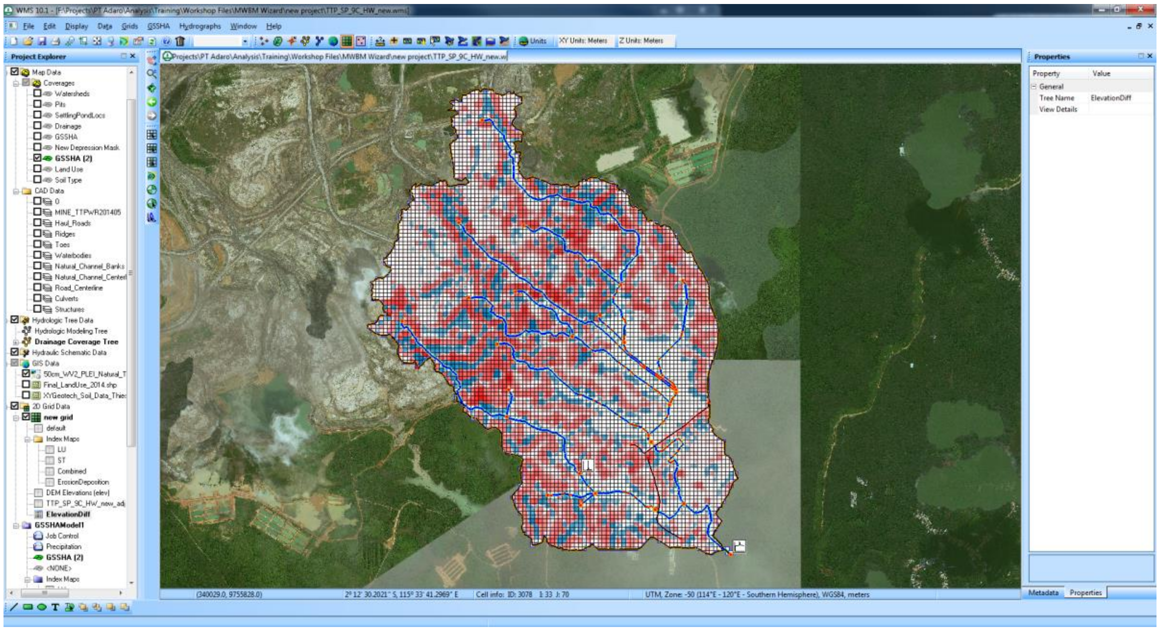
WMS

v. 10.1

WMS 10.1 Tutorial

Updating a GSSHA Model using the MWBM Wizard

Use the Mine Water Balance Modeling (MWBM) Wizard to update a GSSHA model



Objectives

This tutorial demonstrates how to import an existing GSSHA model and update the model with new terrain data, new land use and soil type data, new pumping information, new embankment information, new rainfall depths and a new particle size distribution.

Prerequisite Tutorials

- GSSHA – WMS Basics – Watershed Delineation using DEMs and 2D Grid Generation

Required Components

- Data
- Drainage
- Map
- Hydrology
- 2D Grid
- GSSHA

Time

- 30-60 minutes

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2 MWBM Wizard

The Mine Water Balance Modeling Wizard was designed to take an existing calibrated GSSHA model and automate the process of updating the model using a series of new inputs including new terrain, land use, and soil type information. The tool is meant to give engineers the ability to quickly predict runoff and sediment production in response to a rapidly changing watershed. This tutorial will demonstrate this process using actual data for a watershed near the Tutupan mine in South Kalimantan, Indonesia.

2.1 Launch the MWBM Wizard

1. Run WMS and click on the MWBM Wizard icon  on the top toolbar to launch the MWBM wizard

2.2 Open an Existing WMS Project File

The first step in the wizard is to open an existing WMS project file. This project should contain an existing calibrated GSSHA model. This model will become the basis for a revised model that incorporates updated data sources.

1. Click on the browse button  to browse for an existing WMS project file
2. Navigate to the MWBM Wizard folder in the Workshops directory and open the WMS project file named "*TTP_SP_9C_HW.wms*"

3. Click *OK* to read the land use table and *OK* again to read the soil type table. Click *OK* on any messages about missing shapefiles that may appear.

The MWBM wizard is a non-modal dialog, meaning the main WMS window and tools can be interacted with while the wizard is open. Notice the existing GSSHA model displayed in the WMS graphics window.

4. Click *Next* > to advance to the next step in the wizard

2.3 Define Model Changes

The next step in the wizard defines which changes to make to the model. For models where only minor changes will be made, check only a couple of the options that pertain to the changes they wish to make. For this example, assume that all the available model changes will be carried out.

1. Make sure that all the available model changes are toggled on
2. Click *Next* > to advance to the next step in the wizard

2.4 Update Elevation Data

The Elevation Data step of the wizard allows selecting an updated digital terrain dataset. The elevation dataset currently shown was the terrain dataset used to create the current model. Read in a new terrain dataset and select this as the new terrain data source for the model.

1. Click on the browse button  to browse for a new terrain data file.
2. In the *New Data Sources* folder, selec the *"Modified Terrain.asc"* file and click Open
3. Make sure the dataset projection is set to *UTM, Zone -50 (114°E - 120°E – Southern Hemisphere), WGS84, Meters* and click *OK*.
4. Once the dataset has loaded, make sure "*Modified Terrain"* is listed as the updated elevation data source

The next step would normally be to click the *Compute* button under the Flow directions/accumulations heading to compute flow directions and accumulations for the new terrain dataset. Since the terrain dataset for this tutorial is quite large, alternatively open pre-computed flow direction and flow accumulation grids stored with the workshop files.

5. In the main WMS window, scroll to the top of the *Project Explorer* and right-click on the *Modified Terrain* DEM listed under the *Terrain Data* heading and click *Open Flow Direction*
6. Choose the file named *"flowdir.tif"* and click Open
7. Right-click on the *Modified Terrain* DEM again and click *Open Flow Accumulation*
8. Choose the file named *"flowaccum.tif"* and click Open
9. Click *Next* >

2.5 Outlet Location

The next step is to define a new outlet location for the model. Do this graphically inside the WMS graphics window. But first, turn off the display of several data layers to make the graphics window less cluttered.

1. If present, toggle off the display of the two shapefiles listed under the GIS Data portion of the Project Explorer
2. Click the Frame macro to zoom to the model extents
3. Click the *Change Outlet Location* button and create a point anywhere downstream of the current watershed boundary by single clicking in the graphics window
4. Click *OK* on the warning that all drainage data in the Copy of Drainage coverage will be deleted and that the outlet is not inside a flow accumulation cell.
5. On the right-hand side of the WMS graphics window notice a Properties window. With the outlet point still selected, locate the *Feature Point X* and *Feature Point Y* fields and enter the following coordinates:

Feature Point X	*340553.29*
Feature Point Y	*9752143.81*

6. Click *Next >*

2.6 Delineate Watershed

The next step allows delineating a new watershed boundary from the updated digital terrain and outlet point location.

1. Click on the *Units…* button
2. Make sure the parameter units are set to *Square Kilometers* for Basin Areas and M*eters* for Distances
3. Click the *Drain Data Compute Opts…* button
4. Toggle off all the computation options that WMS allowed, except *Length*. All the others are not needed for GSSHA.
5. Click *OK* and *OK* again to return to the MWBM Wizard
6. Click the *Delineate Watershed* button to delineate the watershed
7. Notice the warning that the outlet point is not located in a flow accumulation cell. Move the outlet point slightly to meet this requirement. Click *OK*.
8. Right-click on the *Copy of Drainage* coverage and select *Zoom to Layer* to zoom to the outlet point.
9. Choose the Zoom tool and right-click inside the graphics window twice to zoom out enough to be able to see the blue flow accumulation cells
10. Choose the Select Feature Point/Node tool and click on the outlet point and move it to one of the nearest flow accumulation cells

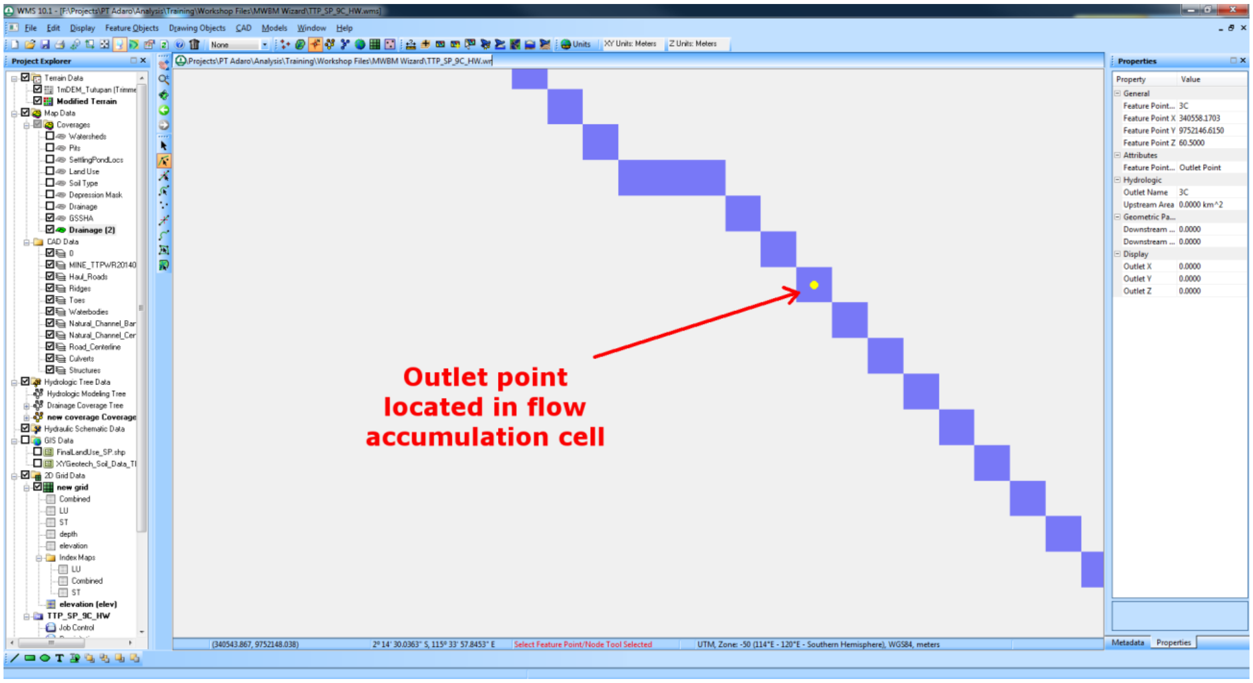


Figure 1 Outlet point moved to nearest flow accumulation cell

11. With the outlet point located inside a flow accumulation cell (Figure 1), click the *Delineate Watershed* button to delineate the watershed.

It may take a minute to delineate the watershed. WMS displays the progress of the watershed delineation at the bottom of the WMS window in red.

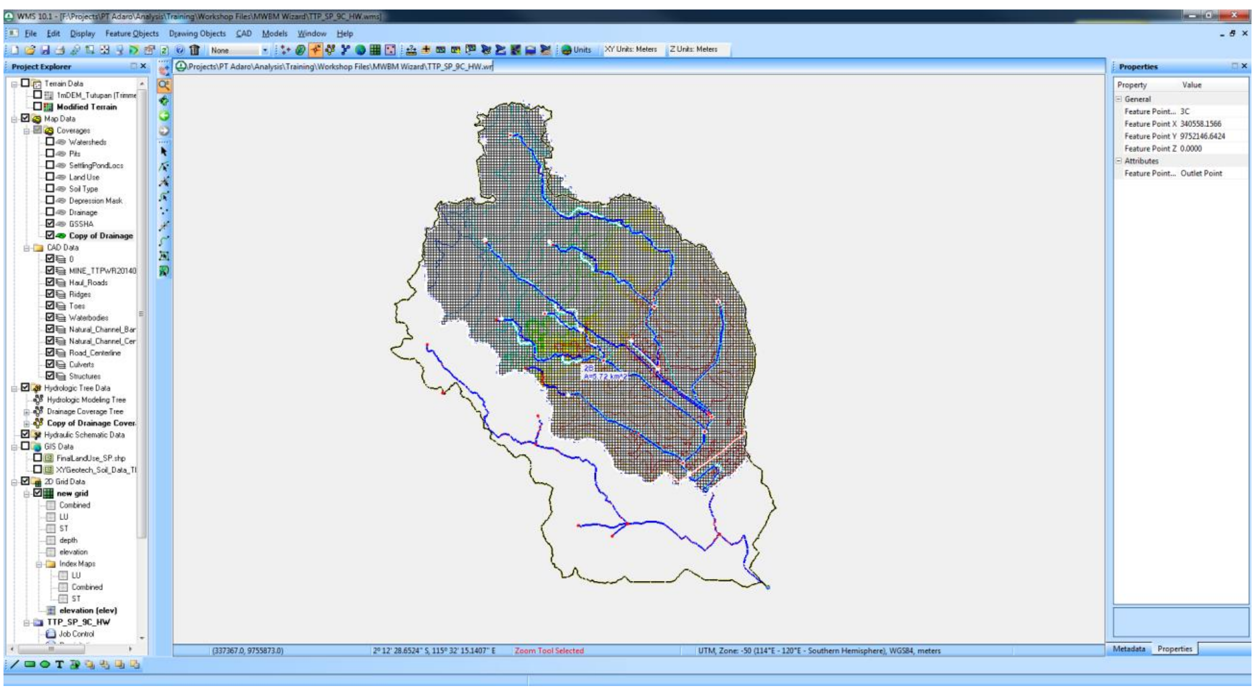


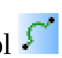
Figure 2 Revised Watershed Boundary

12. Click *Next>*

2.7 Create Depression Mask Coverage

Next define a new depression mask coverage. The depression mask coverage is used to identify lakes, ponds, and other important depressions that should be preserved in the terrain data. Without a depression mask, GSSHA will artificially fill all depressions to allow runoff to drain toward the watershed outlet.

The Depression Mask coverage created previously was converted from a Waterbodies layer in a CAD Data file. For this example, assume that the new watershed contains a new settling pond that was not part of the existing model. Open a CAD file containing the new settling pond and use this to create a new depression mask coverage.

1. In the main WMS window, select *File* | *Open* and in the *CAD* folder, open *"ExistingCAD_newPond.dwg"*
2. In the WMS window, toggle off the display of all the CAD layers except *Waterbodies*
3. In the Project Explorer, right-click on *ExistingCAD_newPond.dwg* under the *GIS Data* folder.
4. Select *CAD To* **| Feature Objects…**.
5. Change the *Coverage name* to *New Depression Mask* and click *OK*
6. Click *OK* on the Clean Options
7. Change the *Coverage type* dropdown to *GSSHA* and click *OK*
8. Click *Yes* if asked to renumber links
9. In the Project Explorer, toggle off the display of the DEMs, all coverages except the *Copy of Drainage* and the *New Depression Mask* coverage, the Waterbodies CAD layer, and the 2D Grid Data
10. With the *New Depression Mask* coverage selected, choose the *Select Feature Arc* tool 
11. Select *Edit* | *Select with Polygon*
12. Choose the *Enter a polygon interactively* option and click OK
13. Draw a polygon around all the waterbodies that lie outside the watershed boundary to select them and click *Delete*
14. Choose the *Create Feature Arc* tool 
15. Zoom in to each waterbody polygon and draw a small arc across any small gaps on the boundary polygons to close them

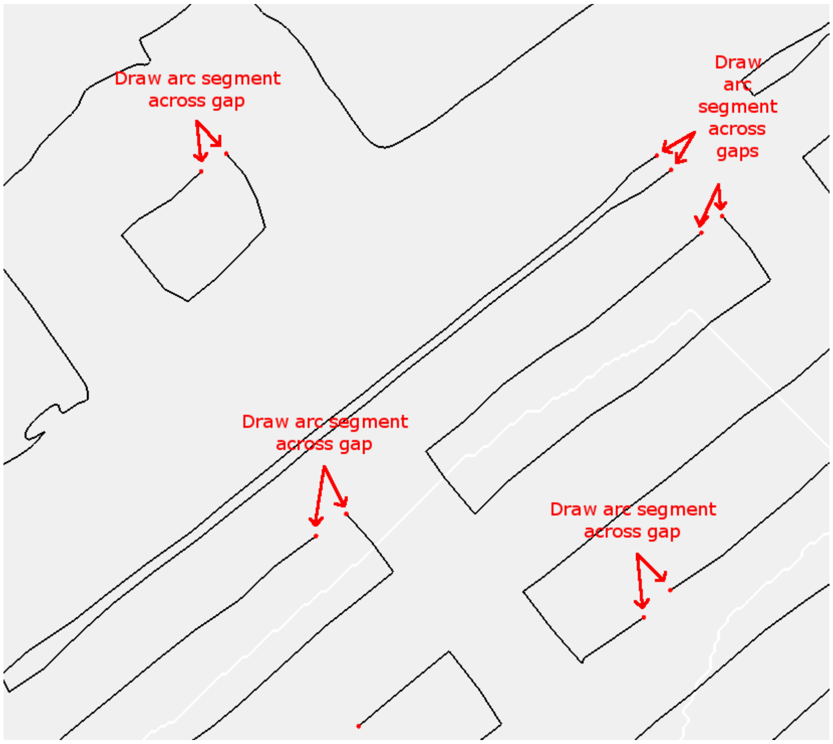


Figure 3 Gaps in Waterbody Polygons

16. Select *Feature Objects* | *Build Polygon*
17. Click *OK* to use all arcs
18. Choose the *Select Feature Polygon* tool and click and drag a box around all the waterbody polygons. All the polygons should be selected. If one or more polygons are not shown as being selected, then either the selection box was too small and needs to be reselected, or those waterbody polygons still have gaps that need to be filled. Be sure to fill all remaining gaps before continuing.
19. With all the waterbody polygons selected, select *Feature Objects* | *Attributes*
20. In the *GSSHA Polygon Attributes* dialog, change the *Polygon type* to *Depression Mask* and click *OK*

An updated Depression Mask coverage has been created that will be used in generating the GSSHA model.

21. In the Create 2D Grid step of the wizard, click the *Update Coverage Lists* button to refresh the list of Depression Mask coverages
22. Make sure the *Use a depression coverage* option is turned on and change the coverage shown in the drop down menu to *New Depression Mask*

2.8 Create 2D Grid

With the new drainage boundary defined and depression mask coverage created, create a 2D grid for the GSSHA model. There are three main components to the Create 2D Grid step. The first step is to set the cell size.

23. Notice the cell size is set to 20 m. This was the cell size used in the original model. Change the cell size to **25 m**.

Since the new model covers a larger area, changing the cell size to 30 will cause the run time to stay about the same as the previous model.

24. Make sure the *add structures from existing GSSHA coverage* option is turned on and that the coverage shown in the drop down menu is set to *GSSHA*.

This option ensures that all hydraulic structures contained in the previous GSSHA model will be transferred to the new GSSHA coverage that gets created when generating a new GSSHA grid. This includes all pumping nodes, embankment arcs, and reservoir nodes.

25. Click the *Create 2D Grid* button
26. Click *Yes* if asked to renumber links
27. Click *OK* to accept the default background interpolation options
28. Click *No* when asked to delete the background DEM

The Create 2D grid command performs several tasks. In addition to generating a 2D grid at the specified resolution, it also adjusts elevations along stream segments that lie outside a depression mask polygon to remove any adverse slopes. It also assigns generic channel attributes and, if specified, adds any hydraulic structures that were contained in the previous GSSHA model to the new GSSHA coverage.

29. Click *Next >*

2.9 GSSHA Parameters

The next step in the wizard allows specifying GSSHA land use and soil type parameters.

1. Click the *Read CMT File from Existing Project…* button. The CMT file is the GSSHA file containing land use and soil type parameters.
2. Choose the file named *"TTP_SP_9C_HW.cmt"* and click *Open*

The land use and soil parameters are populated from the existing GSSHA model. Notice some land use and soil type parameters that have missing values. This is caused by the fact that the land use and soil type coverages cover a much larger extent than the current model extents and have more land uses and soil types than are needed for this particular model. Since the model area has grown, there may be some additional land uses and soil types that were not included in the previous model. Address these issues later.

3. Click *Next >*

2.10 Define Land Use and Soil Data

Land use and soil data can be updated from updated shapefiles, generated as shown in a previous workshop.

1. Locate the *GIS Data* section of the *Project Explorer* and delete any shapefiles that may be shown there.
2. In the MWBM Wizard, click the *Add Shapefile* button to add new land use and soil type shapefiles

3. In the *New Data Sources* directory, open the *Land Use* folder and select *"Final_LandUse_2014.shp"* and click *Open*
4. Click the *Add Shapefile*  button again and in the *Soil Type* directory, select the *"XYGeotech_Soil_Data_Thiessen_poly_w_atts.shp"* file and click *Open*
5. Make sure the land use and soil type shapefiles are paired with the correct coverage types and click *Create Coverages*

The Create Coverages command creates new land use and soil type coverage and guides through the process of mapping shapes contained in the GIS shapefiles to WMS coverages and transferring relevant attributes. This will be done first for the land use shapefile and repeated for the soil type shapefile.

6. In the *GIS to Feature Objects Wizard* that opens, click *Next >*
7. In the *LU_CODE_1* column, change the Mapping drop down control to *Land use*.
8. In the *LU_DESC* column, change the Mapping drop down control to *Land Use Name*.
9. Click *Next >*
10. Click *Finish* to finish mapping the land use shapefile to a land use coverage
11. In the *GIS to Feature Objects Wizard* window, click *Next >*
12. Scroll through the attribute table and notice that WMS automatically recognizes several attribute columns and assigns WMS attributes by default. Be sure that *TEXTURE* is mapped to *Texture*, *KSAT* to *Hydraulic conductivity*, *MOISTURE* to *Initial Moisture*, *FIELDCAP* to *Field capacity*, and *WILTINGPT* to *Wilting point*.
13. Click *Next >*
14. Click *Finish* to finish mapping the soil type shapefile to a soil type coverage
15. Click *Next >* to advance to the next step in the MWBM Wizard

2.11 Create Index Maps and Populate Mapping Tables

Index maps are used to assign GSSHA parameters to the model domain. They are created by overlaying WMS coverages on top of a GSSHA grid to create polygonal regions that contain uniform properties. For this model, create three index maps: a land use index map, a soil type index map, and a combined land use and soil type index map.

1. In the first row of the Index Map spreadsheet, select *Land Use* as *Coverage 1* and enter *"LU"* as the index map name
2. In the second row of the Index Map spreadsheet, select *Soil Type* and *Coverage 1* and enter *"ST"* as the index map name
3. In the third row of the Index Map spreadsheet, select *Land Use* as *Coverage 1* and *Soil Type* as *Coverage 2*. Enter *"Combined"* as the index map name
4. Click the *Create Index Maps* button to generate the GSSHA Index Maps

Once the Index Maps are generated, WMS automatically assigns the new index maps to their respective GSSHA mapping tables. The land use index map is automatically assigned to the Roughness table, the soil type to index map to the Initial Moisture table and the combined soil type/land use index map to the Infiltration and Soil Erosion mapping tables.

5. In the *GSSHA Map Table Editor* dialog that opens, review the parameters shown on the *Roughness* tab. In this example, no new land uses were added. If this were the case, enter roughness values for the new land use(s) in this table
6. Switch to the *Infiltration* tab
7. All the soil and land use combinations have stayed the same except for two: *Clay and Land ID #1 Dump Areas* and *Silty clayey sand and Land ID #1 Dump Areas*. Enter infiltration parameters for this new combination manually. Based on the calibration results, the Hydraulic Conductivity for Dump Areas was found to be **1.5** cm/hr. Enter this value for Hydraulic Conductivity for the new combinations. For the rest of the infiltration parameters, use the starting parameters for the *Clay* and *Silty clayey sand* soil textures from Table 1.

Table 1 Infiltration Parameters based on Soil Texture

	KSAT	CAP HEAD	POROSITY	PORE DIST	RES SAT	FIELD CAP	WILTING PT
Clay	0.03	31.63	0.385	0.165	0.09	0.396	0.272
Clayey Sand	2.99	6.13	0.401	0.553	0.035	0.125	0.055
Mudstone	0.03	31.63	0.385	0.165	0.09	0.396	0.272
Sand	11.78	4.95	0.417	0.694	0.02	0.091	0.033
Sandy Clay	0.06	23.9	0.321	0.223	0.109	0.339	0.239
Silty Clay	0.05	29.22	0.423	0.15	0.056	0.387	0.25
Silty Sand	2.99	6.13	0.401	0.553	0.035	0.125	0.055
Clayey Silt	0.1	27.3	0.432	0.177	0.04	0.318	0.197
Silty Clayey Sand	2.99	6.13	0.401	0.553	0.035	0.125	0.055
Sandy Silty Clay	0.055	25.56	0.372	0.187	0.083	0.363	0.245
Clayey Sandstone	0.03	31.63	0.385	0.165	0.09	0.396	0.272

8. Switch to the *Initial Moisture* tab
9. Initial Moisture must be lower than the porosity assigned for each soil type. Enter the starting initial moisture for each soil type as shown in the table below.

Soil Texture	**Initial Moisture**
Silty Clayey Sand	0.4
Mudstone	0.35
Clayey Silt	0.4
Silty Clay	0.4
Clay	0.35

10. Switch to the *Soil Erosion* tab

Soil Erosion parameters, like Infiltration parameters, are assigned based on the Combined land use/soil type index map. As with the Infiltration parameters, there is an additional land use and soil type combination for which parameters must be entered.

11. Locate the new land use/soil type combinations in the spreadsheet. Enter values for the first five rows of parameters from the following spreadsheet. For Dump Areas, please assume that ground cover (GC) and canopy cover (CC) are equal to 0.

Table 2 Soil Erosion Parameters by Soil Texture

	Coefficient for detachment by rainfall (1/J)	Rill erodibility coefficient (s/m)	Rill erodibility exponent (dimensionless)	Critical rill detachment (Pa)	Erodibility coefficient (dimensionless)
Clay	46.35*(1-GC)*(1-CC)	0.000175	1.0	3.5	1.0
Clayey Sand	62.4*(1-GC)*(1-CC)	0.00302	1.0	3.5	1.0
Mudstone	16.2*(1-GC)*(1-CC)	0.00001	1.0	3.5	1.0
Sand	62.4*(1-GC)*(1-CC)	0.00302	1.0	3.5	1.0
Sandy Clay	32.13*(1-GC)*(1-CC)	0.00035	1.0	3.5	1.0
Silty Clay	18.2*(1-GC)*(1-CC)	0.00162	1.0	3.5	1.0
Silty Sand	46.1*(1-GC)*(1-CC)	0.00302	1.0	3.5	1.0
Clayey Silt	40.8*(1-GC)*(1-CC)	0.000255	1.0	3.5	1.0
Silty Clayey Sand	40.3*(1-GC)*(1-CC)	0.00302	1.0	3.5	1.0
Sandy Silty Clay	32.13*(1-GC)*(1-CC)	0.000985	1.0	3.5	1.0
Clayey Sandstone	16.2*(1-GC)*(1-CC)	0.00001	1.0	3.5	1.0

12. The last four rows in the spreadsheet represent the particle size distribution for this part of the watershed. Given that a single particle size distribution was available for this watershed, enter the same distribution used for all the other index map IDs. Copy the grain size distribution values from another column and paste them into the new combination.
13. Repeat steps 11 and 12 for any other new combinations that may appear in the table.
14. Click *Done* to close the *GSSHA Map Table Editor*
15. Click *Next >* to advance to the next step in the wizard

2.12 Embankment Locations

Embankment arcs are used to create a barrier to overland flow and are used to represent dams downstream of the settling ponds. The Embankments spreadsheet displays embankments that have been transferred from the previous GSSHA model. In this step, create new embankments, delete embankments, assign parameters to new embankments, or change parameters for existing embankments. For this example, keep the existing embankment and add a new embankment for the new settling pond.

1. Toggle off the display of all coverages except the *GSSHA (2)* coverage and the *New Depression Mask* coverage. Toggle on the display of the Land Use shapefile.
2. Using the *Zoom* tool , zoom in around the new settling pond shown in a white outline (Figure 4)
3. Click the *Add Embankment Button* and click to create a new embankment along the hauling road downstream of the new settling pond as shown in Figure 4.

Figure 4 New Embankment Arc Location

4. Notice there are now two embankment arcs shown in the Embankments spreadsheet. Click the *Define…* button next to the newly created embankment arc in the spreadsheet
5. Click the *Offset Arc* button, enter an offset elevation of **64** and click *OK*
6. Click *OK* to close the *Embankment Arc Profile Editor*
7. With the *GSSHA (2)* coverage selected, choose the *Create Feature Point* tool and click to create a new node on the GSSHA stream arc just upstream of the embankment arc. Be sure the point is upstream of not only the embankment arc, but also of the red cell faces denoting embankments boundaries that will be used by the grid.
8. Click *Yes* if asked to renumber links
9. Choose the *Select Feature Point/Node* tool and double-click on the node
10. In the Node *Properties* window, click the *"…"* button shown under *Hydraulic Structures*
11. In the *GSSHA Hydraulic Structures* dialog, click the *Detention Basin* button
12. Enter a *Minimum Water Surface Elevation* of **61.0** m, an *Initial Water Surface Elevation* of **62.5** m and a *Maximum Water Surface Elevation* of **64.0** m
13. Click the *Sched. Discharge* button
14. On the right hand side, click the large button to define a *Scheduled Discharge Curve*
15. Change the *Curve Name* to *"Scheduled_Discharge2"*
16. Build the curve by entering a constant rate of 0.03 cms for 1500 min as shown below. The duration of the scheduled discharge should match the duration of the simulation.

Time (min)	Discharge
0	0.03
1500	0.03

17. Click *OK* to close the *XY Series Editor*, *OK* again to close the *GSSHA Hydraulic Structures* window, and *OK* again to close the Node *Properties* window
18. Click *Yes* if asked to renumber links
19. Click *Next >* to advance to the next step in the wizard
20. Click *Yes* if asked to renumber links

2.13 Edit Pumping Locations

The base model did not contain any pumps. This is why the list of pumping locations is currently empty. For this exercise, add a pump and define a pumping curve.

1. Right-click on the *GSSHA (2)* coverage and select *Zoom to Layer*
2. Toggle off the display of the Land Use shapefile
3. Click the *Add Pumping Location* button
4. Add a pump just inside the watershed boundary, somewhere upstream of the longest reach coming out of the new settling pond (Figure 5).

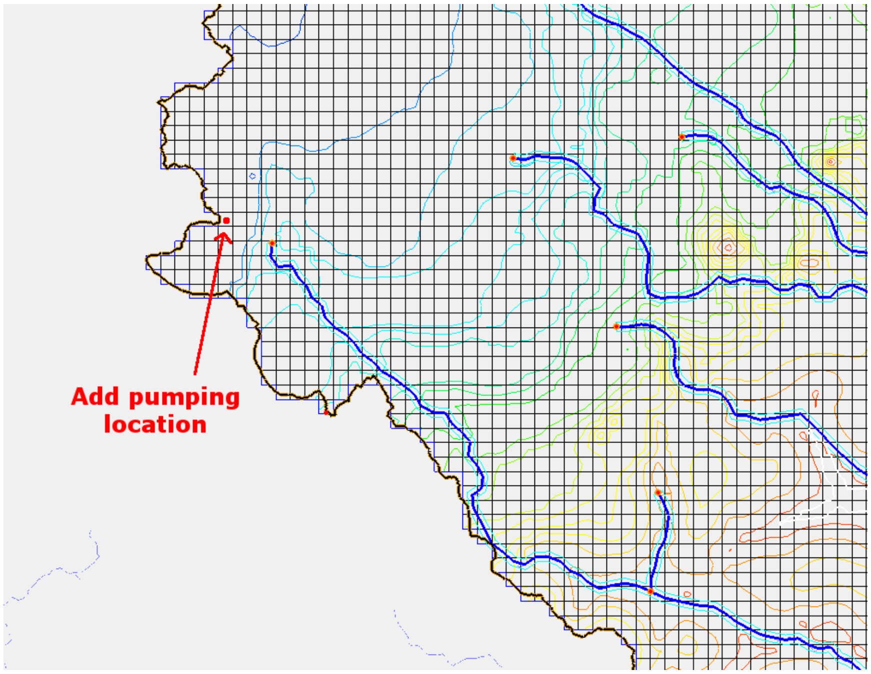


Figure 5 New Pumping Location

5. Click the *Define…* button next to the newly added pumping location in the *Pumping Locations* spreadsheet
6. Change the *Curve Name* to *"Two Pumps"*
7. Build the pumping curve by entering a constant rate of 0.3 cms for 1500 min as shown below. The duration of the pumping curve should match the duration of the simulation.

Time (min)	Discharge (cms)
0	0.3
1500	0.3

8. Click OK to close the *XY Series Editor*
9. Click *Next >* to advance to the next step in the wizard

2.14 Define Precipitation

The Define Precipitation step allows defining new rainfall parameters for the simulation. In this example, simply change the rainfall depth.

1. Click the *Define Precipitation…* button
2. Change the rainfall depth to **90** mm
3. Click *OK* to close the *GSSHA Precipitation* window
4. Click *Next >* to advance to the next step in the wizard

2.15 Output Locations

By default, GSSHA will generate a runoff hydrograph and other output at the most downstream watershed outlet. Additional output locations can be generated at any point along a GSSHA stream arc. For this example, add an outlet location just upstream of the new settling pond.

1. Click the *Add Output Location* button and click on the main channel arc entering the new settling pond just as it crosses the waterbody polygon

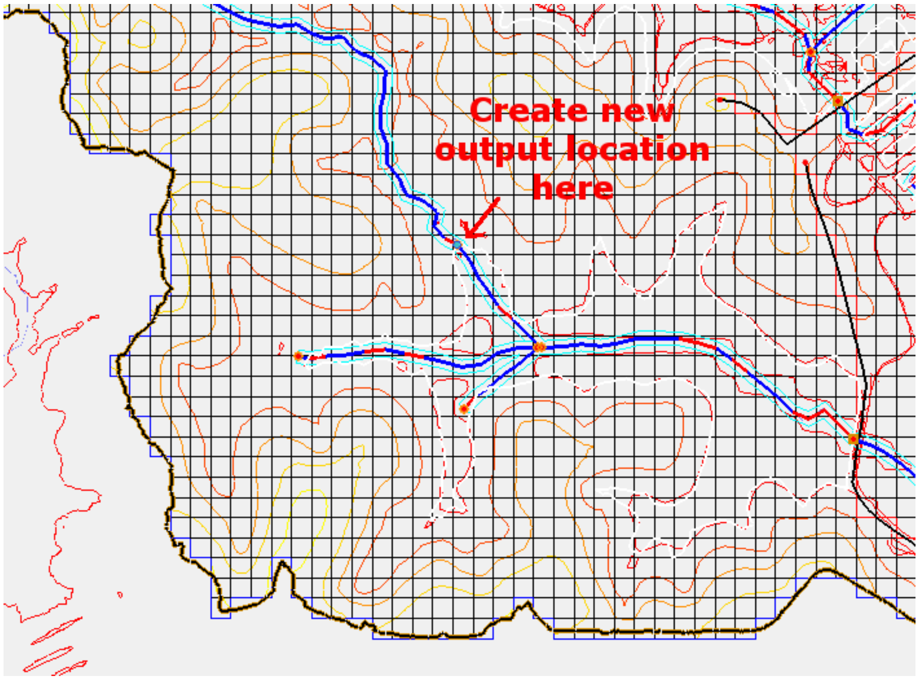


Figure 6 New Output Location

2. Click *Yes* if asked to renumber links

3. Click *Next >* to advance to the next step in the wizard

2.16 Run GSSHA

Now to run the modified GSSHA model.

1. Change the *Filename prefix* to *"TTP_SP_9C_HW_new"* and click the *Update Filenames* button
2. Click the *Input File* browser to change the directory path
3. In the File Browser window, create a new folder in the MWBM directory called *"new model"* Open the new directory, and with the file name still shown as *"TTP_SP_9C_HW_new.prj"* click *Save*
4. Click the *Run Simulation* button to run the GSSHA model
5. WMS first launches a program called CleanDam that removes all digital dams in the model that lie outside a depression mask polygon. Click *Close* once this program is done running.
6. In the *GSSHA Model Run* dialog, toggle off the option to *Suppress screen printing* and click *OK*
7. The model should take a little while to run. When the model finishes, make sure the *Read solution on exit* button is toggled on and click *Close* to read the solution
8. Once the solution is read in, click *Next >* to advance to the next step in the wizard

2.17 Summarize Model Output

The MWBM Wizard has the ability to export model output to a comma separated file that can be read into Microsoft Excel. The file can be reused for each watershed so that model results for all settling pond locations are contained in a single file.

1. Click the browse button and change the model results filename to *"WatershedModelResults.csv"* and click Save
2. Click the *Export Output File…* button to save the model output to the CSV file
3. Click OK to view the results file in Notepad

Notice the model results contain the amount of sediment settled in lakes by volume, the peak flowrate and runoff volume at each output location and the runoff hydrograph for the entire model run at each output location.

4. Close the *WatershedModelResults.csv* file
5. Click *Next >* to advance to the next step in the wizard

2.18 Erosion/Deposition Maps

The GSSHA model run produces an adjusted elevation dataset that includes the effects of erosion and deposition. The MWBM wizard has the ability to read this dataset and compare it with the original model elevations to create an erosion-deposition map.

1. Click the *Build Erosion/Deposition Maps* button

The resulting erosion/deposition map shows areas of erosion in red and deposition in gray.

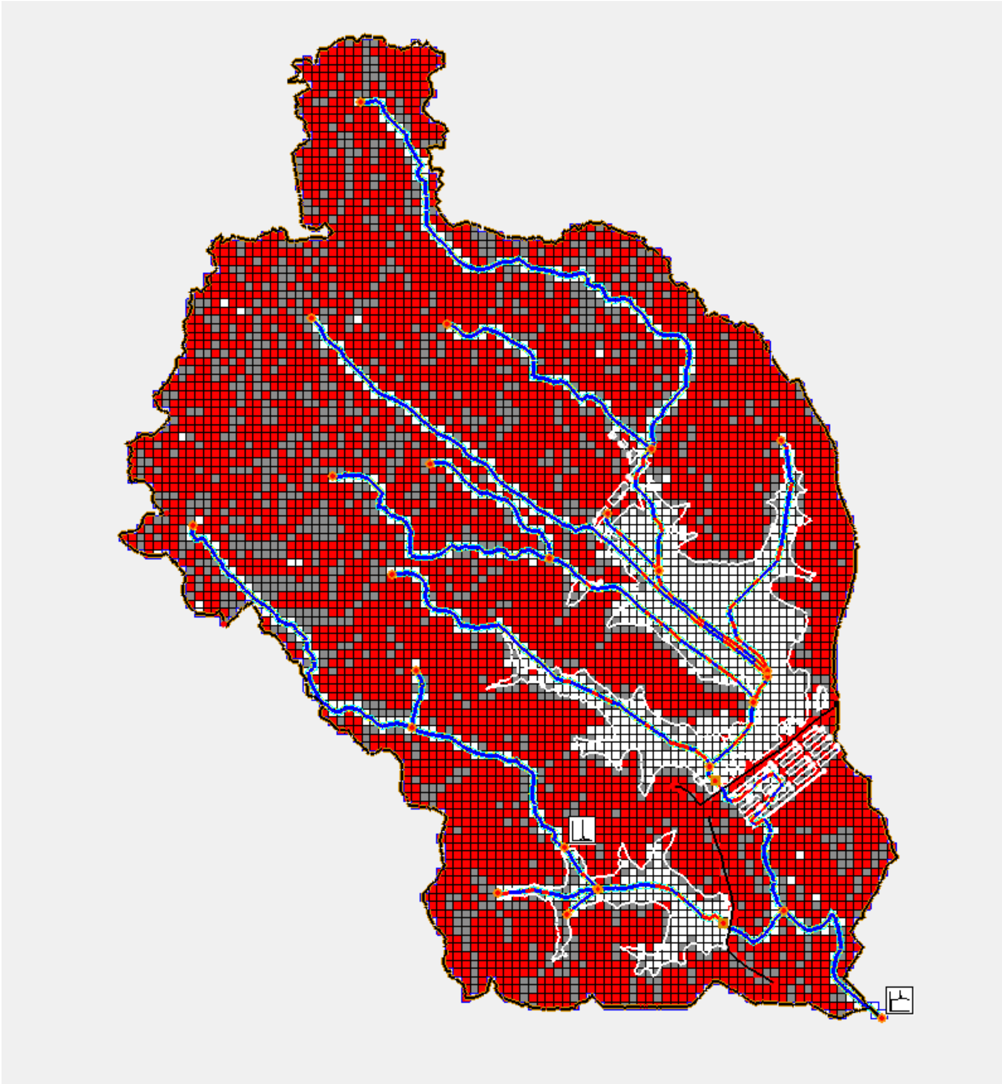


Figure 7 Erosion/Deposition Map

The degree of erosion and deposition can be viewed by selecting the *ElevationDiff* dataset.

2. In the *Project Explorer*, click to select the *ElevationDiff* dataset under the *2D Grid* section
3. Right-click on the *ElevationDiff* dataset and select *Contour Options*
4. Change the *Contour Method* drop down to *Color Fill*
5. Click the *Color Ramp…* button
6. Select the *User Defined* Palette Method and make sure *Palette1* is selected in the User Defined Palette list
7. Click *OK*
8. Change the *Number of Contours* to **11**

9. Change the Contour Interval drop down to *Specified Values*
10. Copy and paste the contour intervals shown in the table below

	Start Value	End Value
1	-100000	-10000
2	-10000	-1000
3	-1000	-100
4	-100	-10
5	-10	0
6	0	0
7	0	10
8	10	100
9	100	1000
10	1000	10000
11	10000	100000

The erosion/deposition values have been exaggerated by a factor of 10,000 to aid in the development of the automated erosion/deposition maps. This means that in the contour scale shown above, a value of -10,000 represents 1 meter of erosion and a value of 10,000 represents 1 meter of deposition. If having used a different exaggeration factor when generating the erosion/deposition maps, change the contour intervals accordingly.

11. In the Contour Method section, change the *Use Color Ramp* option to *Specify Each Color*
12. Click on the light pink and light blue colors shown on either side of the white color and change them to white so that there are three bands of white between the red and blue contours. This will make sure that any depth changes less than +/- 1 mm are shown to be essentially unchanged.
13. Click *OK* to update the erosion/deposition gradient map

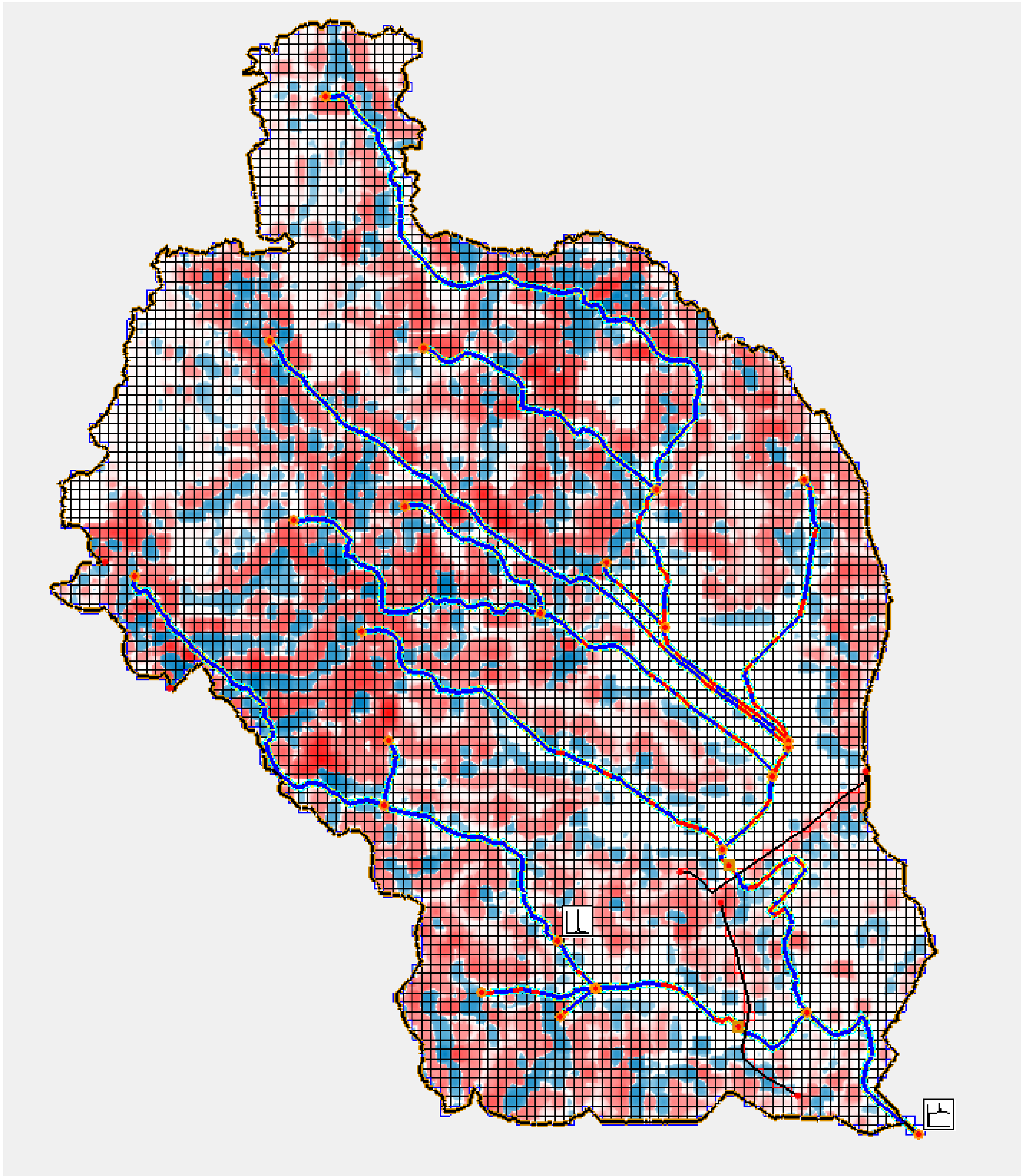


Figure 8 Erosion/Deposition Gradient Map

2.19 Save WMS Project

A GSSHA model has now been successfully updated to incorporate several new data sources.

1. Click *Finish* to Close the MWBM Wizard

When saving a WMS project, WMS also saves the GSSHA project and gives it the same name as the WMS project. In order to avoid overriding the previous model, save the WMS project with a different name.

2. Click *File | Save As…*
3. In the MWBM Wizard directory, create a new folder called *"new project"*

4. In the *new project* directory, save the new WMS project with the name *"TTP_SP_9C_HW_new.wms"* and click Save

Any future modifications to this site could now be done using the new WMS project file as a starting point.

