

# FY 2010 RESEARCH PROBLEM STATEMENT

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## TITLE ([more info](#))

Production of metal phosphates to remove dissolved copper from highway runoff

## PROBLEM (Description of need) ([more info](#))

Salmon have been shown to be ultra-sensitive to dissolved copper in streams. It appears from National Marine Fisheries Service (NMFS), Seattle lab research, that any level above pre-urbanization development may cause harmful behavioral and sensory effects in salmon (e.g. oceanic background levels of dissolved copper are in the range of 0.2-2 µg/L).

Regulators (NMFS, ODFW, DEQ) have responded to this research with greatly increased emphasis on the need to infiltrate highway runoff where ever practicable. If 100% infiltration is not possible on a project then the regulators require the use of methods to significantly reduce dissolved metals in highway runoff. A matrix of BMPs was developed which classified their ability to reduce targeted pollutants and the BMPs with the most robust performance were set as the highest priority for implementation where ever practicable.

The immediacy of the threat to salmon behavior, that could affect their ability to successfully migrate past urbanized watersheds and successfully spawn, has caused ODOT to respond with a commitment to use existing BMPs developed by WSDOT, especially ecology embankments (EEs), because of their ability to reduce dissolved copper from highway runoff. EEs typically reduce dissolved copper from 15-20 µg/L (typical highway runoff) to 5-7 µg/L. WSDOT does not appear to have installations that reduced dissolved copper below these levels.

Preliminary research, funded by Jason Tell in Region 1, with fish bone meal reduced dissolved copper in highway runoff to levels of 2 µg/L (at filtration rates of 1 gpm/sq.ft. of fish bone meal media).

## PROPOSED RESEARCH, DEVELOPMENT OR TECHNOLOGY TRANSFER ACTIVITY ([more info](#))

1. Complete literature review of copper and other metal pollution from highway runoff. Also review sources of copper pollution in highway runoff.
2. Review Best Management Practices (BMPs) used to-date for treatment of highway runoff.
3. Bench scale tests to re-test the I-205 runoff results to confirm the preliminary research results regarding extent of metal removal and develop a filtration rate vs. removal extent curve.
4. Set up field studies of media filters with fish bone meal at selected existing water quality swales. Several in R1 were originally constructed as potential research sites. The media filters may be modified ecology embankments where fish bone meal is added to the existing mix components.
5. Develop cost curves for ecology embankment systems with and without fish bone meal media and evaluate the benefits and costs associated with the addition of fish bone meal to ecology embankments (i.e. fish bone meal may be useful as an additional component to the ecology mix which currently is composed of: crushed rock, perlite, dolomite and gypsum).

## BENEFITS [\(more info\)](#)

The chemistry of metal phosphates makes these compounds more stable (less soluble) than metal hydroxides, metal carbonates or organic metal complexes.

Adding fish bone meal to the components of ecology embankments could significantly reduce the construction cost of this type of BMP. The benefit to ODOT from a workable (i.e. economical and maintainable) dissolved copper reduction system that uses metal phosphate formation as an additional mechanism may allow treatment facilities for highway runoff to operate at significantly better removal rates and at a significantly lower cost than the current configuration of ecology embankments appears to offer.

As an illustration of the scale of the issue and the potential benefit, the planning-level costs of highway preservation projects recently developed in the 2010-2013 scoping effort were reviewed. There are many circumstances that can increase a projects cost, but it appears that typical preservation project costs might be in the range of \$300,000 to \$1,000,000 per lane mile. The cost of water quality treatment prior to the requirement for dissolved copper treatment appears to have cost, typically, 15% to 25% of roadway work. With the change to infiltration and ecology embankment BMPs the cost appear to have increased to approximately 30% to 50% of the roadway work (based on WSDOT values and recent ODOT designs).

By adding fish bone meal to the ecology mix, reductions in the amount of media and the footprint of the embankment may allow costs to reduce to approximately 20% or 25% of the roadway. (Note: These projections are based on widely ranging project cost estimates and bids, they are rough estimates. On any particular project the values may vary widely, however there appears to be the potential for significant cost savings with better dissolved copper removal rates based on preliminary review of typical costs).

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