NORTHWEST FLORIDA WATER MANAGEMENT DISTRICT

Closed Basin Modeling

Closed Basin Modeling involves the identification of flood hazards in areas that do not have an outlet. Depressed areas and sinks act like a bowl collecting water during rainfall events and rely primarily on infiltration to drain the water since there is not a surface outlet.

Why Use Closed Basin Modeling

Closed basins do not exhibit conveyance systems and so traditional steady state or conveyance models cannot be used to identify floodplains. Because of this, a volumetric rather than a conveyance approach must be taken for this type of analysis.

Methods Used for Closed Basin Modeling

A key step to closed basin modeling is the identification of contributing drainage area and the approximation of rainfall runoff volumes. Drainage areas are most easily determined using Digital Elevation Models (DEMs) although often, DEMs of sufficient detail are not available. When a suitable DEM is available, contributing drainage areas can be delineated automatically using Spatial Analysis techniques in Geographic Information Systems (GIS). If a suitable DEM is not available, then the best available data must be used which is normally a USGS Quad. Rainfall runoff volumes can be approximated using the NRCS Curve Number techniques.

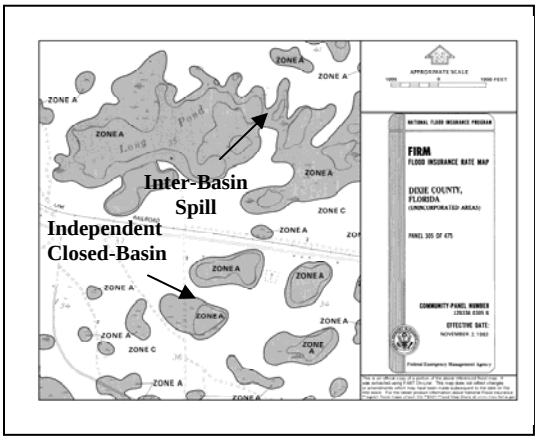
Hydrodynamic computer models like Advanced Interconnected Pond Routing (AdICPR) and XP-SWMM are commonly used for closed basin modeling although the simple nature of closed basins does not always require a complicated hydrodynamic computer model to identify flood elevations. When these types of models are used, a stage storage relationship is required by calculating the area of the closed basins at various elevations to enable the computer to identify how high the volume of runoff will rise as it settles to the bottom of the closed basin. When this table has been developed, the corresponding flood elevation can be determined by identifying at which elevation, the storage volume of the closed basins matches the volume of rainfall runoff.

When using a DEM within GIS or Computer Aided Design (CAD) systems, the same techniques that are applied to cut and fill calculations can be used to identify the stage storage relationships of a closed basin from which the flood elevation can be determined. When using this technique, the volume of rainfall runoff is used as the fill volume and the cut volume is taken as zero (0).

Because rainfall-runoff volume is critical to determining the flood elevation in closed basins, careful selection of an appropriate storm duration and intensity must be selected. Atlas-14, produced by the National Oceanographic and Atmospheric Association contains cumulative rainfall depths for storm durations up to 24-hour. Technical Paper 49 by the US Weather Bureau contains cumulative rainfall depths for storms durations of 2-day to 10-day. 5-day rainfall totals are commonly used in closed basin models to determine flood hazards on a Flood Insurance Rate Map.

Calculated runoff volumes have infiltration built-in; in other words the volume of water that infiltrates is subtracted, “off the top”, from the rainfall. In highly detailed studies infiltration is sometimes simulated explicitly as a method for drawing down the flood elevation. The longer the rainfall event considered the more sensitive the flood elevation will be to infiltration rates. This is because longer durations storms generally have a lower intensity than shorter storms and infiltration rates are normally much slower than rainfall.

During extreme flood events, it is common for closed basins to fill to a point where they no longer function as closed basins because inter-basin spilling occurs. When this occurs, overland spills must be used to route flood waters over watershed ridgelines into adjacent basins. The spill elevation of every closed basin must be identified and careful checks must be made to ensure that if the basin does spill, there are one or many overland spills to route the water to the adjacent basin. Overland flows must be carefully located along the low points of ridgelines that divide closed basins.



When USGS quads are the best available topographic information source, it can often be very difficult to identify closed basins. Wetland maps may be of help to identify closed basins since most closed basins are likely to have some area of wetlands at the low point of the basin. Ground survey can be very useful when performing closed basin modeling although budget constraints often restrict the development of detailed topography or transect lines. In these situations, the floodplains identified may only be suitable for use as an approximate flood plain identified as Zone-A on the FIRM.