Do Constructed Flow-Through Wetlands Improve Water Quality in the San Joaquin River?

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In the California's Central Valley, constructed wetlands can improve the water quality of irrigation return flows by intercepting particulate organic carbon, nitrogen, phosphorous, and sediment before it reaches the San Joaquin River. The longer a constructed wetland has been established, the more efficient it becomes at these removals.

Two constructed wetlands (CW) in California's Central Valley were monitored to evaluate their impact on irrigation water quality prior to its return to the San Joaquin River during the 2004 irrigation season (April-September). The initial stage of this project encompassed baseline sampling of seasonally submerged soils and identification of appropriate strategies for water quality and flow monitoring in a new CW (W-1) and 10-year-old CW (W-2).

Our results demonstrate that CWs are effective traps for sediment, particulate organic carbon, nitrogen and phosphorus removed from irrigated farmland. Soil samples were analyzed for C, N, P and their particle size distribution was determined. Intricate input/output flow monitoring systems were designed and tested, in order to calculate constituent loads in subsequent years. Input/output waters from CWs were collected on a weekly basis and analyzed for the following constituents: total nitrogen (TN), total phosphorus (TP), dissolved organic carbon (DOC), particulate organic carbon (POC), total suspended solids (TSS), volatile suspended solids (VSS), and chlorophyll-a (a measure of algal biomass). Carbon, nutrient and sediment retention efficiency was evaluated from input/output concentration data.

First year results indicate that the older W-2 was more efficient at removing POC and contaminants. Average POC retention was 75% in W-2 and 66% in W-1. Chlorophyll-a tended to be higher at W-1 compared to W-2, especially in the inputs. Initially, output concentration of chlorophyll-an increased 15 fold in W-2, however over time, as emergent vegetation became established, chlorophyll-a decreased to 35% of input levels. While W-1 was generally a sink for DOC, W-2 was often a source of DOC possibly due to leaching of DOC from vegetation and litter.

Average TN removal efficiency was 44% for W-2 compared to 15.5% in W-1. After an initial release of P due to establishment of reducing conditions in the wetland sediments, average P removal efficiency was 71% at W-2 compared to 19% at W-1. CWs were most effective at removing TSS with average removal efficiency of 84 and 97% for W-1 and W-2, respectively.

Jon Maynard collects samples from constructed wetlands that intercept irrigation run-off prior to its return to the San Joaquin River. Water and soil samples are analyzed to determine how efficient these ecosystems are at improving water quality.

Collaborative Efforts

Mike McElhiney, USDA-NRCS District Conservationist for Stanislaus County; Erwin Van Nieuwenhuyse, U.S. Bureau of Reclamation

Professional Presentations

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