

Land Use Change

Part 1: Making Predictions

Look at the five Land Use Change Image pairs carefully. Predict what type of **changes** you think each image pair shows. [**Helpful hint:** How are the images different?]

Answers will vary. Actual answers below. Refer to the Land Use Change – Explanation Guide for additional details.

Site #1: City growth in all directions. Loss of desert land area. Increase in urban and suburban areas.

Site #2: Increased city area, development of a large harbor, and the construction of the Palm Islands in the Persian Gulf - the largest human-made islands in the world.

Site #3: The coastline has become bare of vegetation and man-made structures.

Site #4: Areas of the city have been flooded.

Site #5: Vegetation is destroyed by pumice and ash followed by vegetative regrowth.

Part 2: Exploring land use change in natural-color and false-color images

Background information review:

A **natural-color composite image** consists of blue, green, and red visible light portrayed in a natural manner. The appearance of the image often resembles a color photograph. Active vegetation appears green, bare soil and fallow (not cultivated) fields are brown, urban structures are white, and clean water is often blue.

A **false-color composite image** consists of green, red, and near-infrared light portrayed in a false-color manner. Active vegetation appears red-pink, bare soil and fallow (not cultivated) fields are green, and urban structures are bluish-white. Clean water bodies appear black.

Residential areas, however, may have a speckled appearance of light blue/white and red. The light blue/white indicates buildings and pavement, and the red indicates the grass and trees that may line the streets and surround places where people live.

Helpful hints to identify features in false-color images:

- Red represents actively growing green vegetation. A large red area could be a forest.
- Black represents water. Black areas may be oceans, lakes, ponds, or rivers.
- Green usually represents fields in agricultural areas.
- Blue-white represents urban areas.

Site #1:

Site #1 displays **false-color composite images** of the Las Vegas area in 1972 (left image) and 1992 (right image). Each image is approximately 26 miles wide.

1. What types of land cover features can you identify in these images? Support each claim with evidence. **Hint:** Remember to think about tone, size, texture, pattern, site, or association in the image.

Responses will likely vary. The tip of Lake Mead is visible east of the city (black color). Pre-construction land appears medium gray-green in the Landsat image. This color comes from sparse desert vegetation, reddish soils, and stone darkened by an inorganic patina of oxidization. An old neighborhood appears dark, brownish red from the mature trees and more grass. In these false-color images, photosynthesizing vegetation always adds a red tint. Golf courses appear bright red because they are the most intense vegetation. New courses tend to be mixed into residential developments while older courses tend to be separate.

2. What do you think is the black color in the image pairs?

Water. The tip of Lake Mead is visible east of the city.

3. Bright red areas occur in many places in the 1992 image. What might these areas be?

Golf courses.

4. What color do you think represents residential neighborhoods?

An old neighborhood appears dark, brownish red from the mature trees and more grass. In these false-color images, photosynthesizing vegetation always adds a red tint.

5. How has the Las Vegas area **changed** from 1972 to 1992? Support your answer with **evidence** from the image pairs.

The city of Las Vegas has significantly grown in 20 years. There is much more colored areas in the 1992 satellite photo that was once barren desert land in the 1972 photo. This is an expanded city area.

6. The population of Las Vegas in 1992 was 863,000. The projected 2008 population is 2,156,313. Lake Mead, Las Vegas's main water source, is shrinking. How should further development occur to conserve water? What could communities do to help conserve water?

Water conservation practices by communities are important for continued development. Community water conservation practices may include water rations, encouraging desert landscaping instead of growing grass in yards, and installing low flow plumbing fixtures.

Site #2:

Site #2 displays **false-color composite images** of the city of Dubai in 1973 (left image) and 2006 (right image). Dubai is located on the Persian Gulf coast in the northern part of the United Arab Emirates in the Middle East. Each image is approximately 13 miles wide.

7. Describe **four features** in the 2006 image that are **not** present in the 1973 image.

The Palm Islands (palm-shaped structures in the Persian Gulf), the Jebel Ali Harbor (prominent black color on the inland coast), more roads, and an expanded city area.

Dubai is one of the fastest-growing cities in the world. The population of Dubai in 1985 was 183,000. The population in 2006 was 1,200,000.

8. Notice the "Palm structures" located in the Persian Gulf in the 2006 image. What do you think these might be?

These are the Palm Islands, the largest human-made islands in the world. The palm-shaped structure displays 17 huge fronds (leaves) framed by a 12-kilometer protective barrier. When completed, this resort area will include 2000 villas, 40 luxury hotels, shopping centers, cinemas, and other facilities and is expected to support a population of approximately 500,000 people.

Site #3:

Site #3 displays **true-color composite images** of the Aceh Province in Indonesia. The Aceh Province is located on the northern end of Sumatra (part of Indonesia). Each image is approximately 37 miles wide.

9. What major changes do you observe between the two images? **Hint:** Remember to think about tone, size, texture, pattern, site, or association in the image.

The image pair shows that the western coastal area changed from a green to brown color. This brown area is bare, exposed coastal area. Vegetation and man-made structures on the coast that appear in the December 13 image are not present in the December 29 image. Clumps of white color appear inland on the December 29 image. These are low-lying cumulus clouds.

10. What type of natural event do you think might have caused such changes?

Tsunami.

Site #4:

Site #4 displays **true-color composite images** of the New Orleans and Lake Pontchartrain area. Each image is approximately 37 miles wide. New Orleans sits between Lake Pontchartrain and the Mississippi River.

11. What color is the city of New Orleans in the April 2000 image?

The city appears a pinkish shade in the April 2000 image.

12. What color is the city of New Orleans in the August 2005 image?

These flooded portions of the city appear a dark blue color in the 2005 image.

13. What major changes do you observe between the two images? **Hint:** Remember to think about tone, size, texture, pattern, site, or association in the image.

The blue color (water) has expanded into previous land areas.

14. What type of natural event do you think might have caused such changes?

Flooding resulting from a hurricane.

Site #5:

Site #5 displays three **true-color composite images** of the Mt. St. Helens area in Washington. Each image is approximately 35 miles wide.

15. What **major changes** do you observe between the three images? **Hint:** Remember to think about tone, size, texture, pattern, site, or association in the image.

A large white area appears in the 1980 image.

16. What type of **natural event** do you think might have caused the observed changes between the 1972 image (left image) and the 1990 image (middle image)?

The three true-color composite images show the Mt. St. Helens volcano eight years before its 1980 eruption (left image), ten years after the eruption (middle image), and almost twenty years after the eruption (right image).

17. What type of **natural event** do you think might have caused the observed changes between the 1990 image (middle image) and the 1999 image (right image)?

Vegetation has regrown and has expanded its area closer to the volcano's peak.

Part 3: Applications

18. How can city planners use time-sequenced satellite images to plan for the future population growth of a city?

Answers will vary. City planners can use time-sequenced satellite images to observe effects of natural hazards in an area (for example, flooding) and plan to develop or not to develop in a specific area. Planners can observe features in areas and decide if such features (for example proximity to water) will facilitate infrastructure for the expanded population.

19. How can emergency management planners use satellite images to prepare for a natural disaster? Provide a specific example.

Emergency management planners can use satellite images to pinpoint hazards and begin to evaluate the consequences of potential emergencies or disasters. When hazards (earthquake faults, fire hazard areas, flood zones, shoreline exposure, etc.) are viewed with other map data (streets, buildings, residential areas, powerlines, storage facilities, etc.), emergency management officials can begin to formulate mitigation, preparedness, response, and possible recovery needs. In the case of a volcano or flood plain area, satellite images can be used to identify facilities (key bridges, primary roads, freeway overpasses, hospitals, hazardous material storage facilities, etc.) that located are in high hazard areas. Mitigation may include implementing legislation that limits building in hazard zones.