die-off in days up to 2 weeks if temperatures at >50C. (76) May show initial growth, followed by decline with subsequent regrowth possible if temperatures not high enough, long enough. (26,28) CWMI research indicated die-off excellent; appropriate pile temperature achieved; meets Class A solids use criteria. (68)
E. coli O157:H7 (VTEC/SLT; cytotoxin-producing, enterohemorrhagic; hemolytic uremic syndrome, HUS))	Contact, ingestion (75) Feces, blood, importance of aerosol exposure unknown (74) Ingestion of deer feces and meat (30,53,56)	2	Collection Transporting Vehicle/tool maint. Building pile (12,13,16,17,19)	Biological safety cabinet (thus respiratory protection); splash shields, face protection, gowns, and gloves; handwashing and waste decontamination facilities. (74) Checked for vaccination recommendations as per MMWR; not found. (74)	May show initial growth, followed by decline with subsequent regrowth possible if temperatures not high enough, long enough. (26,28) Die-off in minutes at 60C. (76) Especially avoid hand-to-mouth transfer, including nailbiting. (84,85)
Enterococci	Ingestion (fecal-oral) (76)	Not found	Collection Transporting Vehicle/tool maint. Building pile	as per O157:H7	Wood chips (Day 0). (77) Die-off in hours at 55 C. (76) CWMI research indicated die-off excellent; appropriate pile temperature achieved; meets Class A solids use criteria. (68)

Genus Species	**Route of Entry**	**Bio-Safety Level** (74)	**Task or Process Hazards**	**Hazard reduction using engineering controls or personal protective equipment**	**Background information and related administrative and/or process controls**
Fecal coliform	Ingestion (fecal-oral) (76)	Not found	Collection Transporting Vehicle/tool maint. Building pile	as per O157:H7	May be more resistant to compost temperatures than *E. coli.* Die off <120 days at 55 C.(76) Wood chips (Day 0). (77) May re-grow during cooling phase (23) Temperature variation in pile produces inconsistent pathogen reduction. (35) CWMI research indicated die-off excellent; appropriate pile temperature achieved; meets Class A solids use criteria. (68)
Fecal streptococcus *Streptococcus faecalis* (see also enterococci)	Ingestion (fecal-oral)	Not found	Collection Transporting Vehicle/tool maint. Building pile	as per O157:H7	Wood chips (Day 0). (77) Die-off in minutes at 60 C. <120 days @ 55 C. (76) May be more resistant to compost temperatures than *E. coli.* (76) Adequate nitrogen speeds up die-off. (52) CWMI research indicated die-off excellent if appropriate pile temperature achieved. (68)

Genus Species	**Route Of Entry**	**Bio-Safety Level** (74)	**Task or Process Hazards**	**Hazard reduction using engineering controls or personal protective equipment**	**Background information and related administrative and/or process controls**
Salmonella spp. (8)	Aerosol, contact, ingestion, wound infection (75) Feces, blood, urine; ingestion, injection; importance of aerosol exposure unknown (74)	2	Collection Transporting Vehicle/tool maint. Building pile (13,16)	Biological safety cabinet (thus respiratory protection); splash shields, face protection, gowns, and gloves; handwashing and waste decontamination facilities. (74) Handwashing (85)	*Salmonella enteritidis* die off in manure compost after 48 hours. (37) Die-off about 80 days at 55 C.; minutes at 60 C. (76) Mesophilic curing to allow colonization of curing piles by gram-negative bacteria, especially coliforms, should prevent repopulation by salmonellae. (43) Die-off in <21 days of several species in composted manure. (51) Adequate nitrogen speeds up die-off. (52) Considered less hardy than enterococci and *Streptococcus faecalis* which both died off as per CWMI research. (68)
Francisella tularensis (tularemia (5))	Dressing deer carcass by injection injury. (81) Bite (injection) of parasitic Deer Tick (*Ixodes scapularis*), also dog tick, wood tick, and lone star tick; and bite of deer fly (*Chrysops discalis*) (83,87); prone to desiccation (5) Skin contact, mucous membranes, tick or mosquito bite, ingestion of infected meat, inhalation of contaminated dust, aerosols, droplets; exposure to lesion exudates, cerebrospinal fluid, blood, urine, tissues (spleen, liver, bone marrow). (74,82,83)	2 3 for cultures and experimental animal studies	Collection Transporting Vehicle/tool maint. Building pile	Biological safety cabinet (thus respiratory protection); splash shields, face protection, gowns, and gloves; handwashing and waste decontamination facilities. Vaccination for those working with infectious materials and cultures (see MMWR; further recommendations not found) (74)	Found in deer in NY, PA, MA, and western US. (81,87) Also found in 50 species of mammals; rabbits, hares, muskrats, voles; occasionally in fox, coyote, beaver, bobcat, badger, dog, cat, sheep, goat, calf, and horse; few reports in deer. (83) Die-off in minutes at 57C. (76) Worker to inspect own body daily for attached ticks. Removal procedure specified. Tick may be submitted to USDOH for testing. USCDC recommends vaccination for those at risk at work. (4)

Genus Species	**Route of Entry**	**Bio-Safety Level** (74)	**Task or Process Hazards**	**Hazard reduction using engineering controls or personal protective equipment**	**Background information and related administrative and/or process controls**
Mycobacterium bovis (10)	Inhalation (possible) Injection (46) Sputum, cerebrospinal fluid, urine, lesions from variety of tissues; possible aerosols during manipulation of tissue (74) Ingestion (of milk and cheese products not pasteurized nor aged sufficiently (88))	2 for animal studies in guinea pigs or mice; 3 for animal studies in primates or for cultures	Collection Transporting Vehicle/tool maint. Building pile Screening Use	Biological safety cabinet (respiratory protection would be required); splash shields, face protection, gowns, and gloves; handwashing and waste decontamination facilities. See MMWR for vaccine recommendations; BCG vaccine not typically used in U.S.; PPD testing recommended as surveillance procedure (74)	Not identified in any states other than Michigan where significant progress has been made toward eradication. (78,79) Older male deer more likely to be positive. (46) *M tuberculosis* destroyed in 20 minutes at 70 C. (76) This temperature did not seem likely to be achieved in composting, thus survival of the compost process was assumed. Prevalence in free-ranging deer at 5%. (109) CWMI study of *Mycobacterium avian paratuberuclosis* (M.A.P.) indicated initial die-off then re-growth. (68) (If this disease becomes an issue in NYS, the procedures noted here could be instituted)
Brucella abortus (infection, potential hypersensitivity)	Aerosol, skin contact, ingestion, possible skin penetration. (75) Blood specimens (65); cerebrospinal fluid, semen, and urine (74)	2 (animal specimens)	Collection Transporting Vehicle/tool maint. Building pile Screening Use	Biological safety cabinet (thus respiratory protection); splash shields, face protection, gowns, and gloves; handwashing and waste decontamination facilities. Vaccine exists in other countries, not U.S. (74)	Heat inactivation @ 61.7 C for 30 minutes. (97)

Genus Species	**Route of Entry**	**Bio-Safety Level** (74)	**Task or Process Hazards**	**Hazard reduction using engineering controls or personal protective equipment**	**Background information and related administrative and/or process controls**
Campylobacter jejuni (7) *C. lari; C. hyointestinalis* (9) *Campylobacter* spp.	Contact, ingestion (75) Ingestion of feces Fecal (33) Importance of aerosol exposure unknown (74)	2	Collection Transporting Vehicle/tool maint. Building pile	Biological safety cabinet (thus respiratory protection); splash shields, face protection, gowns, and gloves; handwashing and waste decontamination facilities. (74) Handwashing (85)	Personal hygiene. Proper handling of contaminated clothing. Training; hand-to-mouth transfer. Found in feces and visceral smears (33) Killed in minutes at 60 C. (76) Considered less hardy than enterococci and *Streptococcus faecalis* which both died off as per CWMI research. (68)
Listeria spp.	Fecal (33) Cerebrospinal fluid, blood (74) Ingestion (74) Eye and skin infections from direct exposure (74)	2	Collection Transporting Vehicle/tool maint. Building pile	Gloves and eye protection (74)	Found in feces and visceral smears (33) Survival in poultry manure composting. (50) Killed in minutes at 60 C. (76) Severe illness in pregnant women and immunocompromised persons (74) Considered less hardy than enterococci and *Streptococcus faecalis* which both died off as per CWMI research. (68)

Genus Species	**Route of Entry**	**Bio-Safety Level** (74)	**Task or Process Hazards**	**Hazard reduction using engineering controls or personal protective equipment**	**Background information and related administrative and/or process controls**
Clostridia spp. *Clostridium tetani*	Injection (puncture wounds from bones); wound infection (75) Mucous membrane risk unknown for aerosols and droplets (74)	2 (cultures or toxin of *C. tetani*)	Collection Transporting Vehicle/tool maint. Building pile Screening Use	Vaccination. Adult diphtheria-tetanus toxoid at 10-year intervals highly recommended; also sufficient if wound minor and uncontaminated. For other wounds, booster is appropriate if person has not received toxoid within preceding 5 years. (74,89,90) Biological safety cabinet (thus respiratory protection); splash shields, face protection, gowns, and gloves; handwashing and waste decontamination facilities. (74)	Adequate nitrogen speeds up die-off. (52) Die off of *C. botulinum* in minutes at 70 C. (76). This temperature did not seem likely to be achieved in composting, thus survival of the compost process was assumed.
Clostridium perfringens (7); Clostridium perfringens type A (microflora of soil and intestinal tracts; B,C,D, and E are obligate parasites of animals and humans)	Ingestion, wound infection (75)	2 (assumed as for other *Clostridia* spp., above)	Collection Transporting Vehicle/tool maint. Building pile	Assume same as for other *Clostridia*.	Survival of anaerobic spore-formers. (50) Types B,C,D,E die out in a few months in soil. (66) Die-off in minutes at 59 C. (76)

Genus Species	**Route of Entry**	**Bio-Safety Level** (74)	**Task or Process Hazards**	**Hazard reduction using engineering controls or personal protective equipment**	**Background information and related administrative and/or process controls**
Leptospira icterohemorrhagiae Leptospira pomona (20)	Fluids, tissues, necropsy, especially urine and blood. (74) Ingestion, injection, skin contact, mucous membranes (74)	2	Collection Transporting Vehicle/tool maint. Building pile	Gloves for handling and necropsy of infected animals or likelihood of direct skin contact with infectious materials. (74) Biological safety cabinet (thus respiratory protection); splash shields, face protection, gowns, and gloves; handwashing and waste decontamination facilities. (74)	*Leptospirosis* antigens found in deer blood. (55,65) Organism found in renal tissue. (58) Inactivated @ 60 C for 15 min. (98) Survives in distilled water for 110 days; in semi-solid medium of water and agarose for 347 days. (99)
Micrococcus		Not found	Collection Transporting Vehicle/tool maint. Building pile	Assume necessary to protect all routes of entry.	Survive composting and reach high concentrations in the compost. (23) Eliminated in vegetative form during rising temperatures in compost after 22 hours. (109)
Yersinia enterolitica, fredriksenii, kristensenii, intermedia, pseudotuberculosis	Contact, ingestion; possible aerosol, possible bite or scratch (75)	Not found	Collection Transporting Vehicle/tool maint. Building pile	Assume necessary to protect all routes of entry.	Decomposes rapidly from other bacterial contamination/decomposition of carcass in deer. (24) Found in feces. (25) Holding in manure at 25 C for 90 days decreased concentrations to below detection. (109) Also found in gray fox, porcupine, and birds. (64)

Genus Species	**Route of Entry**	**Bio-Safety Level** (74)	**Task or Process Hazards**	**Hazard reduction using engineering controls or personal protective equipment**	**Background information and related administrative and/or process controls**
Lyme Disease (*Borrelia burgdorferi*, spirochete) (6,18,39,40)	Bite (injection) of parasitic Deer Tick (*Ixodes scapularis)* in eastern U.S. (91), tick prone to desiccation (5) Ingestion without vector (18)	Not found	Collection Transporting Vehicle/tool maint. Building pile Screening Use	USCDC recommends vaccination for those at risk at work; vaccination withdrawn from market in Feb. 2002 due to low sales and concerns about theoretical risk of causing autoimmune reactions (101); no longer commercially available. (4,90,91,101) Wear light-colored clothing, long sleeves; tuck shirt into pants; with tight cuffs at wrists and ankles. Tuck pants into socks or boot tops, use two-sided tape around ankles to immobilize crawling ticks. (4,91,101) Use insect repellent (especially DEET) on clothing, exposed skin . Permethrin on clothes. (4,91)	Worker to inspect own body daily for attached ticks. Removal procedure specified. Tick may be submitted to USDOH for testing. (4) As tick nymphs are about the size of a poppy seed, they often go unnoticed until fully engorged, and are therefore responsible for majority of human Lyme disease cases. (6) Especially in summer months when high nymphal activity. (48) Estimates of tick abundance in relation to deer density as a predictor for Lyme disease risk only very weakly related. (54) Deer are principal maintenance hosts for adult ticks; but blood sera complement is lytic to *B. burgdorferi.* Disease and ticks also found in birds and rodents. (101). Disease transmission unlikely before 36 hours of tick attachment; especially more than 48 hours; thus prophylactic antibiotic treatment after 2 days could be highly effective. (101). Seek medical attention if symptoms develop; especially rash or flu-like illness. Also, severe headache, mild neck stiffness, fever, chills, migratory musculoskeletal pain, joint swelling and pain (especially knees), profound malaise and fatigue. Can develop into cardiovascular problems and chest pain; and/or neurological problems. (91,100,101) At site of tick bite, localized infection may develop into “bull’s eye” skin lesion (erythema migrans) in 3 – 32 days after exposure; and sometimes secondary sites develop remote from the primary site. (101) Forms cysts at temperatures of 4 – 80 C. (102) Expected to survive composting process.

Genus Species	**Route of Entry**	**Bio-Safety Level** (74)	**Task or Process Hazards**	**Hazard reduction using engineering controls or personal protective equipment**	**Background information and related administrative and/or process controls**
Rocky Mountain Spotted Fever Group (*Rickettsia rickettsia*)	Bite (injection) of parasitic American Dog Tick (and others) ; also infected tissues, injection and possibly infectious aerosols (74)	3 (necropsy of infected animals)	Collection Transporting Vehicle/tool maint. Building pile Screening Use	Biological safety cabinet (respiratory protection would be required); splash shields, face protection, gowns, and gloves; handwashing and waste decontamination facilities. (74) No vaccine available. (92)	Widespread in U.S., especially south Atlantic and south central states; reported in all contiguous states except VT and ME. (92) Worker to inspect own body daily for attached ticks. Removal procedure specified. Tick may be submitted to USDOH for testing. (4) On the rise, in 2004, highest numbers ever reported in U.S. history. (105) Report febrile illness promptly for antibiotic therapy in early stages of infection. (74) *R. burneti* more resistant to heat than other rickettsiae; dies at 63-65 C in 30 minutes. (103)
Rickettsia helvetica (39,40)	Tick *Ixodes ricinus* Bite (injection)	Not found (assume 3 as per Rocky Mt Spotted Fever)	Collection Transporting Vehicle/tool maint. Building pile Screening Use	As per other tickborne diseases	*R. burneti* more resistant to heat than other rickettsiae; dies at 63-65 C in 30 minutes. (103)
Bartonella quintana, Bartonella henselae (39,40)	Tick *Ixodes ricinus* Bite/scratch; wound infection (75)	Not found	Collection Transporting Vehicle/tool maint. Building pile	As per other tickborne diseases	Heat inactivation at 56 C in 30 min. (104) Expected to die off in composting at temperatures seen in experimental piles by CWMI. (68)

Genus Species	**Route of Entry**	**Bio-Safety Level** (74)	**Task or Process Hazards**	**Hazard reduction using engineering controls or personal protective equipment**	**Background information and related administrative and/or process controls**
Human monocytropic ehrlichiosis (HME) (*Ehrlichia chaffeensis)*; human granulocytropic anaplasmosis (formerly ehrlichiosis) (HGA) Also *Ehrlichia ewingii* (5,11,15,36,39,40, 47) (Rickettsia)	Bite (injection); HME and *E. ewingii* by Lone-Star Tick (*Amblyomma americanum*); HGA by parasitic Deer Tick (*Ixodes scapularis* in NYS*)*	Not found (assumed 3 as per Rocky Mountain spotted fever)	Collection Transporting Vehicle/tool maint. Building pile Screening Use	As per other tickborne diseases (RMSF and Lyme disease). HGA, Lyme disease, and babesiosis transmitted by same tick vector and have high incidence rates in same states. (92) Hat and closed-toe shoes. (2) No vaccine available. (92) DEET at 10 -35% considered optimal, no higher concentrations needed. (92) Apply permethrin to clothing in well-ventilated area and allow to dry completely before wearing. Pre-treated clothing is available and effective for multiple laundering. (92)	Worker to inspect own body daily for attached ticks. Removal procedure specified. (Remove tick with tweezers or forceps; not fingers; do not crush. Wash hands. Disinfect bite wound. (92)) Tick may be submitted to USDOH for testing. (4) Rickettsia transmitted by bite in 2 – 20 hours after tick attachment. (92) Check self for ticks and have a "buddy" check you: behind knees, between fingers and toes, under arms, in and behind ears, on neck, hairline, and top of head; where clothing presses on the skin; beltline, under socks; groin. (15,92) Location of tick may be obscure; bite typically painless. Bites from nymphs (1-2 mm, size of head of pin) might not be readily detected. Other types of bites may be indistinguishable from tick bites. (92) HGA especially in NYS. (92) Rickettsia in bone marrow and rumen lymph node – collection an issue. Seek medical attention if symptoms develop. Sudden onset of fever, chills, headache; may be associated with malaise, and mylagia, photophobia, nausea, vomiting, anorexia, diarrhea, rash. Report febrile illness and consider this diagnosis even if definite tick attachment unknown or uncertain. (91,92) Lone star ticks especially in white-tailed deer; also in coyotes, dogs, goats; deer ticks in deer, elk, and wild rodents. (92) *R. burneti* more resistant to heat than other rickettsiae; dies at 63-65 C in 30 minutes. (103) This temperature did not seem likely to be achieved in composting, thus survival of the compost process was assumed. Lone star tick has moved into NYS, especially on Long Island. (114)

Genus Species	**Route of Entry**	**Bio-Safety Level** (74)	**Task or Process Hazards**	**Hazard reduction using engineering controls or personal protective equipment**	**Background information and related administrative and/or process controls**
Coxiella burnetii (Q fever) (rickettsia)	Infected arthropods; blood, urine, feces, milk, and tissues of infected hosts. (74) Aerosol, contact, ingestion, skin penetration, wound infection (75)	3 (necropsy of infected animals)	Collection Collection Transporting Vehicle/tool maint. Building pile Screening Use	Q fever vaccine available from US Army Medical Research Institute for Infectious Diseases; use should be limited to those at high risk of exposure. (74) Biological safety cabinet (respiratory protection would be required); splash shields, face protection, gowns, and gloves; handwashing and waste decontamination facilities. (74) See also recommendations for RMSF and Lyme disease.	Deer, moose, and raccoons (38) (antibodies in serum) Coyotes, foxes, rodents, skunks, raccoons, rabbits, deer, and birds; livestock handlers had higher prevalence of antibodies than those with no known risk; occupational exposures in research facilities, farm environments, and slaughterhouses. (41) Highly infectious; resistant to drying and environmental conditions. (74) Individuals with valvular heart disease should not work with *C. burnetii.* (74) Killed at temperatures of 63 – 80 C. (76) *R. burneti* more resistant to heat than other rickettsiae; dies at 63-65 C in 30 minutes. (103) This temperature did not seem likely to be achieved in composting, thus survival of the compost process was assumed.

FUNGI

Genus Species	**Route of Entry**	**Bio-Safety Level** (74)	**Task or Process Hazards**	**Hazard reduction using engineering controls or personal protective equipment**	**Background information and related administrative and/or process controls**
Fungal propagules *Aspergillus* *Penicillium* *Stachybotrys*	Inhalation (75)		Screening Use	Recommendations as per conventional composting. (96)	Survive composting and reach high concentrations in the compost. (23)

VIRUSES (Note: possible West Nile Virus exposure at compost site if mosquito breeding areas present; especially standing water or leachate. (96))

Genus Species	**Route of Entry**	**Bio-safety level** (74)	**Task or process hazards**	**Hazard reduction using engineering controls or personal protective equipment**	**Background information and related administrative and/or process controls**
Rabies (2)	Especially animal body fluids in the eye. Animal bite (injection). May be present in all animal tissues, but especially central nervous system, saliva, salivary glands. (74) Injection (puncture and to broken skin), exposure of mucous membranes. (74) (Inhalation via aerosols in labs; airborne exposure in bat caves. (93) Via transplanted corneas. (93))	2	Collection Transporting Vehicle/tool maint. Building pile	Heavy work gloves (gauntlet if available?) (2) Immunization not recommended for this task. (2) Faceshield? (74) Biological safety cabinet (thus respiratory protection); splash shields, face protection (especially eye protection), gowns, and heavy protective gloves; handwashing and waste decontamination facilities; immunization recommended. (74) Pre-exposure vaccination recommended for animal handlers; also useful protection for people with inapparent exposures to rabies. Serologic testing every 2 years; booster if antibody titer unacceptable. (93,95) Bagging of carcass using work procedure, using bag stronger than 4 mil.(1) When is this procedure utilized for deer??? Need to initiate post-exposure prophylaxis as soon as possible unless animal shown by testing not to be rabid. (93)	Universal precautions: assume all animals are infected**.** (Deer not usually **)** Training in handling and disposal. If bitten, keep animal for testing. (2) Disinfect contaminated tools and equipment outdoors using fresh 5% - 10% solution of bleach and water. (2) Wash skin with soap and water immediately.(2) Apply virucidal agent. (93) Found only occasionally in NYS deer. (94) Note: raccoons (34), bats, skunks, cats, dogs. (94) (consider contamination of wood chips) Rabies virus inactivated by desiccation and UV irradiation. If material containing virus is dry, virus considered noninfectious. (93) Pile probably not sufficiently dry for inactivation. Rabies virus inactivated by heating at 60C for 30 – 60 min. (110-113)

Genus Species	**Route of Entry**	**Bio-safety level** (74)	**Task or process hazards**	**Hazard reduction using engineering controls or personal protective equipment**	**Background information and related administrative and/or process controls**
HPAI H5N1 (Highly pathogenic avian influnza)	Inhalation (74) Respiratory tissues and secretions of infected animals; multiple organs in animals possible (74)	2	Consider if composting birds or if virus jumps to other species of interest.	Biological safety cabinet (thus respiratory protection); splash shields, face protection, gowns, and gloves; handwashing and waste decontamination facilities. (74)	Inactivated after 10 days of composting of poultry carcasses. (63)
Adenovirus (Egg Drop Syndrome in chickens)			Consider if composting birds		Inactivated after 20 days of composting of poultry carcasses. (63)
Parvovirus					Note: raccoons (34) (possible contamination of wood chips)
Newcastle Disease (ND virus (75))	Aerosol, contact; inhalation, skin contact (75)	Not found	Collection Transporting Vehicle/tool maint. Building pile		Composting process including cover material indicates virus retained by compost and not released to surroundings. (21)
Hepatitis E	Ingestion (22); fecal-oral Inhalation (86) Feces, saliva, blood; importance of aerosol exposure has not been demonstrated. (74)	2	Collection Transporting Vehicle/tool maint. Building pile	Gloves (74) Biological safety cabinet (thus respiratory protection); splash shields, face protection, gowns, and gloves; handwashing and waste decontamination facilities. (74)	Ingestion of raw deer meat (22) Population mortality rate about 1%. Serious risk during pregnancy; up to 25% mortality rate. (74,80) Probably survives 60 C for 30 minutes, but inactivated by conventional cooking processes. (106) Expected 4 log reduction in composting. (86) Found in swine; rates as vectors (86) Viruses typically retained by compost and not expected as exposure during screening or end use. (96)

PRIONS (Transmissible Spongiform Encephalopathies)

Genus Species	**Route of Entry**	**Bio-Safety Level** (74)	**Task or Process Hazards**	**Hazard reduction using engineering controls or personal protective equipment**	**Background information and related administrative and/or process controls**
Chronic wasting disease (deer, elk)	From environment contaminated by decomposed carcasses or excreta (42) Note: No evidence of occupational transmission of CJD in health care workers. Highest potential risk from exposure to high-infectivity tissue through needlestick injury (injection); splashing of mucous membranes (conjunctiva) or unintentional ingestion considered a hypothetical risk. (72) No evidence yet of transmission to humans. Avoid aerosols during necropsy. Skin puncture. Exposure to central nervous system, spleen, thymus, lymph nodes, lung; no evidence suggests aerosol transmission, but prudent to avoid generating aerosols (74)	2	Collection Transporting Vehicle/tool maint. Building pile Screening Compost use (affects choices for uses)	Wear latex or rubber gloves. (60) Health care workers exposed to CJD use standard precautions: gloves for handling of blood and body fluids; masks, gowns, and protective eyewear if exposure to blood or other material potential infectious to mucous membranes or skin is anticipated. Laundry managed as per 29 CFR 1910.1030. (72) Biological safety cabinet (thus respiratory protection); splash shields, face protection, gowns, and cut-resistant gloves; handwashing and waste decontamination facilities.(74) Respiratory protection anticipated as N95 (95% removal at > 0.3 u) due to HEPA filtration required on exhaust air of biological safety cabinet for Class 2 cabinet. (74) HEPA is equivalent to an N100 respirator; there is no equivalent to an N95 respirator.	Prion found in lymphoid tissues thus alimentary tract shedding may occur. Risk greatest in handling brain, spinal cord, lymph nodes, spleen, tonsils, and eyes. (60) Exposure to environment contaminated by decomposed carcasses 1.8 – 2.2 years after infected deer last resided there. (42) May be observable as prime-aged animal in poor condition; otherwise no other indicators in carcass. (60,61) Subtilisin proteases from *Bacillus licheniformis* strain PWD-1 appears to be able to decompose prions, in present of detergents and heat pretreatment >100C. (69) Use of strong sodium hypochlorite solution: 8250 ppm free available chlorine for 30 – 120 minutes; WHO recommends 20,000 ppm free available chlorine for 1 hour; also, phenol disinfectants Environ LpH or LpHse, STERIS, 5% v/v, 30 minutes @ 20C. Recommendations would be corrosive or damaging to stainless steel equipment. (67,70,71,73) Environmental surfaces contaminated with high-risk tissues (CJD) should be cleaned and then spot-decontaminated with a 1:10 dilution of sodium hypochlorite. Disposable cover sheets could be used to minimize environmental contamination. (72) Inactivation requires sodium hypochlorite of >2%. To conduct autopsy for human prion disease: disposable waterproof gown; cut-resistant gloves underneath 2 pairs of surgical gloves or chainmail gloves between 2 pairs of surgical gloves; if aerosols such as from opening of skull, wear powered air-purifying respirator. (74)

PROTISTANS

Genus Species	Route of Entry	Bio-Safety Level (74)	Task or Process Hazards	Hazard reduction using engineering controls or personal protective equipment	Background information and related administrative and/or process controls
Cryptosporidium parvum; Cryptosporidium spp.	Ingestion of oocysts in moist feces; dead after dry several hours (7) Possible airborne transmission of oocysts. (74) Possible skin penetration through wounds or microabrasions; arthropod bites. (74)	2	Collection Transporting Vehicle/tool maint. Building pile	Gloves (74) Biological safety cabinet (thus respiratory protection); splash shields, face protection, gowns, and gloves; handwashing and waste decontamination facilities. (74) Handwashing (85)	Oocysts shed in feces of deer. (57) Oocyst inactivation due to freeze-thaw cycles and soil particle abrasion. (27) Deer, chipmunk, mouse, skunk, raccoon, muskrat. (49) Infective stages may be present in blood, feces, lesion exudates, and infected arthropods. (74) Inactivation of 99.999% of viable oocysts in 82-3 days @ 35 – 50 C. (27) Inactivation at 55 C in 2 days. (86) Holding in manure at 25 C for 90 days decreased concentrations to below detection. (109)
Giardia duodenalis; Giardia spp.	Ingestion of oocysts in moist feces; long survival under moist conditions (7) Possible skin penetration through wounds or microabrasions. (74)	2	Collection Transporting Vehicle/tool maint. Building pile	Gloves (74) Biological safety cabinet (thus respiratory protection); splash shields, face protection, gowns, and gloves; handwashing and waste decontamination facilities. (74) Handwashing (85)	Cysts shed in feces of deer. (57) Note: raccoons (34); beaver, and cattle. (62) Infective stages may be present in blood, feces, lesion exudates, and infected arthropods. (74) Expected to survive composting process. (86) Holding in manure at 25 C for 90 days decreased concentrations to below detection. (109)

Genus Species	**Route of Entry**	**Bio-Safety Level** (74)	**Task or Process Hazards**	**Hazard reduction using engineering controls or personal protective equipment**	**Background information and related administrative and/or process controls**
Toxoplasma gondii (20)	Ingestion of oocysts in moist feces (7) Possible skin penetration through wounds or microabrasions. (74)	2	Collection Transporting Vehicle/tool maint. Building pile Screening Use	Gloves (74) Biological safety cabinet (thus respiratory protection); splash shields, face protection, gowns, and gloves; handwashing and waste decontamination facilities. (74)	Infective stages may be present in blood, feces, lesion exudates, and infected arthropods. (74) Immunocompromised individuals should avoid working with live organisms. (74) Serologically-negative women of childbearing age who might become pregnant should not work with *Toxoplasma* in same laboratory room where these materials are handled. (74) Unknown behavior in composting. (86) Due to insufficient information, assumed it survives the composting process.

Genus Species	**Route of Entry**	**Bio-Safety Level** (74)	**Task or Process Hazards**	**Hazard reduction using engineering controls or personal protective equipment**	**Background information and related administrative and/or process controls**
Babesia microti (in NYS) (babesiosis)	Bite (injection) of parasitic Deer Tick (*Ixodes scapularis*) Blood, feces, cerebrospinal fluid, bone marrow, lesion exudates (74)	2	Collection Transporting Vehicle/tool maint. Building pile	Long sleeves and long pants tucked into socks. Wear hat and tie hair back. (14) Gloves, faceshield. (74) Use repellent containing DEET on exposed skin except for face; use products containing permethrin on clothing not skin. (14)	Worker to inspect own body daily for attached ticks. Removal procedure specified. Tick may be submitted to USDOH for testing. (4) Check self for ticks and have a "buddy" check you: behind knees, between fingers and toes, under arms, in and behind ears, on neck, hairline, and top of head; where clothing presses on the skin. (14) Wear light-colored clothing for easy tick discovery; tuck pants into socks and shirt into pants. Check every 2 or 3 hours of outdoor activity for ticks on clothing or skin. Risk is minimal if tick removal occurs within 36 hours. If tick is sent (procedure specified) to NYSDOH Tick Identification Service, they can provide information on species, etc. but not whether tick is infected. (45) Seek medical attention if symptoms develop. (91) Found on Long Island, upstate and western NY. Expected where endemic for Lyme disease (due to same tick vector). (107) Inactivated at 60 C for 10 hours. (108)

WORMS

Genus Species	**Route of Entry**	**Bio-Safety Level** (74)	**Task or Process Hazards**	**Hazard reduction using engineering controls or personal protective equipment**	**Background information and related administrative and/or process controls**
Baylisascaris procyonis (nematode)	Fecal-oral; injection (74)	2 (aerosolized antigens may produce allergic reactions)	Building pile Screening Compost use	Biological safety cabinet (thus respiratory protection); splash shields, face protection, gowns, and gloves; handwashing and waste decontamination facilities. (74)	Note: raccoons (34) (possible issue for wood chips) Eggs very resistant; can survive for 12 years refrigerated. (34) Eggs and larvae in freshly passed feces not usually infective; development to infective stages may take 1 day to several weeks. (74)

ARTHROPODS (INSECTS, ARACHNIDS) As these can be attracted to carcass, should they be considered???

Genus Species	**Route of Entry**	**Bio-Safety Level** (74)	**Task or Process Hazards**	**Hazard reduction using engineering controls or personal protective equipment**	**Background information and related administrative and/or process controls**
Bees, wasps, hornets ?????					

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