5.0 NUMERICAL MODELING OF GENERAL AND WARD CREEKS AND THE UPPER TRUCKEE RIVER

5.1 Introduction

Numerical simulations of upland and channel processes using AnnAGNPS and CONCEPTS, respectively were carried out on three representative watersheds to:

(1) Determine the relative contributions of sediment from upland and channel sources;
(2) Simulate the effects of the January 1997 runoff event on future sediment loads;
(3) Evaluate 50-year trends in suspended-sediment delivery to Lake Tahoe from the three watersheds.

5.2 Input Database for the AGNPS Model

The development of input parameters used for AnnAGNPS to describe the Lake Tahoe watersheds conditions involved assembling many sources of available information, such as elevation maps, soil data, landuse and operation management data, and especially weather information. All of the required model parameters can be selected from the available data, which is available publicly or obtained from the measured data collection phase needed for CONCEPTS. The compilation of the data into the form needed by AnnAGNPS was performed using the AGNPS Arcview Interface and the AnnAGNPS Input Editor.

5.2.1 GIS Database

The use of a geographic information system (GIS) is critical in gathering the needed data to perform simulations for watersheds of the size contained in the Lake Tahoe basin. The GIS data provides the vital link between the characteristics of the watershed and the parameters needed by the model. Fortunately, for the Lake Tahoe basin there is a data warehouse that serves as a central location for much of the GIS data available for any watershed in the basin. The Lake Tahoe Data Clearinghouse Internet web site is produced by the United States Geological Survey (USGS) and is located at http://tahoe.usgs.gov/.

For the application of the entire suite of AGNPS, the basic GIS data needed are: the digital elevation models (DEMs) to describe the topography; the landuse GIS layer to describe the vegetative cover; and, a soils GIS layer, which all together can provide the spatial variation of the important characteristics of the watershed. Additional GIS data is useful in assessing the creation of model parameters and the impact various features may have on the watershed system. This can include digitized quad sheets, aerial photographs, location of streams, roads, erosion control structures on fields and in the channels, lakes, and other features impacting the watershed. For information that is not available from digital sources, information may be digitized from other maps, or transferred from field work using global positioning system (GPS) techniques.

The projection used for the AGNPS data development by all of the GIS data layers was the UTM NAD27 zone 10 projection. This provided consistency among all of the layers when

data was analyzed or paper maps were produced. Other GIS layers can easily be reprojected from another projection to the UTM projection.

Topographic Analysis

Every watershed has unique topography that is difficult to characterize without having maps that describe the elevation throughout the watershed. Topographic information is crucial in determining the watershed and subwatershed boundaries, channel locations, channel slopes, routing of flow from fields to channels to the watershed outlet, field slopes, travel time of flows, the RUSLE LS-factor, aspect and elevation of fields. The use of DEMs provides a convenient source of topographic information, but often is derived from basic topographic contours, such as USGS 7.5 minute quad maps. Thus, the resolution can range from 120m x 120m raster grids with 5m elevations, to 30m x 30m with 1m elevations, to 10m x 10m with 0.1m elevations, depending on the source of the DEMs. The 10m x 10m raster grid can provide a better definition of the watershed topography, but generates a much larger file size needed to store the data. Other considerations in using the 10m x 10m raster grid are that this will require more computer resources to execute the AGNPS topographic tools, such as more memory, more hard disk space, and additional computational time. Also, the 10m x 10m DEM raster grid is available from MARIS with the elevation provided in feet and requires the conversion to meters before using TOPAGNPS, while the 30m x 30m DEM already has the elevation in meters. The current modeling effort used 10m x 10m raster grid.

Digital Elevation Model (DEM)

The USGS Western Geographic Science Center created DEMs with 10m x 10m resolution from 18 7.5-minute quadrangle hypsographic maps that have 40 ft contours covering the entire Lake Tahoe Basin (Figure 5-1). From this DEM, each of the DEMs covering the watersheds of General Creek, Ward Creek, and Upper Truckee River were clipped and used individually for to develop AnnAGNPS data sets to minimize the computational time needed for the topographic analysis of each watershed. The Upper Truckee River watershed DEM was clipped closely to the expected boundary to minimize the amount of the Trout Creek watershed that would be captured during the topographic analysis procedure. The confluence of Trout Creek and the Upper Truckee River occurs near Lake Tahoe and only the Upper Truckee River watershed was simulated.

Modification of Digital Elevation Models (DEMs)

The modification of DEMs may be required when local features within a watershed are not captured during the development of the DEM. This could be because of recent human activities that change the elevation within areas of the watershed. This includes land-leveling of fields, channel straightening, road construction, or development of ditches to route water around fields or residential areas. The watershed characteristics generated by AGNPS components then may not correspond to actual stream locations or watershed boundaries. To account for these topographic variances, the DEM is modified to adopt the required features. More likely areas that may require modification of a DEM are measures that have produced straightened or altrered channels.

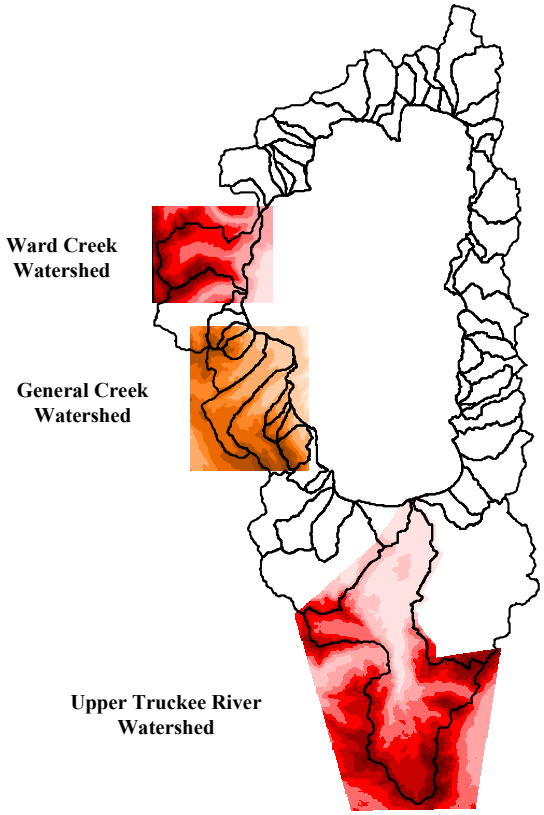

Figure 5-1. The Lake Tahoe watersheds with the digital elevation model (DEM) obtained from USGS at the 10 m by 10 m resolution for the Ward Creek, General Creek, and Upper Truckee River watersheds.

Digitized Soil Maps

The soils GIS layer obtained from the United States Department of Agriculture (USDA) - Natural Resources Conservation Service (NRCS) is the Soil Survey Geographic (SSURGO) data base layer based on the NRCS County Soil surveys that is available for the entire Lake Tahoe Basin. From the SSURGO GIS layer, every digitized soil is assigned a mapping-unit symbol, which corresponds to a database of soil characteristics needed for use with AnnAGNPS. This is also obtained from the NRCS. Soils in the Lake Tahoe Basin are too numerous to list or easily show in a figure, but an example of the spatial variability of the digitized soils contained within General Creek watershed is shown in Figure 5-2.

Digitized Landuse Maps

An accurate description of the landuse is critical in defining the impact land-management practices may have on soil erosion. The determination of the historical landuse for large watersheds such as the Lake Tahoe Basin can be difficult without the use of satellite imagery. Although, local information based on documented aerial photography can be used, this often requires considerable time in analyzing and digitizing the data. Various sources were used to