



Potential Health Impacts of Certain Persistent^{1, 2, 3, 4} and Other Chemicals Detected in Sludge^{5, 6}

Chemical Compound	Common Use/ Source	Endocrine Disruptors ^{7, 8, 9, 10, 11} (known or suspected)	Human Carcinogen	Other Potential Health Impacts Related to Ingestion
PCBs (Polychlorinated biphenyls)	Banned in U.S.	X	Reasonably anticipated to be carcinogens by the Department of Health and Human Services (DHHS); known to cause cancer in animals and considered to be probable carcinogens by the EPA and International Agency for Research on Cancer (IARC). ¹²	Linked to changes in behavior, brain development and immune function in children. Low-level, longer-term exposures cause effects such as anemia, acne-like conditions, and liver, stomach and thyroid gland injuries in animals. ¹³
PAHs (Polynuclear aromatic hydrocarbons) incl. benzo(a)pyrene	Combustion byproducts; a few are also used to make dyes, plastics and pesticides	X	DHHS has determined that some PAHs may reasonably be expected to be carcinogens; ¹⁴ the EPA and IARC consider benzo(a)pyrene and several other PAHs to be probable human carcinogens. ¹⁵	Causes reproductive problems and birth defects in mice; impacts the immune system. ¹⁶
Dioxin [Chlorinated dibenzo-p-dioxins (CDDs)] incl. TCDD	Combustion byproducts formed during the bleaching process at pulp and paper mills; may also be formed during chlorination by waste- and drinking water plants	X	TCDD, the best-studied and most toxic dioxin, considered a human carcinogen by the World Health Organization; may reasonably be anticipated to cause cancer, according to DHHS. ¹⁷	TCDD causes endocrine disruption, reproductive damage, birth defects and immune system impacts at lower level exposures in animals. ¹⁸
BPA (Bisphenol A)	Plastic additive	X	Stimulates prostate cancer cells ¹⁹ and causes breast tissue changes resembling early stage breast cancer in both mice and humans. ^{20, 21}	Significant developmental, reproductive and immune effects from low-level exposure in numerous animal studies. ²² In humans, higher BPA levels in urine have been associated with ovarian dysfunction. ²³
PBDEs (Polybrominated diphenyl ethers)	Flame retardants used in electronics and textiles	X	One PBDE, Decabromodiphenyl ether, is classified as a possible human carcinogen by the EPA; others cannot be classified due to a lack of cancer safety testing. ²⁴	Exposure to PBDEs in the womb and through nursing has caused thyroid effects and neurobehavioral alterations in newborn animals. ²⁵

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Organochlorine pesticides (including Chlordane, DDT, Lindane)	Chlordane, DDT no longer in production in U.S. Lindane is imported for use as an insecticide on produce and forest crops, and prescribed to treat head and body lice, and scabies.	X	DDT is a "probable human carcinogen" or may cause cancer according to the EPA, DHHS and IARC. ²⁶ Chlordane linked to liver cancer in mice, but IARC determined that its human carcinogenicity is not classifiable; ²⁷ Lindane may cause cancer (DHHS) or is a "possible" carcinogen (IARC); the EPA found some evidence that lindane causes cancer, but has determined that there is insufficient evidence to conclude it is cancer-causing in humans. ²⁸	Many organochlorine pesticides including chlordane and DDT have shown evidence of endocrine disruption. ²⁹ Many health effects can be linked to ingestion of both large and small amounts of chlordane and DDT, and from both short- and long-term exposure. ^{30, 31} Lindane is a neurotoxin, and is linked to a variety of other toxicities, including to the reproductive and endocrine systems. ³²
Nonylphenols (NPEs)	Product of detergent breakdown. Used in cleaning products, cosmetics, hygiene products, paints and pesticides	X	May be related to increased hormone-dependent cancers. ³³	May be related to decreases in sperm quality and quantity in humans. ³⁴
DEHP Di(2-Ethylhexyl) Phthalate	Softener in plastic. Additive in paints, glues, inks, etc.	X	DEHP is probable or "reasonably anticipated" to cause cancer in humans (EPA, DHHS); IARC deems the evidence insufficient to classify DEHP as causing or not causing cancer in people. ³⁵	DEHP can probably cause adverse health effects on human development and reproduction, especially for male infants and children. ³⁶
Triclosan	Antimicrobial compound added to soap, detergent, cosmetics, cutting boards, toys and hosiery	X		Interferes with activities of key enzymes in the liver, the chief detoxification organ in the body. ³⁷

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- ² U.S. Environmental Protection Agency (EPA). *Federal Register Environmental Documents*. "Persistent Bioaccumulative Toxic (PBT) Chemicals; Lowering of Reporting Thresholds for Certain PBT Chemicals; Addition of Certain PBT Chemicals; Community Right-to-Know Toxic Chemical Reporting." Oct. 29, 1999. Jun. 14, 2008 <<http://www.epa.gov/fedrgstr/EPA-WASTE/1999/October/Day-29/f28169.htm>>.
- ³ European Commission. *ESIS: European chemical Substances Information System*. PBT. Jun. 14, 2008 <<http://ecb.jrc.it/esis/index.php?PGM=pbt>>.
- ⁴ Jochen Heidler and Rolf U. Halden. "Mass balance assessment of triclosan removal during conventional sewage treatment." *Chemosphere* 66 (2007) 362-369.
- ⁵ Ellen Z. Harrison, Summer Rayne Oakes, Matthew Hysell and Anthony Hay. "Organic chemicals in sewage sludges." *Science of the Total Environment* 367 (2006) 481-497.
- ⁶ Chad A. Kinney et al. "Survey of Organic Wastewater Contaminants in Biosolids Destined for Land Application." *Environmental Science and Technology* 40 (2006) 7207-7215.
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- ⁸ Kinney, *op. cit.*, p. 7211.
- ⁹ Andrew C. Chang et al. *Developing Human Health-related Chemical Guidelines for Reclaimed Waster and Sewage Sludge Applications in Agriculture*. World Health Organization European Environmental Bureau, p. 13 Sep. 30, 2001(revised May 17, 2002) Dec. 18, 2006 http://www.who.int/water_sanitation_health/wastewater/gsuww/en/index.html>.
- ¹⁰ Heidler, *op. cit.*, p. 363.

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