

embankment is overtopped, the difference between the upstream and downstream water surface (head differential) is so great that the embankment erodes and fails. Hydrologic and hydraulic flow modeling should be accomplished in order to determine the proper amount and location of flow relief.



The area of Chluteca near and riverward of the cemetery should not be rebuilt.

- *(Short Term)* It is recommended that the area near and riverward of the cemetery located on the south side of town not be re-built. This area is located in the active flow area of the Rio Choluteca floodplain.

- *(Long Term)* For those low-lying areas of Choluteca which were flooded, filled with sediment, but not destroyed, a likely solution may be construction of a levee or floodwall to protect these areas. A levee may be feasible due to the relatively small area to be protected, minimal infringement on the floodplain, and the absence of significant interior drainage to account for. The map shown above illustrates a likely levee

alignment for the city. Hydrologic, hydraulic, geotechnical, and structural studies will be required to determine levee height, alignment, length, and structural design.

- *(Short Term)* It is not recommended that the Rio Choluteca be dredged or excavated as a measure to reduce flooding. A tremendous amount of sediment has been introduced into the river system at Choluteca and the watershed upstream. For many years to come, this sediment will be moving through the channel and overbank during high-water events and will likely negate any local efforts at sediment removal. The only exceptions to this recommendation is for the removal of aggregate material for construction purposes, or if needed, localized dredging to re-align the low-flow channel.
- *(Intermediate Term)* Further analysis of aerial photography taken of the area will be needed in order to evaluate the production of sediment by landslides and the movement of sediment to the floodplain. Such an evaluation would be accomplished from an inventory of landslides using aerial photography of the drainage basins that affect the floodplain of the Rio Choluteca near the city of Choluteca. With digitization to a GIS platform, areas and volumes can be calculated and the sediment production due to landslides estimated. Such an estimate of sediment production and the spatial variation of the sediment volume may be critical to the placement of any control structures that may mitigate the river's future flooding potential. The cost for the landslide inventory and GIS analysis would be \$200,000 with \$50,000 for information, data transfer, and training of personnel from the local agencies.

Evaluation of Proposed Housing Sites

Nueva Choluteca

Flooding. The absence of river-transported sediment reveals that the site is not on the active nor



Site work has begun at Nueva Choluteca

ancient flood plain, hence flooding due to high river flows is unlikely. On the other hand, in the event that the rainfall rate exceeds the infiltration capacity of the soil, sheet flow may produce shallow (<0.10m) inundation. Moreover, the production of sheet flow will be enhanced by the conversion of fallow lands to urbanized lands. We anticipate that a local drainage system for the planned development will be required.

Landslides: The absence of slopes of over 5° precludes landslides, which would pose any significant hazard to the site. A low hill about

100 m to the north of the site has slopes of greater than 20°, but it is far enough from the housing area that any landslide that might form on the hill will not present a threat to the residences. In addition, there was no evidence of any slope failure present on the hill.

Water Supply: Water can possibly be provided at the site by wells, however, a test well is recommended to confirm this fact. A hill located immediately north of the site is probably volcanic and indicates that bedrock beneath the site is at a shallow depth. A well constructed in bedrock in the general area of Choluteca produces less water (generally about 30 gpm) than a well drilled in the alluvial aquifer. Wells producing from the alluvial aquifer in the Choluteca area generally pump in the 160-gpm range. Some of these higher producing alluvial wells are reportedly located west of Choluteca. If sufficient production cannot be obtained from wells at the site, it is recommended that additional wells be drilled in the direction of those producing from the alluvium. The cost for wells at this site is about \$15,000 each. Assuming alluvial wells can be drilled, two wells would be required and cost would be \$30,000.

Sanitary: An oxidation pond is being planned for this site. This option is recommended as a minimum.

Environmental: Development of this site would have limited environmental impacts. Effluent discharged from the oxidation pond would have localized adverse water quality impacts.

Site Access. Access to the site is excellent.

Nueva Eden

Flooding. This site is not on the active nor ancient flood plain and is less susceptible to river inundation. Poor drainage from improper site development may cause localized drainage problems. These may be aggravated by the proposed housing development. Adequate site grading and storm drainage should be provided.