RESEARCH IN PROCESS

# Development of a model to predict the impact of sediments on microbial irrigation water quality


## SUMMARY:

The concentrations of *Escherichia coli*, *Salmonella*, *Listeria monocytogenes*, and viruses are higher in sediments than in the overlaying water in irrigation canals and river systems. Resuspension of these microorganisms from the sediments can result in the rapid increase in their concentration in the overlaying water. The overall goal of this project is to determine how the type of sediment, the pathogen species, and water flow properties impact the microbial quality of irrigation waters. This will be done in a series of experiments by identifying flow/velocity on the resuspension of sediment-bound bacteria and viruses in the overlaying water. The data will then be used to develop a predictive model on the degree of resuspension based on environmental factors. The project objectives will be accomplished through a series of laboratory experiments using a hydrologic flume and field studies.


## OBJECTIVES:

1. Identify factors which would result in the resuspension of sediment-bound bacteria/viruses in irrigation channels, specifically *E. coli*, *L. monocytogenes,* and MS-2 and phiX-174 viruses.
2. Quantify the impact of resuspension of different levels of these bacteria and viruses on the quality of the overlaying water.
3. Suggest guidelines for growers and producers to minimize the occurrence of pathogenic bacteria and viruses in irrigation water.

## METHODS:

The project objectives will be achieved through a series of laboratory experiments in a hydraulic flume (**Figure 1**) and through a field study. Sediments of different composition (sand, silt, clay) will be used in flume experiments in which the flow rate and velocity can be controlled. The degree of study organisms attached to the sediment will then be determined and the impact of changing environmental conditions on their resuspension determined. (See **Figure 2** for conceptual model of microorganism in sediment transport). A predictive model will be developed using the laboratory data. These relationships will be verified using field measurements at various locations in irrigation canals in Arizona (see **Figure 3** for typical irrigation canal). The field measurements will include flow velocity, flow depth, water temperature, suspended sediment concentration, bacterial counts in the water, bed sediment size gradation, bacterial counts in the bed sediment, and bed load transport rate.

## RESULTS TO DATE:

Experiments are currently being conducted with a hydraulic flume comparing the impact of flow rate, velocity, and sediment type on the resuspension of MS-2 and phiX-174 viruses. These experiments will be completed by the middle of June and incorporated into a predictive model.

**Figure 1.** Hydraulic flume

## BENEFITS TO THE INDUSTRY:

This study will aid in the management of irrigation waters used for food crops by providing guidelines to quantify bacterial/virus counts in irrigation waters based on flow rates and microbial concentrations in the sediments, recommending maximum irrigation flow rates to minimize bacteria/virus resuspension, and providing data to risk models that can guide farmers to identify bacterial/virus contamination on produce. The model will aid in the assessment of the impact of extreme events (e.g., above normal rainfall) on the microbial quality of the irrigation water, help in the design of sampling programs to maximize contaminant detection, and facilitate integration with microbial risk assessment models.

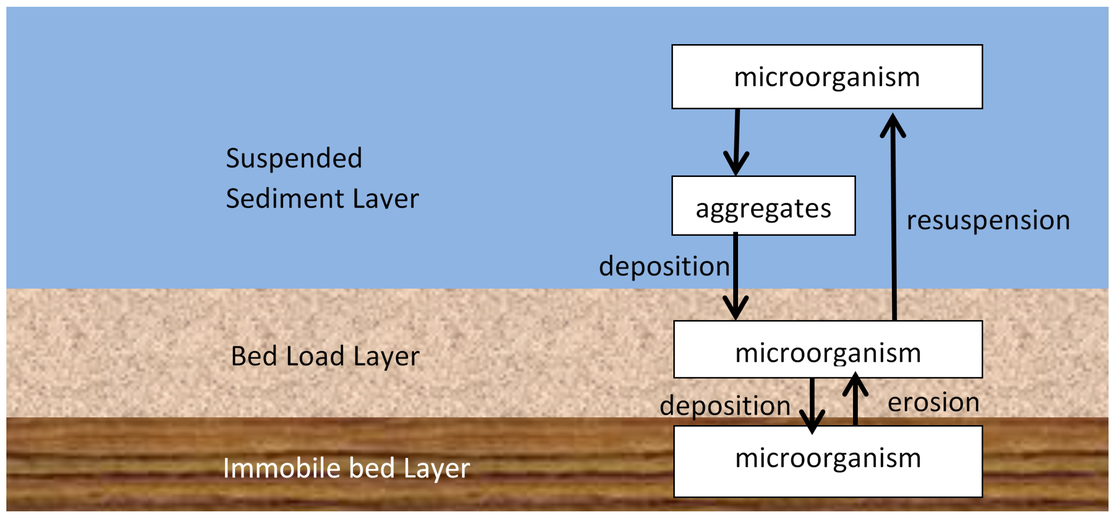
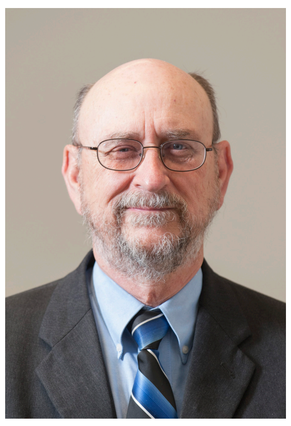



**Figure 2.** Conceptual model of microorganism in sediment transport

**Figure 3.** Irrigation canal in Arizona

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