
GIS 592
City of Portland
Landslide Risk Map
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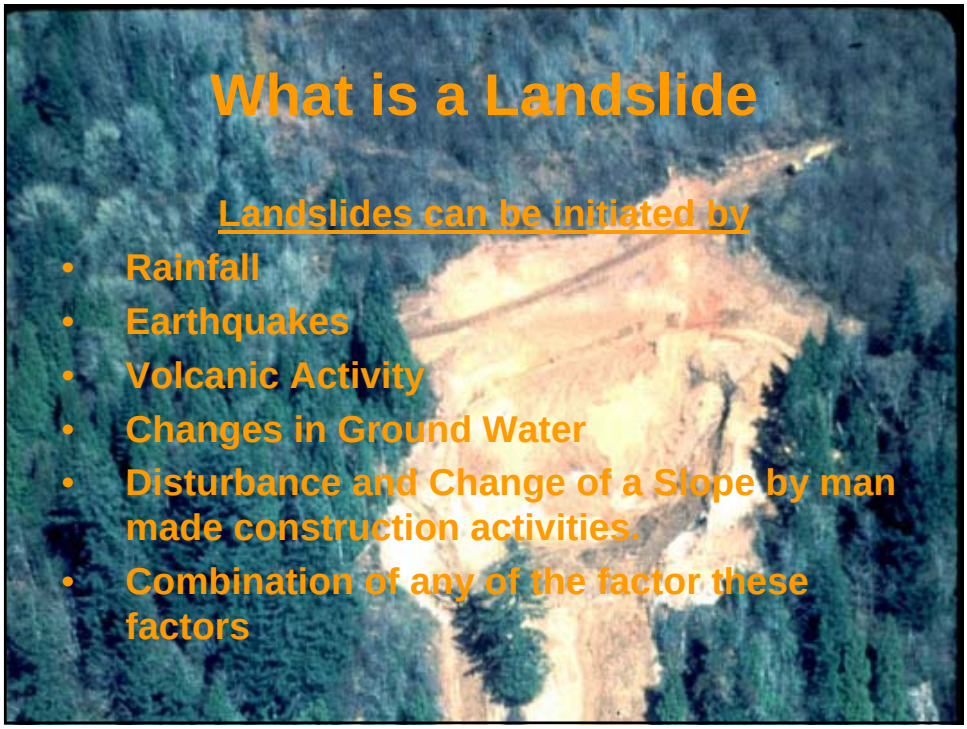
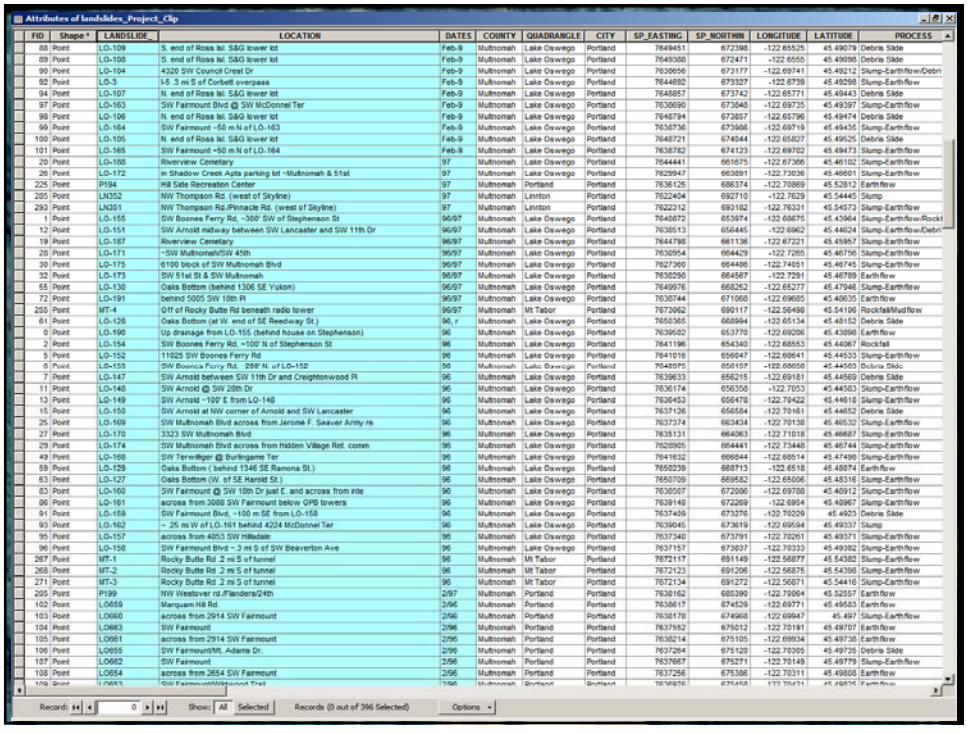
Purpose
• What factors cause landslides
• Create a model
• Test the model


What is a Landslide
Landslides can be initiated by
• Rainfall
• Earthquakes
• Volcanic Activity
• Changes in Ground Water
• Disturbance and Change of a Slope by man made construction activities.
• Combination of any of the factor these factors

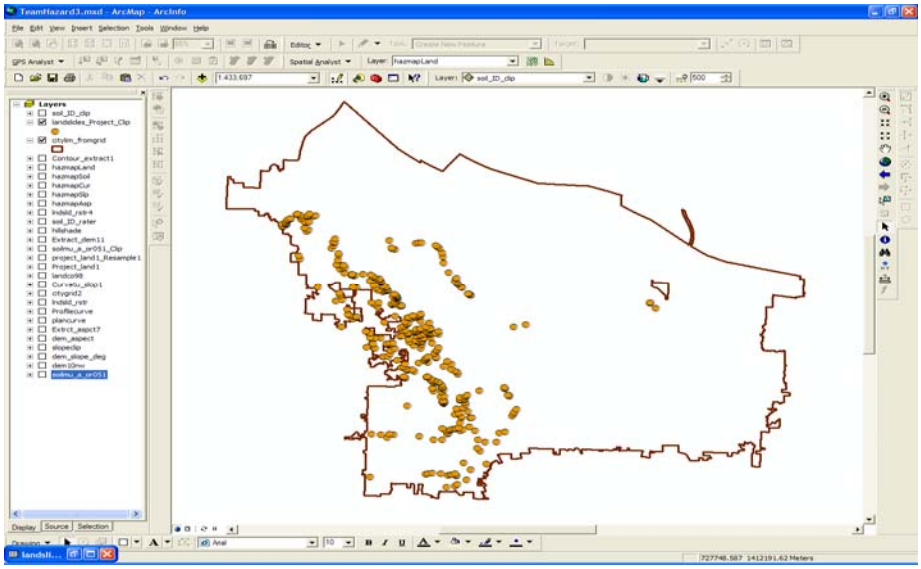

Data Sources
1. RLIS
• Boundary
• DEM
• Environment
• Water
2. Oregon Geospatial Data Liabrary
• Landslides

Data Issues-Restrictions

- Landslides
- Rainfall



Landslides within City of Portland



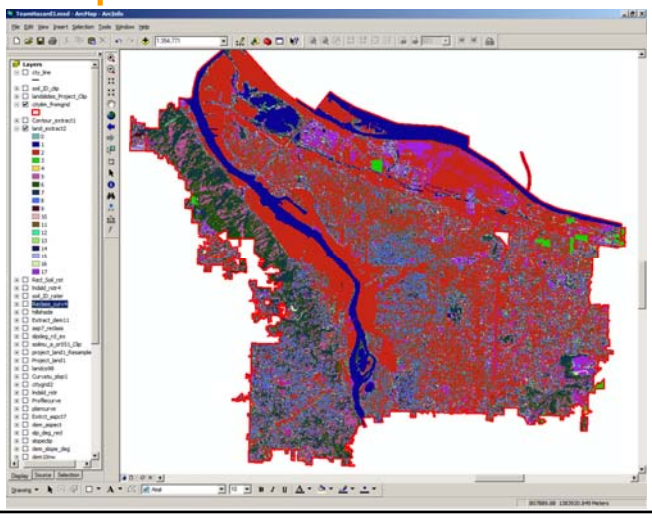
Process of Creating The Risk Map

Reclassification of Landslide Factors

- Slope- 10 degree increments yielding 9 classes.
- Aspect- 45 degree increments yielding 9 classes.
- Curvature- 2 classes – Positive/Negative.
  - Positive = upwardly convex
  - Negative = upwardly concave

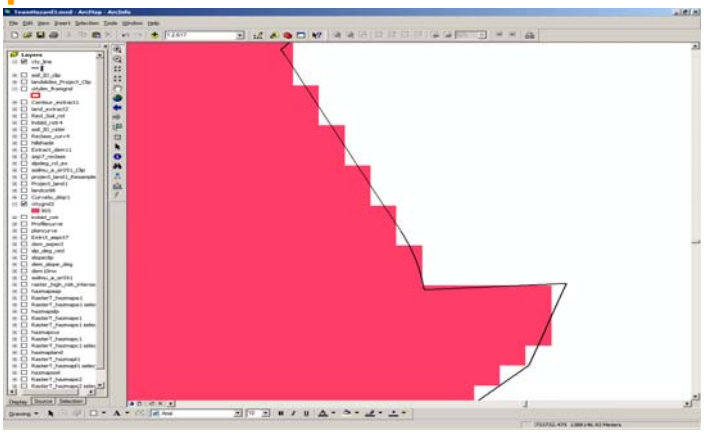
Landcover

- Landcover – original cell size was 82 feet. Resampled to the cell size of the DEM.

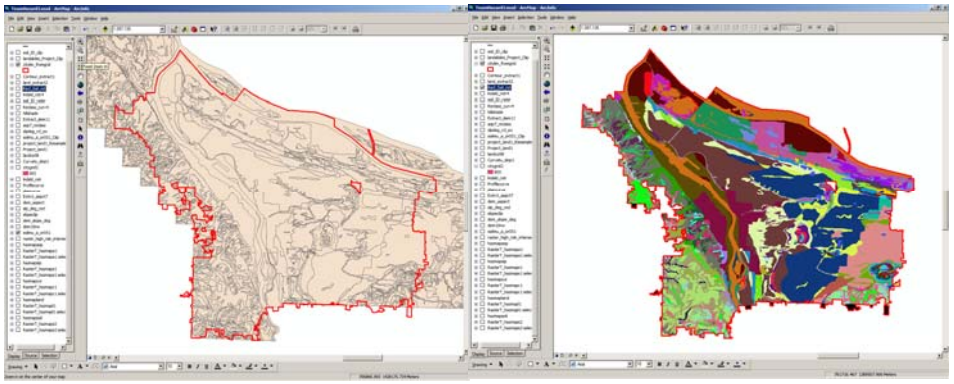


Study Area

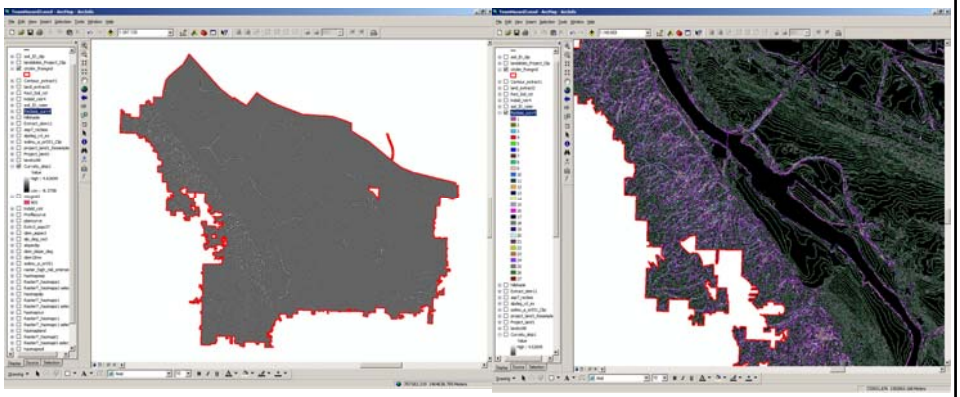
- City Shape file Rasterized
- Boundary created from city and snapped to DEM.



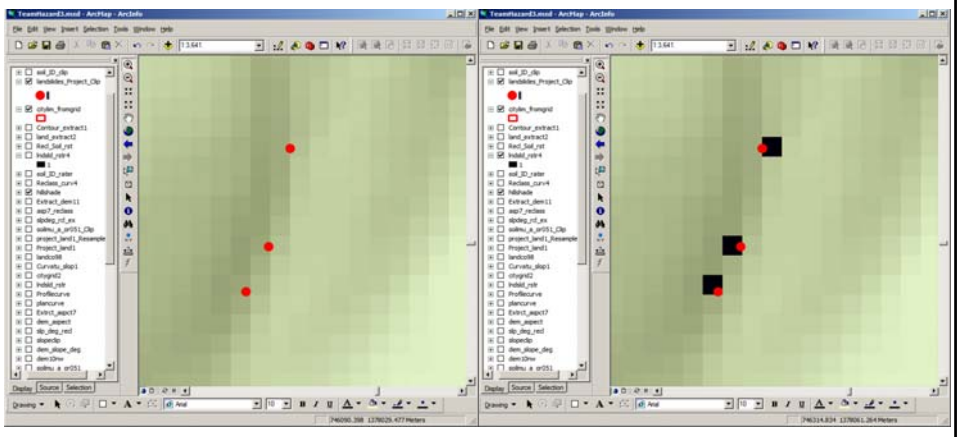
Soil Rasterized & Reclassed



Curvature Reclassed



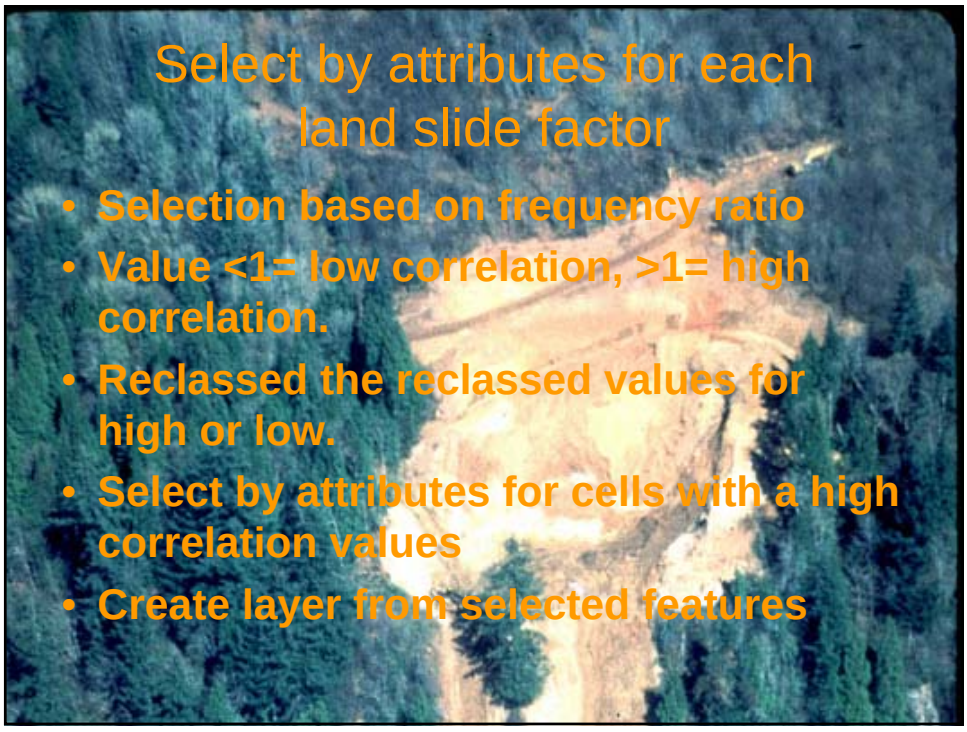
Landslide Points Rasterized



Aspect	Class			value (degrees)	total # pix in class	% total pix in class	# pix showing LS	% Pix showing LS	Frequency Ratio	Hazard Map	Correlation
		1	Flat	-1 - 0	1,097,489	29.25%	0	0.00%	0.00	1	low
		2	NE	000 - 45	440,474	11.74%	41	10.35%	0.88	1	low
		3	ENE	045 - 90	286,799	7.64%	53	13.38%	1.75	2	high
		4	ESE	090 - 135	282,868	7.54%	57	14.39%	1.91	2	high
		5	SSE	135 - 180	343,561	9.16%	68	17.17%	1.88	2	high
		6	SSW	180 - 225	435,593	11.61%	44	11.11%	0.96	1	low
		7	WSW	225 - 270	282,812	7.54%	40	10.10%	1.34	2	high
		8	WNW	280 - 315	287,346	7.66%	43	10.86%	1.42	2	high
		9	NNW	315 - 360	295,023	7.86%	50	12.63%	1.61	2	high
	Total				3,751,965	100.00%	396	100.00%		15	1.63

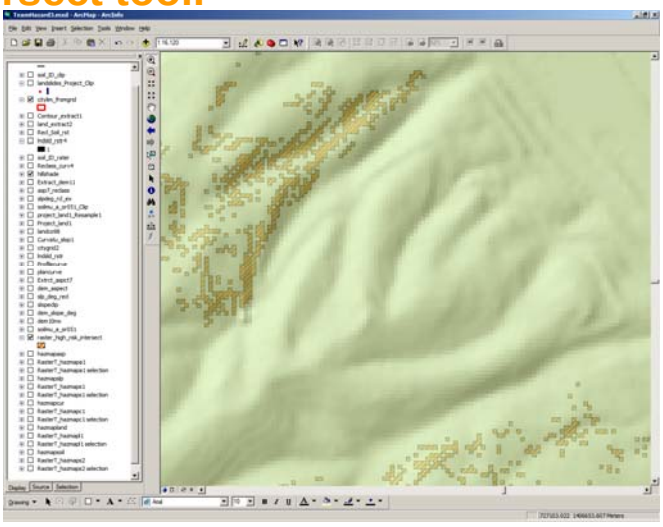
Slope	Class	value (degrees)	total # pix in class	% total pix in class	# pix showing LS	% Pix showing LS	Frequency Ratio	Hazard Map	Correlation
	1	00-10	3,200,388	85.30%	105	26.52%	0.31	1	low
	2	010-020	368,608	9.82%	132	33.33%	3.39	2	high
	3	20-30	139,772	3.73%	88	22.22%	5.97	2	high
	4	30-40	37,523	1.00%	62	15.66%	15.66	2	high
	5	40-50	5,361	0.14%	8	2.02%	14.14	2	high
	6	50-60	313	0.01%	1	0.25%	30.27	2	high
	Total		3,751,965	100.00%	396	100.00%		11	1.83

Curvature	Class	value	total # pix in class	% total pix in class	# pix showing LS	% Pix showing LS	Frequency Ratio	Hazard Map	Correlation
	13	-2.5 - -2.0	3,103	0.08%	1	0.25%	3.05	2	high
	14	-2.0 - -1.5	7,458	0.20%	6	1.52%	7.62	2	high
	15	-1.5 - -1.0	20,847	0.56%	14	3.54%	6.36	2	high
	16	-1.0 - -0.5	126,363	3.37%	61	15.40%	4.57	2	high
	17	-0.5 - 0.0	2,329,018	62.07%	116	29.29%	0.47	1	low
	18	0.0 - 0.5	1,112,199	29.64%	97	24.49%	0.83	1	low
	19	0.5 - 1.0	116,009	3.09%	61	15.40%	4.98	2	high
	20	1.0- 1.5	25,069	0.67%	23	5.81%	8.69	2	high
	21	1.5 - 2.0	6,837	0.18%	7	1.77%	9.70	2	high
	Total		3,751,965	100.00%	396	100.00%			1.46

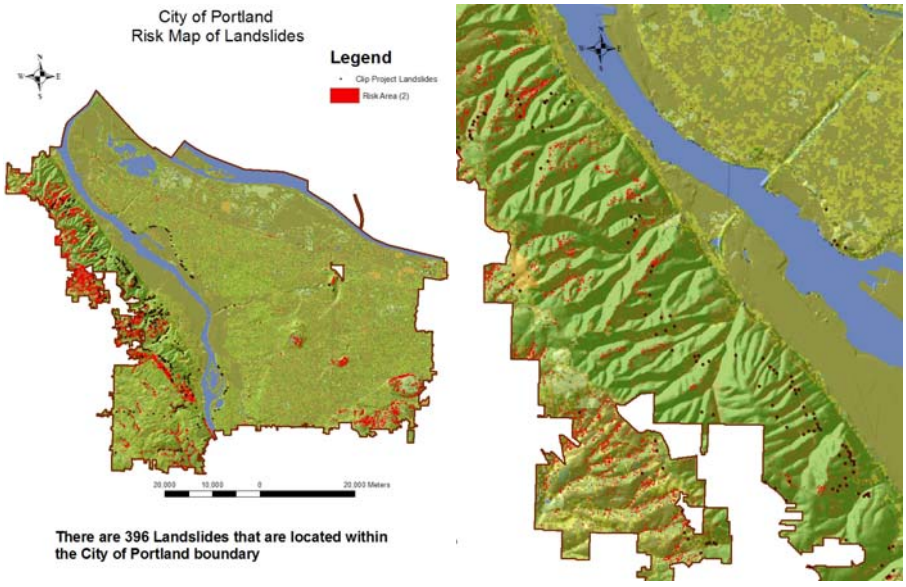


Intersect

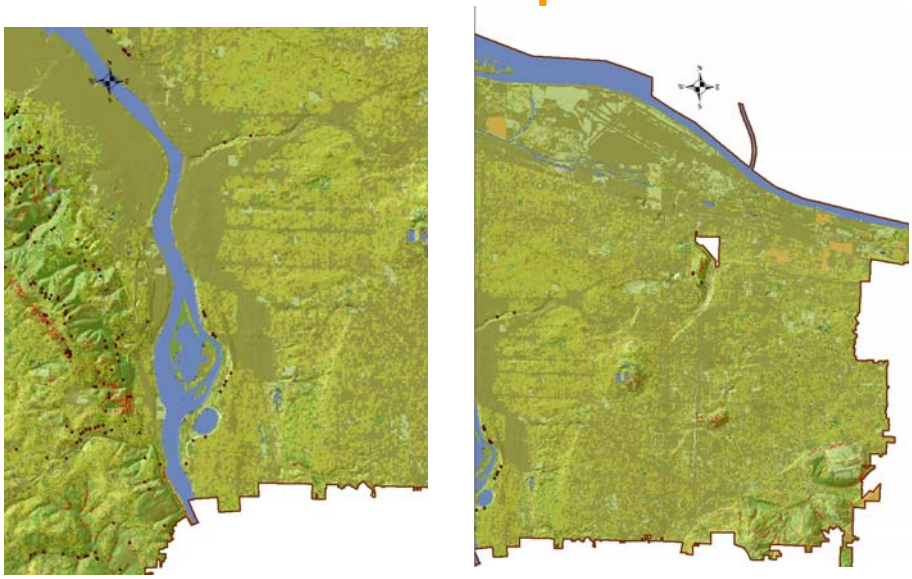
Combine new high correlation layer with intersect tool.



Risk Map



Risk Map



Guideline

- Goal:

  Evaluate efficiency of the risk model (frequency ratio, multi-criteria, weight factors, risk value map…)

- Method (18 slides)

- Reslut: T-test

Method

7. Project the landslide data

6. Create 200 feet buffer of all 396 landslides. (why 200ft?)

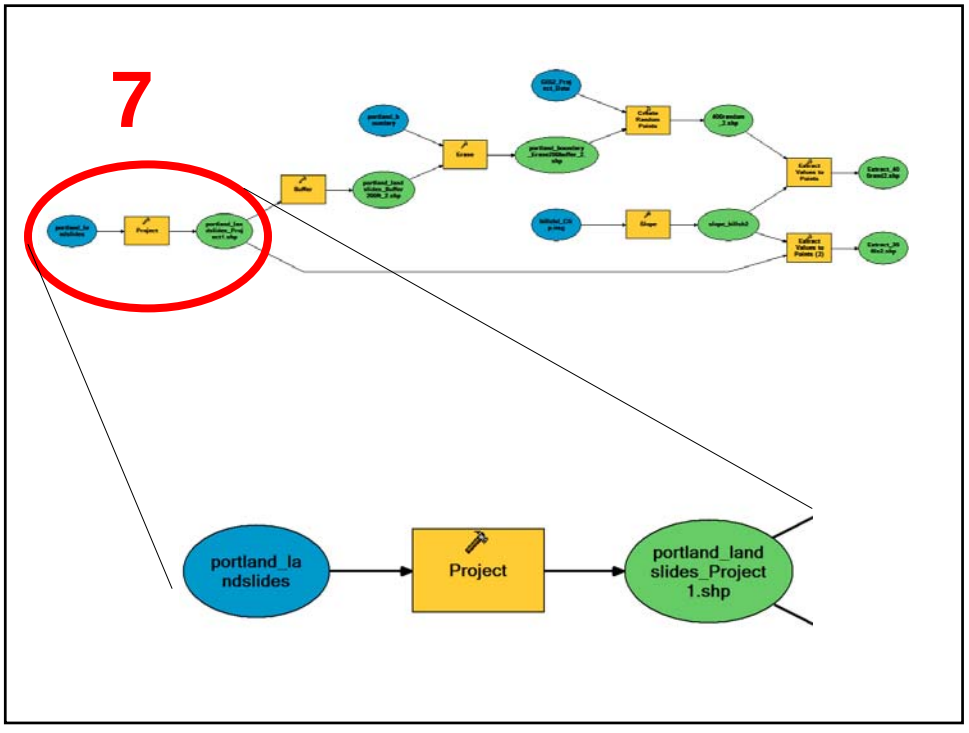
5. Create a polygon without the buffer areas

4. Create random points in the new polygon

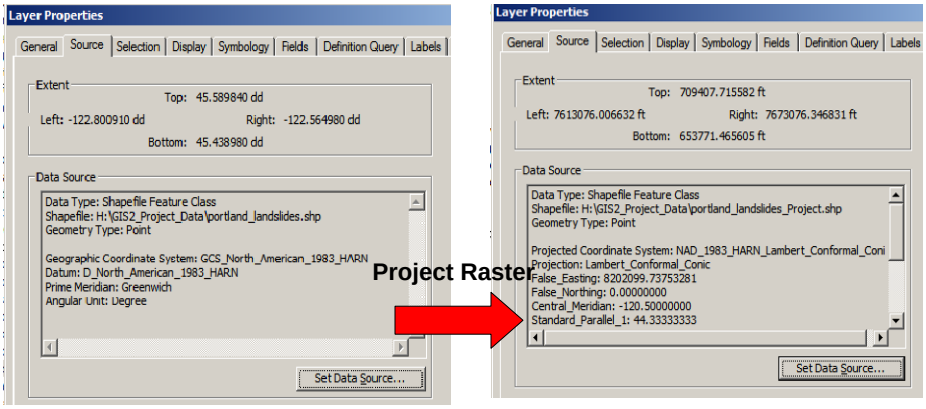
3. Calculate slope.

2. Extract risk value to each known landslide points and random point

1. Use T-test to evaluate the model: compare the risk values of all 396 known landslides and 400 random choose positions.

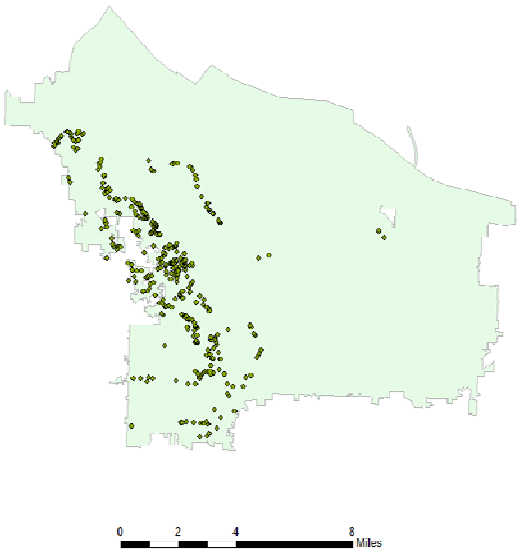


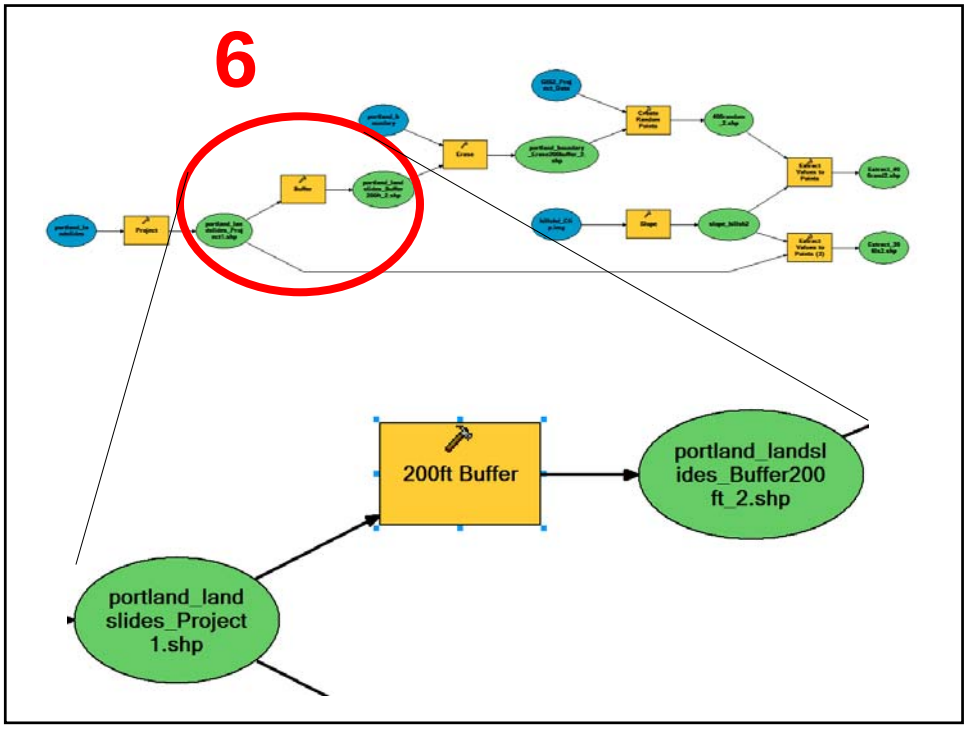
Project Raster *



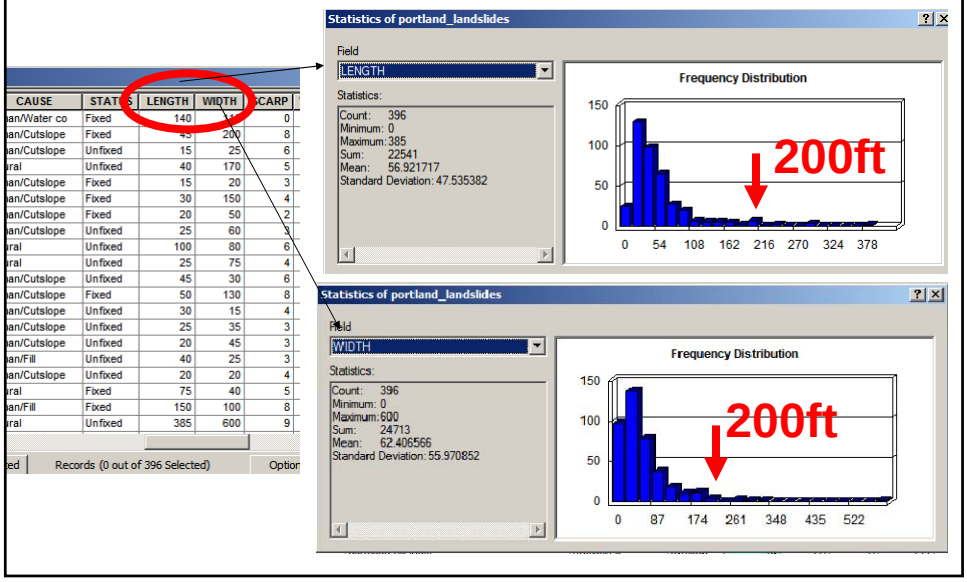
* The landslide data is not from RLIS and it needs to be projected to the map correctly.

Landslides in Portland

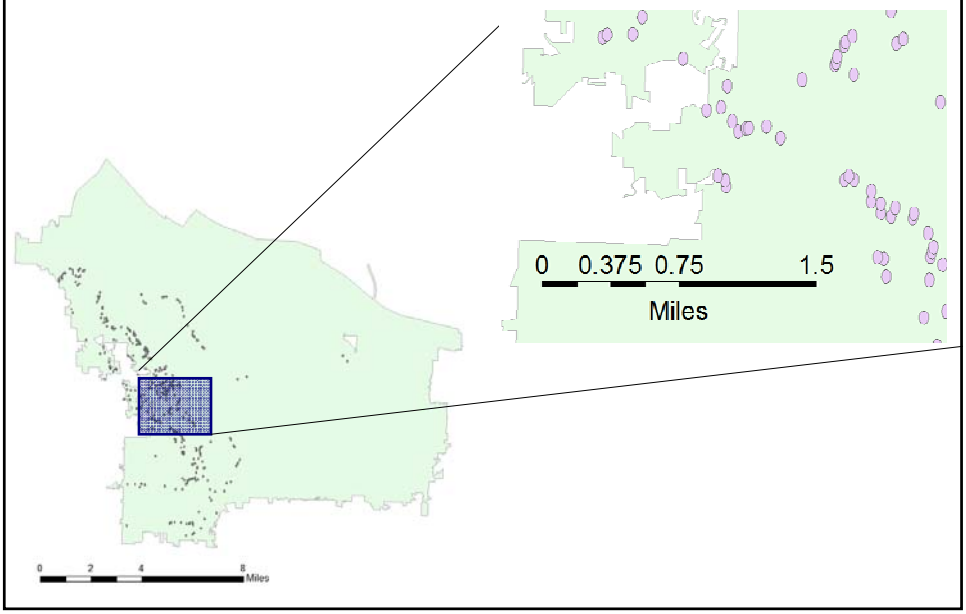


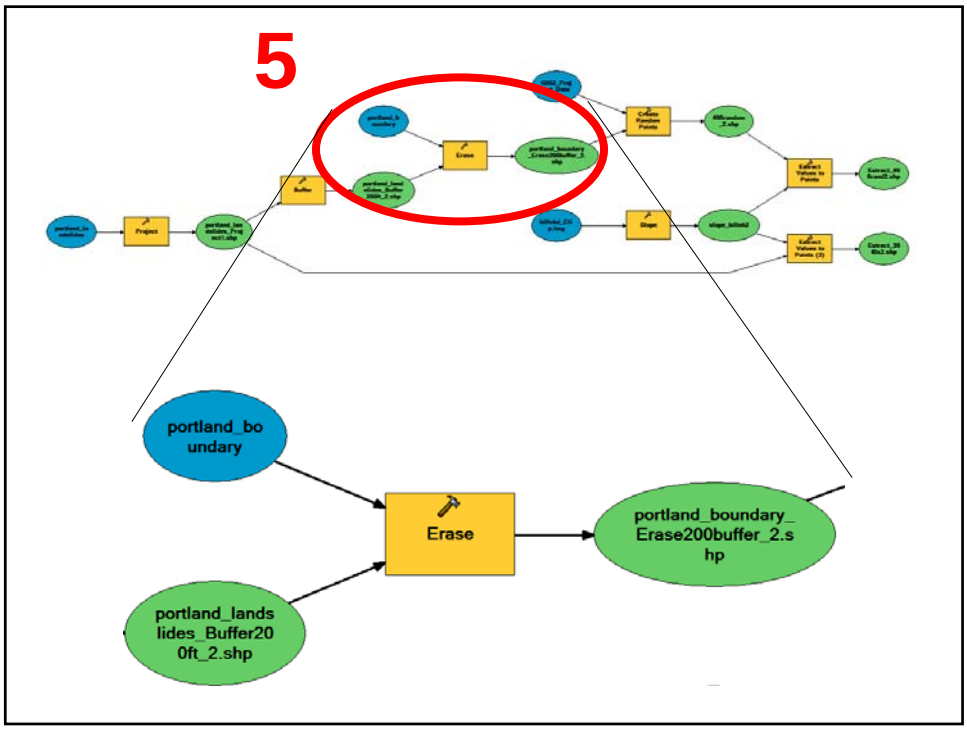


Why the buffer is 200 feet?

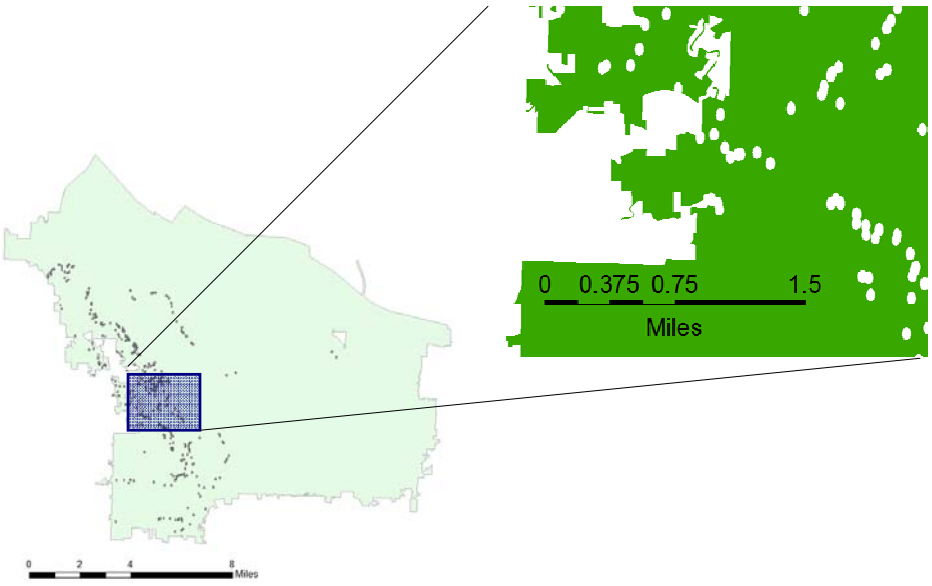


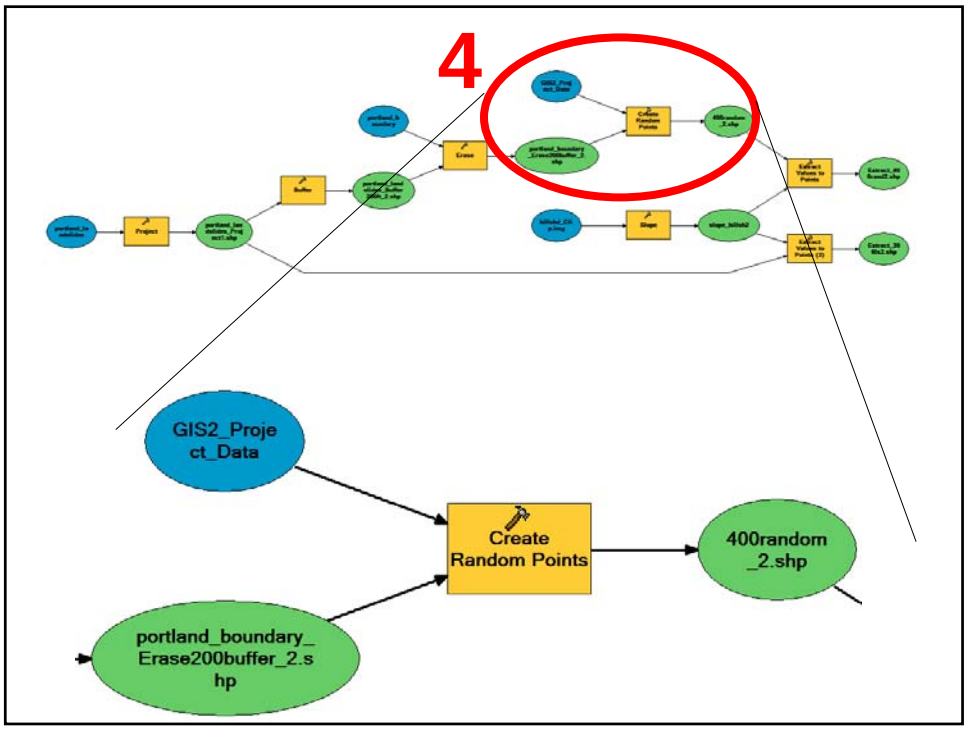
Create 200 feet buffer of landslide points



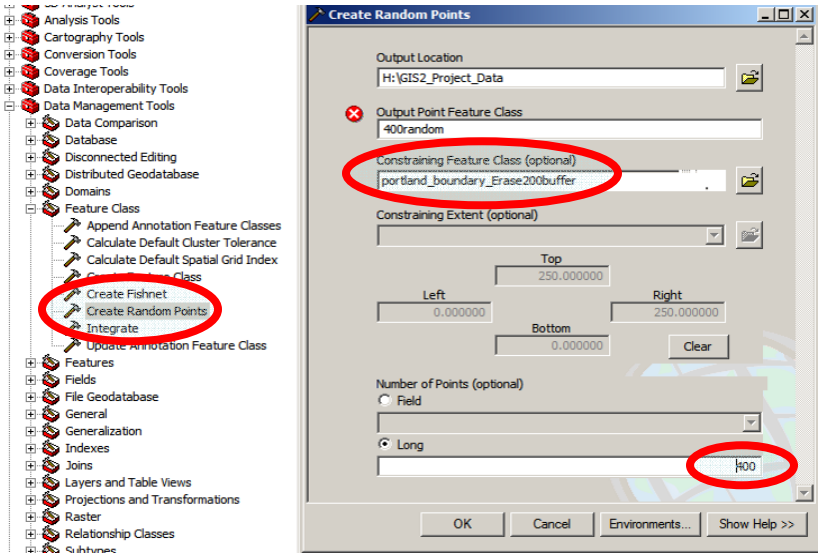


Remove the buffer areas

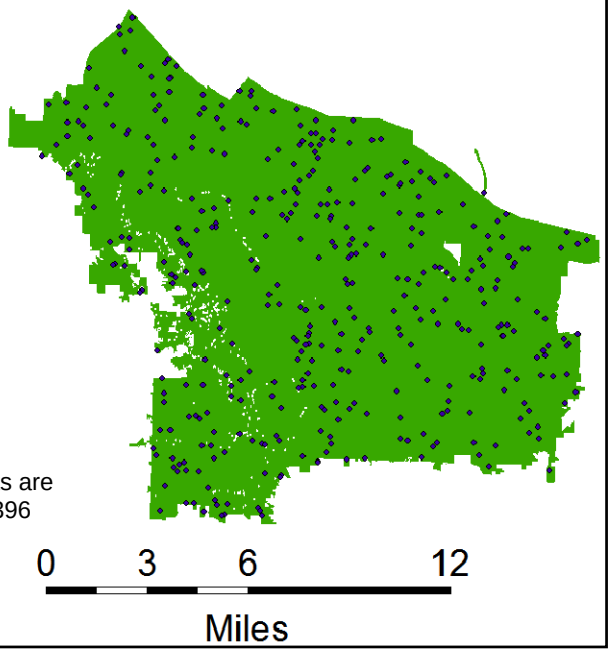




Create 400 random points



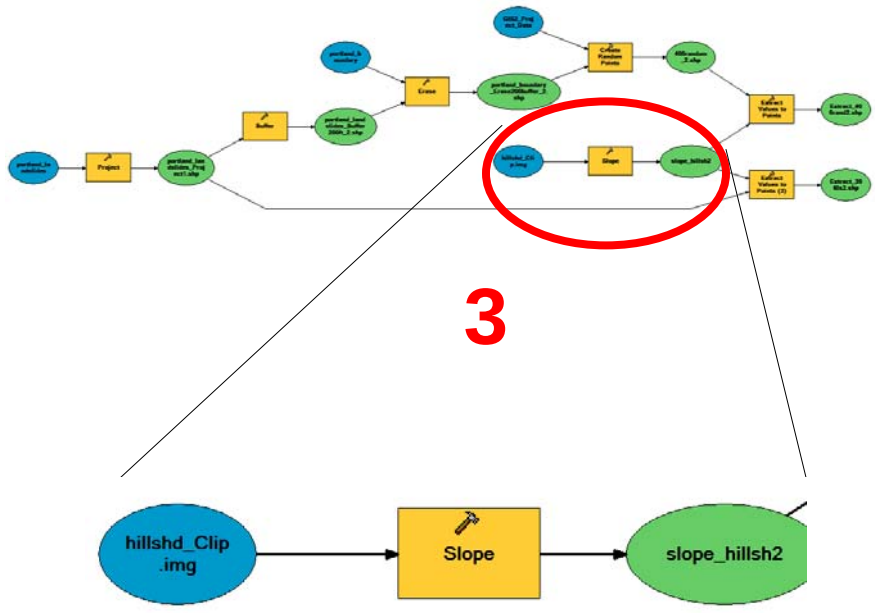
400 random points



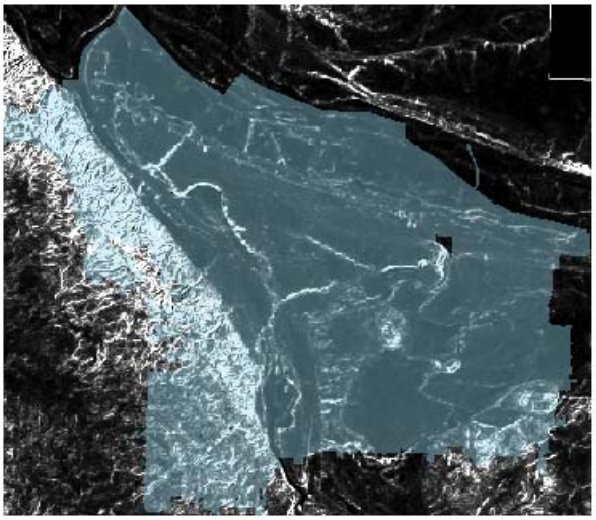
NOTE:
None of these 400 random points are in the 200ft buffer region of the 396 known landslide points.

Choose slope value as the ONLY risk value

	Correlation
Aspect	1.63
Slope	**1.83**
Curvature	1.46
Soil	1.26
Land cover	1.56



Slope in Portland



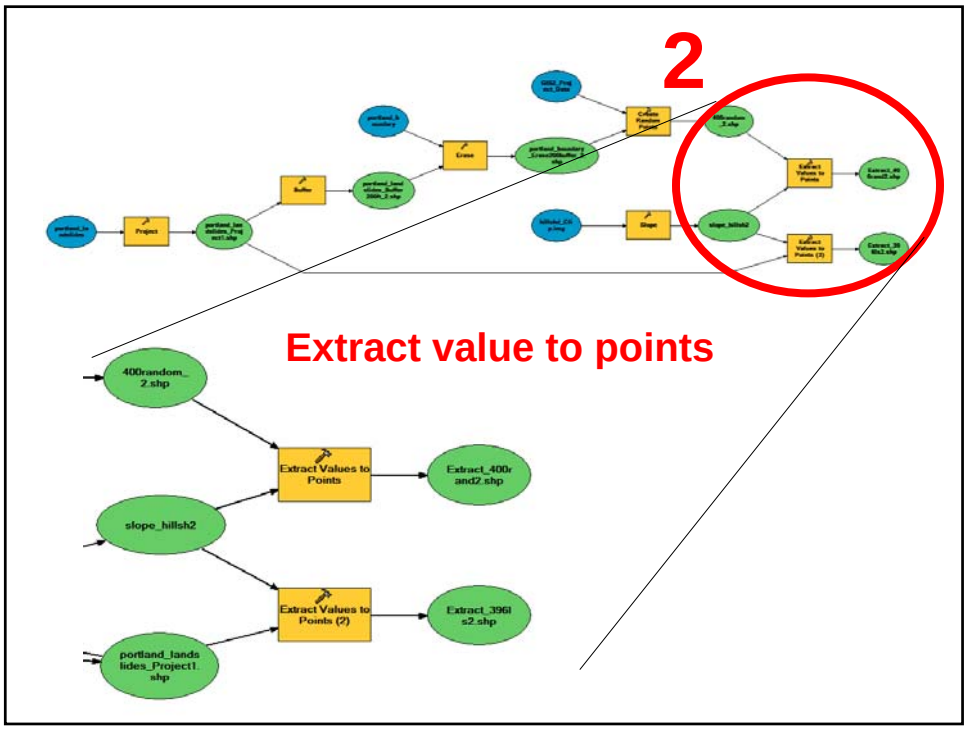
0 2 4 8

Miles

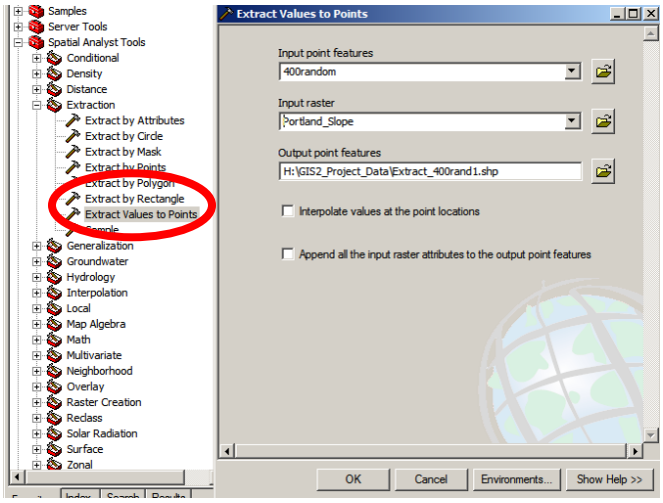
Portland_Slope

High : 68.8 degree

Low : 0 degree

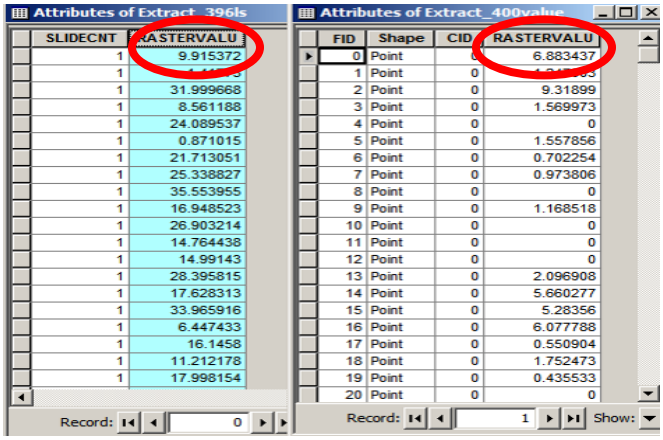


Extract value to points *



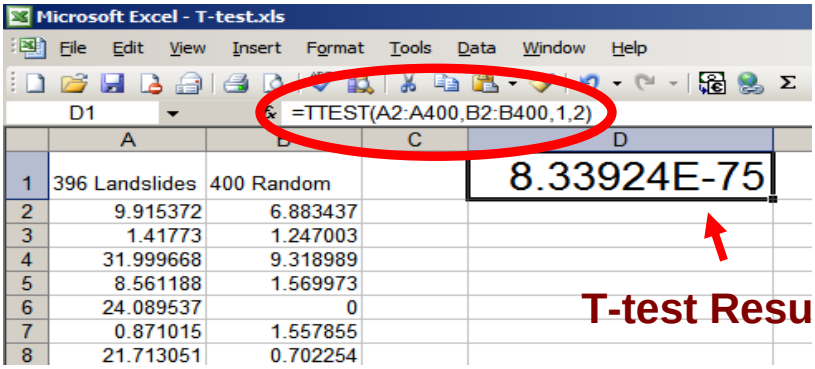
* Extract risk value to 400 random points and 396 known landslide points.

Extract value to points



Each data set was assigned a new column. This column shows the risk value of each point.

T-test *



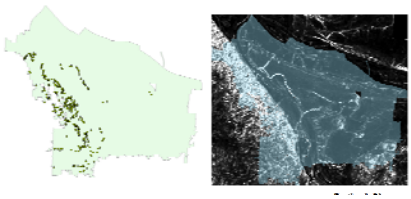
*

TTEST(**array1**,**array2**,**tails**,**type**)

Array1 is the first data set.
Array2 is the second data set.
Tails tails=1, TTEST returns the probability of a higher value of the t-statistic under the assumption that array1 and array2 are samples from populations with the same mean
Type is the kind of t-Test to perform. (Type3: Two-sample equal variance)

Conclusion

- The 10^-74 p value indicates that the two sets of samples are not from the same population. One set came from the "risk cell“ population and the other came from the "non-risk cell" population. Our risk model works.
- Slope is highly correlated with landslides



- The Model Builder can be used when the risk map is available.


Questions