Attachment 6

3/25/2009

Rural Reserves Natural Hazards Model

Background

This document is intended to provide documentation about the logic and procedures used to create the model of natural hazards in the Reserves project.

Based on Oregon Administrative Rule -**OAR 660-027-0060,** Factors for Designation of Rural Reserves, this model was developed to define locations that:

"(b) Are subject to natural disasters or hazards, such as floodplains, steep slopes and areas subject to landslides;"

Assumptions

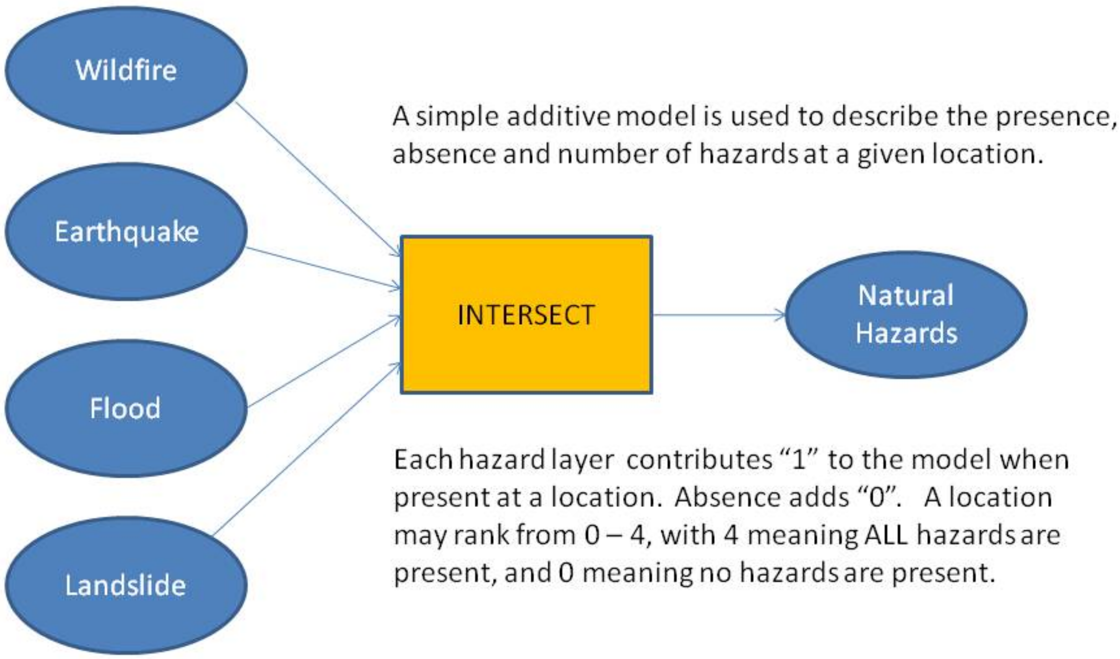
Given the relatively vague language in the requirements, the model is designed to be relatively simple. No assumptions have been made about the interdependence or relative importance of each of the individual hazard layers included in the model.

Each of the hazard layers that are included in the model were compiled by domain experts outside of Metro. Therefore, staff made no attempt to interpret or add "weight" to the inputs. The model is simply describing the presence or absence as well as the *number* of hazard types that exist at a particular location. *(NOTE: there is some complexity to be considered here; for example, while the floodplain is either in or out, the wildfire index is an expression of the danger to existing communities based on a number of factors. Another issue is how to treat landslides vs. slope failures. The former is an index of danger, the later a record of activity.)*

The model is additive: each layer can count up to a total of 1, and those that have gradation are modeled as a decimal number – up to a value of 1 – so that a layer with four categories (low, medium, high, highest) would receive a score of 0.25, 0.5, 0.75 and one respectively).

Processes

Hazard layers were collected from expert sources and loaded into the Geographic Information System (GIS). Each of the layers was projected into Metro's standard map projection (Stateplane OR North). They were then intersected to form a composite hazards dataset. Individual hazard layers are retained for further analysis as necessary. This process is illustrated in the figure below.



The final index is based on this simple additive principle and calculated in the final table resulting from the INTERSECT process. Since Flood hazard and Landslide hazard are binary (simply TRUE or FALSE) they will be assigned a hazard code of 1 for true, and 0 for false. Wildfire hazard is calculated according the weights described in the table below. The final index will range from 0 – no hazard present – through 4 – the presence of all hazards at a specific location. Earthquake data of sufficient detail were not available at the time of this analysis to create any nuance within the study area. For this reason, a weight of 1 was applied regionally. *Note that subsequent analysis was done using individual earthquake hazard attributes – liquefaction, amplification and slope instability in the portion of the study area that is in Clackamas County.*

Wildfire:

Code	Desc.	Percentage
0	Low	0.2
1	Low	0.4
2	Med	0.6
3	High	0.8
4	Very High	1.0

Proposed weighting scheme for relative wildfire hazards

Caveats: Earthquake Data

The Earthquake component of the regional model does not show any variation within the Metro region. While detailed studies were conducted in the region by DOGAMI the extent of the datasets created was limited to Metro's Urban Growth Boundary (UGB). The study area for the Reserves Project does not include the area inside of the UGB, and therefore does not include detailed earthquake hazard information. For the purposes of this model, statewide hazard data were applied. These values are consistent across the study area and include no variation. For that reason, a value of 1 is applied to the whole study area. As noted above, in a separate analysis using county-specific data, Clackamas County was mapped showing individual elements of the relative earthquake hazard data. Please see the Appendix for more information regarding this analysis.

Output

The final output of the model is a map and an integrated GIS shapefile/database with attribute columns summing up the individual and all hazard codes.

WFIRE_CODE	FLOOD_CODE	LS_CODE	EQ_CODE	ALL_HAZCODE
0.0 -1.0	1 or 0	1 or 0	1 only	0.0 – 4.0

Sources

Flood plains

100 Year Flood Plain as delineated by the Federal Emergency Management Association (FEMA). Digitized by the Portland Office of the Army Corps of Engineers, 1992.

In 2001, data was updated based on local input as part of the Goal 5 process by Metro.

In 2004, Tualatin Basin flood plain data was integrated by Metro.

Earthquake

USGS, August 1997

File name: uspga100 - PGA with 5% PE in 50 yrs

PE = probability of exceedance, PGA = peak ground acceleration
The attribute used in this study is **acc_val**:

Acceleration value in percent of gravity of the polygon. The polygon represents the range of acceleration values that are contained within its borders. The polygon is assigned the lowest value allowed within the polygon's borders. The range of values allowed within a polygon is controlled by the contours.

Landslide

Oregon Department of Geology and Mineral Industries, 2002

Attribute used in this study is RML_Hazard:
Area is a potential rapidly moving landslide hazard zone.

Wildfire

Oregon Department of Forestry, 2006

Community at Risk: Hazard Rating for Wildfire Risk

Appendix

<u>Relative Earthquake Hazard Map (source/disclaimer):</u>

Relative Earthquake Hazard Areas determined by Clackamas County GIS staff basedon data developed by the Oregon Department of Geology and Mineral Industries (DOGAMI).The relative earthquake hazard map integrates four separate earthquake hazard components:

amplification (of ground shaking by a "soft" soil column), liquefaction (of water-saturated sand, creating areas of "quicksand"), instability of slopes (triggered by the shaking of the earthquake), and historic landslides. It delineates areas that likely will experience the greatest effects from any earthquake. The map predicts the tendency of a site to have greater or lesser damage than other sites in the area. It does not depict the absolute degree of earthquake hazard at any site, which means that in any given earthquake it is possible that damage in even the highest relative hazard category will be light. Conversely, in a severe earthquake even the lowest relative hazard category could experience severe damage. The areas depicted should not be used as the sole basis for any type of restrictiveor exclusionary policy.

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In order to create the relative earthquake hazard areas, the four data layers that were provided by DOGAMI had to be reclassified into the same four categories (0-3 representing "None/Very Low", "Low", "Moderate" and "High). The liquefaction layer came to us this way so nothing was done with the liquefaction. The historic landslides were either present or absent so they were assigned a "0" for absent and a "3" for present. The slope stability layer is a combination of soils and slope. This was created as 6 classes (0-5). Here 0/1 became 0 (or None/Very Low), 2 became a 1(Low), 3 became a 2 (Moderate), and 4/5 were combined to become a 3 (High). Amplification started as a 1-3 or Low, Moderate and High. Amplification was initially reclassed in a way to downplay its significance in the overall equation. Low became 0 or Very Low, and High was combined with Moderate as a 2. This still gave too much weight to amplification (according to Jon Hoffmeister at DOGAMI). The second time High was given a 2, Moderate a 1, and Low a 0.   The concern was that liquefaction and landslide hazards were being diluted based on fairly consistent ground shaking amplification hazards. (It should be noted that this combined grid is a helpful starting point, but that one should check the individual layers for more detail on the particular source of the hazard.)

Once the four layers had been reassigned into the classes of 0-3, we simply took the "MAX" of the four to created the relative earthquake hazard grid. Basically, the highest value of any of the layers was carried over to the final grid.