ECOLOGICAL AND PUBLIC HEALTH RISKS: ANALYSIS AND MANAGEMENT

S. J. T. Pollard
National Centre for Risk Analysis and Options Appraisal, Environment Agency, Reading, UK

Keywords: ecological risks, exposure assessment, hazardous waste, participation, planning, public health, risk assessment, regulation, hazardous waste management facilities

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Summary

The management of hazardous waste has emerged as a major public concern of the latter twentieth century. Effective management of the hazards posed by these wastes relies on a full understanding of their environmental setting; and the processes and procedures used to ensure public health, and ecological protection. Risk assessment is a valuable management tool that can assist in the appropriate placing and operation of hazardous waste management facilities, and is used by operators and regulators alike to

direct resources to the most significant risks. Society has learnt, however, that a sound technical assessment of risk, in isolation is unlikely to address public concerns in full, and that citizen participation in decisions over hazardous waste is a critical component of effective management. This article focuses principally on the process of risk assessment as applied to hazardous wastes. Component stages of the approach are described in context.

1. Introduction

The management of society's waste has been high on public, political and industrial agendas since the early 1970s. High among the concerns raised has been the nature and magnitude of risks posed to public health and the environment that result from storage, treatment, and disposal practices. In response to these concerns, risk assessment has emerged as one of the principal management tools adopted for directing responsible waste management. As such, it has become enshrined within the planning and environmental protection regimes of many developed and developing countries as a means of improving the placing, design, operation, and regulation of hazardous waste facilities.

The issue of the public perception of risks from hazardous waste facilities has been a constant theme throughout the debate over the last 30 years. The need to address these perceptions, which has grown out of a recognition that technical approaches to waste management are not, in isolation, with a solution to this societal problem, have forced valuable progress in risk communication, and stakeholder involvement. As a result, a growing participatory approach to the issue of hazardous waste management in emerging set in the broader context of sustainable development.

2. Hazardous Wastes

2.1 What are "Hazardous Wastes?"

A distinction is made between hazardous and non-hazardous waste by reference to the inherent properties of the waste under consideration. Although in some countries the term may be strictly legally defined, "hazardous waste" generally refers to any solid waste that poses a substantial present or potential risk to public health or the environment through improper generation, handling or disposal. In practice, there is rarely a sharp distinction between non-hazardous and hazardous wastes because, in reality, their potential to cause harm is a function of their inherent properties and the way in which they are managed. However, wastes typically regarded as hazardous are single or mixed waste streams exhibiting one or more of the following hazard characteristics:

- Ignitability.
- Corrosivity.
- Reactivity.
- Toxicity, including radio toxicity.

The disposal of most hazardous waste is covered in most countries by regional or national legislation. The types of materials likely to be classified as hazardous waste include chemical reaction residues from the process industries, clinical wastes, contaminated soils from historic disposals, solid radioactive wastes, military wastes and explosives, process wastewater treatment sludges and waste process chemicals from manufacturing. Typically excluded are household waste, mining overburden and quarrying wastes, agricultural wastes and sewage sludge.

Legislators have generally sought to clarify the generic descriptions above by:

- Reference to individual hazard criteria (e.g. for corrosivity, a pH of <2 or >12.5).
- Providing lists of wastes by specific source (e.g. distillation bottom tars from the production of phenol/acetone from cumene).
- A non-specific source (e.g. spent degreasing solvents).
- Reference to a particularly hazardous constituent (e.g. wastes containing pentachlorophenol).

2.2 Hazard, Risk, Exposure, and Harm

Public concerns have been directed at the health risks and the environmental impacts of hazardous wastes and the facilities that generate, store and treat them. Typically, concerns may relate to:

- The nature and acceptability (or not) of the risks.
- The availability (or not) of evidence establishing causality between a facility and health effects reported in a community.
- The role of the regulatory authorities in controlling the risks and specifically with respect to enforcement.
- The competence of the operator of the facility.
- The placing of hazardous waste treatment facilities in or adjacent to communities.

An understanding of the distinction between hazard, risk, exposure and harm is central therefore to a discussion of these issues and to an analysis of public and ecological risks from hazardous waste facilities. As noted above, hazardous wastes are generally classified according to their hazardous characteristics. However, the potential for these hazards to occur (that is, for an explosion or a bulk release of toxic chemicals to the environment, for example), is a function of both the inherent hazard and the management of that hazard, which is controlled through operation of the waste management facility.

The “hazard” under consideration refers to the potential adverse effect posed by the source of the hazard—a toxic substance or hazardous situation—and this hazard represents the potential to do harm. “Risk” is the term used to denote the probability of suffering harm from a hazard, and embodies both likelihood and consequence. The “harm,” or consequence, that results from a risk relates to the observable damage that occurs and is often referred to as the detriment, impact or response. Harm cannot occur without exposure of receptor (human health or an ecological system) to the source of the

hazard. Hazard, risk, and harm are discrete terms, and should not be used interchangeably.

As an illustrative and familiar example, consider one of the risks from methane gas emanating from a gassing landfill. Methane gas represents an explosion hazard at elevated concentrations and in confined spaces. Methane poses a high risk where the likelihood of concentrations building up to the lower explosive limit is high (high probability; due to sufficient pressure, and available exposure pathways by means of permeable strata and building ingress), and where there are occupied buildings in the vicinity (high consequences). The damage that can result from explosion risks includes loss of life, property, and structural damage (harm).

With this understanding we can distinguish between different types of risk, the characteristics of which will dictate the various risk management options adopted:

- High probability-low consequence events (e.g. treated and regulated emissions from treatment plants).
- Low probability-high consequence events (e.g. a major chemical release from hazardous waste transfer station or storage facility).
- Medium probability-medium consequence events (e.g. chemical fires).

We can also distinguish between sources of a hazard, between receptors that we wish to protect, and between exposure pathways that allow connectivity between sources and receptors. Again, distinction between these components of risk allows options to be devised as to how we might manage the risks from hazardous waste:

- By source control (substitution, minimization, reduction, and treatment).
- By preventing or reducing exposure to acceptable limits.
- By isolating or removing receptors.

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Biographical Sketch

Dr Simon Pollard: BSc (Hons), DIC, PhD, CChem., FRSC, and FCIWEM. Dr Pollard is the Environment Agency's Risk Analysis Manager in the National Centre for Risk Analysis and Options Appraisal, Reading. He has fifteen years experience in environmental pollution and control, having first worked in industrial research and development. The practice of environmental risk assessment has been a continual theme throughout his career. Following his PhD in Environmental Engineering at Imperial College, London, he undertook postdoctoral studies at the University of Alberta (1991–1992), lectured Environmental Chemistry at the University of Edinburgh (1992–4) and then, following a period in environmental consulting, moved into regulation as policy advisor with the Scottish Environment Protection Agency (1996–1998). Currently, he manages a team of 9 risk analysts at the Environment Agency, providing advice in the areas of chemical risk, risks from solid radioactive waste, flood risk, and climate change impacts. He is the author of 60 peer-reviewed papers.

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