

MAP LEGEND

Flood Hazard Zones:

- Regularly to Frequently Flooded Areas
- Occasionally to Rarely Flooded Areas
- Non Flood Prone Areas
- Areas Prone to Bank Erosion

— road
— river
— contour line

EXPLANATIONS:

Flood hazard susceptibility zones were derived based on the geomorphological analysis of landforms and the fluvial system. Information on flood occurrences, flood depths, duration of inundation as well as topographic information supported the geomorphologically-based flood hazard mapping

Regularly to Frequently Flooded Areas:
Areas that are frequently flooded. Mere heavy rains of 1 to 2 days could bring about flooding in these areas. Moderate to strong typhoons could submerge these areas 0.5 to 2.0 m. in flood waters for a few days to a few weeks. Development of urban settlements in these areas is not recommended.

Occasionally to Rarely Flooded Areas:
Areas that become inundated during moderate to strong typhoons. Flood depths vary from a few centimeters to 1 m. Floods last from a few hours to a few days

Non Flood Prone Areas:
Areas with no reported flood occurrences

Areas Prone to Riverbank Erosion:
Areas 0 to 50 m. from river banks that are

Field data collection by: A.E. Dayao, E.L. Laguerta, E.T. Avila
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Digital cartographic processing by: A.E. Dayao, R.R.L. Mapalad
GIS processing by: A.E. Dayao
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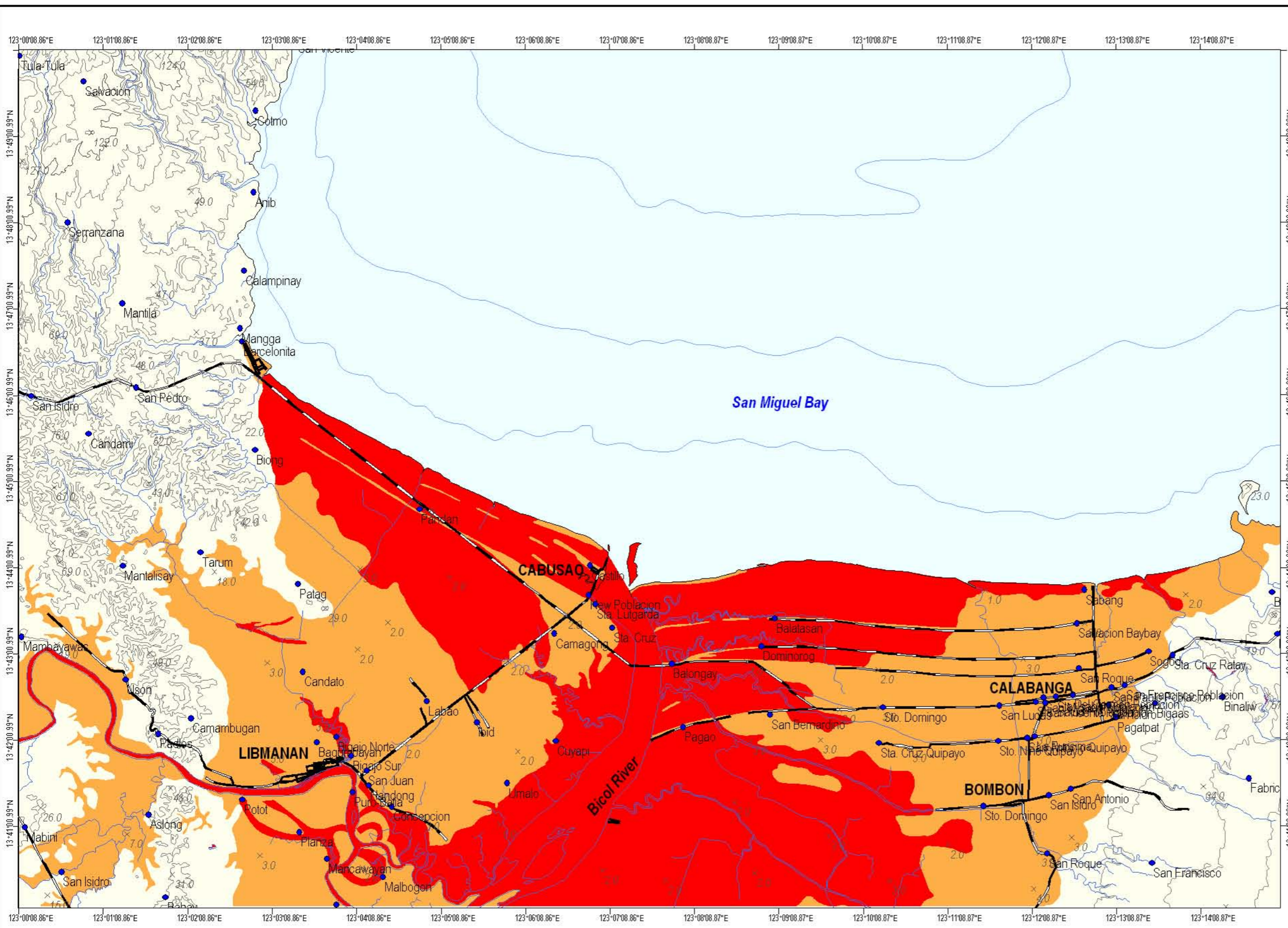
Other sources of Information:
1:50,000 NAMRIA Topographic Map
1951 B/W Aerial photos

FLOOD HAZARD MAP OF LIBMANAN QUADRANGLE

Published by:
Department of Environment and Natural Resources
MINES AND GEOSCIENCES BUREAU-RO5
Daraga, Albay
2007

0 4250 m
UNIVERSAL TRANSVERSE MERCATOR PROJECTION
Clarke 1866, Luzon Datum





MAP LEGEND
Liquefaction Potential Zones:

- Areas where Liquefaction is Likely
- Areas where Liquefaction is Possible
- Areas where Liquefaction is not Likely

— road
 — river
 — contour line

EXPLANATIONS:
 There are no reported liquefaction occurrences in the mapped area based on several field interviews. However, zones of different liquefaction potential were derived based on the geomorphological analysis of the study area following previous studies made by Iwasaki and Yasuda.

Areas where Liquefaction is Likely:
 Areas where liquefaction is likely include river beds, old or abandoned river beds and meanders, backswamps and fluvial basins, channel bars, fluvio-deltaic basins, active tidal flats and sand bars. These areas are unsuitable for urban development. Multi-storey buildings should be required of geotechnical studies addressing or mitigating the effects of liquefaction.

Areas where Liquefaction is Possible:
 The floodplain and the fluvio-marine plain of the Bicol River and their fluvial levees and ridges, fluvio-deltaic levees and ridges, point and alternating bars, the alluvial plains and the fluvio-marine floodplain are areas where liquefaction is possible. Buildings having 5 storeys or more should be required a full geotechnical study.

Areas where Liquefaction is not Likely:
 Areas where the likelihood of liquefaction is

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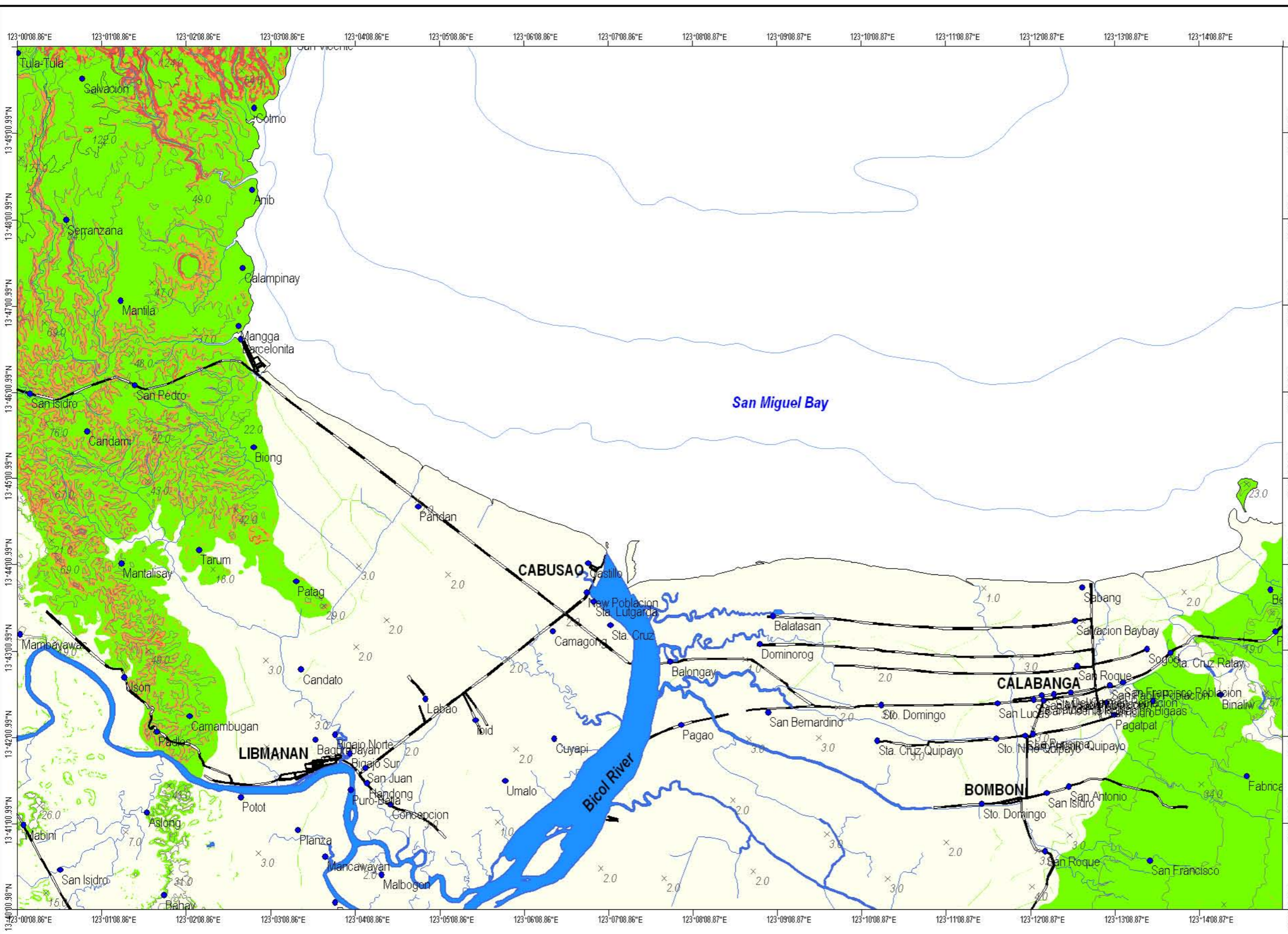
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MAP LEGEND

Landslide Susceptibility Zones:

- Absent
- Low Susceptibility
- Moderate Susceptibility
- High Susceptibility

- road
- river
- contour line

EXPLANATIONS:

Landslide hazard susceptibility zones were derived through qualitative map combination using lithology, geomorphology, slope gradient and fault distance. GIS was used in the map combination and subjective weights were assigned to each unit in the parameter map.

Areas with High Susceptibility to Landslides:
 Areas with equally high probability of occurrence of mass movements particularly rock slides and debris slides. Very steep to nearly vertical slopes, the crater wall of a volcanic cone and the volcanic ravines and gullies are rated high susceptibility areas and are unsuitable for housing and human settlement.

Areas with Moderate Susceptibility to Landslides:
 Areas having moderate likelihood of occurrence of landslides and are recommended for more detailed engineering geological and geohazard assessment prior to housing development.

Areas with Absent or Low Susceptibility to Landslides:

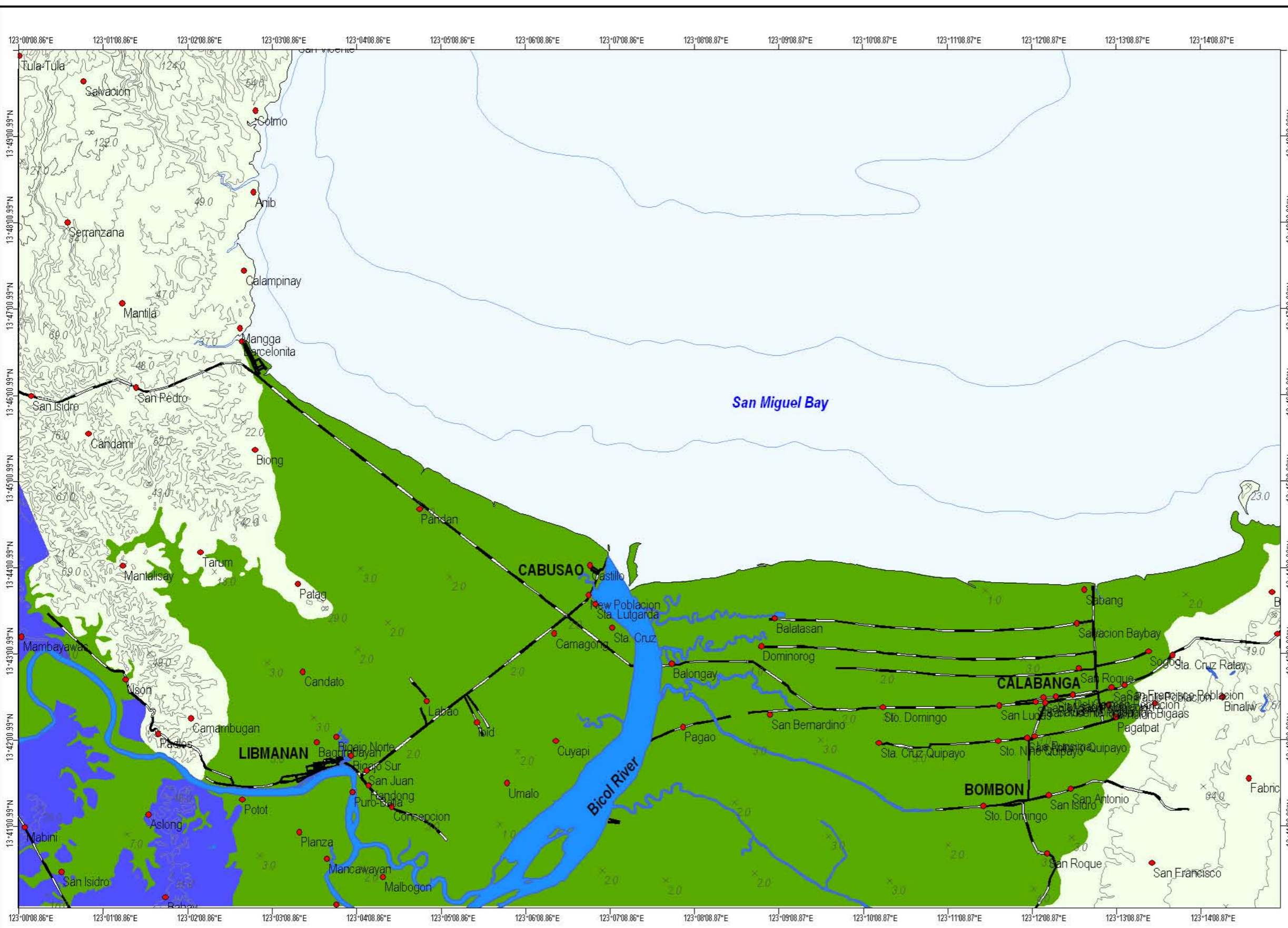
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MAP LEGEND

Ground Settlement and Ground Subsidence Susceptibility Zones:

- Areas susceptible to ground subsidence
- Areas susceptible to ground settlement
- Areas not susceptible to ground settlement/subsidence

— road
— river
— contour line

EXPLANATIONS:

Susceptibility map for ground subsidence due to karst or solution processes was primarily derived from the lithologic map of the study area. Field observations on sinkholes and ground subsidence observed on concrete roads and damaged houses supported the mapping. Areas of possible ground settlement were delineated through the analysis of the geomorphological lay of the study area, the sub-surface soils and the ground water levels.

Areas Susceptible to Ground Subsidence:
Areas that are prone to ground cavitation, sinkhole formation and ground subsidence in areas underlain by limestone and calcareous siltstones and shales.

Areas Susceptible to Ground Settlement:
Areas where fluvialite sands, silts and clays coupled with shallow ground water table are sites of possible ground settlement. Ground settlement may be reduced through appropriate foundation design. Buildings having 3 storeys or more should be tested for settlement and/or consolidation. Buildings having 5 storeys or more should undergo detailed geotechnical studies.

Areas not Susceptible to Ground Settlement or Ground Subsidence:
Areas where the possibility of ground settlement or ground subsidence is low or absent.

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GROUND SUBSIDENCE AND GROUND SETTLEMENT SUSCEPTIBILITY MAP OF LIBMANAN QUADRANGLE



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 Department of Environment and Natural Resources
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