ABSTRACT

Auckland lies on the active Auckland Volcanic Field and during some climatic conditions is downwind of the active Taupo Volcanic Zone. Over the past few years a number of reports have evaluated volcanic risk to Auckland's infrastructure. Building on this previous work, and summarising a range of international case studies, we (a) evaluate the potential for physical and/or chemical contamination of water supplies from volcanic ashfall and (b) outline factors to consider in mitigation before, during and after an ashfall event. The relevant properties of volcanic ash are summarised, especially its abrasive, corrosive, leachate-forming and suspendable nature.

We review reported impacts of volcanic eruptions on water supplies, drawing on case studies from New Zealand (1945, 1969 and 1995/96 eruptions of Mt Ruapehu) and overseas, with eight case studies ranging from the 1953 eruption of Mt Spurr, in Alaska, to the recent (July 2000) eruption of Copahue volcano in Argentina. Common themes to emerge from these case studies are: suspended ash blocking intake filters, particularly for river-fed water supplies; high water demand for cleanup depleting water storage in reservoirs; and contamination of water supplies with high levels of turbidity and acidity (low pH). There has been little consistency with respect to monitoring chemical contaminants, but elevated concentrations of fluoride, iron, sulphate and chloride have been reported. From a public health perspective, the two main issues appear to be outbreaks of infectious disease caused by the inhibition of disinfection by high levels of suspended ash (turbidity), and elevated fluoride concentrations of up to 8 mg/L.

Preliminary results from modelling of chemical contamination of water supplies by volcanic ash indicate that the elements showing the greatest tendency to become enriched to problem levels by the addition of volcanic ash to water supplies are Al, Fe, Mn and Br, followed by fluoride and sulphate. The addition of volcanic ash to water supplies causes breaches of the New Zealand Drinking Water Standards (Ministry of Health, 2000) for aesthetic determinands before Maximum Acceptable Values for health determinants are breached; therefore, ashfall is predicted to make drinking water unpalatable before it presents a health risk.

The 'contamination potential' of a water body (defined as surface area divided by volume A/V) is a useful measure for predicting vulnerability to aerial contamination such as volcanic ashfall. Small, open water supplies such as domestic water tanks with roof drainage are highly vulnerable to volcanic ashfall, and even small quantities of ash are likely to cause problems for potability. For water supply reservoirs, a typical event (such as the 1995/96 eruption of Mt Ruapehu) is not expected to cause major problems, with a 10 cm ashfall needed to make water undrinkable. However, using a worst-case set of assumptions, waters may become undrinkable with a 1 mm ashfall. Even though soluble components leached from volcanic ash may not present a risk to public health, increases in turbidity and acidity caused by ash are

likely to be important issues. As a result of this report a detailed study of the effects of volcanic ashfall on water supplies has been initiated.

In summary, previous experience both in New Zealand and overseas suggests that volcanic ashfall presents a hazard to water supplies. In particular, the suspension of ash in water can block intake filters and cause wear and tear on components of water treatment plants due to its abrasive and corrosive nature. High turbidity levels can compromise the effectiveness of disinfection of pathogenic micro-organisms. Other effects are high water demand for cleanup depleting water storage in reservoirs, and the leaching of soluble components, particularly acidity, into receiving waters.

We have identified a range of mitigation options to help protect water supplies in Auckland and elsewhere from the effects of volcanic ashfall. These include but are not confined to:

- Develop robust integrated warning systems (linked to early warning system - GeoNet)
- Conduct a vulnerability analysis of facilities (especially Ardmore Treatment Plant).
- Develop a priority list of facilities that must be kept operative.
- Identify the most effective and efficient ash-removal methods for specific equipment.
- Stockpile spare parts for critical equipment.
- Implement ash management actions: reduction, shutdown, maintenance and clean-up.
- Apply filtration and/or treatment.
- Protect specific vulnerable equipment and facilities.
- Monitor water demand.
- Manage demand during and following ash fall.
- Allow stored water to have necessary settling time.
- Provide advice about disconnecting rainwater tanks/covering stock watering troughs.

Effective mitigation for physical impacts is highly dependent on the equipment at risk, and further work is needed to define detailed mitigation measures. To meet this need, a PhD project, with industry collaboration, is underway.

KEY WORDS

Auckland, ash, water supply, mitigation, chemical contamination, turbidity, Auckland Volcanic Field, risk, hazard, abrasion