

Integrated Report
Human Health and Environmental Effects
Omya Verpol Facility — Florence, Vermont
Appendix C.7: Assessment of Health Impacts

Table of Contents

C.7.	Assessment of health impacts	C.7-3
C.7.1.	Background	C.7-3
C.7.2.	Goals	C.7-3
C.7.3.	Scope and methods of study	C.7-3
C.7.4.	Results.....	C.7-4
C.7.4.1.	Inhalation of hazardous air pollutants.....	C.7-4
C.7.4.2.	Discharges to Smith Pond and its tributaries	C.7-6
C.7.4.3.	Chrusciel Spring.....	C.7-6
C.7.4.4.	Perchlorate in three private drinking wells and the Florence Municipal Well C.7-6	

C.7. Assessment of health impacts

C.7.1. Background

The Refined Exposure Models discussed in the *Integrated Report* include complete exposure pathways, potentially complete exposure pathways, and incomplete exposure pathways. By definition, people or other organisms are or might be exposed to contaminants that have left the Verpol Site, and/or the Hogback Quarry *via* the complete or potentially complete exposure pathways. These pathways include: (i) inhalation of pollutants emitted to air during Omya's operations at Verpol or the Hogback Quarry; (ii) contact with Hogback Quarry and Site discharges to Smith Pond and its tributaries; (iii) contact with AEEA or stearic acid in the Chrusciel Spring; and (iv) ingestion of perchlorate in drinking water from the Florence Well or three private wells near Hogback Quarry. Regarding this last pathway, we do not know whether perchlorate in these wells derives from the Hogback Quarry or from some other source or sources.

Other potential pathways were extensively investigated and found to be incomplete. In particular, people's drinking water was not found to have been affected by any Verpol-related chemicals. As noted above, Verpol-related chemicals do, from time to time, reach the Chrusciel Spring, but this is not, and has not been, a drinking water source, and the concentrations detected would not harm wildlife, pets, or other animals. Continued monitoring of this spring is warranted. Also, as noted elsewhere, it is not yet known whether arsenic concentrations in groundwater immediately north of (and downgradient of) the Site are elevated (data are expected by June 2008). Water in this area does not serve, and has not served, as drinking water.

In Phase I, we performed "screening analyses" of health risks potentially posed by tailings dust that might reach local crops and animals. These analyses, described in Appendix B, concluded that exposure to tailings dust by this pathway did not pose a risk to human health or the environment. Data gathered in our Phase II Dust Study (please see Appendix C.5) support that conclusion. Also in Phase I, we discussed why it was not feasible or useful to conduct a study of cancer rates in the Florence area as a means to investigate potential health impacts of Omya's operations.

C.7.2. Goals

This Appendix integrates the refined exposure models and toxicity data to determine whether human or environmental health has been, or is likely to be, adversely affected by Omya's operations in Florence that have created complete or potentially complete exposure pathways.

C.7.3. Scope and methods of study

The potential for harm from complete or potentially complete exposure pathways is gauged by comparing the measured or modeled concentrations of the relevant chemicals of concern at the points where humans or other organisms may contact them to the toxicity benchmarks located or derived for these chemicals. As discussed in Appendix B and Appendix C.6, toxicity benchmarks were identified for most but not all contaminants of concern. The exposure concentrations are compared to toxicity benchmarks appropriate to the duration of potential

exposure. Usually, exposure is assumed to last a lifetime in order to not underestimate the potential hazard. The toxicity benchmarks used in this evaluation are displayed in Tables in Appendix C.6. Some of the chemicals included therein were not, as it turned out, contaminants of concern for the refined exposure models and thus were not carried forward in the analyses discussed here.

C.7.4. Results

C.7.4.1. Inhalation of hazardous air pollutants

People near Verpol and the Hogback Quarry breathe air affected by emissions from the same. The toxicologic question is whether these emissions are so high as to degrade local air quality, and so pose a risk to human health — either directly, when people breathe this air, or indirectly, when materials deposited from air contact crop lands, gardens, bodies of water that support fishing, and other sources of food.

Our HAPs Study, described in Appendix C.4, estimated concentrations of pollutants (including AEEA) emitted from Verpol’s on-site sources and from a waste-oil-fired heater at the Hogback Quarry. Annual-average concentrations of these chemicals were modeled in ambient air in Florence, and short-term concentrations were modeled for the subset of chemicals that might pose acute risks.

Estimates of the annually averaged concentrations of chemicals of concern (COCs) were assessed for both cancer hazard and all other health risks — collectively termed “non-cancer health hazard.” For those COCs for which regulatory agencies have developed quantitative estimates of cancer potency, each average concentration at the most-exposed residence, or the most-exposed location, near the Site was multiplied by the cancer potency estimate, and the resulting products were summed to give a total estimated hypothetical increase in lifetime cancer risk for a person deemed to be exposed for a lifetime. The results of this analysis are shown in Table 1. We found the total estimated increases in lifetime cancer risk for a person at the most-exposed residence, or one at the most exposed off-site place near the plant, to be both on the order of one in one million, a risk level normally found “acceptable” by regulatory agencies. For various reasons, these estimates are probably overestimates of risk. For example, in both cases, the major contributors to the estimated excess risk were acetaldehyde, arsenic, and formaldehyde. However, of these, only arsenic (at high concentrations in either air or drinking water) is known to cause cancer in people, and whether minute exposures to arsenic in air, such as we have modeled, pose a genuine risk of cancer is unknown.

For the COCs for which short-term and/or long-term inhalation toxicity benchmarks for non-cancer effects were found, the modeled concentrations at the most-exposed location near the Site were compared to these benchmarks. With the exception of short-term exposures to acrolein, all modeled concentrations of COCs were much smaller than the relevant benchmarks, including Vermont HAASs. In the case of acrolein, the short-term exposure concentration exceeded the strictest benchmark we located, from California EPA’s Office of Environmental Health Hazard Assessment, but not benchmarks used by other states (Vermont has no short-term standard for acrolein in air) or proposed by the Agency for Toxic Substances and Disease Registry. We do

not believe that a significant risk of irritation is posed by the estimated amounts of acrolein coming from Omya.

Overall, then, the data indicate that the health of Omya's neighbors is not endangered by emissions of pollutants from Verpol or the Hogback Quarry.

Table 1 Estimates of cancer risk due to long-term inhalation of HAPs from Verpol

Chemical	Excess lifetime cancer risk at most-exposed off-site location	Excess lifetime cancer risk at most-exposed residence
1,1,2-Trichloroethane	2.624E-10	1.3264E-10
Acenaphthene	2.123E-11	9.735E-12
Acenaphthylene	7.095E-13	9.735E-12
Acetaldehyde	3.432E-07	1.7248E-07
Anthracene	1.8645E-13	8.14E-14
Arsenic	2.2919E-07	1.2255E-07
Benz(a)anthracene	6.358E-11	3.069E-11
Benzene	2.067E-08	1.014E-08
Benzo(b,k)fluoranthene	1.881E-11	9.537E-12
Benzo(ghi)perylene	5.984E-12	3.014E-12
Beryllium	9.6E-08	5.136E-08
Bromoform	8.47E-12	4.378E-12
Cadmium	7.2E-08	3.852E-08
Chloroform	1.9343E-10	9.936E-11
Chrysene	2.948E-12	1.507E-12
Dibenz(a,h)anthracene	2.7467E-10	1.3431E-10
Fluoranthene	3.3275E-09	1.716E-09
Fluorene	4.389E-12	2.002E-12
Formaldehyde	6.6E-07	3.549E-07
Indeno(1,2,3-cd)pyrene	2.728E-11	1.386E-11
Lead	1.44E-09	7.692E-10
Methylene chloride	4.1078E-09	1.8236E-09
Naphthalene	7.65E-08	3.672E-08
Perchloroethylene	4.897E-11	2.5134E-11
Phenanthrene	2.5025E-12	1.122E-12
Pyrene	1.0626E-12	4.774E-13
Total excess lifetime cancer risk estimate	1.5 E-06	7.9 E-07

C.7.4.2. Discharges to Smith Pond and its tributaries

As discussed in C.3, Smith Pond and its tributaries can be affected by this Site, but little in the way of chemical contamination has been detected. Moreover, the biota and reconnaissance surveys conducted in and upstream of Smith Pond found no sign of harm from Omya-related surface water discharges. Thus, while the discharges clearly reach Smith Pond, and hence produce a complete exposure route, our Study found no current evidence of harm.

C.7.4.3. Chrusciel Spring

Two Site-related chemicals, AEEA and stearic acid, have been detected in samples of water from the Chrusciel Spring (see Appendix C.2). The pathways by which these contaminants reach the Spring, *i.e.*, by groundwater, surface water, or a combination thereof, have not been determined. Nevertheless, we assume that these chemicals in the Spring derive from Omya's operations at Verpol.

The Chrusciel Spring is not, and has not been, used for drinking water by people, so there is no complete pathway for human exposure at present. However, there is no barrier to consumption of this water, so we have assessed the significance to health of the contaminants that have been found therein. AEEA has been detected in samples of water from Chrusciel Spring at a maximum concentration of 9 ppb, and stearic acid was detected (by Heindel and Noyes, in May 2007) at a maximum concentration of 820 ppb.

As discussed in Appendix C.6, AEEA is a potent cause of birth defects in rats, according to unpublished and incompletely reported data. Concentrations as small as 9 ppb in water, regardless of whether it is drunk by pregnant women or other pregnant mammals, are likely too small to pose a significant risk of this defect in the fetus. Vermont, based in part on our work, has set a drinking water guideline for AEEA of 20 ppb.

Stearic acid is a saturated fat, present in palm oil, beef fat, and other foods and oils. It is used at Verpol to coat dried ground calcium carbonate. As discussed in Appendix B, no toxicity benchmarks were located for this chemical: it is, *per* U.S. FDA, "generally recognized as safe" when added to foods. While its presence in the Chrusciel Spring suggests transport from Verpol, this stearic acid in water poses no significant risk to humans or other animals.

C.7.4.4. Perchlorate in three private drinking wells and the Florence Municipal Well

Perchlorate detected in water at, and discharged from, the Hogback Quarry presumably derives from its former use in explosives. Whether and/or how perchlorate from this source would reach the Florence Well or the private drinking water wells is unclear, as discussed in Appendix C.2. Regardless, none of the concentrations (0.2 ppb or less) of perchlorate detected in these drinking water wells approaches Vermont's drinking water limit for perchlorate in drinking water of 4 ppb, so all detected concentrations are safe. Appendix C.6 discusses the toxicity of perchlorate and other anions that can, at sufficient doses, interfere with the thyroid's production of its most important hormone, thyroxin.