GDR-NETFLOW Model

GDR-NETFLOW is a network flow model by which an optimum (maximized net income) combination of components for the Grasslands Drainage Reuse Project can be determined. As modeled, drainage is able to be used progressively by salt tolerant grasses and halophytes; evaporated in solar evaporators and other evaporation systems; treated for marketing, reuse, or discharge; and/or discharged directly to the River. The model considers the value of crop production and the sale or reuse of treated water and the costs of drainage treatment (biological and reverse osmosis), disposal of selenium (from biological treatment facility) and salt (from solar evaporators or any other evaporation system), and constraints on the discharge of drainage water to the River. Figure 1 shows the physical features represented. Figure 2 shows the network flow schematic.

A set of equations to calculate a water mass balance and the fate of salt and selenium quantities pertinent to the calculation of salt tolerant grasses, halophytes, and solar evaporator acreages and the use of biological and RO treatment, River discharge, and other evaporation methods has been developed. A network flow model framework is solved by linear programming techniques to determine the economically optimal acreages and the installed capacities of treatment and evaporative facilities subject to WDR load limits (water quality constraints), soil and agronomic requirements (leaching requirement), district and on-farm reuse and percolation and runoff coefficients, and technical (plant efficiency) and economic factors.

The model tells us, given a specified number of acres of irrigated land—some with tile drains generating drainage water—how many additional acres should have drains installed; how many acres are needed for salt tolerant grasses, halophytes, and solar evaporators; how much drainage water should be discharged to the River vs. how much should be treated by RO, biological treatment and/or evaporated by other means; and what is the cost of selenium and salt disposal, etc. Preliminary results show that the results are sensitive to the cost of salt disposal, with biological treatment being a good alternative to dedicating land to solar evaporators (or using other evaporative methods) given currently estimated salt disposal costs. With the currently available data and existing assumptions, of the 94,700 total available acres, about 3,110 acres for salt-tolerant grasses, about 660 acres for halophytes, and the capacity to biologically treat about 2,120 AF of halophyte drainage is needed. Because of year type discharge limits, about 1,790 AF of drainage will need to be biologically treated during wet years and about 2,120 AF during dry years. This result was generated using $42 per ton as the cost.  

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1 Adapted from *Planning and Design for Grasslands Drainage Reuse*, a paper prepared for the UC Salinity Program Conference by Ray Hoagland and Manucher Alemi, Department of Water Resources, March 27, 2002.
of salt disposal and $76 per AF for capacity and $127 per AF for operations and maintenance as the cost of biological treatment of halophyte drainage.

The model is currently set up to handle multiple water year types on a probability-of-occurrence basis. Further development would include obtaining the additional data necessary to specify a seasonal model.
Figure 2 – GDR-NETFLOW Network Flow Model Schematic