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Contaminants of Emerging Concern:How are These Identified?

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SERVICES AND SOLUTIONS FOR A LIVABLE REGION

Introduction

- Metro Vancouver manages its liquid waste in accordance with the Integrated Liquid Waste and Resource Management Plan
- The Plan is based on the CCME Municipal Effluent Strategy, that is being implemented through the Wastewater Systems Effluent Regulation under the Fisheries Act
- The CCME process is conservative and follows an environmental risk management procedure

CCME Strategy – Key Elements

- National Performance Standards (NPS)
- Effluent Discharge Objectives (EDOs)
- Toxicity
- Initial wastewater characterization
- Reduction of pollutants at source (source control)
- Combined and sanitary sewer overflows (CSO/SSO)
- Compliance monitoring and reporting
- Governance
- Economic plan

National Performance Standards (NPS)

- cBOD5 $\leq$ 25 mg/L
- TSS $\leq$ 25 mg/L
- Total residual chlorine $\leq$ 0.02 mg/L
- Non-acutely toxic effluent (Rainbow trout and *Daphnia magna)*

Effluent Discharge Objectives (EDOs)

- Considered since NPS may not be sufficiently protective of the environment
- Determined using a risk-based approach
- Ensure that Environmental Quality Objectives (EQOs) are met at edge of the Initial Dilution Zone (IDZ)
- Degradable substances are allowed to mix in a proportion of the receiving water
- Toxic, persistent and bioaccumulative substances are not allowed a mixing zone (EDO = EQO)
- Established on basis of single-discharge or watershed approach

Single-Discharge Versus Watershed Approach

- For a single discharge, EDOs are to be established for substances of potential concern
- In the watershed approach, substances of concern in the watershed are to be identified and EDOs are to be established for them
- In our assessment, both approaches were incorporated into one and a single list of EQOs was developed

Risk Assessment Approach

- Consider contaminant database
- Develop list of potential environmental quality objectives (EQOs)
- Designate water uses – protection of irrigation waters, primary-contact recreational beaches and ecosystem health (fisheries, aquatic life or marine life, and wildlife areas)

Contaminant Database

- A list of substances of concern is developed based on industrial discharges to the sewer and effluent monitoring results
- Industrial operations included when flows from a specified industrial category exceed 5% of the annual dry-weather flow
- Specified industrial categories for consideration:
  - resource exploration and development
  - manufacturing/fabrication
  - processing (including food)
  - marine and air transport (including container cleaning)
  - landfill leachate
  - hospitals and laboratories (but not nursing stations)

Potential EQOs

- Physical/chemical/pathogenic – describing the level of a particular substance of concern that will protect water quality
- Whole Effluent Toxicity (WET) – specifying the proportion of the effluent discharge that may enter the water body without toxicological effect
- Biological criteria or bio-assessment – describing the level of ecological integrity that must be maintained

Step 1: Development of a List of Applicable EQOs

- First considered EQOs for water column in the receiving water body, BC approved and “working” guidelines, and CCME guidelines for fresh and marine waters
- General order of priority: WQO > BC guidelines > CCME guidelines
- Preliminary list included every potential substance with a WQO or guideline
- Subsequently also considered existing objectives for sediments and fish and developed EQOs for bed sediments and fish tissue

Step 2: Assessment of EQOs and Monitoring Data

- Compared EQOs to maximum effluent concentration - routine monitoring & special studies
  - Substance eliminated if maximum effluent conc. < EQO

Step 3: Assessment of Remaining Substances

- Determined whether remaining substances had “reasonable potential” to be present in the effluent
  - Elimination of substances based on a reasonable potential not to be present in the sewerage area

Step 4: Consideration of Dilution Ratios

- Minimum and average predicted dilution ratios during low river flows and slack water conditions (from dispersion/dilution modeling and dye studies)
- Measured dilution ratios from fecal coliform and ammonia data at IDZ boundary during all three tidal cycles
- Selected the worst case option for maximum environmental protection (conservative approach): the lowest 5th percentile low dilution ratio

Step 5: Comparison of EQOs to Concentrations at Edge of IDZ

- Compared EQOs to maximum actual measured concentrations (over a period of several years) at edge of IDZ
- Considered the lowest dilutions for all three tidal cycles

  Substance eliminated if flow adjusted IDZ conc. < EQO

Step 5: Calculation of EDOs

- For persistent, toxic, bio-accumulative substances

  EDO = EQO
- First used minimum dilution available with present diffuser, then calculated potential EDOs based on projected improvement of minimum dilution ratio (Annacis)
- Ignored any potential reduction in effluent concentrations from secondary treatment (Lions Gate)
- Background adjustment was possible only in few instances, since for many substances EDO = EQO, or due to lack of data (most had non-detectable values)

Process Used to Identify Sediment and Fish Tissue Concerns

- Compiled a list of EQOs for sediments and fish tissue, as per water column – considerably fewer number of EQOs
- EQOs compared to data collected in sediment and fish surveys
- Considered nature of substances, sediment particle size variations and difference in measured concentrations in sediments collected at the IDZ and at reference site
- Included precision and accuracy considerations in assessment of difference between the measured substance concentrations in sediments and EQOs
- Findings of fish tissue assessment either could not be related to the existence of the WWTP, or confirmed the need for EDOs identified in water column considerations

Step 6: Toxicity Considerations

- Acute effluent toxicity is not allowed
- For chronically toxic, biodegradable substances dilution of effluent is acceptable

  EDO based on EQO at the IDZ edge

Chronic Toxicity

- CCME guidance is vague as to end point to use
- One reference states that the NOEL should be used; however, this depends on the dilutions used for testing
- Another CCME reference indicates that IC, EC, NOEL or LOEL can be used. LOEL and NOEL are hypothesis-based values
- Selected use of IC25 because it is a regression-based value with confidence limits

Comparison of EDOs with the Most Recent Monitoring Data

- Very few parameters exceeded EDOs

Additional On-going Work

- Effluent, influent and IDZ data need to be collected for a number of pesticides (and PBDEs at IDZ) to allow an assessment of their true potential to be in the discharge – could be considered as part of an “initial characterization program”
- The CCME Strategy document indicates that ongoing monitoring for the EDOs is required only for those substances where the mean effluent values exceed 80% of the EDO value
- Evaluation of wastewater system required every ten years to confirm whether a significant change has occurred to effluent quality, and if so initial monitoring frequency must be undertaken

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Questions?