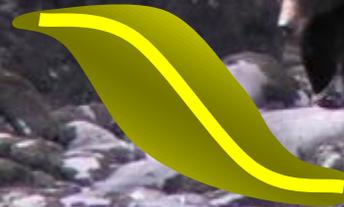
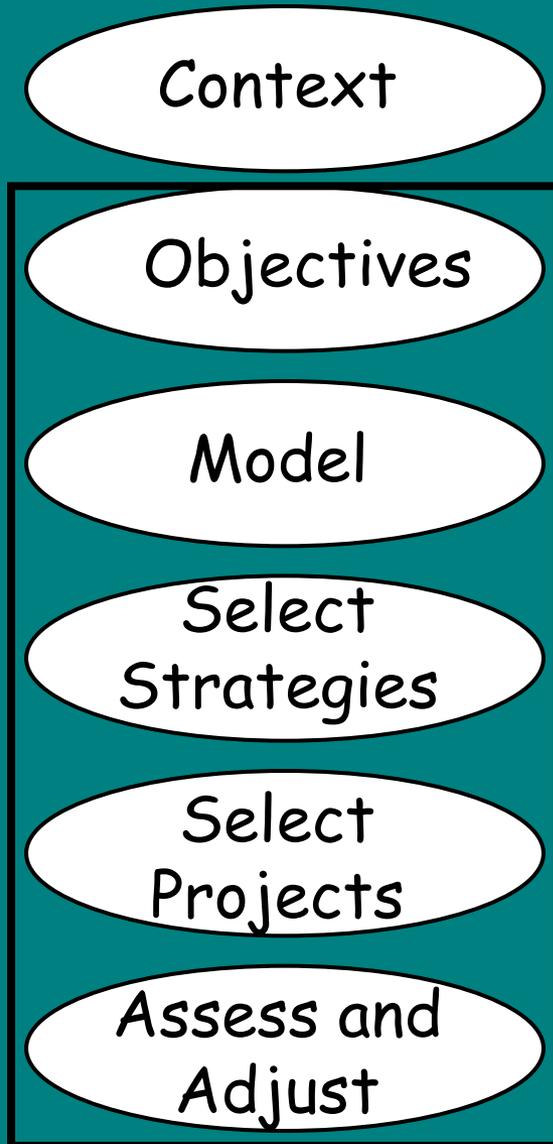


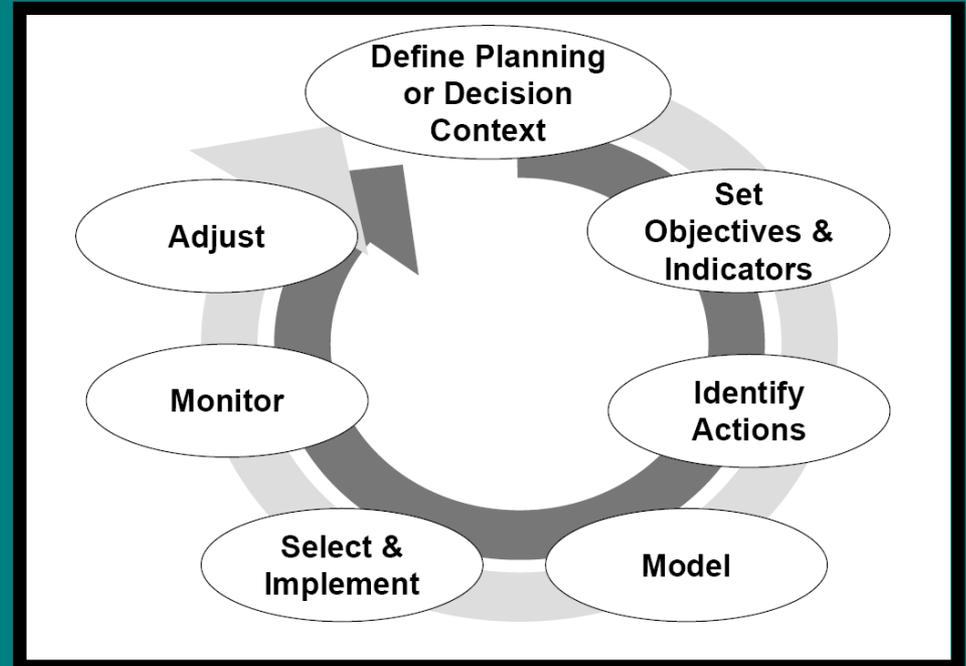
The Babine Monitoring Framework:  
Using Risk and Uncertainty for Learning  
and  
Decision-making



# Outline



Framework



# Definitions

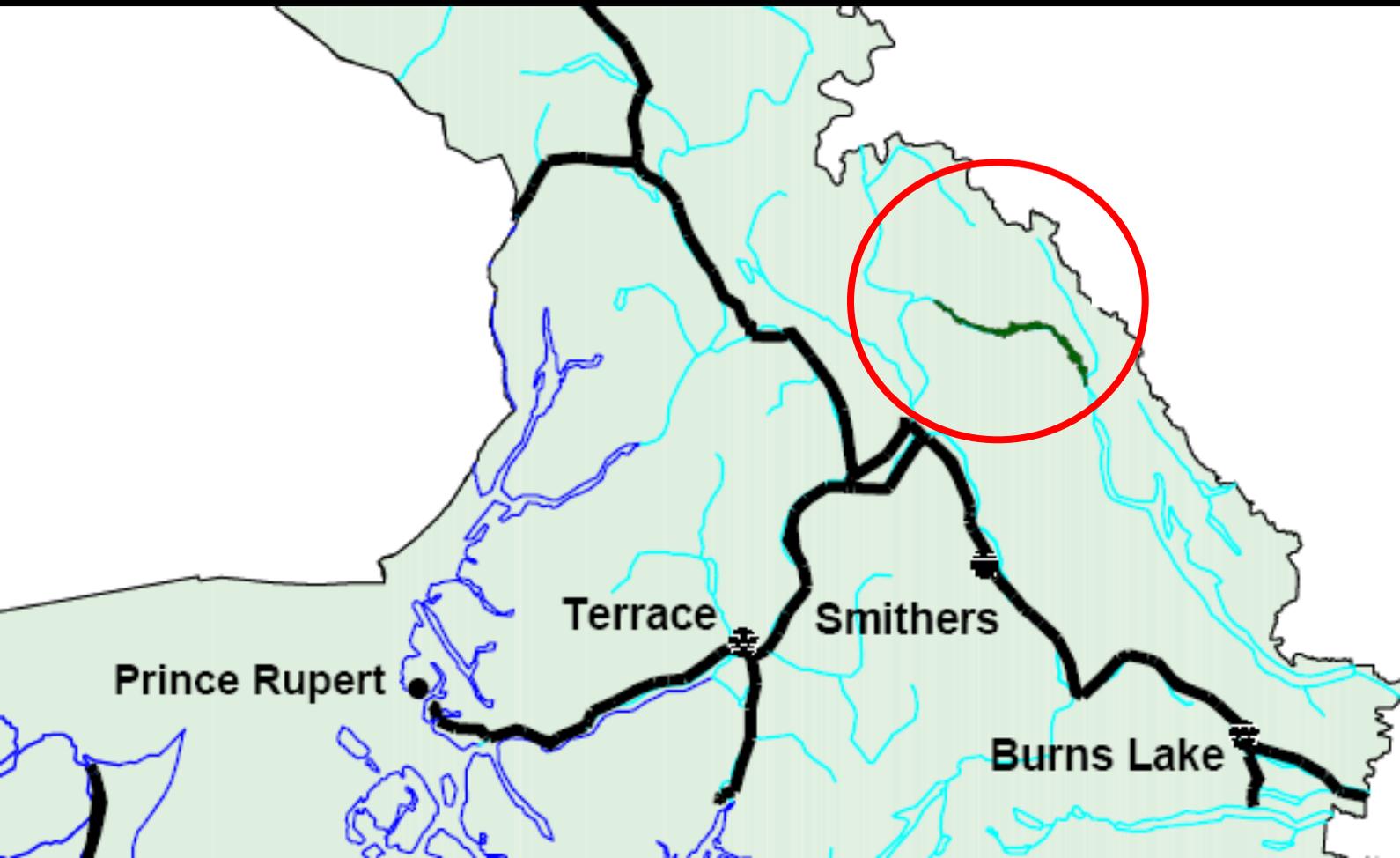


- Objectives (Y)
  - Desired end
  - E.g. Maintain fish habitat; minimise human/bear interaction
- Implementation indicators (x)
  - Variables influenced by management and related to objective
  - Assume that  $Y = f(x)$
  - E.g. amount of structure; road density
- Strategies ( $x_+$ )
  - Target level of an indicator
  - E.g. leave 70% structure around fish streams; limit road density to 0.6 km/km<sup>2</sup>

Context



## Context: Babine Watershed



# Context

- Two groups responsible for confirming or amending management:
  - Babine Watershed Monitoring Trust
    - neutral trustees responsible for monitoring six Babine land-use plans
    - **KNOWLEDGE**
  - Community Resources Board
    - value-based stakeholders responsible for decisions about updating LRMP
    - **VALUES**

# Context

- Past studies could not be use to confirm or amend management
- BWMT wanted to use monitoring to learn and to improve management
  - Transparent
  - Knowledge-based
  - Objective
  - Efficient
- “Adaptive Management” = %\$#@!

# Context: Design Requirements

1. Complete cycle to enable feedback
  - Strategies explicitly linked to objectives
2. Present knowledge to facilitate communication and learning
  - Single knowledge base
  - Graphical summaries
3. Select priorities objectively
4. Consider all types of monitoring simultaneously

# Types of Monitoring

- Implementation monitoring
  - Measures state of indicator ( $x$ )
- Effectiveness monitoring
  - Detects consequences to objective ( $Y$ )
- Validation monitoring, research, AM
  - Decreases uncertainty about the relationship between indicator and objective ( $Y = f(x)$ )

Usual Process

IMPLEMENTATION



EFFECTIVENESS



VALIDATION



# Implementation

Did we do  
what we said?

Not whether  
it will achieve  
objective

Necessary,  
but not  
sufficient

# Effectiveness:

- Hard to detect consequences
- Cause remains a mystery
- Can't improve management
- Necessary but not sufficient



Context

Framework

Objectives

# Summarise Objectives

- Compile complete list of existing land-use objectives
  - 6 plans for the Babine
- Synthesise direction into one document
  - Consolidate wording
  - Review by stakeholders to ensure intent captured

Context

Framework

Objectives



Model

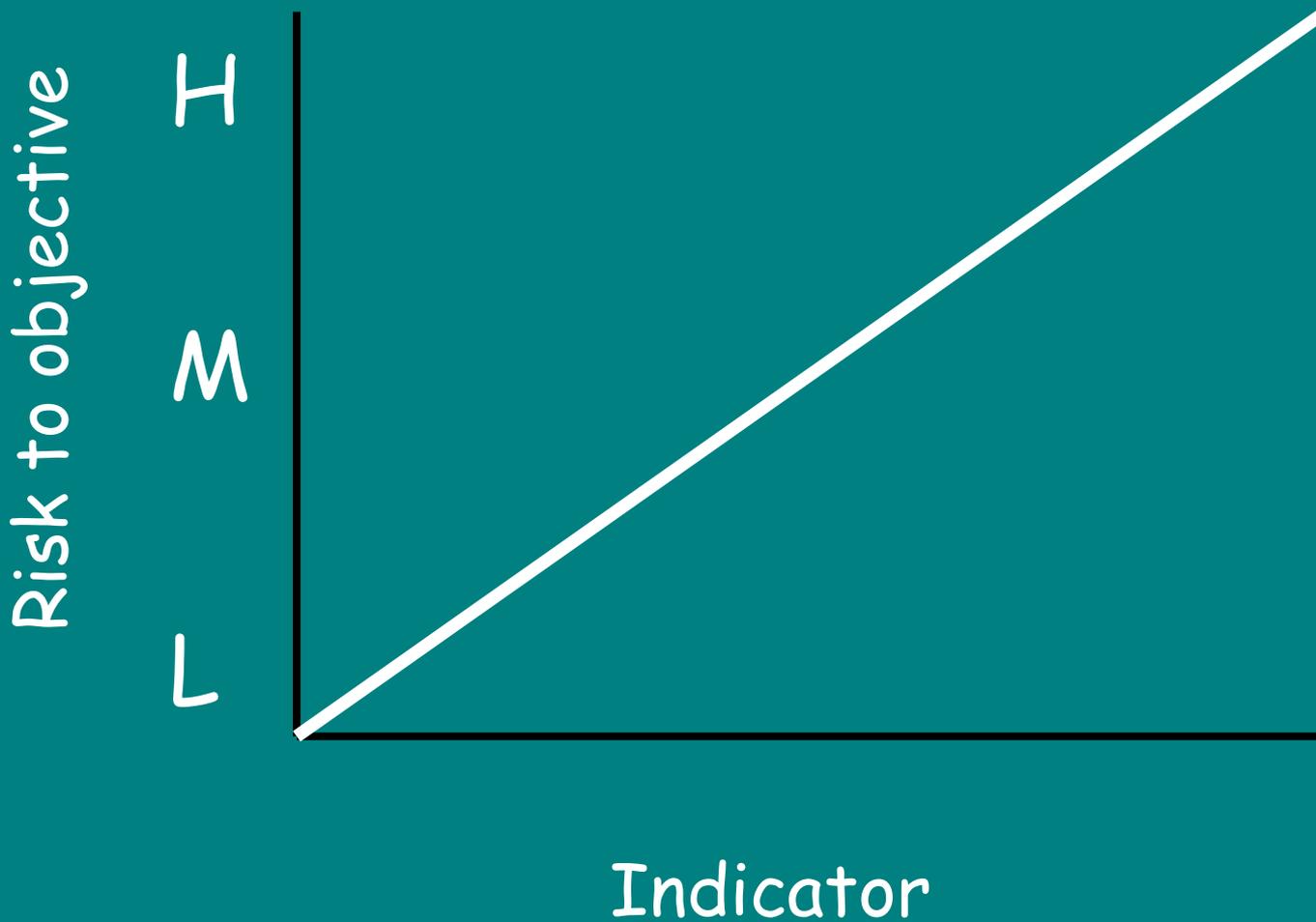
Knowledge Base

# Risk

- Explicit hypotheses about relationship between risk to an objective and an indicator
  - *risk* = probability that the objective will not be achieved
  - *failure to achieve objective* = severe consequence (or "harm that matters")
- 106 objective/indicator pairs for Babine

# Risk

Risk curve = explicit hypothesis



# Risk

Risk to objective

H

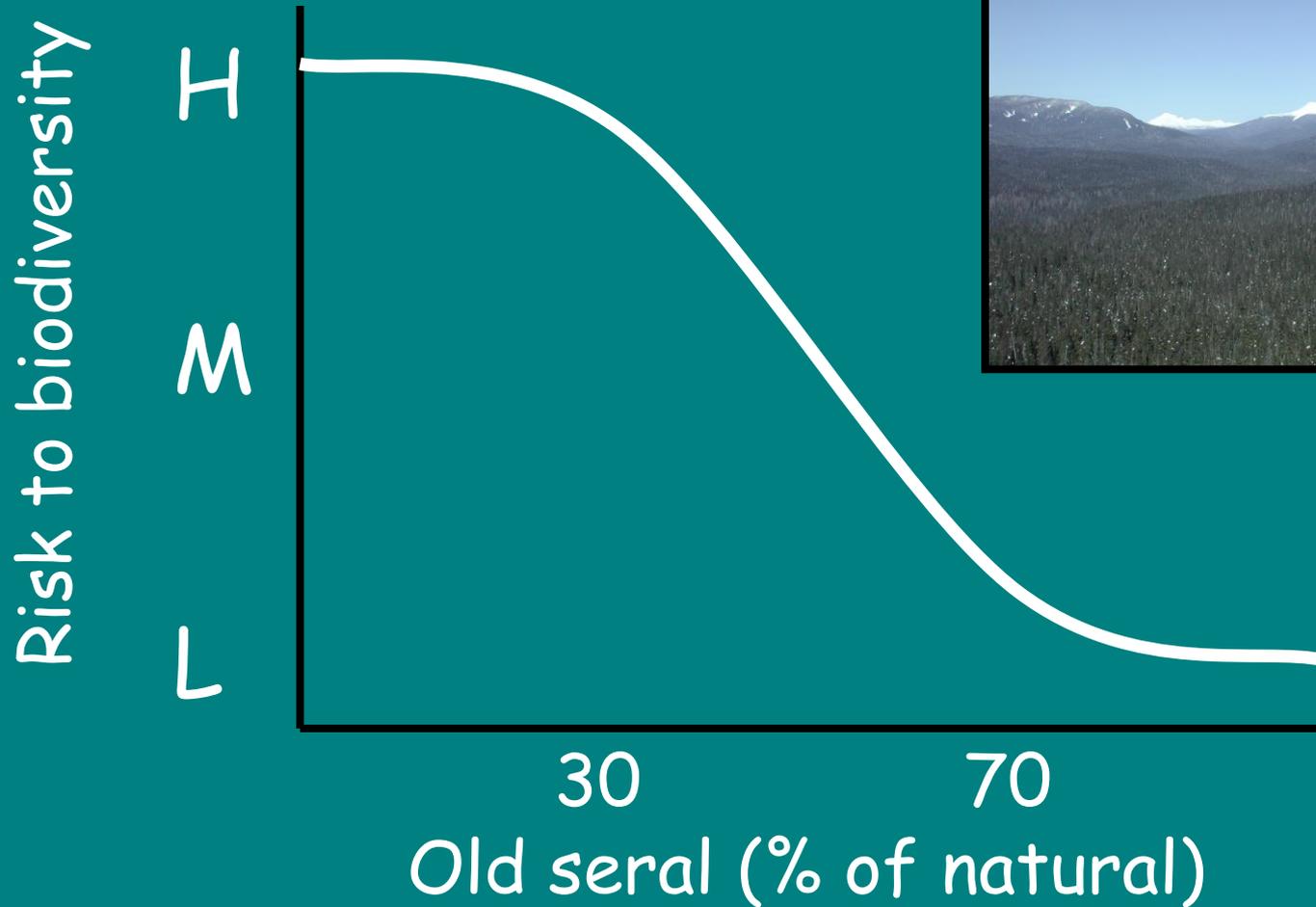
M

L

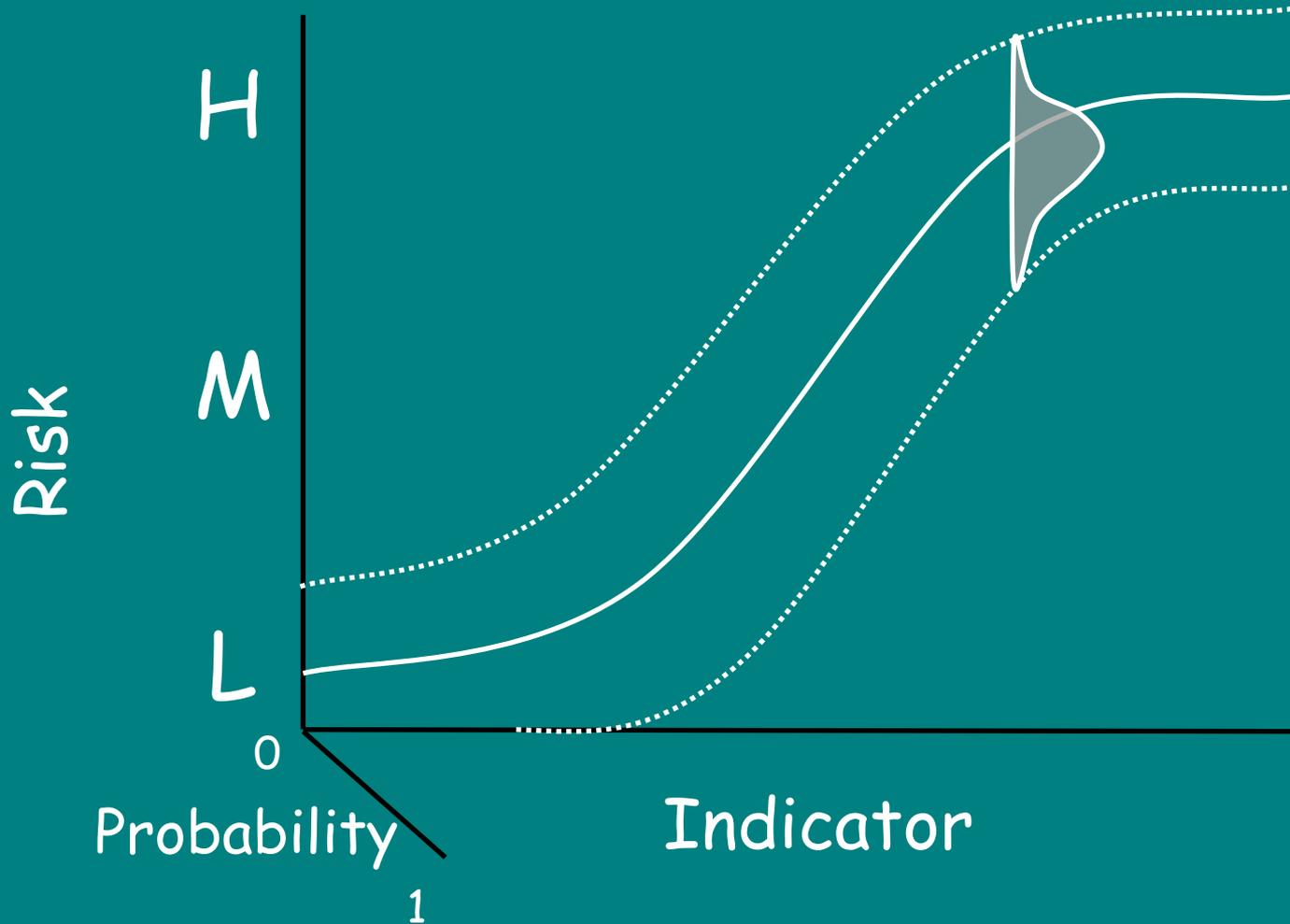
Indicator



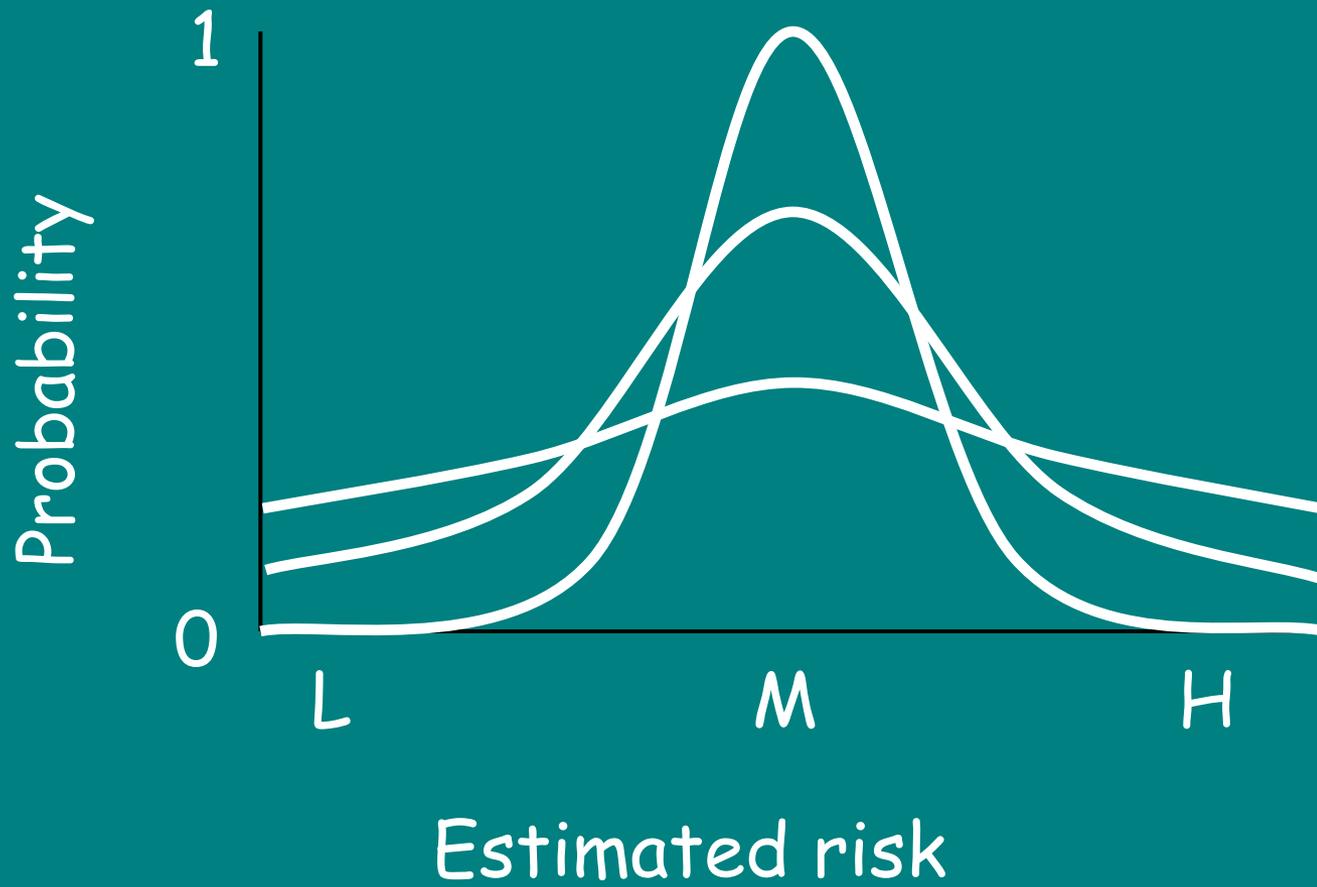
# Risk: Biodiversity



# Uncertainty



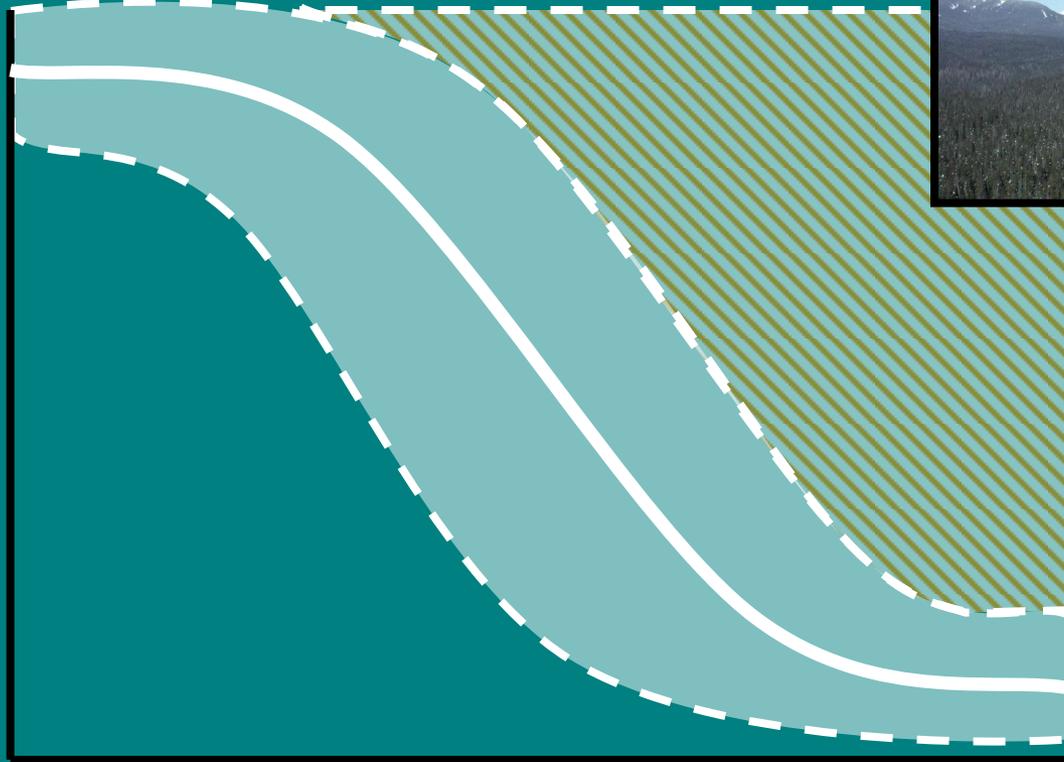
# Uncertainty



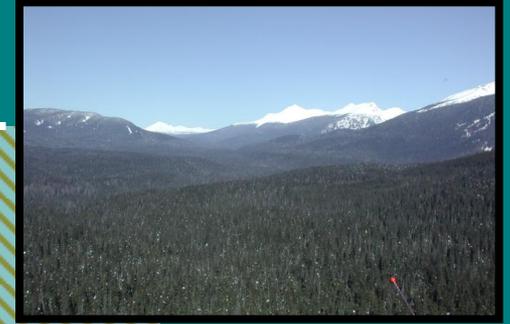
# Uncertainty: Biodiversity

Risk to biodiversity

H  
M  
L



Old seral (% of natural)

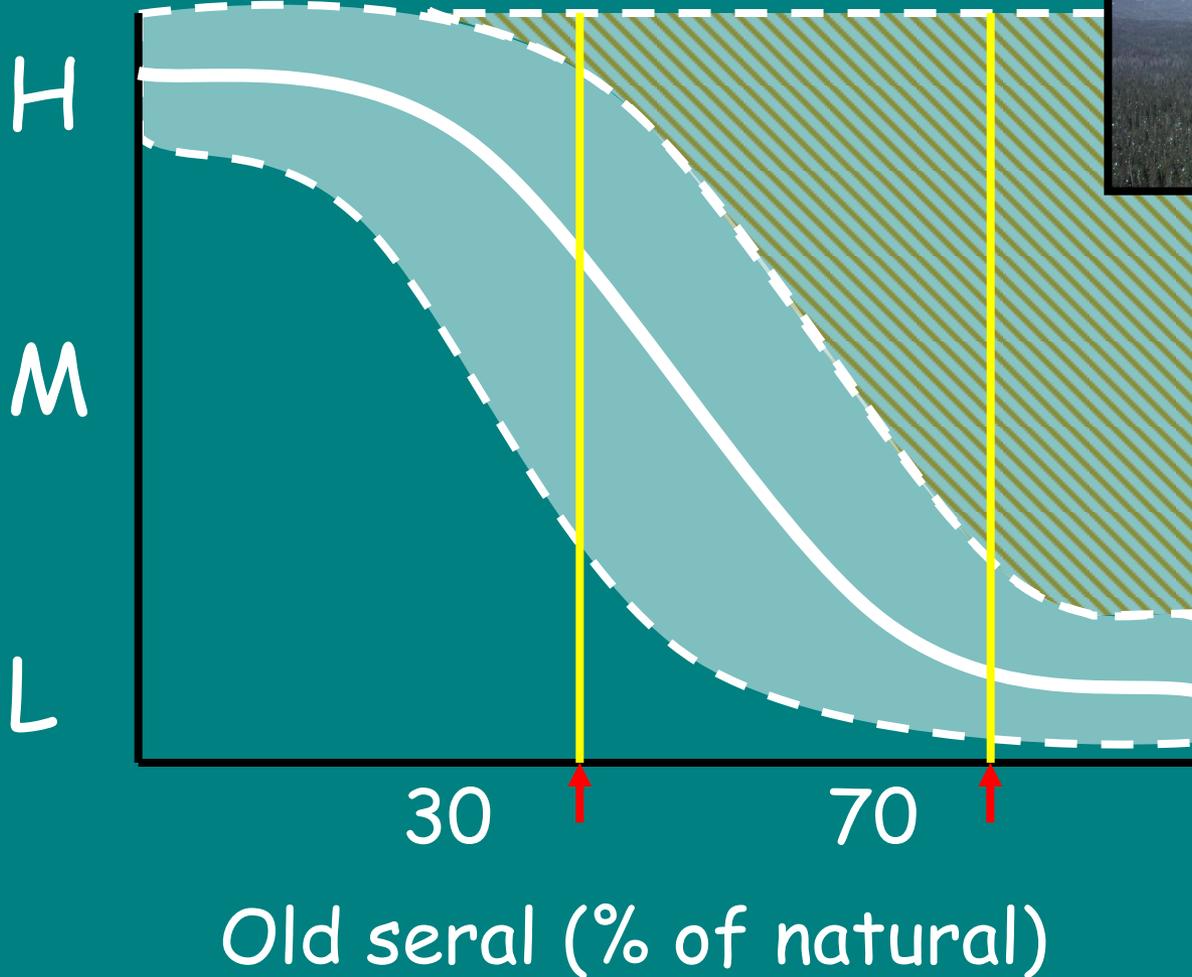


# Risk Analysis

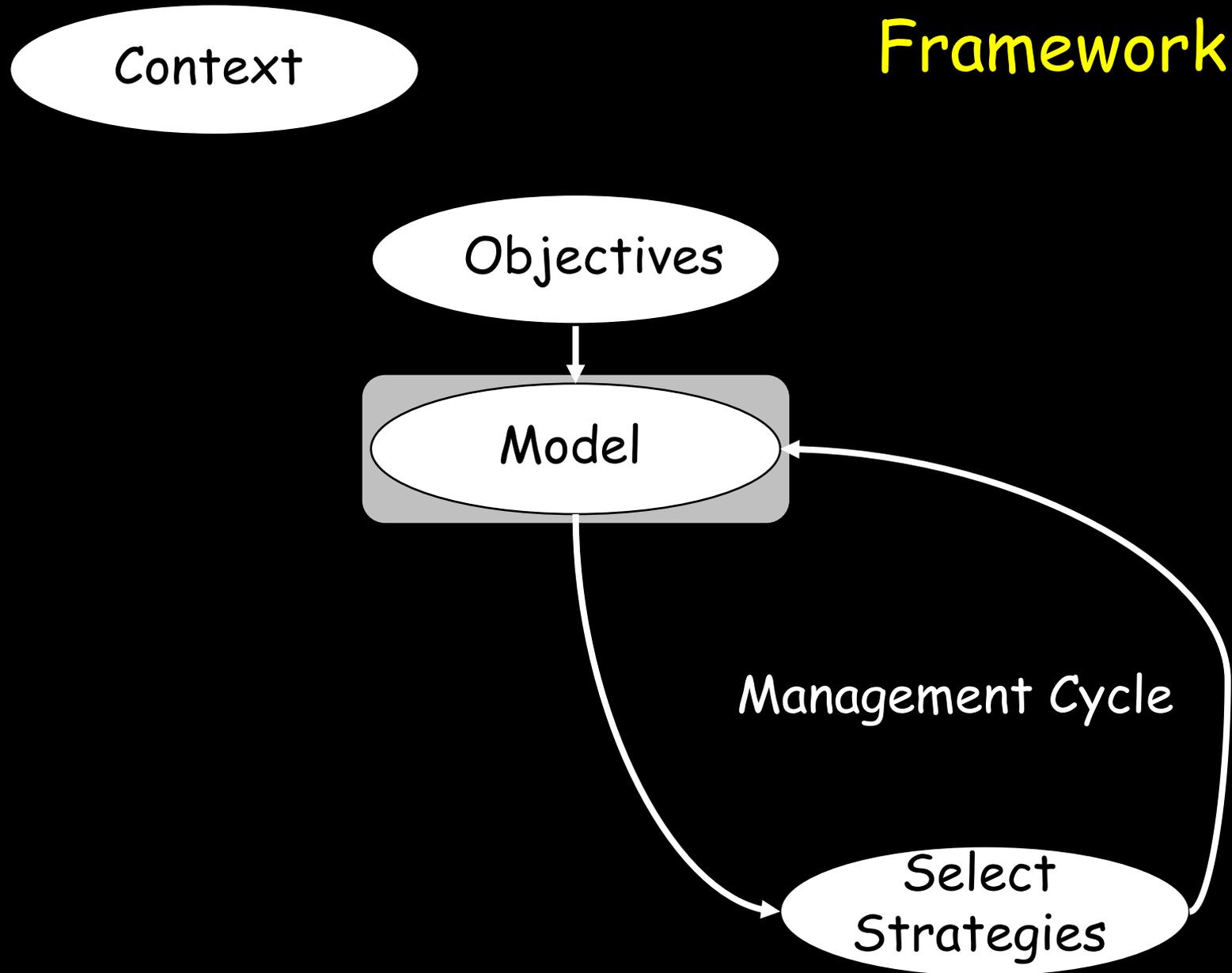
- Estimate current and future risk and uncertainty
  - Implementation monitoring provides current indicator values
  - Targets estimate future indicator values

# Risk Analysis: Biodiversity

Risk to biodiversity



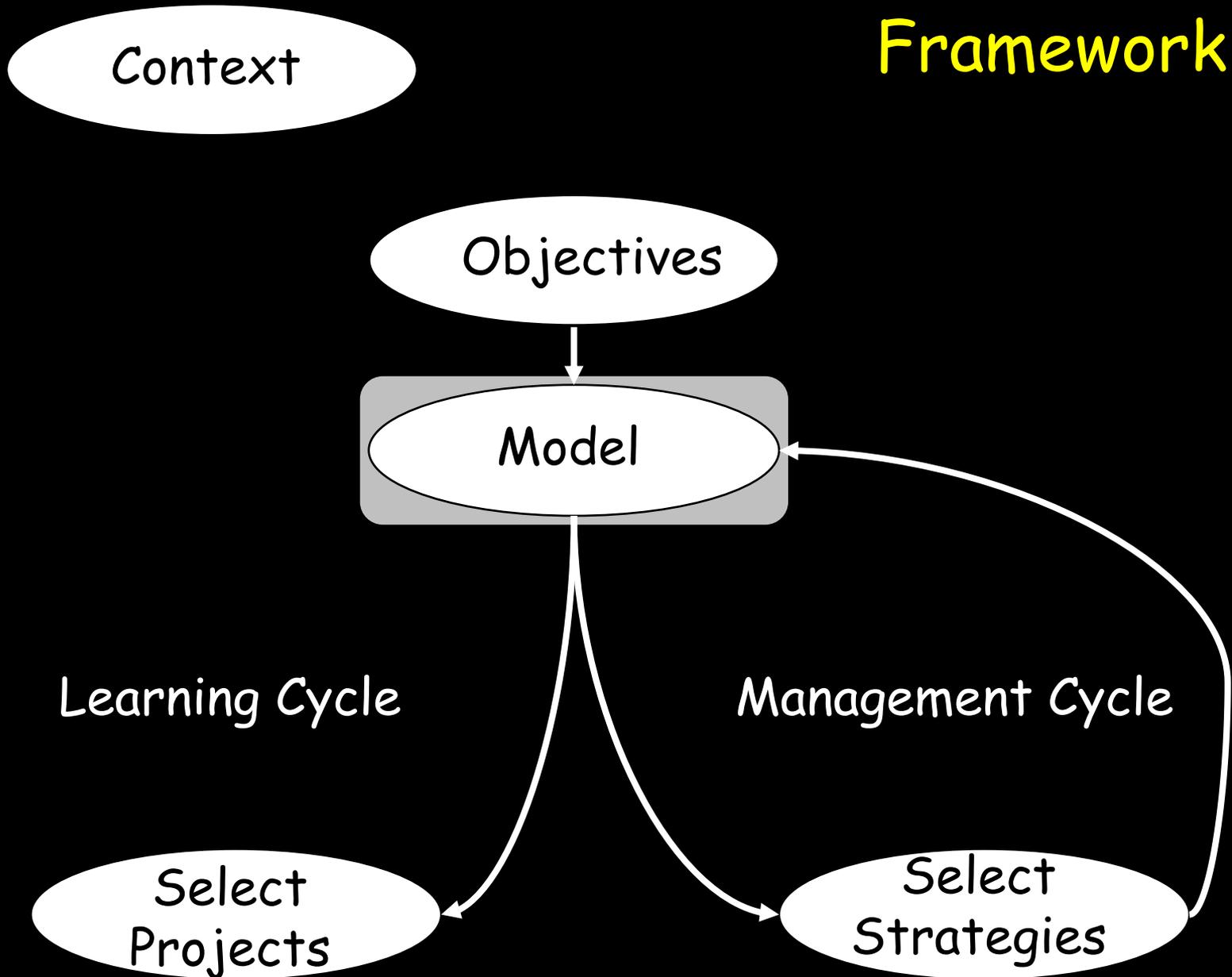
# Framework



# Decision Support

- Ideal world—strategies are chosen based on risk analysis
- Real world—existing strategies were chosen based on unknown analyses
  - If risk is high and uncertainty is low, a planned strategy is unlikely to achieve the objective
  - Strategy and objective inconsistent—adjust
- Provides information about whether strategies are likely to be effective before spending \$ on monitoring or adaptive management

# Framework



# Select Projects

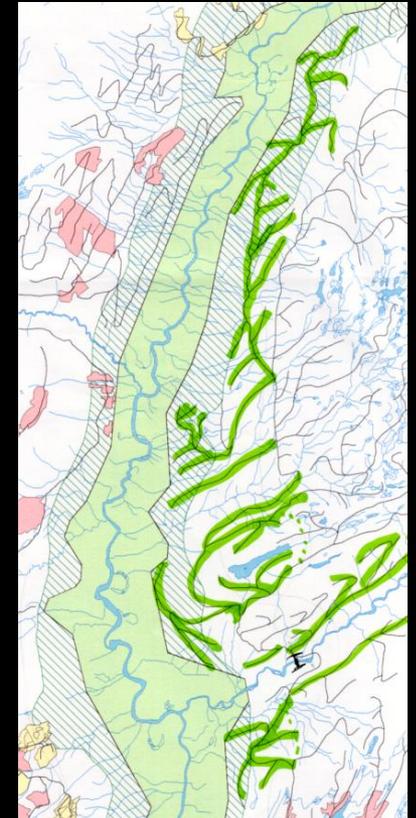


# Select Projects

Risk analysis	Type of project
Insufficient information to analyse risk	Implementation monitoring
High risk with low uncertainty	Effectiveness monitoring
High uncertainty	AM/validation monitoring/research

Interpretative tables and procedures

# Influence of Objective on Goal



# Recovery Period

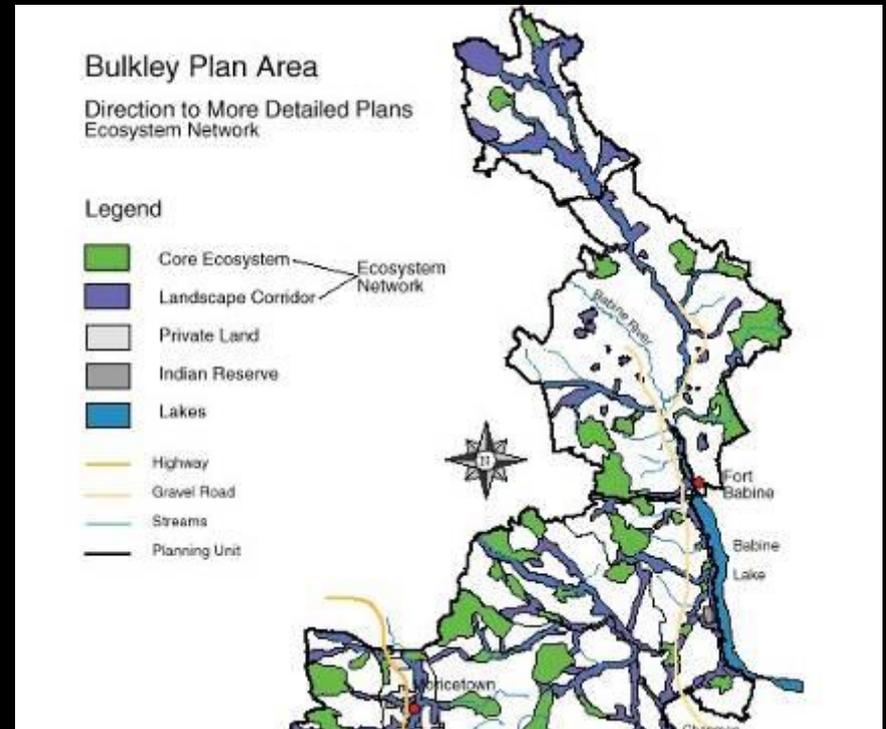


# Select Projects

- Lists of priorities for implementation, effectiveness and validation monitoring ranked
  - by risk and uncertainty
  - by other factors
  - with associated estimates of ease
- About 50 objective/indicator pairs had sufficient information to complete risk analysis:
  - remainder need implementation monitoring
  - 27 priority for validation monitoring
  - 22 priority for effectiveness monitoring
- From lists, BWMT selected projects in one meeting

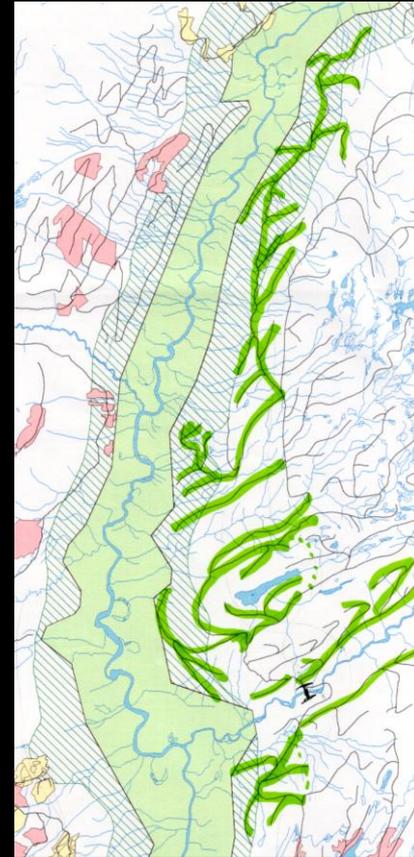
# No need to monitor: core ecosystems

- Low risk, low uncertainty
- No need to monitor



# Need more \$ for useful study: road density

- Uncertainty irresolvable within budget
- Write funding proposals

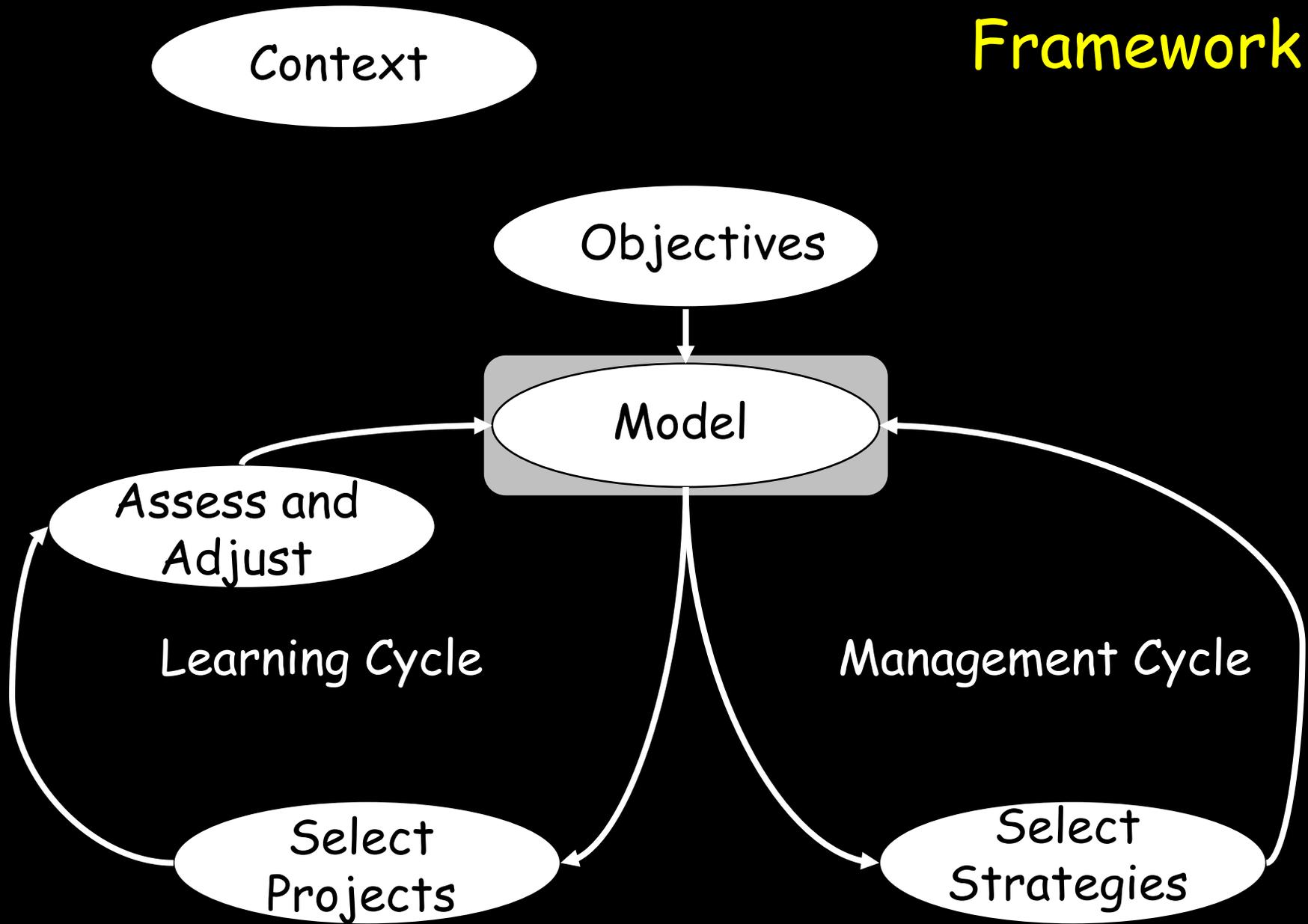


# Effectiveness monitoring: sustainable use



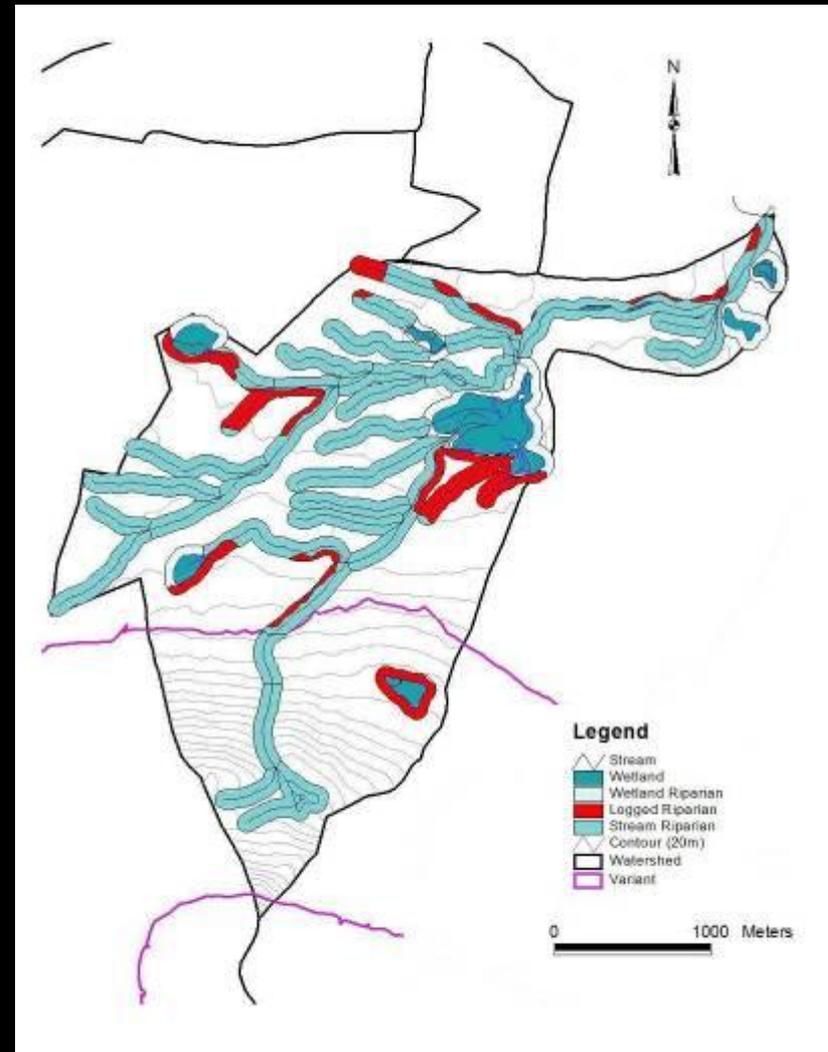
First stage—community buy-in to methodology to determine wilderness value

# Framework



# Validation monitoring: riparian ecosystems

- Reducing uncertainty about windthrow in riparian ecosystems
- Results: very little windthrow—decreased uncertainty
- Confirms buffer strategy



# Implementation monitoring: stream crossing



- Collecting information on sediment hazard at road crossings
- Results: 4 - 17% of streams had high hazard
- Company has subsequently acted to mitigate hazard
- No need to change strategy

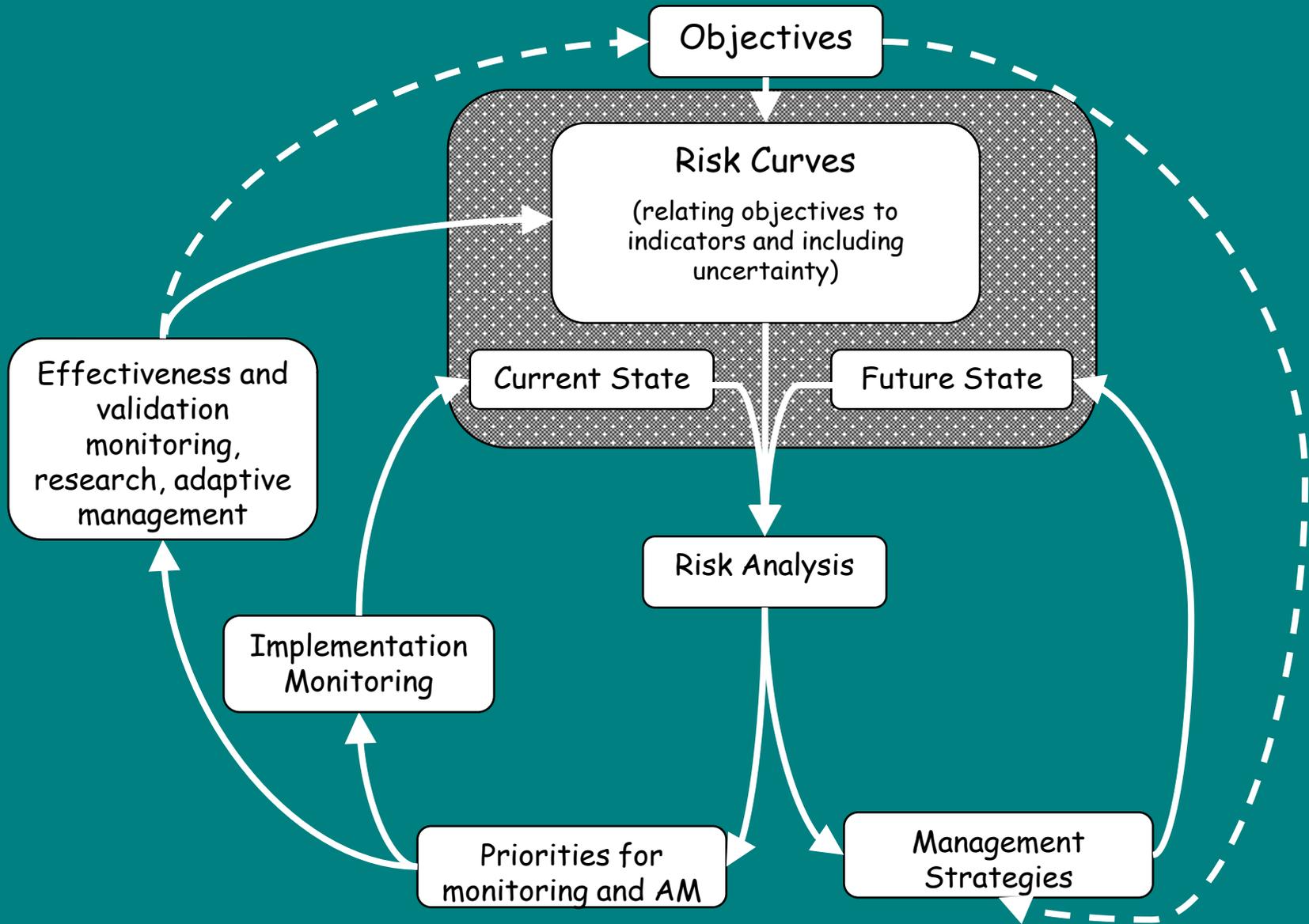


# Implementation monitoring: stand structure

- RONV documented following natural disturbance (2005-6)
- Comparison with managed stands (2007)
- Results: likely high risk—will go to CRB for decision about changing strategy and/or objective



# Complete Framework

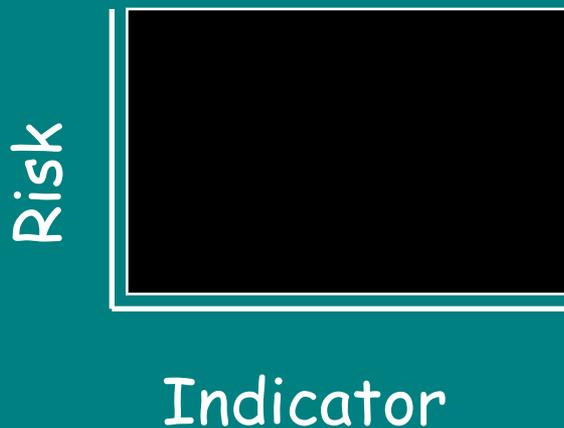


# Benefits of using risk curves

1. Link indicators to existing objectives—  
facilitating feedback to management decisions
2. Summarise current knowledge as explicit,  
updatable hypotheses about risk
  - Avoid hidden, implicit curves that confound values and knowledge
  - Force consideration of uncertainty
  - Facilitate discussion amongst stakeholders
  - Can update hypotheses and improve precision as data improve
3. Prioritise all types of monitoring objectively and  
simultaneously
  - What *not* to worry about
  - Where to focus effort

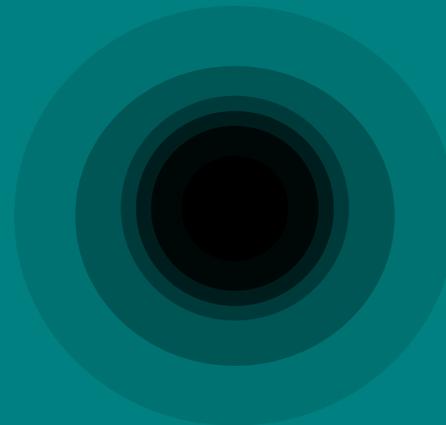
# The alternative?

- Assume knowledge is insufficient to draw curves representing hypotheses



- Not true
- Leads to ad-hoc monitoring

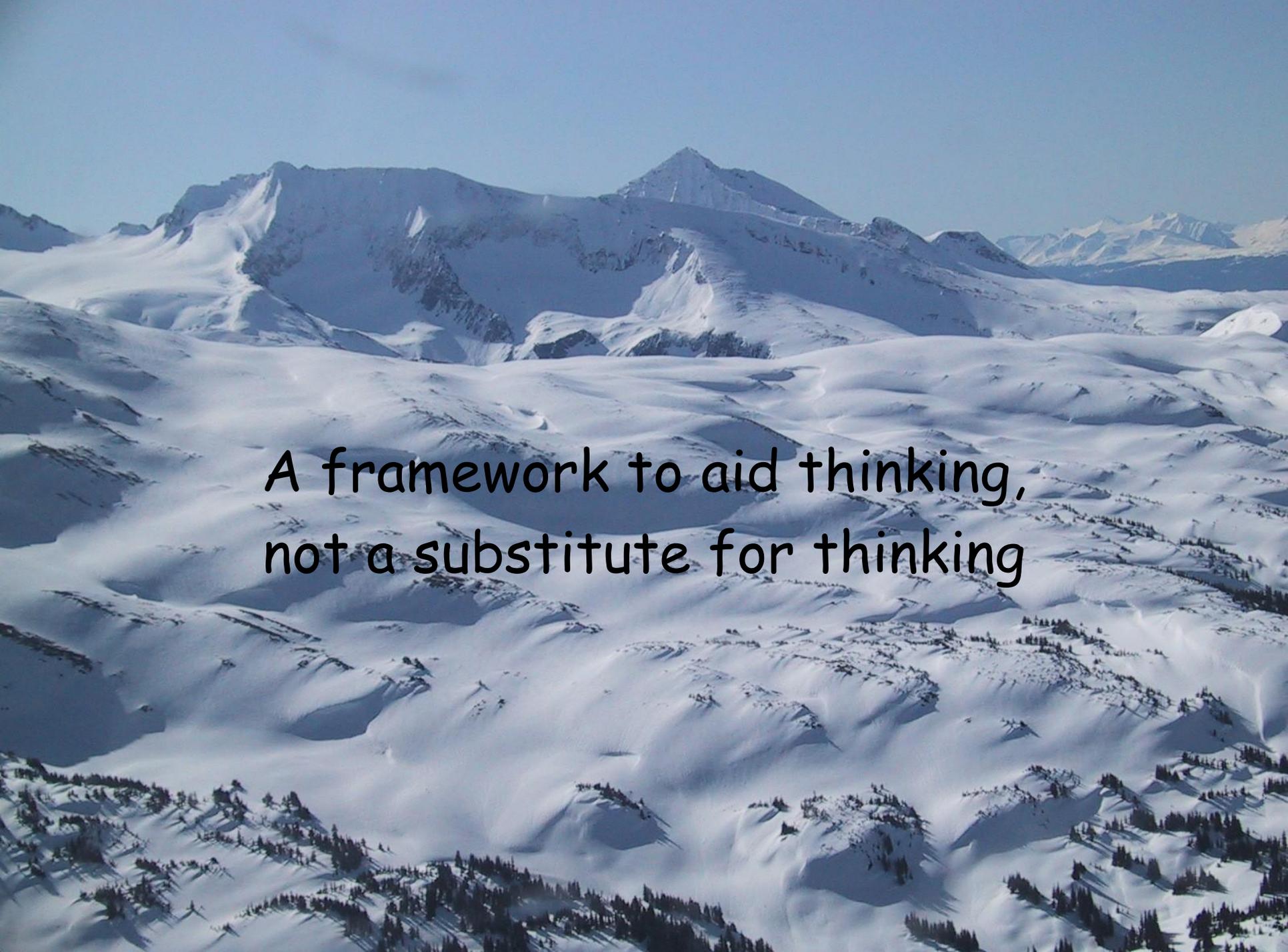
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\$

# Requirements for success

- Community involvement and buy-in to process
- Experts willing to take the time to draw curves
- Group responsible for updating objectives and strategies—management cycle
- Group keeping track of knowledge base and projects—learning cycle
- Credible knowledge sources (science, traditional and local knowledge)



A framework to aid thinking,  
not a substitute for thinking