Figure 11

Flood proofed dwelling

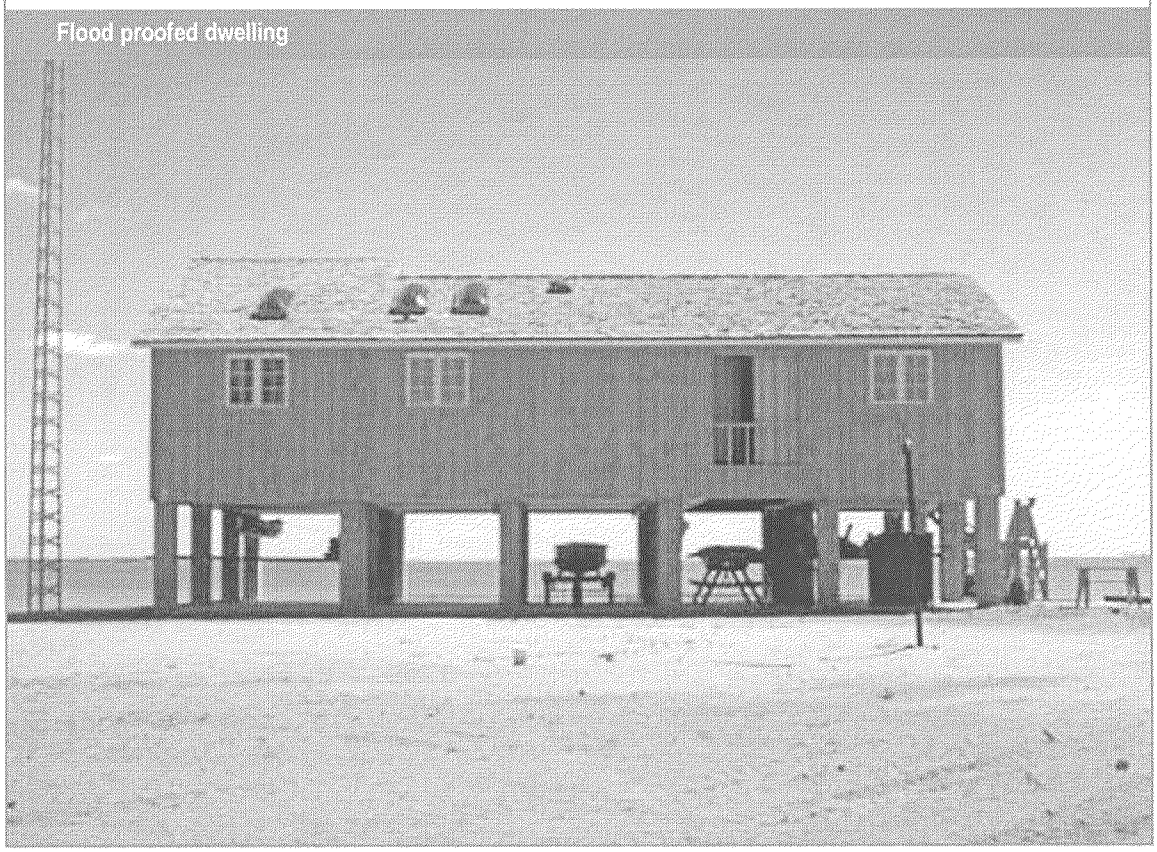

Photo: Environment Canada

A number of critical services such as water lines, power pylons and telephone services often cross the flood plain. These utilities can be protected against the ravages of flooding at relatively low cost through additional depth of burial, a higher design standard for exposed components, and raising of components above design flood levels.

Water supply and treatment plants are particularly vulnerable They are often located on the flood plain yet are critical for the protection of human health during and after a flood event. Such structures need to be protected against extreme events and designed to prevent cross-contamination from floodwaters or sewers.

Bridges and roads

Bridges generally constrict the flow of water, and they can act as artificial dams if debris jams on the structure. In all cases, their hydraulic characteristics must be considered at the design stage to prevent an unacceptable rise of water levels upstream of the structure.

Bridges are important in terms of maintaining access for evacuation and delivery of medical and other emergency services. Key transportation corridors should have high design standards that will withstand extreme flooding events. However not all bridges require a high level of protection, and the design criteria can be to a lesser standard that takes into consideration the possibility of overtopping.

Bridges are expensive, and difficult to replace quickly after a flood event. An alternative strategy is to design the approach roads to be the weak link in the chain so that extreme events wash out the road but do not damage the bridge Approaches can be quickly repaired after a flood event and transportation corridors restored.

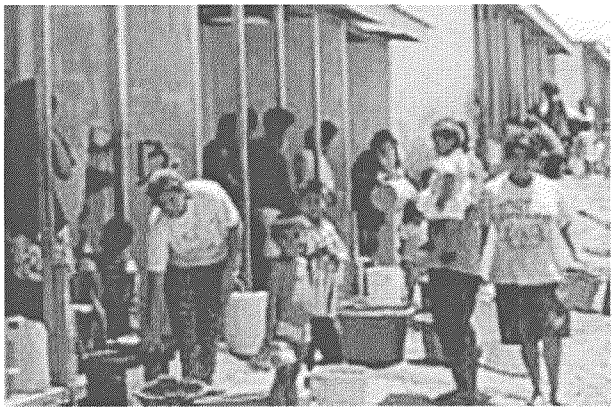

Photo: D. Rayner, GeoResources

In the days and weeks following Hurricane Mitch, people struggled to find even the basic needs such as clean, safe water

Road design, either parallel to the river or leading to bridges, must be given careful consideration. There is a temptation to raise roads that have been overtopped by flood events without giving adequate consideration to the number and size of openings necessary to pass local drainage or tributary inflow. In such cases the road can artificially raise water levels upstream and cause additional flood damage. Roads can also act as levees when they are parallel to the river. This is a two-edged sword: while flood protection is provided, the water level upstream can increase, resulting in additional flood damages there. Hydraulic studies must be undertaken before roads are raised to fully establish the impacts of these activities.

Enforcement of standards and codes

The enforcement of standards and codes for flood-prone areas is as important as their initial development. There is a tendency to bend the rules as the memory of a flood event and its catastrophic consequences gradually fade away with time.

Enforcement procedures and penalties need to be built into the process, and emergency response drills undertaken to ensure that flood prevention measures such as waterproof closures still work. An audit procedure should be performed by higher orders of government with participation of all interested parties to ensure broad national standards are being met and that codes and rules are being suitably followed and enforced.

Governments should consider introducing requirements such as surveyor certificates to verify that design elevations have been met, or inspector reports that flood-proofing measures have been implemented. Lending and insurance institutions could usefully be involved in this process, as they have a vested interest in ensuring that their investments are protected.

B. Non-structural Measures

Non-structural measures are particularly applicable to flood-prone areas that are not yet developed. As such, they are a complement to structural approaches in areas where additional development may occur, and they also represent an independent approach where some control over flood plain development can be exercised at low cost. Non-structural approaches do not mean "no use", but rather "wise use".

Land-use planning

Land-use planning at the local or municipal level can be a useful tool in reducing future flood damages. Consideration should be given to ensuring that there are conforming uses in flood-prone areas as part of master