US Army Corps of Engineers®

Urban Flood Demonstration Program

Evaluation of Floodplain Function for Flood Control and Stream Restoration

Figure 1. The Truckee River at Painted Rock

Products

This research effort will produce a technical report summarizing research problems, approaches and results of floodplain functions and recommendations for floodplain management and stream restoration projects, and manuscripts for peer reviewed journals.

Benefits

The objectives of the study are to 1) understand the floodplain function for flood wave conveyance and attenuation; 2) examine sedimentation process on floodplain during flood events and 3) evaluate the linkage between stream flow-groundwater during and after flood events. These objectives can be realized by using integrated modeling tools addressing stream flow, sediment, and groundwater at the same time. The ADaptive Hydrology/Hydraulics (ADH) model is such a tool. In the meantime, the comprehensive application can make contribution for further advancement of the ADH model.

Issue

Floodplains are the flat land adjacent to rivers created by deposition of sediment as the channel migrates laterally (Marriot 1998) and are inundated during floods (Nanson and Croke 1992). Fine river sediments deposited on floodplains provide rich farmland and flat land for building next to a transport axis. Lateral connectivity between rivers and their floodplains during inundation is a key driving force for the river ecosystem (Junk et al. 1989). Rivers provide the floodplain with nutrients and sediment, whilst the floodplain provides a breeding ground for river species and improves water quality through settlement of sediment, and absorption and re-cycling of nutrients and pollutants (Brookes and Shields 1996). The functions of floodplain in arid regions are not fully assessed and

the benefits are under-evaluated considering the sparsely vegetated landscape. The knowledge of floodplain function, design guidance of floodplain lowering for restoration, and the role of overbank swales as sediment sinks and design methods for arid regions should be thoroughly investigated.

Description

To address the research needs for the floodplain functions, we propose the following research tasks mainly using the modeling approaches to examine the role of floodplain of the selected study reach of the Truckee River or other suitable sites based on data availability.

Task 1. The topographic and bathymetric data for streambed and floodplain will be collected from local USACE offices, local flood control districts, or other relevant agencies. Vegetation information will be collected from USGS land cover data. These data will be used for model development and floodplain characterization analysis including swale locations and volumes. Fieldwork will be conducted to collect sediment samples at representative locations for sediment characteristics.

Task 2. The two-dimensional hydrodynamic and sediment transport modules of ADH model developed by the Coastal and Hydraulics Laboratory (CHL), ERDC, USACE will be used for this evaluation. ADH is an unstructured grid model which can well represent the irregular stream boundary and describe channel-floodplain consortium with flexible grid resolution. The model will be set for the study reach with and (hypothetically) without floodplain, with and without vegetation, to examine the impact of the floodplain on floods. Floods of different frequencies will be simulated using these settings and the hydrograph at the outlet will be compared to examine the flood attenuation capability of the floodplain.

Task 3. The sediment transport during flood events will also be simulated with the ADH model. The simulation will investigate whether sediment deposition or scour on the floodplain will occur during flood events, and the corresponding flow and bed material conditions for different scenarios. The sediment deposition in overbank swales for different flood magnitudes will be calculated using the modeling results of floodplain topography to understand the natural evolution process of the floodplain.

Task 4. Hydrologic functions of overbank swales in flood storage and attenuation and groundwater-streamflow linkage will be examined using the ADH model and the Gridded Surface Subsurface Hydrologic Analysis (GSSHA) model. The ADH model will be used to compare the flood transport process with and without swales so that the impact of swale on flood wave transport can be identified. The hydrological impact of swale water on the streamflow-groundwater interaction after flood events will be analyzed using the GSSHA model to understand the role of swales in linking the streamflow to riparian areas. This analysis will provide clues to better understand the swale function of supporting the floodplain ecosystem.

Task 5. The final task will be to develop a technical report summarizing the research problems, approaches and results of floodplain functions and recommendations for floodplain management.

The proposed study location for this effort is the Truckee River, Reno or an alternate site based on further discussion with the USACE and USACE ADH development group

Sponsor

Urban Flood Damage Reduction and Channel Restoration Development and Demonstration Program for Arid and Semi-Arid Regions (UFDP)

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