A PLAN TO REDUCE LOSSES FROM GEOLOGIC HAZARDS IN UTAH

RECOMMENDATIONS OF THE GOVERNOR'S GEOLOGIC HAZARDS WORKING GROUP 2006–2007

Compiled by
Gary E. Christenson and Francis X. Ashland
Utah Geological Survey

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GOVERNOR'S GEOLOGIC HAZARDS WORKING GROUP

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Cover: Damage caused by the April 9, 2006, landslide in South Weber, Davis County.

Published by the Governor's Geologic Hazards Working Group, 2007

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EXECUTIVE SUMMARY

Summary

Landslides in 2005 and 2006 in Utah, some of which damaged subdivisions deemed safe by predevelopment geologic-hazards investigations, highlighted a need to evaluate the land-use-regulation process and identify possible improvements. To perform this evaluation, Utah Governor Jon M. Huntsman, Jr., approved establishing the Geologic Hazards Working Group (GHWG), chaired by the Utah Geological Survey (UGS), to develop recommendations to improve the process, identify the responsible agencies and resources needed, and determine how the State could help.

Ultimate responsibility for safe development lies with local governments and developers. To reduce losses, local governments should adopt, implement, and enforce ordinances that effectively address geologic hazards. Predevelopment technical reports by developer's consultants required by ordinances must objectively assess geologic hazards, recommend prudent actions to reduce risks, and be reviewed by professionals acting on behalf of local governments. Inspection, monitoring, and final documentation by developer's consultants, with local government oversight, to ensure that site development and grading conform to specifications should improve the efficiency and effectiveness of enforcement and provide technical oversight by qualified professionals.

The State can help local governments principally by providing technical resources to assist in writing ordinances, preparing and updating geologic-hazards maps, and assisting with other technical aspects of the development-approval process such as report reviews. Some actions can be completed with existing resources, but others involve a significant increase in workload to improve programs, develop websites, and assist in planning. Legislation is generally not needed and expanded direct State involvement in local government land-use regulation is not suggested. Funding requirements include general funds to the UGS for additional staff ($183,600/year ongoing) for expanded geologic-hazards mapping and local government outreach and assistance programs. This estimate does not include additional staff for report reviews. The Governor's Office of Planning and Budget (GOPB) administers various grant programs for planning assistance that need to be maintained. Expanding the engineering-geology program(s) at a Utah university(s) will require funding, but the amount will vary depending on existing resources and budgets of the university(s).

The GHWG will provide leadership and coordination to encourage, facilitate, and monitor progress in implementing its recommendations. The Utah League of Cities and Towns will assist by providing training and a forum to disseminate information at their workshops and annual meetings. Professional organizations (American Planning Association, Utah City Engineers Association) will also assist in disseminating information, informing members of recent advances in assessing and mitigating geologic hazards, and providing general guidance. State agencies will participate by providing technical assistance (UGS, Utah Division of Homeland Security, GOPB), geologic-hazards maps (UGS), and funding for planning activities (GOPB), and by implementing steps to improve technical standards of practice (UGS, Utah Division of Occupational and Professional Licensing).

Recommendations

Recommendations of the GHWG are listed below. Although not exhaustive, these recommendations cover important aspects of the land-use-regulation process. Reducing geologic hazards is a complex process involving each individual local government and many stakeholders, so implementation of these recommendations will be a long-term ongoing process.

ADOPTING ORDINANCES

1.1. Educate local governments on their "taking" liability in the development-approval process.

1.2. Encourage local governments to add a geologic-hazards element to their general plans and adopt/enforce appropriate geologic-hazards ordinances.

1.3. Develop a model geologic-hazards ordinance.

IMPLEMENTING ORDINANCES

2.1. Update and improve existing generalized Wasatch Front geologic-hazards maps; provide outreach to cities not presently using available maps.

2.2. Determine the feasibility of adopting and enforcing grading codes in Utah.

2.3. Provide local governments with access to geologic and engineering expertise to review geologic-hazards reports prior to subdivision approval to adequately protect public safety.

2.4. Ensure that the standard of practice of engineering geology and geotechnical engineering in Utah advances.

2.5. Expand training in engineering geology at Utah universities.

ENFORCING ORDINANCES

3.1. Improve enforcement of recommendations in approved site-specific geologic-hazards reports by placing responsibility for on-site inspection and final documentation on developer's consultants.

MISCELLANEOUS

4.1. Establish a Disclosure Working Group to determine a course of action, and pursue disclosure legislation if appropriate.

4.2. Establish an investigative procedure following significant, damaging geologic-hazard events to determine what happened, including the sequence of events, both natural and human, that led to the event.

INTRODUCTION

Statewide losses from landslides in 2005 and 2006 likely exceeded $10 million and brought much public and media attention to the risks and challenges of building on hillsides in Utah. Utah has a long history of damaging landslides, including the particularly heavy losses (more than $300 million) during 1983-84 due to landslides and floods. As our population grows, pressure to build in areas prone to geologic hazards such as landslides increases, as does the need to provide adequate protection from these hazards.

In Utah, local governments (cities, towns, and counties) regulate land use and establish requirements for safe development on hillsides and other areas prone to geologic hazards. Local governments typically regulate land use by adopting and enforcing ordinances that require special studies by developers to address geologic hazards prior to development. These studies are then reviewed by regulatory authorities and, when approved, development proceeds according to agreed-upon recommendations.

Landslides in 2005 and 2006 highlighted shortcomings of this development-approval process. Damage occurred in several areas where studies by developers' consultants had concluded that conditions were safe for development, but subsequent landslide movement damaged homes and forced residents to evacuate and in some cases abandon their homes. Landslide damage is not covered by most homeowners insurance, so in addition to being forced from their homes, residents faced a total loss of equity while in some cases maintaining mortgage liability. Such events are devastating to a family, and likewise incur costs to local governments and taxpayers for response, recovery, and subsequent legal action.

As a result of the landslides of 2005–06, Utah Governor Jon M. Huntsman, Jr., approved establishment of a working group to review the land-use-regulation process in Utah, recommend improvements, and identify how and where the State could assist. The Governor's Geologic Hazards Working Group (GHWG) was established in 2006 and met regularly from September 2006 through June 2007. This report highlights some of the 2005–06 landslides, reviews the establishment and activities of the GHWG, and presents the GHWG's recommendations for reducing losses from geologic hazards.

BACKGROUND-DAMAGING LANDSLIDES OF 2005–06

Record precipitation throughout much of Utah beginning in October 2004, and record snow packs in winter 2004–05, particularly in southwestern Utah, brought an active spring landslide season in 2005. In 2006, a locally wet spring on the heels of the 2005 statewide wet year resulted in another active landslide season in northern Utah. Nearly all of the landslides were reactivations of pre-existing landslides, both natural and human-caused, including slides that had previously moved sometime during the past decade. Here we discuss and illustrate chronologically some of the notable landslides of 2005 and 2006 (figure 1) that led to establishing the GHWG.

On April 28, 2005, a landslide that had moved in 1983 reactivated above a Cedar Hills subdivision in Utah County and slid against the back wall of a four-unit townhouse building (figure 2). Residents of the townhouses evacuated as the slow-moving landslide crushed vinyl fencing, air conditioners, and deck supports at the back of the units and days later

Figure 1. Location of notable 2005 and 2006 landslides.

Figure 2. Damaged townhouse building and disrupted toe and main scarp of the landslide in Cedar Hills.

pushed through the back wall and foundation, destroying the structure which was finally torn down in 2006. The landslide is on a southwest-facing slope and is part of a larger prehistoric landslide complex associated with a highly slide-prone geologic unit commonly found along the east bench of northern Utah County. Attempts have been made to stabilize the landslide using drains and grading, but their long-term success will not be known until wet conditions return.

On May 12, 2005, a large rock fall from a cliff high on Y Mountain above Provo spawned many individual falling rocks, some of which bounced and rolled out nearly a mile from the source. One of the rocks struck the southwest corner of a guest house on the east bench of Provo (figure 3). No one was home at the time, but the structure was a total loss. The source of the rocks was a cliff about 2600 vertical feet above the guest house. The rock that struck the guest house measured approximately 7 x 5 x 4.5 feet and weighed about 13 tons. Many of the fallen rocks left impact craters (bounce marks) and trails of flattened oak brush on slopes at the base of the cliff and on the slope just above the damaged house.

Figure 3. *A boulder in the rock fall from Y Mountain above Provo struck the corner of this guest house and came to rest at the base of the tree behind the trash bin on the left.*

Around 9:30 p.m. on April 9, 2006, a rapidly moving landslide in South Weber broke through the back wall of a house at 7687 South 1650 East, injuring a child inside (figure 4). The landslide started on a steep slope near a pond in a gravel pit atop a bluff behind the house. Subsequent investigation found that water seepage and saturation of materials on the bluff top likely triggered the landslide, but the steep slope, the weight of fill placed on the top of the slope, and weak underlying geologic materials were contributing factors. This landslide and a similar one nearby in 2005 that demolished a barn and blocked South Weber Drive demonstrate the property-damage and life-safety threat these rapidly moving landslides pose to buildings and their occupants at the base of steep slopes.

Homeowners along Sunset Drive in Layton recognized in mid-April 2006 that the 1998 Sunset Drive landslide had reactivated (figure 5). In 1998, landslide movement damaged seven lots and resulted in a house being condemned and

Figure 4. *The rapidly moving landslide that hit this house in South Weber broke through the back wall and injured a child inside.*

Figure 5. *This house at 1843 East Sunset Drive in Layton straddles the main scarp of the landslide. Landslide movement removed support from beneath part of the foundation.*

torn down. The 2006 movement again affected six of the same lots, including two houses. The house at 1843 East Sunset Drive straddles the main scarp, and landslide movement has removed support from beneath part of the foundation. The house is planned to be moved off the landslide.

In 2005, three landslides formed in the Creekside Drive area of Mountain Green in Morgan County (figure 6) in a slope underlain by pre-existing landslide deposits. In 2006, the three landslides reactivated and new landslides formed nearby. Continued movement of the largest of the landslides forced the evacuation of a severely damaged house at the top of the slide and damaged two others. Damage also occurred to Creekside Drive and utilities beneath the road, disrupting water and power to the affected subdivision. Despite favorable subdivision-wide and lot-specific geotechnical studies, landsliding occurred within only a few years of development on the pre-existing landslide deposits.

Figure 6. *A) Damage caused by movement of the main Creekside Drive landslide in Mountain Green forced abandonment of this house. B) On Cascade Drive, Mountain Green, landslide movement left this concrete driveway slab suspended in the air.*

Figure 7. *Damage to road in upper part of Sherwood Hills landslide, Provo.*

Figure 8. *Offset on main scarp by repeated landslide movement, City Creek Canyon, Salt Lake City. Concrete covers the main scarp that formed between 1999 and 2004. Fresh soil is exposed below due to continued movement in 2005 and 2006.*

The Sherwood Hills landslide in northeastern Provo is one of several in northern Utah that has undergone recurrent movement over the past 25 years. Damage to houses and roads caused by landslide movement was first documented in the early 1980s. The landslide has been systematically monitored since May 1999 when Provo City established survey points on the slide and began monitoring movement using a high-precision Global Positioning System survey device. The survey results suggest that the landslide remained active even during the drought years between 1999 and 2004. With the return of wetter-than-normal conditions in 2005, the rate and area of landslide movement increased. By 2006, three houses in the upper part of the landslide had been abandoned, including one built in 2000, and a road had been severely damaged (figure 7). Some data suggest that landslide movement is continuous, slowing in the summer to an undetectable rate and increasing in the late winter and early spring as ground-water levels rise during the snowmelt. The continuing losses due to movement illustrate the potential high costs, both public and private, associated with development on large pre-existing landslides.

In Salt Lake City, a cluster of historical landslides is visible from the hairpin turn of Bonneville Boulevard in lower City Creek Canyon. Movement of the largest and most damaging of these landslides has been monitored since June 1998 by the Utah Geological Survey (UGS) and the Salt Lake City surveyor (figure 8). Four houses at the top of the slide are threatened, and measures to protect one house have cost in excess of $300,000. In 2006 the landslide reactivated again, despite drier-than-normal conditions in Salt Lake City, moving about 2 feet.

The recent landslide damage to homes highlights the importance of considering geologic hazards in residential development. Earthquakes likewise pose a high risk, and projections of likely damage and loss of life in a major earthquake along the Wasatch Front are staggering. Other hazards such as flooding, debris flows, and poor soil conditions continually cause damage. Geologically, Utah is one of the most hazardous states in which to reside in the U.S., but prudent governmental actions as recommended herein can greatly reduce the risk.

ESTABLISHMENT OF THE WORKING GROUP

In response to the attention brought by the landslides of 2005 and 2006, the UGS briefed the Utah Department of Natural Resources (UDNR) leadership team on the problem and failures of the land-use-regulation process to protect homeowners. Mike Styler, UDNR Director, subsequently set up a briefing for Governor Jon M. Huntsman, Jr., and his staff on April 26, 2006. At that meeting, Governor Huntsman approved a recommendation to organize a working group to study the issue and develop recommendations to help solve problems and to outline how the State could help local governments in reducing losses from geologic hazards.

To assess support for establishing a working group and evaluate whether this was the best approach to evaluate the land-use-regulation process, the UGS invited a group of interested parties, including potential members of such a working group, to meet with Governor Huntsman on May 22, 2006, to discuss the issues. Lt. Governor Gary Herbert attended for Governor Huntsman, and following his remarks, the group agreed that, given the complexity of the problem, the best approach was to establish a working group to consider the issues and develop recommendations for the Governor. The GHWG was thus established and the UGS was asked to chair the group and provide administrative support.

Mission and Goals

The mission of the GHWG is to "improve the land-use-regulation process to reduce losses from geologic hazards to an acceptable level." To achieve this mission, the following goals were identified:

- Identify problem areas in the subdivision-approval process with respect to geologic hazards.
- Provide recommendations to correct these problems and improve the process.
- Identify responsible parties and steps needed to implement recommendations.
- Identify where and how the State can help local governments.

Process

The GHWG met in half-day sessions on September 28, October 18, and December 13, 2006, and January 3 and April 25, 2007, to discuss the issues and develop recommendations. Public comments were heard on June 28, 2007, and written comments received until July 6, 2007. The GHWG finalized recommendations and closed its deliberations at a final meeting on August 15, 2007. General topics of the meetings were:

- September 28, 2006: Adopting ordinances
- October 18, 2006: Implementing ordinances
- December 13, 2006: Enforcing ordinances
- January 3, 2007: Miscellaneous, including disclosure
- April 25, 2007: Finalize draft recommendations, plan for public comments
- June 28, 2007: Public comments
- August 15, 2007: Finalize recommendations

Following the meeting on April 25, 2007, the draft recommendations were sent to groups the GHWG believed would be interested in reviewing the results, principally developers, consultants, and homeowners previously affected by geologic hazards. Comments were taken in writing and at the June 28 meeting, and then the GHWG recommendations were finalized. The goals, background, and resources needed to implement each recommendation are included in appendix A. A timeline for achieving certain steps in implementation of these recommendations is given in appendix B. A glossary of terms and list of abbreviations and acronyms used in this report are included in appendix C. Appendix D lists those individuals and organizations that submitted public comments.

The GHWG will continue to meet semi-annually or annually to facilitate implementation of recommendations and judge progress toward meeting the timelines. The UGS will call these meetings as needed, and the original GHWG members will continue or appoint designees as appropriate.

Members

Members of the GHWG were chosen to represent professions involved in land-use regulation, organizations that coordinate and advise local governments, state and local government officials having experience with landslides and other geologic hazards, and state agencies that provide technical resources or funding. Members represent the American Planning Association (APA), Utah City Engineers Association (UCEA), Utah League of Cities and Towns (ULCT), Utah Association of Counties (UAC), Utah Division of Homeland Security (UDHS), Governor's Office of Planning and Budget (GOPB), and the UGS. Members from locations where recent landslide losses and resulting costs have occurred (Layton, Provo, and Alpine Cities and Morgan County) provided first-hand experience. Below is the list of members:

Gary Christenson, Utah Geological Survey, Chair

Francis Ashland, Utah Geological Survey, Facilitator

Laura Ault, Governor's Office of Planning and Budget

Nancy Barr, Utah Division of Homeland Security

Scott Carter, Layton City Director of Community Development

Sherrie Christensen, Morgan County Community Development, representing the American Planning Association, Utah Chapter

Jodi Hoffman, Utah League of Cities and Towns

Nick Jones, Provo City Engineer

Shane Sorensen, Alpine City Engineer, representing the Utah City Engineers Association

Arie Van De Graaff, Utah Association of Counties

The GHWG was formed to review the local-government subdivision approval process and advise the Governor on how the State may help local governments. Because these are governmental functions, we included a broad range of

government officials on the GHWG to develop the recommendations, and then sought input from the broader stakeholder group through a public comment process. Direct involvement and consensus-building with stakeholders such as developers, consultants, real estate professionals, educators, and technical professional groups was seen as most critical to implementing the recommendations, and their involvement is outlined in the "Implementation" sections of each recommendation.

RECOMMENDATIONS

To achieve its mission, the GHWG developed a set of recommendations regarding what can be done to improve the land-use-regulation process and identifying responsible groups and resources needed, including possible State assistance. Reducing geologic hazards is a complex process involving policies and procedures of each local government, ideally developed with stakeholder consensus. Therefore, these recommendations are meant to start a process that in the end will significantly reduce loses. The recommendations are listed below. Specific details of each recommendation, including goals, background, and steps needed for implementation, are outlined in appendix A. The timelines in appendix B are necessarily generalized because implementation will be a long-term, ongoing process.

ADOPTING ORDINANCES

1.1 Educate local governments on their "taking" liability in the development-approval process.

1.2 Encourage local governments to add a geologic-hazards element to their general plans and adopt/ enforce appropriate geologic-hazards ordinances.

1.3 Develop a model geologic-hazards ordinance.

IMPLEMENTING ORDINANCES

2.1 Update and improve existing generalized Wasatch Front geologic-hazards maps; provide outreach to cities not presently using available maps.

2.2 Determine the feasibility of adopting and enforcing grading codes in Utah.

2.3 Provide local governments with ac-cess to geologic and engineering expertise to review geologic-hazards reports prior to subdivision approval to adequately protect public safety.

2.4 Ensure that the standard of practice of engineering geology and geotechnical engineering in Utah advances.

2.5 Expand training in engineering geology at Utah universities.

ENFORCING ORDINANCES

3.1 Improve enforcement of recommendations in approved site-specific geologic-hazards reports by placing responsibility for on-site inspection and final documentation on developer's consultants.

MISCELLANEOUS

4.1 Establish a Disclosure Working Group to determine a course of action, and pursue disclosure legislation if appropriate.

4.2 Establish an investigative procedure following significant, damaging geologic-hazard events to determine what happened, including the sequence of events, both natural and human, that led to the event.

PUBLIC COMMENTS

Following the meeting on April 25, 2007, draft recommendations were distributed to the public for review and comment. The draft recommendations were distributed via e-mail; comments were particularly sought from developers (represented in part by the Utah Property Rights Coalition), consultants, real estate professionals, the academic community, professional geology and engineering groups, homeowners affected by geologic hazards, and selected legislators and other government officials. At the meeting on June 28, 2007, a presentation was given to describe the GHWG process and recommendations and then verbal comments were taken. The deadline for written comments was July 6, 2007.

Written and/or verbal comments were received from 18 individuals and organizations (appendix D). The full text of the comments is available at the UGS website at geology.utah.gov. Written comments were mostly informal e-mail responses; verbal comments at the meeting on June 28, 2007, were tape recorded. A written summary of the verbal comments is available at the website listed above; the tape recording is available from the UGS.

Most public comments addressed details of the Implementation sections of the recommendations (appendix A). No comments were made to add or delete recommendations, but comments resulted in revisions to the text of most recommendations and substantial modification of recommendations 1.3, 2.3, 2.4, and 2.5. One comment that was not addressed in changes to the recommendations was concern over the lack of private-sector (developer, consultant, real estate agent) representation on the GHWG (see Members section above for an explanation of membership). We agree that private-sector involvement is critical to the process and it is outlined in the Implementation section of each recommendation. Revised recommendations were finalized at the August 15, 2007, meeting prior to presentation to Governor Jon M. Huntsman, Jr.

STATE ACTIONS

The State of Utah provides technical and financial support to local governments for land-use planning and regulation. As outlined in appendix A, the principal recommended actions by State agencies relate to making information more accessible, providing additional technical resources to prepare and update geologic-hazards maps, assisting local governments in implementing ordinances, and providing planning grants and assistance. Some actions can be taken by agencies without additional funding, but others involve a significant expansion of workload and will require additional funding for improved programs, website development, and grants.

Few recommendations involve legislation, and expanded direct state control in local government land-use regulatory authority is not suggested. Legislation may be needed for Recommendation 1.1 to provide funding and incentives for training of local government officials, which would include information on "taking" litigation with respect to geologic hazards, and perhaps for Recommendation 4.1 to require disclosure statewide.

Funding for some recommendations will need to be included in state agency, the Governor's, and university budgets and ultimately appropriated by the Legislature. These principally involve additional general funds to the UGS for additional staff ($183,600/year ongoing) for expanded geologic-hazards mapping and local government outreach and assistance programs. This estimate does not include funds to expand review services. The GOPB needs funding for planning grants. Also, legislative appropriations would be necessary to fund an expanded engineering geology program at a Utah university(s).

CONCLUSIONS

Because many recommendations involve complex intergovernmental and private stakeholder involvement, implementation will be a long-term, ongoing process for years to come. The GHWG will provide leadership and coordination to encourage, facilitate, and monitor progress in these efforts. The ULCT will assist by providing training and a forum to disseminate information at their workshops and annual meetings. Professional organizations (APA, UCEA) can also assist in disseminating information, informing members of recent advances in assessing and mitigating geologic hazards, and providing general guidance. The State of Utah can help by providing technical assistance (UGS, UDHS, GOPB), geologic-hazards mapping (UGS), funding for planning activities (GOPB), and by implementing steps to improve technical standards of practice (UGS, DOPL).

Ultimate responsibility for safe development lies with local governments and developers. Local governments must adopt, implement, and enforce ordinances that effectively address geologic hazards. Predevelopment technical reports by developers' consultants must objectively assess geologic hazards and advise prudent actions to reduce risks. Inspection, monitoring, and final documentation by developers' consultants to ensure that their recommendations were followed should improve the efficiency and effectiveness of the process and provide technical oversight by qualified professionals.

ACKNOWLEDGMENTS

The GHWG acknowledges assistance provided by Tammy Kikuchi, UDNR, and support of the UDNR and UGS administrations. We thank Lt. Governor Gary Herbert for comments at the May 22, 2006, meeting, and individuals and organizations listed in appendix D that provided public comments.

APPENDIX A

RECOMMENDATIONS – GOALS, BACKGROUND, AND IMPLEMENTATION

ADOPTING ORDINANCES

Recommendation 1.1. Educate local governments on their "taking" liability in the development-approval process.

Goal

Allow elected, appointed, and staff local government officials to understand their "taking" liability when making land-use decisions.

Background

Issues related to potential infringement on private property rights often arise when development is restricted or prohibited based on geologic hazards, often termed a "taking." Local government officials, particularly city councils and planning commissions, need to understand their authority when making permit-approval decisions related to geologic hazards and their potential for being required to provide "just compensation" for a "taking" or reduction in value of private property.

Implementation

Information related to private property rights and results of court decisions related to "taking" litigation with respect to geologic hazards should be compiled and provided to elected and appointed local government officials and planning commissions, as well as planning department and other city staff. Information could be collected and provided in brochures, websites, and/or training workshops. The ULCT provides training for local government officials, and advocates that this training be mandatory for officials that are considered land-use authorities, including city council and planning commission members. The ULCT could include "taking" issues related to geologic hazards in the training it provides, but because of the large number of individuals to be trained and high turnover rates among these officials, broadly available methods such as web-based training are needed.

Responsible agencies

ULCT – Training will be provided as part of ULCT training for local government officials. Information will be collected and distributed in workshops and at annual meetings, and posted on websites. Workshop materials can be made available to counties.

Utah Legislature – Legislation may be pursued to provide funding and incentives for the training of all appropriate local government officials.

State Property Rights Ombudsman – The Ombudsman can also provide resources and is available for advice on specific issues as they arise.

Resources needed

Training materials will be developed and distributed, and workshops provided using existing resources of the ULCT and other sources; additional funding and incentives from the Legislature may be pursued.

ADOPTING ORDINANCES

Recommendation 1.2. Encourage local governments to add a geologic-hazards element to their general plans and adopt/enforce appropriate geologic-hazards ordinances.

Goal

Encourage local governments to understand their exposure to geologic hazards, evaluate their risk, and develop a plan to reduce the risk where necessary.

Background

The exposure to geologic hazards and resulting risk varies greatly among communities; some are subject to a wide variety of geologic hazards whereas others are relatively free of geologic hazards, depending on their location and geology. As a result, the need to take steps to reduce losses varies. Many local governments in Utah do not understand their community's exposure to geologic hazards, and one mechanism to provide for this understanding is to include a geologic-hazards element in their general plan. Once local governments identify high-hazard areas in their communities, they can better understand their risks and take steps to reduce them by adopting and enforcing geologic-hazards ordinances.

Implementation

General geologic-hazards information that local governments can use to assess their community's vulnerability to geologic hazards is available in much of Utah, including most of the Wasatch Front. Local governments need technical and in some cases financial assistance to collect, understand, and use this information to determine their community's exposure and how best to reduce risks. Agencies providing resources and services should expand outreach efforts to inform local governments of their availability; local governments wishing to use the services should contact agencies for assistance, and/or contract with private-sector consultants for services.

Responsible agencies

ULCT, UAC, and APA – Communicate the recommendation to local governments at annual meetings and other venues; provide technical assistance.

UDHS – Pre-Disaster Mitigation (PDM) and Natural Hazard Mitigation plans provide general information. Based on Congressional funding, PDM grants are made available annually from FEMA.

GOPB – Technical assistance and grants may be available from GOPB with oversight from the Quality Growth Commission for Critical Lands plans and other general planning needs, depending on funding from the Legislature; GOPB can develop a central website with links to all available information sources.

UGS, private consultants – Provide technical information and assistance, and aid in developing ordinances (see Recommendation 1.3).

Resources needed

The extent of resources will depend on the number of local governments that implement the recommendation.

ULCT, UAC – Enter into partnerships with cities and counties to assist using member contributions.

APA – Existing education outreach funds from the membership can be used to inform planners and provide technical assistance.

UDHS – Federal funding, supported by state and local match, are used to develop PDM plans.

GOPB – If funding from the Legislature continues, existing grant programs can be used for this planning, but additional funds will be required as the demand increases. No funding was approved for grants in fiscal year 2007–08. With a small amount of additional funding for technical assistance, existing staff can develop a central website with links to all available resources.

UGS – Existing staff is handling present workload, but an expanded outreach and assistance program would require at least 1/2 additional Geologist FTE ($33,300/year). If many local governments request UGS assistance, additional staff will be required.

Private consultants – Work with local governments to assist in assessing hazards to develop geologic-hazards elements of general plans and ordinances.

ADOPTING ORDINANCES

Recommendation 1.3. Develop a model geologic-hazards ordinance.

Goal

Provide a model geologic-hazards ordinance for use by local governments when updating existing ordinances or adopting new ones.

Background

Local governments typically address geologic hazards in Sensitive-Area, Geologic-Hazards, Subdivision, or Natural-Hazards ordinances. Much has been learned recently in Utah and elsewhere about effective ordinances, and these lessons must be captured in a model ordinance and made available for use by all local governments.

Implementation

Several cities and counties are presently updating ordinances. Most recently, Morgan County and Draper City are developing and implementing ordinances that incorporate recent lessons learned in Utah and other states. These and other recently prepared ordinances in Utah and elsewhere can serve as a basis for developing a model ordinance. Recent experience has also highlighted the need for the ordinance to define: 1) a clear approval and appeal process, perhaps involving expert review panels to resolve technical issues and/or binding arbitration to resolve non-technical issues; 2) in cases of disapproval, clear statements of reasons and recommendations to resolve issues; 3) minimum standards of geologic and engineering practice; and 4) expected performance standards. Also, provisions to protect public safety during investigations (fencing and posting of exploratory excavations) should be included.

The rough-draft model ordinance will be submitted for review and revision in the ongoing ULCT/Utah Property Rights Coalition (UPRC) consensus-building process. Private consultants and professional groups representing geologists and engineers will also review the model ordinance, particularly sections defining minimum standards of practice and setting performance standards. Once developed, the model ordinance will be distributed to the APA Utah Chapter and other appropriate local government and outside parties for public review and comment. Then the finalized model ordinance will be made available on the central GOPB website as well as the UGS, APA, ULCT, and UAC websites.

Responsible agencies

UGS – Develop the initial draft based on work with various local governments, and, with the ULCT, coordinate review by private consultants and professional groups.

ULCT – Coordinate revisions and develop consensus with UPRC.

APA, private consultants, AEG, ASCE, ACEC, and other stakeholders - Participate in the development and review process.

ULCT – Finalize and distribute for posting on websites.

Resources needed

No additional resources needed.

IMPLEMENTING ORDINANCES

Recommendation 2.1. Update and improve existing generalized Wasatch Front geologic-hazards maps; provide outreach to cities not presently using available maps.

Goal

Ensure that modern, up-to-date geologic-hazards maps are available to local governments, and that all local governments are aware of the available information for use in ordinances.

Background

Geologic-hazards maps used in land-use regulation must be scientifically based on the best available data, and incorporate the latest scientific principles and information. Such generalized 1:24,000-scale geologic-hazards maps are available for most of the Wasatch Front and some other urban areas in Utah, prepared by the UGS and geologists in the UGS-sponsored Wasatch Front County Hazards Geologist Program. However, many of the Wasatch Front maps were compiled in the late 1980s, and new information and technology is now available to update the maps. In some areas, new and improved maps are already available or are in development that should be considered for adoption by local governments. Also, not all local governments use the available maps in geologic-hazards ordinances. Local governments within the mapped areas should be made aware of their availability and trained in their use.

Implementation

The UGS and local governments should set up a procedure and schedule (for example, formal review and update every 10 years) for updating and improving maps using new data, and preparing new maps in areas not yet mapped. The UGS is presently compiling existing maps for the Wasatch Front into a GIS map database using funding from UDHS, so updates can be completed and made available electronically. Local government planning, engineering, and/or GIS departments will then replace older maps in their systems with these updated maps. Maps need to be made accessible on local government, UGS, and other websites as appropriate.

Responsible agencies

UGS
Local Governments
Private consultants

Resources needed

UGS – Existing staff presently completes a new set of geologic-hazards maps for one area every several years, and requires partial funding from local governments. Existing maps in the Wasatch Front area are presently being compiled into a uniform digital map database to be made widely available. To begin a systematic update of all existing maps and to accelerate mapping in new areas, at least one additional Geologist and GIS Analyst are needed. Total cost - $117,000/year (1 Geologist, 1 GIS Analyst).

Private consultants – Local governments can use existing funding or available State grant funding to contract with private consultants to update existing maps and produce new maps.

IMPLEMENTING ORDINANCES

Recommendation 2.2. Determine the feasibility of adopting and enforcing grading codes in Utah.

Goal

Implement proven practices in mass grading as a pilot project to determine the effectiveness of grading codes in hillside development in Utah.

Background

Grading codes have been tremendously successful in reducing losses from ground settlement and landslides in mass-grading projects in southern California and elsewhere, where much experience has been gained in administering these codes. In Utah, only Salt Lake County enforces a grading code and employs a grading inspector. Now that mass-grading projects are being proposed and implemented in Utah, including in areas where landslide-risk reduction is a major goal, a need exists to evaluate the feasibility of using grading codes in subdivision development, and to develop a process to adequately administer such codes, if feasible.

Implementation

Identify a city (or cities) with a proposed mass-grading project in landslide terrain to perform a pilot project to determine the feasibility of adopting and enforcing grading codes and develop methods to implement and administer them. Administration of grading codes typically involves requiring developers to provide on-site supervision (inspection, testing, monitoring) by geotechnical professionals during construction, with periodic reporting to local government inspectors. Involvement of professionals experienced in administering such codes in Salt Lake County and elsewhere, such as California, would be of great value in a pilot project. Large-scale development proposals that could be pilot projects are presently being considered in Draper and Layton.

Responsible agencies

Cities where pilot projects are undertaken
Developers and their consultants undertaking the mass-grading project
UGS, private consultants – Technical advice and assistance to local government

Resources needed

Cities – Costs for staff time will be incurred by the cities to administer and enforce the grading code; additional funding sources may be needed for training and technical assistance to implement the process.

Developers – Costs for their consultants to prepare grading plans, inspect and report to local government inspectors, and provide final as-built documentation will be incurred when using mass-grading techniques.

IMPLEMENTING ORDINANCES

Recommendation 2.3. Provide local governments with access to geologic and engineering expertise to review geologic-hazards reports prior to subdivision approval to adequately protect public safety.

Goal

Provide local governments with access to geologic and engineering expertise to review predevelopment geologic-hazards reports to assist in implementing geologic-hazards ordinances.

Background

To effectively implement geologic-hazards ordinances, local governments need access to geologic-hazards expertise. Geologists and engineers working on behalf of a local government are needed to advise local officials regarding the community's risk from geologic hazards, review site-specific reports, and work with local officials, planning commissions, and developers and their consultants to ensure safe development.

Implementation

Various options are available to provide this expertise, including hiring professionals on staff, contracting with private sector consultants, forming a volunteer review board comprised of local professionals, using the UGS, and/or cooperating in a circuit-rider program where geologists and engineers are shared with other communities (perhaps housed at the UGS or Association of Governments office). For certain specific needs, such as report reviews for high-hazard sites, high-level expert technical panels may be used. The 1985–88 federally funded, UGS-sponsored Wasatch Front County Hazards Geologist Program that placed geologists in county governments to provide these services, both to cities within each county and the unincorporated county, was not continued once federal funding expired, principally due to city and county funding issues and perceived work loads. However, the County Geologist Program demonstrated the value to a local government of having ready access to geologic expertise. Presently, local governments use private sector geologists, volunteer review boards, or the UGS to provide reviews, or do not perform reviews. Some local governments charge developers directly for reviews; others use either State (UGS) or other resources to provide reviews. Funding of reviews through fees or other sources may be required.

The UGS presently provides review services for a limited number of local governments as requested, but because of staff limitations recommends that local governments use private sector reviewers whenever possible and use the UGS mainly under special circumstances (for example, when a local government cannot find or is unsatisfied with private sector reviewers, or needs a review panel member).

The GHWG considers the UGS role in performing reviews for local governments of critical importance, and recommends this service continue.

Responsible agencies

Responsible agencies will depend on the approach taken to provide services, and include:

Local Governments
UGS
Private consultants
Possibly Associations of Governments (for circuit-rider programs)

Resources needed

Local governments - Procedures are needed to fund report reviews by in-house staff or contracted consultants or circuit riders, or to use UGS state-funded resources.

UGS – The UGS presently provides reviews free of charge with existing staff. Expansion of review services will require additional staff (initially 1-2 Project Geologists; $73,700-$147,400/year ongoing). This estimate of needed resources is not included in the total State requests at this time (see State Actions section of report) because of high uncertainties in the number of reviews that may be requested by local governments. Such requests for additional funding will be postponed until needs are better understood.

Private consultants – Provide review services under contract to local governments.

IMPLEMENTING ORDINANCES

Recommendation 2.4. Ensure that the standard of practice of engineering geology and geotechnical engineering in Utah advances.

Goal

Ensure that the technical and ethical standard of practice advances through education, experience, training, and professional development.

Background

Geologic-hazards evaluations, particularly paleoseismic and landslide stability analyses, require specialized expertise not commonly obtained in university undergraduate geology programs. Also, undergraduate geotechnical engineering programs are de-emphasizing coursework in geology. The knowledge base and standard of practice for such investigations is rapidly advancing, and consultants and reviewers must keep up-to-date with these advances. Recent damage caused by movement of landslides that were determined by geologic and engineering consultants to be sufficiently stable for development has highlighted the need for the standard of practice in Utah to advance, particularly with respect to landslide-stability evaluations. High-level-expert geologists and engineers from California, Oregon, and Colorado that have worked in Utah have similarly indicated a need to improve the standard of practice here, particularly with respect to landslide evaluations. In general, professional licensing is not as effective as it could be in improving the standard of practice, and other methods are needed as well.

Implementation

Local government ordinances should specify minimum qualifications for geologists and engineers, consistent with licensing requirements, particularly with respect to specialty education and experience in engineering geology and geotechnical engineering. Increased use of third-party expert review panels to resolve disputes in the approval process will likely contribute to advancing the standard of practice. The UGS, Association of Environmental and Engineering Geologists (AEG) Intermountain Section, and American Society of Civil Engineers (ASCE) Utah Geotechnical Group should approach the Utah Division of Occupational and Professional Licensing (DOPL) and the Geology and Engineering Licensing Boards concerning ways to improve the effectiveness of licensing and in advancing standards of practice. The UGS and AEG Intermountain Section should approach DOPL and the Professional Geology Licensing Board regarding instituting a continuing education requirement for Professional Geologists and/or a specialty certification in engineering geology. Utah professional and other organizations (AEG, ASCE, ACEC) should sponsor workshops and seminars on geologic hazards, and prepare a standard of care document for assessment of landslides similar to the 2002 Southern California Earthquake Center (SCEC) document, *Guidelines for Analyzing and Mitigating Landslide Hazards in California*. Private consultants should present results of investigations at professional meetings and field trips to disseminate information and technology. The UGS should maintain and expand its programs of technical publications, presentations, and field trips to make geologic-hazard research results more available.

Responsible agencies

UGS
Professional/other organizations (AEG, ASCE, ACEC)
DOPL
Private consultants

Resources needed

UGS – To expand outreach programs and sponsor training, UGS would require an additional ½ Geologist FTE ($33,300/year); UGS can also redirect existing technical staff to target research to answer critical questions needed to improve the standard of practice.

Professional organizations, private consultants – Increased emphasis on training, research, and outreach.

Recommendation 2.5. Expand training in engineering geology at Utah universities.

Goal

Provide educated engineering geologists so that Utah consultants can hire local well-qualified staff.

Background

Although most major Utah universities maintain geotechnical-engineering programs that offer graduate degrees, only the University of Utah (UU) offers an accredited geological engineering program but few graduates from the UU program are presently employed by Utah consultants. Utah universities should add or expand graduate programs in engineering geology with specialized training in paleoseismology, slope stability, engineering geology, Quaternary geology, geomorphology, structural geology, and soil and rock mechanics. This specialized training is needed to prepare geologists for work in consulting companies performing engineering-geologic and geologic-hazards investigations. As a result, companies often must hire geologists without an engineering-geology specialty and train them on the job. Close mentoring by an experienced engineering geologist is a critical part of this training.

Implementation

The need for engineering-geology education, recommendations for specialized coursework, and potential for employment must be communicated to Utah universities so that they can evaluate whether the need and resources are adequate to establish or expand engineering geology programs. The UGS and Professional Geology Licensing Board should meet with geology department heads of Utah universities to discuss the need for and importance of such education, and whether or not more than one Utah university should emphasize such a program. A "cooperative education" program with local employers may be a possible means of encouraging properly educated engineering geologists to stay in Utah and join local consulting companies. Private consultants, UGS, and professional organizations can also assist universities in training by providing seminars, workshops, and field trips on existing projects for students.

Responsible agencies

UGS
Utah universities
Private consultants, professional/other organizations (AEG, ASCE, ACEC)
Legislature (funding)

Resources needed

Cost estimates to hire faculty and initiate or expand programs will need to be provided by universities.

ENFORCING ORDINANCES

Recommendation 3.1. Improve enforcement of recommendations in approved site-specific geologic-hazards reports by placing responsibility for on-site inspection and final documentation on developer's consultants.

Goal

Ensure that final recommendations in site-specific reports are implemented by developers and contractors.

Background

Enforcement has been a weakness in final implementation of geologic-hazards ordinances. Adequate funding for code enforcement officers is generally lacking, and most building officials are not technically qualified to perform geologic-hazards inspections, particularly for excavation and grading. However, enforcement is an important and final step in protecting private property, infrastructure, and public safety.

Implementation

Geologic-hazards reports by developer's consultants commonly recommend that they observe conditions during development to ensure that their investigation adequately characterized conditions and that their recommendations are followed. This is an important step which protects all parties involved. It protects the consultant by ensuring their recommendations are followed and unanticipated conditions are recognized, and prevents them from being unfairly held responsible if problems arise because their specifications were not met by contractors. It protects the developer by providing for accountability on the part of their contractors and consultants, and protects local governments by ensuring qualified professionals are performing inspections on site. The final documentation by the developer's consultants helps ensure safe development and provides a record of accountability and liability if problems arise. This is a process that has been proven to work and has become standard practice in many urban areas of the U.S.

Responsible agencies

Local governments
Developers and their consultants

Resources needed

Costs for inspection and final documentation are a developer's business expense ultimately passed on to homebuyers. Additional costs incurred by local governments for administration and monitoring of inspections should not be unwieldy, but if so, will require additional funding sources.

MISCELLANEOUS

Recommendation 4.1. Establish a Disclosure Working Group to determine a course of action, and pursue disclosure legislation if appropriate.

Goal

Provide adequate information to home buyers regarding risks from geologic hazards when purchasing a home.

Background

Buying a home is probably the greatest investment most families make in a lifetime. In making a decision on purchasing a home, they need accurate information. A commonly overlooked concern is geologic hazards because most homebuyers are unaware of geologic hazards and falsely assume that government would not allow homes to be built in hazardous areas. Homebuyers need to know the risks they are incurring.

Disclosure can be implemented at either the state or local government level. Uniformity statewide is desirable, and would require legislation. Accurate maps showing geologic hazards are useful to inform sellers, real estate agents, and local governments of potential hazards, but aren't available everywhere. Thus, disclosure requirements may need to vary depending on the availability of information. Also, issues related to possible hazards from adjacent properties should be considered.

Implementation

Disclosure is a complex process involving many stakeholders, including local governments (Recorders), lenders, real estate agents (including the Utah Association of Realtors), state agencies (e.g., Utah Division of Real Estate), and title companies. A Disclosure Working Group or Task Force should be established to study the issues and develop recommendations. The UGS will get the process started by contacting the Utah Division of Real Estate to attempt to establish a Working Group or Task Force to study the issue.

Responsible agencies

Utah Division of Real Estate
Utah Association of Realtors
Local governments
Utah League of Cities and Towns
Utah Geological Survey (to provide hazard information)
Utah Seismic Safety Commission (see Strategy 1.3 of *A Strategic Plan for Earthquake Safety in Utah* by the USSC)

Resources needed

Establishment of the Disclosure Working Group or Task Force can be done with available resources. One task of the group will be to define resources needed to implement their recommendations.

MISCELLANEOUS

Recommendation 4.2. Establish an investigative procedure following significant, damaging geologic-hazard events to determine what happened, including the sequence of events, both natural and human, that led to the event.

Goal

Improve the standard of practice of professionals performing geologic-hazards studies and the land-use-regulation process by investigating damaging geologic-hazard events.

Background

Failures of engineered structures, particularly those that result in significant damages and injuries or death, typically generate an investigation to determine the cause (e.g., National Transportation Safety Board investigations of airline and train accidents, structural-engineering reviews of building failures, dam-safety reviews of dam failures). Such investigations are extremely valuable from a public safety standpoint. They are very detailed and often costly, and are performed by independent, objective professionals who typically determine the causes and give recommendations to prevent recurrence.

Investigations of geologic-hazard events that cause damages, at a level of detail appropriate to the severity of damages, would be valuable to identify where the land-use-regulation process failed and can be improved, and also to provide information that affected parties can use in considering actions to recover losses.

Implementation

The State Hazard Mitigation Team (SHMT), coordinated through UDHS, presently investigates hazard events to advise local governments in emergency response and mitigation strategies to lessen the impact of future hazard events. For damaging landslides, the UGS typically prepares summary reports based on its emergency investigations. The SHMT member agencies, principally the UGS with regard to landslides and earthquakes, could perform additional investigations as needed to evaluate possible causes and identify where the regulatory process failed, including the steps in the process to ensure that adequate predevelopment studies are performed. For particularly damaging events, an expert panel or other entity could be brought in to perform or supervise such investigations. The best method to perform such studies may need to be decided on a case-by-case basis, although in general extensive and costly government-funded investigations are not proposed.

This information can be used as a basis for local governments to evaluate weaknesses in their regulations and improve procedures and policies, and for affected parties to consider professional licensee or legal actions. Ultimate liability and appropriate legal action would be determined by DOPL and State Licensing Boards or the courts based on complaints filed or litigation that may require detailed investigations. In conjunction, an appropriate consumer protection agency could establish a program to use these reports to file complaints with DOPL when damages occur in subdivisions where predevelopment studies have been completed and found to be inaccurate.

Responsible agencies

UDHS SHMT members
Utah Geological Survey
Consumer protection agency

Resources needed

Costs for investigations may vary greatly depending on the amount of damages, complexity of issues, extent and availability of existing reports, and persons performing investigations. Costs for standard SHMT-type investigations could be covered by existing agency budgets, but costs for outside experts and panels for particularly damaging or politically sensitive events could be considerable.

Consumer protection agency – This may fall under the mission of the appropriate agency and not require additional resources. If a large number of events requiring action occur, additional one-time funding may be needed.

APPENDIX B

TIMELINE FOR IMPLEMENTING RECOMMENDATIONS

(Timelines assume requested resources are provided; additional staff requests assumed to be filled 7/2008 at the earliest)

GENERAL OUTREACH

General Presentations of GHWG Recommendations

3/07	APA Utah Chapter; Workshop at Annual Meeting, Springdale
4/07	Utah Counties Insurance Pool, Annual Meeting, Provo
6/07	Public comments, Salt Lake City
9/07	ULCT Annual Meeting, Salt Lake City APA Utah Chapter Annual Meeting, Davis County
9/07	Presentation to Governor's Office

RECOMMENDATIONS

1.1. Educate local governments on their "taking" liability in the development-approval process

9/07	ULCT completes addition of "taking" element to existing training
2008 Leg.	Pursue legislation for funding and incentives for training (if needed)
2008+	ULCT provides training in workshops, annual meetings, websites, brochures

1.2. Encourage local governments to add a geologic-hazards element to their general plans and adopt and/or enforce appropriate geologic-hazards ordinances.

9/07+	Communicate recommendation at ULCT, APA meetings
12/07	GOPB prepares comprehensive website identifying information sources
2008+	Prepare general plan elements and ordinances

1.3. Develop a model geologic-hazards ordinance.

8/07	Complete draft model ordinance (without technical appendices); ULCT and Property Rights Coalition begin stakeholder input and consensus-building
10/07	Complete draft technical appendices; UGS, professional organizations, and consultants begin stakeholder review and consensus-building
2008	Finalize model ordinance; post on websites (GOPB, UGS, UDHS, ULCT, UAC)

2.1. Update and improve existing generalized Wasatch Front geologic-hazards maps; provide outreach to cities not presently using available maps.

7/08	UGS consult with local governments that use maps; develop plan to update maps
2008+	UGS hold regional hazards workshops with local government personnel (include discussion of Recommendations 1.2, 1.3, 2.3, and 3.1)
2008+	Ongoing updates and outreach

2.2. Determine the feasibility of adopting and enforcing grading codes in Utah.

2007–08	Initiate pilot project as opportunity arises

2.3. Provide local governments with access to geologic and engineering expertise to review geologic-hazards reports prior to subdivision approval to adequately protect public safety.

2008+	UGS meet with local government personnel (see Recommendations 1.2 and 2.1 above) and/or AOGs to define a process

2.4. Ensure that the standard of practice of engineering geology and geotechnical engineering in Utah advances.

12/07	UGS make initial contacts with AEG, ASCE, ACEC to develop plan

2.5. Provide training in engineering geology at Utah universities.

6/08	UGS make initial contacts with universities, in conjunction with Utah Professional Geologist Licensing Board

3.1. Improve enforcement of recommendations in approved site-specific geologic-hazards reports by placing responsibility for on-site inspection and final documentation on developer's consultants.

9/07	Present at ULCT and APA Annual Meetings
2008+	Local governments update and enforce ordinances

4.1. Establish a Disclosure Working Group to determine a course of action, and pursue disclosure legislation if appropriate.

6/08	UGS meet with Utah Division of Real Estate to discuss establishing a Disclosure Working Group

4.2. Establish an investigative procedure following significant, damaging geologic-hazard events to determine what happened, including the sequence of events, both natural and human, that led to the event.

Immediate	Implement for next damaging event; coordinate with SHMT

APPENDIX C

GLOSSARY AND LIST OF ABBREVIATIONS AND ACRONYMS

GLOSSARY

Alluvial Fan: A generally low, cone-shaped landform composed of sediment deposited by a stream issuing from mountains as it flows onto a lowland.

Critical Facilities: Essential, hazardous, and special occupancy facilities as defined in the 2006 International Building Code Occupancy Categories III and IV. Some lifelines such as major utility, transportation, and communication facilities and their connections to critical facilities may also be considered critical.

Debris Flow: A slurry of rock, soil, organic material, and water transported in an extremely fast and destructive flow down channels and onto and across alluvial fans.

Development: Includes all subdivisions, single- and multi-family dwellings, commercial and industrial buildings, critical facilities, additions to existing buildings, storage facilities, pipelines and utility conveyances, and other land uses.

Engineering Geologist: A geologist, who, through education, training, and experience, is competent in applying geologic data, geologic techniques, and geologic principles (which includes conducting field investigations), so that geologic conditions and geologic factors affecting engineered works, ground-water resources, and land-use planning are recognized, adequately interpreted, and clearly presented for use in engineering practice, land-use planning, and for the protection of the public. Engineering geologists utilize their specialized geologic training and experience to provide quantitative geologic information and recommendations, and also work with and for land-use planners, environmental specialists, architects, public policy makers, and property owners to provide geologic information on which decisions can be made. Licensing as a Professional Geologist is required through the State of Utah.

Engineering Geology: Engineering geology is geologic work that is relevant to engineering and environmental concerns and the public health, safety, and welfare. Engineering geology is the application of geological data, principles, and interpretation so that geological factors affecting planning, design, construction, and maintenance of engineered works, land use, and ground-water resources are adequately recognized and properly interpreted for use in engineering, land-use planning, and related practice.

Fault: A fracture in the earth's crust forming a boundary between rock or soil masses that have moved relative to each other (faults are considered "active" if movement has occurred in the past 10,000 years).

Fault Scarp: A steep slope formed by movement along a fault.

Geologic Hazard: Surface fault rupture, liquefaction, landslides, debris flows, rock falls, and/or other geologic processes that may present a risk to life and property.

Geotechnical Engineer: A professional, licensed civil engineer whose education, training and experience is in the field of geotechnical engineering. Professional licensing is required through the State of Utah.

Geotechnical Engineering: The investigation and engineering evaluation of earth materials including soil, rock, and man-made materials and their interaction with earth retention systems, foundations, and other civil engineering works. The practice involves the fields of soil mechanics, rock mechanics, and earth sciences and requires knowledge of engineering laws, formulas, construction techniques, and performance evaluation of engineering. Geotechnical engineering includes investigating existing subsurface conditions and materials; assessing risks posed by site conditions; designing earthworks and structure foundations; and monitoring site conditions, earthwork and foundation construction.

Global Positioning System: A system of satellites that are used for high-precision surveying that is capable of detecting movement of only a few centimeters.

Grading Code: A regulatory document defining technical and administrative requirements for excavation and grading.

Landslide: A general term for the downslope movement of a mass of soil, surficial deposits, or bedrock, including a continuum of processes among slides, flows, and falls. Debris flows and rock falls are defined separately.

Liquefaction: A process by which certain water-saturated soils lose bearing strength because of earthquake-related ground shaking and subsequent increase of ground-water pore pressure.

Qualified Professional: An engineering geologist or geotechnical engineer as defined above, qualified to perform geologic-hazards studies.

Rock Fall: A rock, or mass of rock, newly detached from a cliff or other steep slope which moves downslope by falling, rolling, toppling, or bouncing; includes rockslides, rock-fall avalanches, and talus.

Slope Stability: The resistance of a natural or artificial slope or other inclined surface to failure by landsliding; usually assessed under both static and dynamic (earthquake-induced) conditions.

Surface Fault Rupture: Propagation to the ground surface of an earthquake-generating fault rupture, displacing the surface and forming a fault scarp.

Taking(s): Potential infringement on private-property rights that may arise when development is restricted or prohibited based on geologic hazards or other land-use considerations.

Talus: Rock fragments, commonly derived from rock fall, lying at the base of a cliff or a very steep rocky slope.

LIST OF ABBREVIATIONS AND ACRONYMS

ACEC: American Council of Engineering Companies
AEG: Association of Environmental and Engineering Geologists
AOG: Association of Governments
APA: American Planning Association
ASCE: American Society of Civil Engineers
BYU: Brigham Young University
DOPL: Division of Occupational and Professional Licensing
FEMA: Federal Emergency Management Agency
FTE: Full-time equivalent (employee)
GHWG: Governor's Geologic Hazards Working Group
GIS: Geographic Information Systems
GOPB: Governor's Office of Planning and Budget
IBC: International Building Code
PDM: Pre-Disaster Mitigation (Plan)
SHMT: State Hazard Mitigation Team
UAC: Utah Association of Counties
UCEA: Utah City Engineers Association
UDHS: Utah Division of Homeland Security
UDNR: Utah Department of Natural Resources
UDOT: Utah Department of Transportation
UGS: Utah Geological Survey
ULCT: Utah League of Cities and Towns
USSC: Utah Seismic Safety Commission
USU: Utah State University
UU: University of Utah

APPENDIX D

PUBLIC COMMENTS – LIST OF SUBMITTERS

WRITTEN COMMENTS

Harry Audell, Geologist, Geodynamics Consultant Group, Inc.

Greg Baptist, Grading Inspector, Salt Lake County Development Services

Steve Bartlett, University of Utah Civil and Environmental Engineering Department

James Evans, Utah State University Department of Geology

Wendell Gibby, Developer, Mapleton

Jack Hamilton, UGS Board and University of Utah Experiment Station

Ron Harris, Brigham Young University Department of Geology

Leslie Heppler, Geologist, Utah Department of Transportation

Intermountain Section Board, Association of Environmental and Engineering Geologists

Dave and Linda McCallister, Creekside Drive area landowners, Morgan County

Fred Meese, Heather Drive landslide homeowner

Bob Nicholson, St. George Community Development Director, Hillside Review Board

Jim Pechmann, University of Utah Seismograph Stations

Joergen Pilz, Geotechnical Engineer, Rio Tinto

Jim Shervais, Utah State University Department of Geology

VERBAL COMMENTS AT JUNE 28, 2007, MEETING

Hiram Alba, Geotechnical Engineer and Geologist, American Council of Engineering Companies and Intermountain Geo-Environmental Services Inc.

Carolyn Bachman, Falcon Ridge Community Coalition, Layton

Bruce Baird, Utah Property Rights Coalition and Suncrest