

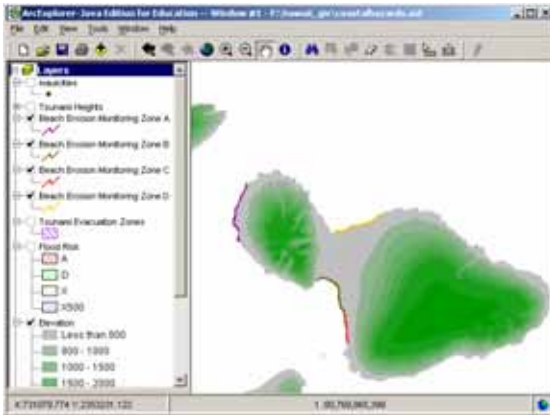
# Stay Clear: Coastal Hazards on Maui

## Lesson Overview


In this activity, learners will explore and analyze the spatial relationships between elevation, flood risk, historical tsunamis, and beach erosion in Maui and throughout Hawaii.

## Student Instructions

Start ArcExplorer and access the menu File→ Open to open the project “coastal\_hazards\_lesson.axl” from the folder that your instructor directs you to. You should see a map that looks like the image below:



This map shows Maui elevation and 4 beach erosion study areas. These areas were mapped by Makai Ocean Engineering, Inc., and Sea Engineering, Inc., in June 1991 using historical aerial photography taken from 1955 through 1988.

Turn on and off each of the beach monitoring zones. Use the zoom in tool  to draw a box around the areas you wish to examine more closely. You can always go back to

### Geography Standards

- How to use maps and other geographic representations, tools, and technologies to acquire, process, and report information from a spatial perspective.
- The physical & human characteristics of places.
- The process-patterns-functions of settlement.
- How physical systems affect human systems.

### Science Standards

- Science in Social Perspectives: Types of Resources.
- Motions and Forces
- Populations and Ecosystems
- Change, Constancy, and Measurement
- Structure of the Earth System
- Environmental Quality
- Science and Technology in Local, National, and Global Challenges

### Mathematics Standards

- Understand measurable attributes of objects and the units, systems, and processes of measurement.
- Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.
- Problem-solving, reasoning and proof, communication, and representation.


### Environmental Studies Standards

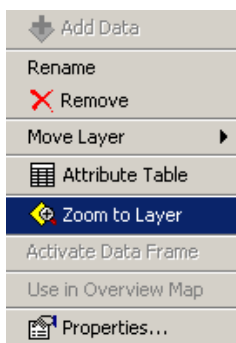
#### Historical Thinking Standards

- Historical Analysis and Interpretation: Consider multiple perspectives
- Historical Issues-Analysis and Decision-Making: Formulate a position or course of action on an issue.

#### Technology Standards

- Students demonstrate sound understanding of the nature and operation of technology systems and are proficient in the use of technology.
- Students develop positive attitudes toward technology uses that support lifelong learning, collaboration, personal pursuits, and productivity.
- Students use technology to enhance learning, increase productivity, and promote creativity.
- Students use productivity tools to collaborate in constructing models, prepare publications, and produce other creative works.
- Students use a variety of media and formats to communicate information and ideas effectively to multiple audiences.
- Students use technology to locate, evaluate, and collect information from a variety of sources.
- Students use technology tools to process data and report results.
- Students use technology resources for solving problems and making informed decisions.
- Students employ technology in the development of strategies for solving problems in the real world.

the full extent of your map layers using the globe  tool. You can zoom to the extent of each map layer by right-clicking on the layer and selecting “zoom to layer”, as follows:



- 1) Why is beach erosion one of the top global concerns?
- 2) Indicate which coast of Maui (north, west, southwest), on which each of the monitoring zones is located in the table below:

<u>Zone</u>	<u>Coast</u>
A	
B	
C	
D	

Turn on the Maui cities layer by checking the box to the left of the layer name.


- 3) How can humans cause beach erosion to become worse than it would be naturally?
- 4) According to the map, what is the relationship between the location of population centers and areas of beach erosion? Why?

Examine the elevation layer on Maui.

- 5) Do you think the elevations are in feet or meters? Why?

Examine coastal areas.

- 6) What would a beach look like where the elevation is high a short distance from the ocean? What would a beach look like where the elevation is low as you move in from the beach? Why?
- 7) According to the locations of the beach monitoring zones and the elevation on Maui, which types of beaches seem to be a concern for erosion—beaches near low, flat ground or beaches that are near steep slopes? Why?

8) Use the measure tool  and drag a line along each of the beach erosion monitoring zones—A, B, C, and D—to measure its length in kilometers. Which is the longest beach erosion monitoring zone? Which is the shortest?

9) Turn on the Tsunami Evacuation Zones layer. What is the relationship between the evacuation zones and the location of beach erosion monitoring zones? Why?

10) Which of the 4 major Maui communities shown on the map are in a tsunami evacuation zone?

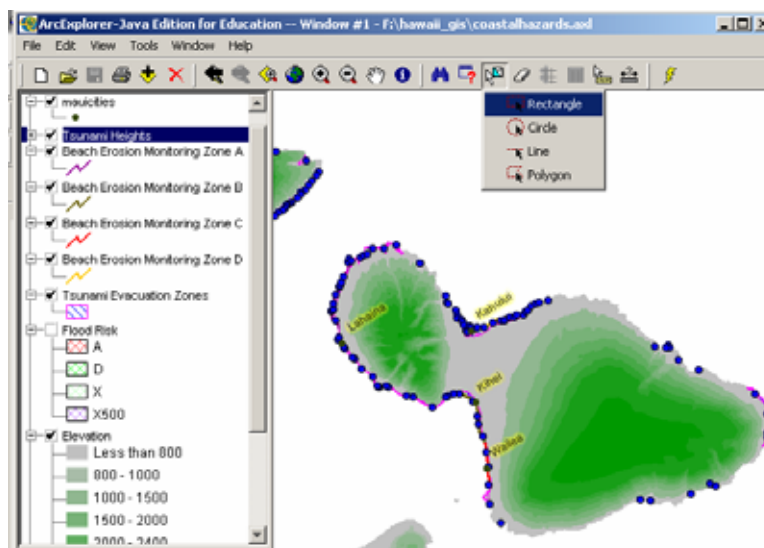
11) Do you live in a tsunami evacuation zone? Do you know what to do in the event of a tsunami evacuation warning?

Next, make the Tsunami Heights map layer visible. This layer shows locations of tsunami waves in Hawaii at various locations from the 1946, 1952, 1957, 1960 and 1964 tsunamis, compiled from "*Tsunami Wave Runup Heights In Hawaii*," by Harold G. Loomis, 1976.

With the Tsunami heights layer highlighted, right click on the layer and open the attribute table. Scroll to the bottom and look at the left-most number. This shows the number of tsunami locations in Hawaii.

12) How many tsunami heights are recorded in this database? Does the number surprise you?

With the Tsunami heights layer highlighted, use the "select features" tool, as shown below, and draw a rectangle around Maui.



After selecting the Maui tsunamis, right click on the Tsunami Heights layer and open the attribute table as you did earlier.

13) How many tsunami readings were recorded in Maui?

14) What percentage of all of the tsunami heights in the database (Hawaii) have been recorded on Maui? Show your work.

Next, turn the flood risk map. This map was compiled by the Federal Emergency Management Agency (FEMA) from Digital Flood Insurance Rate Maps (DFIRMs). The letters in the map legend correspond to the flood hazard zone, as explained below:

- A Zone A (1% Annual Chance/100 Year Floodplain)  
These areas have a 1% chance of flooding each year.
  
- D Zone D - An area of undetermined but possible flood hazards.
  
- X500 Zone X (0.2% Annual Chance/500 Year Floodplain)  
These areas have a 0.2% chance of flooding each year;  
or an area protected by levees from 1% annual chance flooding.
  
- X Zone X  
An area that is determined to be outside the 1% and  
0.2% annual chance floodplains.

15) Estimate the percentage of all the land on Maui that are in each zone:

A:

D:

X500:

X:

16) From what 2 main sources can land on Maui become flooded?

17) What is the relationship between elevation and flood risk? Why?

18) What is the relationship between tsunamis and flood risk? Why?

19) Present the results of your investigations from this lesson to the class in a 5-minute oral report. Use the maps and data you have been studying in your presentation. Include in your presentation what you think we should do in the future with regard to protecting Maui's residents from flooding and where these efforts should be concentrated.

