References by Contaminant Category

Prepared by: 301 Organics

This bibliography was compiled by **301 Organics** to support the scientific foundation of its post-fire soil restoration program, which utilizes compost as a biological, in situ treatment approach to reduce potential human and ecological exposure to contaminants associated with urban-wildland interface fires.

The referenced studies collectively demonstrate that compost and biologically active organic amendments can improve soil health while reducing contaminant mobility and bioavailability through natural biological processes. The literature documents successful applications for contaminants commonly associated with wildfire ash, urban combustion byproducts, industrial activities, and mining legacies, including **CAM-17 metals (lead, arsenic, cadmium, chromium, copper, nickel, zinc, mercury, and antimony), petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), per- and polyfluoroalkyl substances (PFAS), and asbestos-associated materials**.

Research summarized in this bibliography shows that compost supports diverse soil biological communities, including bacteria, fungi, mycorrhizae, protozoa, nematodes, and other soil organisms that contribute to contaminant attenuation through **biodegradation, biosorption, bioaccumulation, metal immobilization, phytostabilization, humification, and carbon sequestration**. These mechanisms can reduce contaminant bioavailability, improve vegetation establishment, accelerate ecosystem recovery, and enhance long-term soil resilience following disturbance.

To facilitate technical review, references are organized by contaminant category and supplemented with a summary table describing the soil food web components and biological mechanisms that support remediation and ecological recovery. Together, these resources provide a science-based framework for evaluating compost-based soil restoration as part of post-fire risk reduction, human health protection, and ecosystem recovery efforts.

General Compost, Soil Biology, and Bioremediation

Kästner, M., & Miltner, A. (2016). Application of compost for effective bioremediation of organic contaminants and pollutants in soil. *Applied Microbiology and Biotechnology, 100*(8), 3433–3449. https://doi.org/10.1007/s00253-016-7378-y

Lin, C., Cheruiyot, N. K., Bui, X.-T., & Ngo, H. H. (2022). Composting and its application in bioremediation of organic contaminants. *Bioengineered, 13*(1), 1073–1089. https://doi.org/10.1080/21655979.2021.2017624

Peña-Álvarez, V., Benavente-Hidalgo, L., Rodríguez-Valdés, E., Peláez, A. I., & Gallego, J. L. R. (2026). Environmental forensics of compost-assisted bioremediation in complex co-contaminated soils. *Journal of Hazardous Materials, 514*, 142657. https://doi.org/10.1016/j.jhazmat.2026.142657

Arsenic (As)

Boukhatem, A., Rached, O., Bentellis, A., Vasileiadis, S., Castaldi, P., Garau, G., & Diquattro, S. (2025). Promoting the recovery of soil health in As- and Sb-polluted soils: New evidence from the biochar-compost option. *Environmental Science and Pollution Research, 32*(2), 559–574. https://doi.org/10.1007/s11356-024-35650-3

Yang, L., Chen, Y., Wang, S., Lin, S., Huang, G., Wang, Z., Yu, Z., & Zeng, L. (2024). Arsenic-contaminated soil remediation with hyperthermophilic compost: Effects on arsenic bioavailability, soil fertility and bacterial community. *Journal of Environmental Management, 370*, 122774. https://doi.org/10.1016/j.jenvman.2024.122774

Asbestos and Chromite-Asbestos Mine Waste

Banerjee, S., Ghosh, S., Jha, S., Kumar, S., Sarkar, D., Datta, R., & Bhattacharyya, P. (2025). Enhancing mycophytoremediation potential of *Chrysopogon zizanioides* in chromite-asbestos mine waste soil using arbuscular mycorrhizal fungi: A natural bioaccelerator for soil ecosystem rehabilitation. *Science of the Total Environment, 989*, 179884. https://doi.org/10.1016/j.scitotenv.2025.179884

Cadmium (Cd)

Umeobi, E. C., Ducey, T. F., Basta, N. T., & Ippolito, J. A. (2026). Bioaccessibility-based human health exposure assessment of compost-amended heavy metal-contaminated soil. *Soil Systems, 10*(7), 83. https://doi.org/10.3390/soilsystems10070083

Chromium (Cr)

Agency for Toxic Substances and Disease Registry. (n.d.). *Chromium: Public health statement*. U.S. Department of Health and Human Services.

Agency for Toxic Substances and Disease Registry. (n.d.). *ToxFAQs™ for chromium*. U.S. Department of Health and Human Services.

Bartlett, R. J. (1991). Chromium cycling in soils and water: Links, gaps, and methods. *Environmental Health Perspectives, 92*, 17–24.

James, B. R., & Bartlett, R. J. (1983). Behavior of chromium in soils: VI. Interactions between oxidation-reduction and organic complexation. *Journal of Environmental Quality, 12*(2), 173–176.

U.S. Environmental Protection Agency. (2024). *Toxicological review of hexavalent chromium (CAS No. 18540-29-9)*. Integrated Risk Information System (IRIS).

U.S. Environmental Protection Agency. (n.d.). *In situ chemical reduction of chromium(VI) in groundwater*.

U.S. Geological Survey. (2011). *Chromium(VI) generation in vadose zone soils and alluvial sediments of the southwestern Sacramento Valley, California*.

Lead (Pb)

Ferreyroa, G. V., Vergara Cid, C., Verdenelli, R. A., Dominchin, M. F., Meriles, J. M., Pignata, M. L., & Rodriguez, J. H. (2019). Availability of lead in agricultural soils amended with compost of biosolid with wood shavings and yard trimmings. *Environmental Science and Pollution Research, 26*, 30168–30180. https://doi.org/10.1007/s11356-019-06190-y

Gómez, M. E., Ferreyroa, G. V., Salazar, M. J., Pignata, M. L., & Rodriguez, J. H. (2024). Effect of biosolid compost amendment on Pb availability in soils cultivated with lettuce. *International Journal of Environmental Science and Technology*. https://doi.org/10.1007/s13762-023-05281-1

Guan, X., Bai, J., Yuan, X. Z., Guo, J. W., & Liu, X. (2026). Synergistic remediation of Pb contamination in rice field soil with FeMg-LDH@Bentonite and compost: Impacts on Pb bioavailability and soil environment. *Frontiers in Microbiology, 17*, 1756444. https://doi.org/10.3389/fmicb.2026.1756444

Umeobi, E. C., Ducey, T. F., Basta, N. T., & Ippolito, J. A. (2026). Bioaccessibility-based human health exposure assessment of compost-amended heavy metal-contaminated soil. *Soil Systems, 10*(7), 83. https://doi.org/10.3390/soilsystems10070083

Mercury (Hg)

Kästner, M., & Miltner, A. (2016). Application of compost for effective bioremediation of organic contaminants and pollutants in soil. *Applied Microbiology and Biotechnology, 100*(8), 3433–3449. https://doi.org/10.1007/s00253-016-7378-y

Lin, C., Cheruiyot, N. K., Bui, X.-T., & Ngo, H. H. (2022). Composting and its application in bioremediation of organic contaminants. *Bioengineered, 13*(1), 1073–1089. https://doi.org/10.1080/21655979.2021.2017624

Mine Tailings, Multi-Metal Contamination, Copper (Cu), Nickel (Ni), Zinc (Zn), and Antimony (Sb)

Boukhatem, A., Rached, O., Bentellis, A., Vasileiadis, S., Castaldi, P., Garau, G., & Diquattro, S. (2025). Promoting the recovery of soil health in As- and Sb-polluted soils: New evidence from the biochar-compost option. *Environmental Science and Pollution Research, 32*(2), 559–574. https://doi.org/10.1007/s11356-024-35650-3

Proto, M., & Courtney, R. (2023). Application of organic wastes to subsoil materials can provide sustained soil quality in engineered soil covers for mine tailings rehabilitation: A 7 years study. *Ecological Engineering, 192*, 106971. https://doi.org/10.1016/j.ecoleng.2023.106971

Trippe, K. M., Manning, V. A., Reardon, C. L., Klein, A. M., Weidman, C., Ducey, T. F., Novak, J. M., Watts, D. W., Rushmiller, H., Spokas, K. A., Ippolito, J. A., & Johnson, M. G. (2021). Phytostabilization of acidic mine tailings with biochar, biosolids, lime, and locally-effective microbes: Do amendment mixtures influence plant growth, tailing chemistry, and microbial composition? *Applied Soil Ecology, 165*, 103962. https://doi.org/10.1016/j.apsoil.2021.103962

Vertical stratification of mine tailings microbial communities along geochemical gradients one decade after organic cover application. (2026). *Applied Soil Ecology*. [Author list and DOI require publisher verification.]

Per- and Polyfluoroalkyl Substances (PFAS)

Li, Y., Zhi, Y., Weed, R., Broome, S. W., Knappe, D. R. U., & Duckworth, O. W. (2024). Commercial compost amendments inhibit the bioavailability and plant uptake of per- and polyfluoroalkyl substances in soil-porewater-lettuce systems. *Environment International, 186*, 108615. https://doi.org/10.1016/j.envint.2024.108615

Michaud, A. M., Saliu, T. D., Munoz, G., Feder, F., Sappin-Didier, V., Watteau, F., Houot, S., & Sauvé, S. (2025). In situ occurrence and mobility of per- and polyfluoroalkyl substances in soils amended with organic waste products. *Science of the Total Environment, 984*, 179708. https://doi.org/10.1016/j.scitotenv.2025.179708

Tansel, B., Katsenovich, Y., Manzano, M. M., Nasir, J., Fuentes-Rodriguez, G., de la Sierra, J., Brill, C., Puntura, P., & Quinete, N. (2026). Partitioning, mobility and persistence of PFAS in biosolids-based compost products across solid and aqueous matrices. *Journal of Hazardous Materials, 512*, 142344. https://doi.org/10.1016/j.jhazmat.2026.142344

Petroleum Hydrocarbons and Mixed Organic Contaminants

Kästner, M., & Miltner, A. (2016). Application of compost for effective bioremediation of organic contaminants and pollutants in soil. *Applied Microbiology and Biotechnology, 100*(8), 3433–3449. https://doi.org/10.1007/s00253-016-7378-y

Lin, C., Cheruiyot, N. K., Bui, X.-T., & Ngo, H. H. (2022). Composting and its application in bioremediation of organic contaminants. *Bioengineered, 13*(1), 1073–1089. https://doi.org/10.1080/21655979.2021.2017624

Peña-Álvarez, V., Benavente-Hidalgo, L., Rodríguez-Valdés, E., Peláez, A. I., & Gallego, J. L. R. (2026). Environmental forensics of compost-assisted bioremediation in complex co-contaminated soils. *Journal of Hazardous Materials, 514*, 142657. https://doi.org/10.1016/j.jhazmat.2026.142657

Polycyclic Aromatic Hydrocarbons (PAHs)

Hadibarata, T., Syafrudin, M., Fitriyani, N. L., & Lee, S. W. (2025). Advancements in composting technologies for efficient soil remediation of polycyclic aromatic hydrocarbons (PAHs): A mini review. *Sustainability, 17*(13), 5881. https://doi.org/10.3390/su17135881

Sayara, T., & Sánchez, A. (2020). Bioremediation of PAH-contaminated soils: Process enhancement through composting/compost. *Applied Sciences, 10*(11), 3684. https://doi.org/10.3390/app10113684

Soil Food Web and Microbial Mechanisms Supporting Contaminant Remediation

This summary table includes the reference list that supports each biological component of the soil food web to its primary remediation functions, contaminants addressed, and supporting literature.

Soil Food Web Component	Primary Functions in Soil Restoration	Key Remediation Mechanisms	Principal Contaminants Addressed	Supporting References
Bacteria	Organic matter decomposition, nutrient cycling, contaminant transformation	Biodegradation, biosorption, bioaccumulation, nutrient mineralization, redox transformations	Petroleum hydrocarbons, PAHs, PFAS, Pb, As, Cr, Cd, Cu, Ni, Zn	Kästner & Miltner (2016); Lin et al. (2022); Peña-Álvarez et al. (2026); Yang et al. (2024); Michaud et al. (2025); Trippe et al. (2021)
Archaea	Nitrogen cycling, carbon turnover, ecosystem resilience	Ammonia oxidation, nutrient cycling, support of microbial stability	Multi-contamina nt soils, mine tailings, post-fire soils	Kästner & Miltner (2016); Lin et al. (2022);

				Trippe et al. (2021)
Saprophytic Fungi	Decomposition of lignin, cellulose, and complex organic compounds	Enzymatic degradation, co-metabolism, humification, carbon stabilization	PAHs, hydrocarbons, wildfire residues, organic contaminants	Kästner & Miltner (2016); Lin et al. (2022); Sayara & Sánchez (2020); Hadibarata et al. (2025)
Arbuscular Mycorrhizal Fungi (AMF)	Plant nutrient acquisition, stress reduction, root-soil interactions	Phytostabilization, metal sequestration, glomalin production, aggregate formation	Pb, As, Cr, Ni, Cu, Zn, asbestos mine waste, mine tailings	Banerjee et al. (2025); Boukhatem et al. (2025); Trippe et al. (2021)
Ectomycorrhizal Fungi	Nutrient exchange, plant establishment, ecosystem recovery	Metal immobilization, carbon sequestration, revegetation support	Forest soils, mine wastes, post-fire landscapes	Proto & Courtney (2023); Trippe et al. (2021)
Protozoa	Regulation of bacterial populations	Nutrient mineralization, stimulation of microbial turnover	General soil restoration and ecosystem recovery	Kästner & Miltner (2016); Lin et al. (2022)

Nematodes	Regulation of bacterial and fungal communities	Nutrient cycling, trophic regulation, food-web stabilization	Organic-amended and restored soils	Lin et al. (2022); Trippe et al. (2021)
Microarthropods	Organic matter fragmentation and incorporation	Aggregate formation, nutrient cycling, microbial regulation	Compost-amended soils, mine reclamation sites	Lin et al. (2022); Proto & Courtney (2023)
Plant Roots and Rhizosphere Communities	Carbon inputs, habitat formation, soil development	Rhizodegradation, phytoremediation, phytostabilization, microbial stimulation	Metals, hydrocarbons, PAHs, PFAS, mine tailings	Banerjee et al. (2025); Peña-Álvarez et al. (2026); Proto & Courtney (2023); Trippe et al. (2021)

Whole Soil Food Web	Soil formation, ecosystem recovery, resilience, long-term function	Biodegradation, humification, metal immobilization, carbon sequestration, nutrient retention	CAM-17 metals, PFAS, hydrocarbons, PAHs, asbestos, mine wastes, post-fire contaminants	Banerjee et al. (2025); Boukhatem et al. (2025); Kästner & Miltner (2016); Lin et al. (2022); Peña-Álvarez et al. (2026); Proto & Courtney (2023); Trippe et al. (2021); Umeobi et al. (2026)

Summary: Collectively, these soil food web components support the five primary biological remediation pathways documented throughout the literature: **(1) biodegradation, (2) biosorption and bioaccumulation, (3) metal immobilization, (4) phytostabilization/phytoremediation, and (5) humification and carbon sequestration.** These mechanisms have been demonstrated across soils contaminated with **CAM-17 metals, PFAS, petroleum hydrocarbons, PAHs, chromite-asbestos mine wastes, and post-wildfire contaminants**, supporting the use of compost and biologically active organic amendments as effective restoration tools.