



# Subsidence

Subsidence is the gradual settling or sudden sinking of the Earth's surface due to subsurface movement of earth materials. The level of subsidence ranges from a broad lowering to collapse of land surface. Most causes of subsidence are human-induced, such as groundwater pumpage, aquifer system compaction, drainage of organic soils, underground mining, hydrocompaction, natural compaction, sinkholes, and thawing permafrost. Areas located above or adjacent to karsts topography have a greater risk of experiencing subsidence. Sudden collapses of surface areas can damage and destroy buildings and infrastructure.

### SU-1 Map and Assess Vulnerability to Subsidence

**Some areas with subsidence risk may not be fully identified in your community. Consider actions such as:**

- Using GIS to map areas that are susceptible to subsidence.
- Identifying and mapping old mining areas or geologically unstable terrain so that development can be prevented or eliminated.
- Using ground-penetrating radar to detect lava tubes and map their location.
- Supporting mapping efforts to identify areas of existing permafrost.
- Improving accuracy of hazard area maps to educate residents about unanticipated risks. Upgrading maps provides a truer measure of risks to a community.

### SU-2 Manage Development in High-Risk Areas

**Development regulations should consider areas with poor soil conditions, including the following:**

- Prohibiting development in areas that have been identified as at-risk to subsidence.
- Restricting development in areas with soil that is considered poor or unsuitable for development.

### SU-3 Consider Subsidence in Building Design

**If subsidence is considered during building design, future damage may be prevented. Potential actions include:**

- Educating design professionals about where to locate information on subsidence rates and maps.
- Incorporating structural designs that can resist loading associated with subsidence.
- Adopting an ordinance promoting permafrost sensitive construction practices.
- Including potential subsidence in freeboard calculations for buildings in flood-prone areas.

### SU-4 Monitor Subsidence Risk Factors

**Several risk factors can be monitored to help predict subsidence, such as the following:**

- Monitoring areas at risk to subsidence by remaining aware of changes in groundwater levels.
- Monitoring areas where natural resources are removed from underground.
- Filling or buttressing subterranean open spaces, as with abandoned mines, to prevent or alleviate collapse.

## Structure and Infrastructure Projects

### SU-5 Remove Existing Structures from Subsidence Hazard Areas

To prevent property loss, acquire and demolish or relocate buildings and infrastructure in high-risk areas.

*FEMA Resources/Publications*

*FEMA 20, P-85, 361, 453*

## Education and Awareness Programs

### SU-6 Educate Residents about Subsidence

Increase residents' knowledge of subsidence through the following:

- Promoting community awareness of subsidence risks and impacts.
- Offering GIS hazard mapping online for residents and design professionals.

*Other subsidence-related mitigation actions may also apply to other hazards. See the sections entitled "Landslide," "Erosion," and "Multiple Hazards" for other possible ideas.*



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