Watershed Protection Through Building Material Substitution and Controlled Use
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a. Problem and Research Objectives
Developmental pressures throughout the state of Alabama pose an increasing potential threat to sensitive watersheds. Areas such as the Lake Purdy watershed, which provides drinking water for much of the greater Birmingham area, and watersheds feeding tributaries and estuaries of Mobile Bay represent attractive building sites in rapidly developing areas of the state. If development is allowed to proceed in these areas, it is essential that it be carried out in ways that minimize the long term impact to the natural resources we depend on for drinking water, recreation and tourism, the seafood industry and commerce. Some sources of pollution linked to development, such as sedimentation during construction, are obvious. Others, such as the slow leaching of metals and organics from building materials, and their transport in the environment, are insidious, but perhaps no less important in the long run. If select building materials represent an important source of pollutants, reducing emissions at the source, through material substitution, will probably be more cost effective than attempting to treat stormwater runoff that has come in contact with these materials.

The objective of this research was to identify and quantify selected toxicants that are added to urban stormwater through contact with a variety of building materials. This information will be used to analyze the potential pollution prevention benefits and economic impacts associated with building material substitutions in sensitive watersheds.

b. Methodology
Aggressive and mild leaching tests were conducted on a variety of construction materials. The initial tests were gross leaching tests using a modified toxic characteristic leaching procedure (TCLP). Triplicate tests were made for each material, using the most aggressive water conditions to which they may likely be exposed. Water samples were analyzed for an extensive list of chemicals, including common constituents (pH, conductivity, TDS, total solids), nutrients (nitrates and phosphates), COD, heavy metals (including copper, zinc, lead, cadmium, chromium, and aluminum), organic compounds (especially the base-neutrals including: PAHs, phthalate esters, and phenols) and toxicity (using the Azur Microtox screening procedure). Results from these tests were used to determine the relative potential of each tested material for contributing runoff pollutants, and to provide a comprehensive list of the potential pollutants associated with the various materials tested. This information was used to direct the selection of materials and laboratory analyses for the second set of tests.

The second set of tests determine pollutant releases from a sub-set of construction materials under field conditions. These tests quantify the likely pollutant concentrations expected when the selected materials are exposed to actual weathering and rainfall conditions. Rainfall runoff from the materials is being collected and analyzed as the material ages. The chemical analyses conducted on runoff from each material are based on pollutants identified in the initial tests.

c. Findings and Significance
The results of the modified TCLP test are shown in Figures below. Results of particular interest include evidence of elevated levels of phosphate, nitrate and ammonia in runoff following exposure to common roofing and siding materials, resulting in an unexpectedly high
eutrophication potential. Elevated levels of semi-volatile organics and metals are also of concern due to potential for ecological toxicity. The samples are currently undergoing metals analysis.

The results for the ammonia show that the first test of the galvanized metal contributed 11 – 14 mg/kg. Testing on roofing felt showed that it leached 5 – 15 mg/kg, indicating that the roofing felt would leach ammonia into the rainwater under the right conditions, but that the amounts would be highly variable.

Testing for nitrate showed that nitrate was contributed from a variety of sources, including the roof patching compound “Leak Stopper.”

The phosphate results indicate that the galvanized metal roofing is a potential source of phosphate in runoff. Metal roofing leached between 5 and 75 mg/kg. In addition, several of the roof-patching compounds have the potential to leach phosphate into stormwater runoff. In particular, the Gardner Wet-R-Dri compound has the potential to release a significant amount of phosphorus (up to 300 mg/kg).
Organic results indicate that very few organics were seen in the leachate. The organic compound seen in the greatest concentration was bis(2-ethylhexyl) phthalate, a plasticizer in the roofing felt.

Preliminary results have shown that galvanized aluminum roofing has contributed the greatest concentrations of the pollutants of interest – conductivity, cations, and nutrients. Metals results are not available yet; however, the galvanized roofing is expected to contribute a significant metals load also. Other roofing materials that have been investigated to date appear to be leaching the phthalate esters from the plasticizers. In general, nutrient leaching from construction materials has not been investigated. The preliminary results of this project demonstrate that nutrient leaching may be significant in the right environmental conditions. The galvanized aluminum roofing had comparatively elevated concentrations of phosphate and nitrate in the leachate. Potential testing for environmental compatibility should include a wide range of potential pollutants, rather than simply focusing only on the expected organic and metallic pollutants.