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US EPA Optimal Well Locator (OWL): A Screening Tool for Evaluating Locations of Monitoring Wells

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•Region 5 ORD Product Expo
•October 6, 2004

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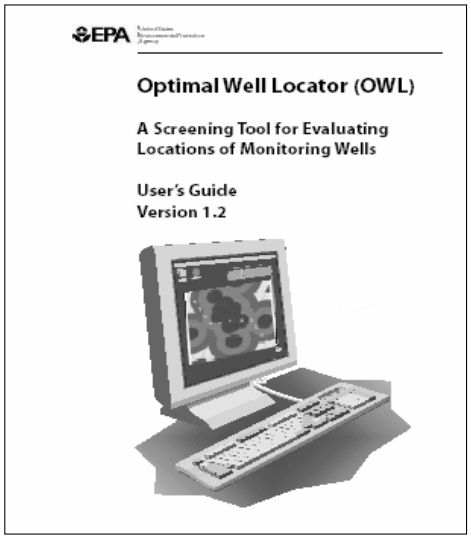
Optimal Well Locator (OWL) Version 1.2

Ponniah Srinivasan, CertainTech, Elise A. Striz, US EPA, John T. Wilson, US EPA, and Daniel F. Pope, Dynamac



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OWL Questions

1. ***What is the variation in ground water flow magnitude and direction at the site over time?***

2. ***How does the variation in ground water flow magnitude and direction affect the plume migration at the site over time?***

3. ***Are the existing monitoring wells able to intercept the plume? Where is the best place to put a new monitoring well?***

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Question 1

What is the variation in ground water flow magnitude and direction at the site over time?

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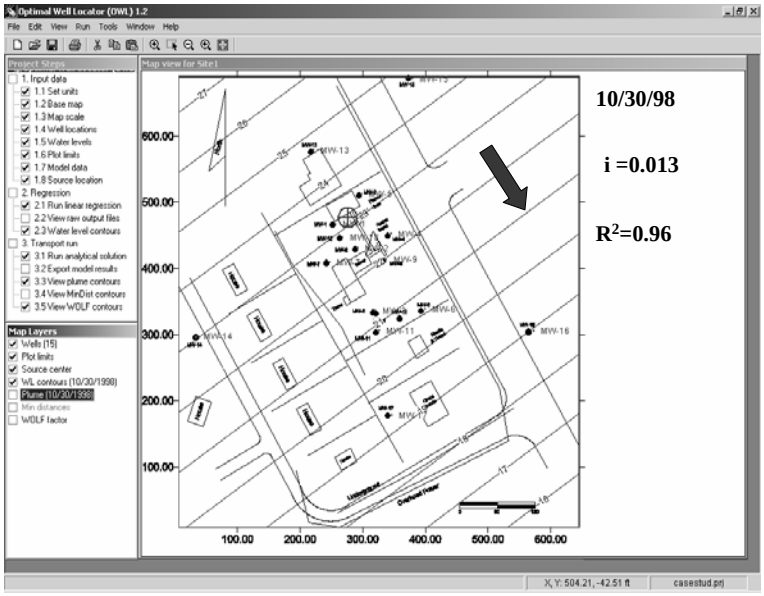
Ground Water Flow Field 10/30/98



10/30/98

i =0.013

R^2=0.96

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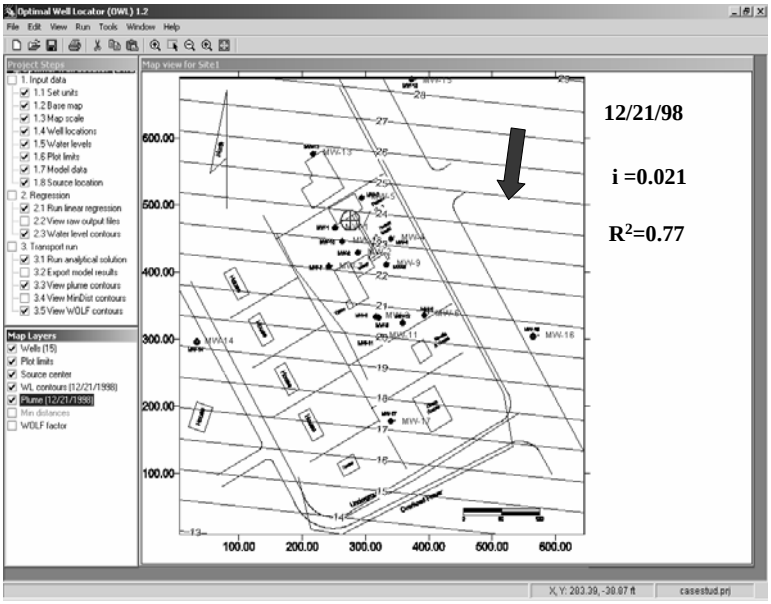
Ground Water Flow Field 12/21/98



12/21/98

i =0.021

R^2=0.77

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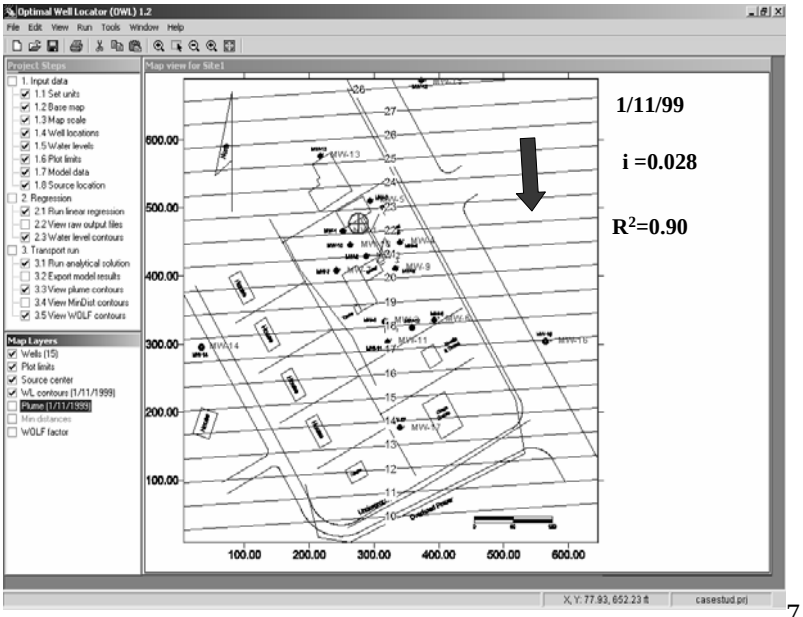
Ground Water Flow Field 1/11/99



1/11/99

i =0.028

R^2=0.90

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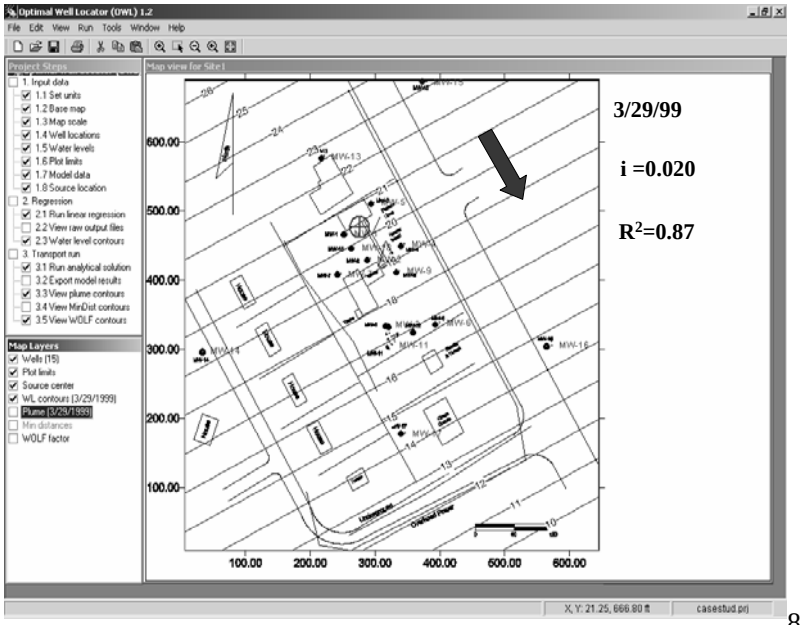
Ground Water Flow Field 3/29/99



3/29/99

i =0.020

R^2=0.87

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Question 2

How does the variation in ground water flow magnitude and direction affect the plume migration at the site over time?

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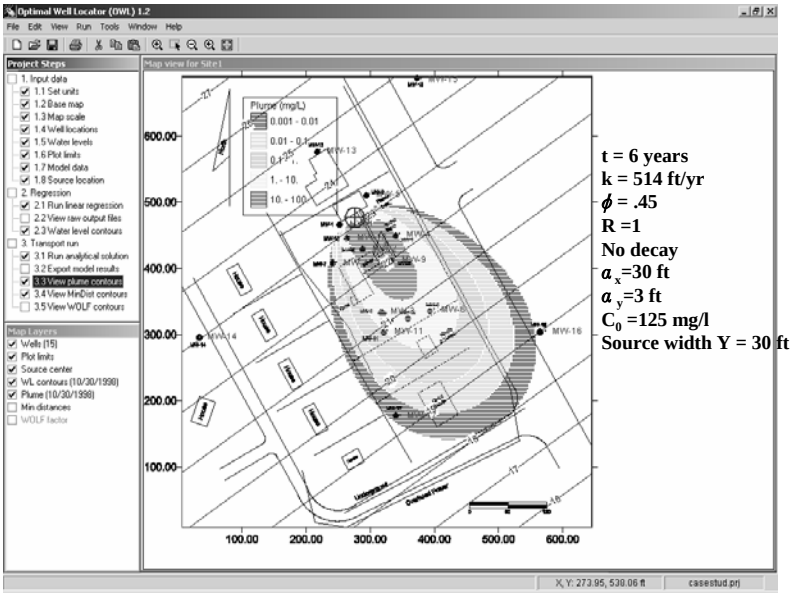
Plume Migration Path 10/30/98



t = 6 years
k = 514 ft/yr
ϕ = .45
R =1
No decay
α_x=30 ft
α_y=3 ft
C_0 =125 mg/l
Source width Y = 30 ft

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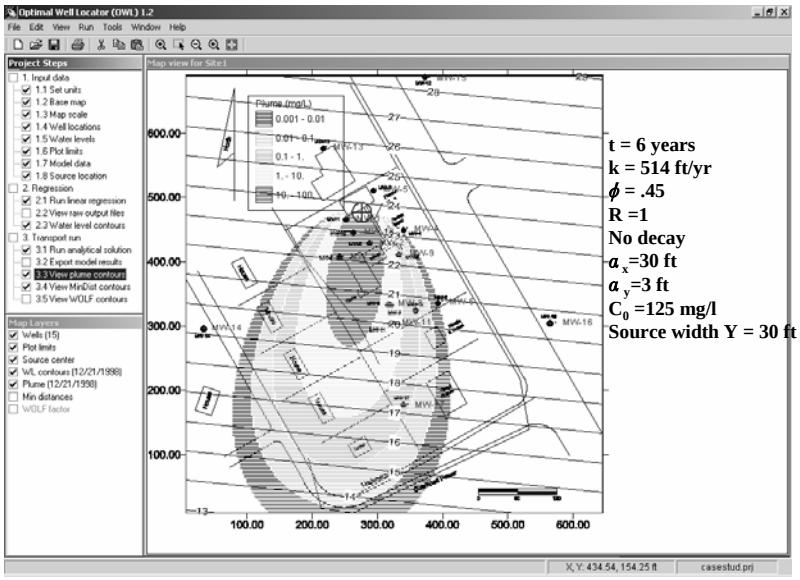
Plume Migration Path 12/21/98



t = 6 years
k = 514 ft/yr
ϕ = .45
R =1
No decay
α_x=30 ft
α_y=3 ft
C_0 =125 mg/l
Source width Y = 30 ft

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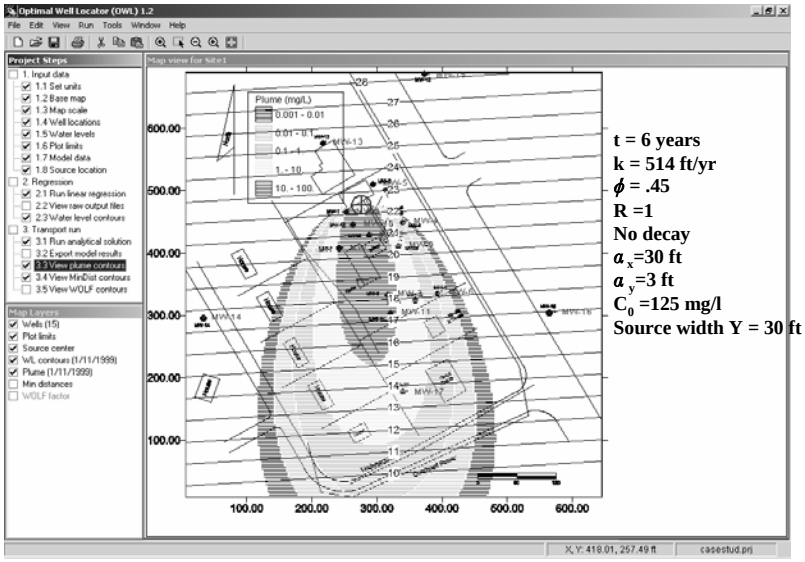
Plume Migration Path 1/11/99



t = 6 years
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ϕ = .45
R =1
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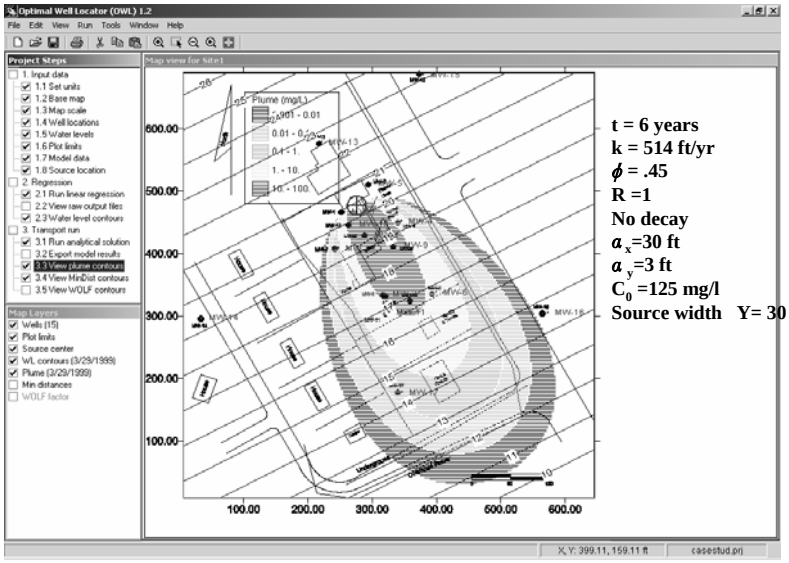
Plume Migration Path 3/29/99



t = 6 years
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R =1
No decay
α_x=30 ft
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Question 3

Are the existing monitoring wells able to intercept the plume? Where is the best place to put a new monitoring well?

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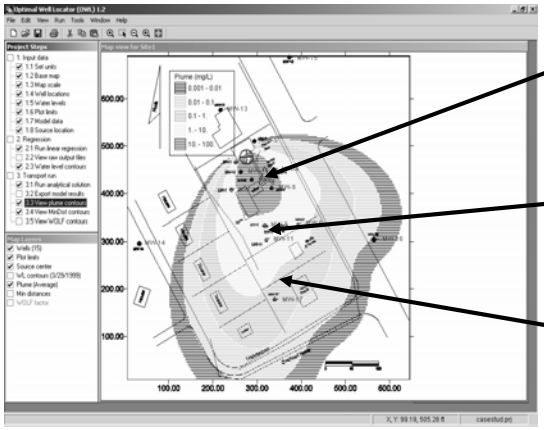
Average Composite Plume



Red : **10-100 mg/l**
Existing MW coverage good

Yellow: **1-10 mg/l**
Existing MW coverage sparse

Green: **0.1-1.0 mg/l**
One existing MW

$$C_{avg}(i,j) = \frac{1}{n}\sum_{t} C(i,j,t)$$

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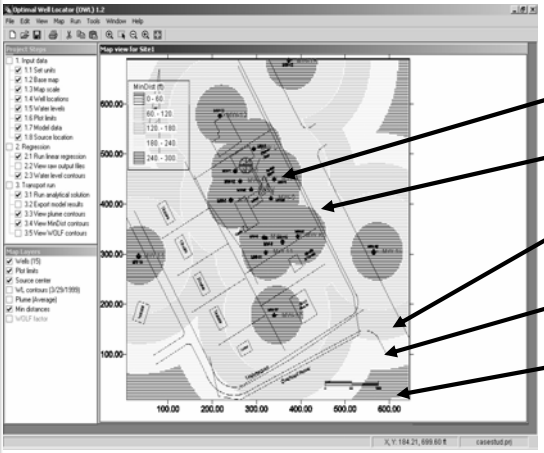
Minimum Distance to Nearest Monitoring Well: Measure of MW Coverage



Dark Blue : 0-60 ft to nearest MW (*best*)
Light Blue: 60-120 ft to nearest MW
Green: 120-180 ft to nearest MW
Yellow: 180-240 ft to nearest MW
Red: 240-300 ft to nearest MW *(worst)*

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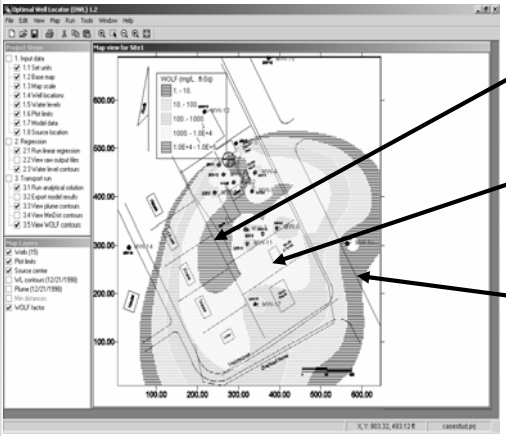
Well Optimal Location Factor (WOLF)



Red : **10,000-100,000**
best place for new wells

Yellow: **1000-10,000**
another good place for new wells

Dark Blue: **1-10**
existing well may not be necessary here

$$WOLF(i,j) = D_{\min}(i,j)^2 \cdot C_{avg}(i,j)$$

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OWL Input Data

<u>A Scaled Basemap</u> : The OWL program requires the user to have a scaled basemap of the site in electronic form. The program accepts raster (*.bmp, *.tif) and vector (*.dwg, *.shp) electronic formats.

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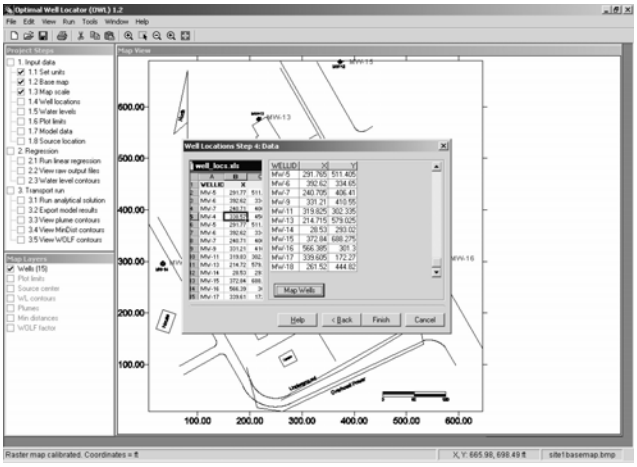
OWL Input Data



Well Locations: ***OWL requires the well locations to be in consistent (x, y) coordinates from a rectangular grid based on the map dimensions. These data must be saved and imported into the program from a spreadsheet (Excel, Lotus).***

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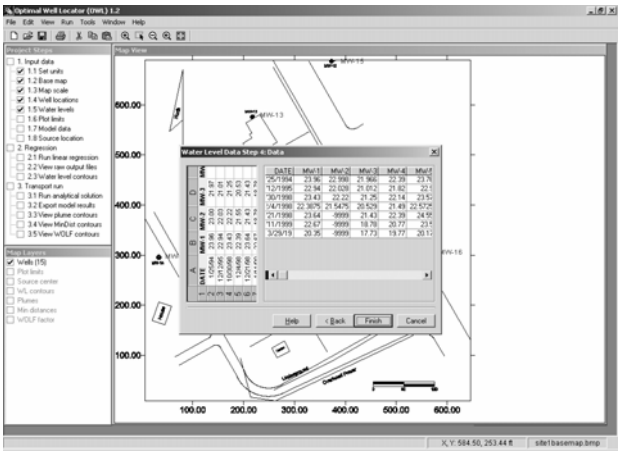
OWL Input Data



<u>Ground Water Elevations</u>: The OWL program requires routine measurements of ground water levels (preferably monthly or quarterly) from a monitoring well network demonstrating good spatial coverage of the site. These data must be saved and imported into the program from a spreadsheet file (Excel, Lotus).

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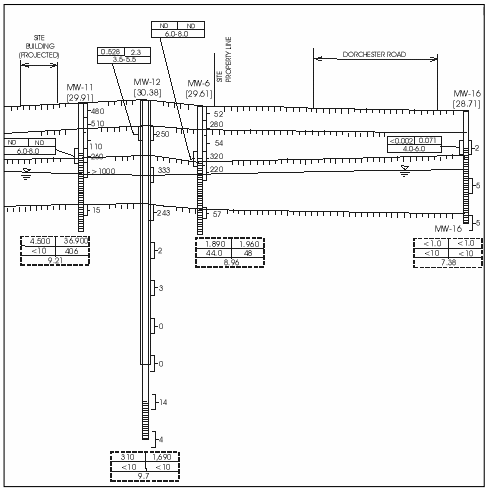
OWL Input Data



Subsurface Geology: The monitoring wells used to provide water level data for OWL must be screened in the same aquifer. The aquifer should be homogeneous, isotropic and of constant thickness .

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OWL Input Data

Site Characterization: The contamination and hydrologic characteristics of the aquifer at the site must entered into the OWL program. This information includes:

a. contaminant source width

b. contaminant source concentration

c. contaminant retardation factor

d. contaminant half-life

e. aquifer hydraulic conductivity

f. effective porosity

g. longitudinal/transverse dispersivity

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OWL Assumptions/Limitations

- ***Assumes simple ground water flow regimes in which water table surface can be represented by a linear plane.***
- ***Not suited to sites with significant surface water/groundwater interaction, pumping/injection wells, ground water divides, or vertical gradients.***
- ***Assumes 1D advective and dispersive contaminant transport.***

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OWL Computer Requirements

1. ***PC with MS Windows 95, 98, NT, ME, 2000, XP***
2. ***32 MB RAM, 40 MB disk space***
3. ***Spreadsheet software (Excel or Lotus)***

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OWL Learning Curve

1. ***Time to learn software: 1 day***
2. ***Time to work up site data: 1hour-1/2 day***
3. ***Time to enter data and run program: 1 hour***

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OWL Potential Applications and Users

- ***Leaking Underground Storage Tank Sites***
- ***Monitored Natural Attenuation Sites***
- ***State Regulators***
- ***Site Consultants***

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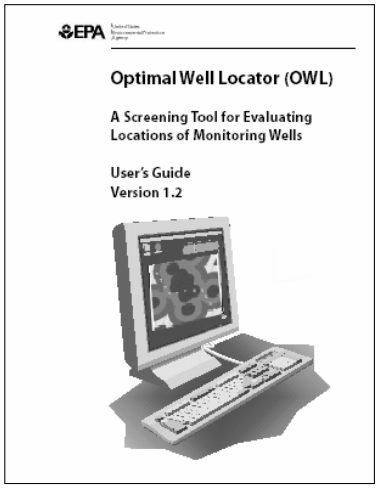
OWL Program Availability and Tech Support



- ***The OWL program and user's manual is available for download from the EPA Center for Subsurface Modeling Support (CSMoS) web site at http://www.epa.gov/ada/csmos/models.html***
- ***Technical support for OWL is provided by the EPA Center for Subsurface Modeling Support (CSMoS).***

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