

recurrence intervals can be determined, design discharge velocities can be computed which would aid in design of flood channels and other hydraulic structures, and current hydraulic structures that may be causing constriction of the flow. The U.S. Geological Survey operates 7,000 streamflow gages in the United States and has compiled a complete proposal for installation of a realtime streamflow-gaging network for the basins upstream of Tegucigalpa as well as other strategic locations throughout Honduras. The proposal contains plans for installation of the network, calibration of required stage discharge relations, and training of in-country personnel for long-term operation and maintenance of the network. Total cost for this effort is \$750,000.

- *(Intermediate to Long Term)* Construction of upstream reservoirs in strategic locations also would be beneficial to alleviate flooding problems in Tegucigalpa. Portions of these reservoirs would be reserved for storage of floodwaters during flooding, which would alleviate flooding problems in Tegucigalpa. If needed, water supply/hydropower/recreation features could be incorporated in a multipurpose reservoir system. Hydrologic and hydraulic investigations would be required to determine the effectiveness of the system.
- *(Intermediate to Long Term)* In addition to the specific areas that have been identified in Tegucigalpa, there may be other areas that might be considered for relocation or non development based on the incidence of the much shallower debris flows that were triggered by the storm and destroyed property and infrastructure within the city. An inventory map of all landslides that occurred within Tegucigalpa coupled with a GIS-based analysis involving data layers, such as geology and Hurricane Mitch precipitation, may result in the delineation of other areas of high susceptibility. Judicious planning of future use would result in the saving of people and property in future extreme climatic events such as Hurricane Mitch. Such a landslide inventory and analysis for the Tegucigalpa area would cost approximately \$200,000 to \$250,000.

## Evaluation of Proposed Housing Sites

### El Ingles

General: This is a second proposed housing site. It is located approximately 8 kilometers south of Tegucigalpa on a ridge and adjoining low slope



*Access to the El Ingles site is via a very poor 5 km long road characterized by numerous landslides.*

Flooding: The site is located in an upland area and, therefore, is not susceptible to widespread flooding. Local drainage should be considered, however. Relocated population should not build or encroach on the channels adjacent to the relocation site.

**Landslides:** The site is underlain by volcanic rock. There are no geologic hazards at the site. The site itself has little landslide hazard due to very low slopes; however, the access road to the site is highly vulnerable to debris flows. Seven debris flows triggered by the rain from Hurricane Mitch were observed both above and below the road with debris encroaching onto the road from above and scarps below the road removing portions of the outer road edges.



*The El Ingles site has no flooding or landslide problems.*

**Water Supply:** Due to the local relief, the underlying volcanic rocks, and the non-perennial nature of the adjacent Quebradas El Aguila and El Ingles groundwater is not considered to be capable of being the primary source of water for this site. Yields are expected to be less than 30 gpm from wells drilled at least to 100 m. It is expected that most water will have to be developed from a surface source, possible Rio Sabacuante, or trucked to the site from some other source. Prior to trucking, however, the road leading from the highway to the site will have to be repaired in several areas where it is undermined by slides. The cost for wells at this site is about \$20,000 each. The cost for water delivered to the site by commercial sources is approximately 10 cents per gallon. For 20,000 people using 30 gallons per day each, the commercial cost of water delivered to the site would be \$60,000 per day.

**Sanitation:** Latrines are not appropriate on the shallow rock, which underlies the site. An oxidation pond is considered to be the best alternative.

**Environmental:** Development of this site will remove the existing vegetation and increase the runoff from the site due to construction of impervious surfaces. Additionally, due to the reliance on wood for fuel, the increased population in this area can be expected to utilize the forested areas in the vicinity as a source. This practice will further increase runoff in the watershed and increase flooding downstream. Unless sanitary sewage is highly treated, water quality of nearby stream will be degraded.

**Site Access:** The site is located approximately 5 km off the main highway. The access road is in very poor condition and would require extensive upgrading. There are numerous debris flows along both sides of the five kilometers of road, which connect the site to the main highway. At several locations these debris flows have partially undermined the road. Possible future deforestation associated with the proposed settlement could aggravate the slope stability problems. On the basis of US Army Corps of Engineers cost factors for Honduras, it is estimated that upgrade of the 2-lane road would be approximately \$2.5 million.

## **Las Trancas (Nueva Capital)**

**General:** The site is located approximately 2 km southwest of the Laguna de Pedregal in the City of Tegucigalpa. The site is located near the proposed location for the new Tegucigalpa airport.