Risk Management for Water and Wastewater Utilities

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Presentation Overview

- Introduction
- Methodology
- Results
- Successes and Lessons Learned
- Summary

What is Risk Management?

A powerful management framework that is used to identify risks and to assist in prioritization of projects and expenditures based on the most critical needs (the highest risks)

Background Information

- Is used in the private sector, particularly in insurance and financial companies
- A relatively new practice for water and wastewater utilities in North America
- Used as an integral part of decision-making processes for water and wastewater utilities in Australia and New Zealand

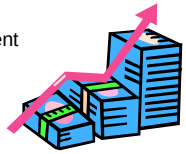
Grimsby Water Treatment Plant

Baker Road Wastewater Treatment Plant

Introduction Methodology Results Discussion Summary

Why Did We Do It?

- To comply with regulatory requirements
  - Drinking Water Quality Management Standard
  - Provincial Order from Ministry of Environment (Wastewater)
- To be proactive
- To strive for continuous improvement



Introduction Methodology Results Discussion Summary

Risk Assessment Projects

- Niagara Region conducted the risk assessment for its water and wastewater utilities under two separate projects:
  - Risk Management Plan for Niagara Region Drinking Water Assets (2007)
  - Wastewater Enterprise Risk Management Plan (2008)

Introduction Methodology Results Discussion Summary

Main Project Objectives

- To establish a framework for identifying, evaluating, and prioritizing risks
- To increase knowledge of system vulnerabilities
- To reduce the Region's overall level of risk and ensure a safe, reliable, and adequate operation of water and wastewater systems
- To develop a tool to assist with objective and systematic allocation of funds

Introduction Methodology Results Discussion Summary

Learning Objectives

- By attending this session participants will be able to:
  - Promote the value of risk management for water and wastewater utilities
  - Facilitate a risk assessment workshop
  - Apply the risk management methodology to their own operations

Introduction Methodology Results Discussion Summary

Niagara's Water & Wastewater Systems

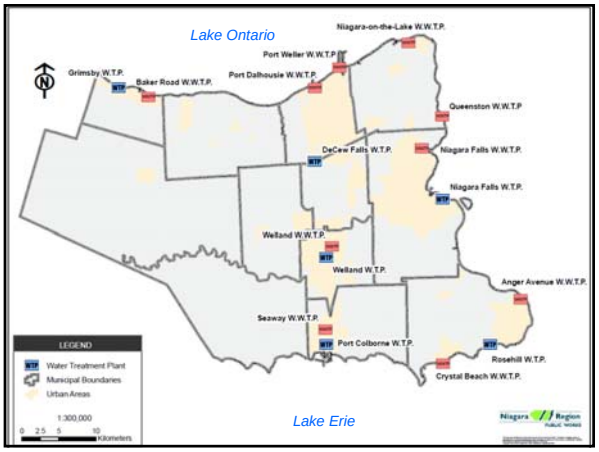
- Niagara Region owns and operates:
  - Water Systems:
    - 6 water treatment plants
    - ~300 km of pipe infrastructure
    - ~ 40 storage and pumping facilities
  - Wastewater Systems:
    - 12 wastewater treatment plants and lagoons
    - ~ 240 km of pipe infrastructure
    - ~130 pumping stations
- Service eleven local municipalities with a total population of 390,000

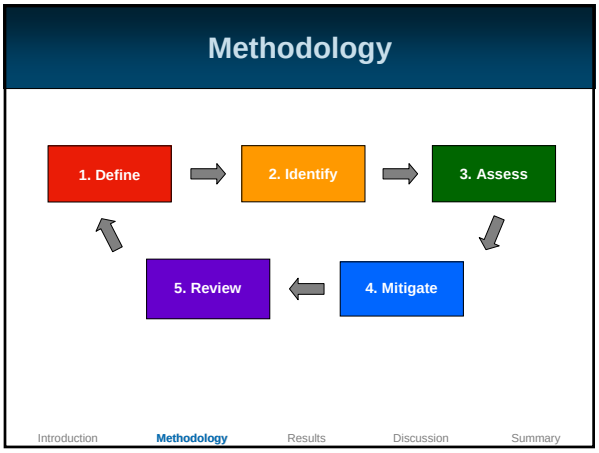
Niagara Falls Water Treatment Plant

Port Dalhousie Wastewater Treatment Plant

Introduction Methodology Results Discussion Summary

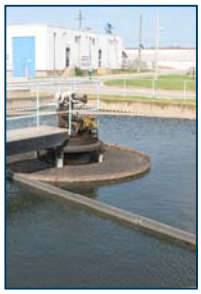
NORTH AMERICA
Outline Map
ARCTIC OCEAN
Gulf of Alaska
Labrador Sea
Hudson Bay
CANADA
PACIFIC OCEAN
UNITED STATES
ATLANTIC OCEAN
Gulf of Mexico
Caribbean Sea
SOUTH AMERICA
LEGEND
International Boundary


Lake Ontario
Niagara-on-the-Lake W.W.T.P.
Port Weller W.W.T.P.
Grimsby W.T.P.
Baker Road W.W.T.P.
Port Dalhousie W.W.T.P.
Queenston W.W.T.P
DeCew Falls W.T.P.
Niagara Falls W.W.T.P.
Niagara Falls W.T.P.
Welland W.W.T.P.
Welland W.T.P.
Anger Avenue W.W.T.P.
Seaway W.W.T.P.
Port Colborne W.T.P.
Rosehill W.T.P.
Crystal Beach W.W.T.P.
LEGEND
Water Treatment Plant
Municipal Boundaries
Urban Areas
1:300,000
Kilometers
Lake Erie


Methodology
1. Define
2. Identify
3. Assess
4. Mitigate
5. Review
Introduction
Methodology
Results
Discussion
Summary

1. Define Objectives

- This step involves setting the scope of the risk management process
- Risks are defined in terms of their effect on the achievement of the organization's objectives



Introduction **Methodology** Results Discussion Summary

1. Define Objectives and Context

Council's Business Plan Objectives:

- Community and Social Well Being
- Environmental Stewardship
- A Responsive Region
- Proactive Marketing and Communications
- Economic Prosperity

Context:

- Public Health Risks
- Compliance Risks
- Environmental Risks
- Reputation Risks
- Financial Risks

Introduction **Methodology** Results Discussion Summary

1. Define Objective and Context

- To conform with the requirements of the Drinking Water Quality Management Standard, only risks related to water quality were identified

Water Quality Risks

Context:

- Public Health Risks
- Compliance Risks

Introduction **Methodology** Results Discussion Summary

2. Identify Risks

- Identify events that could prevent, degrade, delay or enhance the achievement of objectives
- Divided water infrastructure into components including:
  - Source Water
  - Water Treatment Plant
  - Distribution System
- Divided wastewater infrastructure into components including:
  - Collection System
  - Wastewater Treatment Plant
  - Outfall

Introduction **Methodology** Results Discussion Summary

2. Identify Risks

- Risks were expressed in terms of:
  - Component / Process Step
  - Hazardous event or incident
  - Consequence
  - Preventative, monitoring, and response controls

Introduction **Methodology** Results Discussion Summary

2. Identify Risks

Site visit and facilitated brainstorming workshop

- Workshop Participants:
  - Senior Management
  - Engineering
  - Operations and Maintenance Staff
- Workshop Material:
  - Spreadsheet containing a preliminary list of Components / Process Steps, Hazardous events, and Consequences
  - Risk scales and criteria
- Workshop Results:
  - Risk scores
  - Preventative, monitoring, and response controls

Introduction **Methodology** Results Discussion Summary

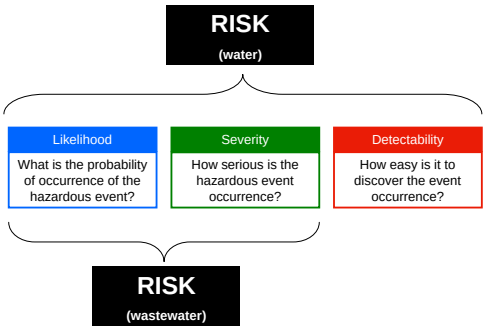
Example

Component / Process Step	Hazardous Event	Consequence	Preventative, Monitoring, and Response Controls
Coagulation/ Flocculation	Alum pump failure	■ No injection of alum ■ No flocculation ■ Increase in turbidity	■ SCADA monitoring and no flow alarms ■ Preventative maintenance program ■ Backup pump
Smithville Forcemain	Forcemain break	■ Potential for basement flooding ■ Large cost to repair/replace ■ Potential health risk to public	■ Refer to ERP 09R: Forcemain Break ■ Refer to ERP 10R: Handling of Wastewater Calls by Switchboard

3. Assess Risks

- This step involves establishing the magnitude of each and every risk identified
- A semi-quantitative approach is utilized
- Risks are quantified by a combination of variables

3. Assess Risks



3. Assess Risks - Likelihood

Water and Wastewater

Description	Likelihood of Hazardous Event Occurring	Rating
Rare	May occur in exceptional circumstances, and has not occurred in the past. It is new (within warranty period).	1
Unlikely	Could occur at some time. Historically, has occurred less than once every 5 or 10 years. It is refurbished or rebuilt.	2
Possible	Has occurred or may occur once or more per year. It is approaching the end of its life cycle.	3
Likely	Has occurred or may occur on a monthly to quarterly basis.	4
Very Likely	One or more occurrences on a monthly or more frequent basis. It has exceeded its life cycle.	5

Introduction **Methodology** Results Discussion Summary

3. Assess Risks - Severity

Water

Description	Severity of Hazardous Event Occurring	Rating
Insignificant	Little disruption to normal operation.	1
Minor	Some manageable operation disruption. Train out of service.	2
Moderate	Significant modification to normal operation but manageable or not producing water just pumping water into the distribution system.	3
Major	Drinking water advisory. Possible reduced production.	4
Catastrophic	No water available for distribution therefore negative pressures in the distribution system. Production and uncontrolled distribution of unsafe water.	5

Introduction **Methodology** Results Discussion Summary

3. Assess Risks - Severity

Wastewater

Description	Severity of Hazardous Event Occurring	Rating
Insignificant	No injuries; no environmental impact; minor investment required	1
Minor	Potential injuries; minor environmental impact; unplanned investment covered by current budget; no loss of Region's reputation.	2
Moderate	Minor injuries; easily reversible environmental impact; unplanned investment ($25,000-$100,000); non-compliance	3
Major	Severe injury; significant environmental impact; unplanned investment ($100,000-$250,000); basement flooding	4
Catastrophic	Death or serious injury; severe and irreversible contamination; large population affected for extended period of time; significant unplanned investment greater than $250,000)	5

Introduction **Methodology** Results Discussion Summary

3. Assess Risks - Detectability

Water

Description	Detectability of Hazardous Event	Rating
Very detectable	Easy to detect, on-line monitoring through SCADA.	1
Moderately Detectable	Alarm present but not on SCADA. May require operator to walk by and notice alarm. Problem can be indicated promptly by in-house lab test results.	2
Normally Detectable	Visually detectable on operator rounds or regular maintenance.	3
Poorly Detectable	Visually detectable but not inspected on a regular basis. Not normally detected before problem becomes evident. Lab test not done on a regular basis (e.g. quarterly).	4
Undetectable	Cannot detect.	5

Example (continued)

Hazardous Event	Likelihood	Severity	Detectability
Alum pump failure	2 (Unlikely)	2 (Minor)	1 (Very Detectable)
Forcemain break	5 (Very Likely)	5 (Catastrophic)	N/A

Risk Assessment

Water

Risk = Likelihood + Severity + Detectability	Risk Category
3 – 5	Low
6 – 8	Moderate
9 – 11	High
12 - 15	Very High

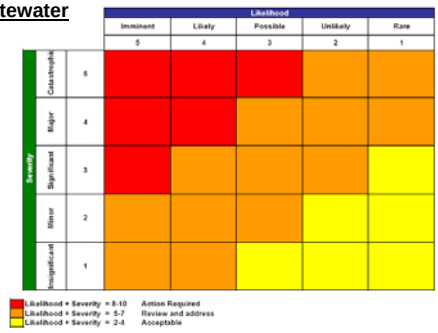
Risk Assessment

Wastewater

Risk = Likelihood + Severity	Risk Category
2 – 4	Acceptable
5 – 7	Review and Address
8 – 10	Action Required

Risk Assessment

Wastewater



Example (continued)

Water					
Hazardous Event	Likelihood	Severity	Detectability	Risk Total	Risk Category
Alum pump failure	2	2	1	5	Low

Wastewater				
Hazardous Event	Likelihood	Severity	Risk Total	Risk Category
Forcemain break	5	5	10	Action Required

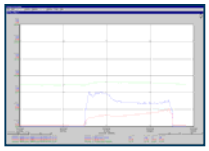
4. Mitigate Risks

- Avoid the risk - eliminate the activity that gives rise to the risk
- Change the likelihood, severity, and/or detectability of the risk by:
  - Preventative measures
  - Post-event responses
  - Additional monitoring to decrease response time
- Share the risk - involve other parties (insurance and partnerships)
- Retain/accept the risk - do nothing approach

Introduction **Methodology** Results Discussion Summary

Niagara's Preventative and Mitigating Measures

- Continuous SCADA monitoring
- SCADA Alarming
- Equipment Redundancy
- Process Redundancy



Introduction **Methodology** Results Discussion Summary

Niagara's Preventative and Mitigating Measures

- Security Systems
- Emergency Response Procedures
- Critical Control Point Response Procedures
- Succession and Pandemic Planning

Introduction **Methodology** Results Discussion Summary

5. Risk Assessment Review

- Necessary to ensure the risk assessment is relevant
- Factors may change that could affect the likelihood, severity, and detectability of each risk
- Cost of mitigating measures may change
- Incidents, accidents, and successes provide an opportunity to assess how the risk assessment process can be improved
- Annual review and a complete re-assessment every three years

Introduction **Methodology** Results Discussion Summary

Risk Assessment Results

- Over **400** risks to water quality identified
- Over **1,300** risks associated with wastewater systems identified
- 90% of identified risks considered minor
- Demonstrates an excellent understanding of system and vulnerabilities

Introduction Methodology **Results** Discussion Summary

High Scoring Risks

- Niagara's top **water quality** risks relate to:
  - Catastrophic failure of infrastructure
  - Staff recruitment and retention
  - Pandemic
  - Vandalism/Terrorism

Introduction Methodology **Results** Discussion Summary

High Scoring Risks

- Niagara's top **wastewater** risks relate to:
  - Equipment failure due to age and condition
  - Forcemain break or gravity sewer failure
  - High energy consumption of certain process equipment
  - SCADA communication failures
  - Insufficient or inadequate standby power at facilities
  - Staff recruitment and retention

Introduction Methodology **Results** Discussion Summary

Focus On NIAGARA

Niagara at forefront of clean drinking water

DRINKING WATER FAST FACTS:

Successes

- Niagara Region's Project Objectives achieved:
  - ✓ Achieve regulatory compliance
  - ✓ Be proactive
  - ✓ Strive for continuous improvement

Introduction Methodology Results **Discussion** Summary

Successes

- Installation of critical monitoring equipment
  - Flow switches
  - CT Calculators
  - Level sensors and alarming

Successes

- Initiation of numerous capital projects including:
  - Assessment of SCADA and COMM systems prone to failure
  - Investigation of raw sewage pumps beyond service life
  - Investigation of chemical storage and containment for tanks beyond service life

Successes

- Initiation of a Pump Station Condition Assessment:
  - Increased in priority based on risk assessment (RA)
  - What is wrong with each asset? When it is required to be fixed? How much it will cost?
  - RA helped to prioritize top 10 pump stations to review
  - Condition assessment provided more detailed information
  - Encouraged by Ontario Municipal Benchmarking Initiative

Successes

- More confident and rigorous basis for decision making and planning
- Reduction of operational surprises and losses
- Better understanding of systems and vulnerabilities
- Staff empowerment
- The know-how to repeat the risk assessment process
- Motivation to complete comprehensive risk assessments in the future

Introduction Methodology Results **Discussion** Summary

Challenges and Lessons Learned

- Consider team membership and dynamics
  - Diverse team is essential
  - Senior management must be included from the beginning
  - Operators must be comfortable to speak up in front of senior management
  - No ideas are bad or incorrect

Introduction Methodology Results **Discussion** Summary

Challenges and Lessons Learned

- Ensure careful wording of recommendations
  - For example:
    - *"Initiate a capital budget request for the replacement of the raw sewage lift pumps."*
  - Changed to:
    - *"Initiate a capital budget request to assess the condition of the raw sewage lift pumps."*

Introduction Methodology Results **Discussion** Summary

Challenges and Lessons Learned

- Data management
  - Large spreadsheets / databases
  - Avoid duplication of information
  - Consider future updates

- Monitoring and review
  - Continuous need for staff involvement and resources must be recognized

Introduction Methodology Results **Discussion** Summary

Challenges and Lessons Learned

- Ensure consistency
  - As you move through the process new ideas will inevitably arise
  - Important to go back and ensure consistency

- You will not get it perfect the first time but you will continuously improve!

Review Learning Objectives

- By attending this session participants will be able to:
  - ✓Promote the value of risk management for water and wastewater utilities
  - ✓Facilitate a risk assessment workshop
  - ✓Apply the risk management methodology to their own operations

Introduction Methodology Results **Discussion** Summary

Summary

- Risk management is a “Best Practice”
- Should be embedded in organization’s business plan
- Diverse assessment team is essential
- Significant undertaking with many challenges and rewards
- More than assessing risks; most value in what comes after

Introduction Methodology Results Discussion **Summary**

Questions?

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