the uncertainty in travel distance and /or travel direction should be modelled as shown in the example presented in Table C8.

Table C8: Example of modelling uncertainty in travel distance and the probability of spatial impact ($P_{(S:H)}$).

Travel Distance Range metres	Estimated Probability the Travel Distance will be in this Range	Probability of spatial impact ($P_{(S:H)}$) assuming the element at risk is 32 metres below the landslide
<20	0.2	0
20 to 30	0.6	0
30 to 40	0.2	0.2
	Total 1.0	Total 0.2

The probability values could be further modified by the conditional probability associated with travel direction, where this is appropriate. For example, if a rockfall is assessed to have a variety of possible trajectories, only some of which will result in spatial impact on the element at risk, then application of the conditional probability for the trajectory would be applied to the travel distance probability.

C6 CONSEQUENCE ANALYSIS

C6.1 ELEMENTS AT RISK

No further comment.

C6.2 TEMPORAL SPATIAL PROBABILITY ($P_{(T:S)}$)

Roberds (2005) gives a detailed account of how to estimate temporal spatial probability where the elements at risk are mobile. AGS (2000, 2002) Appendix E gives details for the case of traffic travelling on a road.

For most assessments involving persons at risk in a building, the practitioner should make an estimate of temporal spatial probability based on the use of the building. This should include assessment of the probability of non-evacuation which may be used as a conditional probability. The landslide velocity and possibility of forewarning of the landslide failure will be relevant considerations.

The assessment may need to be based on a regulator's notional occupancy for a dwelling, not necessarily the client's proposed occupancy. For example, a client may wish to build a holiday house with relatively low occupancy factors (particularly for the time of year most likely to have a landslide event). However, a subsequent owner may be occupying with an average family on a fulltime residential basis. The later occupancy would be more critical and should be adopted for assessment purposes for the development.

C6.3 EVALUATION OF CONSEQUENCE TO PROPERTY

C6.3.1 Estimate the extent of damage likely to property arising from each of the landslides

The assessment of vulnerability and damage to property is subjective, and there is little published information. The Practice Note Appendix F has some data but note that for property this represents the judgements of those doing the study and is not a record of actual vulnerability. There are some general points which should be considered:

- Landslides which move slowly (particularly those with a near planar, horizontal surface of rupture) may cause little damage to structures on the landslide, though those structures which are on the boundaries of the landslide will experience differential displacement.
- For stuctures on the landslide, the rate of movement is less important for damage to the structures, except insofar as it affects the time rate of damage, than it is for loss of life.
- For stuctures below the landslide, the velocity of the landslide has a major effect on the damage and hence vulnerability. Hence structures which are near the toe of a landslide which will travel a long distance are likely to experience a high velocity impact and will suffer extensive damage (high vulnerability), and structures which are near the limit of the travel (or run-out) of the landslide will experience low velocity impact by only part of the landslide mass and will probably suffer "minor" damage (low vulnerability).

- It will sometimes be appropriate to consider vulnerability of a small part of the element at risk. For example, a room in a house which may be affected by a small landslide such as rock fall, may have a vulnerability of 1.0, whereas this may represent only a proportion of the value of the house as a whole.
- The proportion of a structure damaged is unlikely to represent the same proportion of the value of the structure. For example, damage to 10% of structure may represent 50% of the value of the structure.

C6.3.2 Estimate the indicative cost of the damage

The direct cost of damage to the structure is not the Total Cost to the owner if a landslide occurs. The Practice Note details the costs to be considered to derive an estimate of the Total Cost.

For many risk assessments it will be sufficient to estimate the costs approximately for example by using published construction cost guides which are relatively inexpensive (such as Rawlinson's, Cordell's, Reed's or similar). However, the practitioner is not a quantity surveyor and caution should be used in providing broad brush guesstimates on which legal decisions may be made and enforced. All cost estimates should be well documented and referenced using up to date industry sources appropriate to the location and types of costs involved.

Experience using the qualitative terminology in AGS (2000) Appendix G indicated that evaluation of the meaning of the description of the consequences to property can be subject to wide interpretation. In an effort to narrow the interpretation, de Ambrosis and Mostyn (2004) suggested use of estimates of the cost of damage as a more objective measure so as to limit disputes of interpretation of the description. The Practice Note definition builds on that proposal. Assessment of the consequences to property has been normalised as the Total Cost relative to the Market Value of the property under consideration. AGS recommends adoption of this updated approach using a semi-quantitative method as presented in Appendix C of the Practice Note.

There may be some situations where the regulator will require the risk from all landslide hazards to be brought to tolerable risk levels as part of the remedial works in the event of a landslide on a property. Regulators who will take this approach should make it clear to Practitioners doing risk assessments in their area.

For Practice Note Appendix C, the consequences scale has been adjusted in conjunction with appraisal of the risk categories as discussed in Appendix CC. It is considered that the adopted consequence scale is preferable to the order of magnitude scale in de Ambrosis and Mostyn (2004) as the Appendix C scale enables a more workable subdivision of risk in the Medium and Major categories (10% to 100% consequences) and shifts the descriptors towards the higher consequences, which is more realistic.

There is an obvious limitation in application of the method if the practitioner is not experienced enough to appreciate the civil engineering and structural engineering implications of particular landslide events. However, as consequences are an essential input to risk evaluation, this limitation has to be addressed and may require assistance ffom other experts, such as civil or structural engineers (as appropriate) or quantity surveyors for refinement of cost estimates.

C6.3.3 Estimate the market value

No additional comments.

C6.3.4 Consider the resulting Consequence classification, such as using Practice Note Appendix C, and implied accuracy of the above estimates.

No additional comments.

C6.4 EVALUATION OF CONSEQUENCES TO PERSONS

The assessment of vulnerability to persons is subjective and there is little published information. The Practice Note Appendix F has some data but note that except for the data in Finlay et al (1999) this represents the judgements of those doing the study and is not a record of actual vulnerability. There are some general points which should be considered:-

- For persons below the landslide, the velocity of the landslide has a major effect on the vulnerability. Persons who are near the toe of a landslide which will travel a long distance are likely to experience a high velocity impact and will have a high vulnerability and persons who are near the limit of the travel (or run-out) of the landslide will experience low velocity impact by only part of the landslide mass and will have a lower vulnerability.
- Persons who are in buildings which collapse totally have high vulnerability.
- Persons who are in buildings are less vulnerable than those in the open unless the building collapses.