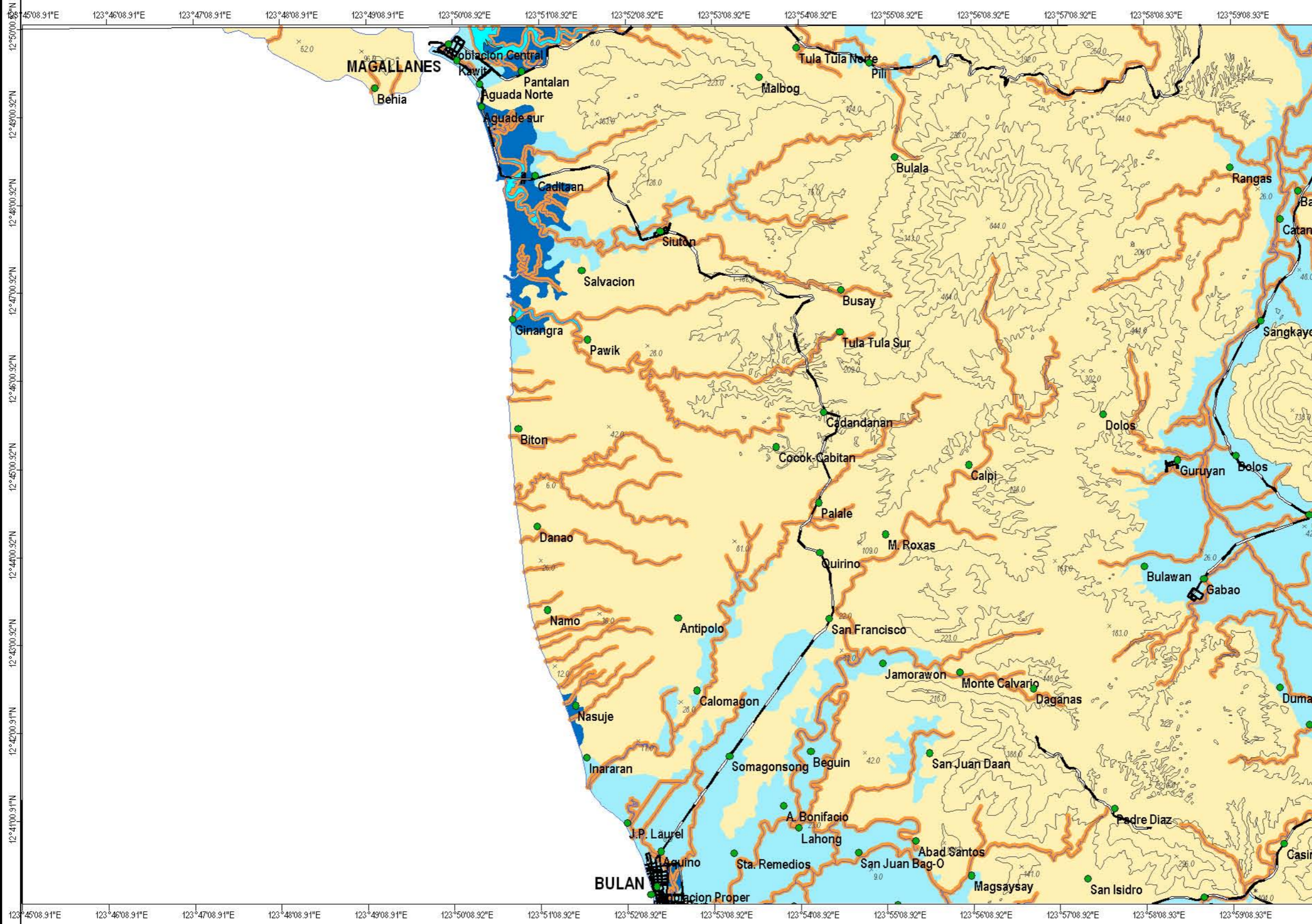


FLOOD HAZARD MAP OF BULAN QUADRANGLE



MAP LEGEND:
Flood Hazard Zones:

- regularly to frequently flooded areas
- occasionally to rarely flooded areas
- non flood prone areas
- areas prone to riverbank erosion

— river
 — road
 — contour

EXPLANATION:

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 weeks.

Non Flood Prone Areas:
 Areas with no reported flood occurrences except along low lying areas adjoining rivers and creeks.

Areas Prone to Riverbank Erosion:
 Areas 0 to 50 m. from river banks that are prone to scouring and erosion.

Field data collection by: M.R.M.Rint
 Geomorphological interpretation by: M.R.M.Rint
 Digital cartographic processing by: R.L. Mapalad
 GIS processing by: M.R.M.Rint
 Checked by: A.E. Dayao
 Approved by: R.A. Juan

Other sources of Information:
 1:50,000 NAMRIA Topographic Map
 1951 B/W Aerial photos



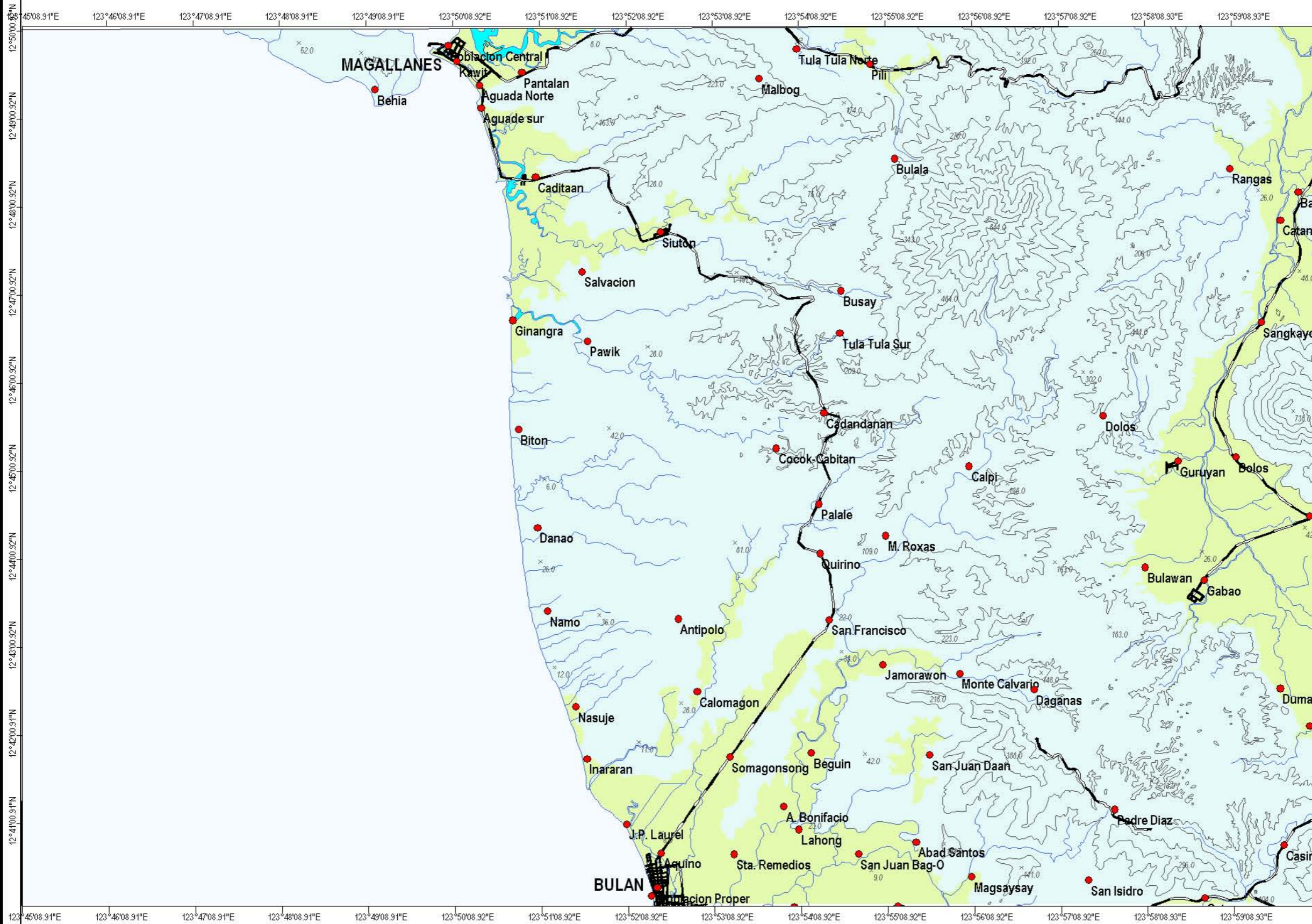
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GROUND SETTLEMENT AND GROUND SUBSIDENCE SUSCEPTIBILITY MAP OF BULAN QUADRANGLE



MAP LEGEND:
Ground Settlement and Ground Subsidence Susceptibility Zones:

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

— river
 — road
 — contour

EXPLANATION:

Susceptibility map for ground subsidence due to karst or solution processes was primarily derived from the lithologic map of the study area. Field observation 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 Settlement:
 Areas where fluvial and fluvio-marine 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 Prone to Ground Settlement/Subsidence:
 Areas where the possibility of ground settlement or ground subsidence is unlikely.

Field data collection by: M.R.M.Rint
 Geomorphological interpretation by: M.R.M.Rint
 Digital cartographic processing by: R.L.Mapalad
 GIS processing by: M.R.M.Rint
 Checked by: A.E.Dayao
 Approved by: R.A.Juan

Other sources of Information:
 1:50,000 NAMRIA Topographic Map
 1951 B/W Aerial photos



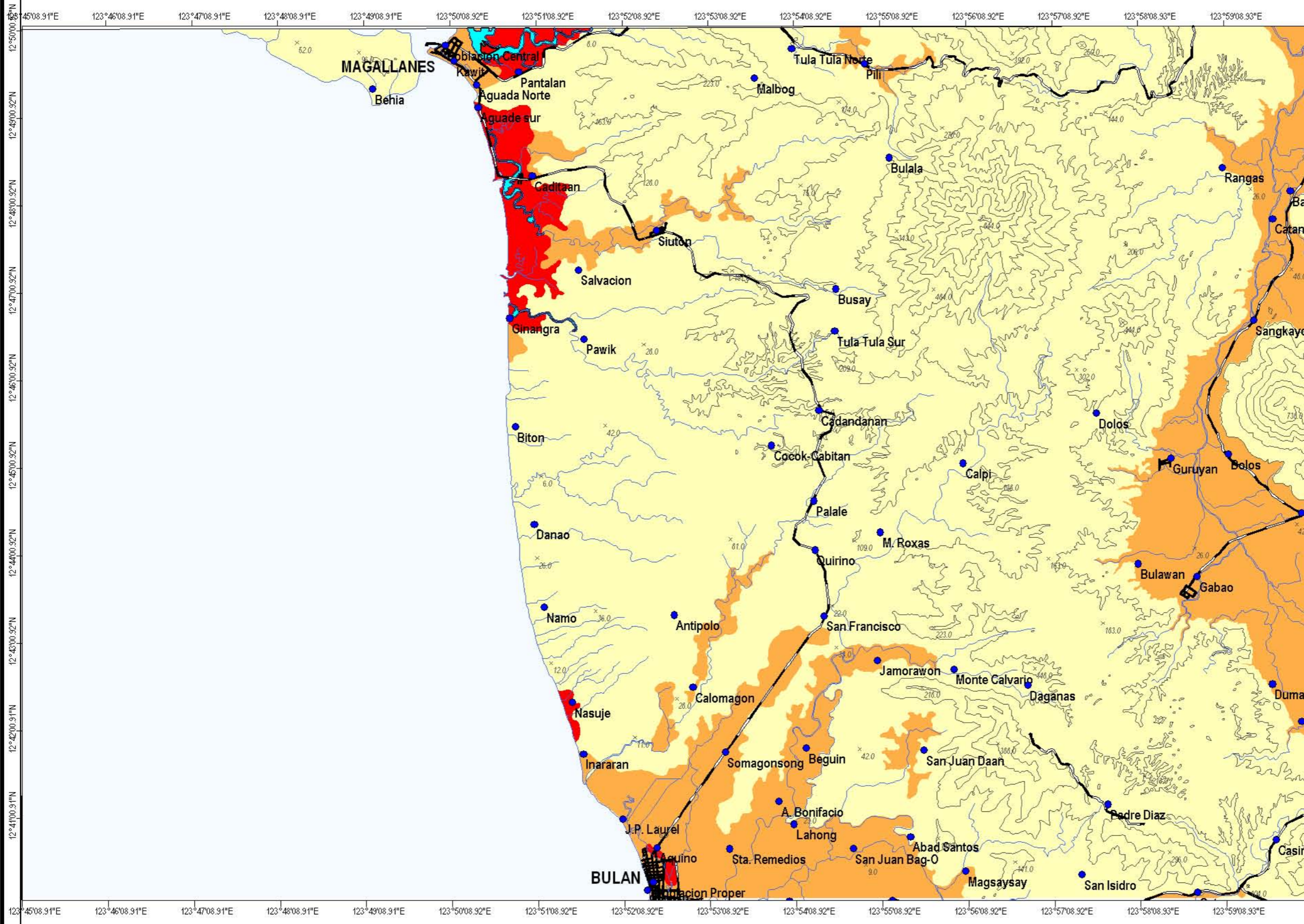
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LIQUEFACTION POTENTIAL MAP OF BULAN QUADRANGLE



MAP LEGEND:

Liquefaction Potential Zones:

- Areas where liquefaction is likely
- Areas where liquefaction is possible
- Areas where liquefaction is not likely

— river
— road
— contour

EXPLANATION:

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, beaches, and active tidal flats. 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:
Alluvial plains 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 liquefaction occurrence is unlikely to happen.

Field data collection by: M.R.M.Rint
 Geomorphological interpretation by: M.R.M.Rint
 Digital cartographic processing by: R.L.Mapalad
 GIS processing by: M.R.M.Rint
 Checked by: A.E.Dayao
 Approved by: R.A.Juan

Other sources of Information:
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 1951 B/W Aerial photos



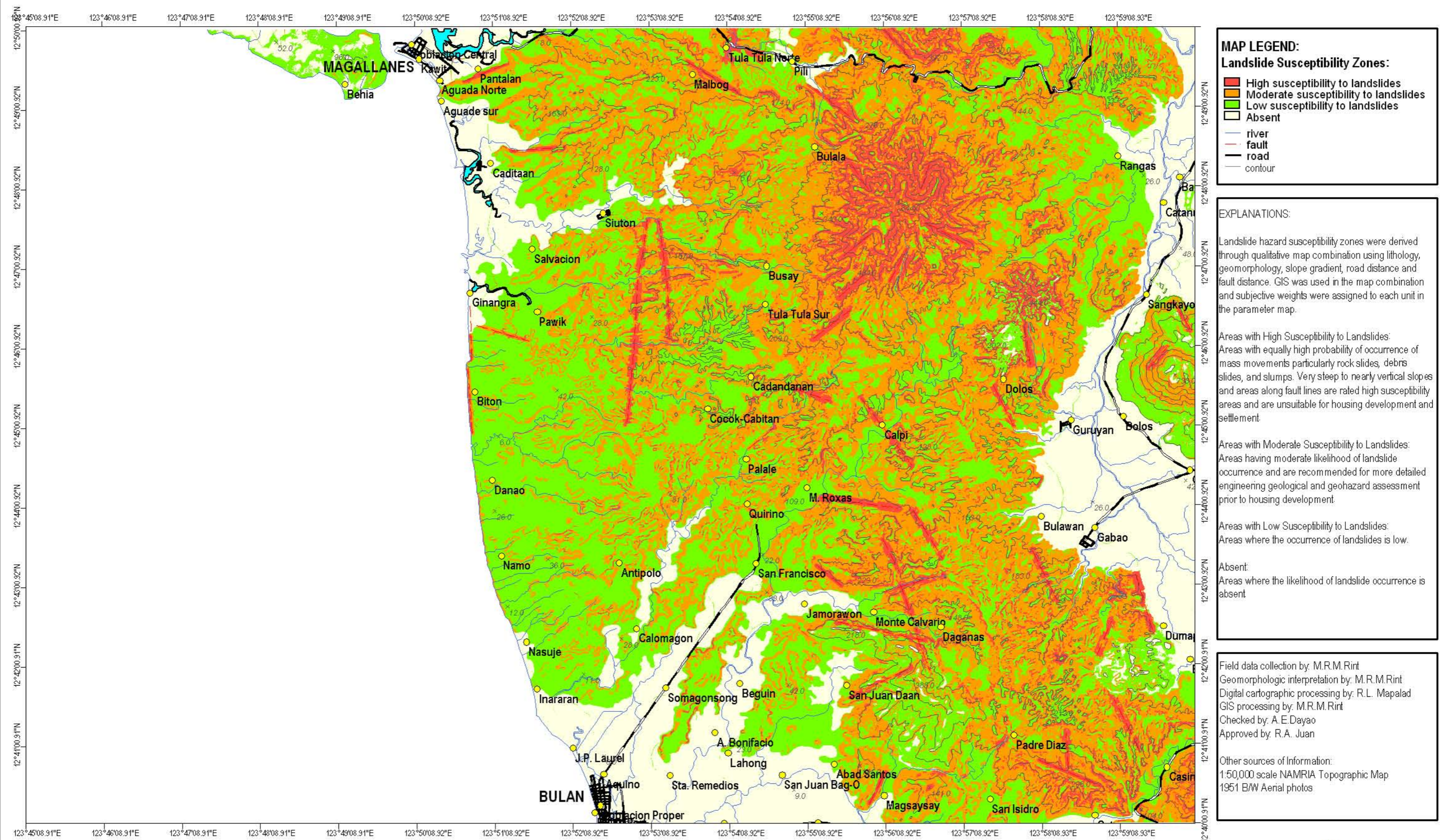
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LANDSLIDE SUSCEPTIBILITY MAP OF BULAN QUADRANGLE



MAP LEGEND:

Landslide Susceptibility Zones:

- High susceptibility to landslides
- Moderate susceptibility to landslides
- Low susceptibility to landslides
- Absent

— river
— fault
— road
— contour

EXPLANATIONS:

Landslide hazard susceptibility zones were derived through qualitative map combination using lithology, geomorphology, slope gradient, road distance 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, debris slides, and slumps. Very steep to nearly vertical slopes and areas along fault lines are rated high susceptibility areas and are unsuitable for housing development and settlement.

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

Areas with Low Susceptibility to Landslides:
 Areas where the occurrence of landslides is low.

Absent:
 Areas where the likelihood of landslide occurrence is absent.

Field data collection by: M.R.M. Rint
 Geomorphologic interpretation by: M.R.M. Rint
 Digital cartographic processing by: R.L. Mapalad
 GIS processing by: M.R.M. Rint
 Checked by: A.E. Dayao
 Approved by: R.A. Juan

Other sources of Information:
 1:50,000 scale NAMRIA Topographic Map
 1951 B/W Aerial photos



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