APPENDIX A
WinTR-55 and TR-20

National Engineering Handbook, Part 630, Hydrology (NEH630)

The Soil Conservation Service (SCS, now NRCS) first developed the National Engineering Handbook, Section 4, Hydrology (NEH-4) as a means of documenting the procedures which were being developed for evaluating the hydrology of watersheds in watershed planning projects. Prior to this time (the early 1950s), there was no comprehensive guidance available for such projects. Later, the SCS became the Natural Resources Conservation Service (NRCS) and the NEH-4 was renamed to be the National Engineering Handbook, Part 630, Hydrology (NEH630).

NEH630 documents the technical aspects of the hydrologic methodologies used to develop runoff hydrographs, to a limited extent, to route such hydrographs. The NRCS NEH Part 630 can be downloaded by chapter from the NRCS eDirectives web-site at: **http://directives.sc.egov.usda.gov/viewDirective.aspx?hid=21422**

TECHNICAL RELEASE NO. 20: PROJECT FORMULATION – HYDROLOGY (TR-20)

Technical Release No. 20, Project Formulation – Hydrology (TR-20) was developed in the 1960s to automate the hydrologic evaluation of large multi-sub-area watersheds using procedures found in the National Engineering Handbook, Section 4, Hydrology (NEH-4) TR-20 was originally issued as a mainframe computer program designed to run on a Harris mainframe system. In the 1980s, TR-20 was updated to run in a disk-operating system (DOS) environment on a personal computer (PC). Eventually, TR-20 was updated to run in a Windows environment on the PC. In this iteration, the computation engine, TR-20, sits behind the graphical user interface, WinTR-20 which allows users to enter, edit, and display input date; run the TR-20 model; and display output.

TR-20 develops full hydrographs at user specified locations throughout a watershed and allows the user to route the hydrographs through stream channels and structures based on user input rating curves. The TR-20 model has been updated over time to take advantage of advances and updates in hydrologic science. One example of this is the procedure used to route hydrographs through stream channels. The original TR-20 utilized the convex routing procedure. Later that was replaced by the Att-Kin method. The current TR-20/WinTR-20 uses the Muskingum-Cunge method.

The current WinTR-20 computer program and documentation can be downloaded from the following web-site: **http://www.nrcs.usda.gov/wps/portal/nrcs/!ut/p/c4/04_SB8K8xLLM9MSSzPy8xBz9CP0os_hAE3NjV08fEwOLs-CAXA09PMx_HIBcLY3cDA_2CbEdFAJZtSik!/?ss=16&navtype=TOPNAVIGATION&cid=stelprdb1042198&navid=860000000000000&pnavid=null&position=Not%2520Yet%2520Determined.Html&ttype=detail&pname=USDA%2520NRCS%2520-%2520Natural%2520Resources%2520Conservation%2520Service%2520-%2520National%2520Design,%2520Construction,%2520and%2520Soil%2520Mechanics%2520Center**

TECHNICAL RELEASE NO. 55 IN,URBAN HYDROLOGY FOR SMALL WATERSHEDS (TR-55)

Technical Release No. 55, Urban Hydrology for Small Watersheds (TR-55) was originally developed in 1975 in response to an increased focus on the analysis of small urbanizing watersheds. The procedures found in the SCS-TP 149, A *Method for Estimating Volume and Rate of Runoff in Small Watersheds* (which later morphed into the Engineering Field Manual Chapter 2, Estimating Runoff Volume and Peak Discharge), and the methodologies found in the NEH-4 were focused on agricultural watersheds.

The curve number tables found in NEH-4 and TP-149 did not cover urban or urbanizing areas. TR-55 expanded the curve number tables to include urban and urbanizing areas.

TR-55 was developed as a manual method

by utilizing multiple runs of TR-20 to develop generalized tables and graphs from the output to cover a range of watershed conditions, primarily restricted by time of concentration. Contrary to popular belief, TR-55 was not limited to watersheds of a specific size, but instead was limited to watersheds with times of concentration ranging from 0.1 to 5 hours

Additionally, the 1975 version of TR-55 covered only areas for which the Type II rainfall distribution was appropriate. The 1986 version of the TR-55 added generalized curves and tables for Types I, IA, and III rainfall distributions and expanded the range of applicability for time of concentration up to 10 hours. A DOS based TR55 computer program was also developed in the 1980s. This computer program was a sort of spread-sheet based program that mirrored the published document.

TR-55 gives the user an estimate of runoff volume and a peak discharge estimate, or in the case of the tabular method, a partial hydrograph bracketing the peak discharge.

NRCS no longer supports (updates) TR-55 and no longer encourages its use. We do understand that TR-55 has gained widespread acceptance and use, so, while it is not available as an official NRCS directive, we do still make it available for download. Information on downloading the 1986 TR-55 and accompanying computer program can be found at the following web-site **http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/technical/alphabetical/water/hydrology/?&cid=stelprdb1042922** which provides links for this and other computer programs no longer supported by NRCS.

The updated WinTR-55 computer program, Small Watershed Hydrology, was developed as a windows update/replacement to the DOS based TR55 computer program. While TR55 was based on generalized tables and graphs to provide an estimate of peak discharge and allowed the user to develop a partial hydrograph, the WinTR-55 computer program uses the latest TR-20 computational engine (behind the WinTR-55 graphical user interface) to compute full hydrographs.

The limitations, now including a drainage area size limitation, placed on WinTR-55 were done so in order to limit its use to watershed similar to those that could be modeled with the DOS based TR55.

A more complete discussion of the differences between TR55 and WinTR-55 can be found in a technical paper The New USDA-NRCS WinTR-55 Small Watershed Hydrology Model by Claudia Scheer and Karl Visser, and presented at the 2002 Federal Interagency Hydrologic Modeling Conference, Las Vegas, NV can be found in the conference proceedings (pp. 404-410) through the following web-site: **http://acwi.gov/hydrology/mtsconfwkshops/conf_proceedings/index.html/** (Please note that the web-links referenced in the paper (including the e-mail addresses) are no longer valid).

The WinTR-55 computer program can be downloaded at:
http://www.nrcs.usda.gov/wps/portal/nrcs/!ut/p/c4/04_SB8K8xLLM9MSSzPy8xBz9CP0os_hAE3NjV08fEwOLsCAXA09PMx_HlBcLY3cDA_2CbEdFAJZtSik!/?ss=16&navtype=TOPNAVIGATION&cid=stelprdb1042198&navid=860000000000000&pnavid=null&position=Not%2520Yet%2520Determined.Html&ttype=detail&pname=USDA%2520NRCS%2520-%2520Natural%2520Resources%2520Conservation%2520Service%2520-%2520National%2520Design,%2520Construction,%2520and%2520Soil%2520Mechanics%2520Center

Additional information on all NRCS hydrologic tools and methodologies can be found at: **http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/alphabetical/water/hydrology.** The “Tools and Models” and “Technical Information” links specifically link to a great deal of additional information.

WIN TR-20

BACKGROUND

Using a 24- hr design storm distribution is standard practice in Win TR-20. In order to best reflect the updated NOAA Atlas 14 precipication data, a site specific distribution iis developed based on the text file download from the NOAA Atlas 14 website. The 24- hr design storm distribution is developed based on maximixing

the rainfall during and duration from 5-minutes to 24-hours. The duration from 5 minutes to 24 hours are centered on 12 hours and extended symmetrically for the periods before and after 12 hours. Investigations were conducted which showed that regional storm distribution similar to the prior standard NRCS storm distributions (Type 1, Type IA, Type II and Type III) are not feasible in states covered by NOAA Atlas 14.

TO DATA SMOOTHING TECHNIQUE

Several mathematical techniques were investigated to determine a computationally efficient, accurate, practical, stable and robust procedure. Since the generated hydrograph is primarily dependent on the relationship of precipitation intensity with duration, this relationship is what is smoothed. This relationship of intensity (inches/hour) and duration is based on a factor defined as incremental intensity. Incremental intensity is defined as the difference in precipitation divided by the difference in duration. The incremental intensity for the 5-minute duration is equal to the 5-minute precipitation divided by ½ and has the units of inches per hour (or mm/hour in metric units). The incremental intensity for the 10 minute duration is the 10-minute precipitation minus the 5 and 10 minutes in units of hours. Each incremental intensity is calculated based on the difference in precipitation divided by the difference in duration. Incremental intensity is calculated and smoothed for each return period independently.

The final smoothing procedure keeps the 5-minute, 60-minute and 24-hour precipitation unchanged from the original NOAA Atlas 14 values. 10,15,30 and 120-minute and 3,6,12-hour values are open to adjustment. The incremental intensity for the 5-minute duration is unchanged. A straight line on the log-log plot extends from 5-minute to 60–minute duration. A second straight line segment on the log-log plot extends from the 60-minute value to 24-hour value.

CONCLUSION and SUMMARY – the user has the option to develop storm distributions based on the original NOAA Atlas 14 data or smoothed data. Comparing hydrographs generated by original and smoothed data indicated that with the smoothed data, peak discharges may vary by as much as plus or minus 10%.

OVERVIEW

The Win TR-20 System Controller/Editor allows running on any of the system components (TR-20 model, input convertor, import NOAA Atlas data, and HEC-RAS reformatter) as well as editing a WinTR-20 input file. The Controller/Editor is organized following the input sections described in the user documentation. For editing, each WinTR-20 input section has its own entry window which is accessible by clicking the input section name on the main window. In addition to the input section entry windows, there are entry windows for locally added land used identifiers (w/ runoff curve numbers by hydrologic soil group) and locally added soils (w/ applicable hydrologic soil groups). Entry windows for these two local additions are accessible from the File pull down on main window.

HELP FACILITIES

Help windows of a general nature on the program system are available via the new user button (available at program start up) or from the Help pull down on the main window. All of the Help windows are available from the pull down while only selected ones are available via the “New User ? Click Here” button.

The data entry window that allow for entry and/or editing of input data contain additional Help in the form of information about the current window and the information about each variable to be entered. This Help is available by clicking the window or variable name on the entry window. A Help box opens in the lower left corner of the entry window and displays the window or variable name, its description and range of values (if appropriate). Only window and variable names shown in yellow have such help available. A second click on the window or variable names closes the Help box.

GETTING STARTED

TO EDIT WIN TR-20 INPUT FILE

Select one of the first three File pull down choices (New WinTR-20 File, Open Existing WinTR-20 File, and Re-Open Last Session) on

the main window. No matter which of the three are selected, the WinTR-20 Identifier entry window appears. Make sure the proper input unit system (English or metric) is selected. Once the information on the window is completed, accept the data by clicking the “Accept Changes (Close)” button. The WinTR-20 Identifier Window will close leaving the main window. Continue by clicking (selecting) another input section entry window from the list on the main window. To save data entered, use the Save or SaveAs selections on the File pull down. Remember to save early and save often.

TO CONVERT OLD TR-20 INPUT FILE – Select Convert Old Data from the File pull down on the main window. Then select the file name to be converted to start the converter. When the converter run is complete, either the Error File (indicating a problem with converting the data) will displayed or the WinTR-20 Identifier entry window will open for editing the converted data.

TO REFORMAT HEC-RAS from the File pull down on the main window. Then select the HEC-RAS output file name to be reformatted. If a WinTR-20 input file is currently loaded, the choice to either add to the current data or start a new file can also be made. After reformatting is complete, either the Error File will be displayed or the WinTR-20 Identifier entry window will open for editing the file containing the reformatted data.

To IMPORT NOAA ATLAS 14 DATA – Select Import NOAA Data from the File pull down menu on the main window. Then enter NOAA Atlas text file. Do not try to import NOAA Data into WinTR-20 input file if currently loaded, the data will be deleted and substituted with NOAA Atlas data. It is recommended to open a new file to include only NOAA Atlas data.

TO RUN WINTR-20 INPUT FILE USING THE EDIT, CONVERT, and/or REFORMAT techniques described above. Select WinTR-20 from the Run pull down on the main window to run WinTR-20 model. When the run is complete either the Error file or WinTR-20 output file will be displayed. (Note: The Run pull down is ONLY available if the current data has a file name (not”>Untitled<”) and the data has not been modified since it was loaded or saved. If Run is not displayed, then save the current data to make the Run pull down visible.)

EFH2 PEAK DISCHARGE DETERMINATION

A program for determining peak discharge as prescribed by Engineering Field Handbook Chapter 2. Required information includes watershed characteristics (drainage area, curve number, hydraulic length, watershed slope) and rainfall amount and distribution.

This program has restricted applications. May be applied when:

- Watershed is accurately represented by a single runoff curve number between 40 and 98.
- Watershed area is between 1 and 2,000 acres.
- Watershed hydraulic length is between 200 and 26,000 feet.
- Average watershed slope is between 0.5 and 64%.
- No valley or reservoir routing is required.
- Urban land use within the watershed does not exceed 10%.

For complete information please visit: http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/water/manage/?cid=stelprdb1042921