

# Maryland



## Geologic Map Depicts Sinkhole Susceptibility

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### Defining the Problem

Sinkholes, which abound in the Frederick Valley in west-central Maryland, impact urban growth and development (Fig. 1). Sinkholes form in carbonate areas as the dissolving and weakening of bedrock cause it to collapse. Activities, such as quarrying, which alter surface drainage and lower the water table also can decrease ground strength and exacerbate the **sinkhole** hazard. It is important to assess potential **risks** of infrastructure damage and personal injury due to sinkhole formations.



Fig. 1. Sinkholes in collapsed parking area, Frederick, MD. Sinkholes form in carbonate areas as the dissolving and weakening of bedrock cause it to collapse.

### The Geologic Map

The geologic map of the Frederick Valley shows the presence of two **limestone** formations, the Frederick and Grove (Fig. 2). At the formational level, there is no discernable difference in sinkhole proclivity between the two units. When the two formations are subdivided into lithologically distinct parts, the increased detail allows the geologic map to be used as a **predictive tool** for potential sinkhole development.

### Applying the Geologic Map

The map of bedrock units and sinkholes demonstrates the **correlation** between sinkhole distribution and rock type. Table 1 shows that most sinkholes are present in the upper part of the Frederick Formation, contradicting the long-held belief that the Grove Formation is the unit most susceptible to sinkhole development in the Frederick Valley. While the Grove Formation clearly has a significant number of sinkholes, a **ranking** of geologic units **demonstrates** that the upper member in the Frederick Formation is the most susceptible to sinkhole occurrence (Fig. 3). An increased level of detail in both the lithologic description and the mapping practices facilitates the evaluation of the **susceptibility** of these geologic units to sinkhole formation. By subdividing and mapping units as precisely as possible, and accurately locating sinkholes with a Global Positioning System (GPS), geologists are able to develop a new tool, the susceptibility index (SI), that portrays the relative sinkhole propensity for each unit (Fig. 3). Planners and developers can use the SI as a comparative tool to evaluate the likelihood of sinkhole occurrence in areas considered for development.

### Conclusion

Sinkholes and other **karst** features represent one of the most widespread and **underevaluated** geologic **hazards** in carbonate terrains. Geologic maps are the principal tools for displaying and conveying data important to understanding reasons for sinkhole distribution. Although sinkhole development in susceptible areas cannot be completely prevented, policy makers and the public can use geologic maps that delineate karst features to **develop strategies** that can minimize or avoid property damage and personal injuries.

# geologic map

- Qal** Alluvium flood plain deposits
- Qr** Weathering residuum
- Qt** Terrace deposits
- Grove Formation**
- Ogn** middle member (informal)
- Ogl** lower member (informal)
- Frederick Formation**
- Cl** Lime Kiln Member
- Ca** Adamstown Member
- Ch - Cde** Rocky Springs Station Member
- Cu - Cde** Unnamed member (informal)
- Car** Anaby Formation

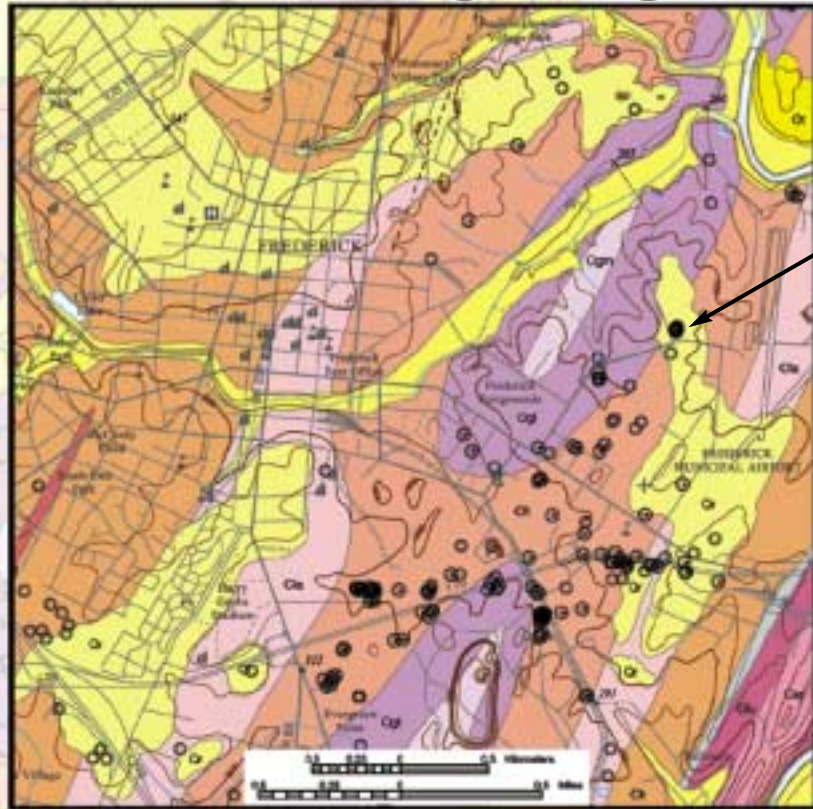


Fig. 2. On this geologic map of the Frederick, MD, area, note the prevalence of sinkholes (circles with hachures) in the Lime Kiln Member of the Frederick Formation. Sinkholes and other karst features are among the most widespread and undervaluated natural hazards in carbonate areas.

## sinkhole susceptibility

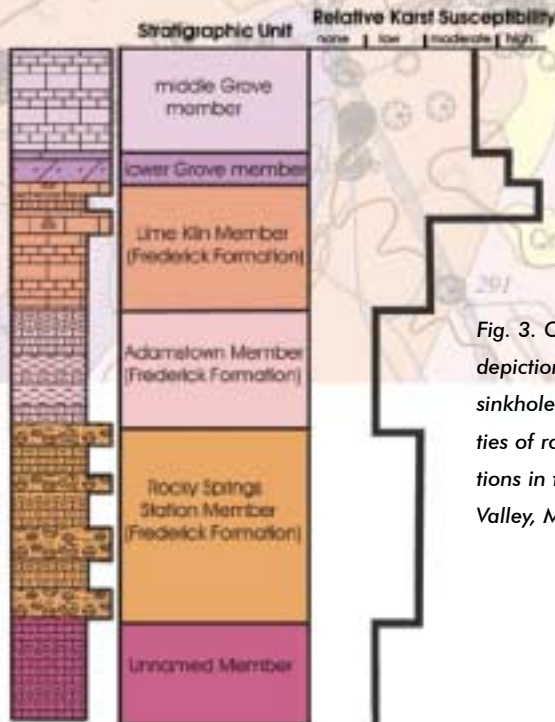


Fig. 3. Conceptual depiction of relative sinkhole susceptibilities of rock formations in the Frederick Valley, MD.

## sinkholes

Stratigraphic Unit	Number of Sinkholes
Grove Formation middle member	0
Grove Formation lower member	20
Frederick Formation Lime Kiln member	83
Frederick Formation Adamstown member	17

Table 1. Number of sinkholes occurring in various stratigraphic units as revealed by recent geologic mapping.

### References

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