



Project Summary

Rapid Assessment of Potential Ground-Water Contamination Under Emergency Response Conditions

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This manual provides a methodology for estimating potential ground water contamination under emergency response conditions at abandoned hazardous waste or toxic chemical spill sites. Specifically, this manual is designed for use by field personnel who must estimate quickly how contaminant concentrations change with time and distance from an emergency response site. The procedures include evaluation of critical contaminant and site characteristics as input to an assessment methodology for analyzing the fate and movement of chemicals through both the unsaturated and saturated (i.e., ground water) soil zones. A graphical technique (nomograph) has been developed as an integrated methodology for assessing contaminant movement through both the unsaturated and saturated (ground water) zone. Guidelines for evaluating critical waste and site characteristics are provided to allow estimation of needed nomograph parameters.

This Project Summary was developed by EPA's Office of Health and Environmental Assessment, Washington, DC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 established a national fund

for cleaning-up spills and abandoned sites containing hazardous substances. When these sites are discovered, EPA must decide quickly if an urgent threat exists requiring immediate action. This project is intended to aid the Agency in making these decisions by providing a method for rapidly evaluating the human health and environmental threat caused by discharges to ground water. The Agency's final decision must also consider the threat caused by releases to the air and surface waters. The EPA Exposure Assessment Group hopes to eventually provide similar methods which can be used to assess the threats associated with the other media as well.

The assessment procedures in this manual are designed to allow emergency response personnel to make a first-cut, order-of-magnitude estimate of the potential extent of contamination from a waste site or chemical spill within the 24-hour emergency response time frame. These procedures are not intended to provide a definitive, in-depth analysis of the complex fate and transport processes of contaminants in the subsurface environment.

The primary goal of this manual is to provide the basis for determining the need for emergency actions such as emergency sampling, containment/removal, and drinking water restrictions in order to preclude or minimize human exposure from ground water contamination at an emergency response site. Two specific emergency response situations

are envisioned where the assessment procedures in this manual would be applied.

1. Discovery of an abandoned hazardous waste site where an assessment of the potential extent of the waste plume is needed within the emergency response time frame.
2. Spill (or leakage) of a toxic waste or chemical where the potential for ground water contamination and the extent of contamination must be assessed within the emergency response time frame.

Time and resource limitation expected during an emergency response have required a number of simplifying assumptions in our assessment procedures; additional simplifications may be needed by the user due to limited data and information available at a particular emergency response site. The major assumptions incorporated into the assessment procedures in this manual are as follows:

1. Homogenous and isotropic properties are assumed for both the unsaturated and saturated zones (or media).
2. Steady and uniform flow is assumed in both the unsaturated and saturated zones.
3. Flow and contaminant movement are considered only in the vertical direction in the unsaturated zone and the horizontal direction in the saturated zone.
4. All contaminants are assumed to be water soluble and exist in concentrations that do not significantly affect water movement.

Methodology

The procedures developed in this model are based on a one-dimensional transport equation for flow through a porous medium. The equation considers dispersion, advection, equilibrium adsorption (linear isotherm) and degradation/decay (first order kinetics). Analytical solutions to the transport equation were presented for both continuous (step function) and pulsed inputs of contaminants. The pulse solution was used to simulate short-term releases such as might occur from a spill or tank leak. The nomograph was developed from the continuous input solution but can also be used on pulse problems by subtracting the solutions to

two continuous inputs lagged by the pulse duration.

Results

The nomograph (Figure 1) predicts contaminant concentrations as functions of both time and location in either the unsaturated or saturated zone. Separate computations, parameter estimates, and use of the nomograph are required for each zone. The prediction requires evaluation of four dimensionless quantities (A_1 , A_2 , B_1 , and B_2) and subsequent evaluation of the result (C/C_0) through use of the nomograph. The parameters required for this procedure are:

- initial contaminant concentration
- dispersion coefficient
- average interstitial pore water velocity
- degradation rate coefficient
- soil bulk density
- soil water content or effective porosity
- partition coefficient

Extensive guidelines for evaluation of these parameters are provided.

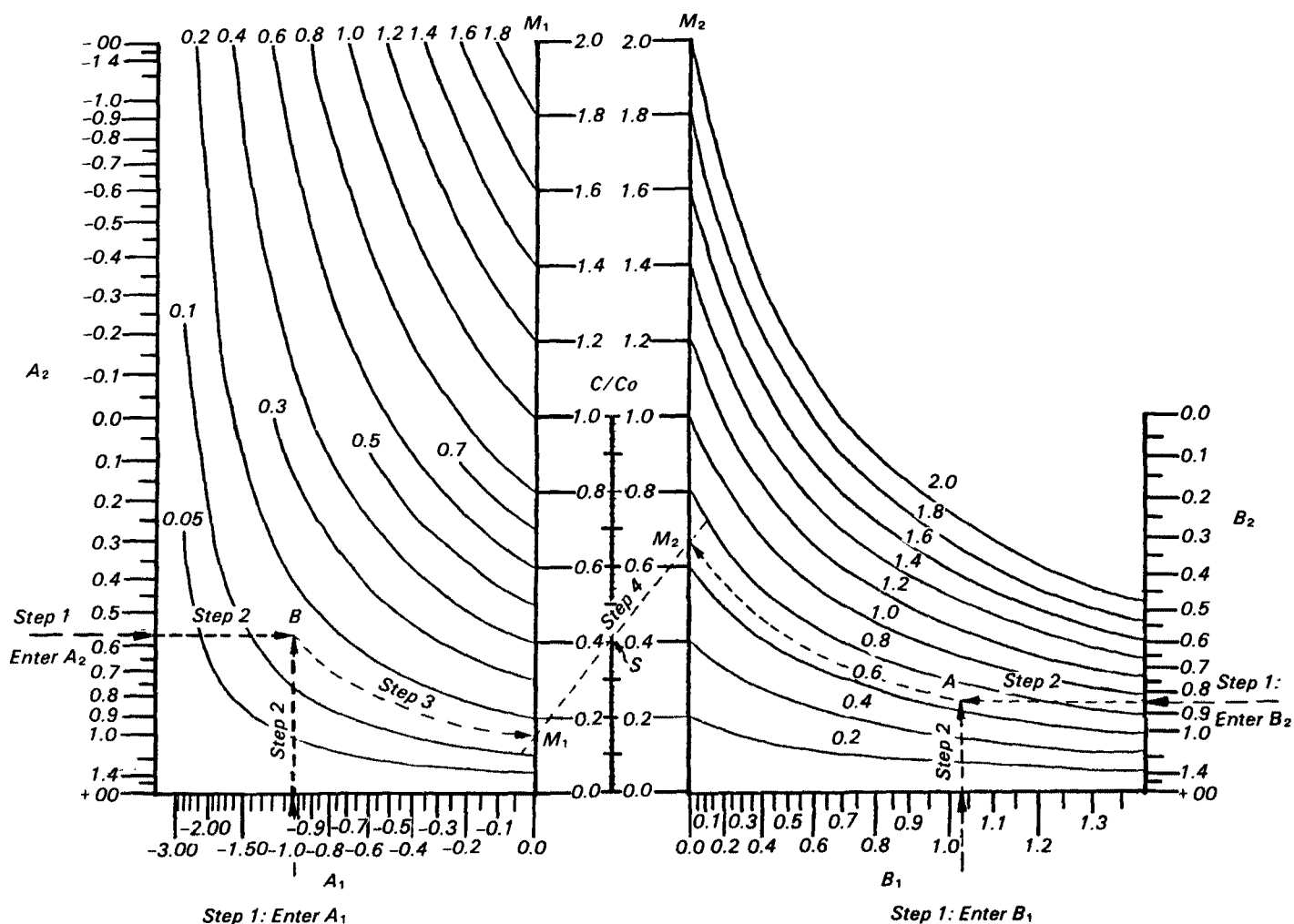


Figure 1. The rapid assessment nomograph.

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The complete report, entitled "Rapid Assessment of Potential Ground-Water Contamination Under Emergency Response Conditions," (Order No. PB 84-133 123; Cost: \$16.00, subject to change) will be available only from:

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