

WiscLEACH[©] 2.0 Tutorial

**Department of Civil and Environmental Engineering
Jackson State University**

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Software Website: <http://wiscleach.engr.wisc.edu>

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WiscLEACH[©] 2.0

- A web-based computing tool to evaluate groundwater impacts from beneficial use of industrial byproducts in roadway stabilization and embankment/structural fill applications.
 - The tool is based on three analytical solutions to the advection-dispersion-reaction equation that describe transport in the vadose zone and groundwater (Li et al. 2006, 2011)
 - The application was designed to be computationally efficient and can be used without experience in numerical modeling.
- WiscLEACH is distributed in the hope that it will be useful, but **WITHOUT ANY WARRANTY**; without even the implied warranty of **MERCHANTABILITY** or **FITNESS FOR A PARTICULAR PURPOSE**.
 - Contact Information for Q & A: Dr. Lin Li (lin.li@jsums.edu), Department of Civil and Environmental Engineering, Jackson State University, Jackson, MS 39217-0168, US
 - Acknowledgement: Financial support for the development of WiscLEACH software was provided by the Recycled Materials Resource Center and Wisconsin Department of Natural Resources Waste Reduction and Recycling Demonstration Grant and Alliant Energy.
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Homepage of Web-based WiscLEACH[©] 2.0

Home

Roadway Stabilization ▼

Embankment/Structural Fill Applications ▼

User Manual

WiscLEACH_{2.0}

A computing tool to evaluate groundwater impacts from beneficial use of industrial byproducts in roadway stabilization and embankment/structural fill applications. The tool is based on three analytical solutions to the advection-dispersion-reaction equation that describe transport in the vadose zone and groundwater. The application was designed to be computationally efficient and can be used without experience in numerical modeling. © 2011. Developed by Dr. Lin Li at Jackson State University.

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Department of Civil and Environmental Engineering, Jackson State University

P. O. Box 17068

Jackson, MS 39217-0168, US

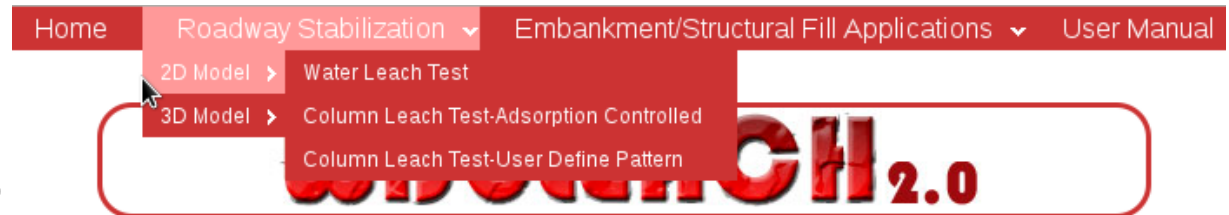
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Structure of Web-based WiscLEACH[©] 2.0

- **There are nine modules for simulation scenarios:**
 - **Roadway stabilization**
 - **2D Model**
 - Water leach test
 - Column leach test – adsorption control
 - Column leach test – User defined pattern
 - **3D Model**
 - Water leach test
 - Column leach test – adsorption control
 - Column leach test – User defined pattern
 - **Embankment/Structural Fill Application**
 - **3D Model**
 - Water leach test
 - Column leach test – adsorption control
 - Column leach test – User defined pattern

Module #1: Roadway Stabilization (2D model) - Water Leach Test

- Select the menu/Roadway Stabilization/2D Model/Water Leach Test



A computing tool to evaluate groundwater impacts from beneficial use of industrial byproducts in roadway stabilization and embankment/structural fill applications. The tool is based on three analytical solutions to the advection-dispersion-reaction equation that describe transport in the vadose zone and groundwater. The application was designed to be computationally efficient and can be used without experience in numerical modeling. © 2011. Developed by Dr. Lin Li at Jackson State University.

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Initial Webpage After Launching Module #1



Enter input data

2D Water Leach Test

WisLeach 2.0

Enter Site Parameters:

Point of Compliance (m)

Pavement Width (m)

Shoulder Width (m)

Depth to Groundwater (m)

Depth to Top of Stabilized Layer (m)

Depth to Bottom of Stabilized Layer (m)

Infiltration Rate (m/yr)

Maximum Simulation Time (yr)

Enter Hydraulic Properties above Groundwater Table:

	Pavement	Base	Stabilized Layer	Subgrade
Hydraulic Conductivity (m/yr)	<input type="text" value="1.0"/>	<input type="text" value="3650"/>	<input type="text" value="0.042"/>	<input type="text" value="0.31"/>
Porosity	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>

Enter Contaminant Properties:

Contaminant Name

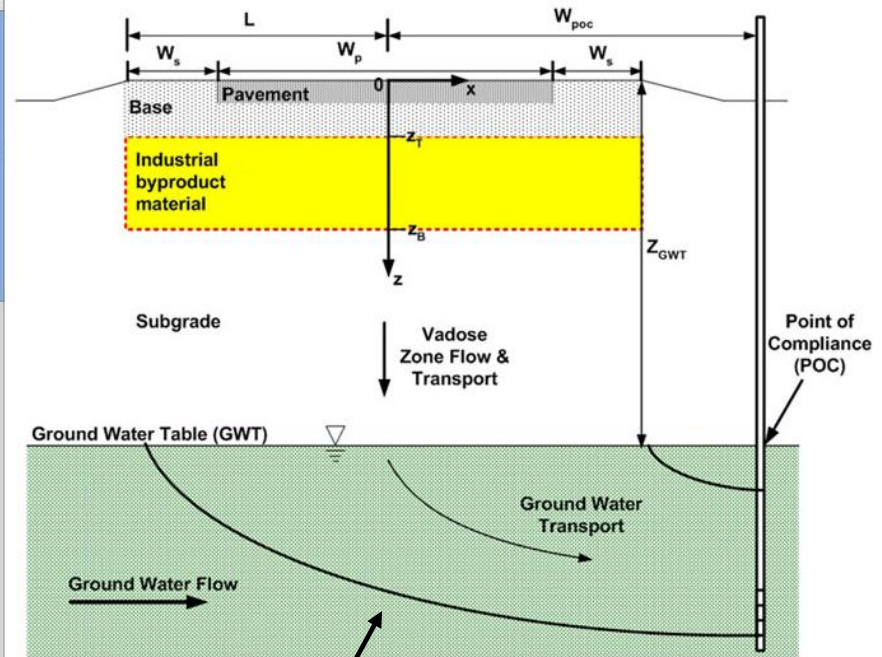
Leaching Concentration from WLT test (mg/l)

Water Leaching Test Scaling Factor

Retardation Factor in Stabilized Layer

Retardation Factor in Subgrade

Enter Aquifer Parameters:



Conceptual model in Module #1

Data Input Windows for Module #1

File Edit View History Bookmarks Tools Help

2D Water Leach Test

143.132.96.67/~wischleach/2dwtl.html

Home Roadway Stabilization ▾ Embankment/Structural Fill Applications ▾ User Manual

2D Water Leach Test

WISLEACH 2.0

Enter Site Parameters:

Point of Compliance (m)

Pavement Width (m)

Shoulder Width (m)

Depth to Groundwater (m)

Depth to Top of Stabilized Layer (m)

Depth to Bottom of Stabilized Layer (m)

Infiltration Rate (m/yr)

Maximum Simulation Time (yr)

Enter Hydraulic Properties above Groundwater Table:

	Pavement	Base	Stabilized Layer	Subgrade
Hydraulic Conductivity (m/yr)	<input type="text" value="1.0"/>	<input type="text" value="3650"/>	<input type="text" value="0.042"/>	<input type="text" value="0.31"/>
Porosity	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>

Enter Contaminant Properties:

Contaminant Name

Leaching Concentration from WLT test (mg/l)

Water Leaching Test Scaling Factor

Retardation Factor in Stabilized Layer

Retardation Factor in Subgrade

Enter Aquifer Parameters:

- Enter geometric variables, including point of compliance, pavement width, shoulder width, depth to groundwater table, depth to top of stabilized layer, depth to bottom of stabilized layer.
- Enter precipitation and simulation time.
- Enter hydraulic properties of layers above the groundwater table.
- For water leach test, enter contaminant name and leaching concentration from WLT test. Enter WLT scaling factor, retardation factor in stabilized layer and in subgrade.

Data Input Windows for Module #1 (Cont')

File Edit View History Bookmarks Tools Help

2D Water Leach Test

143.132.96.67/~wischleach/2dwtl.html

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2D Water Leach Test **WISCHLEACH 2.0**

Enter Aquifer Parameters:

Saturated Hydraulic Conductivity of Aquifer (m/yr)

Porosity of Aquifer

Regional Hydraulic Gradient

Enter Expert Mode Parameters (Non-Default Built in):

Use Expert Mode? Yes No

Grid X (m)

Grid Z (m)

Time Step (yr)

Horizontal Dispersivity above Groundwater (m)

Vertical Dispersivity above Groundwater (m)

Horizontal Dispersivity in Groundwater (m)

Vertical Dispersivity in Groundwater (m)

Molecular Diffusion Coefficient (m²/yr)

Enter Output Parameters:

Do you want to get Max C at POC over time? Yes No

Do you want to get concentration at monitoring points? Yes No

What is Monitoring Wells Numbers (maximum 6)?

Input Monitoring Wells location:

Horizontal location (m)	Vertical location (m)
<input type="text" value="0.0"/>	<input type="text" value="0.0"/>

- Enter aquifer properties.
- Additional options for Expert Model Parameters: grid size, time step, dispersivity and diffusion coefficient.
- Select output at the Point of Compliance.
- Select concentrations are to be reported at monitoring well locations. Enter coordinates of these locations. The coordinates are defined based on the coordinate system shown in conceptual model.

Data Input Windows for Module #1 (Cont')

File Edit View History Bookmarks Tools Help

2D Water Leach Test

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2D Water Leach Test

WiscLEACH 2.0

Do you want to get concentration at monitoring points? Yes No

What is Monitoring Wells Numbers (maximum 6)?

Input Monitoring Wells location:

Horizontal location (m)	Vertical location (m)
<input type="text" value="0.0"/>	<input type="text" value="0.55"/>
<input type="text" value="0.0"/>	<input type="text" value="1.0"/>
<input type="text" value="0.0"/>	<input type="text" value="2.0"/>
<input type="text" value="0.0"/>	<input type="text" value="3.0"/>
<input type="text" value="0.0"/>	<input type="text" value="4.0"/>
<input type="text" value="0.0"/>	<input type="text" value="5.0"/>

Do you only want to get 2D contour? Yes No

What is total Number of Contour Plots (maximum 4)?

Input time for the contour plot (yr)

<input type="text" value="1"/>	<input type="text" value="5"/>
<input type="text" value="20"/>	<input type="text" value="40"/>

Input X/Z axis intervals:

X-axis interval(put a comparable interval with model setting): (m)

Z-axis interval(put a comparable interval with model setting): (m)

- Enter coordinates of monitoring well locations (maximum locations = 6).
- Select if 2D contour graphs are desired, and enter times when contours are to be output. (maximum contour = 4)
Note: contouring can require considerable processing time.
- Enter the axis intervals for the contour graph axis.
- Click it to run the WiscLEACH model

Webpage to Running WiscLEACH Module #1

WiscLEACH is running in the web browser. The results are calculated.

File Edit View History Bookmarks Tools Help

Connecting. ←

143.132.96.67/~wiscleach/2dwlt.html

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2D Water Leach Test

WiscLEACH 2.0

Enter Site Parameters:

Point of Compliance (m)

Pavement Width (m)

Shoulder Width (m)

Depth to Groundwater (m)

Depth to Top of Stabilized Layer (m)

Depth to Bottom of Stabilized Layer (m)

Infiltration Rate (m/yr)

Maximum Simulation Time (yr)

Enter Hydraulic Properties above Groundwater Table:

	Pavement	Stabilized Layer	Subgrade	
Hydraulic Conductivity (m/yr)	<input type="text" value="1.0"/>	<input type="text" value="1.0"/>	<input type="text" value="0.042"/>	<input type="text" value="0.31"/>
Porosity	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>

Enter Contaminant Properties:

Contaminant Name

Leaching Concentration from WLT test (mg/l)

Water Leaching Test Scaling Factor

Retardation Factor in Stabilized Layer

Retardation Factor in Subgrade

Enter Aquifer Parameters:

Transferring data from 143.132.96.67...

Webpage to Visualize Model Output for Module #1

File Edit View History Bookmarks Tools Help

2D Water Leach Test

143.132.96.67/~wischleach/2dwtl.html

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2D Water Leach Test

WISCLEACH 2.0

Input Monitoring Wells location:

Horizontal location (m)	Vertical location (m)
0.0	0.55
0.0	1.0
0.0	2.0
0.0	3.0
0.0	4.0
0.0	5.0

Do you only want to get 2D contour? Yes No

What is total Number of Contour Plots (maximum 4)?

Input time for the contour plot (yr)

Input X/Z axis intervals:

X-axis interval (put a comparable interval with model setting): (m)

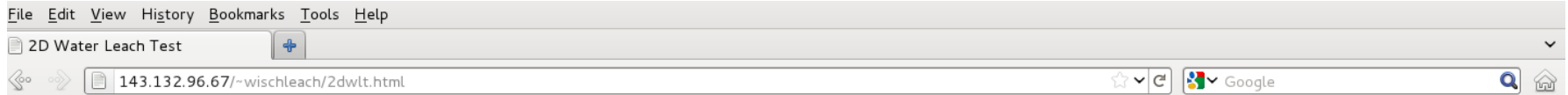
Z-axis interval (put a comparable interval with model setting): (m)

Visualize Model Output:

Choose 1 graph to display

After simulation, the results are allowed to graphically output.

Webpage to Visualize Model Output for Module #1



2D Water Leach Test

WISLEACH 2.0

Input Monitoring Wells location:

Horizontal location (m)	Vertical location (m)
<input type="text" value="0.0"/>	<input type="text" value="0.55"/>
<input type="text" value="0.0"/>	<input type="text" value="1.0"/>
<input type="text" value="0.0"/>	<input type="text" value="2.0"/>
<input type="text" value="0.0"/>	<input type="text" value="3.0"/>
<input type="text" value="0.0"/>	<input type="text" value="4.0"/>
<input type="text" value="0.0"/>	<input type="text" value="5.0"/>

Do you only want to get 2D contour? Yes No

What is total Number of Contour Plots (maximum 4)?

Input time for the contour plot (yr)

<input type="text" value="1"/>	<input type="text" value="5"/>
<input type="text" value="20"/>	<input type="text" value="40"/>

Input X/Z axis intervals:

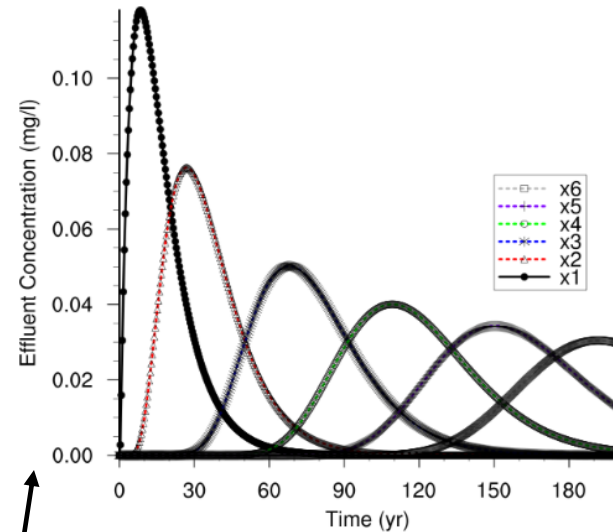
X-axis interval(put a comparable interval with model setting):

 (m)

Z-axis interval(put a comparable interval with model setting):

 (m)

Visualize Model Output:



After simulation, the concentrations at the monitoring locations are allowed to graphically output. The graphic can be saved as separated file.

Webpage to Visualize Model Output for Module #1

File Edit View History Bookmarks Tools Help

2D Water Leach Test

143.132.96.67/~wischleach/2dwtl.html

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2D Water Leach Test WiscLEACH 2.0

Input Monitoring Wells location:

Horizontal location (m)	Vertical location (m)
0.0	0.55
0.0	1.0
0.0	2.0
0.0	3.0
0.0	4.0
0.0	5.0

Do you only want to get 2D contour? Yes No

What is total Number of Contour Plots (maximum 4)?

Input time for the contour plot (yr)

Input X/Z axis intervals:

X-axis interval(put a comparable interval with model setting): (m)

Z-axis interval(put a comparable interval with model setting): (m)

Visualize Model Output:

After simulation, the maximum concentrations at the POC during the maximum simulation time are plotted. The figure can be saved as separated file.

Webpage to Visualize Model Output for Module #1

File Edit View History Bookmarks Tools Help

2D Water Leach Test

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2D Water Leach Test

WISCLEACH 2.0

Input Monitoring Wells location:

Horizontal

Do you only want
What is total Num
Input time for the

Input X/Z axis int
X-axis interval(pu
setting):
Z-axis interval(pu
setting):

Concentration distribution at 40-year

Depth (m)

X (m)

CONTOUR FROM .004 TO .056 BY .004

Concentration distribution at 40-year

Depth (m)

X (m)

C (mg/l)

0.056
0.052
0.048
0.044
0.04
0.036
0.032
0.028
0.024
0.02
0.016
0.012
0.008
0.004

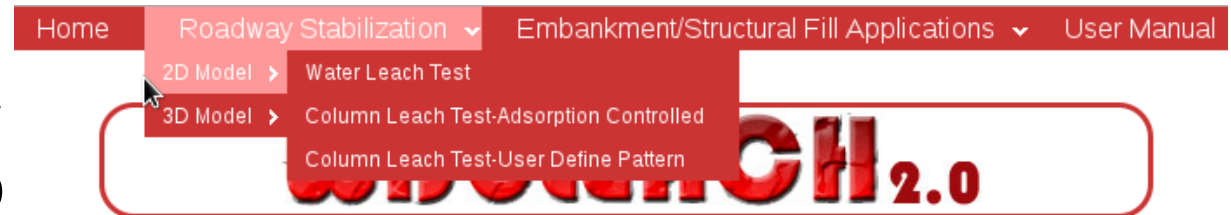
RUN MODEL

Visualize Model Output:
Contour shaded for 40year

After simulation, the 2D contour can be plotted (contour shaded or line format) at the specified time. The graphic can be saved as separated file.

Module #2: Roadway Stabilization (2D model) - Column Leach Test – Adsorption Controlled

- Select the menu/Roadway Stabilization/2D Model/Column Leach Test – Adsorption Controlled



A computing tool to evaluate groundwater impacts from beneficial use of industrial byproducts in roadway stabilization and embankment/structural fill applications. The tool is based on three analytical solutions to the advection-dispersion-reaction equation that describe transport in the vadose zone and groundwater. The application was designed to be computationally efficient and can be used without experience in numerical modeling. © 2011. Developed by Dr. Lin Li at Jackson State University.

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Initial Webpage After Launching Module #2

File Edit View History Bookmarks Tools Help

2D Column Leach Test--Adspor... +

143.132.96.67/~wischleach/2dclt_A.C.html

wang bin

Home Roadway Stabilization Embankment/Structural Fill Applications User Manual

2D Column Leach Test - Adsorption Controlled WiscLEACH 2.0

Enter Site Parameters:

Point of Compliance (m)

Pavement Width (m)

Shoulder Width (m)

Depth to Groundwater (m)

Depth to Top of Stabilized Layer (m)

Depth to Bottom of Stabilized Layer (m)

Infiltration Rate (m/yr)

Maximum Simulation Time (yr)

Enter Hydraulic Properties above Groundwater Table:

	Pavement	Base	Stabilized Layer	Subgrade
Hydraulic Conductivity (m/yr)	<input type="text" value="1.0"/>	<input type="text" value="3650"/>	<input type="text" value="0.042"/>	<input type="text" value="0.31"/>
Porosity	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>

Enter Contaminant Properties:

Contaminant Name

Initial Effluent Concentration from CLT test (mg/l)

Scaling Factor (Default = 1)

Retardation Factor in Stabilized Layer

Retardation Factor in Subgrade

Enter Aquifer Parameters:

Enter input data

Conceptual model in Module #2

Data Input Windows for Module #2

File Edit View History Bookmarks Tools Help

2D Column Leach Test--Adspor... +

143.132.96.67/~wischleach/2dclt_A.C.html wang bin

Home Roadway Stabilization ▾ Embankment/Structural Fill Applications ▾ User Manual

2D Column Leach Test - Adsorption Controlled WisCLEACH 2.0

Enter Site Parameters:

Point of Compliance (m)

Pavement Width (m)

Shoulder Width (m)

Depth to Groundwater (m)

Depth to Top of Stabilized Layer (m)

Depth to Bottom of Stabilized Layer (m)

Infiltration Rate (m/yr)

Maximum Simulation Time (yr)

Enter Hydraulic Properties above Groundwater Table:

	Pavement	Base	Stabilized Layer	Subgrade
Hydraulic Conductivity (m/yr)	<input type="text" value="1.0"/>	<input type="text" value="3650"/>	<input type="text" value="0.042"/>	<input type="text" value="0.31"/>
Porosity	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>

Enter Contaminant Properties:

Contaminant Name

Initial Effluent Concentration from CLT test (mg/l)

Scaling Factor (Default = 1)

Retardation Factor in Stabilized Layer

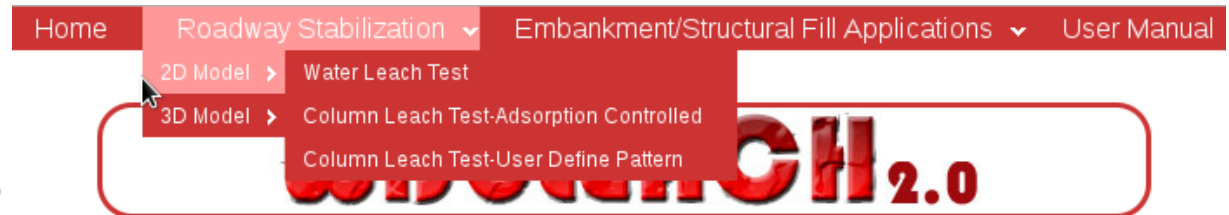
Retardation Factor in Subgrade

Enter Aquifer Parameters:

- Date input are similar to Module #1, except:
 - For column leach test – adsorption controlled module, enter column leaching data where adsorption-controlled release can be assumed with instantaneous linear and reversible sorption.

Module #3: Roadway Stabilization (2D model) - Column Leach Test – User Defined Pattern

- Select the menu/Roadway Stabilization/2D Model/Column Leach Test – User Defined Pattern



A computing tool to evaluate groundwater impacts from beneficial use of industrial byproducts in roadway stabilization and embankment/structural fill applications. The tool is based on three analytical solutions to the advection-dispersion-reaction equation that describe transport in the vadose zone and groundwater. The application was designed to be computationally efficient and can be used without experience in numerical modeling. © 2011. Developed by Dr. Lin Li at Jackson State University.

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Initial Webpage After Launching Module #3

2D Column Leach Test--User Defined - Mozilla Firefox

Enter input data

File Edit View History Bookmarks Tools Help

2D Column Leach Test--User D... +

143.132.96.67/~wischleach/2dclt_UD.html

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WISLEACH 2.0

Enter Contaminant Properties:

Contaminant Name

Input value of data points (C - mg/l vs t - yrs)
time(yrs) [space] c(t)

0.01	0.032
0.54	0.004
0.64	0.003
0.72	0.004
0.87	0.0032
1.05	0.0021
2.77	0.0017
2.89	0.001
3.69	0.0006
4.04	0.0005
4.62	0.0007
4.72	0.00023
100	0.0

Do you want to get concentration at monitoring points? Yes No

Retardation Factor in Stabilized Layer

Retardation Factor in Subgrade

Enter Aquifer Parameters:

Saturated Hydraulic Conductivity of Aquifer (m/yr)

Conceptual model in Module #3

Data Input Windows for Module #3

2D Column Leach Test--User Defined - Mozilla Firefox

File Edit View History Bookmarks Tools Help

2D Column Leach Test--User D... +

143.132.96.67/~wischleach/2dclt_UD.html

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2D Column Leach Test--User Defined Pattern

WISCLEACH 2.0

Enter Contaminant Properties:

Contaminant Name

Input value of data points (C - mg/l vs t - yrs)
time(yrs) [space] c(t)

```
0.01 0.032
0.54 0.004
0.64 0.003
0.72 0.004
0.87 0.0032
1.05 0.0021
2.77 0.0017
2.89 0.001
3.69 0.0006
4.04 0.0005
4.62 0.0007
4.72 0.00023
100 0.0
```

Do you want to get concentration at monitoring points? Yes No

Retardation Factor in Stabilized Layer

Retardation Factor in Subgrade

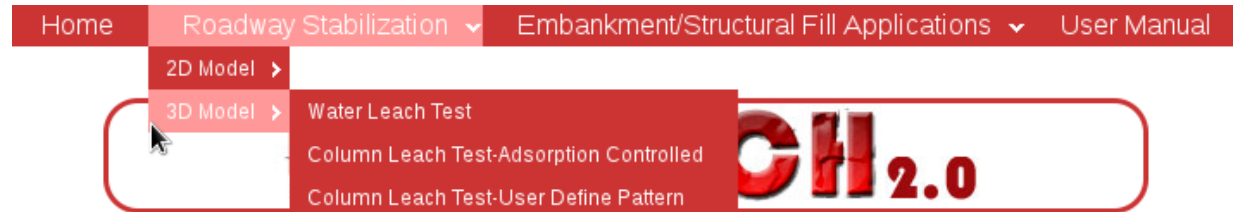
Enter Aquifer Parameters:

Saturated Hydraulic Conductivity of Aquifer (m/yr)

- Date input are similar to Module #1, except:
 - For column leach test – user defined pattern module, enter leachate concentrations at various time.

Module #4: Roadway Stabilization (3D model) - Water Leach Test

- Select the menu/Roadway Stabilization/3D Model/Water Leach Test



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Initial Webpage After Launching Module #4

File Edit View History Bookmarks Tools Help

3D Water Leach Test (base) **Enter input data**

143.132.96.67/~wischleach/3dwl_t.B.html

Home Roadway Stabilization Embankment/Structural Fill Applications User Manual

3D Water Leach Test **WISCLEACH 2.0**

Enter Site Parameters:

Point of Compliance (m)

Pavement Width (m)

Shoulder Width (m)

Lateral CCRs Half Width in y-direction (m)

Depth to Groundwater (m)

Depth to Top of Stabilized Layer (m)

Depth to Bottom of Stabilized Layer (m)

Infiltration Rate (m/yr)

Maximum Simulation Time (yr)

Enter Hydraulic Properties above Groundwater Table:

	Pavement	Base	Stabilized Layer	Subgrade
Hydraulic Conductivity (m/yr)	<input type="text" value="18.25"/>	<input type="text" value="3650"/>	<input type="text" value="0.19"/>	<input type="text" value="1.0"/>
Porosity	<input type="text" value="0.35"/>	<input type="text" value="0.35"/>	<input type="text" value="0.35"/>	<input type="text" value="0.35"/>

Enter Contaminant Properties:

Contaminant Name

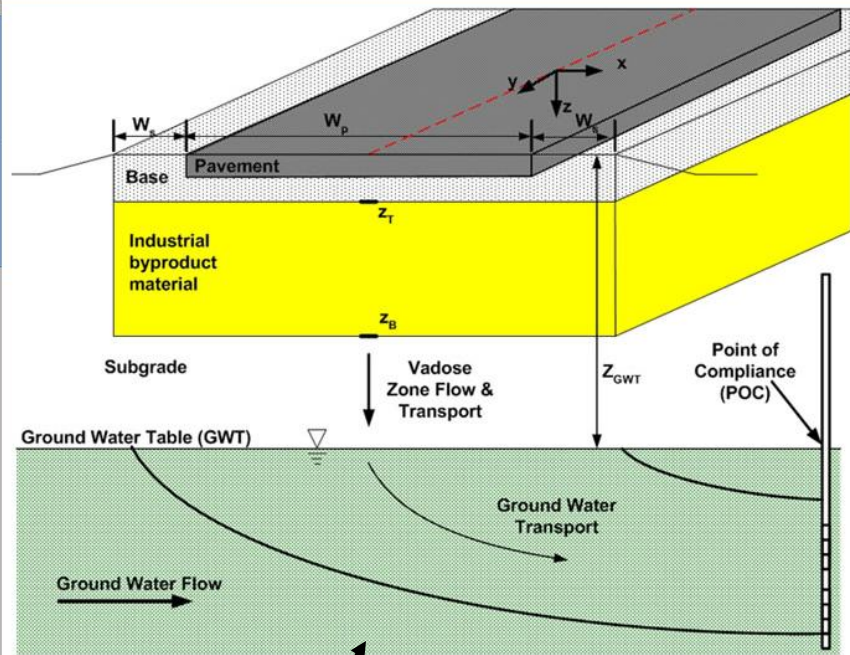
Water Leaching Test Effluent Concentration (mg/l)

Water Leaching Test Scaling Factor

Retardation Factor in Stabilized Layer

Retardation Factor in Subgrade

Lateral data



Conceptual model in Module #4

Data Input Windows for Module #4 (Cont')

File Edit View History Bookmarks Tools Help

3D Water Leach Test (base)

143.132.96.67/~wischleach/3dwtl_B.html

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3D Water Leach Test

Enter Contaminant Properties:

Contaminant Name	Cadmium
Water Leaching Test Effluent Concentration (mg/l)	0.032
Water Leaching Test Scaling Factor	4.0
Retardation Factor in Stabilized Layer	3.5
Retardation Factor in Subgrade	3.5

Enter Aquifer Parameters:

Saturated Hydraulic Conductivity of Aquifer	3650	(m/yr)
Porosity of Aquifer	0.3	
Regional Hydraulic Gradient	1e-3	

Enter Expert Mode Parameters (Non-Default Built in):

Use Expert Mode? Yes No

Grid X	2.0	(m)
Grid Y	0.5	(m)
Grid Z	0.1	(m)
Time Step	0.4	(yr)
Horizontal Dispersivity above Groundwater	6e-3	(m)
Lateral Dispersivity above Groundwater	6e-3	(m)
Vertical Dispersivity above Groundwater	6e-2	(m)
Horizontal Dispersivity in Groundwater	2.1e-2	(m)
Lateral Dispersivity in Groundwater	2.1e-2	(m)

- Date input are similar to Module #1, except
 - Enter lateral grid space.
 - Enter lateral dispersivity.

Data Input Windows for Module #4 (Cont')

File Edit View History Bookmarks Tools Help

3D Water Leach Test

143.132.96.67/~wischleach/3dwlwt_B.html wang bin

Home Roadway Stabilization ▾ Embankment/Structural Fill Applications ▾ User Manual

3D Water Leach Test WisLEACH 2.0

Enter Output Parameters:

Do you want to get Max C at POC over time? Yes No

Where do you want to get Max C at POC (y direction)?

Do you want to get concentration at monitoring points? Yes No

What is Monitoring Wells Numbers (maximum 6)?

Input Monitoring Wells location:

Horizontal location (m)	Lateral location (m)	Vertical location (m)
<input type="text" value="0.0"/>	<input type="text" value="0.0"/>	<input type="text" value="6.0"/>
<input type="text" value="1.0"/>	<input type="text" value="0.0"/>	<input type="text" value="6.1"/>
<input type="text" value="2.0"/>	<input type="text" value="0.5"/>	<input type="text" value="6.5"/>
<input type="text" value="4.0"/>	<input type="text" value="0.0"/>	<input type="text" value="6.7"/>
<input type="text" value="2.0"/>	<input type="text" value="0.0"/>	<input type="text" value="3.0"/>
<input type="text" value="0.0"/>	<input type="text" value="0.0"/>	<input type="text" value="5.0"/>

Do you only want to get 2D contour? Yes No

Where do you want to get 2D C contour? (m)

What is total Number of Contour Plots (maximum 4)?

Input time for the contour plot (yr)

<input type="text" value="10"/>	<input type="text" value="30"/>
<input type="text" value="60"/>	<input type="text" value="80"/>

Input X/Y/Z axis intervals:

- Date input are similar to Module #1, except:
 - Enter lateral location for POC
 - Enter lateral location for MW locations
 - Enter lateral location for contours

Webpage to Visualize Model Output for Module #4

File Edit View History Bookmarks Tools Help

3D Water Leach Test (base)

143.132.96.67/~wischleach/3dwtl_B.html

Home Roadway Stabilization Embankment/Structural Fill Applications User Manual

3D Water Leach Test

WISLEACH 2.0

The screenshot displays the Wisleach 2.0 web interface. At the top, there is a navigation menu with 'Home', 'Roadway Stabilization', 'Embankment/Structural Fill Applications', and 'User Manual'. The main content area is titled '3D Water Leach Test'. On the left, there is a graph showing 'Effluent Concentration (mg/l)' vs 'Time (yr)' with multiple curves for different X-axis intervals (X6, X5, X4, X3, X2, X1). Below this graph, there are input fields for 'Y-axis interval' and 'Z-axis interval'. In the center, there is a graph showing 'Depth below Pavement Surface (m)' vs 'Maximum Concentration (mg/l)'. On the right, there is a contour plot titled 'Concentration distribution at 80-year' showing 'Depth (m)' vs 'X (m)' with a color scale for concentration 'C (mg/l)' ranging from 1e-09 to 9e-09. At the bottom, there is a 'Visualize Model Output:' section with a dropdown menu set to 'Contour shaded for 80year' and a 'GO' button. Arrows point from the 'Visualize Model Output:' section to the various plots.

Effluent Concentration (mg/l)

Time (yr)

Y-axis interval (put a comparable interval with setting):

Z-axis interval (put a comparable interval with setting):

RUN MODEL

Visualize Model Output:

Contour shaded for 80year GO

Concentration distribution at 80-year

Depth (m)

X (m)

C (mg/l)

9e-09

8e-09

7e-09

6e-09

5e-09

4e-09

3e-09

2e-09

1e-09

CONTOUR FROM 10^{-9} TO $9 \cdot 10^{-9}$ BY 10^{-9}

After simulation, results can be plotted and saved as separated file.

Module #5: Roadway Stabilization (3D model) - Column Leach Test – Adsorption Controlled

- Select the menu/Roadway Stabilization/3D Model/Column Leach Test – Adsorption Controlled



A computing tool to evaluate groundwater impacts from beneficial use of industrial byproducts in roadway stabilization and embankment/structural fill applications. The tool is based on three analytical solutions to the advection-dispersion-reaction equation that describe transport in the vadose zone and groundwater. The application was designed to be computationally efficient and can be used without experience in numerical modeling. © 2011. Developed by Dr. Lin Li at Jackson State University.

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Contact Information for Q & A:

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Acknowledgement: Financial support for the development of WiscLeach software was provided by the Recycled Materials Resource Center and Wisconsin Department of Natural Resources Waste Reduction and Recycling Demonstration Grant and Alliant Energy.

Initial Webpage After Launching Module #5

File Edit View History Bookmarks Tools Help

3D Column Leach Test--absorp... +

143.132.96.67/~wischleach/3dclt_AC_B.html

Home Roadway Stabilization ▾ Embankment/Structural Fill Applications ▾ User Manual

3D Column Leach Test - Adsorption Controlled

WisCLEACH 2.0

Enter Site Parameters:

Point of Compliance (m)

Pavement Width (m)

Shoulder Width (m)

Lateral CCRs Half Width in y-direction (m)

Depth to Groundwater (m)

Depth to Top of Stabilized Layer (m)

Depth to Bottom of Stabilized Layer (m)

Infiltration Rate (m/yr)

Maximum Simulation Time (yr)

Enter Hydraulic Properties above Groundwater Table:

	Pavement	Base	Stabilized Layer	Subgrade
Hydraulic Conductivity (m/yr)	<input type="text" value="18.25"/>	<input type="text" value="3650"/>	<input type="text" value="0.19"/>	<input type="text" value="1.0"/>
Porosity	<input type="text" value="0.35"/>	<input type="text" value="0.35"/>	<input type="text" value="0.35"/>	<input type="text" value="0.35"/>

Enter Contaminant Properties:

Contaminant Name

Initial Effluent Concentration from CLT test(mg/l)

Scaling Factor (Default=1)

Retardation Factor in Stabilized Layer

Retardation Factor in Subgrade

Enter input data

The diagram shows a 3D perspective of a pavement structure. From top to bottom, the layers are: Base, Pavement, Industrial byproduct material, and Subgrade. A coordinate system (x, y, z) is shown. Key parameters labeled include: W_s (shoulder width), W_p (pavement width), W_b (base width), z_T (depth to top of stabilized layer), z_B (depth to bottom of stabilized layer), and z_{GWT} (depth to groundwater table). Below the subgrade, the vadose zone is shown with 'Vadose Zone Flow & Transport' and the groundwater table is shown with 'Ground Water Table (GWT)'. Arrows indicate 'Ground Water Flow' and 'Ground Water Transport' towards a 'Point of Compliance (POC)' on the right.

Conceptual model in Module #5

Data Input Windows for Module #5

File Edit View History Bookmarks Tools Help

3D Column Leach Test--absorp... +

143.132.96.67/~wischleach/3dclt_AC_B.html

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3D Column Leach Test - Adsorption Controlled

WISCLEACH 2.0

Enter Site Parameters:

Point of Compliance (m)

Pavement Width (m)

Shoulder Width (m)

Lateral CCRs Half Width in y-direction (m)

Depth to Groundwater (m)

Depth to Top of Stabilized Layer (m)

Depth to Bottom of Stabilized Layer (m)

Infiltration Rate (m/yr)

Maximum Simulation Time (yr)

Enter Hydraulic Properties above Groundwater Table:

	Pavement	Base	Stabilized Layer	Subgrade
Hydraulic Conductivity (m/yr)	<input type="text" value="18.25"/>	<input type="text" value="3650"/>	<input type="text" value="0.19"/>	<input type="text" value="1.0"/>
Porosity	<input type="text" value="0.35"/>	<input type="text" value="0.35"/>	<input type="text" value="0.35"/>	<input type="text" value="0.35"/>

Enter Contaminant Properties:

Contaminant Name

Initial Effluent Concentration from CLT test(mg/l)

Scaling Factor (Default=1)

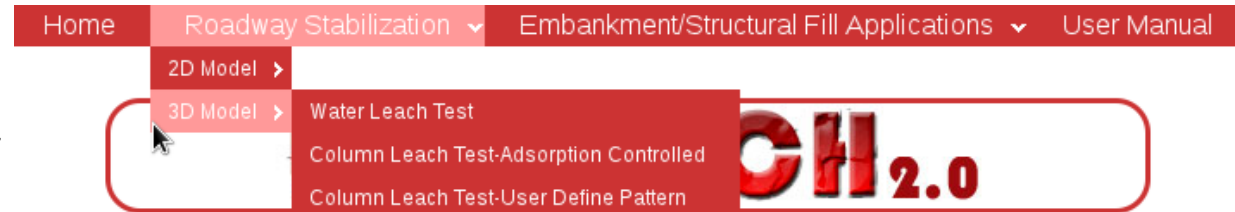
Retardation Factor in Stabilized Layer

Retardation Factor in Subgrade

- Date input are similar to Module #4, except:
 - For column leach test – adsorption controlled module, enter column leaching data where adsorption-controlled release can be assumed with instantaneous linear and reversible sorption.

Module #6: Roadway Stabilization (3D model) - Column Leach Test – User Defined Pattern

- Select the menu/Roadway Stabilization/3D Model/Column Leach Test – User Defined Pattern



A computing tool to evaluate groundwater impacts from beneficial use of industrial byproducts in roadway stabilization and embankment/structural fill applications. The tool is based on three analytical solutions to the advection-dispersion-reaction equation that describe transport in the vadose zone and groundwater. The application was designed to be computationally efficient and can be used without experience in numerical modeling. © 2011. Developed by Dr. Lin Li at Jackson State University.

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Initial Webpage After Launching Module #6

Enter input data

File Edit View History Bookmarks Tools Help

3D Column Leach Test--user D... 143.132.96.67/~wischleach/3dclt_UD_B.html

Home Roadway Stabilization Embankment/Structural Fill Applications User Manual

3D Column Leach Test--User Defined Pattern WISCLEACH 2.0

Enter Site Parameters:

Point of Compliance (m)

Pavement Width (m)

Shoulder Width (m)

Lateral CCRs Half Width in y-direction (m)

Depth to Groundwater (m)

Depth to Top of Stabilized Layer (m)

Depth to Bottom of Stabilized Layer (m)

Infiltration Rate (m/yr)

Maximum Simulation Time (yr)

Enter Hydraulic Properties above Groundwater Table:

	Pavement	Base	Stabilized Layer	Subgrade
Hydraulic Conductivity (m/yr)	<input type="text" value="1.0"/>	<input type="text" value="3650"/>	<input type="text" value="0.3135"/>	<input type="text" value="0.90"/>
Porosity	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>

Enter Contaminant Properties:

Contaminant Name

Input value of data points (C - mg/l vs t - yrs)
time(yrs) [space] c(t)

```
0.01 0.032
0.54 0.004
0.64 0.00313
0.72 0.004
0.87 0.0032
1.05 0.0021
```

Conceptual model in Module #6

Data Input Windows for Module #6

File Edit View History Bookmarks Tools Help

3D Column Leach Test--user D... +

143.132.96.67/~wischleach/3dclt_UD_B.html

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3D Column Leach Test--User Defined Pattern

WISCHLEACH 2.0

Enter Contaminant Properties:

Contaminant Name

Input value of data points (C - mg/l vs t - yrs)

time(yrs)	[space]	c(t)
0.01	0.032	
0.54	0.004	
0.64	0.00313	
0.72	0.004	
0.87	0.0032	
1.05	0.0021	
2.77	0.00169	
2.89	0.001	
3.69	0.0006	
4.04	0.0005	
4.62	0.0007	
4.72	0.00023	
100	0.0	

Do you want to continue to run WischLeach without more column leach data? Yes No

Retardation Factor in Stabilized Layer (Default = 1)

Retardation Factor in Subgrade (Default = 1)

Enter Aquifer Parameters:

- Date input are similar to Module #4, except:
 - For column leach test – user defined pattern module, enter leachate concentrations at various time.

Module #7: Embankment/Structural Fill Applications (3D model) - Water Leach Test



A computing tool to evaluate groundwater impacts from beneficial use of industrial byproducts in roadway stabilization and embankment/structural fill applications. The tool is based on three analytical solutions to the advection-dispersion-reaction equation that describe transport in the vadose zone and groundwater. The application was designed to be computationally efficient and can be used without experience in numerical modeling. © 2011. Developed by Dr. Lin Li at Jackson State University.

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Jackson, MS 39217-0168, US

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- **Select the menu/Embankment/Structural Fill Applications/3D Model/Water Leach Test**

Initial Webpage After Launching Module #7

Enter input data



Water Leach Test for Embankment/Structural Fill Applications

Enter Site Parameters:

Point of Compliance	<input type="text" value="30.0"/>	(m)
Pavement Width	<input type="text" value="6.0"/>	(m)
Shoulder Width	<input type="text" value="4.0"/>	(m)
Lateral Byproduct Half Width in y-direction	<input type="text" value="0.5"/>	(m)
Depth to Groundwater	<input type="text" value="10.0"/>	(m)
Depth to Top of Byproduct Layer	<input type="text" value="1.0"/>	(m)
Depth to Bottom of Byproduct	<input type="text" value="4.0"/>	(m)
Depth to Ground Surface	<input type="text" value="5.0"/>	(m)
Embankment Side Slope H:V	<input type="text" value="3.00"/>	(m)
Infiltration Rate	<input type="text" value="0.19"/>	(m/yr)
Maximum Simulation Time	<input type="text" value="300.0"/>	(yr)

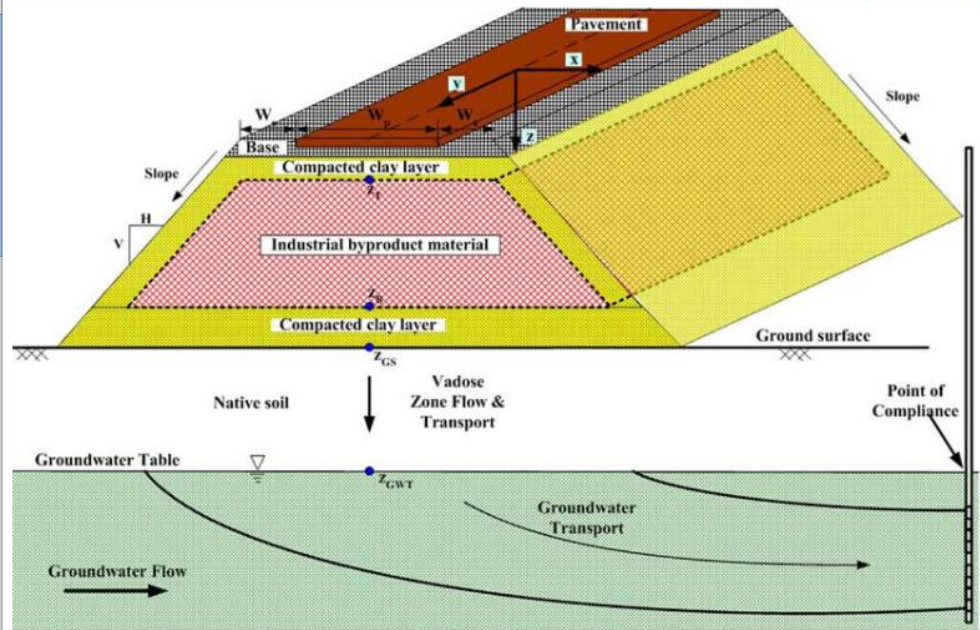
Embankment data

Enter Hydraulic Properties above Groundwater Table:

	Pavement	Base	Compact Clay Layer	Byproduct Layer	Subgrade
Hydraulic Conductivity (m/yr)	<input type="text" value="18.25"/>	<input type="text" value="3650"/>	<input type="text" value="0.042"/>	<input type="text" value="1.0"/>	<input type="text" value="3.56"/>
Porosity	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>

Enter Contaminant Properties:

Contaminant Name	<input type="text" value="Cadmium"/>
Are byproducts in different layers?	<input type="radio"/> Yes <input type="radio"/> No



Conceptual model in Module #7

Data Input Windows for Module #7 (Cont')

Enter Contaminant Properties:

Contaminant Name: Cadmium

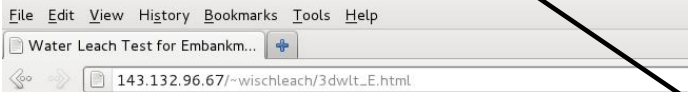
Are byproducts in different layers? Yes No

Water Leaching Test Effluent Concentration (mg/l): 0.032

Water Leaching Test Scaling Factor: 1.0

Retardation Factor in Compacted Clay Layer: 3.5

Retardation Factor in Byproduct Layer: 3.5



Enter Contaminant Properties:

Contaminant Name: Cadmium

Are byproducts in different layers? Yes No

Provide Co for each Δz layer

0.032
0.032
0.032
0.032
0.032
0
0
0
0
0
00.032
0.032
0.032
0.032
0.032
0
0
0
0
00.032
0.032
0.032
0.032
0.032
0
0

Retardation Factor in Compacted Clay Layer: 3.5

Retardation Factor in Byproduct Layer: 3.5

Retardation Factor in Subgrade: 3.5

Enter Aquifer Parameters:

- Date input are similar to Module #4, except
 - Select the byproducts in different layer. If “No”, the byproducts is in one layer. Enter the WLT concentration and scaling factor.
 - If “Yes”, the byproducts are in different layers. Enter WLT concentration in each Δz layer.

Data Input Windows for Module #7 (Cont')

File Edit View History Bookmarks Tools Help

Water Leach Test for Embankm... +

143.132.96.67/~wischleach/3dwl/E.html wang bin

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Water Leach Test for Embankment/Structural Fill Applications WisLEACH 2.0

Enter Output Parameters:

Do you want to get Max C at POC over time? Yes No

Where do you want to get Max C at POC (y direction)?

Do you want to get concentration at monitoring points? Yes No

What is Monitoring Wells Numbers (maximum 6)?

Input Monitoring Wells location:

Horizontal location (m)	Lateral location (m)	Vertical location (m)
<input type="text" value="0.0"/>	<input type="text" value="0.0"/>	<input type="text" value="6.5"/>
<input type="text" value="10.0"/>	<input type="text" value="0.0"/>	<input type="text" value="11.1"/>
<input type="text" value="2.0"/>	<input type="text" value="0.5"/>	<input type="text" value="11.5"/>
<input type="text" value="4.0"/>	<input type="text" value="0.0"/>	<input type="text" value="11.7"/>
<input type="text" value="0.0"/>	<input type="text" value="0.8"/>	<input type="text" value="4.0"/>
<input type="text" value="0.0"/>	<input type="text" value="0.8"/>	<input type="text" value="5.0"/>

Do you only want to get 2D contour? Yes No

Where do you want to get 2D C contour? (m)

What is total Number of Contour Plots (maximum 4)?

Input time for the contour plot (yr)

Input X/Y/Z axis intervals:

X-axis interval(put a comparable interval with model) (m)

- Date input are similar to Module #4, except:
 - Enter lateral location for POC
 - Enter lateral location for MW locations
 - Enter lateral location for contours

Webpage to Visualize Model Output for Module #7

File Edit View History Bookmarks Tools Help

Water Leach Test for Embankm... +

wang bin

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Structural Fill Applications

WISLEACH 2.0

Effluent Concentration (mg/l)

Time (yr)

Legend: X1, X2, X3, X4, X5, X6

11.1

11.5

11.7

Input time for the contour plot (yr)

Input X/Y/Z axis intervals:

X-axis interval (put a comparable interval setting):

Y-axis interval (put a comparable interval setting):

Z-axis interval (put a comparable interval with model setting):

(m)

Visualize Model Output:

Contour shaded for 150 year

Depth below Pavement Surface (m)

Maximum Concentration (mg/l)

Concentration distribution at 150-year

Depth (m)

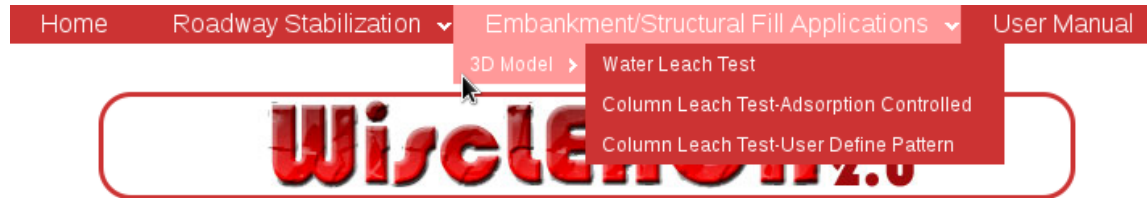
X (m)

C (mg/l)

CONTOUR FROM .1 TO .9 BY .1

After simulation, results can be plotted and saved as separated file.

Module #8: Embankment/Structural Fill Applications (3D model) - Adsorption Controlled



A computing tool to evaluate groundwater impacts from beneficial use of industrial byproducts in roadway stabilization and embankment/structural fill applications. The tool is based on three analytical solutions to the advection-dispersion-reaction equation that describe transport in the vadose zone and groundwater. The application was designed to be computationally efficient and can be used without experience in numerical modeling. © 2011. Developed by Dr. Lin Li at Jackson State University.

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- **Select the menu/Embankment/Structural Fill Applications/3D Model/Adsorption Controlled**

Initial Webpage After Launching Module #8

File Edit View History Bookmarks Tools Help

Column Leach Test--adsorption... +

143.132.96.67/~wischleach/3dclt_AC_E.html

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Column Leach Test - Adsorption Controlled for Embankment/Structural Fill Applications

WisLEACH 2.0

Enter Site Parameters:

Point of Compliance (m)

Pavement Width (m)

Shoulder Width (m)

Lateral Byproduct Half Width in y-direction (m)

Depth to Groundwater (m)

Depth to Top of Byproduct Layer (m)

Depth to Bottom of Byproduct (m)

Depth to Ground Surface (m)

Embankment Side Slope H:V (m)

Infiltration Rate (m/yr)

Maximum Simulation Time (yr)

Enter Hydraulic Properties above Groundwater Table:

	Pavement	Base	Compact Clay Layer	Byproduct Layer	Subgrade
Hydraulic Conductivity (m/yr)	<input type="text" value="18.25"/>	<input type="text" value="3650"/>	<input type="text" value="0.042"/>	<input type="text" value="1.0"/>	<input type="text" value="3.56"/>
Porosity	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>

Enter Contaminant Properties:

Contaminant Name

Are byproducts in different layers? Yes No

Initial Effluent Concentration from CLT test (mg/l)

Enter input data

Conceptual model in Module #8

Data Input Windows for Module #8

File Edit View History Bookmarks Tools Help

Column Leach Test--adsorption... +

143.132.96.67/~wischleach/3dclt_AC_E.html

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Column Leach Test - Adsorption Controlled for Embankment/Structural Fill Applications

WISCLEACH 2.0

Enter Contaminant Properties:

Contaminant Name

Are byproducts in different layers? Yes No

Initial Effluent Concentration from CLT test (mg/l)

Scaling Factor (Default = 1)

Retardation Factor in Compacted Clay Layer (Default = 1)

Retardation Factor in Byproduct Layer (Default = 1)

Retardation Factor in Subgrade (Default = 1)

Enter Aquifer Parameters:

Saturated Hydraulic Conductivity of Aquifer (m/yr)

Porosity of Aquifer

Regional Hydraulic Gradient

Enter Expert Mode Parameters (Non-Default Built in):

Use Expert Mode? Yes No

Grid X (m)

Grid Y (m)

Grid Z (m)

Time Step (yr)

Horizontal Dispersivity above Groundwater (m)

Lateral Dispersivity above Groundwater (m)

- Date input are similar to Module #7, except:
 - For column leach test – adsorption controlled module, enter column leaching data where adsorption-controlled release can be assumed with instantaneous linear and reversible sorption.

Module #9: Embankment/Structural Fill Applications (3D model) - User Defined Pattern



A computing tool to evaluate groundwater impacts from beneficial use of industrial byproducts in roadway stabilization and embankment/structural fill applications. The tool is based on three analytical solutions to the advection-dispersion-reaction equation that describe transport in the vadose zone and groundwater. The application was designed to be computationally efficient and can be used without experience in numerical modeling. © 2011. Developed by Dr. Lin Li at Jackson State University.

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- **Select the menu/Embankment/Structural Fill Applications/3D Model/User Defined Pattern**

Initial Webpage After Launching Module #9

File Edit View History Bookmarks Tools Help

Column Leach Test--User Defin... Google

Home Roadway Stabilization ▾ Embankment/Structural Fill Applications ▾ User Manual

Column Leach Test--User Defined for Embankment/Structural Fill Applications

WiscLEACH 2.0

Enter Site Parameters:

Point of Compliance (m)

Pavement Width (m)

Shoulder Width (m)

Lateral Byproduct Half Width in y-direction (m)

Depth to Groundwater (m)

Depth to Top of Byproduct Layer (m)

Depth to Bottom of Byproduct (m)

Depth to Ground Surface (m)

Embankment Side Slope H:V (m)

Infiltration Rate (m/yr)

Maximum Simulation Time (yr)

Enter Hydraulic Properties above Groundwater Table:

	Pavement	Base	Compact Clay Layer	Byproduct Layer	Subgrade
Hydraulic Conductivity (m/yr)	<input type="text" value="18.25"/>	<input type="text" value="3650"/>	<input type="text" value="0.2"/>	<input type="text" value="1.0"/>	<input type="text" value="3.56"/>
Porosity	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>

Enter Contaminant Properties:

Contaminant Name

Input value of data points (C - mg/l vs t - yrs)
 time(yrs) [space] c(t)

Enter input data

Conceptual model in Module #9

Data Input Windows for Module #9

File Edit View History Bookmarks Tools Help

Column Leach Test--User Defin... +

143.132.96.67/~wischleach/3dclt_UD_E.html

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Column Leach Test--User Defined for Embankment/Structural Fill Applications **WISCLEACH 2.0**

Enter Contaminant Properties:

Contaminant Name

Input value of data points (C - mg/l vs t - yrs)
time(yrs) [space] c(t)

0.01	0.032
0.54	0.004
0.64	0.00313
0.72	0.004
0.87	0.0032
1.05	0.0021
2.77	0.00169
2.89	0.001
3.69	0.0006
4.04	0.0005
4.62	0.0007
4.72	0.00023
100	0.0

Do you want to continue to run WischLeach without more column leach data? Yes No

Retardation Factor in Compacted Clay Layer (Default = 1)

Retardation Factor in Byproduct Layer (Default = 1)

Retardation Factor in Subgrade (Default = 1)

Enter Aquifer Parameters:

- Date input are similar to Module #7, except:
 - For column leach test – user defined pattern module, enter leachate concentrations at various time.

Software Developers

- The algorithms used in WiscLEACH[©] 2.0 were developed by Dr. Lin Li of Jackson State University.
- The web-based WiscLEACH[©] 2.0 were developed by Dr. Lin Li, Dr. Duanjun Lu, and Ms. Cindy Mei Wu of Jackson State University.

Publications on WiscLEACH[©]

- **Li, L.**, B. Peng, F. Santos, Y. Li, and F. Amini, 2011, Groundwater Impacts from Leaching of Coal Combustion Products in Roadways Embankment Constructions, *Journal of ASTM International*, 8(8): 1-12.
- Cetin, B., Aydilek, A. and **L. Li**, 2011, Experimental and Numerical Analysis of Metal Leaching from Fly Ash Amended Highway Bases, *Resources, Conservation & Recycling*, In Print.
- Cetin, B., Aydilek, A. and **L. Li**, 2011, Leaching of Chromium Metal from High Carbon Fly Ash Stabilized Highway Base Layers, *Geo-Frontiers 2011*, 1066-1074, ASCE.
- **Li, L.**, J. Li, and N. Kebede, 2010, Using WiscLEACH to Estimate Groundwater Impacts from Fly Ash Stabilized Layers in Roadways, *GeoFlorida 2010: Advances in Analysis, Modeling & Design*, D. Fratta, A. Puppala, B. Muhunthan (Eds), 199: 99-108, ASCE.
- **Li, L.**, C.H. Benson, T. B. Edil, and B. Hatipoglu, 2006, Groundwater Impact from Coal Ash in Highways, *Waste and Resource Management*, 159(4): 151-162.
- **Li, L.**, C.H. Benson, T. B. Edil, and B. Hatipoglu, 2006, WiscLEACH: A Model for Predicting Ground Water Impacts from Fly-Ash Stabilized Layers in Roadways, *Geotechnical Engineering in the Information Technology Age*, DeGroot, D.J., DeJong, J.T., Frost, D.J., Baise, L.G. (Eds), 187(58): 1-8, ASCE.