Using Geologic-Hazards Information to Reduce Risks and Losses — a Guide for Local Governments

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Introduction

Many of the geologic processes that shaped Utah's landscape over the past few million years remain active today. When these natural processes endanger life and property we term them geologic hazards. Utah has experienced loss of life and property damage from geologic hazards throughout its history, and may expect more in the future. Local governments can reduce both risks and losses if they use geologic-hazards information in ordinances and general plans. **This brochure describes how local governments can use geologic-hazards information as a part of land-use regulation to decide if proposals to develop land are safe and appropriate.**

Knowing the geology of a proposed development site is one thing; using that information to ensure safe development is another. Effective land-use regulation features:

- a rational basis for requiring geologic-hazards studies of development sites,
- independent review of geologic-hazards studies,
- measures to ensure that projects are designed and constructed as recommended in the geologic-hazards studies and as approved in the review, and
- monitoring, inspection, and maintenance of risk-reduction structures.

Specific procedures adopted by local governments will vary depending on many factors including:

- types and characteristics of the geologic hazards present,
- availability of geologic-hazards maps,
- ability of local-government staff, elected and appointed officials, and consultants to understand and use geologic-hazards information,
- potential for new development, and
- community attitudes toward risk.

Unless geologic hazards are recognized and reduced in development siting and design, deaths, injuries, and financial losses may result.

Why Require Geologic Studies?

Geologic hazards exist in all types of terrain. Usually their potential can be identified prior to development, and measures can be taken to prevent damage. These measures may include:

- avoiding construction in hazardous areas,
- engineering buildings and other facilities to withstand the effects of hazards,
- erecting structures to protect buildings and other facilities from hazards, or
- grading the site to reduce risks.

However, hazard mitigation is impossible without hazard recognition. Failure to recognize and do something about geologic hazards prior to development has caused personal tragedy and property loss in Utah. The first step in reducing potential losses involves understanding the type and nature of the hazards present. The most common geologic hazards in Utah are:

- landslides,
- debris flows,
- flooding,
- problem soil and rock, and
- earthquakes.

Landsliding threatens a house in Mountain Green, Morgan County

Landslide damage to a house in Layton, Davis County

Costs and Benefits of Geologic-Hazards Studies

Reluctance to use geologic-hazards information in project review may be related to the delay between identifying hazards and being affected by them.

- Costs for study and risk reduction are immediate and measurable.
- Benefits are long term and uncertain.

When geologic-hazards studies are not standard practice, the housing market provides little incentive to consider geology in project siting and design. A home sited carefully on the basis of a geologic-hazards study will not necessarily command a higher price than one sited on an unrecognized hazard. **However, as geologic-hazards studies become standard practice, homes safe from geologic hazards may be worth more as the public becomes better informed and expects hazards to be addressed in design and construction.**

Who is Liable for Damage?

- Insurance?
  - Most policies do not cover damage from geologic hazards.
  - Few owners purchase appropriate supplemental insurance.

- Property developer, contractor, designer, or geological consultant?
  - Often hard to locate or no longer liable.
  - May be out of business.
  - Often difficult to prove negligence or substandard work.
  - Followed codes and standard practice at the time work was done.

- Public Agency?
  - Issued development approvals and permits.
  - Easy to locate and always present.
  - Often considered a “deep pocket.”

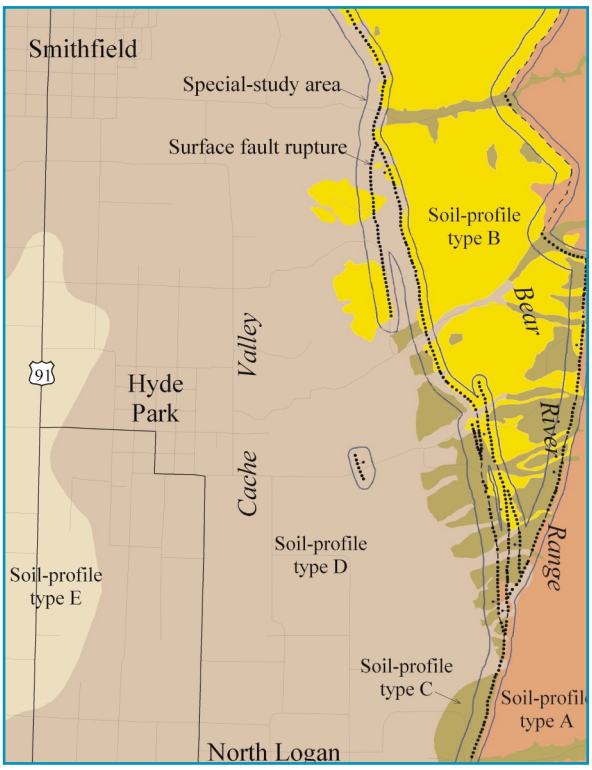
Now that some local governments in Utah routinely use geologic-hazards information in project review, its use is becoming standard practice. Consequently, all public agencies are more likely to be held liable for failing to acquire the necessary geologic-hazards information and use it appropriately. **The use of geologic-hazards information generally reduces the liability of local governments.**

Geologic-Hazards Maps—A Guide for Study Requirements

Local governments need some knowledge of a potential hazard to require a site-specific geologic-hazards study. This information is found on geologic-hazards maps, which show areas subject to potential hazards based on the analysis of geologic data. Hazard maps:

- show where hazards may exist, their relative severity, and sometimes the probability of occurrence,
- are typically at a scale of 1:24,000 to match U.S. Geological Survey 7-1/2 minute topographic quadrangles, and
- are planning tools to indicate the need for site-specific studies to determine appropriate land use.

Ideally, local governments adopt geologic-hazards maps as part of an ordinance and general plan.



An earthquake-hazard map of part of the central Cache Valley, Utah.

Ordinances and General Plans

Prudent land use in geologically hazardous areas is made possible by including geologic-hazards maps in ordinances and general plans. In taking this action, local governments can protect the health, safety, and property of local citizens by:

- identifying potential geologic hazards early in the planning process,
- requiring site-specific investigations to address hazards,
- defining the qualifications of geologists and engineers conducting the investigations, and
- recommending appropriate action prior to development.

What will be less costly?

Addressing hazards prior to development (1998 flooding near Spring City, Sanpete County), or…

…after development (1983 flooding, downtown Salt Lake City, Salt Lake County)?

A site-specific investigation may find that no hazards exist and recommend that no action be taken. If an investigation identifies hazards, recommended actions may include:

- disclosure of hazards to potential buyers,
- use of appropriate design features and engineering techniques,
- land-use restrictions,
- reduced density,
- clustered construction,
- recommendations for further study, and/or
- site abandonment.

However, a site-specific investigation is not the final step in the process. To ensure the adequacy of reports submitted to a public agency, the reports should be reviewed by a qualified engineering geologist and, when necessary, a geotechnical engineer.

Report Review—An Independent Evaluation

In the next step of the process to reduce risks and losses from geologic hazards, qualified engineering geologists and geotechnical engineers acting on behalf of the local government should review site-specific reports. Reports should be reviewed for:

- completeness—are all hazards adequately addressed?
- accuracy—are all interpretations correct and appropriate, given the uncertainties?
- appropriate recommendations—do recommendations reduce risks to acceptable levels?

Following the review, the reviewer may recommend to the local government that:

- Studies are adequate—
  - proceed with the project as originally planned, or
  - redesign the project as recommended to incorporate risk-reduction measures.
- Further study is necessary.
- The risk from geologic hazards cannot be reduced to an acceptable level and the site should be abandoned.

A well-designed risk-reduction measure (debris basin, Bountiful, Davis County) …

…may prevent damage from geologic hazards (debris flow, Farmington, Davis County.

At this point, the local government approves, revises, or disapproves the project or requires further study.

Monitoring, Inspection, and Maintenance

Once a project is approved, additional measures are necessary to guarantee that it is constructed as planned.

- The developer's geologist and geotechnical engineer must inspect the project to ensure it is constructed according to plan or modified appropriately.
- Local government should require an "as-built" report from the developer's architect or engineer certifying that the project was constructed as approved.

If risk-reduction structures are built that require continued maintenance to fulfill their purpose, such as retaining walls or drainage systems, the approved plan must include provisions for that maintenance.

- Maintenance by a homeowners association or Geologic Hazard Abatement District may be a condition of use permits.
- Local government may require easements to maintain improvements in the public's interest.

A Program for Safer Development

Building safely in areas with geologic hazards requires extra care and vigilance. Including geologic-hazards maps in ordinances and general plans is an important first step. Based on these maps local governments may require site-specific geologic-hazards studies before permitting development in potentially hazardous areas. Study results can be used to modify development plans as necessary to reduce risk to an acceptable level and identify long-term maintenance needs. The results of such a program will reduce the potential for death, injuries, private-property losses, and costs to taxpayers.

Do the policies and ordinances of your city or county provide reasonable protection from geologic hazards?

Sources of Additional Information

Utah Geological Survey
Geologic Hazards Program
1594 West North Temple
P.O. Box 146100
Salt Lake City, Utah 84114-6100
Phone: (801) 537-3300 Fax: (801) 537-3400
Web page: www.ugs.state.ut.us

Selected Publications

Blair-Tyler, Martha, 1995, Look before you build—Geologic studies for safer land development in the San Francisco Bay Area: U.S. Geological Survey Circular 1130, 54 p.

Christenson, G.E., 1987, Suggested approach to geologic hazards ordinances in Utah: Utah Geological Survey Circular 79, 16 p.

Eldredge, S.N., 1996, Homebuyers guide to earthquake hazards in Utah: Utah Geological Survey Public-Information Series 38, 27 p.

Hylland, M.D., editor, 1996, Guidelines for evaluating landslide hazards in Utah: Utah Geological Survey Circular 92, 16 p.

Utah Earthquake Preparedness Information Center, Earthquakes—What you should know when living in Utah: Utah Division of Comprehensive Emergency Management, 22 p.

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