Simplified overview to mainstream decision-making under uncertainty[1]

The following table summarises the normal steps in an orthodox economic analysis of the best response to possible future adverse events, and contrasts it with the 2012 situation:

Aspect	Relevant statistical and economic concepts	Situation with KCDC action in 2012
1. Property/management decision rights – whose decision is it?	Property rights, public goods	Owners of private property deemed to have little or no decision rights
2. What is the full range of future possible outcomes (good and bad) and what probability should be assigned to each outcome?	Event analysis, probability theory	50- and 100-year hazard lines represented an unknown position on an unidentified probability distribution. No other possible outcomes were identified, let alone had probabilities assigned to them
3. If these probabilities cannot be objectively determined (ie if it is not like tossing a coin or spinning a roulette wheel), and views differ about how the future is likely to unfold, whose subjective probabilities should prevail?	Bayesian statistics, L.J. Savage (1954), and Harold Jeffries (1961) Optimal decision-making under uncertainty, prior probability distribution, posterior probability distribution, decision function, Bayes Theorem, loss function	No subjective probabilities were identified (despite the KCDC initially representing the hazard lines as likelihoods.)
4. What are the expected values of the outcomes for each event	The expected outcome is a probability-weighted sum of the values of the outcomes for each of all possible events.[2]	No expected values were assessed
5. What is the full range of options for taking action that decision-makers need to assess?	Opportunity cost, private financial analysis, cost-benefit analysis, New Zealand Treasury Cost Benefit Analysis Primer	No attempt to identify the full range of options and no material costings of options were provided to property owners to assist decision-making
6. What are the *expected* costs and benefits of each option, and to whom?	Statistics. Option values.	No calculations were made and none could have been made given the above limitations
7. What option provides the greatest *expected* net benefit?	Utility analysis, profit analysis, standard cost-benefit analysis, such as the New Zealand Treasury's costs-benefit primer, discount rate issues, net present value	No consideration given, and none could be given
8. To what extent is the decision-maker risk averse or risk-loving (if not risk neutral)?	Expected utility theory, certainty-equivalent values, loss function, type I, type II errors.	Relevant concepts not applied. Precautionary approach wrongly applied at step 2.

[1] Bryce Wilkinson, 13 July 2015

[2] Risk is now commonly, if confusingly, defined as the outcome from an event times its probability. That makes the expected market value of an asset the sum or all its risks.

Simplified example:

Suppose a property is worth $1 million today; that there is a 1% chance an earthquake, landslip, or tsunami will destroy its entire value in the next period and that an insurance company will assume that risk if you pay it a premium of $11,000 the start of the period. Ignore all issues of discounting, repairs and maintenance and depreciation.

Apply this example to the above 7 steps

1 Whose decision is it	It is the would-be buyer's decision
2. What is the full range of future outcomes	There is a 99% chance the property will remain intact and a 1% chance it will be destroyed. .
3.Subjective probabilities	The buyer's subjective probability is the critical one, but it will be informed by the views of others. Directly relevant to the decision are the views of others that affect the market value (ie the vendor, other potential buyers and the banks and insurance companies)
4. Expected values of outcomes	There is a 99% chance of no loss in the value of the property by the end of the period and a 1% chance of losing the $1 million value. The expected value of the property at period end (ignoring discounting etc) is $990,000. The expected loss in property value is $10,000 (=0.99*0 + .01*$1 million.) So to justify buying it for $1 million, a risk-neutral owner would need to expect to enjoy ownership benefits worth at least $10,000
5. Full range of options	These include options for strengthening the property against the identified hazards, or reducing its exposure (eg not storing valuable materials there, not maintaining or restoring it). But in this simplified case, we consider only the option to insure or not insure.
6. Expected costs and benefits of each option	An owner who does not insure, puts the expected cost at $10,000. An owner who does insure can expect to end up with property worth $1 million less the insurance premium of $11,000.
7. Greatest expected net benefit	The would-be buyer gains $1,000 from not insuring the property in expected value terms.
8. Optimal decision	A risk neutral or risk loving person would buy the property for $1 million and not insure it if the subjective benefit as owner exceeds $10,000. A sufficiently risk averse person would buy the property and insure it if the subjective benefit as owner exceeds $11,000

Points to note:

- The optimal decision takes into account the full range of possible outcomes, not just adverse outcomes.
- Precautionary issues only enter at step 8.
- Those who are risk averse are likely to contract with others who are less risk averse. (For example, the risk averse might buy insurance or even rent a risky asset rather than buy it.)
- If there is uncertainty as to whether the probability of loss is, say, 2% or 1%, an otherwise sound decision to not insure could be unsound. This uncertainty about the true state of nature creates the risk of taking the wrong decision. Bayesian inference addresses that source of uncertainty.