Copper and Zinc in Urban Runoff: Potential Pollutant Sources and Release Rates

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Introduction

Copper and zinc in stormwater runoff can be harmful to aquatic organisms. Roof runoff has been shown to be toxic to rainbow trout, flathead minnows, and aquatic invertebrates (Bailey et al., 1999; Tobiason and Logan, 2000). Pre-spawning mortality of salmon on the west coast has been linked to urban runoff (Spromberg et al., 2016).

Many studies have looked at the potential sources of copper and zinc in urban environments. It has been shown that commercial and industrial areas contribute the highest concentrations of copper and zinc in surface runoff (Norton et al., 2011; Hobbs et al., 2015). However, few comprehensive surveys have been performed on individual sources of copper and zinc.

The objectives of this study are to:

- Determine sources
- Estimate potential loading
- Rank sources by potential contribution
- Qualify uncertainty
- Identify data gaps

Methods

The potential copper and zinc loading from sources in the built environment are calculated from literature release rates and either the total exposed surface area of construction materials or the wear rate per vehicle kilometers travelled.

The surface areas of construction materials are determined using local county assessor data and digitized building footprints. Vehicle kilometers are tabulated from current traffic count data and are estimated by the number of households present on minor roadways where traffic data are not collected.

Calculations

Loading $\left(\frac{g}{yr}\right) =$ Surface Area (m²) × Release Rate $\left(\frac{g}{m^2 yr}\right)$

Loading $\left(\frac{g}{vr}\right) = Traffic Volume \left(\frac{km}{vr}\right) \times Release Rate \left(\frac{g}{km}\right)$









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Figure 1. Land use in the urban copper and zinc study area (2016).

Figure 2. Sources of copper and zinc in a neighborhood.

Figure 3. Sources of copper and zinc on roadways.









Figure 4. Potential copper loading by source type.



Figure 5. Potential zinc loading by source type.

Results

On average, an estimated 800 pounds of copper and 5,900 pounds of zinc are released each year from the materials reviewed in the study area.

The primary sources of copper are vehicle brake wear, roofing materials, parking lots, treated lumber, building siding, and vehicle exhaust. The main sources of zinc are moss control products, building siding, parking lots, vehicle tire wear, chain-link fence, roofing materials, and vehicle brake wear.

The methods developed in this study are tools that can be used for pollutant source control. The focus of this study is on the primary release of copper and zinc. The fate and transport of these compounds is not addressed here but is an important part of source control efforts.

Next Steps

Monitoring of rainwater runoff from sources of copper and zinc will be performed during the winter of 2017. The sources selected were found to have the highest potential to contribute copper and zinc to the environment and the most uncertainty around the initial loading estimates. The monitoring will collect rainwater runoff from four roofing materials, two siding materials, roof gutters, streetlight poles, and chain-link fence.

Full Report

Bookter, A. 2017. Copper and zinc in urban runoff: Phase 1 - Potential pollutant sources and release rates. Washington State Department of Ecology. 17-03-018. Available soon at:

https://fortress.wa.gov/ecy/publications/SummaryPages/1703018.html References

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