Optimum Site Selection for Watershed Intervention Works

Tutorial

Developed By

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Tutorial: Optimum Site Selection for Watershed Intervention Works

Key Words: Watershed, Intervention works, Remote Sensing, GIS, Optimum

Site Selection of Watershed Intervention Works

Considering the high runoff potential of the water-shed, developmental structures such as farm pond, check dam, subsurface dyke and percolation tanks are suggested in the watershed for water resource development. An attempt is made to evolve a decision rule based approach for identifying the most appropriate sites for each of the proposed Water Harvesting Structures (WHS). Convention-ally, factors such as watershed area, slope, land use, runoff coefficient are considered as criteria in selecting suitable sites for WHS (Padmavaty *et al* 1993; IMSD 1995; El-Awar *et al* 2000; Rao and Satish Kumar 2004; De Winnar *et al* 2007). In this work, in addition to above criteria, factors such as effective storage, foundation and abutment per-meability are also considered (tables 2–4). This

Structure	MWL (m)	Slope (%)	Permeability	Runoff coeff.	Stream order	Watershed area (10^4 m^2)	Storage loss
Farm ponds	2–2.5	0–5	Low	Medium/high	1	1–2	Moderate–low
Check dams	4–5	< 15	Low	Medium/high	1–4	25	Low
Subsurface dykes	–	0–3	High	Medium/low	> 4	> 50	Low
Percolation ponds	6–7	< 10	High	Low	1–4	25–40	Moderate–high

information is derived from maximum water level, storage area, storage volume, seepage loss, perme-ability of foundation and abutment following the procedures of Lund (2006) and Lee and Farmer (1990).

Problem: You have identifying potential water harvesting sites in the Ajmer Area. You have been provided with DEM, Soil map, LULC map, Rainfall map, Stream Order, Watershed Area, Boundary and Slope.

OBJECTID	Value_	MWL
1	1	2
2	2	2.5
3	3	3.5
4	4	4
5	5	5
6	6	5.5
7	7	7

OBJECTID	Value_	Permeability
1	1	High
2	2	Medium
3	3	Low

OBJECTID	Value_	Storage_Loss
1	1	High
2	2	Low
3	3	Moderate_low
4	4	Moderate_High

OBJECTID	Value_	Runoff_Coefficient
1	1	Low
2	2	Medium
3	3	High

Table. *Site selection criteria for water harvesting structures*.

Bore wells

Where runoff coefficient is <40%

Where present land use is crop land or fallow land

Where slope is 0–10%,

Where major lineament intersects

Dug-cum-bore wells

Where runoff coefficient is < 20%

Where land use is crop land or fallow or waste land

Where slope category 0 – 5%,

Where minor lineaments and major lineaments intersect

Dug well

Where runoff coefficient is < 20%

Where land use is crop land or fallow or waste land

Where slope category 0–3%,

Where minor lineaments intersect

Tutorial : Selection of Suitable Sites for FarmPonds

Find out the Suitable sites for Farm ponds Structure for each pixel from the given maps.

Add above mentioned data in ArcGIS. You have been provided with Boundary, DEM, Location, Agriculture_Area, Reclass_Slope, R_Coeff, Stream_Order, Soil_Map.

Structure	Farm ponds	Raster_Calculator
MWL* (m)	2–2.6	Con("MWL_MAP" <= 2.6,1)
Permeability	Low	Con("Permeability" == 3,1)
Runoff coefficient class	Medium/high	Con("Runoff_Coef" >= 2,)
Stream order	1	Con("Str_Ord" == 1,1)
Watershed area (10^4 m^2)	1–2	Con("Farm_Area" <= 3,1)
Storage loss	Moderate–low	Con("Storage_Loss" == 3,1)
Farm ponds	"MWL_MAP_F_N" & "STR_L" & "farm" & "str_1" & "raster3"	

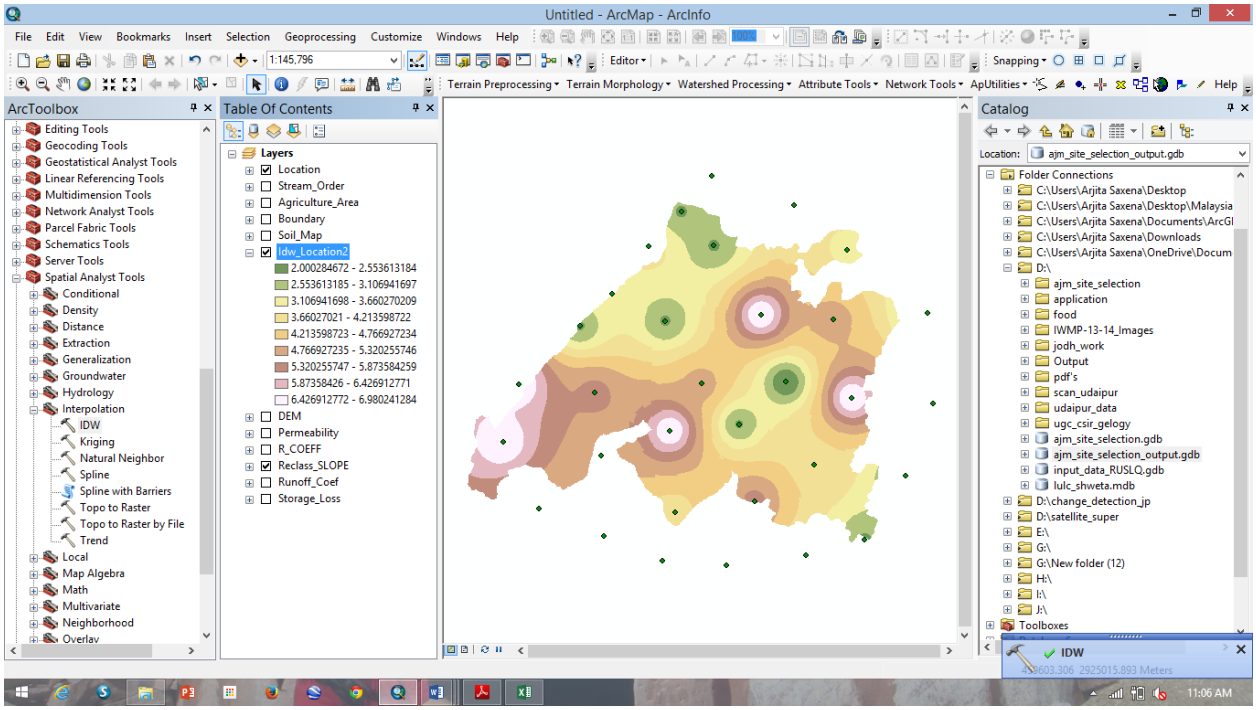
Calculation of Farm ponds Structure

Go to the *Spatial Analyst* >> Interpolation >> Spline

Input point feature – Location.shp

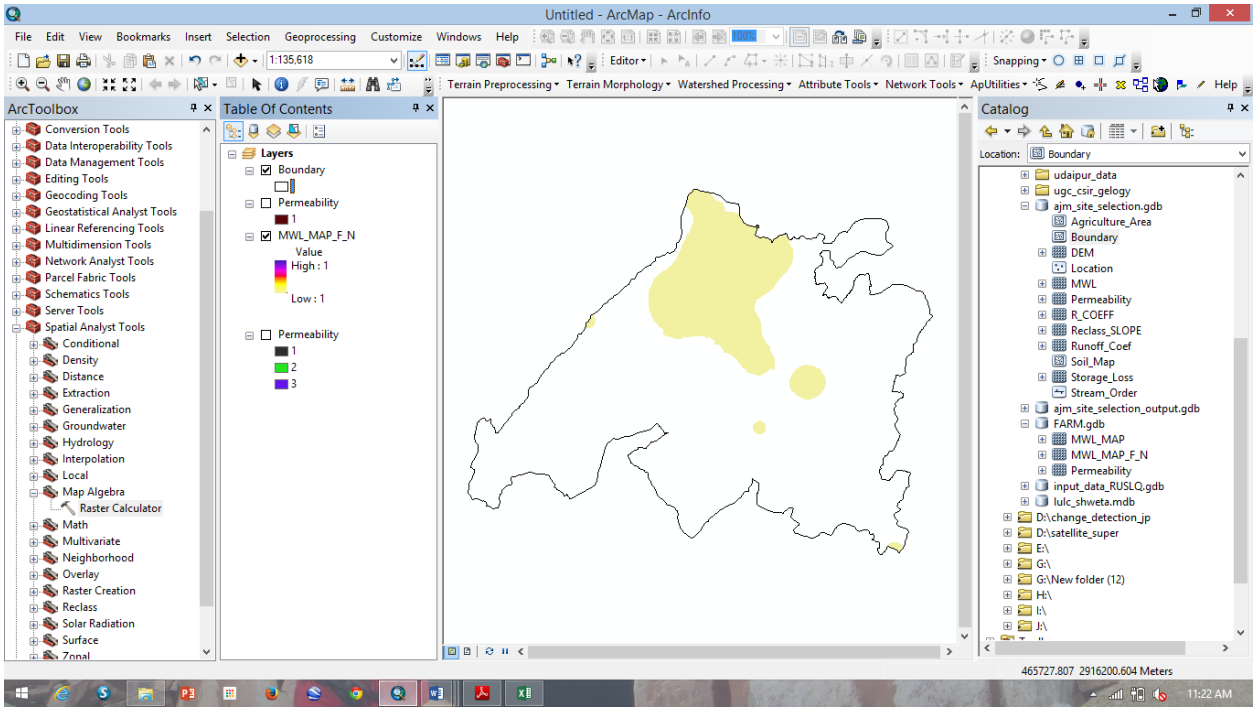
Z value field – MWL

Output- MWL



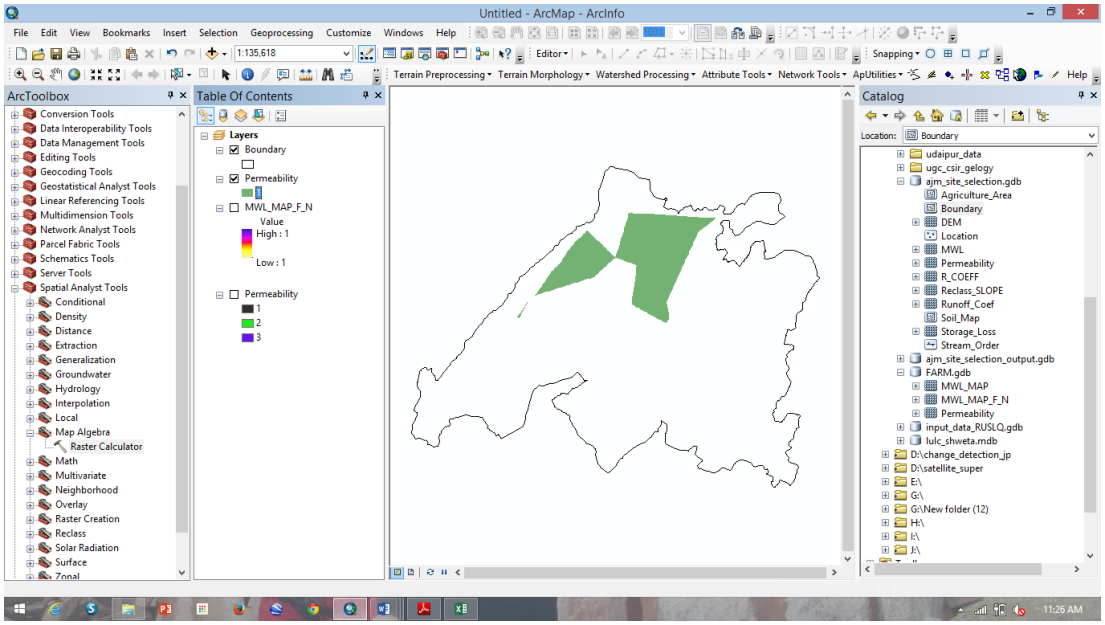
Make sure the *MWL* is added in the viewer, go to the *Spatial Analyst* >> *Raster Calculator*. The *Raster Calculator* window will open.

Structure	Farm ponds	Output	Raster_Calculator
MWL* (m)	2–2.6	MWL_Farm	Con("MWL_MAP" <= 2.6,1)



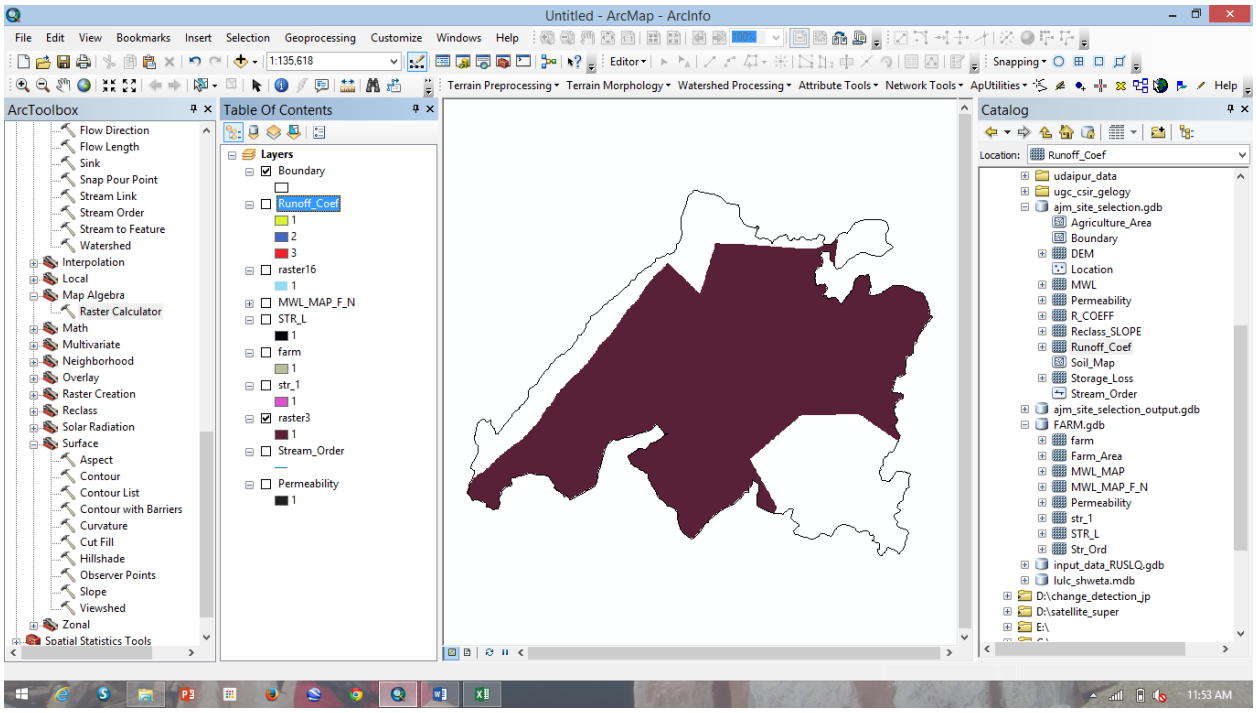
Make sure the Permeability is added in the viewer, go to the *Spatial Analyst >> Raster Calculator*. The *Raster Calculator* window will open.

Structure	Farm ponds	Raster_Calculator	Output
Permeability	Low	Con("Permeability" == 3,1)	Permeability



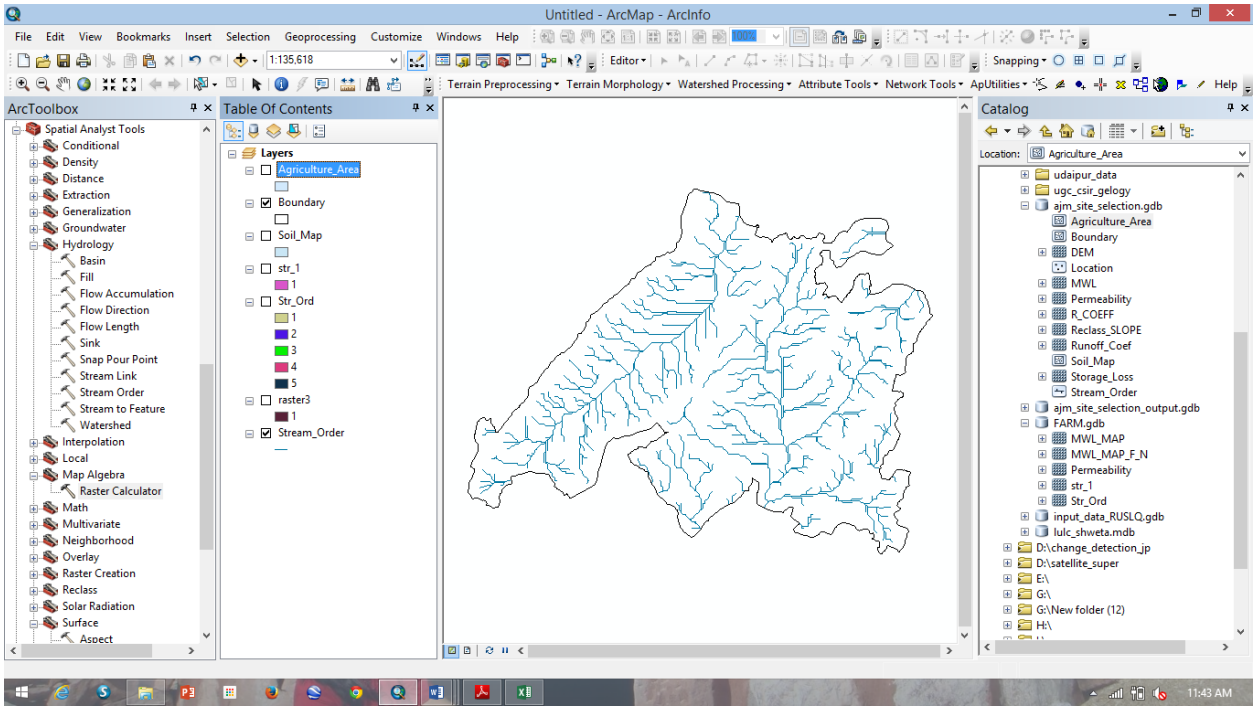
Make sure the Runoff_Coefficient is added in the viewer, go to the *Spatial Analyst* >> *Raster Calculator*. The *Raster Calculator* window will open.

Structure	Farm ponds	Raster_Calculator	Output
Runoff_Coefficient	Medium/high	Con("Runoff_Coef" >= 2,)	Runoff_Coefficient



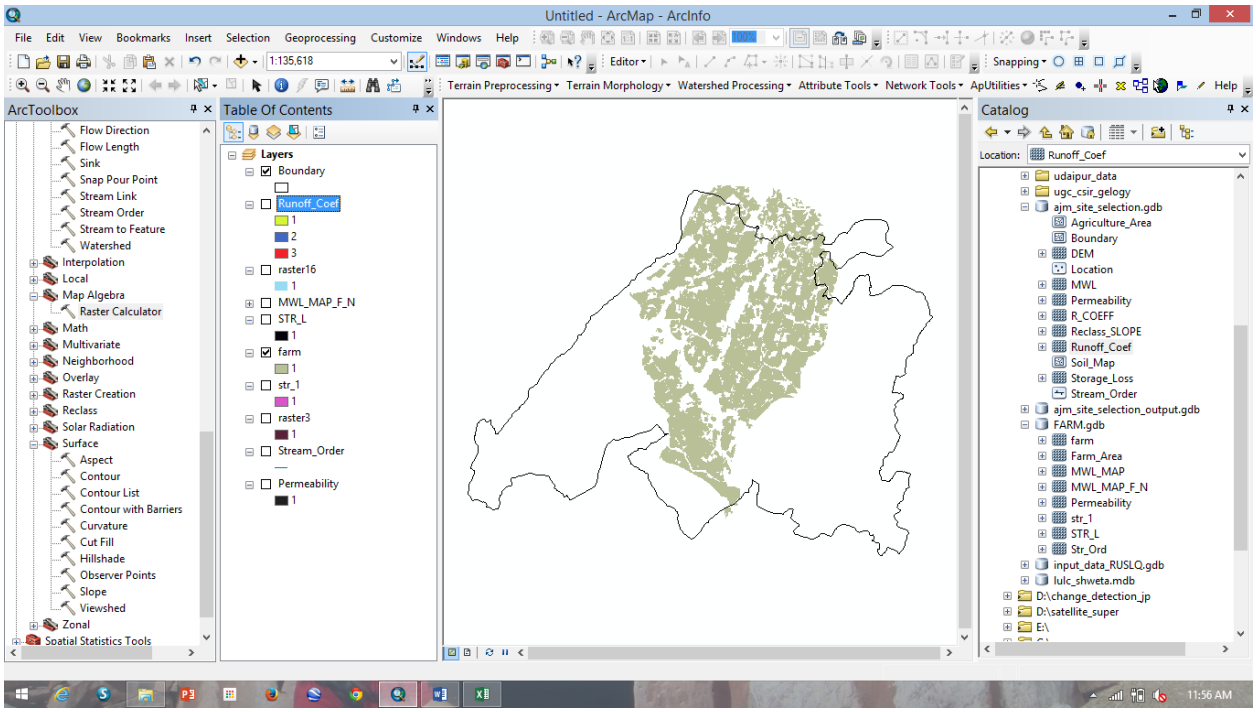
Make sure the Stream order is added in the viewer, go to the *Spatial Analyst* >> *Raster Calculator*. The *Raster Calculator* window will open.

Structure	Farm ponds	Raster_Calculator	Output
Stream order	1	Con("Str_Ord" == 1,1)	Stream_order



Make sure the Farm_Area is added in the viewer, go to the *Spatial Analyst >> Raster Calculator*. The *Raster Calculator* window will open.

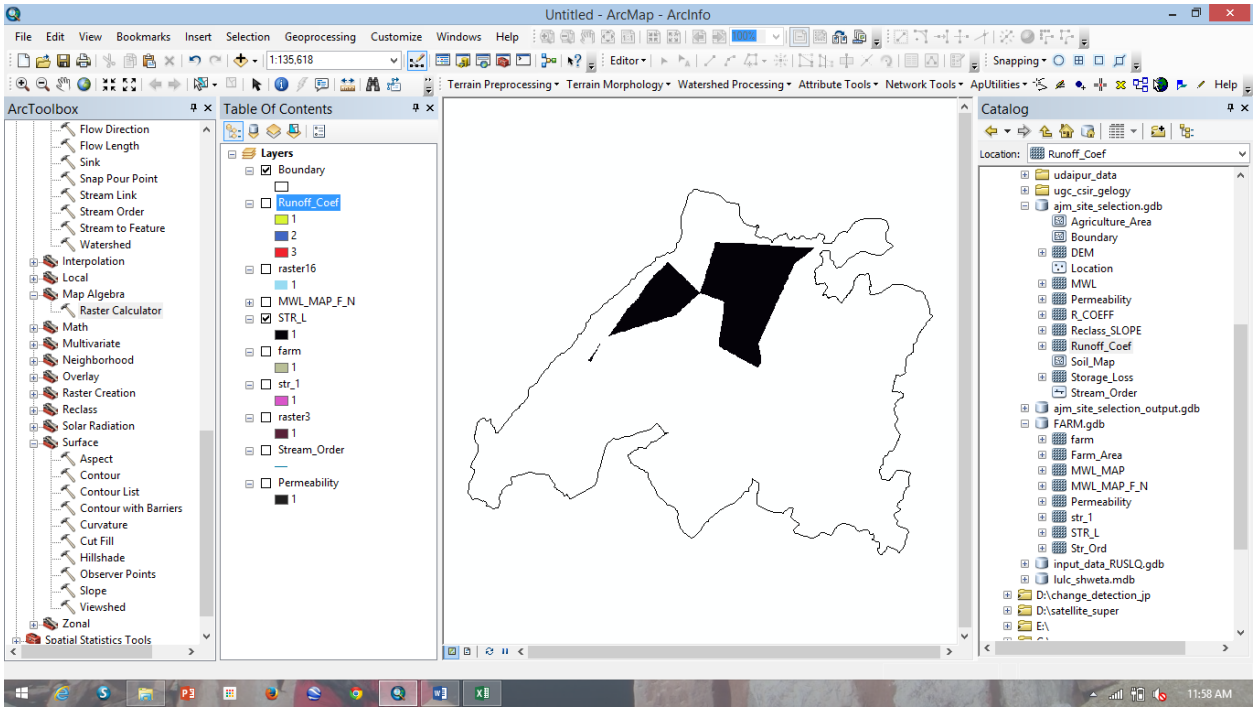
Structure	Farm ponds	Raster_Calculator	Output
Watershed area (10^4 m^2)	1–3	Con("Farm_Area" <= 3,1)	Farm_Area



Make sure the Farm_Area is added in the viewer, go to the *Spatial Analyst >> Raster Calculator*. The *Raster Calculator* window will open.

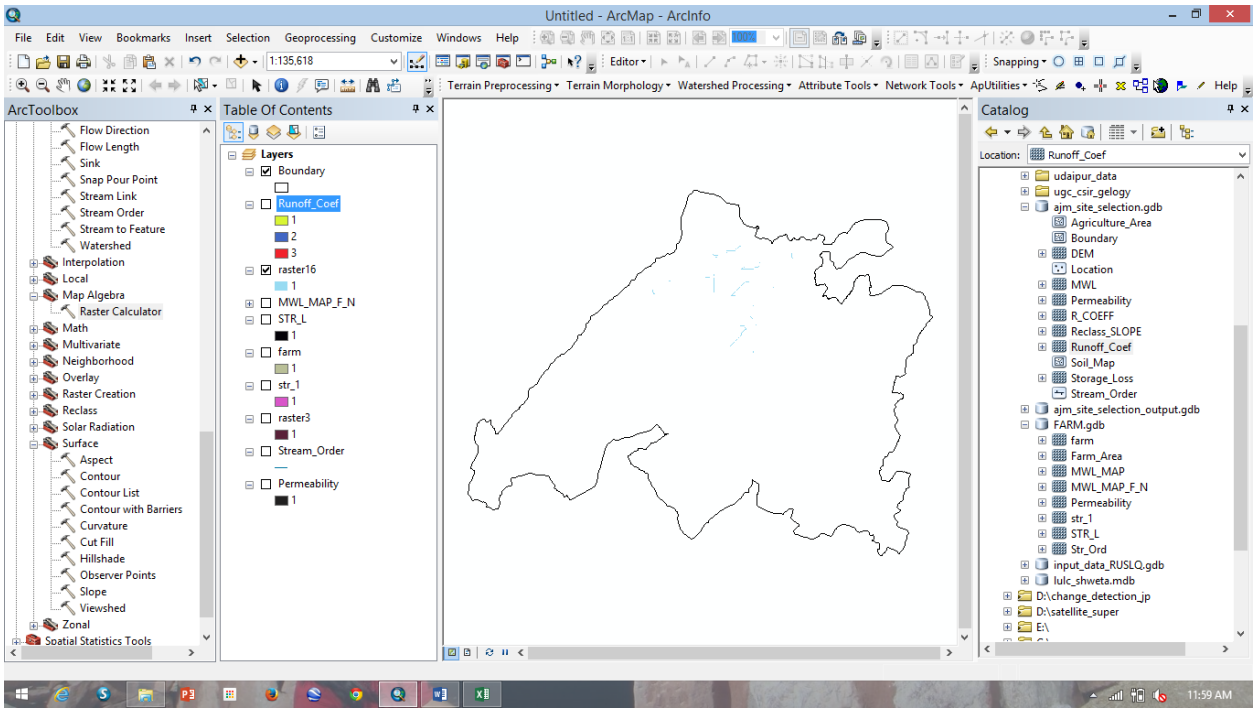
Structure	Farm ponds	Raster_Calculator	Output

Storage loss	Moderate–low	Con("Storage_Loss" == 3,1)	Storage_loss



Make sure the all output filesis added in the viewer, go to the *Spatial Analyst >> Raster Calculator*. The *Raster Calculator* window will open.

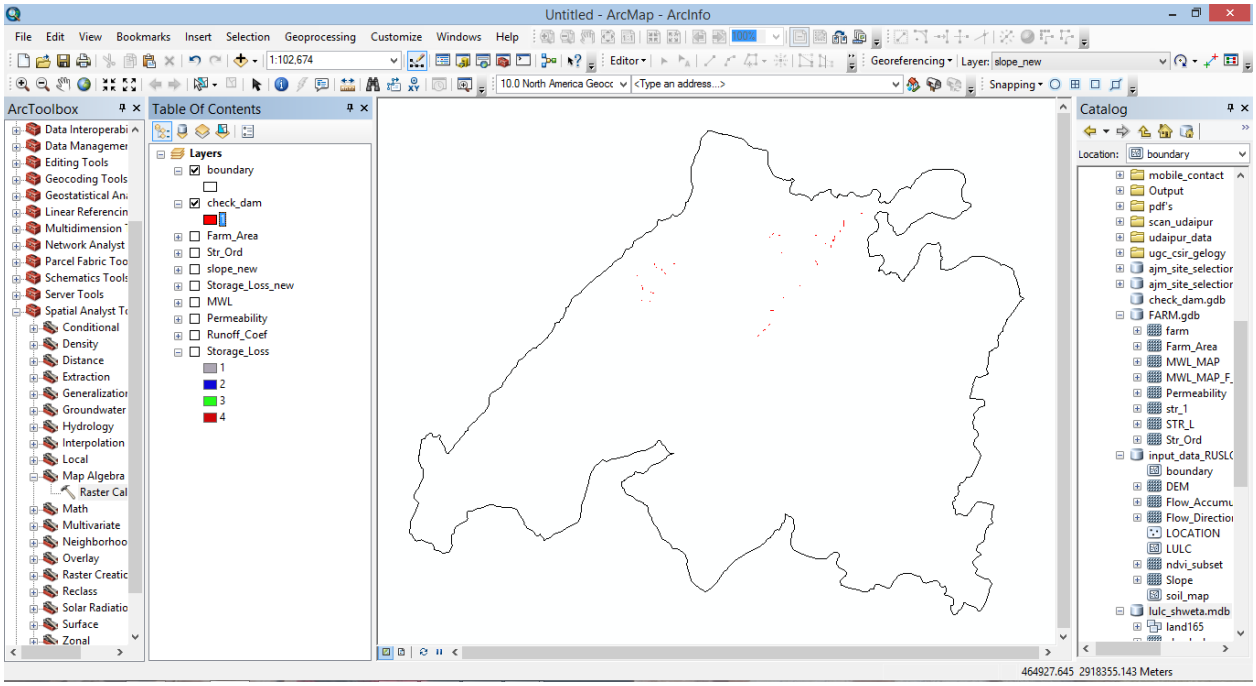
Farm ponds	"MWL_MAP_F_N" & "STR_L" & "farm" & "str_1" & "raster3"



4–5	< 15	Low	Medium/high	1–4	25	Low

Make sure the all layer is added in the viewer, go to the *Spatial Analyst >> Raster Calculator*. The *Raster Calculator* window will open.

MWL	4–5	Con((Con("MWL" >= 4,1) & (Con("MWL"<= 5,1))),1)
SLOPE	< 15	Con("slope_new" <= 15,1)
Runoff Coefficient	Medium/high	Con("Runoff_Coef" >= 2,1)
Stream Order	1–4	Con("Str_Ord" <= 4,1)
watershed_area	25	Con("Farm_Area" <= 25,1)
Storage_Loss	Low	Con((Con("Storage_Loss" <= 3,1) & (Con("Storage_Loss" >= 2,1))),1)
Permeability	Low	Con("Permeability" == 3,1)
CHECK DAM	"mwl" & "SLOPE" & "Permeability" & "Runoff_Coef" & "str_ord" & "watershed_area" & "Storage_Loss"	



Make sure the all layer is added in the viewer, go to the *Spatial Analyst >> Raster Calculator*. The *Raster Calculator* window will open.

Tutorial : Site Selection for Check Dam

Suitability Conditions

MWL		Con((Con("MWL" >= 6,1) & (Con("MWL"<= 7,1))),1)
SLOPE		Con("slope_new" <= 10,1)
Runoff Coefficient		Con("Runoff_Coef" == 1,1)
Stream Order		Con("Str_Ord" <= 4,1)
watershed_area		Con("Farm_Area" >= 25,1)
Storage_Loss		Con((Con("Storage_Loss" <= 3,1) & (Con("Storage_Loss" >= 2,1))),1)
Permeability		Con("Permeability" == 1,1)
Percolation ponds	"mwl" & "SLOPE" & "Permeability" & "Runoff_Coef" & "str_ord" & "watershed_area" & "Storage_Loss"	

MWL	4–5	Con((Con("MWL" >= 4,1) & (Con("MWL"<= 5,1))),1)
SLOPE	< 15	Con("slope_new" <= 15,1)
Runoff Coefficient	Medium/high	Con("Runoff_Coef" >= 2,1)
Stream Order	1–4	Con("Str_Ord" <= 4,1)
watershed_area	25	Con("Farm_Area" <= 25,1)
Storage_Loss	Low	Con((Con("Storage_Loss" <= 3,1) & (Con("Storage_Loss" >= 2,1))),1)
Permeability	Low	Con("Permeability" == 3,1)
CHECK DAM	"mwl" & "SLOPE" & "Permeability" & "Runoff_Coef" & "str_ord" & "watershed_area" & "Storage_Loss"	

Problem

Find out the Suitable sites for Farm ponds Structure for each pixel from the given maps.

Add above mentioned data in ArcGIS. You have been provided with Boundary, DEM, Location, Agriculture_Area, Reclass_Slope, R_Coeff, Stream_Order, Soil_Map.

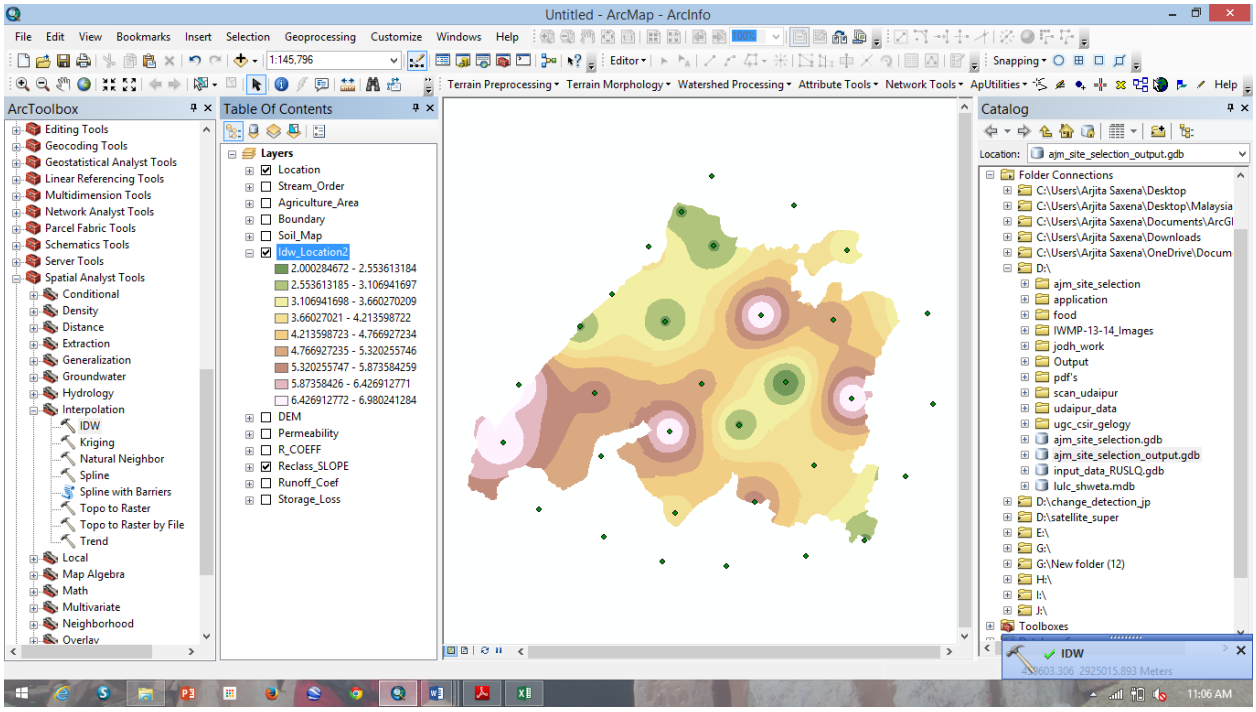
***Calculation of Check Dam* Structure**

Go to the *Spatial Analyst* >> Interpolation >> Spline

Input point feature – Location.shp

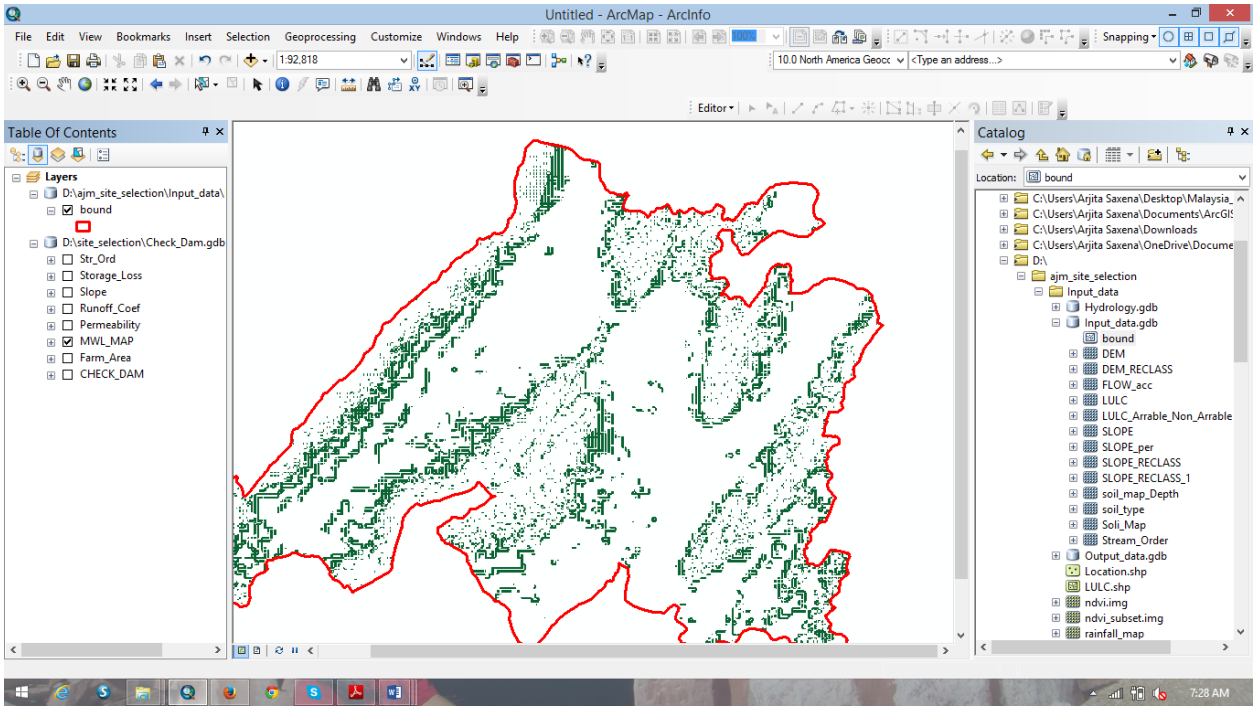
Z value field – MWL

Output- MWL_MAP



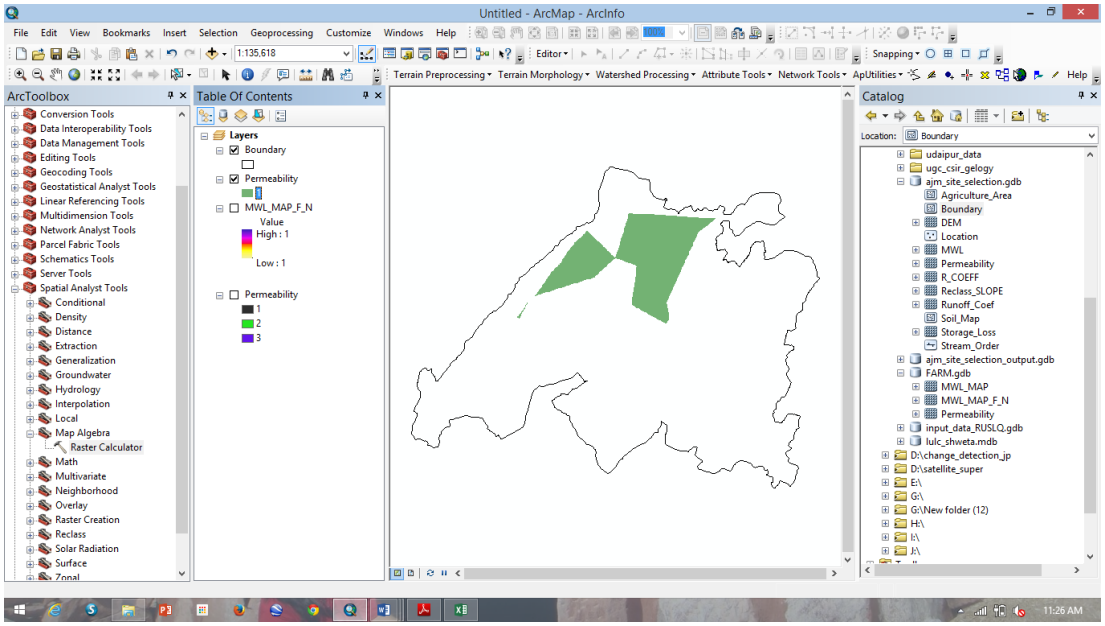
Make sure the *MWL* is added in the viewer, go to the *Spatial Analyst* >> *Raster Calculator*. The *Raster Calculator* window will open.

Structure	Farm ponds	Output	Raster_Calculator
MWL* (m)	4–5	MWL_Farm	Con((Con("MWL" >= 4,1) & (Con("MWL"<= 5,1))),1)



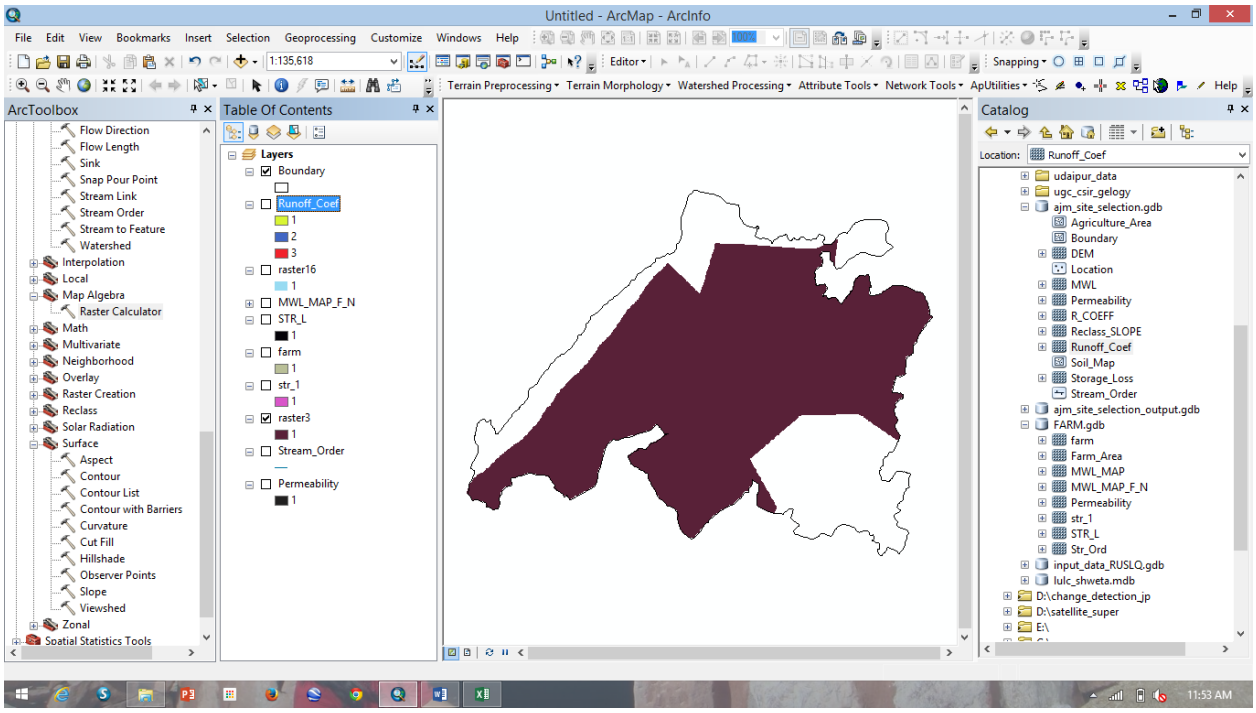
Make sure the Permeability is added in the viewer, go to the *Spatial Analyst* >> *Raster Calculator*. The *Raster Calculator* window will open.

Structure	Farm ponds	Raster_Calculator	Output
Permeability	Low	Con("Permeability" == 3,1)	Permeability



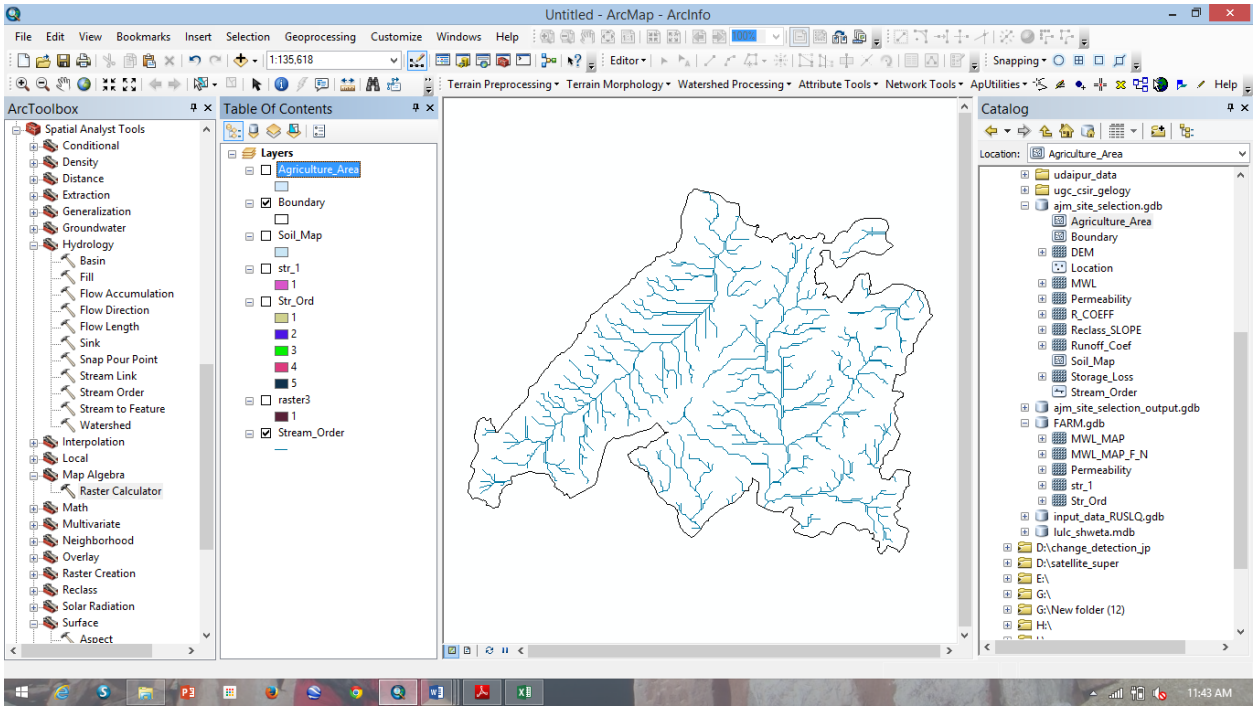
Make sure the Runoff_Coefficient is added in the viewer, go to the *Spatial Analyst* >> *Raster Calculator*. The *Raster Calculator* window will open.

Structure	Farm ponds	Raster_Calculator	Output
Runoff_Coefficient	Medium/high	Con("Runoff_Coef" >= 2,1)	Runoff_Coefficient



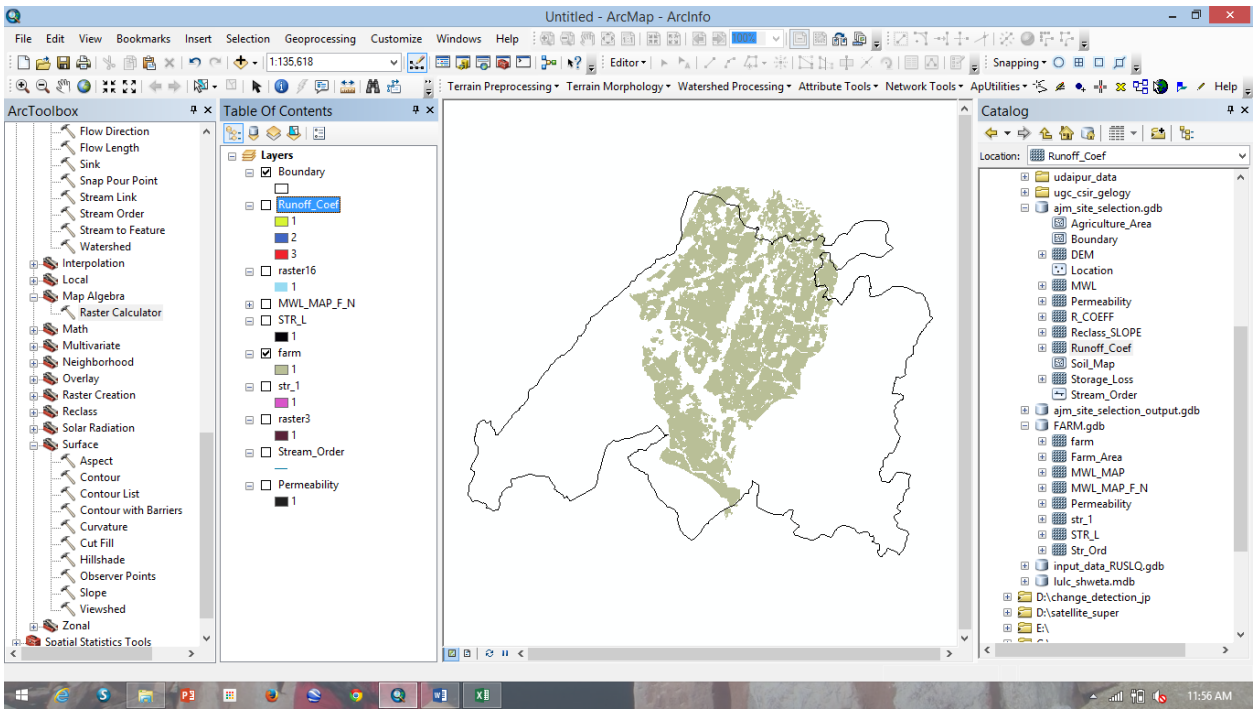
Make sure the Stream order is added in the viewer, go to the *Spatial Analyst* >> *Raster Calculator*. The *Raster Calculator* window will open.

Structure	Farm ponds	Raster_Calculator	Output
Stream order	1–4	Con("Str_Ord" <= 4,1)	Stream_order



Make sure the Farm_Area is added in the viewer, go to the *Spatial Analyst* >> *Raster Calculator*. The *Raster Calculator* window will open.

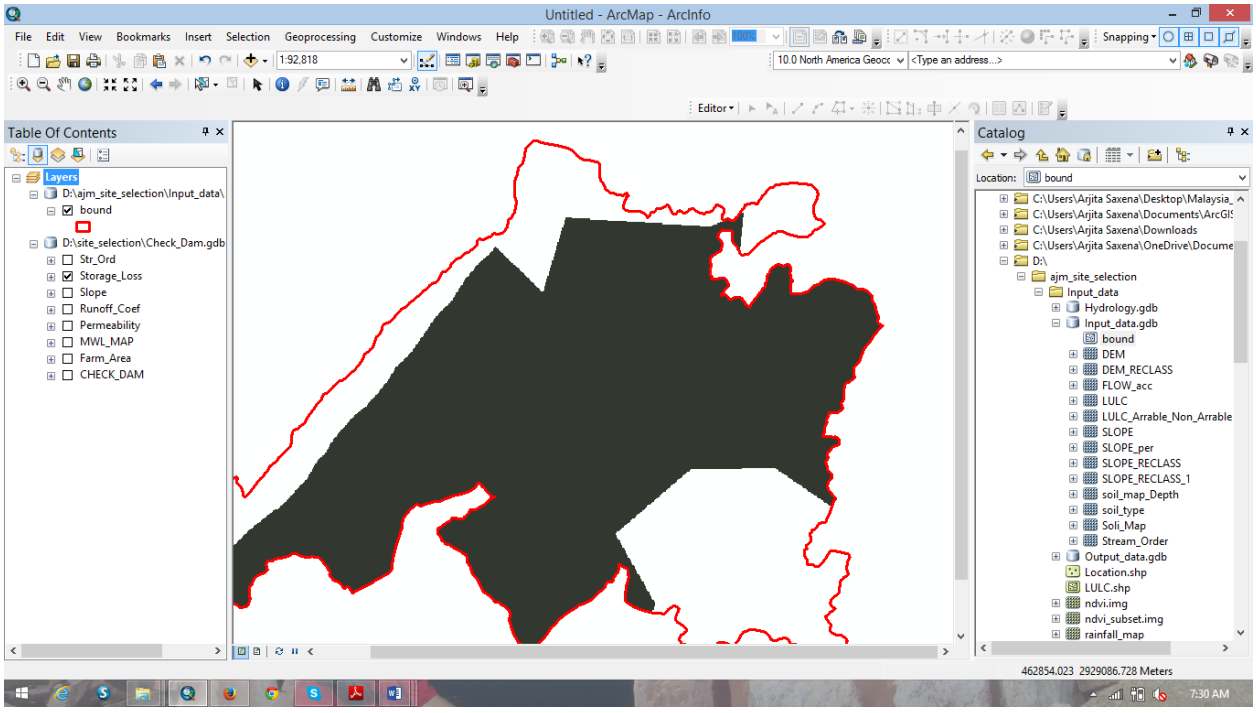
Structure	Farm ponds	Raster_Calculator	Output
Watershed area (10^4 m^2)	25	Con("Farm_Area" <= 25,1)	Farm_Area



Make sure the Farm_Area is added in the viewer, go to the *Spatial Analyst* >> *Raster Calculator*. The *Raster Calculator* window will open.

Structure	Farm ponds	Raster_Calculator	Output

Storage loss	Low	Con((Con("Storage_Loss" <= 3,1) & (Con("Storage_Loss" >= 2,1))),1)	Storage_loss



Make sure the all output filesis added in the viewer, go to the *Spatial Analyst* >> *Raster Calculator*. The *Raster Calculator* window will open.

Check_Dam	"MWL_MAP_F_N" & "STR_L" & "farm" & "str_1" & "raster3"