

HEALTH RISK ASSESSMENT – AN EMERGING ISSUE IN MUNICIPAL WASTEWATER

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Karen A. Phillipps, M.Sc, DABT

Gordon L. Brown, Ph.D, QEP



Agenda

- Introduction
- CCME Municipal Wastewater Strategy
- Proposed Environment Canada Regulations
- Examples of Wastewater Health Risk Assessments
- Other Health Risk Issues
- Summary



Introduction

Human health and environmental impacts related to municipal wastewater are emerging areas of interest:

- Increasing public concern regarding **viability of public water supplies** for drinking water, industry and agriculture
- **Concern about water quality** – chemical and microbiological, short-term and long-term impacts
- **Regulatory changes** – *CCME 2009 and Proposed Environment Canada Regulations for municipal wastewater*

CCME 2009 Municipal Wastewater Strategy

General Highlights:

- Will affect *new* and *upgraded* facilities to varying degrees, depending on facility size (very small to very large) and flow
- Canada-Wide Strategy covers governance, facility performance, municipal effluent quality and quantity as well as economic considerations
- **National Performance Standards** proposed for Carbonaceous Biochemical Oxygen Demand (CBOD), Total Suspended Solids (TSS), Total Residual Chlorine (TRC)
- **Sampling** and **testing** requirements
- **Environmental Risk Assessments**

CCME 2009 Municipal Wastewater Guidelines

Testing Requirements Include:

- **Microbiological** – *Escherichia coli*, total coliforms
- **Aquatic toxicity** testing, acute and chronic
- **Water chemistry testing** – frequency and parameters specified separately for initial and continuous monitoring, dependent on facility size



CCME 2009 Municipal Wastewater Guidelines

Comprehensive chemical analysis

- General chemical parameters and nutrients (N, P, DO)
- Metals
- Pathogens (*E. coli*)
- Organochlorines
- Polychlorinated Biphenyls
- Polycyclic Aromatic Hydrocarbons
- Volatile Organic Compounds
- Phenolic Compounds
- Surfactants

CCME 2009 Municipal Wastewater Strategy

Environmental Risk Assessment

- CCME definition includes both human and aquatic health
- Is part of a risk-based decision-making process
- Involves (but not limited to) screening against **Environmental Quality Objectives** (e.g. CCME water quality criteria or jurisdictional values)
- Development of site-specific **Environmental Discharge Objectives** (EDO) for each facility
- CCME 2009 approach described is very general – should be discussed with local jurisdictional authority and public stakeholders

CCME 2009 Municipal Wastewater Strategy

Environmental Discharge Objectives (EDO)

- 'end of pipe' criteria developed for a specific facility by proponent
- Based upon risk assessment results
- Derived such that concentrations at edge of mixing zone meet EQO (e.g. CCME water quality criteria) or other concentrations of interest
 - Employ mixing model to calculate EDO
 - No mixing/dilution – EDO can be equivalent to EQO
 - Upstream issues – EDO can be determined from upstream water quality

Proposed Environment Canada Regulations

- Proposed Wastewater Systems Effluent Regulations in Canada Gazette, March 2010
- Developed under the Fisheries Act to help implement CCME 2009 strategy
- Outlines monitoring requirements, record-keeping and reporting requirements for wastewater facilities
- National Performance Standards for CBOD, TSS, TRC and un-ionized ammonia

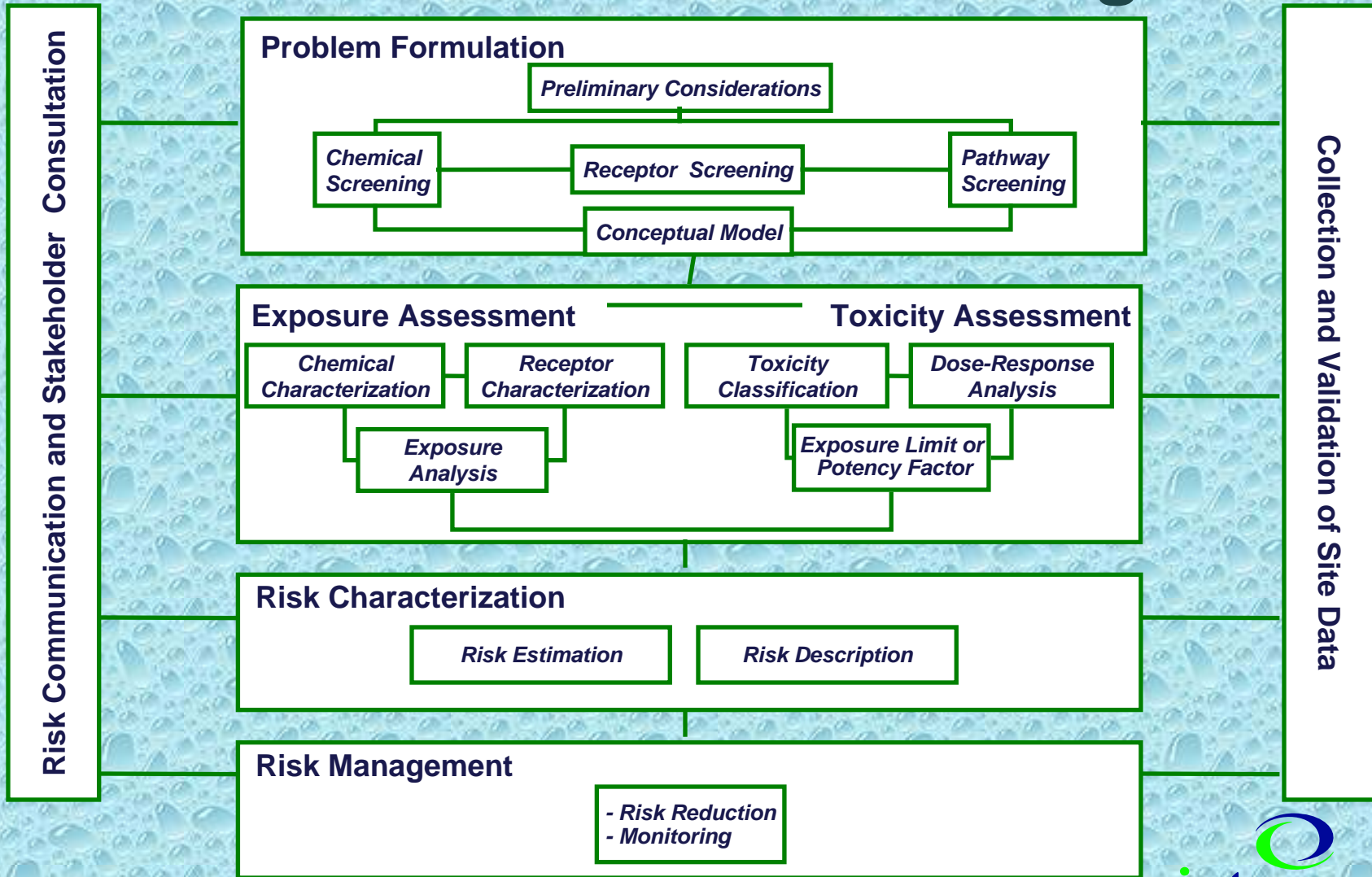


EXAMPLES OF WASTEWATER RISK ASSESSMENT APPROACHES – CASE STUDIES

Screening Level Risk Assessment (SLRA)

Quantitative Risk Assessment (QRA)

Risk Assessment Paradigm



Example 1 – Screening Level Risk Assessment (SLRA)

Wastewater Treatment Plant Project in Alberta

- Existing wastewater outfall discharging into a river upstream of a drinking water intake for an Aboriginal community and potentially local landowners
- Application to expand and upgrade facility based on community growth
- High level of stakeholder (i.e., aboriginal community, government agencies) interest in project

Example 1 – SLRA (cont'd)

Approach

- Collection of undiluted effluent samples to characterize existing effluent quality (Nutrients, Metals, Volatile Organic Compounds, Polycyclic Aromatic Hydrocarbons, pesticides)
- Review of historical data for effluent, upstream and downstream water quality
- Measured chemical concentrations compared to available drinking-water criteria (CCME, HC, US EPA, World Health Organization) or aquatic life criteria (CCME, US EPA)
- Only the drinking water pathway was evaluated

Example 1 – SLRA (cont'd)

Results

- All chemical parameters detected were below human health-based drinking water quality criteria
- *E.coli* and total coliform met approval conditions but were above drinking water guidelines (i.e. raw water must be treated)
- Four metals (total Hg, Al, Ag, and Zn), phenols and one nutrient (P) slightly exceeded aquatic life guidelines (but no aquatic receptor present in effluent – hypothetical)
- Provided valuable information to stakeholders that the receiving river water quality was not impacted by the effluent discharge

Example 1 – SLRA (cont'd)

Recommended Next Steps

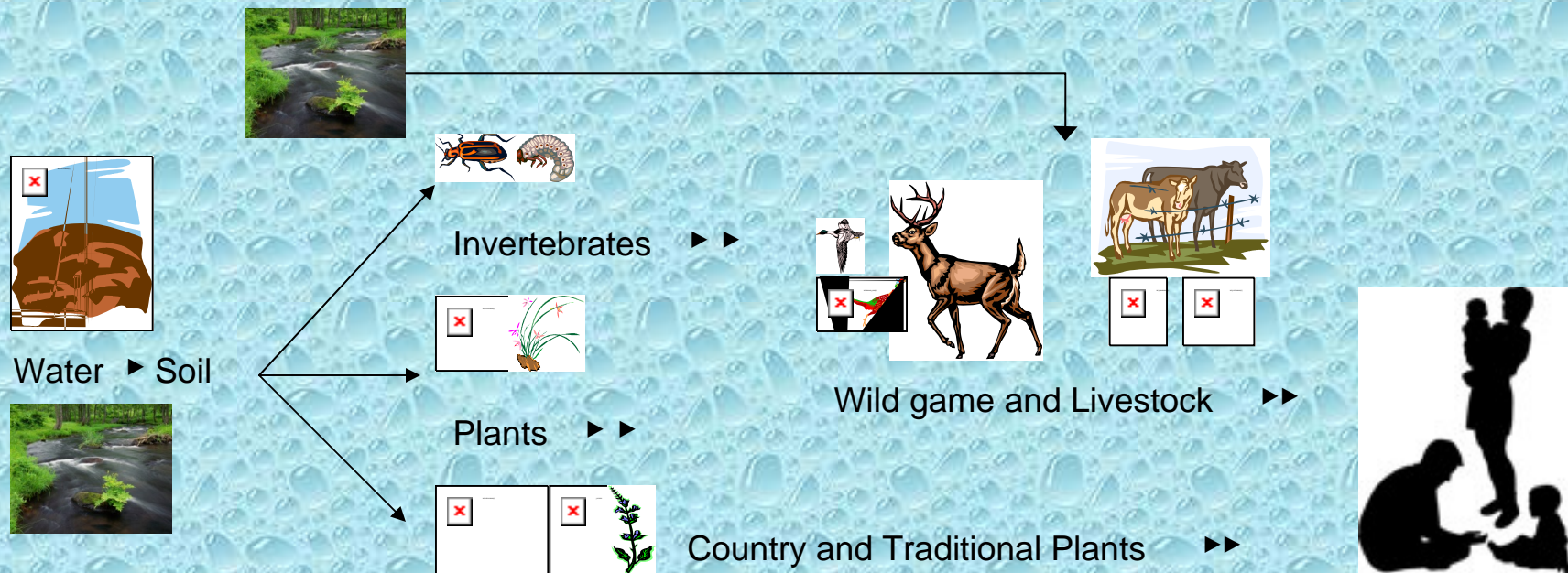
- Additional sampling to further characterize effluent
- Quantitative risk assessment to address multiple pathways of exposure (drinking water, swimming, fish and food consumption, traditional activities)

Example 2: Quantitative Risk Assessment (QRA)

- Quantitative risk assessments can be customized to address specific exposure pathways as needed
- Can be 'blended' into a screening level assessment - provides more information about long-term health impacts
- Involves quantitative prediction of exposures to chemicals from multiple pathways of exposure (water, fish, country food, traditional plants, etc.)
- Exposure estimate compared to health-based exposure limits

Relationship Between Water and Human Exposure Pathways

Indirect Ingestion



Direct Contact or Ingestion



Example 2: QRA (cont'd)

Exposure Assumptions

- Assumed that individuals exposed continuously for a lifetime and had a variety of different behaviour patterns that could affect their potential exposure
- Exposure estimates were based on:
 - Dietary data from previous surveys conducted for the community in question
 - Stakeholder consultation - personal meetings and communications with individuals to gain understanding of concerns and exposure-related information
 - Food consumption rate and exposure data from Health Canada, US EPA
 - Risk assessment guidance and methods from Health Canada and the US EPA

Example 2: QRA (cont'd)

Results

- Comprehensive multiple exposure pathway risk assessment based on highly conservative exposure assumptions demonstrated **negligible potential health risks** for the effluent alone and the receiving waters
- Results of assessment were accepted by stakeholders
- Approval for facility was granted

Other Risk Issues

Pharmaceuticals and Emerging Contaminants

- Pharmaceuticals and their metabolites, Endocrine disruptors etc.
- No health-based standards or exposure limits
- Area of on-going research

Cyanobacteria (“blue-green algae”) and microcystin toxin

- Highly variable, dependent on many factors
- Toxin, if produced, can cause liver damage

Pathogens

- *Cryptosporidium*, *Giardia*, etc.

What are the benefits of risk assessment?

- Provides a means to identify and manage any environmental risks
- Provides scientifically-based information to the public and other stakeholders
- Public consultation programs aid in building and maintaining positive relationships between operator and community stakeholders
- May identify areas of interest to a municipality or an entire region for future evaluation, and the development of sampling strategies

Summary

- The format and content of risk assessments completed under the new regulatory frameworks will likely vary, and be very site-specific
- There will be an increasing need for the completion of risk assessments for proposed and upgraded facilities
- Environmental risk assessments will need to address environmental health, human health, pathogens, and involve stakeholder consultation



**Thank
you**

Intrinsik Environmental Sciences Inc.

736 8th Ave SW Calgary AB

www.intrinsikscience.com

