QUESTION #1:
Is landfill gas hazardous?

ANSWER:

Landfill gas consists mostly of methane and carbon dioxide, but also contains small amounts of at least 170 other chemicals (http://www.epa.gov/ttn/chief/ap42/ch02/draft/d02s04.pdf). Some of these constituents — such as propane and butane — are harmless at all but extreme concentrations; but others — including benzene, vinyl chloride, hydrogen sulfide, and mercury — pose at least theoretical risks of cancer, respiratory damage, or nervous system damage — at concentrations much closer to ambient levels. Thus, the answer to the question, "Is landfill gas hazardous," is not only *qualitative*, but also *quantitative*.

We estimate risks due to landfill gas emissions by taking into account (i) the specific composition of the gas at issue, (ii) the amounts and rates at which this gas is emitted, and (iii) the modeled short-term and long-term dispersion of the gas to nearby homes, schools, parks, or other locations of interest. Typical results suggest that concentrations of landfill gas constituents in ambient air are too small to harm health — although some odorous constituents may be present, from time to time, at detectable concentrations. If the latter condition is believed to be a nuisance (and/or a health effect *per se*), neighbors, local boards of health, or others may seek additional modeling studies, an air quality monitoring program, and/or corrective action.

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Cambridge Environmental Inc

58 Charles Street Cambridge, Massachusetts 02141
617-225-0810 FAX: 617-225-0813 www.CambridgeEnvironmental.com info@CambridgeEnvironmental.com

QUESTION #2:

What are the pluses and minuses of using processed construction and demolition debris (C&D fines) as daily cover material at landfills?

ANSWER:

In the U.S. and elsewhere, regulations dictate that landfilled solid waste must be covered, daily, with of compacted soil or similar material. Over the past few years, processed construction and demolition debris (C&D fines) have been permitted and used as "alternative daily cover" material. On the plus side, this practice allows both material reuse and soil conservation. On the minus side, at some landfills, the practice has increased nuisance odor production by up to 100-fold. This problem arises because (i) C&D fines are typically rich in gypsum wallboard (drywall), (ii) chemically, gypsum is hydrated calcium sulfate — *i.e.*, $CaSO_4 \cdot 2(H_2O)$, and (iii) sulfate-reducing bacteria in MSW landfills use SO_4 (rather than O_2) in respiration, thereby generating inorganic sulfides, such as hydrogen sulfide (H_2S), which, of course, have unpleasant odors.

One solution is to increase the efficiency of a landfill's gas collection and flaring system. However, doing so results in increased emissions of oxidized sulfur compounds, notably sulfur dioxide (SO_2). We have worked to model air quality impacts from such emissions, in response to concerns that SO_2 impacts might exceed regulatory thresholds for health protection.

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QUESTION #3:

At what concentration in air is hydrogen sulfide (H_2S) dangerous?

ANSWER:

Hydrogen sulfide (H_2S) is a common, highly odorous air pollutant released by natural and man-made sources (such as landfills and wastewater treatment facilities). Two very different dose-response relationships govern people's responses to hydrogen sulfide. People exposed to low concentrations can indeed smell it, but won't be *directly* harmed at levels smaller than 1 ppm. People exposed to high concentrations (hundreds of parts per million [ppm]) in air cannot smell this gas, but it can kill them. At the same time, it is important to acknowledge that annoyance reactions to unpleasant odors may create or intensify other responses, such as headaches and fatigue.

Several regulatory or scientific organizations have derived standards or guidelines for H_2S exposure for different populations, and these values vary considerably. The most stringent is U.S. EPA's "reference concentration" (essentially, an allowable upper limit of exposure), which is only 2 $\mu g/m^3$ (0.0015 ppm).

We have (i) examined the toxicologic and epidemiologic data on H_2S, (ii) found that EPA's reference concentration is much more stringent than needed, and (iii) developed alternative guidelines for community exposures.

Ask or contact us about relevant studies and reports on this topic.

QUESTION #4:

Are waste-to-energy plants major sources of airborne emissions of “dioxins” (PCDD/PCDF’s) and mercury (Hg)?

ANSWER:

Not anymore. Twenty years ago, *per* U.S. EPA’s national inventories, commercial combustion of municipal solid waste (MSW) was a major source of both PCDD/PCDF and Hg emissions to the atmosphere. Since then, substantial advances in air pollution control engineering have reduced PCDD/PCDF emissions from MSW combustors by orders of magnitude. Reductions in Hg emissions have resulted over the same period primarily due to reductions in the Hg content of consumer products, and, to lesser extents, from increases in recycling of these products, and improvements in post-combustion controls.

Some people concerned about MSW combustors and these pollutants are unaware of these changes. At public hearings, health board meetings, or other venues, we quantify, depict, and explain these trends. We also explain and interpret the dose-response relationships that govern these and other MSW combustor-related pollutants. Our aim, as engineers and scientists, is to encourage evidence-based analysis with regard to MSW combustors and impacts to public health and welfare.

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QUESTION #5:

Do the lead-based pigments in artificial turf ("plastic grass") pose risks to children playing on turf-covered fields?

ANSWER:

Since its creation in the mid-1960's, AstroTurf® and other artificial turfs have been used to cover thousands of playing fields in the U.S. To protect the artificial green and other colors from fading upon repeated exposure to sunlight, most of these turfs were formulated with lead chromate-based pigments. Parents and others have become concerned that children playing on these fields may be receiving unacceptable doses of lead.

To address these concerns, we have designed and conducted testing programs. Results indicate that total lead concentrations of the artificial turf samples are on the order of 300 to 5,000 parts per million (ppm), and lead levels measured in wipe samples range from 10 to 30 micrograms per square foot ($\mu g/ft^2$). Using clinical dose-response data and other factors, we have developed guidelines for safe use of these fields and have communicated our findings to schools, town officials, and others. We have also provided information with regard to the prevention of lead poisoning from sources such as paint dust, imported canned foods, "home remedies," and other sources.

Ask or contact us about relevant studies and reports on this topic.

QUESTION #6:
Is perchlorate contamination of drinking water a threat to public health?

ANSWER:
Perchlorate (ClO_4^-) causes health effects in humans because it competes with iodide (I^-) for uptake by the thyroid. Iodide uptake is required for production of the important prohormone, tetraiodo-l-thyronine (also known as T_4 or thyroxine). Perchlorate contamination of groundwater and drinking water is not uncommon, and some states have adopted extremely restrictive maximum contaminant level guidelines in the low part per billion (ppb) range. These standards are meant to protect the most sensitive population, which is typically taken to be fetuses and breastfed infants of women with hypothyroidism; however, for several reasons, the perchlorate standards for water are much more restrictive than required to protect public health.

In recent work involving drinking water contaminated with perchlorate, we have presented information to multiple stakeholders with regard to the beneficial interactions between perchlorate and iodide, the iodide nutrition status of people in the U.S., the effects of nitrate and thiocyanate in foods with regard to thyroid function, and the causes of neonatal hypothyroidism. These and other details allowed us to design and present guidelines for acceptable concentrations of perchlorate in drinking water in the situation at issue.

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QUESTION #7:

Is compost derived from municipal solid waste safe to use in a vegetable garden?

ANSWER:

Municipal solid waste (MSW) can be composted along with biosolids (aka sewage sludge) from municipal wastewater treatment to produce compost for use as a soil amendment. The composition of compost produced from such a process depends both on the MSW used to produce the compost and on the steps taken to remove recyclables and inorganic contaminants prior to composting. In some cases, the presence of certain materials in the waste stream may result in the presence of undesired contaminants in the compost. Some plastics, for example, if not removed from the waste stream, may result in unacceptably high concentrations of phthalates in the resulting compost. However, if appropriate steps are taken to screen out inorganic contaminants from the waste stream, compost can be produced that contains concentrations of contaminants that are within federal standards for the land application of biosolids, and state standards or guidelines for the beneficial use of compost.

We have assisted composting facilities by developing health-protective standards for the presence of contaminants in compost. By communicating with state regulators throughout the development of these standards, we ensured that they would be acceptable to the state. Compost meeting the standards can be sold for unrestricted use, providing the composting facility with maximum revenue for the product.

Ask or contact us about relevant studies and reports on this topic.

QUESTION #8:

What are the impacts of dust generated by truck traffic and other "fugitive" sources on air quality?

ANSWER:

Fugitive dust emissions can be significant at facilities where large amounts of soil, minerals, or aggregate materials are handled, or where there is a large amount of traffic over dusty roads. Fugitive dust emissions tend to be dominated by coarse fraction particulate matter (TSP and PM_{10}) rather than the fine fraction material ($PM_{2.5}$) that is produced by combustion processes. Nonetheless, some of this dust is of the $PM_{2.5}$ size-range, and newly stringent air quality standards have put a focus on all sources, however small.

Assessing impacts from fugitive dust is challenging: emission estimation methods and dispersion models are quite uncertain, and can lead to significant overestimates. Best Management Practices (BMPs) such as cleaning/wetting roads, enclosing processes, and planting windbreaks can reduce dust emissions, but degrees of control are difficult to predict. On a recent project in Vermont, we designed and conducted a monitoring study, and found that traffic-related fugitive emissions roughly doubled dust concentrations in air along a truck route.

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QUESTION #9:

Will landfills comply with a new federal 1-hour air quality standard for sulfur dioxide (SO_2)?

ANSWER:

When landfill gas that contains hydrogen sulfide (H_2S) is combusted, it creates airborne emissions of sulfur dioxide (SO_2). This in turn can lead to two problems. First, at sufficiently high emission rates, operating permit limits can be exceeded. Second, since U.S. EPA plans to introduce a new national ambient air quality standard (NAAQS) that would limit SO_2 impacts to strict 1-hour limits (on the order of 50 – 150 parts per billion [ppb]), modeled impacts from landfills (combined with background concentrations) may exceed these planned standards.

We have worked on this issue in two ways. First, as toxicologists and statisticians, we have critically examined the clinical data and the assumptions and calculations used by EPA in designing the concentration and form of this planned NAAQS. Second, as air quality modelers, we have developed an iterative methodology to assess both fugitive-related H_2S and flare-related SO_2 impacts at a closed landfill where a series of athletic fields are planned. Our assessment tool will incorporate new measurements of landfill gas quantity and quality to predict when conditions at the fields will meet current and proposed air quality and health standards.

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QUESTION #10:
Is it dangerous to site a cell tower close to a daycare center?

ANSWER:
Because of the increasing reliance on mobile telephone technology, the potential for this technology to cause adverse health effects has been the subject of considerable research. Health-based guidelines for exposure to radiofrequency (RF) energy are based on levels at which an increase in body tissue temperatures could occur. Public exposures to RF energy from cellular telephones and towers are typically well within these guideline values. Studies of workers in the industry, users of mobile phones, and animals exposed to RF energy have not found any evidence of adverse health effects. Though cellular telephones operate at different frequencies from radio stations (1,000-2,000 MHz as opposed to 1-100 MHz), it is interesting to note that the human body absorbs several times more RF energy from radio stations than from cellular telephone antennas. RF energy from radio stations has not posed any demonstrable risk of adverse health effects.

We evaluate RF energy from cellular telephone and radio equipment on behalf of our clients. We measure RF energy at locations of interest and provide an interpretation of the results in the context of current research on the health effects of RF radiation. Our clients include those interested in installing cellular telephone equipment on their property and members of the community concerned about nearby installations.

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QUESTION #11:
Is it safe to burn pressure-treated lumber?

ANSWER:
As a fuel, wood waste is a renewable energy source. If mixed wood waste includes construction and demolition debris, it can contain pressure-treated lumber that has elevated levels of arsenic, and painted wood that has elevated levels of lead. When these materials are burned, the lead, arsenic, and other non-combustible elements end up in the residual ash. Fortunately, modern combustion systems are designed with high efficiency particle collectors that capture the great majority of potential ash emissions to the atmosphere. Emissions not captured, however, will lead to slight increases in arsenic and lead in ambient air.

In a recent health risk assessment of a proposed wood-waste power plant, we determined that the incremental concentrations of arsenic and lead due to facility emissions would, at most, increase existing background levels by very small percentages. The facility was estimated to increase arsenic and lead levels in air by 2% and 4%, respectively, in populated areas. As a side note, in the case of lead, the present-day background concentration of 0.012 $\mu g/m^3$ (the baseline for comparison) is more than ten times lower than ambient lead concentrations in the 1980s, and about a hundred times lower than levels from the 1970s when lead was still used as a gasoline additive. Given the small anticipated increases to background levels, arsenic and lead emissions from the wood-waste facility will not pose a significant risk to public health.

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QUESTION #12:
How can global climate change affect water resource infrastructure?

ANSWER:
The term "global climate change" refers to any change in average weather patterns that had been considered to be more or less stable. Of course, abrupt climate changes have happened many times over many thousands of years, but current interest in climate change focuses on man-made contributions to this otherwise natural process. Climate change may manifest as shifts in averages and extremes of rainfall, snow, evaporation/transpiration, river discharge, temperature, humidity, and sea level, all of which can directly and/or indirectly affect water resource systems. Depending on the region, water resources could be directly affected by drought and desertification, changes in precipitation type (more rain and less snow; more infrequent but intense storms with high runoff), sea level rise causing salinization of groundwater and coastal surface waters, and/or greater mobility of contaminants increasing surface water pollution. Indirect effects could arise due to changes in land use, demographics, and water demand due to migrations and shifts in agricultural productivity. Consequently, communities may need to incorporate greater capacity and flexibility in plans for drinking water and wastewater infrastructure.

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