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A GIS to Estimate Requisite Vegetated Ditch BMPs for Pesticides on a Watershed Scale

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Vegetated agricultural drainage ditches are an increasingly important management tool for the remediation of non-point source pesticide pollution in agriculturally dominated watersheds. Results from lab experiments and field studies have enabled the modeling of ditches to determine design parameters to maximize pesticide removal. To utilize ditches as best management practices on a watershed scale, new tools are required to estimate the requisite number and size of vegetated ditches to meet water quality goals.

A geodatabase of Orestimba Creek in the San Joaquin basin, California was created using the California Department of Pesticide Regulation Pesticide Use Reporting database and Surface Water Database of monitoring data combined with other publicly available elevation, hydrography, streamflow, land use, and meteorology data. The watershed was defined and a surface water network built as a GIS watershed model at a scale relevant to pesticide applications and transport. Chlorpyrifos applications to individual fields were identified then connected to associated ditches in the hydro-network. This model was used to understand the spatial and temporal patterns of chlorpyrifos transport in sub-catchments and estimate the chlorpyrifos mitigation required to meet water quality criteria.

Information from previous studies on the adsorption of chlorpyrifos to plants and soils were used in vegetated ditch models to address the impact of plant species selection and growth density on removal and to determine the mass removal of chlorpyrifos per unit length of ditch under several planting scenarios. Models were tuned with data from field studies on ditch performance. These models were integrated into the watershed model and used to estimate the land area required for conversion to vegetated natural treatment systems at less than 2 percent of the watershed area.

Site suitability analysis techniques were used to rank sites according to their chlorpyrifos application rate, vegetative cover, soil type, and distance from receiving waters, identify the most promising locations for further investigation. Suitable land area was compared with required area calculated with the watershed model to determine if sufficient suitable sites were available in the watershed for vegetated ditch construction.