The Editor,

[1]RE: LANDSLIDE RISK MANAGEMENT CONCEPT AND GUIDELINESREPORT BY AGS SUB-COMMITTEE, AGS JOURNAL VOL 35 NO 1 MARCH 2000

I am writing to you with my comments on the above paper. The comments arise as the result of work I have been carrying out for the National Parks and Wildlife Service on Risk Assessments for the various lodges and infrastructure development in the Kosciuszko National Park following the Thredbo Landslide. Can you please pass them on to the committee responsible for issue of the report for their consideration.

My comments follow:

1. In Section 1.0 when talking about the deficiencies of the 1985 approach it appears to me that a significant shortfall of this earlier approach was that it did not consider the consequence of any identified hazard. That is, whilst the purpose of that paper was to define the risk of instability at a site, the word "risk" was used as a synonym for likelihood because it did not take into account the consequence of that landslide. Therefore the 1985 approach was a method for determining the likelihood of a landslide.

2. In Section 3.1, Scope Definition, I believe that any risk assessment which omits injury to persons or loss of life as a consequence should also carry a warning that it is an incomplete assessment. I say that because, if we are aware of a situation with the potential to pose a serious risk to a person's welfare i.e. tolerable, high or very high risk as defined by the guidelines document, then I believe that the duty of care in our legal system will require us to inform of that risk. I don't believe our legal system will allow us to avoid that duty by limiting our scope in the risk assessment. The duty of care is likely to still apply if the client specifically requests that injury / loss of life be omitted from the assessment. I believe it to be worthwhile to have a legal opinion on this aspect.

3. In Section 3.5.3 the recommendation is made that risk for loss of life should be quantified. However, the paper also recognises that in general any such quantification will require significant judgement to assign probabilities to the various elements of the probability product chain because of the difficulty of obtaining numerical data in most situations. As stated in the paper this approach can only be called (at best) a semi-quantitative approach.

   I believe that any attempt to quantify what is in effect a qualitative judgement will have the effect of conveying a degree of accuracy to the assessment which it does not have. Further, having to assign quantitative estimates of likelihood to the assessment process will add a further degree of difficulty for no further gain in accuracy.

   As an alternative and as a means of avoiding the above situations, I suggest that a qualitative scale of consequence can be used which addresses the varying prospects for injury / loss of life. That is, in Appendix G, the table which gives the qualitative measure of consequence can be modified to include the varying prospects for injury / loss of life.

   I developed one such table for use in our work for the NPWS in which I assigned a likelihood for loss of life to each consequence level (see attached). The same likelihood descriptions for loss of life have been used as for the qualitative measure of likelihood. In the modified table I have assumed that the likelihood for injury is similar to that for loss of life. I have found that this approach can work successfully and that it is easily understood by non-geotechnical personnel. This same table has also been adopted by Wollongong Council for their internal use.

   A possible criticism of this approach is that the description of consequence contains a probability term. However, I don't believe this to be a serious drawback because the table can in this instance be considered as combining vulnerability and consequence.

4. The Qualitative Risk Matrix in Appendix G.

   (i) I must admit to being confused by the dual notations on some of the risk levels in this table e.g. a D1 risk classified as an M-H risk level. Does this mean a risk level intermediate between M and H or does it mean that it can be either? In the latter case I presume that it is the assessor who decides which one to assign?

   (ii) You would be aware that the risk analysis matrix given in AS/NZS 4360 : 1999 (the Standard) has only four risk levels. The Standard also gives a legend to describe these levels. I have tried to compare the risk levels of the matrix in the Standard with those of the matrix in the Guidelines document. However, I find that the wording which is provided in the Standard to describe the levels is very confusing. As a result I have found it difficult to compare the risk levels in the two matrices. I have interpreted the risk levels L, Mand H in the Standard to compare respectively with levels VL, L and M of the Guidelines document. However, this

[1] These letters were originally published in AG Volume 35 No 3 September 2000

requires one to interpret the legend for Level H of the Standard to mean that "senior management attention" allows for the possibility of no action by them to reduce the risk This may not be what is intended because why would you bring a situation to senior management's attention if they are not going to act on it?

If the above interpretation is correct then the E risk level of the Standard encompasses both the H and VH levels of the Guidelines document. I can understand why the Standard would group these two risk levels into a single unacceptable risk level. However I would still favour the use of the five risk categories as defined in the Guidelines paper. Notwithstanding, can the Committee offer comment on the earlier comparisons as I believe a correlation to the Standard is important. Was the Guidelines risk matrix discussed with any member of the Standards Committee?

(iii) Further, if the above interpretation is correct then the H level of the Standard would be equivalent of what we would generally accept as a tolerable risk.

Review of the risk matrix in the Standard shows that a hazard with an almost certain likelihood and minor consequence (i.e. an A2 hazard in the Standard) is tolerable. A B3 hazard is also tolerable in this matrix. In contrast the Guidelines document defines both these hazards as having an unacceptable risk.

At the low likelihood end of the matrix, the Standard considers a D5 hazard as unacceptable whilst the Guidelines document defines it as M-H, and an E4 as tolerable whilst the Guidelines document defines it as L-M.

That is, from the above it appears to me that the Standard has "skewed" the acceptability criterion in the direction of consequence - if the consequence is not great then it is prepared to consider the situation acceptable notwithstanding that other numerically similar risk levels (along the same matrix diagonal) but with a more serious consequence are defined as having an E level. This same "skewing" is apparent with the E4 hazard which the Standard considers to be tolerable whereas other hazards along this same matrix diagonal are considered acceptable.

The Guidelines document tends to follow a consistent pattern for risk rating along the diagonals except that it does allow some reduction in the risk level at the low likelihood end of the matrix.

I would be interested in the Committee's comments on the reasons why the risk matrix was structured in the manner shown in the report, particularly at the high likelihood end. In the document we have prepared for the NPWS I have structured our matrix by skewing it in the manner shown in the Standard at this end. I believe this to be more in keeping with what the general public might accept. For example from a personal point of view I would be prepared to accept the risk from an A2 hazard on the basis that any damage would likely be only of nuisance value. The alternative of this risk being classified as an unacceptable risk could result in large costs to clients.

In closing I'd like to take this opportunity to congratulate Bruce and the Committee on the publication of the paper. I believe it to be an excellent document and one which will aid enormously in the preparation and understanding of slope stability risk assessments.

Yours faithfully,

GHD-LONGMAC PTY LTD

Laurie de Ambrosis

Manager

Alternative Table for the Defination of Vulnerability and Consequence.

Qualitative Measures of Vulnerability and Consequences

Level	Descriptor	Description
1	CATASTROPHIC	Almost certain fatality, or structure completely destroyed or large scale damage requiring major engineering works for stabilisation.
2	MAJOR	Likely fatality or extensive damage to most of structure, or extending beyond site boundaries requiring significant stabilisation works.
3	MEDIUM	Possible fatality or moderate damage to some structure, or significant part of site requiring large stabilisation works.
4	MINOR	Unlikely fatality and limited damage to part of structure, or part of site requiring some reinstatement stabilisation works.
5	INSIGNIFICANT	Rare fatality and little damage.

Note: The "Description" may be edited to suit a particular case.

Note: The likelihood of human fatality has been added as an assessment criterion when compared to the Guidelines.

Dear Editor,

Re: Land Risk Management Concepts and Guidelines & Hillside Building Guidelines

I would like to congratulate the society for the publication of the latest guidelines which are a continuation of the "risk" and probabilistic approach to the assessment of slope stability pioneered by Dr Barry McMahon in 1971 [Ref: 1]. I also note that Dr McMahons' work was developed by myself to the urban environment in 1975 [Ref: 2] and later by a NSW committee of the society in 1985 [Ref: 3]. It is pleasing to see the way in which the "risk assessment" approach to the evaluation of slope stability has now been accepted nationally.

As such, my consulting practice has naturally adopted the latest guidelines and is incorporating the same in the various geotechnical reports issued by the firm.

However, in the course of implementing this policy it has become apparent that the guidelines need further development; this is because the latest publication really only provides guidance for the assessment of a "particular development" in a "specific" situation, whereas many geotechnical reports are written in an environment where the style, or details of a proposed development are not known. It is also difficult to apply the guidelines to the slopes behind cliff-top and coastal bluff areas where several conflicting mechanisms are occurring. Perhaps therefore the society could consider devoting one of its technical meetings / seminars to an open discussion of the guidelines to identify those areas of the guidelines that need further refinement.

Further, whilst the latest publication refers to the importance of "hazard zoning", there is little guidance [other than in the most general of terms] as to how such hazard zoning should be carried out. In this regard, I refer you to my 1975 paper in which a basis for hazard zoning as applied to town planning was suggested; I also note that this suggestion was further developed in 1983 [Ref: 4]. Also, as land stability issues are often associated with coastal processes, perhaps the more developed hazard identification / classification system for town planning could also embrace the work of coastal engineers [e.g. Lex Nielsen - Ref: 5].

I now refer to the suggestion by the society that the task of developing appropriate hillside building guidelines should be the subject of a "funded program" [i.e. carried out by a paid consultant, or group] and in this regard make the following observations:

1. In the society publications to date, no reference has been made to the work of Ingles in the 1970's on hillside building guidelines [Refs: 6 & 7], nor to his latest paper [Ref: 9] which addresses desirable hillside building practice & landslide risk zoning in Tasmania.
2. Whilst the Thredbo inquest paid particular attention to the Hillside Building Guidelines published by myself and Peter Burgess in 1976 [Ref: 8] the latest publication does not refer to these guidelines although the 1985 Society guidelines [Ref: 3] substantially embraced them.
3. Whilst the society as a whole has not provided extensive technical information on hillside building practice since 1985, a number of consulting firms [including my own] have regularly appended notes on hillside construction to their various geotechnical reports since the late 1970's, with some firms issuing very extensive notes.

In view of the above, I suggest that the society convene at an early date a committee to formulate a "draft set" hillside building guidelines based on what is currently available within the technical community. These draft guidelines could then be published in "draft form" [similar to the draft codes produced by Standards Australia] and form the basis for a series of "seminars / workshops" by the various state groups. These seminars would then naturally lead to a formal set of published guidelines.

In this way the finally published guidelines would have wide "technical consensus" with the significant expenses associated with the workshops, etc., being the subject of the "funded development".

Sincerely,

A F Shirley.

SHIRLEY CONSULTING ENGINEERS PTY LTD

References:

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9. Ingles O G & Pedersen A M [1999] "Recognition and Responsible Development of Unstable Land"; Proceedings of the 1999 Australian Disaster Conference 'Disaster Prevention for the 21st Century'. pp. 27-32.

cc A Leventhal, B Walker
B McMahon, O G Ingles.

The Editor,

Subject: Australian Geomechanics Society - Landslide Risk Management Concepts and Guidelines

I refer to our discussion in relation to this matter and make the following comments on the guidelines:

1 The definition of landslide in appendix B is very difficult to understand. It is very unclear and I also do not understand why ground subsidence and collapse are excluded;

2 While the document expressly deals with risk of loss of life or injury, appendix G is limited to property damage. No example seems to be provided of an assessment for loss of life or injury;

3 Most importantly, there appears to be some conflict between the concepts which underlie the document and the legal theory of liability in negligence. In short, the document focuses on tolerable and intolerable risks, which concept does not seem to take into account the capacity (in monetary and other terms) to remove the risk but, rather, appears to be based on the likelihood of the event and its consequences in terms of property damage or loss of life/injury. In terms of the common law of negligence, the practicality and cost associated with remedial options is critical and it is a relevant issue in determining whether or not a duty of care exists at all. In short, if reasonably practicable steps are available to remove even a tolerable risk, then the duty of care will be discharged.

The document, however, seems to work on the basis that if the risk is tolerable, then no steps, in particular, need to be taken.

4 It is not clear to me how the document distinguishes between loss of life and capacity for injury in terms of determining "vulnerability". In fact, although the document refers to injury, it seems to me that the actual risk assessment is based on loss of life, rather than injury. Particularly, the basis appears to be the annual probability of the loss of life of an individual (not the risk of injury at all). If this is the case, then the document should not purport to deal with risk of injury.

5 Related to my comments above, the consequence analysis in section 3.4 refers to a number of matters other than property damage, injury or loss of life. I think it is important to recognise that while those additional factors may be relevant to a decision to take some action to remove risk, they could never justify a decision not to take some action to remove risk.

That is to say, political effects, loss of business confidence and effect on reputation, as well as the potential for litigation, could not be relevant matters in determining whether or not removing or mitigating the risk is an appropriate action. Just as it is not appropriate for a car manufacturer to fail to withdraw cars from the market for a defect, the car manufacturer could not defend proceedings in negligence by reference to failing to take steps to protect their reputation. In deed, this would be an aggravating circumstance.

Kind regards

Jayne Jagot

Partner - National Environment and Planning Group Mallesons Stephen Jaques Sydney

The Editor,

[2]Re: LANDSLIDE RISK MANAGEMENT CONCEPTS AND GUIDELINES

Letter from ANDREW SHIRLEY, Shirley Consulting Engineers Pty Ltd

I write as Chairman of the AGS Sub-Committee on Landslide Risk Management in response to the above letter.

We thank the Andrew Shirley for his contribution. We note that he has found some difficulty in applying the Guidelines to some situations.

In response, we consider it is sufficient to say that the methodology given in the Guidelines enables any situation to be addressed. For situations of "conflicting mechanisms", then each mechanism (that is, each hazard) should be addressed separately using the methodology. The interaction between the mechanisms (hazards) should also be considered. The risk assessment would only be limited by the understanding of the processes thought to be applicable.

Since the methodology given in the Guidelines requires consideration of the consequences of the hazard, it is necessary to have a "notional development" to enable the consequences to be evaluated. At a preliminary stage this may be simply a designated site area. Clearly if the hazard is considered unlikely to affect that area, then the form and details of the development are immaterial. If the hazard does affect that area, then the consequences could be considered in relation to different forms and extent of development, or alternatively the minimum treatment options identified. Clearly, there should be the interaction and reassessment implied by the Figure 1 Flowchart as the design develops.

The general steps for Hazard Zoning are given in Section 6 and should be sufficient for experienced practitioners. Other references may assist and we thank Andrew Shirley for those given. It is important to recognise that past zoning studies may have been titled as "hazard" or "risk" zoning studies, but may be neither under the current definitions.

Andrew Shirley's comments on hillside construction are noted. Appendix J of the Guidelines has been based on the Guidelines for Hillside Construction given in the 1985 paper but they have been revised to be consistent with the Risk Management Guidelines. It is hoped that the IEAust Landslide Taskforce will proceed to formulation of more extensive guidelines covering all aspects of landslides in relation to engineering works, including more detailed discussion of hillside construction. It is expected that the Risk Management Guidelines will form an integral part of such future guidelines.

B F WALKER

Chairman

AGS Sub-Committee on Landslide Risk Management

[2] This response was originally published in AG Volume 35 No 3 September 2000

The Editor,

[3]LANDSLIDE RISK MANAGEMENT CONCEPT AND GUIDELINES RESPONSE TO DISCUSSION BY L. DE AMBROSIS

I am providing the following response as Chairman of the AGS Sub-Committee.

We thank Laurie de Ambrosis for his discussion, which raises a number of issues, most of which were debated during the preparation of the Guidelines paper. Further discussion may be helpful to demonstrate some of the considerations relevant to risk management approach. We adopt below the de Ambrosis discussion paragraph numbering.

1. DEFICIENCIES OF 1985 APPROACH

This comment demonstrates that there has been significant evolution in the formalisation of risk management since the 1985 paper. The most important development has been standardisation of terminology and it is hoped that the Guidelines will help promote adoption of internationally accepted terminology and concepts. Although the 1985 paper did not specifically address consequences as an issue, most practitioners were aware of this and included it in their assessment.

2. SCOPE DEFINITION

As we all practice under the increasing threat of litigation and liability, the comment with respect to loss of life / injury is appropriate. As in other situations, it may be appropriate to provide advice with respect to loss of life / injury in a separate report or letter when the brief has specifically omitted this issue. However, we would caution against this and recommend that all briefs should include the risk to life.

3. LOSS OF LIFE / INJURY IN QUALITATIVE TERMS

The Guidelines have recommended use of quantitative evaluation for loss of life / injury so that comparison can be made with the usual acceptance criteria. Initially practitioners may feel there is some difficulty it quantification. However, adoption of quantification is part of the way forward for evolution and acceptance of better methodology. Although the limitations have to be recognised, it is considered that the judgement required for the quantitative estimate is no more onerous than trying to adopt a purely qualitative estimation. The quantitative estimate has the advantage that the component parts are overtly stated and hence more readily defended or reassessed.

The qualitative terminology suggested by de Ambrosis has raised the issue of conditional probabilities, which has to be recognised, even for qualitative assessments for property. The Risk Calculation equation in Figure 1 of the Guidelines demonstrates the conditional probabilities that usually have to be considered. Care is needed to include the probability of spatial impact and temporal probability, though which terms are included may vary. For example, when considering loss of life in relation to a specific element at risk (such as a dwelling), the assessment of likelihood may include both the likelihood of the landslide and the probability of spatial impact of the landslide on the dwelling. The assessment of consequences to loss of life may include temporal probability of occupation and vulnerability of the persons potentially affected. This separation will be appropriate for most qualitative estimates since it separately considers whether the element will be impacted by the landslide, and the consequences if it does.

The de Ambrosis qualitative terminology has a number of shortcomings and inconsistencies. We assume the terms include both temporal probability and vulnerability. There is no indication as to how the risk to a number of persons should be considered, yet this is straightforward for a quantitative estimate. The risk levels derived from the matrix do not give acceptability results totally consistent with the quantitative risk estimates that would be derived using the indicative annual probability values given in Appendix G. We reiterate that we consider loss of life should be considered in a quantitative estimate to enable comparison with the loss of life criteria.

4. QUALITATIVE RISK MATRIX

i. It was intended that the dual descriptors given for risk in the Appendix G matrix demonstrate the possibility of a range. For a specific case, a single descriptor may be assigned. For another, the range may be appropriate. The assessor should decide.

ii. The risk matrix given in AS/NZS 4360:1999 is clearly labeled as an "example" and that "Tables need to be tailored to meet the needs …" and that the number of risk categories "should reflect the needs of the study". Therefore the Sub-Committee felt there was no compulsion to mirror the Standard's risk matrix and terms. On the contrary, there was every reason to have a scheme that reflected the needs of landslide risk management in particular. The Very Low risk category was considered to be an appropriate addition to cater for routine cases without the need defined, site specific treatment

[3] This response was originally published in AG Volume 35 No 4 December 2000

procedures.

We consider the de Ambrosis interpretation with respect to comparison of risk levels to be wrong. In the absence of specific criteria in the Standard for acceptable or tolerable risk, we would consider the H high risk in the Standard to mean an unacceptable risk requiring "senior management attention" to control the risk to an acceptable or tolerable level.

iii. The matrix given in the Guidelines evolved from the conscious decision to have five risk categories and to draw a distinction between unacceptable, tolerable and acceptable risks. The five categories enabled an element of symmetry. We inverted the Consequence position in the matrix such that A1 was the worst case, not A5 as in the Standard. The question of what risk the public might "accept" is debatable. For the de Ambrosis example of an Almost Certain event with Minor consequences, we doubt if it would be acceptable. If "large costs to clients" is the reason to reject it being unacceptable then it would be tolerable, but not acceptable. If the assumed de Ambrosis combined probability for loss of life (as given in item 3 above) is considered, then clearly an annual risk to life of about 10^{-2} to 10^{-3} (that could reasonably be estimated from Almost Certain and Minor) would not be within normal acceptance criteria. This demonstrates the difficulty of deriving a consistent system for both property and loss of life and we do not recommend the use of such schemes.

Yours faithfully

B F Walker
Chairman
AGS Sub-Committee on Landslide Risk Management

Errata

Opposite: This figure is an extract from "Landslide Risk Management Concepts and Guidelines" as presented in *Australian Geomechanics*, Vol 35, No. 1, 2000 (p. 55) which discusses the matter more fully.

Note: Under the first table in Appendix G (p. 87) it should read "…**1/2** order of magnitude, or more".

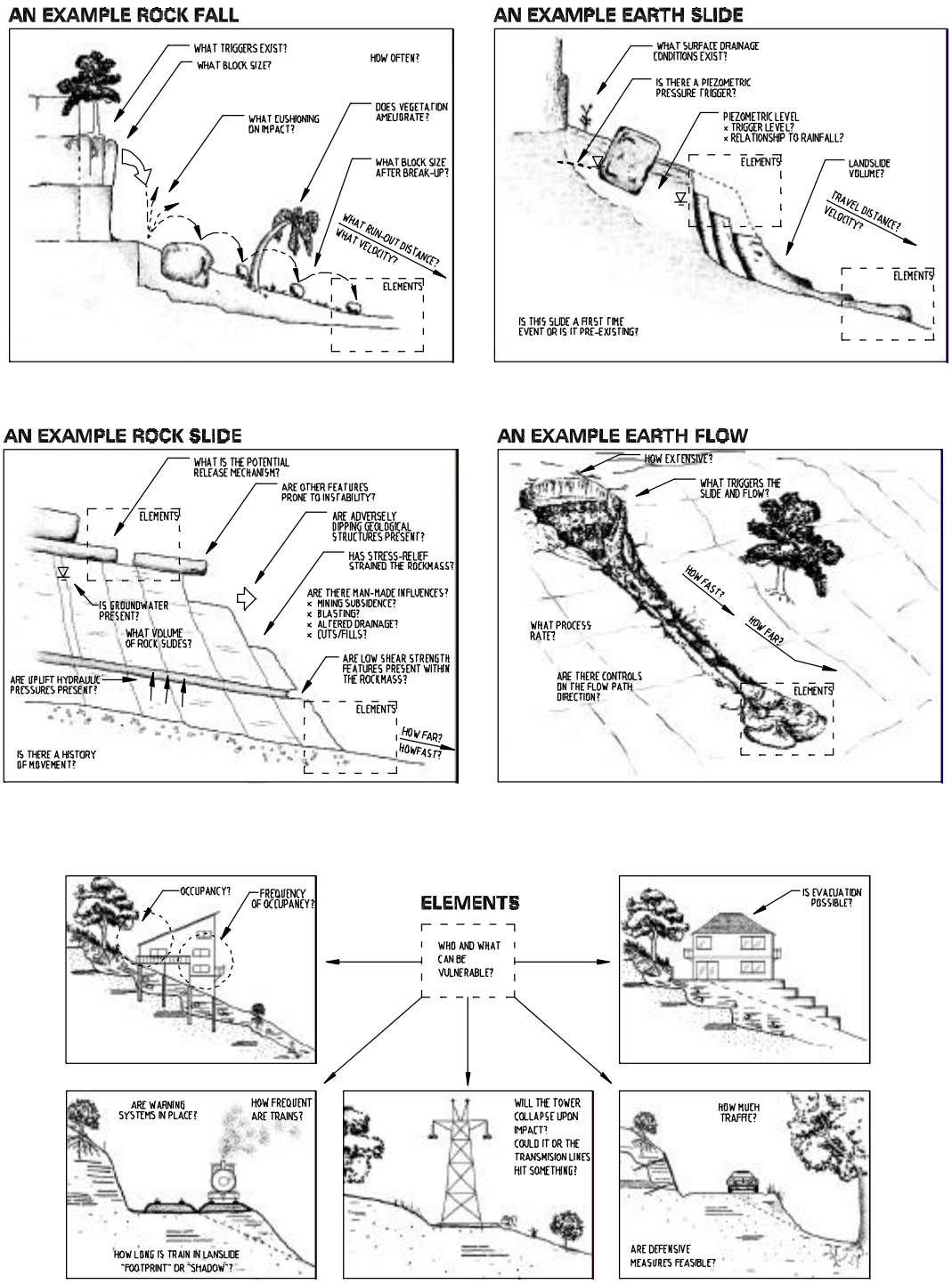

FIGURE 2: Examples of Landslide Risk Assessment Issues