

Summary of Oregon's Susceptibility (Sensitivity) Analysis Procedures

This process was developed for determining Use and Susceptibility Waivers for the SOCs and VOCs. The procedures make use of a combination of site-specific information pertaining to the monitoring history of the source, hydrogeological characteristics of the vadose (unsaturated) zone, and important chemical characteristics of the contaminants pertaining to their mobility and persistence in the environment. The format is a series of matrices in which related parameters are plotted against one another to determine their combined effect. The results of one matrix is passed on to the next in order to obtain an estimate of their cumulative effect. Data used in the process are derived from well reports (well logs), soil survey reports, meteorological data and, as appropriate chemical data on individual chemicals tendency for sorption and field dissipation (half-life). OHD compiled the chemical data for the phase 2/5 SOCs and VOCs from the literature and incorporated it into the guidance document. In all cases, the system has the option of submitting additional data in support of low susceptibility.

1. History and Nature of the Source. The first step in evaluating the susceptibility of the aquifer is to characterize well construction and monitoring history for the specific well. The main target for well construction was whether or not the casing seal (grout seal) was emplaced in a manner that takes advantage of any natural protection (low permeability layers) that existed in the subsurface. If the grout seal is judged inadequate, or if no well report is available, the aquifer is determined to be susceptible.

a. Abandoned and Other Wells. A ground survey is undertaken within 1000 feet (or 6-month time-of-travel, determined by the calculated fixed radius method, whichever is less), to determine if there are wells that are either inadequately constructed or improperly abandoned within the area. If so, the aquifer is considered susceptible unless the system submits data to the contrary.

b. Nitrate/Coliform Bacteria. If the system has a history of coliform detections that are source related, or has nitrate concentrations exceeding regional background, or 2 mg/L in absence of regional data, the aquifer is considered susceptible.

c. VOC/SOC/Hydraulic Connection. Susceptible if there have been confirmed detections of organic chemicals or if the aquifer supplying the well is in hydraulic connection with, i.e. receiving water from, a surface water body.

2. If the system makes it through the "History and Nature of the Source" consideration, it moves on to evaluating the "environmental conditions", those parameters that have an impact on the ability of the soil and geologic materials to transmit water and the contaminant from the surface to the aquifer.

a. Area of Susceptibility Analysis. The wellhead protection area is used in this phase. Different time-of-travel zones could be targeted as a function of the contaminant.

b. Matrix Evaluation. A series of matrices is used to evaluate the potential of [1] water

migrating from the surface to the aquifer and [2] a given contaminant persisting and moving with the water. In each matrix, two parameters are plotted. Their intersection within the matrix yields a score from 1 to 10. The higher the score, the greater the potential that these parameters will contribute to aquifer susceptibility.

1. **Traverse Potential.** This matrix assesses the ability of the unsaturated zone to transmit water to aquifer. Considered are the depth to the aquifer and the weighted hydraulic conductivity of the vadose zone. Higher scores (i.e. 10) are assigned to shallow wells and high hydraulic conductivity. The matrix score is assigned as the traverse potential which is carried to the next matrix.

2. **Infiltration Potential.** This matrix assesses the combination of the traverse potential and the availability of water at the surface. It plots the traverse potential against the hydraulic surplus, equal to rainfall + irrigation - evapotranspiration - runoff. These data are not always available, so methods of estimation are provided. The score produced by the intersection of the hydraulic surplus and the traverse potential is assigned to the infiltration potential.

The infiltration potential can be used as a general estimate of the susceptibility of the aquifer. If specific contaminants are involved, then the process continues with the mobility potential matrix which takes into account the sorption characteristics of the chemical.

3. **Mobility Potential.** This matrix is primarily designed for organic contaminants, but in practice could be used for others. In this exercise, the organic matter score, a number related to the percent organic matter in the various soil layers, is plotted against the organic-carbon partition coefficient (Koc) for the chemical of concern. The higher the organic matter content and the Koc value, the lower the susceptibility of the aquifer for that specific chemical. The matrix value obtained is referred to as the mobility potential.

4. **Leach Potential.** This matrix combines the infiltration potential (hydrogeologic parameters) and the mobility potential (chemical specific characteristics) to estimate the potential for the contaminant to leach to groundwater. Obviously, even a highly mobile contaminant is not likely to impact groundwater if the vadose is very thick and/or relative impermeable. On the other hand, even a low mobility component could impact groundwater under conditions of shallow aquifer and highly permeable vadose zone. The score from this matrix is referred to as the leach potential.

5. **Susceptibility.** The final matrix plots the leach potential against the persistence of the component in the environment. The shorter is the half-life of the constituent, the less will be the potential impact of the chemical, unless, of course, the leach potential is high. The matrix is divided into low-, moderate- and high-relative risk fields. Which relative risk applies to a given well will depend on the numerical values of the persistence and the leach potential.

A copy of the the Guidance Document for Monitoring Reduction Through a Use and Susceptibility Waiver can be obtained from the Division.