Rainwater Harvesting for Non-potable Reuse in Gardens: Green vs. Traditional Roofing
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Introduction
- Early stormwater management assumed roof pollutant loadings were overwhelmingly due to atmospheric deposition.
- Roofing materials themselves seen as environmentally benign. Is this true? Literature review indicated concerns.
- Laboratory “leach” testing indicated that potential for pollutant release potential (primarily nutrients, lighter hydrocarbons, pesticides, and metals) is high from traditional materials.

Questions to Be Addressed
- Given this large “store” of pollutants in the materials, would they be released in actual field conditions?
- What are the long-term concentrations/loadings from these materials?
- How do these releases compare to green roofing?

Environmental Significance
- If roofing materials pollute, they must be included both as a source in modeling and as a location needing remediation.
- Rainwater harvesting from roofing requires careful selection of materials based on runoff quality throughout the roof’s life.
- Green roofing is known to cool urban heat islands and to provide water retention of rainfall. Is cleaner runoff (compared to traditional materials) an additional benefit of green roofs?

Objectives
- Determine the pollutant release (nutrients and metals primarily) from commonly-used roofing materials and from a green roof throughout their life cycle.
- Evaluate runoff quality in relation to plant toxicity for harvesting for non-potable uses (landscape irrigation could save ~ 15 – 30% of household drinking water use).

Methods
- **Phase I**: Laboratory testing (modified TCLP) was conducted on a variety of roofing materials and sealants to determine potential pollutant release.
- **Phase II**: Intact panels of traditional materials installed to monitor long-term degradation. Roof slope and material spacing based on roofer’s recommendations. Investigate climatic effects including:
  - salt spray; freeze-thaw; UV exposure, generally less-intense rains than southeast US.
- Field (Phase II) monitoring in late July/early August 2005.

Results and Discussion
- Laboratory testing demonstrated that many traditional materials had a “reservoir” of pollutants potentially available for release.
- Median nutrient concentrations meet aquatic life and drinking water criteria. Wood products released more N, while green roof released more P into runoff. P levels, though, were low.
- Most roofs released N concentrations above the 25th percentile of PA stream concentrations.
- Concerns regarding metals from traditional roofing materials.
- Copper – Elevated in wood product runoff; stream criteria maximum concentration = 65 µg/L; Plant toxicity = 2,000 µL.
- Zinc – Elevated in uncoated, galvanized metal roof runoff; stream criteria maximum concentration = 120 µg/L; Plant toxicity = 2,000 – 11,000 µL.

Conclusions and Future Research
- Uncoated galvanized metals and wood products primary concerns for release of metals and organics.
- Copper-based preservatives used in wood.
- Nutrient releases seen early in several materials’ lives, with rapid reductions in runoff concentrations seen after several storms.
- The aged roofing panels showed that some materials will release measurable concentrations of pollutants over their entire life.
- Rainwater harvesting from some traditional roofing materials (cedar shakes, uncoated galvanized metal) is problematic.
- If runoff collected from these materials, pretreatment required prior to reuse for even landscape irrigation.
- Green roof runoff chemically “cleaner” compared to traditional roofing.

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