

Managing Risk and Uncertainty in Water Quality Trading Programs


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Why examine risk and uncertainty?

- Clean Water Act (CWA) goals still not met
- Transition underway in National Water Program; emphasis shifting...
 - From: technology-based approaches
 - E.g., Effluent limitation guidelines, TBEL
 - To: information-based approaches
 - E.g., Watershed strategy, WQBEL
 - Implications
 - Mechanism for collective action is changing
 - Potential to be more effective, transparent and efficient

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- Institutional progress is hindered by actual and perceived sources of risk and uncertainty
 - Is WQT risky?
 - Real progress is possible with:
 - Improved understanding of actual and perceived risks
 - Improved risk management
 - This presentation is intended to provide some structure and focus to risk management in the WQT setting
 - Takes transition to information-based approaches as given



Defining Risk and Uncertainty

□ Risk

- Potential harm that may arise from a future event
 - An expected cost
 - Accounts for the probability of a negative event occurring and how harmful that event would be

□ Uncertainty

- Applies to prediction of future events, to physical measurements, or to the unknown
 - Described quantitatively as a probability
 - *Factors into the calculation of risk*



General strategies to reduce risk

- Account for who bears the risk
 - STRATEGY for efficient allocation of risk
 - *Allocate risk to the party best capable of minimizing the risk*
 - Who has unique information?
 - STRATEGY for fair allocation of risk
 - *Allocate risk according to societal values*
 - Similar to property rights (liability) allocation
 - Who “should” bear the risk? What’s “fair”?
 - STRATEGY for building trust and ability to adapt over time
 - *Develop institutions that share and jointly manage risk*
 - Clearinghouse, brokers, certification
 - Insurance, risk pooling, joint responsibility



□ Account for ability to quantify risk

■ STRATEGY for managing quantified risk

□ *Develop targeted solutions*

- Collect data, utilize theory, develop models, develop strategy that addresses various statistical outcomes

■ STRATEGY for managing qualitative risk

□ *Hedge your bets wisely*


- Utilize collective decision-making processes to seek buy in, maximize information
- Use theory, approaches applied in law and statistics



Hedging your bets wisely

- Decision-making in the presence of uncertainty
 - Legal setting
 - Which party is assigned the burden of proof?
 - What is the standard of proof that this party must achieve?
 - Statistical setting
 - What is the null (default) hypothesis?
 - What is the confidence level that is required to reject the null hypothesis?

WQT illustration

- For example:
 - What BMPs should be included in your trading program?
 - Option A: Best empirical evidence on effectiveness? 
 - Option B: Easiest to install?
 - If frame answer as “use A unless can prove should use B”
 - Default (null hypothesis) is A
 - Burden of proof is on use of B
 - Can consider different standards of proof (i.e., confidence levels)
 - How easy is it to prove that you should reject your default?
 - Proof beyond a reasonable doubt (99% certain)
 - Preponderance of the evidence (51% certain)



Implications

- Get specific about plans and talk it out
 - Share information, insights, concerns
 - Don't need to be as literal as described here, but keep concepts in mind
 - Get on the same page
- Know that mistakes will happen
 - Which way do you want to hedge your bets?
 - How can you minimize risk?
 - Reduce the probability of making mistakes
 - Reduce the harm done by mistakes
- Quantify risks whenever possible, then develop targeted solutions



A Framework for WQT

- People
 - Institutional
 - Sociopolitical
 - E.g., values, ethics, cultural, political
 - Regulatory and legal
 - E.g., the rules of the game
 - Economic
 - E.g., incentives
 - General strategy to mitigate risk is process oriented
 - Policy, politics, diplomacy
 - Getting everyone on the same page
 - Information gathering, analysis and diffusion
 - Consensus building
 - “Change management”



□ Places and Things

■ Places

□ Watershed characteristics

- E.g., geography, hydrology, precipitation, human disturbance

■ Things

□ Technology

- Control technologies (e.g., BMP effectiveness)
- Monitoring technologies (e.g., end-of-pipe, ambient)
- Modeling technologies (e.g., fate and transport)


■ General strategy to mitigate risk is analytically oriented

- Science, engineering, statistics
- Associated with “environmental equivalency”
- Quantify, then develop strategies to minimize risk



Strategy for managing “People” risks


- Lessons from “Change Management”
 - A process of developing a planned approach to change
 - Typical objective is to:
 - Maximize the collective benefits to all people involved in the change
 - Minimize the risk of failure of implementing the change
 - Focuses on human aspect of change
 - Psychology of change focuses on attitudes towards change
 - Complex interplay of emotions and cognitive processes
 - Lots of information on the internet, books, consultants (e.g., Wikipedia)

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- Many approaches, but several core concepts
 - Situational leadership and responsibility
 - Key players “buy in”
 - Vision...of the past...and the future
 - Common knowledge base
 - Custom fit the plan to the circumstances



Strategy for managing “Places” & “Things” risks

- Gain insight through multidisciplinary analysis
 - Theory to organize conceptual relationships
 - Data to understand the real world
 - Integrated analysis, including natural, physical, health, social sciences

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- Focus on economic theory of market design
 - Theory provides insight on cause-effect relationships
 - Useful when data are scarce
 - “Rules of the game”
 - Big picture
 - “Good rules will lead to good outcomes”
 - “Rules” guide individual behavior, based on individual interests
 - “Outcomes” determined collectively to meet group interests
 - Road map for sources of risk and uncertainty



- Two important starting points

- Coase Theorem

- Tells us something about individual bilateral exchanges
 - 1 buyer, 1 seller

- Theory of competitive markets

- Tells us something about a collection of bilateral exchanges
 - Multiple buyers and sellers

Coase Theorem

- A resource will be allocated efficiently if its property right (liability) is:
 - “Well-defined”
 - Exclusive (no externalities, no 3rd party effects)
 - WQT: *Does the trade cause new costs or benefits?*
 - Universal (all entitlements/liabilities are known and specified)
 - WQT: *Are baseline responsibilities clearly understood?*
 - Transferable
 - WQT: *Are all liabilities/rights transferable or are some nontransferable?*
 - Enforceable
 - WQT: *How is performance observed and enforced before and after the trade?*
 - There are no transaction costs
 - WQT: *How easy is it for buyers and sellers to trade?*

Theory of competitive markets

- Standardized product
 - *WQT: How is environmental equivalence established? Is the commodity being traded unique to each trade or standardized?*
- Enough buyers and sellers to create competition
 - *WQT: How "big" does the market need to be?*
- Resources are mobile - technology transfer, best practices, information diffusion, low barriers to entry
 - *WQT: Can buyers and sellers enter and exit the market easily?*
- Buyers and sellers have perfect information
 - *WQT: Do the market rules encourage the sharing of information that is pertinent to overall market efficiency (e.g., prices, quantities, potential buyers and sellers)?*



Closing thoughts

- Use this as a check list and an organizing framework to reduce and manage risk
- Use process and analysis together as strategic compliments (demand & supply of information)
- Examine both what is gained and what is lost
- Pay attention to the “macroenvironment”
 - What else is going on?
 - Markets for co-produced ecosystem services
 - Benefits analysis
 - Green accounting