



Site assessment for groundwater vulnerability to pesticide contamination

E.A. Kerle, P.A. Vogue, J.J. Jenkins, and J.H. Huddleston

The procedure described in this publication helps you assess the potential for any specific pesticide to travel through any specific soil to reach groundwater. The objective is to provide you with information about soils, pesticides, and their interactions that will help you make good decisions about pesticide management and avoid pollution of groundwater resources.

This procedure uses a worksheet to record all pertinent information about soils, pesticides, and their interactions to rate groundwater vulnerability. Data sources required for this procedure include the soil survey report for your area, the *OSU Extension Pesticide Properties Database* (EM 8709), and the *OSU Extension Soil Sensitivity Database*. See page 8 for ordering information.

Soil and geologic materials below the root zone also influence groundwater vulnerability to pesticide contamination. This procedure, however, does not take into account those factors because surface soils, where soil organic matter is highest, and subsoils in which there is biological activity provide the greatest opportunity to manage pesticides to minimize the risk of groundwater contamination.

You will need

- A county soil survey
- *OSU Extension pesticide properties database*, EM 8709
- *OSU Extension soil sensitivity database*

Other helpful materials

- PNW Plant Disease, Weed, and Insect Control handbooks for current year
- *Understanding pesticide persistence and mobility for groundwater and surface water protection*, EM 8561
- *How soil properties affect groundwater vulnerability to pesticide contamination*, EM 8559
- Product labels from pesticides you use

See page 8 for ordering information.





Steps in the procedure

1. Make enough copies of the worksheet on page 4 to have one for each field. A completed example is provided for your reference (page 5).
2. Fill in your field ID, crop (including whether it is an irrigated or a dryland crop), and target pest at the top of each copy.

Proper pest management requires correct identification of the target pest. Verify pest identification with your county Extension agent, farm service advisor, or a competent consultant.

3. Organize the soil information for each field:
 - a. Locate each field on the corresponding map sheet in the County Soil Survey. Write the map unit symbols for the map delineations that occur in your field in column 1 of the worksheet. Look up the map unit name that corresponds to each symbol in the soil survey legend and write these names on the worksheet too. See the sample worksheet on page 5.
 - b. Look up the soil sensitivity rating for each map unit in your field in the *OSU Extension Soil Sensitivity Database* for your county. Separate ratings are given for irrigated and nonirrigated conditions, so be sure you use the one that's appropriate for the crop of interest. Record these sensitivity ratings in column 2 of the worksheet.
Soil sensitivity represents the potential for a soil to transmit pesticides to groundwater. It is based on separate ratings of soil leaching potential and soil sorption potential.
If any of your soil sensitivity ratings turn out to be moderate or higher, you may wish to look at these separate ratings of leaching potential or sorption potential to determine what it is about the soil that makes it sensitive. Further information on soil sensitivity ratings and their interpretations may be found in *How Soil Properties Affect Groundwater Vulnerability to Pesticide Contamination* (EM 8559), *Determination of Soil Sensitivity Ratings for the Oregon Water Quality Decision Aid* (EM 8708), and *An Overview of the Oregon Water Quality Decision Aid* (EM 8705).

4. Organize the pesticide information for each field:

- a. Check the current Pacific Northwest pest control handbooks or other appropriate sources of information to identify pesticide alternatives for the target pest. List your pesticide choices in column 3.

Double check product labels for current registration and other regulatory information; legal restrictions could change after the handbooks are printed.

- b. Look up the pesticide movement rating for each of the chemicals listed on your worksheet in the *OSU Extension Pesticide Properties Database*, EM 8709. The database is arranged alphabetically by pesticide common names. Record these ratings in column 4 of the worksheet.

The pesticide movement rating is a measure of the combined effects of pesticide mobility and pesticide persistence on a chemical's tendency to be transported through the soil to groundwater. Mobility is evaluated with chemical Koc values, and persistence is evaluated with chemical half life values.

If any of the chemicals you selected has pesticide movement ratings of moderate or above, you may want to look at the separate ratings of mobility and persistence to see what it is about the chemical that creates a higher risk of transport to groundwater. Further information about pesticide movement ratings and their interpretations may be found in *Understanding Pesticide Persistence and Mobility for Groundwater and Surface Water Protection* (EM 8561) and *An Overview of the Oregon Water Quality Decision Aid* (EM 8705).

5. Use the Groundwater Vulnerability Table (page 3) to determine the groundwater vulnerability rating for each combination of soil map unit and chemical selected on your worksheet. Find the soil sensitivity rating for a map unit of interest at the lefthand side of the table. Then move across that row to the column with the pesticide movement rating of interest. The groundwater vulnerability rating is given at the intersection of the soil sensitivity row and the pesticide movement column. Record this rating in column 5 of your worksheet.



Groundwater vulnerability table

Soil sensitivity rating	Pesticide movement rating					
	Extr. low	Very low	Low	Moderate	High	Very high
Very low	Very low	Very low	Very low	Low	Moderate	Moderate
Low	Very low	Very low	Low	Low	Moderate	Moderate
Moderate	Very low	Low	Low	Moderate	Moderate	High
High	Low	Low	Moderate	Moderate	High	Very high
Very high	Low	Moderate	High	Very high	Very high	Very high

Interpreting your ratings

Soils having low and very low sensitivity tend to be slowly permeable and high in organic matter. In these soils, leaching is limited and there is maximum retention of a chemical by sorption onto organic matter. Soils having high and very high sensitivity tend to be rapidly permeable and low in organic matter. They transport chemicals very readily and have very little capacity to retain them in the soil.

Chemicals that have extremely low, very low, and low pesticide movement ratings tend to have either very high Koc values, relatively short half lives, or both. They pose very little risk of groundwater contamination. Chemicals rated high or very high tend to have either longer half lives, low Koc values, or both. Longer residence time combined with little tendency to bond with soil organic matter increases the risk of their being transported to groundwater.

In general, chemicals with low pesticide movement ratings that are applied on soils with low or very low sensitivity ratings are very unlikely to reach

groundwater. The corresponding groundwater vulnerability ratings are low. Conversely, chemicals with high pesticide movement ratings applied on highly sensitive soils pose a real potential for transport through the soil to groundwater. These situations are indicated by high or very high groundwater vulnerability ratings. Rating combinations between these extremes give rise to intermediate ratings of groundwater vulnerability.

These soil, pesticide, and groundwater vulnerability ratings present only part of the information needed to make good management decisions to protect groundwater resources. Other factors, such as variable soil and landscape conditions; crop canopy density; pesticide formulation and method of application; and the rate, timing, and frequency of application with respect to weather conditions and irrigation management all are important in developing a comprehensive management plan to minimize the risk of groundwater contamination. Use column 6 of your worksheet to jot down any of this or any other information that may be pertinent to optimizing soil, crop, and chemical management for efficient production and groundwater protection.

Groundwater vulnerability worksheet



Field ID _____ Crop _____ Target Pest _____ Date _____

1 Soil map unit	2 Soil sensitivity rating	3 Pesticides recommended for control of pest	4 Pesticide movement rating	5 Groundwater vulnerability rating	6 Comments



Sample completed worksheet

Field ID 1 East Crop Summer fallow after winter wheat Target Pest Canada thistle Date 7/8/97

1 Soil map unit	2 Soil sensitivity rating	3 Pesticides recommended for control of pest	4 Pesticide movement rating	5 Groundwater vulnerability rating	6 Comments
89C Shano silt loam, 7-12% slopes	Low	Clopyralid	Very high	Moderate	Clop. has high water sol. Time applic. when no storms are forecast
		2,4-D amine	Moderate	Low	
75B Quincy loamy fine sand, 0-5% slopes	Moderate	Clopyralid	Very high	High	
		2,4-D amine	Moderate	Moderate	

5

Related OSU Extension materials

Determination of Soil Sensitivity Ratings for the Oregon Water Quality Decision Aid, EM 8708, by J.H. Huddleston (1998). \$2.50

A detailed technical discussion of the development and interpretation of the soil sensitivity ratings used in OWQDA, including such factors as throughflow potential, runoff potential, and hydraulic loading.

How Soil Properties Affect Groundwater Vulnerability to Pesticide Contamination, EM 8559, by J.H. Huddleston (1994). \$1.00

A general introduction to the key factors involved in determining a soil's leaching potential and sorption potential. Explains the role of permeability, water table conditions, organic matter content, and clay content.

Introduction to the OSU Extension Soil Sensitivity Database, EM 8707, by J.H. Huddleston, W.R. Mendez, M. Brett, E.A. Kerle, and P.A. Vogue (1998). 50¢

A brief introduction to the factors included in the OWQDA soil sensitivity database, including throughflow potential, runoff potential, and hydraulic loading.

An Overview of the Oregon Water Quality Decision Aid (OWQDA), EM 8705, by J.H. Huddleston (1998). \$1.00

An introduction to the OWQDA, including a brief explanation of the soil sensitivity and pesticide movement ratings.

Oregon Water Quality Decision Aid Computer Software, EM 8706, by J.H. Huddleston (1998). \$25.00

Fully automated version of OWQDA, including the complete pesticide properties database and the complete soil sensitivity database.

The OSU Extension Pesticide Properties Database, EM 8709, by P.A. Vogue, E.A. Kerle, and J.J. Jenkins (1998). \$2.50

Hard copy version of the pesticide database for using OWQDA manually.

The OSU Extension Soil Sensitivity Database (1998).

Hard copy version of the soils database for using OWQDA manually. *Order this publication from the OSU Department of Soil Science (541-737-5712).*

There is a nominal fee for photocopying and mailing.

Understanding Pesticide Persistence and Mobility for Groundwater and Surface Water Protection, EM 8561, by E.A. Kerle, J.J. Jenkins, and P.A. Vogue (1994). \$1.50

A general introduction to the key factors involved in determining the potential for pesticides to reach groundwater and surface water. Explains the role of photo-, chemical, and microbial degradation; sorption; plant uptake; volatilization; wind erosion; runoff; and leaching.

PNW Weed Control Handbook (revised annually). \$25.00

PNW Plant Disease Control Handbook (revised annually). \$25.00

PNW Insect Control Handbook (revised annually). \$25.00

How to order

To order copies of the OWQDA computer software or the above publications (except for *The OSU Extension Soil Sensitivity Database*), send the complete title and series number, along with a check or money order for the amount listed, payable to Oregon State University, to the address below. We offer discounts on orders of 100 or more copies of a single publication and of 12 or more copies of a single computer software program. Please call 541-737-2513 for price quotes. Send orders and payment to:

Publication Orders
Extension & Station Communications
Oregon State University
422 Kerr Administration
Corvallis, OR 97331-2119
Fax: 541-737-0817

Our Educational Materials catalog and many of our publications are available on the World Wide Web at eesc.orst.edu

Order *The OSU Extension Soil Sensitivity Database* from:

Extension Soil Science
Oregon State University
3017 Ag and Life Science
Corvallis, OR 97331-7306
Phone: 541-737-5712

E-mail: J.Herbert.Huddleston@orst.edu

Obtain your County Soil Survey from your county office of the OSU Extension Service or from your local office of the Natural Resources Conservation Service.

© 1998 Oregon State University

This publication was produced and distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914. Extension work is a cooperative program of Oregon State University, the U.S. Department of Agriculture, and Oregon counties.

Oregon State University Extension Service offers educational programs, activities, and materials—*without regard to race, color, religion, sex, sexual orientation, national origin, age, marital status, disability, and disabled veteran or Vietnam-era veteran status*—as required by Title VI of the Civil Rights Act of 1964, Title IX of the Education Amendments of 1972, and Section 504 of the Rehabilitation Act of 1973. Oregon State University Extension Service is an Equal Opportunity Employer.

Published January 1994. Revised May 1998.

