13. Hands-on exercise: Estimating subcatchment attributes based on land-use and soils layers

This exercise illustrates how to estimate subcatchment attributes from land-use and soils layers, including the directly connected impervious area, depression storage and Manning's coefficients. This chapter is the fourth of five chapters using the Valleyfield modeling data.

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13. Hands-on Exercise: Estimating subcatchment attributes based on land-use and soils layers

This example illustrates the steps a planner or engineer may consider if there was a change in the subdivision design to incorporate a small park. In this example, 8 of the subcatchment attributes will be calculated based on a land-use and soils map.

Normally the user would re-discretize subcatchments however, for simplicity sake, this example uses the same subcatchment discretization created in earlier Valleyfield exercises.

Subcatchment attributes can be calculated based on a land-use layer. User-defined attributes matching those in the subcatchment layer can be added to a land-use layer in order to obtain an area-weighted average of the subcatchment parameters. In this section the user-defined attributes IMPERV, NIMPERV, NPERV, PSPERV and DSIMPERV have already been added to the land-use layer for you.

Another approach for estimating SWMM attributes is through the use of look-up tables. In the second part of this exercise we will estimate subcatchment infiltration using a soils layer in combination with a look-up table.

This section is to track your individual progress and document your experience completing the exercise. Please fill out your start and stop times and note if you found the exercise helpful. You are also encouraged to provide any other comments regarding this exercise.

Start Time: _____

Finish Time: _____

Duration: _____

Sections completed (please check):

- ☐ *13.1*
- ☐ *13.2*
- ☐ *13.3*
- ☐ *13.4*

How beneficial did you find this exercise?

(1) Very beneficial *(2) Somewhat beneficial* *(3) Not beneficial*

Additional comments:

13.0 Outline of this design *exercise*

13.1 Rendering a land-use map

1. Launch PCSWMM and click the **Open**  button in the toolbar.
2. Click **Browse…**  in the **Project Browser** dialog.
3. Browse to the folder **PCSWMM Exercises\PCSWMM-13\Initial** and open **Valleyfield to-be pond.inp** file completed in a previous exercise. (If you were unable to complete the exercise open **Valleyfield to-be pond-solution.inp** and click on the **Run**  button).
4. In the **Project Panel** click **File** and select **Save Project As...**
5. Change the name of the project to **Valleyfield Area-weighting** and click **Save.**
6. If layer **H64020_r14_Residential** is still listed in the **Layers Panel**, highlight it and click the **Close layer**  button to close the layer.
7. Click the **Open layer**  button in the **Map panel**.
8. Click on the **Browse** button and browse to the folder **PCSWMM Exercises\PCSWMM-13\Initial**.
9. Select two files (holding the **Ctrl** key down) **H64020_r14_Park.dxf** and **Land-Use Valleyfield.shp** and click on the **Open** button.
10. In the **Layers Panel** arrange the layers (by dragging-and-dropping) as shown below.

It is a good habit to render a layer based on the attribute of interest. In this case the actual assigned land-use is of greatest interest.

11. Click on the **Render**  button in the **Map Panel**.
12. Select the **Land-Use layer Valleyfield** layer from the list of layers.
13. Under the **General** section slide the **Transparency** slider bar to around 50%.
14. Under the **Thematic mapping** section set the **Attribute** to render to as **LAND_USE** and under the **Labeling** menu select **LAND_USE** and uncheck **Avoid overlap.**
15. Click **Apply** and then **Close**.

The **Map Panel** should look something like the illustration below (colors may vary).

13.2 Performing area-weighting from Land-use layer attributes

1. Open the **Tables Panel** and click on the **Tables**  button and select **Land-Use Valleyfield** from the menu.

Examine the values in the table. You should notice that there are 8 attributes, 5 of which we will use to calculate the subcatchment attributes.

	LAND_USE	IMPERV	NIMPERV	NPERV	DSPERV	DSIMPERV	GIS_LENGTH	GIS_AREA
▶	Transportation	90	0.015	0.3	3.81	1.9	3365.328947530963	25804.162332978987
	Residential	50	0.015	0.3	3.81	1.9	672.12110350193416	16780.029670450549
	Residential	50	0.015	0.3	3.81	1.9	289.57346747528288	3354.6641834884085
	Residential	50	0.015	0.3	3.81	1.9	610.68752066647687	9320.3137585770219
	Residential	50	0.015	0.3	3.81	1.9	710.11953935862721	14771.963979180582
	Residential	50	0.015	0.3	3.81	1.9	1110.4827978998503	31551.560304676623
	Open Space	0	0.015	0.3	5.08	1.9	253.00953986101465	3436.8572263420397
	Open Space	0	0.015	0.3	5.08	1.9	934.11385200073278	34026.958333324255
	Open Space	0	0.015	0.3	5.08	1.9	2596.1397605666734	295487.82422523655

Shown in SI units (US units will differ)

The 5 attributes that will be used for the area-weighting can be found in the table below:

Attribute Name	Attribute Definition
IMPERV	Imperv (%) - Percent of directly connected impervious area
NIMPERV	Mannings N for impervious area
NPERV	Mannings N for pervious area
DSPERV	Depth of depression storage on pervious area (mm)
DSIMPERV	Depth of depression storage on impervious area (mm)

Note
You should notice how the attributes are named. These names are the subcatchment field names recognized by PCSWMM. By having these attributes named with the subcatchment field names in the land-use map, the area-weighing tool will automatically recognize the attribute and match it with the same attribute in the subcatchments layer. Otherwise the user can manually select the matching layer attributes.

2. Click on the **Tools**  button in the toolbar of the **Map Panel** to open the **Tools Browser**.
3. Click on the **Area Weighting** tool (in the Subcatchments, Nodes and Conduits sections).
4. In the **Area Weighting** tool, set the **Data source layer** to **Land-Use Valleyfield** and the **Destination layer** to **Subcatchments.**
5. Click on the **Next** button.

The area weighting tool calculates the value of one or more attributes for entities in a polygon layer (e.g. the SWMM5 Subcatchments layer, or any other layer) by area-weighting matching attributes from the intersecting entities on a source polygon layer

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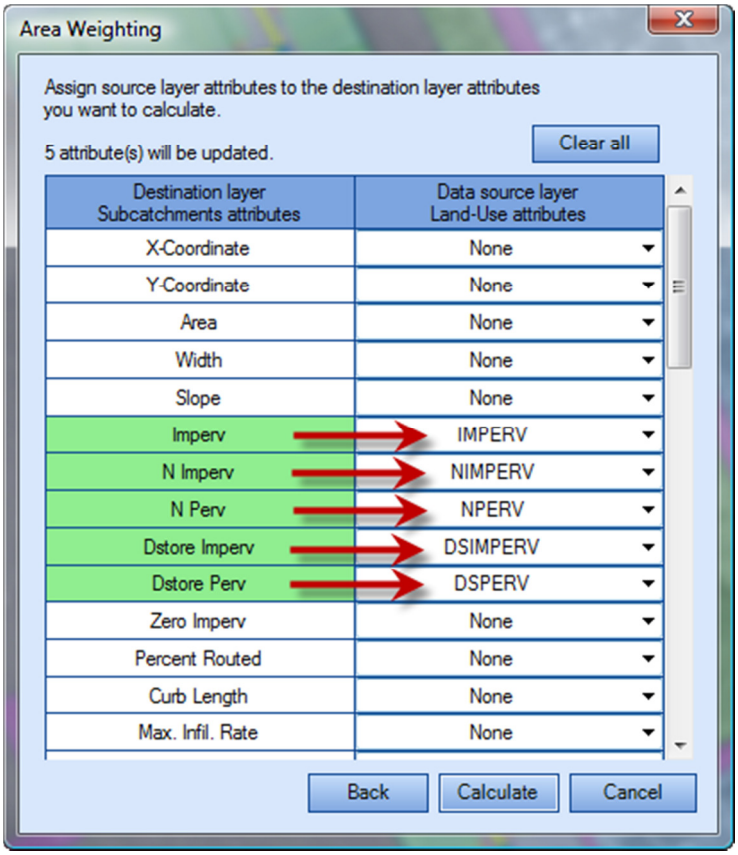
Note

The **Area Weighting** dialog will appear, displaying a table with two columns. The first column displays the destination layer attributes (**Subcatchment** attributes) while the second contains dropdown lists of the attributes in the data source layer (**Land-Use Valleyfield** attributes). Because the land-use attributes were named using subcatchment field names, the area-weighing tool should have already identified the 5 attributes that are to be used for the area-weighting calculation.

6. Ensure the destination layer (Subcatchment) attributes are properly matched with the data source layer (**Land-Use Valleyfield**) as shown below:



7. Click on the **Calculate** button to perform the area-weighting operation. A report should appear saying that 9 entities on the **Subcatchment** layer have been updated.

8. In the report, you should notice that for each of the subcatchments both the old and new values are displayed for each of the **subcatchment** attributes updated.

You will also notice, in the **Area weighing** report, the number of **Land-Use** components (polygons) located in the boundaries of each of the subcatchments. Also listed is the percentage of area for each component located in each subcatchment. The sum of these fractions should equal 1.0, meaning that 100% of the subcatchment area has been accounted for in the **Land-Use Valleyfield** layer.

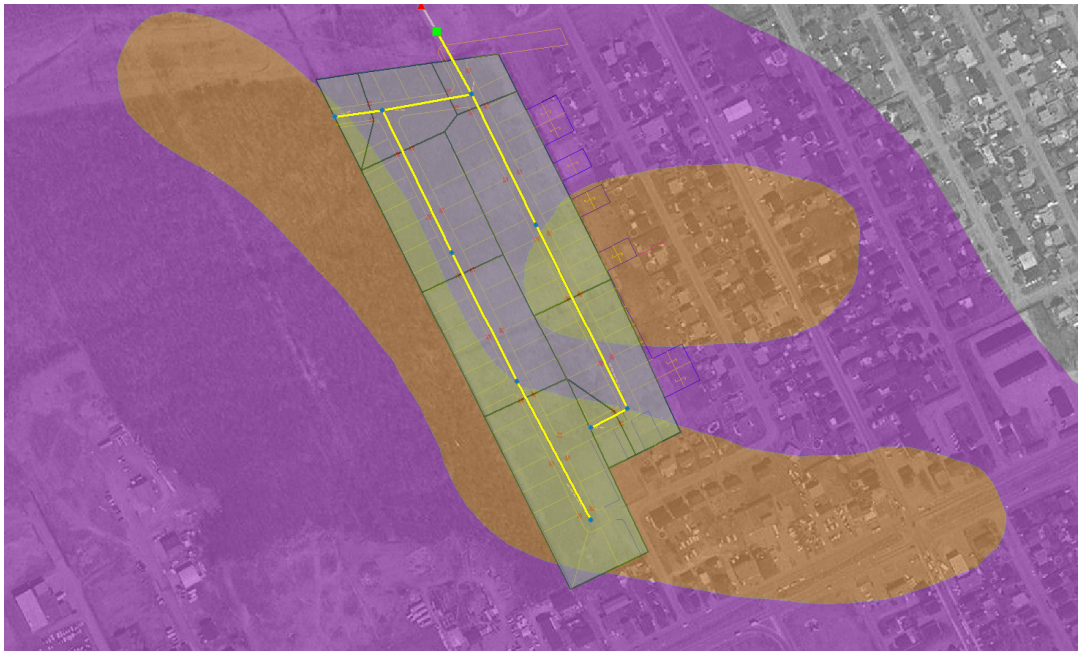
9. Click the **Close** button to close the report.
10. Click on a subcatchment and inspect the attributes to ensure they are reasonable.

13.3 Performing area-weighting from a soils layer with a look-up table

Soils layers commonly consist of the spatial distribution of soil types for a specific area. Soil layers can be valuable in setting up a SWMM model, as they allow for the infiltration properties for the subcatchments be estimated in setting up a SWMM model.

1. Click the **Open layer** button in the **Map panel**.
2. Click on the **Browse** button and open **PCSWMM Exercises\PCSWMM-13\Initial\Soils layer Valleyfield.shp.**

   The soils layer should look like the screen capture below (you may have to move the soils layer up in the layers list or un-check the Land-Use Valleyfield.shp layer).



3. Click on the **Soils layer Valleyfield** layer in the **Layers Panel** and click the **Lock/Unlock** button to unlock the layer.
4. Click on the **Table** tab to open the **Table Panel**.
   If the attributes for the **Soils layer Valleyfield** are not already being displayed, click the **Tables** button and select **Soils layer Valleyfield** (should be located close to the bottom of the layers list).

5. Examine the given attributes and notice the attributes provided including the **UNIT, ID, SOILTYPE** and **GIS** coordinates.

The infiltration type selected for the Valleyfield model was Green-Ampt. The Green-Ampt equations require three input attributes: **Suction Head** (Ψ), **Conductivity** (K) and **Initial Deficit** (WP).

13.4 Estimating subcatchment infiltration based on the soils layer

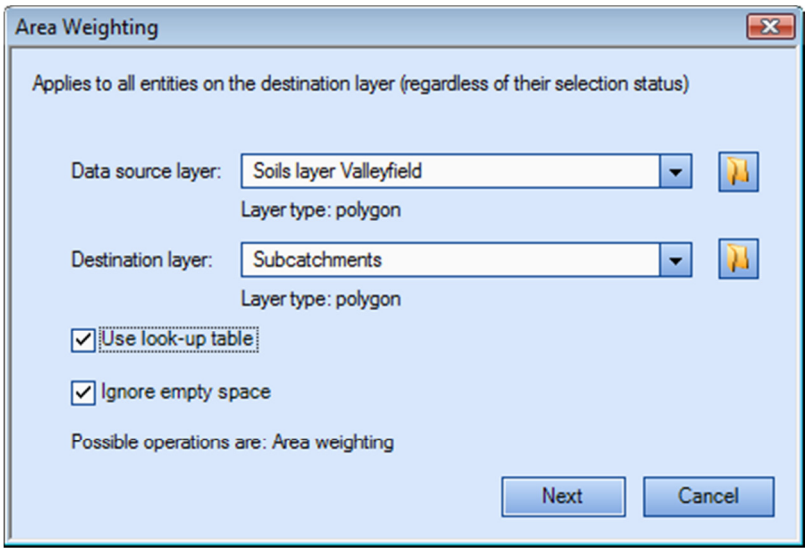
The subcatchment Green-Ampt infiltration attributes can be estimated using the soils layer in conjunction with a lookup table. This is also done using the **Area Weighting** tool.

The infiltration attributes required by the subcatchment layer are the **SUCTIONHEAD** (Suction head)**, CONDUCT** (Conductivity) and **INITDEFICIT** (initial deficit)**.**

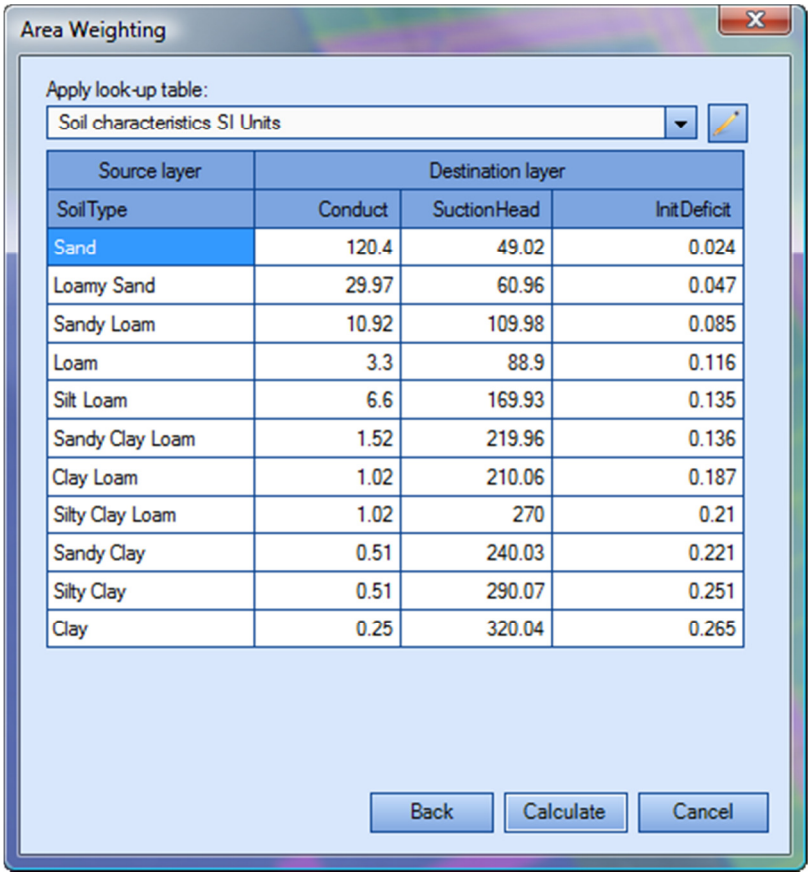
The area weighting tool will match up the attributes between the soils layer and the subcatchment layer.

The **Area Weighting** tool can be used to estimate the subcatchment infiltration attributes.

1. Click on the **Tools** button in the toolbar of the **Map Panel** to open the **Tools Browser**.
2. Click on the **Area Weighting** tool, (in the Subcatchments, Nodes and Conduits sections).
3. In the **Area Weighting** tool, set the **Data source layer** to **Soils layer Valleyfield** and the **Destination layer** to **Subcatchments.**
4. Place a checkmark next to the **Use look-up table** option.



5. Click on the **Next** button.
   At the top of the **Area weighting** dialog there is a look-up table drop down box. Select the **Soil characteristics SI** or **Soil characteristics US** depending on what units you are using. The **Area weighting** tool will display a table of default infiltration values for different soil types.



Note
The look-up table uses attributes that match the destination layer (i.e. SOILTYPE, CONDUCT, SUCTIONHEAD and INITDEFICIT). If the look-up table attribute names were not found in the destination layer an error message would have appeared in the **Area Weighting** dialog.

6. Click **Calculate** to perform the **Area-weighting** calculation with the selected look-up table.

The **Area weighing** report shows the number of **Soils layer Valleyfield** components (polygons) intersecting each subcatchment.

Also listed is the percentage of area for each component located in each subcatchment. The sum of these fractions should equal 1.0, meaning that 100% of the subcatchment area has been accounted for in the **Soils layer Valleyfield.**

7. Click the **Close** button to close the report.
8. In the **Map Panel**, select a subcatchment and inspect the Green Ampt Infiltration attributes to ensure they are reasonable.
9. Click on the **Run** button the model and check that the continuity results are reasonable.

13.5 Acknowledgements

CHI gratefully acknowledges the cooperation of the City of Salaberry-de-Valleyfield, Quebec, Canada for supplying some of the data files and problem.

13.6 Summary

If you were unable to complete this exercise the Valleyfield Area weighting-solution.inp files are provided in the Solution folder.