CHAPTER 11
DATA COLLECTION

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Synopsis

Identification of data needs should be a part of the early planning phase of a project, when preparing to develop a site and/or appropriate procedures for performing hydrologic and hydraulic calculations are selected. Several categories of data may be relevant to a particular project, including published data on precipitation, soils, land use, topography, streamflow, and flood history (including floodway data defining buffers zones of non-disturbance). Field investigations are generally necessary to determine drainage areas, identify pertinent features, obtain high water information, and survey channel sections and bridge and culvert crossings.

11.1 General Information

Useful data usually fall into one of the following four categories:

1. Previous hydrologic studies
2. Natural resources data
3. Manmade features
4. Field investigations

Not all the information presented in this chapter may be required to address the needs of each project.

There are many potential sources of the data typically required for development projects. Identifying these sources can be difficult, and making the subsequent necessary contacts can be time-consuming. To assist with identification, typical data sources are presented in this chapter. In general, the watershed master plans developed by MWS, provide the best source of data for the watersheds studied and provide a consistent starting point for watersheds not studied.

The principal use of stormwater data is to establish the hydrologic and hydraulic characteristics of a watershed in order to evaluate stormwater runoff quantity and quality conditions. Both existing and future watershed conditions should be considered. Stormwater data should be collected before calculations are initiated, using the following general guidelines;

1. Identify data needs, sources, and uses.

2. Collect published data, based on sources identified in Step 1 and information presented in Sections 11.2, 11.3, 11.4, and 11.5.

3. Compile and document the results of Step 2, and compare data needs and uses with published data availability. Identify any additional field data needs.

4. Collect field data based on needs identified in Steps 1 and 3, using information presented in Section 11.6.

5. Compile and document the results of Step 4.

11.2 Previous Studies

11.2.1 MWS

MWS can provide master plans for selected watersheds in Nashville and Davidson County. These plans, available from MWS, should be consulted at the beginning of a drainage study or beginning of site planning. MWS has also performed hydrologic studies for specific project areas and should be contacted for availability. These studies are the basis for a stream buffer defining no-disturbance areas as required in Volume 1 Sections 2.2.14 and 5.9.

11.2.2 Metro Planning

Metro Planning maintains a series of 14 Subarea Plans that among other things define the intended long-term use and character for various areas of the Metro area. The plans also present existing land use, steep slope areas, restrictive soils areas, general information about the transportation system, utilities, local area policies, and other planning information. While these studies may not provide much specific information for stormwater management design in a site development it does provide insight in overall site development planning. These plans are available in hard copy from the Planning Commission.

11.2.3 U.S. Geological Survey

The USGS has published several papers, studies via hard copy or electronically via the internet on the hydrologic aspects of Tennessee, among the most pertinent of which are the following:

1. Yearly Water Resources Data for Tennessee.

2. Historical daily stream flows at http://water.usgs.gov/osw/

3. Randolph, W.J. and C.R. Gamble. Technique for Estimating Magnitude and Frequency of Floods in Tennessee. 1976.

4. Wibben, H.C. Effects of Urbanization on Flood Characteristics in Nashville-Davidson County, Tennessee. 1976.

5. Gamble, C.R. Technique for Estimating Depth of Floods in Tennessee. 1983.

6. Robbins, C.H. Basic Data Report on Effects of Urbanization on the Magnitude and Frequency of Floods on Small Streams in Tennessee. 1984a.

7. Robbins, C.H. Synthesized Flood Frequency for Small Urban Streams in Tennessee. 1984b.

8. Robbins, C.H. Techniques for Simulating Flood Hydrographs and Estimating Flood Volumes for Ungaged Basins in Central Tennessee. 1986.

9. Water Resources Investigations in Tennessee: Programs and Activities of the U.S. Geological Survey. 1992-94:OFR-94-498. 1995-96:OFR-97-113. and subsequent reports.

More information on USGS activities can be obtained by contacting the Nashville District Office at the following address:

U.S. Geological Survey
Water Resources Division
A-413
Federal Building, U.S. Courthouse
Nashville, Tennessee 37203
(615) 736-5424

A wide variety of other data on geology, mapping, water resources can be purchased and/or downloaded from the USGS on the world wide web at http://www.usgs.gov/pubprod/.

11.2.4 U.S. Army Corps of Engineers

The Corps of Engineers may be a source for the following information:

1. Event of record high water marks

2. Local flood control studies

3. A report from 1979 entitled Managing Our Urban Water Resources that provides extensive background information for the Metro area on the following topics:

   a. Environmental resources
   b. Population
   c. Economic resources
   d. Flood damage abatement

e. Water supply
f. Wastewater management
g. Navigation
h. Stream bank stabilization
i. Water-related recreation
j. Fish and wildlife

11.2.5 U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS – Formerly SCS)

The USDA NRCS develops and maintains a variety of natural resources data, studies, reports, and technical tools. They are particularly know for good soils data, soil management techniques, and urban hydrology. Information about the NRCS technical resources can be reviewed at http://www.nrcs.usda.gov/techres.html.

11.2.6 Other Studies

The Greater Nashville Area 208 Waste Treatment Plan completed by the Mid-Cumberland Council of Governments and Developments districts in April 1978 provides environmental information on the Metro area in the following categories:

1. Population economic activity and land use

2. Water quality sampling and modeling

3. Development of technical subplans

4. Management planning

5. Environmental assessment

6. Public participation and area-wide planned recommendations

11.3 Metropolitan Planning Commission

The Metropolitan Planning Commission has some information on a variety of natural resource data and manmade feature data that is discussed in the next section. They maintain Geographic Information System (GIS) data layers for Metro Nashville and Davidson county. Data layers including property mapping, topography (5-foot contours), edge of pavement, road centerline, building footprints, approximate stream and other hydrologic feature locations, major TVA utility data, railroads, zoning, and other similar mapping information. This data is available in hard copy or electronically. The Planning Commission can be contacted by an individual or

company to set up an internet user agreement that allows them to download electronic data in DXF format. It can also be purchased directly from the Planning Commission in Arc/Info, DXF or Arc/Info Export formats. Electronic GIS data can currently (April 2000) be purchased electronically for $71.00 per map tile which corresponds to an area of 12,000 by 8,000 feet on the ground. Currently (April 2000) a standard topography plot will generally cost $20.00 and a standard zoning plot will cost $6.00.

For more information on data sales or for obtaining an internet user agreement for professional access contact the Metro Planning Commission Mapping Services at (615) 862-7181.

11.4 Natural Resources Data

The major categories of pertinent natural resources data include precipitation, soils, topography, streamflow and flood history, and groundwater.

11.4.1 Precipitation

Published precipitation data should be collected by the following procedure:

1. Select an appropriate procedure for hydrologic calculations using information presented in Chapter 2.
2. Determine the type of precipitation data that are needed. Generally, either IDF curves or hyetographs for historic or design storm conditions are used (see Chapter 2). However, hourly electronic precipitation data is also available electronically. The National Climatic Data Center (NCDC) for National Oceanic and Atmospheric Administration (NOAA) has fee based historical and near real-time on-line climate data available for Tennessee at http://www.srcc.lsu.edu/srcc.html.

MWS compared rainfall records from the Nashville Metropolitan Airport with published data from the National Weather Service for durations of 1 to 24 hours. The 1-hour rainfall depths determined from a frequency analysis of the airport data agreed well with HYDRO 35 (Frederick et al., 1977), which was consequently adopted for durations of 1 hour or less. It was determined that TP-40 (Hershfield, 1961) underestimates rainfall depths compared to recorded data for durations of 1 to 24 hours, and that the results of the frequency analysis should therefore be used for those durations. For applications requiring larger durations (such as some storage facilities), the National Weather Service publication by Miller (1964) is appropriate for determining rainfall depths. All such duration data are compiled for ready use in Chapter 2 and replace data published in the previous Metro Nashville Drainage Manual.

11.4.2 Soils

Information from the SCS Soil Survey of Nashville and Davidson County completed in 1981 is suitable for use in hydrologic modeling, but additional site-specific data from more detailed or later surveys may be appropriate as a supplement to the published data. The NRCS publication Erosion and Sediment Control Handbook for Urban Areas and Construction Sites in Tennessee (1974) contains valuable information for quantifying erosion and specifying erosion control practices, with graphs and charts tailored for Tennessee. Selected information from the NRCS Soil Survey and Handbook can be found in Chapter 9. However, it should be noted that erosion prevention and sediment control practices presented in Volume 4, Sections 3 (TCP) and 5 (PESC) are to be applied in the Metropolitan Nashville and Davidson County area.

11.4.3 Topography

USGS 7.5-minute topographic quadrant maps of the area were prepared in 1968 and photorevised in 1983 for planimetric features only. The maps, which are at a scale of 1 inch to 2,000 feet with a contour interval of 10 feet, are suitable for general information on larger basins. There are several commercially available products that have the USGS quadrant map data in an electronic format. This and a wide variety of other maps, databases, reports and publications may also be purchased from the USGS and/or downloaded from the world wide web site (http://www.usgs.gov/pubprod/).

MWS has prepared 1-inch to 200-foot scale topographic maps with a contour interval of 5 feet for Davidson County based on aerial photography from 1996. This data can be acquired from the Metro Planning Commission. These maps should be used for drainage boundary delineation and measurement, time of concentration flow path analysis, and flood plain mapping. More current mapping information may also be available at the time of study.

11.4.4 Streamflow

The USGS maintains a computerized data retrieval system that includes all the stream gage data available throughout Davidson County. Numerous gage sites of various types and with specific individual purposes have been identified. Data include coincident rainfall-runoff data, time series of annual peaks, and occasional crest-stage measurements. All available pertinent data should be reviewed before completing hydrologic studies. For a summary of existing data on each watershed the USGS should be consulted.

11.4.5 Groundwater

Data on groundwater levels and movements could be obtained from information on existing detention ponds and other ponds in the area; existing nonpumping wells or wells that could be temporarily shut off to determine the static groundwater level; observations made by inspectors and others during construction of sanitary sewers, storm sewers, and major

buildings; and regional or areawide reports prepared by the USGS or state agencies. If existing data sources are not sufficient to define the position of the groundwater table, it may be necessary to construct special observation wells, particularly at potential sites of detention facilities. These wells could be installed in the boreholes used to take soil samples during a site-specific subsurface exploration.

11.5 Manmade Features

11.5.1 Land Use

If historical information such as flood records or high water marks is being considered in an analysis, older land use maps or aerial photos should be sought that can identify early conditions that may have undergone change. MWS should be contacted about the availability of such data.

Existing land use can first be ascertained from recent land use maps, zoning maps, and aerial photos. Data should be confirmed by checking the Property Map Book at the MWS office, and any recent development indicated therein verified by field reconnaissance. The effective date of the existing land use should be noted for future reference.

Future land use projections can be developed from information on planned development for the Nashville area in the "General Plan for Nashville" or the 14 subarea plans discussed in Section 11.2.2. The latest amendments to the plans should be obtained.

11.5.2 Impoundments

Site-specific watershed master plans, available from MWS as appended material to the manual, provide information on impoundments that impact basin-wide hydrologic analysis, and should be consulted before field reconnaissance is performed to assess the effect of impoundments on a particular site.

11.5.3 Stream Channels

Natural stream channel features, conveyance improvements, and channel conditions are generally described in the appended watershed master plans from MWS. More detailed information may be available from engineering reports for specific projects. For older facilities and areas not covered by watershed master plans, field surveys may be required to obtain appropriate information.

11.6 Field Investigations

A field investigation should be made at each site to verify site-specific conditions and obtain survey data when published data are inadequate.

11.6.1 Site Visits

Site visits allow the engineer to verify information obtained from published sources, identify conditions relevant to the analysis, and obtain first-hand knowledge concerning site-specific constraints. Each aspect of the analysis should be field-verified.

Soil and soil cover are important components requiring field verification. Rock outcrops, vegetative cover, and land use are important to select appropriate runoff coefficients or SCS curve numbers. Total imperviousness and the degree of hydraulic connection to the channel network are both important in developed areas. Unusual circumstances concerning interception of depression storage should be recorded for use in assigning a value of initial abstraction of rainfall.

Drainage boundaries identified on topographic maps should be checked, as streams may often have been re-aligned or mapped incorrectly, storm sewers may cross apparent drainage divides, or drainage divides shown on the maps may be incorrect. Areas draining to detention ponds or storm sewers should be identified when such features may impact peak flow calculations. Where flow routing or time of concentration is involved, flow paths should be observed for channel geometry and hydraulic roughness, or for length of flow for overland and gully flow. Overland and channel slopes can be measured from topographic maps unless substantial regrading has occurred.

Channel geometry and constrictions should be considered in locating cross sections and assigning roughness coefficients for hydraulic modeling to establish flood elevations and flood plain and floodway limits. High water marks and other historic flood evidence should be recorded in detail for future reference.

11.6.2 Stream Channels

Stream channel surveys may be required to obtain hydraulic data for calculating design flood elevations, flood plains, and floodways. They are also necessary to define buffers for no-disturbance as defined by Volume Sections 2.2.14 and 5.9. Project-specific needs and the method of hydraulic analysis will dictate the type of data to obtain and the accuracy required for a particular application. In general, the following guidelines will apply:

1. In determining permissible disturbance areas the floodway or the top of the stream bank must be determined and buffer width measurements taken in accordance with Volume 1 Section 5.9.

2. For backwater calculations, cross sections are needed at representative locations throughout a stream reach, at locations where changes occur in discharge, slope, shape, or roughness, and at bridges or control structures such as weirs. Where abrupt changes occur, several cross sections should be used to describe the change. Cross section spacing is also a function of stream size, slope, and the uniformity of cross section shape.

3. At any cross section, sufficient data points should be field surveyed to describe the section geometry representative of the nearby reach. Local depressions and tributary channels generally do not contribute to effective flow area and should be excluded from the cross section. Special attention should be given to the channel and below water areas where most flow occurs. Additional points should be taken where the flood plain ground slope changes. Cross sections should extend beyond the expected flood plain limits.

11.6.3 Survey Requirements

Survey information is generally required for the following items:

1. Channel cross sections
2. Elevation reference marks (ERMs)
3. Hydraulic structures

Third-order leveling closures within ±0.05 times the square root of the distance, in miles, shall be used to tie temporary bench marks and ERMs to the National Geodetic Vertical Datum (NGVD) of 1929; to determine the elevation of high-water marks; and, where needed, to establish vertical control for aerial photogrammetry. Available vertical control and detailed topographic maps should be used whenever possible.

Field surveys should normally be accomplished by trigonometric or differential leveling using transit-stadia or transit-electronic distance measurements, with vertical error tolerances of ±0.5 foot across the 100-year flood plain. Cross section elevations should be determined at those points that represent significant breaks in slope. Each cross section shall cross the entire 500-year flood plain and should be carefully selected to be representative of reaches that are as long as possible, without permitting excessive conveyance change between sections.

ERMs shall be established and recorded in and near the flood plains of streams studied in detail. These shall include existing elevation references and those ERMs that can be established in the course of setting temporary bench marks for cross sections or vertical control for photogrammetry. Third-order leveling methods and standards of accuracy, as defined above, shall be used for any ERMs determined for the study.

Necessary dimensions and elevations of all hydraulic structures and underwater sections along the streams shall be obtained from available sources or by field survey where necessary. Elevations of hydraulic structures may not be established by aerial photogrammetric methods.